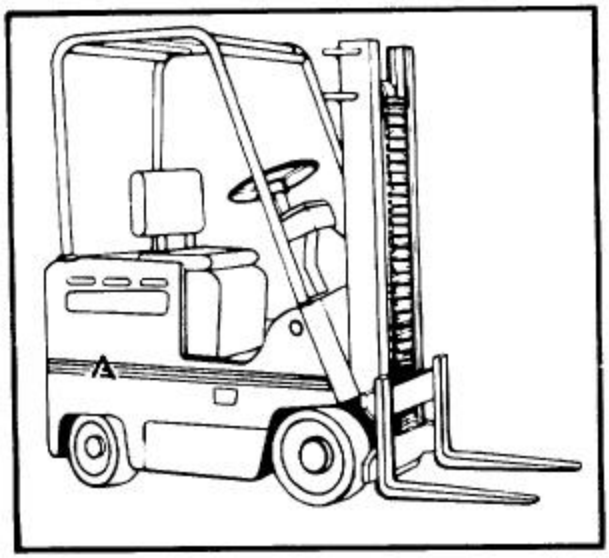
TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST)



TRUCK, FORK, LIFT
SRT: EMD
MODEL ACE 45K EV EE36V
4,000 LB. CAP ACITY, MHE 257
ALLIS-CHALMERS
(NSN 3930-01-126-7505)

HEADQUARTERS, DEPARTMENT OF THE ARMY
28 MAY 1985

WARNING

Before operating a lift truck, the operator should be trained, qualified, and thoroughly familiar with the operating controls. Anytime the operator finds the truck or controls malfunctioning, operation of the truck should be halted and the condition reported to your supervisor.

WARNING

Hydraulic system is under pressure. Release pressure by lowering mast and moving hydraulic levers. Always release hydraulic pressure before loosening hydraulic lines.

WARNING

The electrolyte In the battery is a sulfuric acid solution. Be careful not to get electrolyte on you or equipment. If electrolyte spills on you, splash affected areas with cold water to flush electrolyte. Should the solution get on your face or in your eves, flush the area with cold water and get medical attention immediately.

WARNING

Do not smoke or have open flame or sparks near battery Sparks or flame can cause battery gases to explode

WARNING

Do not be misled by the term "low voltage" Voltages as low as 50 volts can cause death. Use extreme care when handling electrical connections.

WARNING

Electrolyte and battery corrosion can cause injury to you. Wear safety goggles and gloves

WARNING

When recharging the batteries post signs that read "NO SMOKING WITHIN 50 FEET OF VEHICLE"

WARNING

Dry cleaning solvent. SD-2. used to clean parts. is potentially dangerous Do not use near open flame or excessive heat. Flash point of solvent is 59 C (138 F).

WARNING

Compressed air used for cleaning purposes will not exceed 40 pounds per square inch (psi) The use of eye goggles is recommended.

WARNING

If you sustain any injuries. no matter how slight. follow the first aid procedures outlined in FM 21-11

WARNING

The use of diesel fuel oil. gasoline. kerosene. or benzene (benzol) for cleaning purposes is prohibited

WARNING

To prevent electrical shock and before performing any maintenance or repairs on the lift truck. disconnect the battery and discharge the truck capacitors as follows: Disconnect the battery and momentarily touch a suitable jumper wire across all capacitor terminals on the static panel.

WARNING

After Nuclear, Biological or Chemical (NBC) exposure of this vehicle all air filters shall be handled with extreme caution. Unprotected personnel may experience injury or death if residual toxic agents or radioactive material are present. If vehicle is exposed to chemical or biological agents, servicing personnel shall wear protective mask, hood, protective overgarments, and chemical protective gloves and boots. All contaminated air filters shall be placed into double lined plastic bags and moved to a segregation area away from the work site swiftly. The same procedure applies for radioactive dust contamination; however, the Company NBC team should measure the radiation prior to filter removal to determine the extent of safety procedures required per the NBC Annex to the unit Standard Operating Procedures (SOP.) The segregation in which the contaminated air filters are temporarily stored shall be marked with appropriate NBC placards. Final disposal of contaminated air filters shall be in accordance with local SOP.

SCOPE

WARNING

Use care when traveling with or without load. Avoid excessive speeds and abrupt turns.

WARNING

A. Observe the truck load rating on the nameplate. Never handle loads in excess of specified rating.

B. Do not handle unstable or loosely stacked loads.

WARNING

Forward tilting of the load mast should be at flow level only or in the rack area for deposit or retrieval of loads.

WARNING

Tilting of the loaded mast should always be slow by feathering (metering) of the tilt control lever.

WARNING

Adhesives, solvents, and sealing compounds can burn easily, can give off harmful vapors, and are harmful to skin and clothing. To avoid injury or death, keep away from open fire and use in a well-ventilated area. If adhesive, solvent, or sealing compound gets on skin or clothing, wash immediately with soap and water.

WARNING

Fuel and oil are slippery and can cause falls. To avoid injury, wipe up spilled fuel or oil with rags.

SAFETY PRECAUTIONS

⚠ WARNING

The use of diesel fuel oil, gasoline, kerosene, or benzene (benzol) for cleaning is prohibited.

⚠ WARNING

Clean electric lift truck in a well ventilated area when using Freon or Chlorothene NU solvents in accordance with applicable OSHA and EPA standards.

⚠ WARNING

The electrolyte in the battery is a sulfuric acid solution. Extreme care should be exercised when working around the battery. Should any of the electrolyte come in contact with your clothing or skin, flush the area immediately with cold water. If the solution gets on your face or eyes, flush the area with cold water and get prompt medical attention.

⚠ WARNING

Refrain from smoking in the immediate vicinity of the battery, or exposing the battery to any open flame or spark, especially during or immediately after charging.

⚠ WARNING

To prevent electrical shock and before performing any maintenance or repairs on the lift truck, disconnect the battery and discharge the truck capacitors as follows: Disconnect the battery and momentarily touch a suitable jumper wire across all capacitor terminals located on the static panel.

⚠ WARNING

Block the inner mast channel and carriage securely.

⚠ WARNING

Do not attempt to operate the truck until this manual has been thoroughly studied. Be especially aware of all safety precautions contained in this topic and in the safety section at the front of this manual.

⚠ WARNING

Keep the steering wheel dry and free from oil or grease. Wipe any oil or grease for, your hands before attempting to steer the truck.

⚠ WARNING

If the truck is parked on an incline, depress the brake pedal to prevent the truck from rolling down the incline.

⚠ WARNING

Before proceeding in either direction, be absolutely certain no one is standing in the area and the intended path of travel is free from obstructions.

The plugging function should only be used to assist in slowing down the lift truck in conjunction with using the service brakes. Do not use plugging in lieu of the service brakes to stop the lift truck.

⚠ WARNING

Do not attempt to stop the truck with the seat (parking) brake. In addition to being in a dangerous operating position, damage to the arrive system components will result.

⚠ WARNING

The load capacity of the truck must never be exceeded. Overloading is hazardous to the safety of the operator or others, will endanger other equipment, or will damage the truck.

⚠ WARNING

Watch for low hanging pipes, electrical lines, stacked materials, or other obstacles.

⚠ WARNING

Handle only stable and safely arranged loads.

⚠ WARNING

Extra care must be taken while traveling in the reverse direction because the operator does not have a constant view of the load.

⚠ WARNING

To eliminate load spillage, apply the brakes with care.

⚠ WARNING

Maintain a safe distance from the edge of the dockboards, ramps, and elevated platforms.

⚠ WARNING

Maintain a safe distance from the edge of the bridgeplate.

⚠ WARNING

Never enter a trailer or railcar unless the trailer or railcar wheels are properly chocked. Trailers must also be supported at the nose end by stabilizing jacks to prevent upending.

⚠ WARNING

Stockpiles should always be stable to avoid injury to personnel, and damage to equipment or stock.

⚠ WARNING

Make certain the intended path of travel is free from obstruction.

⚠ WARNING

Stacks should always be stable to avoid injury to personnel and damage to equipment or stock.

⚠ WARNING

Make certain the intended path of travel is free from obstructions.

⚠ WARNING

Extreme caution should be exercised to assure that the polarity of the lift truck is not reversed when the battery is installed or when the battery connectors are changed. Prior to removing the battery or battery connectors, the cables should be carefully marked as to positive and negative polarity. If in doubt, check the polarity with a voltmeter.

⚠ WARNING

The electrolyte in the battery is a sulfuric acid and water solution; therefore, extreme care should be exercised when working around the battery. Should any of the electrolyte come in contact with your clothing or skin, flush the area immediately with cold water. Should the solution get on your face or in your eyes, flush the area with cold water and get medical help immediately.

⚠ WARNING

Never allow plates to become exposed due to low electrolyte level. Do not overfill cells as liquid will expand and spill over as battery is put into use and warms up.

⚠ WARNING

Make certain the vent holes in the filler plugs are open to allow the gas to escape from the cells. When battery charger is connected to the battery connector, it is imperative that correct polarity be observed. That is, positive lead of the charger must be connected to the positive terminal and negative lead to the negative terminal.

⚠ WARNING

Refrain from smoking in immediate vicinity of battery or from exposing battery to an open flame during or immediately after charging.

⚠ WARNING

The following precautions must be observed through all test and adjustment procedures. ALWAYS discharge the capacitors before working on the control.

⚠ WARNING

It is strongly recommended that all hand jewelry such as wrist watches and rings are not worn by the person performing any maintenance, tests, or adjustments on the lift truck.

⚠ WARNING

Clean the lift truck in well ventilated areas only. Comply with all safety regulations noted on the cleaning solution package.

⚠ WARNING

Terminal boards and other exposed SCR control parts should be kept free of dirt and paint that might change the effective resistance between parts.

⚠ WARNING

Before performing the following inspections and tests, block the steer (rear) wheels to prevent the truck from rolling backwards. Raise and block up the front of the truck so the drive wheels clear the floor. Place jack stands under both sides of the frame just behind and clear of the drive wheels. Always disconnect the battery and discharge the capacitor(s) by momentarily touching a suitable jumper wire across all capacitor terminals before performing any maintenance or tests on the electronic control. Reconnect the battery as required for specific checks.

⚠ WARNING

Discharge the capacitor(s) by momentarily touching a suitable jumper wire across the capacitor terminals.

⚠ WARNING

This is the battery connector receptacle that is permanently mounted on the lift truck, not the connector with the cables from the battery.

⚠ WARNING

This is the battery connector receptacle that is permanently mounted to the left side of the truck; not the connector with cables from the battery.

⚠ WARNING

Before performing any of the following tests, disconnect the battery and discharge the capacitors by momentarily touching a suitable jumper wire across all capacitor terminals.

⚠ WARNING

Be careful not to pinch any cables or wires, or cause any grounds in the electronic control during the close-up procedure.

⚠ WARNING

Before performing the following repair procedures on the static panel, disconnect the battery and discharge the capacitor(s) by momentarily touching a suitable jumper wire across all capacitor terminals.

⚠ WARNING

Do not attempt any repairs to the static panel until all capacitors have been discharged.

⚠ WARNING

Before performing the following repair procedures on the contactor panel, disconnect the battery and discharge the capacitor(s) by momentarily toughing a suitable jumper wire across 'the capacitor terminals.

⚠ WARNING

Before performing the following repair procedures on the contactor panel, disconnect the battery and discharge the capacitor(s) by momentarily touching a suitable jumper wire across the capacitor terminals.

⚠ WARNING

Before performing the following repair procedures on the speed control box, disconnect the battery and discharge the capacitor(s) by momentarily touching a suitable jumper wire across all capacitor terminals.

⚠ WARNING

Before performing the following repair procedures on the directional switch, disconnect the battery and discharge the capacitor(s) by momentarily touching a suitable jumper wire across all capacitor terminals.

⚠ WARNING

Before troubleshooting, block the steer wheels to prevent the truck from rolling. Place suitable jackstands under both sides of the frame behind the clear of the drive wheels. Disconnect the battery and discharge the capacitor(s) by momentarily touching a suitable jumper wire across all capacitor terminals. Reconnect the battery as required for specific checks; then disconnect the battery and discharge the capacitor when the check is completed.

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitors or the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals.

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitors on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals.

⚠ WARNING

Make certain battery is disconnected and the key switch is in the OFF position.

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals.

⚠ WARNING

Disconnect the Battery before performing any work on the vehicle.

⚠ WARNING

Before proceeding with removal, disconnect battery, then discharge capacitors.

⚠ WARNING

Disconnect the battery and discharge the capacitors before making adjustments.

⚠ WARNING

Do not remove the spring retaining nut from the stud. The large spring, which is under pressure, is installed on the stud at the factory with, a holding fixture.

⚠ WARNING

Make certain battery is disconnected and tone key switch is in the OFF position.

⚠ WARNING

Before performing any of the following adjustments, make certain the battery is disconnected and the key switch is in the OFF position.

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitors. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

⚠ WARNING

Disconnect the battery and discharge the capacitors. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.

⚠ WARNING

Make certain hoist is adequately rated for estimated weight of counterweight. Do not attempt to lift a counterweight with a hoist rated below the weight of the counterweight.

⚠ WARNING

Make certain hoist is adequately rated for weight of counterweight before attempting to lift it.

⚠ WARNING

Be certain overhead hoist is rated to safely support mast assembly weight.

⚠ WARNING

Naturally, the weight of each fork depends upon its size. Therefore, exercise caution while fork is being removed from the carriage to avoid injury to personnel and to prevent damage to the equipment.

⚠ WARNING

Clean lift truck in a well ventilated area when using Freon or Clorothene NU solvents in accordance with applicable OSHA and EPA standards.

⚠ WARNING

Disconnect the battery and discharge the capacitors before any for the following inspections, services, etc., are performed. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals.)

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitor(s). (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.

⚠ WARNING

Make certain the battery is disconnected and discharge capacitors.

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitor(s). (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

⚠ WARNING

Perform cleaning operation in a well ventilated area whenever a solvent is used.

⚠ WARNING

When using a solvent, always use in a well ventilated area.

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

⚠ WARNING

Make certain the battery is disconnected and discharge capacitors.

⚠ WARNING

Before any of the following removal procedures are performed, disconnect the battery and discharge the capacitors. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors on static panel, or momentarily touch a suitable jumper wire across the capacitor terminals.

⚠ WARNING

When using a solvent, always use in a well ventilated area.

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitors. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

⚠ WARNING

Before any of the following removal procedures are performed, disconnect the battery and discharge the capacitors.

⚠ WARNING

When using a solvent always use in a well ventilated area.

⚠ WARNING

Disconnect the battery before performing any work on vehicle.

⚠ WARNING

Disconnect the battery and discharge the capacitors. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control, or 703 control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

⚠ WARNING

Perform cleaning operation in a well ventilated area whenever a solvent is used.

⚠ WARNING

Before proceeding with the removal, disconnect the battery and discharge the capacitors.

⚠ WARNING

Under no circumstances should two notches be exceeded.

⚠ WARNING

Disconnect the battery before performing any work on vehicle.

⚠ WARNING

Disconnect the battery and discharge the capacitors before the removal is performed.

⚠ WARNING

Disconnect the battery before performing any work on vehicle.

⚠ WARNING

Do not use gasoline, kerosene, paint thinner or other mineral base solvents as they will damage the rubber components.

⚠ WARNING

Before proceeding with removal, disconnect battery, then discharge capacitors.

⚠ WARNING

When lockring is removed entire piston assembly will spring out if not held in place.

⚠ WARNING

Mineral base cleaning solvents (gasoline, kerosene, distillates, carbon tetrachloride, acetone, paint thinners, etc.) deteriorate rubber and the parts become soft, tacky, and swollen.

⚠ WARNING

Disconnect the battery and discharge the capacitors before making adjustments or repairs.

⚠ WARNING

Do not attempt to remove the spring retaining flange nut from the stud. The large spring, which is under pressure, is installed on the stud at the factory with a holding fixture.

⚠ WARNING

Disconnect the battery and discharge the capacitors. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with "ACTRONIC" control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitors.

⚠ WARNING

Before proceeding with removal, disconnect battery, then discharge capacitors.

⚠ WARNING

Before proceeding with removal, disconnect the battery, and discharge the capacitors. Refer to Topic 2 for proper discharging procedures.

⚠ WARNING

Make certain the battery is disconnected and the key switch is in the OFF Position. Discharge the capacitors. Refer to Topic 2 for proper discharging procedures.

⚠ WARNING

Disconnect the battery and discharge the capacitors before the removal is performed. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control or 703 control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

⚠ WARNING

Disconnect the battery and discharge the capacitors before the removal is performed. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control or 703 control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

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⚠ WARNING

Disconnect the battery and discharge the capacitors before the removal is performed. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control or 703 control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

⚠ WARNING

Fully retract or lower lift cylinders.

⚠ WARNING

Naturally, the weight of each fork depends upon its size. Therefore, exercise caution while fork is being removed from the carriage to avoid injury to personnel and to prevent damage to the equipment.

⚠ CAUTION

Extreme caution should be exercised to assure that the polarity of the truck is not reversed when the battery is installed, or when the battery connectors are changed. Prior to removing the battery or battery connection, the cables should be carefully marked as to positive or negative polarity. If in doubt, check the polarity with a voltmeter.

⚠ CAUTION

Never allow plates to become exposed to low electrolyte level. Do not overfill the cells as the electrolyte will expand and spill over as the battery is put into use and warms up.

⚠ CAUTION

Do not flush the top of the battery while it is installed in the lift truck as water will seep into the electrical compartment and cause severe damage.

⚠ CAUTION

Make sure that dirt or other foreign material does not enter the master cylinder while the cover is removed.

⚠ CAUTION

Do not release the lift control valve suddenly when lowering the load. This causes severe mechanical shock.

⚠ CAUTION

Use care when tilting the mast forward to prevent the load from falling.

⚠ CAUTION

Do not jam on the brakes with a loaded lift truck because this may cause the load to topple.

⚠ CAUTION

Extra care must be taken with the forks raised. Watch for low clearances.

⚠ CAUTION

Do not flush top of battery while it is installed in the lift truck. Water will seep into electrical compartments and cause serious damage.

⚠ CAUTION

Never dress or file the contractor tips by any means. Tips that are tampered with may weld. Never replace tips singly; always replace both tips as a set.

⚠ CAUTION

Do not dress or file the contactor tips by any means. Never replace the tips singly; always replace both tips as a set.

⚠ CAUTION

The coils have voltage suppression cast integral with the coil. If a test voltage is applied in the wrong direction, or if the coil is connected backwards, permanent damage may result. Always observe the polarity markings on the coil during maintenance and testing.

⚠ CAUTION

Do not plug the drive motor with the drive wheels off the floor.

⚠ CAUTION

Do not store the analyzer for long periods of time with the batteries installed.

⚠ CAUTION

Do not plug the drive motor with the drive wheels off the floor.

⚠ CAUTION

Do not use a lubricant or solvent, of any kind, on or around the commutator.

⚠ CAUTION

Exercise care when removing drive wheel so no damage results to brake shoes, drum, or spindle threads.

⚠ CAUTION

When bearings are being removed, make certain the pressure is exerted against the inner race of the bearing cone and not on the roller portion. Also exercise care to prevent damage to the axle shaft cap.

⚠ CAUTION

Use extreme care when installing drive wheel so no damage results to brake shoes, drum, or threaded end of drive wheel spindle.

⚠ CAUTION

Operate lift truck only when lining is greater than 1/16" thickness.

⚠ CAUTION

Exercise care when removing drive wheel so no damage results to brake shoes, drum., or spindle threads.

⚠ CAUTION

Use extreme care when installing drive wheel so no damage results to brake shoes, drum, or threaded end of drive wheel spindle.

⚠ CAUTION

Due to importance of fluid used in brake system, use only premium quality, heavy duty brake fluid with an extreme heat-cold range that conforms to SAE specification MIL-B-46176.

⚠ CAUTION

Be sure to keep fluid level in master cylinder high enough to prevent reentry of air into the system.

⚠ CAUTION

Exercise care when self-adjuster is handled or installed. Do not bend the tangs of the slide assemblies in any way because the holes for the roll pins must be parallel with each other. If the holes are not parallel, the roll pins will lie at a slight angle through the mounting holes in the brake shoes. Improper alignment of the roll pins could lead to improper brake shoe retraction due to lack of proper roll pin clearance in the brake shoe holes. This in turn could create brake shoe drag on the drum.

⚠ CAUTION

Keep the hydraulic system clean. A dirty hydraulic system is a major cause of hydraulic pump, control valve, and packing wear or failure. Contaminated hydraulic oil is the major cause of hydraulic-system failures. It is therefore advised that ANY oil that is added or replaced be final filtered through a 10 micron filter, or finer, before entering the hydraulic system.

⚠ CAUTION

Before operating the lift control lever, verify that the hydraulic oil level in the reservoir is at the FULL mark on the dipstick.

⚠ CAUTION

Operate the control lever ONLY in the direction specified in the following steps.

⚠ CAUTION

The gasket of this filter cartridge will seal properly when the filter cartridge is hand tightened.

⚠ CAUTION

The hydraulic pump should only be used for pumping oil thru the hydraulic system.

⚠ CAUTION

Fully retract or lower lift cylinders.

⚠ CAUTION

Cap or plug all hydraulic openings to prevent contamination by foreign particles.

⚠ CAUTION

Cluster cylinders must be in fully lowered position for removal.

⚠ CAUTION

Do not use a lubricant or solvent of any kind, on or around the commutator.

⚠ CAUTION

Depending upon the model of the lift truck, there are either shims or a gasket between the motor housing and carrier. Make certain shims between motor and carrier are not damaged when removing motor. When assembling motor to carrier, shims must be in the same order and position as when motor was removed.

⚠ CAUTION

Use extreme care whenever a gear puller is used or center of shaft will be damaged. An improper puller will flare out shaft center and damage threads to the extent of requiring a new armature shaft. It is recommended to use a shaft protector on end of armature shaft when a gear puller is used.

⚠ CAUTION

Lift armature straight up carefully to avoid damage to commutator or core.

⚠ CAUTION

Use extreme care whenever a gear puller is used or center of shaft will be damaged. It is recommended to use a shaft protector (Fig. 5-2) when a gear puller is used.

⚠ CAUTION

Do not subject bearing to impact.

⚠ CAUTION

Overgreasing bearing will cause overheating, so care must be taken to make certain grease cavity is packed only half full. When reassembling make certain shield faces outward.

⚠ CAUTION

Handle field coils carefully to avoid damage to the insulation.

⚠ CAUTION

Whenever connections have to be soldered, a rosin flux must be used. Acid flux must never be used on electrical connections.

⚠ CAUTION

Meter needle will jump wildly; precautions should be taken to avoid damage to instrument.

⚠ CAUTION

Do not use silicon base varnishes.

⚠ CAUTION

Make certain the top end of the pipe makes complete contact with the core from above shaft, but within a radius of the core rivets.

⚠ CAUTION

Do not cause burrs or nick bearing shaft shoulder.

⚠ CAUTION

Handle field coils carefully to avoid damage to insulation.

⚠ CAUTION

Do not subject bearing to impact.

⚠ CAUTION

Semi-conductors, small transformers, voltage regulators, and other devices that may be injured by the high voltage must not be in the circuit.

⚠ CAUTION

Do not use a lubricant or solvent, of any kind, on or around the commutator.

⚠ CAUTION

Exercise extreme care when removing armature to prevent damage to core, commutator, or pole faces. Make certain armature is pulled straight up out of field yoke.

⚠ CAUTION

Use extreme care when using a gear puller or center of shaft could be damaged. It is recommended that a shaft protector be used between the shaft and the gear puller.

⚠ CAUTION

Handle field coils carefully to avoid damage to insulation.

⚠ CAUTION

Whenever connections have to be soldered, a rosin flux must be used. Acid flux must never be used on electrical connections.

⚠ CAUTION

Meter needle will jump wildly; precautions should be taken to avoid damage to instrument.

⚠ CAUTION

Do not use silicon base varnishes.

⚠ CAUTION

Make certain the top end of the pipe makes complete contact with the core from above the shaft, but under the core rivets.

⚠ CAUTION

Handle field coils carefully to avoid damage to insulation.

⚠ CAUTION

Semi-conductors, small transformers, voltage regulators and other devices that may be injured by the high voltage must not be in the circuit.

⚠ CAUTION

Do not use a lubricant or solvent, of any kind, on or around the commutator.

⚠ CAUTION

Exercise extreme care when removing armature to prevent damage to core or commutator. Make certain armature is pulled straight out of field shell.

⚠ CAUTION

Handle field coils carefully to avoid damage to insulation.

⚠ CAUTION

Whenever connections have to be soldered, a rosin flux must be used. Acid flux must never be used on electrical connections.

⚠ CAUTION

Meter needle will jump wildly; precautions should be taken to avoid damage to instrument.

⚠ CAUTION

Do not use silicon base varnishes.

⚠ CAUTION

Handle field coils carefully to avoid damage to insulation.

⚠ CAUTION

Semi-conductors, small transformers, voltage regulators, and other devices that may be injured by the high voltage must not be in the circuit.

⚠ CAUTION

Exercise care when removing drive wheel so no damage results to brake shoes, drum, or spindle threads.

⚠ CAUTION

When bearings are being removed, make certain the pressure is exerted against the inner race of the bearing cone and not on the roller portion. Also exercise care to prevent damage to the axle shaft cap.

⚠ CAUTION

Use extreme care so as not to cut or scratch oil seal with the splines on end of jackshaft while it is being installed.

⚠ CAUTION

Use extreme care when installing drive wheel so no damage results to brake shoes, drum, or threaded end of drive wheel spindle.

⚠ CAUTION

When backlash is adjusted, turn each adjusting nut exactly the same distance so proper bearing preload is maintained.

⚠ CAUTION

To prevent damage to the wheel, the tire must be installed with the chamfered side of the wheel up.

⚠ CAUTION

Exercise care when removing drive wheel so no damage results to brake shoes, drum, or spindle threads.

⚠ CAUTION

In order to prevent possible damage to the bull gear when installing the spirol pins, the edge of the outer coil should lie on the bolt circle as illustrated (Fig. 7-3). Make certain bull gear is seated properly and spirol pins and capscrews do not extend beyond the face of bull gear.

⚠ CAUTION

Use extreme care when installing drive wheel so no damage results to brake shoes, drum, or threaded end of drive wheel spindles.

⚠ CAUTION

Use only silicone based heavy duty brake fluid with an extreme heat-cold range that conforms to MIL-B-46176.

⚠ CAUTION

Exercise care when removing driving wheel so no damage results to brake shoes, drum, or spindle threads.

⚠ CAUTION

Do not machine more than .050" from a drum. Thin drums are subject to excessive heat expansion and flexing which cause fade and spongy pedal. They also could break under strain of severe use. (Refer to following chart.)

⚠ CAUTION

Whenever brake shoes are handled, be careful not to get grease, oil, or dirt on the lining.

⚠ CAUTION

Exercise care when self-adjuster is handled or installed. Do not bend the tangs of the slide assemblies in any way because the holes for the roll pins must be parallel with each other. If the holes are not parallel, the roll pins will lie at a slight angle through the mounting holes in the brake shoes. Improper alignment of the roll pins could lead to improper brake shoe retraction due to lack of proper roll pin clearance in the brake shoe holes. This in turn could create brake shoe drag on the drum.

⚠ CAUTION

Do not apply pressure to brake pedal until drive wheels are installed.

⚠ CAUTION

Use only silicone based heavy duty brake fluid with an extreme heat-cold range that conforms to MIL-B-46176.

⚠ CAUTION

Be sure to keep fluid level in master cylinder high enough to prevent reentry of air into the system.

⚠ CAUTION

After the disc is removed from the brake pad area, do not attempt to loosen the spring retaining flange nut (Fig. 4-2) on the stud, otherwise damage could result to the retainer pins (Fig. 4-4). Back off the spring retaining flange nut only after the disc brake assembly is installed on the motor with the disc in place.

⚠ CAUTION

Do not use a hammer to free the shaft. Upper shaft bearing may be damaged.

⚠ CAUTION

Use extreme care when removing these parts, because they are very closely fitted and must be rotated slightly as they are withdrawn.

⚠ CAUTION

The spool must rotate freely in the sleeve with finger tip force applied at the splined end.

⚠ CAUTION

Exercise extreme care so the parts do not cock out of position while entering.

⚠ CAUTION

Alignment of the cross slot in the drive with the valleys between the teeth of the meter gear star determines the proper valve timing of the unit. There are 12 teeth on the spline and 6 on the star. Alignment will be right in 6 positions and wrong in 6 positions. Should the parts slip out of position during this part of the reassembly, make certain that proper alignment is obtained.

⚠ CAUTION

Do not attempt to remove piston from plunger rod. They do not separate.

⚠ CAUTION

Use care when removing bearing cups to prevent damage to the bearing surface.

⚠ CAUTION

To prevent damage to the wheel, the tire must be installed with the chamfered side of the wheel up.

⚠ CAUTION

Keep the hydraulic system clean. A dirty hydraulic system is a major cause of hydraulic pump, control valve, and packing wear or failure. Contaminated hydraulic oil is the major cause of hydraulic system failures. It is therefore advised that ANY oil that is added or replaced be final filtered through a 10 micron filter, or finer, before entering the hydraulic system.

⚠ CAUTION

The hydraulic pump should only be used for pumping oil through the hydraulic system.

⚠ CAUTION

A needle bearing should be installed with an arbor, either hand or power operated. Always apply pressure against the end which has the bearing type number stamped on it. Do not tap or pound directly on needle bearing shell end lips, otherwise damage will result which will lock the needles against movement.

⚠ CAUTION

If any of the cylinders move as soon as the pump motor starts to operate, excessive pump contactor tip arcing swill occur and also damage to the pump motor could result.

⚠ CAUTION

If it is necessary to modify a control valve in the field to provide high volume flow, it is absolutely essential that the accessory section is installed adjacent to the lift section (immediately downstream) and it must be B section (Figs. 7-4, 7-5, and 7-6). If an A section is installed at this location, only low volume pump flow will be passed. The high volume flow will be blocked and the relief valve in the lift section will open.

⚠ CAUTION

Operate the control lever ONLY in the direction specified in the following steps.

⚠ CAUTION

Leave piston and plunger rod as an assembly for they are replaced as a unit when damaged.

⚠ CAUTION

Before operating the lift control lever, verify that the hydraulic oil level in the reservoir is at the FULL mark on the dipstick.

⚠ CAUTION

The hydraulic pump should only be used for pumping oil thru the hydraulic system.

⚠ CAUTION

Always use pre-filtered oil in the hydraulic system. Make sure containers and surrounding parts are clean when reservoir is filled to prevent dirt from contaminating the oil.

⚠ CAUTION

Be certain overhead hoist is rated to safely support entire mast assembly weight.

⚠ CAUTION

Do not soak bearings in solvent as this may remove the lubricant from the bearings.

⚠ CAUTION

Always handle cylinders in the fully retracted position to avoid scratching or nicking of ram surface.

⚠ CAUTION

Always use care when handling the rod so that it will not be nicked or damaged.

Technical Manual
No. 10-3930-651-14&P

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC *28 May 1985*

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL (INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST) FOR

TRUCK, FORK, LIFT
SRT: EMD
MODEL ACE 45K EV EE 36V
4,000 LB. CAPACITY, MHE 257
ALLIS-CHALMERS
(NSN 3930-01-126-7505)

REPORTING OF ERRORS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures. please let us know. Mail your letter. DA Form 2028 (Recommended Changes to Publications and Blank Forms). or DA Form 2028-2 located in the back of this manual direct to: Commander, US Army Tank-Automotive Command. ATTN: AMSTA-MB. Warren, MI 48090. A reply will be furnished direct to you.

TABLE OF CONTENTS
General Description and Specifications

This technical manual is an authentication of the manufacturers commercial literature and does not conform with the format and content specified in AR 310-3. Military Publications. This technical manual does. however. contain available information that is essential to the operation and maintenance of the equipment.

FOREWORD

Allis-Chalmers Lift Trucks are designed, operator-engineered and manufactured to rigid specifications so that your company can achieve the most production for its investment. Correct operation and regular preventive maintenance, coupled with authorized Allis-Chalmers service and parts will ensure long operational life and continued top performance of your lift truck.

INTENDED USE

A lift truck is a mobile, self propelled machine intended to lift, stock, and carry material within its rated capacity in and around plants, warehouses, yards, loading platforms, docks, railroad cars, and highway trailers over paved and well graded, semiprepared surfaces for short distances. It is usually associated with manufacturing or warehousing and is not intended for such uses as earth moving, snow removal or over the road hauling. Any unintended use may seriously affect its operational safety, reliability, and longevity.

WARNING

DO NOT ATTEMPT TO OPERATE THE LIFT TRUCK UNTIL YOU ARE THOROUGHLY FAMILIAR WITH THE INFORMATION AND SAFETY PRECAUTIONS SET FORTH IN THIS MANUAL.

TABLE OF CONTENTS

TITLE **PAGE**

NOTE

This manual is published for the purpose of identifying on authorized commercial manual for the use of personnel to whom this Forklift Truck is issued.

Allis Chalmers
21800 South Cicero Avenue
Matteson, IL 60443
Procured under Contract No. DAAE07-81-C-6161

GENERAL CLEANING PROCEDURE

A. GENERAL

This section contains the necessary information and instructions for cleaning the vehicle.

B. CLEANING EXTERIOR PARTS

The exterior parts of the equipment should be thoroughly cleaned prior to disassembly of the truck to remove accumulated mud, tar, and grease.

⚠ WARNING

The use of diesel fuel oil, gasoline, kerosene, or benzene (benzol) for cleaning is prohibited.

Precaution must be taken during cleaning of electric lift trucks. It is important not to clean the electric truck with steam or water as these methods will result in damage to electric components of the truck.

Proper cleaning of an electric lift truck is accomplished through the use of an industrial vacuum cleaner or low air pressure (40 psi max.) EXTREME CAUTION must be exercised in cleaning electric and electronic components.

Using an industrial vacuum cleaner, clean the lift truck as follows:

1. Clean all electrical components and electrical compartments.

2. Remove all foreign material or objects from all compartments.

3. To finish cleaning the lift truck use non-conductive, nonflammable solvent such as DuPont Freon TF or Dow Chemical Chlorothene NU. Apply with a brush or cloth or spray the surface requiring cleaning.

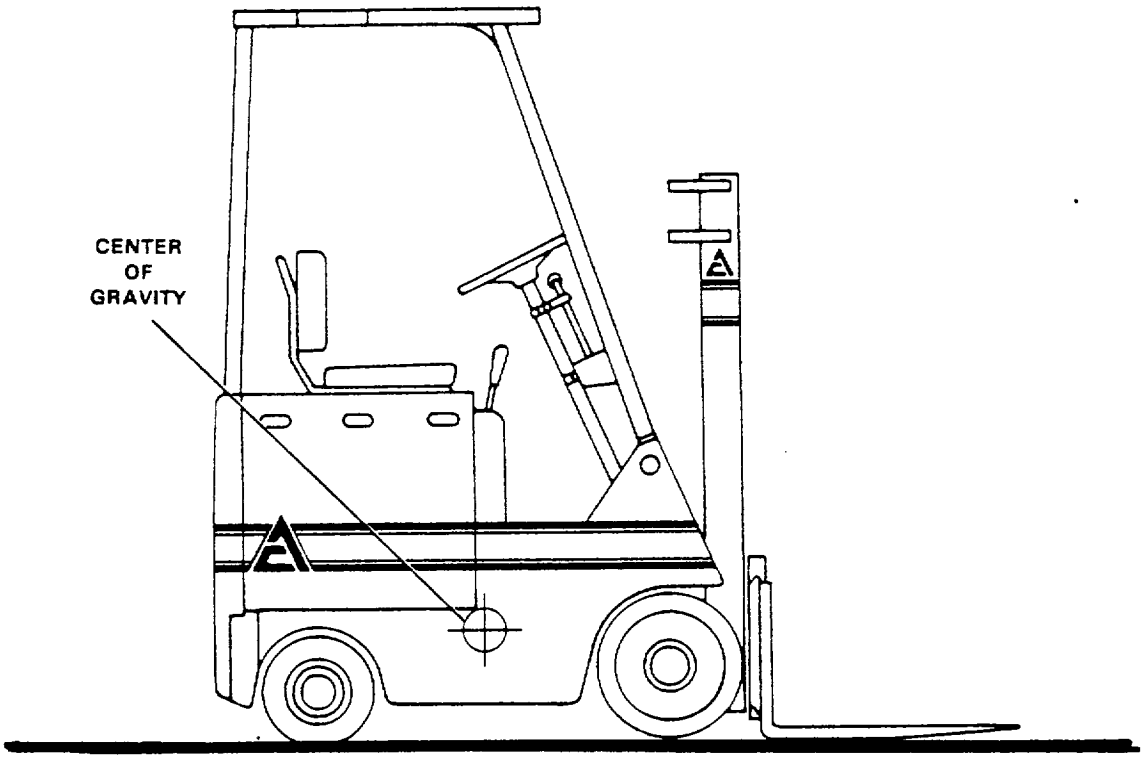
⚠ WARNING

Clean electric lift truck in a well ventilated area when using Freon or Chlorothene NU solvents in accordance with applicable OSHA and EPA standards.

C. CLEANING COMPONENT PARTS

Refer to specific items for cleaning procedures.

FRONT PIECE



1. Weight-- 6150 lbs.
2. Overall Height - 83.0 in.
3. Overall Width - 40.0 in.
4. Overall Length (less forks) - 72.69 in.
5. Wheel Base - 48.0 in.
6. Turning Radius - 70.0 in.
7. Free Lift - 45 in.
8. Lift - 144 in.
9. Fork Length - 36.0 in.
10. Fork Width - 8.0 in. to 38.0 in.

ACE 45 Lift Truck

PREPARATION FOR RESHIPMENT

To prepare the truck for reshipment perform the following:

1. Drain hydraulic system.
2. Disconnect battery at battery connector.
3. Remove forks from front of truck.
4. Strap forks to overhead guard.

STORAGE

1. Disconnect battery at battery connector.
2. Store truck indoors if possible.
3. If stored outdoors, cover seat, instrument panel and battery area with tarpaulin or plastic.

SAFETY PRECAUTIONS

⚠ SAFETY

Before operating a lift truck, the operator should be trained and qualified and also must be thoroughly familiar with the operating controls. Any time the operator finds that the truck or the controls are not functioning properly, operation of the truck should be halted and the condition reported to the supervisor.

A. BEFORE STARTING TO OPERATE AND TRAVEL WITH THE LIFT TRUCK

1. The operator ,must be in the normal operating position (seated and facing forward).
2. Make certain the parking brake is set and the shifting levers are In NEUTRAL before the key switch is turned on.
3. Start the engine and check the functioning of the tilt and lift system. directional and speed levers, inching pedal, horn, steering, brakes, and lights lift so equipped.

B. OPERATING

1. Operation of the truck, or any auxiliary device, must be performed only when the operator is in the normal operating position {seated and facing forward.
2. Load the truck only up to the rated capacity.
3. Operate the truck on authorized ramps only.
4. At no time should anyone stand or pass under the elevated portion of the lift truck. whether loaded or empty.
5. Keep hands. arms. feet, and legs inside the confines of the operator s compartment.
6. Make certain there is sufficient headroom under overhead installations such as lights, pipes, sprinklers, etc.
7. Observe all traffic rules, aisle line markings. stop signs, etc.
8. Stunt driving or horseplay is prohibited.
9. The carrying of any person on the lift truck, other than the authorized operator. Is also prohibited.
10. Travel in the direction of the maximum visibility except on grades as indicated In following item 11.
11. All graces should be ascended and descended slowly
    a. When ascending or descending a grade, the loaded truck should be operated with the load upgrade.
    b. An unloaded truck should be operated on all grades with the fork end of the truck downgrade
    c. On all grades, the load and/or forks should be raised only as far as necessary to clear the grade and floor surface.
12. Be extremely careful In congested areas and heavy pedestrian traffic, safeguard the pedestrian at all times.
13. Travel at the safest speed that conditions allow, and never more than the authorized plant speed limits. Always reduce speed on wet and slippery floors.
14. Sharp turns at full speed must be avoided Use extreme caution when turning on an incline.
15. Avoid running over any loose objects in the path of the lift truck.
16. Maintain a safe distance from other vehicles; caution must be used In passing them.
17. While on a ramp, elevated dock or platform, maintain a safe distance from the edge of the ramp, dock or platform.
18. Stop at corners and intersections.
19. Avoid jerky starts and stops; apply the brakes with care and manipulate the load smoothly with caution
20. When handling off-center loads which cannot be centered, operate the truck with caution. Use extreme care when handling long, high, or wide loads.
21. Only handle loads which are safely arranged.
22. Make certain the forks and/or load are clear of all obstructions before lifting or lowering.
23. All daily checks. maintenance and repair on the lift truck must be performed by qualified and authorized personnel only.

C. LEAVING TRUCK UNATTENDED

When the lift truck is left unattended. the forks must be fully lowered. controls neutralized, parking brake set. and engine stopped (key switch OFF and key removed). The wheels must be blocked whenever the truck is parked on an Incline.

A truck is considered unattended whenever the operator leaves the truck and it is out of the operator's view, or when the operator is more than 25 feet (7.6 m) from the truck even though it remains in the operator's view

When the operator as dismounted and within 25 feet (7.6 m) of the lift truck, but it is still In the operator s view the forks must be fully lowered, controls neutralized. engine stopped (key switch OFF), and the parking brake set to prevent movement.

D. SAFETY SYMBOLS

The following symbols are used throughout this manual to represent a condition or hazard the operator should be aware of.

⚠ WARNING

Denotes a serious hazard that could cause injury to the operator or other personnel from a particular action or condition.

⚠ CAUTION

Denotes a less serious hazard from an action or condition that could cause damage to the lift truck, is load, or other equipment.

OPERATING INSTRUCTIONS

CHAPTER 1

TOPIC 1. GENERAL DESCRIPTION

A. DESCRIPTION

The Allis-Chalmers electric sit down rider type lift trucks are battery powered units designed for quiet and odor-free operation.

The battery is the power source of the unit. It is an electrochemical device that stores chemical energy which Is converted into electrical energy during discharge.

These trucks are equipped with either a 36V or 48V electrical system and the drive control system is one of three types: the ACTRONIC control system, the SCR control system, and the EV-1 control system.

The EV-1 Control System Is a solid state, modular type, SCR electrical control system designed to operate a d.c. series motor load with a battery powered source. The EV-1 control system module is the heart of the control. All control adjustments such as creep speed, controlled acceleration, current limit, 1 A timer, 1 A dropout, plugging, field weakening pick-up, and field weakening dropout functions are adjustable by trim pots located on the oscillator control card of the EV-1 control module.

To reduce maintenance time, the EV-1 control system has an optional control system analyzer. The rechargeable analyzer Is a testing -instrument which is installed to the EV-1 module via a dummy oscillator control card.

The analyzer duplicates system functions and indicates which component(s) Is/are faulty. If all components check-out as operating correctly. the oscillator control card Is defective.

The drive and pump motors are series wound, drip-proof, fan cooled, and fully guarded. Both have type H Insulation.

All units incorporate a hydraulic system which controls lift, tilt, and accessory operations. The system includes a 10 micron replaceable, return line filter, 50 mesh filler tube screen, a 10 micron replaceable breather-filler cap filter, and a large capacity reservoir with an easily accessible dipstick and breather cap. The rest of the hydraulic system includes a tandem dual hydraulic pump directly driven by a single pump motor. The pumps have primary and secondary outputs which supply the exact amount of hydraulic oil required for lift, tilt, or operation of attachments.

A sectional control valve allows individual valve section replacement in the event of wear. Models ACE 35 thru 120 Incorporate power steering as part of the hydraulic system. Power steering Is accomplished through the use of a power' steering cylinder, orbitrol unit and a hydraulic pump and motor unit.

Models ACE 20 thru 80 Incorporate a jackshaft type heavy-duty, double-reduction, drive axle. The first gear reduction Is accomplished with a heavy spiral bevel ring gear and pinion gear arrangement. The final reduction at the drive wheels is through the jackshaft and internal tooth ring gear.

Shoe-type hydraulic service brakes are self-centering, and self-adjusting. A mechanical "deadman" brake is a disc-type and is mounted on the drive motor armature shaft. The brake is automatically applied and power to the control circuit is cut off when the operator leaves the seat.

The lifting mechanism comprises of a three stage tri-max (TM) mast. Single stage chrome plated displacement cylinder cluster arrangement is common on high free lift and tri-max masts. All masts feature constant lift speeds. Built in lifting eyes provide easy mast removal and installation. Carriages and forks are of the hook-type.

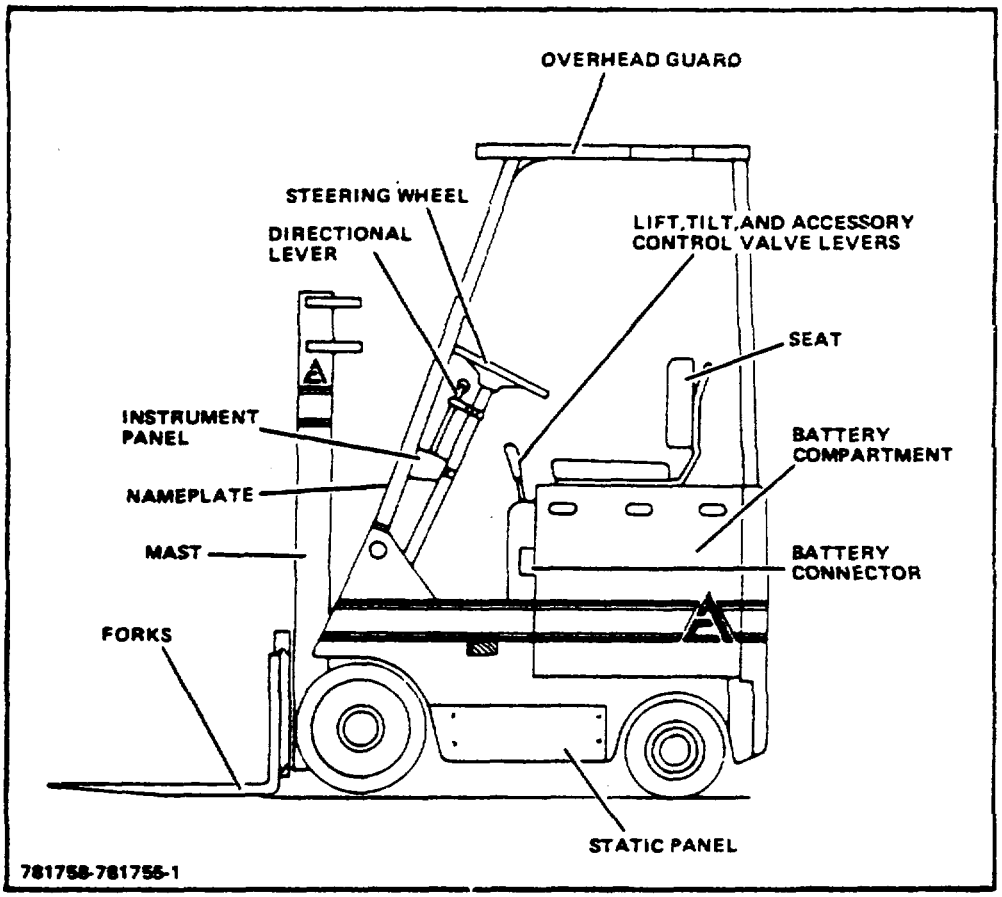


Figure 1-1. ACE 45

TOPIC 2. PREPARING THE NEW TRUCK FOR SERVICE

For your protection, make a thorough inspection of the vehicle immediately upon delivery. In case of any 'damage or shortage, have the delivering carrier's agent make a notation on the delivery receipt and file your claim with the carrier.

Check the following components before placing your Allis-Chalmers lift truck in service:

A. BATTERY

The battery is located in the compartment below the operator's seat. Check the polarity of the battery with a voltmeter.

Check the polarity of the cables and the connector to see that they agree.

⚠ CAUTION

Extreme caution should be exercised to assure that the polarity of the truck is not reversed when the battery is installed, or when the battery connectors are changed. Prior to removing the battery or battery connection, the cables should be carefully marked as to positive or negative polarity. If in doubt, check the polarity with a voltmeter.

B. BATTERY SERVICE

⚠ WARNING

The electrolyte in the battery is a sulfuric acid solution. Extreme care should be exercised when working around the battery. Should any of the electrolyte come in contact with your clothing or skin, flush the area immediately with cold water. If the solution gets on your face or eyes, flush the area with cold water and get prompt medical attention.

Due to the variation of battery types and uses, only general rules for routine maintenance will be given. The value of specific gravity of the electrolyte in a lead acid type battery should be approximately 1.275 with the battery fully charged. Do not discharge a battery beyond the point where the specific gravity , falls below 1 .1 25. These readings are with the electrolyte at 800F (27°C) and the electrolyte at the normal level in each cell.

To obtain "corrected specific gravity" readings when checking the electrolyte, add 1 point (0.001) of gravity for each 3°F (1 .7°C) above 80°F (27°C) (electrolyte temperature) or subtract 1 point for each 3°F (1.7°C) below 80°F (27°C). Also, subtract 15 points for 0.5" (1 2.7 mm) below the normal level of the electrolyte or add 15 points for each 0.5" (1 2.7 mm) above the normal electrolyte level.

Every 8 hours of operation, check the electrolyte level and specific gravity. The electrolyte level 0.25" (6.35 mm) below the vent well in each cell, and the specific gravity should be 1.260 (minimum at the beginning of each shift. When making the daily check, check all the cells. Fill the cells to the proper level with distilled water.

⚠ CAUTION

Never allow the plates to 'become exposed due to low electrolyte level Do not overfill the cells as the electrolyte will expand and spill over as the battery is put into use and warms up.

The battery specific gravity readings with the electrolyte at 800F (270C) are:

HYDROMETER INDICATION	CHARGE CONDITION
1.110-1.1 35	Completely Discharged
1.140-1.200	One-Fourth Charged
1.205-1.230	One-Half Charged
1.235-1.260	Three-Fourths Charged
1.265-1.290	Fully Charged

The most important factor in battery service and life is proper charging. Make certain the proper method for each application is carefully followed.

In general, a battery may be charged at any rate in amperes that does not cause excessive gassing or produce temperatures above 110°F (43°C). 125°F (52°C) is acceptable for infrequent short periods.

⚠ WARNING

Refrain from smoking in the immediate vicinity of the battery, or exposing the battery to any open flame or spark, especially during or immediately after charging.

Make certain the plug vent holes are open when charging to allow the gas to' escape from the cell.

Keep the battery top clean and dry to the extent that corrosion, dust, or moisture cannot offer a conducting path to partially short-circuit the cells, or contact "ground". Never place any metallic articles on top of the battery. Neutralize any spilled acid with amonia water or baking soda solution (1 lb. [0.454 Kg.] of soda to 1 gallon [3.785 1.] of water). Keep the vent plugs in place when operating, cleaning, or charging the battery.

⚠ CAUTION

Do not flush the top of the battery while it is installed in the lift truck as water will seep into the electrical compartment and cause severe damage.

Lead acid batteries should not require any routine overhaul or electrolyte changes during their entire life except in case of accidental loss of the electrolyte solution. For exact information regarding the service of individual batteries, refer to the manufacturer's data enclosed with the battery.

C. BATTERY CONNECTOR

The battery connector, located on the left side of the operator's compartment, is a quick disconnect type. To disconnect the power supply from the components, flip the handle up and completely remove the battery connector. To connect, push the handle down. Check the battery connector (Fig 2-1) for any foreign material before using the lift truck.

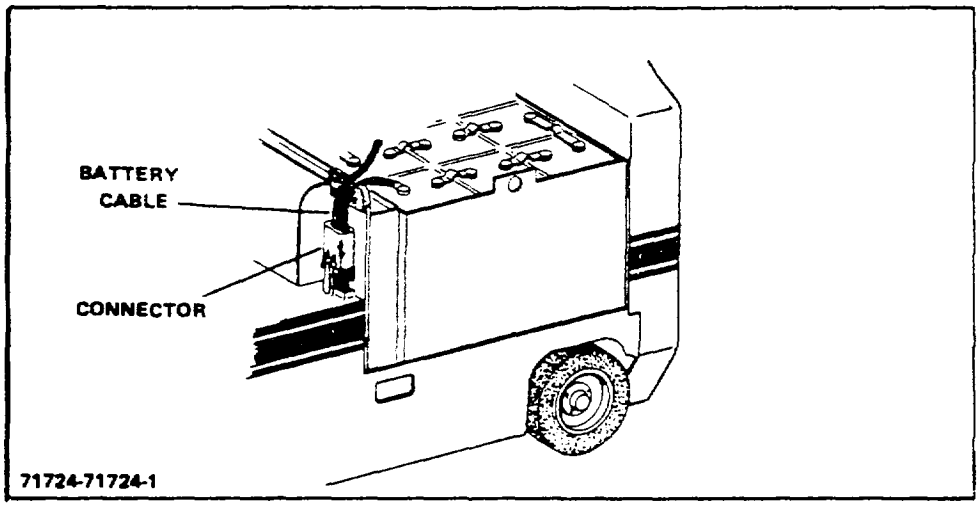


Figure 2-1. Battery Connector

⚠ WARNING

To prevent electrical shock and before performing any maintenance or repairs on the lift truck, disconnect the battery and discharge the truck capacitors as follows: For lift trucks equipped with the ACTRONIC drive control, disconnect the battery, turn the key switch to the ON position and depress the horn button, then; turn the key switch to the OFF position; or disconnect the battery and momentarily touch a suitable jumper wire across all capacitor terminals located on the static panel For lift trucks equipped with the SCR and EV7 drive control systems, disconnect the battery and momentarily touch a suitable jumper wire across all capacitor terminals located on the static panel.

D. DRIVE AXLE

1. Jackshaft Type Drive Axle

The oil level in the drive axle housing should be checked at the filler plug located on the front side of the housing.

With the lift truck on a level surface, raise the forks and carriage sufficiently to expose the axle housing.

⚠ WARNING

Block the inner mast channel and carriage securely.

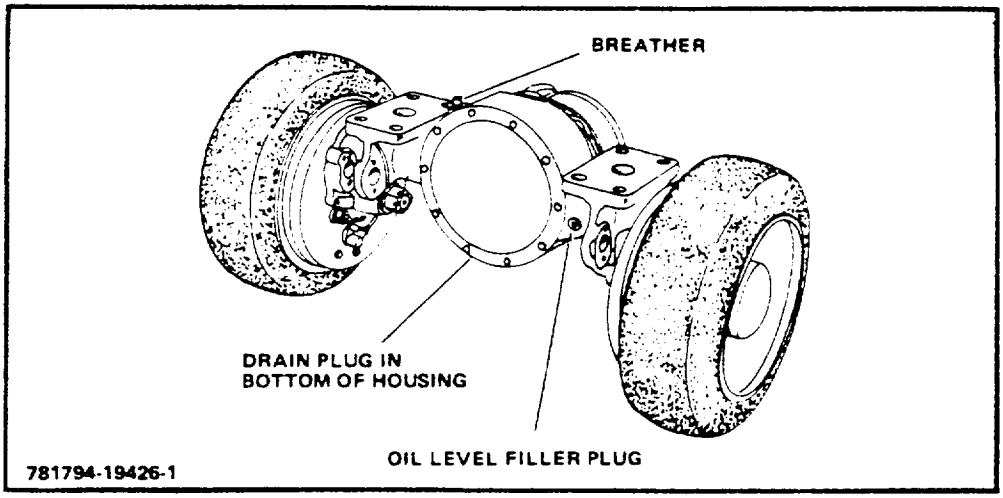


Figure 2-2. Drive Unit

Remove the filler plug from the housing. The gear oil should be at the bottom of the filler plug hole. Add SAE 90 EP (extreme pressure) when necessary to bring the level up to this point (Fig 2-2).

Install the filler pug, remove the blocks from the inner mast channel and carriage. Lower the carriage and forks.

E. HYDRAULIC SYSTEM

Check the hydraulic oil level as follows: Completely lower the carriage and forks. Operate the tilt control (See Topic 3) until the mast is in the full backward tilt position. Turn the key switch off. Turn the T-handle on the filler cap countercjockwise and remove the cap from the hydraulic oil reservoir (Fig. 2-3). Wipe off the dipstick on the filler cap and reinsert the cap back into the reservoir. Withdraw the cap. The oil level should be up to the FULL mark on the dipstick with the oil at 72°F (220C). Install the filler cap to the hydraulic reservoir and turn the T-handle clockwise to tighten.

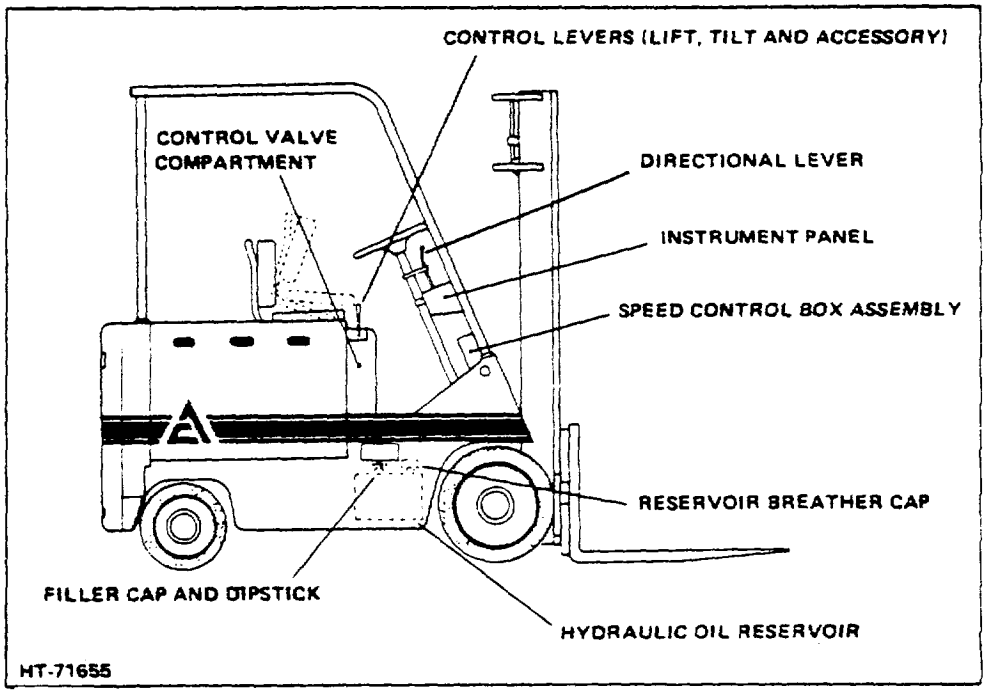


Figure 2-3. Hydraulic Oil Reservoir Location

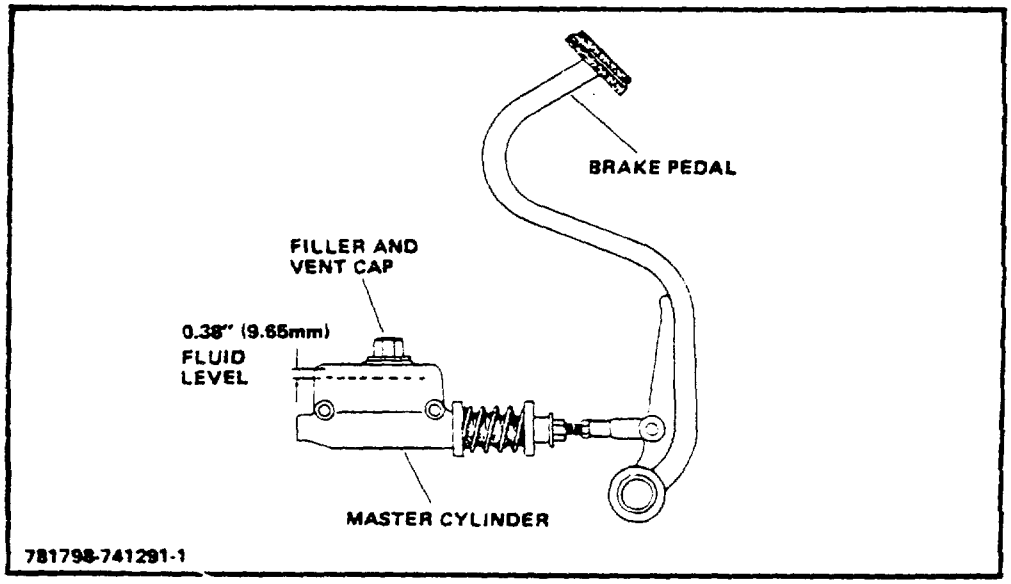


Figure 2-4. Brake Master Cylinder.

F. BRAKE MASTER CYLINDER

The brake master cylinder is located under the floor plate on the right side of the lift truck. It should be filled to approximately 0.38" (9.65 mm) from the bottom of the filler neck (Fig. 2-4). Check the brake lines and master cylinder for leaks.

⚠ CAUTION

Make sure that dirt or other foreign material does not enter the master cylinder while the cover is removed.

G. MAST AND CARRIAGE

Check to make certain the carriage and mast operate freely. The carriage and mast should RAISE and LOWER smoothly and in direct response to the movement of the control lever. The mast should also tilt forward and backward smoothly and in direct response to the movement of the tilt control lever.

H. LUBRICATION

Be sure the truck has been thoroughly lubricated. Check all lubrication points shown in the lubrication chart illustrated in Topic 4.

I. GENERAL INSPECTIONS

Have a qualified serviceman check, correct, or report the following where applicable.

1. Electrical Connections, loose or disconnected wires, cables, or terminals.
2. Visually inspect the control wires and cables for grounds.
3. Mounting hardware: Make certain all mounting hardware is tight and none are missing.
4. Grease in drive wheel bull gears,
5. Grease in drive wheel bearings.
6. Check the speed control adjustments.
7. Brake adjustment, free play and pedal height.
8. The steering should be smooth and immediate.
9. Check the lift chains adjustment for equal tension.
10. Make certain the carriage and mast are properly centered, shimmed for side thrust, and operates freely (Fig. 2-5).
11. Inspect the tires for wear and damage.
12. Inspect lift chains for stretching. Measure 12 links of chain (Fig. 2-6). Distance should be 12-3/8" maximum. If the distance is not within limits. replace both chains.

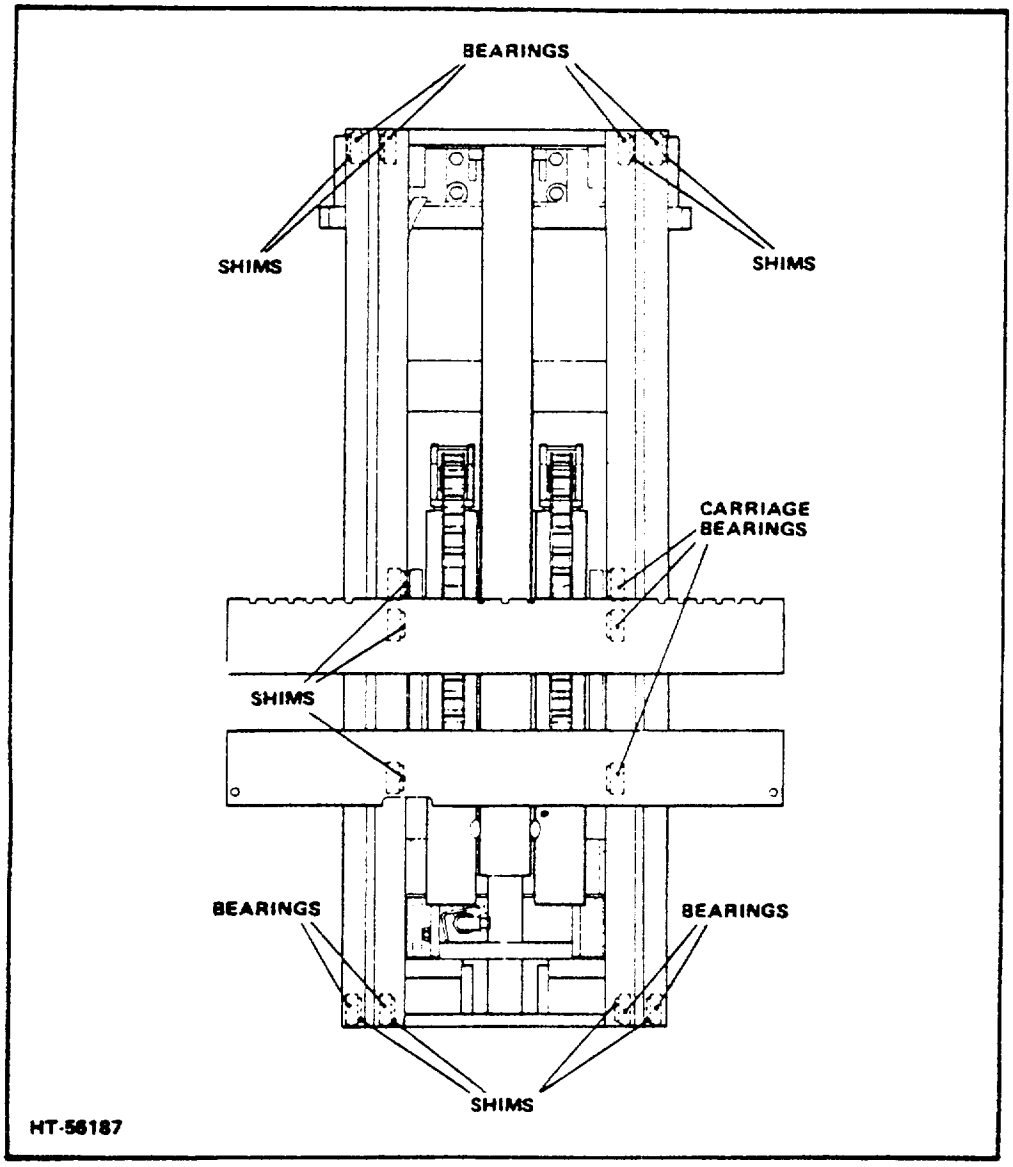


Figure 2-5. Canted Bearing Mast

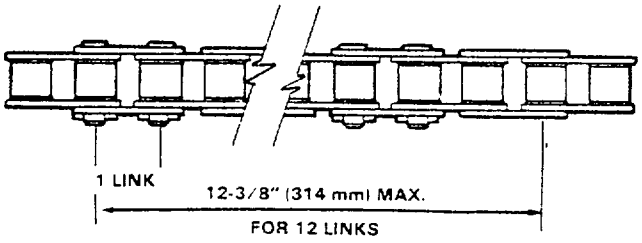


Figure 2-6. Chain Measurements

TOPIC 3. OPERATION OF THE TRUCK

⚠ WARNING

Do not attempt to operate the truck until this manual has been thoroughly studied. Be especially aware of all safety precautions contained In this topic and in the safety section at the front of this manual.

The operator must aquaint himself with the location and function of the various controls and Instruments as well as rear wheel steering before attempting to operate the truck (Fig 3-1).

A. OPERATING CONTROLS

1. Horn Button:

The horn button is located under a rubber cover in the center of the steering wheel. Depress directly on the cover to sound the norm.

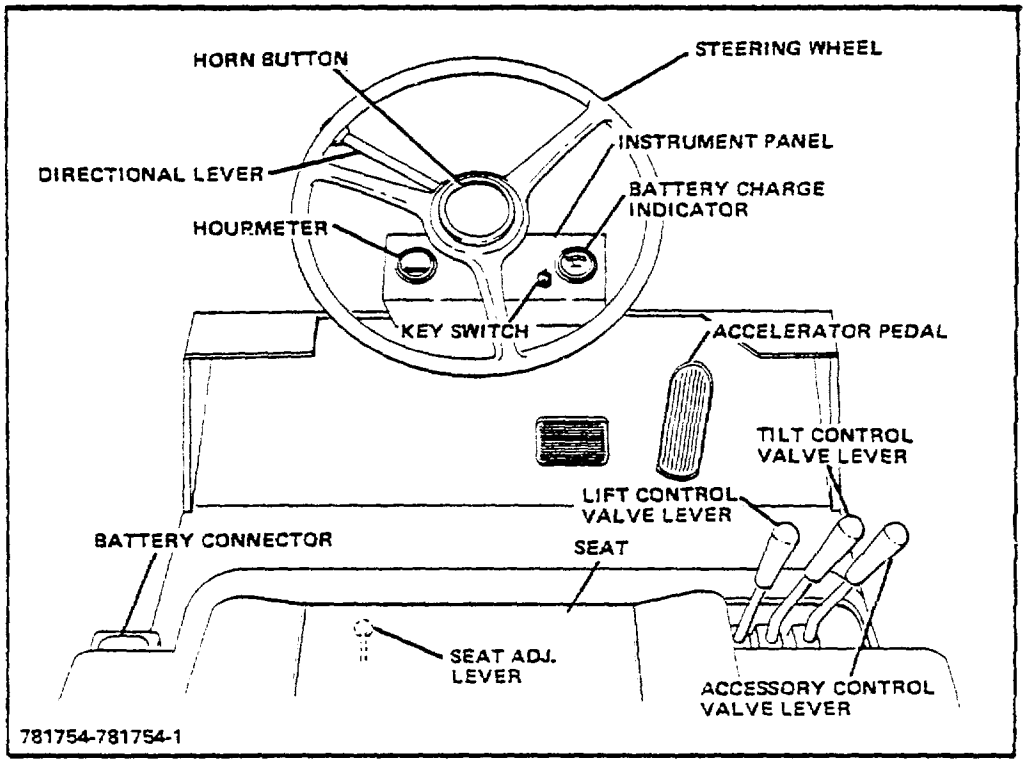


Figure 3- 1. Operator's Compartment

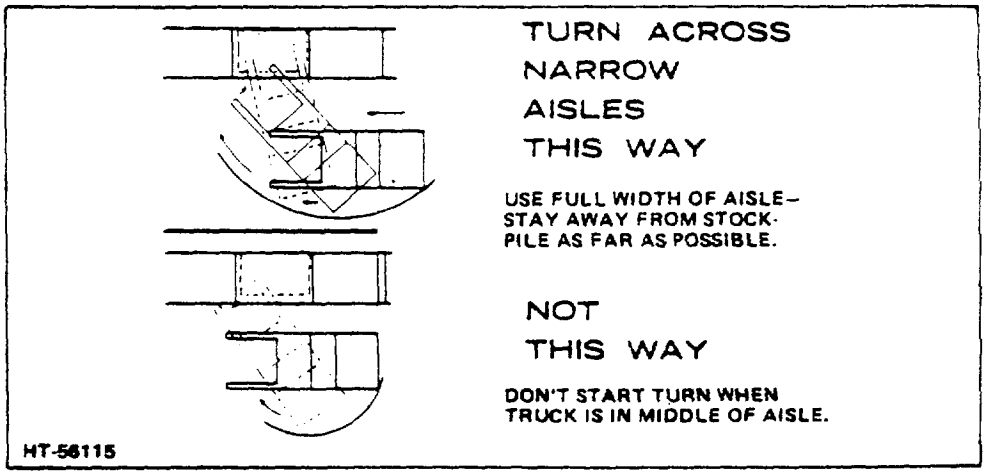


Figure 3-2. Aisle Turning Procedure

2. Steering Wheel:

The steering wheel is operated in the conventional manner, that is, when the wheel is turned right, the lift truck will turn right. The lift truck will turn to the left when the steering wheel is turned to the left. The steer wheels are located at the rear of the lift truck, therefore; the operator must allow for the rear-end swing towards the opposite direction of the turn while the turn is being executed (Fig 3-2).

NOTE:

A lift truck that is equipped with power steering includes a hydraulic power steering unit located at the base of the steering column. As the steering wheel is turned, the power steering unit directs hydraulic oil to aid in steering. However; after the steer wheel spindle contacts the mechanical stop, the steering wheel can still be turned slowly. This condition is called "motoring". Turning the steering wheel after the steer wheels can no longer turn causes the power steering unit to act as a hand pump. The operator should not become alarmed if the spokes of the steering wheel change position after a turn is completed.

⚠ WARNING

Keep the steering wheel dry and free from oil or grease. Wipe any oil or grease from you hands before attempting to steer the truck.

3. Directional Lever

The directional lever is located beneath the steering wheel and on

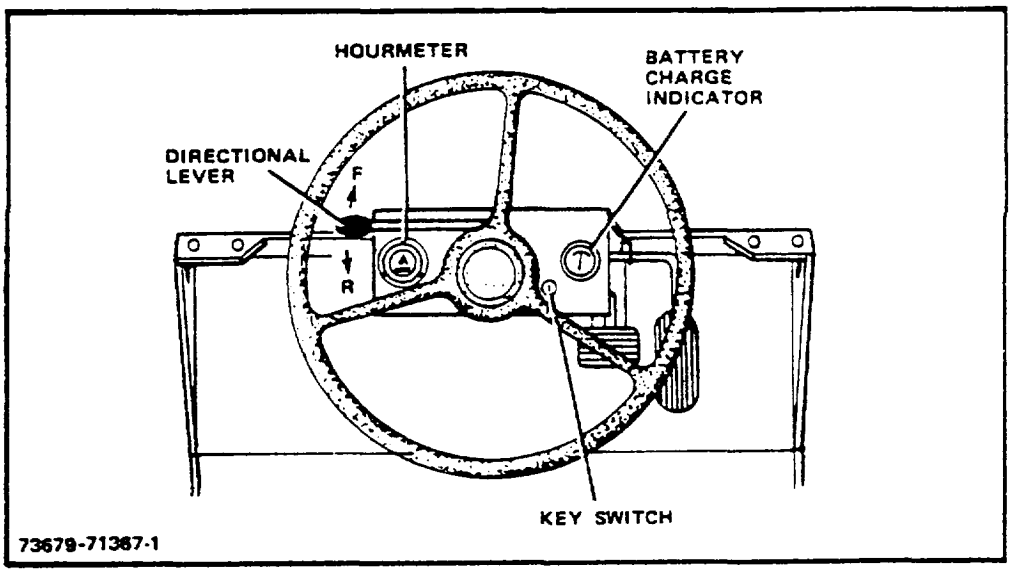


Figure 3-3. Instrument Panel

the left side of the steering column. Push the lever towards the mast to operate the truck in THE FORWARD direction. Pull the lever back towards the seat to operate the truck in the REVERSE direction. Place the lever in the center or NEUTRAL position (between the F and R positions) during lifting or lowering operations, and leaving the truck unattended.

4 Instrument Panel:

The instrument panel Is located in front of the operator contains the. following switch and meters (Fig 3-3):

a. Key Switch

The two position key switch turns electrical current on or off. Insert the key in the switch and turn the key switch clockwise to the "ON" position to operate the lift truck. Turn the key switch counterclockwise to the "OFF" position to deactivate the lift truck. Remove the key from the switch when leaving the truck unattended.

b. Hourmeter

The purpose of the hourmeter is to visually display the length of

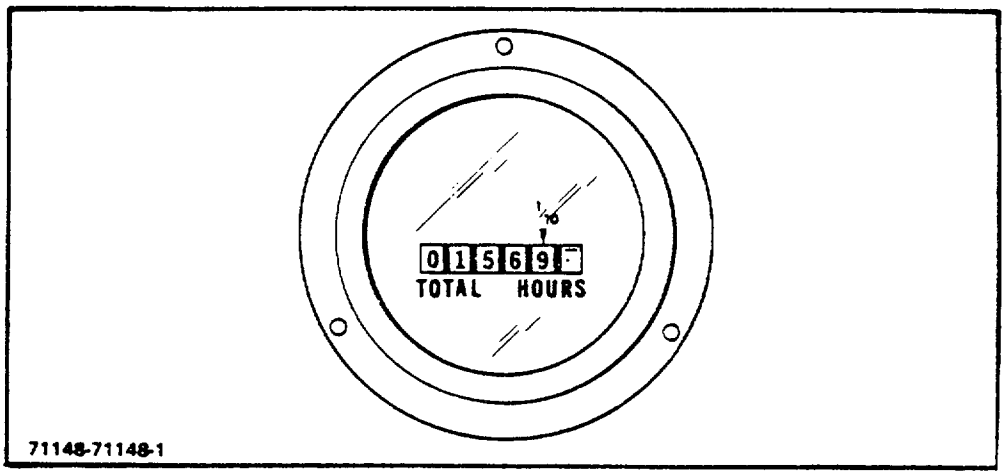


Figure 3-4. Hourmeter

time a truck has been in service and give the operator a means of scheduling maintenance.

The hourmeter is a direct reading type meter. The meter records up to 9,999.9 hours and then repeats itself. The hour figures are to the left of the decimal point. 10ths of an hour are recorded to the right of the decimal point (Fig 3-4).

c. Battery Charge Indicator

The battery charge indicator is used to measure battery voltage. There are three colored areas on the dial: green, yellow, and red. Whenever the pointer is in the red area during operation of the lift truck, the battery requires charging (Refer to the table below for the voltage range in each colored zone).

36 Volts	
RED	25 to 30 V
YELLOW	30 to 35 V
GREEN	35 to 39 V

5. Accelerator Pedal

The accelerator pedal is the furthest pedal to the right of the steering column. Depressing the accelerator pedal increases the traveling speed of the lift truck.

6. Brake Pedal

The brake pedal is the closest pedal to the right of the steering column. The brake pedal operates the brake master cylinder, which in turn actuates the wheel cylinders and brake shoes. Depress the brake pedal gradually to slow the truck down or stop. Avoid sudden stops.

7 Lift and Tilt Controls:

The lift and tilt control levers are located to the right of the operator's seat. The lever closest to the seat is the lift lever, and the next lever is the tilt lever. All accessory control levers are located to the right of the tilt lever.

Lifting and lowering action of the mast is controlled by the lift control valve lever. Pull the lever back to lift and push it forward to lower.

The lever is designed to automatically return to the neutral (center) position when released.

The rate of lift is controlled by the position of the lever. Pulling the lever back as far as possible increases the speed of lift. When the forks are raised to the desired height, release the lever smoothly to the neutral position.

Lowering speed is controlled by the weight of the load and position of the control lever. Push the lever forward slowly for smooth operation. To increase the speed of lowering, push the lever forward as far as possible. Release the lever slowly to the neutral position as the load reaches the desired level. Maximum lowering speed is held within safe limits by the lift cylinder flow regulator valve.

⚠ CAUTION

Do not release the lift control valve suddenly when lowering the load. This causes severe mechanical shock.

The tilt control lever Is mounted to the right of the lift lever. Rate of tilt is controlled by the position of the lever. Pulling the lever back or pushing it forward as far as possible Increases the speed of tilt. When the mast Is tilted to the desired position, release the lever to the neutral position.

⚠ CAUTION

Use care when tilting the mast forward to prevent the load from falling.

8. Seat Brake

When weight i.e., the operator ,s removed from the seat, the parking brake is automatically applied and power to the drive motor is cut off.

9. Operator's Seat Adjustment

The operator's seat can be adjusted forward or backward for maximum comfort. The adjusting lever is located below the seat. Move the lever to the left to release the seat lock, then; move the seat forward or backward to the desired position by shifting body weight. Release the lever to lock the seat in the desired position (Fig 3-5).

B. OPERATION OF THE TRUCK

1. Fork Adjustment:

For maximum balance, always position the forks in proportion to the width of the load. Pull up the lock on the top of each fork to release it from its position. Move the fork to the desired location on the carriage. Seat the fork in the notch on the carriage nearest the location chosen and lock the fork in place. Keep the forks as far apart as possible (Fig 3-6).

2. Operating Procedures

a. Start-up Sequence:

The following must be performed in the sequence presented in order to make the truck operational:

(1) Connect the Battery Connector:

The operator's first requirement in operation of the lift truck is to connect the battery. Install the quick-disconnect battery connector into its receptacle and push the lever down to lock it in place.

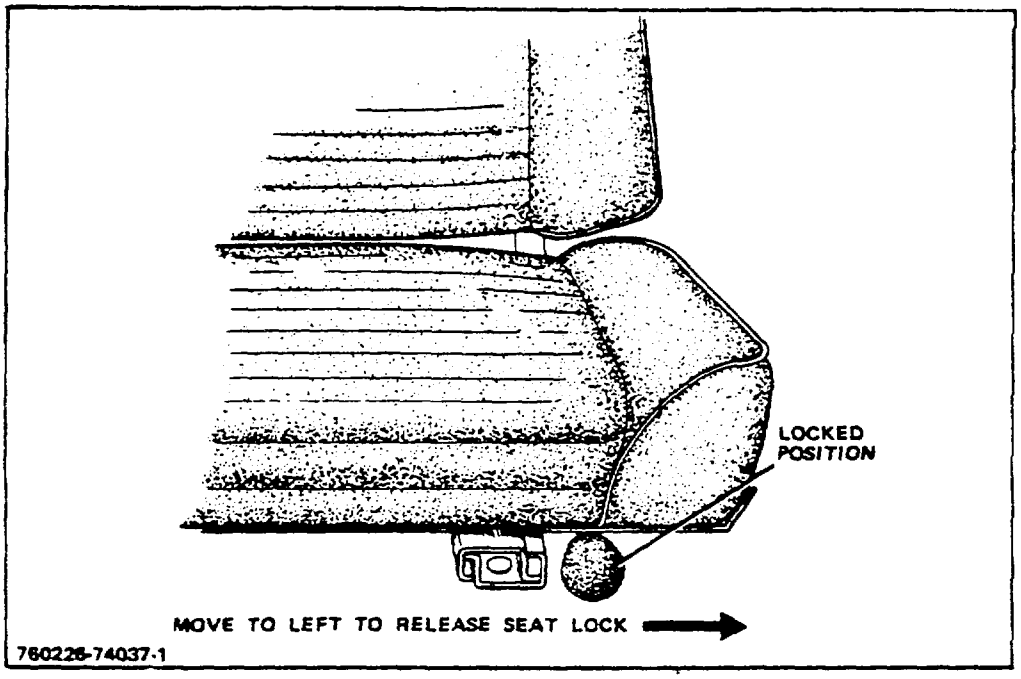


Figure 3-5. Seat Adjustment

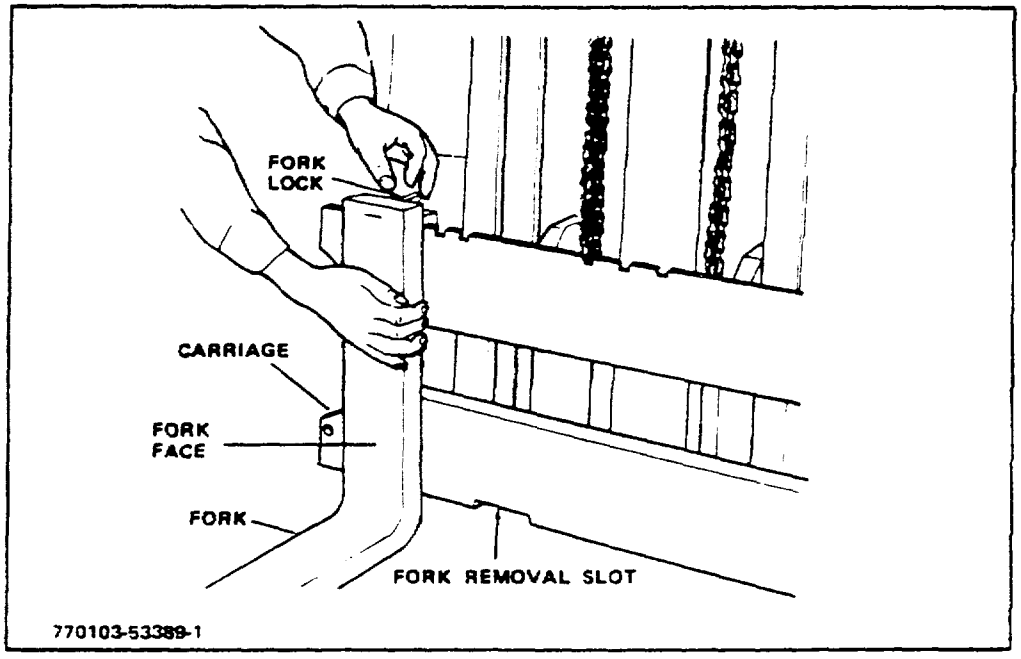


Figure 3-6. Fork Adjustment

(2) Sit on the Seat:

After the battery has been connected, the operator must seat himself properly on the seat. When the seat is in the down position, the parking brake is released and the seat switch is closed.

⚠ WARNING

If the truck is parked on an incline, depress the brake pedal to prevent the truck from rolling down the incline.

(3) Place the directional control lever in the NEUTRAL position.

(4) Turn the Key Switch to the ON Position:

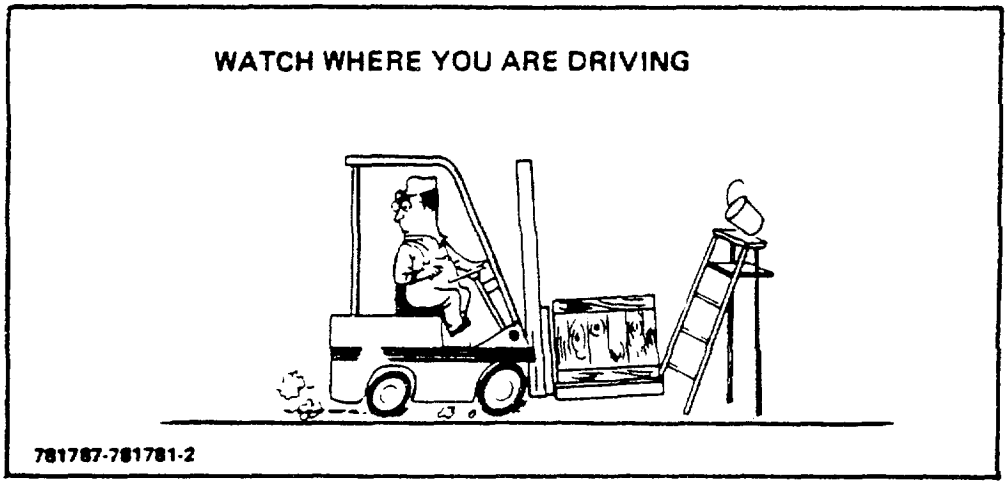
Insert the key in the switch on the instrument panel and turn clockwise to the ON position.

(5) Select a direction.

(6) Raise the carriage and forks high enough to clear obstructions. Place the directional control lever In the desired position (forward or reverse).

(7) Depress the Accelerator Pedal

With a direction selected, gradually press down on the accelerator pedal until the desired speed is obtained.



⚠ WARNING

Before proceeding in either direction, be absolutely certain no one is standing in the area and the intended path of travel is free from obstructions.

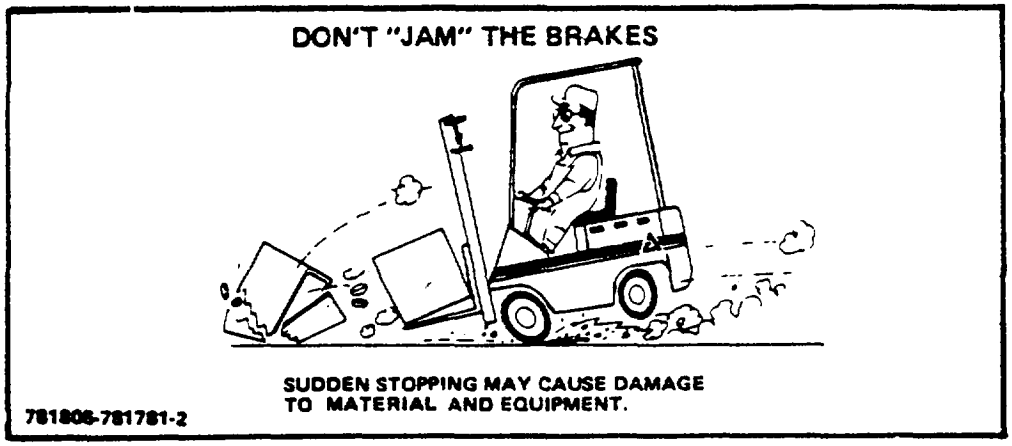
b. Changing Direction of Travel

When it becomes necessary to change directions (forward to reverse direction or vice versa), take your foot off the accelerator pedal, and gradually depress the brake pedal until the truck comes to a complete stop. Then, shift the directional control lever to the desired position. Depress the accelerator and look in the intended path of travel.

Whenever the directional control lever is shifted from the forward to reverse direction, or vice versa, the drive motor armature rotation must be reversed. To accomplish this task, the drive control system enters into a plugging mode. The plugging function slows down the rotation of the drive motor armature gradually and smoothly until it stops rotating and then begins to rotate in the opposite direction. This prevents the armature from stopping rotation In one direction and beginning to rotate in the other direction too abruptly, possibly damaging drive system components. Voltage spikes across the motor field are also suppressed in the plugging mode. The rate at which plugging is accomplished is controlled by an adjustable plugging potentiometer. This controlled plugging results In truck deceleration (braking torque) which the operator can use to assist in slowing down the lift truck in conjunction with using the service brakes. For example: when proceeding down to a grade, to slow down the lift truck, plug the drive motor as follows: ease up on the accelerator, shift the directional lever to the opposite direction, and depress the accelerator pedal again. The' truck is now in the plugging mode and will come to a complete stop before the truck will move in the direction selected. To prevent the truck from moving In that direction, plug the drive motor in the opposite direction or remove your foot from the accelerator and apply the service brakes to stop the truck.

⚠ WARNING

The plugging function should only be used to assist in slowing down the lift truck in conjunction with using the service brakes. Do not use plugging in lieu of the service brakes to stop the lift truck.



c. Stopping and Parking

Bring the lift truck to a safe, smooth stop by taking your foot off the accelerator and gradually depressing the brake pedal. On slippery surfaces it may be necessary to pump the brake pedal until the truck gradually slows down and comes to a complete stop. This will prevent the drive wheels from locking when the brakes are applied (Plugging the drive motor may be used to assist in slowing down the truck. Refer to preceeding Paragraph b).

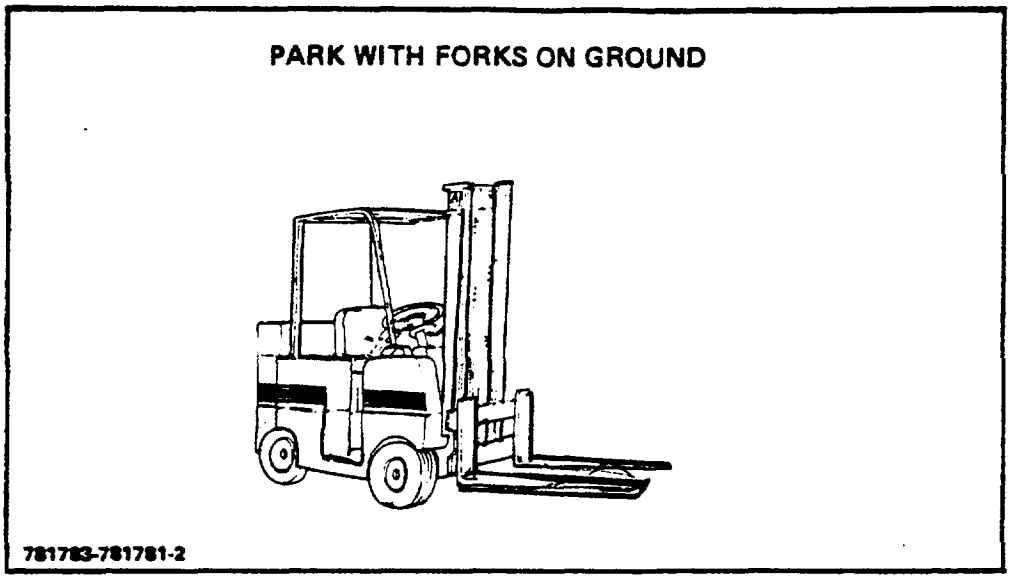
⚠ CAUTION

Do not jam on the brakes with a loaded lift truck because this may cause the load to topple.

⚠ WARNING

Do not attempt to stop the truck with the seat (parking brake. In addition to being in a dangerous operating position, damage to the drive system components will result.

When the lift truck is parked, lower the carriage and forks to the floor, remove the key, to prevent unauthorized use of the lift truck and disconnect the battery. When the operator leaves the seat, it rises. As the seat rises, the seat (parking) brake is automatically applied and the seat switch opens. Block the wheels if the truck is parked on an incline.



3. Load Handling Procedures:

a. Truck Stability

Lift truck stability is based on the counterbalance principle. The drive axle acts like a balancing point (fulcrum). The load is carried at the front end of the lift truck and is counterbalanced by the counterweight on the rear of the lift truck (Fig 3-7).

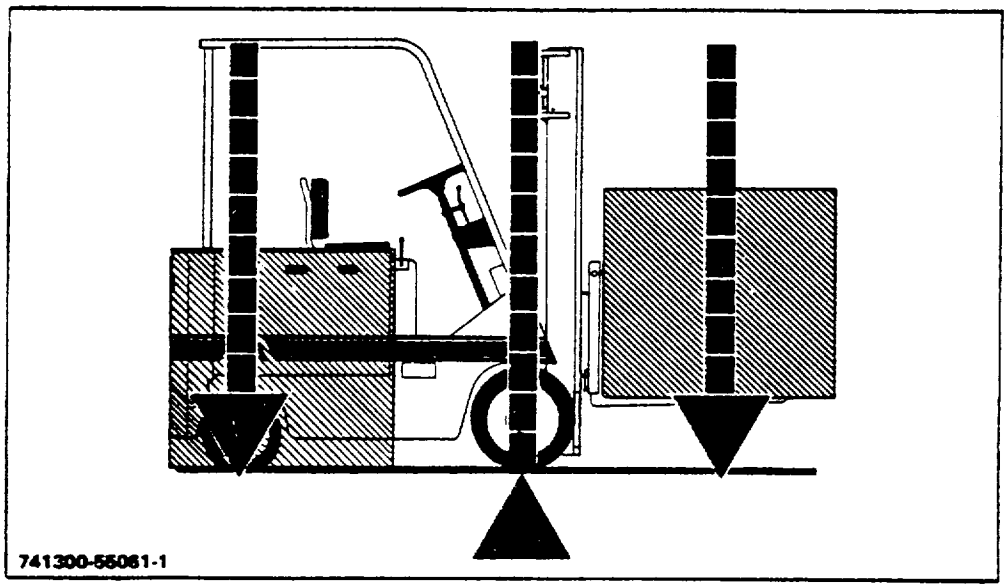
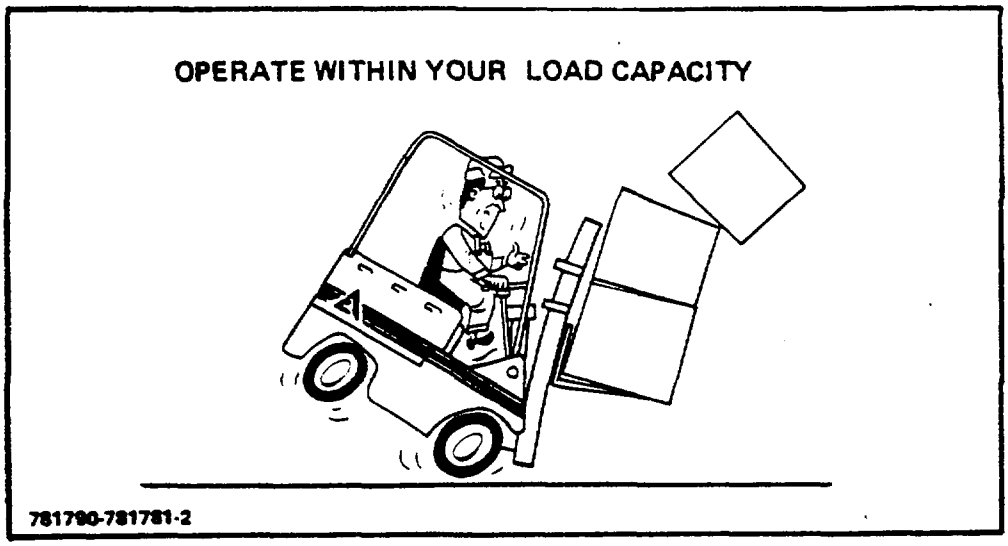


Figure 3-7. Counterbalance Principle



Stability of the lift truck is achieved by placing the load close to the fulcrum (resting against the fork faces). Each lift truck is rated for a specific load capacity at a given load center, usually 24" (0.6096 m). This information is contained on the truck's nameplate. The load center is the distance measured in inches (mm) from the face of the forks to the center of gravity of the load. When various attachments or special masts are added, the load capacity usually decreases, depending upon the size and weight of the special mast or attachment.

⚠ WARNING

The load capacity of the truck must never be exceeded. Overloading is hazardous to the safety of the operator or others, will endanger other equipment, or will damage the truck.

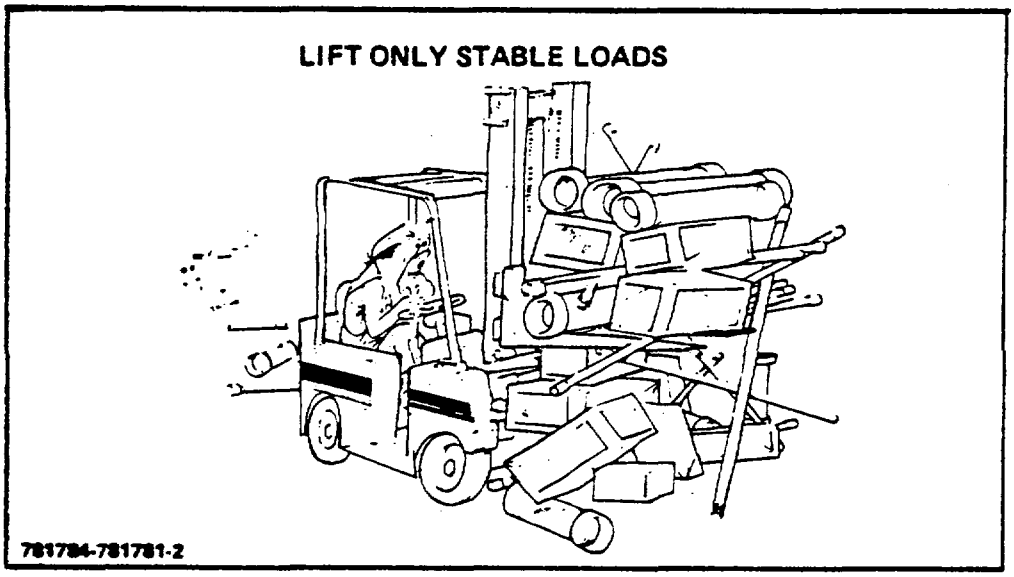
b. Lifting a Palletized Load:

(1) Position the lift truck squarely in front of the load.

(2) Raise the forks to a point midway between the upper and lower members of the pallet.

(3) With the mast in a vertical position, and the forks parallel to the floor, slowly insert the forks into the pallet until the load rests, against the fork faces. If the mast is not in the vertical position, the forks may hang up when they are inserted.

(4) Lift the load using the lift control lever just enough to clear the



stack or floor. Use the tilt control lever to cradle the load against the backrest.

⚠ WARNING

Watch for low hanging pipes, electrical lines, stacked materials, or other obstacles.

⚠ WARNING

Handle only stable and safely arranged loads.

(5) Back away from the stack and lower the load just enough to clear the surface.

c. Traveling

(1) The load should always be carried cradled against the backrest and as low as possible for maximum stability and vision (Fig 3-8).

(2) Travel in the reverse direction and look in the intended path of travel when the load is so bulky that vision is obstructed by the load (Fig 3-9).

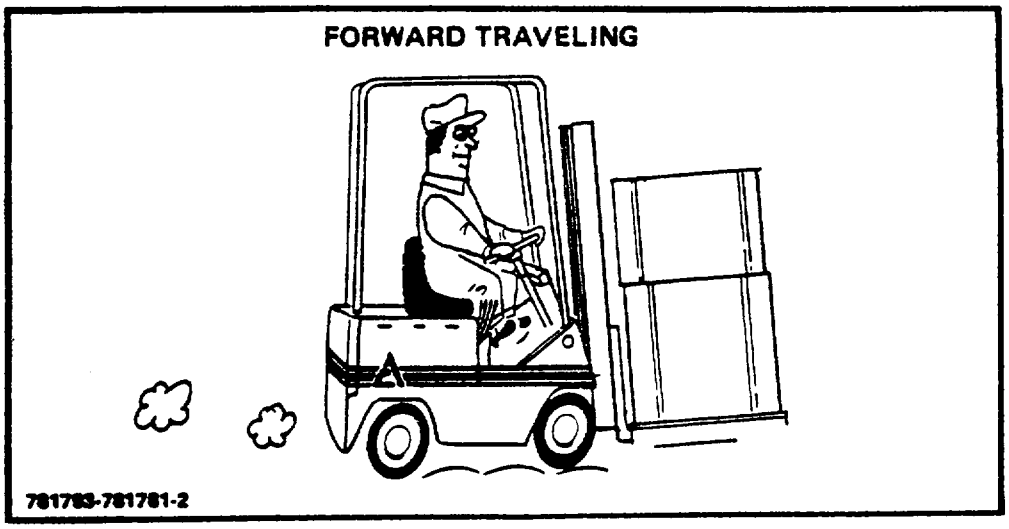


Figure 3-8. Traveling in the Forward Direction with a Loaded Lift Truck

⚠ WARNING

Extra care must be taken while traveling in the reverse direction because the operator does not have a constant view of the load.

(3) Travel at a safe speed for existing conditions. The operator must be able to bring the truck to a safe smooth stop at all times under all travel conditions. Obey all plant traffic rules.

(4) Always look in the intended direction of travel.

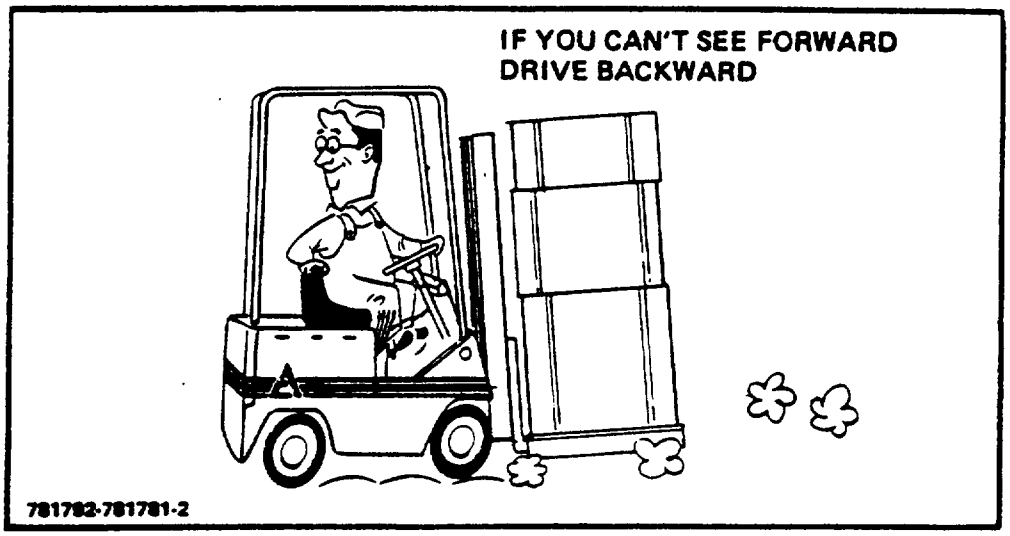
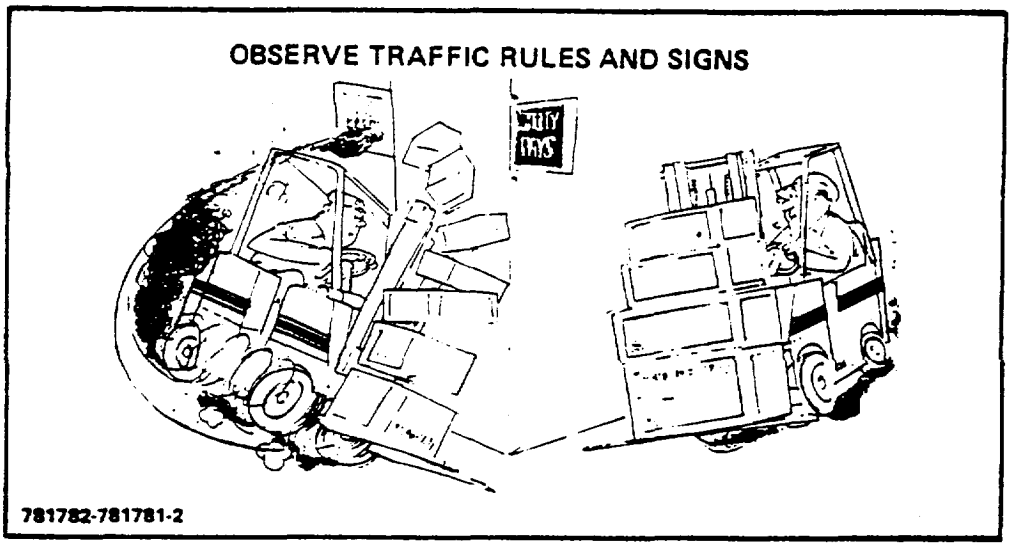


Figure 3-9. Traveling in the Reverse Direction with a Loaded Lift Truck



(5) Stop at comers and intersections. Sound the horn to alert others of your presence.

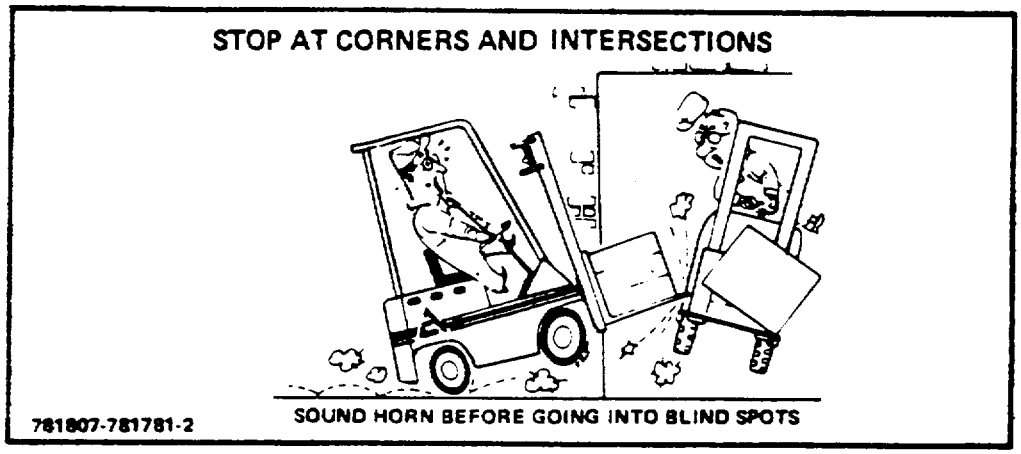
⚠ WARNING

To eliminate load spillage, apply the brakes with care.

(6) When ascending or descending a grade travel with the load upgrade (Figs 3-10).

(7) An unloaded truck should always be operated on all grades with the fork end of the truck downgrade (Fig 3-11).

(8) On all grades, the load and/or forks should be raised only as far as necessary to clear the grade or floor surface.



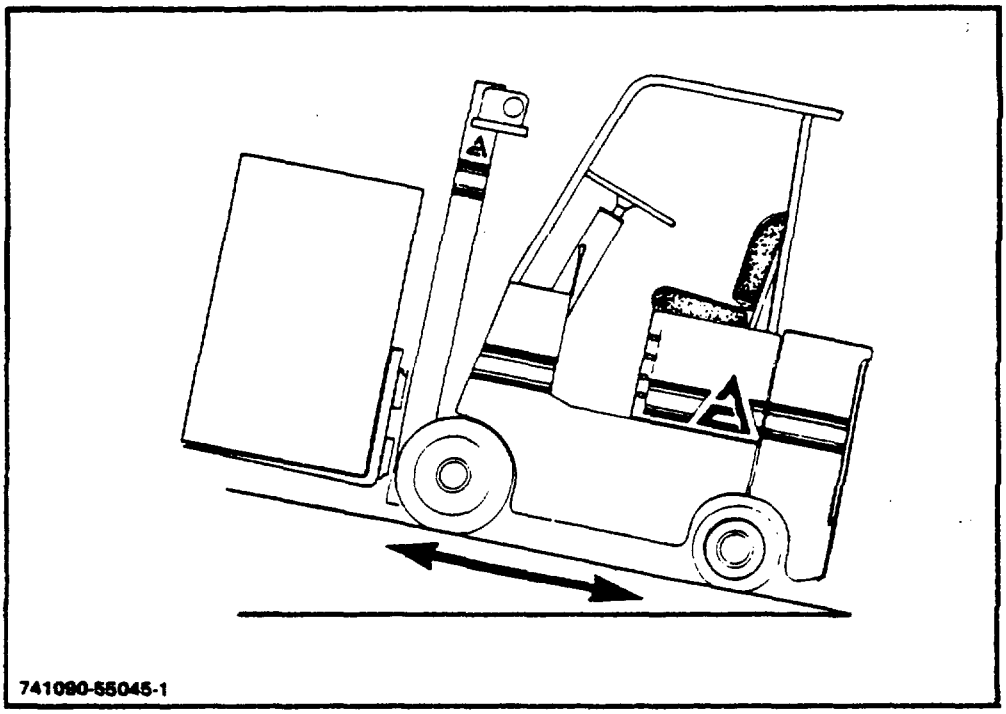


Figure 3-10. Ascending or Descending a Grade

(9) Cross all railway tracks slowly and at a slight angle. Travel slowly over rough surfaces.

(10) When turning a corner, begin the turn when the front wheels are at a right-angle to the intended path of travel and allow for rear end swing.

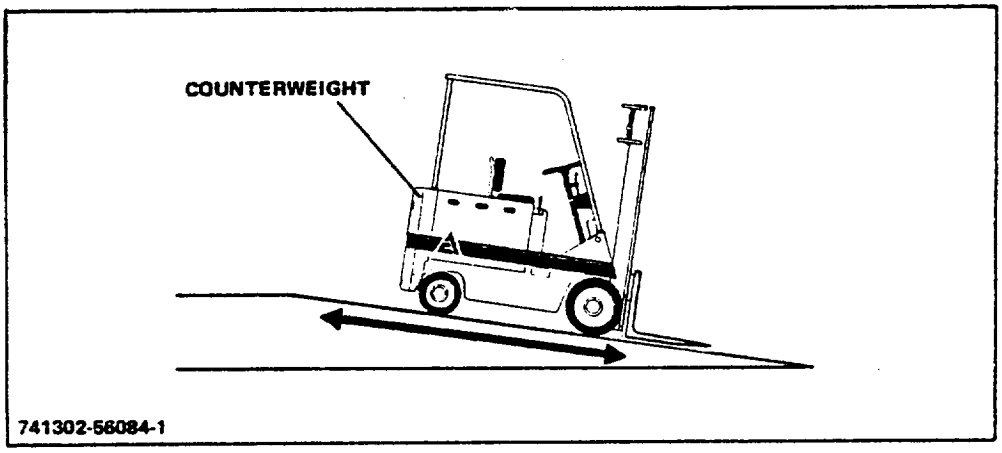
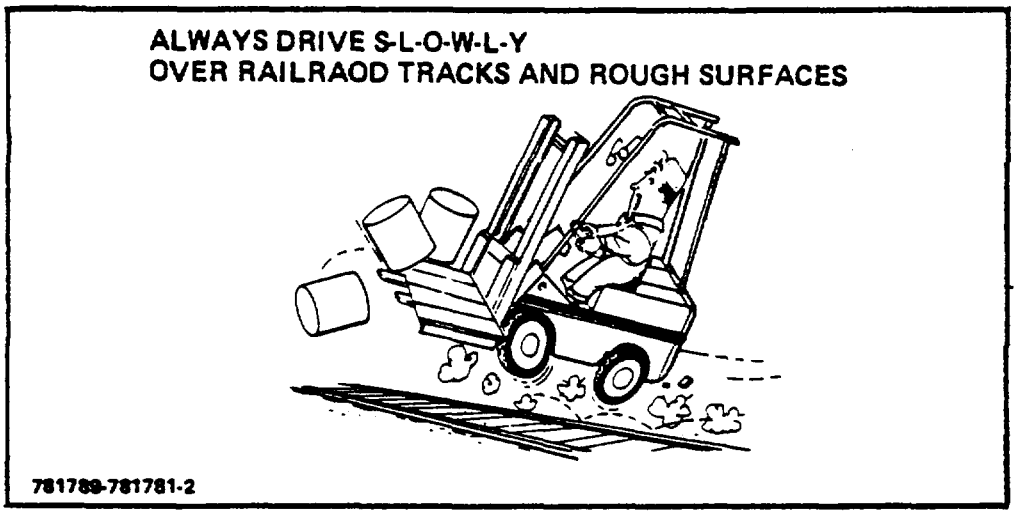


Figure 3-11. Traveling Unloaded Up or Down Inclines



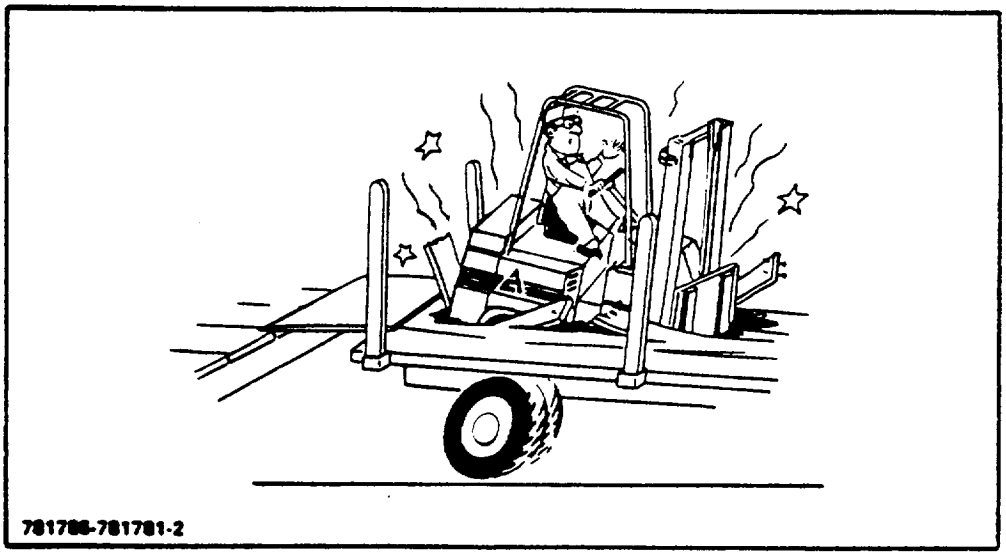
(11) Check the condition of all floors, dockboards, and semi-trailer beds to make certain that these surfaces will support the weight of the lift truck, its load and the operator.

(12) Keep clear of low hanging obstructions such as lights, pipes, doorways and overhead cranes.

⚠ WARNING

Maintain a safe distance from the edge of the dockboards, ramps, and elevated platforms.

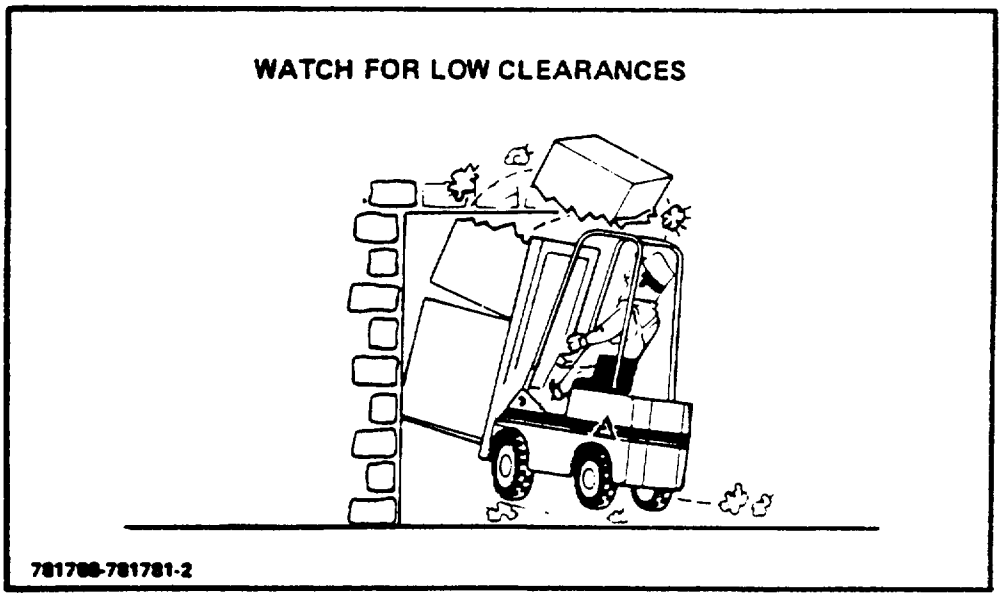
(13) To maneuver in narrow aisles, raise the forks high enough to clear the stack and gain additional maneuvering area (Fig. 3-12).



⚠ CAUTION

Extra care must be taken with the forks raised. Watch for low clearances.

(14) Take full advantage of operating space in narrow aisles (Fig 3-13). Stay as far away from the stockpile as possible but allow for rear-end swing.



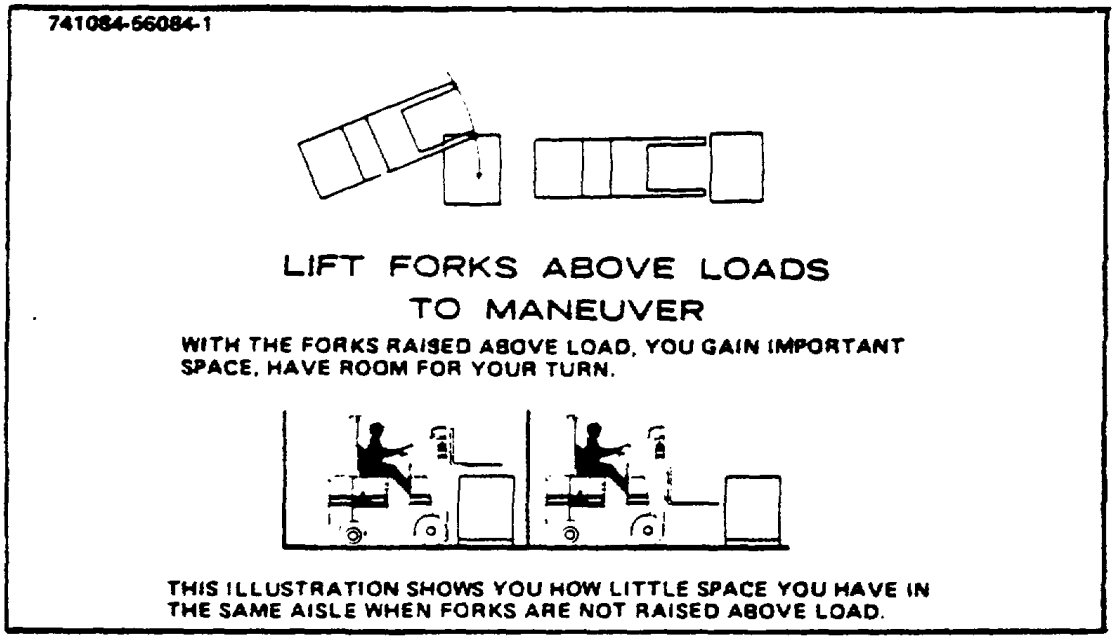


Figure 3-12. Narrow Aisle Maneuver

(15) Slowly drive the truck straight In when you enter a railway car. Keep to the left of the bridgeplate when a left turn is made inside the railway car. Do the opposite for a right turn. However: If the lift truck is one of the larger models, you may have to enter the railway car slowly at a slight angle and begin the turn as soon as possible.

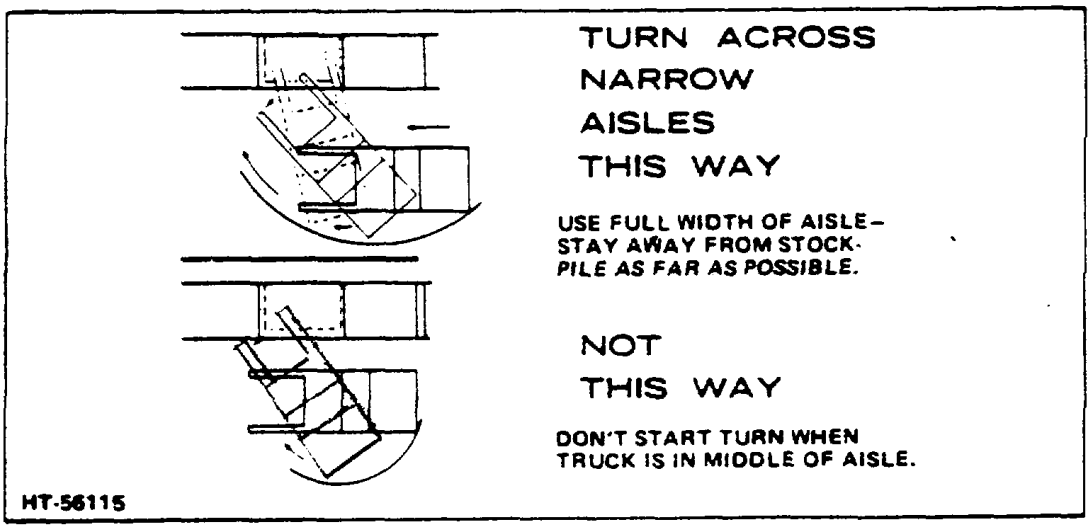


Figure 3-13. Aisle Turning Procedure

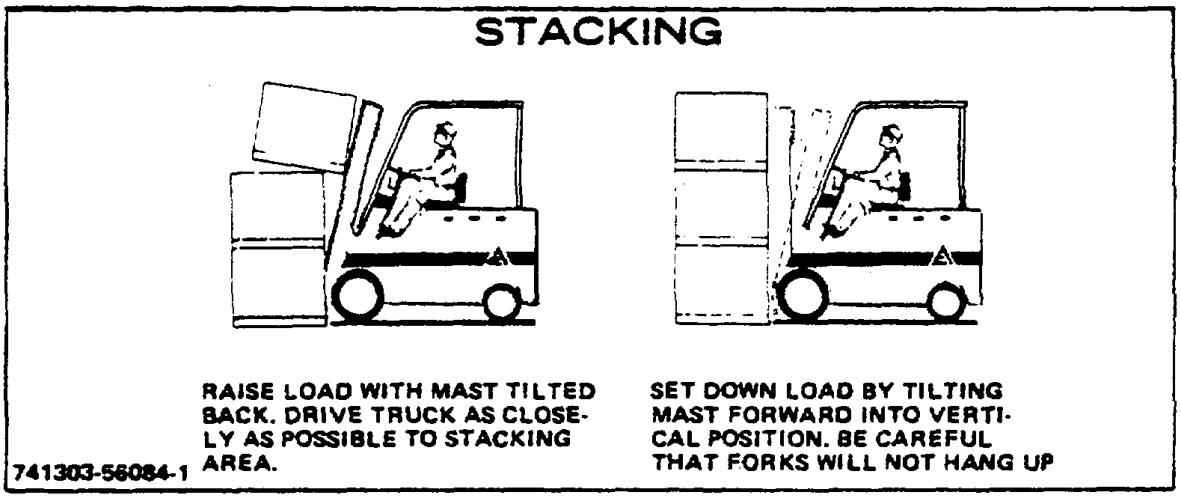


Figure 3-14. Stacking and Unloading

⚠ WARNING

Maintain a safe distance from the edge of the bridgeplate.

⚠ WARNING

Never enter a trailer or railcar unless the trailer or railcar wheels are properly chocked. Trailers must also be supported at the nose end by stabilizing jacks to prevent upending.

d. Positioning, Stacking, and Unloading

(1) Slowly maneuver the lift truck to the deposit area with the load. Position the truck squarely in front of the stack.

(2) Check the low hanging obstructions. Raise the load to the proper height to clear the stockpile with the mast tilted slightly back (Fig. 3-14).

(3) With the load elevated, slowly and carefully move the lift truck to position the load squarely over the stockpile. Tilt the mast forward to the vertical position and lower the load onto the stockpile until the forks are halfway between the upper and lower members of the pallet

⚠ WARNING

Stockpiles should always be stable to avoid injury to personnel, and damage to equipment or Stock.

(4) Withdraw the forks from the pallet by backing the lift truck away from the stack.

⚠ WARNING

Make certain the intended path of travel is free from obstruction.

(5) With forks clear of the stack, lower them to about 2" (50.8 mm) from the floor before proceeding.

e. Unpalletized Loads:

Unpalletized loads require a special technique in lifting and stacking. Special attachments are often used to handle unpalletized loads. When these attachments are not available and the load must be stacked or moved, proceed as follows (Fig 3-15).

(1) Tilt the forks forward so the tips contact the floor.

(2) As carefully as possible insert the forks under the load until the load rests against the fork faces. Tilt the load slightly back.

(3) The rest of the procedure is the same as the procedure for handling palletized loads.

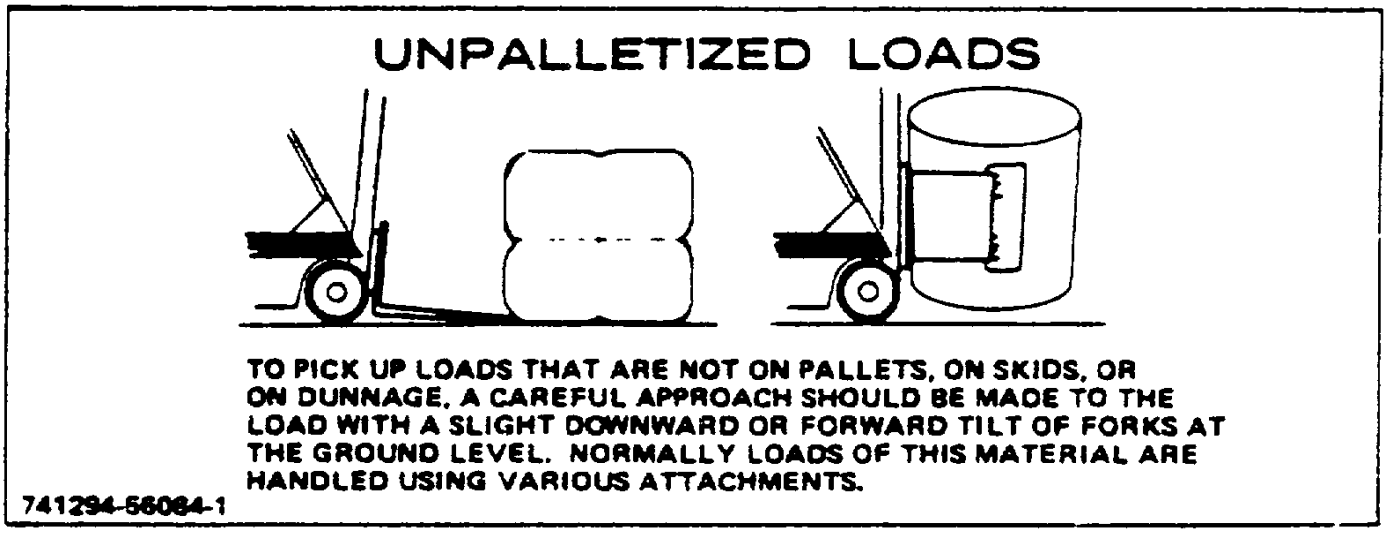


Figure 3-15. Unpalletized Load Handling

(4) To stack an unpalletized load, position the lift truck squarely in front of the stack.

(5) Check for low hanging obstructions. Raise the load to the proper height to clear the stockpile with the mast tilted slightly back.

(6) Position the load squarely over the stockpile, then lower the forks slowly until the forks rest on the stack.

⚠ WARNING

Stacks should always be stable to avoid injury to personnel and damage to equipment or stock.

(7) Tilt the load slightly forward and begin to back the lift truck away from the stack until the forks are completely withdrawn from the stack.

⚠ WARNING

Make certain the intended path of travel is free from obstructions.

(8) Lower the forks to about 2" (50.8 mm) from the floor.

TOPIC 4. LUBRICATION AND SERVICE

A LUBRICANT SPECIFICATIONS

1. Brake Master Cylinder

   Use only premium quality, heavy-duty, brake fluid with an extreme heat-cold range that conforms to specification MIL-B-46176.

2. Hydraulic System Oil

   Use a hydraulic oil that conforms to Allis-Chalmers specification MA 170.103, or SAE 10 SE engine oil, or MIL-L 2104B in the hydraulic system.

   Hydraulic system storage containers MUST be kept free of contaminants, such as dirt, water, metal chips, etc. Contaminated hydraulic oil is the major cause of hydraulic system failures. It is therefore advised that ANY oil that Is added or replaced be filtered through a 10 micron filter, or finer, before entering the hydraulic system. It is recommended that each storage container be clearly marked FOR USE IN HYDRAULIC SYSTEM ONLY.

3. Differential and Manual Steering Gear Oil

   Lubricate with extreme pressure gear lube which is non-corrosive and resists oxidation and foaming. Use SAE 140 EP gear lube in temperatures above 32°F(0°C), and SAE 90 EP gear lube in temperatures below 32°F()°C).

4. Drive Axle

   a. Lubricate with a high quality, Grade 2, lithium base grease (characterized by the word "Moly") that contains a maximum of 5% micronized molybdenum disulfide. The lubricant must be waterproof and heat resistant

   b. Planetary

      Lubricate with SAE 90 EP (extreme pressure) gear lube which is non-corrosive and resists oxidation and foaming.

5. Wheel Bearings and Jackshaft Bearings

   Lubricate with a high-quality, Grade 2, lithium base grease (characterized by the word "Moly") that contains a maximum of 5% micronized molybdenum disulfide. The lubricant must be waterproof and heat resistant Apply the grease with an applicator designed to force the lubricant into the bearing rollers. Do not paint dip, or swab by hand.

6. Pressure Gun Fittings

   Lubricate with a high quality chassis lubricant N.L.G.I., Grade 2, heavyduty, sodium base grease available from any reputable oil company.

7. Oil Can Points

   Lubricate the following points with SAE 10 or 20 engine oil.

   Seat Hinge — Battery Cover Hinges

   Control Valve Linkage — Accelerator Pedal Pivot

8. Masts

   Lubricate roller contact surfaces of the mast uprights with a high quality, Grade 2, lithium base grease (characterized by the word "Moly") that contains a maximum of 5% micronized molybendum disulfide. The lubricant must be waterproof and heat resistant

9. Tires Check tires, pneumatic and cushion types for wear and damage. Unevenly worn or badly damaged tires will vibrate excessively and cause hard steering. Remove steel chips and other foreign material from tire treads to prevent further damage.

B. SERVICE GUIDE

The following paragraphs provide the operator and maintenance man with a comprehensive list of service operations that should be performed periodically. Close adherence to the list by qualified personnel will go far toward preventing major trouble and subsequent downtime of equipment.

NOTE:

The time intervals given in this guide are based on normal operating conditions. These services should be performed as often as required to maintain the unit in good operating condition.

1. 8 Hour Service Check List

   Refer to the check list at the rear of this topic. Make copies of this form or make up a similar form and use as a check list for performing the 8 hour inspections. Perform each inspection daily. Some inspections may be performed during the normal workshift without loss of time. As each inspection is performed, check (√) it off.

The following explanations correspond to the inspections on the check list:

a. The electrolyte level in the battery must be .25" (6.35 mm) below the bottom of the vent well in each cell.

b. The specific gravity of the electrolyte in each cell should be between 1.265 and 1.290 with the electrolyte at 80°F(27°C).

c. Inspect the battery cables. They must not be frayed or loose.

d. Inspect the battery connector to make certain there is no foreign material in the connector.

e. Check the hydraulic oil level on the dipstick. The level should be up to the FULL mark on the dipstick with the oil at 72°F(22°C).

f. Check for oil leaks from the hydraulic and brake systems.

g. After the battery is connected, make certain the horn operates when the horn button is depressed.

h. After the key switch is turned on, make certain the hourmeter is energized and operating.

NOTE:

The hourmeter may not function until the drive motor or the pump motor is operating.

i. Inspect the condition of the tires. If the tires are badly worn or have an excessive amount of breaks in them, they must be replaced. Steel chips or other foreign material should always be removed to prevent further damage. Tires that are worn unevenly or have sections of tread tom out can affect the stopping of the vehicle or can cause excessive truck vibration, hard steering, and rapid battery drain.

j. Check the axle toggle stops that are welded to the frame (underside of the battery deck) and are located directly above the top of the steer axle housing yokes (Fig. 4-1).

   Turn the steer wheels first to the full right and then to the full left position. Visually check to make sure the axle stop on each side is not bent out of position, damaged. or missing.

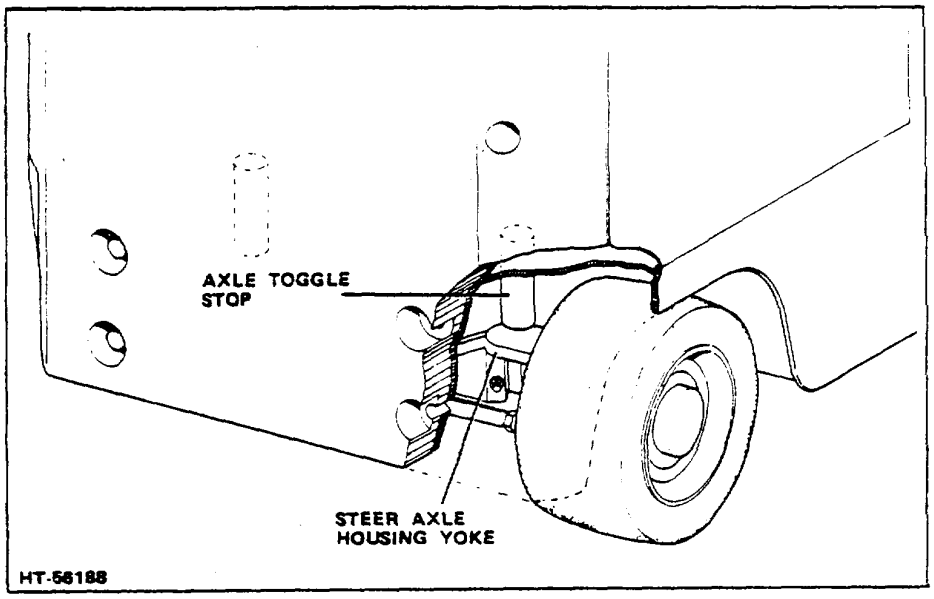


Figure 4-1. Location of Steer Axle Toggle Stops

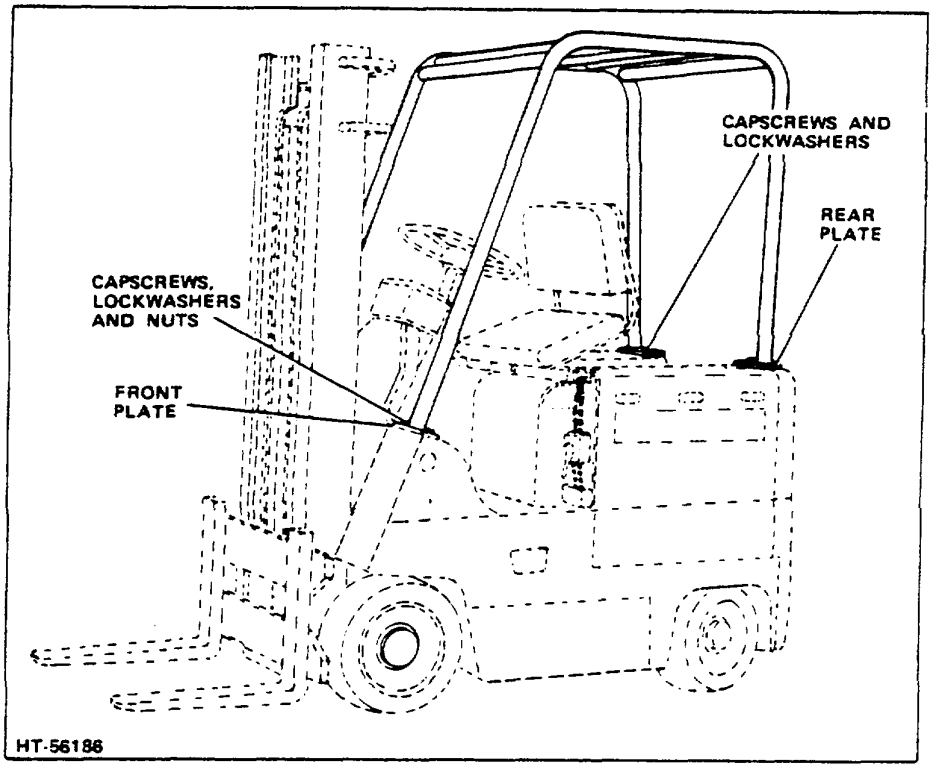


Figure 4-2. Overhead Guard Typical

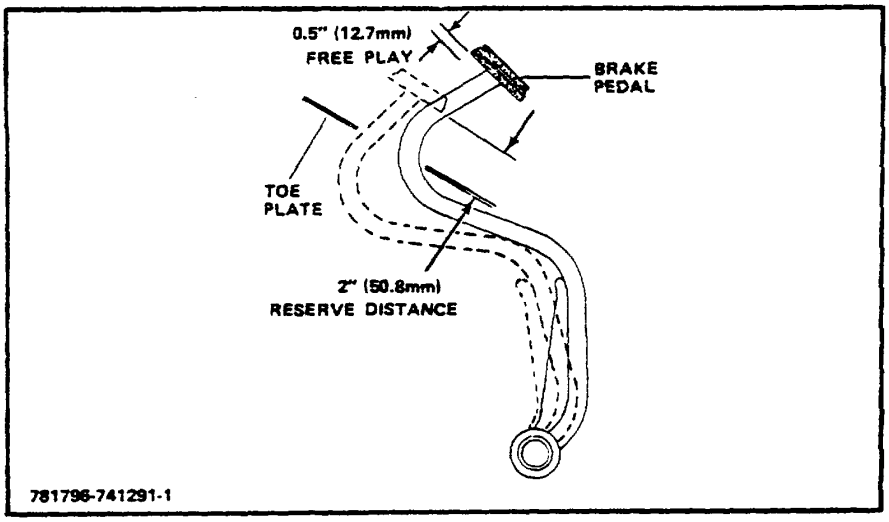


Figure 4-3. Brake Pedal

k. Inspect the overhead guard mounting plates (Fig. 4-2). Make certain they are securely mounted. Visually inspect the welded joints and structure for possible cracks.

l. During operation, the lift truck should accelerate gradually and smoothly when the accelerator pedal is depressed slowly.

m. The lift truck should stop with normal brake pressure. The brake should have 0.5" (12.7 mm) free play as it is depressed. When the pedal is fully depressed, there should be a reserve distance of approximately 2" (50.8 mm) between the bottom of the pedal and the toe plate (Fig. 4-3).

n. During operation, check the steering. It should be smooth and the steering wheel should operate freely.

o. The lift and lowering speed of the mast should be immediate and smooth.

p. The forward and backward tilt operation should be immediate and smooth.

q. If the lift truck is equipped with a fire extinguisher, examine the cylinder fordents. Check the seal, gauge or pin (however equipped) to make certain it has not been used and left empty.

r. Report and describe any unusual noises.

2. 50 Hour Service

   Perform the following in addition to the 8 hour service:

   a. Mast - Lubricate and check for adjustment.
   b. Carriage - Lubricate.
   c. Mast Sliding Surfaces - Lubricate.
   d. Oil Can Points - Lubricate.
   e. Lift Truck - Inspect for leaks.
   f. Clean Truck - Use an industrial type vacuum cleaner or light air pressure around electrical components. Remove all material from all components.

3. 100 Hour Service

   Perform the following in addition to the 8 and 50 hour service:

   a. Pressure Gun Fittings - Lubricate
   b. Lift Chains - Clear and inspect for bent or cracked links. Inspect for adjustment and lubricate.
   c. Drive Axle Housing - Check oil level.
   d. Differential Breather - Remove, clean, and reinstall.
   e. Parking Brake - Check adjustment and pads or lining wear.

4. 200 Hour Service

   Perform the following in addition to the 8, 50, and 100 hour service:

   a. Hydraulic Oil Filter - Replace.
   b. Hydraulic Oil Reservoir Breather - Replace.
   c. Contactor Panel - Inspect the contactor tips for wear and check the air gap between the tips. Check for foreign material lodged between the contactor armature and armature retainer.
   d. Bull Gear (ACE20 thru 80 and ACET20 thru 55) - Check the mounting hardware for tightness.

5. 500 Hour Service

Perform the following in addition to the 8, 50, 100, and 200 hour service:

a. Electrical System - Perform ground checks and check the tightness of the terminals, wires, cables, and electrical components.

b. Control Valve - Check the linkages and the operation of the microswitches.

c. Fork Carriage - Check for side play and chain adjustment if the carriage is not level.

d. Lift Chains - Remove, clean, and inspect for wear and broken or cracked links. Install, adjust, and lubricate.

e. Brake Master Cylinder - Check fluid level.

f. Brakes and Wheel Cylinders - Inspect.

g. Chassis - Check tightness of all mounting hardware.

h. Hoses, Tubes, and Fittings - Inspect and replace if necessary.

Correct any leaks that are evident.

i. Bull Gears, Jackshaft and Drive Wheel Bearings (ACE20 thru 80 and ACET20 thru 55) - Clean and lubricate.

j. Steer Wheel Bearings - Clean and lubricate.

6. 1.000 Hour Service

Perform the 8, 50, 100. 200, and 500 hour services in addition to the following:

a. Hydraulic Oil Reservoir - Drain, flush, and refill.

b. Drive Axle Housing - Drain oil, flush, and refill.

c. Electric Motor - Check for brush wear and spring tension.

d. Drive Axle Mounting Bolts - Check for specified torque.

e. Frame Stress Areas Check weldments of the frame, overhead guard mast tilt cylinder, steer axle, and drive axle mounting for cracks or deterioration. Check the crossmember weldments of the mast and carriage for evidence of cracking or deterioration.

f. Tilt Cylinder Yokes Check for tightness.

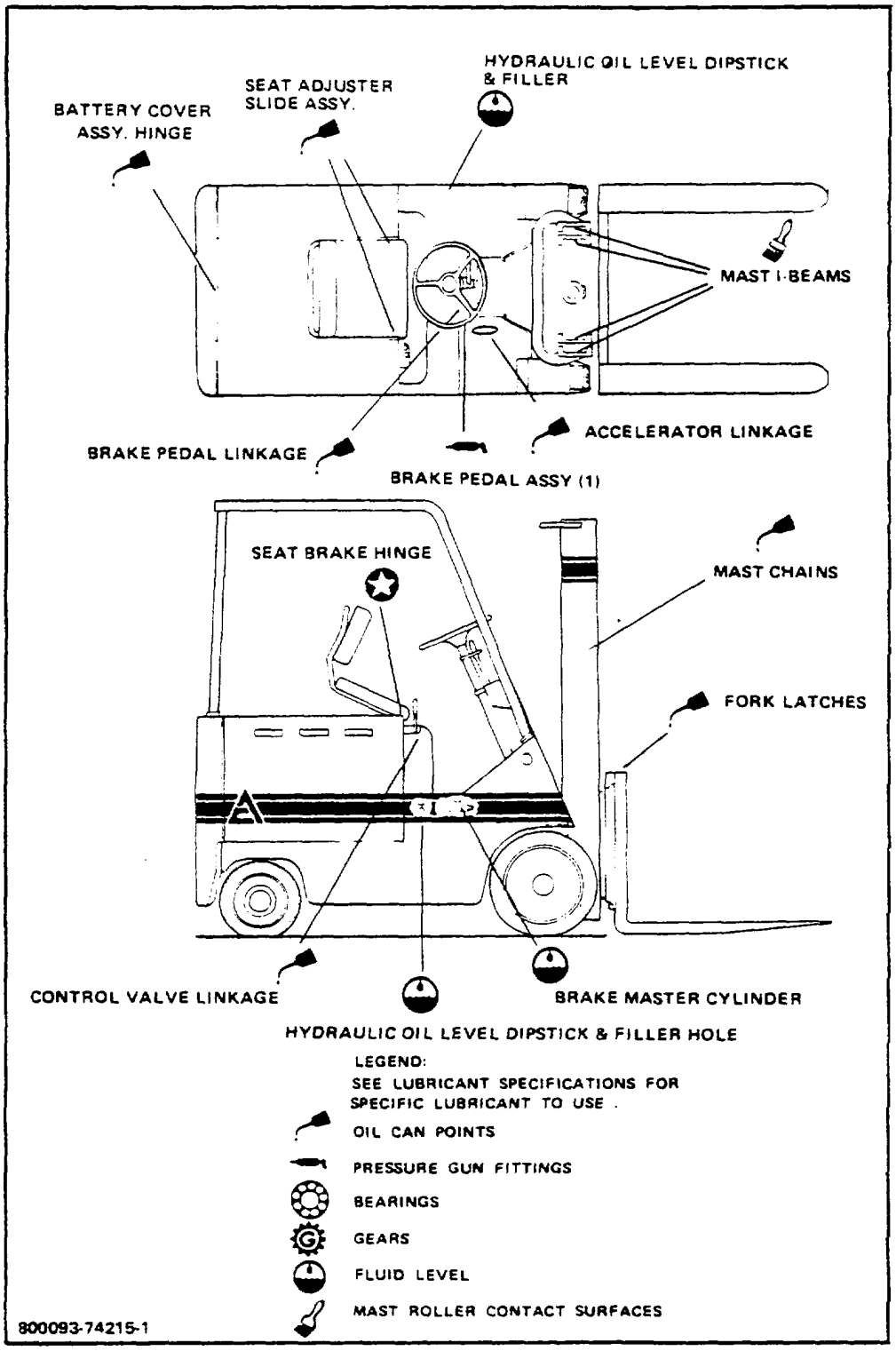


Figure 4-4. Lubrication Chart

Top and Side Views

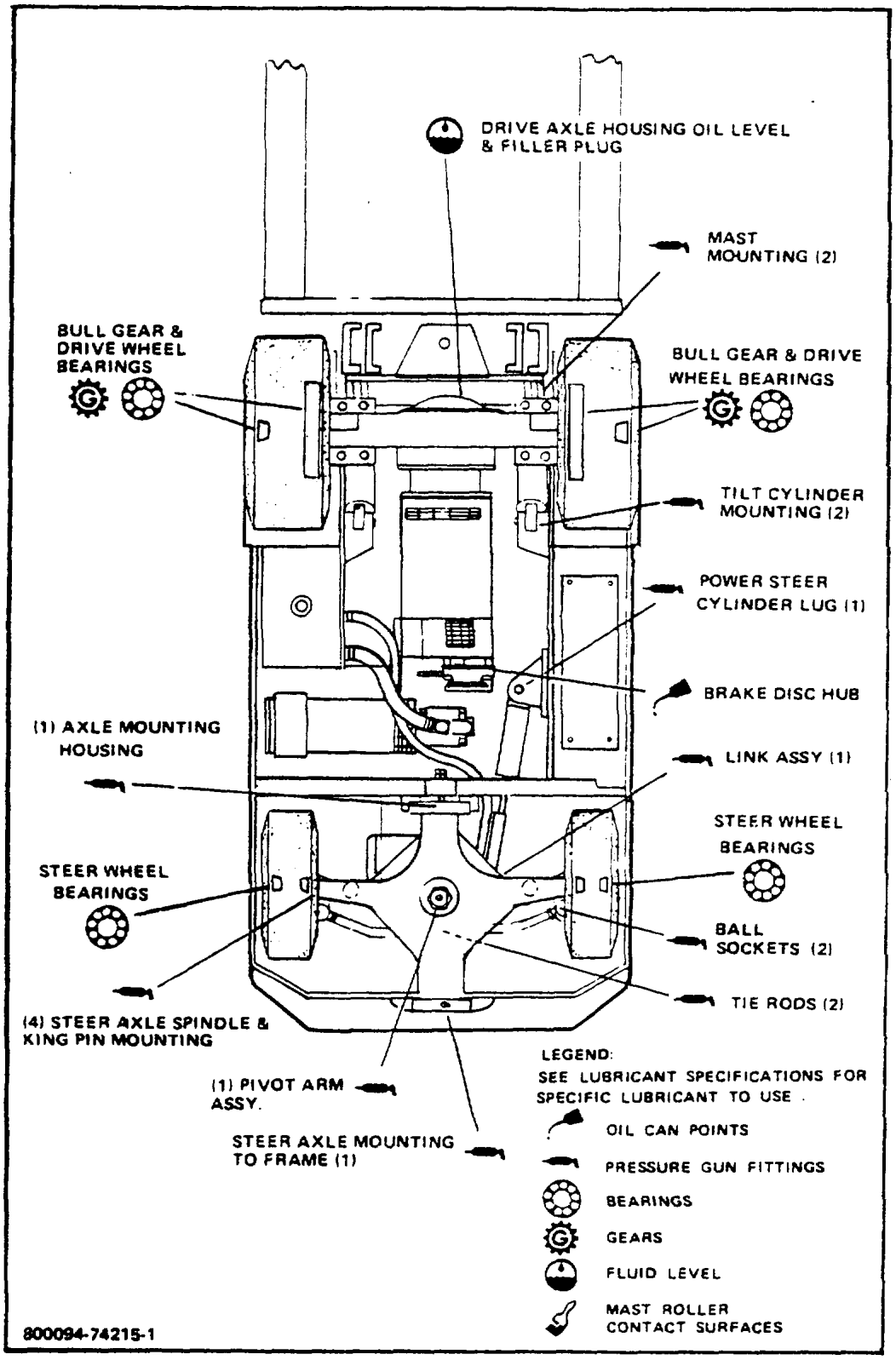


Figure 4-5. Lubrication

Chart Bottom View

8 HOUR SERVICE CHECK LIST

TRUCK SERIAL NO.	MON		TUES		WED		THUR		FRI		SAT		SUN	
INSPECTION NO.	OK	*	OK	*	OK	*	OK	*	OK	*	OK	*	OK	*
1. Electrolyte Level														
2. Specific Gravity														
3. Battery Cables														
4. Foreign Material in Battery														
Connector														
5. Hydraulic Oil Level														
6. Oil Leaks and Drippings														
7. Horn														
8. Hourmeter														
9. Tires														
10. Axle Toggle Stops														
11. Overhead Guard														
12. Accelerator Pedal														
13. Brake Pedal														
14. Steering														
15. Lift and Lowering Speed														
16. Forward and Backward Tilt														
17. Fire Extinguisher														
18. Unusual Noises														
Date														
Hourmeter Reading														
Employee														

*NEEDS ATTENTION BY MAINTENANCE PERSONNEL

MAINTENANCE INSTRUCTIONS

CHAPTER 2

TOPIC 1. GENERAL DESCRIPTION AND OPERATION

A. GENERAL DESCRIPTION

The lead-acid battery is an electrochemical device that stores chemical energy which is converted into electrical energy during discharge. During subsequent recharging, the electrical energy supplied to the battery changes the active materials back to the original state, thus restoring the chemical energy necessary for another discharge. These changes of energy are made possible by the design of the battery cell. The cell is composed of a container, which contains the electrolyte into which two electrodes of an unlike nature are placed. The battery consists of a number of cells joined together by intercell connectors.

B. OPERATION

Batteries are rated in ampere hours over a set period of time and should be of proper size for the particular work intended. Extending the work beyond the capacity of the battery such as discharging it below a specific gravity of 1.110 may shorten its life. Overcharging the battery by using too high a rate of charge causing it to gas vigorously after it has reached nearly full charge gravity will also shorten its life. The battery should always be recharged immediately following a complete discharge. It should never be allowed to remain in a discharged condition.

⚠ WARNING

Extreme caution should be exercised to assure that the polarity of the lift truck is not reversed when the battery is installed or when the battery connectors are changed. Prior to removing the battery or battery connectors, the cables should be carefully marked as to positive and negative polarity. If in doubt, check the polarity with a voltmeter.

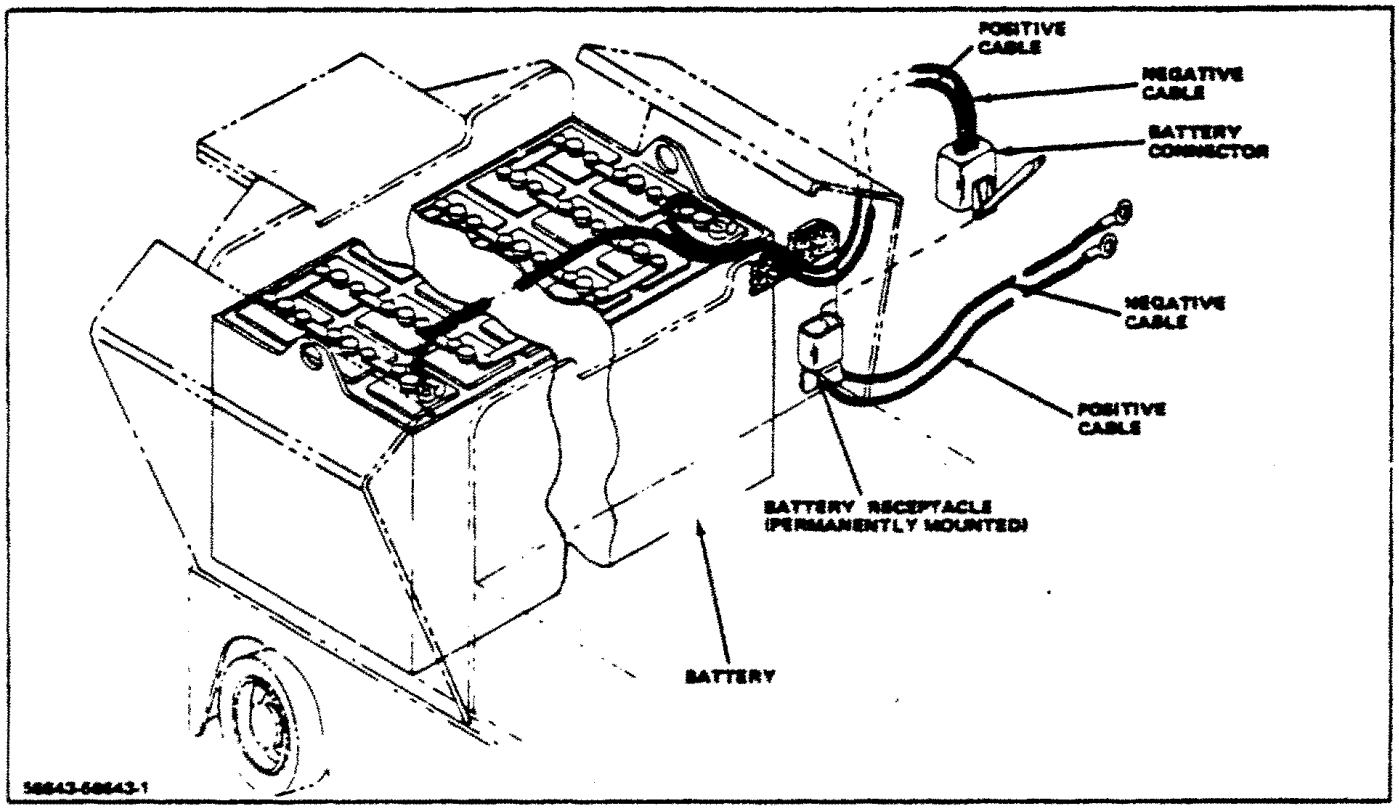


Figure 1-1. Battery, Cables, and Connector

TOPIC 2. SAFETY PRECAUTIONS

⚠ WARNING

The electrolyte in the battery is a sulfuric acid and water solution; therefore, extreme care should be exercised when working around the battery. Should any of the electrolyte come in contact with your clothing or skin, flush the area immediately with cold water. Should the solution get on your face or in your eyes, flush the area with cold water and get medical help immediately.

A. GENERAL

When a battery is being charged, an explosive gas mixture forms within and around each cell during the charging period. When the area is not properly ventilated, this explosive gas way remain in or around the battery for several hours after it has been charged. An open flame or spark can ignite this gas and serious damage or injury will result. The following precautions should be observed by personnel who work with or around a battery.

B. PRECAUTIONS

1. Do not smoke or use an open flame near the battery.
2. Make certain the area is well ventilated before the battery charger is connected to the battery.
3. Make certain the vent holes in the filler plugs are open to allow the gas to escape from the cells.
4. Keep filler plugs firmly in place at all times except when electrolyte level is checked or water is added or when specific gravity is checked with a hydrometer.
5. Do not allow cleaning solution, dirt, or any foreign matter to enter the cells.
6. Never add water during or after normal rate charging.
7. Do not lay any metallic object on top of the battery because it may cause a short circuit.
8. Do not break live circuits at the battery terminals because a spark usually occurs at the point where a live circuit is broken.
9. Wear rubber gloves, goggles, and a rubber apron whenever battery electrolyte is handled. A 4% boric acid solution will neutralize the effect of the electrolyte spilled on the skin if applied promptly. An eye cup and the boric acid solution will aid in the treatment of the eyes; then get medical help immediately.
10. Use extreme caution whenever a battery is filled with electrolyte especially, when it is installed in the truck. Do not overfill cells or allow electrolyte to spill over on battery and run into electrical compartments. The electrolyte is extremely harmful to any component that it contacts and could cause extensive damage.

TOPIC 3. MAINTENANCE

A. DAILY CHECKS

1. Check Electrolyte

⚠ WARNING

Level Never allow plates to become exposed due to low electrolyte level. Do not overfill cells as liquid will expand and spill over as battery is put Into use and warms up.

Daily, check the electrolyte level in the battery cells; level should be 5/8" above the baffles. Check electrolyte level daily at least at the center cells and weekly at all of the cells. Add only distilled water or water that has been tested and approved.

Battery Water Specifications

Impurity limits for battery water are as follows:

	Maximum Permissible Parts Per 1,000,000
Iron	0.40
Chlorine	4.00
Nitrates	4.00
Total Solids	50.00
Fixed Solids	35.00
Organic and Volatile	15.00

Check with local public authorities to determine if your water supply falls within permissible impurity limits indicated. Use a clean glass, earthenware, rubber, or wooden container and always allow water to run a few moments from the tap before filling the container.

2. Check Specific Gravity Daily, check the specific gravity (Fig 3-1) of the electrolyte; specific gravity should be above 1.260. Check specific gravity daily at least at the center cells and weekly at all of the cells. When only the outer cells are checked, it will not necessarily indicate the true condition of the battery. After specific gravity is checked, return electrolyte to same cell from which it was taken.

   The value of the specific gravity of the electrolyte in a lead-acid type battery should be approximately 1.275 with battery fully charged. Never continue to discharge a battery beyond the point where specific gravity falls below approximately 1.125.

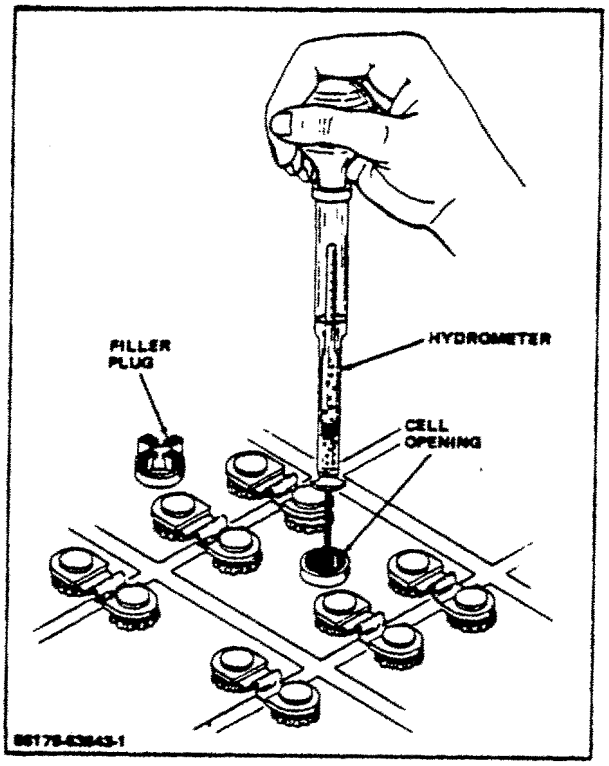


Figure 3-1. Checking Specific Gravity

To obtain "corrected specific gravity" readings when checking the electrolyte, add 1 point (0.001) of gravity for each 30F, above 77°F (electrolyte temperature) or subtract 1 point for each 30F, below 770F. Also subtract 15 points gravity for each 1/2" below normal level of electrolyte or add 15 points for each 1/2" above normal electrolyte level.

3. Check Exterior Of Battery Daily, check the battery cables, posts, and exterior of the battery. Battery cables must not be frayed nor loose at the battery posts. Also inspect battery connector (Fig 3-2) and make certain there is no foreign material inside the connector. Make certain filler plugs are tight and vent holes in the filler plugs are not clogged.

   The top of the battery should be kept clean and dry so-corrosion, dust, or moisture cannot offer a conducting path to short-circuit the cells or contact a ground. A dirty battery or one where electrolyte has been spilled on it should be washed with a solution of baking soda and water (one pound of baking soda to one gallon of water).

Disconnect battery connector and remove battery from lift truck for cleaning operation. Clean entire top of battery with the soda solution. After foaming stops, flush with clean water. Dry battery completely and install in lift truck. Apply a thin coat of petroleum jelly to battery post and cable terminals.

⚠ WARNING

Do not flush top of battery while It is installed in the lift truck. Water will seep Into electrical compartments and cause serious damage.

B. BATTERY CHARGING

⚠ WARNING

Make certain the vent holes In the filler plugs are open to allow the gas to escape from the cells. When battery charger is connected to the battery connector, it is imperative that correct polarity be observed. That is, positive lead of the charger must be connected to the positive terminal and negative lead to the negative terminal.

The most important factor in battery service and life is proper charging. Make certain the proper method for each application is carefully followed. In general, a battery nay be charged at any rate in amperes that does not cause excessive gassing or produce temperatures above 1100F (120°F for short periods only).

A lead-acid battery should not require any routine overhaul or electrolyte changes during its entire life except In case of accidental loss of electrolyte. For exact information regarding charging and maintenance of individual battery, refer to the battery manufacturer's data.

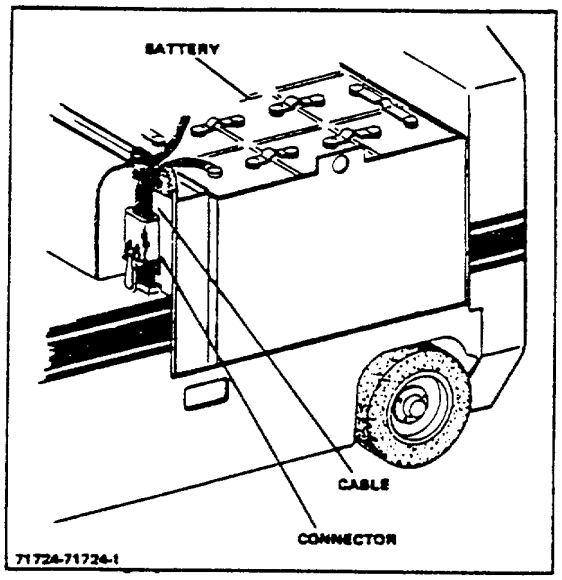


Figure 3-2. Battery Connector

⚠ WARNING

Refrain from smoking in immediate vicinity of battery or from exposing battery to an open flame during or immediately after charging.

Battery specific gravity readings with electrolyte at 80°F are as follows:

HYDROMETER READING	CHARGE CONDITION
1.110 - 1.135	Completely Discharged
1.140 - 1.200	One Fourth Charged
1.205 - 1.230	On-Half Charged
1.235 - 1.260	Three-Fourths Charged
1.265 - 1.290	Fully Charged

C. BATTERY STORAGE

The battery should be stored in a clean, cool, dry location that is well-ventilated and away from a radiator or a heat duct.

Before battery is placed in storage, make certain electrolyte is at proper level in all of the cells, filler plugs are tight, and battery is fully charged.

Check electrolye level and specific gravity every 30 days during storage. Whenever specific gravity is less than 1.230, the battery must be charged.

TOPIC 4. SOURCES OF TROUBLE

A battery of the proper size for the service required, which Is properly operated and maintained, can be depended on to give very satisfactory performance. There are numerous sources of trouble which nay be encountered and when not corrected or eliminated, often Cause service failures. Perhaps the most common of these are in connection with the charging system. Improper operation of this system may result in overcharging or undercharging of the battery, both of which are undesirable.

Overcharging causes excessive corrosion, softening of active materials, and high temperature which often weakens and destroys separators. The plate surfaces thus exposed tend to become inactive. Occasional controlled overcharging is beneficial as it tends to equalize the various cells but consistent overcharging should be avoided.

Undercharging, when continued for any length of time, very generally produces plate buckling. Buckled plates press or cut through separators causing internal shorts. When the battery gravity shows a continued dropping off, undercharging is evident and in addition to giving the battery an equalizing charge, the charging system should be checked for regulation or defects. Defective external connections such as corroded terminals or lugs and loose connections may introduce sufficient resistance into the circuit to lower the effective battery voltage below the necessary value. Corroded surfaces should be cleaned and then coated with petroleum jelly.

A cracked case may permit the electrolyte to leak out of one or more cells to such an extent that these cells become partially or wholly Inoperative. This may result in failure of the truck to operate. Internal short circuits are evidenced by abnormally low gravity readings, loss of charge on open circuit, and low voltage. Shorts may be produced by excessive shedding of active material due to over charging and by separator failure.

When electrolyte levels are allowed to be low consistently, active material may be forced out of the plates. When caught in time, no serious damage will occur. Maintain proper electrolyte level to avoid damage. Freezing may occur when a discharged battery is exposed to low temperatures, and may result in disrupting the active materials and splitting the separators.

Internal corrosion often results from the introduction of impurities into the electrolyte. Some corrosion occurs naturally during the life of the battery due to the forming action of charging current, but excessive corrosion is an indication of trouble and should be investigated.

Charging a battery in the wrong direction is very harmful in that it greatly aggravates local action and introduces undesirable chemical and physical changes in both positive and negative active materials.

In general it may be said that a battery which has been carefully engineered for its specific job and then operated and maintained with reasonable care can be depended on to perform satisfactorily with a minimum of trouble. Before blaming the trouble on the battery, make certain that some other factor is not wholly or partially responsible.

TOPIC 1. SYMBOLS

To fully understand a system of operation, it Is advisable to become familiar with the symbols, and what they stand for. The symbols attempt to be self-explanatory ; however , a brief description is Included to explain the function of each symbol.

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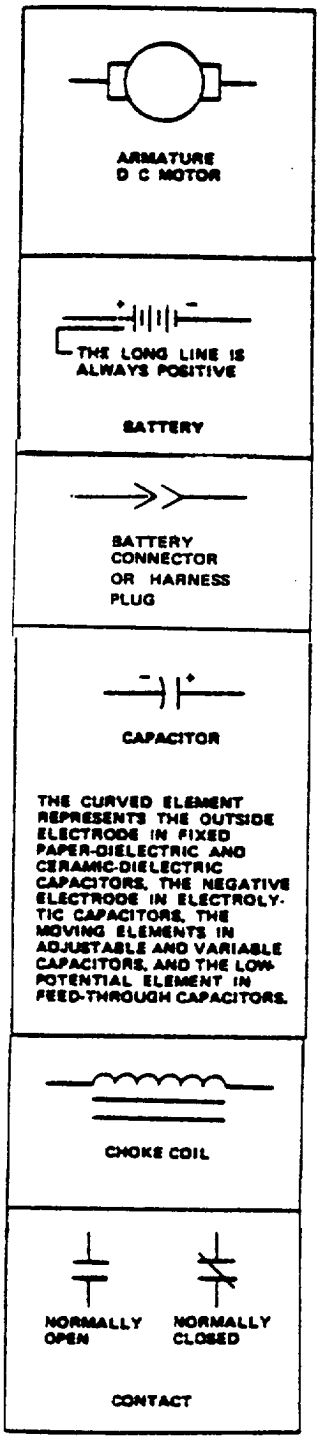


ARMATURE. The armature is the rotating portion of a dc motor.

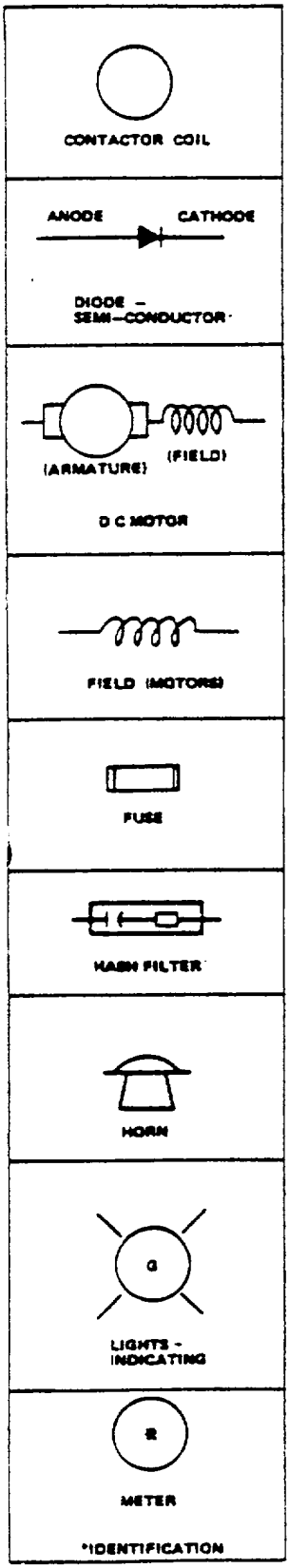
BATTERY. A battery is an electrical dc power source. The battery is made up of chemically active materials that produce a current flow when the battery Is connected in a complete circuit. One long and one short line in the symbol indicates one cell.

CONNECTOR/PLUG. A device used to connect and disconnect the battery or circuits in the truck electrical system.

CAPACITOR. A capacitor consists of two electrical conductors, separated by a dielectric, to receive and retain a charge of electricity when current is applied to it. Current flow in the opposite direction will discharge the capacitor. Direct current will not flow through a capacitor.

CHOKE COIL. A choke coil is a high inductance coil used to prevent the passage of pulsating current, but allows direct current to pass. The 1X choke in the SCR control system provides protection against sudden current rises through 2REC by slowing down the initial rush of current through 2REC.

CONTACT. Contacts are mechanically or electrically operated devices used to open or close a circuit.



CONTACTOR COIL. A contactor coil has a number of turns of insulated wire wound upon a magnetic core material. The principal function is to operate various contacts throughout the circuits.

DIODE. A diode permits current flow in the circuit in the direction of the arrow, and blocks its flow in the other direction.

DC MOTOR. Consists of an armature and field. The armature is the rotating portion of a dc motor. The field coils are stationary around the inside circumference of the motor housing.

FIELD WINDING. A field winding is the stationary portion of a dc motor. It establishes a magnetic field.

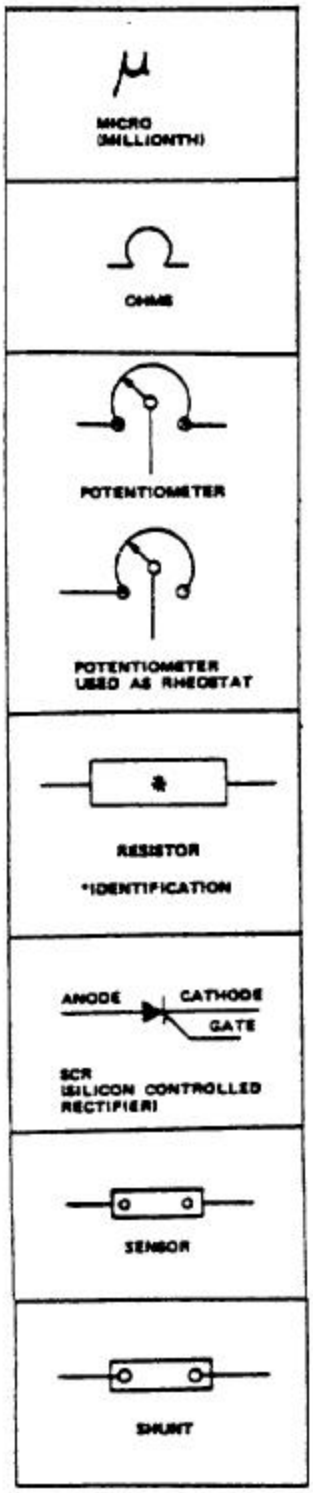
FUSE. A fuse is a protective device designed to open a circuit when current flow is excessive. Excess current heats and melts an alloy conductor in the fuse.

HASH FILTER. The hash filter is used to suppress voltage spikes around the horn, coils, etc.

HORN. A horn is an electrically operated, sound producing, signaling device.

LIGHTS INDICATING. Indicating lights are devices used to visually show the operation or non-operation of a circuit or circuits. The letter within the circle of the symbol indicates the abbreviation for the color of the light.

METER. A meter is an instrument used for measurement of physical quantities, such as amperes, volts, watts, or time.



MICRO. This symbol, before a unit of size or measurement, means one millionth of that unit. For example μ farad means one millionth of a farad.

OHM. The ohm is the unit of electrical resistance. One ohm is defined as the resistance of a circuit in which an electrical pressure of one volt causes one ampere of current to flow.

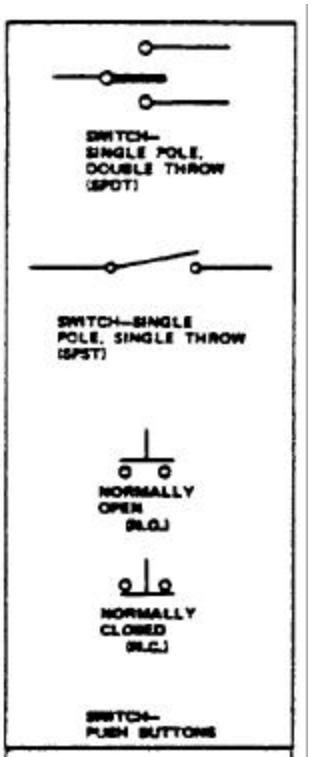
POTENTIOMETER. A potentiometer Is a variable resistor used as a voltage divider. The total resistance is connected across the terminals of the device, and any portion of this total may be obtained between one terminal and the moveable arm. A rheostat is a potentiometer that has only two terminals wired into the circuit; however, in this manual, all references to a device of this type will be potentiometer or trimpot. The variable resistance of the rheostat allows an adjustment of the opposition to current flow.

RESISTOR. A resistor is a device In which voltage drop is proportional to the current flowing through it.

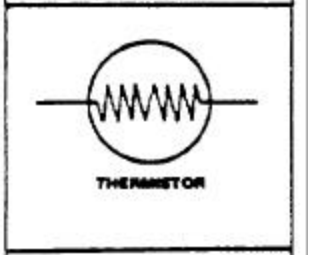
SCR (Silicon Controlled Rectifier). The SCR is a fast operating switch (conducts like a diode). It must be turned on by a pulse of control current to the gate. To turn it off, it is necessary to remove its gate current and interrupt or stop the main current flow.

SENSOR. The sensor in the SCR control system provides increased resistance in the plugging circuit for monitoring of a plugging condition. The increased resistance increases the voltage drop for better sensing of a plugging condition.

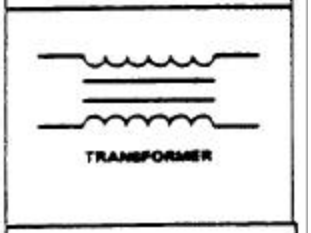
SHUNT. A shunt is a low resistance device which is calibrated to provide a given voltage drop in order to measure current flow.



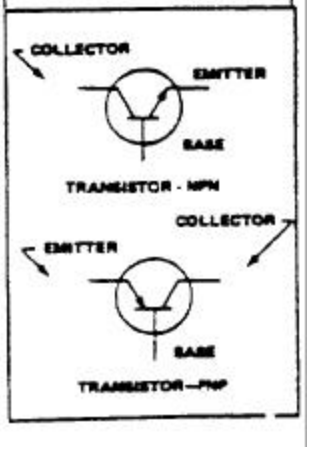
SWITCH. A switch is a device for opening, closing, or routing an electric circuit. For example, a SINGLE POLE-SINGLE THROW switch is used as a key switch in the system. A SINGLE POLE-DOUBLE THROW switch is used as the directional selector in the system. A normally open PUSH BUTTON switch energizes the horn when It is closed.



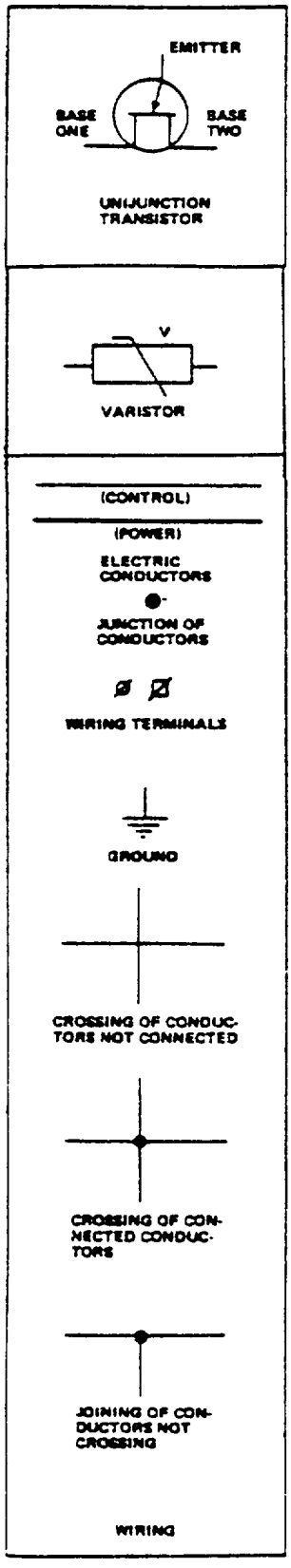
THERMISTOR. A thermistor is a resistor with the characteristic that as it gets warm, its resistance value changes. A positive coefficient resistor increases in resistance ; whereas, a negative coefficient resistor decreases.



TRANSFORMER. A transformer is an electrical device, with no moving parts, that transfers electrical energy from one circuit to another by electromagnetic induction. The transformer uses an alternating magnetic field produced by the pulsating dc current to transfer the electrical energy.



TRANSISTOR. The characteristic of the transistor Is that it electrically performs the same function as a mechanical switch, but much faster. A transistor has three connections; the emitter, base, and collector. The arrow of the emitter always points in the direction of current flow. The transistor is thought of as a perfect switch; a completely open circuit when fully OFF, and a completely closed circuit when fully ON.



UNIJUNCTION TRANSISTOR. A unijunction transistor, used in the PWM timing pulse circuit, requires very low current to fire, and is self-compensating for temperature or power supply variations. Its controlled high holding current make it suitable for delivering high energy pulses. The unijunction only passes pulses of current when the voltage across Base One is of a different potential than the voltage across Base Two.

VARISTOR. A varistor is a resistor which has a noticeable reduced resistance when the applied voltage is increased. A varistor suppresses voltage in both directions.

WIRING. The schematic diagram of an electronic circuit is shown by these self-explanatory symbols. Distinction between power and control circuits, including device symbols, is made by using heavy and light lines respectively. Wiring symbols do not show actual physical layout, but do show paths of current and electrical relationship of circuit components.

TOPIC 2. TERMINOLOGY

Various terms are used throughout several electrical system manuals. These terms and meanings are given as follows:

AMBIENT TEMPERATURE. The temperature of the air surrounding a component or device.

ANODE. The positive terminal of a semiconductor device through which current flows into the device.

AVERAGE CURRENT. In a pulsed system, the effective value of current that performs work. Average current can be read with a conventional dc ammeter.

BOARD. A printed circuit board that contains small electronic components.

CAPACITANCE. The inherent property of an electric circuit which opposes a change in voltage. The property whereby energy may be stored in an electrostatic field.

CATHODE. The negative terminal of a semiconductor device through which current flows out of the device.

CHARGING TRANSFORMER. A transformer which supplies voltage to the oil-filled capacitor that is used to turn OFF the SCR.

CIRCUIT. A circuit is a path through which an electric current may flow. Circuits through which current is flowing are said to be CLOSED. Circuits with no current flow are said to be OPEN.

CONDUCTOR. A conductor is a substance, usually metal, that allows free flow of current.

CURRENT (AMP). One amp of current flows through one ohm of resistance when one volt is applied to the resistance.

DIODE. A semiconductor which consists of an anode and a cathode. A diode will permit current to flow easily in the direction from anode to cathode and will block the flow of current in the opposite direction.

FILTERING. The use of devices such as a varistor or small diode to remove spikes of voltage from a circuit which may be generated by switching of contactors or other circuit operations.

FREQUENCY MODULATION. The method of obtaining adjustable speed control by varying the number of pulses per second.

GATE. The control element of an SCR. A small signal applied to this element will cause the SCR to conduct large amounts of current between anode and cathode.

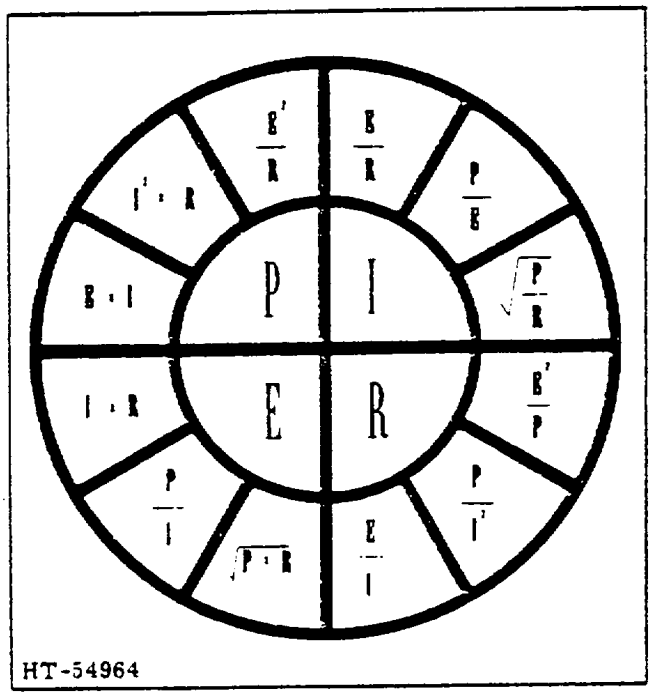


Figure 1. Ohm's Law and Power Formula Chart

HEATSINK. A mounting device for a semiconductor designed to dissipate any heat generated within the semiconductor.

IMPEDANCE. The total resistance to the flow of ac current as a result of resistance and reactance.

INDUCED VOLTAGE. Voltage induced in a conductor as it moves through a magnetic field.

INDUCTANCE. The inherent property of an electric circuit which opposes a change in current. The property of a circuit whereby energy may be stored in a magnetic field.

INSULATOR. A substance or material that will not conduct current.

LOADED-LEVEL MOTOR CURRENT. The current draw with lift truck running on level ground and with a full capacity load.

OHM (R)The ohm is the unit of electrical resistance of a circuit in which an electrical pressure of one volt causes one ampere of current to flow.

OHM'S LAW. Ohm's law defines the relation between volts, amperes, and resistance. Voltage (in volts) is equal to the current (in amperes) times the resistance (in ohms). The equation is: E : I times R. (See Figure 1.)

OSCILATOR. A device composed of a small transistor and a resistor-capacitor network that is used to generate pulses.

PEAK CURRENT. The highest instantaneous value that current reaches during a given time period.

POTENTIOMETER. A small variable resistor.

PULSE. Electrical energy that flows for a very brief interval of time.

REACTANCE. The opposition to ac current as a result of inductance and capacitance.

SEMICONDUCTOR. Any of a family of solid-state electronic devices, such as diodes, transistors, SCR's, etc.

SILICON CONTROLLED RECTIFIER (SCR). A semiconductor rectifier used as a latching switch, i.e., it may assume either a conducting or nonconducting state (ON or OFF).

STATIC TIMER. A timing device which utilizes electronic components.

TRANSISTOR. A semiconductor device which will carry varying amounts of current, depending upon the applied control signal.

VOLT (E). The volt is the unit of electrical pressure or electromotive force.

WATT (P). The watt is the unit of electric power. Power is equal to the product of the current (in amperes) times the voltage (in volts). The equation is P = E times I. (See Figure 1.)

TOPIC 1. GENERAL INFORMATION

A. DESCRIPTION

The EV-1 SCR Control is a solid state modular control system designed to operate a DC motor load from a battery power source. The EV-1 static panel (Figs 1-1) is located in a compartment on the Left-hand side of the lift truck, and contains the control card, Silicon Controlled Rectifiers (SCRs), commutating capacitors, power terminals, and control performance adjustments. The contactor panel is located behind a panel under the operator's seat, and contains the control contactors, fuses, contactor drivers, coil suppressors, and power terminals.

The EV-1 control uses silicon controlled rectifiers (SCRs) to control current flow through the drive motor. The SCR (Fig 1-2) is an electronic latching switch that connects the drive motor directly across the battery for short time intervals at a very rapid rate. An SCR includes a cathode, anode, and 'gate" (turn-on signal input). The SCR is turned ON

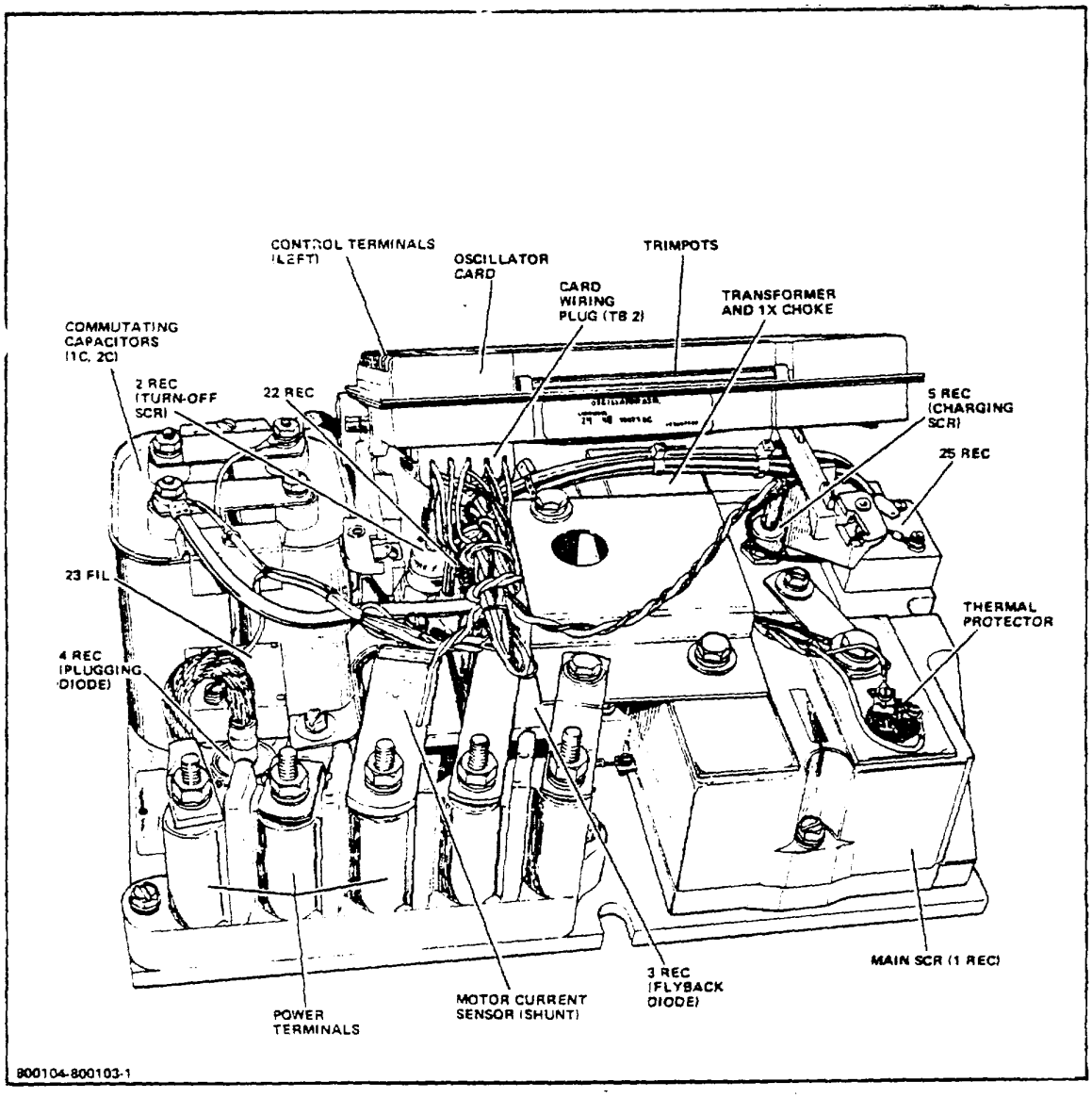


Figure 1-1. EV-1 "B" Control Static Panel

by a momentary application of voltage to the gate, and will conduct until it is turned OFF. To turn it OFF, it is necessary (in addition to removing the turn-on signal from the gate) to reduce current flow through the SCR to zero, which is sometimes accomplished by applying a momentary reverse voltage between the cathode and anode. The main SCR switch for the drive motor is called I Rec. The SCR is connected between the battery and a D.C. series-wound motor and is controlled by circuitry that can vary the number of times per second that it is switched ON and OFF (pulse frequency modulation), and the length of time the switch is left ON in any one pulse (pulse width modulation).

Battery voltage is applied to the motor for brief intervals of time as the SCR is switched ON and OFF (Fig 1-3). If the frequency (or ON time) of pulses is increased, the average voltage to the drive motor is increased, because more voltage is present in a given interval of time (Fig 1-4).

The EV-1 control begins to pulse at 5% of full ON time, and increases the pulse frequency as the accelerator pedal is depressed until the SCR reaches 50 ON time. From this point on, The control increases the pulse width to increase voltage to the drive motor (Fig 1-5). Figure 1-8 shows the relationship of pulse frequency to per cent of ON time (refer to section C for a description of the 1A demand pickup feature shown).

Since motor speed depends upon the average voltage applied, increasing the pulse frequency (up to 50% ON time) or the pulse width (above 50% ON time) will increase motor speed. The 1A contactor bypasses the control and places the motor directly across the battery for full speed operation (100% ON time).

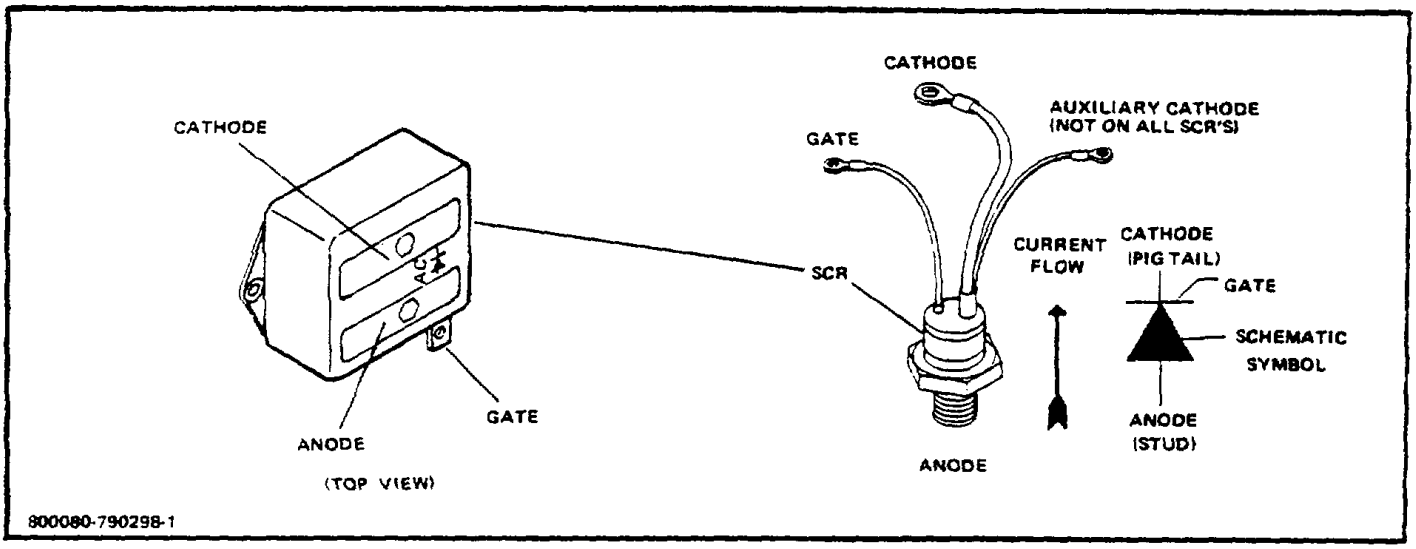


Figure 1-2. Silicon Controlled Rectifier (SCR) (Typical)

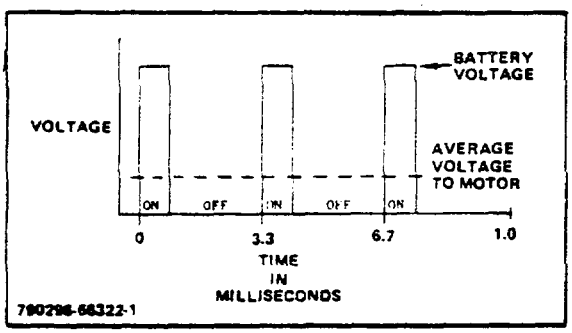


Figure 1-3. Available Voltage for Brief Intervals

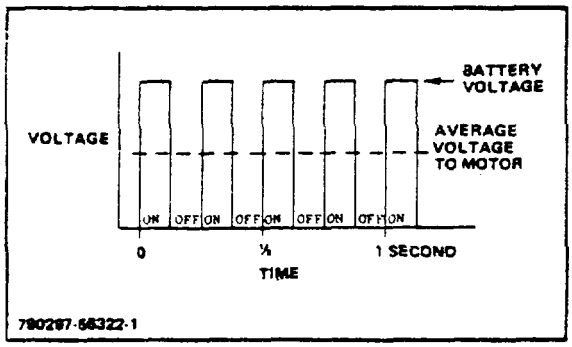


Figure 1-4. Available Voltage With Pulse Frequency Increased

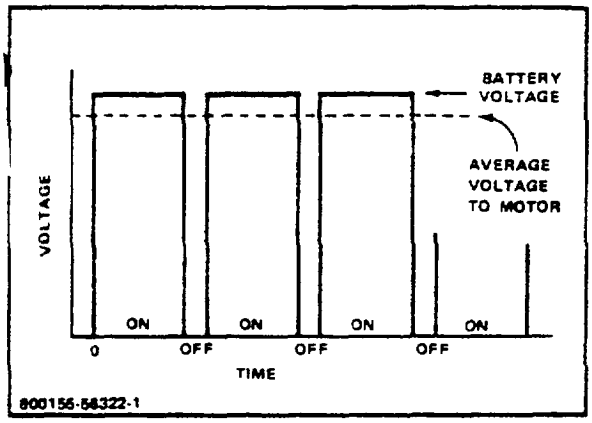


Figure 1-5. Available Voltage With Increased Pulse Width

B. OPERATION

1. Start-up Sequence.

The control circuit is energized by closing the seat switch, key switch, selecting a direction, and depressing the accelerator pedal. This start-up sequence applies power to the oscillator card. The Pulse Monitor Trip (PMT) and Static Return to OFF (SRO) circuits check for a fault condition. If no fault exists, the control energizes the coil driver which closes the selected directional contactor (refer to schematic diagrams in Topic 9).

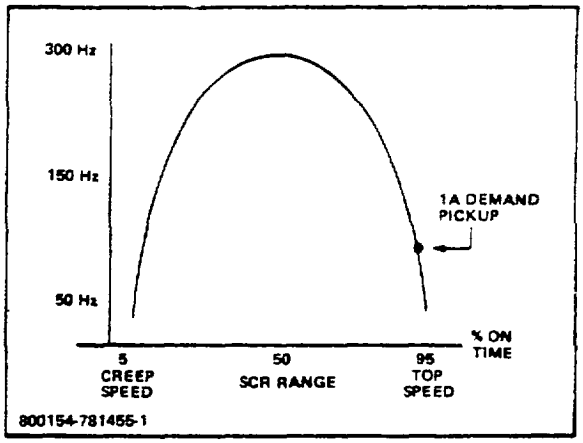


Figure 1-6. Oscillator Frequency Curve

2. Capacitor 1C Precharge on First Pulse

The oscillator card supplies a gate pulse to SCR 2 Rec, switching it to a conducting state. Current flows from the positive side of the battery through the power fuse, capacitor 1C, SCR 2 Rec, Choke 1X, transformer windings (T1 to T2), motor field and armature, current sensor, and returns to the negative side of the battery. After capacitor 1C charges, current flow in this circuit stops, shutting OFF 2 Rec. The oscillator card senses when IC is properly charged and 1 Rec can be gated ON.

3. Basic Power Circuit (1 Rec Turn-On) and IC charging circuit (Fig 1-7).

When the oscillator card senses that 1C is properly charged, it gates on 1 Rec (from terminal 4) and 5 Rec (from terminal 2) simultaneously. Current flows from battery positive through the power fuses, 1 Rec, transformer windings (T1 to T2), drive motor field and armature, current sensor, and back to battery negative. This applies battery power to the drive motor power circuit. 1 Rec continues to conduct after the gate pulse is removed. The initial rise of current flow through the transformer primary windings (T1 to T2) induces a voltage in the secondary windings (T3 to T4). This induced voltage causes current to flow from T4 to T3, through capacitor 1C, 1 Rec, 5 Rec, and back to T4. This circuit charges IC to the polarity shown. After 1C becomes fully charged, 5 Rec turns OFF due to lack of current flow.

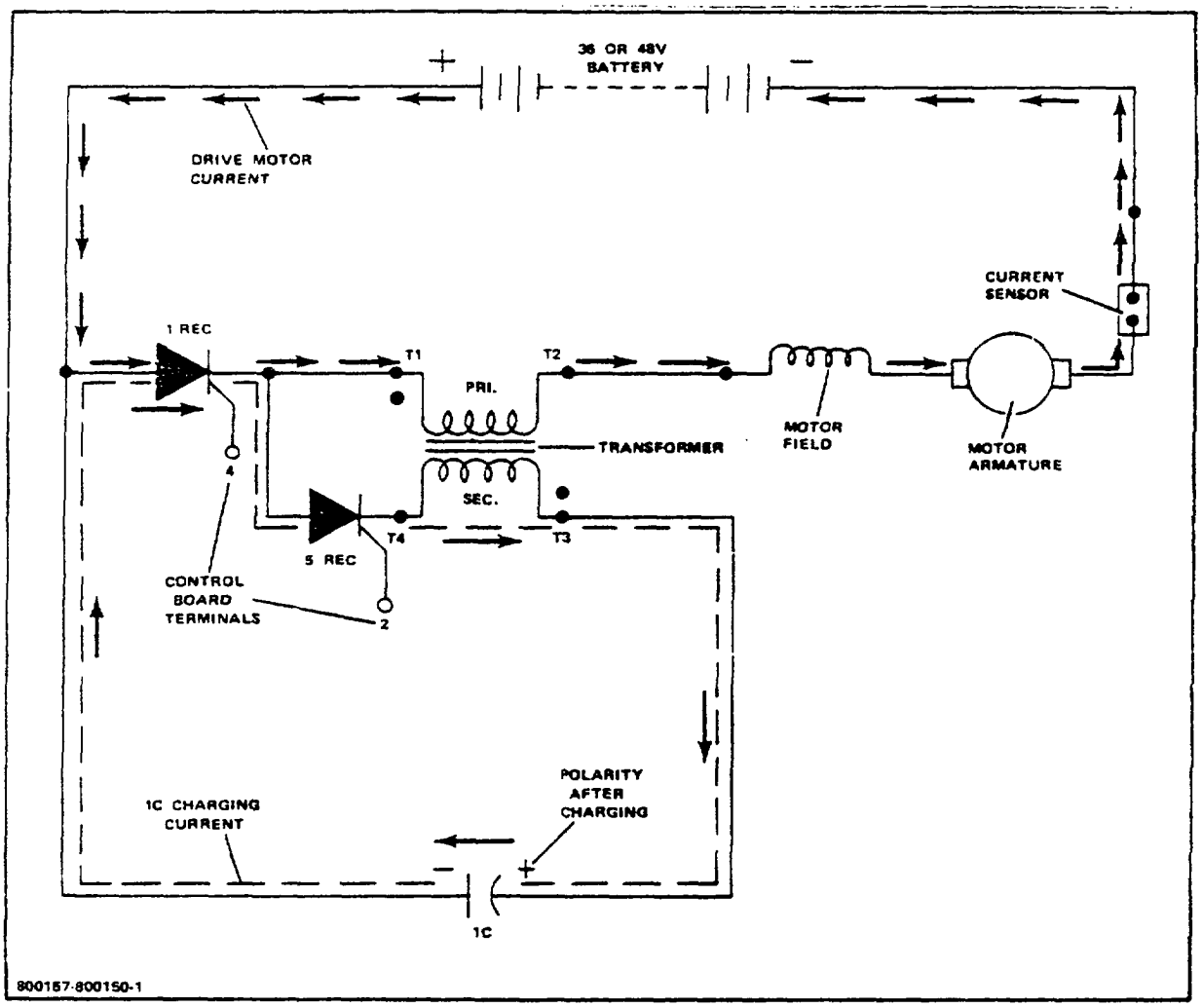


Figure 1-7. Basic Power Circuit (1 Rec Turn-on) and 1C Charging Circuit

4. Power Circuit Shut-Off (Fig 1-8)

   Current continues to flow through rectifier 1 Rec until the oscillator card turns ON rectifier 2 Rec. When 2 Rec turns ON, capacitor 1C discharges through the circuit consisting of capacitor 1C, rectifier 2 Rec, choke 1X, and rectifier 1 Rec. This discharge current opposes the battery current through rectifier 1 Rec until the resultant current is zero, and 1 Rec is turned OFF. Current continues to flow in capacitor 1C, rectifier 2 Rec, motor, and' battery loop until the capacitor is fully charged to the polarity shown, which shuts off current flow, and turns OFF 2 Rec.

5. "Flyback" Current Flow During EV-1 OFF Time (Fig 1-9)

   A characteristic of an inductive circuit, such as a motor, is a tendency to try to maintain current flow in the circuit after the power source is removed. The current which flows during the control OFF time as a result of motor inductance is called flyback current. Traction controls utilize this characteristic to increase torque by placing a flyback (Free-Wheeling) diode (3 Rec) around the motor. 3 Rec is a silicon diode used as a high-current rectifier which allows current to pass freely in one direction, but not in the other. This allows the flyback current to circulate through the motor during control OFF time.

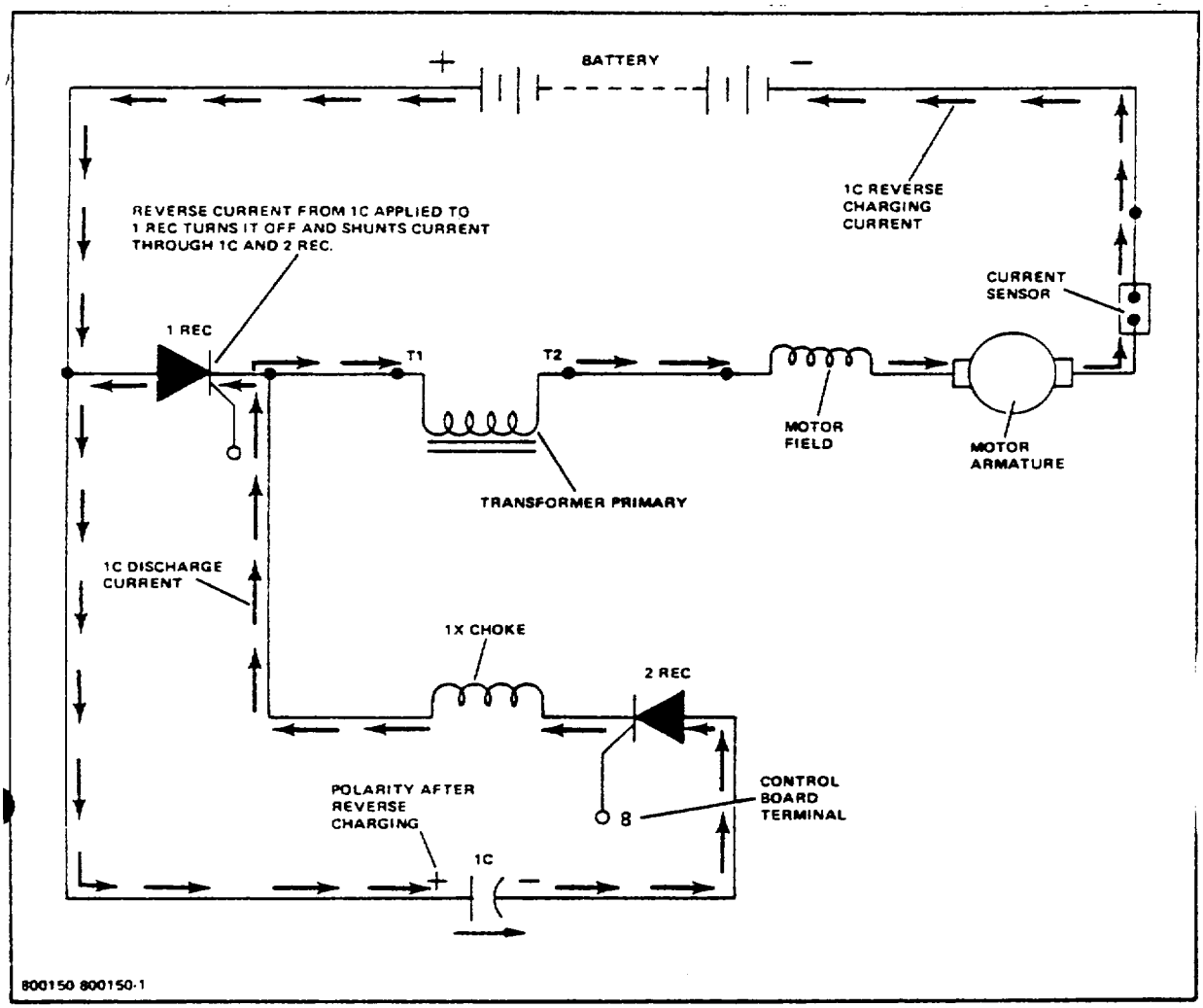


Figure 1-8. Power Circuit Turn-OFF (2 Rec)

In Figure 1-10, note that no battery current flows during the OFF time. In Figure 1-11, the addition of flyback current (shaded areas) raises the average motor current to a higher level than average battery current. This high average motor current provides high torque for the truck at low speeds. As the ON time increases, the average motor current decreases; while the average voltage to the motor increases to provide higher speeds.

6. Plugging Current

When the truck is moving and the directional lever is shifted from one direction to the other, the current through the motor field is reversed, which causes the armature voltage to be reversed. The control card senses the directional lever change and current flow through the current sensor, and triggers the control into "Plug" mode. During ON time, armature voltage and battery voltage cause high reverse current flow through the motor field, providing a retarding torque to slow the motor and assist in braking the truck; and current generated in the armature flows through 4 Rec. During OFF time, current induced by the motor field flows through the plugging diode (4 Rec [Fig 1-9]), which provides a smooth plug and maintains low motor terminal voltage. During plug mode, the control card lowers the ON time to provide the proper level of retarding torque. The severity of plug is adjustable at the PLUG trimpot on the control card.

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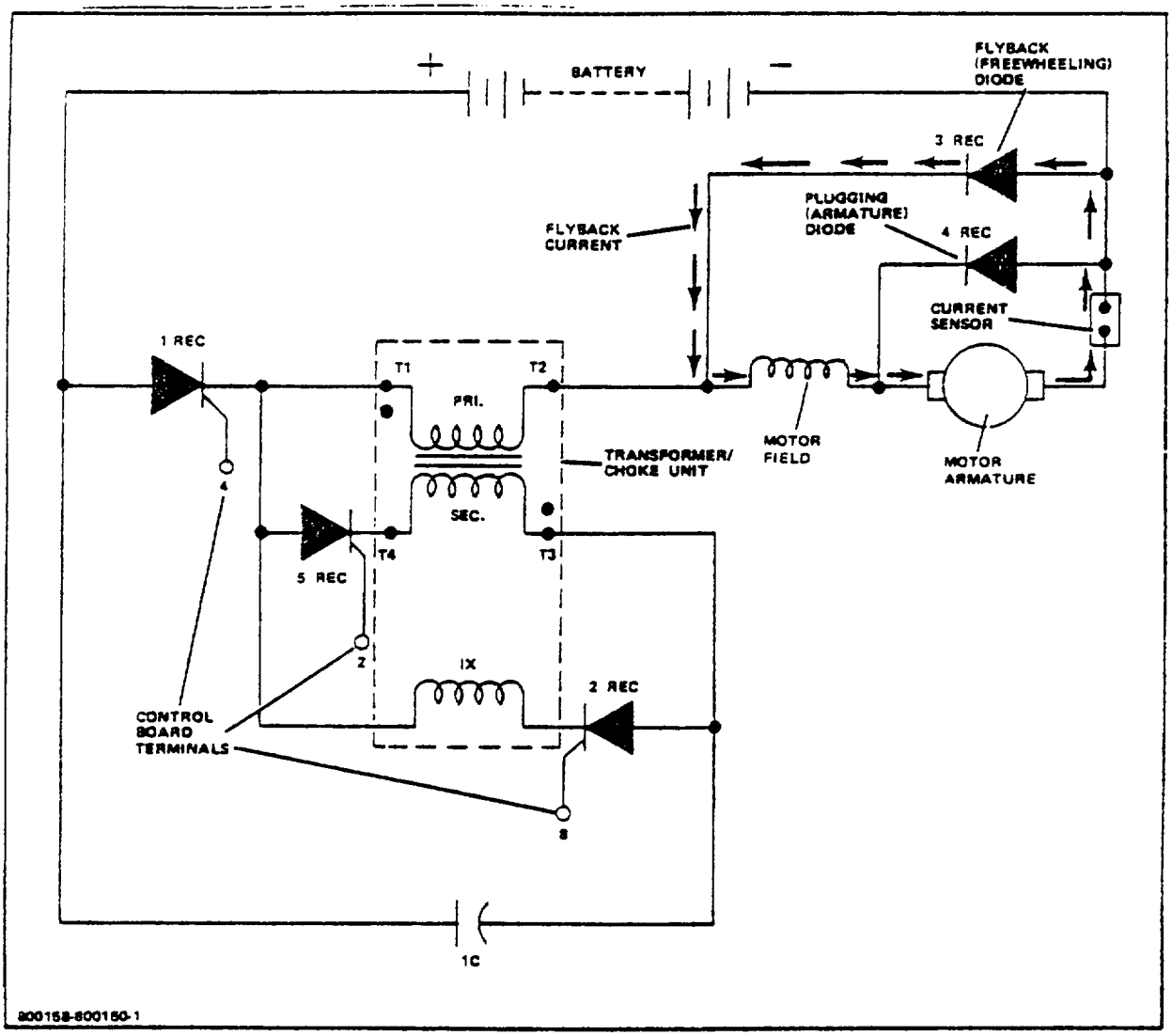


Figure 1-9. SCR Cycle and Flyback Current

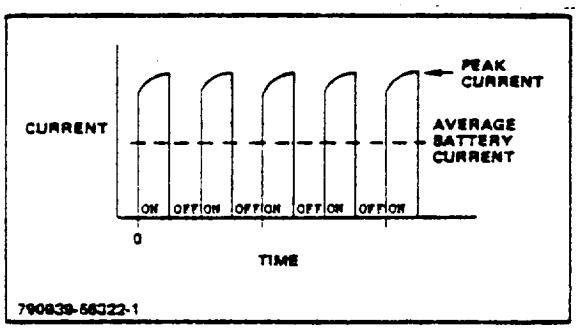


Figure 1-10. Battery Current

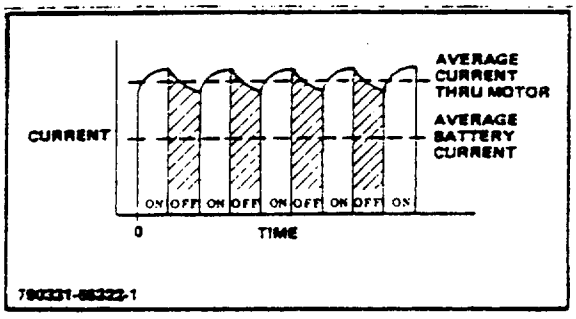


Figure 1-11. Motor Current

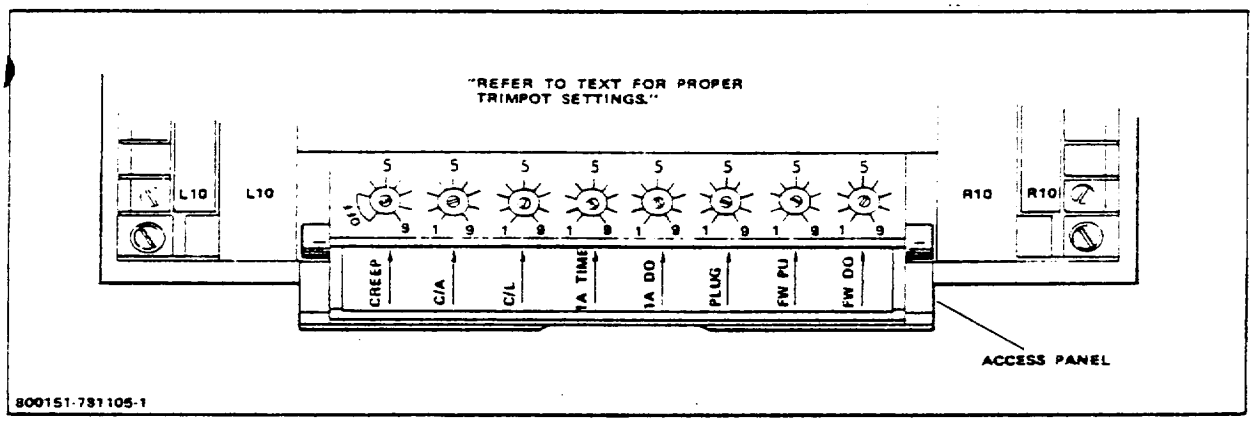


Figure 1-12. Trimpot Adjustments

C. EV-1 CONTROL SYSTEM FEATURES

The trimpot adjustments for the EV-1 control card are located behind a hinged access panel located on the control board (Fig 1-12). These trimpots adjust the following functions: Creep Speed (CREEP), Controlled Acceleration (C/A), Current Limit (C/L), 1A Timer (1A TIME), 1A Drop-Out Current Level (1A DO), Plugging Severity (PLUG), Field Weakening Pick-Up Current Level (F.W. P.U.), and Field Weakening Drop-Out Current Level (F.W. D.O.).

1. Oscillator -

   The oscillator section of the control card has two adjustable functions (creep speed and acceleration delay) and one fixed function (top speed).

   With the accelerator potentiometer at maximum ohms (pedal fully released), the creep speed can be adjusted with a trimpot on the card (CREEP). Top speed is fixed by the card design and is obtained with the accelerator potentiometer at minimum ohms (pedal fully depressed). The rate at which the oscillator may increase its percentage of ON time is limited by controlled acceleration. The maximum time required to go from creep speed to top SCR speed is adjustable at the indexed trimpot (C/A) on the card from 0.5 to 1.0 seconds.

   The percentage of ON time has a range of approximately 5 to 95 percent. The oscillator's midrange setting (50S ON time) uses a maximum operating frequency of 300 HZ, and both ON and OFF times equal to 1.7 milliseconds. At creep speed, the ON time will decrease to approximately 0.8 milliseconds. At full SCR operation, this condition will be reversed (snort OFF time, long ON time).

2. Current Limit -

   This circuit monitors average motor current by utilizing a sensor (shunt) in series with the armature. The voltage drop detected across the sensor is fed back to the oscillator card which limits current to a maximum safe value. If heavy load currents are detected, this circuit overrides the oscillator and limits the percentage of ON time (motor voltage), lowering the average current. Because of the flyback current through 3 Rec, the motor current usually runs 2 to 3 times the average battery current. The current limit level is adjustable at the C/L trimpot. This adjustment affects the quickly rising transformer current (T4 to T3) that charges capacitor(s) 1C, keeping the capacitor voltage within its rating.

3. 1A Bypass Control -

   The 1A contactor bypasses the control and places the motor directly across the battery for full speed operation (100% ON time). The 1A contactor has the following modes of control: a. Demand Pick-Up (fixed feature of the oscillator card) If the oscillator has attained a percent ON time equivalent to a motor voltage of 80 to 85% of the available battery volts, the 1A contactor will automatically pick up. It is not necessary for the 1A switch in the speed box to close for this function. b. Timed Pick-Up This feature is activated by the 1A switch in the speed box. The time delay pick-up of the 1A contactor is

provided by a circuit in the oscillator card. This feature allows 1A to be picked up after a time delay without reaching the demand point, and is normally used to apply full power at or near stall conditions. This time delay is adjustable by means of a trimpot (1A TIME) on the oscillator card.

c. 1A Thermal Hold-Off -

This feature prevents the 1A contactor from closing when the truck is in severe thermal cutback to avoid torque jumps. When a truck starts to go into thermal cutback, the 1A time delay will rapidly increase, approaching infinity as the control goes deeper into thermal cutback.

d. 1A Plugging Hold-Off This feature is designed to prevent 1A closure anytime during plugging to protect the motor from excessive currents, and to keep plugging severity within the operator's control range.

e. 1A Drop-Out (1A DO) This feature is used to open the 1A contactor if the motor is subjected to excessive currents. The dropout is adjustable with the 1A dropout (1A DO) trimpot. The directional or accelerator switch must be returned to NEUTRAL to reset the dropout circuit.

4. Plugging -

When the truck is moving and the directional lever is shifted from one direction to the other, the control is triggered into "Plug" mode, and reverse current flow through the drive motor field provides a retarding torque to assist in braking the truck. The severity of plugging is adjustable at the PLUG trimpot on the control card.

5. Field Weakening -

Field Weakening is a method of attaining higher running speed for the vehicle in level operation by inserting a shunt resistor around the drive motor field. The normal settings for this feature are: pick up of the field weakening contactor from 125 to 150% of normal full-load running current (in 1A bypass mode) and drop out of the field weakening contactor from 275 to 300% current. The drop out function puts the control back to the 1A range to climb ramps and inclines. Pick-Up (FW PU) and Drop-Out (FW DO) are adjustable at the control card trimpots. Refer to Topic 3, Section G. for trimpot and current settings.

6. Ramp Start (Anti-Rollback) -

This feature provides full SCR torque to restart a vehicle on an incline. The memory for this is the directional logic in the card. When stopping on an incline, the directional switch must be left in its original position to allow the control to assume full power when restarting in the same direction. The current limit trimpot (C/L) affects this torque.

7. Full Power Transition -

This feature provides a smooth transition from the SCR to 1A bypass range by continuing to pulse the SCR until the 1A contactor tips close.

8. Pulse Monitor Trip (PMT) -

The PMT circuit monitors the control far a short in the power circuit (1A tips welded or I Rec shorted). This function contains three features: the look ahead (presample), look again, and the automatic look again reset.

If 1 Rec is shorted or 1A is welded, the PMT will prevent the forward and reverse contactors from closing if either condition exists.

If 1 Rec fails to commutate (turn OFF) or if the 1A power tips remain closed when they should be open, the control will open the forward or reverse contactors.

The PMT will then look again by testing for a fault and if none exists it will reclose the forward or reverse contactors. If the fault reoccurs, the forward or reverse contactors will reopen and remain open until the circuit is reset.

If the truck control goes into the 1A bypass range before the PMT circuit sees the fault a second time, the look again counter will automatically reset. This eliminates the Inconvenience of resetting the PMT with the key switch if the tripping is due to random noise. Once the PMT circuit is tripped, it can only be reset by opening the keyswitch.

9. Static Return To OFF (SRO)

This feature of the control requires the operator to return the directional lever to NEUTRAL anytime he leaves the vehicle momentarily. If the seat switch is opened, the control will shut OFF and cannot be restarted until the directional switch is returned to NEUTRAL. A time delay (0.5 second) is

built into the seat switch input which allows momentary opening of the seat switch without shutting OFF the control to prevent the circuit from tripping while driving over bumps.

J. Tip Bounce Timer -

After the Forward or Reverse contactors close or 1A opens, the oscillator card checks that the capacitor(s) is properly charged and that there is battery voltage across 1 Rec. The card will not gate on 1 Rec until a time delay has passed to be sure the contactor tips are settled and have stopped bouncing. Since tips that conduct while bouncing may arc, this feature reduces the possibility of tip welding and extends tip life.

11. Coil Driver Modules -

These modules are located on the contactor panel, and switch power to the Forward, Reverse, 1A, Field Weakening, and Line (if so equipped) contactor coils on command from the control card. All driver modules are equipped with reverse battery protection so that if the battery is connected in the wrong polarity, none of the contactors can be closed electrically.

12. Thermal Protector (TP) -

The thermal protector is a temperature sensitive device mounted on the 1 Rec heatsink that increases in resistance as its temperature is increased. The control card monitors the TP for high temperature (resistance), and will lower the maximum drive current limit as needed to safeguard 1 Rec from exceeding its temperature limits. The truck will normally reach sufficient speed even with reduced current limit to reach 1A bypass operation, allowing the control to cool. As the panel cools, the control will sense the drop in TP temperature, and allow the current limit to increase.

13. Low Voltage -

Batteries that are undersized or more than 80% discharged (specific gravity less than 1.150) can produce low voltages at the control terminals. If the battery voltage is too low (discharged and under load) to allow proper control functioning, the control will automatically shut down.

A. SAFETY PRECAUTIONS

⚠ WARNING

The following precautions must be observed through all test and adjustment procedures. ALWAYS discharge the capacitors before working on the control.

1. Check the battery polarity.
2. When necessary for a specific test or maintenance function, discharge the capacitor(s) by disconnecting the battery and momentarily touching a suitable jumper wire across all capacitor terminals. The capacitor must be discharged before taking resistance readings, performing ground tests, or replacing components.

NOTE

The capacitor(s) is mounted on the static panel which is located on the left side of the lift truck.

3. Do not ground or short any heatsinks as they are integral parts of circuits.

   Never eliminate or modify heatsinks.

4. Flake certain that the battery is fully charged prior to testing. Specific gravity readings at 80°F (23°C) are as follows:

HYDROMETER READING	CHARGE CONDITION
1.110-1.135	Completely Discharged
1.140-1.200	One-Fourth Charged
1.205.1.230	One-Half Charged
1.235-1.260	Three-Fourths Charged
1.265.1.290	Fully Charged

5. Check the operation of the replaced component to make certain that the trouble has been corrected.
6. Do not plug the drive motor while the drive wheels are raised off the floor.
7. Always tag all wires and cables for proper identification and location before they are removed from any terminals to facilitate their proper installation after a check or test has been completed. After the wires or cables are installed, make certain that the connections are tight.

⚠ WARNING

It is strongly recommended that all hand jewelry such as wrist watches and rings are not worn by the person performing any maintenance, tests, or adjustments on the lift truck.

B. MAINTENANCE PROCEDURES

The semiconductors have operating temperature limits above which these devices may be damaged. For this reason, normal maintenance should guard against any actions which will expose the components to excessive heat such as steam cleaning, or methods which will reduce the heat dissipating ability of the control.

NOTE

Heat is removed by conduction. Bad mechanical connections will cause excessive heat in the control cables, components, and the control itself. Always apply heat transfer grease where and only where specified.

In dirty atmospheres, clean the electrical system components by using low pressure air (35 PSI [241 kPa]) to blow off the control. In oily or greasy areas, a mild solution of detergent or denatured alcohol can be used to wash off the control and then blow completely dry with low-pressure air. The control can also be cleaned with Dupont Freon TF degreaser or equivalent.

⚠ WARNING

Clean the lift truck in well ventilated areas only. Comply with all safety regulations noted on the cleaning solution package.

Terminal boards and other exposed SCR control parts should be kept free of dirt and paint that might change the effective resistance between parts.

TOPIC 3 TESTS AND ADJUSTMENTS

⚠ WARNING

Before performing the following inspections and tests, block the steer (rear) wheels to prevent the truck from rolling backwards. Raise and block up the front of the truck so the drive wheels clear the floor. Place Jack stands under both sides of the frame Just behind and clear of the drive wheels. Always disconnect the battery and discharge the capacitor(s) by momentarily touching a suitable jumper wire across all capacitor terminals before performing any maintenance or tests on the electronic control. Reconnect the battery as required for specific checks.

NOTE

During the following tests and adjustments, correct all problems as they are located. Refer to the troubleshooting guide in TOPIC 8 for the appropriate checks and guidelines.

A. TEST EQUIPMENT

The following list of test equipment or their equivalents is required in addition to standard hand tools:

1. EV-1 Control System Analyzer (optional)
2. Volt-Ohm-Multimeter (VOM) with 20,000 ohm-per-volt D.C. sensitivity and 5,000 ohm-per-volt A.C. sensitivity (Simpson model 260, Figure 3-1, or equivalent). These are minimum specifications.
3. Two IN4004, IN4005, IN4006, or IN4007 diodes (1 amp, 300 volt or higher).
4. Clip Leads.
5. Continuity tester with a 6 volt battery and 6 volt lamp (12 volt battery and lamp for 35/120 trucks [EV-1 C and D Controls]).
6. A 50 millivolt 500 Amp D.C. shunt (50 millivolt, 1000 Amp D.C. shunt for 35/120 trucks).
7. A 50 millivolt D.C. meter (Simpson model 1329, Triplett model 420, or equivalent).
8. 6 Jumper wires (each approximately 12" [305 mm] of #16 wire with alligator clips on each end).
9. 6 Jumper wires (each approximately 30" [762 mm] of #16 wire with alligator clips on each end).

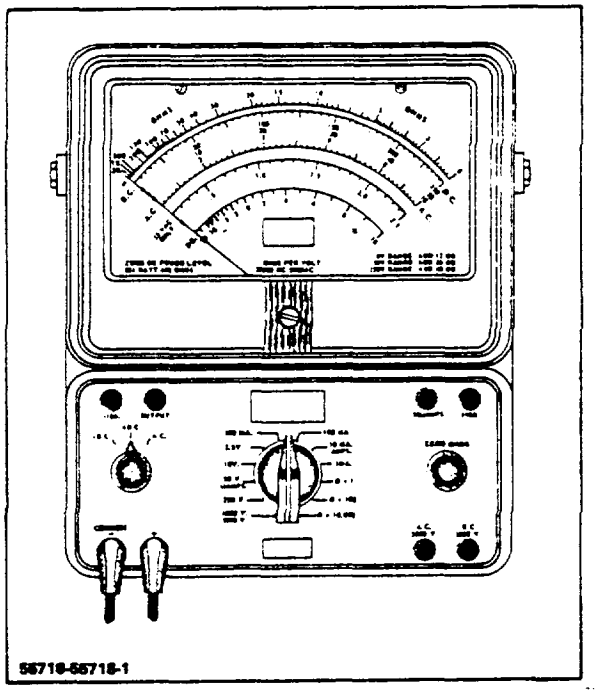


Figure 3-1. VOM Test Meter

B. METERS

NOTE

When testing with a meter, always start the test with the meter set on the highest scale if approximate values to be measured are unknown.

1. Ammeter: Measures current in amps. With the power ON, always connect the ammeter in series with the component through which you are measuring current flow.
2. Voltmeter: Measures potential difference (electromotive force) in volts. With the power ON, always connect the voltmeter in parallel with the component to determine the voltage across it.
3. Ohmmeter: Measures resistance in ohms. Always de-energize the circuit and discharge the capacitors before using an ohmmeter. Isolate one end of the component for an accurate reading and connect the meter across the component.

   When checking for resistance, the ohmmeter should be zeroed before taking each reading. All checks are read on one of the ohms scales. If a times X range is used, add the number of zeros in that range to the reading shown by the meter needle. If a decimal point is involved in the reading, move the

decimal point the same number of places to the right as the number of zeros in the range that was selected.

Examples: Rx1000 range and the meter needle is at 40. The correct value would be 40,000 ohms.
Rx100 range and the meter needle is at 4.5. The correct value would be 450 ohms.

NOTE

After a resistance reading is taken with a VOM meter, always change the selector to a different scale position than one of the resistance scales. This will prevent the battery inside the meter from discharging whenever the meter is not being used.

C. VISUAL INSPECTION

NOTE

Operation of the lift truck in high duty cycle applications or dirty atmospheres may require that the following inspections be performed more often than the recommended 500 hour interval.

1. Disconnect the battery. Remove the toe and floor plates. Remove the contactor panel cover. Remove the speed control box cover. Open the SCR control static panel door located on the lower left side of the lift truck.

⚠ WARNING

Discharge the capacitor(s) by momentarily touching a suitable jumper wire across the capacitor terminals.

2. Check all fuses to insure proper value and continuity.
3. Inspect the lay of all cables, wire harnesses, and control wires to assure there is no chafing of these items against sharp edges of the lift truck.
4. Inspect all terminals to assure that all wires and cables are properly crimped and all connections are tight.
5. Inspect the speed control box to assure that the operating shaft, speed potentiometer, and all microswitches are mechanically secured to their mountings.
6. Check the tightness of all mounting hardware. Make certain there are no broken or missing cotter pins and replace any missing or broken mounting hardware.
7. Inspect the directional switch to assure that terminal connections are tight.
8. Check that the seat switch terminal connections are tight and that the switch closes when the seat is depressed.
9. Inspect all relays and contactors to assure that there is no interference to operation from dirt and foreign materials and that the units have satisfactory overtravel.
10. Inspect the contactor tips for wear. When the tips are burnt or worn to a point where the silver facings are almost eroded through to copper, replace the contactor tips.

⚠ CAUTION

Never dress or file the contactor tips by any means. Tips that are tampered with may weld. Never replace tips singly; always replace both tips as a set.

11. Check the horn, hourmeter, battery discharge indicator, and pump switches for proper operation.

D. GROUND TESTS

Perform the following tests with the battery disconnected and the key switch in the ON position.

⚠ WARNING

This Is the battery connector receptacle that is permanently mounted on the lift truck, not the connector with the cables from the battery.

Disconnect the battery and discharge the capacitor(s) by touching a suitable jumper wire across all capacitor terminals before performing these tests.

1. Set the multimeter on the high ohms scale, and zero the meter. Connect one lead from the meter to the frame of the lift truck at a location where paint will not insulate the frame. Touch the other lead to another good point on the frame to assure that proper ground connections have been obtained. The meter reading should be zero ohms.

2. With the key switch in the ON position, connect one lead of the meter to a good ground on the frame. Touch the second lead of the meter first to one pole and then to the other pole of the battery receptacle that is mounted on the left side of the lift truck frame. The resistance mist be greater than 20,000 ohms .

⚠ WARNING

This is the battery connector receptacle that is permanently mounted to the left side of the truck; not the connector with cables from the battery.

3. Touch the second lead of the meter to all terminals on the contactor panel, SCR control static panel, instrument panel, and control valve microswitches. Resistance readings must be greater than 20,000 ohms.

4. Touch the second lead of the meter to all current carrying parts of the contactors, motor terminals, and power terminals on the SCR panel. Resistance readings must be greater than 20,000 ohms.

5. If a low resistance reading or zero resistance is obtained at any terminal, remove the wires or cables from that terminal. Check the resistance of the wires or cables and continue through the individual circuits from that point until the ground has been located. After the ground has been located and corrected, connect all wires and/or cables securely to the proper terminals. Then recheck for grounds at the battery receptacle poles to make certain the ground has been eliminated.

E. SPEED POTENTIOMETER RESISTANCE TEST

1. Disconnect the battery. Set the meter on the Rx100 scale, and zero the meter. Disconnect plug P4 at the speedbox, and connect the meter to terminals 4-3 and 4-4; or disconnect and tag all wires from terminals R4 and R5 of the oscillator card, and connect the meter leads to the wires removed (Fig 3-2).

2. With the accelerator pedal in the completely released (up) position, the reading should be 4,000 to 6,500 ohms.

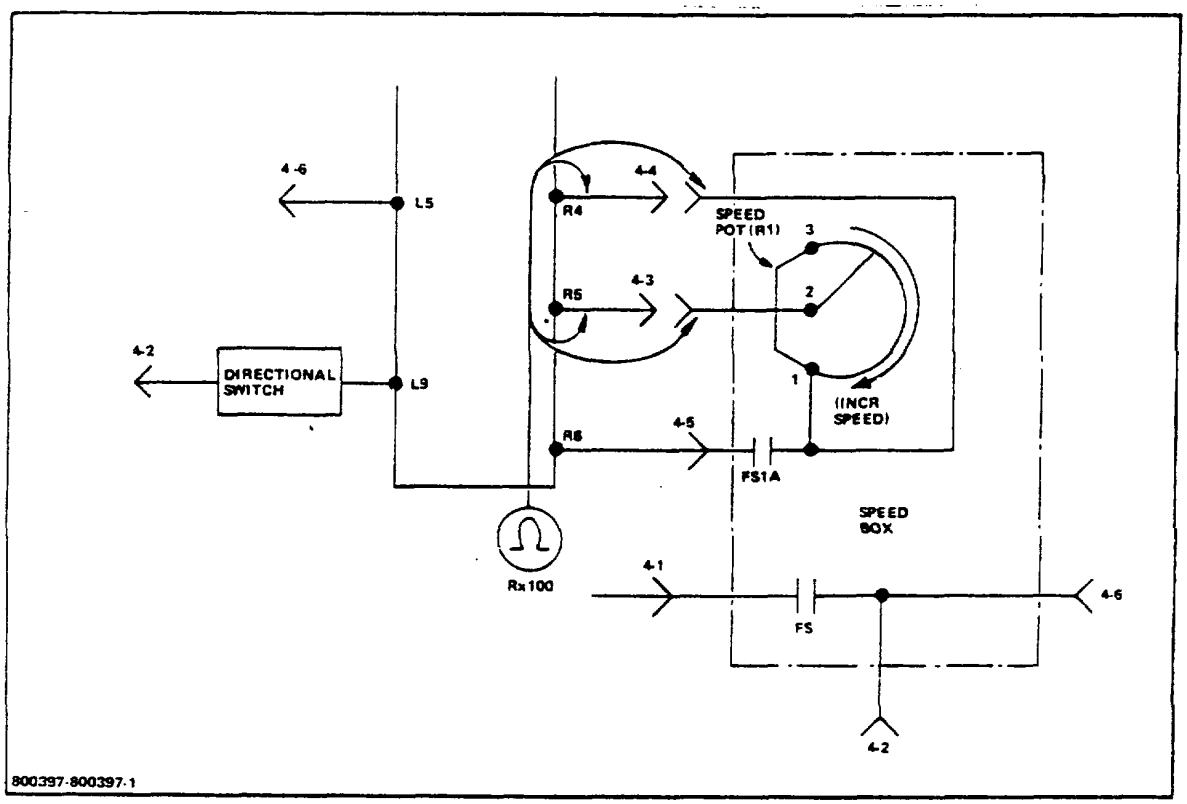


Figure 3-2. Speed Pot resistance Test Connections.

3. Depress the accelerator pedal slowly and fully until it contacts the bottom stop in the speed control box. Resistance should be less than 200 ohms.

NOTE

The force required to move the accelerator shaft should be 17-25 lbs. (7.7-11.3 Kg). The potentiometer movement should be 90-94°.

4. Check the FS1A switch adjustment as follows:
   (a) Disconnect plug P4 and connect a continuity test light to terminals 4-4 and 4-5 of the plug leading to the speedbox, and connect an ohmmeter set on the Rx100 scale to terminals 4-3 and 4-4.
   (b) Depress the accelerator pedal until FS1A closes (the lamp will light).
   (c) Resistance reading should be less than 200 ohms when FS1A closes.
   (d) If necessary, loosen FS1A mounting hardware, adjust the switch position until the specified reading is obtained, and tighten the hardware.
5. Check the accelerator start switch (FS) as follows:
   (a) Set the ohmmeter to the Rx1 scale, and zero the meter.
   (b) Connect the ohmmeter (or a continuity lamp) to terminals 4-1 and 4-6 of P4.
   (c) Depress the pedal slightly, or move the arm 0.25-0.5" (7-13 mm). The switch should close (zero resistance or test lamp lights).
   (d) If necessary, loosen the FS mounting hardware, adjust the switch position for specified actuation, and tighten the hardware.
6. Disconnect the VOM or test lamp, connect plug P4 to its jack, and connect the leads to terminal board terminals R4 and R5 as tagged (if removed during tests).

F. MECHANICAL SWITCHING

1. Block the truck so that the drive wheels clear the floor and the blocks.
2. Connect the battery. Nothing should operate electrically.
3. Depress the horn button. The horn should operate.
4. Close the seat switch. Nothing should operate electrically.
5. Turn the key switch ON. The battery meter should operate. The power steering contactor (if so equipped) should pick up, and the power steering motor should operate.

NOTE

On trucks equipped with "Power Steer Neutral Drop-Out", the power steering contactor should not pick up until a direction is selected, and should drop out 1 to 4 seconds after returning to NEUTRAL.

6. Check the operation of the hydraulic pump and contactors. The contactors should pick up and the motor should operate after slight but definite movement of the control valve levers. The pump motor should operate under no hydraulic load and without operation of any hydraulics.
7. Place the directional selector in the FORWARD position, and depress the accelerator pedal 0.25-0.5" (7-13 mm). The footswitch should close and the forward contactor should pick up.
8. Depress the pedal gradually and smoothly. The drive wheels should accelerate smoothly.
9. Continue to depress the pedal. The 1A contactor should pick up on demand when motor voltage reaches 80-85% of the battery voltage.
10. If the truck is equipped with Field Weakening, keep the pedal depressed. The Field Weakening contactor should close, and the motor should increase in speed.
11. Slowly and evenly release the pedal. The Field Weakening contactor (if so equipped) should drop out, then the 1A contactor should drop out. The motor should decelerate through the SCR range. The directional contactor should drop out when the pedal is fully released.
12. Repeat steps 7 through 11 with the directional selector in the REVERSE position.

G. OSCILLATOR CARD ADJUSTMENTS

NOTE

The lift truck battery must be fully charged before performing these tests.

1. Open the hinged access panel on the control card that covers the control board trimpots (Fig 3-3).

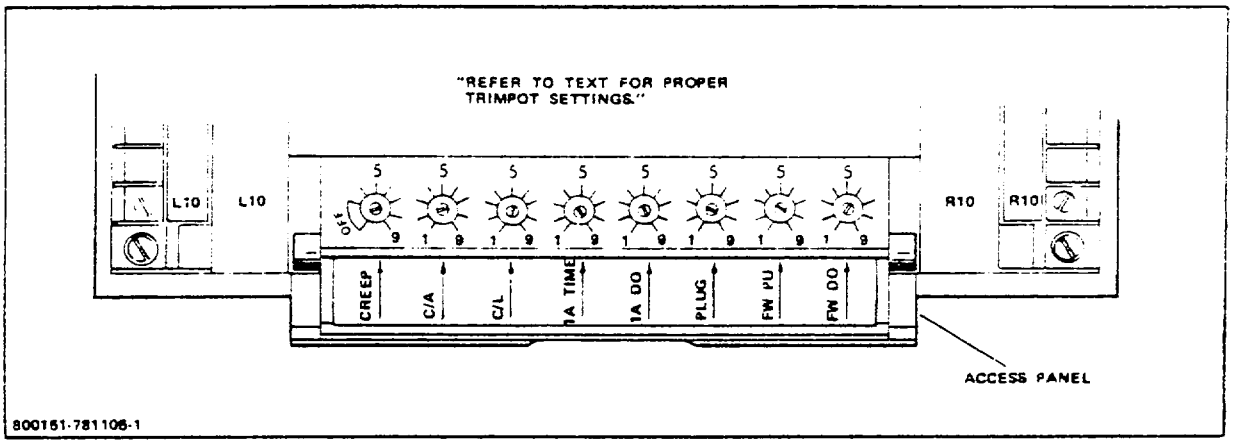


Figure 3-3. Trimpot Adjustments

2. Adjust the pots to the following settings:

TABLE 1. TRIMPOT SETTINGS

TRIMPOT	ADJUSTMENT SETTINGS			
	20/30	35/55	60/80	100/120
CREEP	6	6	7.5	6
C/A	5	5	4	5
C/L	9	9	9	9
1 A TIME	3.5	9	9	9
1A DO	2.0 (500 Amp)	1.5 (750 Amps)	2.5 (1000 Amps)	2.5 (1200 Amp)
PLUG	5	6	2	3.5
FW PU	3.5 120 Amps)	3.5 (160 Amps)	5 (200 Amps)	3.0 (230 Amps)
FW DO	3.5 (300 Amps)	4.8 (400 Amps	5.5 (450 Amps)	4.5 (600 Amos)

3. Block the lift truck so that the drive wheels clear the floor and the blocks.

4. Install a 50 millivolt 500 amp D.C. shunt (50 millivolt 1000 Amp D.C. shunt for 35/55 trucks) in series with the battery, and connect a D.C. voltmeter set on the 50 mA (microAmp [50 Volt]) scale across the shunt.

5. Sit on the seat, turn the keyswitch to ON, and select a direction. Depress the accelerator pedal fully; the motor should accelerate and the 1A and then the FW contactors should pick up.

6. Apply the brakes gradually while fully depressing the accelerator pedal. The Field Weakening contactor should drop out. Continue to apply the brakes until the 1A contactor drops out. Record the meter reading at which 1A drops out.

7. Multiply the meter reading (in millivolts) by 10 (using 500 Amp shunt) or by 20 (using 1000 Amp shunt) to find the current level (in amperes).

Examples:

500 Amp Shunt -
23 millivolts = 230 Amps
120 millivolts = 1,200 Amps

1000 Amp Shunt -
42 millivolts = 840 Amps
60 millivolts = 1,200 Amps

8. Compare this reading with the current level given in Table 1 under 1A DO. Adjust the trimpot as required to obtain the specified reading.

9. With the accelerator pedal fully depressed, gradually release the brake and allow the motor to accelerate until the 1A and then the FW contactor picks up. Record the meter reading at which the FW contactor picks up, and multiply the meter reading by 10 (using 500 Amp shunt) or by 20 (using 1000 Amp shunt). Compare this current level with the value listed in Table 1. Adjust the FW PU trimpot if required to obtain this reading.

10. Gradually apply the brakes until the FW contactor drops out. Multiply the meter reading by 10 (500 Amp shunt) or by 20 (1000 Amp shunt) to find the current

level in Amps. Adjust the FW DO trimpot if required to obtain the reading in Table 1.

11. Release the accelerator pedal, turn the key switch to OFF, and remove the truck from its blocks if no further testing is required.

H. PROTECTIVE CIRCUITRY CHECKOUT

Perform these checks with the battery connected and the drive wheels blocked off the floor.

1. Presample and PMT Checks

   a. Perform the start-up sequence to reset the control. With the key switch and seat switch closed, place the directional selector in FORWARD.

   b. Connect a 1 K ohm, 5 watt resistor across the 1A contactor tips using insulated clip leads. Depress the accelerator pedal, but do not close the FS1A footswitch. The Forward contactor should not pick up.

   c. Disconnect the resistor from the 1A contactor tips. With the foot pedal depressed, the Forward contactor should pick up and the drive wheels should spin. Do not accelerate into the 1A bypass range.

   d. With the drive wheels still in motion, connect the resistor across the 1A tips again. The directional contactor should drop out. Remove the resistor; the directional contactor should not pick up, because a fault has occurred twice (look again feature).

   e. Reset the PMT protection circuit by performing the start-up sequence, and accelerate the control into the SCR range. Do not accelerate into the 1A bypass range.

   f. Connect a 1 K ohm, 5 watt resistor across the 1A contactor tips using insulated clip leads. The directional contactor should drop out.

   g. Remove the resistor from across the 1A tips . The directional contactor should pick up and the drive wheels should turn.

   h. With the drive wheels still in motion, connect the resistor across the 1A tips again; the directional contactor should drop out. Remove the resistor from the 1A tips; the directional contactor should not pick up, because a fault has occurred twice.

   i. Repeat steps (a) through (h) with the directional lever in REVERSE.

   j. If the PMT circuit does not test as specified, 3 Rec may be "leaky". To check for a leaky 3 Rec, repeat the Presample and PMT checks; but hold the contactor closed manually (with an insulated screwdriver) instead of connecting the resistor across the tips in each step that the resistor is used. If the Presample and PMT circuits now test as specified, 3 Rec is leaky. If the circuits still do not test as specified, replace the control card.

2. Static-Return-to-Off (SRO) Checkout

   a. Close the seat switch, key switch, and accelerate the drive motor.

   b. Open the seat switch. The directional contactor should drop out.

   c. Close the seat switch. The directional contactors must not pick up until the start-up sequence is performed.

If the protective circuitry does not operate properly, test the PMT driver (HY-1; refer to section I). If HY-1 does not test properly, replace HY-1. If HY-1 does test properly, replace the oscillator card.

NOTE

If HY-1 is shorted, it will never inhibit contactor closing. If HY-1 is open, it will always inhibit contactor closing.

I. COMPONENT CHECKING

⚠ WARNING

Before performing any of the following tests, disconnect the battery and discharge the capacitors by momentarily touching a suitable jumper wire across all capacitor terminals.

1. Contactor Panel

   a. Contactors (F,R,1A,FW, etc.) (1) Inspect the contactor tips for wear. When the tips are burnt or worn to a point where the silver facings are almost eroded through to copper, replace the contactor tips.

⚠ CAUTION

Do not dress or file the contactor tips by any means. Never replace the tips singly; always replace both tips as a set.

Inspect the armature and all moving parts for freeness of operation. Check that there is no foreign material lodged between pieces which might prevent proper movement.

(2) Inspect the contactor coils as follows:

⚠ CAUTION

The coils have voltage suppression cast integral with the coil. If a test voltage is applied in the wrong direction, or if the coil is connected backwards, permanent damage may result. Always observe the polarity markings on the coil during maintenance and testing.

NOTE

Always test pick-up and drop-out voltages with the coil at room temperature. Testing coils that are above room temperature will give faulty indications.

If the contactor fails to operate, measure the voltage being applied to the coil terminals through the truck wiring. The coil should pick up and fully seal at 65% of battery voltage at room temperature. If the voltage applied to the coil terminals is less than 65% of the rated battery voltage, check the battery charge, contactor driver, and truck wiring. Replace the coil if the contactor does not seal at 65% of battery voltage or if the coil shows signs of being overheated.

b. Drivers (HY-1,2,3, and 5, where used)

(1) Remove the driver from the contactor panel.

(2) Connect a coil load, resistor, switch, battery, and the driver as shown in Figure 3-4.

(3) The voltmeter should read battery volts with the switch open.

(4) Close the switch. The meter reading should be less than 3 volts.

(5) Move the coil load from terminal 3 to terminal 4 and repeat the test.

(6) Replace any driver that does not test as specified.

c. Contactor Driver/Timer (HY-4) If the lift truck is equipped with the power steering timed shut-off in Neutral feature, the contactor panel will include line contactor driver and timer modules. Test the timer module (HY-4) for proper operation as follows:

(1) Perform the start-up sequence to turn on the truck.

(2) Select a direction. The power steering contactor should pick up.

(3) Shift the directional lever to NEUTRAL. The power steering

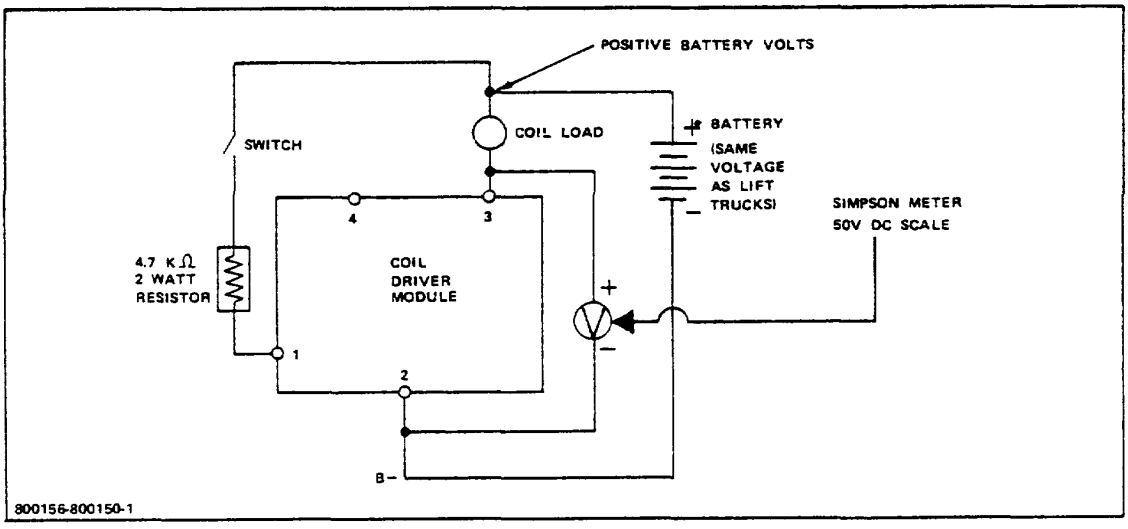
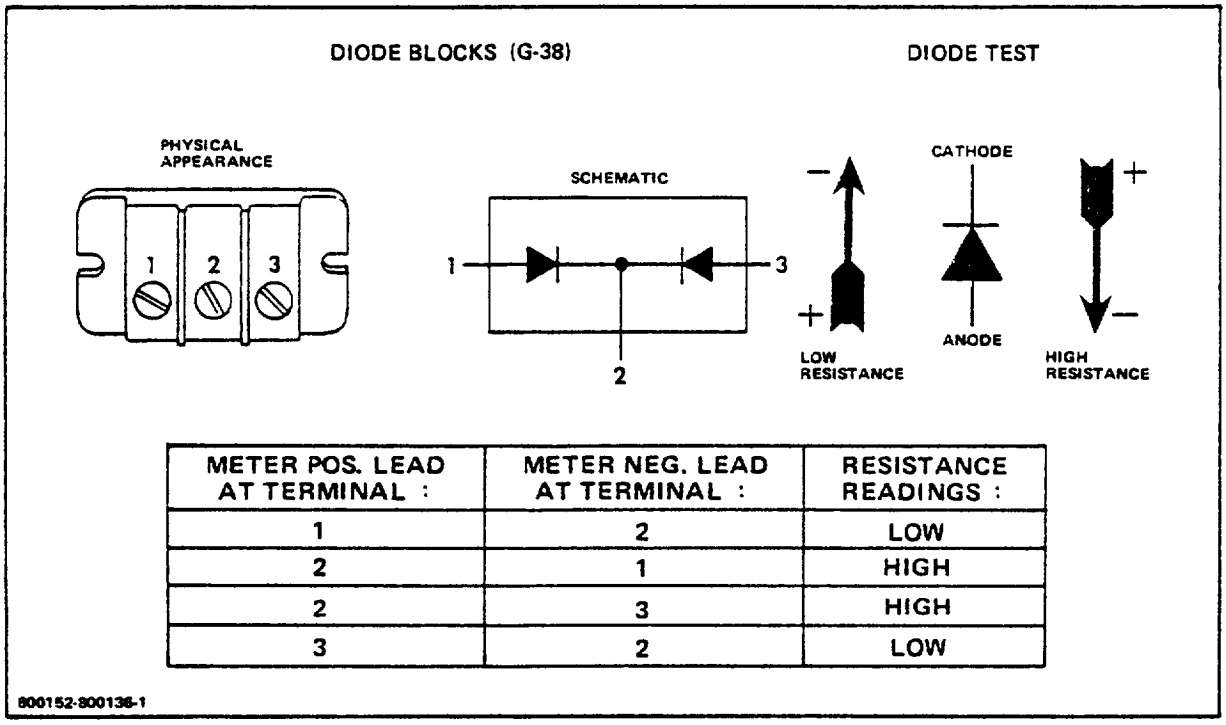


Figure 3-4. Driver Test Schematic



METER POS. LEAD AT TERMINAL :	METER NEG. LEAD AT TERMINAL :	RESISTANCE READINGS :
1	2	LOW
2	1	HIGH
2	3	HIGH
3	2	LOW

Figure 3-5. Diode Block Testing

contactor should drop out after a 1 to 4 second time delay. If the contactor does not pick up or does not drop out within the specified time period, replace HY-4.

d. Fuses Check all fuses for proper value and continuity.

e. Field Weakening Resistor If the lift truck is equipped with Field Weakening, the F.W. resistor is mounted next to the F.W. contactor. Check that no welds are broken on the resistor.

f. Filter (diode) Blocks (HY-6,7, and 8) The filter blocks contain two diodes (Fig 3-5). Check the resistances between the filter block terminals. Replace any block that does not give the resistance readings as specified in Figure 3-5.

2. Hash Filter (Horn)

a. Tag and disconnect the wires from the hash filter, which is located on the truck frame near the horn.

b. Set the ohmmeter on the Rx10,000 scale, and zero the meter.

c. Connect the meter leads to the terminals of the filter to charge its internal capacitor.

d. After several seconds, reverse the meter leads on the terminals. The needle should deflect and return to infinity. If this capacitive action is not obtained, replace the hash filter.

3. Component Checking - Static Panel

a. SCRs 1 Rec, 2 Rec, and 5 Rec These are silicon controlled rectifiers located on the static panel. SCRs must not conduct until. gated ON, and must continue to conduct after the gate signal is removed. Test the SCRs as follows:

NOTE

To check an SCR, it is necessary to have a 6 volt test lamp, 6 volt battery, and two lamp diodes (12 volt test lamp and battery on models C and D, 1 Rec (35/120). A low voltage or weak test battery may give faulty test results.

(1) Disconnect the battery and discharge the capacitors by momentarily touching a suitable jumper wire across all capacitor terminals.

(2) Refer to Topic 4, and remove the wiring harness plug from the oscillator card.

(3) Refer to Figure 3-6, and note the location of the pins on the oscillator card plug (TB-2). Pin numbers do not appear on the plug itself.

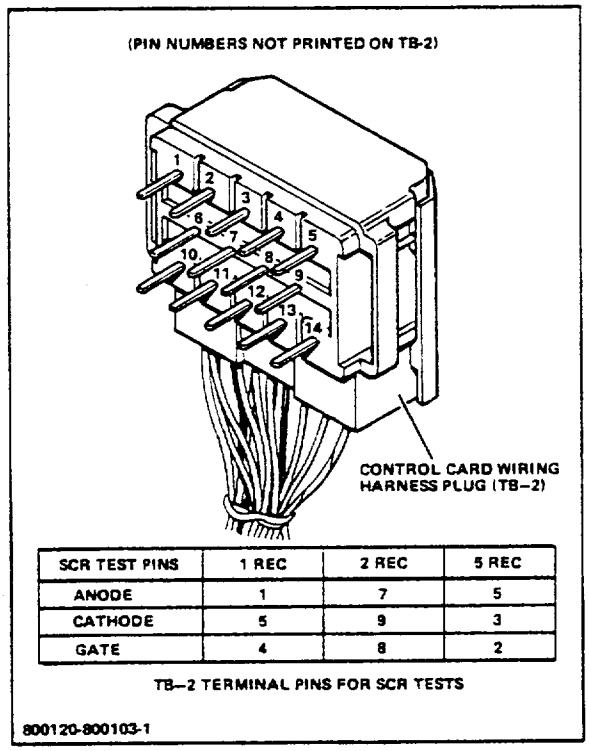


Figure 3-6. TB-2 Terminal Pins For SCR Tests

(4) Each SCR has three terminals: Anode, Cathode, and Gate (Fig 3-7). Connect the test lamp positive lead to the anode pin on TB-2, and the negative lead to the cathode pin on TB-2.

(5) The lamp must not light. If the lamp lights, the SCR is shorted and must be replaced.

(6) With the cathode and anode still connected, connect the positive lead through the two diodes to the gate pin on TB-2 (Fig 3-8). The light must turn ON. Remove the positive lead from the gate pin. The light must remain ON.

(7) If the lamp does not light and remain lit as specified in step 6, replace the SCR.

NOTE

If 2 Rec or 5 Rec test faulty, remove the cathode wire from the respective snubber and retest. If the Rec still tests faulty, replace the Rec. If the Rec now tests good, replace the snubber and retest the Rec.

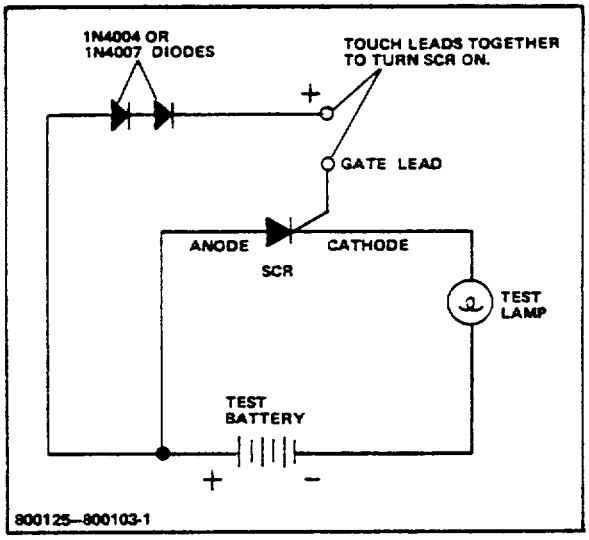


Figure 3-8. SCR Test Schematic

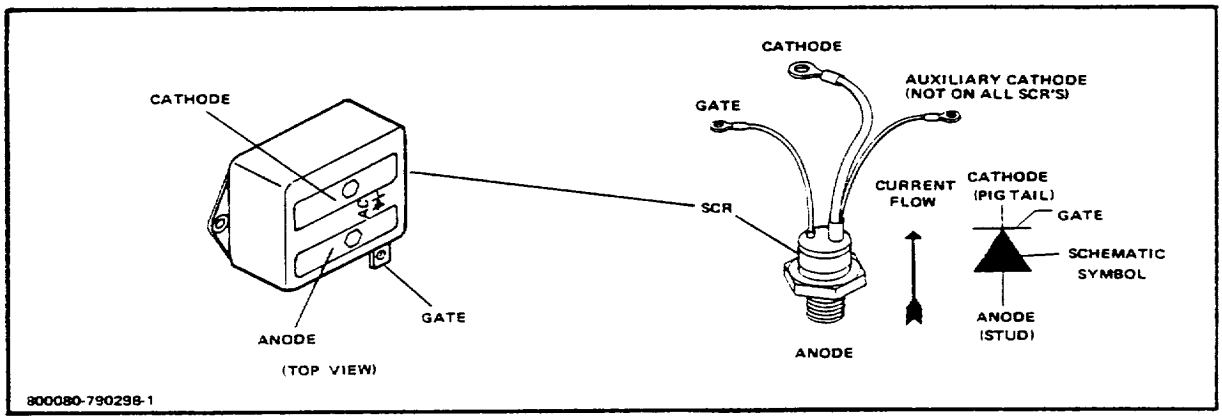


Figure 3-7. SCR Terminals (Typical)

(8) On stud type SCRs, check that there is continuity between the red and black cathode (pigtail) leads. Replace any stud type SCR that is open between these leads.

If a test light is not available to check the SCRs as described above, they can be checked with an ohmmeter for shorts and opens as follows:

(1) Set the ohmmeter on the RX100 scale, and zero the meter.

(2) Measure the resistance from the anode to the cathode. Replace the SCR if it is shorted (zero ohms).

(3) Measure the resistance from the gate to the cathode, and from the cathode to the gate. If there is very low resistance (shorted), or infinity in BOTH directions, replace the SCR.

b. Diode Rectifiers (3 Rec and 4 Rec)

(1) Disconnect the cathode lead to electrically isolate the diode.

(2) Set the ohmmeter on the RX1 scale, and zero the meter.

(3) Connect the positive lead to the anode and the negative lead to the cathode (Fig 3-9). Resistance should be 7-12 ohms.

(4) Reverse the meter leads. Resistance must be 10,000 ohms or greater.

5. Replace any diode that does not test as specified.

c. Thermal Protector (TP)

(1) Tag for identification and remove the leads from the thermal protector.

(2) Check the resistance between the thermal protector terminals. Resistance at 700F (21°C) should be between 100 and 200 ohms.

(3) Set the VOM on the highest ohms scale and check the resistance of each thermal protector terminal to the heatsink. Resistance should be infinity.

(4) Replace any thermal protector that does not test as specified. Connect the leads to the thermal protector as tagged during removal.

d. Capacitor(s)

Disconnect the battery and discharge the capacitor(s). Disconnect the leads from the capacitor terminals. Check each capacitor as follows:

(1) Connect a fully charged test battery or lift truck battery, a 100 K ohm resistor in series, and a voltmeter to the capacitor (Fig 3-10), but do not connect the negative lead to the battery.

(2) Use a watch with a sweep second hand to time the period of charging. Connect the negative lead to the battery and begin timing. After 15 seconds, the capacitor voltage should be 22 or 30 volts (±20%) as indicated in the following chart.

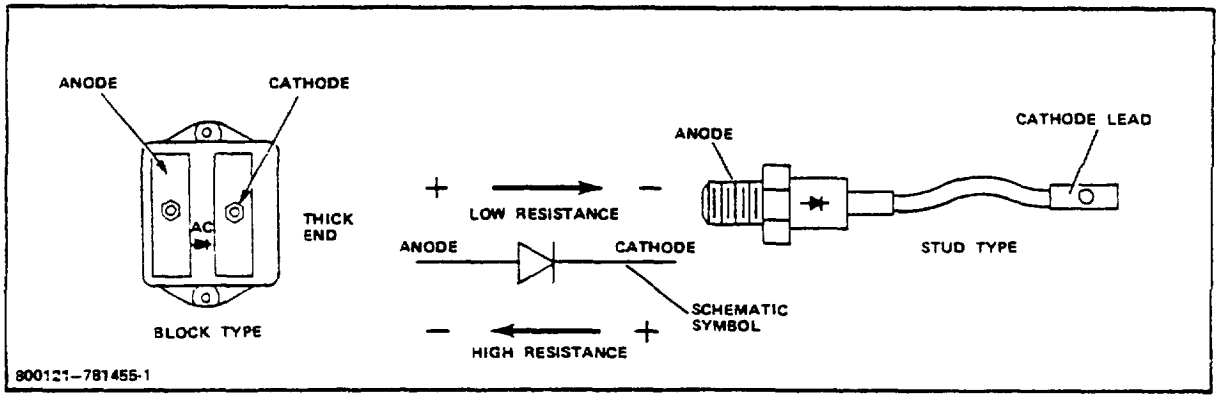


Figure 3-9. Diode Resistance Test

CAPACITOR CHARGING TIME

Battery Voltage	Capacitance (mfd)	Charging Time	Cap. Voltage at End of Charging Time
36V	150	15 sec	22 volts
48V	150	15 sec	30 volts
*Plus or minus 20%			

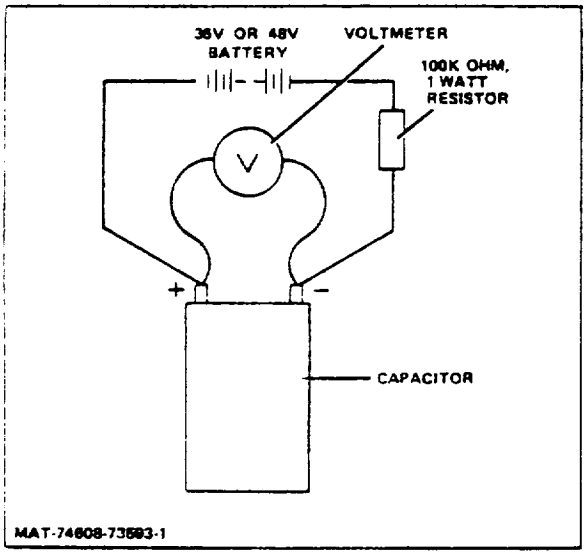


Figure 3-10. Charging the Capacitor

(3) If the capacitor charges too fast, it has lost its capacitance. If the capacitor charges too slowly, it is leaking and will not charge to full battery voltage with a 100 K ohm resistor in series. Replace any capacitor that does not test within the range specified.

(4) Remove the resistor from the circuit and continue to charge the capacitor to full battery voltage. Disconnect the battery leads and immediately connect the voltmeter and 100 K ohm resistor as shown in Figure 3-11. After the resistor is connected, begin timing the discharging period with the watch. The capacitor should discharge at the rate indicated in the following chart.

CAPACITOR DISCHARGING TIME

Capacitor Voltage (fully charged)	Capacitance (mfd)	Discharging Time	Voltage End of Discharging Time
36V	150	15 sec	*14 volts
48V	150	15 sec	*18 volts
*Plus or minus 20%			

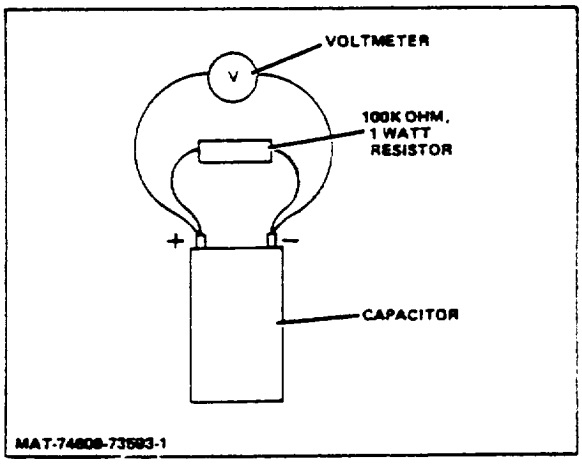


Figure 3-11. Discharging the Capacitor

(5) Reverse the leads on the capacitor, and repeat the above tests. Replace any capacitor that does not test as specified.

e. Filter (23 Fil)

23 fil is a filter around 3 Rec. To check 23 Fil, tag and disconnect all wires from the filter block. With a VOM on the Rx10,000 scale, touch the leads to the filter terminals to charge the internal capacitor. After a few seconds, reverse the meter leads on the terminals. The VOM needle should deflect and return to infinity. If the needle does not deflect as specified, replace the filter.

f. Filter Block (23 Res) ("B" controls [20/30] Only)

23 Res (also called 23 Rec) is a S ohm resistor placed around 3 Rec on B controls. Visually inspect the resistor for damage and signs of overheating. Check the resistance of 23 Res with the VOM. Replace if the resistance is not 5 ohms.

q. Filter Blocks 22 Rec and 25 Rec (snubbers)

Set the VOM on the Rx10,000 scale, and touch the leads to the filter terminals to charge the internal capacitor. After a few seconds, reverse the leads. The needle should deflect and return to infinity. If the control has symptoms as listed in section 1E of troubleshooting table #1, switch 22 Rec with 25 Rec. If the problem is corrected, replace 25 Rec. If the problem is not corrected, replace both 22 and 25 Rec.

h. 24 Fil (varistor) "C" and "D" controls Only

24 Fil is a varistor that protects 4 Rec from voltage transients. If 4 Rec fails, check 24 Fil visually for signs of damage and replace if required.

i. IX Choke and Transformer

Refer to the static panel wiring diagrams, and locate the transformer winding terminals. Check the resistance of the windings with a VOM, and replace if the windings are open (infinite resistance).

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J. CLOSE-UP AND FINAL CHECK

1. Check that all wires and cables are properly connected.
2. Install all covers, panels, and plates securely.
3. Close and secure the static panel access door.

⚠ WARNING

Be careful not to pinch any cables or wires, or cause any grounds in the electronic control during the close-up procedure.

4. Recheck the grounds at the positive and negative terminals of the lift truck battery receptacle with the key switch in the ON position.

TOPIC 4 STATIC PANEL

A. GENERAL

When replacing static panel components, refer to chart on Page 2-42 for component and mounting hardware tightening torques. SCR leads that are not screw connected terminate inside the control wiring plug (TB-2). Swing the card up and remove the plug to gain access to these leads. Components are secured to the baseplate with self-tapping screws which must be installed in the same hole from which they were removed. Always twist leads where shown on the schematic to prevent noise interference. When installing stud type SCRs and diodes, the use of heat transfer grease such as G.E. Versilube G-350M or an equivalent compound is recommended. Apply the heat transfer grease under the hex head of the component and not on the threads (Fig 4-1). Coating the threads may cause component failure.

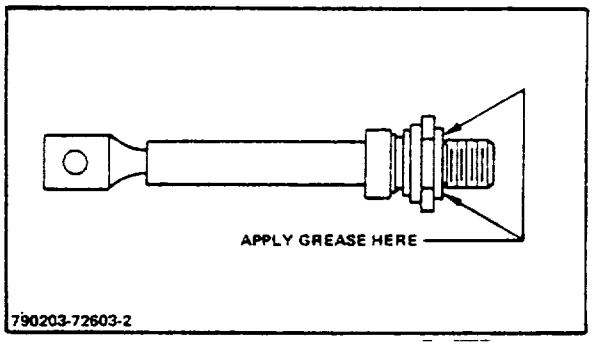


Figure 4-1. Heat Transfer Grease Application

⚠ WARNING

Before performing the following repair procedures on the static panel, disconnect the battery and discharge the capacitor(s) by momentarily touching a suitable jumper wire across all capacitor terminals.

B. REMOVAL

The static panel is located in the compartment on the left lower portion of the truck (Fig 4-2).

1. Remove the mounting hardware securing the compartment cover, and swing the cover open.
2. Tag for identification and remove the electrical cables from the static panel power terminals.

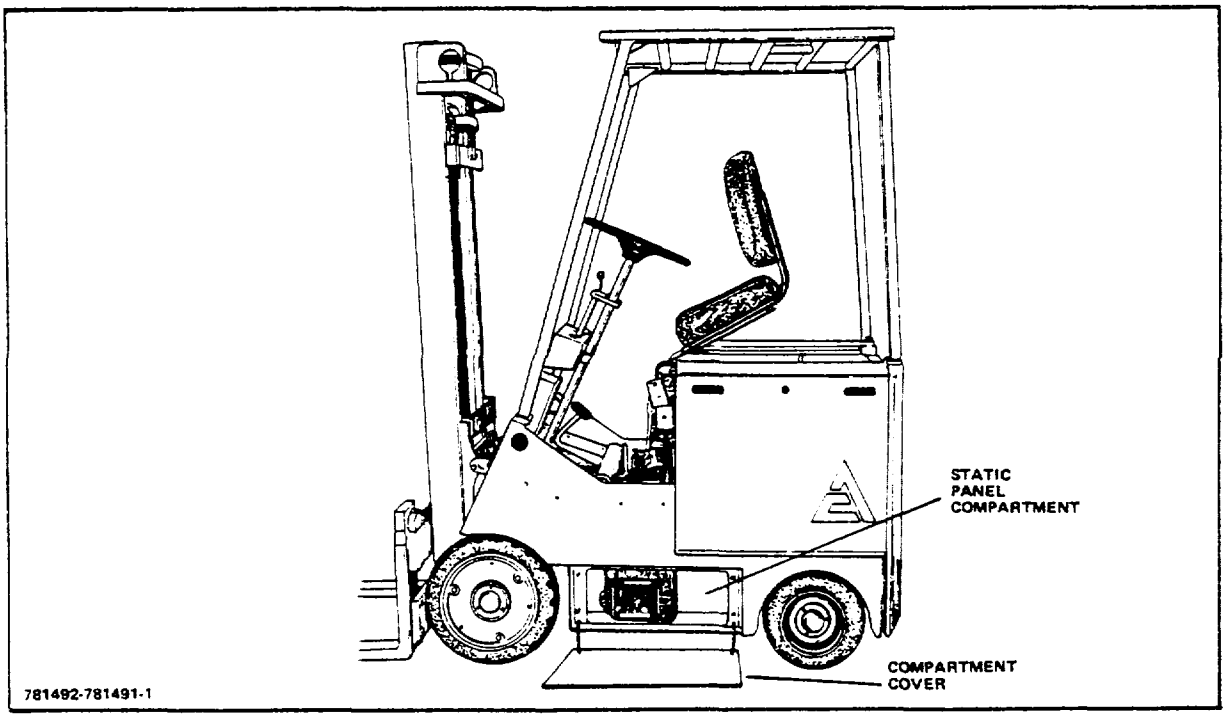


Figure 4-2. Static Panel Compartment

3. Remove the terminal board mounting screws from each side of the control card. Insert a screwdriver in the slot on the side of the terminal board and twist the screwdriver to pry out the terminal board. Leave the wires intact. Remove both terminal boards (Fig 4-3).

4. Remove the mounting hardware securing the static panel to the truck frame. Remove the static panel from the compartment (Fig 4-4).

C. INSTALLATION

1. Apply a thin coat of silicon heat transfer grease to the static panel mounting plate.

2. Install the static panel in the compartment. Tighten the mounting hardware securely.

3. Connect the terminal boards to the static panel. Tighten the mounting screws securely. If any of the electrical leads were removed from the terminal boards, install them to the proper terminals as shown in Figure 4-5.

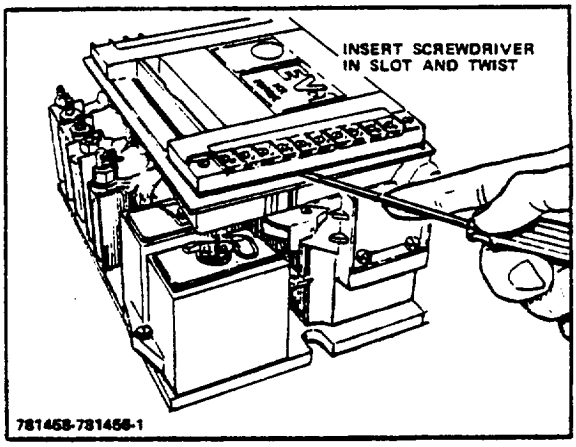


Figure 4-3. Terminal Board Removal

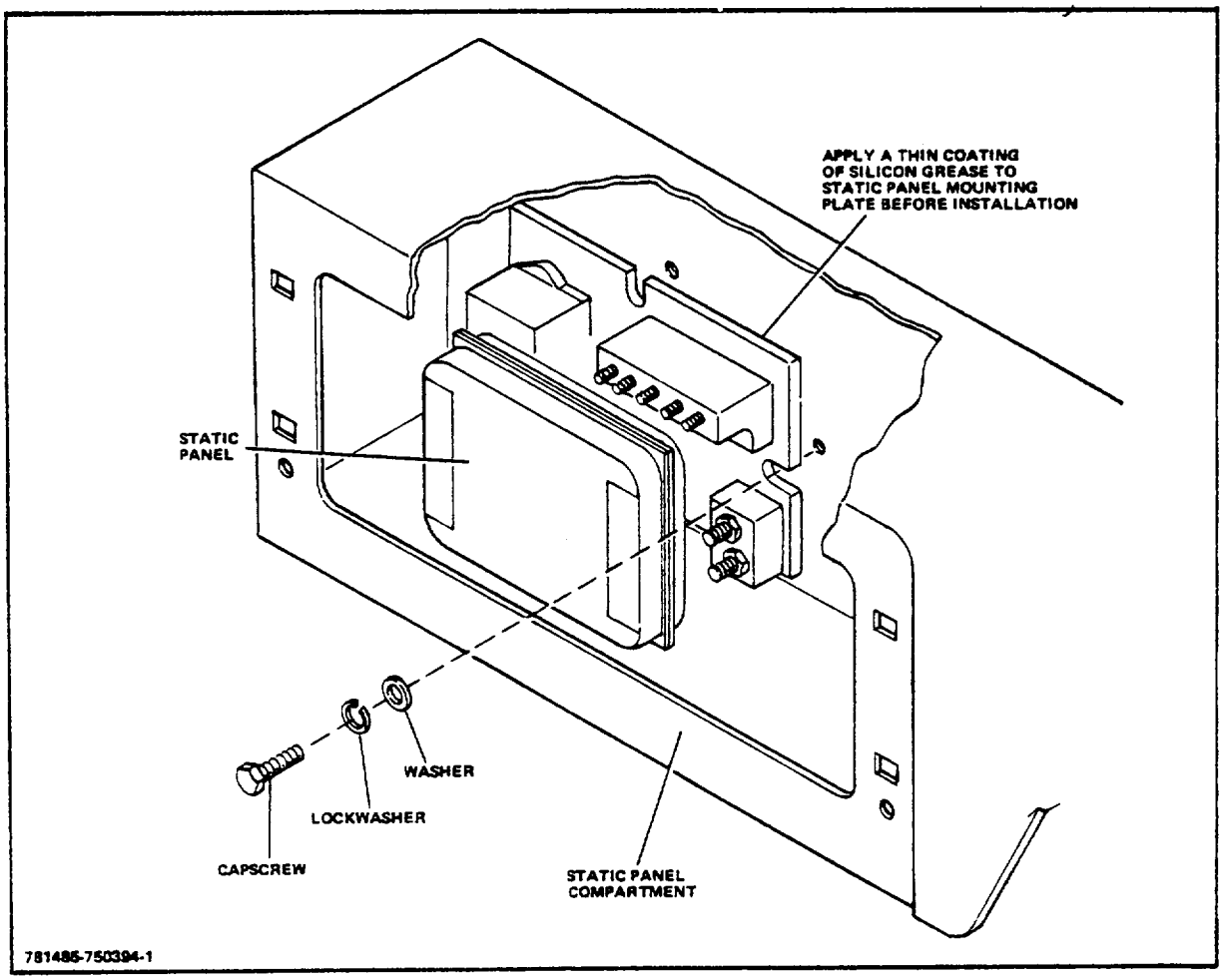


Figure 4-4. Static Panel Mounting

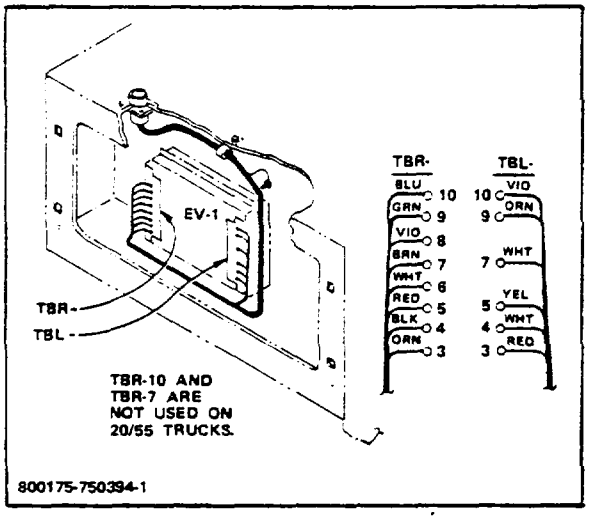


Figure 4-5. Terminal Board Wiring

4. Install the electrical cables to the terminal studs on the static panel. Refer to Figure 4-6 for the proper cable installation.

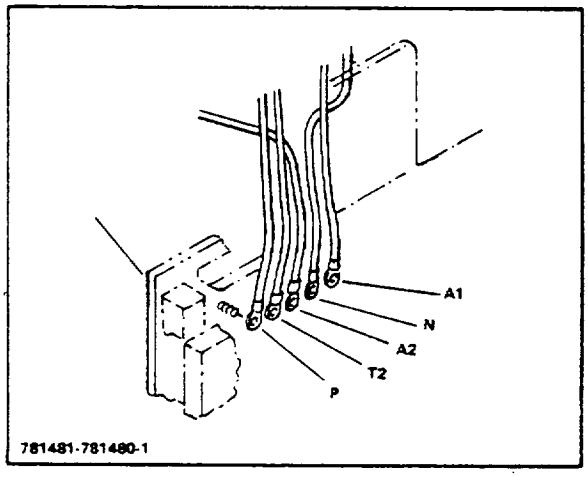


Figure 4-6. Static Panel Cabling

5. Close and secure the static panel compartment cover.

D. COMPONENT REPLACEMENT

To replace any static panel components, first remove the static panel from the truck as outlined in Section B.

NOTE

The screws used to secure components to the static panel baseplate are self-tapping and must be installed into the same hole from which they were removed. Refer to the Torque Table at the end of this Topic for specified component and hardware tightening torques.

1. Oscillator Control Card

a. Removal

(1) Pry open the latches on both sides of the card with a screwdriver (Fig 4-7).

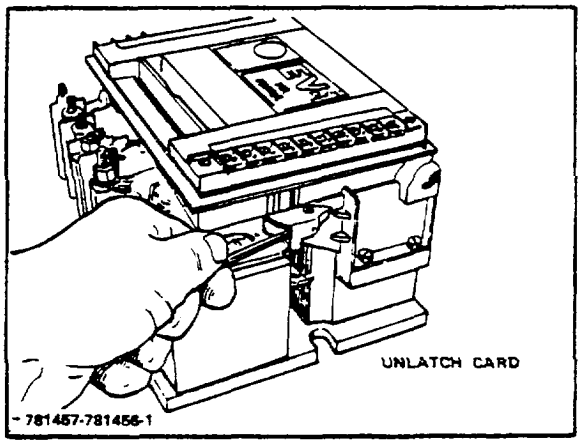


Figure 4-7. Control Card Latches

(2) Lift the oscillator card, and pry the wiring harness plug (TB-2) from the bottom of the card with a screwdriver (Fig 4-8).

(3) Swing the card up 40°, and slide it out of its slotted hinges.

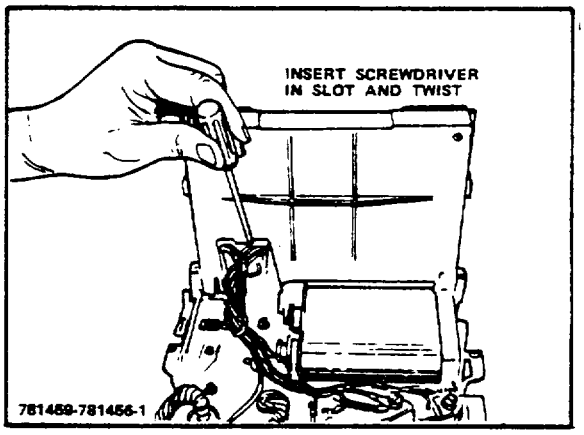


Figure 4-8. Card Wiring Plug (TB-2) Removal

b. Installation

(1) Insert the oscillator card into the hinge slots on the static panel.

(2) Install the wiring harness plug (TB-2) securely into the bottom of the card.

(3) Swing the card down onto its supports, and close the latches on both sides of the panel.

2. Block Type SCRs

a. Removal

(1) Tag for identification and remove the electrical connections and bus bars from the module.

(2) Remove the thermal protector (1 Rec Only).

(3) Remove the SCR mounting hardware. Note the location of the holes in the base from which each screw was removed.

(4) Lift the SCR and insulation off of the static panel baseplate.

b. Inspection

(1) Clean the insulator surface with a clean rag and isopropyl alcohol.

(2) Inspect the insulator for tears or cracks, and replace if defective.

c. Installation

(1) Wipe a light layer of machine oil on the base and smooth the insulator into position.

(2) Coat the insulator with a light coat of heat transfer grease (G.E. Versilube G-350M or equivalent).

(3) Set the module on the insulation, and start the screws back into the base in the same holes from which they were removed.

(4) Tighten the screws finger tight.

(5) Check that the bottom of the module is flat against the insulator and baseplate.

(6) Alternately tighten the screws ¼ turn to the torque listed in the chart.

(7) Install the thermal protector to the module (1 Rec Only).

(8) Install all electrical connections to the proper terminals as tagged during removal.

3. Stud Type SCRs and Diodes

a. Removal

(1) Remove the pigtail of the component from its terminal. On SCRs, tag and remove the gate lead(s). If the gate lead terminates inside the card wiring plug (TB-2), remove the plug from the card, open the plug cover, note the terminal that the lead is connected to, and remove the wire from the plug.

(2) Unscrew the component from the baseplate or heatsink.

b. Installation (1) Apply a thin coat of silicon heat transfer grease (G.E. Versilube G-35011, or equivalent) to the hex portion of the component where it contacts the heatsink (Fig 4-1). Do not apply grease to the threads of the component.

(2) Install the component into the heatsink and tighten to the specified torque.

(3) Connect the pigtail to its proper terminal. Install the gate lead(s) to the proper terminal as tagged during removal (SCRs Only).

4. Capacitors

⚠ WARNING

Do not attempt any repairs to the static panel until all capacitors have been discharged.

a. Removal (1) Tag all leads for identification.

(2) Remove the nuts and leads from the capacitor terminals.

(3) Remove capacitor mounting brackets and bus bars, and lift the capacitors off the static panel.

b. Installation (1) Install the capacitor(s) in their position on the static panel.

(2) Install all electrical leads to the capacitor terminals as tagged during removal, and secure with nuts.

(3) On "8" controls (20/30), install the right-hand card box support and the oscillator card.

5. 22 Rec and 25 Rec (Snubbers) and 23 Fil

a. Removal (1) Tag for identification and remove all electrical leads from the component.

(2) Remove the snubber mounting screws.

Be sure to note the exact location from which the screws were removed.

They must be installed in these same holes.

(3) Remove the component from the static panel.

b. Installation (1) Install the component to the static panel.

(2) Install the mounting screws of the component in the same holes from which they were removed.

(3) Install all leads to the component as tagged during removal.

6. 24 Filter

a. Removal This filter is located behind the power terminal block and is connected between the Al and N terminals. To remove 24 Fil, tag and disconnect all leads, cables, and bus bars from the Al and N terminals, and pull 24 Fil off of these terminals.

b. Installation

Connect the 24 Fil leads to the Al and N power terminals, insert it into its mounting position, and connect all leads, cables, and bus bars to the terminals as tagged during removal.

7. Power Connection Block

a. Removal

(1) Tag for identification, and remove all leads, cables, and bus bars from each terminal stud.

(2) Remove 23 Fil.

(3) Remove the power connections block and its mounting hardware. If necessary, remove 3 Rec and 4 Rec from the heatsink.

b. Installation (1) Clean the insulator surface with a clean rag.

(2) Install the insulator, heatsink, and power connection block to the static panel.

STATIC PANEL HARDWARE TORQUES

COMPONENT	TORQUE in-lbs. (N.m)		
	20/30	35/80	100/120
Transformer	35-40 (4-4.5)	80-100 (9-11)	80-100 (9-11)
1 Rec*	35-40 (4-4.5)	80-100 (9-11)	80-100 (9-11)
2 Rec	25 (2.8)	50 (5.6)	50 (5.6)
3 Rec	20-25 (2.3-2.8)	35-40 * (4-4.5)	80-100* (9-11)
4 Rec	20-25 (2.3-2.8)	50 (5.6)	50 (5.6)
5 Rec	25 (2.8)	25 (2.8)	50* (5.68)
3 Rec/4 Rec Heatsink *	35-40 (4-4.5)	-	-
2 Rec Heatsink*	-	35-45 (4-5)	35-45 (4-5)
4 Rec Heatsink*	-	35-45 (4-6)	35-45 (4-5)
Cables to 1 Rec. shunt. and bus bar	80-100 (9-11)	80-100 (9-11)	80-100 (9-11)
Thermal Protector to 1 Rec	20-25 (2.3-2.8)	20-25 (23-2.8)	20-25 (2.3-2.8)
Capacitor Hardware	30-35 (3.4-4)	30-35 (3.4-4)	30-35 (3.4-4)
Cables to Transformer	45-55 (5-6.2)	45-55 (5-6.2)	46-66 (-6.2)
*Alternate 1/4 turn at a time			

TOPIC 5 CONTACTOR PANEL

⚠ WARNING

Before performing the following repair procedures on the contactor panel, disconnect the battery and discharge the capacitor(s) by momentarily touching a suitable jumper wire across the capacitor terminals.

Two types of contactors are used (Fig 5-1): single pole, single throw, normally open contacts (SPST) and single pole, double throw, with one normally open and one normally closed contact (SPOT). There are no adjustments of tip gap on the contactors. The contactor coils have self-contained arc suppression.

A. REMOVAL

The contactor panel is mounted on the frame center plate beneath and in front of the operators seat. It is protected by a contoured cover.

1. Remove the floor plate.
2. Remove the center plate cover and the contactor panel cover.
3. Tag for identification and disconnect all cables and harness plugs from the bottom of the contactor panel.
4. Remove the mounting hardware securing the contactor panel to the frame center plate, and remove the contactor panel assembly.

B. INSTALLATION

1. Install the contactor panel to the frame center plate. Tighten the mounting hardware securely.
2. Install the electrical cables and leads to their proper terminals on the contactor panel.
3. Install the contactor panel cover and center plate cover.
4. Install the floor plate.

C. COMPONENT REPAIR AND REPLACEMENT

NOTE

the contactor panel does not need to be removed to replace any components.

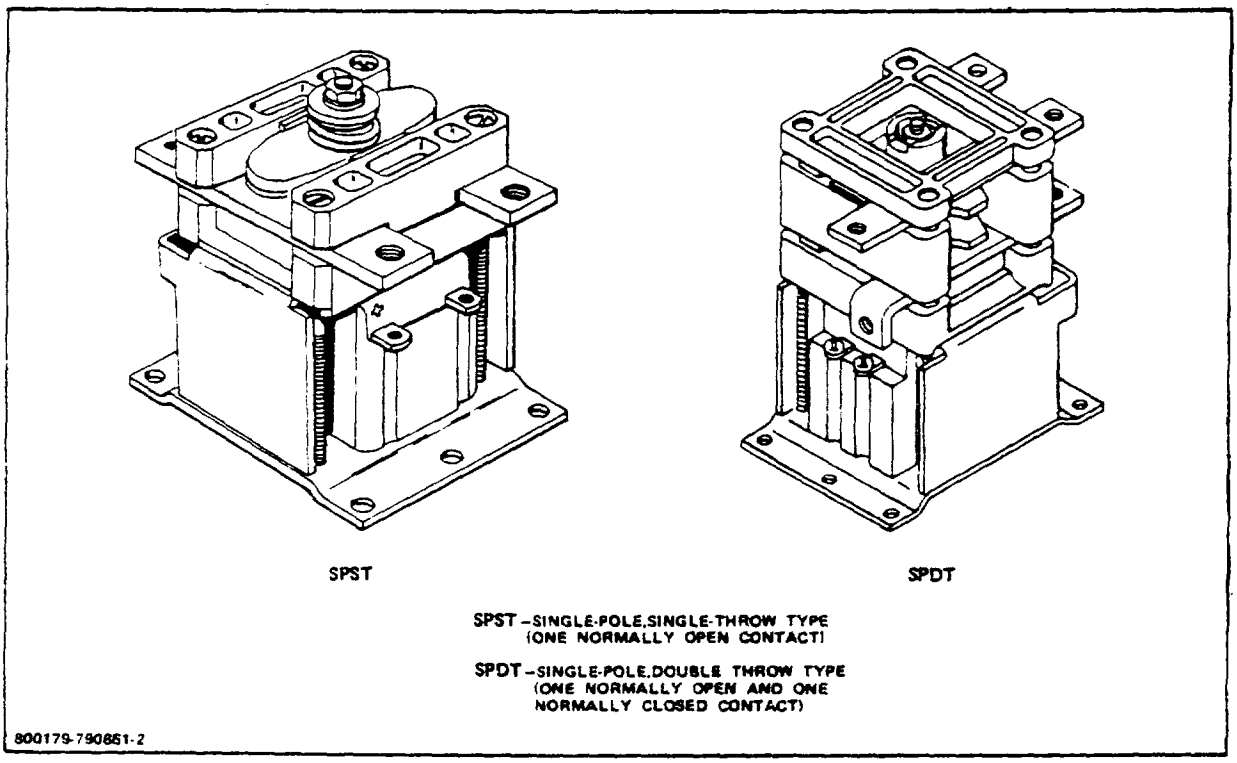
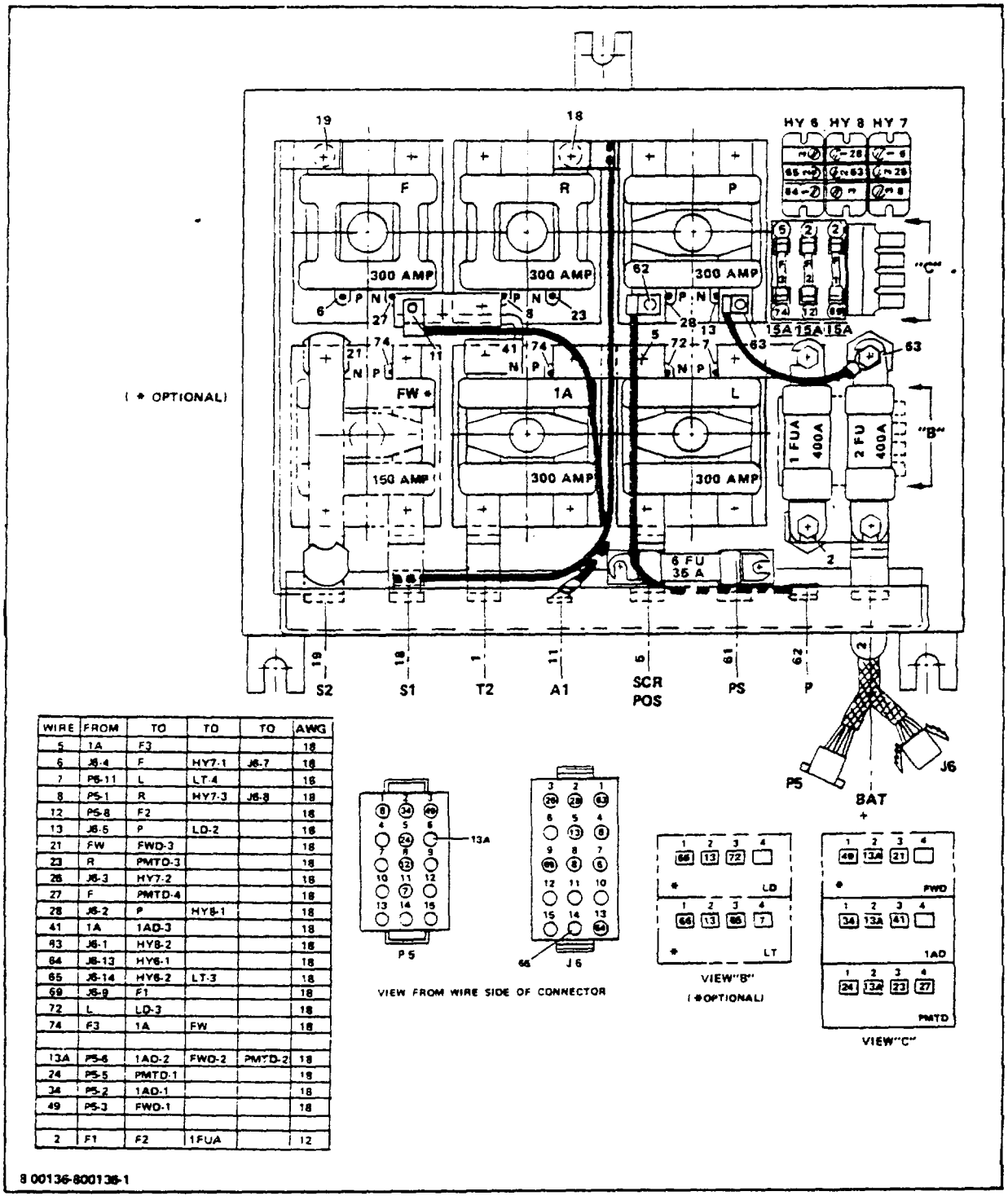


Figure 5-1. Contactors



WIRE	FROM	TO	TO	TO	AWG
5	1A	F3			18
6	J8-4	F	HY7-1	J8-7	18
7	PS-11	L	LT-4		18
8	PS-1	R	HY7-3	J8-8	18
12	PS-8	F2			18
13	J8-5	P	LD-2		18
21	FW	FWD-3			18
23	R	PMTD-3			18
26	J8-3	HY7-2			18
27	F	PMTD-4			18
28	J8-2	P	HY8-1		18
41	1A	1AD-3			18
63	J8-1	HY8-2			18
64	J8-13	HY6-1			18
65	J8-14	HY6-2	LT-3		18
69	J8-9	F1			18
72	L	LD-3			18
74	F3	1A	FW		18
13A	PS-6	1AD-2	FWD-2	PMTD-2	18
24	PS-5	PMTD-1			18
34	PS-2	1AD-1			18
49	PS-3	FWD-1			18
2	F1	F2	1FUA		12

Figure 5-2. Contactor Panel

⚠ WARNING

Before performing the following repair procedures on the contactor panel, disconnect the battery and discharge the capacitor(s) by momentarily touching a suitable jumper wire across the capacitor terminals.

When a component is removed, inspect It for wear or damage which may prevent or impair normal operation. Check for cracked or frayed wires or cables. Replace components as required. Refer to Figure 5-2 for the panel used on 20/55 trucks.

1. CONTACTORS

a. Removal

(1) Tag and disconnect all cables and leads from the contactor.

(2) Remove the contactor mounting hardware, and remove the contactor from the static panel.

b. Disassembly (SPST)

Refer to Figure 5-3 for an exploded view and parts index.

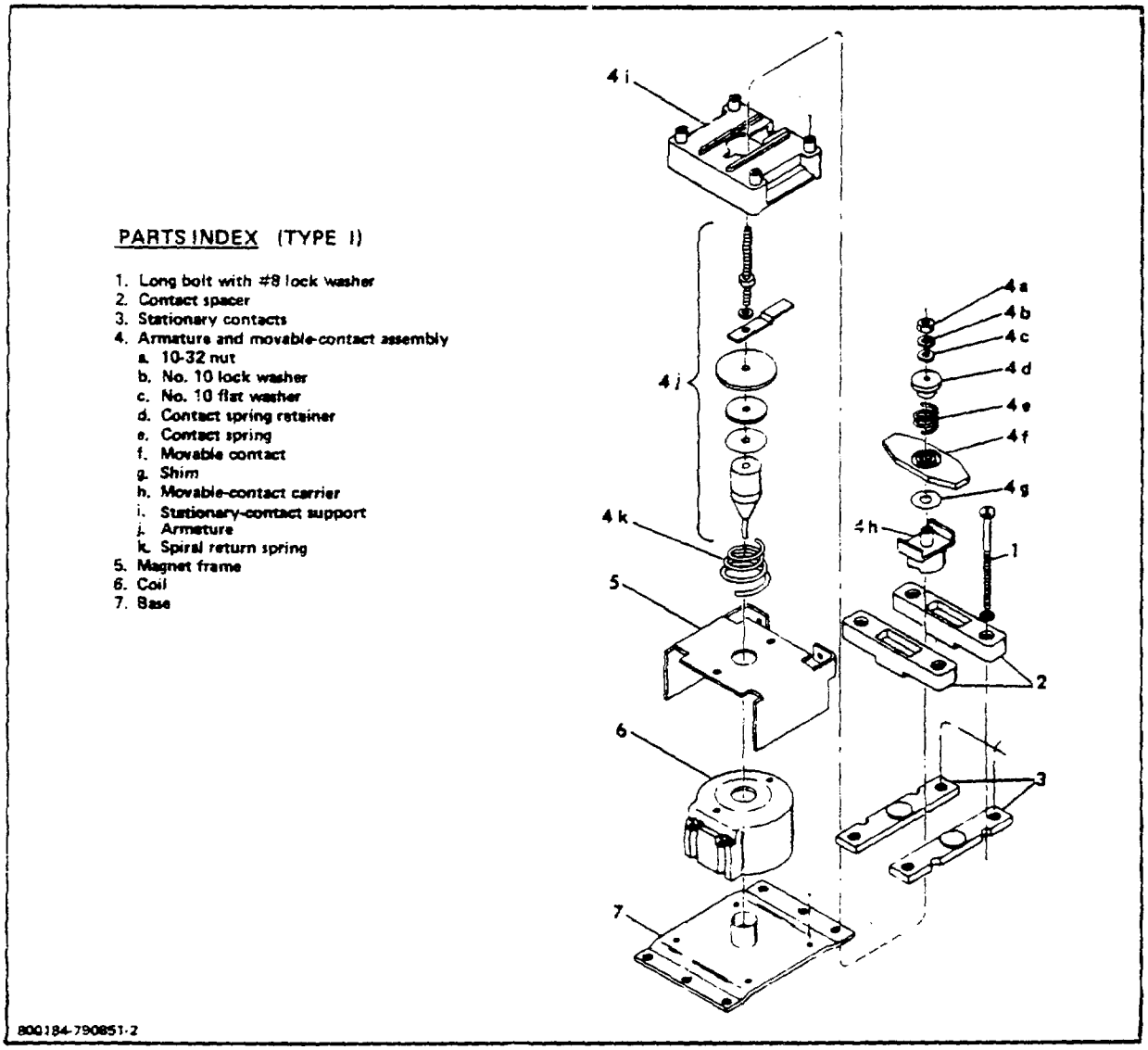


Figure 5-3. Contactor-Exploded View (SPST)

(1) Remove the contactor from the contactor panel.

(2) Loosen the four long bolts in each corner and remove the two contact spacers.

(3) Remove the two stationary contacts.

(4) Remove the armature and movable contact assembly.

(5) Remove the magnet frame and coil from the base.

(6) Loosen and remove the nut from the armature and movable contact assembly using a 3/8 inch socket or nut driver. Note the order in which all parts are removed from the stud.

d. Inspection

Inspect the contractor tips for signs of wear or damage. Replace the tips before they wear through to the base copper beneath the silver.

Check the free length of the spiral return spring (Figure 5-4). Replace the spring if its free length is not within the limits specified in the following table, or if it shows signs of being overheated or corrosion.

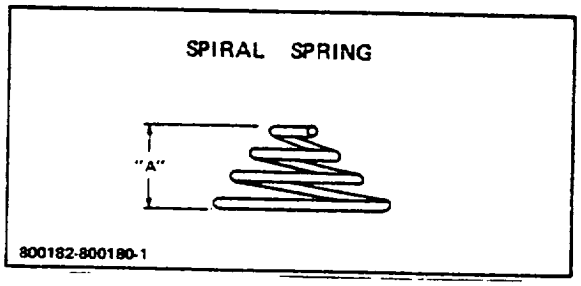


Figure 5-4. Spiral Return Spring Length

SPIRAL RETURN SPRING		
Contractor Part Number	Free Length "A" in Inches (mm)	
4911083	0.73-0.79	(18.5-20.1)
4911081 4911034	0.67-0.73	(17.3-18.5)
4911082 4911035 4911034	0.8-1.00	20.3-25.5)

Check the free length of the contact spring (Figure 5-5). Replace the spring if its free length is not within the limits specified in the following table, or if it shows signs of being overheated or corrosion.

CONTACT SPRING FREE LENGTH		
Contractor Part Number	Free Length "A" in Inches (mm)	
4911083 4911081 4911034	0.38-0.40	(9.6-10)
4911082 4911035 4911084	0.37-0.39	(9.4-9.9)

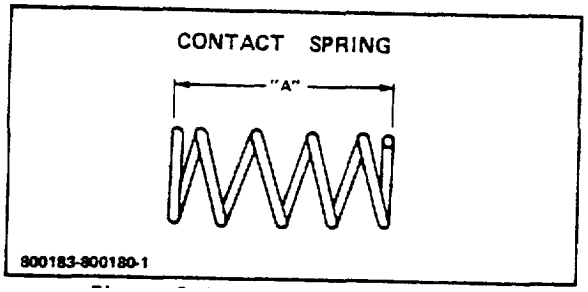


Figure 5-5. Contact Spring Length

e. Assembly (SPST, Fig 5-3)

(1) Inspect all parts for wear or damage and replace as required.
(2) Force the small end of the spiral spring over the small diameter on the armature assembly (Fig 5-6).
(3) Assemble the armature components (Items 4A through 4K, Fig. 5-3). Tighten the nut to 14-18 in-lbs of torque (1.6-2.0 N-m).
(4) Locate the projections on the magnet frame in the indentations on top of the coil with the frame positioned as shown in Figure 5-3.
(5) install the armature and moveable contact assembly to the magnet frame.
(5) Seat the stationary contacts in the slots of the molded stationary contact support and install the two contact spacers.
(7) Tighten the four long bolts to 14-18 in-lbs of torque (1.6-2.0 N-m).

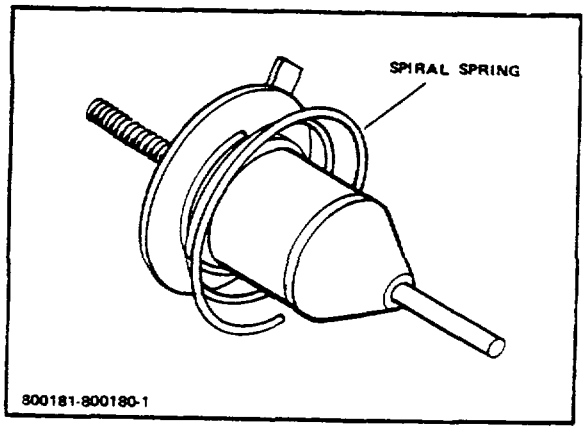


Figure 5-6. Spiral Spring Installation

2. FUSES

   a. F1, F2, and F3

      These are located on the top right-hand corner of the contactor panel. When a fuse is open, remove it from its snap mountings and replace with a fuse of the same type and ampere rating.

   b. F11-1 through F11-6 To remove these fuses from the contactor panel, loosen-the mounting capscrews at each end of the fuse, swing one notched end of the fuse out from beneath the capscrew, and slide the other end of the fuse straight out. Always make sure that replacement fuses are of the proper type and ampereage rating. Slide the replacement fuse beneath the capscrews, and tighten securely.

3. DIODE FILTER BLOCKS (HY6, HY7, and HY8)

   These diode blocks (marked G 38) are located on the top right-hand corner of the contactor panel. Replace diode blocks as follows:

   a. Tag and disconnect all wires from the diode block.
   b. Remove the diode block mounting hardware.
   c. Remove the diode block, and install a new block to the contactor panel.
   d. Connect all wires to the diode block terminals as tagged during removal.

4. CONTACTOR DRIVERS AND TIMER MODULE (HY1,2,3,4, and 5,where used)

   These modules are located under the mounting plate for F1,F2, and F3; and under the power fuses on the right-hand side of the contactor panel. To gain access to the Drivers located beneath the fuse plate, tag and disconnect all wires from the fuse terminals, and remove the fuse block and its mounting hardware. Each stack of Driver modules is mounted to the contactor panel with two long capscrews. Remove these screws, and separate the modules. Tag and disconnect all wires from the faulty module, and connect the wires to the new module as tagged during removal. Stack the modules in the proper order, and secure with the long screws. Replace the fuse mounting block and connect all wires to the fuse terminals if previously removed.

TOPIC 6 SPEED BOX

A. REMOVAL

⚠ WARNING

Before performing the following repair procedures on the speed control box, disconnect the battery and discharge the capacitor(s) by momentarily touching a suitable jumper wire across all capacitor terminals.

The speed control box assembly is located on the truck frame beneath the instrument panel. It can be removed from the frame as a complete unit (Fig 6-1).

1. Remove the speed control box assembly cover. Disconnect the speed control box wiring harness from the main wiring harness and disconnect the harness (Fig 6-2).

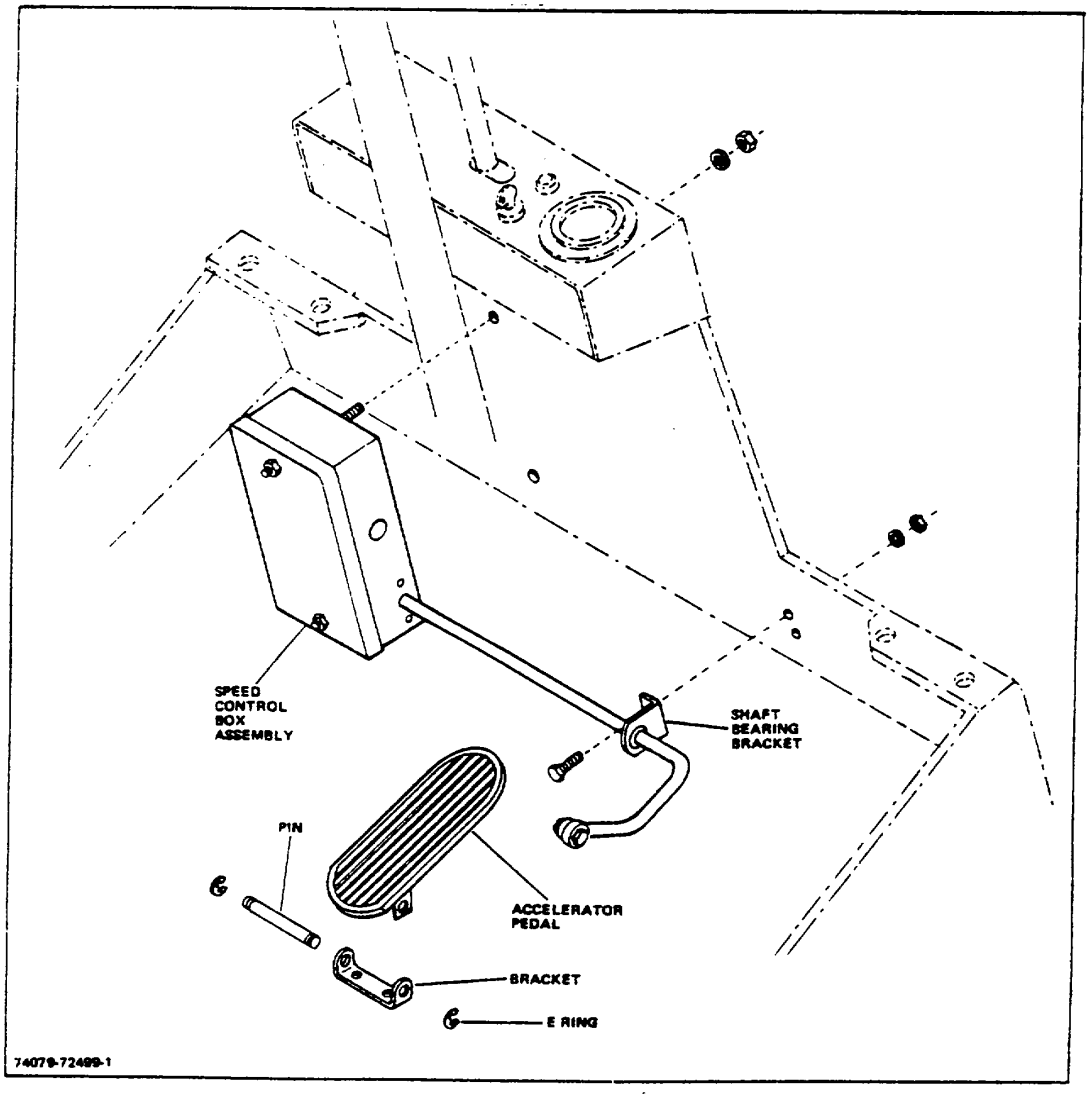


Figure 6-1. Speed Control Box and Accelerator Pedal

EM-19-1

2. Remove the mounting hardware that secures the shaft bearing bracket to the frame.

3. Remove the mounting hardware that secures the speed control box to the frame.

4. Remove the speed control box from the lift truck.

B. DISASSEMBLY

1. Remove the lower stop capscrew, lockwasher, and nut to release the end of the spring (item 10).

2. Drive the roll pin out of the arm and loosen the setscrew in the collar.

3. Remove the shaft from the box assembly through the bearing flange.

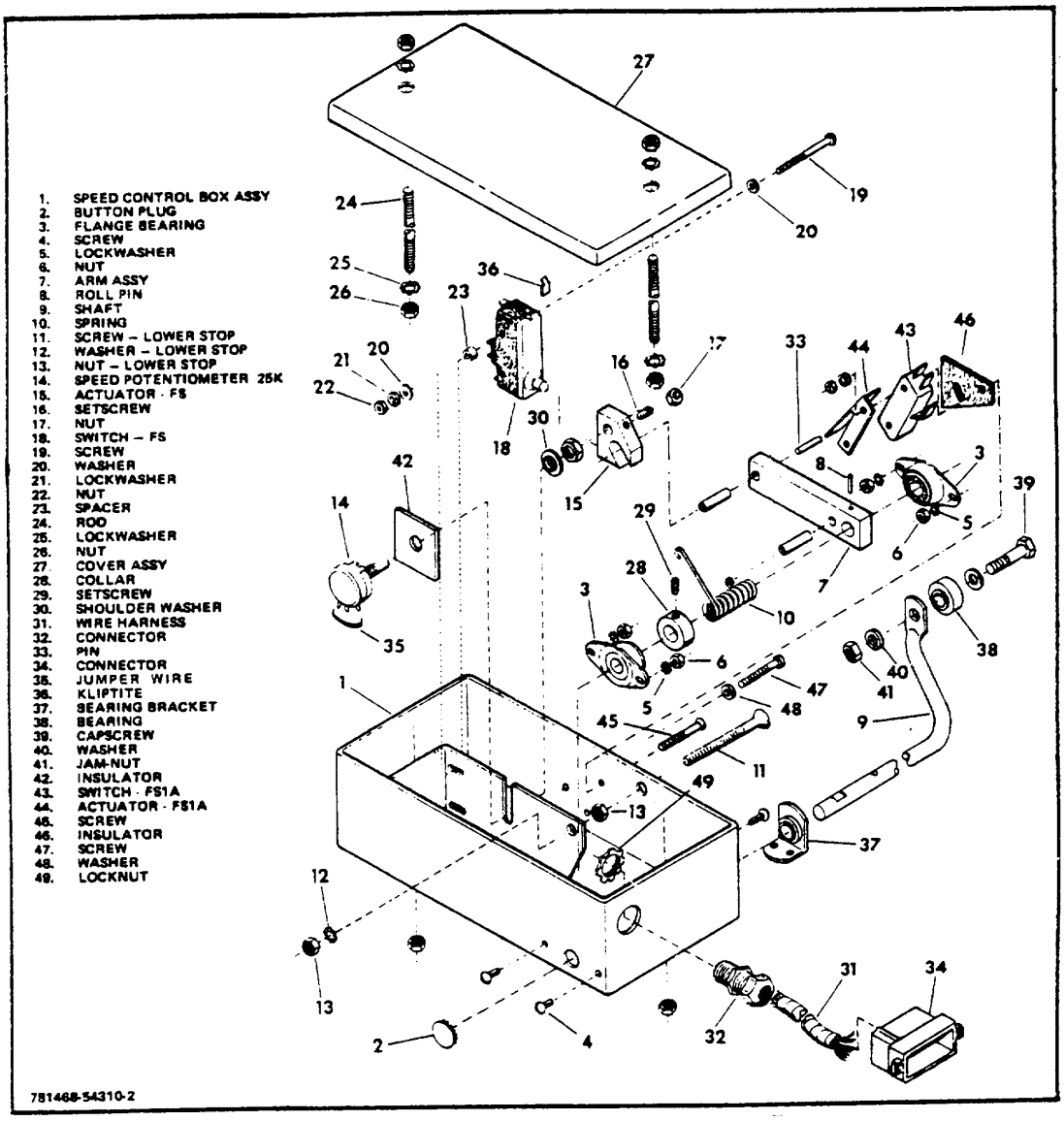


Figure 6-2. Speed Control Box (Exploded View)

EM-19-1

4. Remove the collar spring and arm from the speed control box assembly.

5. Remove the bearing flange from the box.

6. Tag the electrical leads on the speed potentiometer terminals for identification and cut them off the soldered potentiometer terminals.

7. Loosen the setscrew and remove the FS actuator from the speed potentiometer shaft.

8. Remove the speed potentiometer and insulator from the box.

9. Tag the electrical leads for identification and remove them from the accelerator start (FS) microswitch and FS 1A microswitch terminals.

10. Remove the FS and FS 1A microswitches and insulators.

11. Remove the FS 1A actuator.

12. Inspect all components for wear or damage and replace as required.

C. ASSEMBLY

1. Install the FS 1A actuator to the box.

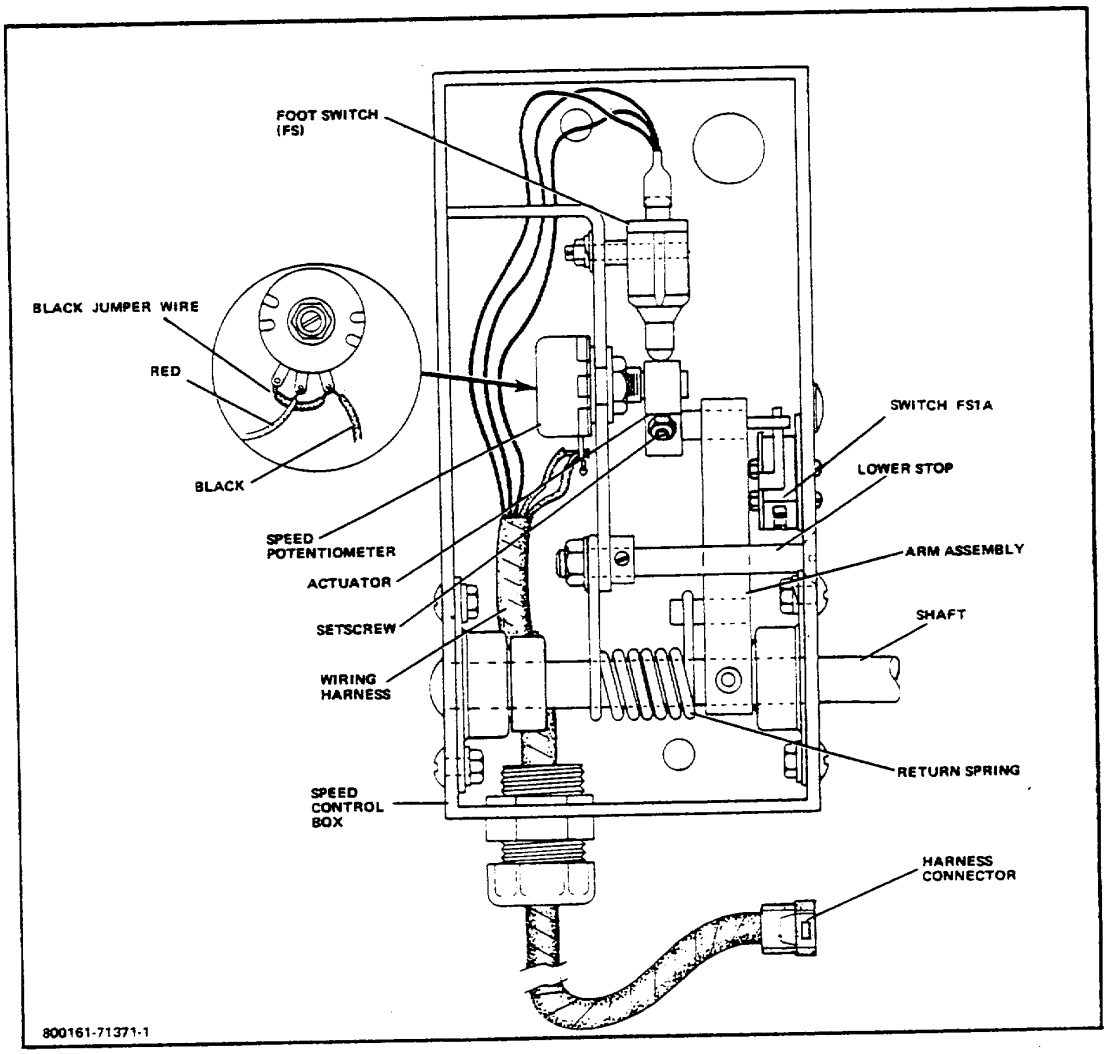


Figure 6-3. Speed Pot Wiring

EM-19-1

2. install the FS 1A microswitch, insulator, and FS microswitch to the box. Connect the electrical leads to the proper terminals.

3. Install the speed potentiometer and insulator to the box.

4. Install the FS actuator in the end of the speed potentiometer shaft. Secure the actuator with the setscrew.

5. Solder the electrical leads to the proper terminals (Fig 6-3).

6. Install the bearing flanges to the sides of the box.

7. Install the shaft bearing bracket to the shaft.

8. Start the end of the shaft into the box. As the shaft is being installed, slide the arm, spring, and collar on the shaft.

9. Drive the roll pin through the arm and into the shaft.

10. Install the lower stop capscrew, lockwasher and nut.

11. Attach the spring to the arm pin. Secure the other end of the spring to the lower stop.

12. Make sure that the shaft operates freely in the box and the switches operate properly.

D. INSTALLATION

1. Install the speed control box to the lift truck. Tighten the mounting hardware securely.

2. Align the holes in the shaft bearing bracket with the holes in the frame. Install the mounting hardware and tighten securely.

3. Perform the speed potentiometer resistance test (Refer to Topic 3).

4. Connect the wiring harness.

5. Install the speed control box assembly cover.

TOPIC 7 INSTRUMENT PANEL AND DIRECTIONAL SWITCH

A. INSTRUMENT PANEL

The instrument panel contains the hourmeter, battery discharge indicator, and keyswitch (Fig 7-1). Optional components may also be mounted on the instrument panel.

⚠ WARNING

Before performing the following repair procedures on the directional switch, disconnect the battery and discharge the capacitor(s) by momentarily touching a suitable jumper wire across all capacitor terminals.

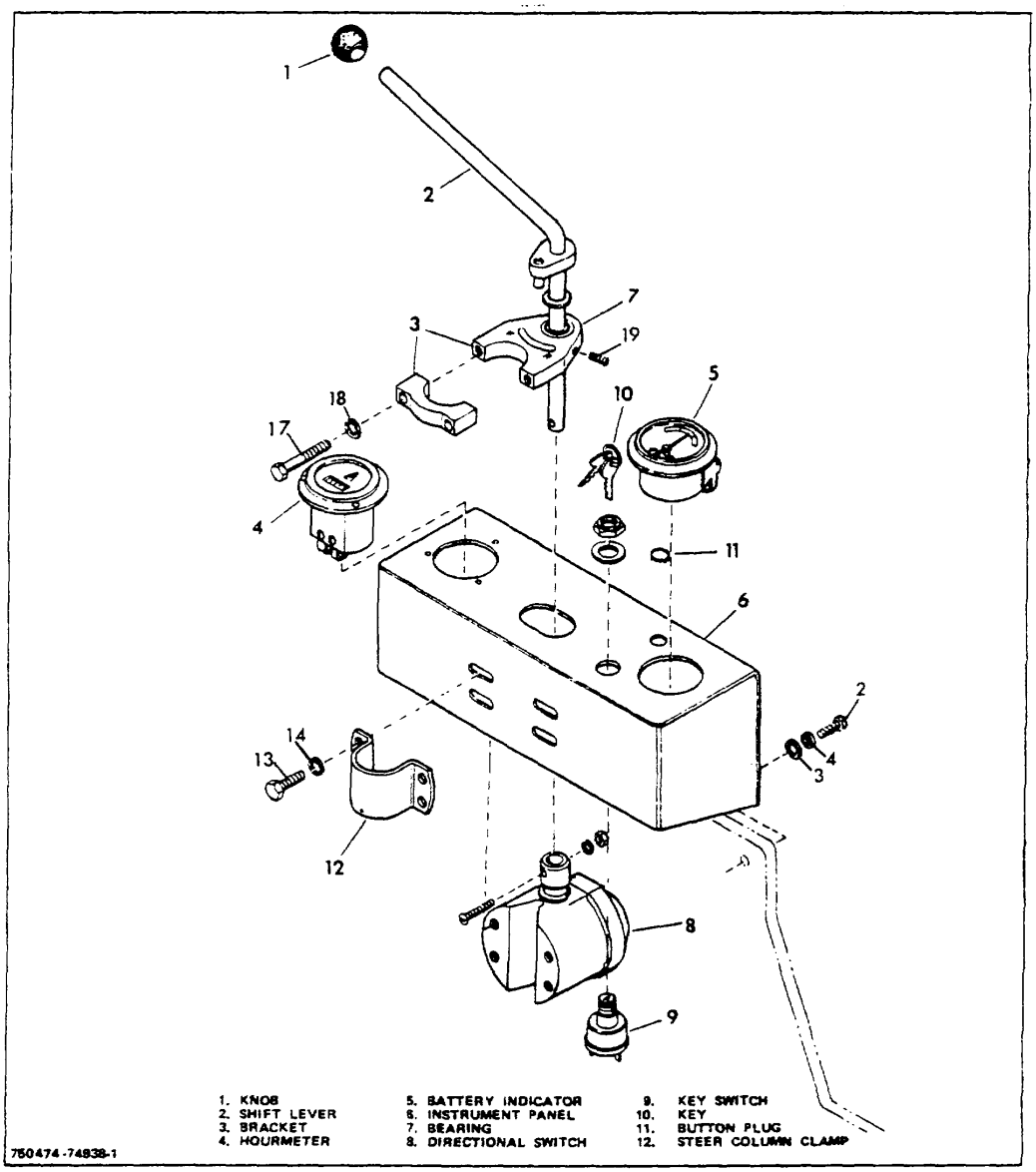


Figure 7-1. Instrument Panel Components

EM-19-1

B. DIRECTIONAL SWITCH

1. Removal

   a. Remove the mounting hardware securing the directional lever to the switch shaft.
   b. Remove the mounting hardware that secures the directional switch to the instrument panel.
   c. Remove the hardware securing the directional switch cover. Remove the cover (Fig. 7-2). Tag for identification and disconnect the electrical leads from the directional switch terminal connection. Remove the directional switch from the instrument panel.

2. Disassembly

   a. Remove the switches from the bracket.
   b. Remove the lever, roller arm assembly, springs, clips, and hinge pins from the housing.
   c. Remove the housing bracket.
   d. Remove the operating shaft, spacer, cam, and associated hardware from the housing.

3. Inspection

   a. Clean all metal parts in a suitable cleaning solvent. Allow to dry thoroughly.
   b. Check the springs for wear or lack of tension.
   c. Replace all worn, damaged, or defective parts.

4. Assembly

   a. Install the cam, spacer, operating shaft, and associated mounting hardware to the housing.
   b. Install the housing bracket.
   c. Install the hinge pins, clips, springs, roller arm assembly, and lever to the housing bearing.

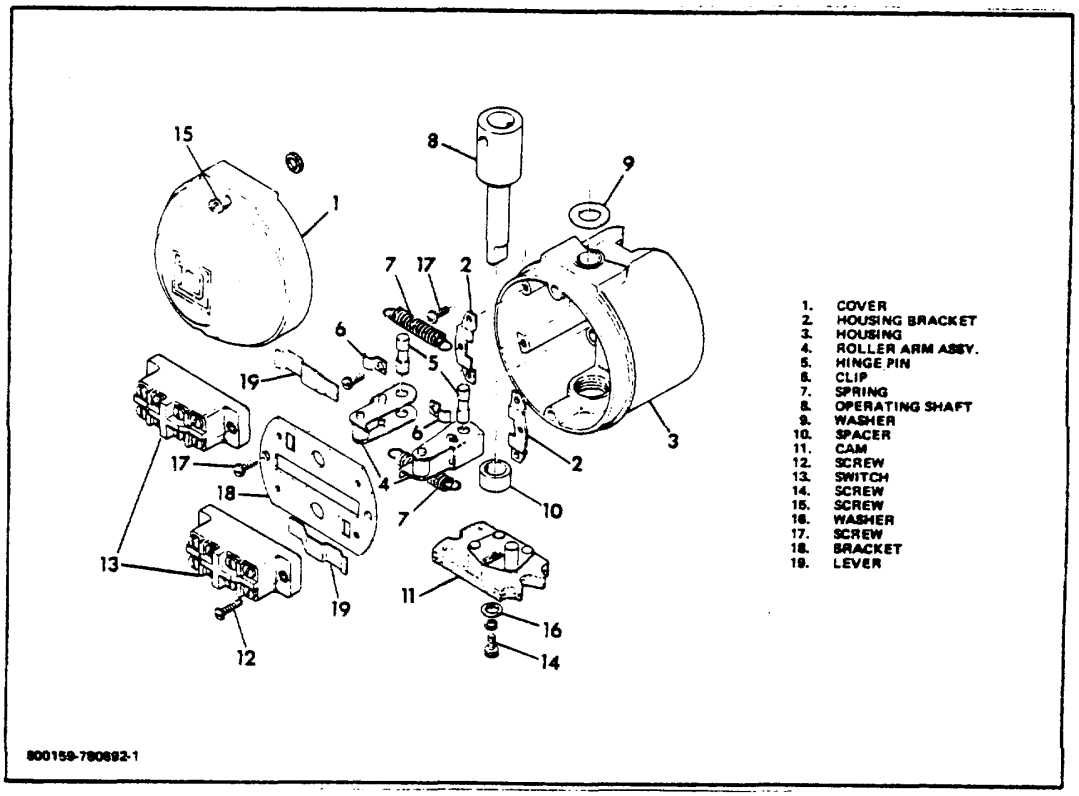


Figure 7-2. Directional Switch

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d. Install the bracket and switches.

5. Installation

a. Install the directional switch to the instrument panel. Install the electrical leads to their proper switch terminals. Install the switch cover and secure with mounting hardware.

b. Install the directional switch mounting hardware and tighten securely.

c. Install the pin which secures the directional lever to the switch shaft.

TOPIC 8 DIAGNOSTIC TROUBLESHOOTING PROCEDURES

A. GENERAL

The pulsing of the main SCR is too fast for conventional instruments to measure. When the control is functioning properly, a low hum can he heard.

Malfunctions of the SCR will generally fall into one of two categories. They are either NO power (Table 1) or FULL power (Table 2). Table 3 lists troubleshooting for malfunctions of special control features.

The trouble-shooting tables are written to check all components except the oscillator card and eliminate them as the source of malfunction. If all other wiring and components are functioning properly, the oscillator card is faulty and must be replaced.

⚠ WARNING

Before troubleshooting, block the steer wheels to prevent the truck from rolling. Place suitable jackstands under both sides of the frame behind and clear -f the drive wheels. Disconnect the battery and discharge the capacitor(s) by momentarily touching a suitable jumper wire across all capacitor terminals. Reconnect the battery as required for specific checks; then disconnect the battery and discharge the capacitor when the check is completed.

Before proceeding, visually inspect the lift truck for loose wiring and misadjusted control trimpots, seat brake linkage, and speed potentiometer (Refer to Topic 3). Check all components for signs of overheating.

The following troubleshooting chart is based on using the voltmeter to determine if the proper voltages are available at the oscillator card to permit the control to operate properly. Refer to the following chart for specified voltages.

B. DIAGNOSTIC PROCEDURES USING TROUBLESHOOTING TABLES

1. Preparation of truck for testing

   a. Disconnect the battery.
   b. Block the steer wheels to prevent the truck from rolling. Raise the front end of the truck until the drive wheels clear the floor and place jackstands under both sides of the frame, behind and clear of the drive wheels.

⚠ CAUTION

Do not plug the drive motor with the drive wheels off the floor.

FUNCTION OF THE EV-1 CARD TERMINALS

TERMINAL (Voltage measurements are taken with the positive meter lead at the terminal listed in the first column, and the negative meter lead at the Battery Negative Stand-OFF.	DESCRIPTION	CONDITION	VOLTS
L3	Card power supply input must be low to satisfy PMT test	Key open Key closed	0 Battery Volts
L4	SRO input. When used ignores open switch between L4 and L5.	Key or seat open Key and seat closed	0 Battery Volts
L5	Accelerator Start and Brake switch input Must be high after	Key, seat, brake or start open	0
	L3 and L7 are at battery volts for over 0.5 seconds	Key, seat, brake, and start closed	Battery Volts
	and while L9 and L10 are low to complete SRO logic.	Key, seat, and direction closed.	2.5 (36V) 3.3 (48V)
		Key and seat closed, start and direction open.	32-34 (36V) 43-45 (48V)

FUNCTION OF THE EV-1 CARD TERMINALS
(CONTINUED)

TERMINAL	DESCRIPTION	CONDITION	VOLTS
L6	Sensor	No current	1.8
		500 Amps average motor current model "B"	3.3
L7	Seat switch input	Key open	0
		Key and seat closed	Battery Volts
L8	Not presently used		
L9	Direction switch input from positive side of "F" coil.	Key open	0
		Key, seat, start, brake and direction "F" dosed	Battery Volts
L10	Direction switch input from positive side of "R" coil.	Key open	0
		Key, seat, start, brake and direction "R" closed.	Battery Volts
R1	Card power supply	Key OFF	0
		Key ON	8.2
R3	Output to PMT Driver	Key OFF	1 Volt
		Key, seat, start, brake, and direction selected. See Note 1.	5.10 milliamps
R4	Common return to card for accelerator pot and 1A	Key OFF, use VOM and read from TBR4 to "Neg"	Let then 1 ohm
R5	Accelerator pot input	Key on and accelerator at "creep".	3-4
		Key on and accelerator at top speed.	0-2
R6	1A switch input	Key ON, 1A switch open	8
		Key ON, 1A switch closed	0
R7	% On time output See Note 2	Creep speed	2.2
		Top speed	6.2
R8	1A driver output	1A contactor open	0 Volts
		Top SCR Speed. See Note 1.	5-10 milliamps
R9	FW driver output	FW contactor open*	0 Volts
		1A closed high speed. See Note 1.	5-10 milliamps
R10	Plugging	Not Plug	0 Volt"
		Plugging	8 Volts

*Option

NOTE 1: Connect milliammeter from terminal to R4. If contactor picks up during this test replace driver. If zero milliamps, open lead and recheck to eliminate possible driver short from terminal 1 to 2.

NOTE 2: If B card is used, remove wire to R7 when checking voltage.

c. Check the specific gravity of the battery. If the reading is 1.265 or below at 80°F (27°C), recharge the battery.

d. Open the static panel compartment door.

e. Discharge the capacitor(s) by momentarily touching a suitable jumper wire across all capacitor terminals.

f. Remove fuses 6FU and F3 (if so equipped)

NOTE

If required for a specific check, reconnect the battery and perform the check. Then discharge the capacitors before proceeding to the next check.

g. Refer to Topics 2 and 3, and perform all maintenance, inspections, ground tests, speed potentiometer resistance tests, mechanical switching, and component checking procedures. Correct, repair, or replace any problems or defective components as they are located .

h. Refer to the Troubleshooting Guide, Tables 1, 2, and 3, and perform each check. Correct, repair, or replace any defective components as they are found.

i. Refer to Topic 2 and perform the drive system and protective circuitry check out procedures. If the trimpots on the oscillator card must be reset (always reset trimpots when a new card is Installed), turn all settings to 1 and turn each trimpot clockwise to its proper setting.

j. Perform the close-up and final checks (Refer to Topic 2).

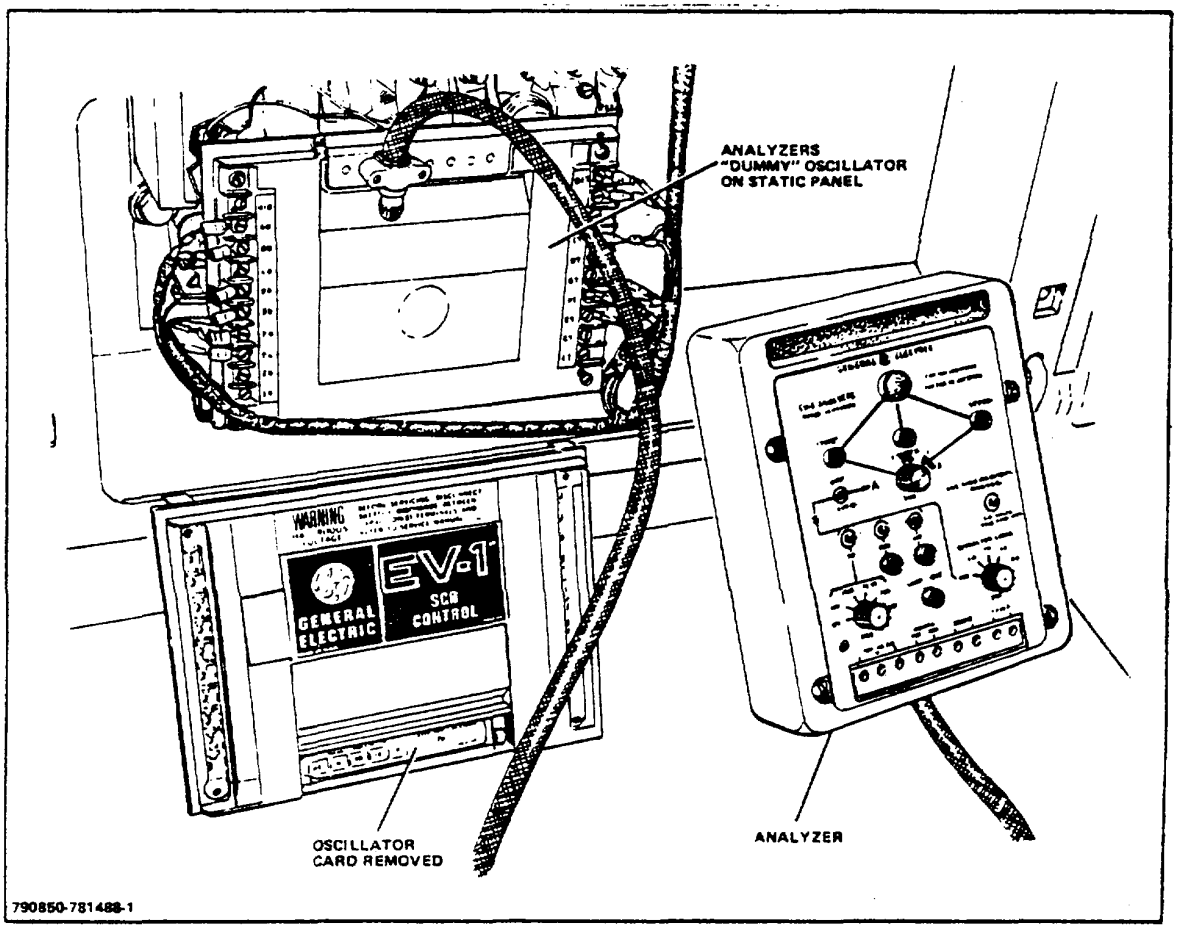

Figure 8-1. EV-1 Analyzer

C. DIAGNOSTIC TROUBLESHOOTING PROCEDURES USING THE EV-1 SYSTEM ANALYZER

1. Description

The EV-1 Analyzer (Fig 8-I) is a testing device which is interfaced with the static panel via a "dummy" oscillator card. When the analyzer is installed, performing the following procedures sequentially duplicates system functions and indicates which components are faulty. If all components check out as operating correctly, then the oscillator card is defective and must be replaced. The bottom terminal board of the analyzer permits external meter connections to check static panel components.

NOTE

The analyzer is shipped less batteries (quantity 5, rechargeable Ni-cad or AA alkaline type recommended). Observe the manufacturer's recharging ratings. After use, return all switches to OFF to prevent battery discharge.

⚠ CAUTION

Do not store the analyzer for long periods of time with the batteries installed.

2. Preparation of the Truck for Testing

a. Disconnect the battery.
b. Block the steer wheels to prevent the truck from rolling. Place jackstands under both sides of the frame, behind and clear of the drive wheels.

⚠ CAUTION

Do not plug the drive motor with the drive wheels off the floor.

c. Check the specific gravity of the battery. If the reading is 1.265 or below at 80°F (27°C), recharge the battery.
d. Open the static panel compartment door.
e. Discharge the capacitor by momentarily touching a suitable jumper wire across the capacitor terminals.

NOTE

If required for a specific check, reconnect the battery and perform the check. Then disconnect the battery and discharge the capacitors before proceeding.

f. Remove the oscillator card as follows:

(1) Loosen the four captive terminal board screws.
(2) Insert a screwdriver into the slot at the sides of the terminal board and twist the screwdriver to pry out the terminal board. Leave the wires intact. Remove both terminal boards (Fig 8-2).

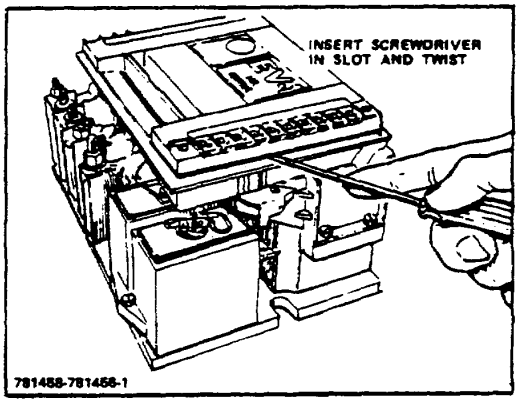

Figure 8-2. Terminal Board Removal

(3) Pry open the latches on both sides of the card carefully with the screwdriver (Fig 8-3)

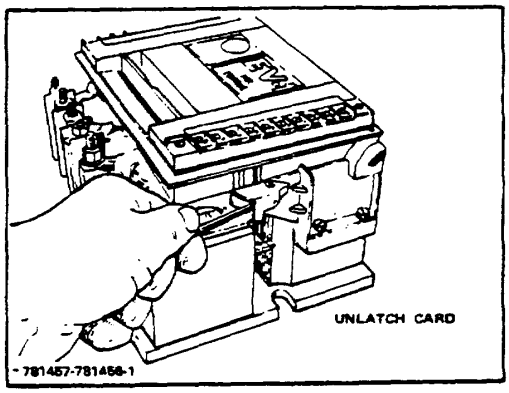

Figure 8-3. Control Card Latches

(4) Swing up the oscillator card, and pry out the wiring harness plug (TB-2) with a screwdriver (Fig 8-4).

g. Connect the analyzer to the static panel as follows:

(1) Insert the "dummy" oscillator card into the hinge slots on the static panel.

TABLE 1
FAILURES WHICH CAUSE REDUCED OR NO MOTOR TORQUE
WITH SCR CONTROL

SYMPTOM	PROBABLE CAUSE
1A. Contactors do not pick up. No control voltage from positive to negative.	Check power and control fuses. Check battery for low specific gravity and connections for looseness or broken fitting.
18. Contactors do not pick up. Control volts present from positive to negative with proper polarity.	Plug in battery with Key switch OFF. Volts on L3 should be 0 volts. Close key with. Check volts at T2. Should be about 50% of battery volts. Above 70% locks out 1 REC. (Control card contains 10 K bridge from pin 5 to L3 and pin 6). If near battery volts, check for shorted 1A tips or a shorted 1REC. If near zero volts, check for shorted 3REC. Close Key, Brake, Start switches (all switches needed to close F or R contactor except the Direction switch). Volts on L3, L5, L7 should be battery volts. Volts on L9 and L10 should be near zero. Wait for one second, then close FORWARD Direction switch. Volts at L10 should remain near zero. Volts at L9 and L9 side of F coil (K11) should be battery volts. If not check wiring and switches. Connect milliammeter (10rna scale) from R3 to R4. Should read 5-10 milliamps. If not, open Key switch, open lead from R3 to PMT driver, reclose all switches except Direction switch, wait over one second and close FORWARD Direction switch. If reading is not 5-10 milliamps, replace control card. If reading is good, the coil or wiring to the PMT driver is open or the PMT driver is defective. Check driver.
1C. Contactors close. NO power and NO SCR hum with accelerator in SCR range.	Check volts at SCR positive stud on the contactor panel. Should be battery volts If not, check power fuse. Perform the following checks with the contactor picked up: Check volts at T2 Should be zero. If not, check volts at S1, S2, A1, and A2 to locate open circuit. Check volts at RS. Should be 3.4 at creep reducing to 0.2 or less at top speed. If R5 remains about 4 volts, check accelerator. If R5 is zero, check volts at R1. Should be 8 - 8.5 volts. If R1 is above 10 or near zero and L3 is battery volts, replace control card and check PMT driver for short. Check volts at R7. Should be 2 - 2.5 when Key switch closed. When F or R contactor is closed and accelerator depressed, should increase to about 6.2 volts. If remains new 2 volts, check volts at 1C (grey wire or 2REC anode). If more than 4.5 (36V) or 6(48V), check If 2REC will gate on. If less than 4.5 (36V) or 6(48V), check if 1REC will gate on. Check current sensor green lead to card input pin 13 on TB-2. Check 23 FIL for shorted resistor. Check if 1 REC will gate ON. If all other components check out O.K. but the fault still exists, replace the control card.
1D. Contactors close. Little or no power. Normal SCR hum.	Check 3REC for open circuit. Check 4 REC for short. Check for open thermal protector.

SYMPTOM	PROBABLE CAUSE
1E. Contactors close. Little or no power. Abnormal SCR hum.	Check 2REC for short.
	Check 5REC for short
	Check 22REC and 2SREC.
	NOTE: A 25REC which checks good with an ohmeter can cause a misoperation of 5REC under load, and can cause 1A to close on demand at lower than normal motor volts.
1F. Contactors dose. Little power. No SCR hum.	Check 1C for low resistance.
1G. One contactor closes with normal operation but opposite contactor will not close.	Close Key, Brake, Start switches (all switches needed to close F or R contactor except the direction switch.) Volts on L9 and L10 should be near zero. Wait for one second, then close Direction switch in the direction that contactor will not close. Volts at other direction input (L9 or L10) should remain near zero. Volts at non-closing direction (L9 or L10) and positive terminal on the coil should be battery volts. If not, check wiring and switches.
	Close switches as above. Check volts at negative side of coil or corresponding terminal of PMT driver. Zero volts indicates open coil, battery volts indicates open driver.
	If all other components test out properly, replace control card.
1H. PMT trips after operating in 1A and acceleration is returned to SCR range.	Check for cause of long 1A dropout time, i.e, defective 1A driver, low resistance in 1A filter, shorted turns in 1A coil, or low voltage coil.

TABLE 2
FAILURES WHICH CAUSE FULL MOTOR TORQUE WITH SCR CONTROL

SYMPTOM	PROBABLE CAUSE
2A. Contactors close. Full SCR speed immediately with audible hum. NO PMT trip.	Key switch ON. Check volts at R5. Should be 34 volts at creep position. If near zero. check Accelerator potentiometer.
	If all other components test out properly, replace control card.
2B. Contactors close once or twice and then remain open. PMT trips.	Check SREC for open circuit or open gate.
	Check 1C for open and connections.
	Check 1C for dead short.
	Check 5REC for short.
	Check 2REC for short.
	Check 1X choke and transformer T3-T4.
	If all other components test out properly, replace control card.
2C. Contactors close. Stall currents, under SCR operation, higher than normal end uncontrollable with C/L trimpot Contactors may open once or twice and then remain open.	Check current sensor yellow lead from negative end of sensor to card input pin 14.
	If all other components test out properly, replace control card.

TABLE 3
MISOPERATION OF OTHER FEATURES

SYMPTOM	PROBABLE CAUSE
3. 1A or FW contactors close with Key switch.	Check driven for short from terminals 2 to 3 by disconnecting wires to terminal 1 (signal) on the driver, and placing the positive meter lead on terminal 3, and the negative lead on terminal 2.
	Check resistance from R4 to SCR negative. If not zero, the control card has been damaged, probably by a high-current input to R4 burning open a run on the card. Check for possible shorts and improper leads being connected to this terminal. Normally only the accelerator pot, 1A switch from RG, and B ad use R4 as a negative.
	If all other components test out properly, replace control card.
3B. F or R will close without returning Direction switch to OFF.	Check location of L5. Any open switch between L5 and Direction switch will satisfy SRO.
	Open lead from R3 to driver. Close switches normally used to close F or R. If F or R close, replace driver.
	Reconnect lead from R3. Close Key switch only. Volts at L3 should be BV, volts at L5, L7, L9, L10 should be near zero. Close Seat, Brake and Direction switches. Volts at L7 should be BV. Volts at L5 should be about 0.07 BV. If near 4.1 volts, check Start switch leakage. Close Start switch. If contactor picks up, replace control card.
3C. PMT does not open F or R contactor.	Operate traction drive. Jumper R3 to R4. If contactor does not drop out, replace PMTD driver.
	Operate traction motor in low speed SCR range. Be sure wheels are turning freely. Push 1A tips closed manually. F or R should open. If not, replace control card.
3D. 1A will not doe at run (demand pick-up at 85-95% of battery volts.	Connect a milliammeter from R8 to R4. Should read 5-10 milliamps when 1A should be closed. If near zero, see later steps for improper inputs or control card. Check volts at terminal 3 of 1A driver. Should be battery volts decreasing to about 2 volts when 1A should be closed. If near zero, check coil and wiring to terminal 3. It remains battery volts, check wiring from R8 to terminal 1 and terminal 2 to negative, then replace 1AD driver.
	If milliamps from R8 to R4 are near zero when 1A should be closed, open lead from R8 to 1A driver and recheck. If now good, there is a wiring short to negative in the lead from R8 or defective driver.
	Check volts at R7. Should be greater than 6 at top speed. If less than 5.7 volts, 1A will not close on demand. Check volts at R5, should reduce to less than 0.2 volts at top speed. If over 0.2 volts, check accelerator. If less than 0.2 volts, check that creep trimpot is not turned too far CCW.
	Check continuity of violet wire from T2 to pin 10.
	If all other components test out properly, replace control card.

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SYMPTOM	PROBABLE CAUSE
3E. 1A will not close at SCR stall (time pickup). (Check truck diagram to see if 1A switch closes card circuit R4 to R6.)	Check 1A switch circuit Key switch on. Volts at R6 should drop to less than 2 volts when 1A switch is closed. Check volts at orange lead to TP. If volts are above 1.6 (0.06 on OSC1A and OSC1B cards), control is in thermal cutback. Allow to cool, and recheck 1A function. Turn 1A trimpot fully CCW and recheck. Check continuity of violet wire from T2 to pin 10. If all other components test out properly, replace control card.
3F. 1A will not open until start switch is opened.	Check volts at R6. Should be near 8 volts when 1A switch is open. If not, check wiring and 1A switch.
3G. FW contactor will not close after 1A pickup.	Check volts at R6. After 1A contactor closes, this point must be less then 2 volts. If not, check 1A switch and wiring. Open lead to R9 and connect milliammeter from R9 to R4. When control signals FW to pick up, should read 5-10 milliamps. If remains at zero, turn FW PU trimpot fully CW and recheck, If remains zero, replace control card. If reads 5-10 ma, reset FW PU trimpot. Reconnect lead to R9 and check volts at R9 when FW should pick up. If near 8 volts, check lead from R9 to terminal 1 of FW driver and R2 to negative for open, then replace driver. If about 2 volts, check volts at terminal 3 of FW driver. Should be battery volts dropping to 2 volts or less when FW should pick up. If volts are near zero, check wiring from positive to FW coil, FW coil, and wiring to terminal 3 of FW driver. If volts remain greater then four volts, replace driver.
3H. FW contactor will not drop out with increasing load.	Check dropout setting on card. If all other component test out property, replace control card.
3J. Stiff plug. Severe reversal.	Check plug adjustment setting on card. Check 4REC for open circuit. If all other components test out properly, replace control card.
3K. Very soft reversal.	Check plug adjustment setting on card. If all other components test out properly, replace control card.
3L. Blown power fuse. Very hot power cables.	Check 3REC for short. (Possible damage also to 1 REC and transformer module.)
3M. Hourmeter feeder faults:	
(1) Pump contactor closes when either F or R direction is selected.	Diode shorted 3 to 4. Replace hourmeter block.
(2) One direction okay: opposite direction picks up both F and R.	Diode shorted 1 to 4 or 2 to 4. Replace hourmeter block.
(3) Either direction selected picks up both F and RA.	Diode shorted 1 to 4 and 2 to 4. Replace hourmeter block.

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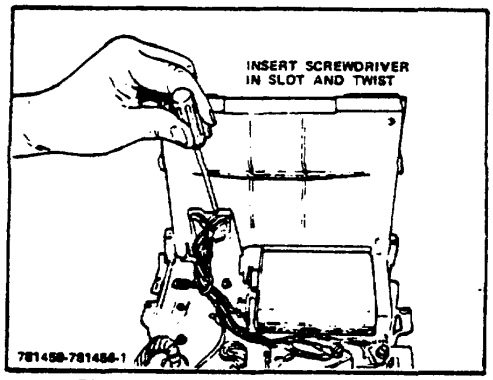

Figure 8-4. Wiring Plug Removal

(2) Install the wiring harness plug (TB-2) into the dummy oscillator card.

(3) Lower the dummy oscillator card and close the latches on both sides of the static panel.

(4) Install the terminal boards to the dummy oscillator card.

h. Refer to Topics 2 and 3, and perform all maintenance, inspections, ground tests, speed potentiometer resistance tests, mechanical switching tests, and component checking procedures.

i. Correct, repair, or replace any problems or defective components as they are located.

j. Refer to the following troubleshooting guides and perform each inspection sequentially. Correct, repair, or replace any defective components as they are located. If necessary, refer to Table 3 in Section B to check for malfunctions in special features.

k. When all tests in the following troubleshooting guide have been completed, remove the analyzer dummy oscillator card as described in section "f"; and install the oscillator control card to the static panel as described in “g".

l. Refer to Topic 2, and perform the drive system and protective circuitry checkout procedures. If the trimpots in the oscillator card must be adjusted (always adjust the trimpots on a new card), turn all settings to 1 and turn each trimpot clockwise to its proper setting.

m. Perform the close-up and final check procedures as detailed in Topic 2.

NOTE

AFTER USE. TURN ALL SWITCHES TO OFF TO PREVENT THE BATTERIES INSIDE THE ANALYZER FROM DISCHARGING.

TEST	PROCEDURE	RESULT
ANALYZER Battery/Lamp	1. SW1-TEST, SW2-OFF, SW3-OFF Push LAMP TEST button.	1. All four lamps must light. If green lamp remains off and red lamps are on, replace green lamp. If red lamps are off, replace batteries. If all red lamps are not off or on as required, replace analyzer.
PREPARATION OF TRUCK FOR TESTING	Disconnect truck battery. Raise and block drive wheels off floor.	
TRUCK BATTERY	1. Check truck battery specific gravity.	1. Recharge battery if specific gravity is low.
PREPARATION FOR ELECTRICAL SYSTEM TESTS All tests must be done sequentially. Be sure truck battery is disconnected.	Discharge commutating capacitor. Remove control card and install analyzer. Check all fuses. Check all contactors visually for welded tips.	
In all following tests, if component shows defective, first check associated wiring continuity before replacing component. After replacing components found defective by EV-1 Analyzer, re-run all electrical system tests with the Analyzer to insure the control is operational before driving truck. If all electrical system tests are good, replace card. If control still misoperates, refer to troubleshooting tables. If a faulty component is then detected, recheck analyzer and replace analyzer if it does not detect faulty component.		
1 REC	1. SW1-1 REC, SW2-OFF, SW3-OFF. 2. Depress and release 1 REC button.	1. Green lamp should be off. 2. Green lamp should light and remain on. If either condition is not met, replace 1 REC.
2 REC	1. SW1-2 REC, SW2-OFF,SR3-OFF 2. Depress and release 2 REC button.	1. Green lamp should be off. 2. Green lamp should light and remain on. If either condition is not met, check 22 REC. If 22 REC is good, remove 2 REC power cathode wire and repeat test. If defective, replace 2 REC.

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TEST	PROCEDURE	RESULT
5 REC	1. SW1-5 REC, SW2-OFF SW3-OFF. 2. Depress and release 5 REC button.	1. Green lamp should be off. 2. Green lamp should light and remain on. If either condition is not met, check 25 REC. If 25 REC is good remove 5 REC power cathode wire and repeat test. If defective, replace 5 REC.
ELECTRICAL TESTS REQUIRING BATTERY POWER	Return all switches to OFF. Connect truck battery. Drive wheels must be off the floor.	
BATTERY POLARITY	1. SW1-TEST, SW2-OFF, SW3-OFF.	1. All four lamps should stabilize to the off condition within 5 seconds. If all red lamps are on, polarity is reversed. If capacitor lamp remains on, replace capacitor (s).
3 REC	1. SW1-TEST, SW2-OFF, SW3-OFF. Push 3 REC button and then release.	1. 3 REC lamp should light only when the button is depressed. If lamp does not light, check main power fuse and 23 FIL. If good, replace 3 REC.
CAPACITOR(S)	1. SW1-TEST, SW2-OFF, SW3.OFF. 2. Push CAP button and release.	1. If lamp lights, replace capacitor(s). 2. CAP lamp should come on and remain on approximately 1 second per capacitor. If not, replace capacitor(s).
PREPARATION FOR TESTING OF OPERATOR CONTROL SWITCHES. SYSTEM SWITCHES. AND CARD WIRING	Person performing test should be on vehicle. Any switch is considered to be shorted, If it reads 20K ohms or less on R x 10,000 scale with battery disconnected and switch mechanically open.	
KEY SWITCH AND CONTROL FUSE	1. SW1-TEST, SW2-KEY, SW3-OFF. 2. Turn on key.	1. Switch lamp should be off. If on, check for short. 2. Switch lamp should light. If not, check for open.
SEAT SWITCH	1. SW1 TEST, SW2-SEAT, SW3-OFF, key on. 2. Close seat switch.	1. Switch lamp should be off. If on, check for short. 2. Switch lamp should light. If not, check for open.
START SWITCH	1. SW1-TEST, SW2-BR/ST, SW3-OFF, key on, seat switch closed. 2. Depress accelerator.	1. Switch lamp should be off. If on, check for short. 2. Switch lamp should light. If not, check for open or open brake switch.
BRAKE SWI TCH	1. Maintain above conditions and step on brake.	1. Switch lamp should go off. If not, check for short.
DIRECTIONAL SWITCH (FORWARD)	1. SW1-TEST, SW2-FOR, SW3-OFF, key on, seat switch closed, brake switch closed depress accelerator, and move directional switch to NEUTRAL. 2. Move directional switch to FORWARD (See Note below) 3. Move directional switch to REVERSE. (See Note below)	1. Switch lamp should be off. If on check for short. 2. Switch lamp should light. If not, check for open 3. Switch lamp should not light. If it does, check PMT driver terminal 3 to 4 for short. If OK, replace hour meter diode (26 REC).
DIRECTIONAL SWITCH (REVERSE)	1. Interchange Steps 2 and 3 above and repeat.	1. Same as above.
NOTE: If selection of directional switch to either F or R activates pump contactor, replace hour meter diode (26 REC).		
CONTACTOR AND MOTOR TESTS	Truck drive wheels must be off the floor.	
FORWARD CONTACTOR, MOTOR CIRCUIT CONTINUITY, AND 3 REC OPEN	1. SW1-TEST, SW2-OFF, SW3-F/R, key on, seat switch closed, brake switch closed move directional switch to NEUTRAL Push 3 REC button. 2. SW3-OFF. Depress accelerator. Move directional switch to FORWARD. 3. SW3-F/R. 4. Push 3 REC button.	1. 3 REC lamp lights. If not, replace 3 REC. 2. If forward contactor picks up, replace PMT driver. 3. If contactor does not pick up, check coil and continuity of wiring. If good, replace PMT driver. 4. 3 REC lamp should remain off. If not check contactor for open tips. Also check motor field and armature (should read less than 5 ohms with VOM on R x 1 scale).
REVERSE CONTACTOR AND MOTOR CIRCUIT CONTINUITY	1. Same as above except directional switch in REVERSE.	1. Same as above except for reverse contactor.
FW CONTACTOR AND DRIVER	1. SW1-TEST, SW2-OFF,SW3.OFF. 2. SW3-FW.	1. If FW picks up, replace FW driver. 2. FW contactor should pick up. If not, check coil. If good, replace FW driver.

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TEST	PROCEDURE	RESULT
B CONTACTOR AND DRIVER	1. SW1-TEST, SW2-OFF, SW3-OFF. Close key and seat switch (plus other switches required to put battery positive to B card and coil). 2. SW3-D/B	1. B contactor should pick up. If not, check coil. If good replace B card. 2. B contactor should drop out when SW3 is moved to D/B. If not, replace B card.
D (DUAL MOTOR) CONTACTOR	1. SW1-TEST, SW2-OFF, SW3-OFF. (Jumper PMT driver terminals2 to 4 and 3to4) 2. SW3-D/B 3. Key on. seat switch dosed, brake switch closed, depress accelerator and move direction twitch to FORWARD. Open each turn switch. 4. Repeat Steps 2 and 3 for directional switch REVERSE.	1. If D contactor picks up, replace D card. 2. D contactor should pick up. If not, check D coil, 33 REC (if used). diodes, turn switches. If OK, replace D card. 3. D contactor and associated F contactors should deenergize. If not, check for shorted turn switch. If OK, replace D card. 4. Same results as Steps 2 and 3.
DISCONNECT THE BATTERY AND DISCHARGE THE CAPACITORS BEFORE PERFORMING THE FOLLOWING TESTS.		
ACCELERATOR POT	SW1-OFF, SW2-OFF, SW3-OFF. Connect VOM (R x 100 sale) into POT test jacks.	Resistance should be 1000 to 12000 ohms with accelerator fully depressed and 6000 to7000 ohms when released. If not, adjust accelerator or replace pot. For reading directly across pot without analyzer, range is 0-200 ohm, min and 50004000 ohms max.
ACCELERATOR 1A SWITCH	SW1-OFF, SW2-OFF, SW3-OFF. Connect VOM (R x 1 scale) into 1A SW test jacks.	Resistance should be less than 10 ohms with accelerator fully depressed. It not, check wiring and switch adjustment or replace 1A switch.
THERMAL PROTECTOR	SW1-OFF, SW2-OFF, SW3-OFF. Connect VOM (R x 1 scale) into T. PROT test jacks.	Resistance should be less than 200 ohms at room temperature. If not, check for loose connections or replace.
CURRENT SENSOR	SW1-OFF, SW2-OFF, SW3-OFF. Connect VOM (R x 1 scale into SENSOR test jacks.	Resistance should be less than 1 ohm. If not, check for loose connections or replace.
POSITIVE OR NEGATIVE GROUND	SW1-OFF, SW2-OFF, SW3-OFF. Connect VOM IR x 10,000 scale) between POS GND test jack and truck frame or NEG GND test jack and truck frame.	Resistance should be greater than 20K ohms. If not, troubleshoot for ground fault.
4 REC	Cannot check with analyzer. Disconnect 4 REC pigtail. With VOM on R x 1 scale, should read 7-12 ohms in the conducting direction (+ I -) with POS on heat sink and NEG on pigtail. Reverse meter leads. With VOM on R x 10.000 scale, should read 50.000 ohms or higher.	

EM-19-1

D. EV-1 CONTROL CARD DAMAGE

The following paragraphs list possible causes of control card damage. In all of the following cases, the control card must be replaced and the cause of the problem eliminated.

1. If battery positive is applied to the R6 terminal of the control card with the 1A switch open, internal damage to the card will result. (This may occur by incorrectly wiring the 1A switch and the start switch leads).

The symptom of this damage is failure of the 1A bypass function to operate.

2. If battery positive is applied to the R4, RS, or R6 terminals of the control card with the IA switch closed and/or the accelerator pot in the top speed position (fully depressed pedal, speedpot at minimum ohms), it will cause internal damage to the control card.

The symptom of this damage is that the 1A and FW contactors pick up when the key switch is closed.

3. If the 14 pin connector (TB-2) is not plugged in to the back of the control card and power is applied to the control, damage to the card may result.

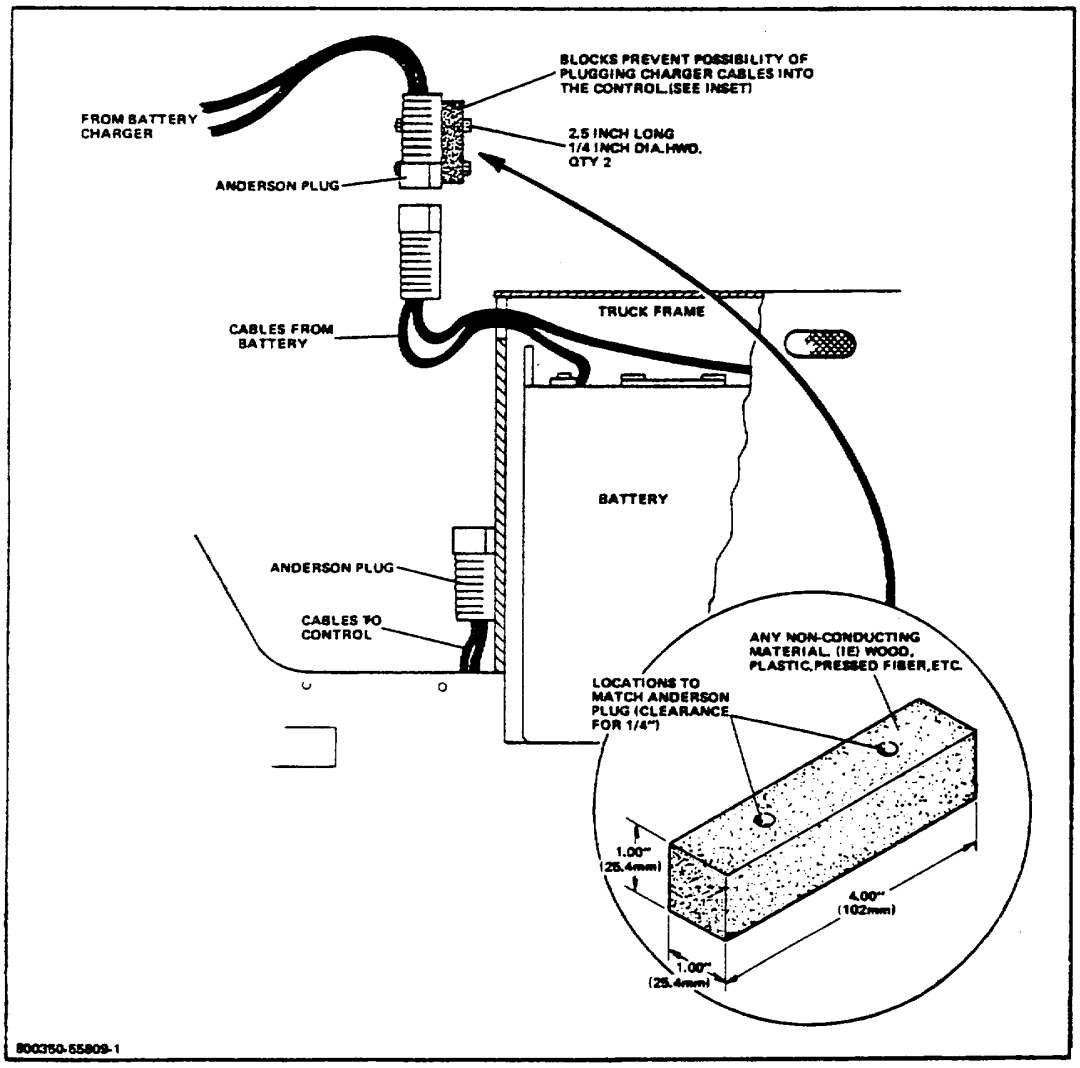


Figure 8-5. Anderson Plug Blocks

The symptom of this damage is failure of the 1A function to operate.

4. Plugging a battery charger into the cables leading to the control instead of the battery cables will damage the card. If the truck will not run and has no visual evidence of card damage, check the voltage at control card terminal R1 (with respect to battery negative) with the key switch closed. Damage caused by a battery charger will cause a reading of zero volts at this terminal.

Figure 8-5 shows a suggested modification to battery charger cables to prevent accidental connection of the charger cables to the control cables.

TOPIC 9 ELECTRICAL DIAGRAMS

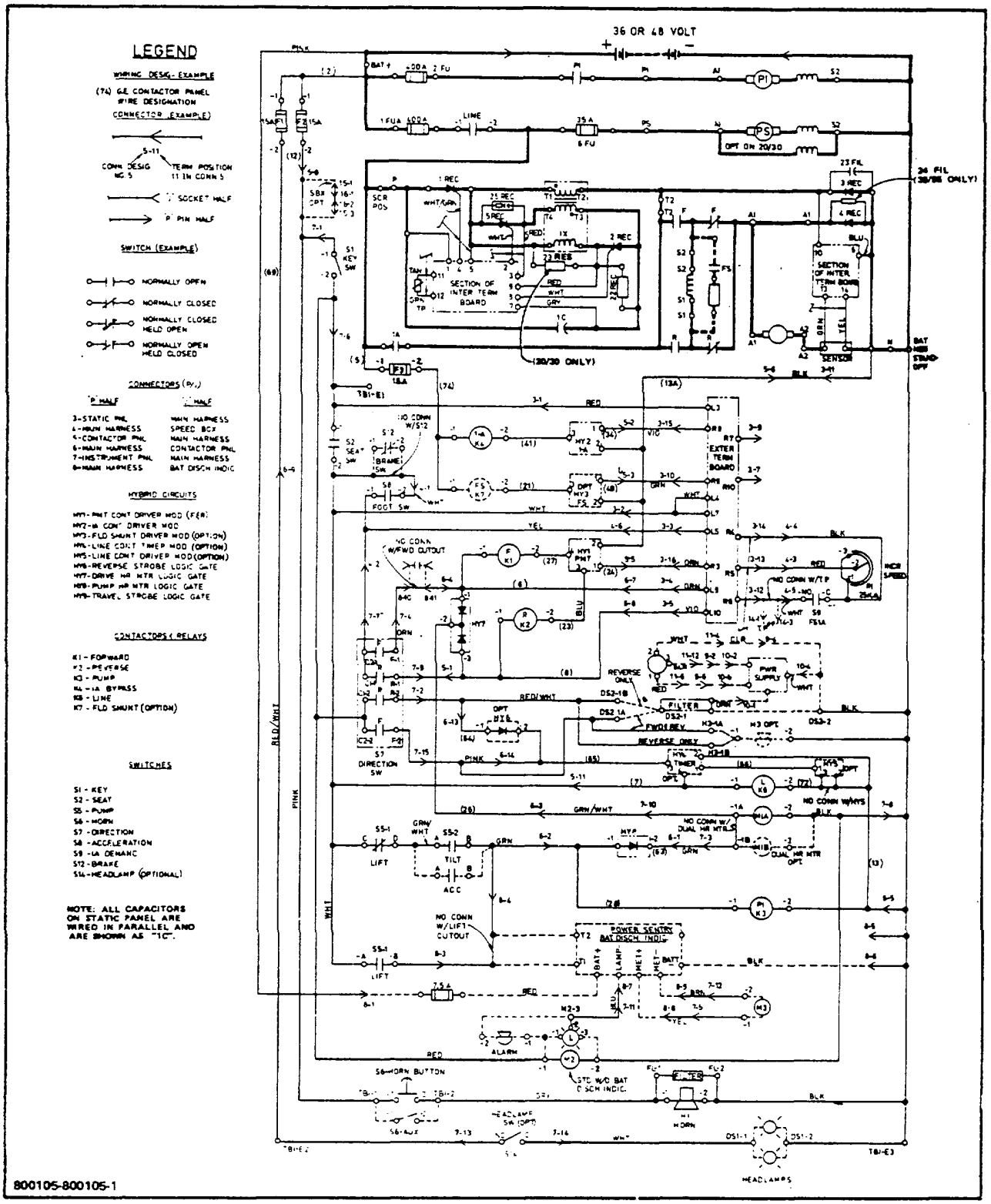


Figure 9-1. Schematic Diagram

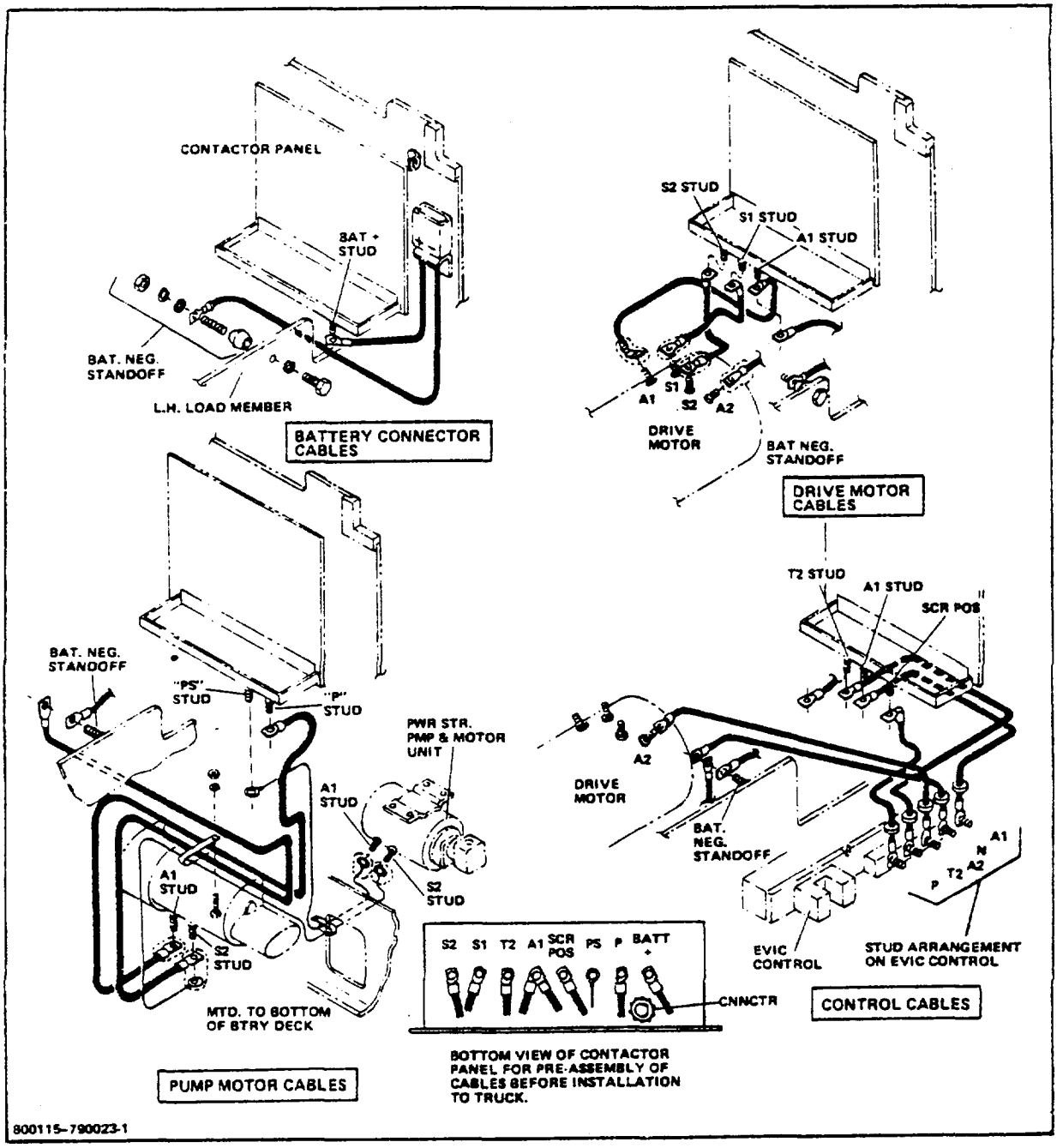
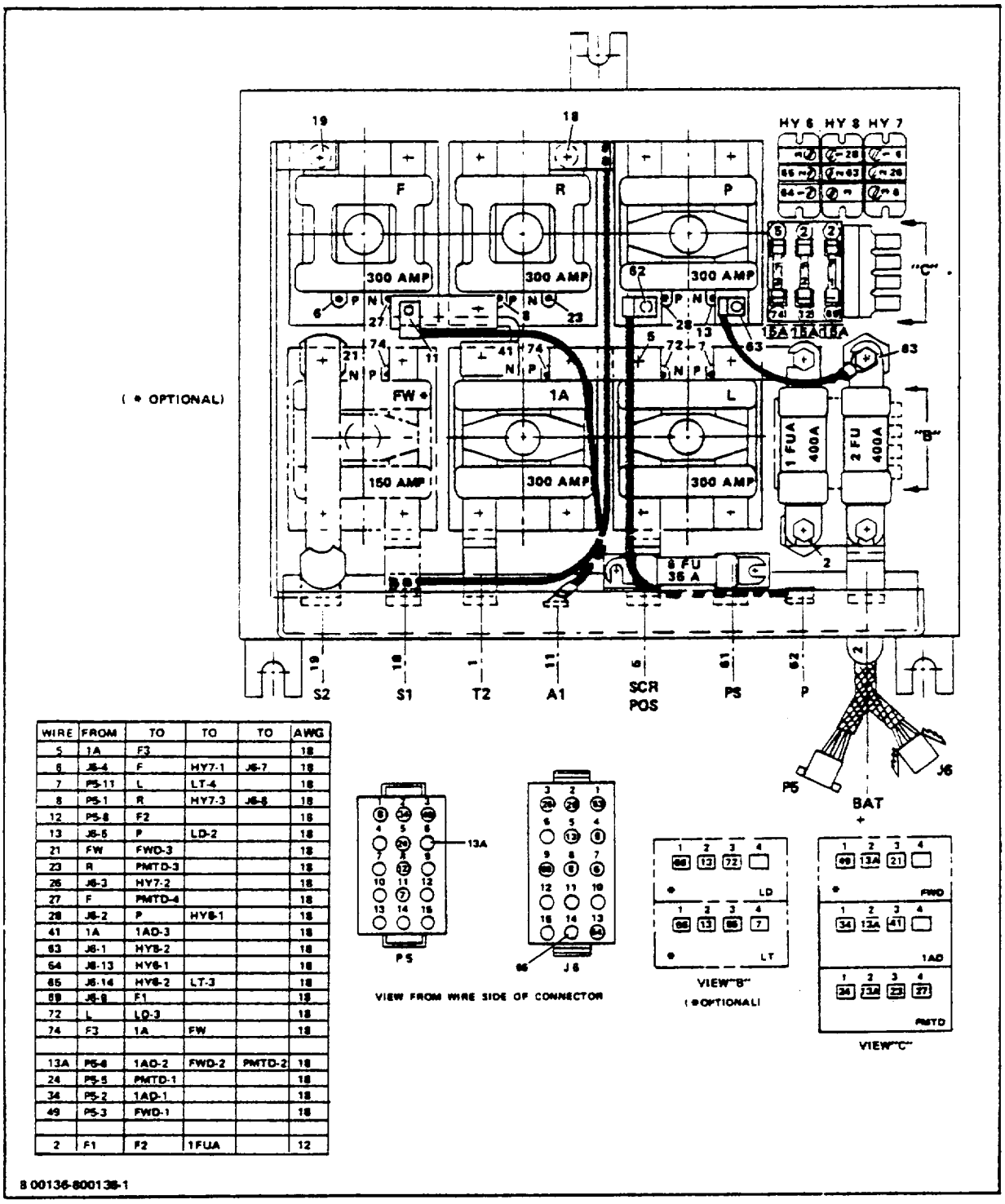


Figure 9-2. Cabling Diagram



WIRE	FROM	TO	TO	TO	AWG
5	1A	F3			18
6	J6-4	F	HY7-1	J6-7	18
7	P5-11	L	LT-4		18
8	P5-1	R	HY7-3	J6-8	18
12	P5-8	F2			18
13	J6-5	P	LD-2		18
21	FW	FWD-3			18
23	R	PMTD-3			18
26	J6-3	HY7-2			18
27	F	PMTD-4			18
28	J6-2	P	HY8-1		18
41	1A	1AD-3			18
63	J6-1	HY8-2			18
64	J6-13	HY6-1			18
65	J6-14	HY6-2	LT-3		18
69	J6-9	F1			18
72	L	LD-3			18
74	F3	1A	FW		18
13A	P5-6	1AD-2	FWD-2	PMTD-2	18
24	P5-5	PMTD-1			18
34	P5-2	1AD-1			18
49	P5-3	FWD-1			18
2	F1	F2	1FUA		12

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Figure 9-3. Contactor Panel Wiring

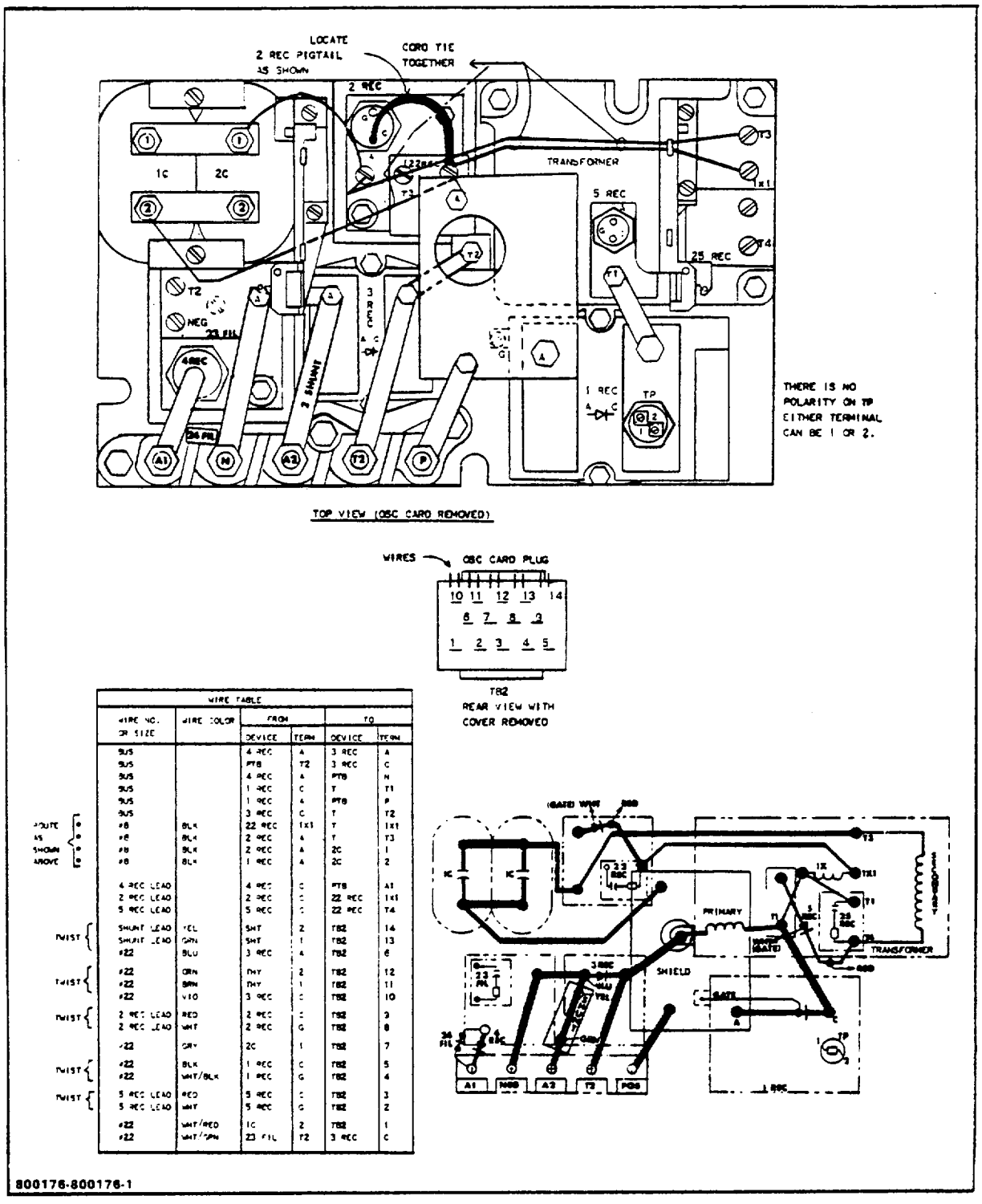


Figure 9-4. Static Panel Wiring

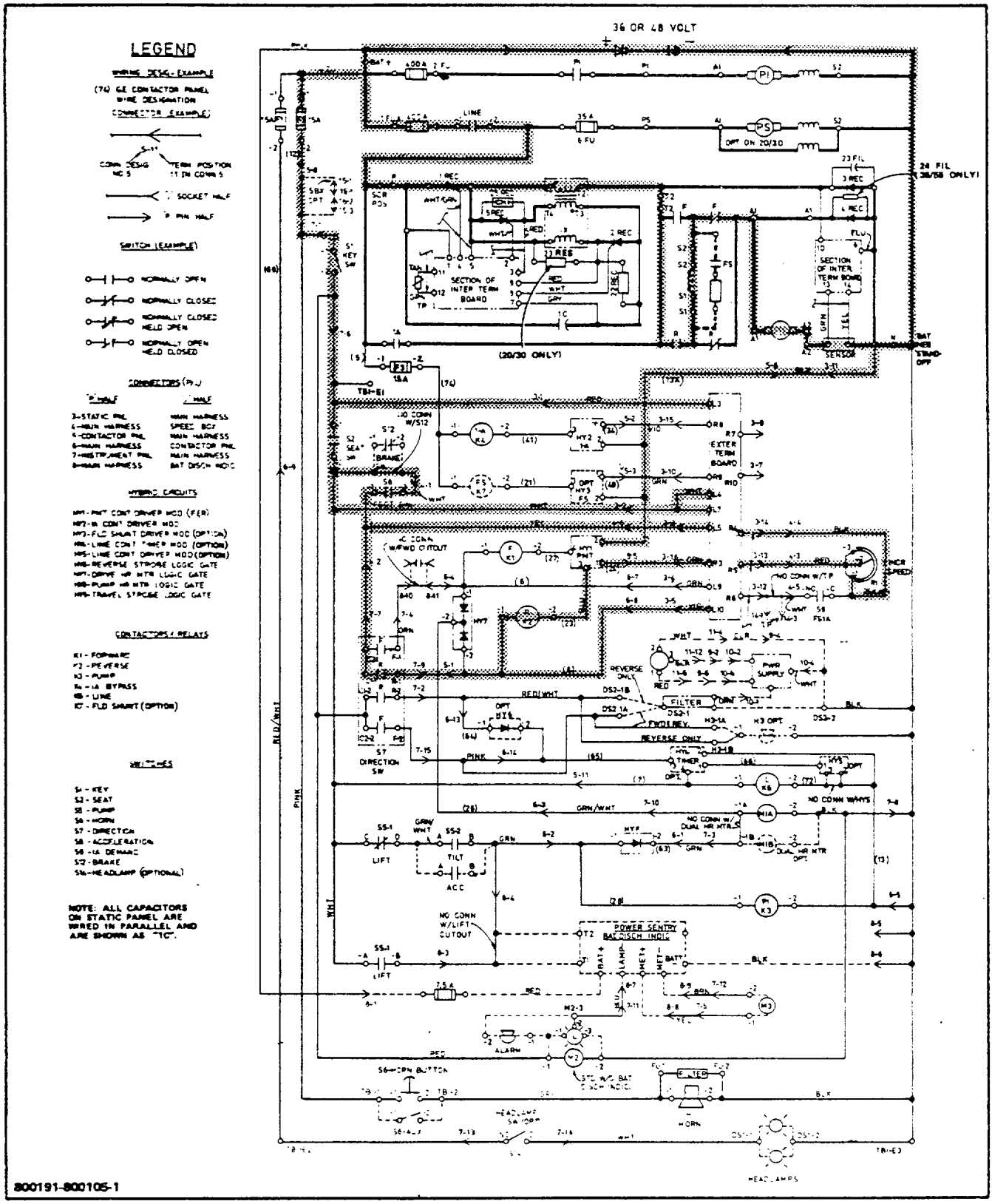


Figure 9-5. Reverse Travel Circuit

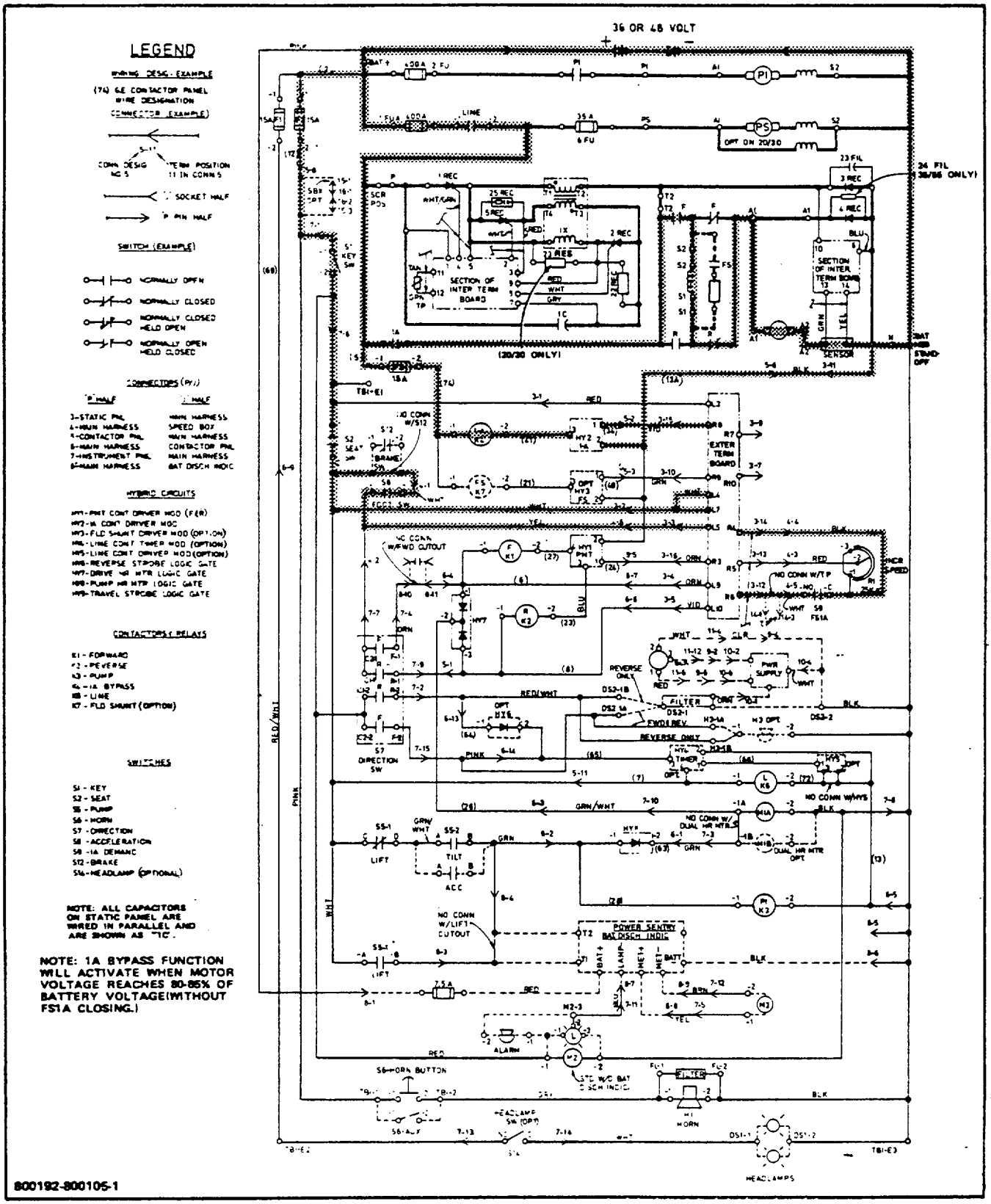


Figure 9-6. Bypass Circuit

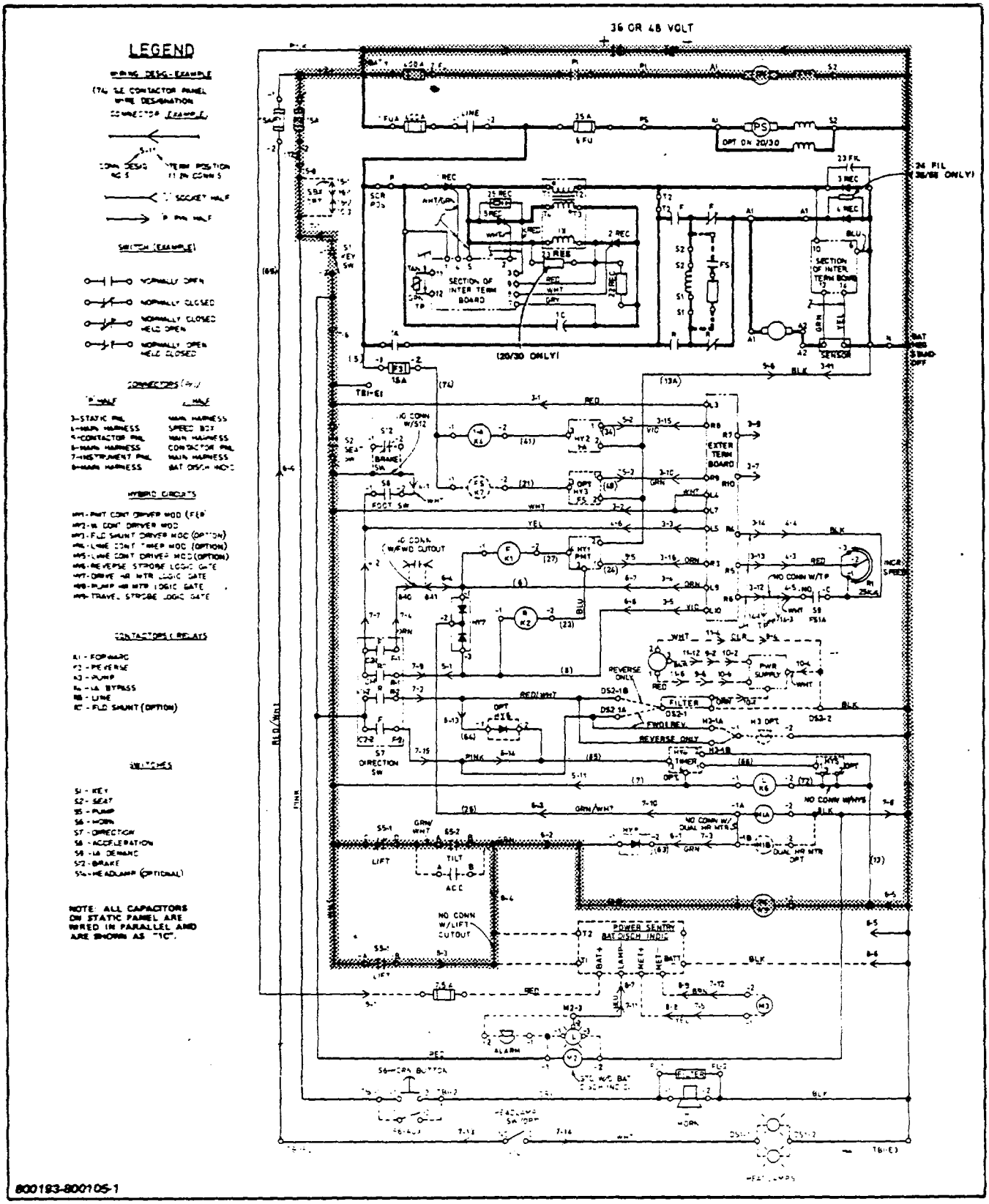


Figure 9-7. Lift/Tilt Circuit

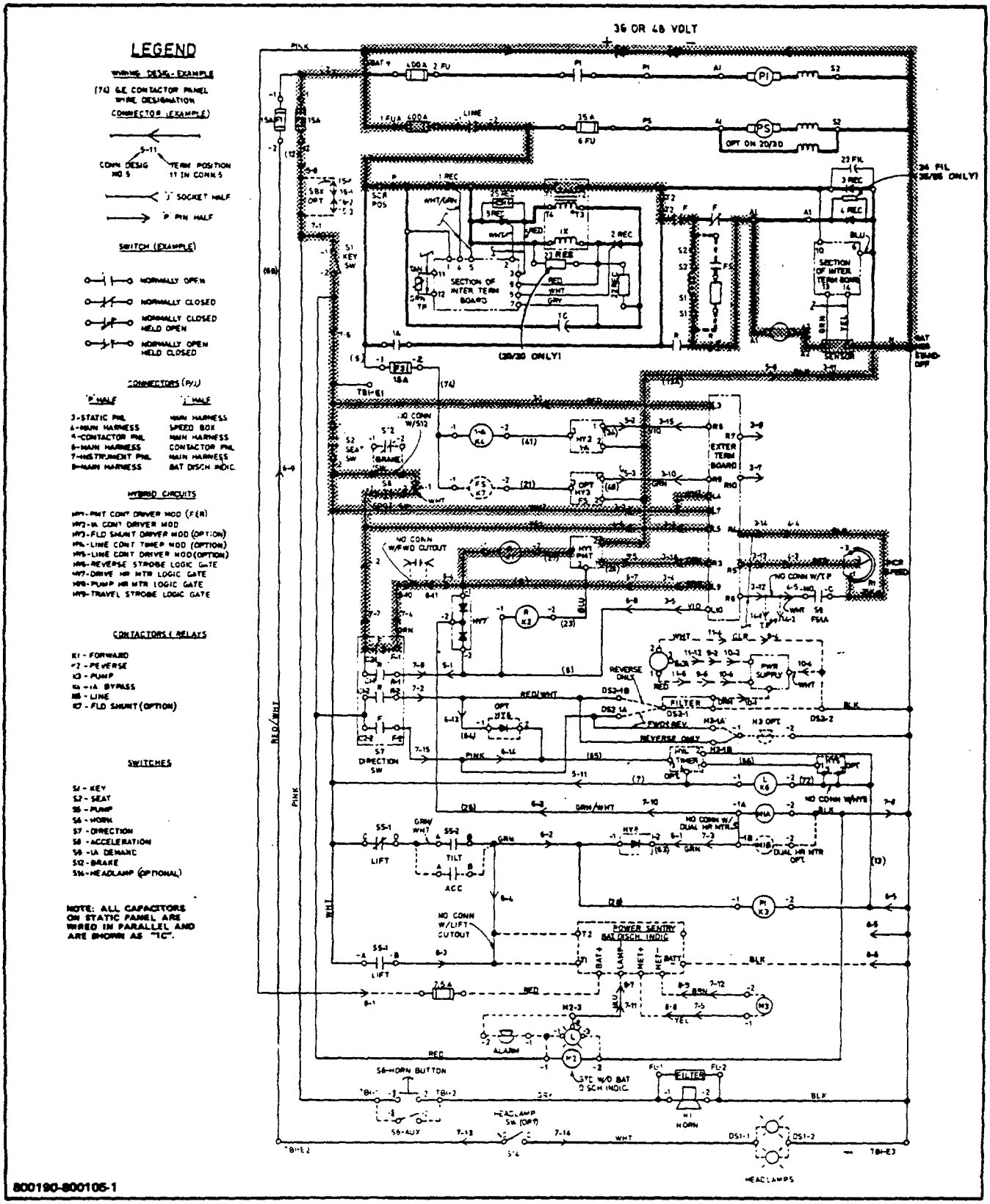


Figure 9-8. Forward Travel Circuit

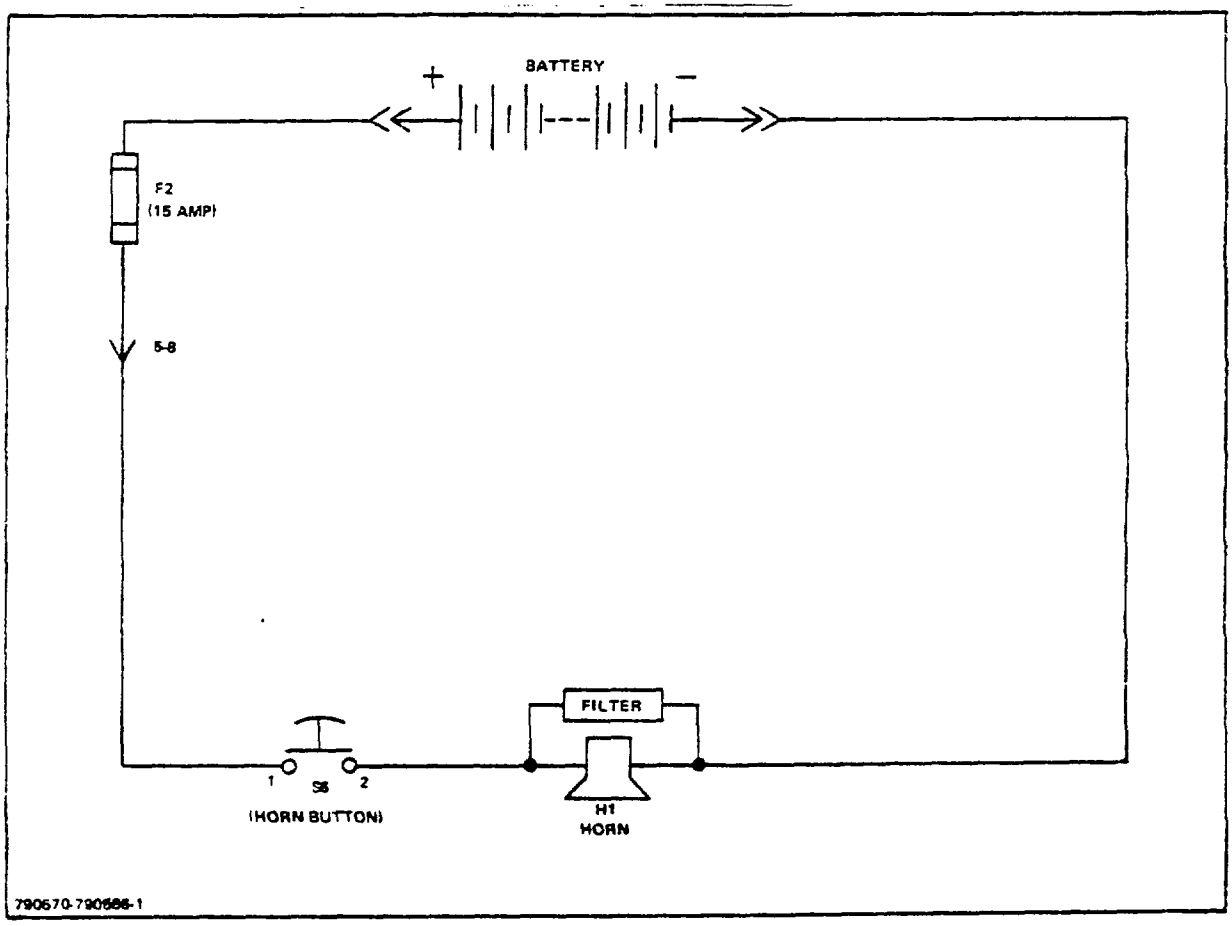


Figure 9-9. Horn Circuit

TOPIC 1. GENERAL DESCRIPTION

The electric motor is dc series wound with connections brazed of high conductive material. The motor armature, which is supported by ball bearings, is statically and dynamically balanced to provide vibration free operation. Specially selected metal graphite brushes, which assure excellent commutation and long service life, are supported in stationary box type holders Inside the motor. To facilitate inspection, removal, testing, etc., the motor is equipped with external connection terminals.

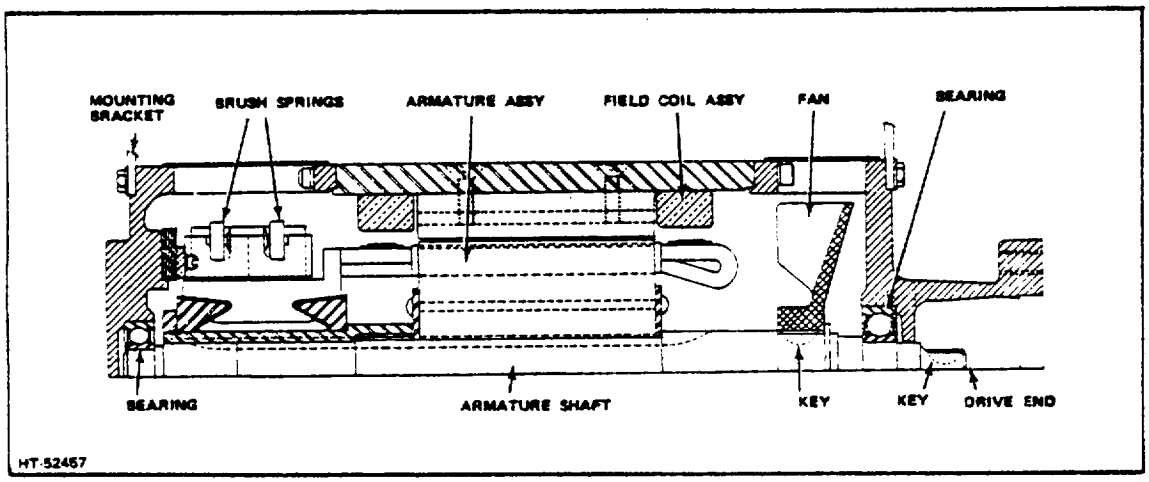


Figure 1-1. Sectional View of Electric Motor (Typical)

TOPIC 2. GENERAL MAINTENANCE

A. 500 HOUR INSPECTION

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitors on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals.

It is recommended that a partial inspection of the motors be made at least every 500 hours of lift truck operation. When the lift truck is used under abnormally severe operating conditions, inspection should be made at a shorter interval. A strict inspection schedule should be set up and rigidly followed to obtain the peak operation of electrical equipment for this type of service. Each partial inspection of the motors should include:

1. Inspect the brushes for wear and for contact with the commutator. A record of brush wear between scheduled inspection periods will give an indication of whether brush should be changed or whether sufficient length is still available to span the interval until the next inspection. Overloading of the motors will increase brush wear over regular operation and, therefore, this must be taken into account in deciding on brush change.

2. Check brush spring pressure for tension on brush and to make sure vibration has not displaced the spring from the hammer plate on brush. In the event of poor brush shunt contact with holder on a burned off shunt, the spring will carry current and may reduce tension. When in doubt, replace with a new spring. Good spring pressure is vital to motor operation.

3. Clean brushes, holders, and wipe commutator with a dry, non-linting cloth. No lubricant of any kind should be used on or around commutator.

4. Check brush holders for solid connection / to mounting support. Tighten by drawing down mounting screws.

5. Check capscrews that hold brush cross/ connectors to brush holder body.

6. Check carefully to make sure motor terminals are tight in the frame. These terminals should be drawn down firmly, but care must be taken not to tighten terminals to the extent of stripping threads or crushing insulating parts.

7. Clean cover band and plate. Make sure insulation is tight to metal surface and Is not damaged. Assemble on motor frame, making sure the openings in frame are entirely covered. Draw down tight to make good, all-around contact with frame.

8. Check all capscrews around frame for tightness.

9. Outside frame of motor should be kept clean and free air passage provided around motor to radiate the heat generated. In a totally enclosed motor all heat must be conducted to the outside surface for cooling and a clean surface is necessary. The rapidity of removing heat from inside the motor determines the temperature in the electrical parts. The lower the temperature, the longer is the life of the insulation, and therefore, the life of the motor.

B. BRUSH SPRING PRESSURE

As stated previously, good spring pressure is vital to motor operation. Spring pressure varies with the size of the brush.

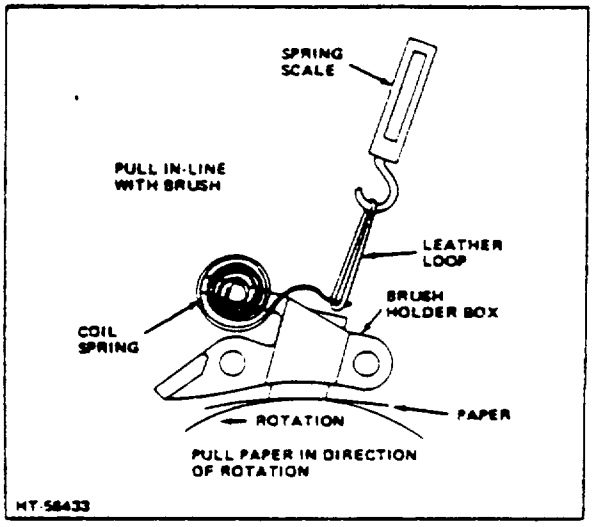


Figure 2-1. Method of Checking Brush Spring for Proper Pressure

TOPIC 3. MOTOR BRUSH SERVICE

A. INSPECTION AND REPLACEMENT OF MOTOR BRUSHES

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitors on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals.

1. Remove the rear band assembly from around the field yoke.
2. Remove brush shunt retaining screws; lift brush retaining springs and withdraw brushes from brush holder.
3. Clean brushes, holders, and wipe commutator with a dry, lint-free cloth.
4. Check appearance of commutator and the brush riding surfaces. The best signs of good commutation are dark, brownish, highly polished commutator and uniform glossy brush wearing surfaces.

⚠ CAUTION

Do not use a lubricant or solvent, of any kind, on or around the commutator.

5. Check brush shunt (Fig 3-1) for good contact with the brush holder. Make certain shunt is not damaged or burned. This my cause pressure spring to carry current and lose tension; good spring pressure Is vital to motor operation. (For proper brush spring pressure, refer to preceding Topic 2).
6. Measure length of brush. A record of brush length at each inspection is the best evidence of brush wear. (This record will help determine if sufficient wear length is present until the next inspection.)

NOTE

Overloading of the motor will increase brush wear and should be taken into consideration.

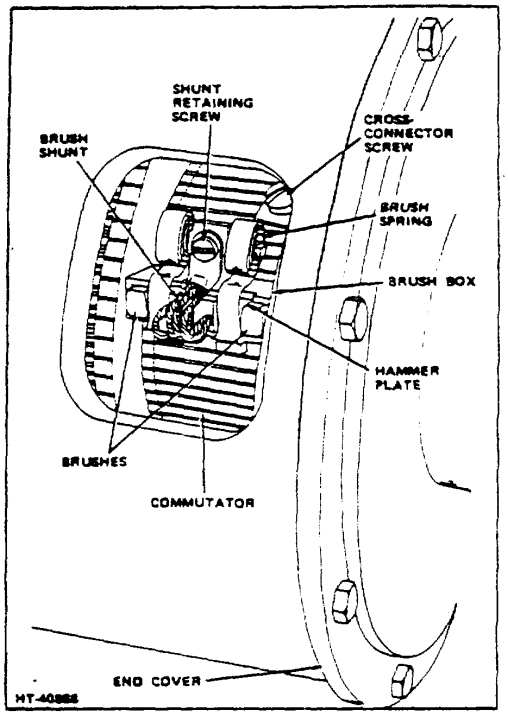


Figure 3-1. Brush Location (Typical)

Replace brushes when brush length is 3/8" or less on drive motors and 5/16 " or less on power steering motors.

7. Before new brushes are installed, they should be contributed on a sanding drum with the same diameter as commutator. Hold brushes to sanding drum to obtain the same radius and brush angle on contact face as was on old brushes. Final seating can be obtained with a fine mesh seating stone compound while commutator is turning.
8. Lift brush spring and place brush into brush box. Make sure each brush spring is on the brush hammer plate and brush slides freely in brush box. Position brush shunt and secure with retaining screw. Repeat procedure for other brush holders.
9. Install the rear band assembly around the field yoke.

To measure Spring Pressure (Fig 2-1):

1. Insert a paper strip between brush and commutator.
2. Place leather loop - or spring scale hook - between pressure spring and brush.
3. With pull in line with center of brush, lift spring scale and pull paper In direction of rotation until paper begins to move freely.

The reading on the spring scale is the total spring force. Record reading and compare with table; replace brush spring as necessary.

Brush Spring Force Table

Motors	Brush Total Spring Force
Drive Motor ACE 20 thru 55	40 oz
Pump Motor	36 oz
Power Steering Motor	22 oz

TOPIC 4. SPECIFICATION CHART

ELECTRIC MOTOR SPECIFICATION CHART

Motor Mode	Normal Application	Rating Data					Brush Total Spring Pressure (Ounces)	Commutator Minimum Wear Diameter (Inches)	Maximum Torque Terminal Leads (lb-in.)
		HP	RPM	Volts	Amps	Duty (Hours)			
8614612-0	Drive	10.29	1300	36	268	1	40	NA	NA
MJV-4006	Pump	7.6	2750	36	125	1/12	36	2.998	80
B48-1228	Steering	0.8	1660	36	24	Cont.	22	NA	NA

TOPIC 1. DRIVE UNIT MAINTENANCE

A. GENERAL

The drive unit is a double-reduction, internal gear five. Each drive wheel is mounted on an axle housing spindle by two opposed, tapered roller bearings locked in correct adjustment by a washer, castellated nut, and cotter pin. The weight of the lift truck is carried by the axle housing and the wheels; therefore, the axle shafts (jackshafts) serve only to drive the wheels.

The differential is of the bevel gear and pinion type with final reduction through the axle shafts and bull gears that set each drive wheel in motion. To hold the differential assembly rigidly in position in the housing, it is mounted on two studs and then held firmly in position by self-locking capscrews.

The axle shafts are splined to the differential side gears at one end and mesh with the bull gears in the drive wheels at the opposite end. Axle shaft teeth are crown-shaved to assure correct mesh. The axle shafts rotate at the drive wheel end in two opposed tapered roller bearings locked in place on the shaft by a sleeve-type nut and spider lock ring. The assembly is locked in position in the axle housing by a bearing cap and capscrews.

B. 100 HOUR SERVICE

After each 100 hours of operation check the oil level in the drive axle housing. Remove the oil level plug and the washer (Fig 1-1) from the front of the drive axle housing. With lift truck in a level position, the oil level Should be up to the bottom of the opening. If necessary, add specified lubricant through the level opening but do not overfill. Then install washer and oil level plug securely.

After each 100 hours of operation check the differential breather to make certain it is clean and open. Remove the breather (Fig 1-1) from the top of the housing. Wash it in a suitable cleaning solvent and dry it with clean compressed air to make certain it is not clogged. Install breather and tighten securely.

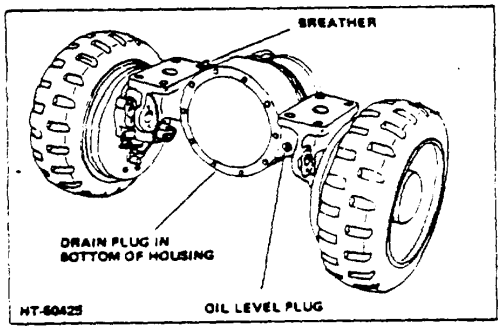


Figure 1-1. Drive Unit for Single Drive Motor

C. 200 HOUR INSPECTION

The bull gear is positioned in the drive wheel by roll pins and is bolted to the wheel from the outside so that tiqhtness can be checked periodically without necessity of removing wheel.

After each 200 hours of operation, check the tightness of bull gear mounting capscrews from the outside of the drive wheels. Replace any lockwashers that are broken or missing.

D. BULL GEAR, WHEEL BEARING, JACKSHAFT, AND JACKSHAFT BEARING 500 HOUR INSPECTION

After each operating interval of 500 hours, check the bull gears, wheel bearings, jackshafts, and jackshaft bearing. To perform this inspection, proceed as follows:

⚠ WARNING

Make certain battery is disconnected and the key switch is in the OFF position.

1. Removal

a. Attach a suitable hoist of adequate capacity to the front of the vehicle and raise it sufficiently so the drive wheels clear the floor. Carefully place sturdy wooden blocks under both sides of the frame just behind the drive wheels. Lower vehicle enough to take stress off the hoist and so the drive wheels clear the floor and the wooden blocks.

b. Remove capscrews and lockwashers that secure the hub cap to the wheel and remove hub cap. Remove cotter pin, retaining nut, and washer from drive wheel spindle.

c. Remove outer bearing cone (Fig 1-2) from wheel and carefully remove the drive wheel.

⚠ CAUTION

Exercise care when removing drive wheel so no damage results to brake shoes, drum, or spindle threads.

d. Remove inner bearing cone (Fig 1-3) and grease shield from spindle. (A grease shield is not used on Models 20/25/30 lift trucks.) .

e. Remove capscrews and lockwashers that secure dust shield to the housing and remove the dust shield.

f. Remove capscrews and lockvwshers that secure axle shaft cap to the housing.

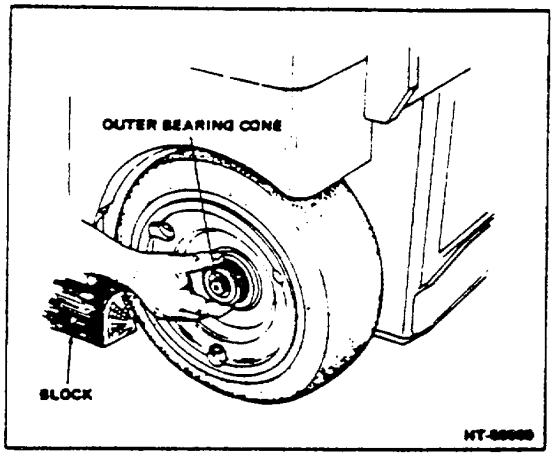


Figure 1-2. Removing Drive Wheel Outer Bearing Cone

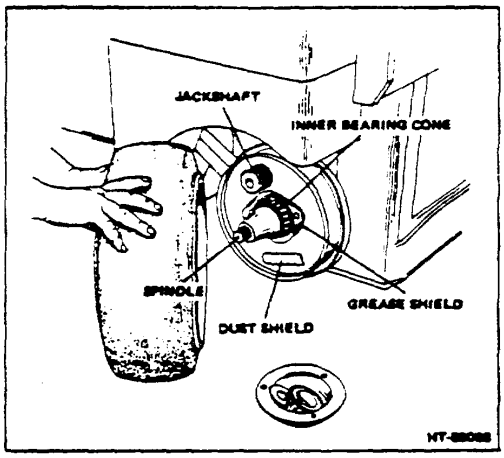


Figure 1-3. Removing Drive Wheel

g. Install a slide hammer puller (Fig 1-4) in threaded hole in the end of the iackshaft; carefully remove jackshaft and bearing assembly from housing as a unit.

h. Straighten locking tabs of lockwasher (Fig 1-5); remove locknut, lockwasher. and tongued washer from jackshaft.

i. Place jackshaft assembly on a suitable press and remove the bearings (Fig 1-5).

⚠ CAUTION

When bearings are being removed, make certain the pressure is exerted against the inner race of the bearing cone and not on the roller portion. Also exercise care to prevent damage to the axle shaft cap.

j. TYPE I Only Remove grease seal and axle shaft cap from jackshaft.

2. Inspection

Wash all parts in a suitable cleaning solvent to remove grease and foreign material; dry with clean compressed air. Inspect for worn or damaged parts and replace if necessary. Inspect jackshaft gear for worn or broken teeth. Wash off bull gear with suitable solvent and dry with compressed air. Check bull gear for cracked or chipped teeth and any signs of uneven or excessive wear. Inspect shaft oil seal in drive axle housing. It is recommended that a new oil seal be installed whenever the jackshaft is removed. Also inspect drive wheels for wear or damage.

3. Installation And Lubrication

a. Lubricate jackshaft bearing cup and cones with specified grease.

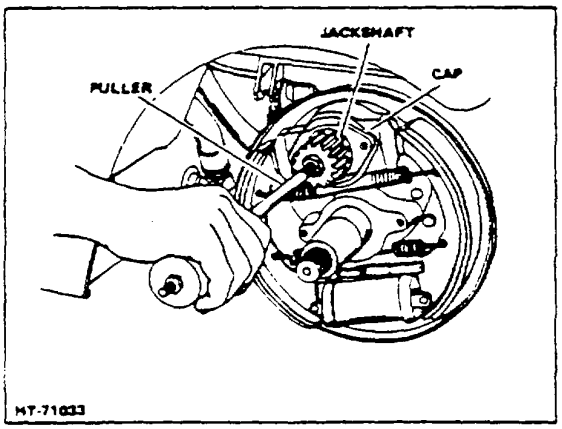


Figure 1-4. Removing Jackshaft

Apply grease with applicator designed to force lubricant into the bearing rollers.

b. Install axle shaft cap (Fig 1-5), grease seal, bearing assembly, tongued washer, tab lockwasher, and locknut on jackshaft. Secure locknut in position with tabs on lockwasher.

c. Install jackshaft assembly through oil seal and into drive axle housing; place it in position and drive it into place with a soft mallet. Align holes in axle shaft cap with threaded holes in housing; secure cap with lockwashers and capscrews.

d. Install dust shield and secure it with lockwashers and capscrews.

e. Lubricate drive wheel inner bearing cone with specified grease. Apply grease with applicator designed to force lubricant into roller bearings.

f. Install grease shield (if applicable) and inner bearing cone on drive wheel spindle.

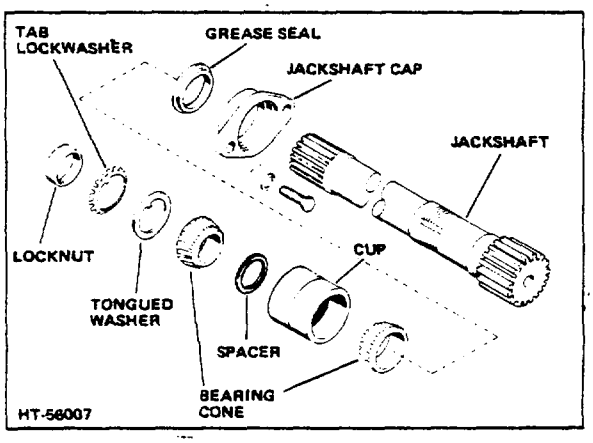


Figure 1-5. Jackshaft Assembly (ACE 20 thru 80)

g. Lubricate bull gear with specified grease. Fill all spaces between the bull gear teeth with specified grease to approximately 3/4 the height of the teeth. Then carefully install drive wheel on spindle.

⚠ CAUTION

Use extreme care when installing drive wheel so no damage results to brake shoes, drum, or threaded end of drive wheel spindle.

h. Lubricate drive wheel outer bearing cone with specified grease. Again apply grease with applicator designed to force lubricant into roller bearing cone on spindle.

i. Install washer and retaining nut on spindle. While tightening retaining nut, rotate the wheel alternately in each direction until a torque of 50 lb-ft maximum is obtained. Then back off the nut 30” minimum to 60” maximum to allow the cotter pin to be installed. Then install cotter pin.

j. Install hub cap to drive wheel; secure with lockwashers and capscrews.

NOTE:
Before lowering the vehicle, repeat all of the preceding steps for the bull gear, wheel bearings, jackshaft, and jackshaft bearings on the other side of the lift truck.

k. Raise vehicle slightly with the hoist and remove the wooden blocks from .under the frame. Then lower vehicle so drive wheels rest on the floor. Remove hoist from front of vehicle.

E. 1000 HOUR SERVICE

After each operating interval of 1000 hours, change the oil in the drive axle housing.

TOPIC 1. HYDRAULIC SERVICE BRAKE SYSTEM

A. GENERAL

Two types of hydraulic service brake systems are used in the ACE SERIES (Self-Adjusting and DuoServo). The Self-Adjusting type is mounted on Jackshaft Drive Axles. The Duo-Servo type is mounted on AC Planetary Drive Axles.

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals.

1. Service Brake System With Jackshaft Orive Axle

   The Self-Adjusting brake system (Fig 1-1) includes a mechanically actuated hydraulic master cylinder with brake lines that transmit hydraulic pressure to the brake wheel cylinders located behind a dust shield in each of the drive wheels.

   The wheel cylinders are the double end type which have activating links that extend from each end of the cylinder.

   These links transmit movement from the wheel cylinders to the brake shoes.

   Fluid enters the wheel cylinders from the master cylinder and forces the pistons in the wheel cylinder to move outward. As the pistons travel, the brake shoes expand against the wheel drum through the activating links on the end of the pistons. When the brake pedal is released, the pistons are returned to their OFF position by the force of the brake shoe return springs.

B. DAILY INSPECTION

During daily operation, visually inspect the floor area where the lift truck was operating to check for oil leaks from the hydraulic brake system.

Also during daily operation, check the brake pedal free play. The brake pedal should have 1/2" free play as it is depressed. When the pedal is fully depressed, there should be a reserve distance of approximately 2" between the bottom of the pedal and the toe plate.

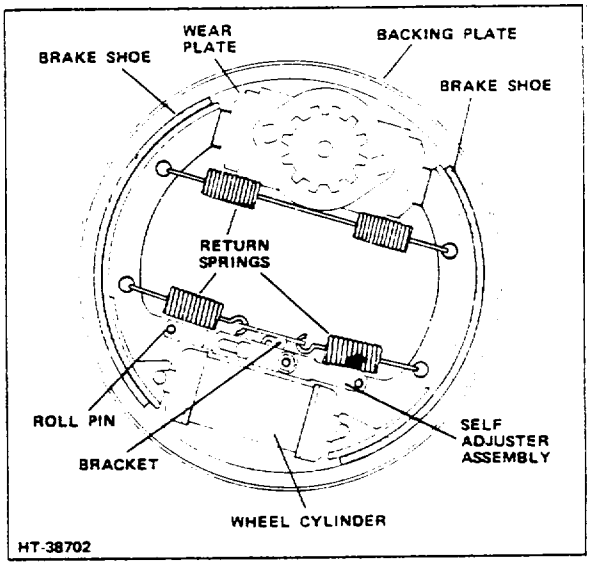


Figure 1-1. Self-Adjusting Brake System

C. 500 HOUR INSPECTION

Every 500 hours of operation, check the fluid level in the master cylinder. Remove the hardware that secures the toe and floor plates to the frame and remove the toe plate and floor plate. Remove filler cap from master cylinder and check fluid level. If necessary, fill master cylinder with specified fluid to within 3/8" from bottom of filler opening in master cylinder (Fig 1-5). Install filler cap and check for leaks; correct any that are evident. Then install floor plate and toe plate to frame with mounting hardware.

After each operating interval of 500 hours remove the drive wheels to inspect the wheel bearings, and the condition of the brake shoes and wheel drums. Check brake shoes to determine the amount lining remaining on the shoes. When the lining has worn down to less than 1/8" thickness, the shoe and lining assemblies should be replaced.

⚠ CAUTION

Operate lift truck only when lining is greater than 1/16" thickness.

Check the wheel cylinders, brake lines, and fittings for leaks and correct any that are evident.

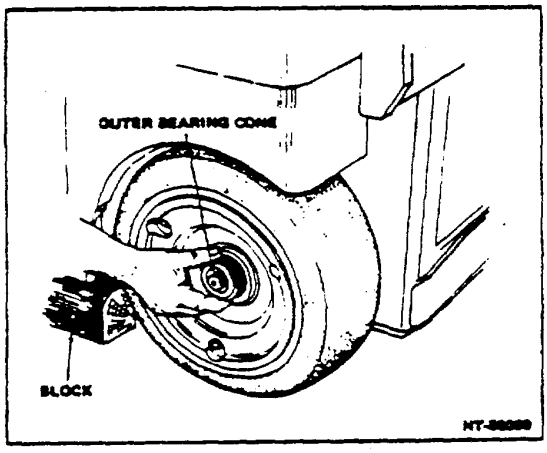


Figure 1-2. Removing Wheel Bearing

1. Drive Wheel Removal For Jackshaft Drive Axle

⚠ WARNING

Disconnect the battery before performing any work on vehicle.

a. Attach a suitable hoist of adequate capacity to the front of the vehicle and raise it sufficiently so the drive wheels clear the floor. Carefully place sturdy wooden blocks under both sides of the frame just behind the drive wheels. Lower vehicle enough to take stress off the hoist and so the drive wheels clear the floor and the wooden blocks.

b. Block steer wheels in position.

c. Slowly rotate drive wheel noting any drag or friction as brakes are applied slightly. Any difference in the amount of drag during rotation indicates an out-of-round drum, or bull gear or differential drag.

d. Remove capscrews, lockwashers and hub cap or wheel cover. Remove cotter key, retaining nut and washer.

e. Remove outer bearing cone (Fig 1-2) and remove wheel (Fig 1-3).

⚠ CAUTION

Exercise care when removing drive wheel so no damage results to brake shoes, drum, or spindle threads.

f. Remove the inner bearing cone, grease shield (if used) and dust shield. Brake components are now exposed for service (Fig 1-4).

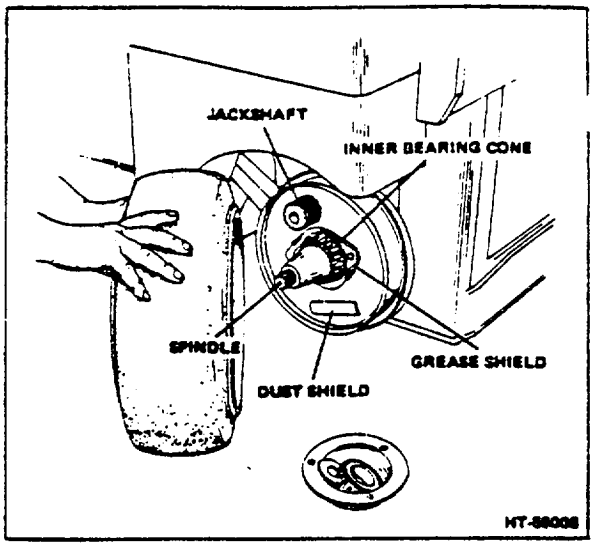


Figure 1-3. Wheel Removed

3. Cleaning And Inspection Brush dirt and lining dust from the drum.

When shoe guide area of support plate is rusty, use steel wool or fine emery cloth to clean this surface.

Check springs for fatigue cracks. Inspect remaining brake components for excessive wear, sheared threads or broken teeth. Replace any defective components.

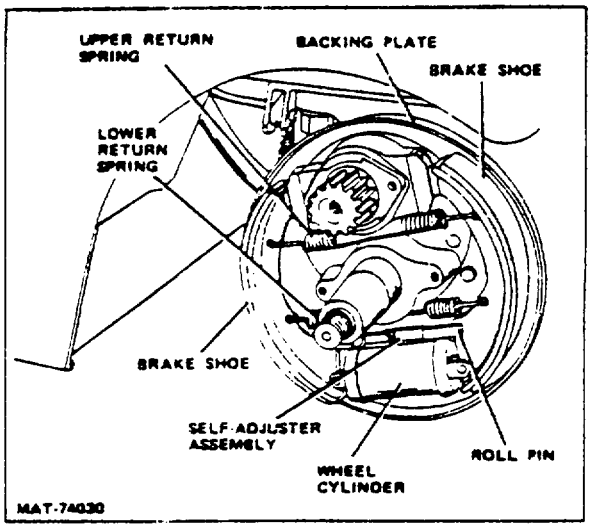


Figure 1-4. Wheel Brake

4. Wheel Cylinder Inspection

   If inspection of the wheel cylinder reveals a hydraulic fluid leak around the dust boots, pull back the boots and check for brake fluid behind the pistons. If there is evidence of fluid leakage, the wheel cylinder should be service or replaced.

5. Drive Wheel Installation For Jacksnaft Drive Axle

   a. Install dust shield and secure it with lockwashers and capscrews.
   b. Lubricate drive wheel inner bearing cone with specified grease. Apply grease with applicator designed to force lubricant into roller bearings.
   c. Install grease shield (if used) and Inner bearing cone on drive wheel spindle.
   d. Lubricate bull gear and jackshaft pinion with specified grease. Carefully install drive wheel on wheel spindle.

⚠ CAUTION

Use extreme care when installing drive wheel so no damage results to brake shoes, drum, or threaded end of drive wheel spindle.

   e. Lubricate drive wheel outer bearing cone with specified grease. Again apply grease with applicator designed to force lubricant into roller bearings. Then install outer bearing cone on spindle.
   f. Install washer and retaining nut on spindle. While tightening retaining nut, rotate the wheel alternately in each direction until a torque of 50 lb-ft maximum is obtained. Then back off the nut 300 minimum to 600 maximum to allow the cotter pin to be installed. Then install cotter pin.
   g. Install hub cap to drive wheel; secure with lockwashers and capscrews.
   h. The first time the brake pedal is depressed after installation of new brake shoes, the brake adjustment is automatically set. No further adjustments are required.

D. MASTER CYLINDER

The system requires a "solid column of fluid" and the fluid should have protective properties which safeguard the hydraulic brake system. The first requirement for a safe and positive hydraulic brake system is the use of the specified high quality brake fluid. Check the master cylinder for leaks. Master cylinders with leaks are defective and should be repaired or replaced.

Remove and install master cylinder assembly using the following procedure:

1. Removal

⚠ WARNING

Before proceeding with removal, disconnect battery, then discharge capacitors.

   a. Remove toe and floor plates.
   b. Disconnect and plug brake hydraulic line attached to master cylinder.
   c. Back off jam nut of yoke until spring tension is relaxed.
   d. Remove clevis pin securing yoke to brake pedal.
   e. Remove capscrews securing master cylinder to inside of frame and remove cylinder.
   f. When replacing master cylinder save retainers, spring. jam nut. and yoke (pedal linkage, Fig 1-5) for installation of new master cylinder.

2. Installation

   a. Install retainer, boot, and spring on master cylinder and assemble rod, retainer, jam nut and yoke as illustrated in Figure 1-5.
   b. Insert rod with assembled parts through spring, boot, and into master cylinder.
   c. Slip boot over rod nut.
   d. Secure master cylinder to lift truck frame with capscrews.
   e. Remove plug and connect hydraulic brake line to master cylinder.
   f. Attach yoke to brake pedal with clevis pin.
   g. Compress spring with retainers and jam nut, locking jam nut against rod nut.
   h. Adjust pedal for 1/2 inch free play when necessary (Refer to paragraph E. BRAKE PEDAL AOJUSTMENT).
   i. Remove master cylinder cap and refer to paragraph 5, Brake System Bleeding.
   j. Install and secure cap with gasket to master cl1inder.

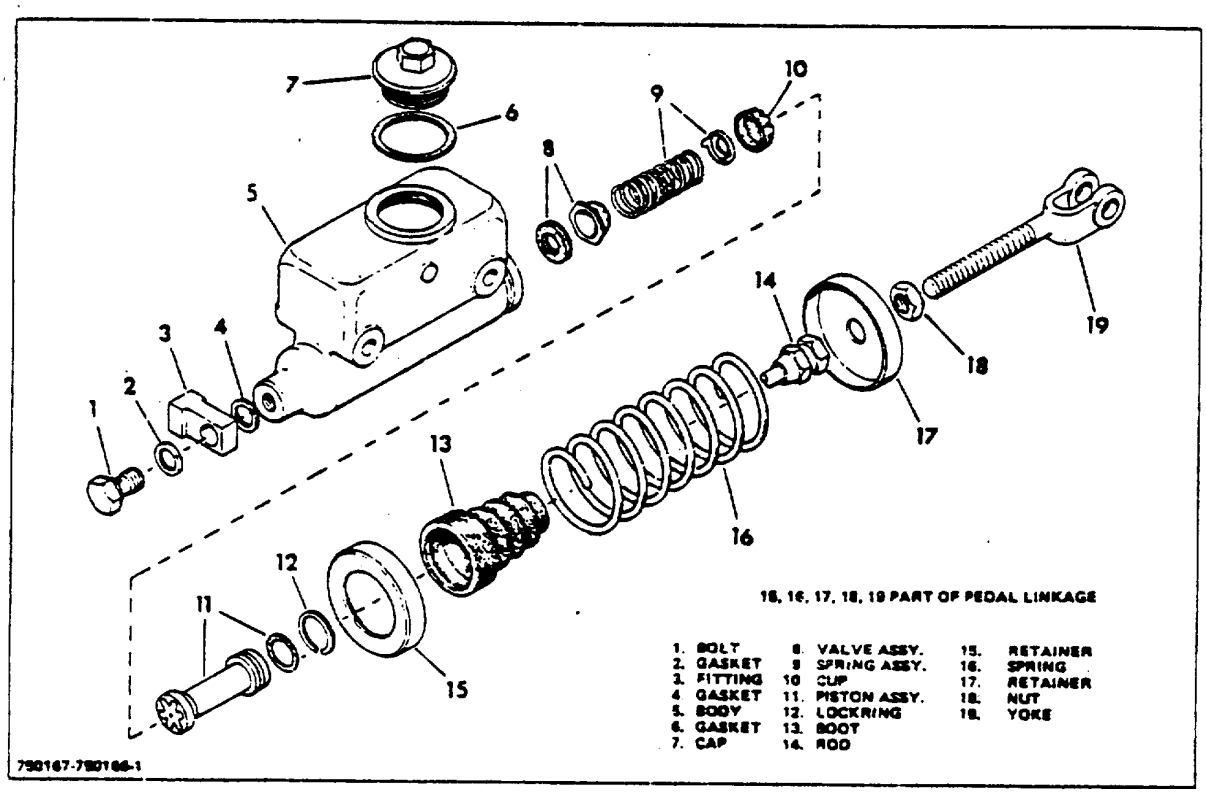


Figure 1-5. Master Cylinder Assembly And Yoke With Pedal Return Spring And Retainers

3. Brake System Bleeding

Whenever the wheel cylinders are serviced, the hydraulic brake system must be bled to remove any air that may have entered the brake lines.

a. Fill master cylinder with clean specified brake fluid.

⚠ CAUTION

Due to importance of fluid used in brake system, use only premium quality, heavy duty brake fluid with an extreme heat-cold range that conforms to specification MIL-S-46176.

b. Bleed the wheel cylinder furthest from the master cylinder first.

NOTE

Normally, the bleed screw is located at the back of each drive axle flange. However, some models of lift trucks are equipped with a central bleeding system. This system utilizes a junction block located near the top of the drive axle housing. The junction block is equipped with two bleed screws, one for each wheel cylinder.

c. Have an assistant apply the brake pedal to apply pressure to the brake fluid and open the bleed screw to allow the air to escape from the wheel cylinder. Close the bleed screw while foot pressure is still on the brake pedal. After the bleed screw is closed, allow the pedal to return to its released position.

d. Repeat step c as many times as required until the brake fluid is free of air bubbles and then tighten the bleed screw before allowing the Se1al to return to its released position.

e. Bleed the other wheel cylinder in the sama manner as outlined in preceding steps c and d.

⚠ CAUTION

Be sure to keep fluid level in master cylinder high enough to prevent reentry of air into the system.

f. Fill master cylinder with specified brake fluid to within 3/8" from bottom of filler opening.

NOTE

Fluid salvaged during bleeding operation is aerated and not suitable for reuse.

E. BRAKE PEDAL LINKAGE ADJUSTMENT

The brake pedal should have 1/2" free play as it is depressed, there should be a reserve distance of approximately 2" between the bottom' of the pedal and the toe plate. If the pedal linkage does not provide the proper adjustment of the piston in the master cylinder with the pedal released, the piston cannot return to its full OFF position. The brakes will drag after several applications of the pedal when the bypass port in the master cylinder is blocked. When necessary, adjust linkage to provide 1/2" free play measured at the brake pedal.

1. Backoff jam nut securing rod of master cylinder and yoke. Figure 1-6.
2. Adjust rod to provide 1/2" of free play measured at brake pedal. More than 1/2" free play reduces usable stroke of master cylinder.

NOTE

When necessary, pedal stop bumper may require adjustment before 1/2" free play can be obtained.

3. Tighten jam nut when 1/2" free play is obtained.

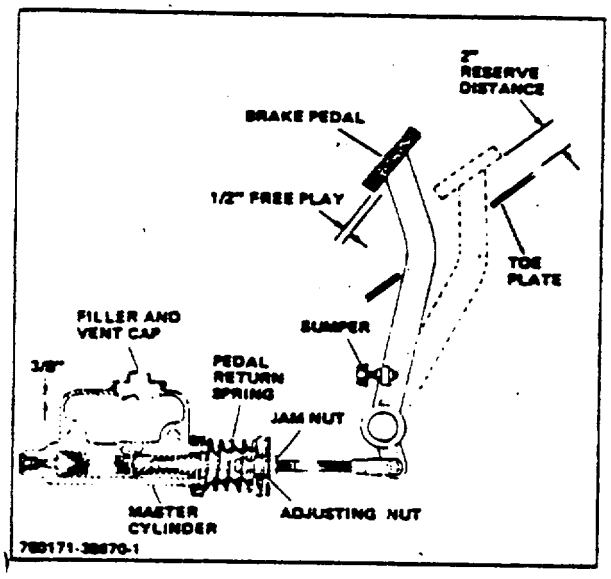


Figure 1-6. Pedal Linkage and Master Cylinder

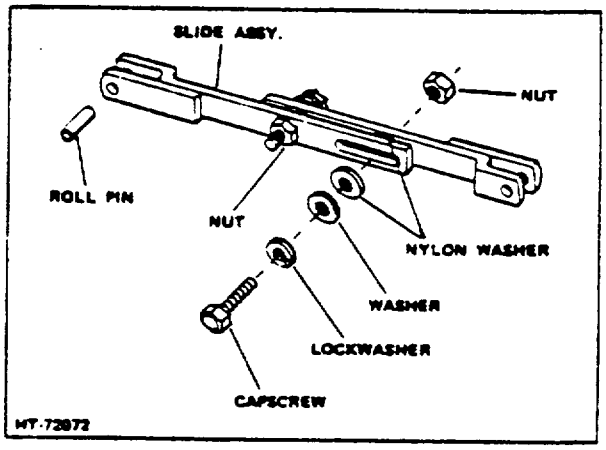


Figure 1-7. Service Brake Self-Adjuster Assembly

F. SELF ADJUSTING SERVICE BRAKES WITH JACXSHAFT DRIVE AXLE

The brake shoes are self-adjusting through the use of a friction operated self-adjuster in each drive wheel. The friction between the two slide assemblies of the self-adjuster is great enough to prevent the brake shoe springs from fully retracting the self-adjuster, but not great enough to prevent hydraulic pressure from expanding the self-adjuster. The selfadjuster assembly is mounted to the brake shoes with roll pins. The roll pin mounting holes in the brake shoes are 1/32" oversize to provide proper working clearance between the brake shoe lining and drum.

⚠ CAUTION

Exercise care when self-adjuster is handled or installed. Do not bend the tangs of the slide assemblies in any way because the holes for the roll pins must be parallel with each other. If the holes are not parallel, the roll pins will lie at a slight angle through the mounting holes in the brake shoes. Improper alignment of the roll pins could lead to improper brake shoe retraction due to lack of proper roll pin clearance in the brake shoe holes. This in turn could create brake shoe drag on the drum.

In order for the self-adjusting brakes to operate properly, the self-adjuster assembly must be properly torqued. If it becomes necessary to remove and disassemble the self-adjuster in the field, use the following recommended procedure to assemble the self-adjuster:

1. Assemble components as illustrated In Figure 1-7.

2. Tighten capscrews in threaded holes of slide assembly to a torque of 14 to 16 lb-in.
3. Hold capscrews-in position and tighten nuts to a torque of 29 lb-in.
4. Check slip resistance of the slide assemblies, resistance must be 250 to 300 lbs.
5. After the assembly Is completed, the self-adjuster should measure 5-1/4" between hole centers when it is fully retracted.

TOPIC 2. PARKING BRAKE SYSTEM (KELSEY-HAYES)

A. PARKING BRAKE CHECK

The parking brake is self-adjusting and normally does not requires adjustment. However, the parking brake should be checked periodically for correct adjustment and operation. Also during lift truck operation, check to make certain the parking brake pads do not drag.

Brake pads that drag can cause premature wear, may cause shortened battery life, and will reduce top speed.

Perform parking brake check as follows:

1. Drive and stop the lift truck on an incline (approximately 15% incline).
2. Remove weight from the operator's seat.
3. Then remove foot from brake pedal. The lift truck should hold in a stationary position.
4. If the lift truck does not hold in a stationary position, the parking brake must be adjusted.

⚠ WARNING

Disconnect the battery and discharge the capacitors before making adjustments.

B. PARKING BRAKE ADJUSTMENT

1. Should the parking brake require adjustment, release parking brake by tightening spring retaining nut (Fig 3-1) so cam lever is in the BRAKE OFF position.
2. Use a large screwdriver and adjust the pad adjusting screws (Fig 3-1) until screws are tight and brake pads contact the disc; then back off screws 1/4 turn.

NOTE

The pad adjusting screws are the large slotted screws and not the parts with the Phillips head. The parts with the Phillips head are pad retainer pins and are under spring pressure.

3. Turn spring retaining nut so it is .015" to .080" from end of the stud (Fig 3-1).

⚠ WARNING

Do not remove the spring retaining nut from the stud. The large spring, which is under pressure, is installed on the stud at the factory with a holding fixture.

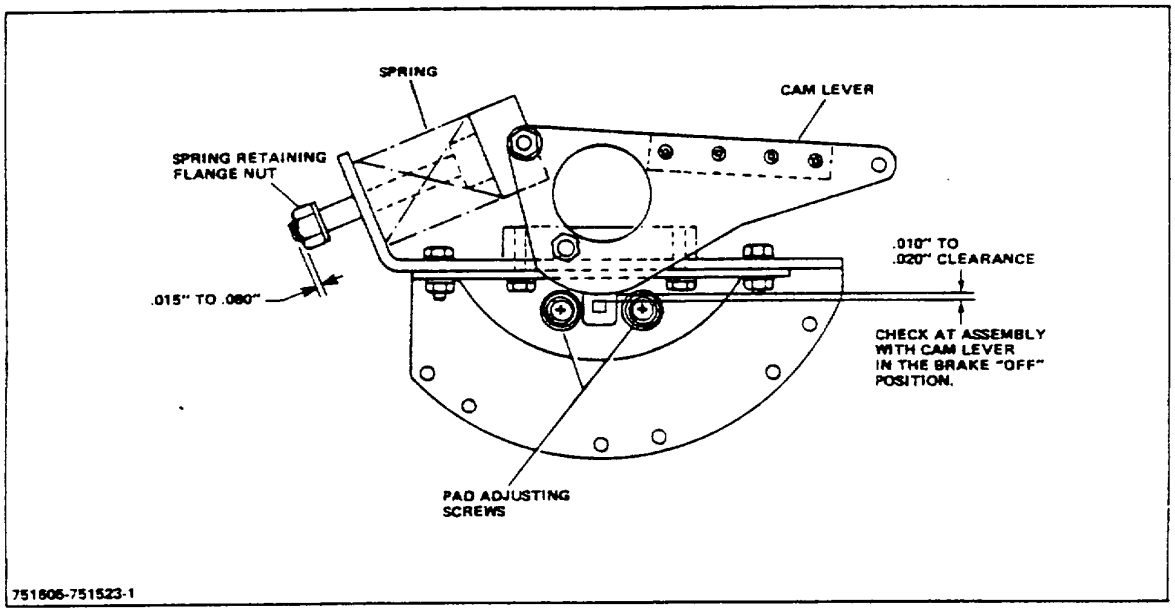


Figure 3-1. Parking Brake Adjustment

NOTE

Brake pads should be applied to the disc when the cam lever is down or in he BRAKE ON position and operator's seat is unoccupied.

4. When the parking brake cable requires adjustment, first tighten spring retaining nut(Fig 3-1) on the stud until tension is released on the brake cable. Then remove yoke pin (Fig 3-2) and remove yoke from seat hinge assembly. Loosen jam nut and turn yoke or rod end clockwise to shorten cable length or counterclockwise to lengthen it. Tighten the jam nut and install yoke to seat hinge assembly with yoke pin and cotter pin. Back off the spring retaining nut so it is .015" to .080" from end of stud (Fig 3-1).

C. SEAT SWITCH ADJUSTMENT

As the operator leaves the lift truck seat, spring tension raises the seat and the seat switch opens. When the seat switch opens, control current flow is interrupted.

The seat switch (Fig 3-2) must be adjusted so the base of the seat hinge assembly contacts the switch roller when the seat cushion is fully depressed.

To adjust the seat switch, loosen locknut and move seat switch up or down until proper contact with the base of the seat hinge assembly is obtained; then tighten the locknut securely.

NOTE:

Electrical leads are wired to the normally open contacts of the seat switch. When seat cushion is fully depressed, the seat switch must be actuated so the contacts close.

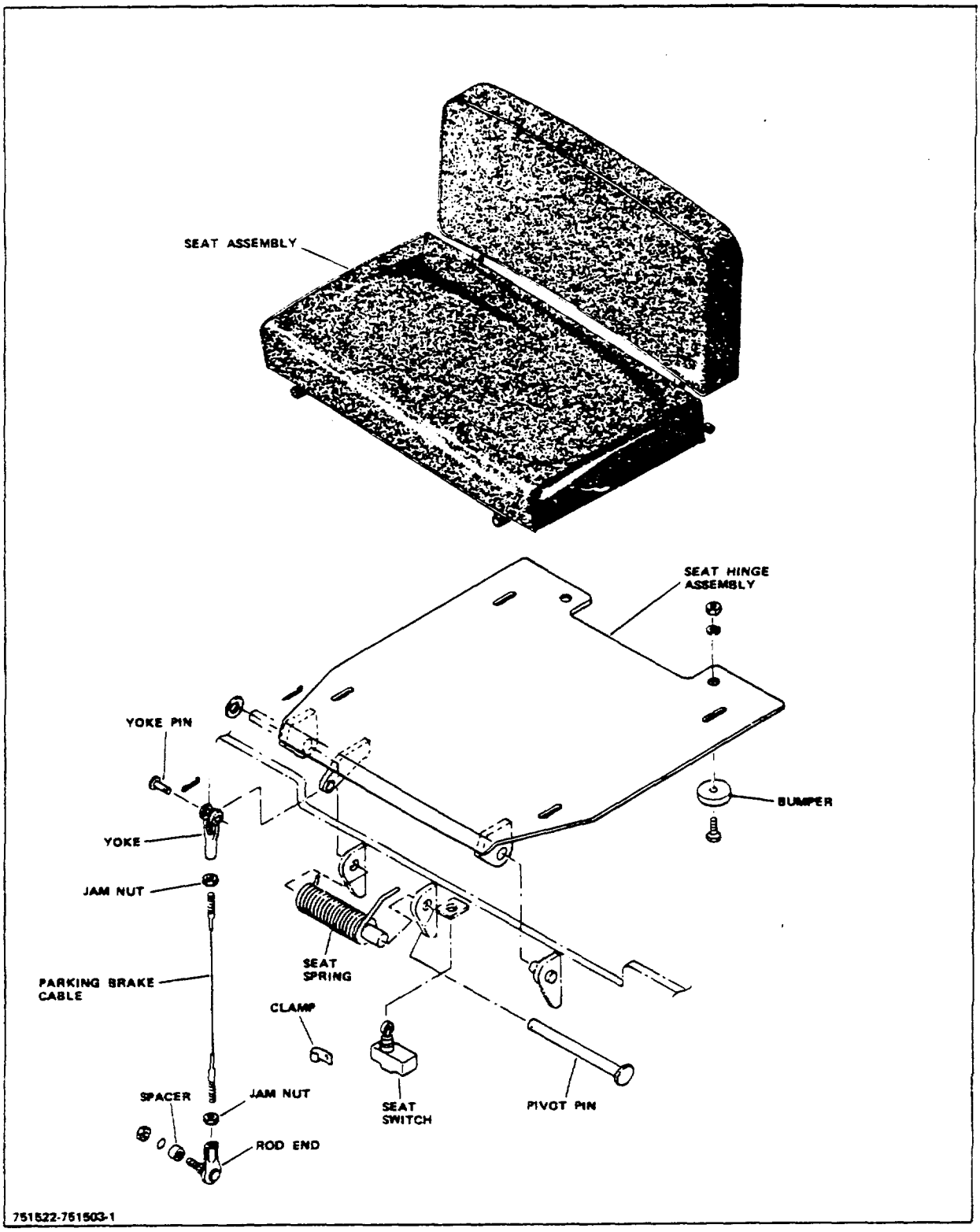


Figure 3-2. Parking Brake Cable and Seat Assembly

EM-41-3

TOPIC 1. LIUBRICATION AND MAINTENANCE

A. GENERAL

The power seering system (Fig 11) converts hydraulic oil movement into mechanical movement to turn the steer wheels with ease. The steer axle assembly with the steer wheels is mounted to the frame and is located at the rear of the lift truck. The main components in the power steering system are the pump motor, power steering pump, steering valve unit, and steering cylinder. The hydraulic oil that is supplied to the steering valve unit is directed to one of the steering cylinder ports. As the oil enters the steering cylinder, the plunger rod extends or retracts, depending upon which port in the cylinder the hydraulic oil is directed. A short drag link or yoke is installed on the end of the steering cylinder plunger rod and is connected to the steer axle pivot arm. Also connected to the pivot arm are right and left tie rods which in turn are attached to the respective steer wheel spindles.

When the steering wheel is turned to the right, oil is directed by the steering unit to the forward port in the steering cylinder. As the hydraulic oil pressure is applied to the piston, the piston and plunger rod move outward. The plunger rod by means of the drag link then pushes on the pivot arm which rotates on the pivot pin. As the pivot arm rotates, the steer wheels move into position for a right turn due to the movement of the tie rods.

The movement of the steering system is just the opposite when the steering wheel is turned to the left. The hydraulic oil is then directed to the rear port in the steering cylinder which causes the plunger rod to retract. As the

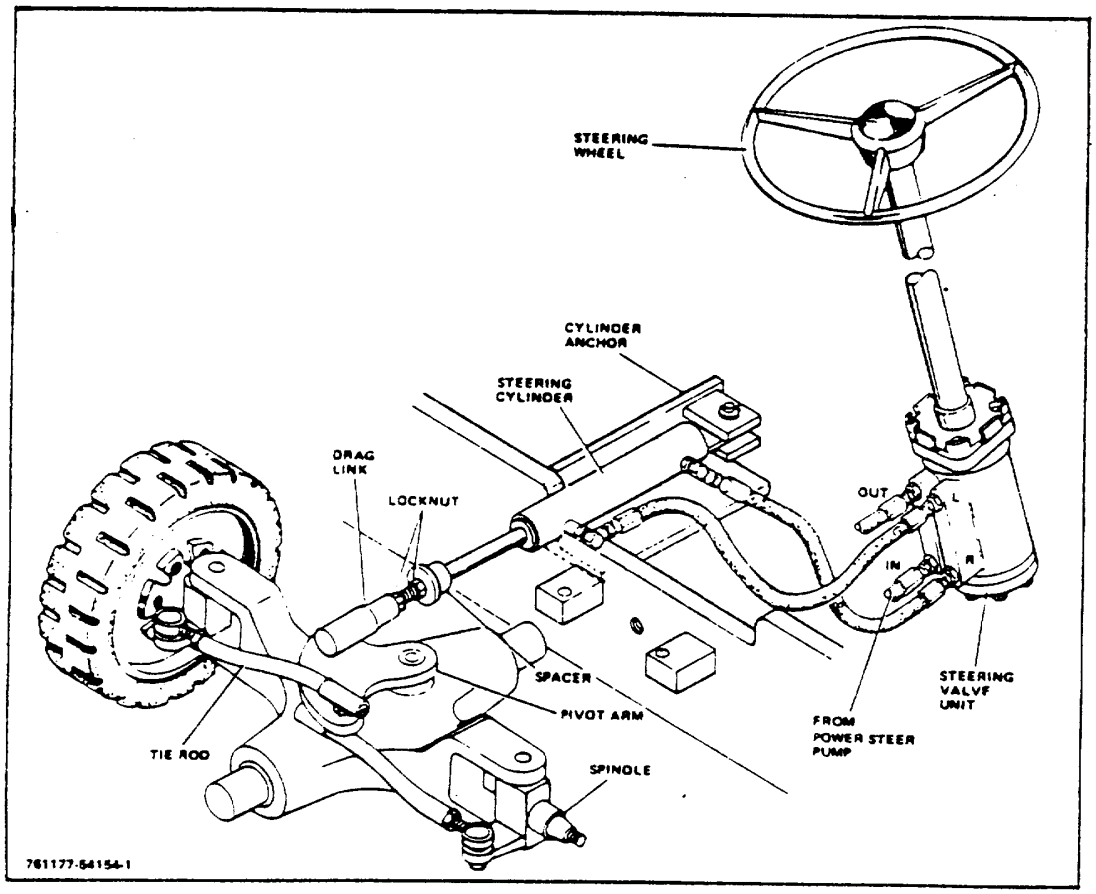


Figure 1-1. Power Steering System

plunger rod retracts, the drag link pulls on the pivot arm and the steer wheels move into position for a left turn due to the opposite movement of the tie rods.

B. DAILY INSPECTION

During operation, check the steering; it should be smooth and the steering wheel should operate freely.

Check the axle toggle stops which are welded to the frame (underside of battery deck) and are located directly above the top of the steer axle housing yokes (Fig 1-2). Turn the steer wheels first to full right and then to full left position; visually check to make certain axle stop on each side is not bent out of position, damaged, or missing.

C. 50 HOUR SERVICE

After each operating interval of 50 hours lubricate all steer axle assembly, tie rod, and drag link fittings with the specified chassis lubricant. Make certain all lube fittings are clean before applying the grease gun. Use enough grease to force out the old lubricant; then wipe off the excess grease.

NOTE

In order to properly lubricate the thrust washers located between the yoke of the steer axle housing and the top of the spindle, it is essential that the weight of the lift truck remains on the steer wheels while the upper needle bearing in the yoke is being lubricated.

D. 500 HOUR INSPECTION

After each operating interval of 500 hours, inspect all hoses and fittings used in the power steering hydraulic system. Replace hoses that are damaged or deteriorated. Check for leaks and correct any that are evident.

After each operating interval of 500 hours, check the condition of the steer wheel bearings. To perform this inspection, proceed as follows:

⚠ WARNING

Make certain the battery is disconnected and the key switch is in the OFF position.

1. Attach a suitable hoist of adequate capacity to the rear of the vehicle and raise it sufficiently so the steer wheels clear the floor. Carefully place sturdy wooden blocks under both sides of the frame. Lower vehicle enough to take stress off the hoist and so the steer wheels clear the floor and the wooden blocks.

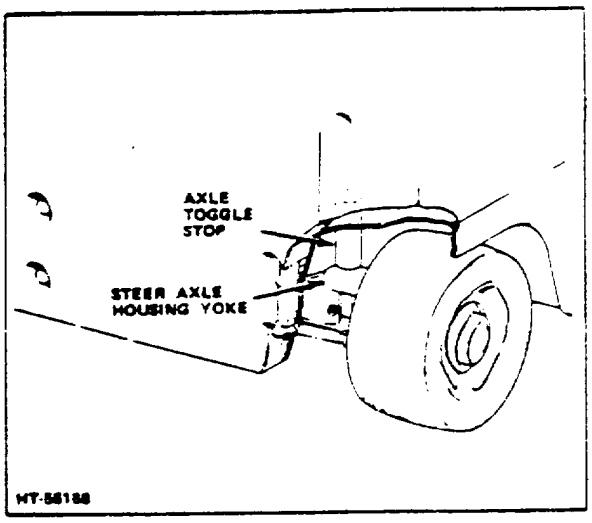


Figure 1-2. Location of Axle Toggle Stops

2. Remove the capscrews and lockwashers that secure the hub cap to the wheel and remove hub cap. Remove the cotter pin, retaining. nut and washer from steer wheel spindle.
3. Remove outer bearing cone (Fig 1-3) from wheel and carefully remove steer -wheel from spindle.
4. Remove inner bearing cone and grease seal from spindle. (Grease seal is used on Models 60 thru 120 Series.)
5. Wash bearing comes in a suitable cleaning solvent to remove grease and foreign material, dry with clean compressed air. Inspect 3earing cones for wear or damage and replace if necessary. Inspect bearing cups in wheel for wear or damage and replace if necessary. Also inspect steer wheel for wear or damage.
6. Lubricate steer wheel inner bearing cone with specified grease. Apply grease with applicator designed to force lubricant into roller bearings.
7. Install grease seal (if applicable) and inner bearing cone on steer wheel spindle.
8. Lubricate bearing cups in wheel and install steer wheel on spindle.
9. Lubricate outer bearing cone with specified grease. Again apply grease with applicator designed to force lubricant into roller bearings.
10. Install outer bearing cone on spindle.

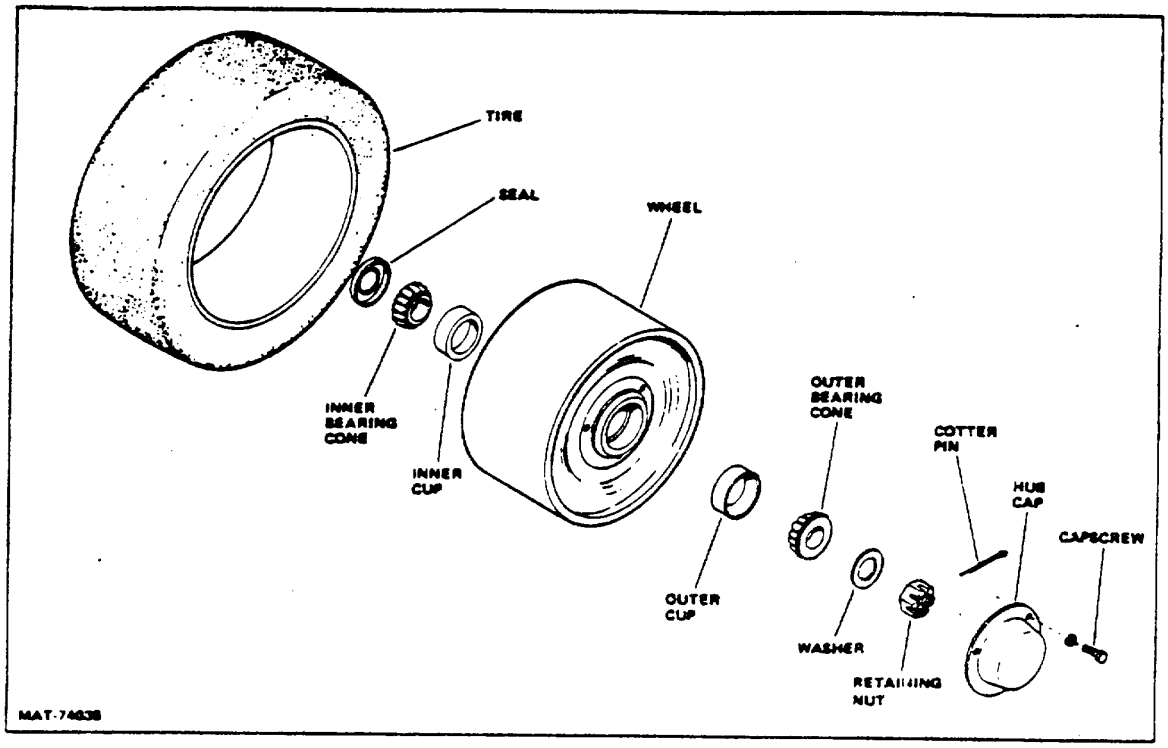


Figure 1-3. Steer Wheel Assembly

11. Install washer and retaining nut on spindle. While rotating steer wheel, tighten retaining nut to a torque of 50 lb-ft; then back off nut until loose (0 lb-ft) Rotate wheel alternately in each direction while tightening retaining rut until a torque of 25 lb-ft is obtained. Then back off nut 30° min to 60° max and install cotter pin.
12. Install hub cap to steer wheel with lockwashers and capscrews; tighten capscrews securely.

NOTE

Before lowering the vehicle, repeat all of the preceding steps for the inspect: on of the steer wheel bearings on the other side of the lift truck.

13. Raise vehicle slightly with the hoist and remove the wooden blocks from under the frame. Then lower vehicle so steer wheels rest on the floor. Remove hoist from rear of vehicle.

E. POWER STEERING SYSTEM PRESSURE ADJUSTMENT

For proper operation of the power steering system, the power steering pump hydraulic pressure must be set at 900 to 1100 psi. To check and adjust the pump pressure, use the following procedure:

1. Remove mounting capscrews and washers that secure the toe plate and floor plate to the frame, and remove the toe plate and floor plate to gain access to the steering valve unit.
2. Remove the pump pressure hose from the adaptor in the steering valve unit (the hose that is connected between the power steering pump and the steering valve unit).
3. Install a suitable tee fitting (Fig 14) between the adaptor and the end of the hose. Install a pressure gauge (0-3000 psi range) In the tee.
4. Connect the battery, close seat switch by depressing seat to full down position, and turn key to ON; power steering motor will operate. (Turning key switch to ON position is not necessary for lift trucks with 702 MK II control.) Turn steering wheel towards left or right and place a sturdy block between the spindle and steer axle so relief valve pressure can be read as spindle is forced against the block.

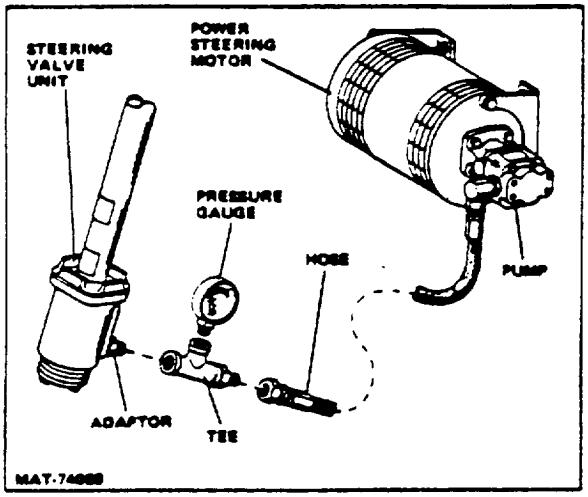


Figure 1-4. Pressure Gauge Location

5. Observe the needle on the pressure gauge. If pressure of 1000 plus or minus 100 psi is not obtained, the pump relief valve must be adjusted.
6. To adjust pressure, remove cap nut (Fig 1-5) from adjusting screw in power steering pump. Turn adjusting screw IN to increase pressure or OUT to decrease it.
7. After adjustment is completed, install cap nut on adjusting screw.

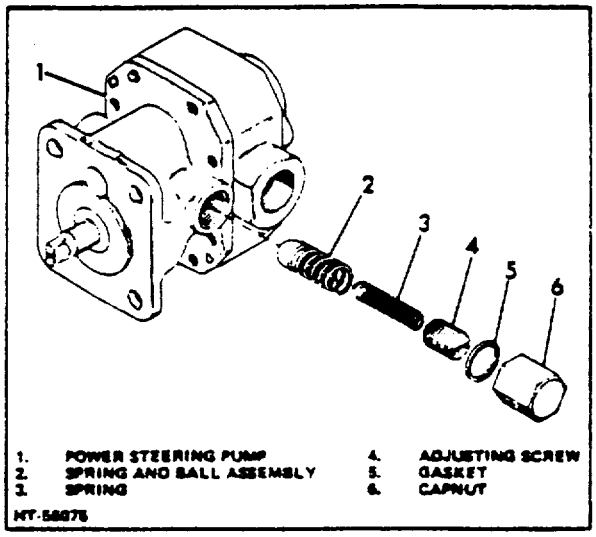


Figure 1-5. Power Steering Pump

8. Disconnect the battery and remove the tee fitting with pressure gauge from the adaptor and pressure hose.
9. Install pump pressure hose to adaptor securely.
10. Install toe plate and floor plate to frame with washers and mounting capscrews.

TOPIC 2. STEERING ADJUSTMENTS

A. GENERAL

Daily during operation, check the steering; It should be smooth and the steering wheel should operate freely.

B. ADJUSTMENTS

⚠ WARNING

Before performing any of the following adjustments, make certain the battery is disconnected and the key switch is in the OFF position.

1. Steering Wheel And Column Adjustment

Proper alignment of the steering column is very important. The column must not be sprung in any direction from its free position. Also the steering wheel must be securely attached to the steering column shaft.

To determine whether or not any misalignment exists, release the upper column support by loosening the support mounting hardware and note whether the column moves to a different position. If it does not move, it is already in its free position and no alignment is necessary. If it does move, it has been out of line and should be clamped in its new position, or its position should be corrected at the upper mounting bracket.

After alignment is checked or corrected, tighten mounting hardware securely.

If the steering column has been bent permanently due to severe misalignment, replacement of the tube, column shaft, or entire unit may be necessary.

2. Tie Rod Adjustment (Toe-In)

The toe-in of the steer wheels must be maintained at zero degrees (0°) at all times. Improper toe-in can result In premature tire wear and shortened battery life due to tire scuffing.

To check toe-in of the steer wheels and adjust the tie rods, proceed as follows:

a. Position the steer wheels straight ahead, parallel with the frame.
b. Raise rear of lift truck with a suitable hoist and cautiously block it in place.
c. One method of checking toe-in is to measure the distance between the centers of the steer wheel tire treads at the rear of the tires. Then measure the distance between the centers of the tire treads at the front of the tires (180° from where the first measurement was taken). If the two measurements taken are equal, no adjustment is necessary.
d. If the measurement taken at the front of the tires is greater than the one taken at the rear, the tie rod ball sockets must be turned out of the tie rods an equal amount. If the measurement taken at the rear of the tires is greater than the one taken at the front, the ball sockets must be turned in.
e. To adjust tie rod, remove cotter pin and retaining nut that secures tie rod ball socket to steer wheel spindle. Remove ball socket from spindle and loosen locknut that secures ball socket to tie rod. With the steer wheel parallel to the frame, turn ball socket IN or OUT until proper adjustment is obtained. Position ball socket in steer wheel spindle, install retaining nut securely, and install cotter pin; then tighten ball socket locknut.
f. With tie rods properly adjusted, perform the spindle stop adjustment in the following Subparagraph 3.
g. After spindle stop adjustment is completed, lower rear of lift truck with the hoist and remove the blocks.

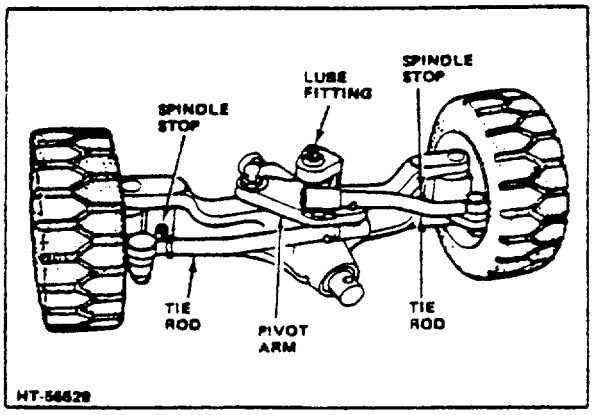


Figure 2-1. Steer Axle Assembly

3. Spindle Stop Adjustment Spindle stops are provided in the steer 2-98

axle housing to limit the inward travel of the steer wheel spindles, and to prevent the piston from bottoming in the power steering cylinder.

To check and adjust spindle stops, proceed as follows:

a. Turn the steer wheels first to the full right and then the full left. Measure the clearance between the wheel and the steer axle housing at both wheels. Clearance should be a minimum of 1/2".

b. Loosen locknut and adjust spindle stop (Fig 2-1) to proper clearance if necessary. After adjustment is completed, hold spindle stop in place and tighten locknut securely.

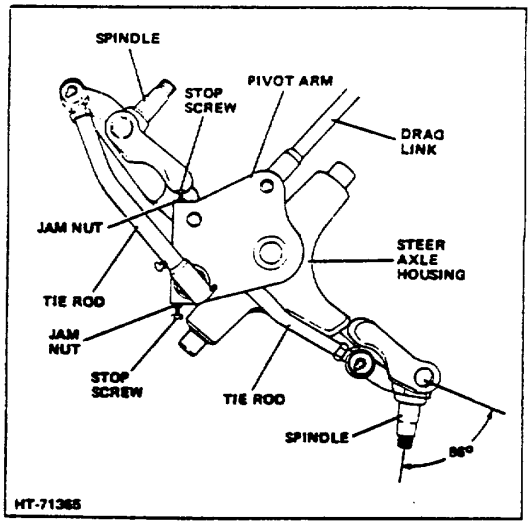


Figure 2-2. Pivot Arm Stop Adjustment

TOPIC 3. DRAG LINK ADJUSTMENTS

A. DESCRIPTION

The drag link assembly is the mechanical connection between the power steering cylinder and the steer axle.

As the steering wheel is turned, either right or left, hydraulic pressure from the power steering valve unit to the power steering cylinder forces the plunger rod in or out of the cylinder. The drag link is connected to the rod and to the pivot arm assembly on the steer axle which cause the wheels to turn.

B. DRAG LINK ADJUSTMENT

The drag link must be adjusted to allow the plunger rod to move an equal distance in and out of the power steering cylinder.

For models ACE 35 thru 120 adjustment for a right turn is accomplished as follows:

(1) Turn the steer wheels to the right until the spindle arm contacts the stop screw on the axle housing (Fig 3-1).

(2) Pull cylinder rod out to maximum extended position. Adjust drag link until the socket lines up with the ball stud on the pivot arm and install link to ball stud.

(3) Seat the adjusting plug against the ball stud, then back off plug until the slot in the plug aligns with the nearest set of holes and insert new cotter pin.

(4) Tighten jam nut "A" against the drag link and torque to 150-170 lb-ft.

For models ACE 35 thru 120 adjustment for a left turn is accomplished as follows:

(1) Turn the wheels to the left until the spindle arm contacts the stop screw on the axle housing (Fig 3-2).

(2) Adjust spacer until it seats over the cylinder tube.

(3) Tighten jam nut "B" against the spacer and torque to 150-170 lb-ft.

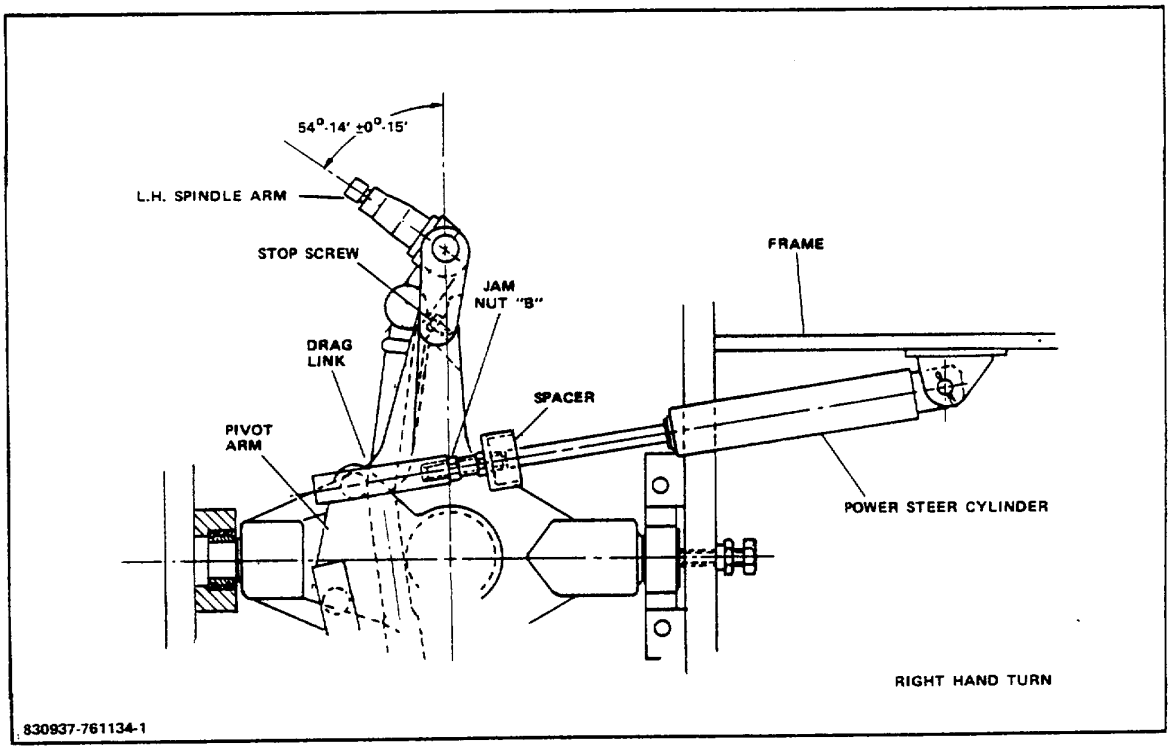


Figure 3-1. Drag Link Adjustment Right Turn

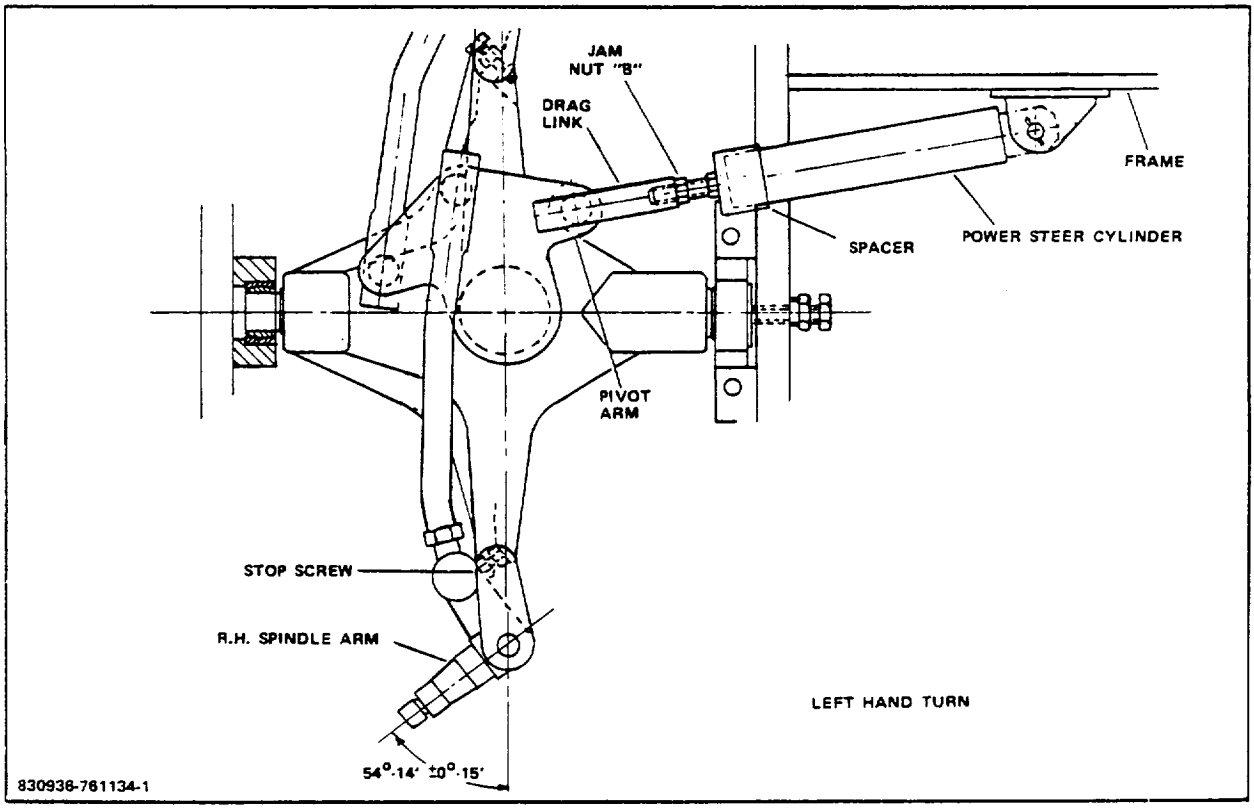


Figure 3-2. Drag Link Adjustment Left Turn

TOPIC 4. STEERING VALVE UNIT

A. DESCRIPTION

The power steering valve unit directs the flow of hydraulic oil from the power steering pump to the appropriate steering cylinder ports when the steering wheel is turned to the right or left.

B. STEERING VALVE UNIT REMOVAL

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitors. (For lift trucks with SCR control, discharge the capacitor(s) on the. SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

1. Remove the floor plate and toe plate.
2. Disconnect hydraulic hoses from steering valve unit. Cover all openings immediately to prevent entry of dirt in the hydraulic system.
3. Disconnect horn button wire.
4. Remove capscrews that secure steering valve unit to the stationary bracket.
5. Lift steering valve unit up and out of the vehicle and place in a clean work area for disassembly.

C. STEERING VALVE UNIT INSTALLATION

1. Position steering valve unit in truck and install attaching clamps and hardware.
2. Tighten bottom mounting hardware, then check column alignment and tighten upper mounting hardware.
3. Connect horn button wire to the horn.
4. Remove plugs and connect hydraulic hoses to the steering valve unit.
5. Install floor and toe plates and secure with attaching hardware.

TOPIC 1. INSPECTIONS AND SERVICES

A. GENERAL

The hydraulic system (Fig 1-1) provides the means by which the lift, tilt, and accessory operations are controlled. Included in the system is a motor driven, gear type pump that supplies hydraulic oil to the control valve. From the control valve, the flow of hydraulic oil under pressure is directed to the appropriate cylinders. Contamination is removed from the hydraulic oil by a filter located in the return line to the reservoir. The reservoir provides an adequate supply of hydraulic oil to the pump plus an ample reserve. Suction ports at the bottom of the reservoir gravity-feed oil to the hydraulic pump and, on models with power steering, to the power steering pump.

A return line filter is installed in the hydraulic system. This filter, when properly maintained, will keep the contamination level low enough so it will not be detrimental to the components in the hydraulic system. Depending upon the model of the lift truck, the filter is placed either in the return line from the control valve to the reservoir, or the return line from the power steering valve unit to the reservoir.

Filter element replacement is recommended at the first 50 hours of service, then at each 200 hour interval thereafter or more often if operating conditions warrant it. If the filter becomes clogged, a bypass valve will open to permit hydraulic oil to return to the reservoir.

B. GENERAL MAINTENANCE

It is essential that personnel responsible for the care of the unit adhere to the following general maintenance recommendations:

1. Store and handle hydraulic oil with utmost care to prevent moisture and foreign matter from entering the hydraulic system. All hydraulic oil handling equipment, such as a container, funnel, and hand pump, should be kept clean at all times and covered when not in use.
2. Keep all fittings and connections tight to eliminate oil leaks. However, do not tighten any brass fittings excessively because damage or distortion will result.
3. Before a component is removed from the Figure 1-1. Hydraulic System (Typical) 2-103

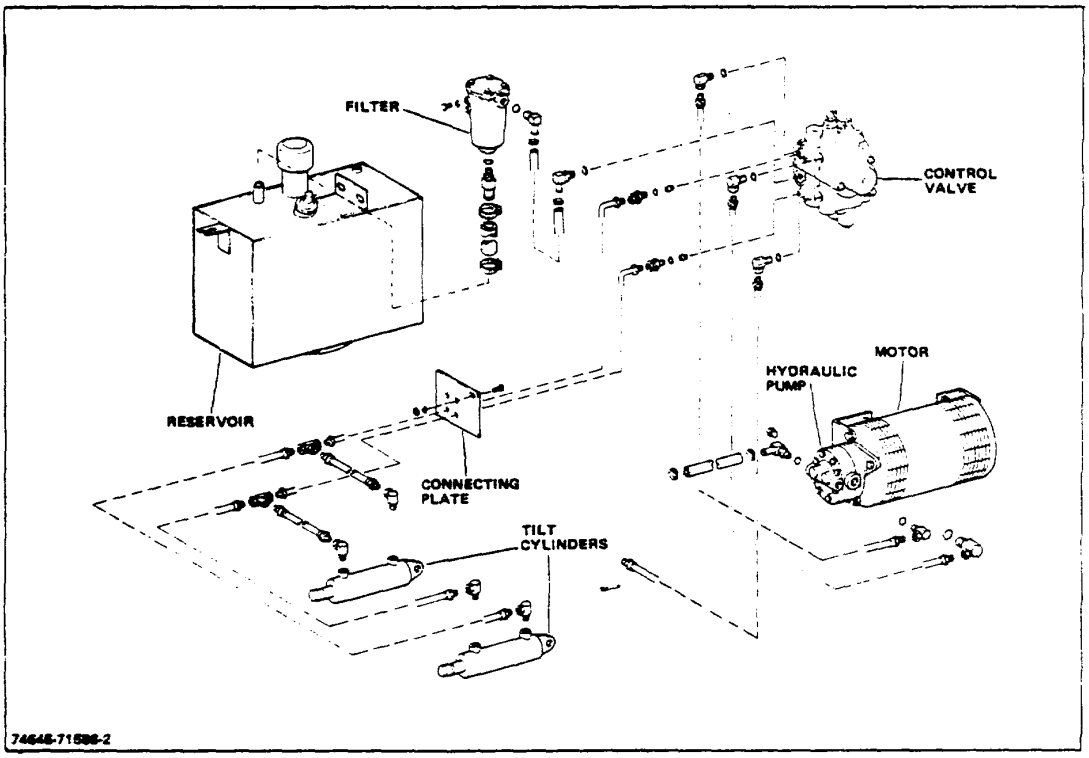


Figure 1-1. Hydraulic System (Typical)

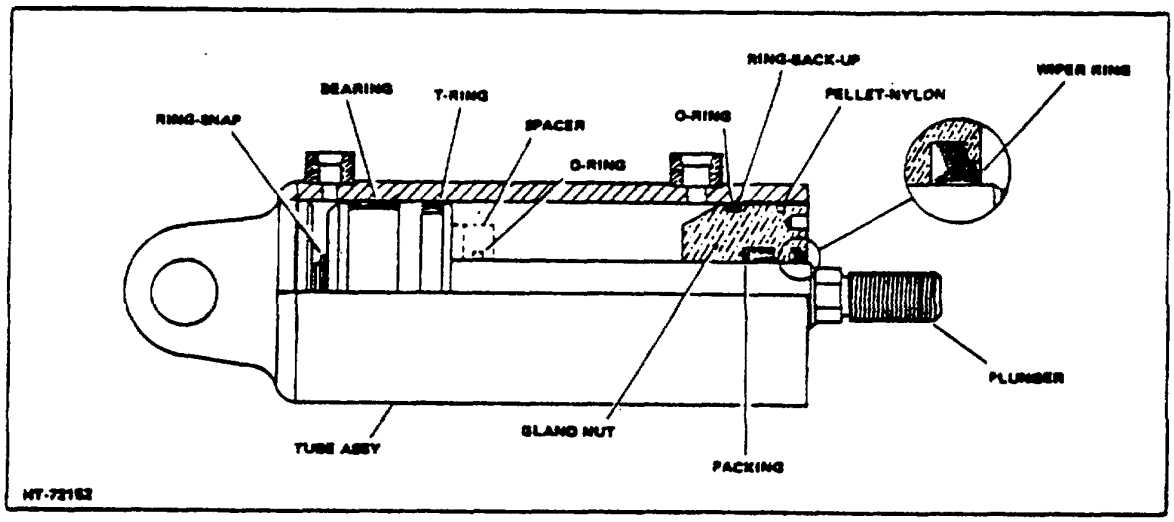


Figure 1-2. Tilt Cylinder

hydraulic system, be sure to wash the component and its surrounding area with cleaning solvent to prevent entrance of foreign matter into the system. Cover all openings immediately.

4. Whenever a fitting with a pipe thread is removed, use a sealing compound on the outside of the threads before the fitting is installed. Make certain all parts are thoroughly cleaned before installation. Do not put sealant on first two threads of fitting, it may contaminate the system.

5. When a hose assembly is installed, make certain it is not twisted when the fittings are tightened. Always use two wrenches on a swivel type fitting, one to hold the hose and the other to tighten the fitting.

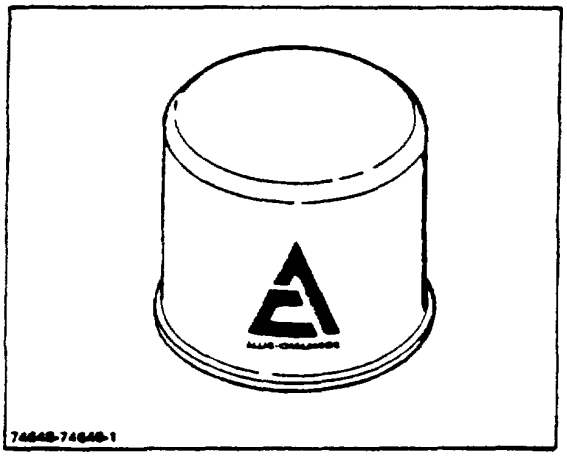


Figure 1-3. Reservoir Breather-Type I

6. Keep hose clamps tight to prevent hose chafing and leakage.
7. All hydraulic system oil leaks should be corrected as soon as leakage becomes evident.
8. Periodically check the pump and control valve mounting hardware for tightness.
9. Replace filter element and reservoir breather, and clean hydraulic oil reservoir at the recommended service intervals.

⚠ CAUTION

Keep the hydraulic system clean. A dirty hydraulic system is a major cause of hydraulic pump, control valve, and packing wear or failure. Contaminated hydraulic oil is the major cause of hydraulic system failures. It is therefore advised that ANY oil that is added or replaced be final filtered through a 10 micron filter, or finer, before entering the hydraulic system.

C. DAILY INSPECTION

Daily during operation, occasionally inspect the floor area where the lift truck was operating to check for oil leaks from the hydraulic system. Correct leaks as soon as they become evident.

Daily, check the reservoir oil level on the dipstick. Oil level should be up to the FULL mark when the mast is lowered so the carriage is at its fully lowered position and mast is at full backward tilt and oil is at approximately 700 F. Add ore-filtered specified

hydraulic oil to obtain proper level if necessary.

⚠ CAUTION

Before operating the lift control lever, verify that the hydraulic oil level in the reservoir Is at the FULL mark on the dipstick.

Daily during operation, check the forward and backward tilt operations. Operate load in forward and backward positions. The forward and backward tilt operations should be immediate and smooth.

D. 50 HOUR INSPECTION

1. Lift Cylinder

   After each 50 hours of operation, inspect the mast lift cylinder(s) for leaks; correct any that are evident. Check lift cylinder hoses and fittings for leaks; correct if necessary.

   No adjustment can be made on the mast lift cylinders. When leakage occurs, the seals must be replaced.

   A flow regulator, which is located at the base of the lift cylinder, controls the flow of hydraulic oil so the load lowers at a controlled rate of speed from the raised position.

2. Tilt Cylinders

   After each 50 hours of operation, check the tilt cylinder hoses-and fittings for leaks; correct if necessary. Check tilt cylinder mountings and make certain the yoke is tight on the plunger so the plunger does not rotate in the cylinder. Check the stroke of both plungers in relationship to the distance between the front of lift truck and the mast. This distance, or amount of mast travel, must be equal on each side, otherwise damage to the tilt cylinders, frame, or mast could result. If the distance is not equal, adjust the position of the yoke on the plunger until it is equal. Also, lubricate yoke pins by lubricating the pressure gun fittings on the mast with specified grease.

   a. Oil Leakage Gland Nut During the 50 hour inspection, check for oil leakage at the gland nut (Figure 1-2.)011 leakage at the gland nut indicates seals are worn. To stop leakage, remove gland nut with a spanner wrench and replace seals.

   b. Oil Leakage Piston Seal

      Check the operation of the tilt cylinders. If the mast assembly should tilt too slowly or if it creeps under load, it is an indication that hydraulic oil is leaking past the piston seal in the tilt cylinders. This can be checked as follows:

      ⚠ CAUTION

      Operate the control lever ONLY in the direction specified in the following steps.

      (1) Tilt the mast assembly forward to its extreme limit.

      (2) Loosen the hoses at the front or yoke end of both tilt cylinders.

      (3) With the battery connected and key switch in the ON position, place and hold tilt control lever in the forward position; check for oil flow through the loosened fittings of both cylinders. If oil flows out of the fitting of either cylinder, remove the cylinder and replace the piston seal.

      (4) To check the piston seal when mast assembly is at its extreme backward position, reverse the procedure in the preceding steps (1), (2), and (3).

3. Initial Filter Element

   After the first 50 hours of new truck operation, the hydraulic oil filter element or cartridge must be replaced and the filter housing cleaned.

E. 200 HOUR SERVICE

1. Hydraulic Oil Reservoir Breather Type I

   The breather (Fig 1-3) is the "spin-on can type with a pleated paper element and is rated at 10 microns. After each operating interval of 200 hours, remove breather from top of hydraulic oil reservoir and replace it with a new one.

2. Filter Cartridge Replacement (Type B)
   After each operating interval of 200 hours, replace cartridge as follows: a. Thoroughly clean the filter head and surrounding area.

b. Unscrew and remove cartridge (Figure 1-4) from filter head. Discard filter cartridge.

c. Inspect inside of filter head. Remove dirt or sediment from inside of filter head when necessary.

d. Screw new filter cartridge into position until cartridge gaskets contact filter head. Use hand pressure and tighten filter cartridge an additional 1/2 to 3/4 of a turn.

⚠ CAUTION

The gasket of this filter cartridge will seal properly when the filter cartridge is hand tightened.

e. Operate hydraulic system and check for leaks. Correct if necessary.

f. Check hydraulic oil reservoir level with all cylinders retracted. Fill reservoir with pre-filtered specified oil to full mark on dipstick if necessary.

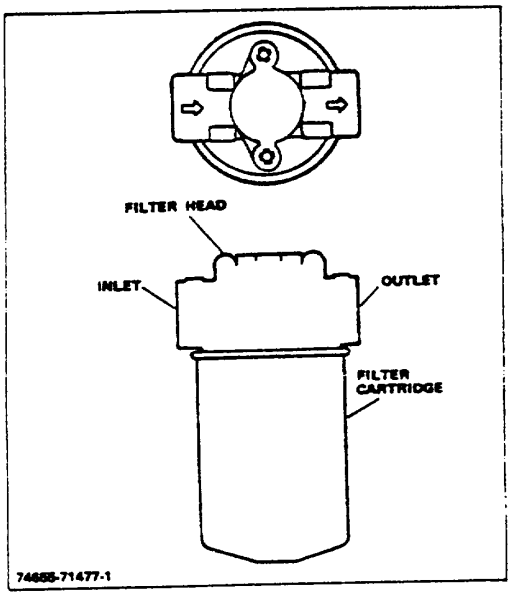


Figure 1-4. Hydraulic Oil Filter (Type B)

F. 500 HOUR INSPECTION

1. Hoses, Tubes, and Fittings

   After each operating interval of 500 hours, inspect all hoses, tubes, and fittings in the hydraulic system. Replace hoses that are damaged or deteriorated. Replace all tubes that are kinked or damaged. Check all connections for leaks and correct any that are evident.

2. Hydraulic Pump

   After each 500 hours of operation, check the tightness of the pump mounting capscrews and the pump motor mounting bracket capscrews. Make certain all mounting capscrews are tightened securely.

   The internal parts of the pump are machined to a high degree of accuracy and the tolerances are very close. When a pump is in need of repair which requires complete disassembly, it is recommended the pump be sent to your local Allis-Chalmers lift truck dealer for repair. Include your purchase order and full information regarding the nature of the breakdown.

   In some cases where a pump is inoperative, it may be possible to repair it in the field. Satisfactory repair can be accomplished, provided a clean, well equipped repair shop manned by a competent mechanic is available.

3. Control Valve

   The control valve requires very little attention with the exception of keeping the lines, fittings, hose connections and mounting hardware tight. Also after every 500 hours of operation, check the control valve linkage and the operation of the microswitches. Make certain that definite pressure is applied to the control valve levers and a slight motion of each lever occurs before the pump operates. The pump motor should start operating and there should be no movement of the lift or tilt cylinders. Further movement backward or forward of the control levers will then allow oil to flow to the appropriate cylinders and cylinder movement will occur.

   The basic control valve is a two section valve. One section controls the lift operation and the other controls the tilt operation. Additional sections may be added to control and operate various accessory attachments. Each section may be replaced separately and all parts of a section may be replaced individually with the exception of the plunger housing and plunger.

   If the control valve becomes inoperative, satisfactory repair can be accomplished by a competent mechanic. However, it is recommended the valve be sent to your local Allis-Chalmers lift truck dealer for repair. Include your purchase order and full information regarding the nature of the breakdown.

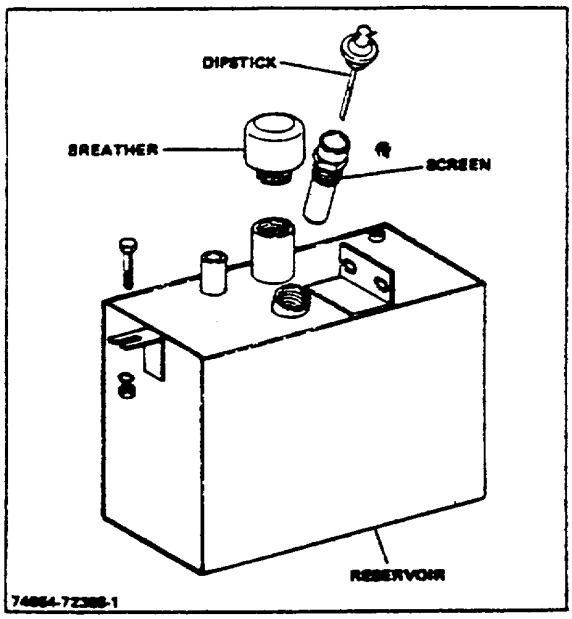


Figure 1-5. Hydraulic 01l Reservoir Components (Typical)

Relief valves are incorporated in the control valve as protective devices. For adjustment procedure of the relief valves, refer to following Topic 2.

G. 1000 HOUR SERVICE

After each operating interval of 1000 hours, the oil in the reservoir should be drained and replaced. This is important primarily because of condensation and contamination. Heating of the oil during operation and cooling of it when the lift truck is not in use contributes to condensation which is detrimental to the hydraulic system. Contaminates such as dirt, rust, scale, and products of oil deterioration are also detrimental. Drain and clean oil reservoir as follows:

1. Lower the mast so the carriage is at its fully lowered position.
2. Remove drain plug from bottom of oil reservoir and allow oil to drain in a container.

⚠ CAUTION

The hydraulic pump should only be used for pumping oil thru the hydraulic system.

3. After oil has drained, flush inside of reservoir with a suitable cleaning solvent and clean the screen (Fig 1-5) in the reservoir filler opening.

NOTE

In order to clean the reservoir properly, it should be removed from the lift truck. If applicable, remove gasket and clean-out cover.

4. Dry the inside of the reservoir with clean, dry compressed air.
5. Install new filter element or cartridge and reservoir breather.
6. Install drain plug in bottom of reservoir and fill reservoir with prefiltered specified hydraulic oil. With oil at approximately 700F, fill reservoir until level is up to the FULL mark on the dipstick. During the filling operation, make certain a clean container or funnel is used and the mast is lowered so the carriage is at its fully lowered position and all other cylinders are retracted.
7. Install filler cap and operate hydraulic system. Check for leaks and correct any if necessary.

TOPIC 2. CHECKING INLET PRESSURE AT THE CONTROL VALVE

A. CHECKING PRESSURES AT THE CONTROL VALVE

Two relief valves, one for lift and one for tilt operation, are incorporated in the control valve as a protective device. The relief valves protect the hydraulic system from damage in case of excessive hydraulic pressure. Whenever the lift or tilt cylinder reaches the full stroke position or when an excessive load is handled, excessive hydraulic pressure is built up. This pressure opens the relief valves and bypasses the hydraulic oil to the reservoir. The relief valves are preset by the manufacturer to open at specified pressures and should be checked at regular intervals, also whenever the control valve or hydraulic pump has been repaired or replaced.

Use the following procedures to check inlet and lift section pressures. Check the inlet section pressure first.

⚠ WARNING

Disconnect the battery and discharge the capacitors. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTORNIC control system. turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.

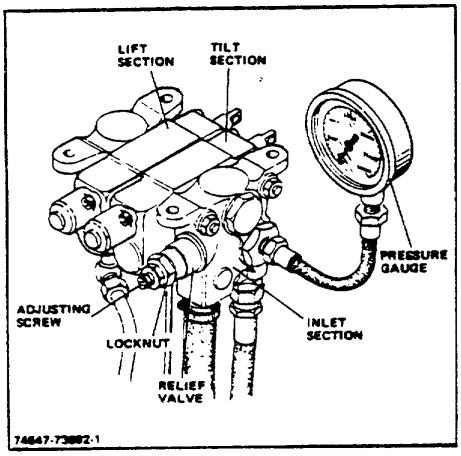


Figure 2-1. Checking Inlet Section Pressure

1. Checking Inlet Section Pressure (Fig 2-1)

   a. Remove center cover panel and floor plate to gain access to the control valve.

   b. Remove pipe plug from large plug in the side of the inlet section. Install a pressure gauge (Fig 2-1) with a zero to 3000 psi range. A short length of high pressure hose with fittings may he installed between the gauge and the large plug to facilitate installation of the gauge.

NOTE

Some lift trucks are equipped with an inlet adaptor which has a pipe plug where a pressure gauge can be installed. If unit is an early model and is not equipped with this adaptor, then either install a large plug and gauge in the side of the inlet section as illustrated in Figure 2-1, or disconnect the hydraulic hose from the upper port in the inlet section, install a tee fitting, and install a zero to 3000 psi gauge and the hydraulic hose in the tee.

   c. Connect battery, leave directional lever in neutral position, and turn key switch ON.

   d. Pull the tilt lever back to retract the tilt cylinders and hold lever in this position.

   e. While holding lever, observe the needle on the pressure gauge. When pressure reading of 2100 psi is attained, the needle will stop, indicating relief valve opening.

   f. If the relief valve opens below or above 2100 psi, it must be adjusted as follows:

   (1) Remove acorn nut covering adjusting screw directly underneath the inlet section of the control valve and loosen the jam nut.

   (2) While holding tilt lever back, turn adjusting screw in to increase or out to decrease relief pressure.

   (3) After pressure is properly adjusted, tighten jam nut to lock adjusting screw in position.

   (4) Recheck relief valve setting described in preceding steps d and e. Then install acorn nut.

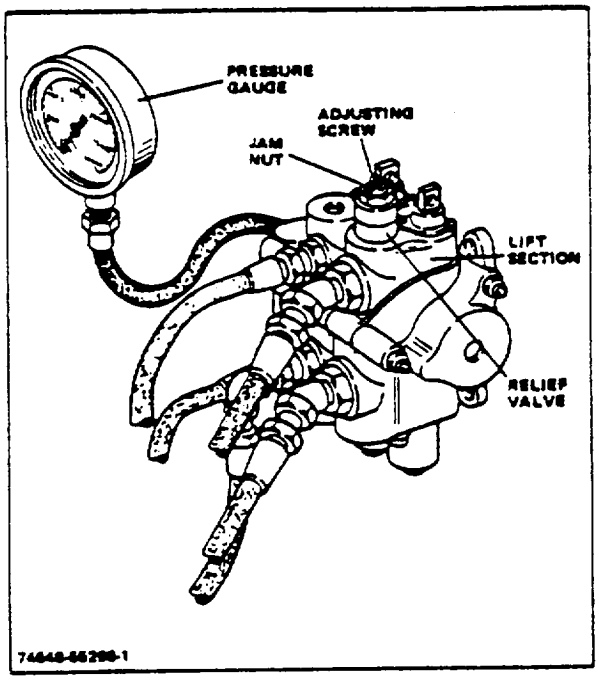


Figure 2-2. Checking Lift Section Pressure

2. Checking Lift Section Pressure (Fig 2-2)

   a. After making the check outlined in .preceding Subparagraph l, leave the pressure gauge installed in the inlet section.

   b. Connect battery, leave directional lever in neutral position, and turn key switch ON.

   c. Pull the lift lever back to operate lift cylinder and hold lever in this position.

   d. While holding lever, observe the needle on the pressure gauge. When pressure reading of 1900 psi is attained, the needle will stop, indicating relief valve opening.

   e. If the relief valve opens below 1900 or above 1950 psi, it must be adjusted as follows:

   (1) Remove acorn nut covering the adjusting screw on top of the control valve and loosen the jam nut.

   (2) While holding lift lever back, turn adjusting screw in to increase or out to decrease relief pressure.

   (3) After pressure Is properly adjusted, tighten jam nut to lock adjusting screw in position.

   (4) Recheck relief valve setting and then install acorn nut.

   f. Turn key switch off, disconnect battery, and discharge the capacitors.

   g. Remove pressure gauge and install pipe plug.

   h. Install floor plate and center cover panel.

TOPIC 1. FRAME AND COMPONENTS

A. GENERAL

The lift truck frame design (Fig 1-1) reflects the latest advancement in stress analysis engineering. The all welded frame consists of one piece side members that utilize box-type construction with cross bracing to provide strength and simplicity of design. The frame is designed for maximum accessibility to all components and to provide a low center of gravity.

B. TOE PLATE AND FLOOR PLATE

As a general rule, the toe plate and floor plate will require no maintenance whatever, but are removed during normal maintenance and service intervals.

1. To remove toe plate (Fig 1-1) and/or floor plate, remove mounting screws and washers; lift plate up and away from lift truck.

2. To Install either or both plates, place In correct position; align holes and install washers and mounting screws securely.

C. SEAT ASSEMBLY

The operator's seat (Fig 1-2) has two vinyl covered, foam rubber cushions; one serves as a backrest and the other as the seat cushion. These cushions are contoured for maximum comfort.

The seat assembly has a forward/backward adjustment to allow for optimum pedal reach as desired by operator.

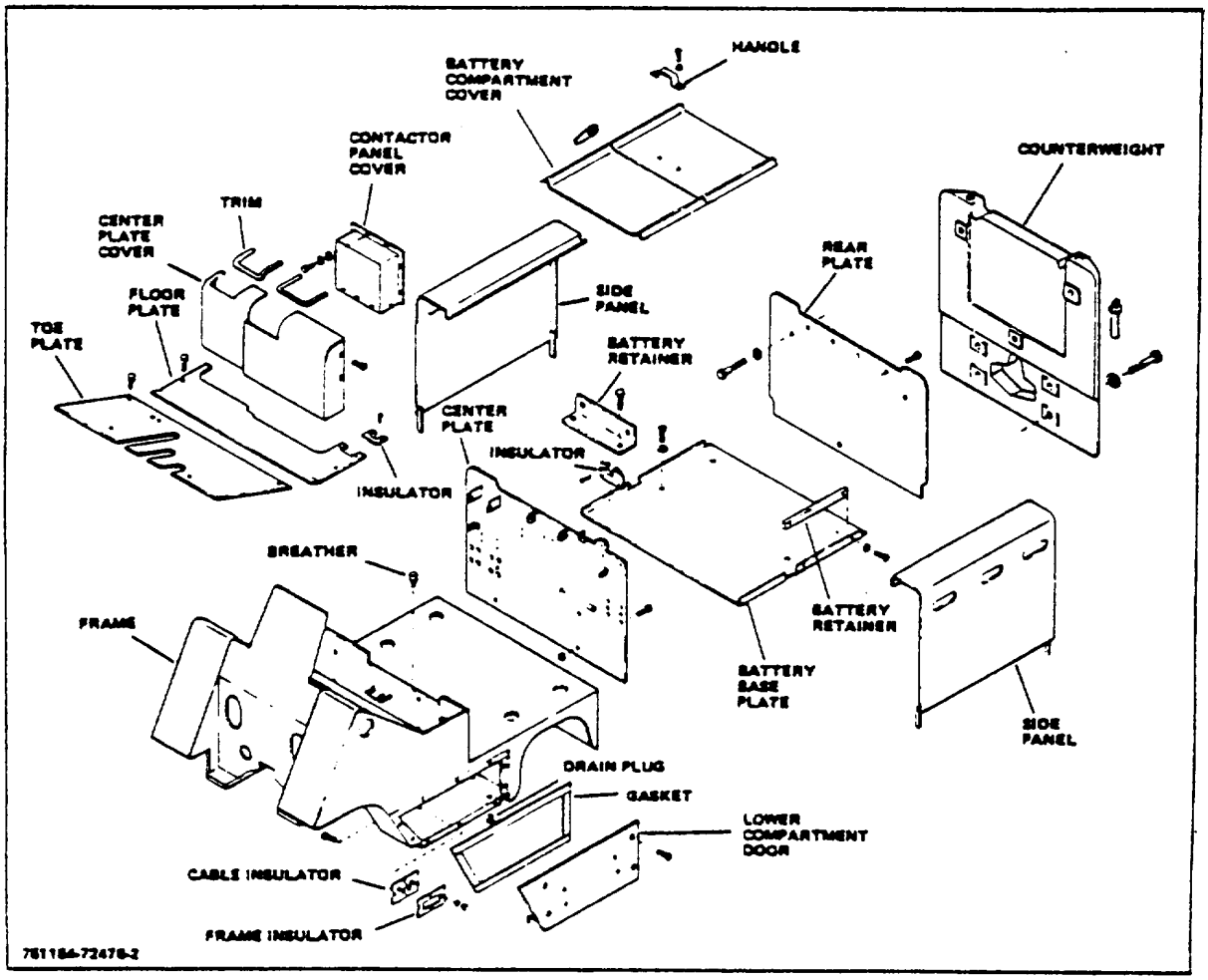


Figure 1-1. Frame and Counterweight

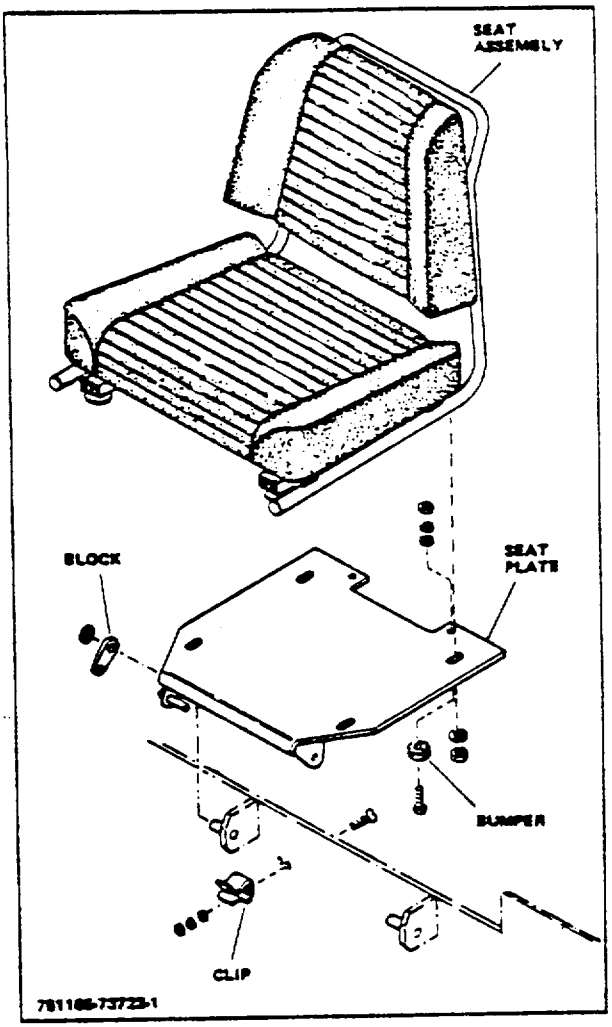


Figure 1-2. Seat Assembly

1. Should it become necessary to remove the operator's seat, remove the seat base mounting nuts and remove the seat assembly from the seat plate.
2. To install operator's seat, place seat assembly in Its mounting position; align seat base mounting caspcrews in seat plate holes and Install mounting nuts securely.

TOPIC 2. OVERHEAD GUARD

A. GENERAL

The overhead guard is a safety feature which is supplied as standard equipment by Allis-Chalmers. Its tubular, all welded construction is designed for maximum operator visibility coupled with operator safety.

The top rail of the electric lift truck overhead guard is slotted to provide for entry of the hook or cables from a hoist. This feature facilitates the removal and installation of the lift truck battery without removing the overhead guard. However, the guard is a bolt on type and can be removed when necessary. If the overhead guard is removed for any reason, it must be replaced securely prior to truck operation.

B. DAILY INSPECTION

Daily, inspect the overhead guard mounting plates (Fig 2-1); make certain plates are securely mounted with the necessary capscrews, lockwashers, and nuts. Visually inspect the welded joints and structure for possible cracks.

C. REMOVAL AND INSTALLATION

The overhead guard assembly may be taken off the truck with the assistance of a hoist and chain, after the removal of the securing capscrews, lockwashers and nuts.

To install the overhead guard assembly, use a hoist and chain to position guard over relative mounting location, then insert capscrews with lockwashers and nuts, and tighten evenly and securely.

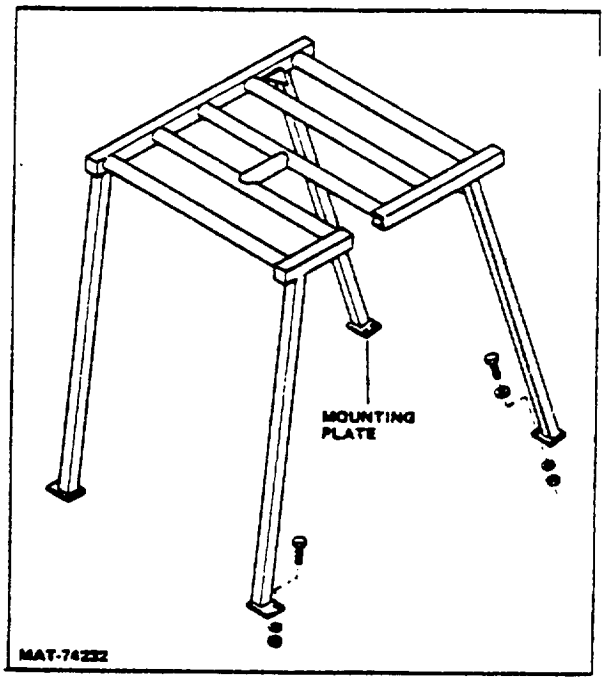


Figure 2-1. Overhead Guard Assembly

TOPIC 3. COUNTERWEIGHT

A. GENERAL

The exterior design contours of all counterweights used on electric lift trucks are similar in appearance, with the exception of different widths and thicknesses. This of course results in variable weight differences. Threaded metal inserts are cast in the top of most counterweights to provide a mounting area for the rear plates of the overhead guard. These inserts can also be utilized for lifting of the counterweight after installation of lifting bolts in the inserts.

Certain care must be exercised during the removal and installation of the counterweights to prevent equipment damage or bodily injury.

B. 200 HOUR INSPECTION

After each 200 hour interval of operation, check counterweight mounting bolts and nuts for tightness (Fig 1-1). Make certain mounting bolts and nuts are tightened securely.

C. REMOVAL

1. Black lift truck wheels to prevent rolling.
2. Attach suitable hoist to counterweight and take up slack in hoist chain.

   ⚠ WARNING

   Make certain hoist is adequately rated for estimated weight of counterweight. Do not attempt to lift a counterweight with a hoist rated below the weight of the counterweight.

3. Remove counterweight mounting bolts, lockwashers, washers, and nuts.
4. Carefully lift counterweight up slightly and then out away from rear plate and frame.
5. Lower counterweight to the floor; make certain it is properly balanced, and blocked if necessary, prior to removal of the hoist.

D. INSPECTION

Carefully inspect counterweight for fractures, especially at the mounting points such as the bolt holes. It is common practice to replace a badly fractured counterweight rather than attempt to repair it.

E. INSTALLATION

1. Make certain counterweight mounting area Is clear of obstructions prior to installation.

   ⚠ WARNING

   Make certain hoist is adequately rated for weight of counterweight before attempting to lift it.

2. Attach a suitable hoist to the counterweight; lift and maneuver counterweight into its relative mounting position.
3. Keep enough tension on hoist to allow insertion of mounting bolts, washers, lockwashers, and nuts. Tighten mounting bolts and nuts securely.
4. Remove hoist from counterweight.

TOPIC 1. GENERAL DESCRIPTION

A. GENERAL

The Tri-Max is a three section mast assembly. Three upright structural assemblies nested together include: an outer mast, intermediate mast, and an inner mast. Each mast consists of a structural steel frame, with mounting brackets and blocks welded to it to support the cylinders, chains, and bearings. The intermediate and inner masts ride on adjustable roller bearings, enabling them to telescope up and down smoothly and with a minimum of friction or drag. Alignment of the mast channels is accomplished by adjusting the roller bearings. A carriage, designed to mount lifting forks and attachments, is supported by chains leading from the outer cylinders of the cylinder cluster (20-55 Series), or primary cylinder (60-120 Series). Action of the chains, cylinders, and masts raise and lower the carriage.

An interlock assembly, spring actuated, is mounted on the right beam of the inner mast. The interlock function is to lock all three mast sections in the lowered position until full free lift is accomplished. When full free lift is reached, the carriage stop screw (or stop assembly) strikes the interlock assembly to release it, allowing all mast sections to function completely.

B. OPERATION

1. Cluster Cylinders (20-55 Series) When the lever on the control valve is pulled to the rear, hydraulic oil under pressure is delivered to the two outer cylinders of the cluster cylinder. The pressure forces the cylinder rams to extend upward raising the chains and lifting the carriage up the mast.

As the carriage reaches the top of the lowered masts the cylinder rams will be extended to their farthest point of travel. With the lever pulled to the rear the hydraulic pressure will then force the center cylinder ram of the cluster cylinder downward, raising the inner mast and carriage.

As the ram reaches its farthest extent of travel, the inner mast will be fully extended above the other two masts with the carriage at the top. Continued operation will force the ram of the single cylinder to extend downward against the outer mast, raising the intermediate mast. Full extension of the ram will raise the carriage to the highest level.

When the lever of the control valve is released to neutral, hydraulic oil under pressure will hold the carriage at the required height. To lower the carriage, push the lever forward. The hydraulic pressure will be released allowing the carriage and masts to lower to the required height.

TOPIC 2. MAST ASSEMBLY

A. MAINTENANCE LUBRICATION

1. 50 Hour Service

   After every SO hours of operation, all inner and outer web surfaces of the mast uprights should be lubricated. To perform this requirement, fully extend the mast; coat all inner and outer web surfaces with a moderate amount of high quality Grade 2 wheel bearing grease, or a Grade 2 lithium base grease (characterized by the word "molly"). Also lubricate all grease fittings.

2. 100 Hour Service

   Lubricate Interlock spacer and screw located on inner section of cluster type or primary and secondary type cylinder mast. Use SAE 10 or 20 engine oil.

NOTE

The mast roller bearings (Fig Z-1) used on all Tri-Max masts are of the prelubricated type and do not require periodic lubrication.

B. REMOVAL

⚠ CAUTION

Fully retract or lower lift cylinders.

1. Remove the carriage. (Refer to CARRIAGE MAINTENANCE MANUAL.)
2. With the mast fully lowered, attach a sling from an overhead hoist to mast lift eyes to secure entire mast assembly during removal.

⚠ WARNING

Be certain overhead hoist is rated to safely support mast assembly weight.

3. Disconnect tilt cylinders from outer mast.
4. Disconnect hydraulic hoses from lift cylinders.

NOTE

Cap or plug all hydraulic openings to prevent contamination by foreign particles.

5. (PIVOT PIN TYPE) Remove lockwires, capscrews and lockwashers which retain mast pivot pins to mast assembly. Raise overhead hoist high enough to relieve pressure on the pins and remove them. Use hoist to lay mast on suitable supports.

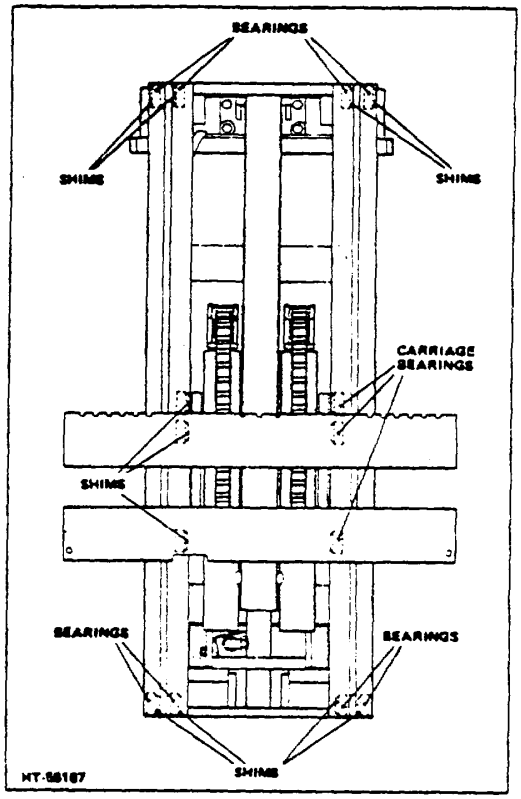


Figure 2-1. Canted Roller Type Carriage and Mast (Typical)

NOTE

Adjustment of the canted bearing type mast must be made before reassembly of mast. Refer to following PARAGRAPH D,. ADJUSTMENT.

C. INSTALLATION

1. Use a properly rated hoist and maneuver the mast assembly to its relative mounting position on front of lift truck.
2. (PIVOT PIN TYPE) Use a drift pin to align the mounting holes on the mast and the lift truck frame. Insert pivot pins, and reinstall retaining capscrews and lockwashers, then torque to 35 to 39 lb-ft. Reinstall lockwires.

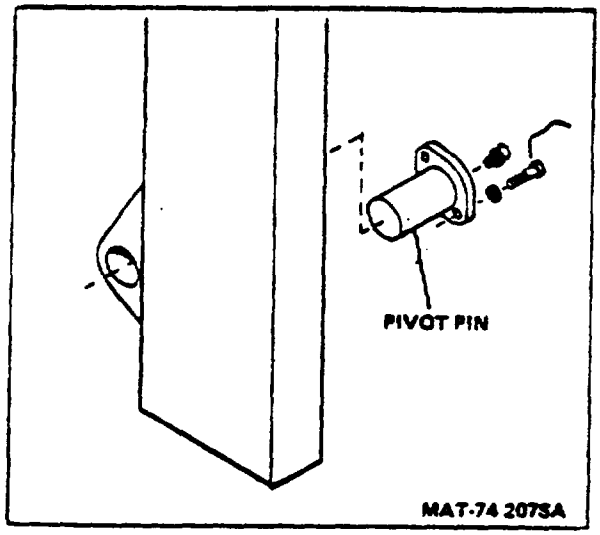


Figure 2-2. Pivot Pin Type Mast

3. Connect and properly secure the tilt cylinder.
4. Reinstall hydraulic hoses.
5. Reinstall the carriage.
6 Lubricate man uprights (Refer to preceding Paragraph A, MAINTENANCE LUBRICATION).

D. AJUSTMENT

To perform the necessary adjustments on the Tri-Max mast. it must be removed and disassembled to allow the placement of shims behind the roller bearings (Fig 2-1).

TOPIC 3. LIFT CYLINDERS

A. GENERAL

The hydraulic oil enters the lift cylinder at or near the base of the cylinder causing the plunger to extend.

A flow regulator, located at the oil inlet port of the lift cylinder, controls the outflow of hydraulic oil so that the load lowers at a controlled rate of speed from the raised position.

B. MAINTENANCE

1. 50 Hour Inspection

   After each 50 hours of operation, inspect the mast lift cylinder, cylinder hoses, and fitting for evidence of leaks and repair as necessary.

2. 100 Hour Inspection

   After each 100 hours of operation, wipe oil and foreign matter from lift chains and inspect them for bent or cracked links. Use a 1" paint brush and lubricate both sides of chains with SAE 20 engine oil. Wipe off excess oil with a clean rag. If chains are loose or carriage is not level, the chains must be adjusted. (Refer to following Paragraph G, LIFT CHAIN ADJUSTMENT.)

3. 500 Hour Service

   Approximately every 500 hours of operation, remove the lift chains from mast assembly and clean them in an oil solvent solution (50 SAE-30 nondetergent engine oil and 50 suitable cleaning solvent). Soak chains in oil-solvent solution for about four (4) hours and agitate them several times during the soaking period. Remove chains from oil-solvent and wipe off all of the cleaning solution. Inspect lift chains for wear and broken or cracked links. Replace entire chain if any links are broken or cracked. Install the chains; then use a l" paint brush and lubricate both sides of chains with SAE-20 engine oil. Adjust chains so fork carriage is level and all slack is removed from the lift chains.

C. REMOVAL CLUSTER & SINGLE (20-55 SERIES)

⚠ CAUTION

Cap or plug all hydraulic openings to prevent contamination by foreign particles.

⚠ CAUTION

Cluster cylinders must be in fully lowered position for removal.

1. Remove the carriage to facilitate lift cylinder removal. (Refer to CARRIAGE MAINTENANCE MANUAL.)
2. Disconnect the lift chains from adjusting screws on the cylinder cluster.
3. With cylinders completely retracted, disconnect the hydraulic line between the cluster cylinder and the single cylinder.
4. Remove the screw and nut which secure the cylinder cluster to the inner and intermediate masts.
5. Carefully lift cylinder cluster from the mast assembly. Remove the crosshead assemblies and ram guards from the outer cylinder rams.
6. To remove the single lift cylinder, remove the fittings, clamps and the flow regulator from the cylinder.
7. Remove the clamp securing the lift cylinder to the intermediate mast. Remove the screw and washer securing cylinder to bracket at top of intermediate mast. Remove nut and washer securing cylinder to bottom of outer mast.
8. Remove the single cylinder from the mast and place it on appropriate supports to prevent its rolling during inspection and repair work.

NOTE

Refer to REPAIR MANUAL for DISASSEMBLY, INSPECTION, REPAIR and REASSEMBLY.

D. INSTALLATION.CLUSTER & SINGLE (20-55 SERIES)

1. Attach a properly rated hoist chain to the single lift cylinder, and carefully maneuver the cylinder into its relative mounting location.
2. Install and secure the washer and nut which attach the single cylinder to the bottom of the outer mast assembly.

   Install and secure the washer and screw which attach cylinder to bracket at top of intermediate mast assembly. Remove hoist chain from cylinder after the

intermediate mast retaining clamp has been replaced.

3. Install all fittings and clamps previously removed from cylinder, and install the flow regulator.
4. To install the cylinder cluster assembly, first ensure that the crosshead assemblies have been correctly installed at the outer cylinder rams, and that the chain adjusting screws and locknuts have been installed.
5. Attach a properly rated hoist chain to the cylinder cluster assembly and maneuver cluster assembly into its relative mounting position within the inner and outer masts.
6. Install the attaching capscrew which secure the cluster cylinder to the inner and intermediate masts. Tighten mounting bolts.
7. Replace the chain guard and connect the hydraulic line between the cluster cylinder and the single cylinder.
8. Install and reconnect the cluster cylinder lift chains at the chain adjusting screws.

NOTE

Refer to following Paragraph E, LIFT CHAIN AOJUSTMENT, prior to operational use of lift truck.

9. Install the carriage

NOTE

Refer to following Paragraph F, for LIFT CYUNDER BLEED SERVICE.

E. LIFT CHAIN ADJUSTMENT (20-55 SERIES)

When it becomes apparent that the fork carriage is not level, that the lift chains are loose, or that the forks (or attachments) are higher than .250 or .50" above the floor when the lift cylinder is fully lowered, then the lift chains require adjustment.

Although the chain anchors are of different sizes and in different locations on the various types of masts, the lift chain adjustment remains the same, with the following exception:

NOTE

ALL CYLINDER CLUSTERS are adjusted with the PRIMARY Cylinder FULLY extended.

1. Position the mast assembly so it is vertical. Ensure that the inner mast section and lift cylinder are in the fully lowered position.

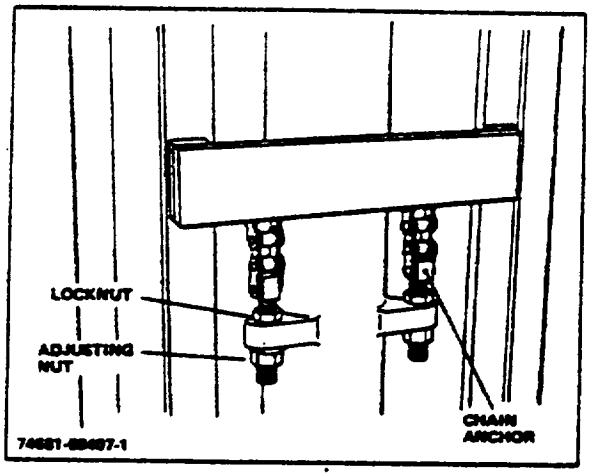


Figure 3-1. Chain Adjustment (On Cylinder)

2. Loosen the chain anchor locknuts (Fig 3-1).
3. Chain tension is adjusted by increasing or decreasing the chain lengths with the adjusting nuts. Alternately tighten or loosen the chain on one side and then on the opposite side, until the chains are snug, with no slack and carriage forks clear the floor within .25" to .50".
4. Make certain that the lift chain tension is equal on each chain and that the fork carriage is level.
5. After the adjustment is completed, tighten the locknuts securely and make certain anchors were not turned.

F. LIFT CYLINODER BLEED SERVICE

It is general good practice to bleed the lift cylinders after cylinder repair or installation, or when erratic cylinder operation is noted.

1. Raise mast until forks are approximately 3 feet off of the ground.
2. Open cylinder bleed screws until a stream of PURE HYDRAULIC OIL is emitted..

NOTE

Be sure the oil being emitted is free of any tiny air bubbles that may be seen only under close inspection. Leave bleed screws open until a pure stream of hydraulic oil is emitted.

3. Close bleed screws tight.
4. Check hydraulic oil level.
5. Raise and lower mast to check for leaks if any, and repair as necessary.

TOPIC 1. CARRIAGES

A. DESCRIPTION

The carriage assembly is a heavy duty structure of welded steel, built to provide ultimate strength and visibility, with a minimum of overhang from the center of the drive wheels to the face of the forks. An optional item used in conjunction with the carriage assembly is the backrest extension. This assembly is a welded metal frame which is attached to the carriage (in front of the uprights vertically), and serves to prevent loads from resting against the mast when the mast is tilted back. It also keeps the load from falling back onto the operator.

B. MAINTENANCE INSPECTION

1. Daily

   Daily during operation, check the lift speed of the mast carriage; it should be immediate and not erratic. The lowering speed of the carriage should be immediate and smooth.

2. 50 Hours

   After each 50 hours of operation, check to make certain the carriage and mast sections are centered; adjust if necessary. (For carriage adjustment, refer to Paragraph E).

3. 500 Hours

   After each operating interval of 500 hours, check the fork carriage for side play and correct it if side play is excessive. (For carriage adjustment, refer to Paragraph E).

C. REMOVAL (EXTRA LIFT AND HIGH FREE 2,000 3,000 lb)

NOTE:
If back rest is used, simply attach a properly rated hoist to the top of it; remove capscrews which attach backrest to carriage and lift it free of carriage.

1. Remove carriage forks (or attachments), (refer to (TOPIC 3. FORKS).

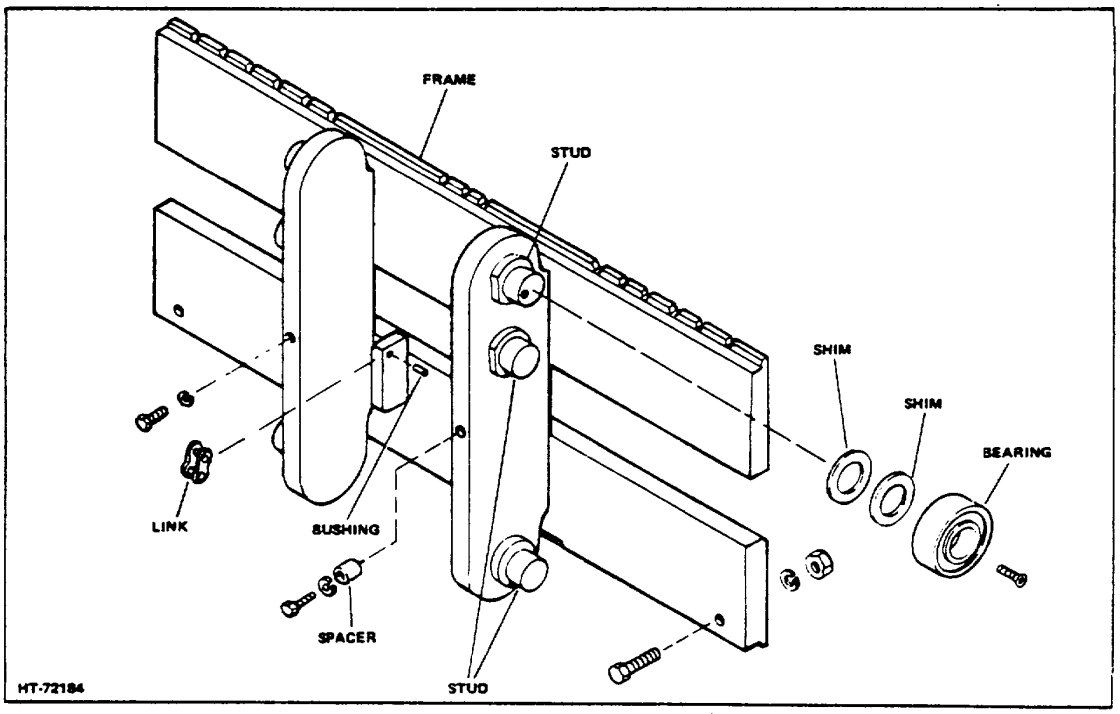


Figure 1. Hook Type Carriage Assembly (Typical)

3. Remove lift chain anchor pins (or connecting link, if applicable), and disconnect chains from carriage.
4. Make certain all attachments are disconnected between the carriage and mast. With the key ON, operate lift lever and raise inner mast high enough so bearings clear inner mast uprights.
5. Back lift truck out of the way and carefully move carriage to desired repair location.

NOTE

If carriage is the canted bearing type, it must be adjusted before installation. (Refer to following PARAGRAPH E, ADJUSTMENT-CANTED BEARING TYPE).

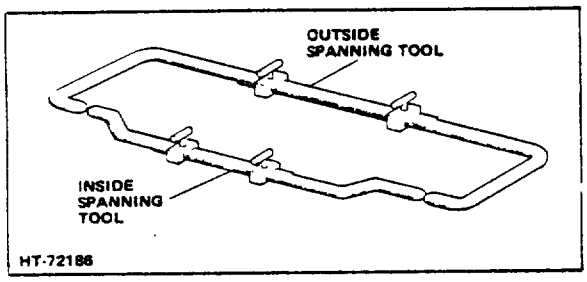


Figure 2. Setting Outside Spanning Tool

D. INSTALLATION (EXTRA LIFT AND HIGH FREE LIFT 3,500-12,000 lb AND ALL TRI-MAX)

1. With carriage resting on wooden blocks, raise inner mast high enough to clear carriage assembly bearings.
2. Position lift truck so that inner mast uprights are directly centered over carriage bearings. Slowly lower inner mast making sure carriage bearings slide into inner mast uprights.
3. Reinstall carriage stop capscrews (or stop, if applicable).
4. Reinstall lift chain anchor pins (or connecting link, if applicable), and reinstall lift chains.

E. ADJUSTMENT-CANTED BEARING TYPE (Fig 1)

1. Use an inside spanning tool and check inside of web of inner mast assembly and determine narrowest point where bearings contact inner mast uprights.
2. Set outside spanning tool (Fig 2) to match inside spanning tool. Lock tool In position.
3. Install bearings on roller studs on carriage. Span bearings on carriage assembly at the maximum camber point with outside spanning tool.. Span all sets of bearings. Shim bearings to produce maximum .015 inch clearance with spanning tool.
4. To check bearing alignment, place a straightedge against stud centerline to all bearings on both sides of carriage assembly. No visible gap should be seen between bearings and the straightedge (Fig 3).

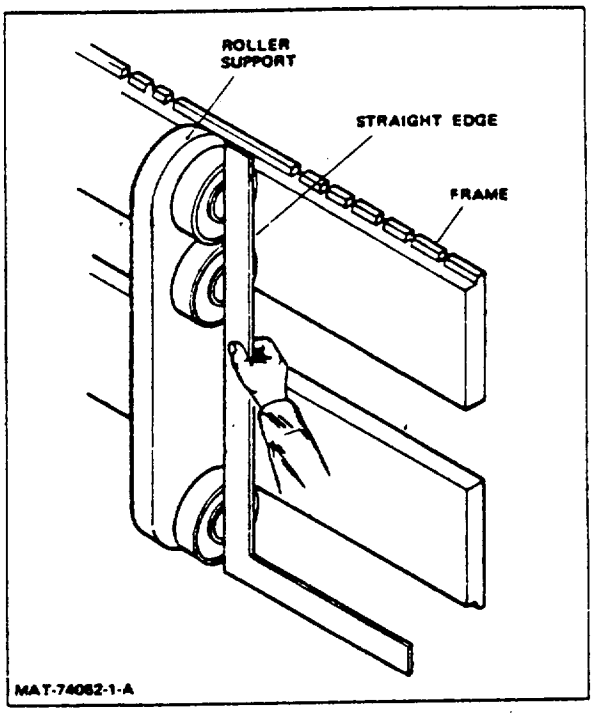


Figure 3. Checking Bearing Alignment

TOPIC 2. SIDE SHIFTER

A. DESCRIPTION

The integral side shift carriage enables the operator to rapidly and accurately position loads and to make more efficient use of available storage areas with a minimum of lift truck jockeying.

The cylinder is enclosed within the steel structure of the carriage frame, minimizing the possibility of damage.

B. 50 HOUR SERVICE

Wear strips and angles are provided which virtually eliminate sliding friction. Several grease fittings are installed at the wear points to ensure proper lubrication. Lubricate these fittings every 50 hours of operation.

C. REMOVAL/INSTALLATION

First disconnect hydraulic hoses at junction block on carriage frame, then refer to TOPIC 1 and perform applicable removal (or installation) procedure.

NOTE

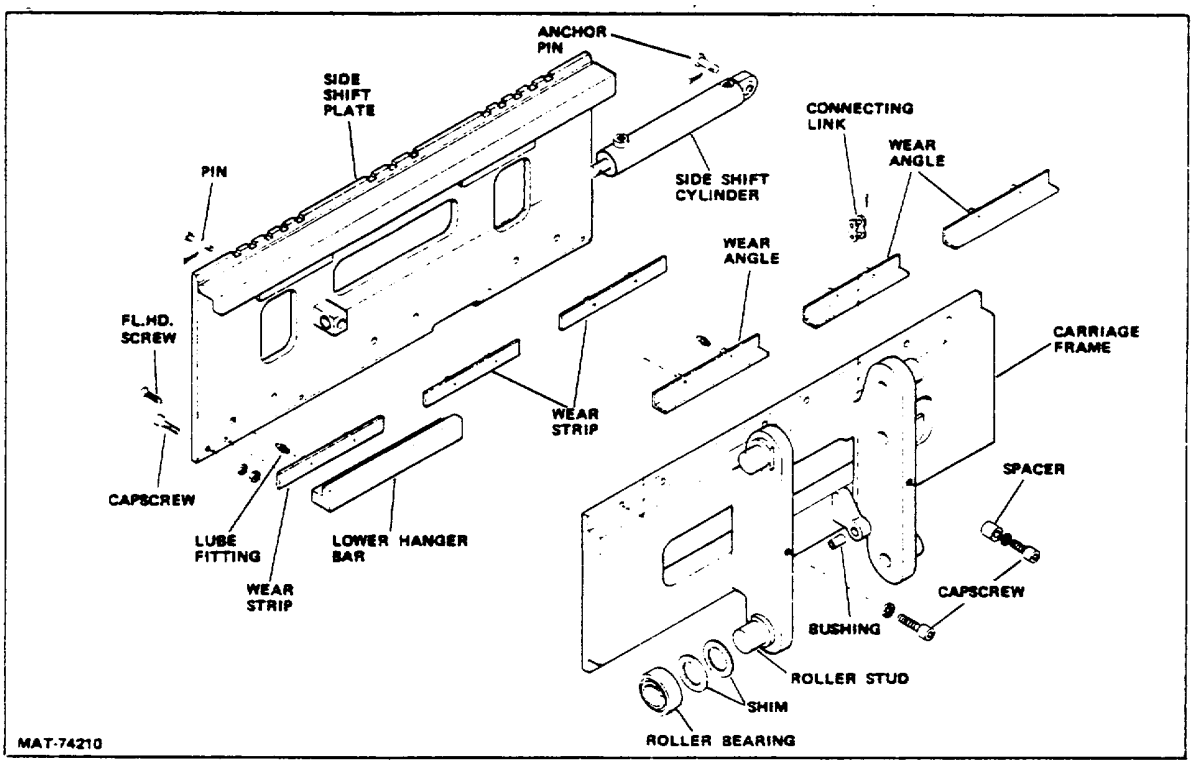
For bearing adjustment, refer to preceding Topic 1.

D. SIDE SHIFTER CYLINDER REMOVAL

1. Remove cotter pin and rod pin from cylinder rod.
2. Retract cylinder rod far enough to clear rod retainer on side shift plate.
3. Disconnect hydraulic hoses from cylinder. Plug cylinder ports and hydraulic hose ends to prevent entry of foreign material.
4. Remove cotter pin and cylinder retainer pin and lift out cylinder.

E. SIDE SHIFTER CYLINDER INSTALLATION

1. Install anchor pin and cotter pin to cylinder and carriage frame.
2. Connect hydraulic hoses.
3. Extend cylinder rod and install retaining pin and cotter pin.



Side Shift Components

TOPIC 3. FORKS

A. DESCRIPTION

Basically, there are two types of forks, the shaft style which pivots on a horizontal support shaft, and the more commonly used hook style fork (Fig 5) which hooks into notches along the top edge of the fork carriage. The standard or hook type fork will be discussed here. Any differences will be noted in shaft type removal and installation.

The forks should always be adjusted on the carriage to obtain the optimum balance in proportion to the width of the anticipated loads.

A fork lock (Fig 6) , is installed in the top of each of the hook type forks to hold it in position in one of the notches along the top bar of the carriage.' To change the fork location, pull up on the lock and move fork to the left or right. Allow fork lock to seat in the notch nearest to location chosen.

⚠ WARNING

Naturally, the weight of each fork depends upon its size. Therefore, exercise caution while fork is being removed from the carriage to avoid injury to personnel and to prevent damage to the equipment.

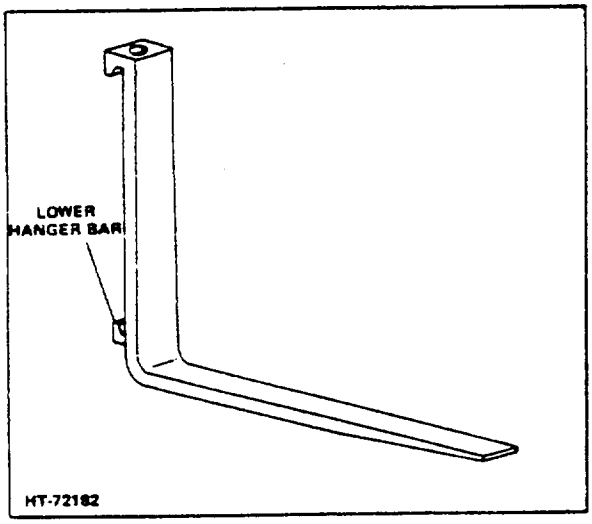


Figure 5. Hook Style Fork

B. REMOVAL

(Hook Type)

1. Lower fork carriage until base of fork just clears the floor.
2. Release the fork lock pin and slide fork to a position over the slot in the lower carriage bar (Fig 6).
3. Tilt the lower portion of the fork forward and upward to release the lower hanger bar (Fig 5) from the lower carriage bar.
4. Refer to CAUTION in preceding Paragraph A; lift fork off upper carriage bar.

C. INSPECTION

1. Inspect hook fork and locking mechanism for any evidence of wear or damage.
2. If locking mechanism is worn or damaged, remove and replace it as a unit.
3. If fork is defective, then replace with same type and capacity rated fork.

D. INSTALLATION (Hook Type)

1. Carefully lift fork up onto upper carriage mounting slot, then slowly lower until back of fork rests against carriage face and fork lower hanger bar passes through lower carriage cutout.
2. Release the fork lock pin and slide fork left or right until properly positioned for anticipated load clearance/balance requirements.

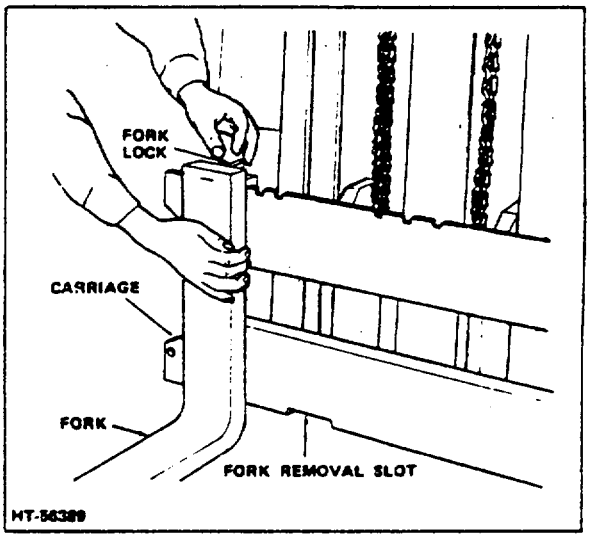


Figure 6. Fork Adjustment and Removal

TOPIC 1. LUBRICANT AND FLUID SPECIFICATIONS

A. HYDRAULIC SYSTEM OIL STORAGE

Hydraulic system oil storage containers MUST be kept free of contaminants, such as dirt, water, and metal chips. Contaminated hydraulic oil is the major cause of hydraulic system failures. It is therefore advised that ANY oil that is added or replaced by final filtered through a 10 micron filter before entering the hydraulic system. It is recommended that each storage container be clearly marked FOR USE IN HYDRAULIC SYSTEM ONLY.

B. HYDRAULIC SYSTEM OIL

Use a high quality hydraulic oil. The hydraulic oil must be fortified with special rust and oxidation inhibitors, plus anti-wear ingredients and treated to minimize foaming. The hydraulic oil must conform to the following Allis-Chalmers Industrial Truck Division (ITD) specification 170.103:

Viscosity at 100°F SUS .....150-170 secs
Viscosity Index.....90 min
Flash Point .....370°F min
Neutralization No.
(mgs KOH/g oil) 0.60
Oxidation Stability (hrs.
to neut. No. 1.0 max)..... 1500
Rust Test ..... Pass
Copper Strip Corrosion
(3 Hours at 2120F)..... Pass 2B
Pour Point ..... -20°F max

C. DRIVE UNIT AND MANUAL STEERING GEAR OIL (Models ACE 20 thru 120, FE 20 thru 100, and FET 25-30) AND A-C PLANETARY DRIVE AXLE

Lubricate with SAE 90 EP (extreme pressure) gear oil which is non-corrosive and resists oxidation and foaming. It should have a low pour point to ensure quick lubrication at either high or low temperatures.

The gear oil should have a minimum specification of American Petroleum Institute service designation API-GL-5.

D. DRIVE UNIT (Models SC, SS, SR, and ACOP)

Lubricate with SAE 80 EP (extreme pressure) gear oil which is non-corrosive and resists oxidation and foaming. It should have a low pour point to ensure quick lubrication at either high or low temperatures.

The gear oil should have a minimum specification of American Petroleum Institute service designation API-GL-5.

E. BRAKE MASTER CYLINDER

Use silicone brake fluid only with an extreme heat-cold range that conforms to MIL-B-46176.

F. BULL GEAR AND JACKSHAFT PINION

Lubricate with a high quality, Grade 2 lithum base grease (characterized by the word "Moly") that contains a maximum of 5% micronized molybdenum disulfide. The lubricant must be waterproof and heat resistant.

G. WHEEL BEARINGS AND JACKSHAFT BEARINGS

Lubricate with a high quality National Lubricant and Grease Institute (N.L.G.I.) heavy duty, Grade 2 (HD-2) sodium base grease. The lubricant must be waterproof and heat resistant.

H. PRESSURE GUN FITTINGS

Lubricate with a high quality National Lubricant and Grease Institute (N.L.G.I.) Multipurpose, Grade 2 (MP-2) lithium base grease.

I. OIL CAN POINTS

Lubricate all points with SAE 10 or 20 engine oil.

J. MASTS

Lubricate the mast uprights with any of the high quality lubricants specified in preceding Paragraphs F, G, and H.

K. ELECTRIC MOTORS

Repack bearings in electric motors with a high temperature lubricant, National Lubricant and Grease Institute (N.L.G.I.) heavy duty, Grade 2 (HD-2) sodium base grease with a minimum melting point of 3000F.

TOPIC 1. TROUBLESHOOTING GUIDE

A. BATTERY

TROUBLE	POSSIBLE CAUSE	POSSIBLE SOLUTION
Battery overheats on discharge.	Over discharge.	Limit discharge to 1.140 (specific gravity), - set up schedule for recharge.
	Excessive current load.	Lubricate equipment. Determine cause of overload and correct. Do not exceed equipment capacity.
	Not fully charged prior to work assignment.	More complete regular charges.
	Electrolyte levels low.	Add water to proper levels as required. Do not assign battery to work if levels are below top of plates.
	Operating in high atmospheric temnperature.	Provide cool location for charging and good ventilation.
Low electrolyte level.	Broken or cracked cell.	Replace cell.
	Water additions neglected.	Better supervision. Adding water as required so that levels do not decrease to below top of plates.
	Cell missed when adding water.	Use better supervision and care.
	Too much overcharging.	Adjust charging equipment.
Unequal specific gravity between cells.	Overfilled with water.	Do not fill above high level - give equalizing.charge and adjust acid.
	Operating cell with cracked case.	Replace case and adjust acid.
	Acid not adjusted properly..-	Adjust acid.
	Operating cell with filler plugs removed.	Keep filler plugs securely in place.; Give equalizing charge and adjust acid.
	Operating battery with broken cell cover.	Replace cover and adjust acid.
	Neutralizing material in cell.	Keep filler plugs in place at all times except when adding water. Keep battery clean.

A. BATTERY (CONTINUED)

TROUBLE	POSSIBLE CAUSE	POSSIBLE SOLUTION
Unequal cell voltages.	Over discharge.	Give an equalizing charge and do not discharge below 1.140 (specific gravity).
	Lack of equalizing charges.	Give an equalizing charge periodically
	Dirty battery top.	Neutralize and clean top of battery.
	Cells operated with low electrolyte level.	Add water as required so that top of plates are not exposed. Give equalizing charge.
	Low fully charged specific gravity of cell.	Adjust acid after equalizing charge.
	Impurities in cell.	Add nothing but distilled water or water from an approved source.
	Variation in charge rate.	Try to take readings when charge rate is constant.
Battery will not work full shift.	Uneven cell voltages and specific	Give an equalizing charge. gravity.
	Low electrolyte levels.	Check electrolyte levels at specified intervals.
	Battery not charged before work.	Check charging schedules. Do not assign discharged battery to work.
	One or more cells cut out of battery.	Repair cell, charge, adjust acid and place in battery.
	Incorrect battery (number of cells) assigned to equipment.	Install correct voltage battery to equipment.
	Fully charged specific gravity below normal.	I Adjust specific gravity to normal.
	Impurities in electrolyte.	Add nothing but distilled or approved water.
	Operator riding brake excessively.	Discourage practice.
	Excessive loads.	Use larger battery or reduce load.

A. BATTERY (CONTINUED)

TROUBLE	POSSIBLE CAUSE	POSSIBLE SOLUTION
Battery will not work full shift (continued).'	Wheels, axles and bearings need grease.	Plan lubrication schedule.
	Brakes dragging.	Adjust brakes properly.
	Tires severely chunked or cut tread.	Replace with new tire.
	Series field in motor shorted or grounded.	Replace field and eliminate grounds.
	Armature needs repair.	Replace or repair armature.
	Ground on equipment.	Locate grounds and insulate.
	Excessive grades.	Use larger battery or revise battery charge schedule.

B. DRIVE UNIT (JACKSHAFT TYPE)

TROUBLE	POSSIBLE CAUSE	POSSIBLE SOLUTION
Failure to operate.	Broken jackshaft.	Replace jackshaft.
	Teeth broken out of jackshaft or bull gear.	Replace jackshaft or bull gear.
	Broken teeth on ring gear or pinion.	Replace ring gear and pinion.
Axle noise on drive or coast.	Excessive wear at ring gear and pinion.	Adjust, if possible, or replace.
	Worn spider gears or side gears in differential case.	Replace worn gears.
Continuous axle noise.	Excessive wear in gears.	Replace worn parts.
	Lack of lubrication.	Lubricate at specified intervals.
	Uneven tire wear. Worn or damaged bearing.	Replace tires. Replace bearings.

B. DRIVE UNIT (JACKSHAFT TYPE) (CONTINUED)

TROUBLE	PROBABLE CAUSE	POSSIBLE SOLUTION
Excessive backlash on unit.	Worn splines on jackshaft.	Replace jackshaft.
	Worn ring gear or pinion.	Replace gear and pinion.

C. HYDRAULIC SERVICE BRAKE SYSTEM

TROUBLE	PROBABLE CAUSE	POSSIBLE SOLUTION
Pedal goes to toe plate.	Normal lining wear.	Check self-adjuster; replace if necessary.
	Low fluid level in master cylinder.	Fill reservoir with specified brake fluid and bleed lines.
	External leak in brake system or leak past master cylinder piston cup.	Check system for leak and repair.
	Air trapped in hydraulic system.	Bleed system.
Both brakes drag.	Pedal lash not correctly adjusted.	Readjust to correct lash.
	Mineral oil in brake system.	Clean out system, replace cups in brake cylinders, and refill system with specified brake fluid.
	Breather port in master cylinder clogged.	Clean out breather port.
One wheel drags.	Weak or broken brake shoe return springs.	Replace broken or weak springs.
	Brake shoe or drum clearance too small.	Check self-adjuster; replace if necessary.
	Loose wheel bearings.	Readjust.
	Obstruction in brake line.	Remove obstruction or replace line.
	Swollen wheel cylinder piston cups or piston binding.	Replace defective or damaged parts.

C. HYDRAULIC SERVICE BRAKE SYSTEM (CONTINUED)

TROUBLE	PROBABLE CAUSE	POSSIBLE SOLUTION
Lift truck pulls to one side.	Grease or brake fluid on brake lining.	Replace with new specified brake shoes.
	Loose wheel bearings.	Readjust.
	Different makes of brake lining.	Replace with new specified brake shoes.
	Brakes incorrectly set.	Realign brake shoes and self-adjuster.
	Uneven tread wear.	Replace tires.
	Lining charred or drum scored.	Replace with new specified brake shoes; repair or replace drum.
Brakes spongy.	Air trapped in hydraulic system.	Bleed brake system.
	Brake adjustment not correct.	Check self-adjuster; replace if necessary.
	Shoe surface not square with drum.	Repair
Excessive pedal pressure.	Brake adjustment not correct.	Check self-adjuster; replace if necessary.
	Incorrect brake lining.	Replace with new specified brake shoes.
	Oil or fluid soaked lining.	Replace with new specified brake shoes.
	Lining making only partial contact.	Realign brake shoes.
Light pedal pressure-brakes too severe.	Brake adjustment not correct.	Check self-adjuster; replace if necessary.
	Small amount of grease or brake fluid on lining.	Correct cause and replace with new specified brake shoes.
	Incorrect lining.	Install new specified brake shoes.

C. HYDRAULIC SERVICE BRAKE SYSTEM (CONTINUED)

TROUBLE	PROBABLE CAUSE	POSSIBLE SOLUTION
Brakes squeak.	Brake shoes twisted.	Repair.
	Particles of metal or dust imbedding in lining.	Remove foreign material; sand lining and drum.
	Chamfer at end of lining too short.	Elongate chamfer.

D. MANUAL STEERING SYSTEM

TROUBLE	PROBABLE CAUSE	POSSIBLE SOLUTION
Hard steering.	Bent linkage, tie rods, etc.	Replace damaged parts.
	Improper wheel alignment.	Align steer wheels.
	Lack of lubrication.	Lubricate all steering system grease fittings.
	Binding steering gear.	Repair or adjust.
Loose steering.	Loose linkage, tie rods, etc.	Tighten, adjust, or replace.
	Worn king pins.	Replace.
	Wheel bearings loose or worn.	Adjust bearings or replace.
	Steering wheel has excessive play.	Adjust backlash to remove play.
	Steering gear out of adjustment.	Adjust cam and worn shaft.
	Lift truck does not respond immediately when steering wheel is turned.	Adjust drag link and tie rods.

E. POWER STEERING SYSTEM

TROUBLE	PROBABLE CAUSE	POSSIBLE SOLUTION
Hard steering.	Failure of pump. Pump badly worn or low pump pressure.	Repair or replace pump.
	Broken or weak relief valve spring.	Replace spring.
	Binding relief valve.	Free valve and adjust to specified pressure.
	Faulty pump relief valve.	Repair or replace.
	Line leakage.	Tighten connections.
	Low oil level.	Fill reservoir to proper level.
	Bent linkage, tie rods, etc.	Replace damaged parts.
	Improper wheel alignment.	Align steer wheels.
	Lack of lubrication.	Lubricate all steering system grease fittings.
	Leakage in steering cylinder.	Repair.
	Air in system.	Bleed the system.
Loose steering.	Loose linkage, tie rods, etc.	Tighten, adjust, or replace.
	Worn king pins.	Replace.
	Wheel bearings loose or worn.	Adjust bearings or replace.
Low oil pressure.	Low oil level.	Fill reservoir to proper level.
	Worn pump.	Repair or replace.
	Weak relief valve spring.	Replace spring.
	Relief valve stuck open.	Free valve and adjust to specified pressure.

E. POWER STEERING SYSTEM (CONTINUED)

TROUBLE	PROBABLE CAUSE	POSSIBLE SOLUTION
Low oil pressure (continued).	Faulty pump relief valve.	Repair or replace.
	External leakage.	Tighten or replace fittings, hoses, or seals.

F. POWER STEERING VALVE UNIT

TROUBLE	PROBABLE CAUSE	POSSIBLE SOLUTION
Steering wheel does not center.	Binding in linkage valve.	Re-align.
	Broken centering springs.	Replace spring.
No response when steering wheel is turned slowly.	Dirt in system.	Drain, flush, and refill reservoir with pre-filtered specified oil and replace filter element.
	Oil level is low.	Fill to proper level.
Slow or hard steering.	Dirt in system.	Drain, flush, and refill reservoir with pre-filtered specified oil and replace filter element.
	Wear on sleeve and spool.	Replace.
	Wear on orbit gear.	Replace.
	Oil level low.	Fill to proper level.
	Trouble in pump.	Check and correct.
	Trouble in actuator.	Check and correct.
	Trouble in lines.	Check and correct.
Wrong response to steering wheel.	Lines connected to wrong ports.	Reconnect.
	Orbit gear misaligned.	Re-align.
Continuous steering wheel rotation.	Dirty oil.	Drain, flush, and refill reservoir with pre-filtered specified oil and replace filter element.
	Broken centering springs.	Replace spring.

F. POWER STEERING VALVE UNIT (CONTINUED)

TROUBLE	PROBABLE CAUSE	POSSIBLE SOLUTION
Continuous steering wheel rotation (continued).	Input linkage is binding.	Re-align.
	Burr on sleeve or spool.	Repair.
No response.	Sleeve and spool locked.	Disassemble; repair or replace.
	Pump failure.	Check and correct.
	Hose clogged.	Check and correct.

G. HYDRAULIC SYSTEM

TROUBLE	PROBABLE CAUSE	POSSIBLE SOLUTION
Unable to lift or tilt load.	Load too heavy.	Check capacity on Serial No. Plate.
	Insufficient or no oil.	Check reservoir for proper oil level or plugged suction line.
	Air leak at suction line.	Tighten connections.
	Damaged or worn pump.	Repair or replace.
	Relief valve binding open.	Free valve and adjust to specified pressure.
	Broken lift chains.	Repair.
	Obstruction in hydraulic lines.	Check flow of oil from pump through hydraulic system.
	Damaged cylinder.	Check for binding or for inoperative plunger.
	Control valve inoperative.	Inspect for internal leakage or damaged parts and repair.
	Broken pump coupling or shaft.	Repair.

G. HYDRAULIC SYSTEM (CONTINUED)

TROUBLE	PROBABLE CAUSE	POSSIBLE SOLUTION
Lift and tilt too slow.	Internal leakage at pump.	Inspect for worn or damaged parts.
	Excessive leakage at cylinder seals.	Replace seals.
	Leaks in system.	Tighten all connections.
	Misalignment or binding.	Check mast, carriage, or tilt linkage for centering or for binding.
	Faulty relief valve.	Check for worn or damaged parts. Repair or replace. Check relief valve setting.
Load creeps-tilting or lowering.	Internal leakage in cylinder.	Repair or replace.
	Oil leak at seals.	Replace seals.
	Leak in control valve.	Check for worn or damaged parts.
	Leaks in oil lines.	Tighten all connections or replace damaged lines.
Noisy hydraulic	Insufficient or no oil. pump.	Check reservoir for proper oil level or restricted suction line.
	Air leaks.	Tighten intake connections.
	Air bubbles in intake oil.	Use specified hydraulic oil with anti foaming characteristics.
	Oil reservoir breather restricted.	Replace breather (or clean if applicable).
	Coupling worn.	Replace.
	Pump mounting screws loose.	Tighten screws securely.
	Worn or broken parts.	Repair or replace pump.

G. HYDRAULIC SYSTEM (CONTINUED)

TROUBLE	PROBABLE CAUSE	POSSIBLE SOLUTION
Hydraulic oil overheating.	Pump too tight after overhaul.	Remove and repair.
	Restricted lines or filter.	Check and repair or replace.
	Relief valve set too high.	Adjust valve to specified pressure.
	Relief valve set too low.	Adjust valve to specified pressure.
	Incorrect oil.	Drain, replace filter and use only pre-filtered specified oil.
	Internal oil leakage in pump.	Repair or replace pump.

TOPIC 1. GENERAL DESCRIPTION

The Allis-Chalmers electric lift truck

is a battery powered unit which is designed for quiet and odor-free operation (Fig 1-1).

A. ELECTRICAL SYSTEM

An item of great If importance In the electrical system naturally is the battery. The battery is the power source of the unit and is an electrochemical device that stores chemical energy which is converted into electrical energy during discharge. To remove the battery or to disconnect the power supply, the lift truck is equipped with a quick detachable connector which allows complete cutoff of the battery from the electrical components (Fig 1-2).

The lift truck is equipped with series wound motors which utilize Class F insulation. The motor armature, which is supported by ball bearings, is statically and dynamically balanced to provide vibration free operation. Specially selected metal graphite brushes, which assure excellent commutation and long service life. are supported in stationary box type holders inside the rotor. To facilitate inspection, removal, testing, etc., the drive motor is equipped with external connection terminals.

B. HYDRAULIC SYSTEM

The hydraulic pump is a positive displacement tandem type gear pump with a primary section and a secondary section. Both sections of the pump supply oil to the lift cylinder and the secondary section supplies oil to the tilt cylinders and accessories.

Included in the hydraulic system are the reservoir with ample reserve capacity and the hydraulic oil filter. The oil filter is located in the return line to the reservoir and is easily accessible for maintenance.

The hydraulic system provides the means by which the lift, tilt, and accessory operations are controlled through the employment of a control valve. From the control valve, the flow of oil under pressure is directed to the appropriate cylinders. Movement of the lift lever attached to the control valve will raise the lift cylinder plunger. Movement of the lever in the opposite direction will lower the plunger. The same applies to the tilt cylinders. Movement of the tilt lever in one direction will tilt the mast forward, and movement of the lever in the opposite direction will tilt the mast backward.

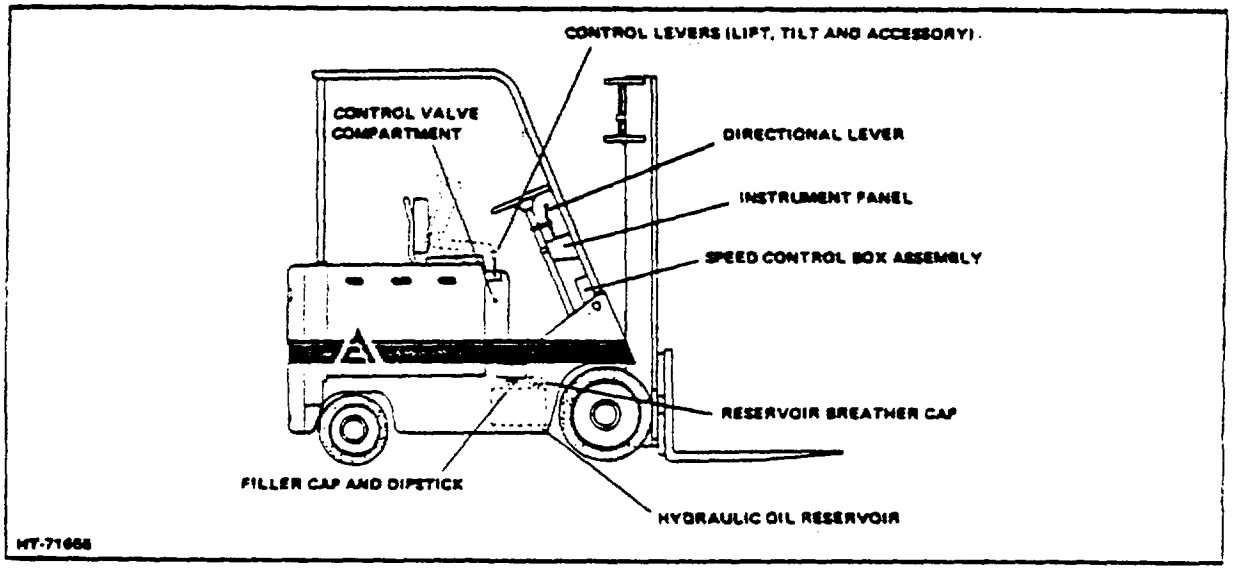


Figure 1-1. Right Side of Lift Truck (Typical)

TOPIC 2. TORQUE VALUES AND CONVERSION TABLE

The torque values listed under GRADE S In the following torque chart also apply to any grade S fastener used with the regular nuts and lockwashers in rigid joints, and joints using rigid gaskets no thicker than .030".

The torque values listed under Grades 6, 7, and 8 In the following torque chart apply to fasteners used with tapped holes and blocks, high strength nuts, heavy duty nuts, heavy duty washers and lockwashers, or hardened washers. They also apply to rigid joints and Joints using rigid gaskets no thicker than .030".

STANDARD TORQUE VALUES

CAPSCREW SIZE	LB-FT	
	NC AND NF GRADE 5	NC AND NF GRADES 6 7 AND 8
1/4"	10 - 11	11 - 14
5/16"	19 - 21	24 - 28
3/8"	35 - 39	43 - 55
7/16"	55 - 60	71 - 90
1/2"	90 - 100	110 - 135
9/16"	120 - 132	152 - 190
5/8"	170 - 187	220 - 280
3/4"	300 - 330	380 - 475
7/8"	470 - 520	600 - 740
1"	700 - 770	900 - 1100
1 1/4"	1240 - 1360	1800 - 2100
1 1/2"	2200 - 2420	3160 - 3560

NOTE: ALL TORQUE VALUES IN THIS TABLE ARE CALCULATED FOR CLEAN THREADS AS RECEIVED FROM THE MANUFACTURER CARRYING RESIDUAL OIL OF MANUFACTURER, OR FOR CLEAN THREADS LUBRICATED WTIH ENGINE OIL, GREASE OR A MIXTURE OF WHITE LEAD AND OIL.

CAUTION: THE STANDARD TORQUE VALUES TABULATED ABOVE ARE FOR USE WHEN SPECIFIC TORQUE DATA IS NOT AVAILABLE.

TORQUE VALUES FOR BRASS FASTENERS
MATERIAL CU63-ZN37
TENSILE STRENGTH 60,000 MINIMUM

SIZE NC AND NF	LB-IN TORQUE
#2	2
03	3.2
#4	4.3
#5	6.3
46	8
#8	16
#10	19
1/4"	62
5/16"	107
SIZE NC AND NF	**LB-FT TORQUE**
3/8"	16
7/16"	26
1/2"	35
9/16"	47
5/8"	76
3/4"	102
7/8"	158
1"	212
1 1/8"	318
1 1/4"	394
1 1/2"	575

TORQUE TABLE FOR 370
FLARE AND STRAIGHT THREAD FITTINGS

SIZE NO.	TUBE O.D.	FITTING STRAIGHT THREAD	STEEL TUBE FITTINGS, AND		COPPER TUBE AND FITTINGS ALUMINUM ALLOY FITTINGS	
			LB-IN TORQUE		LB-IN TORQUE	
			MIN.	MAX.	MIN.	MAX
2	.125"	312"-24	15	50	15	30
3	.187"	375"-24	30	100	30	50
4	.250"	437"-20	50	150	40	65
5	.312"	500"-20	70	200	60	80
6	.375"	562"-18	90	300	75	125
8	.S00"	750"-16	150	5000	120	250
10	.625"	875"-14	220	700	1800	350
12	.750"	1.062"-12	300	1000	250	500
14	.875"	1.187"-12	375	1200	3000	630
16	1.000"	1.312"-12	450	1400	375	700
20	1.250"	1.625"-12	650	2100	500	900
24	1.500"	1.875"-12	900	3000	600	900
32	2.000"	2.500"-12	1400	4500	850	1250

NOTE: MINIMUM TORQUE VALUES ARE ESTABLISHED ON THE BASIS OF HAVING A RELATIVELY SMOOTH CONTACT SURFACE BETWEEN THE FLARE AND SEAT OF THE FITTING.

CONVERSION TABLE

DECIMAL AND METRIC EQUIVALENTS OF FRACTIONS OF AN INCH

INCHES				INCHES			
FRACTIONS	DECIMALS	*NOM. DEC.	MILLI-METERS	FRACTIONS	DECIMALS	*NOM. DEC.	MILLI-METERS
1/64	.0156	.02	.397	33/64	.5156	.52	13.097
1/32	.0312	.03	.794	17/32	.5312	.53	13.494
3/64	.0469	.05	1.191	35/64	.5469	.55	13.891
1/16	.0625	.06	1.588	9/16	.5625	.56	14.288
5/64	.0781	.08	1.984	37/64	.5781	.58	14.684
3/32	.0938	.09	2.381	19/32	.5938	.59	15.081
7/64	.1094	.11	2.778	39/64	.6094	.61	15.478
1/8	.1250	.12	3.175	5/8	.6250	.62	15.875
9/64	.1406	.14	3.572	41/64	.6406	.64	16.272
5/32	.1562	.16	3.969	21/32	.6562	.66	16.669
11/64	.1719	.17	4.366	43/64	.6719	.67	17.066
3/16	.1875	.19	4.763	11/16	.6875	.69	17.463
13/64	.2031	.20	5.159	45/64	.7031	.70	17.859
7/32	.2188	.22	5.556	23/32	.7188	.72	18.256
15/64	.2344	.23	5.953	47/64	.7344	.73	18.653
1/4	.2500	.25	6.350	3/4	.7500	.75	19.050
17/64	.2656	.27	6.747	49/64	.7656	.77	19.447
9/32	.2812	.28	7.144	25/32	.7812	.78	19.844
19/64	.2969	.30	7.541	51/64	.7969	.80	20.241
5/16	.3125	.31	7.938	13/16	.8125	.81	20.638
21/64	.3281	.33	8.334	53/64	.8281	.83	21.034
11/32	.3438	.34	8.731	27/32	.8438	.84	21.431
23/64	.3594	.36	9.128	55/64	.8594	.86	21.828
3/8	.3750	.38	9.525	7/8	.8750	.88	22.225
25/64	.3906	.39	9.922	57/64	.8906	.89	22.622
13/32	.4062	.41	10.319	29/32	.9062	.91	23.019
27/64	.4219	.42	10.716	59/64	.9219	.92	23.416
7/16	.4375	.44	11.113	15/16	.9375	.94	23.813
29/64	.4531	.45	11.509	61/64	.9531	.95	24.209
15/32	.4688	.47	11.906	31/32	.9688	.97	24.606
31/64	.4844	.48	12.303	63/64	.9844	.98	25.003
1/2	.5000	.50	12.700	1	1.0000	1.00	25.400

VOLUME AND WEIGHT CONVERSION CONSTANTS – U.S. TO METRIC

PINTS	x	.4732 =	LITERS
QUARTS	x	.9463 =	LITERS
GALLONS	x	3.7853 =	LITERS
POUNDS	x	.4536 =	KILOGRAMS
CUBIC YARDS	x	.7645 =	CUBIC METERS

LENGTH CONVERSION CONSTANTS – U.S. TO METRIC

INCHES	x	25.400 =	MILLIMETERS
INCHES	x	.0254 =	METERS
FEET	x	.3048 =	METERS
STATUTE MILES	x	1.60935 =	KILOMETERS

* NOMINAL DECIMALS ARE USED IN PLACE OF FRACTIONS OF AN INCH.

TOPIC 3. WELDING PRECAUTIONS

Whenever a welding operation is performed on the lift truck, the mast, or an attachment, the following welding precautions must be observed:

1. Disconnect the battery, turn key switch to ON position, and discharge capacitor(s) on SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals.

2. Perform ground tests on the lift truck and if any grounds are detected, eliminate them before proceeding with the welding operation.

3. Make certain that the area which is to be welded is cleaned thoroughly.

4. Use an asbestos material and protect all electrical components, cables, and wires from sparks and weld spatter.

5. Attach ground cable as close to weld area as possible.

6. Do not perform any welding operation near the electronic components. The delicate leads of transistors and other semiconductors could be damaged by excessive heat.

7. If a welding operation must be performed near the battery compartment, remove the battery from the lift truck.

8. After welding operation is completed, all ground tests and electrical checks should be performed before lift truck is put back into operational service.

TOPIC 4. GENERAL CLEANING PROCEDURE

Precaution must be taken during cleaning of electric lift trucks. It is important not to clean the electric truck with steam or water as these methods will result in damage to electrical components of the truck.

Proper cleaning of an electric lift truck is accomplished through the use of an industrial vacuum cleaner or low air pressure (40 psi max,) EXTREME CAUTION must be exercised in cleaning electric and electronic components.

Using an industrial vacuum cleaner, clean the lift truck as follows:

(1) Clean all electrical components and electrical compartments.

(2) Remove all foreign material or objects from all compartments.

(3) To finish cleaning the lift truck use non-conductive, non-flammable solvent such as DuPont Freon TF or, .Dow Chemical Chlorothene NU. Apply with a brush or cloth or spray the surface requiring cleaning.

⚠ WARNING

Clean lift truck in a well ventilated area when using Freon or Chlorothene NU solvents in accordance with applicable OSHA and EPA standards.

TOPIC 5. LUBRICATION AND MAINTENANCE SCHEDULE

A. GENERAL

The purpose of the following schedule is to inform personnel as to what maintenance functions are to be performed and how often. Close adherence to the schedule is a necessary part of preventive maintenance and all maintenance functions must be performed by qualified personnel.

The intervals specified in the schedule are based on average operation conditions. If the lift truck is operating under abnormal or severe conditions, perform the inspections, services, etc., more often as required to maintain the vehicle in good operating condition.

B. LUBRICATION AND MAINTENANCE GUIDE

Recommended lubrication and maintenance intervals are given in the following schedule:

IMPORTANT: Thoroughly clean all lubricating fittings, caps, filler and level plugs, and the surrounding surfaces before the maintenance functions are performed. Prevent dirt or other contaminants from entering with the lubricants.

⚠ WARNING

Disconnect the battery and discharge the capacitors before any of the following inspections, services, etc., are performed. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals.)

LUBRICATION AND MAINTENANCE SCHEDULE

	REFERENCE PAGE(S)	DAILY	EACH 50 HOURS	EACH 100 HOURS	EACH 200 HOURS	EACH 500 HOURS	EACH 1000 HOURS
Check oil level in hydraulic oil reservoir.	1-8 2-109	X					
Check for oil leaks from hydraulic control system.	2-108 TH-RU 2-112	X					
Check for oil leaks from hydraulic brake system.	2-89	X					
Check the axle toggle stops.	1-37 2-99	X					
Inspect overhead guard.	1-39 2-117	X					
Check the brake pedal free play and reserve distance.	2-93	X					
During operation check the steering; it should be smooth and steering wheel should operate freely	2-102	X					
Check lift and lowering of mast carriage.	2-124 2-125	X					
Check forward and backward tilt operation.	2-110	X					

LUBRICATION AND MAINTENANCE SCHEDULE (CONTINUED)

	REFERENCE MODULE	DAILY	EACH 50 HOURS	EACH 100 HOURS	EACH 200 HOURS	EACH 500 HOURS	EACH 1000 HOURS
Check level of electrolyte in battery.	1-4 2-3	X					
Check specific gravity of electrolyte.	1-4 2-3-4	X					
Inspect battery cables and battery connector.	1-6 2-3	X					
After battery is connected, make certain the horn operates when the horn button is pressed	1-13	X					
Check indicating light (if applicable). It should illuminate when key switch is turned to the ON position.	2-151	X					
Check hourmeter. Make certain it is energized and operating	1-37 2-79	X					
Check battery charge indicator (if applicable). It should operate when key switch is turned to ON position	2-151	X					
Lubricate all pressure gun fittings .	1-36 1-43		 x				
Check to make certain carriage and mast sections are centered.	2-125		X				
Lubricate mast uprights.	2-120 3-124		 x				
Inspect mast lift and tilt cylinders for leaks.	2-110		X				
Lubricate all lever, shafts and linkage oil can points	1-36 1-43		X				
Check the oil level in the A-C Planetary Drive Axle housing	N/A			X			
Check oil level in Jackshaft Drive Axle housing.	1-35 2-85			 X			

LUBRICATION AND MAINTENANCE SCHEDULE (CONTINUED)

	REFERENCE MODULE	DAILY	EACH 50 HOURS	EACH 100 HOURS	EACH 200 HOURS	EACH 500 HOURS	EACH 1000 HOURS
				X			
Check and clean differential breather of Jackshaft Drive Axle.	2-86			X			
Clean and inspect lift chains	2-122			X			
Lubricate interlock spacer and screw on cluster type or primary and secondary cylinder type mast.	2-120			X			
Check the tightness of the bull gear mounting capscrews on the Jackshaft Drive Axle from the outside of the drive wheels. Replace lockwashers that are broken or missing.	2-86				X		
Replace hydraulic oil filter element. Replace or clean hydraulic oil reservoir breather.	2-110 2-109				X X		
Check counterweight mounting bolts and nuts for tightness	2-118				X		
Inspect contactor tips for wear.	2-43				X		
Check air gap between contactor tips	2-43				X		
and check for foreign material. Inspect electric motors and brushes	2-83				X		
Check Jackshaft Drive Axle's: bull gears, drive wheel bearings, jackshafts, and jackshaft bearings. Inspect drive wheels for wear or damage.	2-86				X		

LUBRICATION AND MAINTENANCE SCHEDULE (CONTINUED)

	REFERENCE MODULE	DAILY	EACH 50 HOURS	EACH 100 HOURS	EACH 200 HOURS	EACH 500 HOURS	EACH 1000 HOURS
Check oil level in manual steering gear assembly. Inspect for leaks	N/A					X	
Check and lubricate steer wheel bearings. Inspect steer wheels for wear or damage.	2-99					X	
Inspect hoses, tubes and fittings and check for leaks.	2-108					X	
Check hydraulic pump mounting.	2-111					X	
Inspect wheel cylinders and brake shoes.	2-91 3-55					X	
Check fluid level in brake master cylinder,	2-92					x	
Check parking brake and adjust if necessary.	2-95					X	
Check seat switch for adjustment.	2-96					X	
Check fork carriage for side play.	2-125					X	
Remove, clean, inspect and lubricate lift chains.	2-122					X	
Inspect control valve connections and mounting. Check linkage and operation of microswitches.	2-113					x	
Perform electrical system inspection and ground tests.	2-26					X	
Change oil in Jackshaft Drive Axle housing.	2-86						x
Drain, flush and refill hydraulic oil reservoir.	2-112						X

TOPIC 5. HEADLIGHTS

A. GENERAL

Headlights may be either mast mounted or overhead-guard mounted. Mast mounted lights are equipped with protective guards. The directional aim on both types of lights can be adjusted manually.

B. HEADLIGHT REMOVAL

1. Unplug the wires (6) at connector (7).
2. Loosen clamp (8) and pull wires through.
3. Unscrew the adjusting knob (3) and remove the nut and washer behind it.
4. Remove the headlight (1) from bracket (2).

C. HEADLIGHT DISASSEMBLY

1. Pull the rubber bezel from the base.
2. Loosen the terminal screws and disconnect the wires from the lamp.
3. Using care, push the lamp out of the bezel.

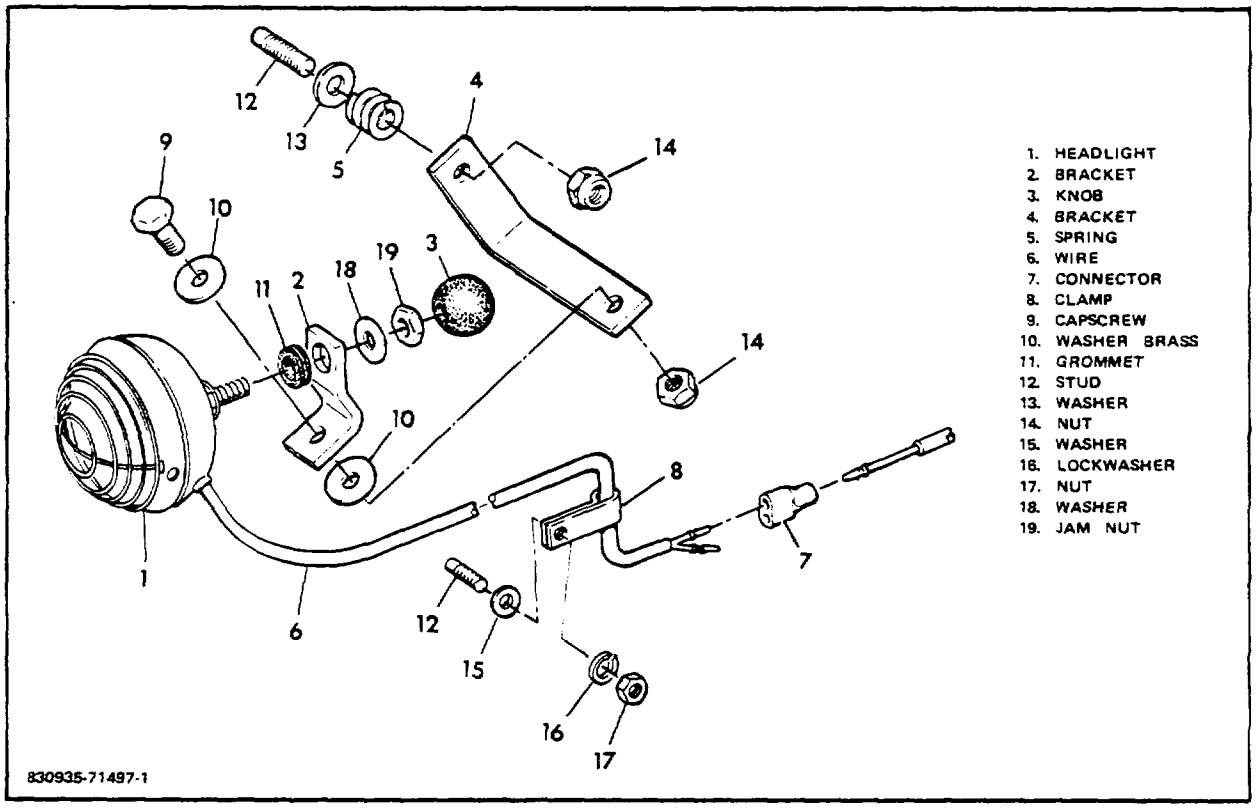


Figure 5-1. Headlight and Connections

TOPIC 6. DISCHARGE INDICATOR

A. GENERAL

A variety of discharge indicators are available. When the charge of the battery drops below a certain point the discharge indicator signals the operator that the battery needs charging. The signal may be in the form of a meter reading or an indicator light. At the same time, the lift circuit is opened so that no lift can be done until the battery is recharged.

B. REPLACEMENT

'When replacing components of the discharge indicator, refer to the wiring diagrams and schematics to assure that wires are properly connected. When replacing individual components refer to figure 6-1.

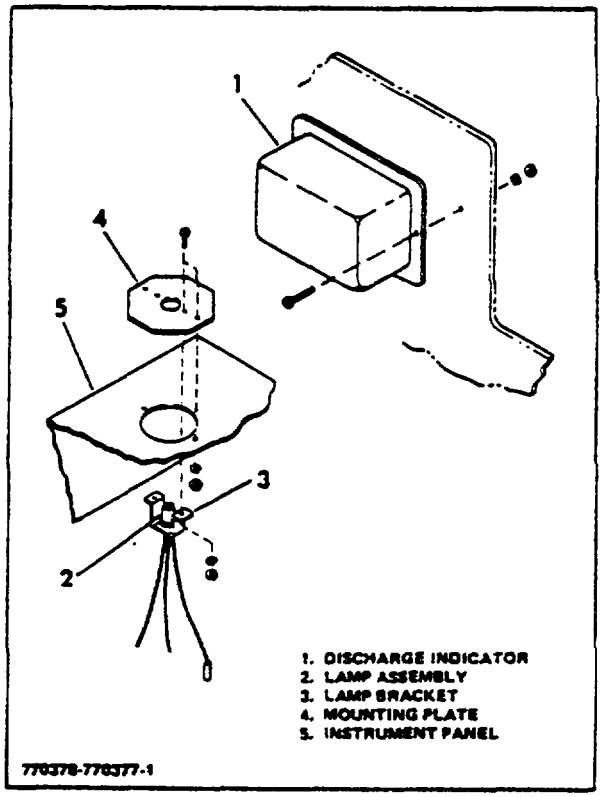


Figure 6-1. Lamp Type Discharge Indicator

REPAIR INSTRUCTIONS

CHAPTER 3

TOPIC 1. GENERAL DESCRIPTION

The drive motor (Fig 1-1) is a flange mounted type, dc series wound with connections brazed of high conductive material. A replaceable armature shaft is employed with a sealed bearing at the commutator end and a double row thrust bearing at the drive end. Dual metal graphite brushes are supported in fixed box type holders to assure proper brush alignment. A metal clip on top of each brush forms a stop device that prevents commutator scoring.

NOTE

When the operator experiences erratic or noticeable changes in truck operation (high current draw or slower acceleration) and the cause is not found in the battery or control circuits, it is possible for motor to have SHORTED WINDINGS. Motor must be removed from lift truck to check for shorts in the windings.

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitor(s). (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.

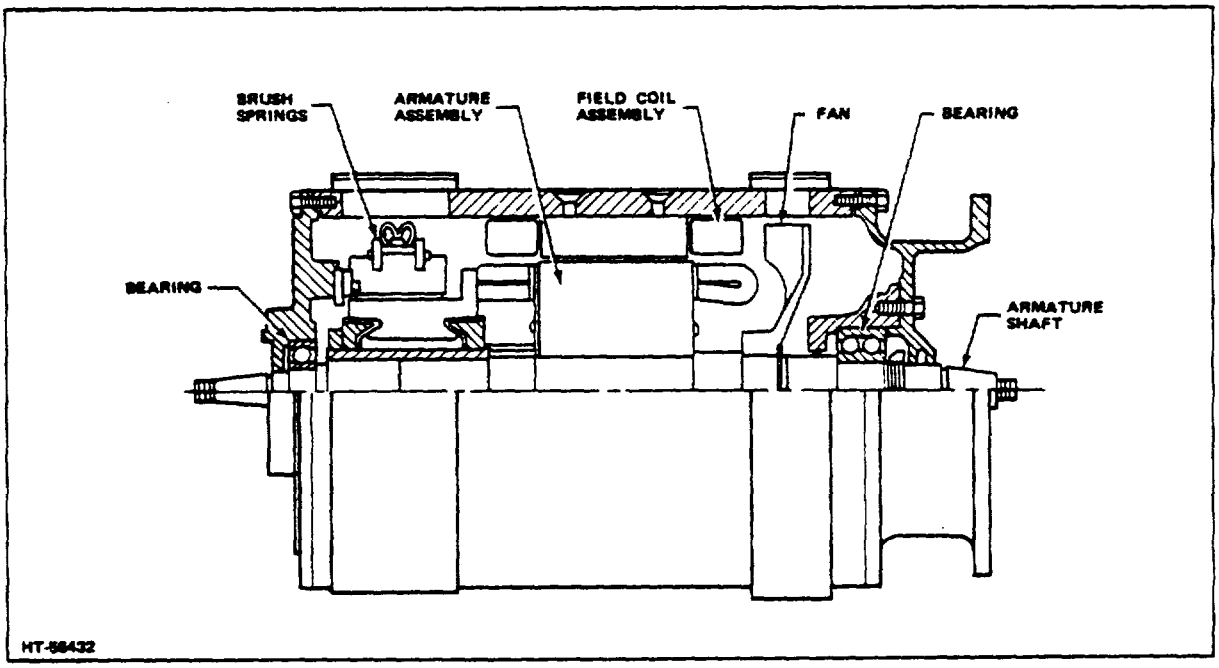


Figure 1-1. Drive Motor - Sectional View (Typical)

TOPIC 2 DRIVE MOTOR BRUSHES

A. INSPECTION AND REPLACEMENT

Brushes may be replaced without removing the drive motor from the truck. To perform this service use the following procedure.

⚠ WARNING

Make certain the battery is disconnected and discharge capacitors.

1. Remove the toe and the floor plates.
2. Remove the rear band assembly from around the field yoke.
3. Remove brush shunt retaining screws; lift brush retaining springs and withdraw brushes from brush holder.
4. Clean brushes, holders, and wipe commutator with a dry, lint-free cloth.
5. Check appearance of commutator and the brush riding surfaces. The best signs of good commutation are dark, brownish, highly polished commutator and uniform glossy brush wearing surfaces.

⚠ CAUTION

Do not use a lubricant or solvent, of any kind, on or around the commutator.

6. Check brush shunt (Fig 2-1) for good contact with the brush holder. Make certain shunt is not damaged or burned. This may cause pressure spring to carry current and lose tension; good spring pressure is vital to motor operation. (For proper brush spring pressure, refer to following SPECIFICATION CHART.)
7. Measure length of brush. A record of brush length at each inspection is the best evidence of brush wear. (This record will help determine if sufficient wear length is present until the next inspection.)

NOTE

Overloading of the motor will increase brush wear and should be taken into consideration.

Replace brushes when brush length is less than 3/8". Measure brush length carefully and check condition of the brush.

8. Before new brushes are installed, they should be contoured on a sanding drum

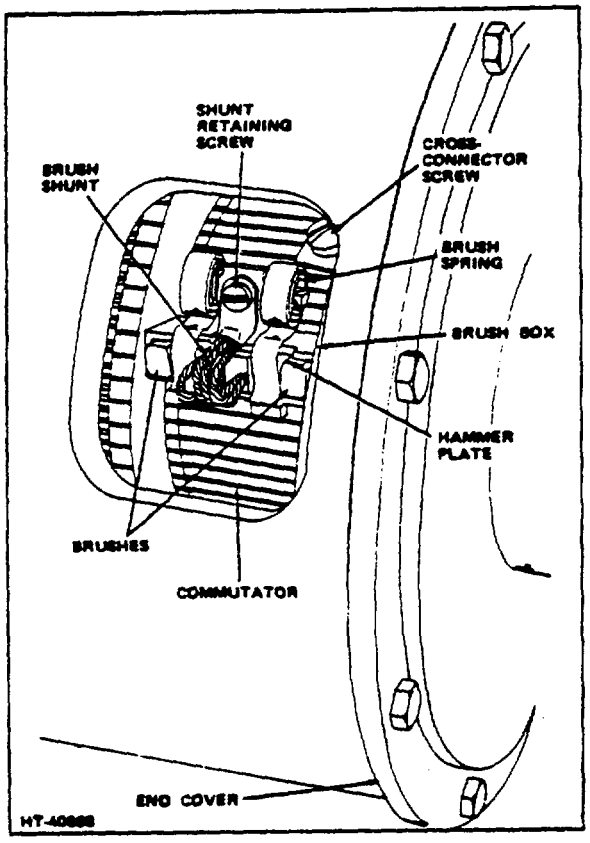


Figure 2-1. Brush Location

with the same diameter as a commutator. Hold brushes into sanding drum to obtain the same radius and brush angle on contact face as was on old brushes. Final seating can be obtained with a fine mesh seating stone compound while commutator is turning.

9. Lift brush spring and place brush into brush box. Make sure each brush spring is on the brush hammer plate and brush slides freely in brush box. Position brush shunt and secure with retaining screw. Repeat procedure for other brush holders.
10. Install the rear band assembly around the field yoke.
11. Install the toe and floor plates.

B. BRUSH SPRING PRESSURE

As stated previously, good spring pressure is vital to motor operation. Spring pressure varies with the size of the brush.

To Measure Spring Pressure (Fig 2-2):

1. Insert a paper strip between brush and

commutator.

2. Place leather loop - or spring scale hook - between pressure spring and brush.
3. With pull in line with center of brush, lift spring scale and pull paper in direction of rotation until paper begins to move freely.

The reading on the spring scale is the total spring force. Record reading and compare with specification chart; replace brush spring as necessary.

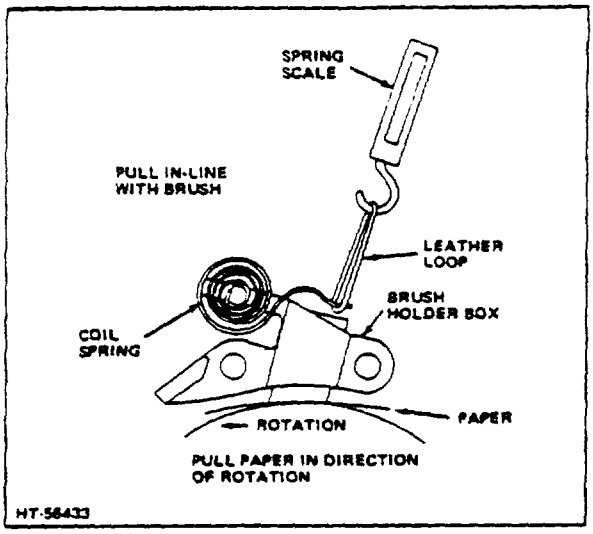


Figure 2-2. Method of Checking Brush Spring for Proper Pressure

DRIVE MOTOR SPECIFICATION CHART

Motor Model	Rating Data					Brushes Total Spring Pressure (Ounces)	Commutator Minimum Wear Diameter (Inches)	Maximum Terminal Hardware Torque (lb-in.)	Terminal Bushing Torque (lb-ft)
	HP	RPM	Volts	Amps	Duty (Hours)				
8614612-0	10.29	1300	36	268	1	40	NA	NA	

ELECTRIC MOTOR CRUSH INSPECTION GUIDE

Type of Motor	Period of Inspection	Replacement
Drive Motor	1. Every 6 months where normal truck duty exits. 2. Every 3 months for heavy duty operation or where truck operates 20 to 24 hours a day.	Replace brushes when brush length is less

TOPIC 3. DRIVE MOTOR REMOVAL (MODELS ACE, FE AND FET)

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitor(s). (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

A. REMOVAL

It is recommended that the drive motor be removed with the drive unit as an assembly. (Refer to proper REPAIR MANUAL MODULE, DRIVE UNIT ASSEMBLY). However, the drive motor, on most models, can be removed by the following procedure.

1. Remove capscrews that secure toe and floor plates and remove plates from truck.
2. Disconnect drive motor cables and tag cable ends and motor terminals to assure proper reinstallation.
3. Remove yoke pin from seat brake actuating lever and remove capscrews that secure seat brake bracket assembly to drive motor housing.
4. Place a transmission jack, or suitable device, under the drive motor. Raise jack enough to support motor.
5. Drain differential housing oil.
6. Remove capscrews and nuts that secure motor to carrier.
7. Check all lines, hoses, cables, wires and linkage to make certain none will be damaged during removal. Remove brake line bracket attached to drive motor flange.
8. Carefully separate motor housing from carrier

Carrier will remain with drive axle.

⚠ CAUTION

Depending upon the model of the lift truck, there are either shims or a gasket between the motor housing and carrier. Make certain shims between motor and carrier are not damaged when removing motor. When assembling motor to carrier, shims must be in the same order and position as when motor was removed.

9. Attach hoist securely to front of vehicle frame. Raise truck carefully and make certain all lines, hoses, etc., stay clear of the motor. Raise high enough to allow the drive motor to be removed from under the truck and place blocks under the frame for safety.
10. Carefully pull motor out from under truck, remove blocks, and lower truck. Clean exterior of motor with a solvent such as mineral spirits and dry with compressed air.

⚠ WARNING

Perform cleaning operation in a well ventilated area whenever a solvent is used.

B. REMOVAL (ACE 35 thru 55 only)

1. Remove drive unit and drive motor as an assembly (refer to REPAIR MANUAL MODULE - DRIVE UNIT ASSEMBLY ACE 35 thru 55.)
2. Drain oil from differential housing.
3. Remove capscrews and lockwashers that secure motor to differential carrier.
4. Carefully separate motor housing from carrier and remove motor from differential carrier.

TOPIC 5. MOTOR DISASSEMBLY (MODELS ACE, FE AND FET)

A. DISASSEMBLY

1. Place the drive motor in a clean working area.
2. Remove seat brake locknut, drum, hub, brake assembly, and woodruff key from shaft.
3. Remove rear band assembly from around field yoke, remove brush shunt retaining screws, lift brush retaining springs and withdraw brushes from brush holders.
4. Place motor on end with drive end up.
5. Remove cotter key, nut, pinion gear, and key from armature shaft. Use a gear puller to remove the pinion gear.

⚠ CAUTION

Use extreme care whenever a gear puller is used or center of shaft will be damaged. An improper puller will flare out shaft center and damage threads to the extent of requiring a new armature shaft. It is recommended to use a shaft protector on end of armature shaft when a gear puller is used.

6. Remove capscrews that secure drive end housing to yoke. Attach chain to housing and with hoist, lift armature, bearings, retainer and housing up and out of field yoke. (See Fig 5-1.)

⚠ CAUTION

Lift armature straight up carefully to avoid damage to commutator or core.

NOTE:
Wrap commutator with heavy paper to protect surface. Support armature assembly in "V" blocks to protect it from damage.

7. Remove capscrews and lockwashers from drive end housing and remove housing.
8. Straighten the tabs of the retainer lockwasher, then use a spanner wrench and remove the locknut.
9. Use a gear puller and remove the retainer from the armature shaft. The oil seal and bearing will come off with the retainer (Fig 5-2).

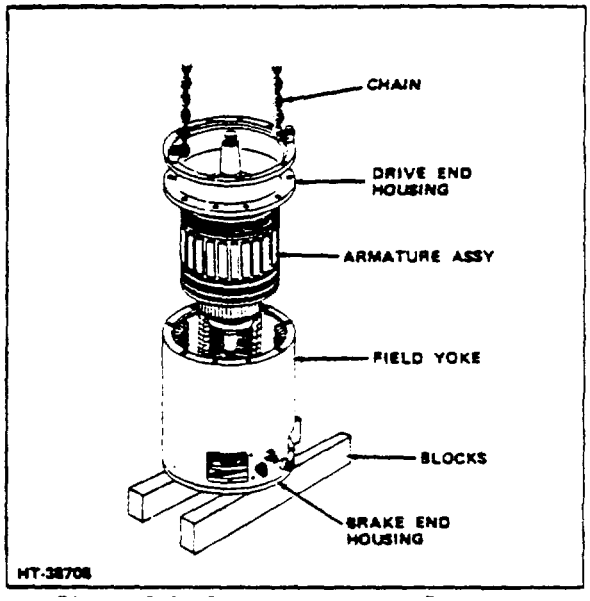


Figure 5-1. Removing Armature From Yoke

⚠ CAUTION

Use extreme care whenever a gear puller is used or center of shaft will be damaged. It is recommended to use a shaft protector (Fig 5-2) when a gear puller is used.

10. Remove the bearing (Fig 5-3) from the retainer.

⚠ CAUTION

Do not subject bearing to impact.

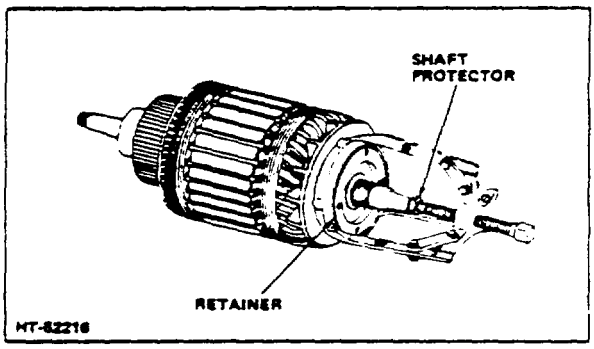


Figure 5-2. Removing Bearing Retainer

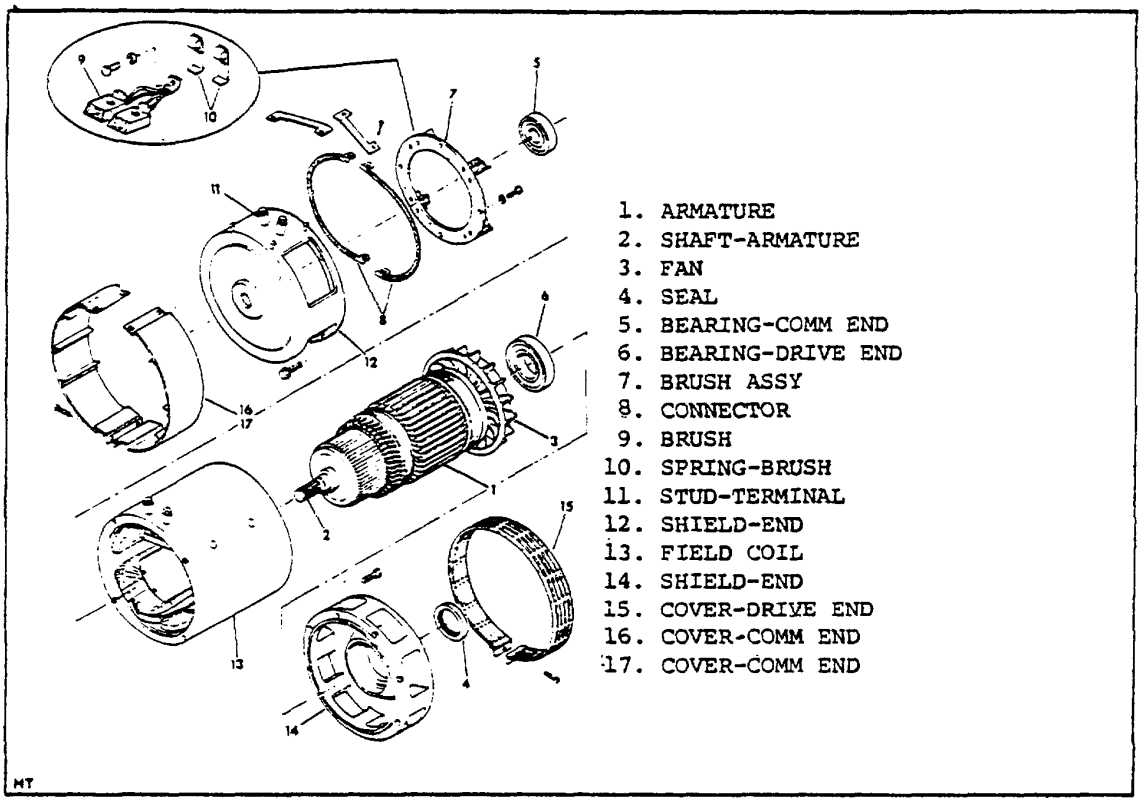


Figure 5-3. Drive Motor - Exploded View

NOTE

Bearing is of the single shielded type and can be regreased. All old grease should be removed from the bearing and the bearing thoroughly washed out. Check the bearing for running smoothness and replace if any roughness is in evidence. Repack bearing only half full with specified grease. Refer to MAINTENANCE MANUAL MODULE, LUBRICATION SPECIFICATIONS.

⚠ CAUTION

Overgreasing bearing will cause overheating, so care must be taken to make certain grease cavity is packed only half full. When reassembling make certain shield faces outward.

11. Remove and inspect retainer O-ring, replace oil seal when worn or damaged. Seal is a light press fit.

12. Remove and replace commutator end bearing when worn or damaged as it is a sealed type and cannot be lubricated.

13. Remove fan by applying a steady amount of Pressure against the back side of

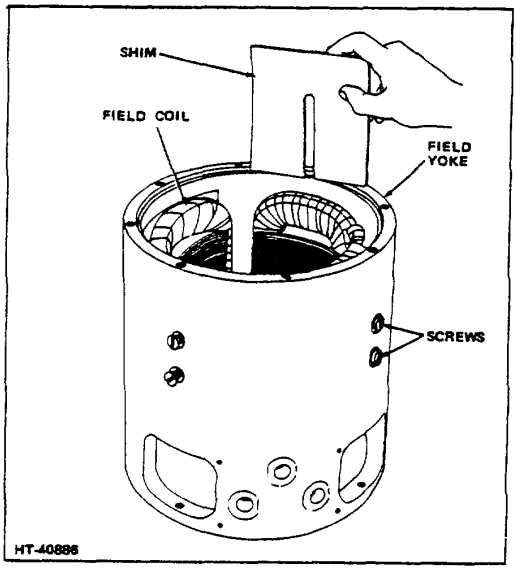


Figure 5-4. Removing Shims

the fan. The fan is hand pressed on against a key, angled up on backside to prevent fan from being pressed on too far and causing possible damage to armature windings.

14. Remove end plate capscrews and lockwashers; tag and disconnect field leads from rocker arm. Remove end plate and rocker arm assembly.
15. Remove rocker arm assembly from end plate; mark the two to assure correct alignment for reassembly

Field coils should not be removed unless replacement is required. To remove, loosen slotted screws securing pole shoes to yoke, remove shims (Fig 5-4) behind pole shoes, noting quantity and location of the shims and remove screws, pole shoes and coils.

⚠ CAUTION

Handle field coils carefully to avoid damage to the insulation.

TOPIC 7. INSPECTION

Clean all parts with proper solvent such as mineral spirits or an equivalent.

NOTE

Armature and fields may be wiped clean with a damp cloth saturated with a solvent. Do not soak, dip or wash.

⚠ WARNING

When using a solvent, always use in a well ventilated area.

Inspect all parts for signs of unusual wear, broken or damaged parts and replace as necessary.

A. CHECKING FOR GROUNDS AND/OR OPEN CIRCUITS

To check for shorted armature, grounded armature, or grounded field coils, the following procedure is recommended.

⚠ CAUTION

Whenever connections have to be soldered, a rosin flux must be used. Acid flux must never be used on electrical connections.

1. Check the armature for shorts by placing it on a "growler" and with a steel strip, or a hacksaw blade held on armature core; rotate armature (Fig 7-1). When blade vibrates, armature is shorted in area of the core below the vibrating blade. Copper or dust in slots between commutator bars sometimes cause shorts which can be eliminated by cleaning out slots.

   Shorts at crossovers of coils at core end can often be eliminated by bending wire slightly and reinsulating exposed bare wire. When shorts cannot be eliminated, armature must be replaced.

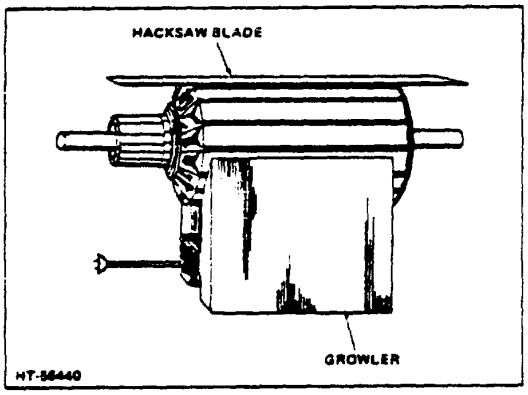


Figure 7-1. Testing an Armature for Shorts

2. To test armature for grounds, place one probe of test lamp on armature core or shaft and place the other probe on each commutator bar in turn. When lamp lights, armature is grounded and must be replaced.

3. Open circuits in an armature may be caused by a poor connection of leads in the commutator bars or by a broken wire in an armature coil. Either will cause sparking at the brushes. Poor connections and broken wires can often be detected visually. When this is not possible, set up the armature on the growler as shown in (Figure 7-1). Test the top two adjacent bars with an a-c millivoltmeter. Rotate the armature and continue testing adjacent bars. When the millivoltmeter bridges the two bars connected to the open coil, the meter pointer will not be deflected. All other bars will give a deflection.

4. The bar-to-bar meter test method of finding an open coil is more satisfactory and reliable than the growler-meter test and is often used in preference to it. Instructions are as follows:

⚠ CAUTION

Meter needle will jump wildly; precautions should be taken to avoid damage to instrument.

   a. Place the armature on "V" blocks and connect a source of direct current to the commutator. (Use the circuit of Fig 7-2.)

   b. Test by spanning bars with millivolt-

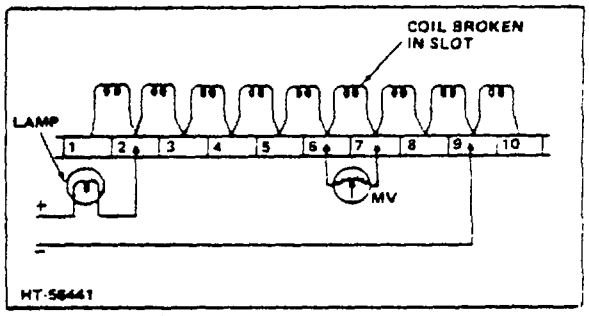


Figure 7-2. Method of Locating an Open Coil

meter leads as illustrated in Figure 7-2.

c. The meter will not show a reading until it bridges bars 6 and 7. The meter completes the circuit.

5. To test for grounded fields, place one probe of test lamp on field frame and other probe on field terminal. If lamp lights, field coils are grounded and must be replaced if ground cannot be located and repaired.

Paint or spray field coils and inside of motor frame with Class F air drying varnish. The armature coils, core, the end of commutator bars and mica cone ring can be sprayed or painted with Class F baking varnish. (Bake, per varnish manufacturer's instructions.)

⚠ CAUTION

Do not use silicon base varnishes.

B. UNDER CUTTING MICA

Carefully inspect the commutator. If commutator is burned, rough, or out-of-round, it must be cut down and the mica undercut.

1. Place armature in a lathe and turn down commutator until true. Make certain cut is not made on commutator riser bars as solder will be removed and weaken coil connections at this section. Remain approximately 3/16" from riser bars when cutting.

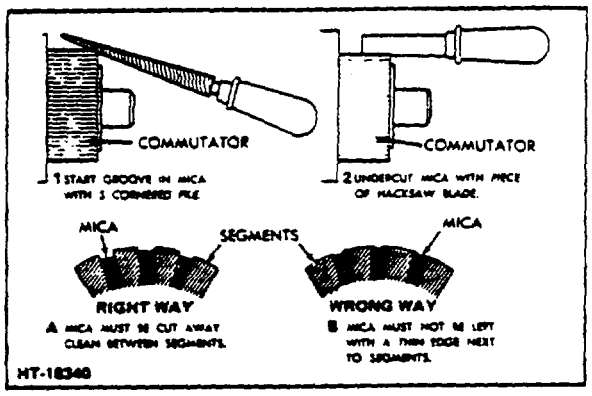


Figure 7-3. Undercutting Mica

2. Undercut mica between bars to a depth not exceeding .030". Undercut must be full width of mica and flat at bottom. After undercutting, clean out slots to remove any dirt and copper dust. (See Figure 7-3.)

3. Sand commutator lightly with No. DO sandpaper to remove any burrs left from undercutting.

4. Check armature on a growler for short circuits. (Refer to Step I in preceding Paragraph A.)

TOPIC 8. ARMATURE SHAFT (MODELS ACE, FE AND FET)

A. REMOVAL

With motor disassembled, proceed in the following manner:

NOTE
Pressure to remove or install shaft may exceed 20 tons.

1. Remove fan snap ring located on shaft in front of fan. Remove fan by applying a steady amount of pressure against the back side of the fan. The fan is hand pressed against a shoulder which prevents fan from being pressed on too far and causing possible damage to armature windings.
2. Place the drive end of the shaft in a heavy duty pipe approximately 2-1/4" 10 and at least 18" long (Fig 8-1).

⚠ CAUTION

Hake certain the top end of the pipe makes complete contact with the core from above shaft, but within a radius of the core rivets.

3. Place a second pipe 1-1/4" ID, 1-1/2" maximum 00 and about 4" long, over commutator end against bearing shoulder on shaft.

⚠ CAUTION

Do not cause burrs or nick bearing shaft shoulder.

4. Apply vertical pressure on pipe, commutator end, and press shaft from armature.

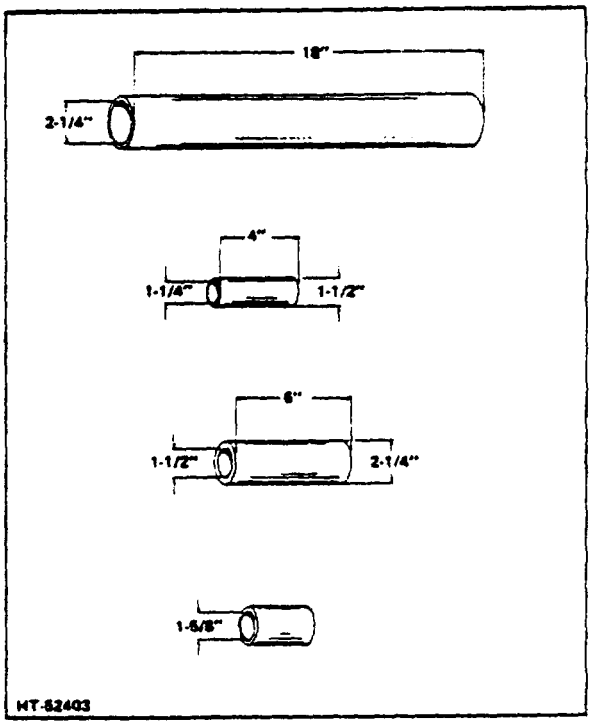


Figure 8-1. Armature Shaft Pipes

B. INSTALLATION

Inspect all parts for signs of unusual wear, broken insulation, or loose connections. Replace any damaged or worn parts.

1. To install shaft, place a pipe 1-1/2" ID, 2-1/4" 00 by 6" long against commutator sleeve and with assembly vertical; insert shaft as far as it will go. Use a 1-5/8" ID pipe against bearing shoulder and apply exact vertical pressure until shaft bottoms against core support.
2. Heat metal fan in an oven to approximately 2000F. Position the key on the shaft and press the fan into place. Avoid scraping the bore when pressing the fan onto the shaft.
3. Install snap ring.

TOPIC 9. DRIVE MOTOR REASSEMBLY AND INSTALLATION (MODELS ACE, FE AND FET)

A. REASSEMBLY

1. Position field coils, pole shoes, and shims in field yoke and secure with screws.

⚠ CAUTION

Handle field coils carefully to avoid damage to the insulation.

2. Reassemble rocker arm to end plate. (Refer to Figure 5-3 in preceding Topic 5.)
3. Align and bolt end plate (with bearing) to field yoke. Connect armature lead jumpers and field leads as marked during disassembly.
4. When the decision is to return the thrust bearing to service, the following procedure is recommended:
   a. All old grease should be removed from the bearing and the bearing thoroughly washed out.
   b. Check the bearing for running smoothness; replace when any roughness is in evidence.
   c. Repack bearing half full with specified grease.
5. Be certain the bearing is packed only half full of the specified grease (refer to LUBRICATION SPECIFICATIONS MAINTENANCE MODULE.)
6. Install seal and O-ring in bearing retainer. Oil seal lip must be as shown in Figure 9-1. Install the bearing retainer on the shaft.

NOTE

Bearing retainer with seal must be installed on shaft before bearing is installed.

7. Heat the bearing in an oven (2000F) and slide the bearing onto the shaft. Make certain bearing shield faces outward towards end of shaft and that the inner race makes a firm even contact with the shaft shoulder.

⚠ CAUTION

Do not subject bearing to impact.

Install new lockwasher and locknut. Tighten locknut securely and bend the lockwasher tabs to secure the locknut.

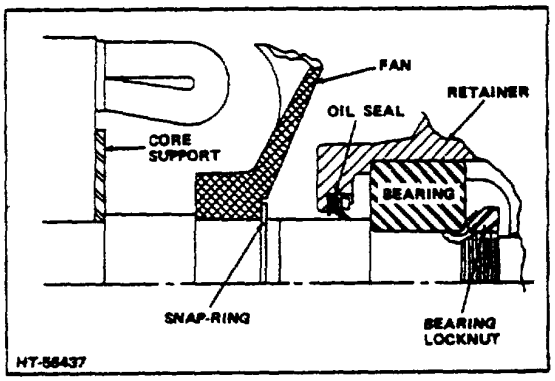


Figure 9-1. Bearing Retainer and Oil Seal

8. Align and bolt drive end housing to bearing retainer.
9. Place field yoke in vertical position. With hoist, lower armature assembly (carefully to avoid damage to commutator or core) into field yoke assembly. Remove paper covering on commutator.
10. Fasten drive end housing to field yoke assembly with capscrews and lockwashers and tighten securely.
11. Install brushes. (Refer to Topic 2, DRIVE MOTOR BRUSHES.) Install band assemblies.
12. Mount brake backing plate to drive motor housing with capscrews. As brake parts are assembled, apply a small amount of chassis grease to pivots, bushings, and brake shoe metal contact areas. Keep brake lining and drum free of grease and dirt.
13. Position actuating lever on backing place mounting pivot.
14. Place actuating arms on brake shoe pivot. Secure arms to mounting pivots with lockwashers and nuts.
15. Place inserts on brake shoe pivots and position brake shoes over inserts. Secure brake shoes with washers and nuts. Attach brake shoe return springs to brake shoes.
16. Position brake drum over brake shoe assembly and secure to drive motor armature shaft with locknut.

    Torque motor terminals. (Refer to DRIVE MOTOR SPECIFICATION CHART in preceding Topic 2.) Check insulation resistance with a 500 volt megger. (Refer to following Paragraph B, FINAL INSPECTION.)

B. FINAL INSPECTION

Check motor windinq insulation as follows:

⚠ CAUTION

Semi-conductors, small transformers, voltage regulators and other devices that may be injured by the high voltage must not be in the circuit.

1. Connect one lead of 500 volt megger to any motor terminal stud, the other lead to the motor frame and apply the voltage.

2. A reading of one megohm or greater is satisfactory. Record reading for future reference.

If reading is less than one megohm, disassemble the motor and check for grounds as detailed in preceding Topic 7, INSPECTION.

C. MOTOR INSTALLATION

1. Install drive motor on carrier assembly and secure with capscrews and lockwashers.

2. Drive unit and drive motor are installed as an assembly (refer to REPAIR MANUAL MODULE-DRIVE UNIT ASSEMBLY, ACE 35 thru 55).

3. Fill differential housing to proper level with clean specified oil.

TOPIC 1. GENERAL DESCRIPTION

The hydraulic pump is the heart of the hydraulic system. It draws oil out of the reservoir and maintains a constant supply of oil under pressure. The pump is attached to the pump motor (Fig 1-1) which drives the pump to provide a constant oil supply. The pump motor is a ventilated, sealed ball bearing type motor. The pump motor is supported on each end by mounting brackets which are secured to the truck frame. The motor is activated through microswitches whenever the key switch is in the ON position and the hydraulic system levers or buttons are operated.

NOTE

When the operator experiences erratic or noticeable changes in pump motor operation (high current draw or slower load lifting) and the cause is not found in the battery or control circuits, it is possible for motor to have SHORTED WINDINGS. Motor must be removed from truck to check for shorts in the windings.

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitors. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

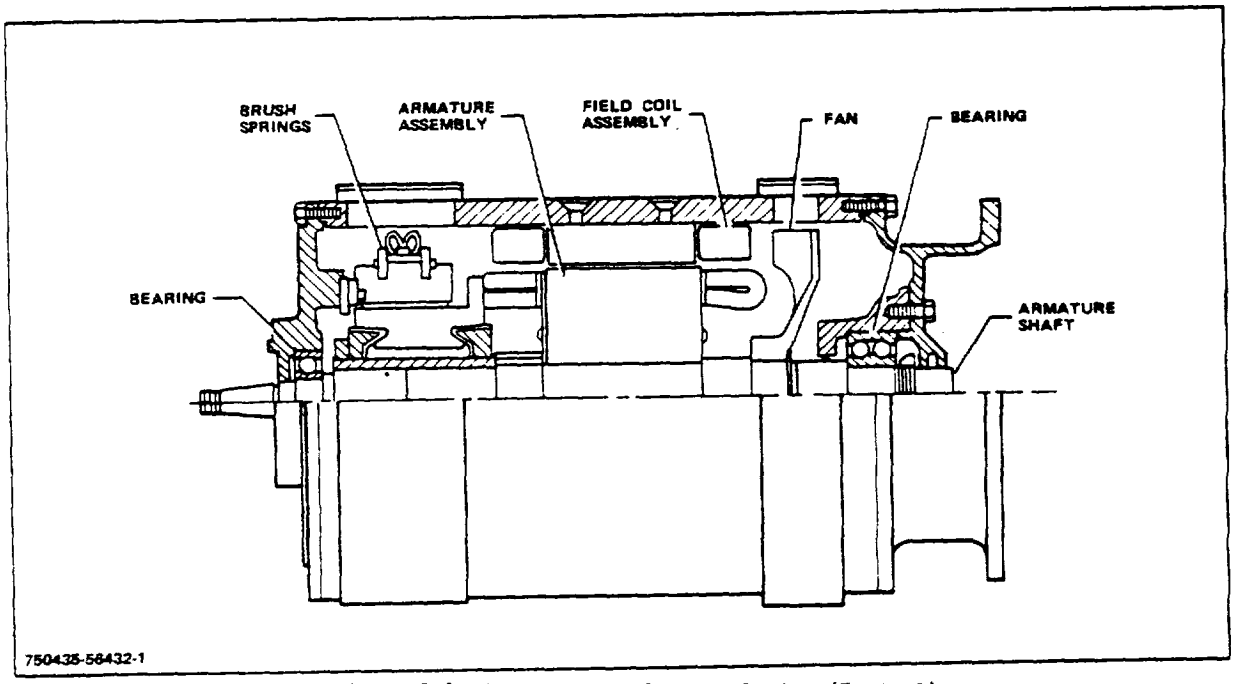


Figure 1-1. Pump Motor - Sectional View (Typical)

TOPIC 2. PUMP MOTOR BRUSHES

A. GENERAL

The dual brushes of high current-carrying capacity fit accurately into broached brush boxes to assure proper brush alignment. A metal clip on top of each brush provides a seat for the spring and also forms a stop device that prevents commutator scoring.

⚠ WARNING

Make certain the battery is disconnected and discharge capacitors.

B. INSPECTION AND REPLACEMENT

1. Raise and securely block the vehicle in position to gain access to the pump motor brushes.

NOTE

Step 1 is not required on Models SC, SR, SS and ACOP. However, the hood in front of the battery compartment on Model SC must be removed to gain access to pump motor. The drive compartment cover must be removed on Model ACOP and the access doors must be opened on Models SR and SS.

2. Unsnap the band assembly around pump motor front housing and remove band.
3. Remove brush shunt retaining screws, lift brush retaining springs and withdraw brushes from brush holders.
4. Clean brushes, holders, and wipe commutator with a dry, lint-free cloth.
5. Check appearance of commutator and the brush riding surfaces. The best signs of good commutation are dark, brownish, highly polished commutator and uniform glossy brush wearing surfaces.

⚠ CAUTION

Do not use a lubricant or solvent, of any kind, on or around the commutator.

6. Check brush shunt (Fig 2-1) for good contact with the brush holder. Make certain shunt is not damaged or burned. This may cause pressure spring to carry current and lose tension; good spring pressure is vital to motor operation. (Refer to following SPECIFICATION CHART for proper brush spring pressure).

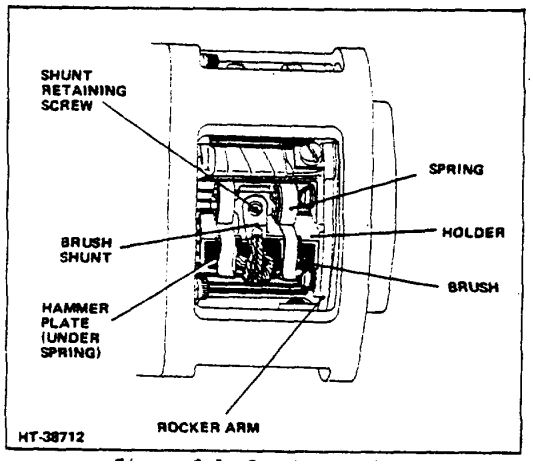


Figure 2-1. Brush Location

7. Measure length of brush. A record of brush length at each inspection is the best evidence of brush wear. (This record will help determine if sufficient wear length is present until the next inspection).

NOTE

Overloading of the motor will increase brush wear and should be taken into consideration.

Replace brushes when metal clips on brushes clear the bottom of the holder indent by less than .125".

8. Before new brushes are installed, they should be contoured on a sanding drum with the same diameter as commutator. Hold brushes to sanding drum to obtain the same radius and brush angle on contact face as was on old brushes. Final seating can be obtained with a fine mesh seating stone compound while commutator is turning.
9. Lift brush spring and place brush into brush box. Make sure each brush spring is on the brush hammer plate and brush slides freely in brush box. Position brush shunt and secure with retaining screw. Repeat procedure for other brush holders.
10. Install the band assembly. (Mesh portion of band should face underside of horizontally mounted motor.)

C. BRUSH SPRING PRESSURE

Correct brush spring pressure is vital to motor operation. Spring pressure varies with the size of the brush.

To Measure Spring Pressure (Fig 2-2):

1. Insert a pacer strip between brush and commutator.
2. Place leather loop-or spring scale hook between pressure spring and brush.
3. With pull in line with center of brush, lift spring scale and pull paper in direction of rotation until paper begins to move freely.

The reading on the spring scale is the total spring force. Record reading and compare with specification chart; replace brush spring as necessary.

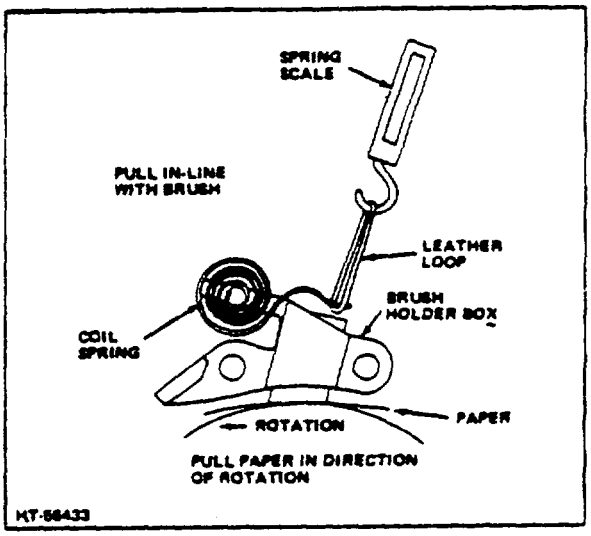


Figure 2-2. Method of Checking Brush Spring for Proper Pressure

PUMP MOTOR SPECIFICATION CHART

Motor Model	Normal Application	Ratinq Data					Brushes Total Spring Pressure (Ounces)	Commutator Minimum Wear Diameter (Inches)	Maximum Torque Terminal Leads (lb-in.)
		HP	RPM	Volts	Amps	Duty (Hours)			
MJV4006	Pump	7.6	2750	36	125	1/12	36	2.998	80

ELECTRIC MOTOR BRUSH INSPECTION GUIDE

Type of Motor	Period of Inspection	Replacement
Hydraulic Pump Motor	1. Every 90 days for normal lifting and tilting duties. 2. Every 60 days under abnormal lifting and tilting usage.	Replace brushes when metal clips on brushes clear the bottom of the holder indent by less than .125".

TOPIC 3. PUMP MOTOR REMOVAL

⚠ WARNING

Before any of the following removal procedures are performed, disconnect the battery and discharge the capacitors. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors on static panel, or momentarily touch a suitable jumper wire across the capacitor terminals.

A. REMOVAL (Models ACE, FE, and FET)

1. Drain hydraulic oil from reservoir.
2. Block drive wheels and attach hoist of adequate capacity to rear of truck.
3. Using hoist, raise rear of truck enough to gain access to pump motor. Place blocks under frame to hold it in position.
4. Disconnect hydraulic lines from pump and plug openings to prevent entry of contaminants. Tag lines for identification. Disconnect and tag cables from motor.
5. Place a floor jack under pump motor and remove capscrews that secure pump to frame. Carefully lower motor and remove from under vehicle.
6. Remove capscrews that secure pump to motor and remove pump.

B. PERIODIC INSPECTION (Motor off truck)

After 3000 hours of Normal Service or when a routine inspection reveals problems that require the removal of the motor from the truck, the following procedures apply:

Remove hydraulic pump motor
- Disassembly
- Bench Testing
- Replacement parts
- Reassembly

TOPIC 4. PUMP MOTOR DISASSEMBLY

A. DISASSEMBLY

1. Remove capscrews that secure mounting brackets to pump motor and remove brackets.

2. Remove both front and rear band assemblies from motor.

3. Remove brush shunt retaining screws, lift brush retaining springs and withdraw brushes from brush holders.

4. Remove remaining capscrews that secure pump adaptor, or rear housing, to field yoke and remove adaptor or housing.

5. Carefully remove armature assembly, complete with bearings, from field yoke assembly (Fig 4-2).

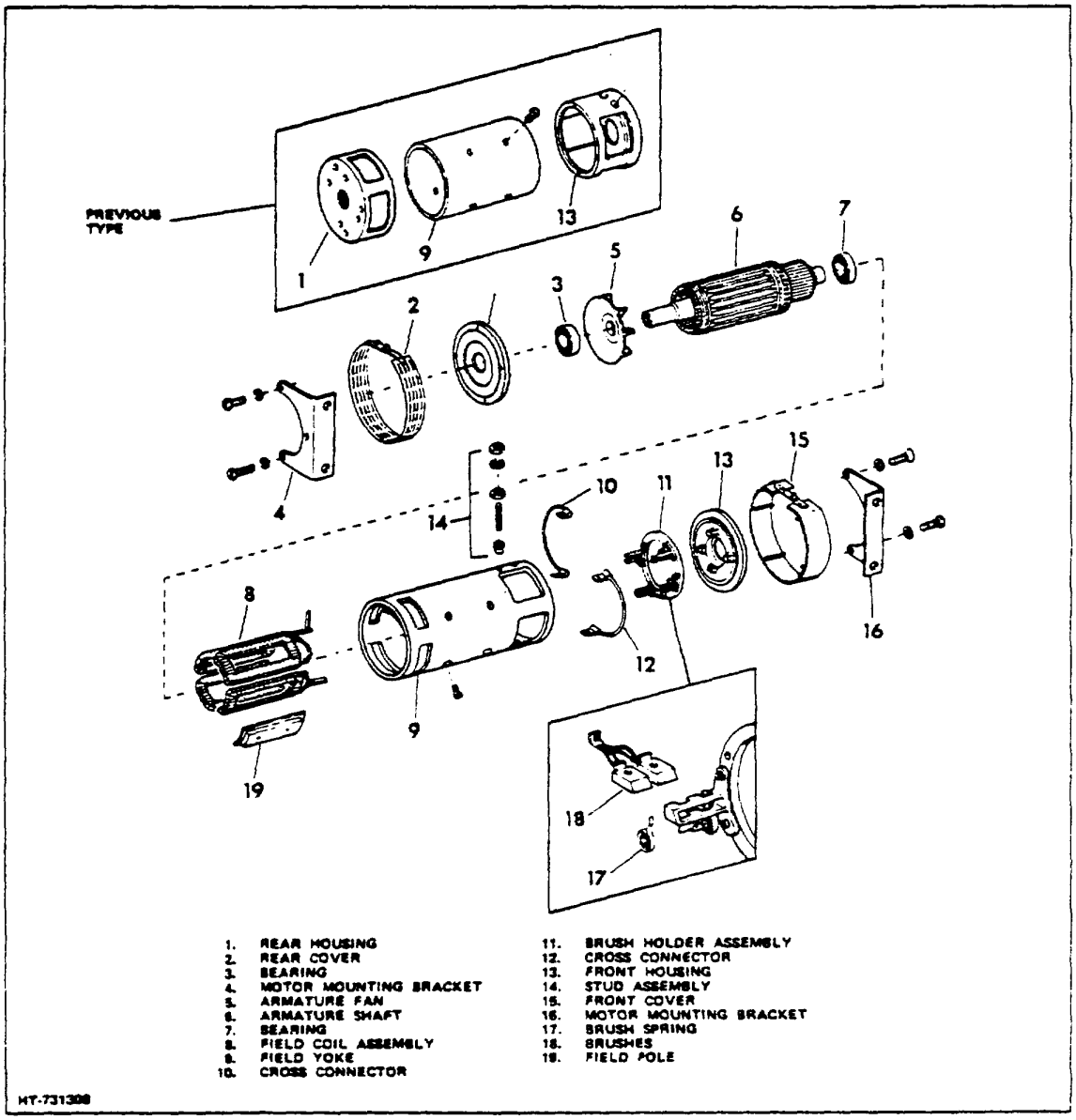


Figure 4-1. Hydraulic Pump Motor (Typical)

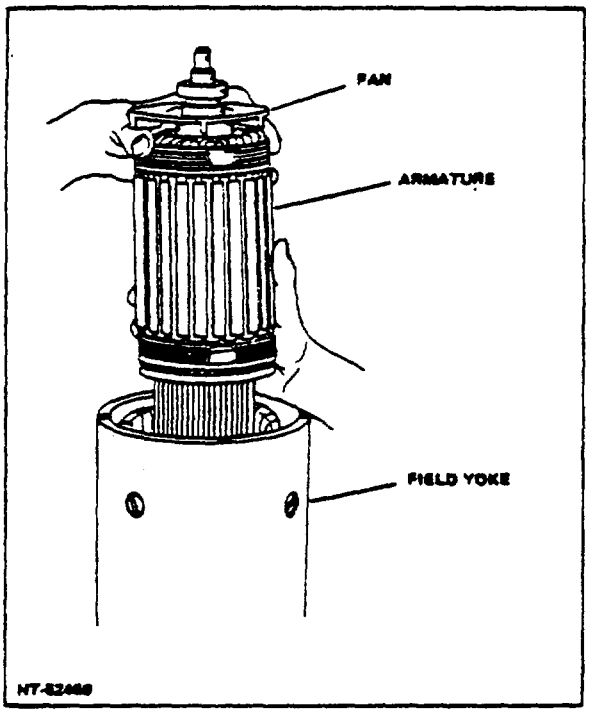


Figure 4-2. Removing Armature

⚠ CAUTION

Exercise extreme care when removing armature to prevent damage to core, commutator, or pole faces. Make certain armature is pulled straight up out of field yoke.

NOTE:
Wrap heavy paper around commutator to protect its surface; place assembly in "V" blocks to prevent damage to it.

6. When bearings are worn, or damaged, remove the bearings from armature shaft with a suitable gear puller (Fig 4-3).

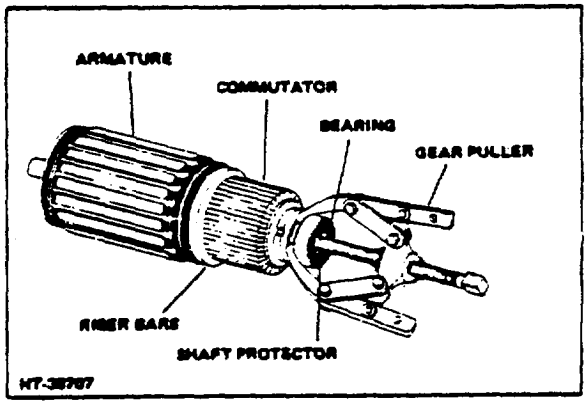


Figure 4-3. Bearing Removal

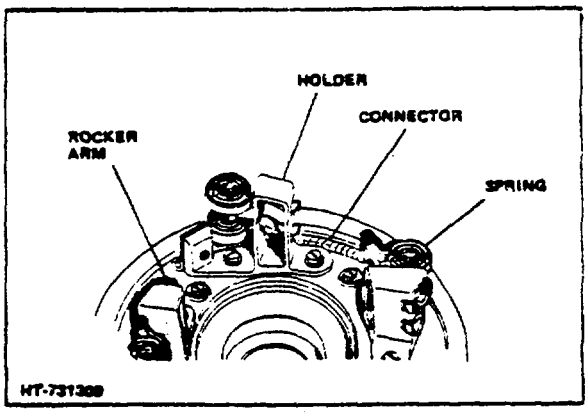


Figure 4-4. Front Housing and Rocker Arm Assembly

⚠ CAUTION

Use extreme care when using a gear puller or center of shaft could be damaged. It is recommended that a shaft protector be used between the shaft and the gear puller.

7. When necessary, remove the fan. The fan is keyed on armature shaft and also has a snap ring to secure it to the armature shaft.

8. Remove front housing and rocker arm assembly. Note and remove leads from stud. Disassemble rocker arm assembly only as far as necessary to replace worn or damaged parts. Note the disassembly sequence to assure proper reassembly. (See Fig 4-4.)

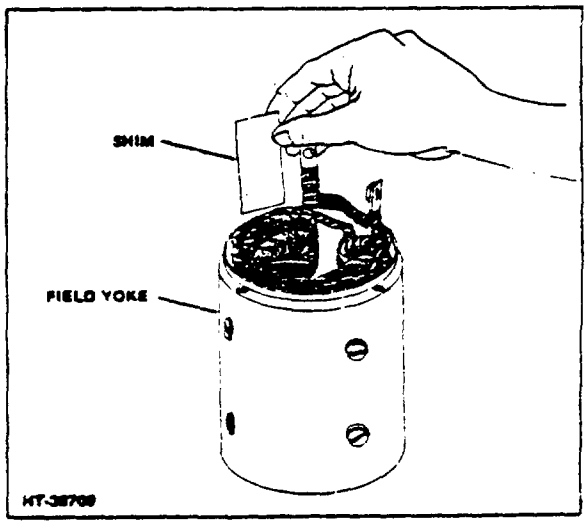


Figure 4-5. Removing Shims

NOTE:

Do not remove field coils unless replacement is required.

9. To remove field coils remove pole retaining screws and note the quantity of shims behind each pole shoe. (See Fig 4-5.)

⚠ CAUTION

Handle field coils carefully to avoid damage to insulation.

10. Remove pole shoe from each field coil, then remove coil assembly.
11. Disassemble and remove terminal studs when damaged (note sequence of disassembly to assure proper reassembly).

TOPIC 5. INSPECTION

Clean all parts with a proper solvent such as mineral spirits or an equivalent.

NOTE

Armature and fields may be wiped clean with a damp cloth saturated with a solvent. Do not soak, dip or wash.

⚠ WARNING

When using a solvent, always use in a well ventilated area.

Inspect all parts for signs of unusual wear, broken or damaged parts; replace as necessary.

A. CHECK FOR GROUNDS AND/OR OPEN CIRCUITS

To check for shorted armature, grounded armature, or grounded field coils, the following procedure is recommended.

⚠ CAUTION

Whenever connections have to be soldered, a rosin flux must be used. Acid flux must never be used on electrical connections.

1. Check the armature for shorts by placing it on a "growler" and with a steel strip, or a hacksaw blade held on armature core; rotate armature (Fig 5-1). When blade vibrates, armature is shorted in area of the core below the vibrating blade. Copper or dust in slots between commutator bars sometimes cause shorts which can be eliminated by cleaning out slots. Shorts at crossovers of coils at core end can often be eliminated by bending wire slightly and reinsulating exposed bare wire. When shorts cannot be eliminated, armature must be replaced.
2. To test armature for grounds, place one probe of test lamp on armature core or shaft and place the other probe on each commutator bar in turn. When lamp lights, armature is grounded and must be replaced.
3. Open circuits in an armature may be caused by a poor connection of leads in the commutator bars or by a broken wire in an armature coil. Either will cause sparking at the brushes. Poor connections and broken wires can often be detected visually. When this is not possible, set up the armature on the growler as shown in Figure 5-1. Test the top two adjacent bars with an a-c millivoltmeter. Rotate the armature and continue testing adjacent bars. When the millivoltmeter bridges the two bars connected to the open coil, the meter pointer will not be deflected. All other bars will give a deflection.

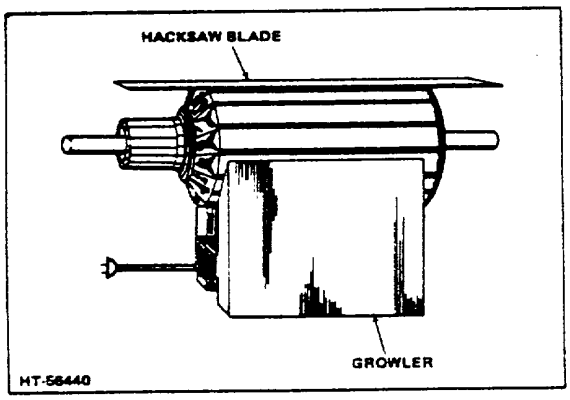


Figure 5-1. Testing an Armature for Shorts

4. The bar-to-bar meter test method of finding an open coil is more satisfactory and reliable than the growlermeter test and is often used in preference to it. Instructions are as follows:

⚠ CAUTION

Meter needle will jump wildly; precautions should be taken to avoid damage to instrument.

   a. Place the armature on "V" blocks and connect a source of direct current to the commutator. (Use the circuit of Figure 5-2.)

b. Test by spanning bars with millivoltmeter leads as illustrated in Figure 5-2.

   c. The meter will not show a reading until it bridges bars 6 *and* 7. The meter completes the circuit.

5. To test for grounded fields, place one probe of test lamp on field frame and other probe on field terminal. When lamp lights, field coils are grounded and must be replaced when ground cannot be located and repaired.

Paint or spray field coils and inside of motor frame with Class F air drying varnish. The armature coils, core, the end of commutator bars and *mica* cone ring can be sprayed or painted with Class F baking varnish. (Bake, per varnish manufacturer's instructions.)

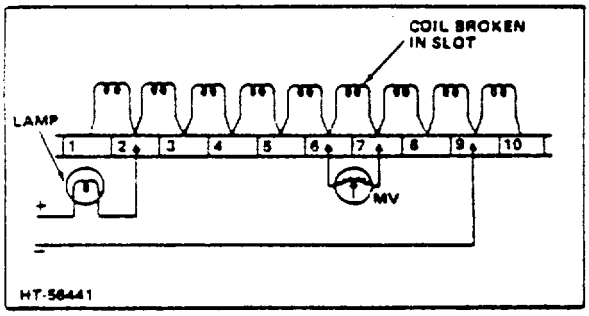


Figure 5-2. Method of Locating an Open Coil

⚠ CAUTION

Do not use silicon base varnishes.

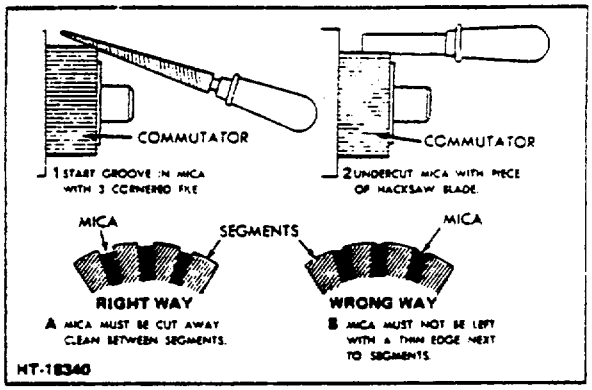


Figure 5-3. Undercutting Mica

B. UNDERCUTTING MICA

Carefully inspect the commutator. When commutator is burned, rough, or out-of-round, it must be cut down and the mica undercut.

1. Place armature in a lathe and turn down commutator until true. Make certain cut is not made on commutator riser bars as solder will be removed and weaken coil connections at this section. Remain approximately .187" from riser bars when cutting.
2. Undercut mica between bars to a depth not exceeding .030". Undercut must be full width of mica and flat at bottom. After undercutting, clean out slots to remove any dirt and copper dust. (See Figure 5-3.)
3. Sand commutator lightly with No. 00 sandpaper to remove any burrs left from undercutting.
4. Check armature on a growler for short circuits. (Refer to Step 1 in preceding Paragraph A.)

C. ARMATURE SHAFT PLUG INSPECTION AND REPLACEMENT

1. Armature shaft plugs should be inspected for wear or damage. Replace as necessary with a new internally splined shaft plug.
2. Installation

   For installation of the shaft plug, proceed as follows:

   a. Use a micrometer and measure O.D. of pump motor armature shaft at splined end; record dimension for reference.

   b. Drill and ream hole in armature shaft to .875" t .0005" diameter (Fig 5-4). Drill and ream hole to original depth in shaft.
   c. Drill out previous welds from holes in shaft.
   d. Install shaft plug in armature shaft by using shrink fit. Chill shaft plug for two to four minutes in a dry ice container or cold box before installation. Install shaft plug to full depth of reamed hole.
   e. Weld shaft plug to armature shaft through holes in shaft.
   f. Grind O.D. of armature shaft to original diameter for proper fit in preceding Step a. (Inside diameter of bearing is 1.1811".)

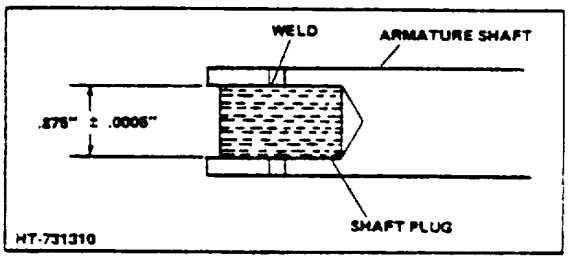


Figure 5-4. Shaft Plug Installation

TOPIC 6. ARMATURE SHAFT

A. REMOVAL

In the event of damage to the armature or armature shaft, the following is procedure for disassembly.

1. Place the drive end of the shaft in a pipe approximately 2" ID and at least 15" long (Fig 6-1).

⚠ CAUTION

Make certain the top end of the pipe makes complete contact with the core from above the shaft, but under the core rivets.

2. Place a solid bar of 1" diameter maximum 00 and about 4" long against the shaft, commutator end.
3. Apply vertical pressure on the bar (commutator end) and press the shaft from the armature.

NOTE

Pressure to remove or install shaft may exceed 20 tons.

4. Remove fan and spacer from armature shaft (where applicable).

B. INSTALLATION

1. Install spacer and fan on shaft (where applicable). Insert shaft in armature as far as possible using hand pressure only.

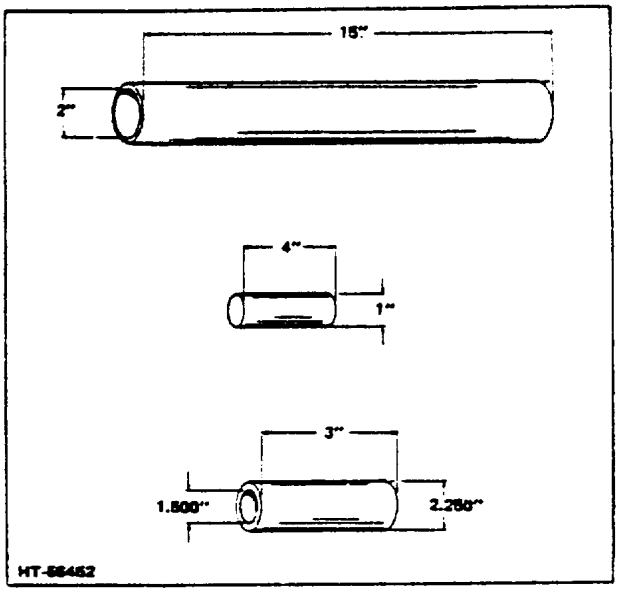


Figure 6-1. Armature Shaft Pipes and Bar

2. Place a 3" long, 1.500" ID, 2.250" 0D pipe against the commutator sleeve with the assembly in the vertical position.
3. Use the bar, press against the shaft (drive end). Apply vertical pressure until the shaft bottoms completely against the fan, or shaft shoulder.
4. Inspect the armature assembly. (Refer to preceding Topic 5, INSPECTION.

TOPIC 7. PUMP MOTOR REASSEMBLY AND INSTALLATION

A. REASSEMBLY

1. If terminal studs were removed, install and torque them. Refer to preceding PUMP MOTOR SPECIFICATION CHART, TOPIC 2.
2. Position field coils, pole shoes, and shims in field yoke and secure with screws.

⚠ CAUTION

Handle field ocils carefully to avoid damage to insulation.

3. Reassemble rocker arm assembly to front housing.
4. Align and bolt front housing to field yoke. Connect armature lead jumpers and field leads as marked during disassembly.
5. If fan was removed, on other than 450C or 4500 series motors, heat fan in oven to 200^0F. Position the key on the shaft and press the fan into place. Avoid scraping the bore when pressing the fan onto the shaft. Install the snap ring.
6. If bearings were removed, replace with new ones. Both bearings are the sealed type and cannot be lubricated.
7. Place field yoke in vertical position. Lower armature assembly (carefully, to avoid damage to commutator or core) into field yoke assembly. Remove paper covering on commutator.
8. Position rear housing, or pump adapter, on field yoke assembly and secure with capscrews and lockwashers.
9. Install brushes. Refer to Topic 2, PUMP MOTOR BRUSHES.
10. Install front and rear band assemblies.
11. Secure mounting brackets to pump motor with capscrews and lockwashers.

B. FINAL INSPECTION

Check motor winding insulation as follows:

⚠ CAUTION

Semi-conductors, small transformers, voltage regulators and other devices that may be injured by the high voltage must not be in the circuit.

1. Connect one lead of 500 volt megger to any motor terminal stud, the other lead to the motor frame and apply the voltage.
2. A reading of one megohm or greater is satisfactory. Record reading for future reference.

   If reading is less than one megohm, disassemble the motor and check for grounds as detailed in preceding Topic 5, INSPECTION.

C. INSTALLATION (Models ACE, FE and FET)

1. Apply a light coat of clean grease to the splines of the pump shaft. Install pump on motor and secure with capscrews.
2. Using floor jack, raise pump and motor into position and secure to frame with capscrews.
3. Reconnect hydraulic lines to pump and cables to motor.
4. Using hoist, remove blocks under truck and lower rear of truck to floor. Remove hoist.
5. Refill hydraulic oil reservoir with clean specified oil.

TOPIC 1. POWER STEERING MOTOR BRUSHES

A. GENERAL

The brushes of high current-carrying capacity fit accurately into stamped brush boxes to assure proper brush alignment.

The power steering motor brushes should be replaced with the pump motor out of the vehicle.

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitors. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

B. INSPECTION AND REPLACEMENT

1. Remove the pump motor (refer to following TOPIC 2, POWER STEERING PUMP MOTOR REMOVAL.)
2. Remove band to gain access to brushes.
3. Remove brushes. Remove brush shunt retaining screws, lift brush retaining springs and withdraw brushes from brush holders (Fig 1-1).
4. Clean brushes. holders, and wipe commutator with a dry, lint-free clot".
5. Check appearance of commutator and the brush riding surfaces. The best signs of good commutation are dark brownish, highly polished commutator, and uniform glossy brush wearing surfaces.

⚠ CAUTION

Do not use a lubricant or solvent, of any kind, on or around the commutator.

6. Check brush shunt (Fig 1-1) for good contact. Make certain shunt is not damaged or burned. This may cause pressure spring to carry current and lose tension; good spring pressure is vital to motor operation. (Refer to following SPECIFICATION CHART for proper brush spring pressure.)

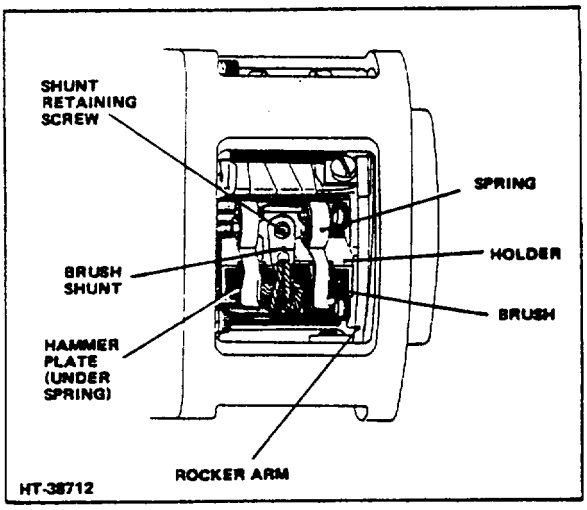


Figure 1-1. Brush Location (Typical)

7. Measure length of brush. A record of brush length at each inspection is the best evidence of brush wear. (This record will help determine if sufficient wear length is present until the next inspection.

NOTE

Overloading of the motor may be indicated by increased brush wear.

Replace brushes when brush length is less than 5/16". Measure brush length carefully and check condition of the brush.

8. Before new brushes are installed, they should be contoured on a sanding drum with the same diameter as commutator. Hold brushes to sanding drum to obtain the same radius and brush angle on contact face as was on old brushes. Final seating can be obtained with a fine mesh seating stone compound while commutator is turning.
9. Install brushes and springs. Brushes must move freely in brush-boxes and must be long enough to press firmly against the commutator. Brush springs should have equal tension. (Refer to following Paragraph C, BRUSH SPRING PRESSURE.)
10. Secure brush shunt with retaining screw. Repeat procedure for other brush holder. Connections must be clean and tight.

11. Install band securely.
12. Install the pump motor.

C. BRUSH SPRING PRESSURE

Correct brush spring pressure is vital to motor operation.

To Measure Spring Pressure (Fig 1-2):

1. Insert a paper strip between brush and commutator.
2. Place leather loop or spring scale hook between pressure spring and brush.
3. With pull in line with center of brush, lift spring scale and pull paper in direction of rotation until paper begins to move freely.

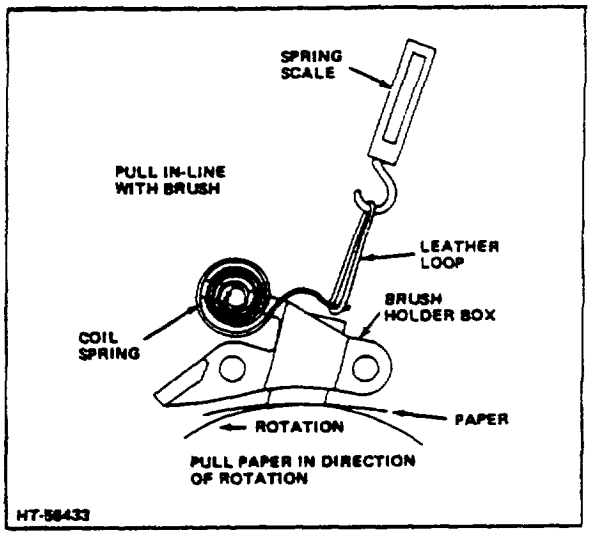


Figure 1-2. Method of Checking Brush Spring for Proper Pressure

The reading on the spring scale is the total spring force. Record reading and compare with specification chart; replace brush spring as necessary.

POWER STEERING PUMP MOTOR SPECIFICATIONS

Motor Model	Normal Application	Rating Data					Brushes Total Spring Pressure (Ounces)	Commutator Minimum Wear Diameter (Inches)	Maximum Torque Terminal Leads (lb-in.)
		HP	RPM	Volts	Amps	(Hours)			
B48-1228	Power Steering	0.8	1660	36	24	Cont.	22	NA	NA

TOPIC 2. POWER STEERING PUMP MOTOR REMOVAL

⚠ WARNING

Before any of the following removal procedures are performed, disconnect the battery and discharge the capacitors.

A. REMOVAL (Models ACE, FE and FET)

The power steering pump and motor for ACE 20-25-30 and ACE 35-55 are located under the battery deck and above the steer axle. The motor is secured to the battery deck with nuts and capscrews.

1. Remove battery from trucks that require access to the battery deck (ACE 20-25-30 and ACE 35-55).
2. When necessary, use a suitable hoist to raise truck enough to gain access to motor; block in position and chock wheels.
3. Tag and disconnect cables from motor.
4. Tag and disconnect hydraulic lines from pump. Plug lines and pump ports to prevent entry of contaminants.
5. Remove capscrews that secure pump and motor unit to frame. Remove pump and motor from truck.
6. Remove capscrews that secure pump to motor and remove pump.

TOPIC 3. MOTOR DISASSEMBLY

A. DISASSEMBLY

1. Remove capscrews that secure mounting brackets to motor and remove brackets (where applicable).

2. Remove both front and rear band assemblies from motor.

3. Remove brush retaining screws, lift brush retaining springs and withdraw brushes from brush holders.

4. Remove retaining hardware and remove drive end housing from field yoke.

5. Carefully remove armature assembly from field yoke.

⚠ CAUTION

Exercise extreme care when removing armature to prevent damage to core or commutator. Make certain armature is pulled straight out of field shell.

NOTE

Wrap commutator with heavy paper to protect surface. Support armature assembly in "V" blocks to protect it from damage.

6. When bearings are worn or damaged, replace them (Fig 3-1).
7. Remove front housing or commutator hood. Disassemble remaining components only as far as necessary to replace worn or damaged parts. Note the disassembly sequence to assure proper reassembly.

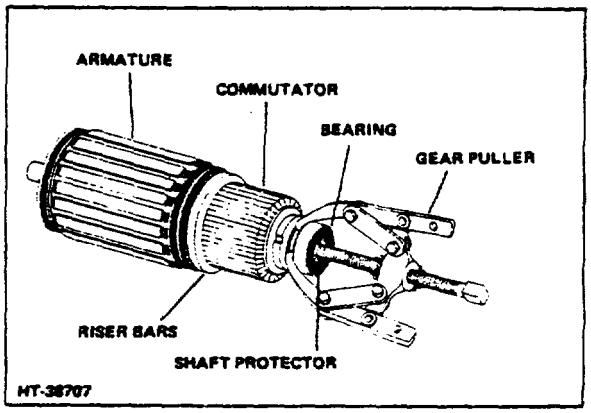


Figure 3-1. Bearing Removal (450A3)

NOTE

Do not remove field coils unless replacement is required.

8. To remove field coils remove pole retaining screws and note the quantity of shims behind each pole shoe (Fig 3-3).

   Handle field coils carefully to avoid damage to insulation.

9. Remove pole shoe from each field coil, then remove coil assembly.

10. Disassemble and remove terminal studs when damaged, noting sequence of disassembly to assure proper reassembly.

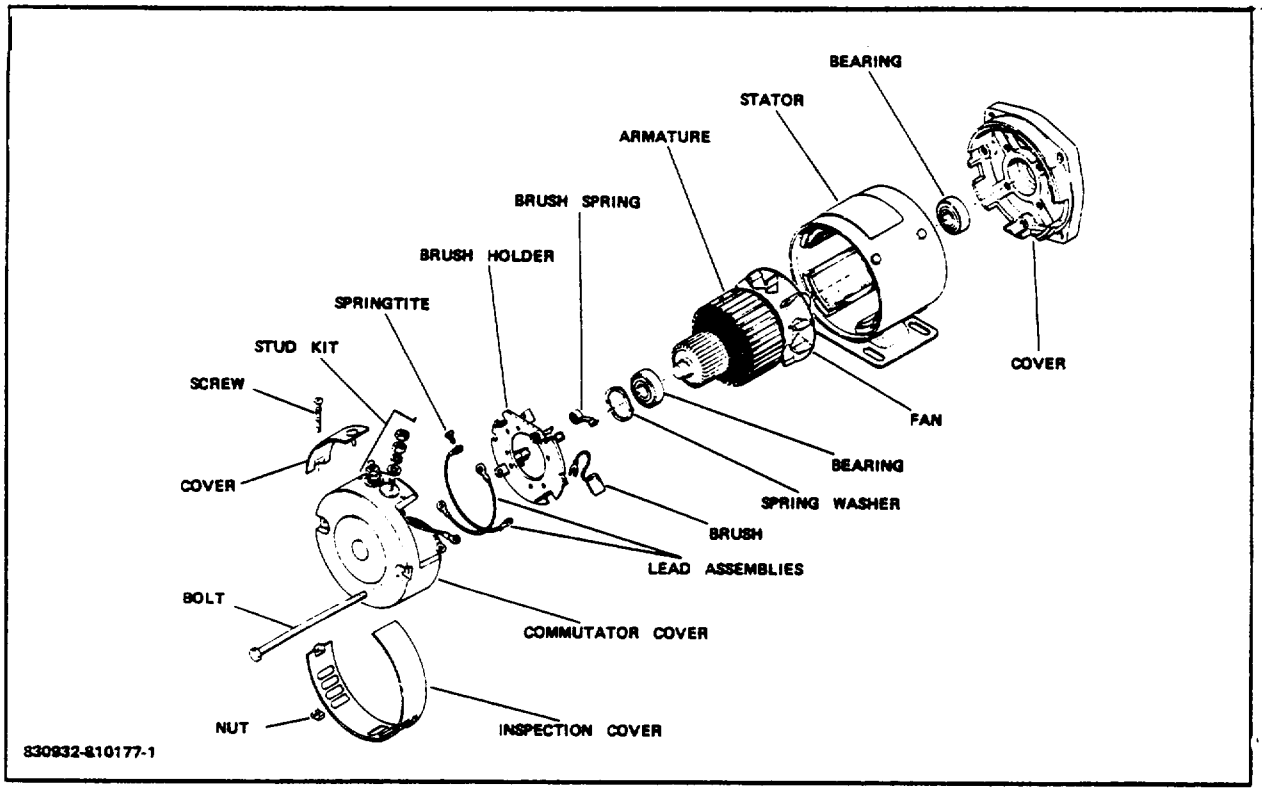


Figure 3-2. Power Steering Pump Motor

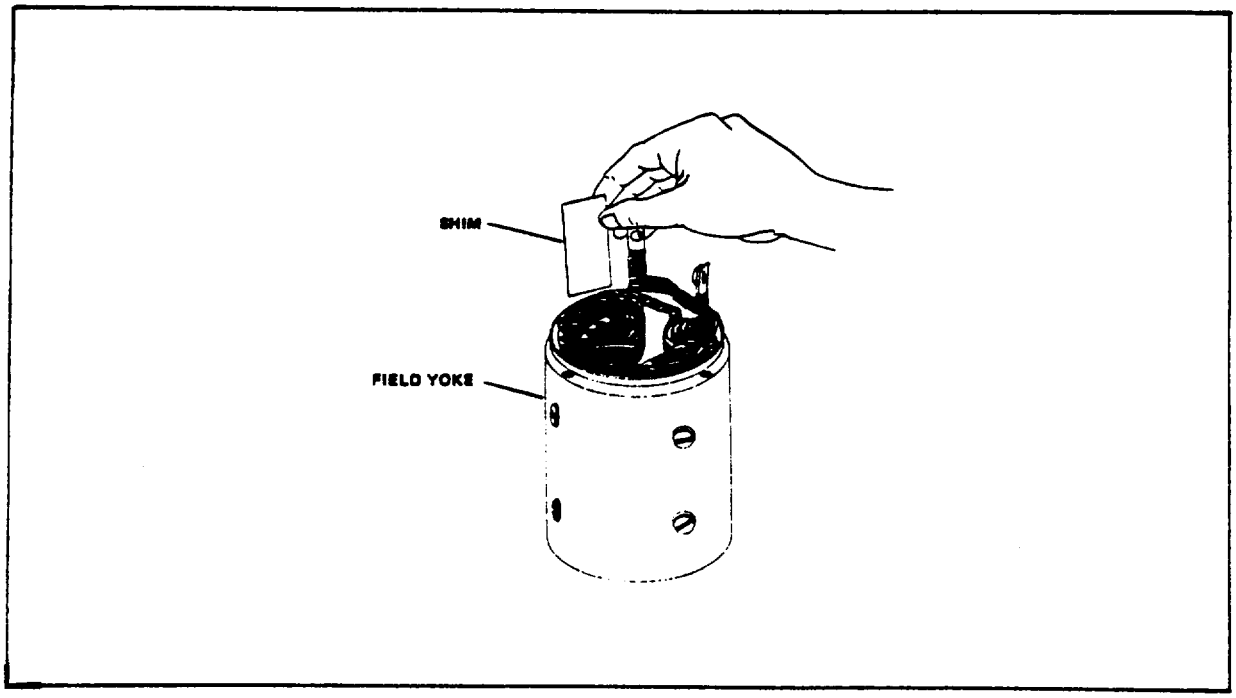


Figure 3-3. Removing Shims

TOPIC 4. INSPECTION

Clean all parts with a proper solvent such as mineral spirits or an equivalent.

NOTE

Armature and fields may be wiped clean with a damp cloth saturated with a solvent. Do not soak, dip or wash.

⚠ WARNING

When using a solvent always use in a well ventilated area.

Inspect all parts for signs of unusual wear, broken or damaged parts; replace as necessary.

A. CHECKING FOR GROUNDS AND/OR OPEN CIRCUITS

To check for shorted armature, grounded armature, or grounded field coils, the following procedure is recommended.

⚠ CAUTION

Whenever connections have to be soldered, a rosin flux must be used. Acid flux must never be used on electrical connections.

1. Check the armature for shorts by placing it on a "growler" and with a steel strip, or a hacksaw blade held on armature core; rotate armature (Fig 4-1). When blade vibrates, armature is shorted in area of the core below the vibrating blade. Copper or dust in slots between commutator bars sometimes cause shorts which can be eliminated by cleaning out slots. Shorts at crossovers of coils at core end can often be eliminated by bending wire slightly and reinsulating exposed bare wire. When shorts cannot be eliminated, armature must be replaced.

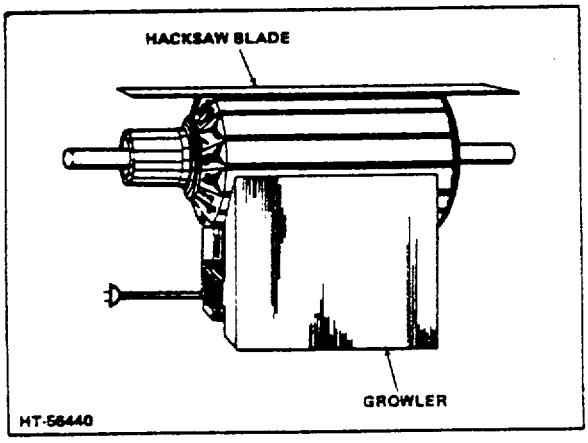


Figure 4-1. Testing and Armature for

2. To test armature for grounds, place one probe of test lamp on armature core or shaft and place the other probe on each commutator bar in turn. When lamp lights, armature is grounded and must be replaced.

3. Open circuits in an armature may be caused by a poor connection of leads in the commutator bars or by a broken wire in an armature coil. Either will cause sparking at the brushes. Poor connections and broken wires can often be detected visually. When this is not possible, set up the armature on the growler as shown in (Figure 4-1). Test the top two adjacent bars with an a-c millivoltmeter. Rotate the armature and continue testing adjacent bars. When the millivoltmeter bridges the two bars connected to the open coil, the meter pointer will not be deflected. All other bars will give a deflection.

4. The bar-to-bar meter test method of finding an open coil is more satisfactory and reliable than the growler-meter test and is often used in preference to it. Instructions are as follows:

⚠ CAUTION

Meter needle will jump wildly; precautions should be taken to avoid damage to instrument.

   a. Place the armature on "V" blocks and connect a source of direct current to the commutator. (Use the circuit of Figure 4-2.)
   b. Test by spanning bars with millivoltmeter leads as illustrated in Figure 4-2.
   c. The meter will not show a reading ,until it bridges bars 6, and 7. The

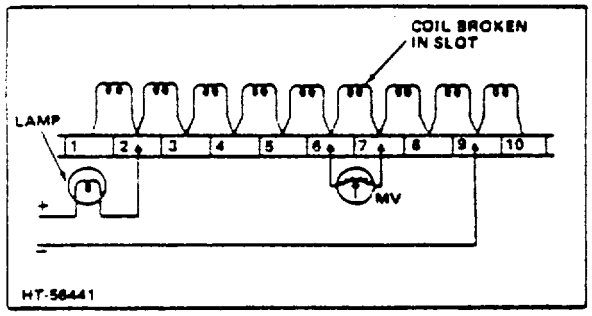


Figure 4-2. Method of Locating an Open Coil

TOPIC 5. POWER STEERING PUMP MOTOR REASSEMBLY AND INSTALLATION

A. REASSEMBLY

1. If terminal studs were removed, install and torque them. (Refer to preceding PUMP MOTOR SPECIFICATION CHART in Topic 1.)
2. Position field coils, pole shoes, and shims in field yoke and secure with screws.

⚠ CAUTION

Handle field coils carefully to avoid damage to insulation.

3. Align and install front housing or commutator hood to field shell.
4. If bearings were removed, replace with new ones.
5. Place field shell in vertical position. Lower armature assembly (carefully, to avoid damage to commutator or core) into field shell assembly. Remove paper covering from commutator.
6. Install rear housing or fan hood to field shell with retaining hardware.
7. Install brushes. Refer to Topic 1, PUMP MOTOR BRUSHES.
8. Install front and rear band assemblies.
9. Secure mounting brackets to pump motor with capscrews and lockwashers (where applicable).

B. FINAL INSPECTION

Check motor winding insulation as follows:

⚠ CAUTION

Semi-conductors, small transformers, voltage regulators, and other devices that may be injured by the high voltage must not be in the circuit.

1. Connect one lead of 500 volt megger to any motor terminal and the other lead to the motor frame; apply the voltage.
2. A reading of one megohm or greater is satisfactory. Record for future reference.

When reading is less than one megohm, disassemble the motor and check for grounds as detailed in preceding Topic 4, INSPECTION.

C. INSTALLATION (Models ACE, FE, FET)

1. Install pump on motor making certain coupling is properly seated. Secure with capscrews.

NOTE

During assembly of the power steering pump and motor, apply grease to the power steering pump motor coupling. The grease applied serves two purposes: (1) to hold the coupling in place when assembling the power steering pump or motor, and (2) as a lubricant for the couplings which will increase the coupling's service life.

Any time the power steering pump or motor is removed from the truck, apply a small amount to both ends of the coupling.

2. Install pump and motor unit in frame and secure with capscrews.
3. Reconnect hydraulic lines to pump and cables to motor.
4. If truck was raised off floor, remove support blocks and lower, with hoist, to floor.
5. If applicable, install battery in truck.

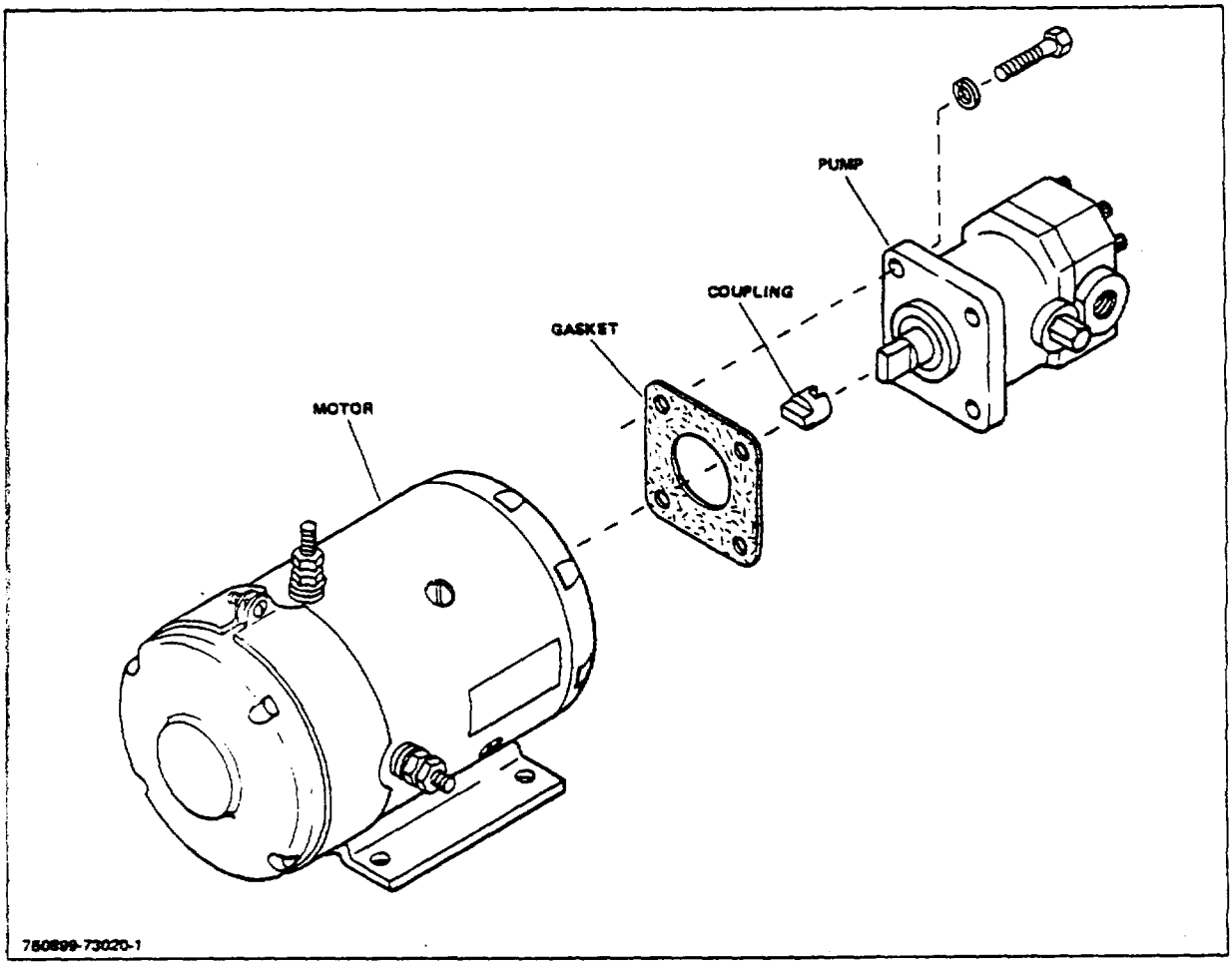


Figure 5-1. Power Steering Pump and Motor

TOPIC 1. GENERAL DESCRIPTION

The drive unit is a double-reduction, internal gear drive. Each drive wheel is mounted on an axle housing spindle by two opposed, tapered roller bearings locked in correct adjustment by a washer, castellated nut, and cotter pin. The weight of the lift truck is carried by the axle housing and the wheels; therefore, the axle shafts (jackshafts) serve only to drive the wheels.

The differential is of the bevel gear and pinion type with final reduction through the axle shafts and bull gears that set each drive wheel in motion.

The axle shafts are splined to the differential side gears at one end and mesh with the bull gears in the drive wheels at the opposite end. Axle shaft teeth are crown-shaved to assure correct mesh. The axle shafts rotate at the drive wheel end in two opposed tapered roller bearings locked in place on the shaft by a sleeve-type nut and spider lock ring. The assembly is locked in position in the axle housing by a bearing cap and capscrews. The bull gear is positioned in the drive wheel by spirol pins and is bolted into the wheel from the outside so that tightness can be checked periodically without necessity of removing the wheel.

TOPIC 2. JACKSHAFT

A. REMOVAL AND DISASSEMBLY

⚠ WARNING

Disconnect the battery before performing any work on vehicle.

1. Attach a suitable hoist of adequate capacity to the front of the vehicle and raise it sufficiently so the drive wheels clear the floor. Carefully place sturdy wooden blocks under both sides of the frame just behind the drive wheels. Lower vehicle enough to take stress off the hoist and so the drive wheels clear the floor and wooden blocks.
2. Remove capscrews and lockwashers that secure the hub cap to the wheel and remove hub cap. Remove cotter pin, retaining nut, and washer from drive wheel spindle.
3. Remove outer bearing cone (Fig 2-1) from wheel and carefully remove the drive wheel.

⚠ CAUTION

Exercise care when removing drive wheel so no damage results to brake shoes, drum, or spindle threads.

4. Remove inner bearing cone (Fig 2-2) and grease shield from spindle.
5. Remove capscrews and lockwashers that secure dust shield to the housing and remove the dust shield.
6. Remove capscrews and lockwashers that secure jackshaft cap to the housing.

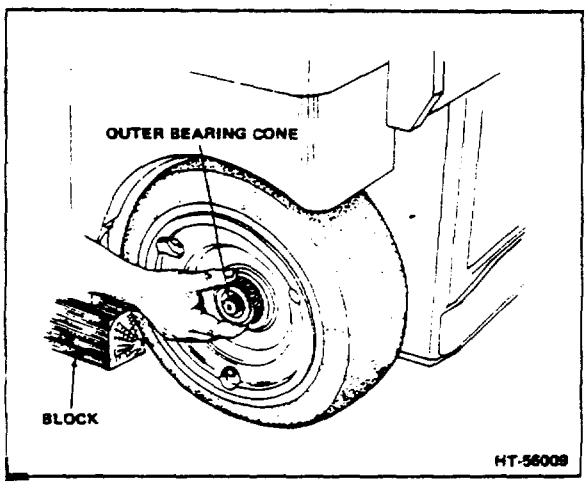


Figure 2-1. Remove Drive Wheel Outer Bearing Cone

7. Install a slide hammer puller (Fig 2-3) in threaded hole in the end of the jackshaft; carefully remove jackshaft and bearing assembly from housing as a unit.
8. Straighten locking tabs of lockwasher (Fig 2-4); remove locknut, lockwasher, and tongued washer from jackshaft.
9. Place jackshaft assembly on a suitable press and remove the bearings.

⚠ CAUTION

When bearings are being removed, make certain the pressure is exerted against the inner race of the bearing cone and not on the roller portion. Also exercise care to prevent damage to the axle shaft cap.

10. Remove grease seal and jackshaft cap from jackshaft.

NOTE

Whenever the jackshaft assembly is disassembled, it is recommended that the grease seal be replaced with a new one.

11. Remove oil seal from drive axle housing.

NOTE

Whenever the jackshaft is removed, it is recommended that the oil seal in the drive axle housing be replaced.

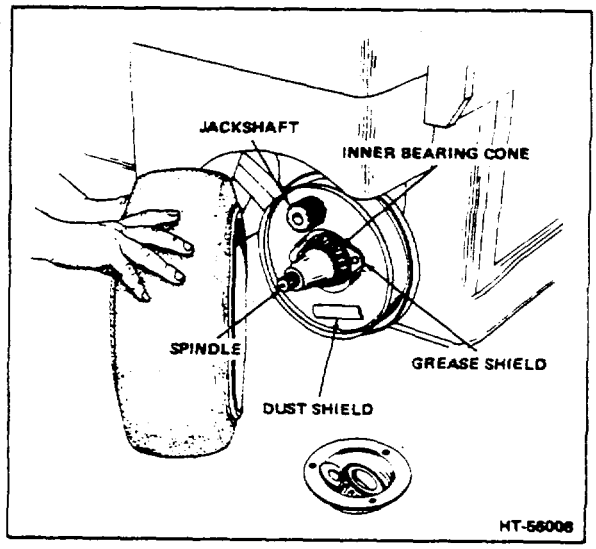


Figure 2-2. Wheel Removed

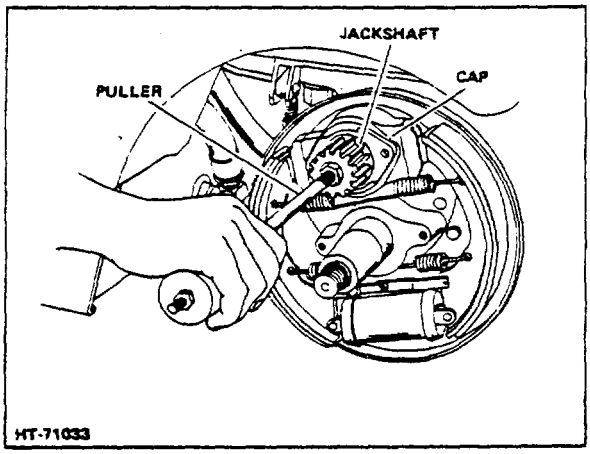


Figure 2-3. Pulling Jackshaft

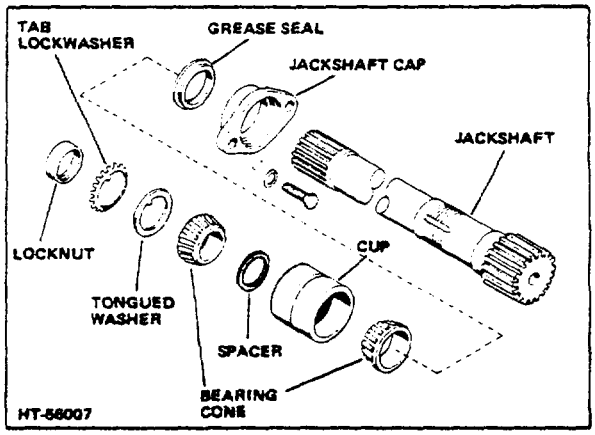


Figure 2-4. Jackshaft Assembly

B. INSPECTION

Wash all parts in a suitable cleaning solvent to remove grease and foreign material; dry with clean compressed air. Inspect for worn or damaged parts and replace when necessary. Inspect jackshaft pinion for worn or broken teeth. Wash off bull gear with suitable solvent and dry with compressed air. Check bull gear for cracked or chipped teeth and any signs of uneven or excessive wear. Also inspect drive wheels for wear or damage.

C. INSTALLATION

1. Lubricate jackshaft bearing cup and cones with specified grease. Apply grease with applicator designed to force lubricant into the bearing rollers.
2. Install jackshaft cap (Fig 2-4), new grease seal, bearing assembly, tongued washer, tab lockwasher, and locknut on jackshaft.
3. Tighten locknut until there is a slight preload on the bearing assembly. Secure locknut in position with tabs on lockwasher.

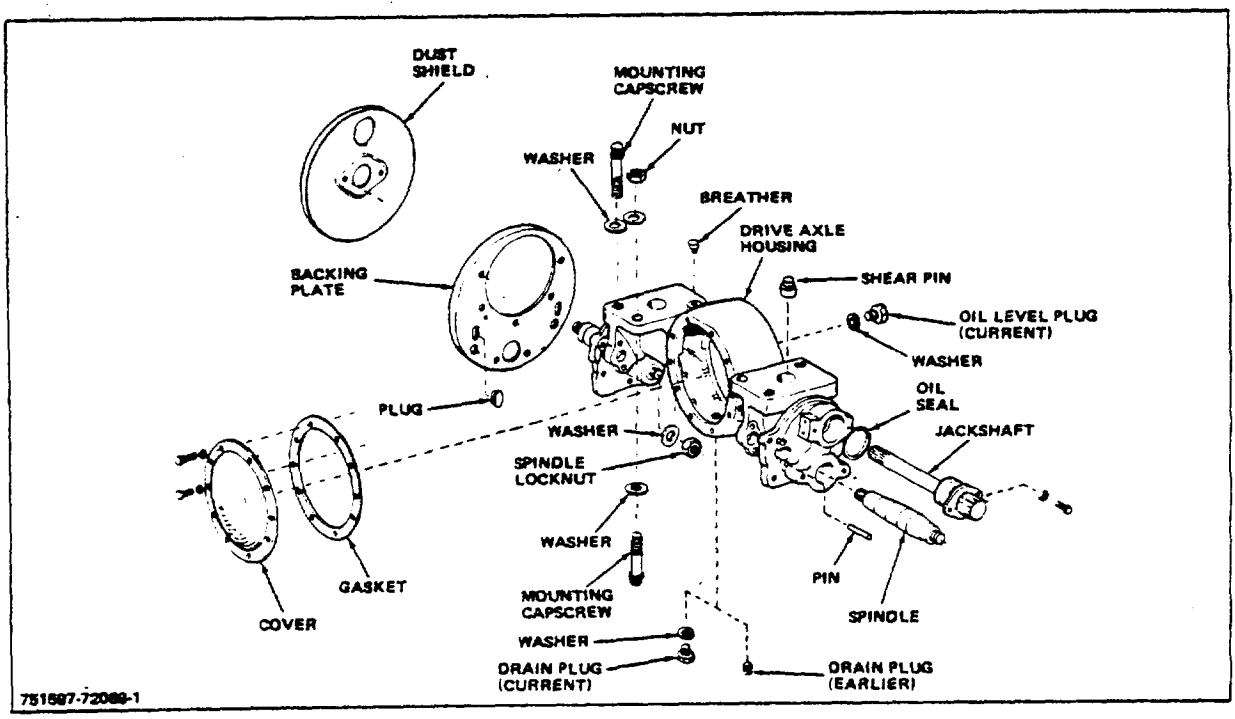


Figure 2-5. Drive Axle Housing Assembly (ACE 35 thru 55)

4. Use a seal driver, and install a new oil seal (Fig 2-5) in the drive axle housing.

5. Carefully install jackshaft assembly through oil seal and into drive axle housing.

⚠ CAUTION

Use extreme care so as not to cut or scratch oil seal with the splines on end of jackshaft while it is being installed.

6. Place jackshaft in position and drive it into place with a soft-headed mallet. Align holes in jackshaft cap with threaded holes in housing; secure cap with lockwashers and capscrews.

7. Install dust shield and secure it with lockwashers and capscrews.

8. Lubricate drive wheel inner bearing cone with specified grease. Apply grease with applicator designed to force lubricant into roller bearings.

9. Install grease shield and inner bearing cone on drive wheel spindle.

10. Lubricate bull gear and jackshaft pinion with specified grease. Carefully install drive wheel on wheel spindle.

⚠ CAUTION

Use extreme care when installing drive wheel so no damage results to brake shoes, drum, or threaded end of drive wheel spindle.

11. Lubricate drive wheel outer bearing cone with specified grease. Again apply grease with applicator designed to force lubricant into roller bearings. Then install outer bearing cone on spindle.

12. Install washer and retaining nut on spindle. While tightening retaining nut, rotate the wheel alternately in each direction until a torque of 50 lb-ft maximum is obtained. Then back off the nut 30° minimum to 60° maximum to allow the cotter pin to be installed. Then install cotter pin.

13. Install hub cap to drive wheel; secure with lockwashers and capscrews.

14. Raise vehicle slightly with the hoist and remove the wooden blocks from under the frame. Then lower vehicle so drive wheels rest on the floor. Remove hoist from front of vehicle.

TOPIC 3. SPINDLE

A. REMOVAL AND INSPECTION

1. Remove drive wheels as detailed in preceding Topic 2.
2. Remove dust shield.
3. Remove locknut and washer from spindle at back of drive housing (Fig 2-5).
4. Install spindle puller and remove spindle (Fig 3-1).
5. Inspect spindle and bearings for damage and replace if necessary.

B. INSTALLATION

1. Insert spindle in drive housing and install washer and locknut. Tighten locknut until spindle seats.
2. Install bearings, dust shield, and wheel assembly. (Refer to preceding Topic 2.)

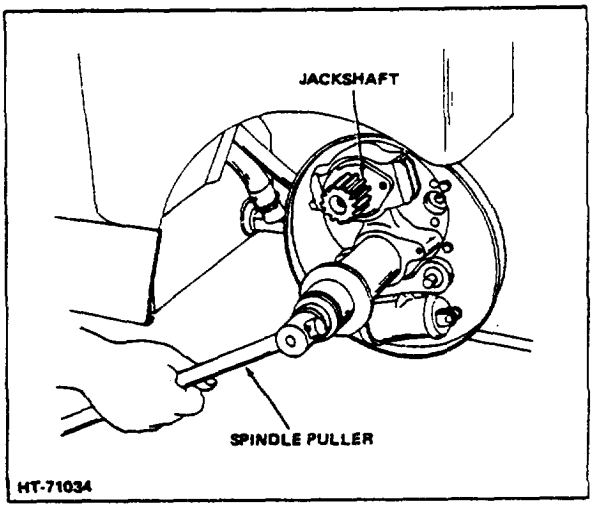


Figure 3-1. Removing Spindle

TOPIC 4. DRIVE UNIT

A. NOISE REDUCTION

Objectional drive axle noise can originate in the drive train as a result of misalignment or misadjustment of the drive train components (i.e. alignment of the drive axle and drive motor, ring and pinion gear adjustments). To correct or reduce the noise level in the drive train the procedure below is recommended to determine the cause. The procedure outlines the checks and adjustments that should be performed when a "noisy" drive axle is experienced. The drive train should be disassembled only far enough to correct or reduce the noise level.

When the drive train is reassembled check each component for noise by operating the drive motor and listening to the noise level. Parts should be reassembled at the lowest noise level.

1. Check the differential oil level and make sure the specified lubricant is used in the differential. For temperatures above 32°F use SAE 140 EP and for temperatures below 32°F use SAE 90 EP. An improperly lubricated differential can result in worn differential parts which can lead to a "noisy" drive train.
2. Operate the lift truck in forward and reverse under full acceleration, coasting, and tight right and left turns. Note any noise in the drive train as the lift truck is operated under each of the above conditions. Operating the lift truck under these conditions may give an indication or may help to identify the cause of noise.

   Noise from the drive train during full acceleration and not heard during coasting, may indicate misalignment of the drive train components, such as between the drive axle and drive motor.

   Noise heard while the lift truck is coasting and not heard during full acceleration may indicate worn parts (i.e. worn bearings) or excessive play between parts (i.e. ring and pinion gear).

   Noise heard while turning the lift truck to the right may indicate the noise is from the left side of the drive train (bull gears, jackshaft, etc.). Noise heard while making a tight left turn may indicate the source of the noise is in the right side of the drive train (bull gear, jackshaft, etc.).
3. To help locate the cause of the noise raise the front of the lift truck until the drive wheels clear the floor and block into position. Operate the drive motor in forward and reverse while varying the speed of the drive wheels. Listen to noise level to give an indication of the sources of noise. If the source of noise cannot be located after performing steps 2 and 3, a step by step "tear down" and inspection will have to be performed to locate the cause.

   After each check and adjustment operate drive motor to check if noise level has been reduced.
4. Readjust the wheel bearing adjusting nut by backing off adjusting nut and retorquing to 50 lb-ft while turning wheel alternately in each direction. Then back off nut to a minimum of 30' or to a maximum of 60' to allow insertion of cotter pin. Install cotter pin but do not secure. Operate drive motor and listen to noise level.
5. If the noise level is unchanged, remove the drive wheel and check to see if the bull gear and jackshaft gear has been properly lubricated. A "dry" bull gear can cause noise in the drive train.

   NOTE

   A grade 2 lithium soap grease containing a maximum of 5% micronized molybdenum disulfide is specified for the bull gear. The valleys between the teeth on the bull gear are to be filled with grease to 3/4 to 7/8 the height of the teeth.

6. Clean and check the bull tooth contact pattern. Contact should be at the same point on each tooth, of equal length and show no signs of pitting or peening.
7. Operate drive train without the drive wheels installed and note noise level. If the noise is still present, remove jackshaft and run drive motor in forward and reverse noting any noise. If noise is no longer present, check the differential side gear splines and jackshaft splines. Also, check the straightness of the jackshaft.
8. Loosen drive motor support bracket nut and operate drive motor. Check noise level while varying the amount of looseness of the bracket nuts. Secure bracket in position of the lowest noise level.
9. Loosen front drive axle *mounting pad* bolts, operate drive motor and check noise level. If no change in noise is heard, loosen rear drive axle pad bolts. If the noise level is reduced check flatness of the axle and frame mounting pads. See step 15.

10. Check the tightness of the capscrews securing the drive motor flange to the differential carrier and the drive axle housing to the carrier. If any of the bolts require tightening, run motor and note any change in noise level.

11. If there is no change in the noise level, remove drive wheel spindle from drive axle housing and reassemble drive wheel and bearings to spindle. Mount a dial indicator to the spindle and check run out of the bull gear face and inside diameter of the bull gear teeth, see Figure 4-1. Run out on the bull gear face must not exceed .010". Maximum allowable run out on the inside diameter of the bull gear teeth is .005".

    If the run out of the bull gear and inside diameter of the bull gear teeth are within the allowable limits, the backlash between the ring gear and pinion gear in the differential should be checked with a dial indicator. Mount a dial indicator on the differential carrier and check the backlash between the ring and pinion gears at four positions on the ring gear 90° apart (1/4 turn). Backlash between the ring and pinion gear is .005" .010" or as etched on pinion gear Face.

12. If adjusting the backlash produces no change in the noise level, a check of the ring and pinion gear tooth contact should be made. Apply a coat of red lead, white lead or Prussian blue to the ring gear teeth. Rotate ring gear slowly until a good tooth contact pattern is impressed in the ring gear tooth coating. Contact pattern must be as illustrated in Figure 4-2. If contact pattern is considerably different, the pinion gear must be reshimmed. (Refer to following Topic 5, Paragraph C, MEASURING PINION HEIGHT.) Recheck backlash if tooth contact pattern is adjusted. Check noise level after shimming and adjustment.

13. If noise level has not been corrected, remove the carrier caps from the carrier and lift differential end bearings with differential from the carrier. Check differential end bearings for contaminants, uneven wear or scoring.

14. Check tighness of the ring gear mounting capscrews.

15. Check each mounting pad on the drive axle and frame for flatness and squareness. Place a straight bar stock across the drive axle pads and check for parallelness. The mounting pads must be parallel with each other and on the same horizontal plane. Repeat above check for frame mounting pads.

16. With the drive motor removed from the lift truck, operate motor with differential carrier attached. Note any noise that may originate in the drive motor or parking brake assembly.

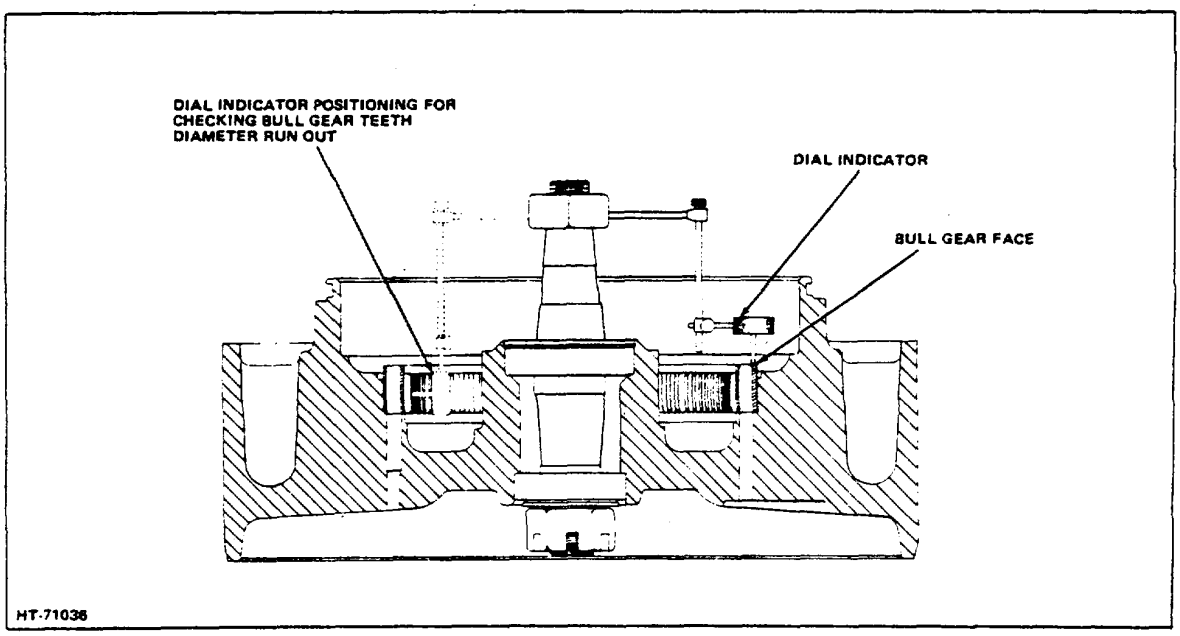


Figure 4-1. Checking Bull Gear Face and Teeth Run Out

Any one of the preceding checks and adjustments may correct or reduce the drive axle noise level or it may require a combination of the checks and adjustments to correct or reduce the noise level.

B. DRIVE UNIT REMOVAL

⚠ WARNING

Disconnect the battery and discharge the capacitors. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control, or 703 control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

1. Remove forks and mast assembly.
2. Remove capscrews that secure toe and floor plate and remove plates from truck.
3. Disconnect drive motor cables and tag cable ends and motor terminals to assure proper installation.
4. Remove yoke pin from seat brake actuating lever and remove capscrews that secure parking brake bracket to drive motor housing and frame.
5. Disconnect, plug, and remove brake lines between master cylinder and drive unit assembly. Check all remaining brake lines, hoses, cables, wires, and linkage to make certain none will be damaged during removal.
6. Attach hoist securely to front of vehicle frame to prepare for removal of the drive unit assembly.
7. Place a transmission jack, or suitable device, under the drive motor and drive unit. Raise jack enough to support assembly and remove mounting capscrews and nuts that secure drive unit to frame.
8. Raise lift truck carefully with hoist and make certain all lines, hoses, etc., stay clear of the motor and drive unit. Raise frame high enough to allow the drive unit and motor to be removed from under the truck and place blocks under frame for safety.

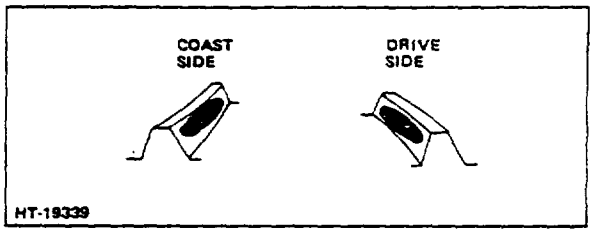


Figure 4-2. Correct Tooth Contact Pattern

9. Carefully pull assembly out from under truck. Clean exterior of drive unit assembly with a solvent such as mineral spirits and dry with compressed air.

⚠ WARNING

Perform cleaning operation in a well ventilated area whenever a solvent is used.

10. Remove drain plug and washer from bottom of drive axle housing and drain oil from housing.

C. DISASSEMBLY OF AXLE HOUSING

1. Remove the jackshafts (refer to preceding Topic 2). Remove oil seals from drive axle housing.
2. Remove nuts and lockwashers that secure differential carrier to drive *axle* housing; remove differential carrier (with motor attached) and gasket from drive axle housing.
3. Remove brake shoes, springs, wheel cylinder, etc. (Refer to Repair Manual, BRAKE SYSTEM SERVICE.)
4. Remove capscrews that secure backing plate to housing and remove plate from housing.
5. Remove locknut and washer from spindle at back side of drive housing.
6. Install a spindle puller and remove spindles.

D. ASSEMBLY OF AXLE HOUSING

1. Align spindle in axle housing and install washer and locknut. Tighten locknut until spindle seats.
2. Make certain the two capscrews used as brake shoe retainers are secured to the backing plate and a lockwasher is installed under the head of each capscrew. Then install backing plate and securing capscrews to the drive axle housing.
3. Install brake shoes, springs, wheel cylinder, etc. (Refer to Repair Manual, BRAKE SYSTEM SERVICE.)

4. Position new gasket on axle housing studs. Install differential carrier (with motor attached), lockwashers and nuts; tighten nuts securely.

5. Install new jackshaft seals in drive axle housing. Install the jackshaft (refer to preceding Topic 2).

E. INSTALLATION

To install drive axle assembly with drive motor attached, proceed as follows:

1. Make certain hoist is securely attached to vehicle frame and frame is raised to the level necessary to allow the drive unit and motor to be moved into position under the frame. Also make certain blocks are under frame for safety.

2. With a transmission jack or other suitable device, position the drive unit assembly under the vehicle and be careful not to damage any lines, hoses, cables, linkage, etc.
3. Install mounting capscrews and nuts and secure drive unit to frame. Tighten 7/8" NC capscrews or nuts to a torque of 575-625 lb-ft,
4. Remove blocks, lower truck, remove transmission jack, and hoist.

5. Install washer and drain plug in bottom of drive axle housing.

6. Fill drive axle housing with specified oil to proper level.

7. Install parking brake bracket on drive motor housing with attaching hardware and reconnect linkage.

8. Refer to identification on tags and connect drive motor cables.

9. Attach brake line bracket to housing and connect brake lines. Bleed the hydraulic brake system.

10. Install and secure toe and floor plates to truck with attaching hardware.

11. Install mast assembly and forks.

TOPIC 5. DIFFERENTIAL CARRIER ASSEMBLY

A. REMOVAL

⚠ WARNING

Before proceeding with the removal, disconnect the battery and discharge the capacitors.

1. Remove drain plug and washer from bottom of drive axle housing and drain oil from housing.
2. Disconnect drive motor cables; tag cable ends and motor terminals for identification to assure proper installation.
3. Remove linkage from parking brake actuating lever; remove nut, lockwasher, washers, and capscrew that secures parking brake bracket to frame.
4. Remove the jackshafts just far enough to remove differential carrier.
5. Remove nuts and lockwashers that secure differential carrier to drive axle housing; remove differential carrier (with motor) and gasket from drive axle housing.
6. Remove capscrews and lockwashers that secure differential carrier to drive motor; remove differential carrier and gasket from drive motor.

B. DISASSEMBLY

1. Pinion Removal

   a. Mark differential case halves (Fig 5-1), bearing caps, and carrier housing to aid in proper location during reassembly; then remove capscrews, washers, and adjusting nut locks; remove bolts and retaining bearing caps from carrier housing.
   b. Remove differential assembly (Fig 5-2) along with bearing cones, cups, and adjusting nuts from carrier housing.
   c. Straighten tabs on lockwasher; remove locknut (Fig 5-3), lockwasher, and washer from end of pinion.
   d. Place differential carrier on an arbor press and press pinion from carrier. Front bearing cone and shims will remain on pinion. Remove rear bearing cone from carrier cup.
   e. To remove bearing cups from carrier, use a brass drift and tap out with a hammer.

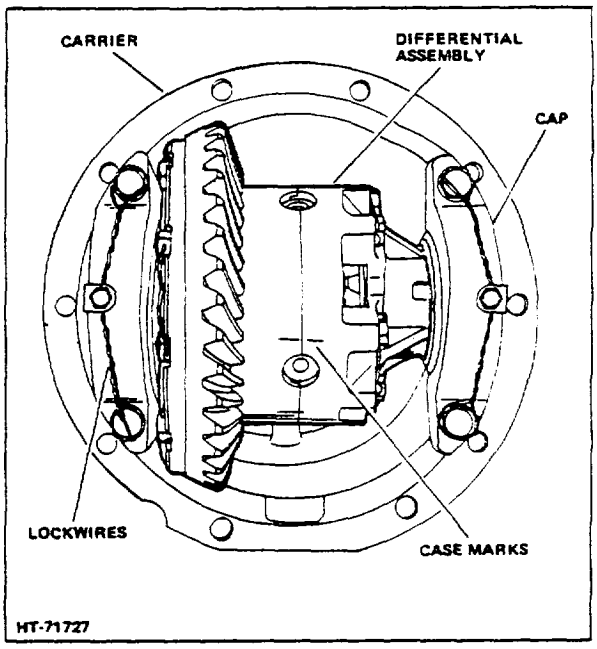


Figure 5-1. Differential Carrier Assembly

   f. If pinion front cone must be replaced, remove with a suitable puller.
   g. Inspect cones, cups, and pinion for damage or excessive wear. Replace where necessary.

NOTE

Pinion and ring gear can only be replaced as a set.

2. Differential Disassembly a. Remove bearings with suitable bearing puller when necessary.

   b. Remove capscrews holding case halves together. Note aligning marks on case halves (Fig 5-1).
   c. Remove plain case. Spider, gears, and washers may then be removed.
   d. Inspect the differential case halves for breaks or wear. Replace as required.

NOTE

The case halves are a matched set and must be replaced as such.

   e. Inspect thrust washers, gears, and spider assembly for evidence of wear or damage. Replace as required.

f. Inspect the case flange for nicks. These must be removed with a flat file prior to reassembly.

3. Ring Gear Removal a. Remove special capscrews holding ring gear to flange.

b. Ring gear is pinned in place. Carefully pry ring gear off case flange.

c. Inspect all parts for wear or damage and replace where necessary.

NOTE

The ring gear and pinion are a matched set and both must be replaced when one is worn or damaged.

C. MEASURING PINION HEIGHT

In order to measure for the proper amount of shims to be used between the pinion gear and the front bearing cone, use a tool equivalent to the one illustrated in Figure 5-5 and proceed as follows:

1. Slide front bearing cone on tool shaft without shims. Place tool with bearing cone in differential carrier and seat cone in front cup. If bearing cup was removed, make certain new bearing cup is firmly seated before tool and cone are inserted.
2. Measure and record OD of differential case (not ring gear pilot).
3. Place differential assembly in position on differential carrier housing. Caps need not be installed.
4. Measure and record the distance between the 00 of the differential case and the face of the tool (Fig 5-6).
5. Add 1/2 of the differential case diameter to the dimension taken in step 4. Subtract 2.650" from the total to get the amount of shims required to locate a theoretical exact pinion. Refer to following example.

2.495" (1/2 diff case OD)
\+ .220" (step 4)
2.71-5" Total
2.650" (theoretical setting distance)
.065" shims required to locate an exact pinion (no manufacturing tolerance)

6. If pinion is a plus .005" and etched 5.2

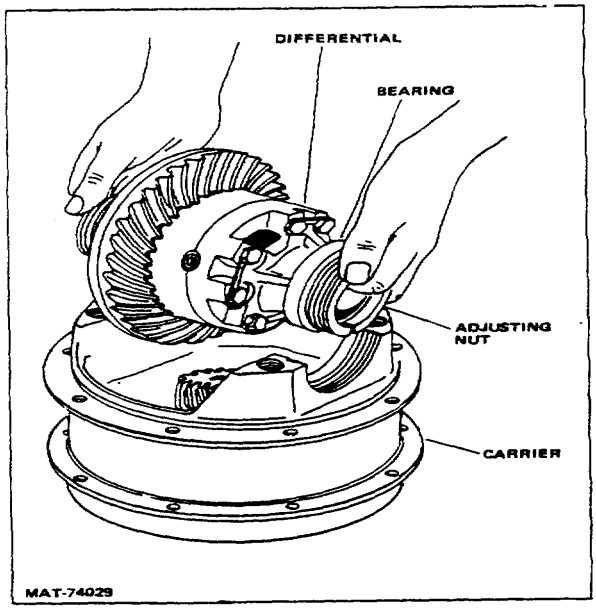


Figure 5-2. Removing Differential from Carrier

2.655", the .005" has already been added to the theoretcial setting distance; therefore, the amount of shims required is as follows:

2.715" Total
2.655" (theoretical setting +.005")
.060" shims required

7. If pinion is a minus .005" and etched 2.645", the .005" has been subtracted from the theoretical setting distance. To determine the amount of shims required is as follows:

2.715" Total
2.645" (theoretical setting .005")
.070" shims required

NOTE

The dimensions used in preceding steps 5, 6, and 7 were for the purpose of examples. When measuring for shims, use 1/2 of the differential case diameter as actually measured, use the exact measured distance between the 00 of the differential case and the face of the measuring tool, and use the dimension etched on the face of the pinion gear.

8. Remove differential assembly from differential carrier housing. Remove tool and front bearing cone from carrier housing.

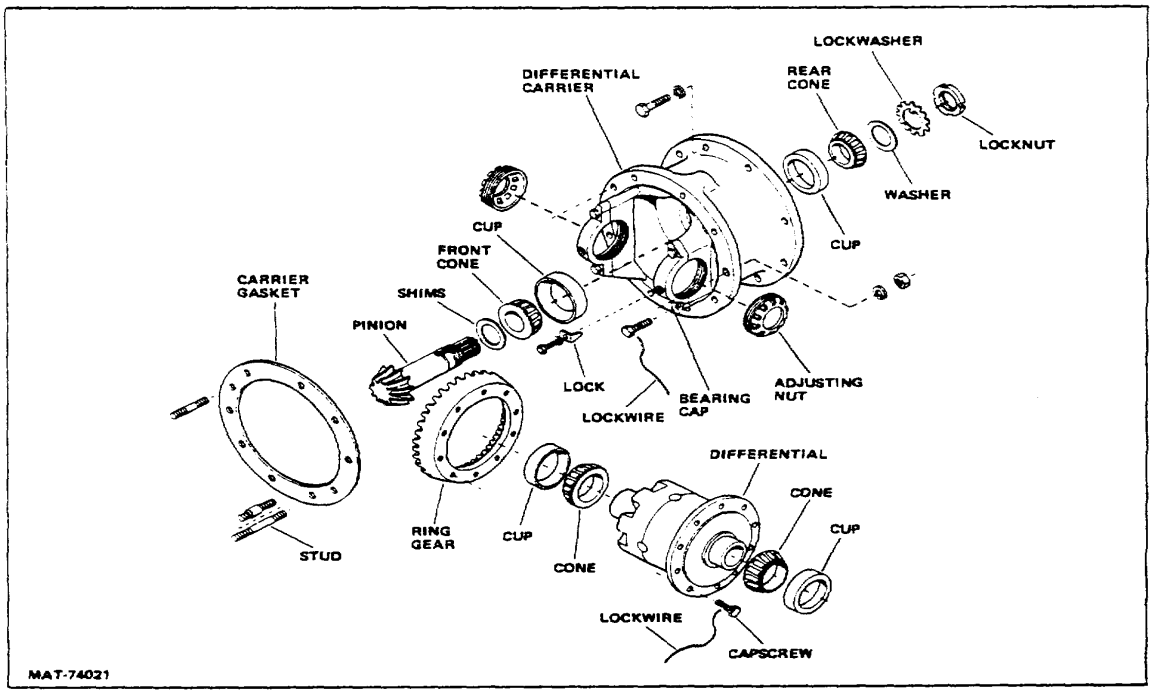


Figure 5-3. Differential Carrier Assembly - Exploded View

9. Install proper shim pack on pinion shaft and then install front bearing cone. Shim pack should be compressed while measuring with a micrometer. Make certain shim stock is clean and free of burrs.

D. REASSEMBLY

1. Ring Gear Installation

   a. To install ring gear, align ring gear holes in flange and install groove pins.

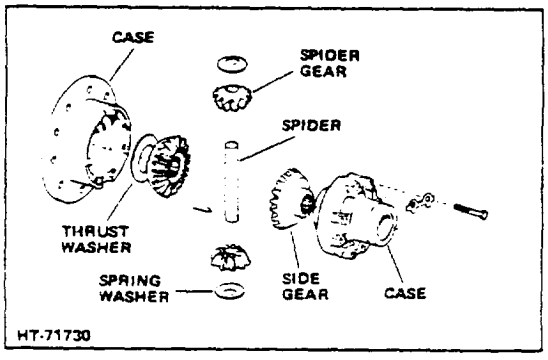


Figure 5-4. Differential Assembly

   b. Install special capscrews and draw ring gear in place, tighten capscrews securely.

2. Differential Reassembly

   a. Place thrust washer in bottom of flanged case. Install side gear, spider, spider gears, spider spring washers and opposite side gear with thrust washer.

   b. Install plain case.

NOTE
Make sure case match marks are aligned.

   c. Install capscrews and tighten to a torque of 17-25 lb-ft. Secure capscrews with retaining clips or wires.

   d. Install bearings, if removal was necessary.

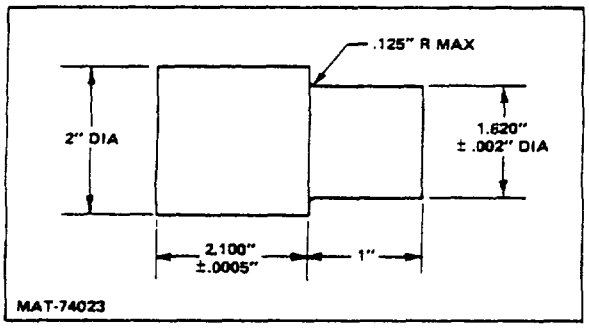


Figure 5-5. Tool for Measuring Shims

3. Pinion and Differential Installation

   a. Press front and rear bearing cups into differential carrier. Make certain cups are firmly seated.

   b. Install proper shim pack and front cone on pinion shaft. (For shim pack information, refer to preceding paragraph C, MEASURING PINION HEIGHT.)

   c. Install pinion shaft (with shims and bearing cone) in carrier housing.

   d. Install rear cone (Fig 5-3), washer, lockwasher, and locknut. Tighten locknut so that 15-25 lb-in torque is required to turn pinion shaft. This will set proper preload on bearing. Bend lockwasher tabs down to secure locknut in place.

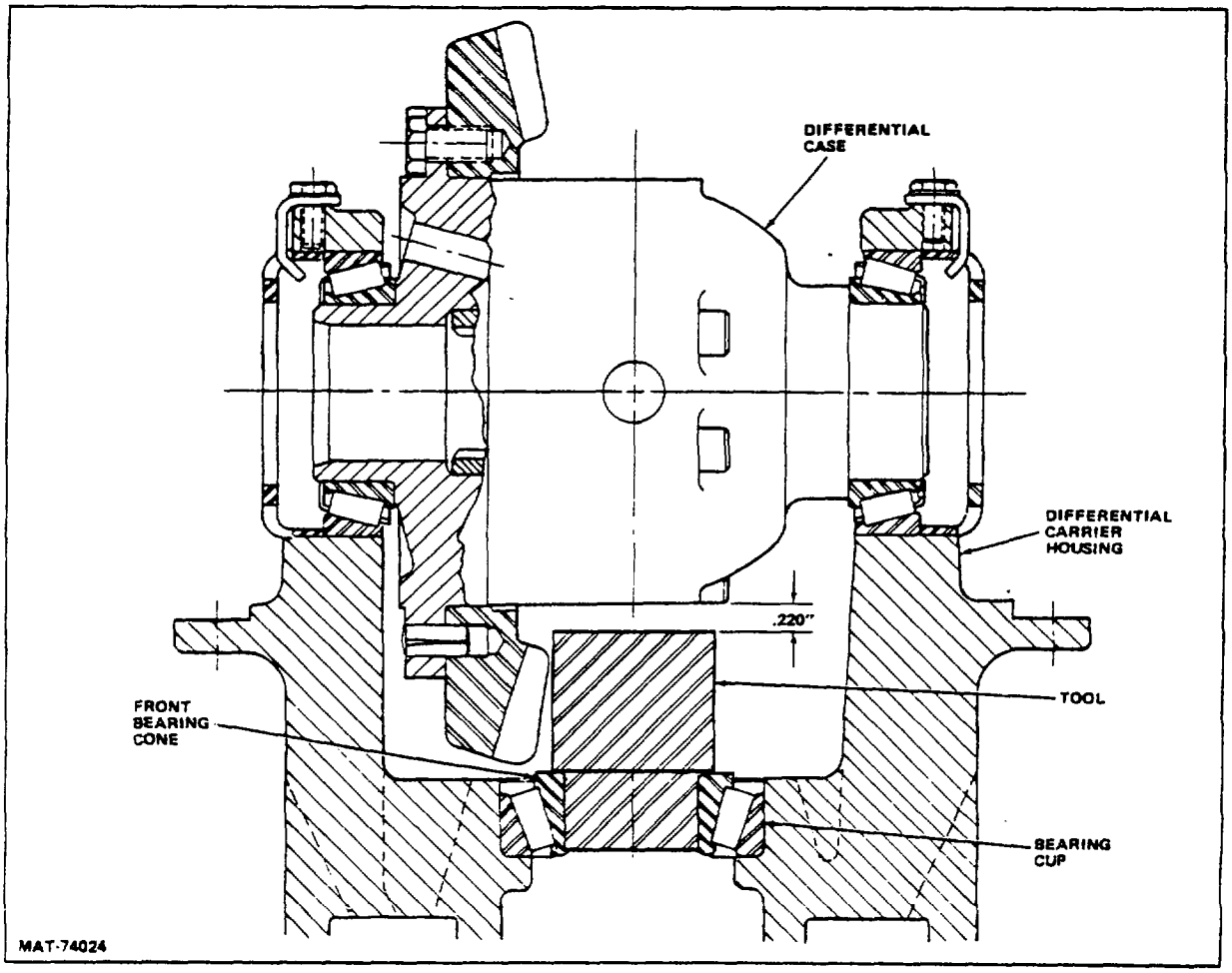


Figure 5-6. Measuring for Shims

NOTE

In order to check the proper torque required to turn the pinion shaft, install a 1/2"-13 capscrew in threaded hole in end of pinion shaft. Apply a torque wrench to head of capscrew to turn pinion shaft. After proper preload of bearing is obtained, remove capscrew from end of pinion shaft.

e. Place the differential assembly, with the proper side bearings and cups, into the bores of the carrier. Exercise care not to install them on top of the threads. Move the ring gear torward the pinion until all the backlash is taken up.

f. Install the two bearing caps (Fig 5-1) to the differential carrier.

NOTE

The correct bearing cap must be installed on the correct side of the carrier assembly as marked during disassembly.

g. Install the side-bearing adjusting nuts into the threads taking care not to crossthread them.

h. Tighten both adjusting nuts until they contact the side-bearing cups.

i. Loosen the right-hand adjusting nut (the one opposite the ring gear), until the ring gear and differential case assembly are loose in the bearings. This should require two or three revolutions.

j. Tighten the left-hand adjusting nut (the one next to the ring gear), against the bearing cup until all backlash between the ring and pinion gear has been eliminated, then back off three or four notches.

k. Tighten the right-hand nut until the bearing race starts to turn indicating preload is being exerted on the bearings.

l. Continue to turn the right-hand nut one or two notches more. Tighten adjusting nuts to a maximum of 25 lb-ft.

⚠ WARNING

Under no circumstances should .two notches be exceeded.

m. Wrap a cord around the differential case and attach a spring scale to the loose end. Start pulling gradually on the scale and note the effort required to rotate case. Case should start and maintain rotation at less than 3 lbs pull.

n. Adjust backlash between ring gear and pinion. (Refer to following paragraph E, BACKLASH ADJUSTMENT.)

E. BACKLASH ADJUSTMENT

To adjust for the backlash between the ring and pinion gear teeth, the adjusting nuts must be turned in sequence. If the righthand nut is tightened two notches, then the lefthand nut must be loosened two notches. This routine is continued until the proper backlash is obtained.

Use a dial indicator and check ring gear for backlash. The backlash should be between .005" and .010".

1. Install a dial indicator (Fig 5-7) to the carrier housing.
2. Move ring gear by hand in clockwise direction until all play or movement is eliminated between ring gear and pinion gear.
3. Position stem of dial indicator against the side (face flank) of ring gear tooth.
4. Move ring gear by hand in opposite direction and read backlash shown on dial indicator. Specified backlash between ring gear and pinion gear is .005" to .010".
5. Check backlash at four places on ring gear approximately 90° apart.

NOTE

Check all four places on ring gear before adjustment of backlash is attempted.

6. If adjustment is required, use a spanner wrench or drift to turn adjusting nut one notch at a time and perform one of the following:

   a. To increase the amount of backlash, remove lockwires and locks from top of caps; loosen adjusting nut in the side of carrier housing which is nearest to the ring gear and tighten the opposite one.

   b. To decrease amount of backlash, remove lockwires and locks from top of caps; loosen adjusting nut in the side of carrier housing which is farthest from the ring gear and tighten the nut nearest to the ring gear.

⚠ CAUTION

When backlash is adjusted, turn each adjusting nut exactly the same distance so proper bearing preload is maintained.

7. After backlash had been adjusted properly, install locks, capscrews, and lockwires to top of caps.

F. INSTALLATION

1. Use a new gasket and install differential carrier to drive motor flange with lockwashers and capscrews; tighten capscrews securely.

2. Position new gasket on drive axle housing studs. Install differential carrier (with drive motor attached), lockwashers, and nuts; tighten nuts securely.

3. Connect linkage to parking brake actuating lever and secure parking brake bracket to frame.

4. Install the jackshafts (refer to preceding Topic 2).

5. Refer to identification on tags and connect drive motor cables securely.

6. Install drain plug and fill axle housing with specified oil to proper level.

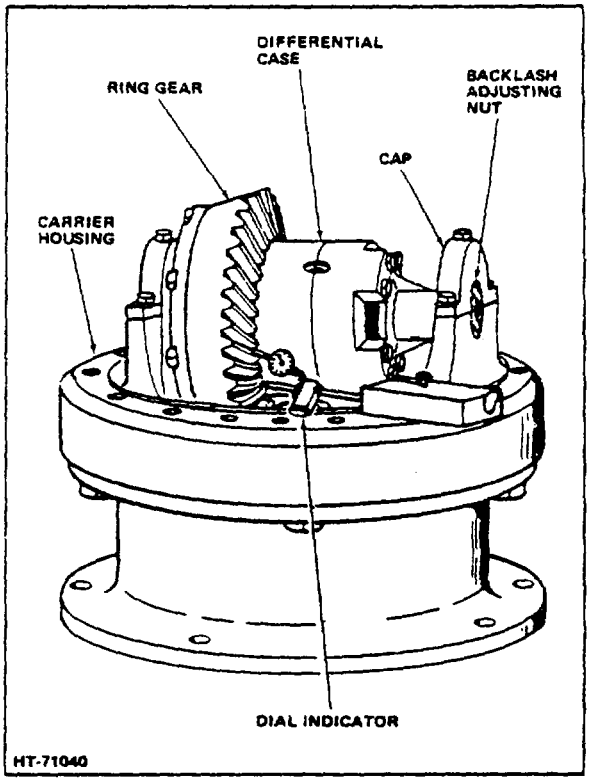


Figure 5-7. Checking Backlash

TOPIC 6. DRIVE UNIT TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	POSSIBLE SOLUTION
Failure to operate.	Broken jackshaft.	Replace jackshaft.
	Teeth broken out of jackshaft or bull gear.	Replace jackshaft or bull gear.
	Broken teeth on ring gear or pinion.	Replace ring gear and pinion.
Axle noise on drive or coast.	Excessive wear at ring gear and pinion.	Adjust, if possible, or replace.
	Worn spider gears or side gears in differential case.	Replace worn gears.
Continuous axle noise.	Excessive wear in gears.	Replace worn parts.
	Lack of lubrication.	Lubricate at specified intervals.
	Uneven tire wear.	Replace tires.
	Worn or damaged bearing.	Replace bearings.
Excessive backlash.	Worn splines on jackshaft.	Replace jackshaft.
	Worn ring gear or pinion.	Replace gear and pinion.

TOPIC 7. DRIVE WHEELS AND TIRES

A. GENERAL

The cushion tire is a heavy duty, industrial tire designed and compounded especially for the electric lift truck.

NOTE:
The use of tires other than those designed for the electric lift truck will affect lift truck traveling speed and battery life.

The condition of the tires should be checked daily. if tires are badly worn, or have an excessive amount of breaks in them, they should be replaced. Steel chips or other foreign material should always be removed to prevent further damage. Tires that are worn unevenly or have sections of tread torn out can cause excessive truck vibrations, hard steering and rapid battery drain. The drive wheels should be removed every 500 hours of operation and inspected for wear or damage.

B. CUSHION TIRE REPLACEMENT

The wheels used on all cushion tire lift trucks are machined from castings. Any misalignment of the tire and wheel, while the tire is being pressed onto the wheel, can cause possible damage to the wheel. Because of this, a chamfer has been provided on the outside edge of the wheel and on the end of the inside diameter of the tire's metal insert. The chamfers help center the wheel and tire during the pressing operation and reduce the possibility of misalignment.

⚠ CAUTION

To prevent damage to the wheel, the tire must be installed with the chamfered side of the wheel up.

To replace cushion tire, perform the following:

1. Remove drive wheel and tire assembly from lift truck. (For drive wheel removal, refer to following paragraph C.)

2. Check inside diameter of metal insert of new tire. Remove any scale or rust with sandpaper. Clean inside of metal insert and lubricate it with bearing grease.

3. Place a circular ram on the press table. The length of the ram must be longer than the width of the old tire that is to be removed to allow complete removal of old tire. The outside diameter of the ram must be small enough to fit loosely in the insert of the tire, but must be large enough to rest squarely on the bull gear's flat surface.

4. If the outside edge of the wheel is not flush with the edge of the metal insert in the old tire, measure how far wheel is recessed inside the tire. New tire must be replaced at the same position that the worn tire is installed on the wheel. A spacer, slightly smaller in diameter than the inside diameter of the tire insert and the sane thickness as the depth of the recess, can be used to obtain the proper amount of recess.

5. Position wheel assembly with worn tire on top of circular ram so outside of wheel is positioned upward (Fig 7-1). The outside edge of the wheel has a chamfer to help guide the new tire onto the wheel. The chamfered edge must always be the leading edge of the wheel whenever a tire is pressed onto a wheel.

6. Center the wheel assembly on top of the ram and make certain they mate-up squarely.

7. Position new tire on top of wheel and tire assembly. Align new tire and wheel so they are concentric with each other.

8. Start pressing new tire onto wheel and worn tire off the wheel. Run press slowly for the first couple of inches of travel because this is the critical stage of the pressing operation. If tire begins to cock, stop press immediately and realign tire. A sharp jar with a soft-headed mallet will usually realign tire on wheel. If wheel is to be recessed in tire, stop press after tire has been started on wheel. Position spacer (mentioned previously) inside the new tire so it rests squarely on the outer edge of wheel. Continue pressing operation until tire is correctly positioned on the wheel.

9. Release press; remove wheel and tire assembly and worn tire from press table. Wipe off grease and inspect wheel and tire assembly.

10. Install wheel and tire assembly on lift truck. (For drive wheel installation, refer to following paragraph E.)

C. DRIVE WHEEL REMOVAL

⚠ WARNING

Disconnect the battery before performing any work on vehicle.

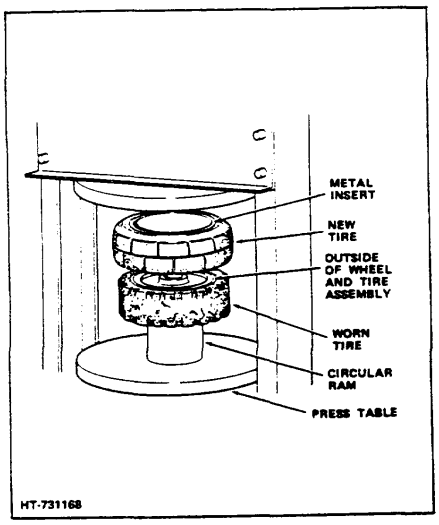


Figure 7-1. Cushion Tire Replacement.

1. Attach a suitable hoist of adequate capacity to the front of the vehicle and raise it sufficiently so the drive wheels clear the floor. Carefully place sturdy wooden blocks under both sides of the frame just behind the drive wheels. Lower vehicle enough to take stress off the hoist and so the drive wheels clear the floor and the wooden blocks.

2. Remove capscrews and lockwashers that secure the hub cap to the wheel and remove hub cap. Remove cotter pin, retaining nut, and washer from drive wheel spindle.

3. Remove outer bearing cone (Fig 7-2) from wheel and carefully remove the drive wheel.

⚠ CAUTION

Exercise care when removing drive wheel so no damage results to brake shoes, drum, or spindle threads.

4. Remove inner bearing cone (Fig 7-2) and grease shield from spindle.
5. Use a bearing cup puller or a brass drift to remove bearing cups from wheel hub. Be careful to avoid damage to wheel hub when removing cups.
6. If bull gear requires replacement, perform the following:

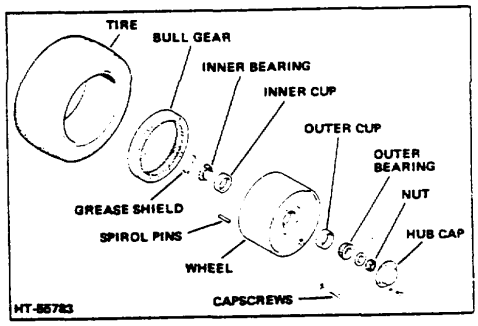


Figure 7-2. Drive Wheel

   a. Remove capscrews that secure bull gear to inner side of wheel.
   b. Turn wheel over and using standard hardened capscrews with three inches of thread, insert in holes provided in bull gear.
   c. Turn capscrews alternately and evenly until bull gear is removed from wheel drum.

D. INSPECTION

Wash all parts with a solvent to remove grease and dirt. Inspect for worn or damaged parts, chipped or cracked teeth, or pitted surfaces, and repair or replace if necessary. If bull gear teeth are worn down to approximately 1/2 of original width, bull gear must be replaced.

E. DRIVE WHEEL INSTALLATION

1. If bull gear was removed, perform the following:
   a. Install bull gear, capscrews and spirol pins in the drive wheel. The bull gear must be installed with the large chamfer down.

⚠ CAUTION

In order to prevent possible damage to the bull gear when installing the spirol pins, the edge of the outer coil should lie on the bolt circle as illustrated (Fig 7-3). Make certain bull gear is seated properly and spirol pins and capscrews do not extend beyond the face of bull gear.

   b. Drive the spirol pins into the bull gear from the bottom side until the pins are flush with top side. Position bull gear, with pins installed, in the drive wheel. Make sure spirol pins and pin holes in the drive wheel

are properly aligned. Place brass or bronze drive bar over spirol pins in bull gear and evenly start bull gear in drive wheel by tapping drive bar. Install capscrews with lockwashers through drive wheel in the bull gear. Continue installing bull gear by alternately tightening capscrews and tapping bull gear until gear seats flush into drive wheel. To check if bull gear is seated properly in drive wheel, check to see if capscrews ends are recessed the same distance in the bull gear. After bull gear is seated in the drive wheel, tighten capscrews evenly and final torque to 28 to 32 lb-ft.

2. Position bearing cups in wheel hub and secure them into position with a hydraulic press. Bearing cups are a press fit in wheel hub. Pressure must be evenly distributed on bearing cup to avoid damage and cocking of the cup.
3. Lubricate drive wheel inner bearing cone with specified grease. Apply grease with applicator designed to force lubricant into roller bearings.
4. Install grease shield and inner bearing cone on drive wheel spindle.
5. Lubricate bull gear with specified grease. Fill all spaces between the bull gear teeth with specified grease' to approximately 3/4 the height of the teeth (Fig 7-4). Then carefully install drive wheel on wheel spindle.

⚠ CAUTION

Use extreme care when installing drive wheel so no damage results to brake shoes, drum, or threaded end of drive wheel spindles.

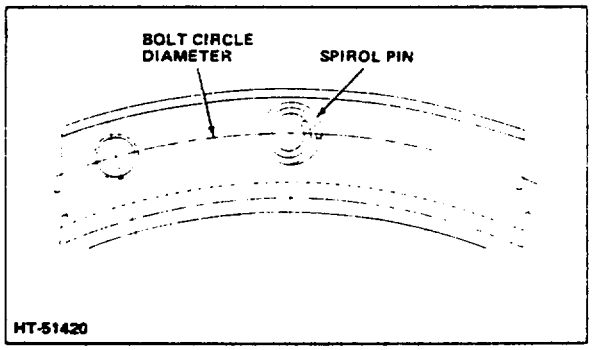


Figure 7-3. Spirol Pin Installed

6. Lubricate drive wheel outer bearing cone with specified grease. Again apply grease with applicator designed to force lubricant into roller bearings. Then install outer bearing cone on spindle.
7. Install washer and retaining nut on spindle. While tightening retaining nut, rotate the wheel alternately in each direction until a torque of 50 lb-ft maximum is obtained. Then back off the nut 300 minimum to 60° maximum to allow the cotter pin to be installed. Then install cotter pin.
8. Install hub cap to drive wheel; secure with lockwashers and capscrews.
9. Raise vehicle slightly with the hoist and remove the wooden blocks from under the frame. Then lower vehicle so drive wheels rest on the floor. Remove hoist from front of vehicle.

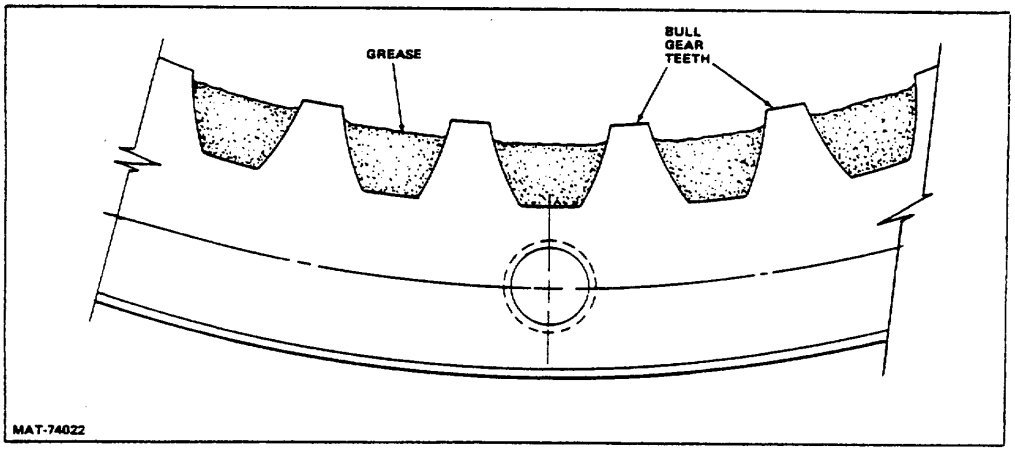


Figure 7-4. Lubricating Bull Gear

ER-32-2

TOPIC 1. DESCRIPTION

A. GENERAL

Two types of hydraulic service brake systems are used in the lift trucks. (Self-Adjusting and Duo-Servo). The Self Adjusting type is mounted on the Jack Shaft Drive Axles. The Duo Servo type is mounted on the AC Planetary Drive Axles. Both systems consist of a brake pedal, mechanical linkage between the pedal and the master cylinder, wheel cylinders, a self-adjusting mechanism, brake shoes, and brake drums.

NOTE

Rubbing of backing plates, tight bearings, or dragging of the brake shoes will affect the performance of the lift truck.

The first requisite for safe, sure hydraulic braking is the use of a high quality brake fluid. The hydraulic brake system requires a "solid column of fluid" and the fluid should possess essential protective properties which safeguard the system.

⚠ CAUTION

Use only silicone based heavy duty brake fluid with an extreme heat-cold range that conforms to MIL-B-46176.

⚠ WARNING

Disconnect the battery and discharge the capacitors before the removal is performed.

B. BRAKE SYSTEM OPERATION WITH JACKSHAFT DRIVE AXLE

When the brake pedal is depressed, the mechanical linkage forces the piston in the master cylinder forward applying pressure through the hydraulic brake lines to the wheel cylinders.

The pistons, in turn, cause links on each end of the wheel cylinders, to push against the brake shoes, moving them into contact with the brake drum. When the brake pedal is released, the brake return springs overcome the hydraulic pressure, causing the wheel cylinder pistons to retract. This forces the hydraulic fluid back to master cylinder reservoir.

The brake shoes are self-adjusting through the use of a friction operated self-adjuster in each drive wheel (Fig 1-1). The friction between the two slide assemblies of the self-adjuster is great enough to prevent the brake shoe springs from fully retracting the self-adjuster,

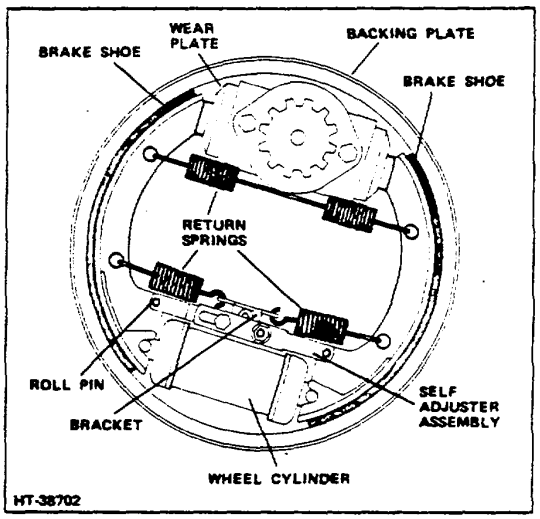


Figure 1-1. Self-Adjusting Brake System

but not great enough to prevent hydraulic pressure from expanding it. The self-adjuster assembly is mounted to the brake shoes with roll pins.

The roll pin mounting holes in the brake shoes are 1/32" oversize to provide proper working clearance between the brake shoe lining and drum.

C. BRAKE MASTER CYLINDER

The brake master cylinder (Fig 1-2) consists basically of a piston assembly, a piston return spring, an actuating rod, a bypass valve, and the cylinder body. The cylinder body provides a reservoir for fluid, and provides the cylin-

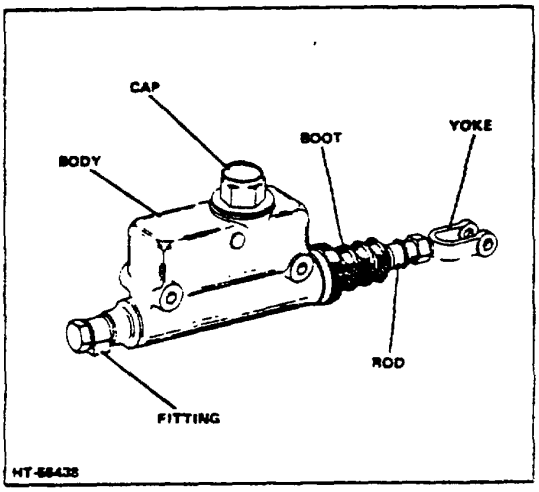


Figure 1-2. Master Cylinder Assembly And Yoke - Typical

der in which motion is imparted to the hydraulic fluid, when the brake pedal is depressed.

D. WHEEL CYLINDERS

The wheel cylinders (Fig 1-3) are mounted on the inside surface of the backing plate at each drive wheel. Each wheel cylinder consists of two pistons, two rubber cups, a spring and the cylinder body. The spring separates the rubber cups. thus creating a chamber for the hydraulic fluid. The rubber cups are in contact with the pistons. As hydraulic fluid enters the chamber, the rubber cups and pistons are forced outward. The lip of the rubber cup is forced against the cylinder wall, thus effecting a positive fluid seal. This allows pressure within the cylinder to be maintained as long as the brake pedal is depressed.

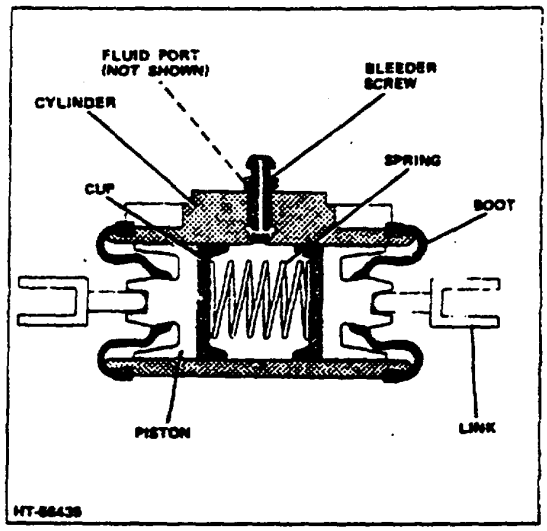


Figure 1-3. Wheel Cylinder - Typical

E. BRAKE SHOES

The brake shoes are of bonded lining type of construction. The brake shoes of a Jack Shaft Drive Axle rest against the wear plates at the top end and are connected to links on the wheel cylinder at the other end.

TOPIC 2. HYDRAULIC BRAKE SERVICE

A. DRIVE WHEEL REMOVAL FOR JACKSHAFT DRIVE AXLE

⚠ WARNING

Disconnect the battery before performing any work on vehicle.

1. Attach a suitable hoist of adequate capacity to the front of the vehicle and raise it sufficiently so the drive wheels clear the floor. Carefully place sturdy wooden blocks under both sides of the frame just behind the drive wheels. Lower vehicle enough to take stress off the hoist and so the drive wheels clear the floor and the wooden blocks.
2. Block steer wheels in position.
3. Slowly rotate drive wheel noting any drag or friction as brakes are applied slightly. Any difference in the amount of drag during rotation indicates an out-of-round drum, or bull gear or differential drag.
4. Remove capscrews, lockwashers and hub cap or wheel cover. Remove cotter key, retaining nut and washer.
5. Remove outer bearing cone (Fig 2-1) and remove wheel (Fig 2-2).

⚠ CAUTION

Exercise care when removing driving wheel so no damage results to brake shoes, drum, or spindle threads,

6. Remove the inner bearing cone, grease shield (if used) and dust shield. Brake components are now exposed for service (Fig 2-3).

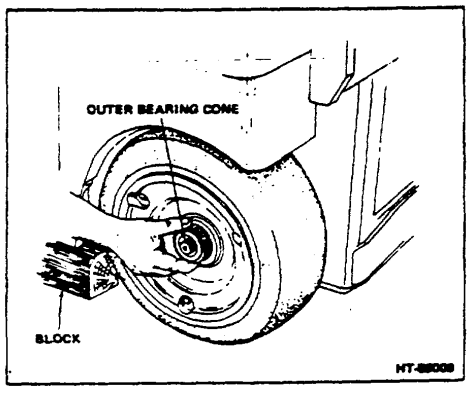


Figure 2-1. Removing Wheel Bearing

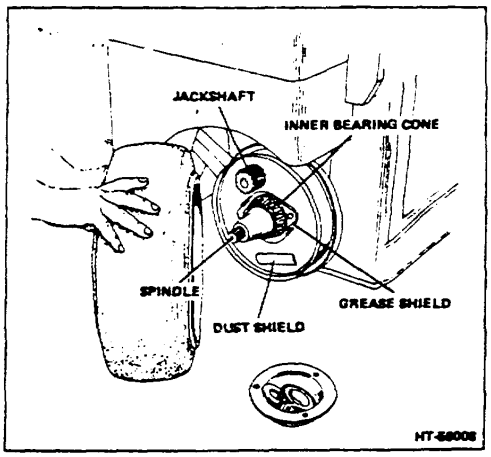


Figure 2-2. Wheel Removed

B. BRAKE DRUM INSPECTION

1. Inspect the brake drum for out-of-round condition. Gauge the diameter or radius at points 450 apart around the inner circumference of the drum. Resurface drum if measurement differences exceed 0.010" on the diameter or 0.005" on the radius.
2. Inspect the lining wear pattern to determine if drum is barrel shaped, scored, or bell mouthed (Fig 2-4). If scoring is less than 0.010" deep the lining will wear in and seat satisfactorily after some use. Heat checked or badly scored drum should be resurfaced or replaced, depending on the extent of damage. Bell mouthed or barrel shaped drum should be refinished or replaced.
3. If drums do not require resurfacing, polish with fine emery cloth to remove discoloration and old lining residue that adheres to the surface.
4. If drums do require resurfacing, always resurface drums in right and left hand pairs to an equal diameter, if needed, by removing material from the inside diameter until the surface is round and smooth. Finish grind or hone drums to remove tool marks, to prevent excessive lining wear, and to avoid "runout" when brakes are applied.

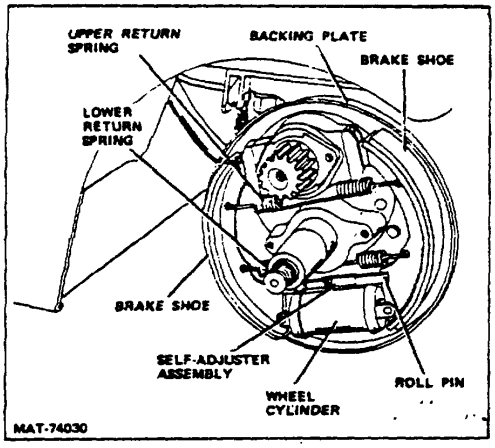


Figure 2-3. Wheel Brake

⚠ CAUTION

Do not machine more than .050" from a drum. Thin drums are subject to excessive heat expansion and flexing which cause fade and spongy pedal. They also could break under strain of severe use. (Refer to following chart.)

Original I.D. of Brake Drum	Maximum Machined I.D.
11.000" to 11.003"	11.053"
12.495" to 12.505"	12.555"
13.135" to 13.138"	13.188"
14.250" to 14.253"	14.303"

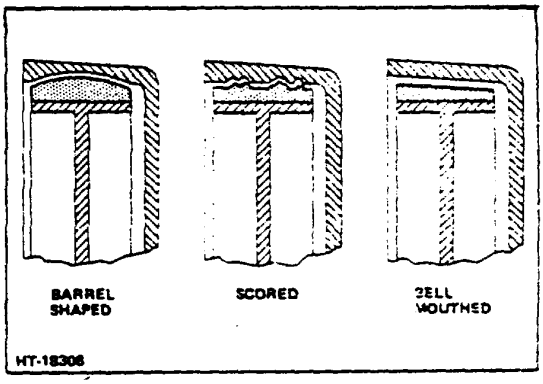


Figure 2-4. Improper Lining Wear

C. BRAKE SHOES AND LINING

1. Disassembly Of Wheel Brake Components For Jackshaft Drive Axle

   Disassemble the brake by removing the upper and lower Drake return springs and remove the, brake shoes and self-adjuster as a unit. Drive the roll pins from the shoes and the self-adjuster.

2. Inspection

   The brake shoes employ bonded lining. When lining replacement becomes necessary, it is recommended that the brake shoes are replaced. Replace brake shoes when any of the following have occurred:

   a. Drums are resurfaced.
   b. Lining is worn to shoe table.
   c. Grease or hydraulic fluid soaked lining, causing brakes to grab or pull to one side.
   d. If difficulty in stopping is traced to lining.
   e. Fade is traced to severely charred or burned lining.

NOTE

Minor charring is sometimes remedied by buffing with sandpaper or grinding.

   f. Lining is scored too deeply to be reworked by grinding.

   g. Brake shoe table is worn, twisted, out-of-round, or cracked.

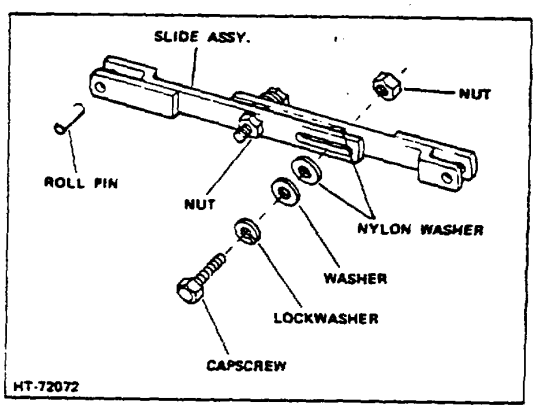


Figure 2-5. Brake Self-Adjuster Assembly

⚠ CAUTION

Whenever brake shoes are handled, be careful not to get grease, oil, or dirt on the lining.

Dirt, oil, or grease on brake lining (not grease soaked) may be remedied by buffing with sandpaper or by grinding. Clean the shoes and lining with-compressed air and dry cloth only.

4. Grinding Replacement Brake Linings Any time brake lining is replaced or brake drum is turned, the lining should be ground to be made concentric with the brake drum. By grinding brake lining properly, correct lining to drum contact is assured. To grind brake lining, the following procedure is suggested.

   a. Set up grinding equipment and brake shoes; follow instructions given by the manufacturer of the grinding equipment.

   b. Measure inside diameter of brake drum. Set grinding equipment to one-half the diameter of the brake drum (radius) and lock in position.

   c. With the grinder running, make one complete grinding cut the full width and length of the lining. Repeat this step for remaining brake lining.

   d. If too deep of a cut has to be taken, increase the adjustment on the grinder and make several passes until the proper diameter has been reached.

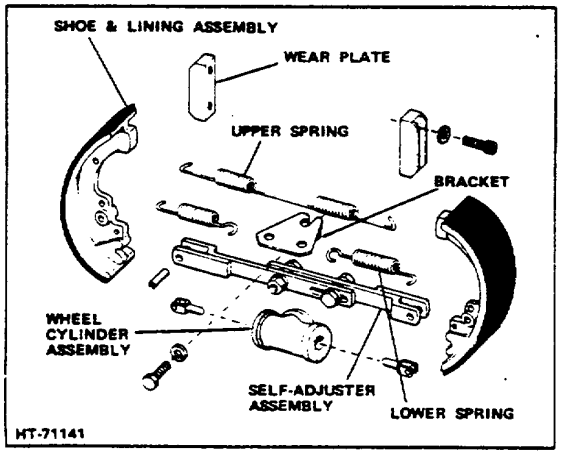


Figure 2-6. Self-Adjusting Brakes (Exploded View)

   e. Clean brake shoes and lining with compressed air or a dry cloth and remove all grinding dust.

5. Reassembly Of Wheel Brake Components For Jackshaft Drive Axle.

   a. Compress the self-adjuster (Fig 2-5) by loosening the nuts and capscrews just enough to allow the two halves to slide together.

NOTE

If self-adjuster was disassembled, assemble the components as illustrated in Figure 2-5.

⚠ CAUTION

Exercise care when self-adjuster is handled or installed. Do not bend the tangs of the Slide assemblies in any way because the holes for the roll pins must be parallel with each other. If the holes are not parallel, the roll pins will lie at a slight angle through the mounting ,holes in the brake shoes. Improper alignment-of the roll pins could lead to improper brake shoe retraction due to lack of proper roll pin clearance in the brake shoe holes. This in turn could create brake shoe drag on the drum.

   b. Tighten capscrews (Fig 2-5) to a torque of 14 to 16 lb-in.

   c. Hold .the head of the capscrews in position and tighten the nuts to a torque of 29 lb-in.

   d. Check slip resistance of the slide assemblies; it should be 250 to 300 lbs. If it is not, readjust the capscrews and nuts.

NOTE

After the assembly is completed, the self-adjuster should be fully retracted and should measure 5-1/4" between hole centers.

   e. Install and secure self-adjuster to brake shoes with roll pins.

   f. Make certain backing plate is secured tightly to the axle, also that it is not sprung or damaged.

   g. Clean inside of backing plate, brake drum, and other parts that are to be installed.

h. Check the wheel cylinder for leakage, even if cylinder appears to be in good condition.

NOTE

It is good practice to rebuild wheel cylinder when new brake shoes are installed (Refer to paragraph E).

i. Install brake shoes with self-adjuster and install springs (Fig 2-6).

⚠ CAUTION

Do not apply pressure to brake pedal until drive wheels are installed.

D. WHEEL CYLINDER

1. Removal

   a. Remove drive wheel and brake shoe to gain access to wheel cylinder using procedures from this Topic.

   b. Remove hydraulic brake line fitting(s) from wheel cylinder. Plug all openings to prevent entrance of foreign material.

   c. Remove capscrews and lockwashers that secure wheel cylinder to backing plate; remove wheel cylinder.

2. Wheel Cylinder Disassembly For Jackshaft Drive Axle.

   Pull boots from cylinder and withdraw pistons and spring.

3. Cleaning And Inspection

   a. Wash all parts thoroughly in denatured alcohol or clean brake fluid.

⚠ WARNING

Do not use gasoline, kerosene, paint thinner or other mineral base solvents as they will damage the rubber components.

   b. Wipe off all metal parts with a clean rag. Use clean rag, free of any grit, to wipe out the cylinder bores. It is recommended that the upper parts (cup and boot) be replaced with new parts when the wheel cylinder is reassembled.

   c. Thoroughly inspect all parts for wear, corrosion, damage, or other conditions which might impair cylinder action.

   d. If the wheel cylinder bore for the AC Planetary Drive Axle is scratched, pitted or marked, it may be reconditioned with a fine crocus cloth. if insert is loose in piston check pistons and piston inserts for any evidence of shear cracks. Replace when necessary.

   e. If the wheel cylinder bore for the Jackshaft Drive Axle is scratched, pitted or marked, it may be reconditioned by honing. (Refer to the following repair instruction).

4. Repair

   a. Clean wheel cylinder according to preceding instructions.

   b. Coat cylinder bore with hydraulic brake fluid to provide a cutting solution and lubrication for honing. Mount wheel cylinder body in a bench vise.

   c. Use honing equipment according to manufacturer's instructions. Make one complete pass through cylinder bore. Remove hone and inspect cylinder bore to see if scratches, pitting, etc., have been removed. Repeat procedure until wheel cylinder has been cleaned.

NOTE

If wheel cylinder of the Jackshaft Drive Axle has been enlarged to a diameter greater than 1.5070", it must be replaced.

   d. Thoroughly wash wheel cylinder in a clean warm water and soap solution.

   e. Rinse wheel cylinder in clean warm water and blow dry with compressed air.

   f. Immediately after drying, submerge wheel cylinder in clean hydraulic brake fluid to prevent rust formation.

5. Reassembly Of Wheel Cylinder For Jackshaft Drive Axle.

   a. Lubricate all parts and cylinder walls with clean brake fluid.

   b. Insert spring and install cup and piston in each end. Never try to push piston through length of cylinder.

   c. Install the cylinder boots. Make certain they are properly located in the grooves provided.

6. Installation

   a. Position and secure wheel cylinder to backing plate with lockwashers and capscrews.

b. Remove plugs and connect hydraulic brake line fitting(s) to wheel cylinder securely. Be careful to prevent dirt from entering the wheel cylinders and brake lines.

c. Install brake shoes and wheel assembly (refer to subparagraph 3 thru 5 of paragraph D).

d. Bleed brake system as outlined in paragraph H.

E. MASTER CYLINDER

Two types of master cylinder and pedal linkage are used on the electric lift trucks (Type I, Fig 2-7.

1. Removal/Disassembly

Remove and disassemble the master cylinder and pedal linkage of both types using Figure 2-7 and the following steps:

⚠ WARNING

Before proceeding with removal, disconnect battery, then discharge capacitors.

a. Remove toe and floor plates.

b. Disconnect and plug brake hydraulic line attached to the fitting of master brake cylinder.

c. Remove clevis pin that secures yoke.

d. Remove capscrews that secure master cylinder to inside frame and remove cylinder.

e. Secure cylinder in vise exercising care so as not to distort cylinder or crack casting.

f. Remove yoke, rod, and boot on Type I master cylinder (Fig 2-7).

g. Pry out the lockring from the Type I master cylinder (Fig 2-7) and carefully withdraw the plate, piston assembly, cup, spring assembly, and valve assembly.

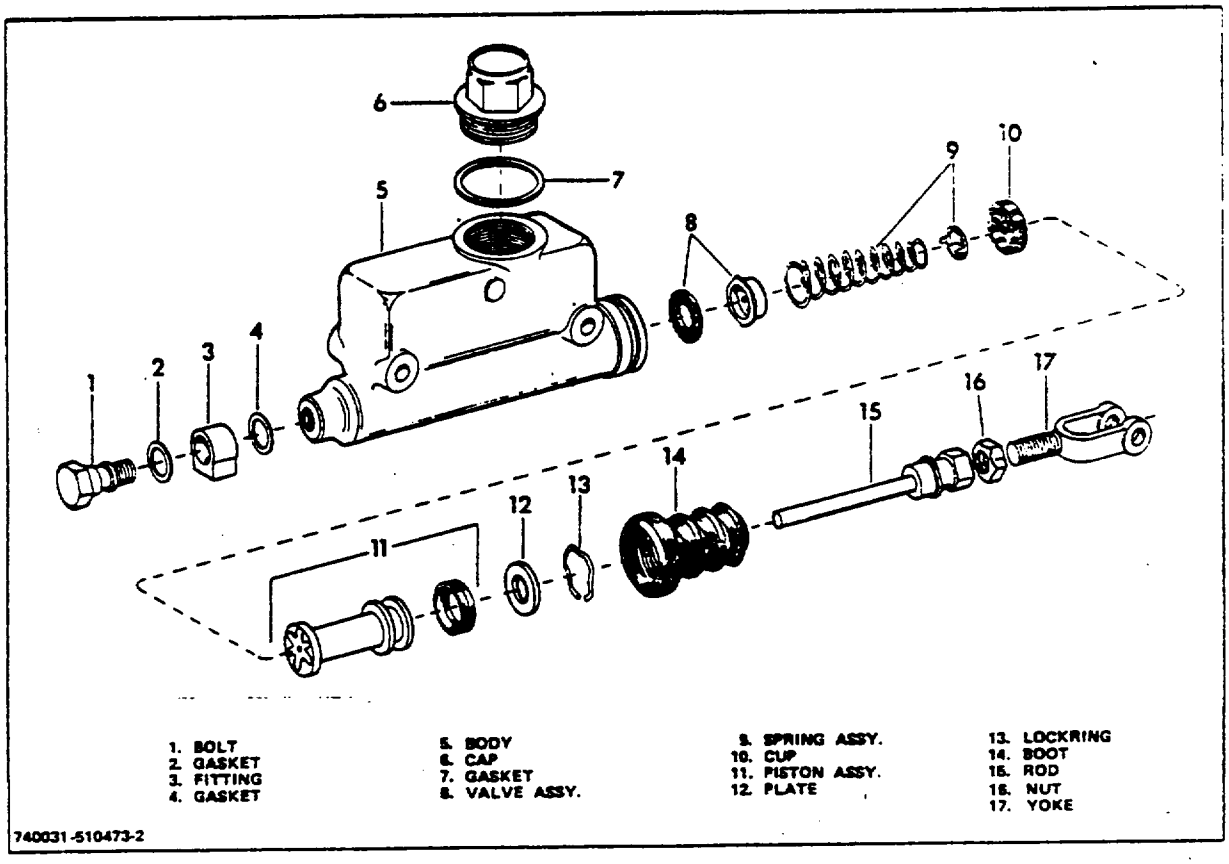


Figure 2-7. Type I Master Cylinder with Brake Pedal Linkage

⚠ WARNING

When lockring is removed entire piston assembly will spring out if not held in place.

h. Working from other end of master cylinder remove outlet bolt, fitting and gaskets.

i. Remove cap and gasket from top of master cylinder.

2. Cleaning and Inspection.

a. Clean hydraulic parts and keep clean so that there is no trace of dirt, metal filings, sludge, or other deposits when unit is ready for assembly. Use lintfree cloth in cleaning. Internal parts must be cleaned in clean denatured alcohol or hydraulic brake fluid. Cylinder castings may be cleaned with usual cleaning methods but must be finish cleaned with denatured alcohol or brake fluid to remove all traces of solvent. Mineral base cleaning solvents (gasoline, kerosene, distillates, carbon tetrachloride, acetone, paint thinners, etc.) deteriorate rubber and the parts become soft, tacky, and swollen.

b. Inspect cylinder bore. Deep blemishes require honing to resurface the cylinder wall. (Refer to following repair instructions.) Pressure marks and discoloration may be polished out with crocus cloth. (Do not use emery cloth or sandpaper.) Make certain intake and bypass ports are open. Bypass port may be probed with soft iron wire.

c. Before assembly, inspect parts for corrosion, scratched or pitted piston bearing surfaces, rubber deterioration, (swelling, softening, tackiness, etc.) and spring action. If cylinder has been honed, replace all parts with new ones in the repair kit. Replace all other parts which appear worn or damaged.

3. Repair.

a. Clean master cylinder according to preceding cleaning instructions.

b. Coat walls of cylinder bore with hydraulic brake fluid.

c. Secure master cylinder body in a bench vise.

d. Follow manufacturer's recommended instructions for use of honing equipment. Remove material from cylinder bore in single passes. After each pass is completed, remove hone and inspect to see if scratches, pitting, etc. have been removed. Remove only enough material to recondition cylinder bore.

NOTE

If master cylinder has been honed oversize (greater than 1.0070"), it must be replaced.

e. Wash master cylinder body in a clean warm water and soap solution.

f. Check to be certain intake and bypass ports are open and free of burrs which may damage piston cups.

g. Rinse cylinder in clean warm water and blow dry with compressed air. Immediately submerge master cylinder body in clean hydraulic brake fluid.

4. Reassembly/Installation.

a. Lubricate parts and cylinder bore with clean hydraulic brake fluid.

b. Install valve assembly and spring assembly in bore of master cylinder.

Large end of piston spring must be positioned towards outlet end of cylinder.

c. Place cup in cylinder bore and install piston assembly in bore of master cylinder; also install plate of Type I master cylinder (Fig 2-7).

d. Compress spring assembly by pushing in piston assembly (and plate of Type I master cylinder, Figure 2-7). Secure internal components with lockring.

e. Install fitting with a gasket on each side and secure with bolt to outlet of master cylinder.

f. Install gasket and cap to top of master cylinder.

g. Install boot, rod, and yoke on Type I master cylinder (Fig 2-7).

h. Slip boot over rod.

i. Secure master cylinder to lift truck frame with capscrews.

j. Remove plug and connect hydraulic brake line to master cylinder.

k. Attach yoke to brake Pedal with clevis pin:

l. Adjust pedal for 1/2 inch free play when necessary (Refer to paragraph F, BRAKE PEDAL ADJUSTMENT).

m. Remove master cylinder cap and fill reservoir with specified hydraulic brake fluid and bleed the brake system using paragraph G. BRAKE SYSTEM BLEEDING.

n. Install and secure cap with gasket to master cylinder.

F. BRAKE PEDAL LINKAGE ADJUSTMENT.

The brake pedal should have 1/2" free play as it is depressed, there should be a reserve distance of approximately 2" between the bottom of the pedal and the toe plate. If the pedal linkage does not provide the proper adjustment of the piston in the master cylinder with the pedal released, the piston cannot return to its full OFF position. The brakes will drag after several applications of the pedal when the bypass port in the master cylinder is blocked. When necessary, adjust linkage to provide 1/2" free play measured at the brake pedal.

Two types of pedal linkage and master cylinder are used on the electric lift trucks. Type I is illustrated in Figure 2-8

1. Backoff jam nut securing rod of master cylinder and yoke.

2. Adjust rod to provide 1/2" of free play measured at brake pedal. More than 1/2" free play reduces usable stroke of master cylinder.

NOTE

When necessary, pedal stop bumper may require adjustment before 1/2" free play can be obtained.

3. Tighten jam nut when 1/2" free play is obtained.

G. BRAKE SYSTEM BLEEDING

Whenever the wheel cylinders are serviced, the hydraulic brake system must be bled to remove any air that may have entered the brake lines.

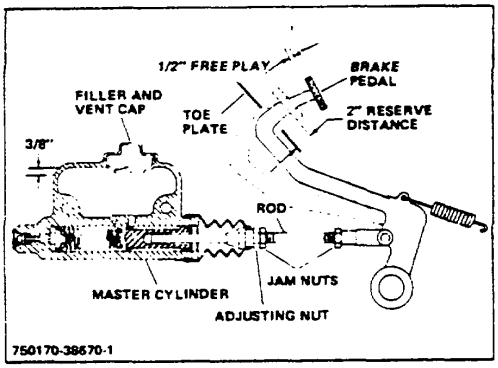


Figure 2-8. Type I Pedal Linkage And Master Cylinder (Typical)

1. Fill master cylinder with clean specified brake fluid.

⚠ CAUTION

Use only silicone based heavy duty brake fluid with an extreme heat-cold range that conforms to MIL-B-46176.

2. Bleed the wheel cylinder furthest from the master cylinder first.

3. Have an assistant apply the brake pedal to apply pressure to the brake fluid and open the bleed screw to allow the air to escape from the wheel cylinder. Close the bleed screw while foot pressure is still on the brake pedal. After the bleed screw is closed, allow the pedal to return to its released position.

4. Repeat step 3 as many times as required until the brake fluid is free of air bubbles and then tighten the bleed screw before allowing the pedal to return to its released position.

5. Bleed the other wheel cylinder in the same manner as outlined in preceding steps 3 and 4.

⚠ CAUTION

Be sure to keep fluid level in master cylinder high enough to prevent reentry of air into the system.

6. Fill master cylinder with specified brake fluid to within 3/8" from bottom of filler opening.

NOTE

Fluid salvaged during bleeding operation is aerated and not suitable for reuse.

H. BRAKE SYSTEM CHECK-OUT PROCEDURE

1. Apply the brake pedal and hold pressure in the brake system. Check for any evidence of fluid leakage if pedal gradually goes to the floor.
2. Operate the vehicle to determine if the brakes operate to stop the vehicle evenly and quickly from a slow speed.
3. If the pedal travel is excessive, this may be due to the brake shoes not being adjusted to the drums properly (shoes should be .020" to drum, total of .040" per assembly). A series of reverse stops will automatically adjust brakes. (Adjust starwheel if grossly under adjusted.)

TOPIC 3. TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	POSSIBLE SOLUTION
Pedal goes to toe plate	Normal lining wear.	Check self-adjuster; replace if necessary.
	Low fluid level in master cylinder.	Fill reservoir with specified brake fluid and bleed lines.
	External leak in brake system or leak past master cylinder piston cup.	Check system for leak and repair.
	Air trapped in hydraulic system.	Bleed system.
Both brakes drag.	Pedal linkage not correctly adjusted.	Readjust to correct.
	Mineral oil in brake system.	Clean out system, replace cups in brake cylinders, and refill system with specified brake fluid.
	Breather port in master cylinder clogged.	Clean out breather port.
One wheel drags.	Weak or broken brake shoe return springs.	Replace broken or weak springs.
	Brake shoe or drum clearance too small.	Check self-adjuster; replace if necessary.
	Loose wheel bearings.	Readjust
	Obstruction in brake line.	Remove obstruction or replace line.
	Swollen wheel cylinder piston cups or piston binding.	Replace defective or damaged parts.
Lift truck pulls to one side.	Grease or brake fluid on brake lining.	Replace with new specified brake shoes.
	Loose wheel bearings.	Readjust.
	Different makes of brake lining.	Replace with new specified brake shoes.
	Brakes incorrectly set.	Realign brake shoes and self-adjuster.

TROUBLE	PROBABLE CAUSE	POSSIBLE SOLUTION
Lift truck pulls to one side (cont.).	Uneven tread wear.	Replace tires.
	Lining charred or drum scored.	Replace with new specified brake shoes; repair or replace drum.
Brakes spongy.	Air trapped in hydraulic system.	Bleed brake system.
	Brake adjustment not correct.	Check self-adjuster; replace if necessary.
	Shoe surface not square with drum.	Repair.
Excessive pedal pressure.	Brake adjustment not correct.	Check self-adjuster; replace if necessary.
	Incorrect brake lining.	Replace with new specified brake shoes.
	Oil or fluid soaked lining.	Replace with new specified brake shoes.
	Lining making only partial contact.	Realign brake shoes.
Light pedal pressure-brakes too severe.	Brake adjustment not correct.	Check self-adjuster; replace if necessary.
	Small amount of grease or brake fluid on lining.	Correct cause and replace with new specified brake shoes.
	Incorrect lining.	Install new specified brake shoes.
Brakes squeak.	Brake shoes twisted.	Repair
	Particles of metal or dust imbed-imbedded in lining.	Remove foreign material; sand lining and drum.
	Chamfer at end of lining too short.	Elongate chamfer.

TOPIC 4. PARKING BRAKE

A. GENERAL

The parking brake (Fig 4-1) is the disc and caliper brake type. The mechanically operated disc brake assembly is the self-aligning type with the disc mounted on the end of the drive motor armature shaft. A cam lever actuated disc brake assembly is used to apply the pads against the disc to hold the lift truck in a stationary position. As spring tension is applied to force the end of the cam lever downward, the pads are actuated against the disc. When the end of the cam lever is pulled up, the cam pad moves away from the disc.

The parking brake is a self-adjusting brake and normally does not require adjustment. As the pads wear, the seat angle increases and no change in brake performance will be noted. Inspection can be made through the inspection hole in the bottom of the brake housing.

B. PARKING BRAKE CHECK

The parking brake should be checked periodically for correct adjustment and operation. Also during lift truck operation, check to make certain the parking brake pads do not drag.

Brake pads that a rag can cause premature wear, may cause shortened battery life, and will reduce top speed.

Perform parking brake check as follows:

1. Drive and stop the lift truck on an incline (approximately 15% incline).

2. Remove weight from the operator's seat.

3. Then remove foot from brake pedal. The lift truck should hold in a stationary position.

4. if the lift truck does not hold in a stationary position, the parking brake must be adjusted.

⚠ WARNING

Disconnect the battery and discharge the capacitors before making adjustments or repairs.

C. PARKING BRAKE ADJUSTMENT

1. Should the parking brake require

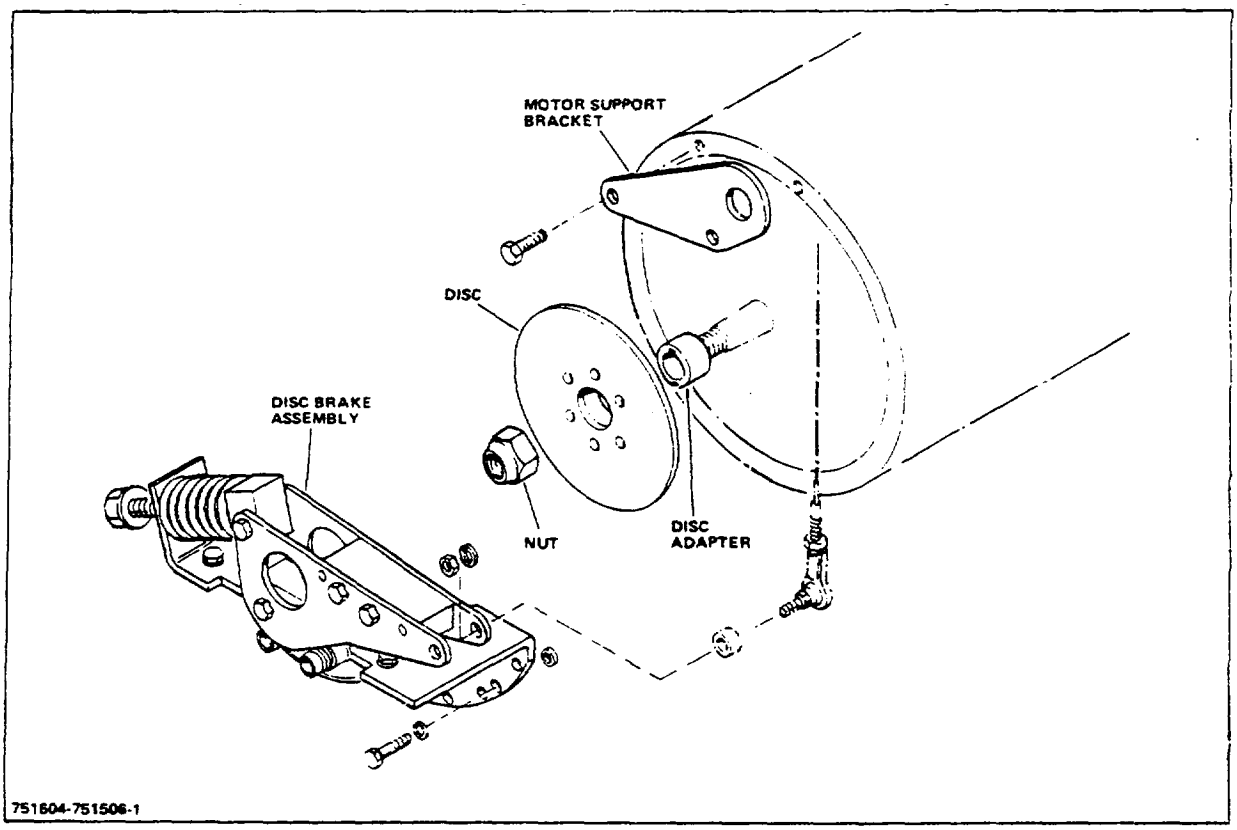


Figure 4-1. Parking Brake

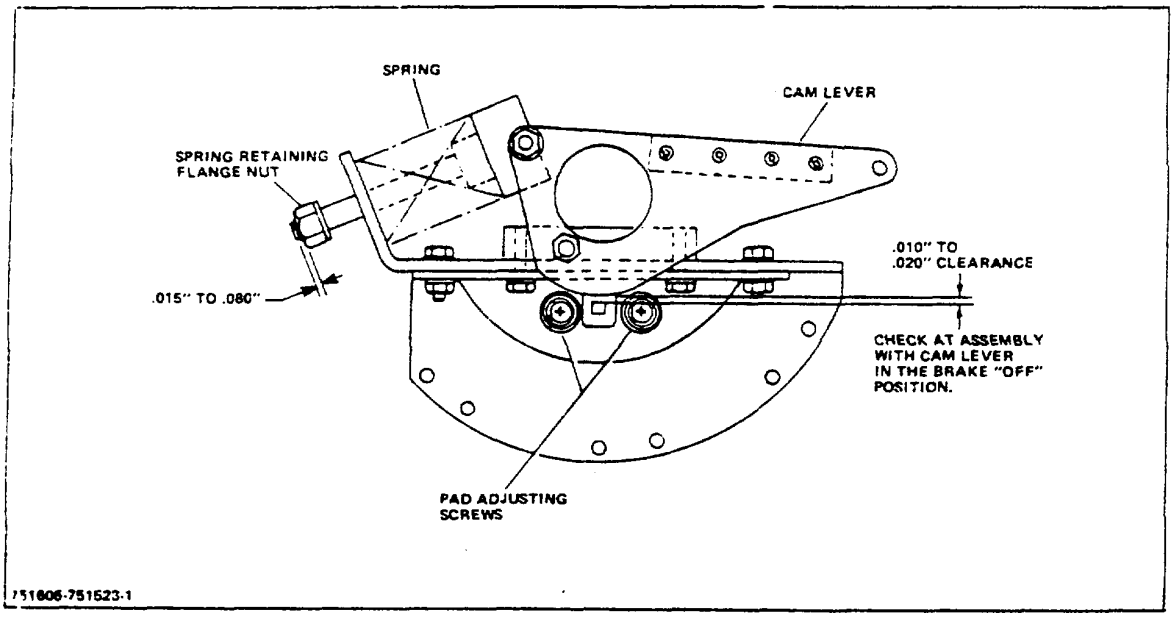


Figure 4-2. Parking Brake Adjustment

adjustment, release parking brake by tightening the spring retaining flange nut (Fig 4-2) so the cam lever is in the BRAKE OFF position.

2. Use a large screwdriver and adjust the pad adjusting screws (Fig 4-2) until screws are tight and brake pads contact the disc; then back off screws 1/4 turn.

NOTE

The pad adjusting ;crews are the large slotted screws and not the parts with the Phillips head. The parts with the Phillips head are retainer pins and are under spring pressure.

3. Back off the spring retaining flange nut until it is .015" to .080" from end of stud (Fig 4-2;.

⚠ WARNING

Do not attempt to remove the spring retaining flange nut from the stud. The large spring, which is under pressure, is installed on the stud at the factory with a holding fixture.

NOTE

Brake pads should be applied to the disc when the cam lever is down or in the BRAKE ON position and the operator's seat is unoccupied.

D. PARKING BRAKE CABLE ADJUSTMENT

When the parking brake cable requires adjustment, perform the following:

1. Tighten spring retaining flange nut (Fig 4-2) until end of the cam lever moves upward enough to release tension on the parking brake cable. Then remove yoke pin (Fig 4-3) and yoke from the seat hinge assembly.
2. Loosen jam nut and turn yoke clockwise to shorten cable length or counterclockwise to lengthen it. (For further adjustment, perform same adjustment at the rod end (Fig 4-3) of cable).
3. Tighten jam nut and install yoke to the seat hinge assembly with yoke pin and cotter pin.
4. Back off the spring retaining flange nut until it is .015" to .080" from end of the stud (Fig 4-2).

E. SEAT SWITCH ADJUSTMENT

As the operator leaves the lift truck seat, spring tension raises the seat and the seat switch opens. When the seat switch opens, control current flow is interrupted.

The seat switch (Fig 4-3) must be adjusted so the base of the seat hinge assembly contacts the switch roller when the seat cushion is fully depressed.

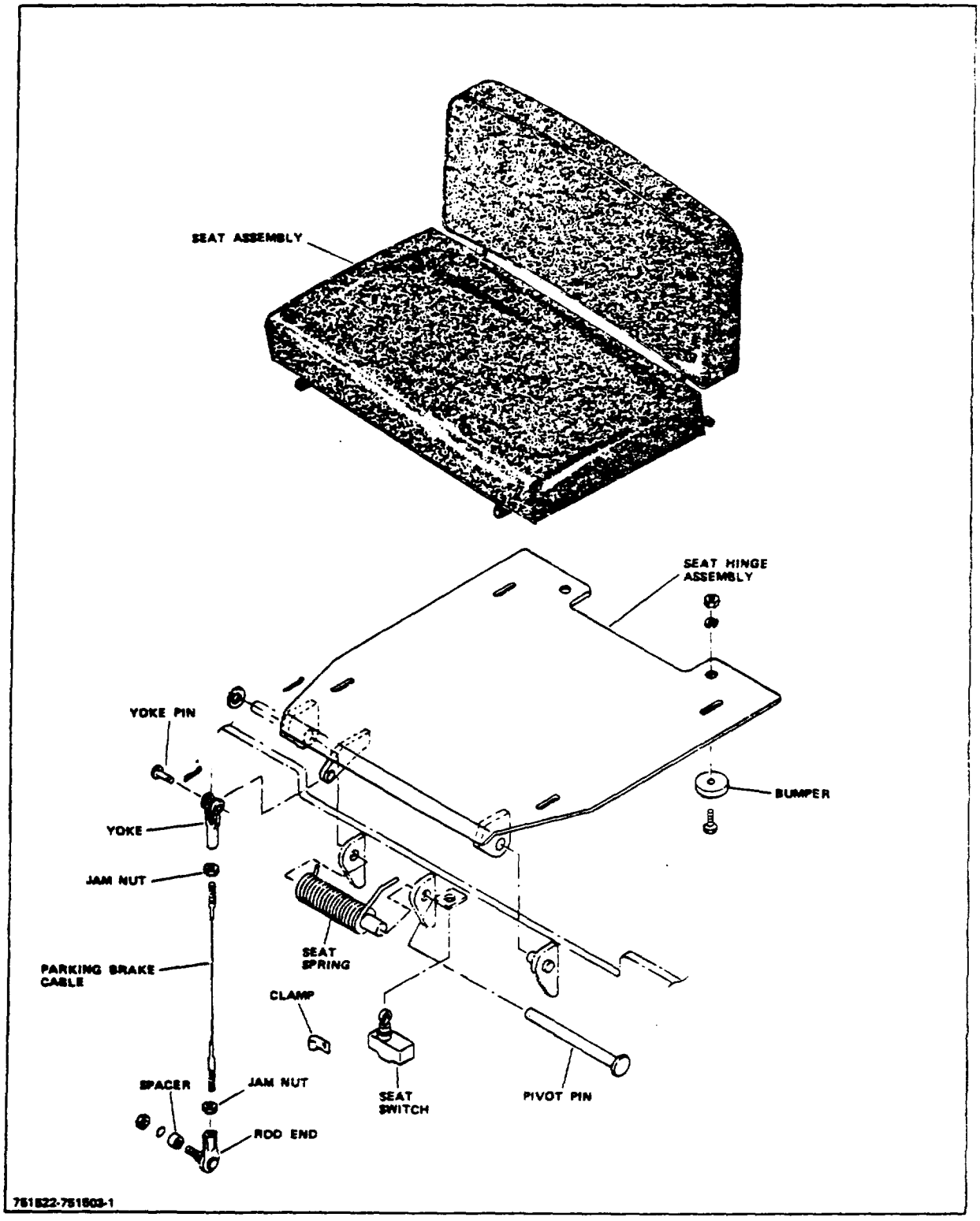


Figure 4-3. Parking Brake Cable and Seat Assembly

To adjust the seat switch, loosen locknut and move seat switch up or down until proper contact with the base of the seat hinge assembly is obtained; then tighten the locknut securely.

NOTE

Electrical leads are wired to the normally open contacts of the seat switch. When seat cushion is fully depressed, the seat switch must be actuated so the contacts close.

F. REMOVAL

⚠ WARNING

Disconnect the battery and discharge the capacitors. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. Forklift trucks with "ACTRONIC" control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

1. Raise lift truck to gain access to the parking brake; block lift truck frame and wheels in position.
2. Tighten spring retaining flange nut (Fig 4-2) on the stud so large spring is compressed and the cam lever is in the BRAKE OFF position.
3. Remove nut, lockwasher, and spacer and disconnect rod end (Fig 4-3) from the cam lever.
4. Remove capscrews, lockwashers, and washers that secure disc brake assembly (Fig 4-1) to drive motor; remove disc brake assembly from motor and at the same time carefully slide the disc from the motor armature shaft, or disc adaptor which is secured to the shaft with a nut (Fig 4-1). Remove the disc from the disc brake assembly.

⚠ CAUTION

After the disc is removed from the brake pad area, do not attempt to loosen the spring retaining flange nut (Fig 4-2) on the stud, otherwise damage could result to the retainer pins (Fig 4-4). Back off the spring retaining flange nut only after the disc brake assembly is installed on the motor with the disc in place.

G. INSPECTION

Inspect brake pads for damage, distortion, or wear; replace as necessary. Inspect brake disc for damage such as cracks or scoring; replace as necessary. Light scratches can be removed with fine emery cloth.

H. BRAKE PAD REPLACEMENT

Whenever the parking brake can no longer be adjusted by the pad adjusting screws, and the parking brake is ineffective in holding the truck securely, the brake pads should be checked and replaced as necessary.

When brake pads are replaced, remove the carrier pad (Fig 4-4) first.

1. Unhook and remove carrier pad spring that secures carrier pad to side of housing; remove carrier pad from inside of housing.
2. Insert Phillips screwdriver into head of retainer pin (Fig 4-4). Hold cam pad in position with one hand and press down on retainer pin; turn retainer pin 900 to release it through slot in cam pad. Slowly withdraw screwdriver until spring tension is released; then remove retainer pin and pin spring from inside of pad adjusting screw. Repeat procedure for removal of the other retainer pin and pin spring.
3. Move cam pad away from side of housing and remove the cam pad and tilt pins from housing.
4. Before a new cam pad is installed, back off the pad adjusting screws several turns. Then position tilt pins and cam pad inside the housing.

NOTE

When brake pads are replaced, both pads must be replaced with new ones.

5. Insert the pin spring and retainer pin inside of pad adjusting screw. Install retainer pin through tilt pin and slot in cam pad; then press down and turn retainer pin 90° to lock it in position. Repeat procedure for installation of the other pin spring and retainer pin.
6. Install carrier pad in the housing and position it against the side of the housing.
7. Position carrier pad spring on outside of housing; first hook one end of spring into carrier pad opening and then hook other end of spring into opposite carrier pad opening.
8. Check clearance between the cam lever

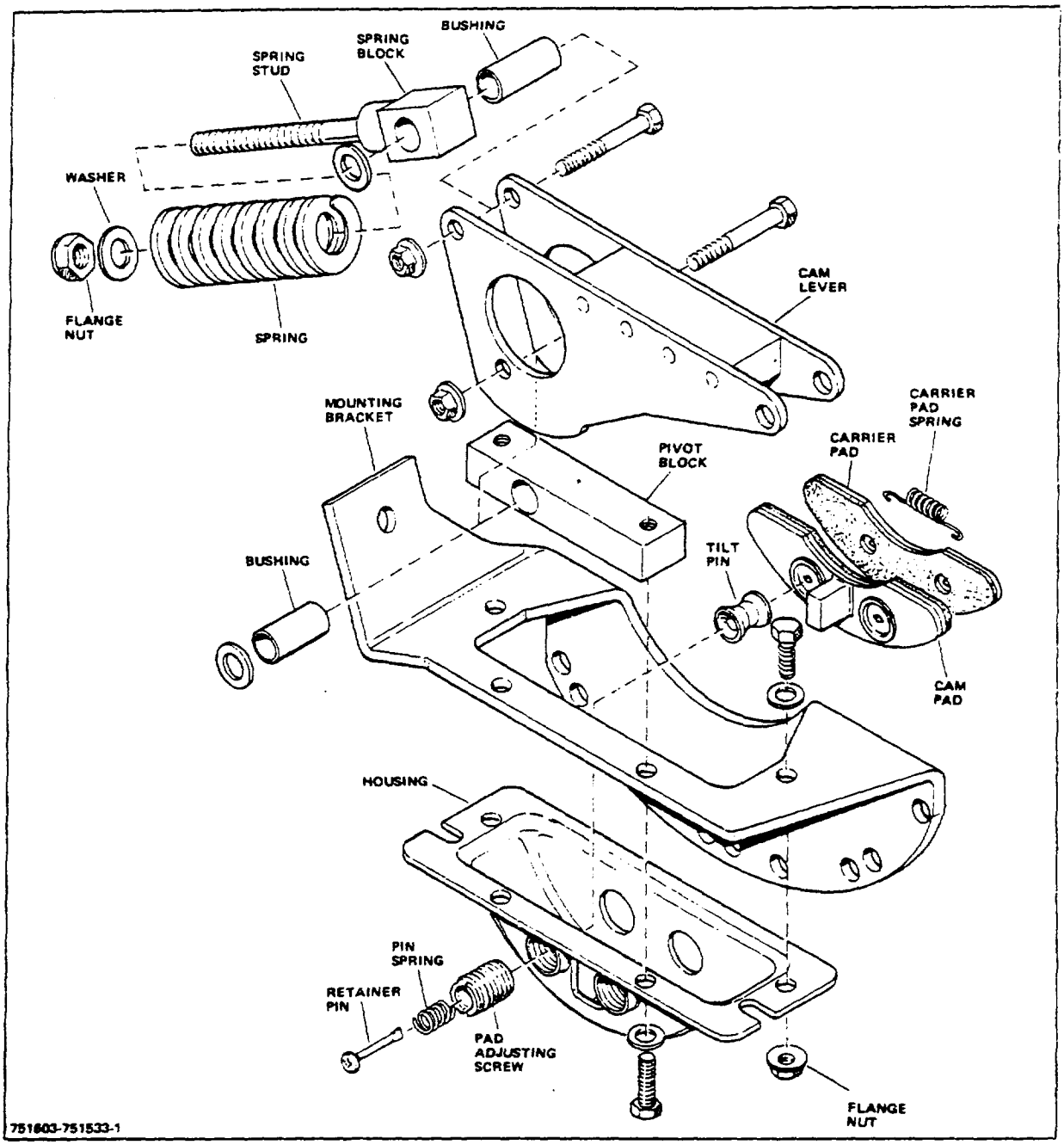


Figure 4-4. Disc Brake Assembly

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and top of boss on cam brake pad; it should be .010" to .020" as shown in Figure 4-2.

I. INSTALLATION

1. Place the disc between brake pads in disc brake assembly. Position disc brake assembly on motor and at the same time carefully slide the disc on motor armature shaft or the disc adaptor; install washers, lockwashers, and capscrews that secure disc brake assembly to motor and tighten securely.

2. Use a large screwdriver and adjust pad adjusting screws (Fig 4-2) until screws are tight and brake Dads contact the disc; then back off screws 1/4 turn.

3. Connect rod end (Fig 4-3) to cam lever and install spacer, lockwasher, and nut securely.

4. Back off the spring retaining flange nut until it is .015" to .080" from end of stud (Fig 4-2).

NOTE

Brake pads should be applied to the disc when the lever is down or in the BRAKE ON position and the operator's seat is unoccupied.

TOPIC 1. GENERAL DESCRIPTION

The power steering system (Fig 1-1) converts hydraulic oil movement into mechanical movement to turn the steer wheels with ease. The steer axle assembly with the steer wheels is mounted to the frame and is located at the rear of the lift truck. The main components in the power steering system are the pump motor, power steering pump, steering valve unit, and steering cylinder. The hydraulic oil that is supplied to the steering valve unit is directed to one of the steering cylinder ports. As the oil enters the steering cylinder, the plunger rod begins to extend or retract, depending upon which port in the cylinder the hydraulic oil is directed. A short drag link or yoke is installed on the end of the steering cylinder plunger rod and is connected to the steer axle pivot arm. Also connected to the pivot arm are right and left tie rods which in turn are attached to the respective steer wheel spindles.

When the steering wheel is turned to the right, oil is directed by the steering unit to the forward port in the steering cylinder. As the hydraulic oil pressure is applied to the piston, the piston and plunger rod move outward. The plunger rod by means of the drag link then pushes on the Divot arm which rotates on the pivot pin. As the pivot arm rotates, the steer wheels move into position for a right turn due to the movement of the tie rods.

The movement of the steering system is just the opposite when the steering wheel is turned to the left. The hydraulic oil is then directed to the rear port in the steering cylinder which causes the plunger rod to retract. As the

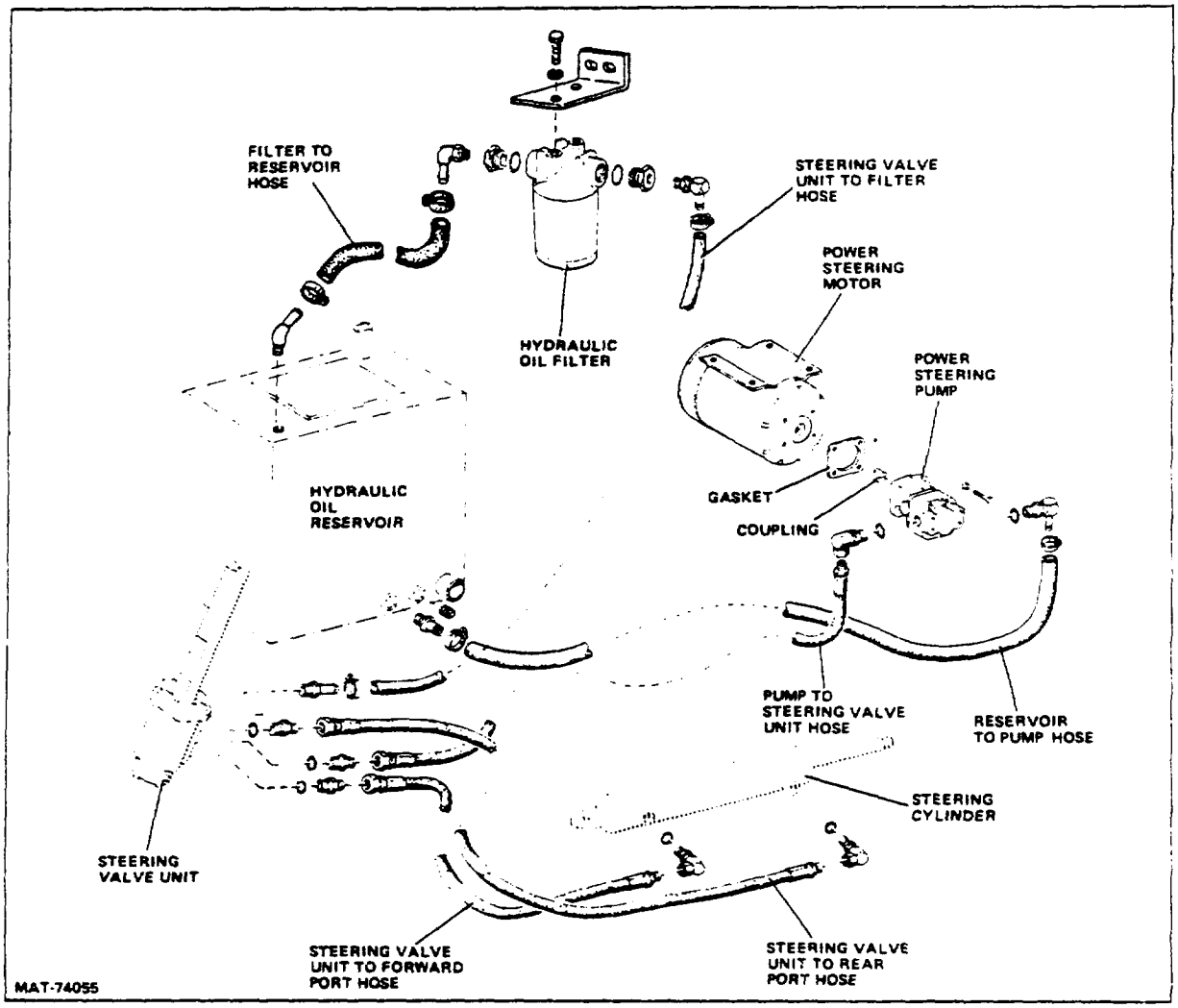

Figure 1-1. Power Steering System - (Typical)

plunger rod retracts the drag link pulls on the pivot arm and the steer wheels move into position for a left turn due to the opposite movement of the tie rods.

TOPIC 2. STEER AXLE

A. REMOVAL

⚠ WARNING

Before any of the following inspections, services, etc., are performed, disconnect the battery and discharge the capacitors.

1. Remove the floor plate and toe plate.
2. Attach a suitable hoist to the rear of the truck and raise the truck until the drag link and steer axle are accessible. Block the front wheels, and place blocks under both sides of the frame to support the rear of the vehicle. Blocks and chain must not interfere with removal of steer axle.
3. Remove steer wheels and wheel bearings.
4. Disconnect drag link from pivot arm by loosening the adjusting plug at the end of the drag link until the link can be lifted from the ball stud on the pivot arm.
5. Place a jack under the steer axle assembly and raise jack enough to take the stress from the axle mounting capscrews and nuts.
6. Type III Steer Axle Only Loosen Jam nut and back off adjusting screw in frame just ahead of the steer axle's front pivot pin. Adjusting screw is used to take up end play between steer axle's front pivot pin and the frame.
7. Remove nuts and/or lockwashers, and capscrews that secure the axle to the frame.
8. Lower the jack with the axle on it, and withdraw the axle from under the vehicle.

B. DISASSEMBLY

1. Remove the axle mounting housing from steer axle pivot pin.
2. Remove cotter pins, adjusting plugs, ball seats, and springs from the tie rods, and separate the tie rods from the pivot arm.
3. Remove cotter pin and nut from ball socket, and remove the tie rods from the spindles. Loosen the nut on the ball socket, and remove the ball socket and nut from the tie rod tubes.
4. Remove expansion plugs from king pin bores in the axle assembly. Drive roll pins from king pins and spindles, and remove the king pins, needle bearings and spindles from the axle.

   Use a punch to straighten out stake indentation in end of nut. Remove nut, washer, seal and lower cone; lift pivot arm from steer axle housing and remove seal and upper cone. Use a brass drift and remove upper and lower bearing cups from steer axle housing; remove retaining ring.

C. CLEANING AND INSPECTION

1. Clean all parts with mineral spirits or other suitable solvent, and dry with compressed air.
2. Inspect all parts for cracks, breaks, bends, other damage, arid wear. Repair or replace parts as indicated by their condition.
3. Lubricate all parts except the ball ., sockets with an SAE 10 or 20 oil. Pack the tie rod ball sockets with high quality chassis lube.

D. REASSEMBLY

1. Type II and III Steer Axle:

   Install retaining ring and lower bearing cup in steer axle housing; install upper bearing cup. Make certain cups are firmly seated. Install seal and cone on pivot arm pin; install pivot arm, lower cone, seal, washer, and new nut. (For proper installation procedure, refer to following Paragraph F, PIVOT ARM INSTALLATION PROCEDURE.)
2. Install king pin needle bearings in the axle assembly. Position the spindle on the axle and insert the king pin. Align the roll pin in the king pin and spindle, and insert the roll pin. Install and stake new expansion plugs.
3. Assemble the nut, ball socket, cup, seats, spring, and plug to tie rods. Position the tie rods on the pivot arm and tighten plug until seats firmly grasp ball stud on the pivot arm. Install ball socket on spindle and secure with nut and cotter pin.

E. INSTALLATION

1. Depending upon the model of the lift truck, install axle mounting housing or

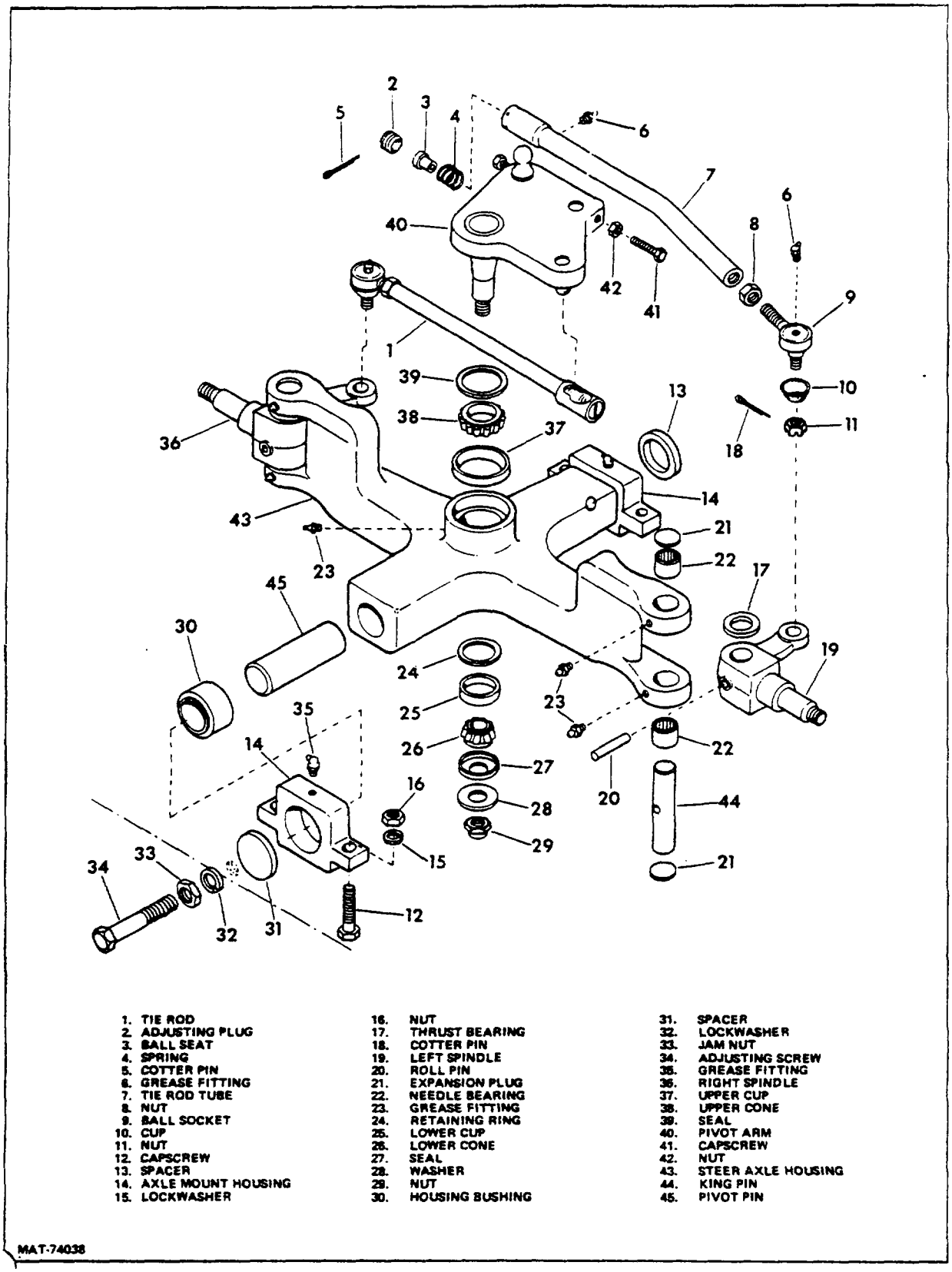

Figure 2-1. Steer Axle Assembly (Type III) (with Adjusting Screw)

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housings on steer axle pivot pins. Type III steer axle requires that solid spacer is positioned between end of pivot pin and frame.

2. Position steer axle on a jack or other suitable device and raise it into position under the truck frame.
3. Install mounting capscrews, lockwashers, and nuts if applicable; tighten until snug .to permit movement for adjustment.
4. Type III Steer Axle: On all model ACE lift trucks, push entire steer axle against rear spacer and hold in place. Turn adjusting screw IN to take up end play between pivot pin and solid spacer. Tighten adjusting screw to a torque of 10-15 lb-ft. Tighten jam nut to a torque of 90-100 lb-ft after adjustment is completed.
5. Tighten steer axle mounting nuts or capscrews securely.
6. Thoroughly lubricate all lube points of the steering system.
7. Connect drag link to the pivot arm. Install floor plate and toe plate and fasten securely.
8. Lubricate the inner wheel bearing cone with specified grease. Use an applicator designed to force lubricant into the bearing rollers.
9. Position inner bearing cone on the spindle. Lubricate the bearing cups in the wheel and carefully install the wheel on the spindle.
10. Lubricate the outer bearing cone with the specified lubricant, using an applicator. Install the bearing cone on the spindle.
11. Install washer and retaining nut on spindle. While rotating steer wheel, tighten retaining nut to a torque of 50 lb-ft; then back off nut until loose (0 lb-ft). Rotate wheel alternately in each direction while tightening retaining nut until a torque of 25 lb-ft is obtained. Then back off nut 30° min to 60° max and install cotter pin.
12. Install hub can and secure with capscrews and lockwashers, tightening capscrews securely. Lower the truck to the floor.

F. PIVOT ARM INSTALLATION PROCEDURE

1. Make certain pivot arm pin, bearing seats, and steer axle housing bore are clean.

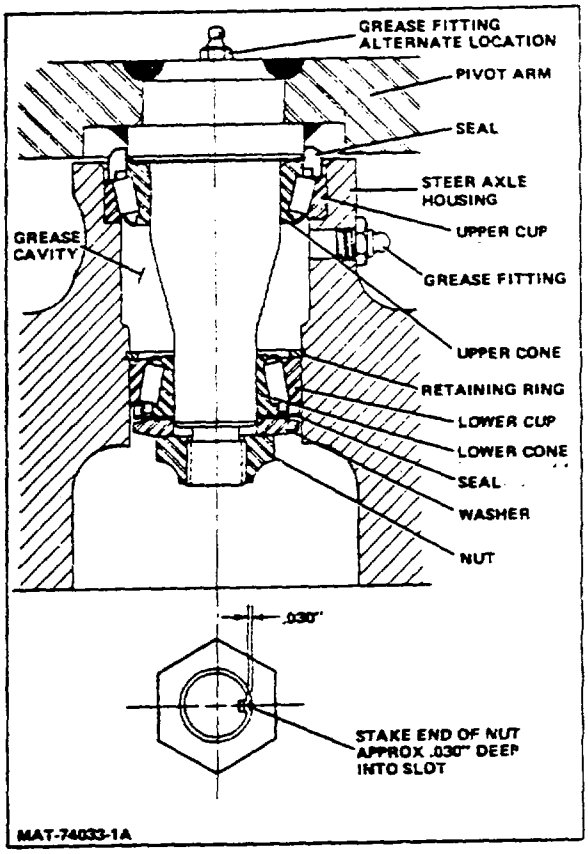


Figure 2-2. Pivot Arm Installation

2. Install retaining ring and lower bearing cup in steer axle housing; install upper bearing cup. Make certain cups are firmly seated.
3. Seat upper seal (Fig 2-2) on pivot arm firmly. Fill seal with specified grease.
4. Pack upper cone with specified grease and press it onto pivot arm pin until it is seated against the shoulder.
5. Install pivot arm with bearing in steer axle housing.
6. Pack lower bearing-cone with grease and install it on pivot arm pin.
7. Fill seal with grease and install it on pivot arm pin.
8. Install washer and start new nut on pivot arm pin.
9. Use a torque wrench and continue to tighten nut. Note torque reading while advancing lower cone to its seated position. You will notice an increase in the torque when the lower cone starts to seat. Continue to tighten nut until torque is 15-25 lb-ft greater than pre-

viously noted before lower cone started to seat.

10. Check rotational bearing torque. Rotate pivot arm back and forth several times and take rolling torque reading. It should require 15-25 lb-in torque to rotate pivot arm in either direction.

NOTE

Tie rods must not be connected to pivot arm whenever rolling torque is checked.

11. If rolling torque is less than 15 lb-in, tighten nut an additional 5 lb-ft torque and repeat Step 10.

12. If rolling torque exceeds 25 lb-in, back nut off one full turn. Strike end of pivot arm pin with softheaded mallet to unseat bearings and repeat Steps 9 and 10.

13. After proper rolling torque is obtained, stake end of nut approximately .030" deep into slot (Fig 2-2).

14. Fill cavity with specified grease until it seeps out between pivot arm and steer axle housing.

TOPIC 3. STEERING VALVE UNIT

A. REMOVAL

⚠ WARNING

Before proceeding with removal, disconnect battery, then discharge capacitors.

1. Remove the floor and toe plates.
2. Disconnect hydraulic hoses from steering valve unit. Cover all openings immediately to prevent entry of dirt in the hydraulic system.
3. Disconnect horn button wire at the horn.
4. Remove capscrews that secure steering valve unit to the stationary bracket.
5. Lift steering valve unit up and out of the vehicle and place in a clean work area for disassembly.

B. DISASSEMBLY (Fig 3-1)

1. Place the power steering unit in a vise, (Fig 3-2). Remove the horn button and rubber cover by pushing down and turning counterclockwise to disconnect it from the attaching wedges located on the base plate.
2. Remove the horn button contact cup, spring and contact washer. Remove the terminal from the horn cable and pull the cable and insulating ferrule from the steering column.
3. Remove the three round head screws from the horn button base plate, and remove the base plate and contact insulator.
4. Remove the nut and lockwasher securing the steering wheel to the column. Using a suitable puller, pull the wheel from the column.
5. Remove the retaining ring and first snap ring. Push shaft free of bearing with thumb pressure. When shaft is removed, bearing and second snap ring can be removed.

⚠ CAUTION

Do not use a hammer to free the shaft. Upper shaft bearing may be damaged.

6. Remove the two capscrews that secure the column to the lower unit. Match mark the capscrew holes so the ports will be in the proper direction when reassembled. Remove the column from the lower unit (Fig 3-2).
7. Clamp the unit in the vise with the meter end up and remove the seven capscrews (Fig 3-3). Remove the three-section cap, gear, and plate as a unit, and set to one side on the bench (Fig 3-4).
8. Remove control assembly from vise, and check for free rotation of the control spool and sleeve parts with the column shaft (Fig 3-5).
9. Place a clean wooden block across the vise throat to support spool parts. Clamp unit across port face with control end up and remove the four capscrews.
10. Hold the spool assembly down against the wooden block, and remove the end cap (Fig 3-6).
11. Inspect mating surfaces for obvious leakage, path wear, and seal condition.
12. Remove cap locator bushing (Fig 3-7).
13. Place port face of housing securely on a solid surface and remove the spoolsleeve assembly from the 14-hole end of the housing.

⚠ CAUTION

Use extreme care when removing these parts, because they are very closely fitted and must be rotated slightly as they are withdrawn.

14. With a small bent tool or wire, remove check valve seal plug from housing (Fig 3-8). Do not pry against edge of hole in housing bore.
15. With housing installed in vise, control end up, remove check valve seat with 3/16 hex wrench (Fig 3-9).
16. Turn the housing over and tap lightly with palm of hand. With check valve hole toward lowest corner, remove check valve seat, ball, and spring.
17. Holding the spool assembly, push the cross pin to loosen it from the spoolsleeve assembly (Fig 3-10). Remove the cross pin and set it aside.

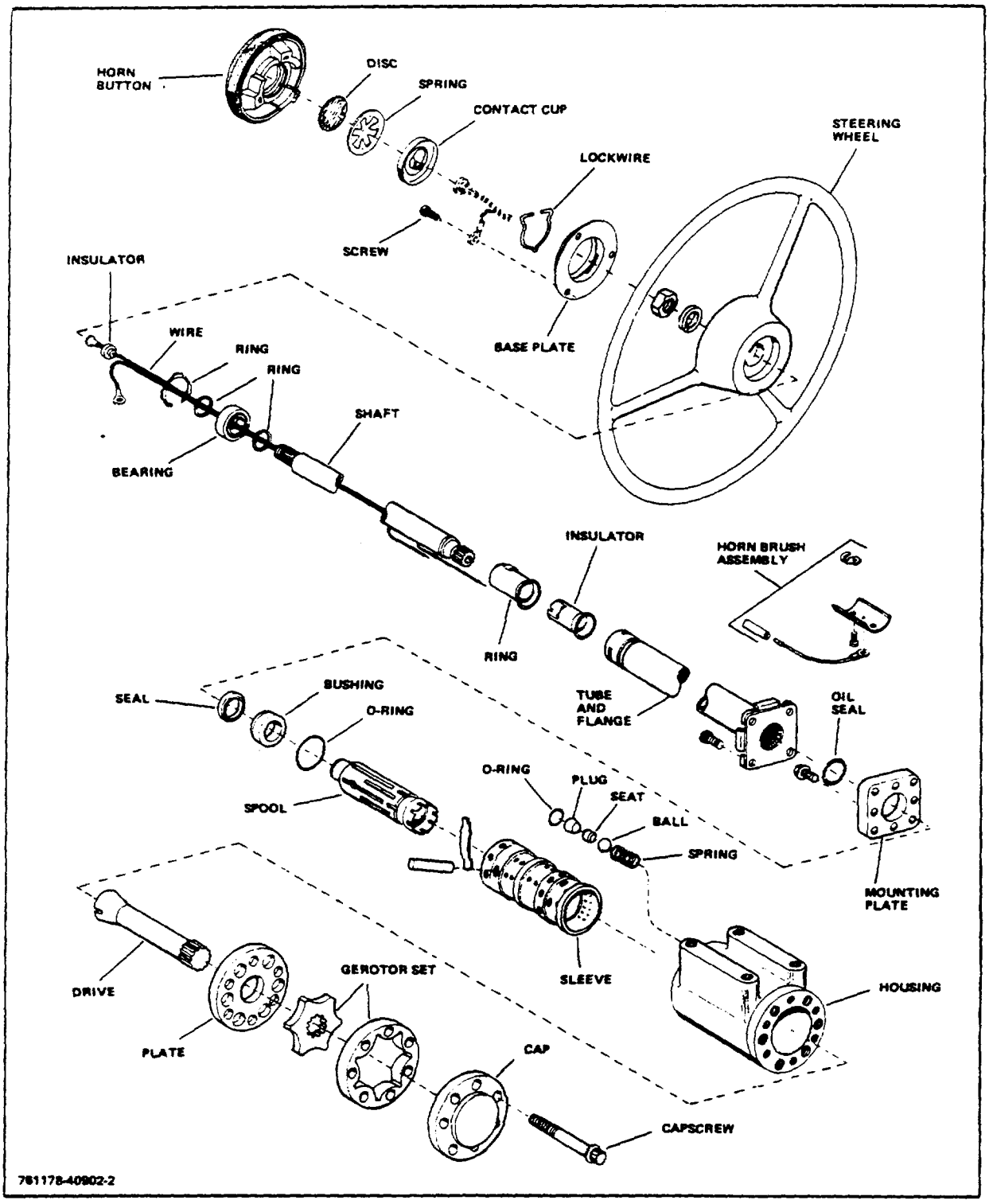


Figure 3-1. Steering Valve Unit Components

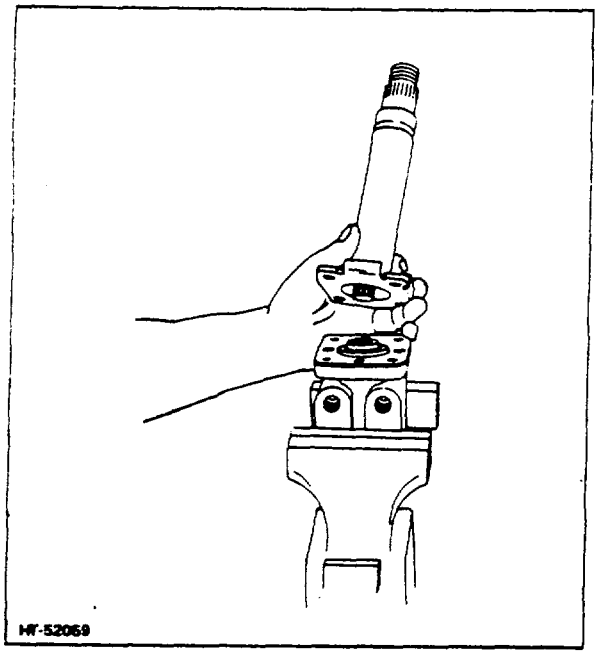


Figure 3-2. Removing Column From Housing

18. Push inside lower edge of spool so the spool moves toward the splined end, and remove spool carefully from the sleeve (Fig 3-11).
19. Push the centering spring set out of the spool (Fig 3-12).

C. CLEANING AND INSPECTION

1. Carefully rinse each part with suitable solvent and allow parts to air dry. Parts should be set to dry on clean paper towels.

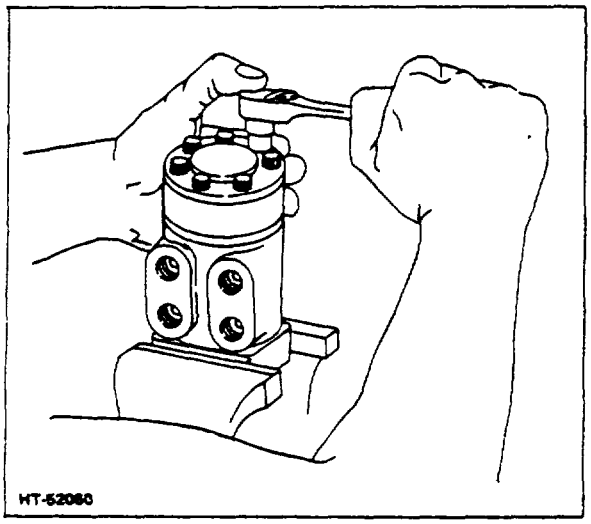


Figure 3-3. Removing End Plate Capscrews

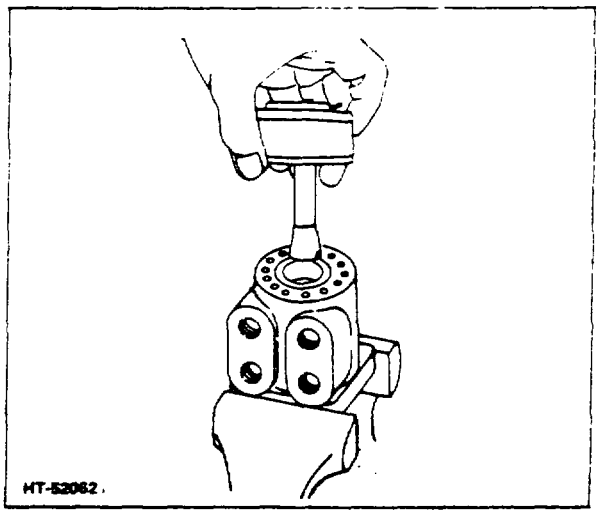


Figure 3-4. Removing End Plate Assembly

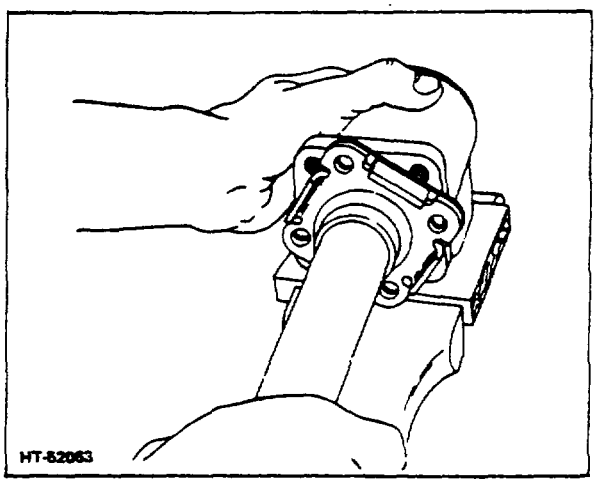


Figure 3-5. Checking Control Spool Rotation

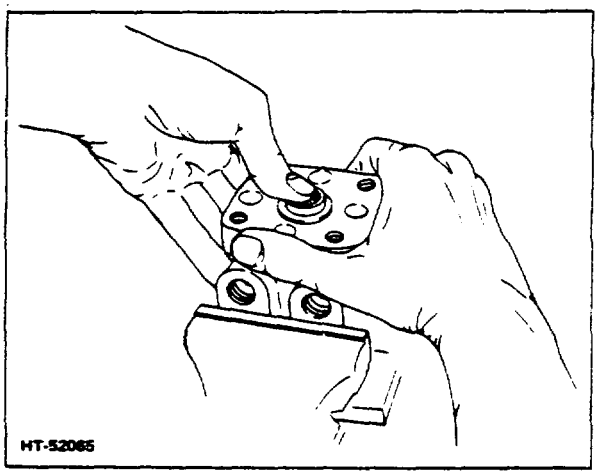


Figure 3-6. Removing End Cap

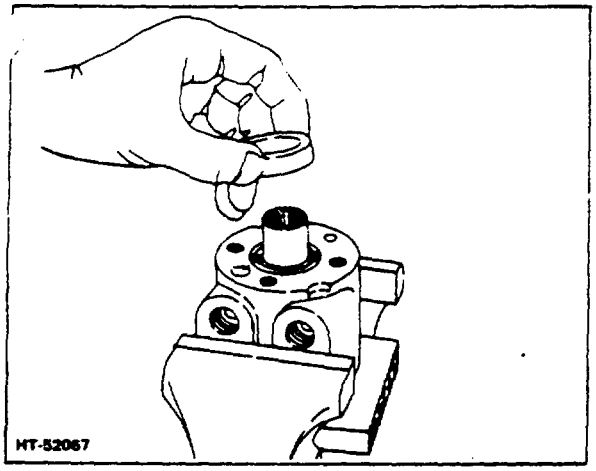


Figure 3-7. Removing Cap Locator Bushing

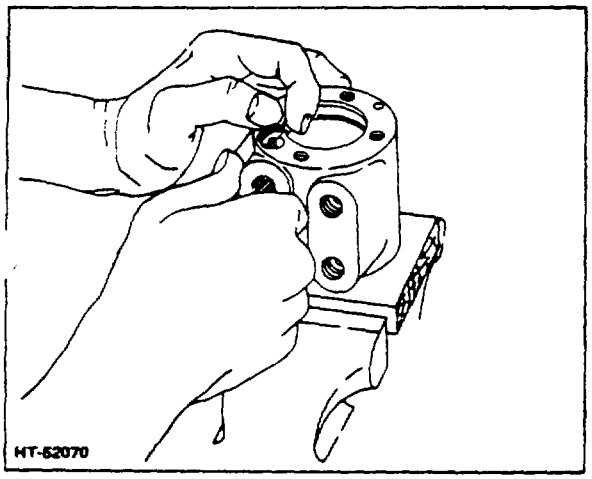


Figure 3-8. Removing Check Valve Seal Plug

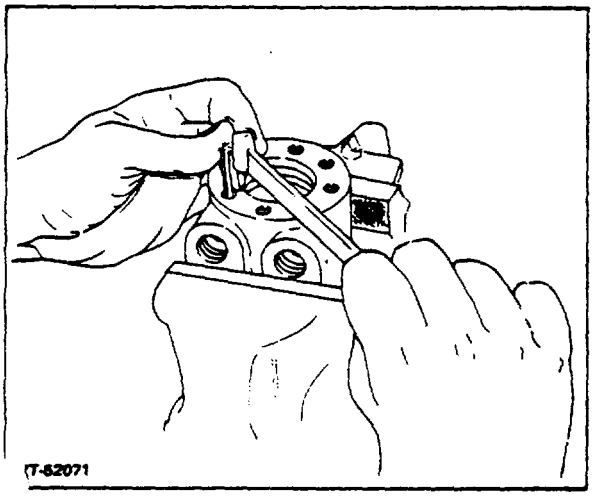


Figure 3-9. Removing Check Valve Seat

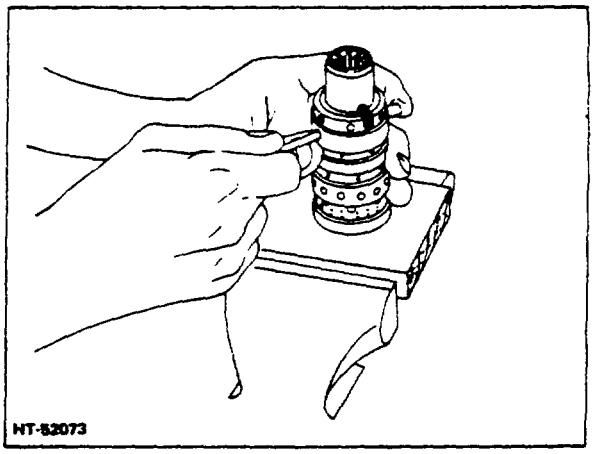


Figure 3-10. Loosening Spool Assembly

2. Inspect the surfaces of all moving parts for scoring and other damage. Slightly scored parts can be cleaned up by hand rubbing with 600-grit abrasive paper. Smooth burnished areas are normal in many areas. DO NOT attempt to clean up these areas, nor mistake them for excessive wear.
3. Replace any parts found to be defective or badly worn. All seals must be replaced with new parts when unit is reassembled.
4. Place a piece of 600-grit abrasive paper face up on a piece of plate glass or similar smooth, flat surface.
5. Clean the ends of the meter section star gear by stroking it across the abrasive.

   This will also remove any sharp grit which could scratch other meter section components.

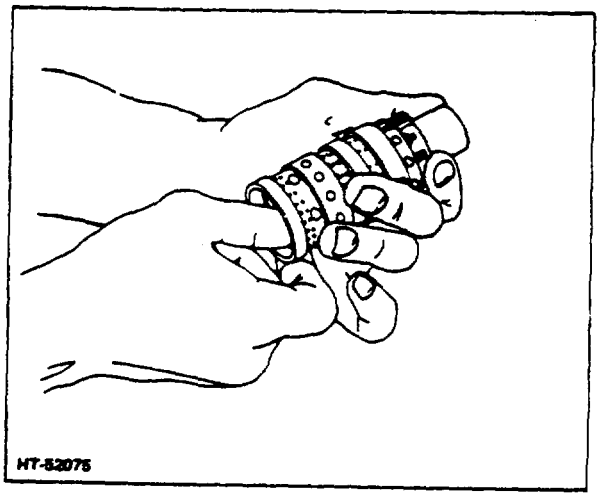


Figure 3-11. Removing Spool From Sleeve

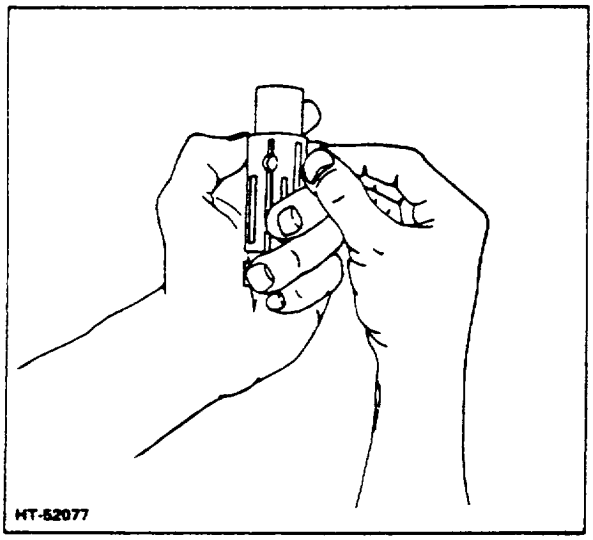


Figure 3-12. Removing Spring From Spool

6. Lightly clean up both sides of the ring gear, both sides of the plate, the 14 hole end of the housing, and the flat side of the end cap. Stroke each surface across the abrasive several times and check the results (Fig 3-13). Any small bright areas indicates a burr which must be removed. When polishing the parts, hold them as flat as possible against the abrasive. After 6 to 10 strokes across the abrasive, check the part to see if it is polished. After each parts is polished, rinse clean in solvent, blow dry with air, and place it where it can remain absolutely clean until reassembly.

D. REASSEMBLY

1. Lubricate all parts lightly with clean hydraulic oil at time of reassembly.

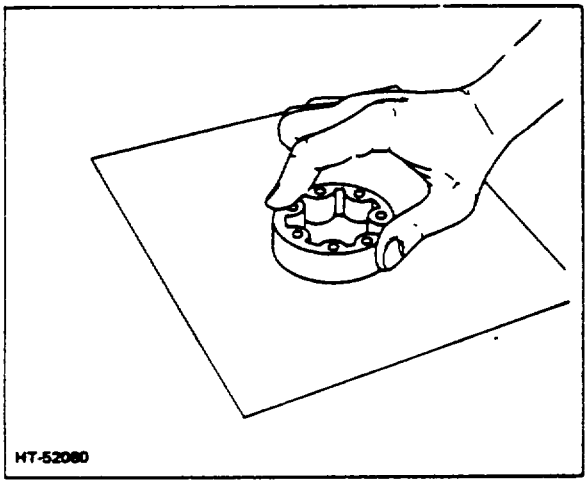


Figure 3-13. Polishing the Ring Gear

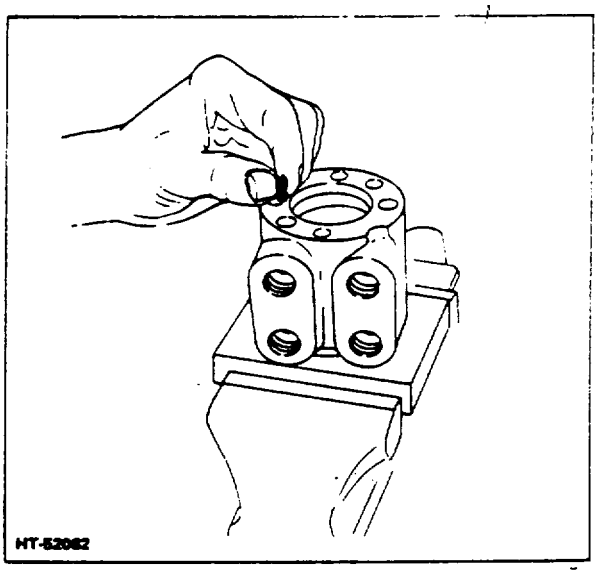


Figure 3-14. Installing Check Valve Spring

2. Install housing in vise with control end up and 14-hole end resting on a clean wooden block. Clamp lightly across the port surface and install check valve spring into check bore with large end down (Fig 3-14).
3. Install check ball into check hole and make sure it rests on top of small end of spring.
4. Place the check valve seat on hex wrench and install it in the check valve hole so the machined counterbore seats on the ball. Tighten the seat to 150 lb-in (Fig 3-15). Check ball action by pushing ball against the spring force with a small pin.

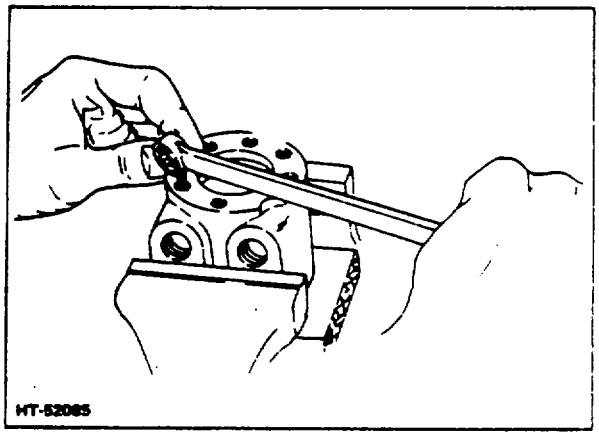


Figure 3-15. Tightening Check Valve Seat

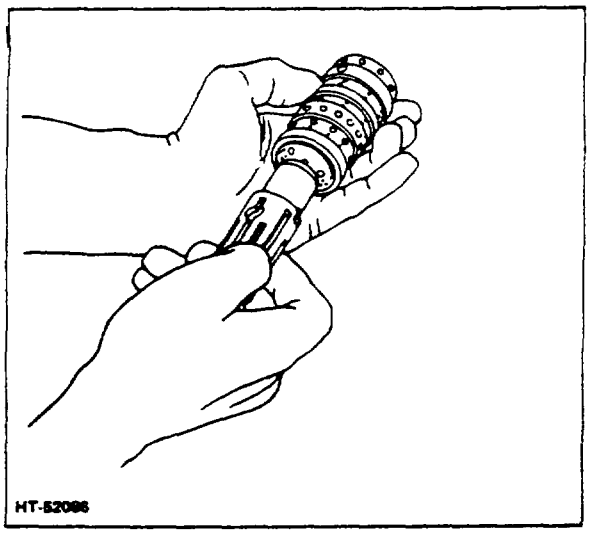


Figure 3-16. Installing Spool in Sleeve

NOTE
Ball does not have to be snug against seat to function properly.

5. Carefully install the spool within the sleeve (Fig 3-16). Be sure that spring slots of both parts are at the same end. Rotate spool carefully while sliding parts together. Test for free rotation.

⚠ CAUTION

Spool must rotate smoothly in sleeve with finger tip force applied at the splined end.

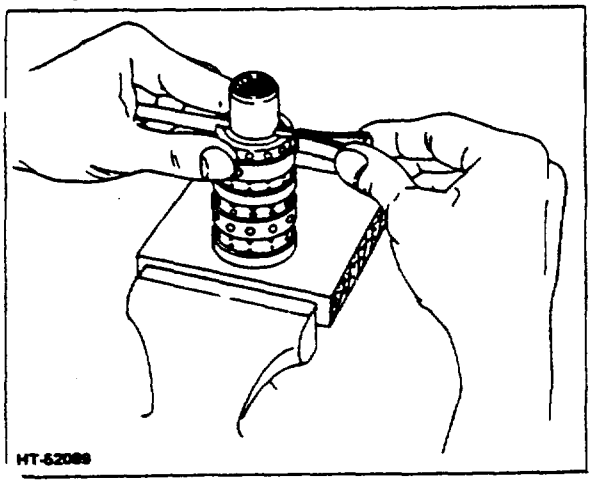


Figure 3-17. Installing Centering Spring Set

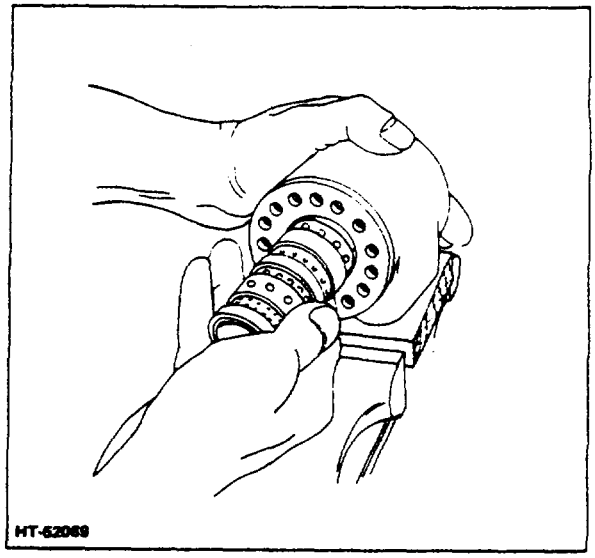


Figure 3-18. Installing Spool Assembly

6. With spring slots of the spool and sleeve in line, stand parts on end and insert spring installation tool through slots in both parts (Fig 3-17). Position 3 pairs of centering springs (or 2 sets of three each) on bench so that extended edge is down and arched center section is together. In this position, enter one end of entire spring set into spring installation tool.

NOTE
Tool is available as part number 600057 from Char-Lynn Company, 15151 Highway 5, Eden Prairie, Minnesota, 55343.

7. Compress extended end of centering spring set and push it into spool-sleeve assembly, withdrawing installation tool at the same time. Be sure the spring set is centered in the parts so they can be pushed down evenly and flush with the upper surface of the spool and sleeve.
8. Install the cross pin through the spool assembly and push into place until cross pin is flush or slightly below the sleeve diameter at both ends.
9. Place the housing on a solid surface with the port face down. Install the spool assembly with the splined end of the spool entering the 14-hole end of the housing first (Fig 3-18). Push parts gently into place with a slight rotating motion.

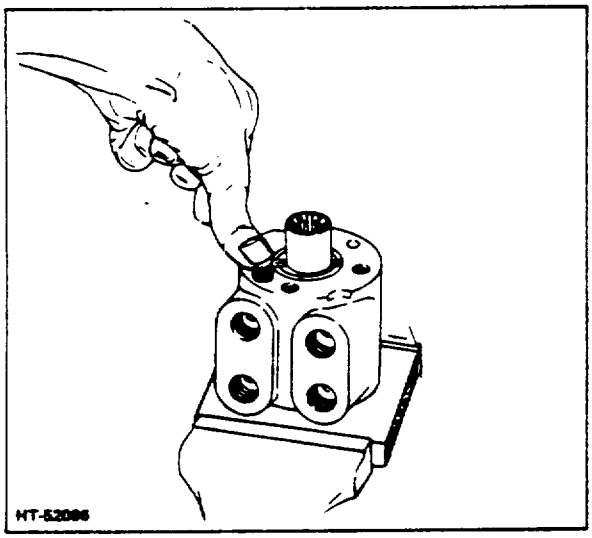


Figure 3-19. Rocking Check Plug During Installation

⚠ CAUTION

Exercise extreme care so the parts do not cock out of position while entering.

10. The spool assembly should be installed within the housing bore until it is flush with the 14-hole end of the housing. Do not install the spool assembly beyond this point, because the cross pin may drop into the discharge groove of the housing. With spool assembly in this flush position, check for free rotation within the housing by turning with light finger force at the splined end. Hold the parts in this position and place the 14 hole end of the assembly on the wooden block in the vise throat and clamp lightly across the port face with the vise.

11. Install a new O-ring on the check plug, and install the plug in the housing, (Fig 3-19). Exert a steady pressure on the plug, rocking it slightly so the O-ring feeds in smoothly without cutting.

12. Insert the cap locator bushing, large O.D. chamfer up, partially into the housing. Rotate the bushing with the fingers to seat it flatly and smoothly against the spool assembly.

13. Install new mounting plate and shaft seals. Push each seal carefully into the seal groove with the fingers. The seal groove is slightly smaller than the seal to provide adequate sealing.

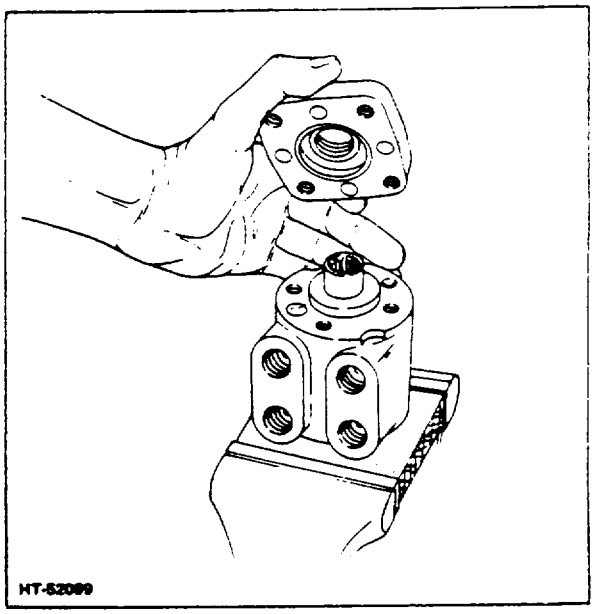


Figure 3-20. Installing Mounting Plate

NOTE

The thin oil seal at exterior of mounting plate is used only to seal out dirt and generally does not need replacement. However, if it is replaced, it must be pressed into the counterbore so that the lip is directed away from the unit.

14. Place the mounting plate subassembly over the spool shaft and slide it down

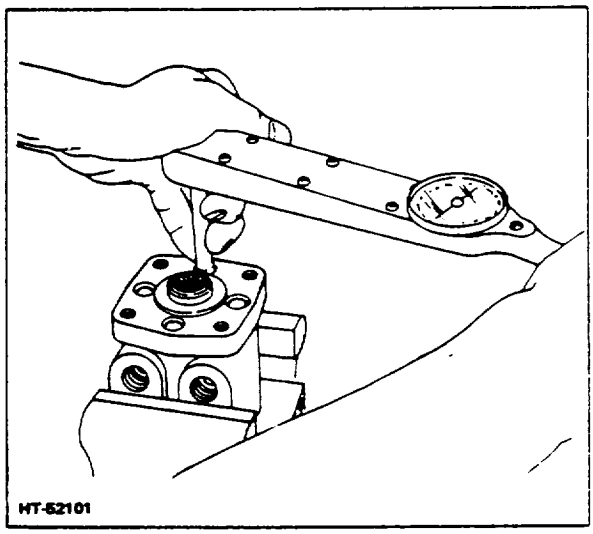


Figure 3-21. Tightening Mounting Plate Capscrews

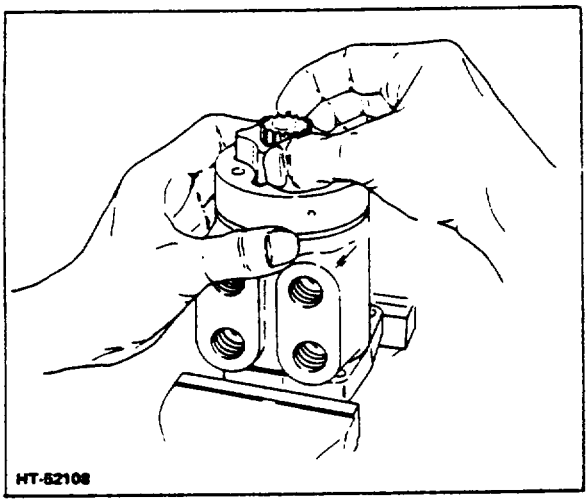


Figure 3-22. Installing Meter Gear Star

smoothly in place over the cap locator bushing so that seals will not be disrupted in assembly (Fig 3-20).

15. Align the bolt holes in the cover with the tapped holes in the housing. Be sure the mounting plate rests fairly flush against end of housing assembly so that the cap locator bushing is not cocked. Install the 4 mounting plate capscrews and torque gradually and evenly to a setting of 250 lb-in (Fig 3-21).

16. Reposition housing in vise and clamp across the edges of the mounting plate. Be sure the spool and sleeve are flush or slightly below the 14-hole surface of the housing.

17. Wipe the upper surface of the housing clean with the palm of your hand or with your thumb. Clean each part of the flat surfaces in a similar way as it is ready for assembly.

18. Install the plate over this assembly so the bolt holes in the plate are aligned with the tapped holes in the housing.

19. Place the meter gear ring on the assembly so the bolt holes are aligned.

20. Install the splined end of the drive into the meter gear star so the slot at the control end of the drive is aligned with the valleys between the meter gear teeth (Fig 3-22).

21. Push splined end of drive through the gear until spline extends about one-half its length beyond meter gear star. Hold it in this position while installing it in the unit. Note position or direction of cross pin within the unit. Install the meter gear star into the meter gear ring and slowly position the parts so the drive does not become disengaged from the meter gear star. Hold the plate and meter gear ring in position on the assembly while the star is being installed. Rotate the meter gear slightly to engage the cross slot of the drive with the cross pin and the splined end of the drive will drop down against the plate.

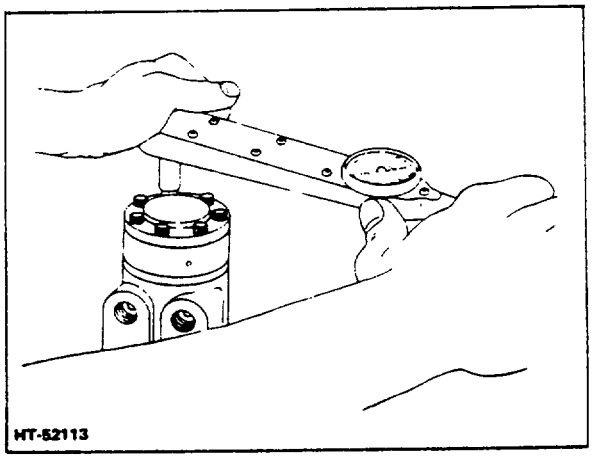


Figure 3-23. Tightening Capscrews

⚠ CAUTION

Alignment of the cross slot in the drive with the valleys between the teeth of the meter gear star determines the proper valve timing of the unit. There are 12 teeth on the spline and 6 on the star. Alignment will be right in 6 positions and wrong in 6 positions. Should the parts slip out of position during this part of the reassembly, make certain that proper alignment is obtained.

22. Place the spacer in position at the end of the meter gear star. If spacer does not fit flush with the gear surface, the drive has not properly engaged the cross pin. After drive is correctly installed, place the meter end cap over the assembly. Install 2 capscrews, finger tight, to maintain alignment of the parts.

23. Install all 7 capscrews and torque them gradually and evenly to 150 lb-in (Fig 3-23).

24. To install the steering column, rotate the shaft to engage the splines while bringing the surfaces into contact.

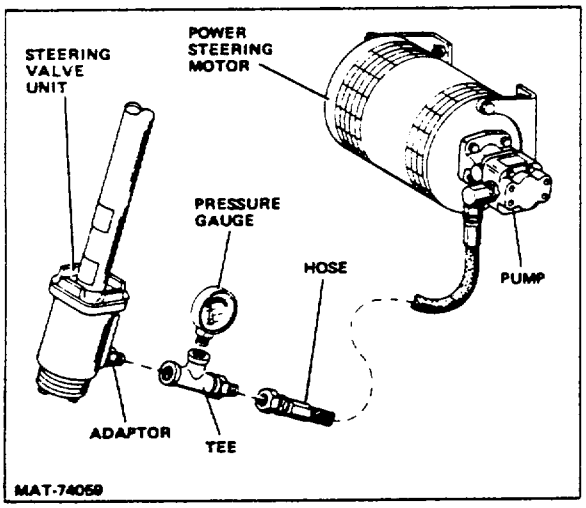


Figure 3-24. Pressure Gauge Location

25. Install the capscrews and torque to 280 lb-in.

E. INSTALLATION

1. Position steering valve unit in truck and install attaching clamps and hardware.
2. Tighten bottom mounting hardware, then check column alignment and tighten upper mounting hardware.
3. Connect horn button wire to the horn.
4. Remove plugs and connect hydraulic hoses to the steering valve.
5. Install floor and toe plates and secure with attaching hardware.

F. POWER STEERING SYSTEM PRESSURE ADJUSTMENT

For proper operation of the power steering system, the power steering pump hydraulic pressure must be set at 900 to 1100 psi. To check and adjust the pump pressure, use the following procedure.

1. Remove mounting capscrews and washers that secure the toe plate and floor plate to the frame, and remove the toe plate and floor plate to gain access to the steering valve unit.
2. Remove the pump pressure hose from the adaptor in the steering valve unit (the hose that is connected between the power steering pump and the steering valve unit).

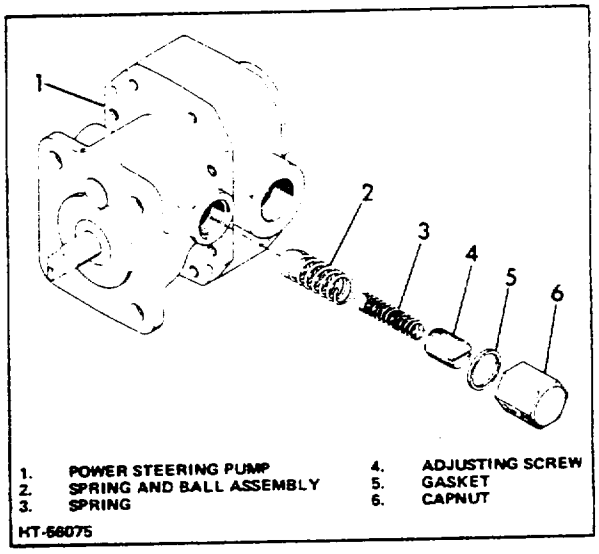


Figure 3-25. Power Steering Pump

3. Install a suitable tee fitting (Fig 3-24) between the adaptor and the end of the hose. Install a pressure gauge (0-300 psi range) in the tee.
4. Connect the battery, close seat switch by depressing seat to full down position, and turn key to ON; (turning key to ON position is not necessary for Models with 702 MK II control.) Turn steering wheel towards left or right and place a sturdy block between the spindle and steer axle so relief valve pressure can be read as spindle is forced against the block.
5. Observe the needle on the pressure gauge. If pressure of 1000 plus or minus 100 psi is not obtained, the pump relief valve must be adjusted.
6. To adjust pressure, remove cap nut (Fig 3-25) from adjusting screw in power steering pump. Turn adjusting screw IN to increase pressure or OUT to decrease it.
7. After adjustment is completed, install cap nut on adjusting screw.
8. Disconnect the battery and remove the tee fitting with pressure gauge from the adaptor and pressure hose.
9. Install pump pressure hose to adaptor securely.
10. Install toe plate and floor plate to frame with washers and mounting capscrews.

TOPIC 5. STEERING CYLINDER AND DRAG LINK TYPE II

A. REMOVAL

⚠ WARNING

Before proceeding with removal, disconnect the battery, and discharge the capacitors. Refer to Topic 2 for proper discharging procedures.

1. Attach a suitable hoist to the rear of the truck. Raise the rear of the truck until drag link and steering cylinder are accessible. Block front wheels for safety and place blocks under both sides of frame to support rear of truck.
2. Place a drain pan under cylinder ports and remove hoses from steering cylinder (Fig 5-1) Plug cylinder ports arid loses to prevent dirt from entering hydraulic system. Tag hoses for identification.
3. Loosen adjusting plug in end of drag link and remove drag link from pivot arm.
4. Disconnect drag link from steering cylinder by loosening locknut and unscrewing drag link from cylinder rod.
5. Remove cotter pin, washer, and anchor pin that secures the cylinder assembly to the cylinder anchor.

B. CYLINDER DISASSEMBLY

1. With cylinder firmly secured in bench vise hold plunger rod with proper wrench on flat spots and remove jam nuts, and

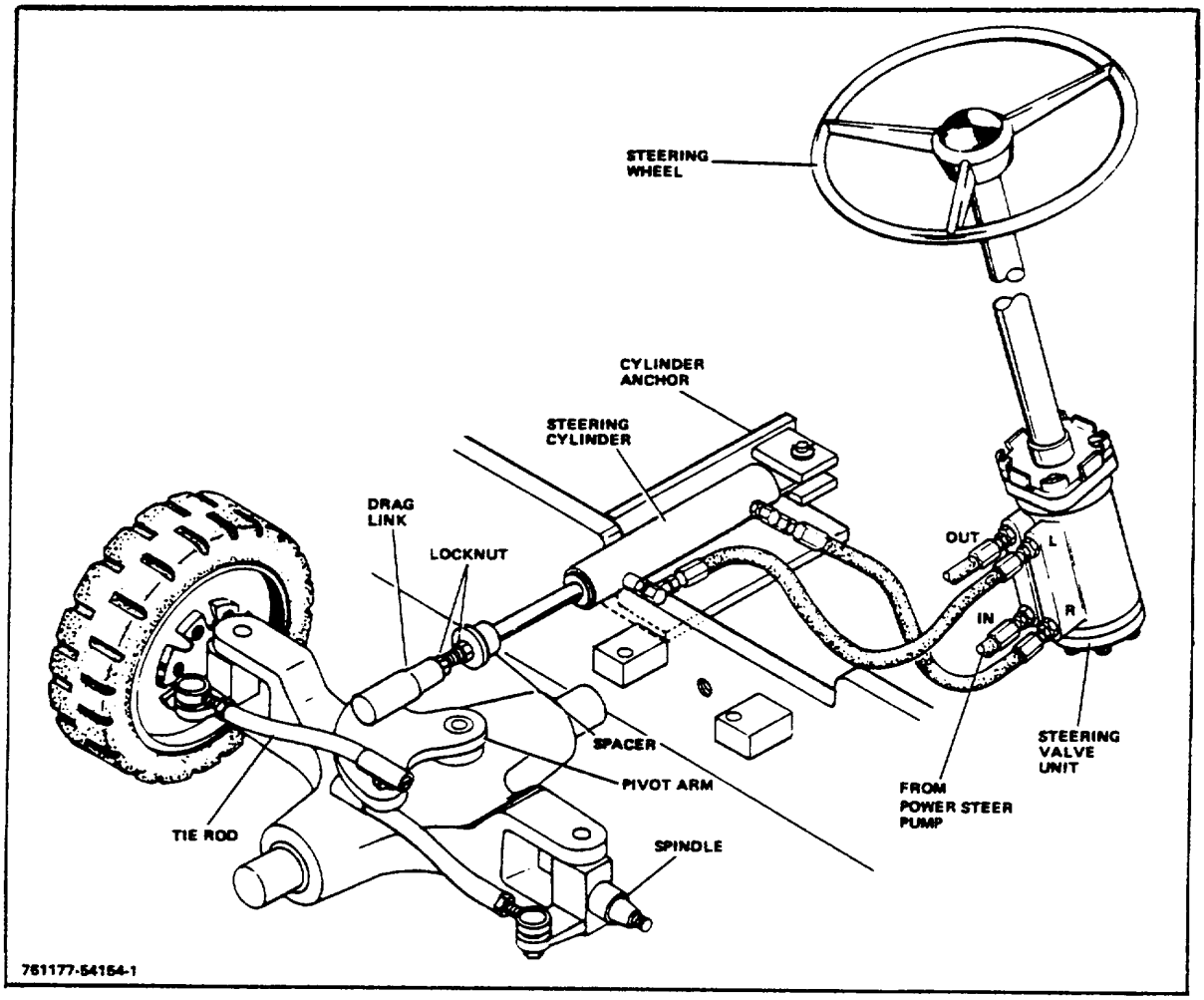


Figure 5-1. Power Steering System

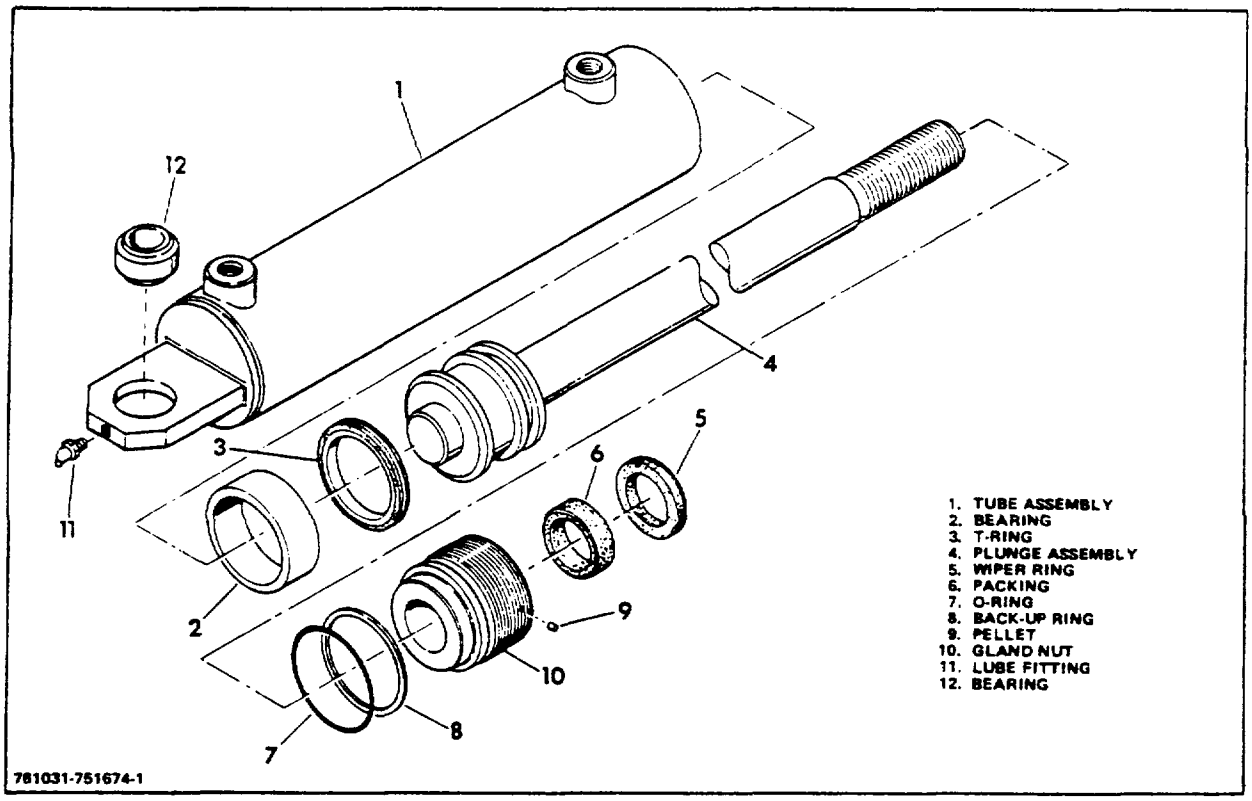


Figure 5-2. Power Steering Cylinder Components

adjusting spacer from plunger rod.

2. Remove packing gland nut and pry out packing and wiper. Also remove O-ring, back-up ring, and nylon pellets.
3. When replacing O-ring, and back-up ring, lubricate with hydraulic oil and do not overstretch when sliding over edge of packing gland.
4. When replacing plunger packing seal, remove items in Steps 1 and 2 in this paragraph, and then withdraw complete piston and plunger assembly from cylinder tube.

⚠ CAUTION

Do not attempt to remove piston from plunger rod. They do not separate.

5. Remove bearing and packing from piston.
6. Thoroughly check cylinder bore for score marks or nicks. These cause damage to piston packing cups.

C. CYLINDER REPAIR

1. When packing starts to wear, renew it, otherwise parts of the packing will contaminate the oil and work into the pump or valve, thus causing damage, or malfunction.
2. Do not disassemble the unit any more than is required to replace the faulty packing.
3. Use only approved packing. Never make substitutions.
4. Before installing, inspect for nicks, cuts or flaws. Do not install if any of these faults are present.
5. All metal surfaces on which packing slides should be very smooth. If surfaces are scored or nicked, replace the parts or resurface them.
6. Soak packing in hydraulic oil before installing.
7. Sharp tools or instruments should not be used when installing packing.

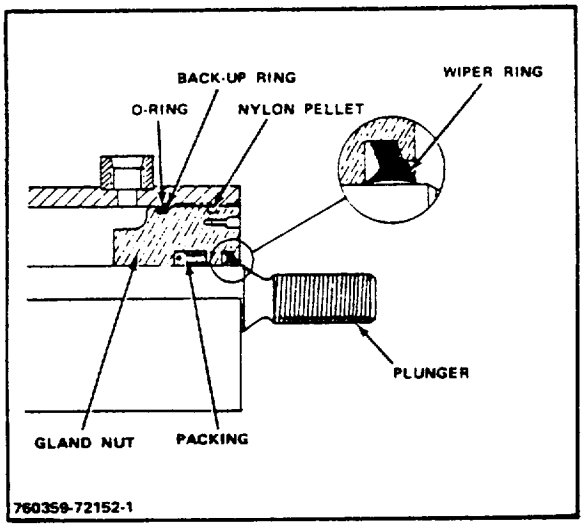


Figure 5-3. Cylinder Assembly

8. When installing seal rings do not stretch them more than absolutely necessary.
9. Fit packing evenly and snugly without using undue force.
10. When packing must be installed over threads or sharp edges, use shim stock to protect packing.
    a. O-rings should be pushed over sharp edges with care. They can be easily cut.
    b. Usually no adjustment is required upon installation; make certain that O-rings are not twisted.
    c. Check to see that the ring is of correct size to give a "squeeze" in the installed position.
11. Do everything possible to keep all hydraulic parts as clean as possible. Keep dirt and fine metal particles from packing and plungers. Such material can quickly damage packing and score plungers.
12. Inspect bushing and lube fitting in anchor pivot assembly. Replace any damaged or worn parts.

D. CYLINDER REASSEMBLY

Reverse disassembly procedure when installing new parts.

1. Install new packing and bearing on piston.

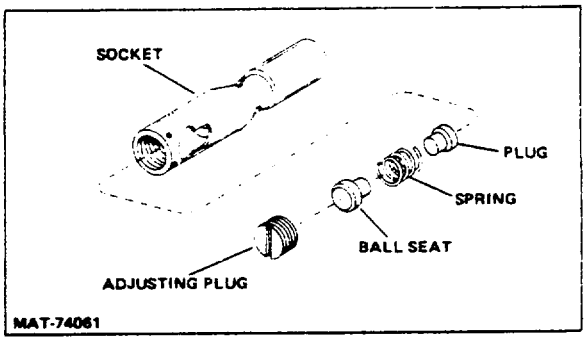


Figure 5-4. Drag Link Components

2. Install piston and plunger assembly in cylinder tube.
3. Install new nylon pellets, O-ring, backup ring, packing and wiper on packing gland nut.
4. Install packing gland nut on plunger assembly and cylinder tube. Gland nut must be flush with outer edge of cylinder tube.
5. Install adjusting spacer and jam nuts on plunger rod.

E. DRAG LINK DISASSEMBLY

1. Remove adjusting plug, safety plug, ball seats and spring from drag link tube (Fig 5-4).
2. Clean all parts in a suitable solvent.

   Be certain all dirt and contaminants are removed.
3. Inspect all parts for cracks, nicks or other damage. Replace any parts that are worn or damaged.

F. DRAG LINK REASSEMBLY

Install one ball seat then the spring and the second ball seat followed by the safety plug and adjusting plug in the end of the drag link tube.

G. INSTALLATION

1. Place steering cylinder into position on truck and secure to mounting anchor with anchor pin, washer, and cotter pin. Cylinder should pivot freely in anchor.
2. First make certain locknut is on cylinder rod and connect drag link to steering cylinder by screwing drag link onto cylinder rod.

3. Connect drag link to pivot arm, screw in adjusting plug, and secure with cotter pin.
4. Remove plugs and connect hoses to power steering cylinder.
5. Make sure hoist is securely attached to truck, raise truck, remove blocks, and lower truck to floor.

TOPIC 6. TIE RODS

A. REMOVAL

1. Remove cotter pins, adjusting plugs, ball seats, and springs from the tie rods, and separate the tie rods from the pivot arm.
2. Remove cotter pin and nut from ball socket, and remove the tie rods from the spindles. Loosen the nut on the ball socket, and remove the ball socket and nut from the tie rod tubes.

B. CLEANING AND INSPECTION

1. Clean all parts with mineral spirits or other suitable solvent, and dry with compressed air.
2. Inspect all parts for cracks, breaks, bends, other damage, and wear. Repair or replace parts as indicated by their condition.
3. Lubricate all parts except the ball sockets with an SAE 10 or 20 oil. Pack the tie rod ball sockets with high quality chassis lube.

C. INSTALLATION

Assemble the nut, ball socket, cup, seats, spring, and plug to tie rods. Position the tie rods on the pivot arm and tighten plug until seats firmly grasp ball stud on the pivot arm. Install ball socket on spindle and secure with nut and cotter pin.

D. TIE ROD ADJUSTMENT

Set the steer wheels straight ahead, parallel with the frame. If wheels are not parallel, adjust the tie rods to obtain this position. Zero degrees (0°) toe-in must be maintained at all times. To adjust tie rod, remove cotter pin and retaining nut that secure tie rod ball socket to steer wheel spindle. Remove ball socket from spindle and loosen nut that secures ball socket to tie rod. With the steer wheel parallel to the frame, turn ball socket IN or OUT until proper adjustment is obtained. Position ball socket in steer wheel spindle, install retaining nut securely, and install cotter pin; then tighten ball socket nut securely.

TOPIC 7. STEER WHEELS

A. REMOVAL AND DISASSEMBLY

⚠ WARNING

Make certain the battery is disconnected and the key switch is in the OFF position. Discharge the capacitors. Refer to Topic 2 for proper discharging procedures.

1. Attach a suitable hoist of adequate capacity to the rear of the vehicle and raise it sufficiently so the steer wheels clear the floor. Carefully place sturdy wooden blocks under both sides of the frame. Lower vehicle enough to take stress off the hoist and so the steer wheels clear the floor and the wooden blocks.
2. Remove the capscrews and lockwashers that secure the hub cap to the wheel and remove the hub cap (Fig 7-1).
3. Remove the cotter pin, retaining nut, washer, and outer bearing cone from the spindle.
4. Carefully remove steer wheel and inner bearing cone from spindle.
5. If needed, remove bearing cups from wheel by driving them out with a soft punch.

⚠ CAUTION

Use care when removing bearing cups to prevent damage to the bearing surface.

B. CLEANING AND INSPECTION

1. Wash bearing cones and cups thoroughly with solvent to remove grease. Tap the bearing cones against a block of wood to remove deposits, and rewash with solvent. Repeat cleaning process until all old grease and deposits are removed.
2. Wipe the spindle and wheel hub with a soft cloth soaked in solvent and dry

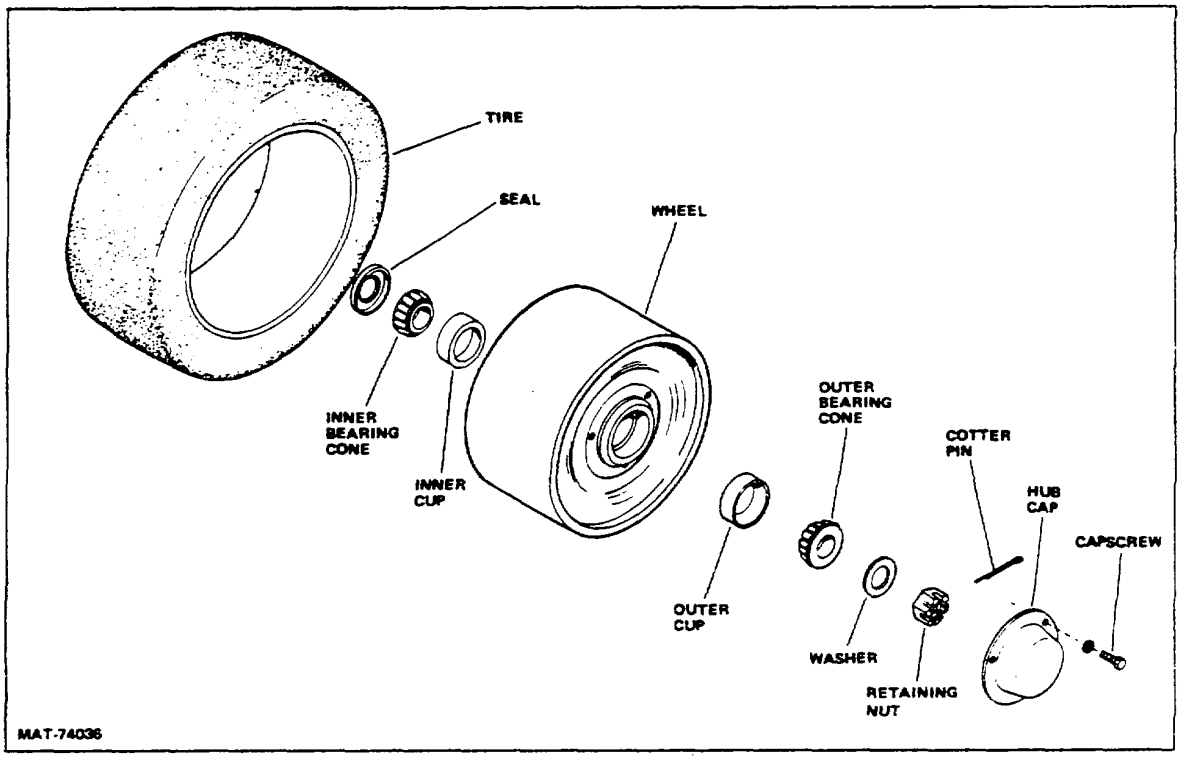


Figure 7-1. Steer Wheel Assembly

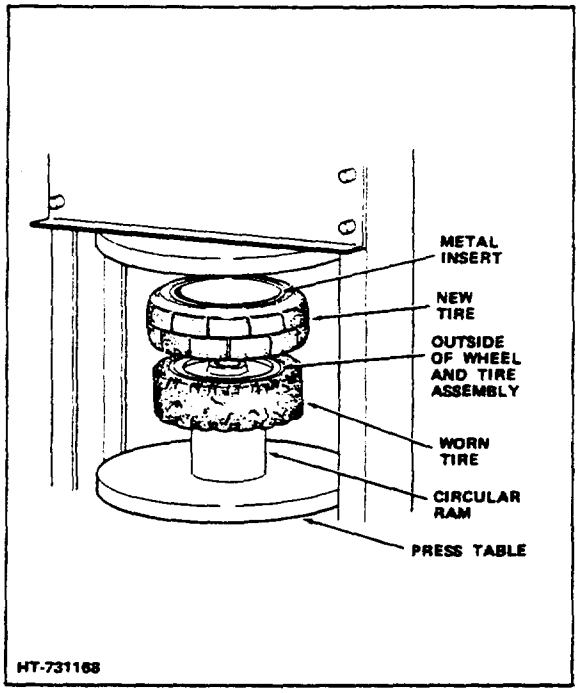


Figure 7-2. Cushion Tire Replacement

with compressed air.

3. Inspect the bearing cones, bearing cups and spindles, for nicks, scratches, scoring and wear. Replace damaged or worn parts.

C. REASSEMBLY AND INSTALLATION

1. If removed, position the bearing cups in the wheel, and press or drive the cups into their bores. Cups must be square with the bores, and fully seated at installation.
2. Lubricate the inner wheel bearing cone with specified grease. Use an applicator designed to force lubricant into the bearing rollers.
3. Position inner bearing cone on the spindle. Lubricate the bearing cups in the wheel and carefully install the wheel on the spindle.
4. Lubricate the outer bearing cone with the specified lubricant, using an applicator. Install the bearing cone on the spindle.
5. Install washer and retaining nut on spindle. While rotating steer wheel, tighten retaining nut to a torque of 50 lb-ft; then back off nut until loose (O lb-ft). Rotate wheel alternately in each direction while tightening retaining nut until a torque of 25 lb-ft is obtained. Then back off nut 30° min to 60° max and install cotter pin.
6. Install hub cap and secure with capscrews and lockwashers, tightening capscrews securely.
7. Raise vehicle slightly with the hoist and remove the wooden blocks from under the frame. Then lower vehicle so steer wheels rest on the floor. Remove hoist from rear of vehicle.

D. CUSHION TIRE REPLACEMENT

The wheels used on all cushion tire lift trucks ire machined from castings. Any misalignment of the tire and wheel, while the tire is being pressed onto the wheel, can cause possible damage to the wheel. Because of this, a chamfer has been provided on the outside edge of the wheel and on the end of the inside diameter of the tire's metal insert. The chamfers help center the wheel and tire during the pressing operation and reduce the possibility of misalignment.

⚠ CAUTION

To prevent damage to the wheel, the tire must be installed with the chamfered side of the wheel up.

To replace cushion tire, perform the following:

1. Remove wheel and tire assembly from lift truck.
2. Check inside diameter of metal insert of new tire. Remove any scale or rust with sandpaper. Clean inside of metal insert and lubricate it with bearing grease.
3. Place a circular ram (Fig 7-2) on the press table. The length of the ram must be longer than the width of the old tire that is to be removed to allow complete removal of old tire. The outside diameter of the ram must be small enough to fit loosely in the insert of the tire, but must be large enough to rest squarely on the flat surface at the outer edge of the wheel.
4. If the outside edge of the wheel is not flush with the edge of the metal insert in the old tire, measure how far wheel is recessed inside the tire. New tire must be replaced at the same position

that worn tire is installed on the wheel. A spacer, slightly smaller in diameter than the inside diameter of the tire insert and the same thickness as the depth of recess, can be used to obtain the proper amount of recess.

5. Position wheel assembly with worn tire on top of circular ram so outside of wheel is positioned upward. The outside edge of the wheel has a chamfer to help guide the new tire onto the wheel. The chamfered end must always be the leading edge of the wheel whenever a tire is pressed onto a wheel.

6. Center the wheel assembly on top of the ram and make certain they mate-up squarely.

7. Position new tire on top of wheel and tire assembly. Align new tire and wheel so the two are concentric with each other.

8. Start pressing new tire onto wheel and worn tire off the wheel. Run press slowly for the first couple of inches of travel because this is the critical stage of the pressing operation. If tire begins to cock, stop press immediately and realign tire. A sharp jar with a soft headed mallet will usually realign tire on wheel. If wheel is to be recessed in tire, stop press after tire has been started on wheel. Position spacer (mentioned previously) inside the new tire so it rests squarely on the outer edge of wheel. Continue pressing operation until tire is correctly positioned on the wheel.

9. Release press; remove wheel and tire assembly and worn tire from press table. Wipe off grease and inspect wheel and tire assembly.

10. Install wheel and tire assembly on lift truck.

TOPIC 8. TROUBLESHOOTING CHART

STEERING VALVE UNIT TROUBLESHOOTING

Steering wheel does not center	Binding in linkage valve	Re-align
	Broken centering springs	Replace spring
No response when steering wheel is turned slowly	Dirt in system	Drain, flush, and refill reservoir with clean specified oil and replace filter element
	Oil level is low	Fill to proper level
Slow or hard steering	Dirt in system	Drain, flush, and refill reservoir with clean specified oil and replace filter element
	Wear on sleeve and spool	Replace
	Wear on orbit gear	Replace
	Oil level low	Fill to proper level
	Trouble in pump	Check and correct
	Trouble in actuator	Check and correct
	Trouble in lines	Check and correct
Wrong response to steering wheel	Lines connected to wrong ports	Reconnect
	Orbit gear misaligned	Re-align
Continuous steering wheel rotation	Dirty oil	Drain, flush, and refill reservoir with clean specified oil and replace filter element
	Broken centering springs	Replace spring
	Input linkage is binding	Re-align
	Burr on sleeve or spool	Repair

No response	Sleeve and spool locked	Disassemble: repair or replace
	Pump failure	Check and correct
	Hose clogged	Check and correct

TOPIC 1. DESCRIPTION

A. GENERAL

The hydraulic system (Fig 1-1) provides the means by which the lift, tilt, and accessory operations are controlled. Included in the system is a motor driven, gear type pump that supplies hydraulic oil to the control valve. From the control valve, the flow of hydraulic oil under pressure is directed to the appropriate cylinders. Contamination is removed from the hydraulic oil by a filter located in the return line to the reservoir. The reservoir provides an adequate supply of hydraulic oil to the pump plus an ample reserve. Suction ports at the bottom of the reservoir gravity-feed oil to the hydraulic pump and, on models with power steering, to the power steering pump.

B. GENERAL MAINTENANCE

It is essential that personnel responsible for the care of the unit adhere to the following general maintenance recommendations:

1. Store and handle hydraulic oil with utmost care to prevent moisture and foreign matter from entering the hydraulic system. All hydraulic oil handling equipment, such as a container, funnel, and hand pump, should be kept clean at all times and covered when not in use.
2. Keep all fittings and connections tight to eliminate oil leaks. However, do not tighten any brass fittings excessively because damage or distortion will result.
3. Before a component is removed from the hydraulic system, be sure to wash the component and its surrounding area with cleaning solvent to prevent entrance of foreign matter into the system. Cover all openings immediately.
4. Whenever a fitting with a pipe thread is removed, use a sealing compound on the outside of the threads before the fitting is installed. Make certain all parts are thoroughly cleaned before installation. Do not put sealant on first two threads of fitting, it may contaminate the system.
5. When a hose assembly is installed, make certain it is not twisted when the fittings are tightened. Always use two

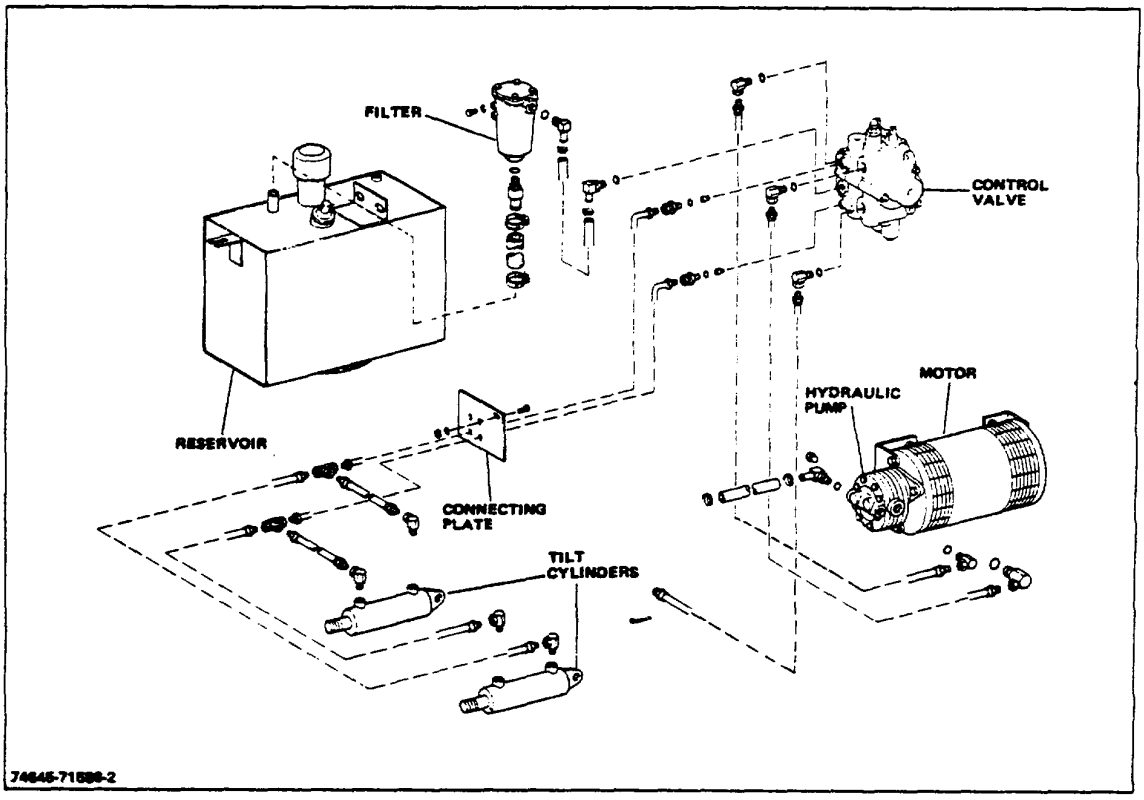


Figure 1-1. Hydraulic System

wrenches on a swivel type fitting, one to hold the hose and the other to tighten the fitting.

6. Keep hose clamps tight to prevent hose chafing and leakage.
7. All hydraulic system oil leaks should be corrected as soon as leakage becomes evident.
8. Periodically check the pump and control valve mounting hardware for tightness.
9. Replace filter element and reservoir breather, and clean hydraulic oil reservoir at the recommended service intervals.

⚠ CAUTION

Keep the hydraulic system clean. A dirty hydraulic system is a major cause of hydraulic pump, control valve, and packing wear or failure. Contaminated hydraulic oil is the major cause of hydraulic system failures. It is therefore advised that ANY oil that is added or replaced be final filtered through a 10 micron filter, or finer, before entering the hydraulic system.

C. HYDRAULIC PUMP

The hydraulic pump is a tandem type dual gear unit driven by the series wound motor. The pump has a common suction port and two discharge ports (primary and secondary). The internal parts of the pump are machined to a high degree of accuracy and the tolerances are very close. If a pump is in need of repair which requires complete disassembly, it is recommended the pump be sent to your local Allis-Chalmers lift truck dealer for repair. Include your purchase order and full information regarding the nature of the breakdown.

In some cases where a pump is inoperative, it may be possible to repair it in the field. Satisfactory repair can be accomplished, provided a clean, well equipped repair shop manned by a competent mechanic is available.

D. CONTROL VALVE

The basic control valve (Fig 1-2) is a two plunger valve with an inlet section, outlet section, and two plunger sections. The basic valve controls the lift and tilt operations. Each section may be replaced separately and all parts of a section may be replaced individually with the exception of the plunger housing and plunger. These must be replaced as a unit.

If the control valve becomes inoperative, satisfactory repair can be accomplished by a competent mechanic. However, it is recommended the valve be sent to your - local

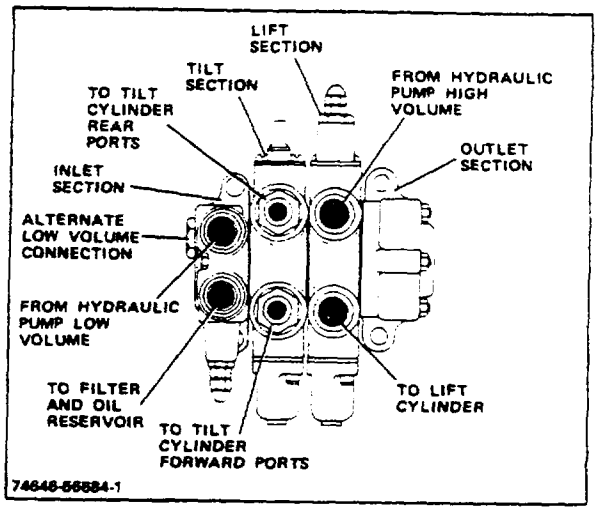


Figure 1-2. Control Valve Connections

Allis-Chalmers lift truck dealer for repair. Include your purchase order and full information regarding the nature of the breakdown.

As previously stated, the primary and secondary sections of the pump supply hydraulic oil to the control valve. Because both the primary and secondary sections of the pump are driven at the same speed and deliver hydraulic oil in different quantities and at different pressures, two adjustable relief valves are incorporated in the control valve. The relief valve in the lift section protects the lift circuit from excessive pressure; whereas, the relief valve in the inlet section protects the tilt and accessory circuits. To check inlet pressures, refer to following Topic 6, CONTROL VALVE.

The control valve requires very little attention with the exception of keeping the lines, fittings, hose connections and mounting hardware tight. Also after every 500 hours of operation, check the control valve linkage and the operation of the microswitches. Make certain that definite pressure is applied to the control valve levers and a slight motion of each lever occurs before the pump operates. The pump motor should start operating and there should be no movement of the lift or tilt cylinder. Further movement backward or forward of the control levers will then allow oil to flow to the appropriate cylinders and cylinder movement will occur.

E. TILT CYLINDERS

The tilt cylinders are used to tilt the mast forward or backward. The tilt cylinders, when activated by the tilt control lever. receive oil in either the forward or rear ports. For example, the hydraulic oil enters the forward ports pushing the plunger backwards. At the same time hydraulic oil is pushed out the rear ports by the plunger piston and returned

to the hydraulic system through the control valve.

After each 50 hours of operation, check the tilt cylinder hoses and fittings for leaks; correct if necessary. Check tilt cylinder mountings and make certain the yoke is tight on the plunger so the plunger does not rotate in the cylinder. Check the stroke of both plungers in relationship to the distance between the front of lift truck and the mast. This distance, or amount of mast travel, must be equal on each side, otherwise damage to the tilt cylinders, frame, or mast could result. If the distance is not equal, adjust the position of the yoke on the plunger until it is equal. Also, lubricate yoke pins by lubricating the pressure gun fittings on the mast with specified grease.

F. FILTER

A hydraulic filter is placed in the return line to the reservoir to provide filtration of the hydraulic system. Depending upon the model of the lift truck, the filter is placed either in the return line from the control valve or the return line from the power steering valve unit. The filter has a replaceable element which is to be replaced at every 200 hour interval or more often if operating conditions warrant it. If the filter becomes clogged, a bypass valve will open to permit hydraulic oil to return to the reservoir.

G. HYDRAULIC HOSE

Flexible hose is used throughout the hydraulic system, mainly to absorb vibration and shock and for ease of installation. The inside diameter of the hydraulic hose is determined by the volume of oil it will be required to carry.

Unless there is obvious damage, hydraulic oil lines need practically no service. Periodic checks for leaks at the fittings, chafing, or deterioration of the outer cover will assure continued reliable service. Replace hydraulic hose with the same original equipment part number or an equivalent.

H. RESERVOIR

The hydraulic reservoir is located on the right side of the operator's compartment below the floor and toe plates. An accessible dipstick allows for a quick check of the reservoir hydraulic oil level. The reservoir level must be maintained at the FULL mark to avoid entry of air into the hydraulic system.

A breather is installed on the top of the reservoir. Air enters or exits through the breather to compensate for changes of the oil level in the reservoir during operation of the hydraulic system. The breather is either the spin-on type or the serviceable type. In either case it should be maintained at the same schedule as the hydraulic system oil filter.

TOPIC 3. HYDRAULIC PUMP - TYPE II

A. REMOVAL

⚠ WARNING

Disconnect the battery and discharge the capacitors before the removal is performed. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control or 703 control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

1. Remove attaching hardware from toe and floor plates and remove plates from truck.
2. Remove drain plug or fitting from the hydraulic oil reservoir and drain the hydraulic oil.

⚠ CAUTION

The hydraulic pump should only be used for pumping oil through the hydraulic system.

3. Remove, tag for identification, and plug hydraulic lines from pump.
4. Remove attaching hardware and separate pump from pump motor by pulling pump shaft out of armature shaft (Fig 3-1).

B. DISASSEMBLY

1. Clean outside of pump with a suitable cleaning solvent. Secure pump in a vice.
2. Scribe mark across back plate, body and dowel assembly, and frontplate to assure proper reassembly (Fig 3-2). If the back plate and body are rotated 1800, the pumping operation will be reversed.
3. Cover drive gear shaft splines with tape to protect splines and oil seal during disassembly.
4. Remove capscrews from back plate and port adaptor. Remove port adaptor and gasket from body. Separate back plate from slip-fit gear body.
5. Remove pump from vise and turn pump shaft end up. Shake pump to remove slip-fit gears from body.
6. Remove key from drive gear shaft.

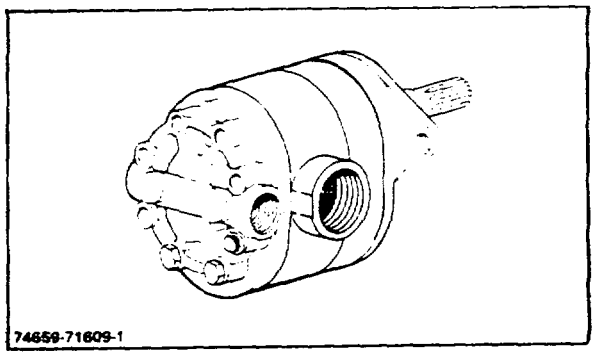


Figure 3-1. Hydraulic Pump - Type I! (ACE 20 thru 80) (FE 20-25-30) (FET 25-30)

7. With a rubber mallet tap splined end of drive gear shaft to separate front plate from body. Remove drive gear and idler shaft from front plate.
8. Lift diaphragm, back-up gasket, gasket protector, and diaphragm seal from front plate and adaptor body assembly. Remove steel balls and springs from front plate.
9. With a drift pin, remove dowel pins that secure body and body adaptor.
10. Separate body and adaptor.

C. INSPECTION

Clean all parts in a suitable solvent and thoroughly dry with compressed air. Remove any nicks or burrs from parts with emery cloth.

Inspect drive gear shaft for broken keyway or damaged splines. The drive gear shaft and idler gear shaft must be inspected in bearing and seal areas for rough surfaces and excessive wear. If shaft measure less than .6850" in bearing area, the gear assembly must be replaced. (One gear assembly may be replaced separately. Shafts and gears are available as assemblies only.)

Inspect the drive, idler and slip fit gear faces for scoring and excessive wear. Replace if necessary.

Measure the inside diameter (I.D.) of the bearings in the front plate or adaptor plate. The front plate or body adaptor will require replacement if the I.D. of the bearings exceeds .691".

The gear pockets in the gear bodies must be

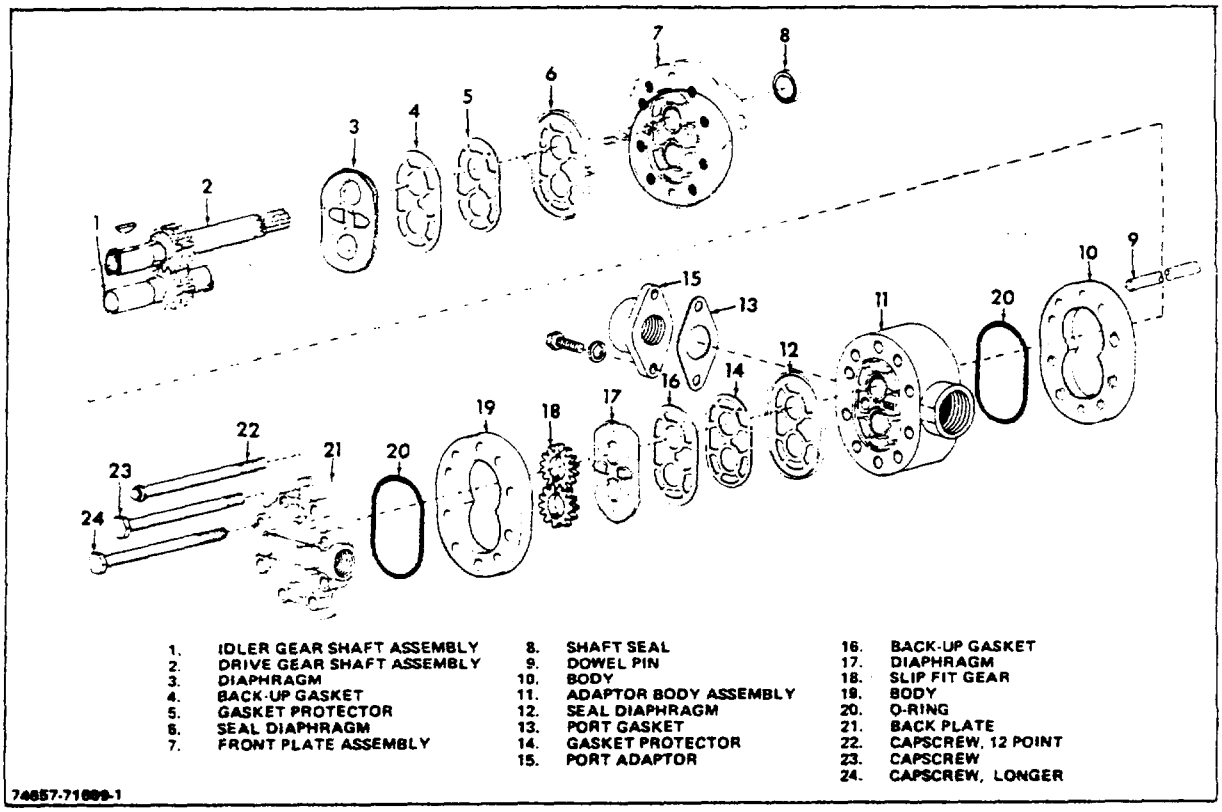


Figure 3-2. Type II Hydraulic Pump (Exploded View)
(ACE 20 thru 80) (FE 20-25-30) (FET 25-30)

checked for excessive scoring or wear. The bodies should be replaced if the inside diameter of the gear pocket exceeds 1.719".

D. REASSEMBLY

Before reassembling pump clean each part in cleaning solvent. Thoroughly dry with compressed air and coat each part with clean hydraulic oil. All seals, gaskets and diaphragms should be replaced with new parts. Be careful to keep parts clear during reassembly.

1. Tuck diaphragm seal into grooves in front plate with open part of "V" section down (Fig 3-2).
2. Press gasket protector, back-up gasket into diaphragm seal. Drop steel balls into seats in front plate and position springs over balls.
3. Place diaphragm on top of back-up gasket, bronze face up.
4. Repeat preceding steps 1, 2 and 3 for installing diaphragm seal, gasket protector, back-up gasket and diaphragm in body adaptor. The steel balls and springs are not used in the body adaptor. The intake hole in the diaphragm must be aligned over the intake hole in the face of the body adaptor.
5. The entire diaphragm must fit inside the raised rim of the diaphragm.
6. Slide gear assemblies through front plate bearings.
7. Apply a thin coat of heavy grease to both milled faces of body. Slip body over gears onto front plate. Half moon port cavities in body must face away from the front plate. The small drilled hole in one of the cavities must be on the pressure side of the pump.
8. Slide body adaptor over gear shaft, tap into place with rubber hammer. Install key on drive shaft and slide slip fit gears onto shafts.
9. Coat both milled surfaces of slip fit gear body with a thin coat of heavy grease. Slide body over gears onto body adaptor. Half moon cavities in body must face away from body adaptor. Small drilled hole in one of the cavities must be on pressure side of pump.
10. Position back plate onto slip fit gear body. Secure pump sections together with

capscrews. Tighten to torque of 25 lb-ft.

NOTE

The two 12 point capscrews are installed on each side of the pressure port. The two longer hex head capscrews are installed directly opposite the 12 point capscrews. The two longer hex head capscrews are installed in the remaining positions in the back plate.

11. Position port gasket and port adaptor to pump housing with lockwashers and capscrews. Tighten capscrews to a torque of 10 to 12 lb-ft.
12. Tape drive gear shaft splines and work shaft seal over shaft into position in back plate. Oil seal liberally when installing. Take care not to damage oil seal rubber lip.
13. Rotate pump shaft by hand or with pliers. Pump will have a small amount of drag. but should turn freely after short period of use.

E. INSTALLATION

1. Lubricate the pump shaft splines lightly with clean grease. Insert the Dump shaft into the armature shaft, place the pump in position, and secure it to the pump motor with attaching hardware.
2. Remove the plugs and connect the hydraulic lines to the proper ports in the pump.
3. Replace filter element or cartridge and reservoir breather.
4. Install drain plug or fittings in hydraulic oil reservoir.
5. Fill reservoir with pre-filtered specified hydraulic oil. Never reuse old oil if repair or replacement of pump was necessary.
6. Before checking operation of hydraulic system, back off pressure relief adjustments on control valve, then operate pump and adjust relief valves to obtain specified pressures. (Refer to following Topic 6 for adjustment procedure.)
7. Operate hydraulic system and check for leaks.
8. Install floor and toe plates with attaching hardware.

TOPIC 5. POWER STEERING PUMP

A. PUMP AND MOTOR REMOVAL

⚠ WARNING

Disconnect the battery and discharge the capacitors before the removal is performed. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control or 703 control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

The power steering pump and motor for ACE 2025-30 and ACE 35 thru 55 are located under the battery deck and above the steer axle. The motor is secured to the battery deck with nuts and capscrews.

1. Remove battery from trucks that require access to the battery deck (ACE 20-25-30 and ACE 35 thru 55).
2. If necessary, use a suitable hoist to raise truck enough to gain access to motor; block in position and chock wheels.
3. Disconnect and tag cables from motor.
4. Disconnect and tag hydraulic lines from pump. Plug lines and pump ports to prevent entry of dirt.
5. Remove capscrews that secure pump and motor unit to frame. Remove pump and motor from truck.
6. Remove capscrews that secure pump to motor and remove power steering pump.

B. DISASSEMBLY

1. Place pump in bench vise and remove capscrews holding gear housing and stator together (Fig 5-1).
2. Separate stator from gear housing.

NOTE

It may be necessary to break the housing loose by tapping it gently with a soft headed hammer.

3. Before the drive shaft can be removed, the snap rings, drive gear and key must be removed from shaft.
4. The drive shaft can now be removed by pulling shaft through the gear housing.
5. Pull idler shaft assembly from gear housing. Remove the snap rings, gear and pin.
6. Remove relief valve cap nut, copper gasket, adjusting screw and spring and ball assembly.

NOTE

Record number of turns required to remove adjusting screw.

7. Use a puller and remove oil seal from stator. Be careful so as not to damage seal bore in stator.
8. Needle bearings seldom require replacement; however, inspect bearings for possible damage. If replacement is required, use a puller and remove needle bearings from housing and/or stator.

C. INSPECTION

Clean all parts, except oil seal, in a suitable cleaning solvent and blow dry with compressed air. Use caution in cleaning so as not to score or damage any parts of the pump, especially the surfaces of the gear pockets, gears, and drive shaft where it makes contact with the oil seal. Gears with scored surfaces or galled teeth must be replaced. If stator or gear housing shows evidence of wear or scoring in the gear pockets, or damage to the sealing surfaces, replace with a new pump.

Inspect idler shaft and drive shaft for wear in the area where contact is made with the bearings and oil seal. Inspect idler shaft pin and drive shaft key for damage.

Inspect relief valve components. Make certain the ball seats properly in the stator and springs are not bent or damaged. Check adjusting screw, gasket, and cap nut for damage. Check pump coupling for wear or damage.

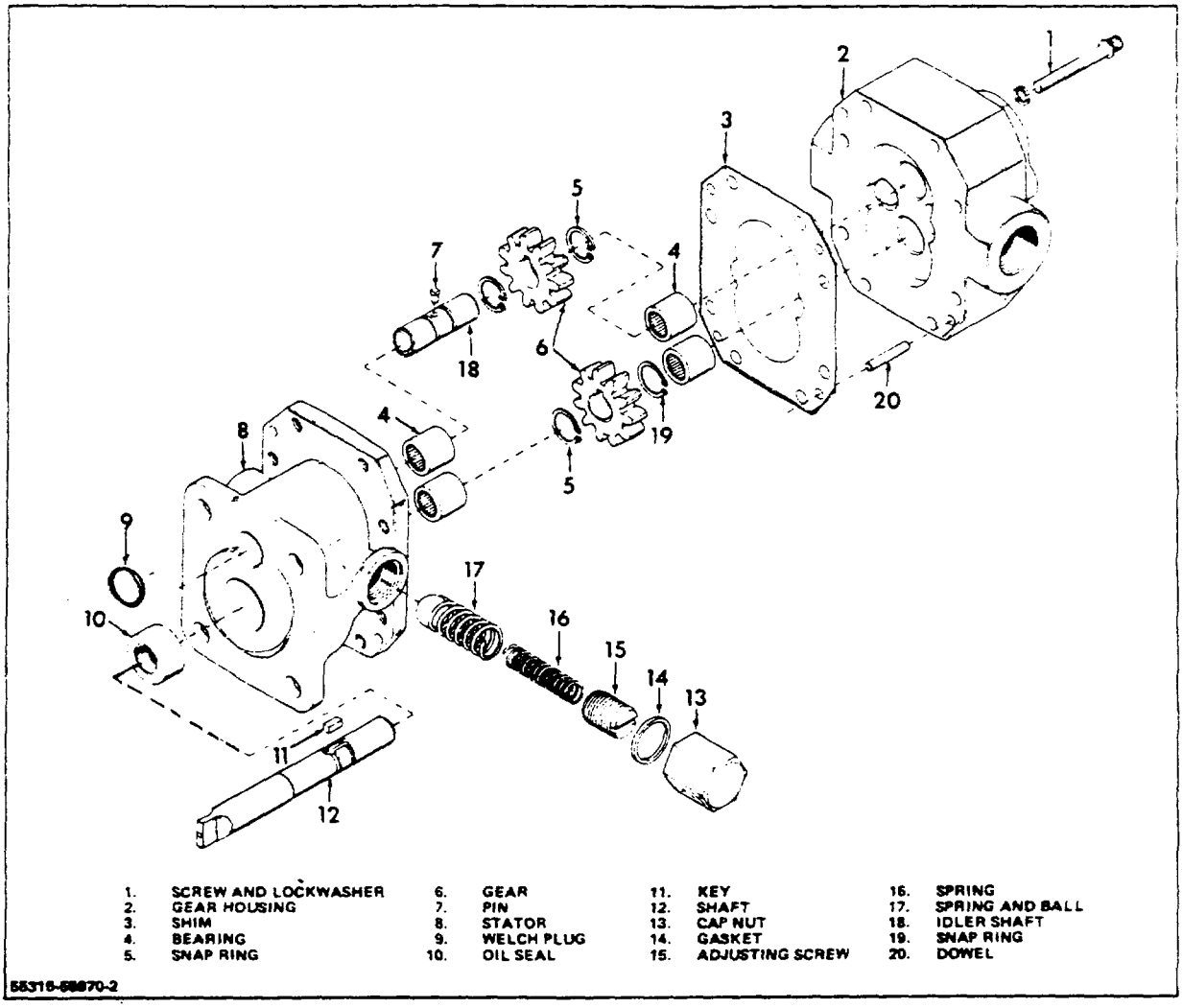


Figure 5-1. Power Steering Pump

Replace all defective or damaged parts.

D. REASSEMBLY

Make certain all parts are clean and coat each part with hydraulic oil prior to reassembly.

NOTE

Make certain tools and work area are clean. Dirt can seriously damage hydraulic components.

1. Carefully install new oil seal in stator (Fig 5-1).
2. If needle bearings were removed, install new ones in housing and/or stator.

⚠ CAUTION

A needle bearing should be installed with an arbor, either hand or power operated. Always apply pressure against the end which has the bearing type number stamped on it. Do not tap or pound directly on needle bearing shell end lips, otherwise damage will result which will lock the needles against movement.

NOTE

If the welch plug was removed, place a pliable lead seal around the OD of the welch plug before it is installed.

3. Lubricate drive shaft generously with oil or grease and very carefully insert shaft through the oil seal in gear housing. Exercise extreme care so as not to damage sealing lip of oil seal.

   Install one snap ring and key on drive shaft. Position gear on shaft. Secure gear in position with second snap ring.

4. Pre-assemble idler shaft assembly before installing in gear housing. Position pin in idler shaft and install one snap ring.

   Slide idler gear into position on idler shaft and secure with second snap ring.

5. Position idler shaft assembly into gear housing and mesh idler shaft gear with drive shaft gear.

6. Measure running clearance between gears and gear housing. Running clearance should be within .0008" to .0013". Select the proper thickness of shims to give the correct gear to housing clearance. Shims are available in .00025" .0005", .003", .002", and .001" thicknesses.

7. Position shim(s) on gear housing mating surface and install stator.

8. Secure stator to gear housing with capscrews. Torque capscrews to 108 to 130 lb-in. Check to make certain pump shaft turns easily.

9. Place ball and spring assembly in relief valve port. Turn adjusting screw in the same number of turns required to remove it. Install gasket and cap nut to adjusting screw.

E. INSTALLATION

1. Apply grease to coupling and install coupling and power steering pump to pump motor.

2. Place pump motor into position under the vehicle. Secure mounting brackets to vehicle frame with attaching hardware.

3. Refer to identification on the tags, remove plugs, and reconnect hydraulic lines to pump and connect motor electrical cables.

4. Replace filter element or cartridge and reservoir breather.

5. Install drain plug or fitting in hydraulic oil reservoir.

6. Fill reservoir with filtered specified hydraulic oil.

7. Back off pump adjusting screw slightly and perform power steering system pressure adjustment. Refer to following Paragraph F.

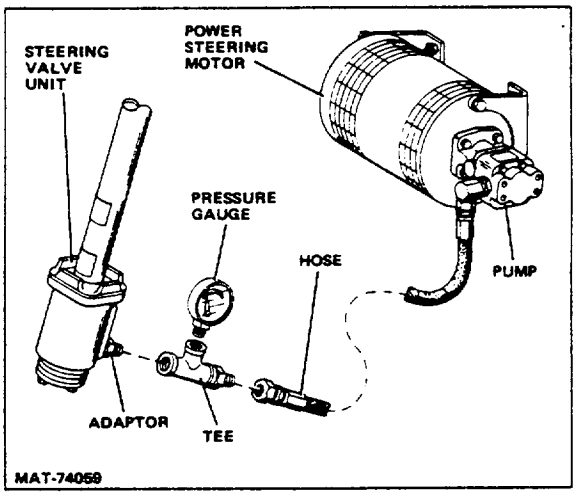


Figure 5-2. Pressure Gauge Location

8. After adjustment is completed, operate power steering system and check for leaks.

F. POWER STEERING SYSTEM PRESSURE ADJUSTMENT

For proper operation of the power steering system, the power steering pump hydraulic pressure must be set at 900 to 1100 psi. To check and adjust the pump pressure, use the following procedure.

1. Remove mounting capscrews and washers that secure the toe plate and floor plate to the frame, and remove the toe plate and floor plate to gain access to the steering valve unit.

2. Remove the pump pressure hose from the adaptor in the steering valve unit (the hose that is connected between the power steering pump and the steering valve unit).

3. Install a suitable tee fitting (Fig 5-2) between the adaptor and the end of the hose. Install a pressure gauge (0-3000 psi range) in the tee.

4. Connect the battery, close seat switch by depressing seat to full down position, and turn key to ON: (turning key to ON position is not necessary for Models with 702 MK II control.) Turn steering wheel towards left or right and place a sturdy block between the spindle and steer axle so relief valve pressure can be read as spindle is forced against the block.

5. Observe the needle on the pressure gauge. If pressure of 1000 plus or minus 100 psi is not obtained, the pump relief

valve must be adjusted.

6. To adjust pressure, remove cap nut (Fig 5-3) from adjusting screw in power steering pump. Turn adjusting screw IN to increase pressure or OUT to decrease it.
7. After adjustment is completed, install cap nut on adjusting screw.
8. Disconnect the battery and remove the tee fitting with pressure gauge from the adaptor and pressure hose.
9. Install pump pressure hose to adaptor securely.
10. Install toe plate and floor plate to frame with washers and mounting capscrews.

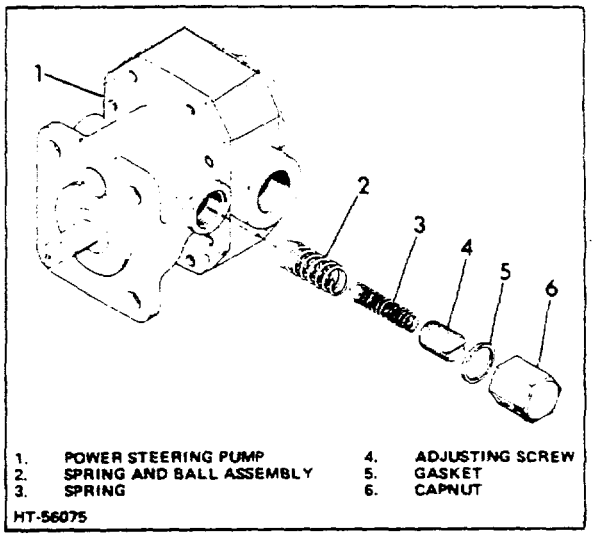


Figure 5-3. Power Steering Pump

G. POWER STEERING PUMP SPECIFICATIONS

Type .....Positive gear
Rotation (shaft end) .....Clockwise
Relief valve setting.....900-1100 psi

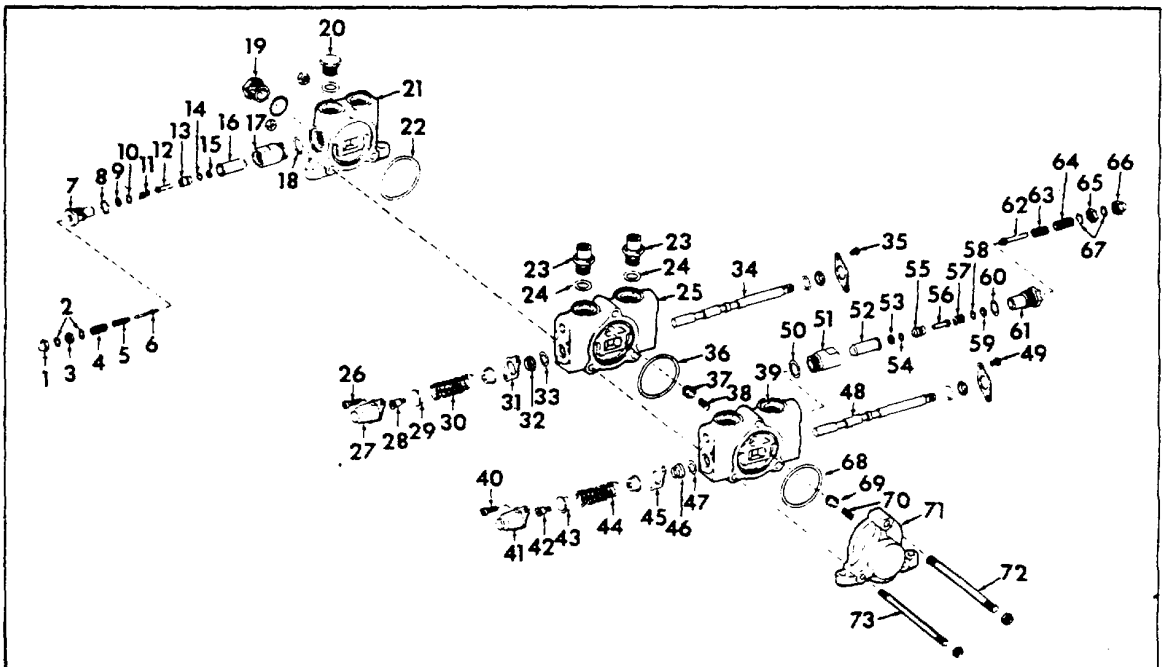
TOPIC 6. CONTROL VALVE

A. REMOVAL

⚠ WARNING

Disconnect the battery and discharge the capacitors before the removal is performed. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control or 703 control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

1. Remove control valve cover and floor plate.
2. Remove shoulder screws that attach levers to valve plungers.
3. Disconnect all hydraulic lines at control valve and plug the lines to keep out dirt.
4. Remove capscrews, nuts, and washers and remove control valve assembly from truck.
5. Remove fitting (Item 23, Fig 6-1) and colored poppet from tilt plunger section of the control valve. Note and record location and position of poppet. It must be installed in the same tilt section



1.	ACORN NUT	20.	PLUG	38.	SPRING	56.	PISTON
2.	WASHER	21.	INLET SECTION	39.	LIFT PLUNGER SECTION	57.	SPRING
3.	JAM NUT	22.	O-RING	40.	CAPSCREW	58.	O-RING
4.	ADJUSTING SCREW	23.	FITTING	41.	PLUNGER CAP	59.	BACK-UP RING
5.	SPRING	24.	O-RING	42.	SPECIAL CAPSCREW	60.	O-RING
6.	POPPET "E"	25.	TILT PLUNGER SECTION	43.	SPRING SEAT	61.	PLUG
7.	PLUG	26.	SCREW	44.	PLUNGER SPRING	62.	POPPET "E"
8.	O-RING	27.	PLUNGER CAP	45.	SEAL PLATE	63.	SPRING
9.	BACK-UP RING	28.	SPECIAL CAPSCREW	46.	WIPER	64.	ADJUSTING SCREW
10.	O-RING	29.	SPRING SEAT	47.	O-RING	65.	JAM NUT
11.	SPRING	30.	PLUNGER SPRING	48.	LIFT PLUNGER	66.	ACORN NUT
12.	PISTON	31.	SEAL PLATE	49.	SCREW	67.	WASHER
13.	POPPET "D"	32.	WIPER	50.	O-RING	68.	O-RING
14.	O-RING	33.	O-RING	51.	CAP	69.	POPPET
15.	BACK-UP RING	34.	TILT PLUNGER	52.	POPPET "K"	70.	SPRING
16.	POPPET "K"	35.	SCREW	53.	BACK-UP RING	71.	OUTLET SECTION
17.	CAP	36.	O-RING	54.	O-RING	72.	TIE ROD
18.	O-RING	37.	POPPET	55.	POPPET "D"	73.	TIE ROD
19.	PLUG						

65331-62105-2

Figure 6-1. Control Valve

port from which it was removed.

B. DISASSEMBLY

NOTE

Hydraulic system components must be repaired in a clean work area to keep parts free of dirt and contaminants during reassembly. Lay out parts in order of disassembly and do not mix parts that are common between sections. Tag parts for reassembly identification.

1. Stand control valve on inlet end and remove nuts from tie rods.
2. Lift outlet section off tie rods.
3. Remove spring, poppet and 0-ring from lift plunger section. If poppet does not come out easily, turn plunger section over and tap housing; poppet will slide out.
4. Slide lift plunger section off tie rods.
5. Remove seal plate from plunger end of section.
6. Remove plunger cap and seal plate at opposite end of housing and pull plunger from housing.
7. Wiper ring and 0-ring can be removed from plunger end of section. Be sure to identify from which end rings were removed.
8. Remove special capscrew, plunger spring, spring seats, wiper ring and O-ring from plunger. Plunger must be identified with correct plunger section. Intermixing of plungers will result in incorrect clearance and possible binding or sticking of plungers.
9. Remove acorn nut, jam nut and copper washers from relief assembly.
10. Turn relief valve assembly out of inlet housing. Flats are provided on cap to remove relief valve assembly.
11. Remove adjusting screw, spring, poppet "E", 0-rings and back-up rings from plug.

    Count and record the number of turns required to remove the adjusting screw.
12. Remove poppet "K" from cap.
13. Remove poppet "D," back-up ring and O-ring from poppet "K."
14. Remove spring, poppet and 0-ring from lift plunger section.
15. Slide tilt section off tie rods.
16. Remove plug and O-rings from housing.
17. Repeat preceding steps 5 through 8 for disassembly of tilt plunger section.
18. Remove O-ring and tie rods from inlet plunger section.
19. Remove plug and O-ring from inlet housing.
20. Remove acorn nut, jam nut and copper washers from relief assembly.
21. Turn relief valve assembly out of inlet housing. Flats are provided on cap to remove relief valve assembly.
22. Remove adjusting screw, spring, poppet "E," O-rings and back-up rings from plug. Count and record the number of turns required to remove the adjusting screw.
23. Remove poppet "K" from cap.
24. Remove poppet "D," back-up ring and 0-ring from poppet "K."

C. INSPECTION

1. Clean each metal part in a suitable solvent and dry thoroughly. Inspect housings for physical damage, such as cracks, etc. Carefully inspect plunger bores for scores, cracks, and other damage. Plunger bores can be reconditioned with a fine hone. If plungers are not scored or damaged, they can be reconditioned with a .001" .002" thick crack-free chrome plating. After plating plungers, evenly grind, lap or hone plungers to be straight and round within .0002" and a finish of 12 RMS or smoother.
2. Measure clearance between plunger and plunger bore; allowable clearance is .0002" .0005". Examine each section's mating surfaces. Surfaces must be free of burrs and pits. Should mating surfaces require resurfacing, remove burrs by lapping sections with fine lapping compound. Reclean and dry all parts before assembly.
3. Replace all damaged or excessively worn parts. Install new seals contained in repair kit when control valve is completely disassembled.
4. Before assembling control valve parts, lubricate each part with clean hydraulic oil.

D. REASSEMBLY

1. Install plug and O-ring in inlet section.
2. Install 0-ring and back-up ring on poppet "D." O-ring is installed on top of backup ring.
3. Place poppet "D" in poppet "K."
4. Position piston and spring in poppet "D" and "K" assembly. Piston is installed first.
5. Place poppet "E" and spring in plug. Secure poppet and spring in position with adjusting screw. Turn screw in the same number of turns required for removal.
6. Install back-up ring and O-rings on plug. Back-up ring is positioned towards adjusting screw end of plug.
7. Install O-ring on plug and assemble plug and cap assembly to complete relief valve. Secure relief valve in inlet housing.
8. Install plugs and O-rings on tilt section.
9. Install wiper and O-ring on spring end of plunger. Position seal plate, spring seats and spring on plunger and secure with special capscrew.
10. Slide plunger assembly into housing bore and coat spring with a light coat of multi-purpose grease. Position plunger cap over spring end of plunger and secure to housing with capscrews.
11. Install O-ring, then wiper on linkage end of plunger. Secure seal plate to housing with screws.
12. Install O-ring poppet and spring on plunger section housing.
13. Repeat steps 2 through 11 to assemble lift plunger section.
14. Position inlet, lift, tilt and outlet sections together. Be sure O-rings, poppets and springs remain in position.
15. Connect control valve sections together with tie rods.
16. Install nuts on each end of tie rods. Torque 3/8" nuts to 26 lb-ft and 5/16" nuts to 14 lb-ft.
17. Tape the openings in the control valve to avoid entry of contaminants before control valve is installed.

E. INSTALLATION

1. Install colored poppet in tilt plunger section of the control valve. Install end with the small orifice first. As mentioned in the preceding removal procedure, poppet must be installed in the same tilt section port from which it was removed. Refer to following chart for different color and orifice size of poppets.

MODELS	POPPET COLOR	ORIFICE SIZE
ACE 35 thru 55	BLACK	.055"

2. Install fitting (with O-ring) that secures poppet in tilt section port.
3. Place control valve assembly in position on truck and secure with attaching hardware.
4. Remove plugs and connect hydraulic lines to appropriate ports.
5. Connect control lever linkage to plungers.
6. Before checking linkage and switch adjustments and operation of hydraulic system, decrease control valve pressure relief adjustments to prevent damage from possible overpressure. Check linkage and switch adjustments, then adjust relief valves to obtain specified pressures. (Refer to following Paragraph F. For

Models FE 80-100 with 703 Control, refer to following Paragraph G.)

7. Check for leaks.
8. Install control valve cover and floor plate and secure with attaching hardware.

F. CHECKING PRESSURES AT THE CONTROL VALVE (ACE, FE, FET SERIES EXCEPT FE 80-100)

Two relief valves, one for lift and one for tilt operation, are incorporated in the control valve as a protective device. The relief valves protect the hydraulic system from damage in case of excessive hydraulic pressure. Whenever the lift or tilt cylinder reaches the full stroke position or when an excessive load is handled, excessive hydraulic pressure is built up. This pressure opens the relief valves and bypasses the hydraulic oil to the reservoir. The relief valves are preset by the manufacturer to open at specified pressures and should be checked at regular intervals, also whenever the control valve or hydraulic pump has been repaired or replaced.

Use the following procedures to check inlet and lift section pressures. Check the inlet section pressure first.

⚠ WARNING

Disconnect the battery and discharge the capacitors. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

1. Checking Inlet Section Pressure (Fig 6-2)

   a. Remove center cover panel and floor plate to gain access to the control valve.
   b. Remove pipe plug from large plug in the side of the inlet section. Install a pressure gauge (Fig 6-2) with a zero to 3000 psi range. A short length of high pressure hose with fittings may be installed between the gauge and the large plug to facilitate installation of the gauge.

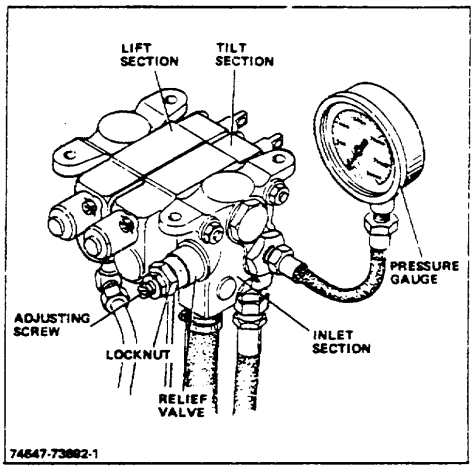


Figure 6-2. Checking Inlet Section Pressure

NOTE:
Some lift trucks are equipped with an inlet adaptor which has a pipe plug where a pressure gauge can be installed. If unit is an early model and is not equipped with this adaptor, then either install a large plug and gauge in the side of the inlet section as illustrated in Figure 6-2, or disconnect the hydraulic hose from the upper port in the inlet section, install a zero to 3000 psi gauge and the hydraulic hose in the tee.

   c. Connect battery, leave directional lever in neutral position, and turn key switch ON.
   d. Pull the tilt lever back to retract the tilt cylinders and hold lever in this position.
   e. While holding lever, observe the needle on the pressure gauge. When pressure reading of 2100 psi is attained, the needle will stop, indicating relief valve opening.
   f. If the relief valve opens below or above 2100 psi, it must be adjusted as follows:

   (1) Remove acorn nut covering adjusting screw directly underneath the inlet section of the control valve and loosen the jam nut.

(2) While holding tilt lever back, turn adjusting screw in to increase or out to decrease relief pressure.
(3) After pressure is properly adjusted, tighten jam nut to lock adjusting screw in position.
(4) Recheck relief valve setting described in preceding steps d and e. Then install acorn nut.

2. Checking Lift Section Pressure

a. After making the check outlined in preceding Subparagraph, leave the pressure gauge installed in the inlet section.
b. Connect battery, leave directional lever in neutral position, and turn key switch ON.
c. Pull the lift lever back to operate lift cylinder and hold lever in this position.
d. While holding lever, observe the needle on the pressure gauge. When pressure reading of 1900 psi is attained, the needle will stop, indicating relief valve opening.
e. If the relief valve opens below 1900 or above 1950 psi, it must be adjusted as follows:
(1) Remove acorn nut covering the adjusting screw on top of the control valve and loosen the jam nut (Fig 6-3).
(2) While holding lift lever back, turn adjusting screw in to increase or out to decrease relief pressure.
(3) After pressure is properly adjusted, tighten jam nut to lock adjusting screw in position.
(4) Recheck relief valve setting and then install acorn nut.
f. Turn key switch off, disconnect battery, and discharge the capacitors.
g. Remove pressure gauge and install pipe plug.
h. Install floor plate and center cover panel.

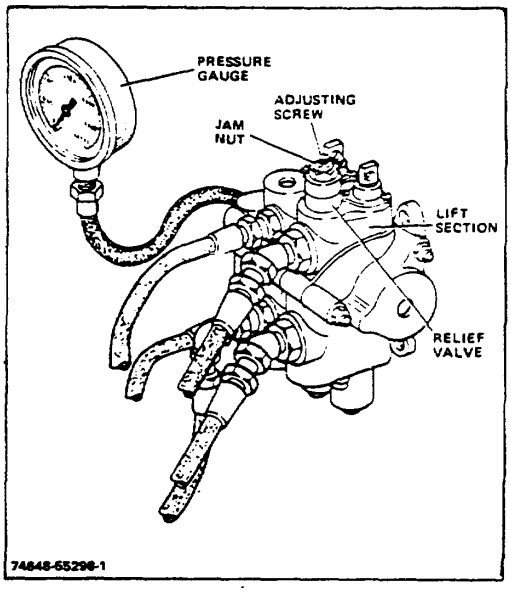


Figure 6-3. Checking Lift Section Pressure

G. LINKAGE AND SWITCH ADJUSTMENT

1. Linkage.

Adjustment of the control valve linkage (Fig 6-4) is made at the upper or lower yokes on the rods. By disconnecting the yokes at the levers or plungers and turning them up or down, this adjustment can be made. Lock the yokes in position with the jam nuts after completing adjustment. Improperly adjusted or out of adjustment linkage can result in binding or bending of the control valve linkage.

2. Switches.

a. To ensure proper operation of the hydraulic pump and pump motor, the switches activated by the control valve linkage must be maintained in proper adjustment. The switches, mounted on the switch mounting bracket, can be adjusted by loosening the switch mounting screws and moving the switch in or out, or loosening the jam nuts that secure the actuators and adjusting the actuator up or down as required. The switches or actuators must be adjusted until the switch rollers just touch the actuators, but do not actuate the switches.

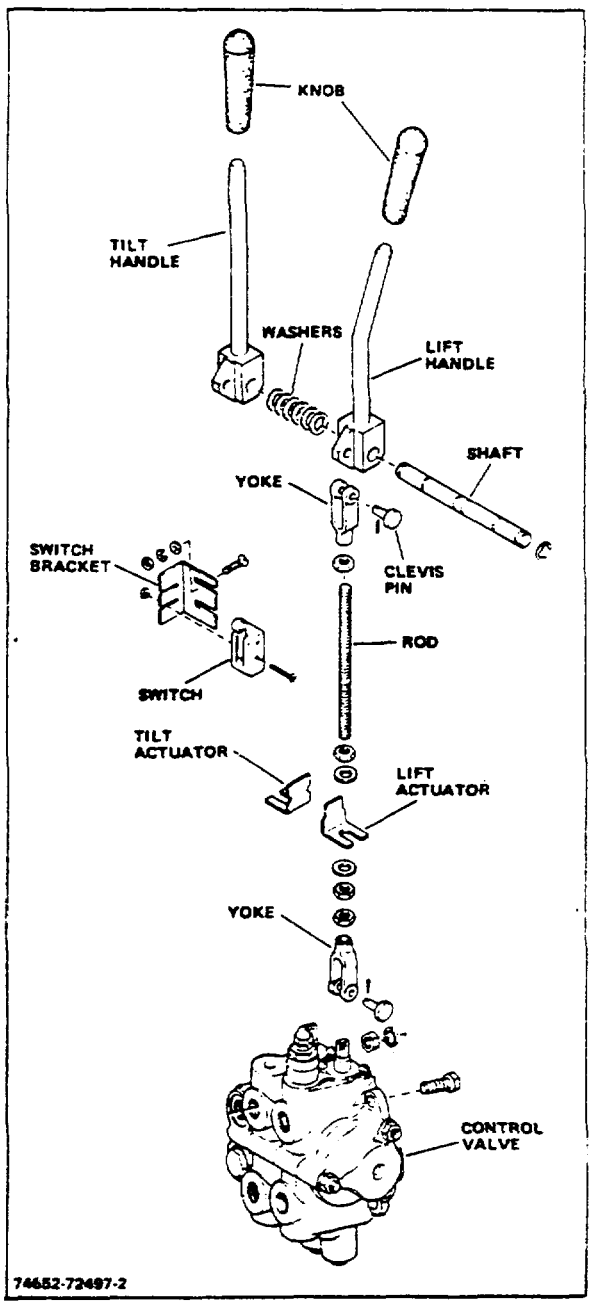


Figure 6-4. Control Valve and Linkage (Type I)

b. Check operation and adjustment of switches. Connect battery and turn on the key switch. Pl1l the lift lever back slightly. The switch should actuate with the first motion of the lever after all of the play is taken up. The hydraulic pump motor should start operating before the lift cylinder begins to extend. Pull tilt lever back slightly, hydraulic pump motor should start to operate before the tilt cylinder starts to move back. When the tilt lever is pushed slightly forward, the motor should start to operate before the cylinder moves forward.

⚠ CAUTION

If any of the cylinders move as soon as the pump motor starts to operate, excessive pump contactor tip arcing will occur and also damage to the pump motor could result.

c. If activation of the lift and/or tilt lever does not result in the proper operation of the pump motor, check switch adjustment, switch connections, continuity of the switch and pump motor, and the motor connections.

TOPIC 7. CONTROL VALVE SECTIONAL ARRANGEMENTS

A. BASIC CONTROL VALVE

The basic control valve is a two plunger sectional valve where one section is used to control the lift operation and the other section is used to control the tilt operation. Additional sections are added to the basic valve to operate and control various optional low volume hydraulic attachments and accessories (Figs 7-1, 7-2, and 7-3).

B. OPTIONAL ARRANGEMENTS

Depending upon the requirements of the lift truck, various arrangements or combinations can be made to the control valve plunger sections where high volume control may be necessary to operate certain optional hydraulic attachments (Figs 7-4, 7-5, and 7-6).

NOTE

References made to upstream or downstream in the following information means that any section located between the lift section and the inlet section, is upstream of the lift section. Conversely, any section located between the lift section and the outlet section, is downstream of the lift section.

Whenever a high volume accessory section is required, it is always installed adjacent to the lift section and opposite from the tilt section location. The high volume section contains a B type housing which has series parallel porting construction. This means that when the B section is installed adjacent to the lift section (downstream), the high volume delivered from the B section is the sum of the low volume inlet and high volume inlet.

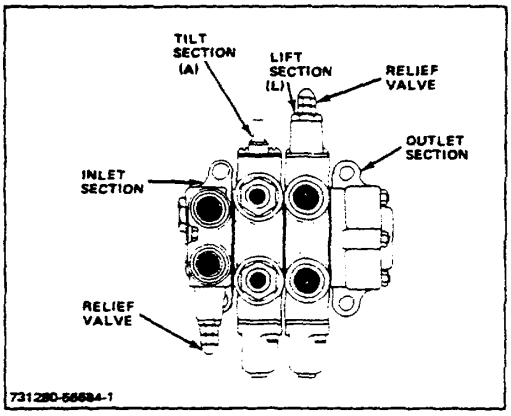


Figure 7-1. Basic Control Valve

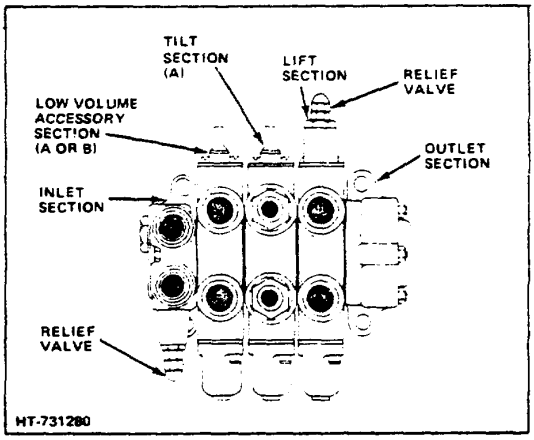


Figure 7-2. Three Plunger Control Valve With One Low Volume Accessory Section

When an A section is located next to the B section (Fig 7-5), then high volume is also delivered from the A section. An A section is normally a low volume section with parallel porting construction.

In order to identify a low volume accessory section (A type) or a high volume accessory section (B type), look for the letter A or B that appears inside the opening in the side of the housing (Fig 7-8).

Effective with lift truck serial number 55449, the two control valves illustrated in Figures 7-2 and 7-3 are equipped with an accessory B section; however, due to its location, it is used for low volume operation.

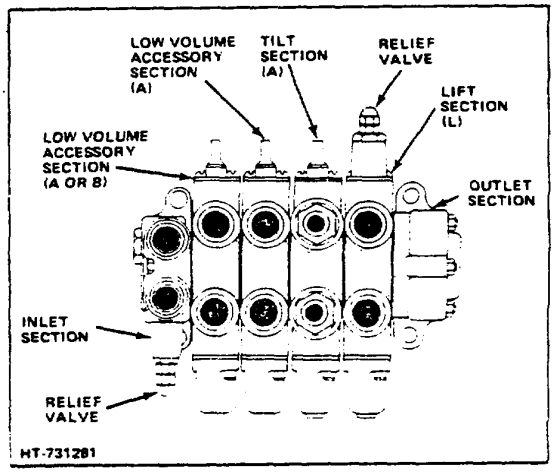


Figure 7-3. Four Plunger Control Valve With Two Low Volume Accessory Sections

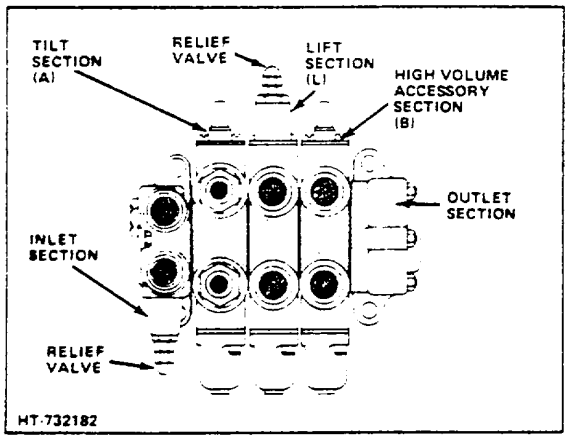


Figure 7-4. Three Plunger Control Valve With One High Volume Accessory Section

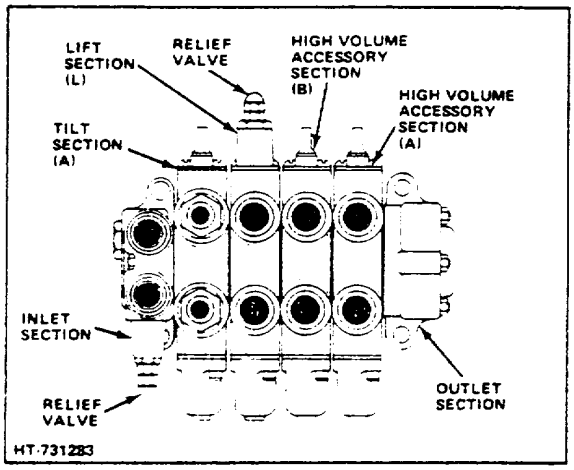


Figure 7-5. Four Plunger Control Valve With Two High Volume Accessory Sections

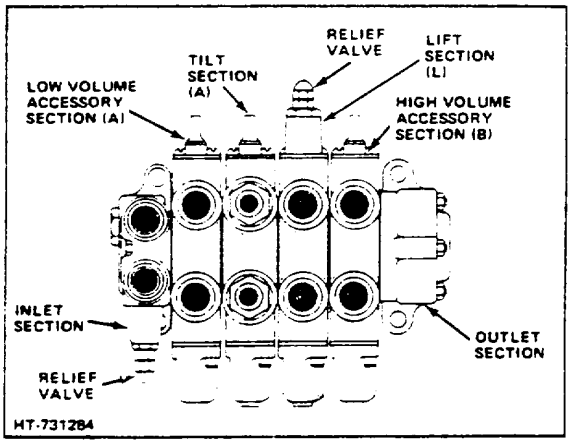


Figure 7-6. Four Plunger Control Valve with One High Volume and One Low Volume Accessory Section

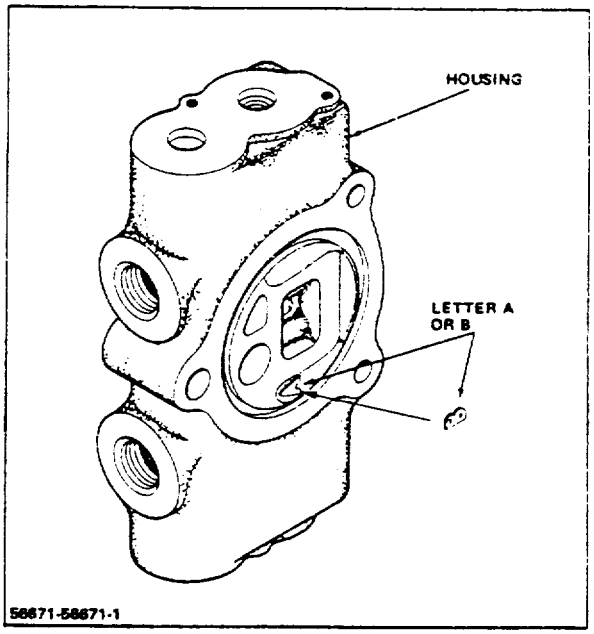


Figure 7-8. Identification of A or B Type Plunger Section

⚠ CAUTION

If it is necessary to modify a control valve in the field to provide high volume flow, it is absolutely essential that the accessory section is installed adjacent to the lift section (immediately downstream) and it must be B section (Figs 7-4, 7-5, and 7-6). If an A section is installed at this location, only low volume pump flow will be passed. The high volume flow will be blocked and the relief valve in the lift section will open.

An A section can be installed adjacent to the B section (downstream) for high volume flow (Fig 7-5) because the B section re-establishes the parallel pressure porting which is blocked by the lift section.

The difference between a low volume section and a high volume section is the location; upstream of the lift section is low volume, and downstream of it is high volume.

Regardless of the arrangement of the plunger sections (Figs 7-1 thru 7-6), all control valves are equipped with a lift section relief valve and an inlet section low volume relief valve. Specified pressure setting for all control valves (Figs 7-1 thru 7-6) is 1900 psi for the lift section relief valve and 2100 psi for the inlet section relief valve.

TOPIC 8. TILT CYLINDER

A. GENERAL

Action of the tilt cylinder is a straight line motion. Any misalignment between the cylinder and piston will cause binding, rapid wear of packing and packing gland, rapid wear of piston rod and packing, and will tend to break the weld on the cylinder case. The welded section is designed to hold hydraulic pressure and should not be subjected the bending force caused by misalignment.

B. 50 HOUR INSPECTION

After each 50 hours of operation, check the tilt cylinder hoses and fittings for leaks; correct if necessary. Check tilt cylinder mountings and make certain the yoke is tight on the plunger so the plunger does not rotate in the cylinder. Check the stroke of both plungers in relationship to the distance between the front of lift truck and the mast. This distance, or amount of mast travel, must be equal on each side, otherwise damage to the tilt cylinders, frame, or mast could result. If the distance is not equal, adjust the position of the yoke on the plunger until it is equal. Also, lubricate yoke pins by lubricating the pressure gun fittings on the mast with specified grease.

1. Oil Leakage - Gland Nut

   During the 50 hour inspection, check for oil leakage at the gland nut (Fig 8-1). Oil leakage at the gland nut indicates seals are worn. To stop leakage, remove gland nut with a spanner wrench and replace seals.

2. Oil Leakage - Piston Seal

   Check the operation of the tilt cylinders. If the mast assembly tilts too slowly or if it creeps under load, it is an indication that hydraulic oil is leaking past the piston seal in the tilt cylinders. This can be checked as follows:

⚠ CAUTION

Operate the control lever ONLY in the direction specified in the following steps.

   a. Tilt the mast assembly forward to its extreme limit.
   b. Loosen the hoses at the front or yoke end of both tilt cylinders.
   c. With the battery connected and key switch in the ON position, place and hold tilt control lever in the forward position; check for oil flow through the loosened fittings of both cylinders. If oil flows out of the fitting of either cylinder, remove the cylinder and replace the piston seal.
   d. To check the piston seal when mast assembly is at its extreme backward position, reverse the procedure in the preceding steps a, b, and c.

C. TILT CYLINDER REPAIR PRECAUTIONS

1. When packing (Fig 8-1) starts to wear, it should be replaced.

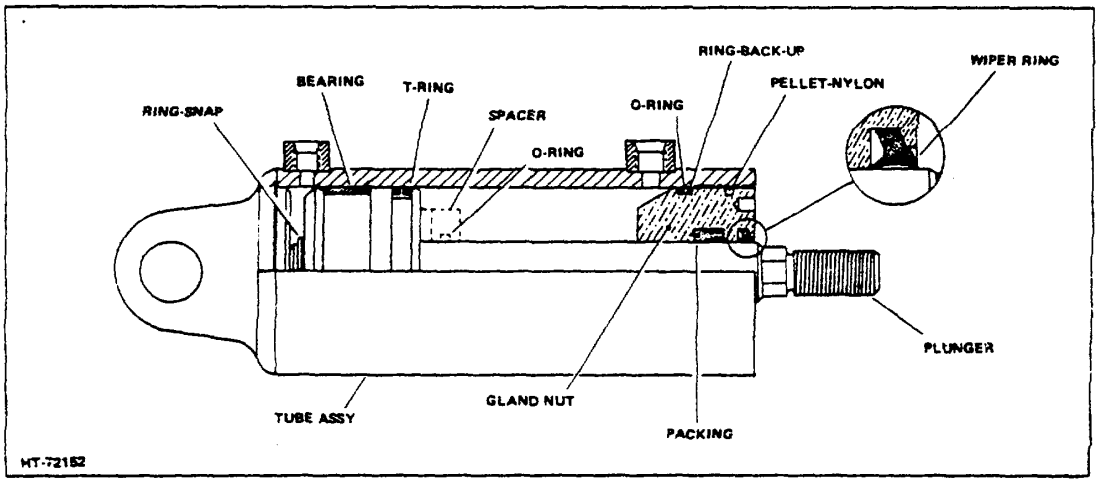


Figure 8-1. Tilt Cylinder (Current Type)

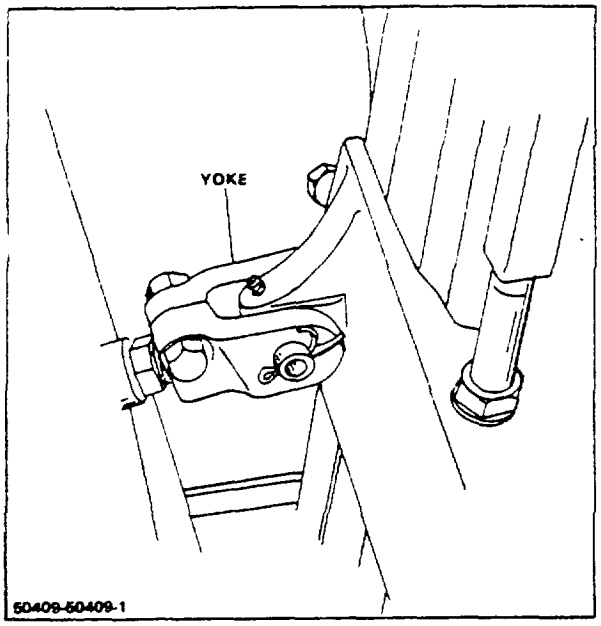


Figure 8-2. Tilt Cylinder Yoke

Otherwise, pieces of it could contaminate the oil and work into the pump or valve, thus causing damage, or malfunction.

2. Do not disassemble the unit any more than is required to replace the faulty part.
3. Use only approved packing or seals. Never make substitutions.
4. Before installing the packing, inspect for nicks, cuts or flaws. Do not install if any of these faults are present.
5. All metal surfaces on which packing slides should be very smooth. If surfaces are scored or nicked, replace the parts or resurface them.
6. Soak packing in hydraulic oil before installing.
7. Sharp tools or instruments should not be used when installing packing.
8. When O-rings are installed, do not stretch them more than absolutely necessary.
9. Fit packing evenly and snugly without using undue force.
10. When packing must be installed over threads or sharp edges, use shim stock to protect packing.

    a. O-rings should be pushed over sharp edges with care. They can be easily cut.
    b. Make certain O-rings are not twisted.
    c. Make certain O-ring is of correct size to give a "squeeze" in the installed position.

11. Do everything possible to keep all hydraulic parts as clean as possible. Keep dirt and fine metal particles from packing and plunger. Such material car quickly damage packing and score plungers.

D. REMOVAL

⚠ WARNING

Disconnect the battery and discharge the capacitors before the removal is performed. (For lift trucks with SCR control, discharge the capacitor(s) on the SCR control panel by momentarily touching a suitable jumper wire across the capacitor terminals. For lift trucks with 702 MK II control or 703 control, discharge the capacitors by turning key switch to the ON position. For lift trucks with ACTRONIC control system, turn key switch to ON position and press horn button to discharge capacitors, or momentarily touch a suitable jumper wire across the capacitor terminals.)

1. Operate the tilt control lever to position the mast in forward position. Attach an overhead hoist securely to the mast and hold mast in this position.
2. Remove floor and toe plates to gain access to tilt cylinder rear mountings.
3. Disconnect the hydraulic lines at the tilt cylinder. Tag and identify each hose to facilitate hose installation. Plug lines and tilt cylinder ports to prevent entry of contaminants into hydraulic system.
4. Remove cotter pins. Pull out the pin that secures the yoke to the mast.
5. Remove shaft or bolt that secures tilt cylinder to lift truck frame; remove the tilt cylinder.

E. INSTALLATION

1. Install each tilt cylinder securely to lift truck frame with shaft or bolt.
2. Unplug tilt cylinder ports and hose connections. Connect hydraulic hoses to tilt cylinders.
3. Turn yokes on plunger rods, install capscrews and nuts but do not tighten.
4. Attach tilt cylinder yokes (Fig 8-2) to mast outer channel tilt pivots by positioning mast with chain hoist.

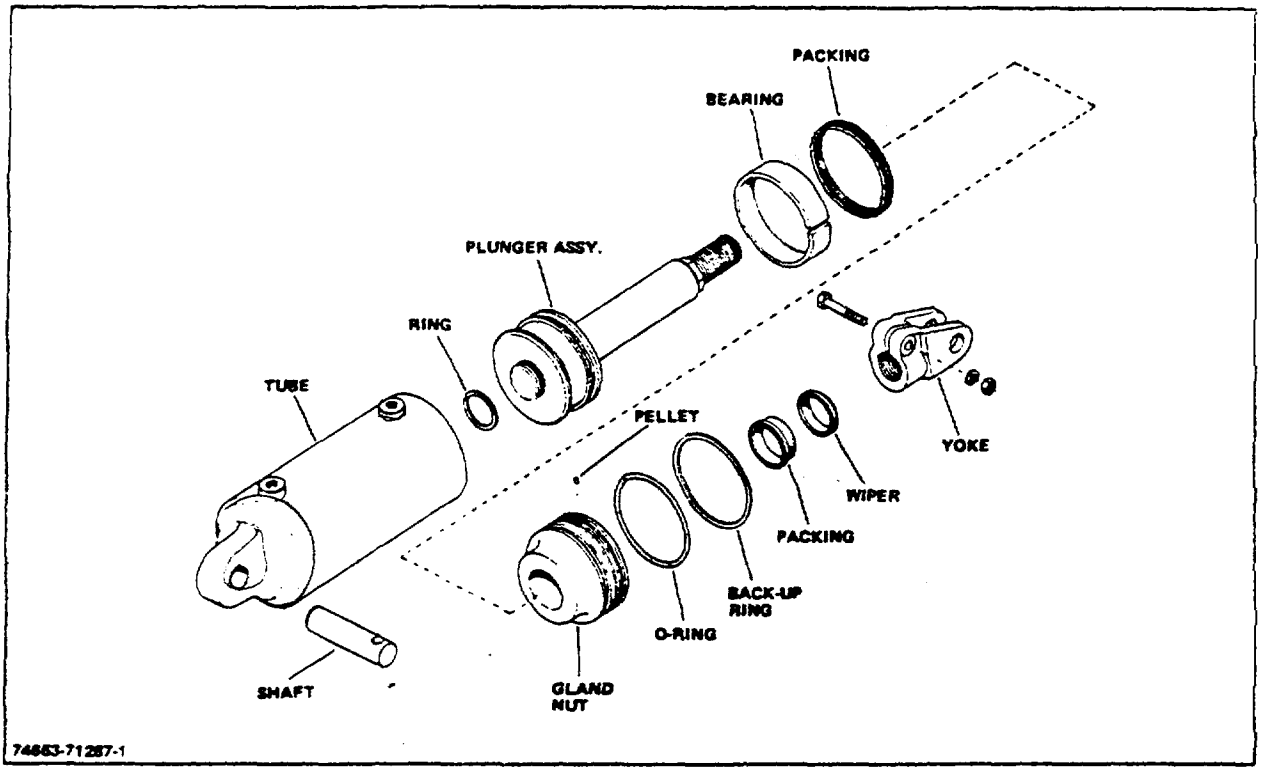


Figure 8-3. Tilt Cylinder Components (Current Type)

Secure yokes to mast with yoke pins. Lubricate yoke pins if mast is equipped with grease fittings.

5. Remove chain hoist from mast, turn key switch ON, and operate tilt lever backward and forward. Tilt cylinder should bottom simultaneously in full backward and full forward direction. If the cylinders do not bottom at the same time with mast in the forward position, place a wrench on hex section provided on plunger rod. Turn plunger rod into or out of yoke to obtain proper adjustment. Then tighten nuts on capscrews to secure yokes on plunger rods.

F. DISASSEMBLY (CURRENT TYPE)

1. With tilt cylinder firmly secured-in bench vise, loosen capscrew on yoke and remove yoke from plunger rod. Record number of turns required to remove yoke.
2. Remove gland nut (Fig 8-3) and pry out packing and wiper. Also remove O-ring, back-up ring, and nylon pellets.
3. When replacing plunger packing seal, withdraw complete piston and plunger assembly from cylinder tube.
4. Remove spacers from plunger rod. An O-ring is installed in the end spacer only.

⚠ CAUTION

Leave piston and plunger rod as an assembly for they are replaced as a unit when damaged.

5. Remove bearing and packing from piston.

G. INSPECTION

1. Clean all metal parts with a suitable solvent and dry thoroughly.
2. Check cylinder tube bore for scores or nicks.
3. Check piston sliding surface for scores, nicks, or other irregularities which could damage cylinder tube bore.
4. Check bores of piston and gland nut and mating surfaces of plunger for damage which could cause faulty seating, leaks, or damage to other parts.
5. Check all parts for cracks, bends, deformation, stripped threads and other damage.
6. If mating or sliding surfaces are damaged the parts should be replaced.

H. REASSEMBLY (CURRENT TYPE)

1. Install new packing and bearing on piston.

2. Install spacers on plunger rod. Be sure that outer spacer has an O-ring in groove.
3. Install piston and plunger assembly in cylinder tube.
4. Install new nylon pellets, O-ring, back-up ring, packing and wiper on packing gland.
5. Install gland nut on plunger assembly and in cylinder tube. It must be flush with outer edge of cylinder tube.
6. Install yoke on plunger rod same number of turns as when removed.

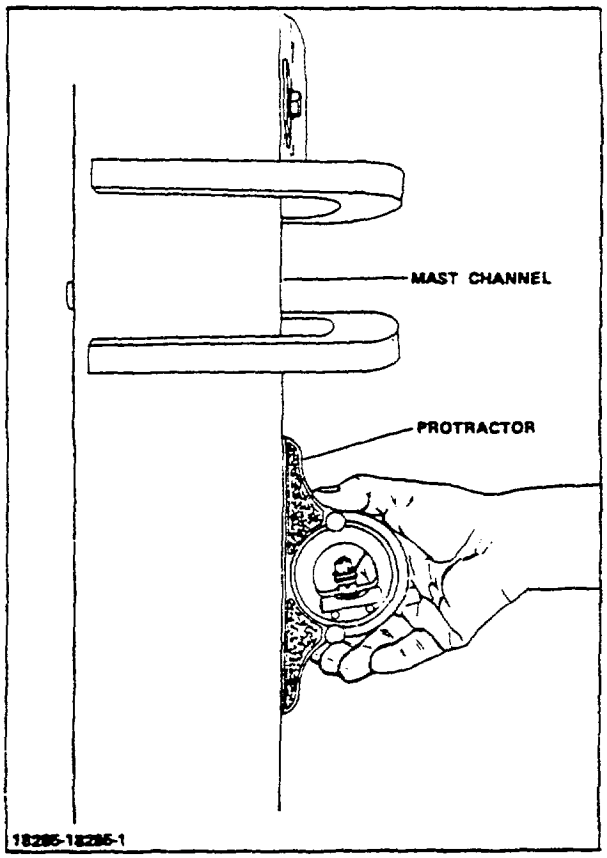


Figure 8-4. Checking Forward and Backward Tilt

1. FORWARD AND BACKWARD TILT ADJUSTMENT

Degree of tilt forward and backward varies with different masts and different models. Use a protractor to obtain proper degree of tilt as follows:

NOTE:
Make certain the lift truck is standing level when checking tilt.

1. Set the protractor for correct degrees of backward tilt. Tilt mast to end of backward stroke and place protractor on back of mast (Fig 8-4).
2. Bubble in level of protractor should center if degree of backward tilt is correct.

NOTE:
Check both right and left side of mast assembly, and at same time make certain both cylinders have come to end of stroke.

3. If adjustment is necessary, tilt mast to forward position and loosen nut on capscrew of tilt cylinder yoke. Place wrench on hex of tilt cylinder rod and turn in or out of yoke to obtain proper adjustment.
4. After each adjustment, check degree of tilt. When proper degree of tilt is obtained, tighten nut on capscrews.

NOTE
To ensure both cylinders give the same degree of forward tilt, check that both have the same number of spacers (refer to Tilt Cylinder Disassembly) or when ordering a tilt cylinder, specify degree of backward and forward tilt.

TOPIC 9. HYDRAULIC HOSE

A. GENERAL

Observe the following precautions when installing hoses.

1. Hose should be clean and unobstructed internally.
2. Hose should be correct length and not stretched between fittings.
3. Hose should not be twisted or distorted.
4. Hose should not have sharp or excessive bends which could restrict flow of oil.
5. Hose should not be exposed to excessive heat.
6. Hose should not be routed against any sharp edge which may chafe or cut hose.

B. INSPECTION

After each operating interval of 500 hours, inspect all hoses and fittings used in the hydraulic system. Replace hoses that are damaged or deteriorated. Check for leaks and correct any that are evident.

TOPIC 10. HYDRAULIC RESERVOIR

A. GENERAL

The hydraulic oil reservoir (Fig 10-1) is located at the right of the operator's compartment below the floor plate. The dipstick is installed in the top of the reservoir to allow for a quick check of the reservoir oil level. To avoid entry of air into the hydraulic system, the reservoir oil level must be maintained to the FULL mark on the dipstick. A breather is installed in the top of the reservoir. Air enters or exits through the breather to compensate for changes of the oil level in the reservoir during operation of the hydraulic system.

B. DAILY CHECK

Daily, check the reservoir oil level on the dipstick. Oil level should be up to the FULL mark when the mast is lowered so the carriage is at its fully lowered position and mast is at full backward tilt, and oil is at approximately 70°F. Add pre-filtered specified hydraulic oil to obtain proper level if necessary.

⚠ CAUTION

Before operating the lift control lever, verify that the hydraulic oil level in the reservoir is at the FULL mark on the dipstick.

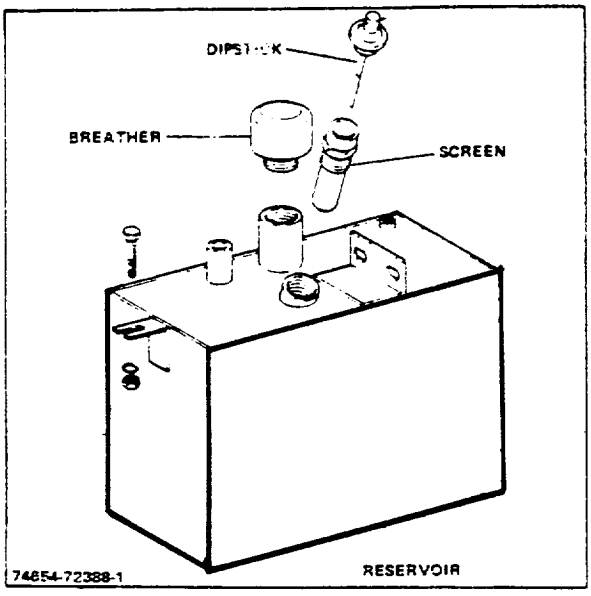


Figure 10-1. Hydraulic Oil Reservoir Components (Typical)

C. 200 HOUR SERVICE

1. Hydraulic Oil Reservoir Breather - Type I

   The breather (Fig 10-2) is the "spin-on" can type with a pleated paper element and is rated at 10 microns. After each operating interval of 200 hours, remove breather from top of hydraulic oil reservoir and replace it with a new one.

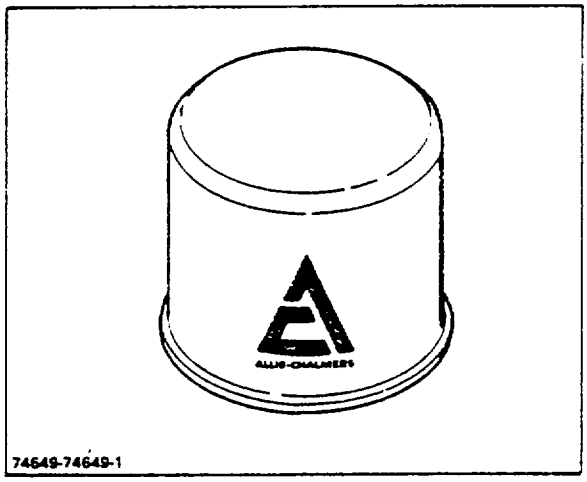


Figure 10-2. Reservoir Breather - Type I

D. 1000 HOUR SERVICE

After each operating interval of 1000 hours, the oil in the reservoir should be drained and replaced. This is important primarily because of condensation and contamination. Heating of the oil during operation and cooling of it when the lift truck is not in use contributes to condensation which is detrimental to the hydraulic system. Contaminants such as dirt, rust, scale, and products of oil deterioration are also detrimental.

E. RESERVOIR REMOVAL

1. Make certain lift truck is level and lower the mast so the carriage is at its fully lowered position.
2. Remove drain plug or fitting from bottom of oil reservoir and allow oil to drain in a container.

⚠ CAUTION

The hydraulic pump should only be used for pumping oil thru the hydraulic system.

3. Remove the toe and floor plates.

4. Remove hydraulic hoses and filter (if applicable) from the reservoir and tag hoses for identification. Plug hoses and openings to keep dirt out.
5. Remove hardware that secures reservoir to frame.
6. Carefully lift the reservoir from the lift truck.

F. RESERVOIR CLEANING

1. If applicable, remove clean-out cover and gasket.
2. Flush inside of reservoir with a suitable cleaning solvent and clean the screen in the reservoir filler opening.
3. Dry the inside of the reservoir with clean, dry compressed air. Then plug all openings to keep dirt out. If applicable, install gasket and clean-out cover.

G. RESERVOIR INSTALLATION

1. Lower the reservoir into position and secure it to vehicle frame with attaching hardware.
2. Remove plugs and install hydraulic hoses, filter (if applicable), and drain plug or fittings.
3. Check tightness of all connections at the reservoir.
4. Install new filter element or cartridge and breather.
5. Fill reservoir with pre-filtered specified hydraulic oil until level is up to the FULL mark on the dipstick.

⚠ CAUTION

Always use pre-filtered oil in the hydraulic system. Make sure containers and surrounding parts are clean when reservoir is filled to prevent dirt from contaminating the oil.

6. Install filter cap and operate hydraulic system. Check for leaks and correct any if necessary.
7. Install toe and floor plates.

TOPIC 11. HYDRAULIC SYSTEM FILTER

A. GENERAL

Contaminants such as dirt, dust, rust, .scale, and products of oil deterioration are detrimental to the hydraulic system.

A return line filter is installed in the hydraulic system. This filter, when properly maintained, will keep the contamination level low enough so it will not be detrimental to the components in the hydraulic system.

Filter element replacement is recommended at the first 50 hours of service, then at each 200 hour interval thereafter or more often if operating conditions warrant it.

B. REMOVAL

NOTE

Filter is located above hydraulic oil reservoir. This allows filter removal without draining hydraulic oil reservoir.

1. Remove floor and toe plates; remove control valve cover (if applicable).
2. Thoroughly clean the filter assembly and surrounding area.
3. Disconnect inlet and outlet hoses at filter. Cap or plug openings.
4. If applicable, remove nuts, capscrews and washers that secure filter assembly to mounting bracket; remove filter from lift truck.

C. INSTALLATION

1. Position the filter in the truck and secure to mounting, bracket with nuts, capscrews and washers.
2. Connect hydraulic inlet and outlet lines.
3. Operate the hydraulic system and check for leaks.
4. Install floor and toe plates and cover (if applicable).

D. FILTER CARTRIDGE REPLACEMENT (TYPE B)

After each operating interval of 200 hours, replace cartridge as follows:

1. Thoroughly clean the filter head and surrounding area.
2. Unscrew and remove cartridge (Fig 11-1) from filter head. Discard filter cartridge.
3. Inspect inside of filter head. Remove dirt or sediment from inside of filter head if necessary.
4. Screw new filter cartridge into position

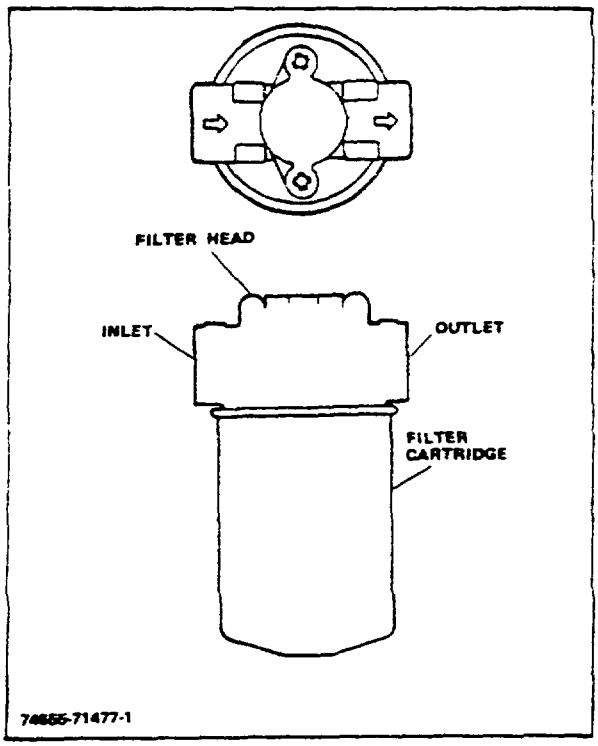


Figure 11-1. Hydraulic Oil Filter (Type B)

TOPIC 12. SCHEMATIC DIAGRAMS

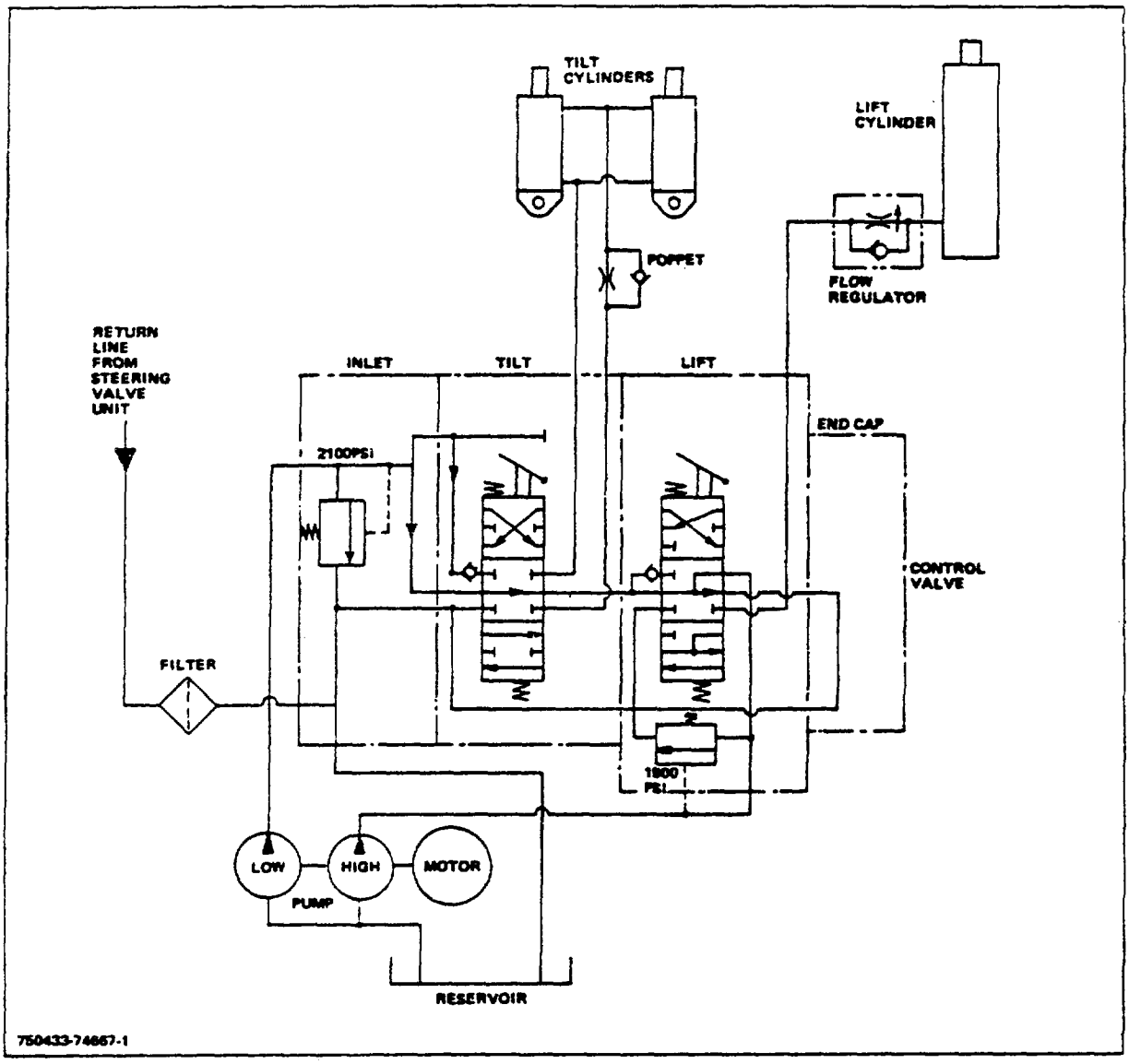


Figure 12-1. Hydraulic Schematic Diagram (ACE 35 thru 55)

TOPIC 1. MAST-CANTED BEARING TYPE

A. GENERAL DESCRIPTION

The Tri-Max mast is a three section mast assembly (Fig 1-1 Three upright structural assemblies nested together include; an outer mast, intermediate mast, and an inner mast. Each upright consists of a structural steel frame with mounting blocks and brackets welded to it to support the cylinders, chains, and bearings.

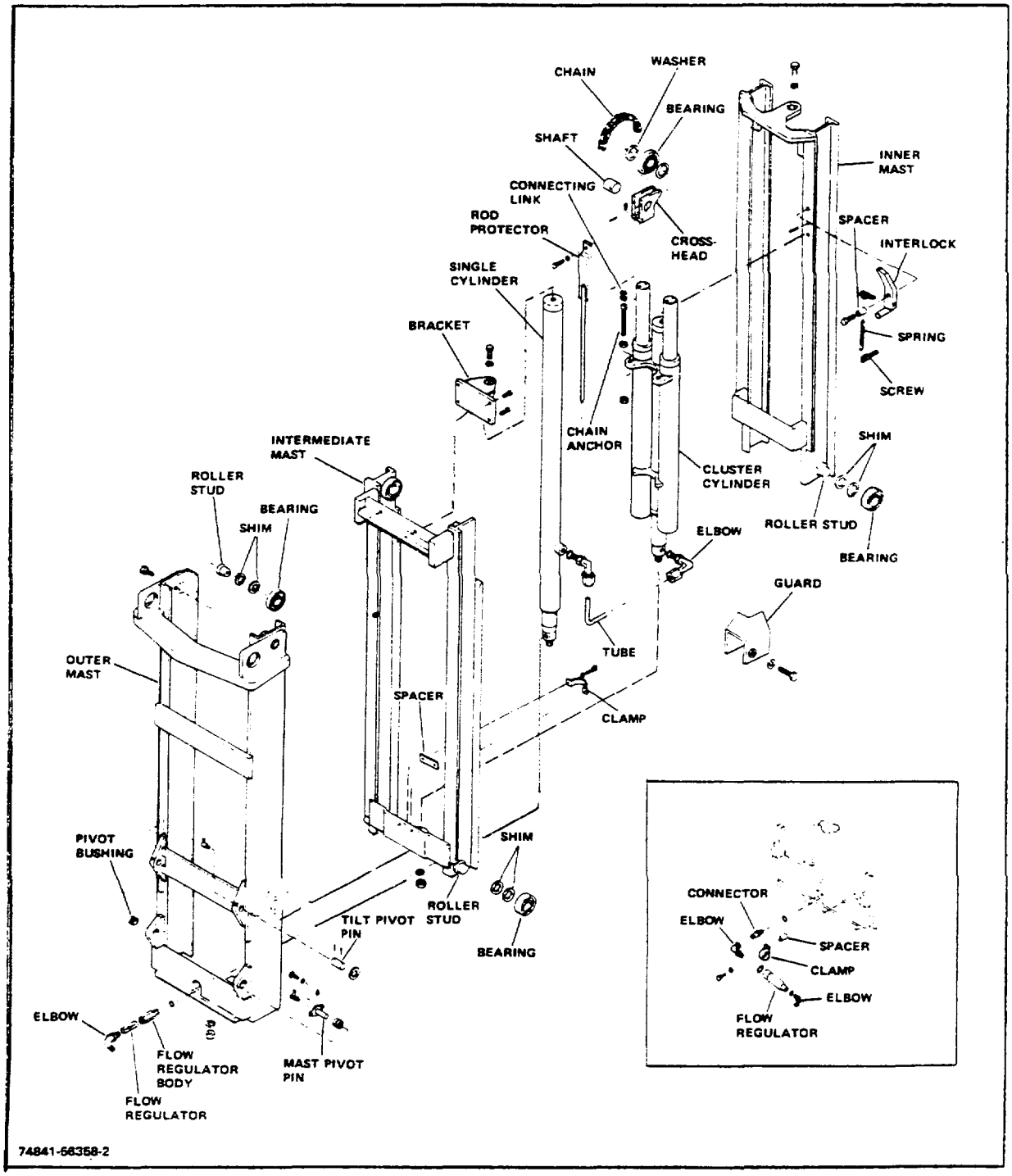


Figure 1-1. Tri-Max Mast (35-55 Series)

The intermediate inner masts ride on adjustable roller bearings. This enables them to telescope up and down smoothly with a minimum of friction or drag. Alignment of the mast uprights is accomplished by adjusting the roller bearings.

B. REMOVAL

⚠ CAUTION

Fully retract or lower lift cylinders.

1. Remove the carriage. (Refer to CARRIAGE REPAIR MANUAL Module.)
2. With mast fully lowered, attach a sling from an overhead hoist to the mast lift eyes to secure entire mast assembly during removal.

⚠ WARNING

Be certain overhead hoist is rated to safely support entire mast assembly weight.

3. Disconnect tilt cylinder from outer mast.
4. Disconnect hydraulic hoses from lift cylinders.

NOTE

Cap or plug all hydraulic openings to prevent contamination by foreign particles.

5. (PIVOT PIN TYPE) Remove lockwires, capscrews, and lockwashers (Fig 1-2) which retain pivot pins to mast assembly. Raise overhead hoist high enough to relieve pressure on the pivot pins and remove pins. Use hoist to lay mast on suitable supports.

C. DISASSEMBLY

1. Remove the lift cluster cylinder assembly and the single cylinder assembly (Refer to TOPIC 4.)
2. Remove capscrews that retain top roller studs to outer mast and remove studs and bearings.
3. Remove the cylinder bracket from the top support on the intermediate mast upright; disassemble and remove the interlock assembly.
4. Carefully slide the inner and intermediate mast uprights out of the top of the outer mast. Then slide inner mast out of top of intermediate mast.
5. Remove the remaining bearings and shims from the mast uprights.

D. INSPECTION

1. Clean all parts with a suitable solvent except the bearings.

⚠ CAUTION

Do not soak bearings in solvent as this may remove the lubricant from the bearings.

2. Carefully inspect all parts for evidence of wear or damage, and replace any worn or badly damaged parts.
3. In the event of any bearing failure where the inner race has been fractured, check the respective roller stud for nicks. Small nicks may be removed with a crocus cloth or a honing stone. Replace any stud that has been too severly damaged (refer to TOPIC 8, WELDING REPAIR PROCEDURE).
4. It is recommended that whenever a stud or bearing that is mounted with a capscrew is replaced, the capscrew must also be replaced and torqued to 245 lb-ft.
5. Repair cracks and minor breaks by welding if practicable.

E. ADJUSTMENT

1. Outer Mast Assembly. Use an adjustable inside spanning tool and check the rear inside of the outer mast upright to find narrowest distance between uprights (Fig 1-2). Lock tool in this position. Set an adjustable outside spanning tool to match inside spanning tool. Lock tool in this position (Fig 1-3).
2. Intermediate Mast Assembly. Install bearings on studs located at bottom of intermediate mast assembly. Use an outside spanning tool as set in Step 1 above and span bearings at maximum camber point where bearings contact outer mast uprights. Shim bearings, if required, to obtain maximum .015 inch clearance between bearings and outside spanning tool. Divide shims as equally as possible between bearings. Shims are available in 0.015 and 0.040 inch thicknesses.

NOTE

If odd shim is required, place odd shim on same side of all mast sections and carriage so mast will be in balance.

3. Outer Mast Assembly Top Bearing. Use outside spanning tool and find widest point In outside width of web where the bearing makes contact on intermediate mast assembly.

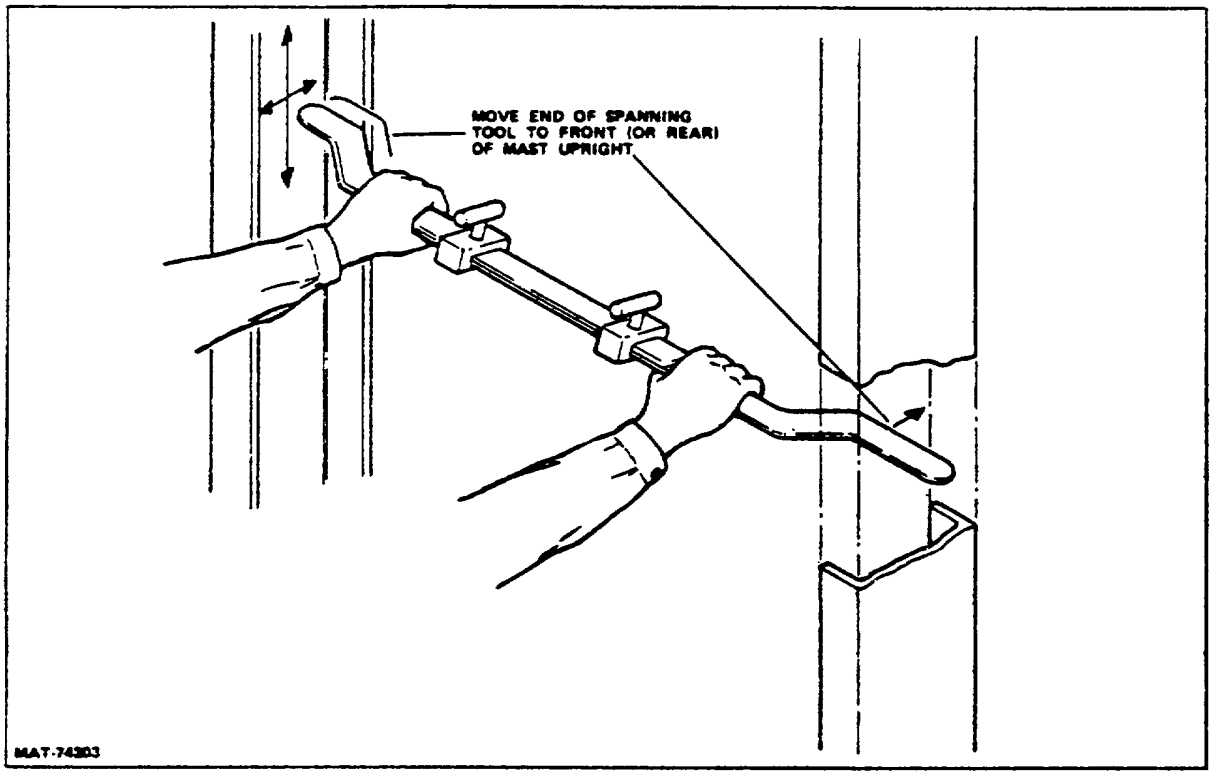


Figure 1-2. Spanning Outer Mast Uprights

Install bearings on studs at top inside of outer mast. Use inside spanning tool to span bearings at maximum camber point. Check clearance between outer and inner spanning tools. Measure clearance accurately and install shims to provide proper clearance. Install shims as equally as possible under both bearings to provide maximum .015 inch clearance.

4. Inner and Intermediate Mast Bearings. Perform Steps 2 and 3 to adjust upper bearings on inside of intermediate mast and lower bearings on inner mast.

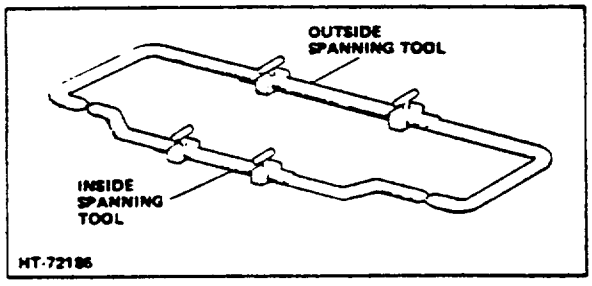


Figure 1-3. Setting Outside Spanning Tool

NOTE

Add the same thickness of shims to each side so the mast uprights remain centered. Insert enough shims behind the upper and lower bearings to eliminate excessive side play; however, if too many shims are added, the mast uprights will bind.

5. After installation, raise and lower the mast and carriage several times to check for free movement throughout the entire range of travel.

F. REASSEBELY (20-55 SERIES)

NOTE

Make certain all roller bearings have been installed and shimmed as necessary.

1. Carefully insert the intermediate mast into the top of the outer mast.
2. Carefully insert the inner mast into the top of the intermediate mast.
3. Install interlock assembly (refer to Figure 1-1.
4. Install cylinder bracket at intermediate mast top support.

5. Install the cluster cylinder assembly and the single cylinder assembly (refer to TOPIC 4).
6. Install bearings and studs previously removed from top of outer mast.

NOTE
For chain adjustment, refer to following Paragraph H.

G. INSTALLATION

1. Use a properly rated hoist and maneuver mast assembly to its relative mounting position on front of lift truck.
2. (PIVOT PIN TYPE) Use a drift pin to align mounting holes on mast and lift truck frame. Insert pivot pins and reinstall retaining capscrews and lockwashers, then torque to 35 to 39 lb-ft. Reinstall lockwires.
3. Connect and properly secure the tilt cylinders.
4. Reinstall hydraulic hoses (including flow regulator and fittings).
5. Install the carriage. (Refer to CARRIAGE REPAIR MANUAL Module.)
6. Lubricate all web surfaces at the mast uprights with specified lubricant.
7. Adjust lift chains for 20-55 Series using paragraph H.

H. LIFT CHAIN ADJUSTMENT (20-55 SERIES)

When it becomes apparent that the carriage is not level, that the lift chains are loose, or the forks (or attachments) are higher than .25" to .50" above the floor, then the lift chains require adjustment.

1. Position mast assembly so it is vertical. Ensure that the inner mast and the lift cylinders are in the fully lowered position.

NOTE
All cluster cylinders are adjusted with the SINGLE cylinder in the fully extended position.

2. Loosen chain anchor locknuts (Fig 1-4).

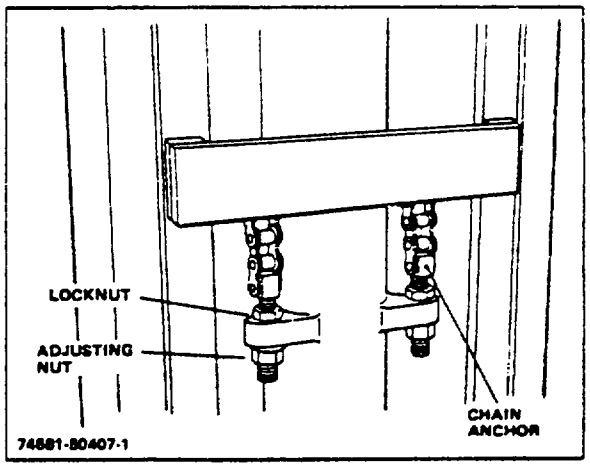


Figure 1-4. Chain Adjustment (on cylinder)

3. Chain tension is adjusted by increasing or decreasing chain lengths with the adjusting nuts. Alternately tighten or loosen the chain on one side and then on the opposite side until the chains are snug with no slack, and carriage forks (or attachments) are no higher than .25" to .50" off the floor.
4. Make certain that the carriage chain tension is equal and that the carriage is level. Also ensure that secondary chain tension is equal. Adjust as to preceding step 3.
5. After adjustment is completed, tighten locknuts securely and make certain anchors were not turned.

I. CHAIN LUBRICATION SERVICE

Approximately every 500 hours operation, remove the lift chains and clean them in an oil-solvent solution (50% SAE 30 non-detergent engine oil and 50% suitable cleaning solvent). Soak chains in oil-solvent solution for about four (4) hours, agitating them several times during the soaking period. Remove chains from solution and wipe off all oil-solvent solution. Inspect chains for wear or broken or cracked links. Replace entire chain if any links are broken or cracked. Install the chains. Then use a 1" paint brush and lubricate. both sides of chain with SAE-20 engine oil. Wipe off excess oil with a clean cloth. Refer to preceding PARAGRAPH H and adjust lift chains.

TOPIC 2. GLAND NUT REASSEMBLY

The gland nut can have a slotted or a grooved type wiper ring mounting (Fig 2-1). The slotted type mounting takes a steel re-enforced wiper ring. The grooved type mounting takes a flexible wiper ring. Observe direction of packing and wiper rings in associated exploded cylinder figures. Install packing and wiper ring on gland nut using the following steps; this procedure can also be used on gland nuts similar to the gland nut in Figure 5-1:

1. Install bearing (when applicable) in bore of gland nut. Compress packing together and feed end into bearing or gland nut bore. Release packing and use push rod to force inserted end of packing through bore and into gland nut groove. Install groove alignment plug through top of gland nut to secure packing. Force lower end of packing into groove with pusher rod (Fig 2-1). The groove alignment plug and the pusher rod can be made of soft metal or plastic.
2. Install flexible wiper rings, through top of gland nut bore, into grooved wiper ring mounting using same procedure in Step 1 but without grooved alignment plug. Steel reinforced wiper rings should be pressed into slotted wiper ring mounting.
3. Install backup ring and O-ring (in that order), on the OD of the gland nut. Use a small screwdriver to slip on rings, but do not over stretch rings.

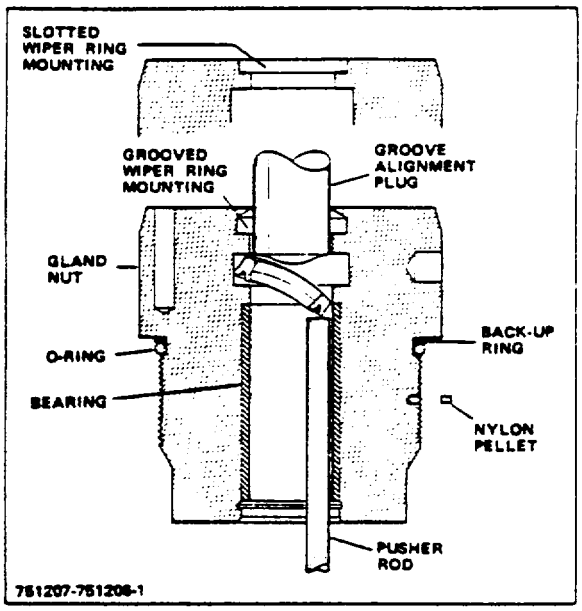


Figure 2-1. Gland Nut Packing Installation

4. Install retaining ring, through bottom of gland nut, to secure bearing.
5. Install nylon pellets into the holes provided along the threaded area of the gland nut (Fig 2-1).

TOPIC 3. INSTALLATION OF RUBBERNEK FITTINGS ON MAST CYLINDERS

Use the following steps and torque table for 37° flare and straight thread fittings in the GENERAL DATA MAINTENANCE MANUAL to install Rubberneck fittings on mast cylinders:

1. Assemble adapter fittings to cylinder. Tighten adapter fittings to recommended torque.
2. Assemble Rubberneck fitting(s) to cylinder using Figure 3-1, but do not tighten Rubberneck nut.
3. Assemble type "A" and "B" tubes to fittings.

   a. Type "A" tube has a brazed fitting on. one end (Fig 3-2).

   (1) Slip tube into Rubberneck fitting.
   (2) Thread nut of brazed fitting over male adapter on cylinder; tighten to its recommended torque.
   (3) Tighten O-ring of Rubberneck fitting to its recommended torque.
   (4) Tighten Rubberneck nut until it comes to a hard positive stop against the connector. There is to be zero clearance between the nut and the connector (Fig 3-3).

   b. Type "A" tube has a Rubberneck fitting on each end (Fig 3-2).

   (1) Slip the short end of the tube into the lower Rubberneck fitting.
   (2) Remove the nut from the upper Rubberneck fitting and slip over the long end of the tube.

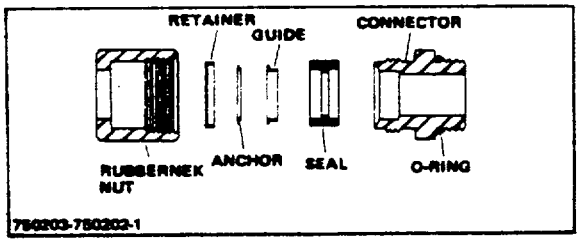


Figure 3-1. Rubberneck Fitting Assembly

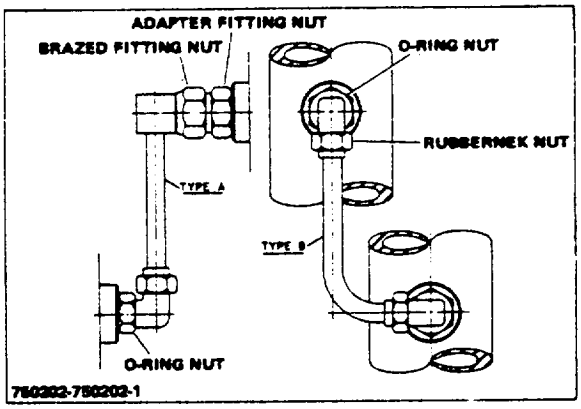


Figure 3-2. Type A and B Tube Assemblies

   (3) Swing tube and lower fitting, so that, longer end of the tube can be slipped into the upper fitting.
   (4) Apply pressure on the lower portion of tube until it bottoms within the fitting. Maintain pressure on the tube and tighten the Rubberneck nut until it comes to a hard, positive stop against the connector. There is to be zero clearance between nut and connector (Fig 3-3).
   (5) Tight O-ring nuts of both fittings to their recommended torque.
   (6) Apply pressure on the upper portion of tube until it bottoms within fitting. Maintain pressure on tube and tighten the Rubberneck nut until it comes to a hard, positive stop against connection. There is to be zero clearance between nut and connector (Fig 3-3).

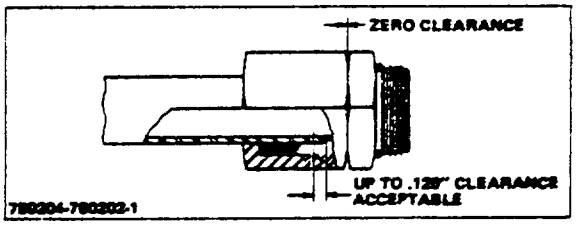


Figure 3-3. Assembled Rubberneck Fitting

TOPIC 4. LIFT CYLINDER REMOVAL AND INSTALLATION

A. REMOVAL-CLUSTER & SINGLE (20-55 SERIES)

NOTE
Cylinders must be in fully lowered position for removal.

1. Remove the carriage. (Refer to CARRIAGE REPAIR MANUAL.)
2. Disconnect lift chains from adjusting screws on cluster cylinder.
3. With cylinders completely retracted, disconnect the hydraulic line between the cluster cylinder and the single cylinder.

NOTE
Cap or plug all hydraulic openings to prevent entry of foreign particles.

4. Remove the screw and nut that secure the cluster cylinder to the inner and intermediate mast respectively.
5. Use a properly rated hoist and carefully lift cluster cylinder from the mast assembly.
6. Remove fittings and flow regulator from bottom of single cylinder.
7. Remove clamp that secures single cylinder to bottom of intermediate mast (if applicable).
8. Remove capscrew that attaches single cylinder to cylinder bracket at top of intermediate mast. Remove nut and washer that secure single cylinder to bottom of outer mast.
9. Use a properly rated hoist and lift single cylinder from mast and place it on appropriate supports for disassembly and repair.

B. INSTALLATION (20-55 SERIES)

⚠ CAUTION
Always handle cylinders in the fully retracted position to avoid scratching the ram surface.

1. Attach a properly rated hoist to the single lift cylinder and carefully maneuver the cylinder into its mounting position.
2. Install and secure the washer and nut that attach the single cylinder to bottom of the outer mast. Install capscrew that attaches single cylinder to cylinder bracket at the top of the inner mast. Torque locknut at bottom of outer mast to 170 to 187 lb-ft. Remove hoist from cylinder.
3. Install all fittings and clamps previously removed from cylinder, including flow regulator (Fig 1-1 or 1-2).
4. To install the cluster cylinder assembly, first ensure that the crosshead assemblies have been correctly installed (if removed) at the outer cylinder rams.
5. Attach a properly rated hoist to cluster cylinder and maneuver cluster assembly into its mounting position within the inner and intermediate masts.
6. Install capscrew that secures cluster cylinder to top of inner mast. Install clamp and capscrews that secure cluster assembly to bottom of intermediate mast.
7. Install washer and locknut to bottom of intermediate mast. Torque locknut to 170 to 187 lb-ft.
8. Install hydraulic line between cluster and single cylinder using Topic 3 for installation of Rubberneck fittings.
9. Install lift chains at cluster cylinder chain anchors.

NOTE
Perform procedures as outlined in paragraph H of TOPIC 1, prior to operational use of lift truck.

10. Install the carriage.

NOTE
Refer to LIFT CYLINDER BLEED SERVICE in following Paragraph C.

C. LIFT CYLINDER BLEED SERVICE

It is generally good practice to bleed lift cylinders after repair or when erratic cylinder operation is noticed. It is suggested to bleed the lift cylinders in the morning before a days use, after sitting all night. This allows small air bubbles to surface, and provides for better bleeding.

1. Raise Mast until forks (or attachment) are approximately 3 feet off the floor.
2. Open bleed screw(s) until a stream of pure hydraulic oil comes out.

NOTE

Be sure that the oil being emitted is free of any bubbles that may only be seen under close inspection. Leave bleed screw(s) open until a PURE stream of HYDRAULIC OIL is emitted.

3. Close bleed screw(s).
4. Check hydraulic oil level. Fill, if required, with pre-filtered specified oil.
5. Raise and lower mast to check for leaks, and repair as necessary.

D. 50 HOUR SERVICE

After each 50 hours of operation, inspect the mast lift cylinder, hoses, and fittings for evidence of leaks; repair as necessary.

TOPIC 5. LIFT CYLINDER (20-55 SERIES)

A. DISASSEMBLY-INSPECTION

1. Remove the lift cylinder. (Refer to preceding Topic 4.)
2. Remove the gland nut (Fig 5-1) and spacer from tube with a spanner wrench.
3. Remove wiper ring, back-up ring, O-ring, packing, and nylon pellets from gland nut.
4. Carefully slide long or short rod from cluster tube and remove wear ring from rod.

⚠ CAUTION

Always use care when handling the rod so that it will not be nicked or damaged.

5. Clean all metal parts in a suitable solvent. Inspect parts for wear or damage.
6. Remove any nicks or scratches with crocus cloth or a honing stone; replace all unserviceable parts.
7. Examine packings and wiper for scores, folded edges, or worn or torn sections.

NOTE

Always replace all packing sets, O-rings, back-up rings, and wiper rings, regardless of the condition. Be certain cluster tube is clean and free of foreign matter.

NOTE

Disassemble and repair remaining cylinders (including single cylinder) in same manner.

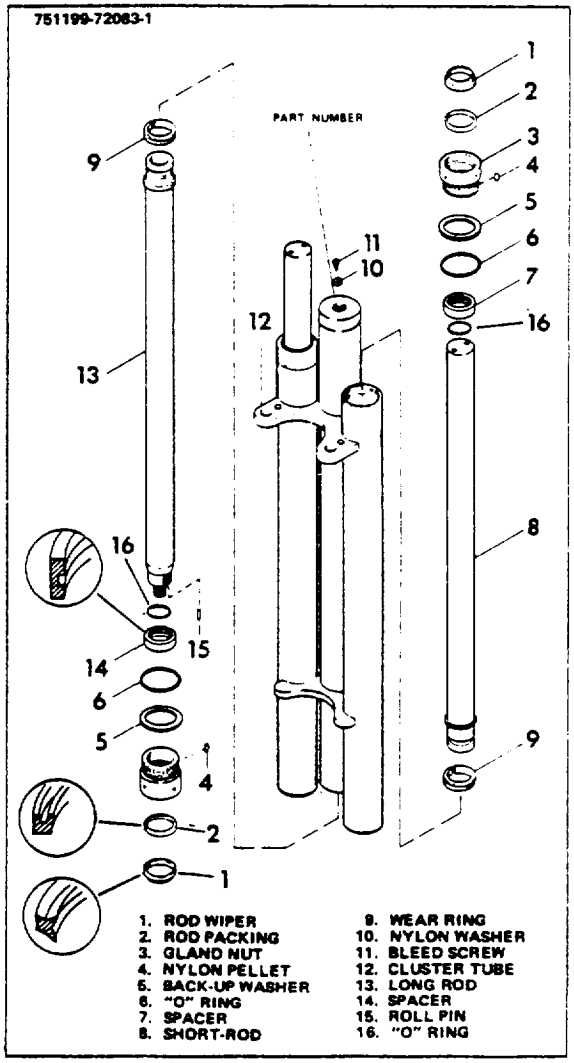


Figure 5-1. Lift Cylinder Cluster

B. REASSEMBLY

1. Refer to Figure 5-1 and place wear ring on rod.
2. Ensure that all parts and rod are free of any foreign matter and insert rod into tube.
3. Install packing and wear ring in gland nut.
4. Install O-ring and back-up ring to gland nut. Insert nylon pellets in gland nut.
5. Install spacer over rod and install gland nut. Tighten gland nut into tube.
6. Reassemble remaining cylinder in same manner.
7. Refer to TOPIC 4 and reinstall lift cylinder.

TOPIC 8. WELDING REPAIR PROCEDURE

For various applications in the mast assembly, specially treated metals are used. Care must be taken when these metals are repaired or replaced by welding. Figures 6-1 and 6-2 illustrate the manner in which the welding is to be performed.

Prepare welding surface by removing all foreign material such as rust, scale, grease, etc. Any part that may be damaged by heat should be removed before welding.

After welding is completed, remove all slag, weld spatter, and excessive weld material.

A. REPAIR WELDING MAST ROLLER STUDS

Process.....Shielded Metal Arc
Equipment.....Manual
Settings:
  Current.....A C
  Amps.....275/325
  Volts.....31/33
Base Metals.....(1) AC 1035-P1
  (2) AC 86-L-20-H (roller stud)
Plate Thickness Range.....3/8" - 1"
Electrode:
Type.....Stick
Class.....E 7018 (hydrogen free)
Size.....3/16"
Flux.....Electrode Covering
Weld Type and Size.....1/4" Fillet
Number of Passes.....1
Position.....Horizontal
Preheat.....400°F
Interpass.....250°F
Postheat.....None

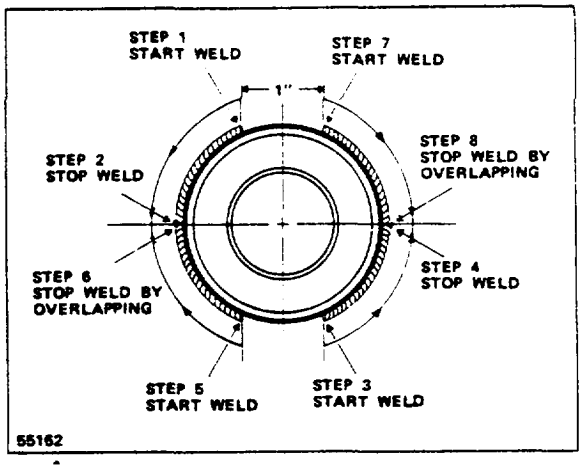


Figure 6-1. Roller Stud Welding Procedure

B. INSPECTION

1. Finished weld should be magnafluxed for defects.
2. The weld defect shall be explored by removing material with a pencil grinder in 0.010" - 0.020" deep passes (length to dept ratio of 4:1). Visually inspect for defect after each pass and magnaflux to confirm disappearance.

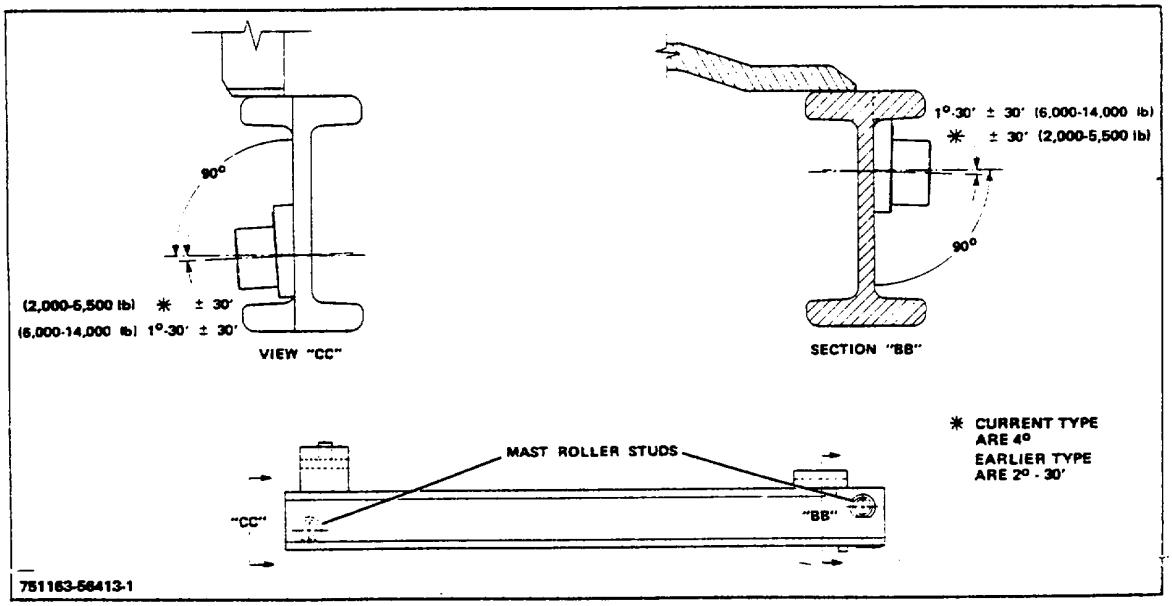


Figure 6-2. Mast Roller Stud Location (Canted Roller Type)

TOPIC 1. REMOVAL AND INSTALLATION

A. CARRIAGE REMOVAL-(EXTRA-LIFT & HIGH-FREELIFT 3,500-12,000 lb & ALL TRI-MAX)

1. Place two pieces of wood approximately 2" thick underneath forks (or attachments) (one towards the front of the forks and one underneath the carriage frame.
2. Remove carriage stop capscrews (or stop if applicable).
3. Remove lift chain anchor pins (or connecting link, if applicable), and remove chains from carriage.
4. Make certain all attachments are disconnected between the carriage and the mast. With key ON, operate lift lever and raise inner mast nigh enough so bearings clear inner mast uprights.

B. CARRIAGE INSTALLATION (EXTRA LIFT A HIGH FREE 3,500-12,000 lb & ALL TRI MAX)

1. With carriage resting on wooden blocks, raise inner mast high enough for carriage bearings to clear inner mast uprights.
2. Then position lift truck so that inner mast uprights are directly centered over carriage bearings. Slowly lower inner mast making sure carriage bearings slide into inner mast uprights.
3. Reinstall carriage stop capscrews (or stop, if applicable).
4. Reinstall lift chain anchor pins (or connecting link, if applicable), and reinstall lift chains.

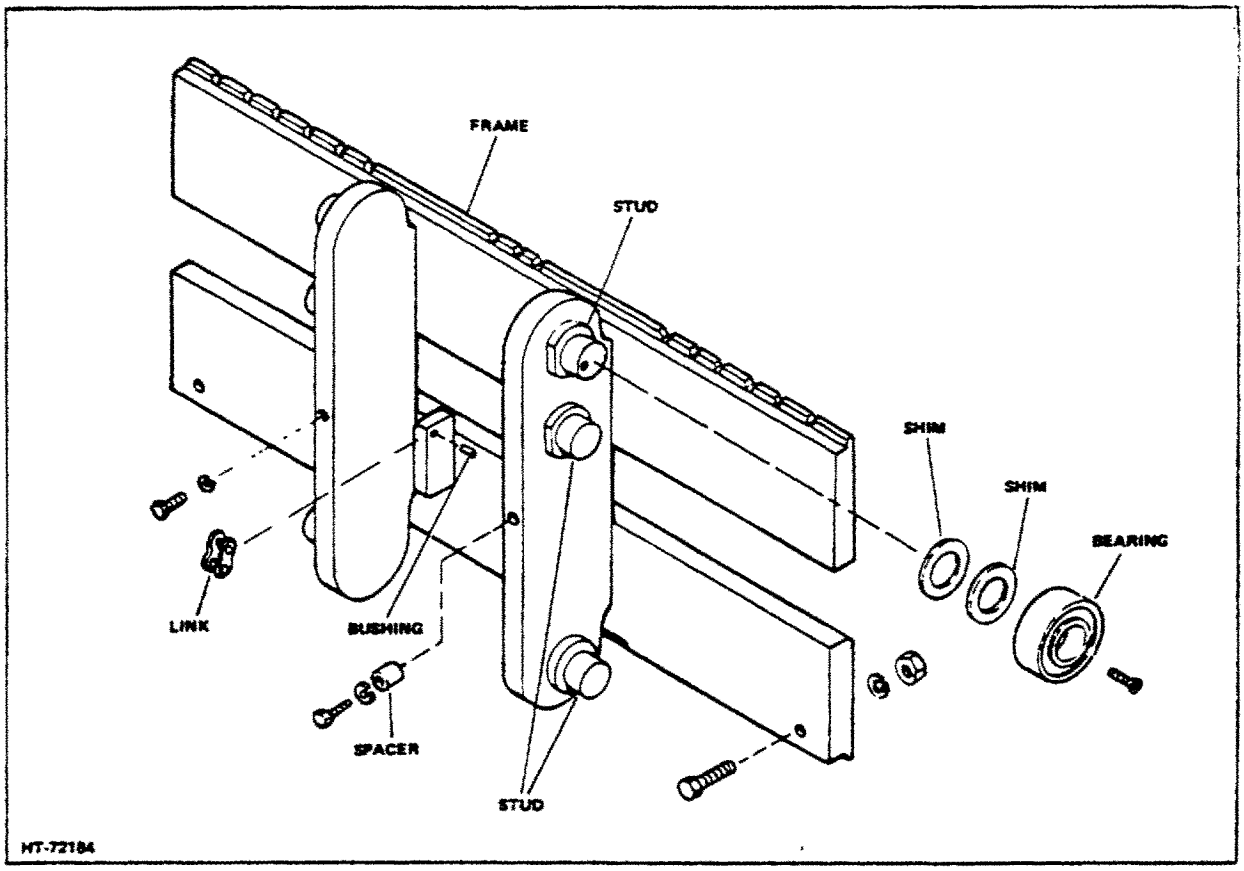


Figure 1. Hook Type Carriage Assembly (Typical)

TOPIC 2. CANTED BEARING TYPE

A. DISASSEMBLY

1. To disassemble the canted bearing type carriage, first refer to Topic 1 and remove the carriage.
2. Remove bearings and shims from roller studs (Fig 1).

NOTE
The top bearing on all three bearing type carriages is retained by a screw. The screw must be removed before removing bearing and shims.

3. Using a drift pin, remove bushing from chain anchor. Examine for wear.
4. Remove all capscrews, spacers, lockwashers, and nuts from carriage frame and check for cracks and damaged threads. Replace as necessary.
5. Inspect bearings for excessive wear or damage. Also inspect for cracked inner and outer races. Replace bearing if any of the conditions exist.
6. Inspect roller studs for excessive wear or damage. Replace any stud, if necessary. (Refer to Topic 8, WELDING REPAIR PROCEDURE).
7. Check carriage frame for damaged or bent sections and broken welds.

B. REASSEMBLY

1. Reinstall all capscrews, spacers, lockwashers and nuts previously removed.
2. Install bushing in chain anchor.

NOTE
Seam of bushing must be facing downward so lift chain does not spread bushing during operation.

3. Reinstall all bearings and their appropriate shims to their respective roller studs.
4. Install bearing retainer on top bearing to a snug fit.

NOTE
Refer to following PARAGRAPH C, ADJUSTMENT, before installing carriage.

5. After adjustment of carriage, refer to Topic 1 and reinstall carriage.

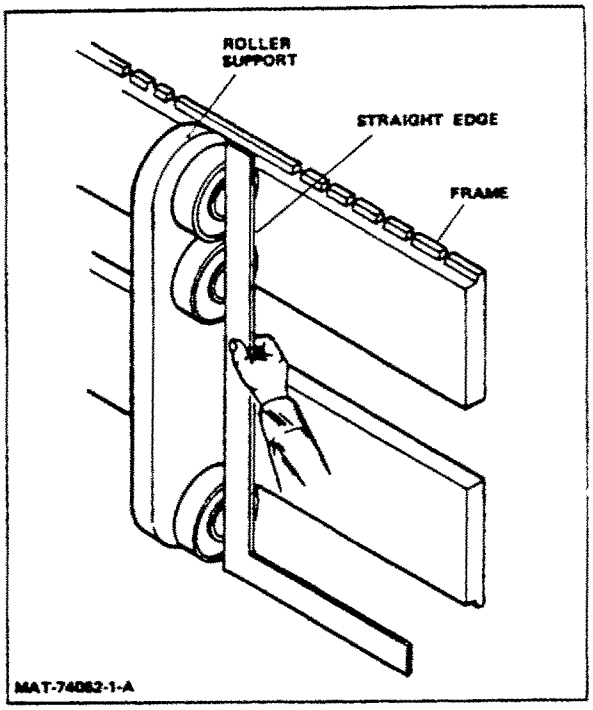


Figure 2. Checking Bearing Alignment

C. ADJUSTMENT

1. Use an inside spanning tool and check inside of web of inner mast assembly and determine narrowest point where bearings contact inner mast uprights.
2. Set outside spanning tool to match inside spanning tool. Lock tool in position.
3. Install bearings on roller studs on carriage. Span bearings on carriage assembly at the maximum camber point with outside spanning tool. Span all three sets of bearings. Shim bearings to produce maximum .015 inch clearance with spanning tool.
4. To check bearing alignment, place a straightedge against stud centerline to all three bearings on both sides of carriage assembly. No visible gap should be seen between bearings and the straightedge (Fig 2).

NOTE
Some canted bearing type carriages also use an additional eccentric roller type adjustment. Refer to TOPIC 4, to adjust eccentric rollers after adjustment of canted bearings.

TOPIC 5. SIDE SHIFTER

A. REMOVAL-INSTALLATION

First disconnect hydraulic hoses at junction block on carriage frame, then refer to TOPIC 1 and perform the appropriate removal or installation procedure.

B. DISASSEMBLY

NOTE

For disassembly of the carriage frame refer to the appropriate carriage topic depending on the type used.

1. To disassemble side shifter, first disconnect and plug the hydraulic hoses from the side shift cylinder to prevent entry of foreign particles.
2. Disconnect side shift cylinder from side shift plate by removing retaining pin and cotter pin.
3. Attach a suitable hoist to side shift plate and take up slack in chain.
4. Slide side shift plate off right side of carriage frame (when facing the carriage) and move it to desired repair location.
5. Remove lower hanger bars.
6. Pry off wear strips at bottom of side shift and too of carriage plates. Wear strips and wear angles should be replaced when worn to a thickness of .063".
7. Check all wear strip and wear angle mating surfaces for nicks, foreign material or any high spots. Repair or replace as necessary.

C. REASSEMBLY

1. Reinstall wear strips and wear angles by snapping into holes provided. Lubricate all wear strips and angles with a light coat of a Grade 2 lithium base grease (characterized by the word "Moly").

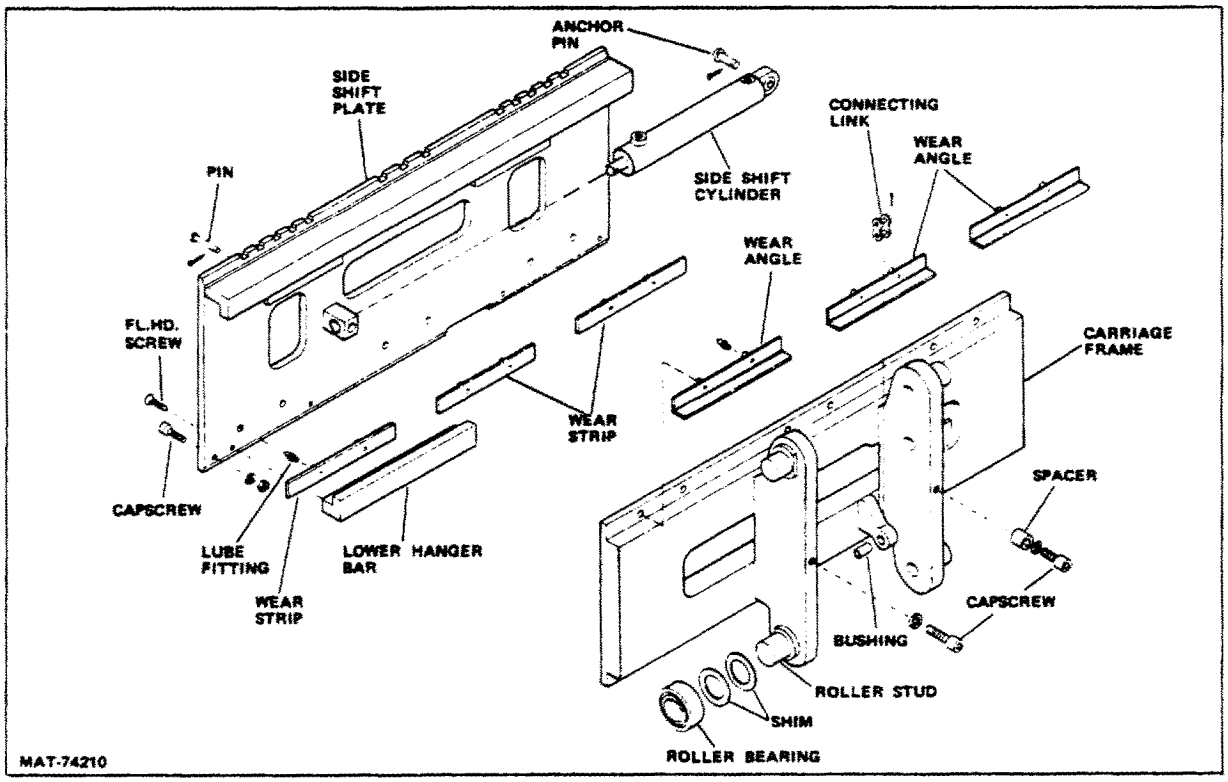


Figure 3. Side Shifter Components (Typical)

2. Use a suitable hoist and lift side shift plate to relative mounting position at right side of carriage frame (when facing carriage).
3. Carefully slide side shift plate onto carriage frame.
4. Reconnect side shift cylinder plunger to side shift plate by reinstalling retaining pin and cotter pin.
5. Reconnect hydraulic hoses to cylinder.
6. Reinstall lower hanger bars. Torque capscrews to required value; see tabulation below.

CAPSCREW SIZE	TORQUE VALUE
.38"-16 x 1.25"	28-33 lb-ft
.38"-16 x 1.50"	28-33 lb-ft
.50"-13 x 1.50"	68-73 lb-ft
.63"-11 x 1.75"	125-135 lb-ft

7. Lubricate all pressure lube fittings on side shifter unit.

D. ADJUSTMENT

Refer to appropriate carriage adjustment topic for the adjustment of the type carriage used.

NOTE

If carriage frame is the canted bearing type, it must be adjusted before installation.

TOPIC 6. SIDE SHIFTER CYLINDER

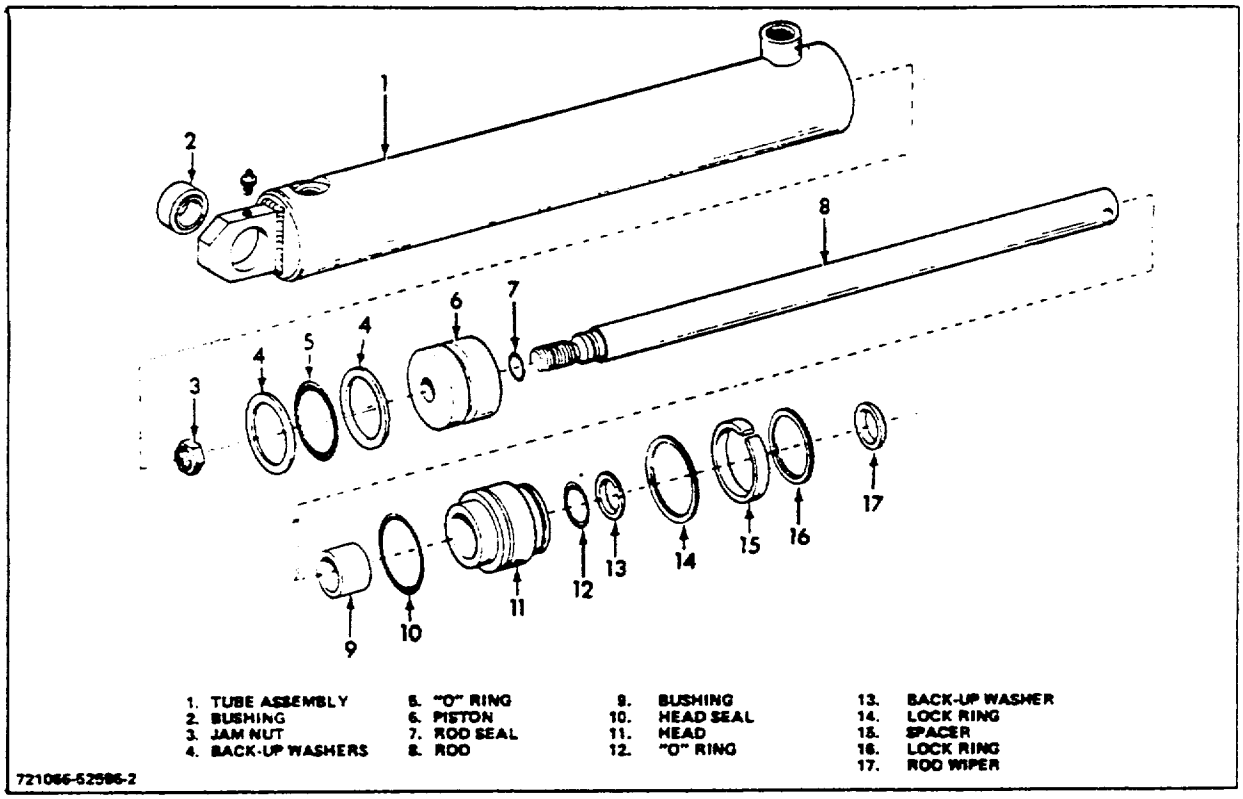


Figure 4. Side Shifter Cylinder

A. REMOVAL

1. Remove cotter pin and rod pin from cylinder rod.
2. Retract cylinder rod far enough to clear rod retainer on side shift plate.
3. Disconnect hydraulic hoses from cylinder. Plug cylinder ports and hydraulic hose ends to prevent entry of foreign material.
4. Remove cotter pin and cylinder retainer pin and lift out cylinder.

B. DISASSEMBLY

1. Remove lock ring securing spacer in position then remove spacer.
2. Compress lock ring holding head to tube and remove from cylinder.
3. Remove remaining internal components by carefully pulling on rod.
4. Carefully slide head off end of rod.

NOTE

Ensure that rod is free of any burrs which may damage bushing in head while removing head from rod.

5. Remove nut securing piston to rod. Slide .piston off end of rod.
6. Remove back-up washer and O-ring from piston. Remove rod seal from rod.
7. Remove head seal, lock ring, O-ring and back-up washer from head.
8. Old head bushing may be pressed out with a new bushing after head is cleaned. (Refer to PARAGRAPH D, REASSEMBLY.)
9. Check bushing and lube fitting at end of tube assembly, if damaged replace.

C. INSPECTION

Inspect tube bore, rod head, and piston for cracks, scratches, scoring and other possible damage. Repair or replace any components that are worn or damaged.

D. REASSEMBLY

Clean all components in a suitable solvent making certain all dirt and contaminants are removed. Prior to assembling, coat each component with clean hydraulic oil to facilitate installation and to provide initial lubrication.

1. Install rod seal on rod.

NOTE

When installing seals and O-rings, be careful not to damage them on threads or sharp edges. Always use new O-rings whenever cylinder is serviced.

2. Position back-up washer and O-ring within piston. Install piston on rod and secure with nut.
3. Install O-ring and back-up washer in head. Position head seal, large lock ring, spacer and small lock ring on head.
4. Carefully slide piston and roc assembly into tube.
5. Position head assembly over rod and compress large lock ring. Slide head assembly (with lock ring compressor, into tube until lock ring snaps into groove in tube.

E. INSTALLATION

1. Insert cylinder end with self-aligning bearing into anchor on carriage plate. Secure with retainer pin and new cotter pin.
2. Connect hydraulic hoses to cylinder.
3. Connect cylinder plunger to side shift plate after plate has been installed. (Refer to Topic 3, PARAGRAPH C.)
4. Lubricate pressure lube fitting on cylinder.

TOPIC 7. FORKS

A. DESCRIPTION

Basically, there are two types of forks, the shaft style which pivots on a horizontal support shaft, and the more commonly used hook style fork (Fig 5) which hooks into notches along the top edge of the fork carriage. The standard or hook type fork will be discussed here. Any differences will be noted in shaft type removal and installation.

The forks should always be adjusted on the carriage to obtain the optimum balance in proportion to the width of the anticipated loads.

A fork lock(Fig 6) is installed in the top of each of the hook type fork to hold it in

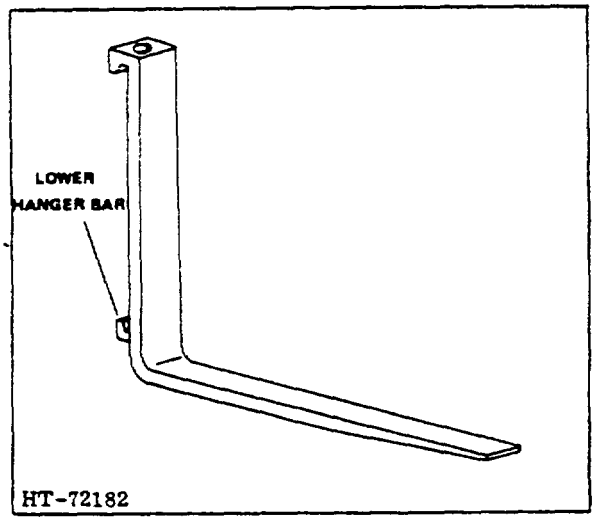


Figure 5. Hook Type Fork

position in one of the notches along the top bar of the carriage. To change the fork location, pull up on the lock and move fork to the left or right. Allow fork lock to seat in the notch nearest to location chosen. The forks can be removed from the carriage by releasing the locks and aligning each fork with the wide removal slot (see Figure 10) at the bottom of the fork carriage.

⚠ WARNING

Naturally, the weight of each fork depends upon its size. Therefore, exercise caution while fork is being removed from the carriage to avoid injury to personnel and to prevent damage to the equipment.

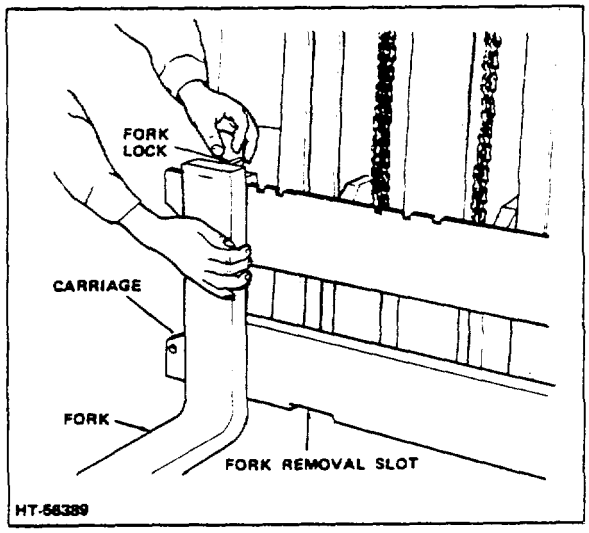


Figure 10. Fork Adjustment and Removal

B. REMOVAL

1. Hook Type
   a. Lower fork carriage until base of fork just clears the floor.
   b. Release the fork lock pin and slide fork to a position over the cut-out in the lower carriage bar (Fig 10).
   c. Tilt the lower portion of the fork forward and up to release the lower hanger (Fig 9) from the lower carriage bar.
   d. Refer to CAUTION in preceding Paragraph A; lift fork off upper carriage bar.

C. SERVICE

1. Inspect hook fork and locking mechanism for any evidence of wear or damage.
2. If locking mechanism is worn or damaged, remove and replace it as a unit.
3. If fork is defective, then replace with same type and capacity rated fork.

D. INSTALLATION

1. Hook Type
   a. Carefully lift fork up onto upper carriage mounting slot, then slowly lower until back of fork rests against carriage face and fork lower hanger bar passes through lower carriage cutout.
   b. Release the fork lock pin and slide fork left or right until properly positioned for anticipated load clearance/balance requirements.

TOPIC 8. WELDING REPAIR PROCEDURE

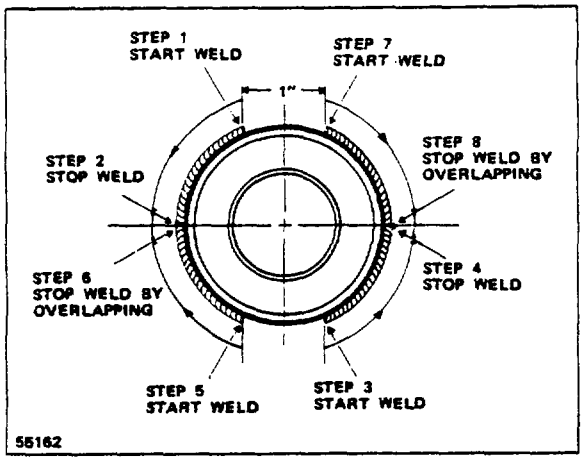


Figure 7. Roller Stud Welding Procedure

For various applications in the mast and carriage assemblies, specially treated metals are used. Care must be taken when these metals are repaired or replaced by welding. Figures 7 and 8 illustrate the manner in which the welding is to be performed.

Prepare welding surface by removing all foreign material such as rust, scale, grease, etc. Any part that may be damaged by heat should be removed before welding.

After welding is completed, remove all slag, weld spatter, and excessive weld material.

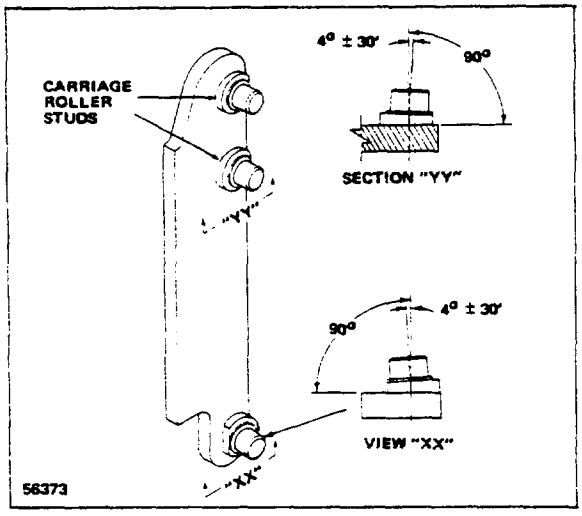


Figure 8. Carriage Roller Stud Location (Canted Roller Type) 3,000-5,500 lb W/4O Canted Studs

A. REPAIR WELDING CARRIAGE ROLLER STUDS

Process.....Shielded Metal Arc
Equipment.....Manual
Settings:
- Current.....A C
- Amps 275/325
- Volts 31/33

Base Metals .....(1) AC 1035-P1
(2) AC 86-L-20-H (roller stud)
Plate Thickness Range.....3/8"-1"
Electrode:
- Type. .....Stick
- Class .....E 7018 (hydrogen free)
- Size.....3/16"
- Flux. .....Electrode Covering

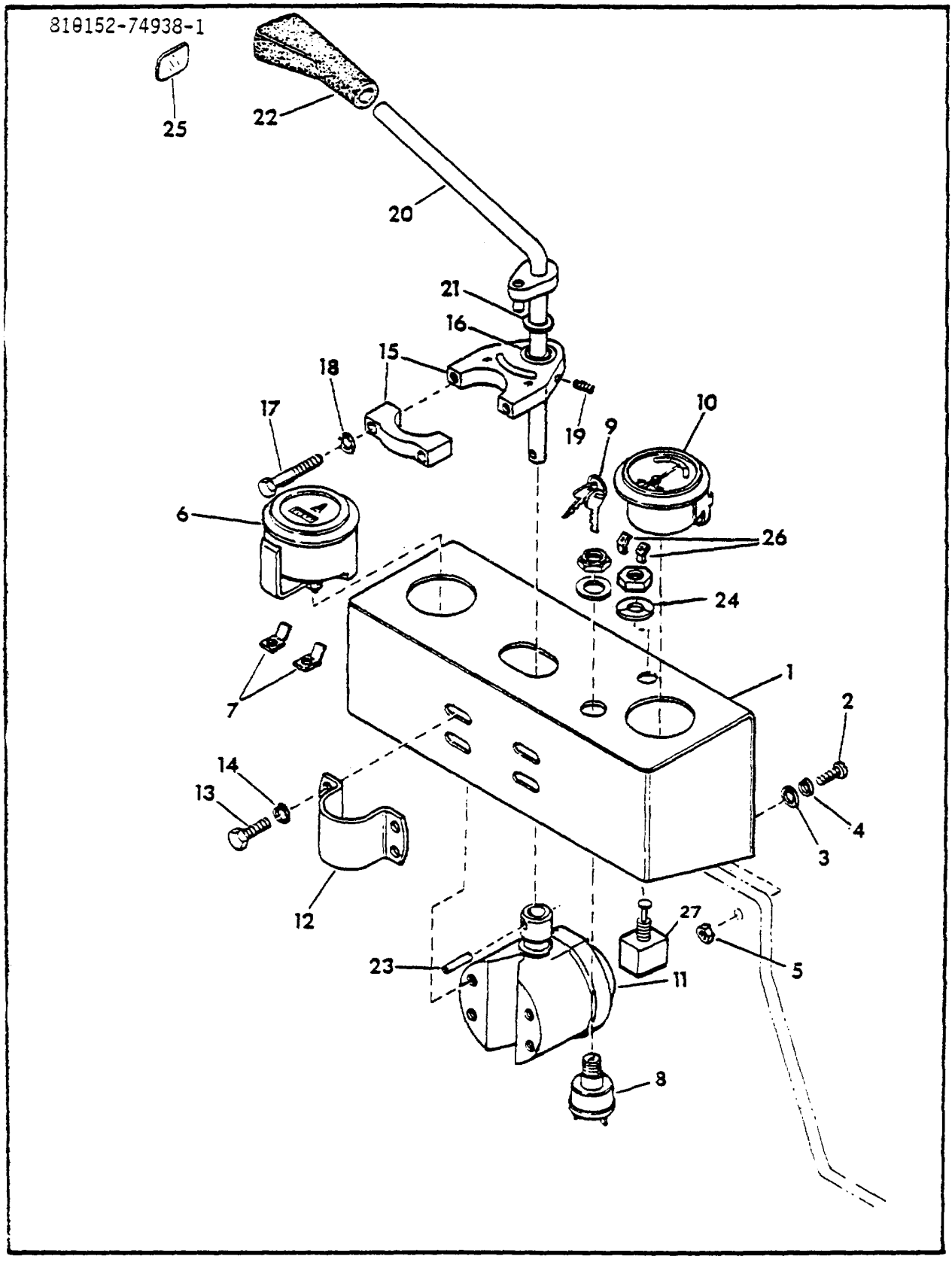
Weld Type and Size.....1/4" Fillet
Number of Passes 1
Position.....Horizontal
Preheat .....400°F
Interpass.....250°F
Postheat.....None

B. INSPECTION

1. Finished weld to be magnafluxed for defects.
2. The weld defect shall be explored by removing material with a pencil grinder in 0.010"-0.020" deep passes (length to depth ratio of 4: 1). Visually inspect for defect after each pass and magnaflux to confirm disappearance.

CHAPTER 4
REPAIR PARTS AND SPECIAL TOOLS LIST

PARTS LIST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INSTRUMENT PANEL

ITEM	PART NO	QTY	DESCRIPTION	
1	4867844-5	1	PANEL-INSTRUMENT	
2	0925944-1	2	SC-.31-18X1.25	
3	0918265-0	2	WSHR-.31	
4	0917356-8	2	LKW-.31	
5	0917372-5	2	NUT-.31-18	
6	8615366-5	1	HOURMETER	
7	4835839-4	2	KLIPTITE	
8	4809363-7	1	SWITCH-KEY	
9	4996516-3	1	.KEY	
10	8615365-7	1	INDICATOR-BATTERY DISCHARGE	
11	4897034-7	1	SWITCH-DIRECTIONAL	SEE PAGE 5
12	4852873-1	1	CLAMP-SWITCH	
13	0923341-2	4	CPSC-.25-20X.75	
14	0916964-0	4	LKW-.25	
15	4852870-7	1	BRACKET AY-F/R LEVER	
16	4827962-4	1	.BEARING-NYLON	
17	0922837-0	2	.CPSC-.25-20X1.50	
18	0916964-0	2	.LKW-.25	
19	0930314-0	2	STSC-#10-24X.50	
20	4850543-2	1	LEVER AY-SHIFT	
21	0924360-1	1	WSHR-.53X1.00	
22	8615330-1	1	KNOB-CONTROL	
23	0921469-3	1	PIN-.22X1.00	
24	4727352-9	1	PLATE-SWITCH	
25	8617635-1	1	LENS	
26	4897041-2	2	TAB-MALE-.25	
27	4724733-3	1	SWITCH-LIGHTS	

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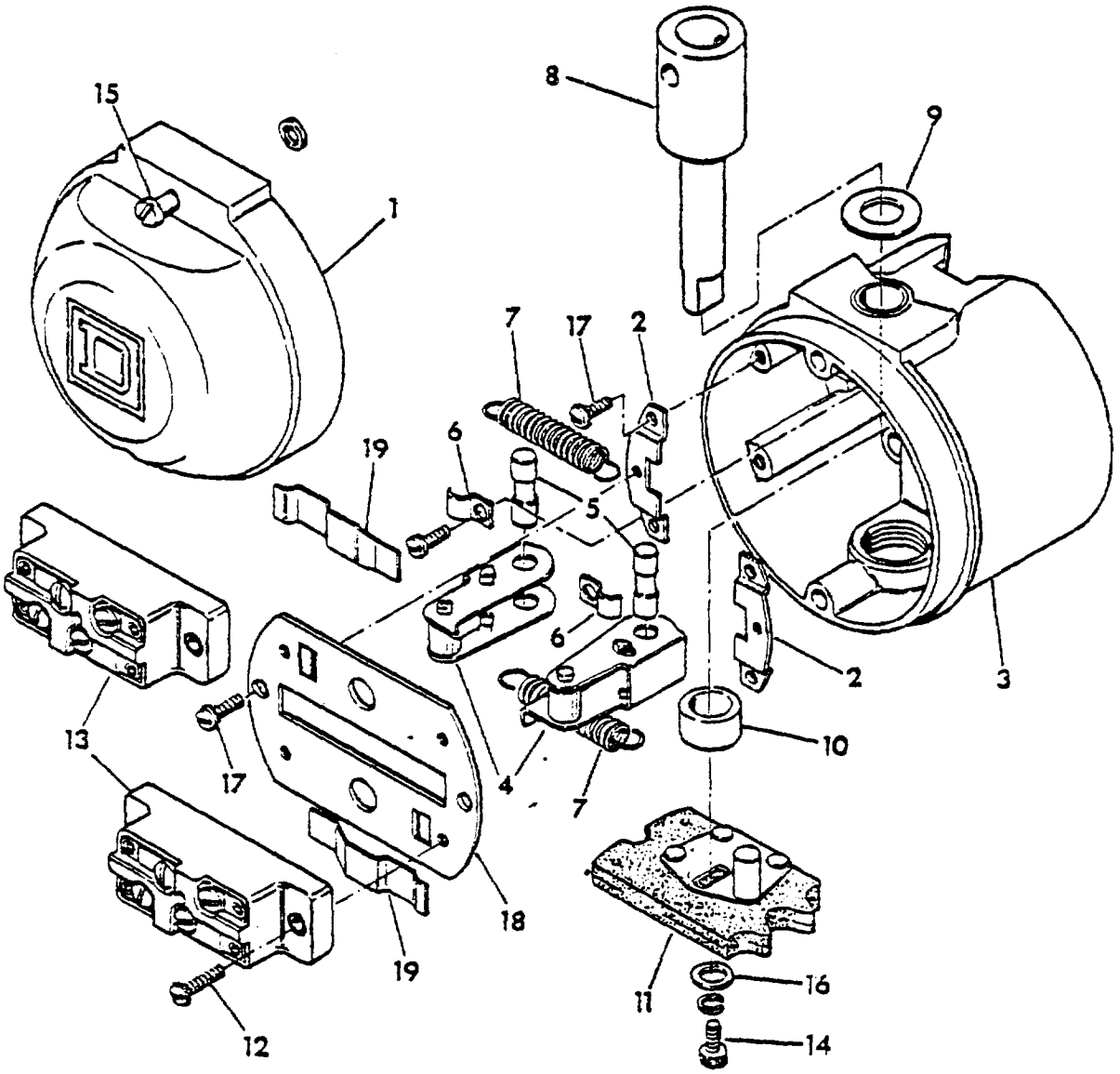

DIRECTIONAL SWITCH-4897034-7

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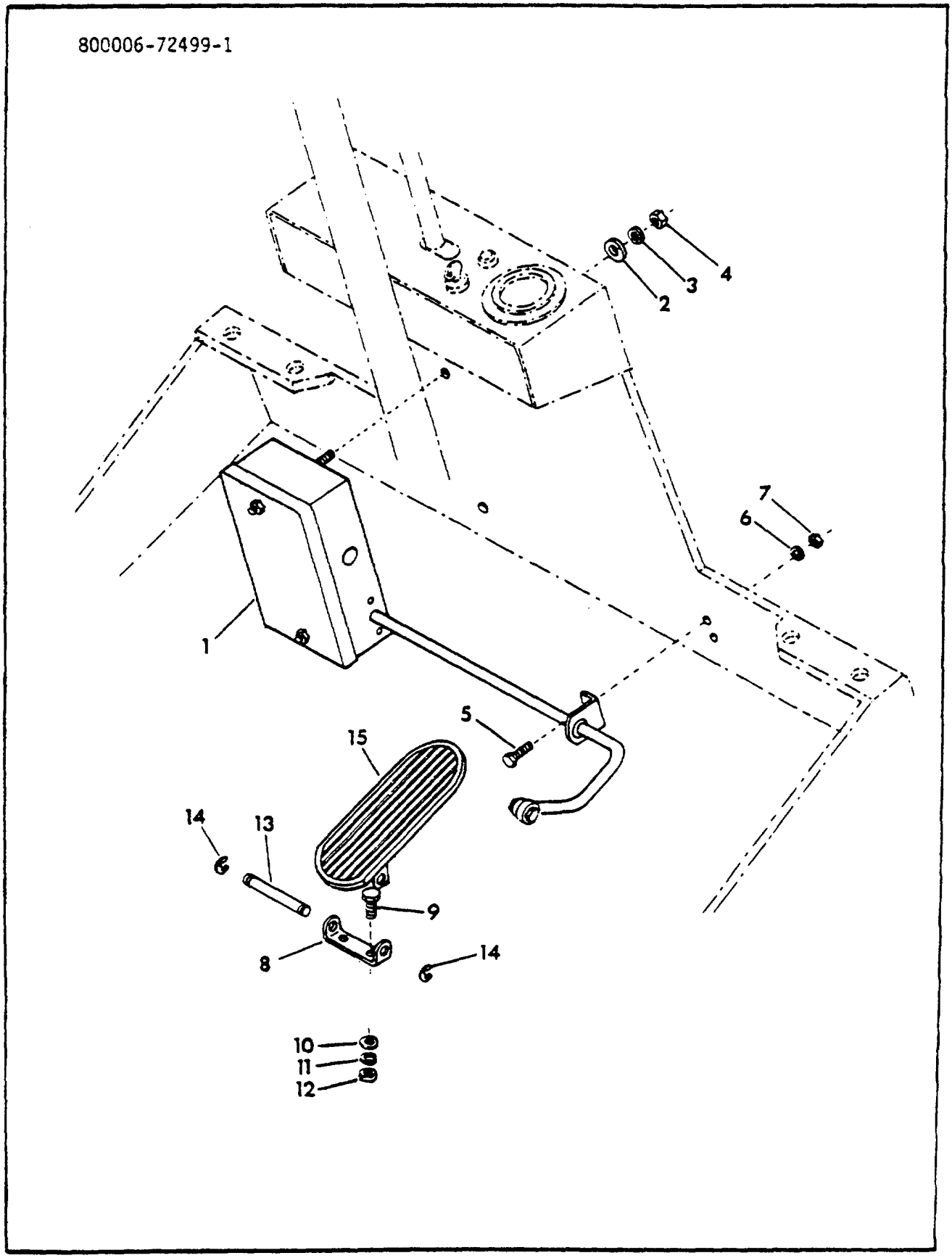
1	4914230-0	1	COVER	
2	4913473-7	2	BRACKET-HOUSING	
3	4914231-8	1	BEARING-HOUSING	
4	4914232-6	2	ARM AY-ROLLER	
5	4914233-4	2	PIN-HINGE	
6	4994145-3	2	CLIP	
7	4994146-1	2	SPRING	
8	4914234-2	1	SHAFT-OPERATING	
9	4913476-0	1	WASHER	
10	4914235-9	1	SPACER	
11	4914236-7	1	CAM	
12	4914260-7	4	SCREW AY-#6-23 X .44	INCL LKW
13	4889905-8	2	SWITCH	
14	4914256-5	1	SCREW AY-#8-32 X .38	INCL LKW
15	4914257-3	2	SCREW AY-#10-32 X .75	INCL WASHER
16	0916955-8	1	WSHR-#8	
17	4914254-0	6	SCREW AY-#6-32 X .31	
18	4913478-6	1	BRACKET	
19	4913479-4	2	LEVER	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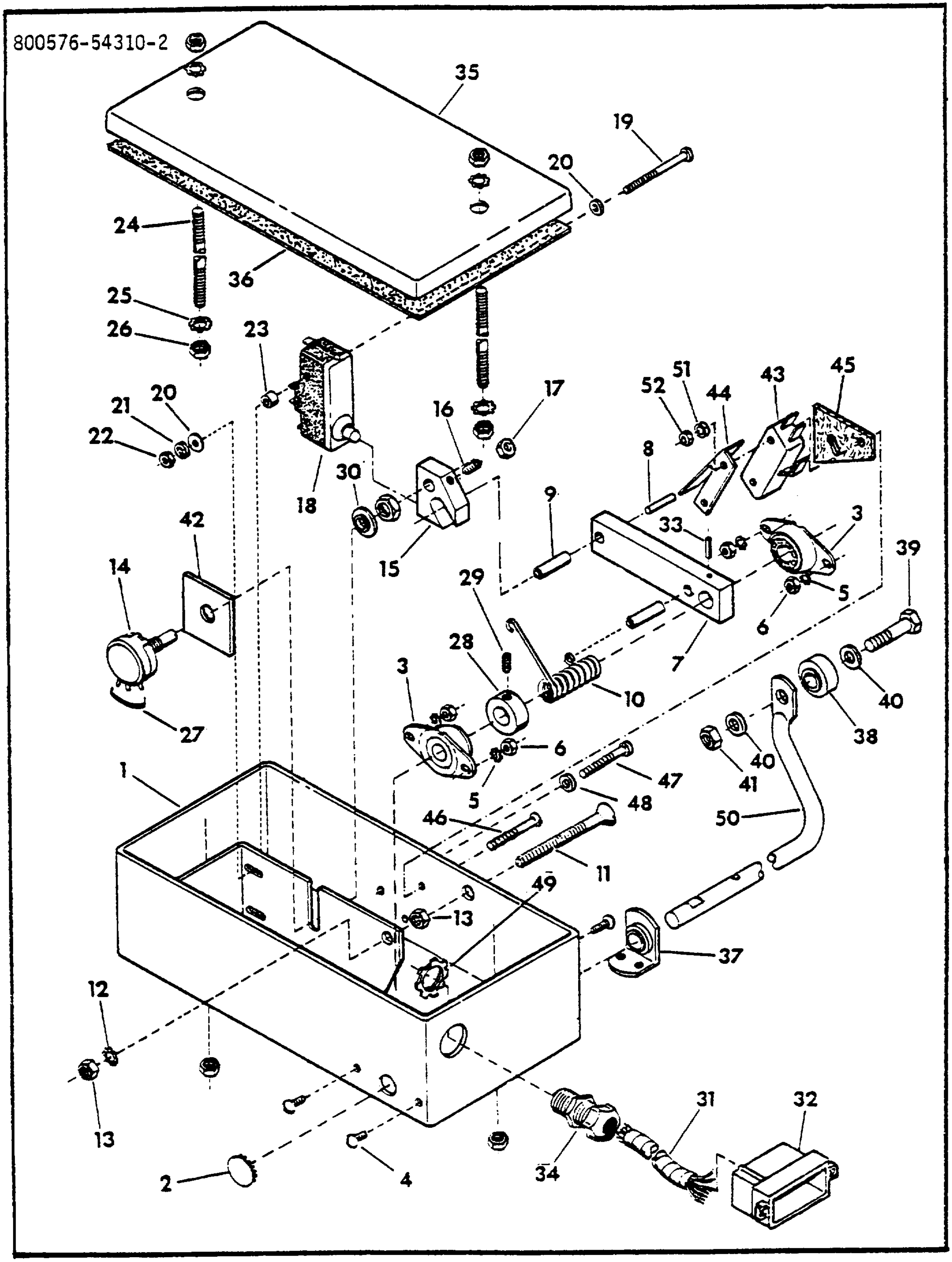
SPEED CONTROL

ITEM	PART NO	QTY	DESCRIPTION	
1	4894146-2	1	BOX AY-SPEED	SEE PAGE 9
2	0918265-0	2	WSHR-.31	
3	0920426-4	2	LKW-ET-.31	
4	0920263-1	2	NUT-.31-24	
5	0918158-7	2	SC-.25-20X1.00	
6	0916964-0	2	LKW-.25	
7	0916622-4	2	NUT-.25-20	
8	4735718-1	1	BRACKET	
9	0923341-2	2	CPSC-.25-20	
10	0917377-4	2	WSHR-.25	
11	0916964-0	2	LKW-.25	
12	0916622-4	2	NUT-.25-20	
13	4774640-9	1	PIN	
14	4255183-8	2	RING-E	
15	4765514-7	1	PEDAL	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SPEED CONTROL BOX-4894146-2

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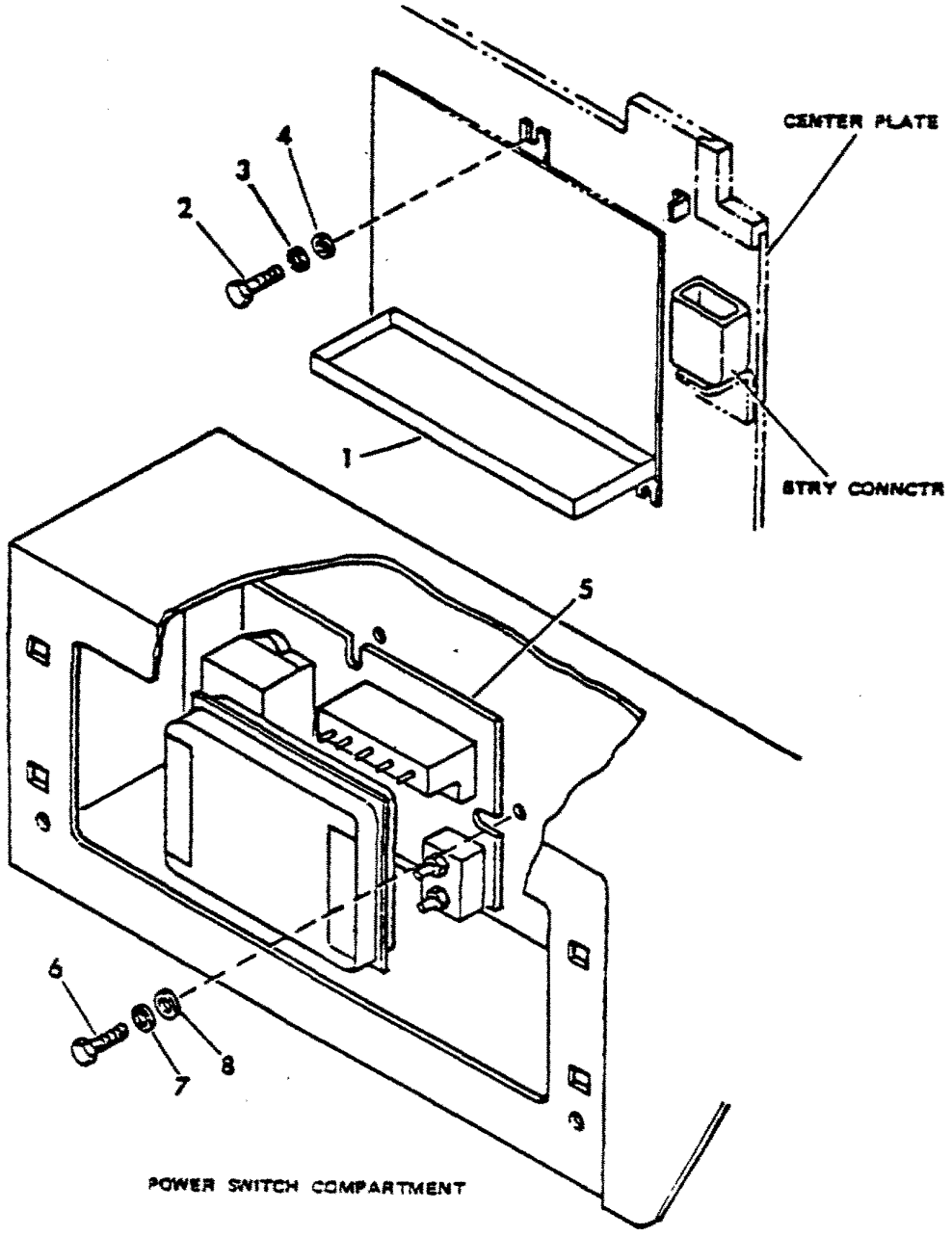
1	4861816-9	1	BOX AY-SPEED CONTROL	
2	0918377-3	2	PLUG-BUTTON-.62	
3	4802669-4	2	BEARING-FLANGE	
4	0918146-2	4	SC-#10-32X.38	
5	0922711-7	4	LKW-ET-#10	
6	0917415-2	4	NUT-#10-32	
7	4862174-2	1	ARM AY	
8	0916872-5	1	.PIN-.16X.75	
9	0925168-7	2	..PIN-.31X1.25	
10	4806104-8	1	SPRING	
11	0929553-6	1	SC-.31-18X2.75	
12	0929361-4	1	WSHR-.31X.63	
13	0917372-5	2	NUT-.31-18	
14	4824309-1	1	POTENTIOMETER-25K	
15	4861072-9	1	ACTUATOR	
16	0912235-9	1	STSC-.25-20X50	
17	0920435-5	1	NUT-JAM-.25-20	
18	4799828-1	1	SWITCH	
19	0925654-6	2	SC-#6-32X1.50	
20	0917458-2	4	WSHR-.16X.38	
21	0917459-0	2	LKW-6	
22	0917479-8	2	NUT-#6-32	
23	4799824-0	2	SPACER	
24	4883584-7	2	ROD	
25	0920426-4	4	LKW-ET-.31	
26	0920263-1	4	NUT- .31-24	
27	4798018-0	1	WIRE-BLACK-16 GA-1.00 INCH	
28	4760861-7	1	COLLAR	
29	0905759-7	1	STSC-.25-20X.25	
30	4861074-5	1	WASHER-SHOULDER	
31	4891111-9	1	HARNESS-WIRE	
32	4821301-8	1	.CONNECTOR	
33	0916169-6	1	PIN-.19X.75	
34	4805457-1	1	CONNECTOR	
35	4805796-2	1	COVER AY	
36	4805781-4	1	.GASKET	
37	4827969-9	1	BRACKET-BEARING	
38	4761270-0	1	BEARING	
39	0921967-6	1	CPSC-.38-16X1.13	
40	0929759-9	2	WSHR-.38X.56	
41	0917421-0	1	NUT-JAM-.38-16	
42	4861075-2	1	INSULATOR	
43	4862172-6	1	SWITCH	
44	4862173-4	1	ACTUATOR	
45	4889088-3	1	INSULATOR	
46	0930857-8	1	SC-FL.HD.-#4-40X1.00	
47	0924951-7	1	SC-RD.HD.-#4-40X1.00	
48	0925152-1	3	WSHR-.13X.25	
49	4460615-0	1	LOCKNUT	
50	4826431-1	1	SHAFT	
51	0928932-3	2	LKW-IT-#4	
52	0917478-0	2	NUT-#4-40	

800138-800124-1

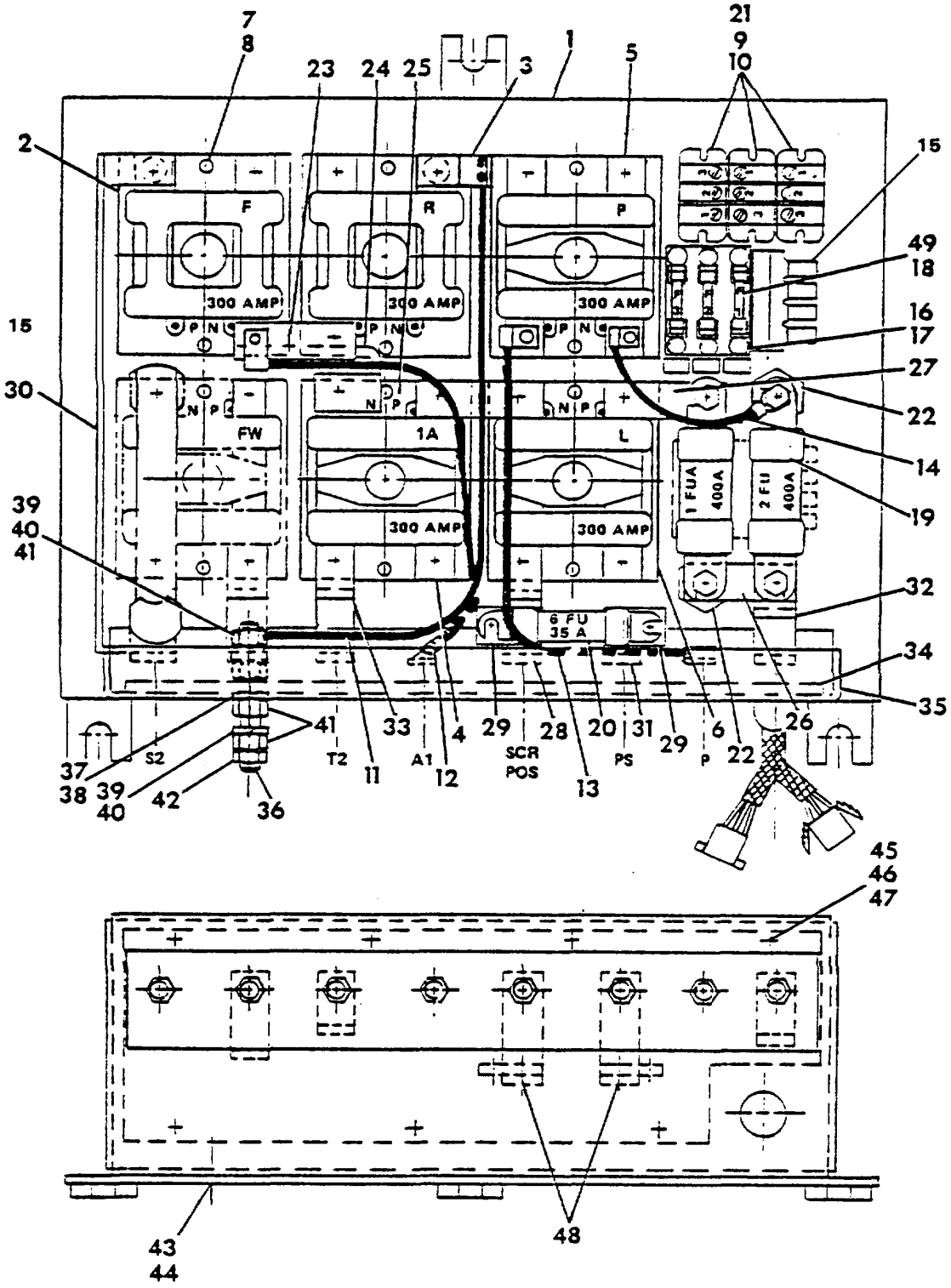


POWER SWITCH COMPARTMENT

EV1 CONTROL

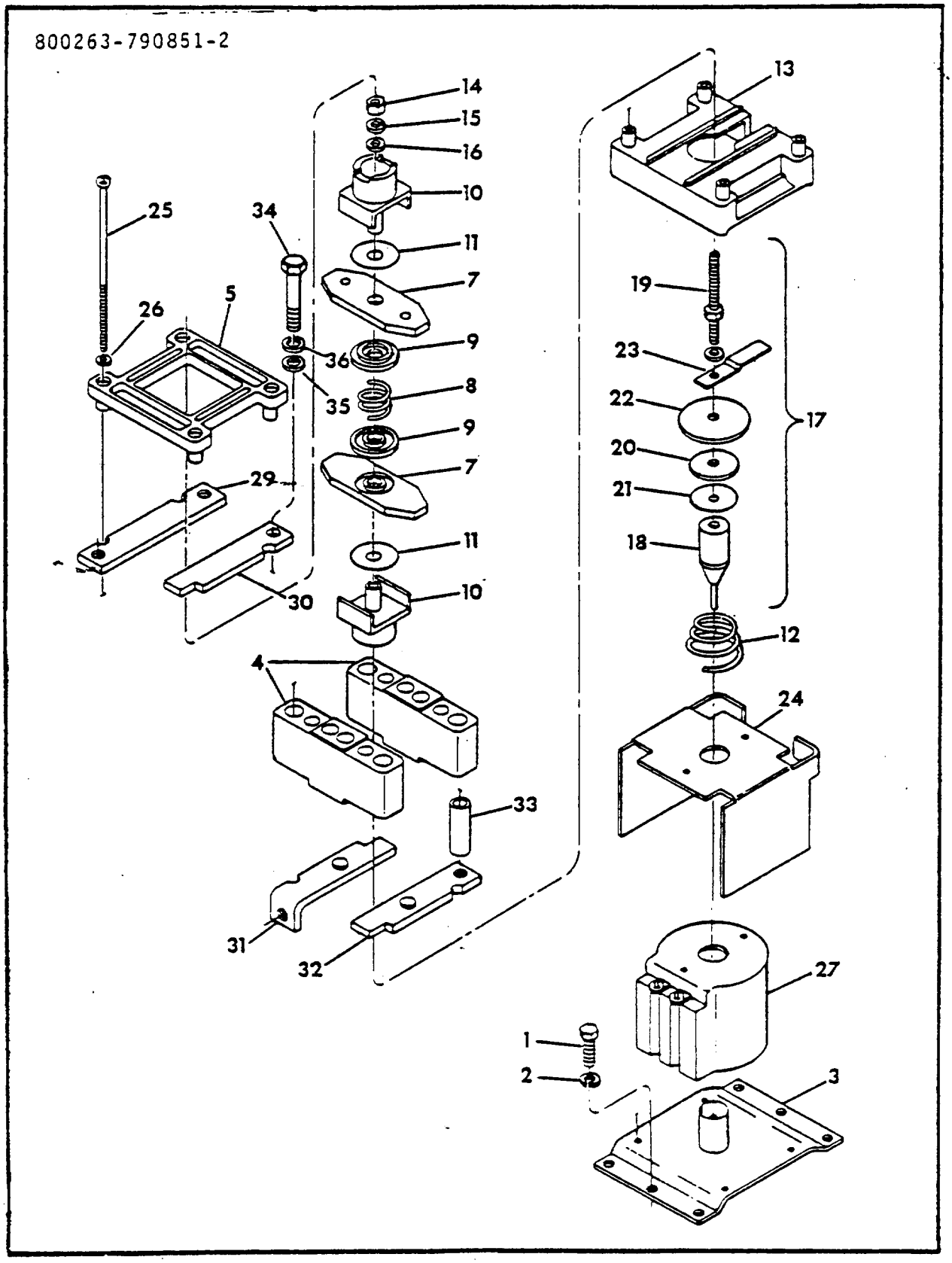
ITEM	PART NO	QTY	DESCRIPTION	
1	4872336-1	1	PANEL-CONTACTOR	SEE PAGE 13
2	0921210-1	3	CPSC-.38-16X1.00	
3	0916965-7	3	LKW-.38	
4	0917378-2	3	WSHR-.38	
5	4894147-0	1	PANEL-EV1C-CONTNOL	SEE PAGE 27
6	0920677-2	3	CPSC-.44-14X1.25	
7	0918199-1	3	LKW-.44	
8	0918267-6	3	WSHR-.44	

800255-800136-1



EV1 CONTACTOR PANEL-4872036-1

ITEM	PART NO	QTY	DESCRIPTION	
1	4911286-5	1	BASE	
2	4911081-0	1	CONTACTOR	SEE PAGE 15
3	4911034-9	1	CONTACTOR	SEE PAGE 17
4	4911082-8	1	CONTACTOR	SEE PAGE 19
5	4911084-4	1	CONTACTOR	SEE PAGE 21
6	4911035-6	1	CONTACTOR	SEE PAGE 21
7	0929486-9	10	CPSC-.25-20X.38	
8	0916964-0	10	LKW-.25	
9	0917437-6	6	SC-#6-32X.75	
10	0917475-6	6	LKW-ET-#6	
11	8610858-6	1	CABLE AY	
12	8610859-4	1	CABLE AY	
13	8610860-2	1	CABLE AY	
14	8610861-0	1	CABLE AY	
15	4890441-1	2	CONTACTOR-DRIVE MODULE	
16	4887353-2	1	BLOCK-FUSE	
17	4911086-9	1	BRACKET-FUSE BLOCK	
18	4708378-7	3	FUSE	
19	4996841-5	2	FUSE	
20	8614335-1	1	FUSE	
21	4911088-5	3	FILTER-BLOCK	
22	4790212-7	2	INSULATOR AY	
23	4911293-1	1	BAR-BUS	
24	4911091-9	1	BAR-BUS	
25	4911295-6	1	BAR-BUS	
26	4911296-4	1	BAR-BUS	
27	4911297-2	1	BAR-BUS	
28	4911298-0	1	BAR-BUS	
29	4311299-8	2	BAR-BUS	
30	4911465-5	1	BAR-BUS	
31	4911301-2	1	BAR-BUS	
32	4911302-0	1	BAR-BUS	
33	4911304-6	1	BAR-BUS	
34	4911305-3	1	TERMINAL BOARD	
35	4911306-1	1	SUPPORT-TERMINAL BOARD	
36	4911336-4	8	STUD	
37	0929759-9	8	WSHR-.38X.56	
38	0916965-7	8	LKW-.38	
39	0917263-6	16	WSHR--BRS-.41X.81	
40	4711108-1	16	LKW-.38 BRONZE	
41	0917252-9	24	NUT-BRS-.38-24	
42	0917421-0	9	NUT-JAM-.38-16	
43	0922121-9	3	SC-#10-32X.38	
44	0909055-6	3	LKW-IT-#10	
45	0917441-8	7	SC-#8-32X.50	
46	0926322-9	7	WSHR-.17X.38	
47	0917395-6	7	LKW-#8	
48	0918214-8	2	SC-.25-20X.62	
49	8611085-5	2	SC-#8-32X2.38	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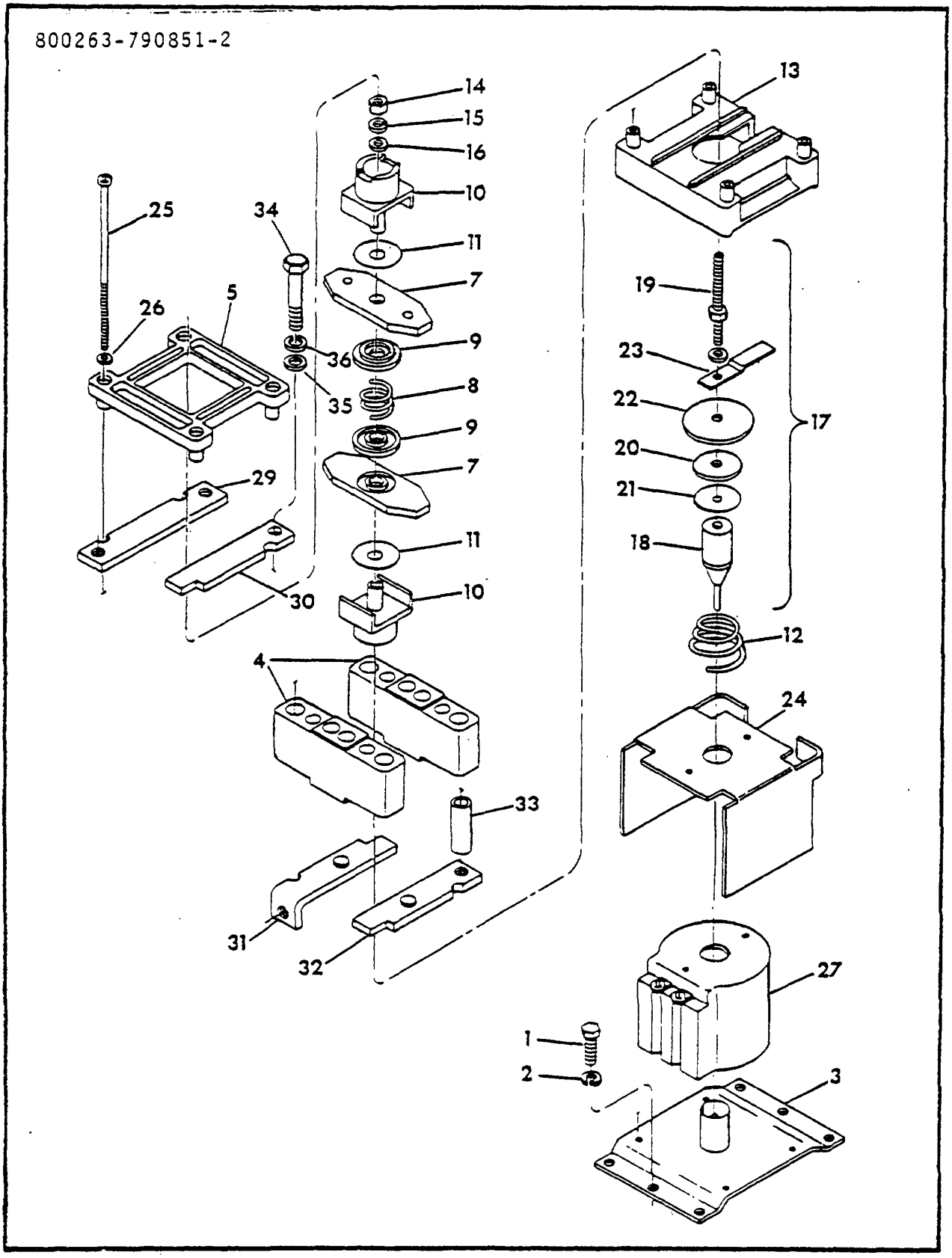
CONTACTOR-4911081-0

ITEM	PART NO	QTY	DESCRIPTION
1	0929486-9	2	CPSC-.25-20X.38
2	0916964-0	2	LKW-.25
3	4911400-2	1	MAGNET
4	4911401-0	2	CLAMP-TIP LOWER
5	4911402-8	1	CLAMP-TIP UPPER
6	4911403-6	1	ARMATURE AY-KIT
7	4911404-4	2	.TIP AY-MOVABLE
8	4911405-1	1	.SPRING-TIP (GOLD)
9	4911406-9	2	.CUP-SPRING
10	4911407-7	2	.CARRIER-TIP-MOVABLE
11	4911408-5	2	.SHIM-TIP
12	4911409-3	1	.SPRING-RETURN (GREEN)
13	4911410-1	1	.CARRIER-TIP-STATIONARY
14	4911411-9	1	.LOCKNUT-#10-32
15	4911412-7	1	.LKW-#10
16	4911413-5	1	.WSHR-#10
17	4911414-3	1	.ARMATURE AY
18	4911415-0	1	..CORE
19	4911416-8	1	..STUD & NUT
20	4911417-6	1	..HEAD-CORE
21	4911418-4	1	..SHIM-CORE HEAD
22	4911419-2	1	..PLATE-BUMPER
23	4911420-0	1	..GUIDE
24	4911421-8	1	FRAME-MAGNET
25	4911422-6	4	SCR-#8-32X4.68
26	4911423-4	4	LKW-#8
27	4911424-2	1	COIL
28	4911425-9	1	TIP KIT
29	4911428-3	1	.TERMINAL-LH TOP
30	4311429-1	1	.TERMINAL-RH TOP
31	4911432-5	1	.TERMINAL-LH BOTTOM
32	4911433-3	1	.TERMINAL-RH BOTTOM
33	4911427-5	1	SPACER
34	0921977-5	1	CPSC-.31-18X1.25
35	0929361-4	1	WSHR-.31
36	0917356-8	1	LKW-.31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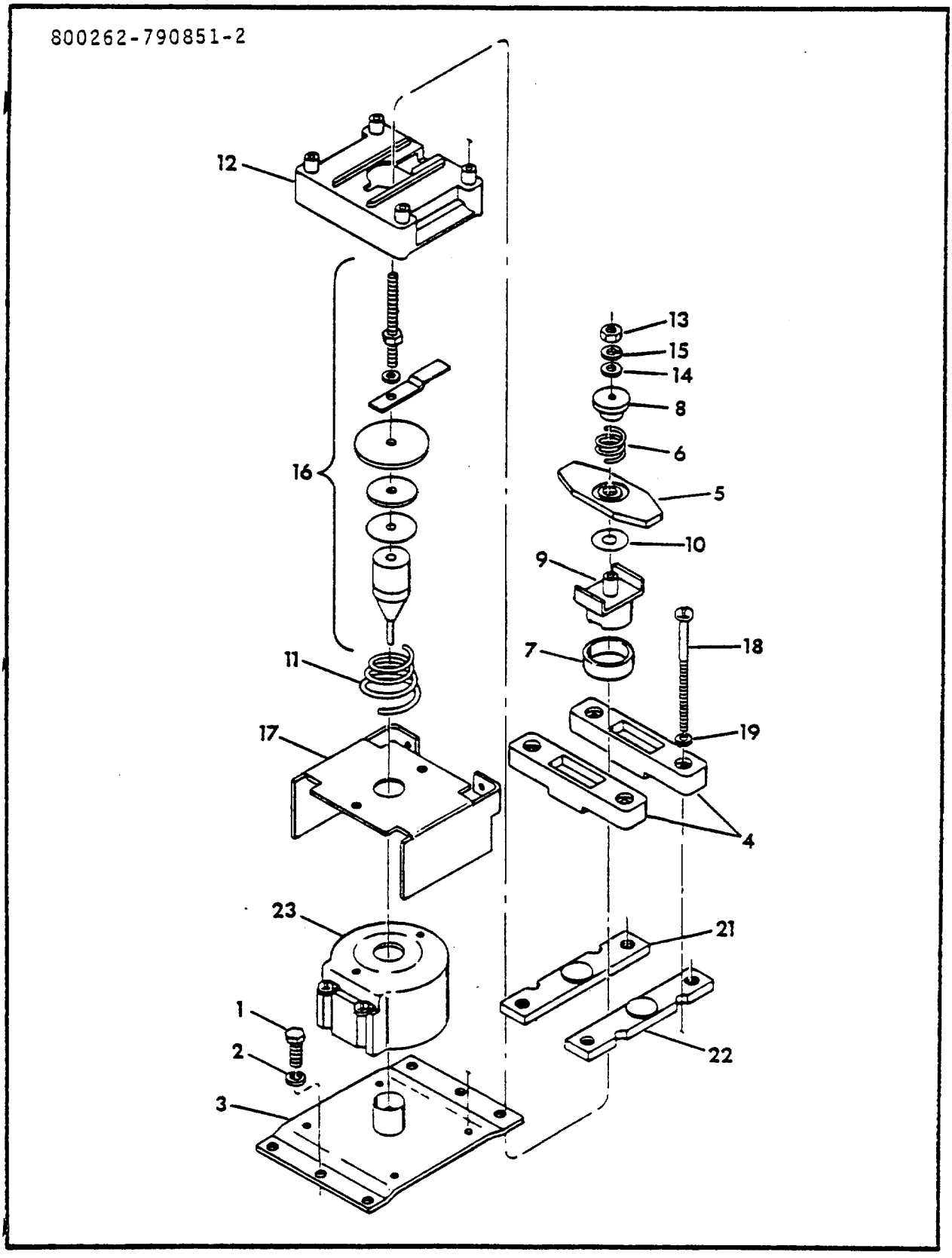
CONTACTOR-4911034-9

ITEM	PART NO	QTY	DESCRIPTION
1	0929486-9	2	CPSC-.25-20X.38
2	0916964-0	2	LKW-.25
3	4911400-2	1	MAGNET
4	4911401-0	2	CLAMP-TIP-LOWER
5	4911402-8	1	CLAMP-TIP-UPPER
6	4911403-6	1	ARMATURE AY KIT
7	4911404-4	2	.TIP AY-MOVABLE
8	4911405-1	1	.SPRING-TIP (GOLD)
9	4911406-9	2	.CUP-SPRING
10	4911407-7	2	.TIP CARRIER-MOVABLE
11	4911408-5	2	.SHIM-TIP
12	4911409-3	1	.SPRING-RETURN (GREEN)
13	4911410-1	1	.CARRIER-TIP-STATIONARY
14	4911411-9	1	.LOCKNUT-#10-32
15	4911412-7	1	.LKW-#10
16	4911413-5	1	.WSHR-#10
17	4911414-3	1	.ARMATURE AY
18	4911415-0	1	..CORE
19	4911416-8	1	..STUD & NUT
20	4911417-6	1	..HEAD-CORE
21	4911418-4	1	..SHIM-CORE HEAD
22	4911419-2	1	..PLATE-BUMPER
23	4911420-0	1	..GUIDE
24	4911421-8	1	FRAME-MAGNET
25	4911422-6	4	SCR--#8-32X4.68
26	4911423-4	4	LKW-#8
27	4911424-2	1	COIL
28	4911426-7	1	TIP KIT
29	4911430-9	1	.TERMINAL-LH-TOP
30	4911429-1	1	.TERMINAL-RH-TOP
31	4911431-7	1	.TERMINAL-LH-BOTTOM
32	4911434-1	1	.TERMINAL-RH-BOTTOM
33	4911427-5	1	SPACER
34	0921977-5	1	CPSC-.31-18X1.25
35	0929361-4	1	WSHR-.31
36	0917356-8	1	LKW-.31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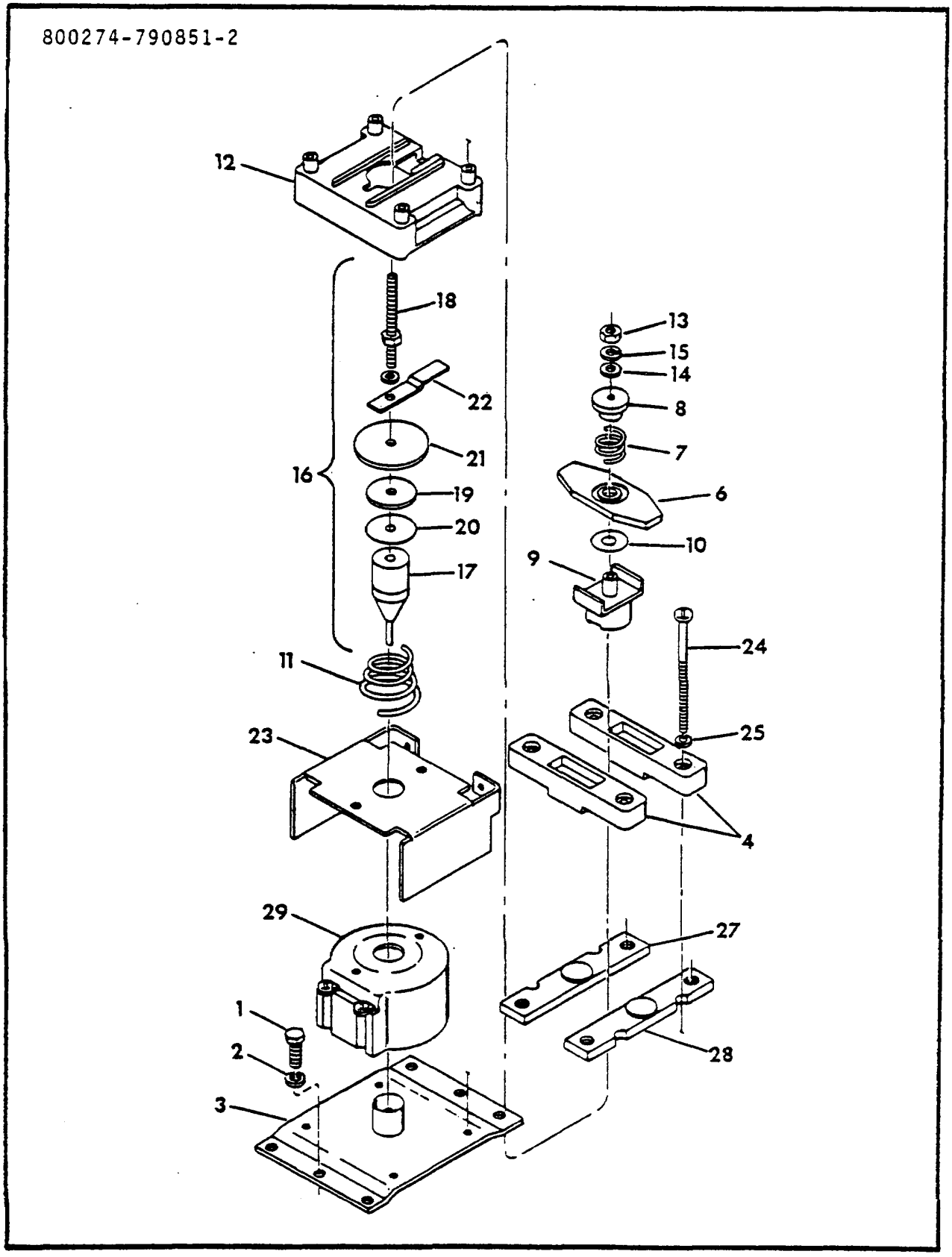
CONTACTOR-4911082-8

ITEM	PART NO	QTY	DESCRIPTION
1	0929436-9	2	CPSC-.25-20X-.38
2	0916964-0	2	LKW-.25
3	4911436-6	1	MAGNET
4	4911437-4	2	CLAMP-TIP-LOWER
5	4911441-6	1	TIP-MOVABLE
6	4911442-4	1	SPRING-TIP (RED)
7	4911443-2	1	SLEEVE-TEFLON
8	4911444-0	1	RETAINER-SPRING
9	4911407-7	1	CARRIER-TIP-MOVABLE
10	4911408-5	1	SHIM-TIP
11	4911446-5	1	SPRING-RETURN (BLUE)
12	4911410-1	1	CARRIER-TIP-STATIONARY
13	4911411-9	1	LOCKNUT--#10-32
14	4911413-5	1	WSHR--#10
15	4911412-7	1	LKW-#10
16	4911447-3	1	ARMATURE
17	4911421-8	1	FRAME-MAGNET
18	4911454-9	4	SCR-#8-32X3.56
19	4911423-4	4	LKW-#8
20	4911456-4	1	TIP KIT
21	4911458-0	1	.TERMINAL-LH
22	4911460-6	1	.TERMINAL-RH
23	4911464-8	1	COIL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INSTRUMENT PANEL

ITEM	PART NO	QTY	DESCRIPTION	
1	0929486-9	2	CPSC-.25-20X.38	
2	0916964-0	2	LKW-.25	
3	4911400-2	1	MAGNET	
4	4911437-4	2	CLAMP-TIP-LOWER	
5	4911639-0	1	ARMATURE AY KIT	
6	4911441-6	1	.TIP-MOVABLE	
7	4911442-4	1	.SPRING-TIP (RED)	
3	4911444-0	1	.RETAINER-SPRING	
9	4911407-7	1	.CARRIER-TIP-MOVABLE	
10	4911408-5	1	.SHIM-TIP	
11	4911446-5	1	.SPRING-RETURN (BLUE)	
12	4911410-1	1	.CARRIER-TIP-STATIONARY	
13	4911411-9	1	.LOCKNUT-#10-32	
14	4911413-5	1	.WSHR-#10	
15	4911412-7	1	.LKW-#10	
16	4911449-9	1	.ARMATURE AY	
17	4911415-0	1	..CORE	
18	4911451-5	1	..STUD & NUT	
19	4911417-6	1	..HEAD-CORE	
20	4911418-4	1	..SHIM--CORE HEAD	
21	4911419-2	1	..PLATE-BUMPER	
22	4911420-0	1	..GUIDE	
23	4911421-8	1	FRAME-MAGNET	
24	4911454-9	4	SCR-#8-32X3.56	
25	4911423-4	4	LKW-#8	
26	4911456-4	1	TIP KIT	
27	4911458-0	1	.TERMINAL-LH	
28	4911460-6	1	.TERMINAL-RH	
29	4911463-0	1	COIL	AY-4911035-6
29	4911462-2	1	COIL	AY-4911084-4

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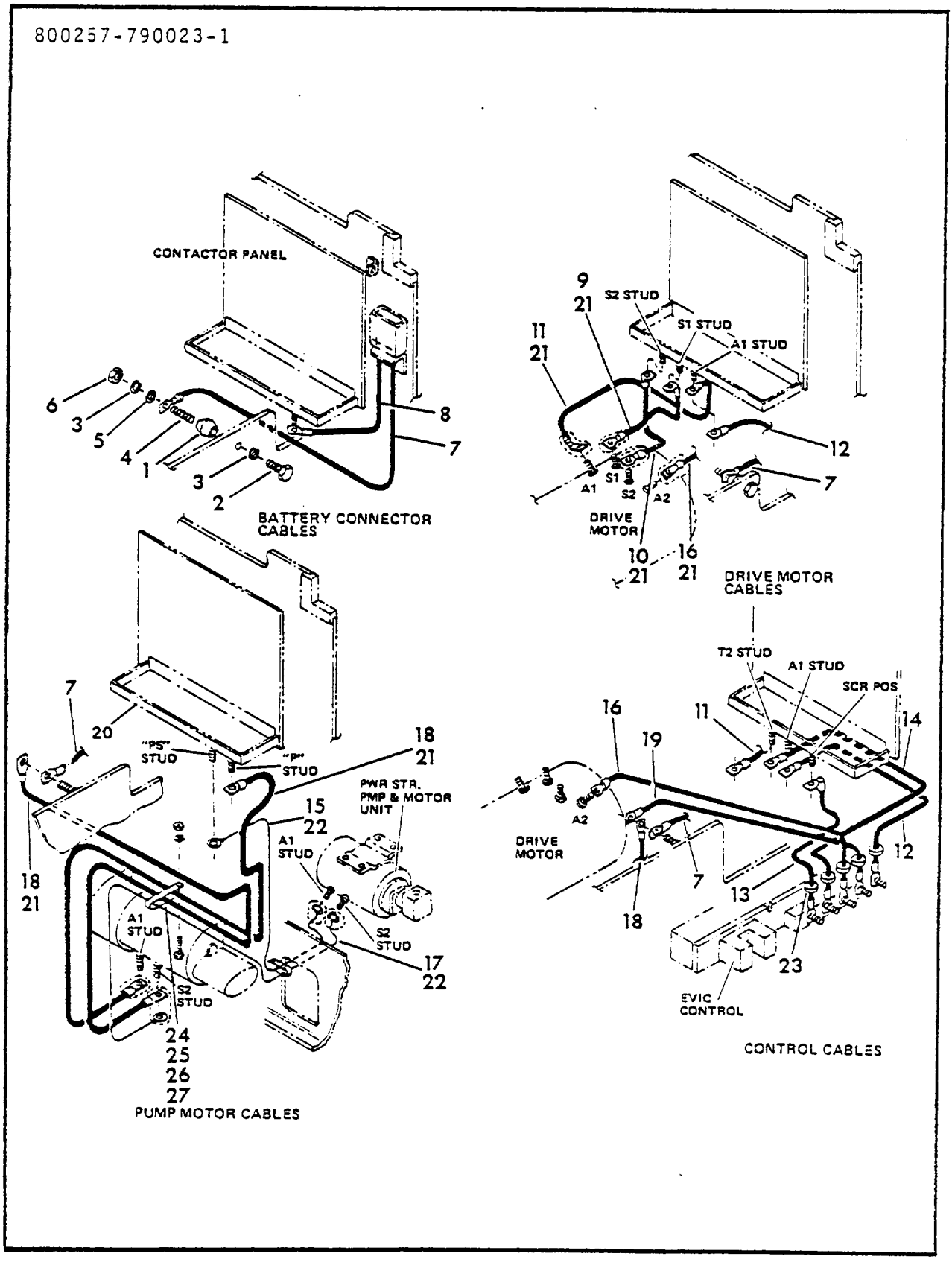

CABLING-EV1

ITEM	PART NO	QTY	DESCRIPTION
1	4803972-1	1	STANDOFF
2	0921210-2	1	CPSC-.38-16X1.00
3	0916333-0	2	LKW-IT-.38
4	4871248-8	1	STUD
5	0901010-9	1	WSHR-BRS-.38
6	0916602-6	1	NUT-.38-24
7	4809337-1	1	CABLE AY
8	4358243-1	1	CABLE AY
9	0925442-6	2	TIE-.18x14.19
10	4871993-4	2	CABLE AY-1/0
11	4871994-2	1	CABLE AY-1/0
12	4871995-9	1	CABLE AY-1/0
13	4871996-7	1	CABLE AY-1/0
14	4871997-5	1	CABLE AY-1/0
15	4892193-6	1	CABLE AY
16	4871998-3	1	CABLE AY-1/0
17	4892193-6	1	CABLE AY
18	4857751-4	2	CABLE AY
19	4884468-2	1	CABLE AY
20	0934838-4	1	TRIM-QUICKEDGE
21	4807446-2	6	BOOT
22	4757673-1	2	BOOT
23	0926779-0	5	GROMMET-.63 OD
24	0928148-6	1	CLAMP-.75 ID
25	0921351-3	1	CPSC-.38-16X1.25
26	0916965-7	1	LKW-.38
27	0916950-9	1	NUT-.38-16

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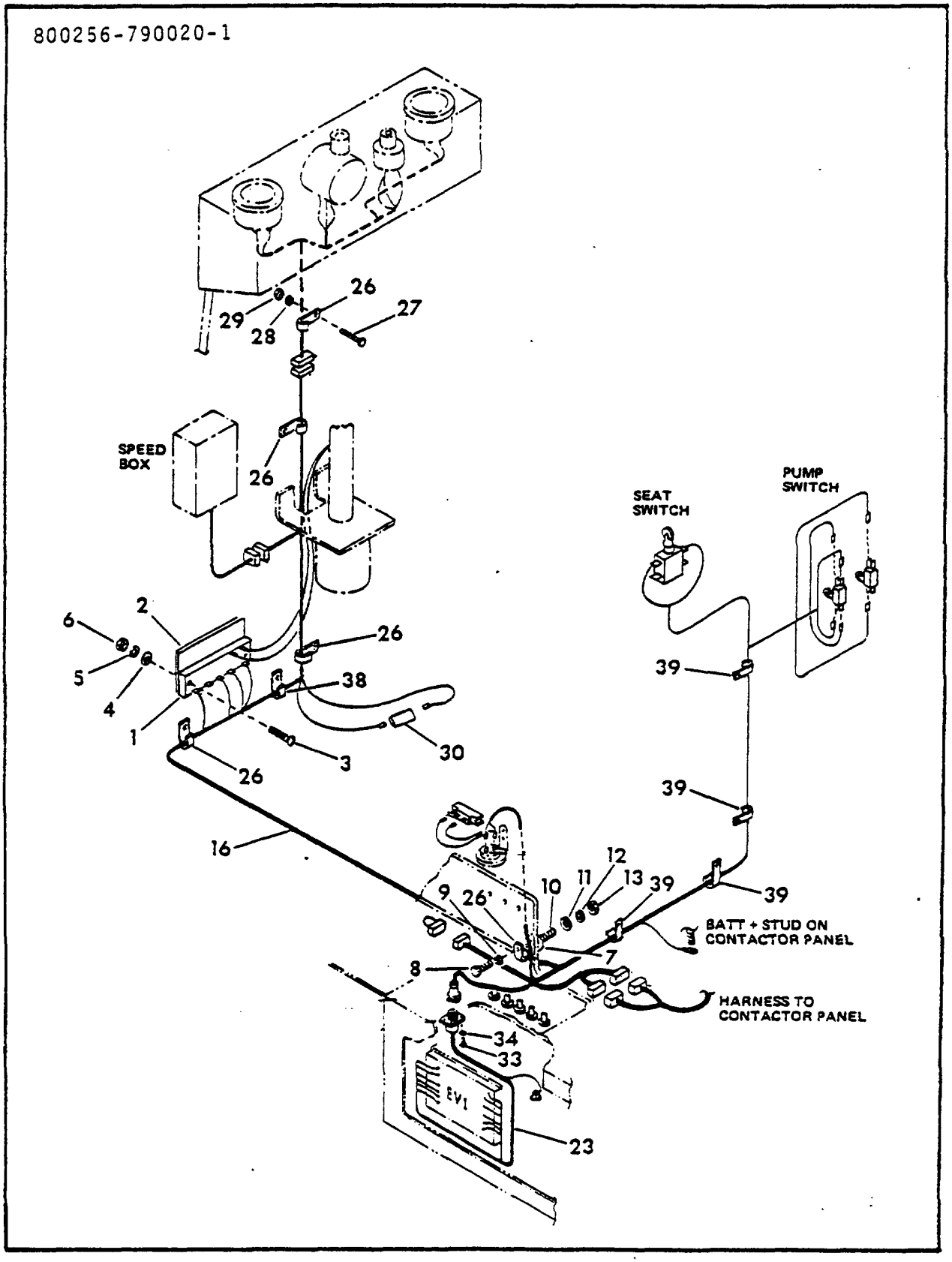

WIRING-EV1

ITEM	PART NO.	DESCRIPTION	QTY.
1	4811019-1	BLOCK	1
2	4850736-2	STRIP-MARKER	1
3	0922929-5	SCREW	2
4	0917458-2	WASHER	2
5	0917459-0	LOCKWASHER	2
6	0917479-8	NUT	2
7	4803972-1	STANDOFF	1
8	0921210-1	CAPSCREW	1
9	0916803-0	LOCKWASHER	2
10	4371248-8	STUD	1
11	0901010-9	WASHER	1
12	0916803-0	LOCKWASHER	1
13	0916602-6	NUT	1
16	4872040-3	HARNESS-MAIN	1
23	4897040-4	HARNESS	1
25	NOT USED		
26	4767130-0	CLAMP	6
27	0921333-1	CAPSCREW	4
28	0917356-8	LOCKWASHER	4
29	0917372-5	NUT	4
30	4255521-9	CONNECTOR	1
33	0917438-4	SCREW	2
34	0919459-0	LOCKWASHER	2
38	0929220-0	CLAMP	1
39	0926921-8	CLAMP	4
	0917479-8	NUT	2

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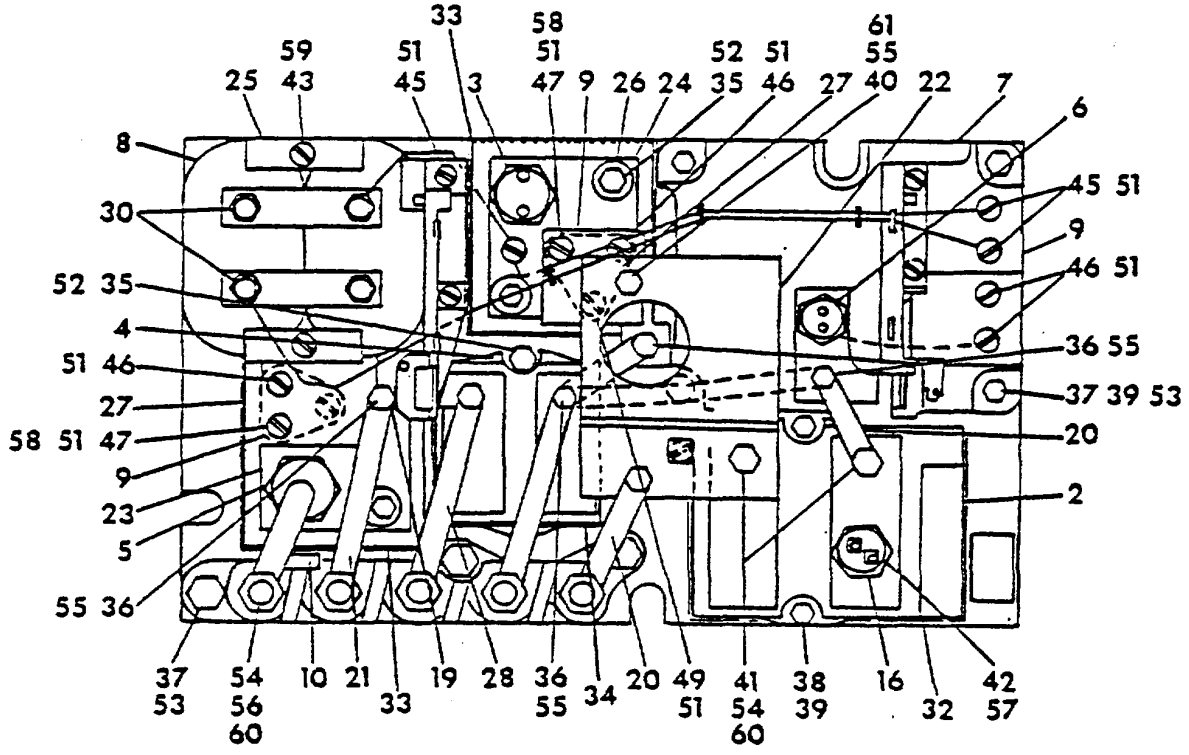

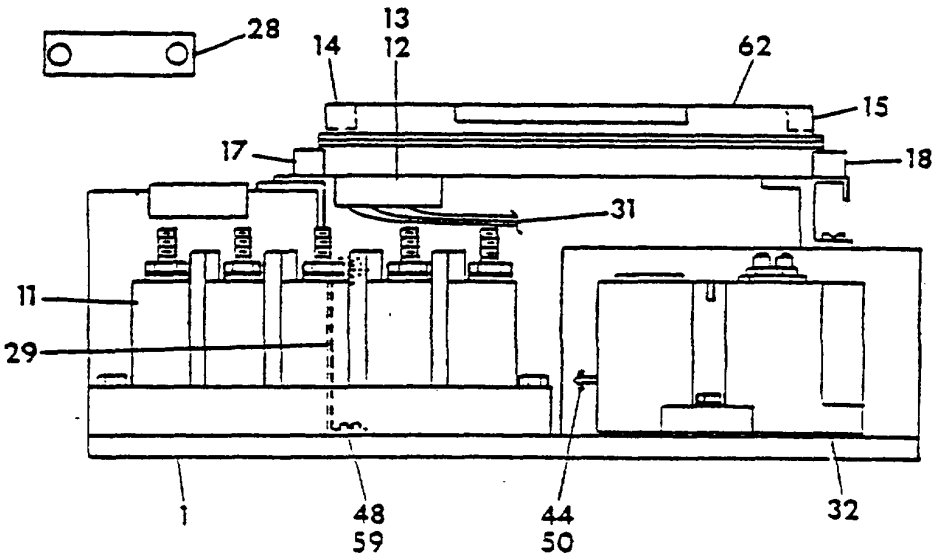

EV1 CONTROL PANEL 4894147-0

ITEM	PART NO	QTY	DESCRIPTION	ITEM	PART NO	QTY	DESCRIPTION
1	4910313-5	1	BASE	50	0934760-0	1	WSHR-#6
2	4910914-3	1	RECTIFIER	51	0934759-2	10	WSHR--#8
3	4910915-0	1	RECTIFIER	52	0934762-6	4	WSHR-#10
4	4910916-8	1	RECTIFIER	53	0934761-8	7	WSHR-.25X.41
5	4910567-9	1	RECTIFIER	54	0924293-4	7	WSHR--.34X.56
6	4910917-6	1	RECTIFIER	55	0918264-3	6	WSHR-.25
7	4910918-4	1	TRANSFORMER	56	0917372-5	5	NUT-.31-18
8	4910919-2	2	CAPACITOR	57	0923397-4	2	LKW-#4
9	4910572-9	3	SNUBBER	58	0917395-6	2	LKW-#8
10	4910921-8	1	FILTER				
11	4910923-4	1	TERM BLOCK-POWER				
12	4910905-1	1	TERM BLOCK-CONTROL				
13	4910906-9	1	COVER-TERMINAL BLOCK				
14	4890409-8	1	TERM- STRIP				
15	4890408-0	1	TERM-STRIP				
15	4910922-6	1	THERMAL PROTECTOR				
17	4910907-7	1	SUPPORT-CARD-LH				
18	4910908-5	1	SUPPORT-CARD-RH				
19	4910910-1	8	BUS-FLEXIBLE				
20	4910926-7	12	BUS	59	0917365-9	4	LKW-#10
21	4910927-5	4	BUS	60	0917356-8	7	LKW-.31
22	4910928-3	1	SHIELD	61	0916964-0	1	LKW-.25
23	4910929-1	1	HEAT SINK	62	4910575-2	1	CARD-CONTROL
24	4910930-9	1	HEAT SINK				
25	4910931-7	2	SUPPORT-CAPACITOR				
26	4910932-5	4	BUSHING				
27	4910933-3	2	MOUNTING-SNUBBER				
28	4910934-1	1	SHUNT AY				
29	4910935-8	1	BRACKET-CARD				
30	4910936-6	6	STRAP-CAPACITOR				
31	4910937-4	1	HARNESS-WIRE				
32	4910971-3	1	INSULATION				
33	4910972-1	1	INSULATION				
34	4910973-9	1	INSULATION				
35	4910958-0	6	SCREW-W/LKW				
36	4910964-8	5	SCREW-W/LKW				
37	4910966-3	7	SCREW				
38	4910967-1	2	SCREW				
39	4910968-9	9	LOCKWASHER				
40	0921959-3	1	CPSC-.25-20X.63				
41	0925205-7	2	CPSC-.31-18X.63				
42	0934775-8	2	SC-#4-40X.25				
43	0934774-1	2	SC-#10-32X4.62				
44	0934763-4	1	SC-#6-32X .38				
45	0934768-3	4	SC-# 8-32X .38				
46	0934770-9	5	SC- #8-32X1.25				
47	0934771-7	2	SC-# 8-32X2.00				
48	0934773-3	2	SC-#10-32X.62				
49	0929906-6	1	SC-#8-32X.62				

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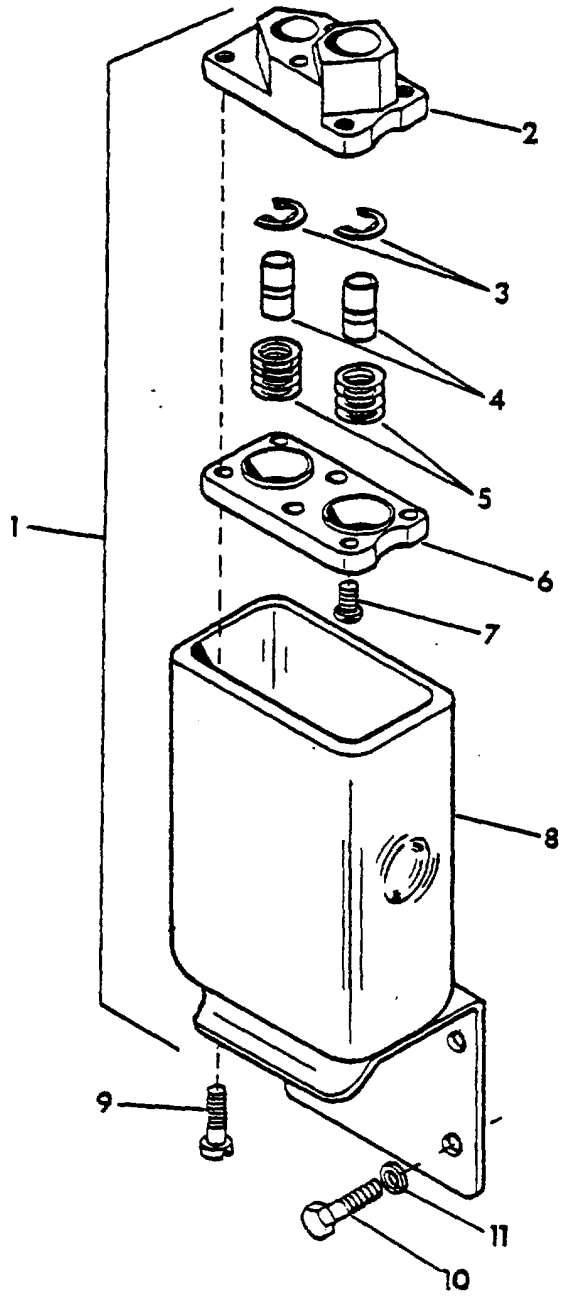


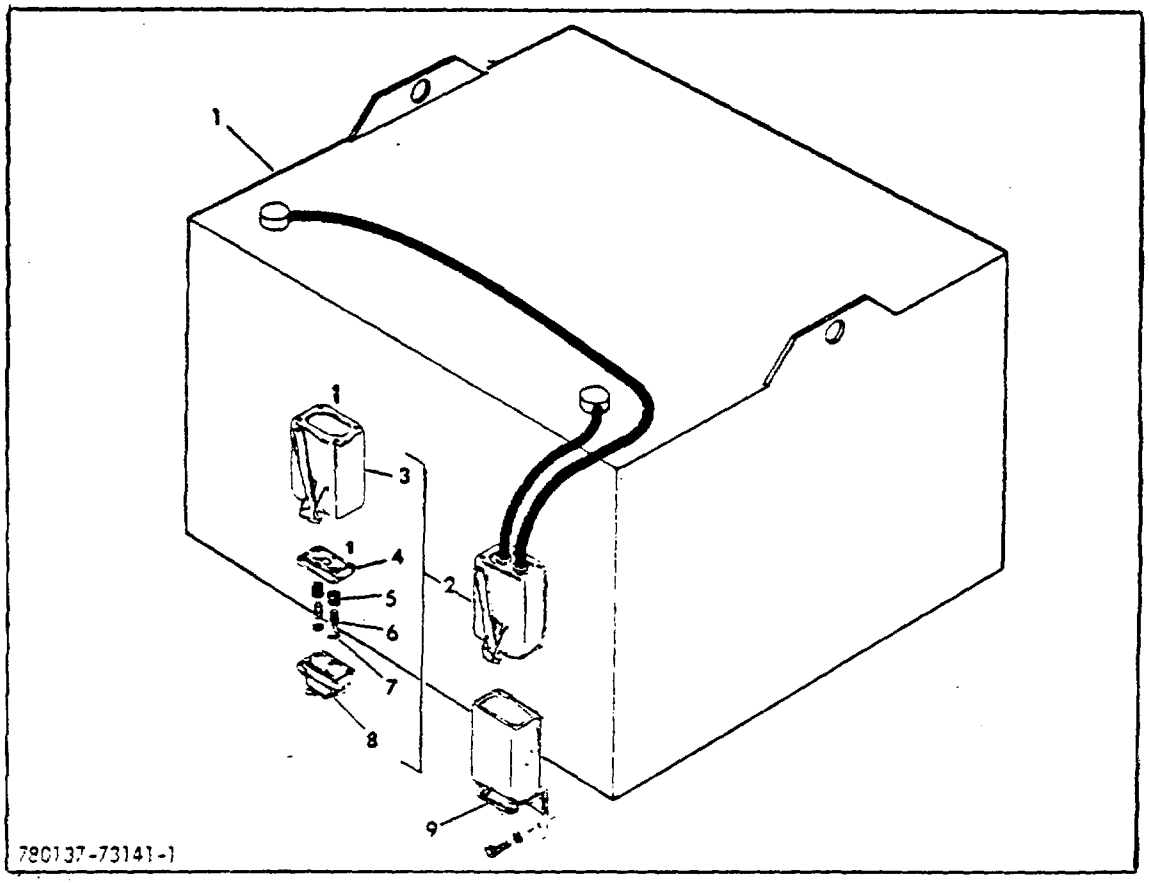
BATTERY CONNECTOR

ITEM		PART NO	QTY	DESCRIPTION
1		4605374-7	1	CONNECTOR-BTRY
2	#	----------	1	.BLOCK-CONTACT
3	*	----------	2	.RING-RTNR
4	*	----------	2	.CONTACT
5	*	----------	2	.SPRING-CONTACT
6	#	----------	1	.BLOCK-CONTACT
7	#	0903767-2	2	.CPSC-#10-24X.63
8		4994043-0	1	.CASE
9	#	0901136-7	2	.CPSC-#10-24x1.00
10		0921959-3	4	CPSC-.25-20X.63
11		0916964-0	4	LKW-.25

#INCL IN KIT 4993644-7
*INCL IN KIT 4998946-2

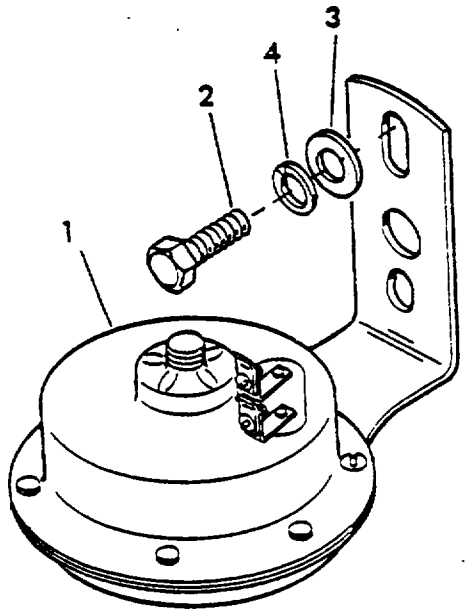
BATTERY & CONNECTOR

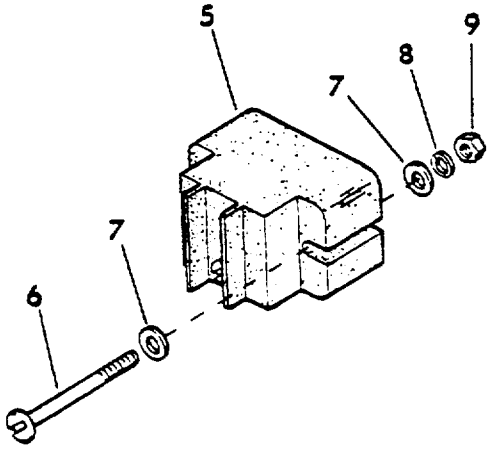
ITEM	PART NO.	DESCRIPTION	QTY.	
1	8624139-6	BATTERY	1	INCL LEADS & ITEM 2
2	4994820-1	CONNECTOR-EC TYPE	1	INCL ITEMS 3 THRU 8
3	4994821-9	CASE	1	
	0910968-7	SCREW	2	
4	----------	*BLOCK-CONTACT	1	
	0922026-0	**SCREW	2	
5	----------	**SPRING	2	
6	----------	**CONTACT	2	
7	----------	**RING-RETAINING	2	
8	----------	*BLOCK-CONTACT	1	
9	4805874-7	CONNECTOR-EC TYPE	1	SEE PAGE 29
10	4998844-7	KIT-INCL ITEMS MARKED*	1	
11	4998846-2	KIT-INCL ITEMS MARKED**	1	

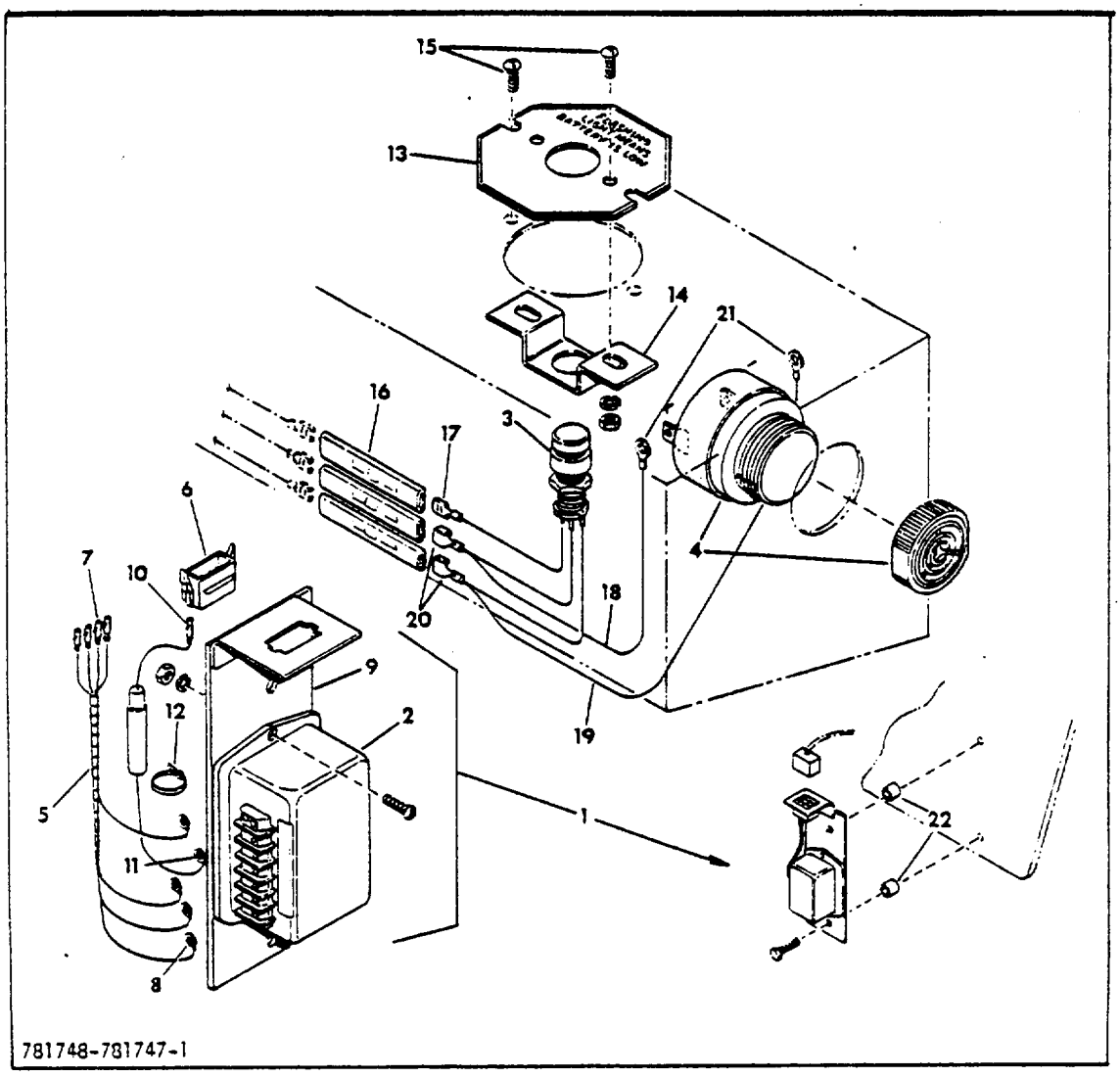


HORN

ITEM	PART NO.	DESCRIPTION	QTY.
1	8614293-2	HORN	1
2	0925205-7	CAPSCREW	1
3	0918265-0	WASHER	1
4	0917356-8	LOCKWASHER	1
5	4816233-3	FILTER-HASH	1
6	0925654-6	SCREW	2
7	0917458-2	WASHER	4
8	0922710-9	LOCKWASHER	2
9	0917479-8	NUT	2



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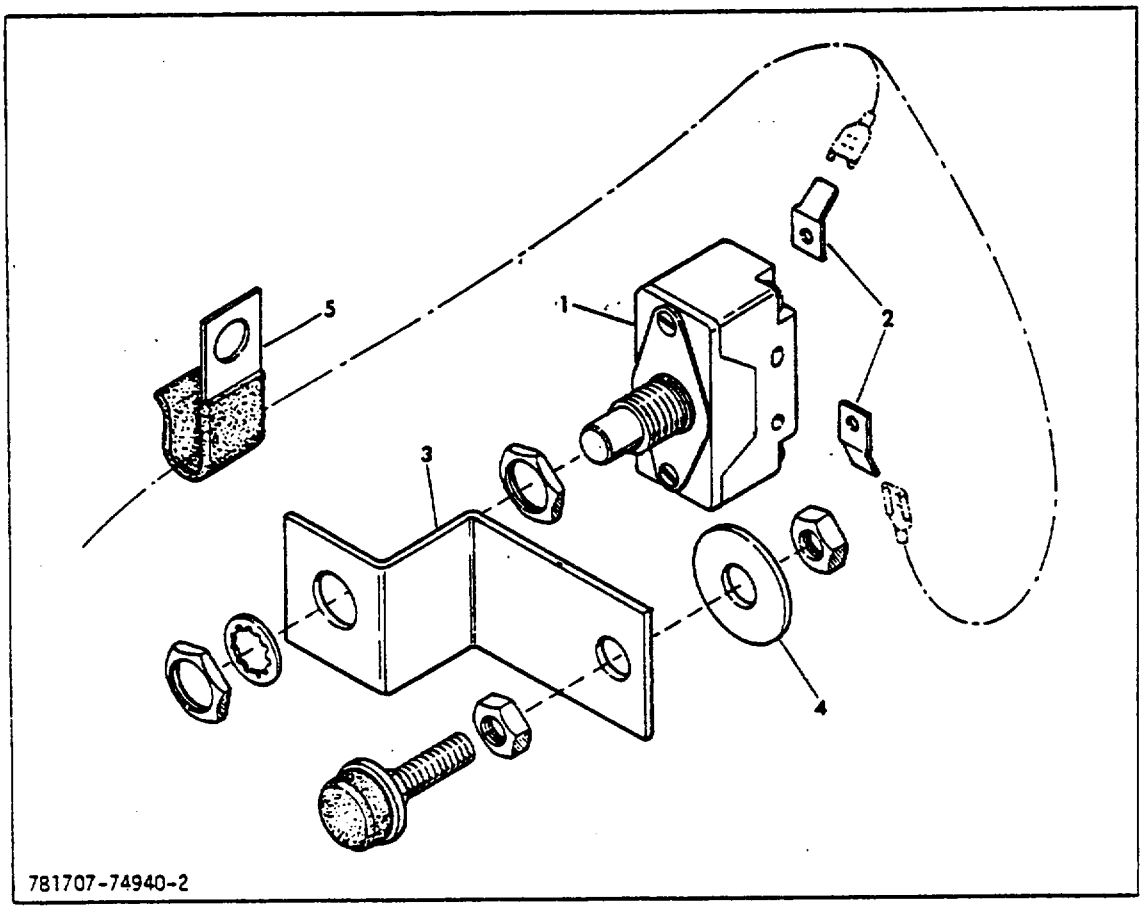
781748-781747-1

DISCHARGE INDICATOR

ITEM	PART NO.	DESCRIPTION	QTY.	
1	4895105-7	PANEL	1	
2	4838660-1	INDICATOR-DISCHARGE	1	
3	4912756-6	LAMP ASSY	1	
	4912751-7	LAMP	1	
	4912759-0	LENS-RED	1	
4	----------	ALARM-AUDIBLE	1	ORDER ITEM 2
5	4894036-5	HARNESS	1	
6	4821302-9	CONNECTOR	1	
7	4821318-5	SOCKET	4	
8	4254845-3	TERMINAL	4	
9	4894025-8	PLATE	1	
	0917441-5	SCREW	2	
	0917395-6	LOCKWASHER	2	
	0917385-7	NUT	2	
10	4821318-5	SOCKET	1	
11	4254845-3	TERMINAL	1	
12	4255430-6	TYWRAP	1	
13	4893900-7	PLATE-WARNING	1	
14	4881516-1	BRACKET	1	
15	0917436-8	SCREW	4	
	0917459-0	LOCKWASHER	4	
	0917479-8	NUT	4	
16	4255521-9	CONNECTOR	3	
17	4869044-0	TERMINAL	3	
18	----------	WIRE-RED-16 GA	1	
19		WIRE-BLUE-16 GA	1	
20	4255271-1	TERMINAL	2	
21	4254845-3	TERMINAL	2	
22	4838316-0	SPACER	2	
	0921961-9	CAPSCREW	2	
	0916964-0	LOCKWASHER	2	
	0916622-4	NUT	2	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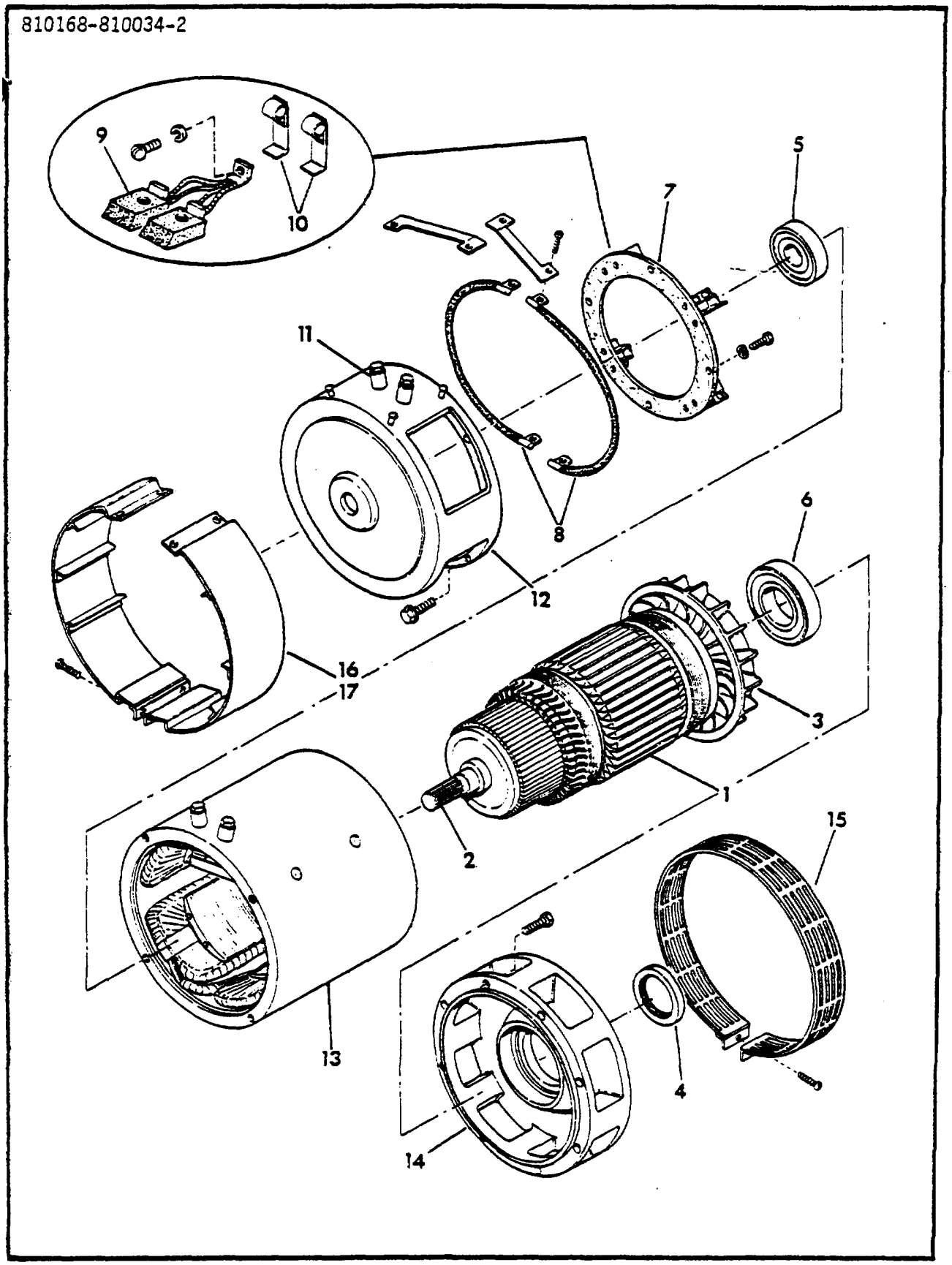
781707-74940-2

BRAKE CUTOUT GROUP

ITEM	PART NO.	DESCRIPTION	QTY.
1	4884324-7	SWITCH-CUTOUT	1
2	4705073-8	TERMINAL	2
3	4884325-4	BRACKET-SWITCH	1
4	0927452-6	WASHER	1
5	4767130-0	CLAMP	1


810168-810034-2
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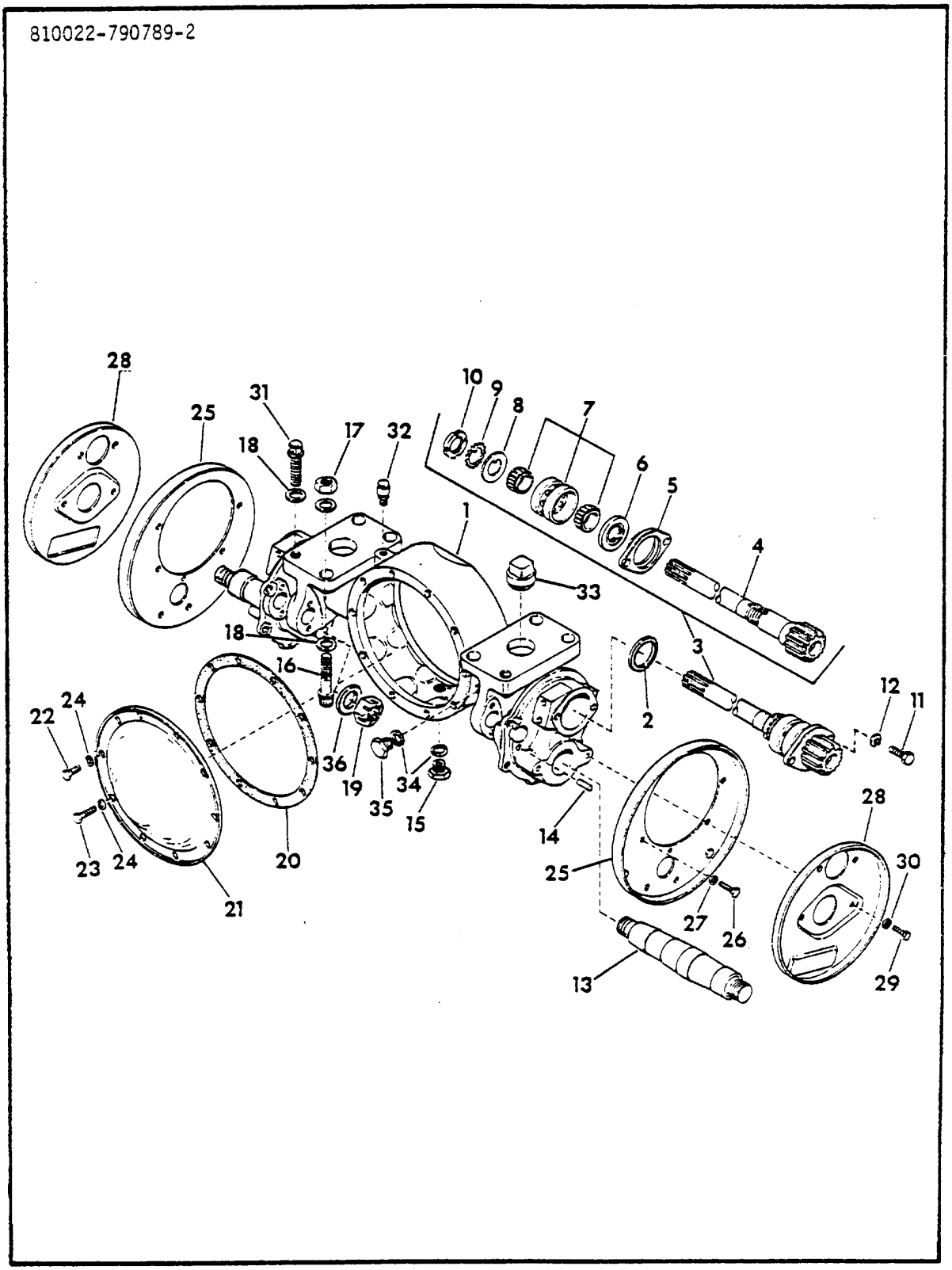
DRIVE MOTOR 8614612-0

ITEM	PART NO	QTY	DESCRIPTION
1	4911694-0	1	ARMATURE
2	4911679-1	1	.SHAFT-ARMATURE
3	4911695-7	1	.FAN-ARMATURE
4	43611070-3	1	SEAL
5	4911062-0	1	BEARING-BALL-COMM END
6	4911069-5	1	BEARING-BALL-DRIVE END
7	&911696-5	1	BRUSH BOX AY-INCL ROCKER ARM & 4 BRUSH BOXES
8	4911699-9	1	.CONNECTOR-CROSS
9	4911698-1	4	BRUSH AY
10	4911697-3	8	SPRING-BRUSH
11	4911610-6	2	STUD-TERMINAL
12	4911611-4	1	SHIELD-END
13	4911612-2	1	FIELD AY
14	4911613-0	1	SHIELD-END
15	4911614-8	1	COVER-DRIVE END
16	49116 15-5	1	COVER-COMM END-1
17	4911616-3	1	COVER-COMM END-2
---	8618065-0	1	COVER KIT-EE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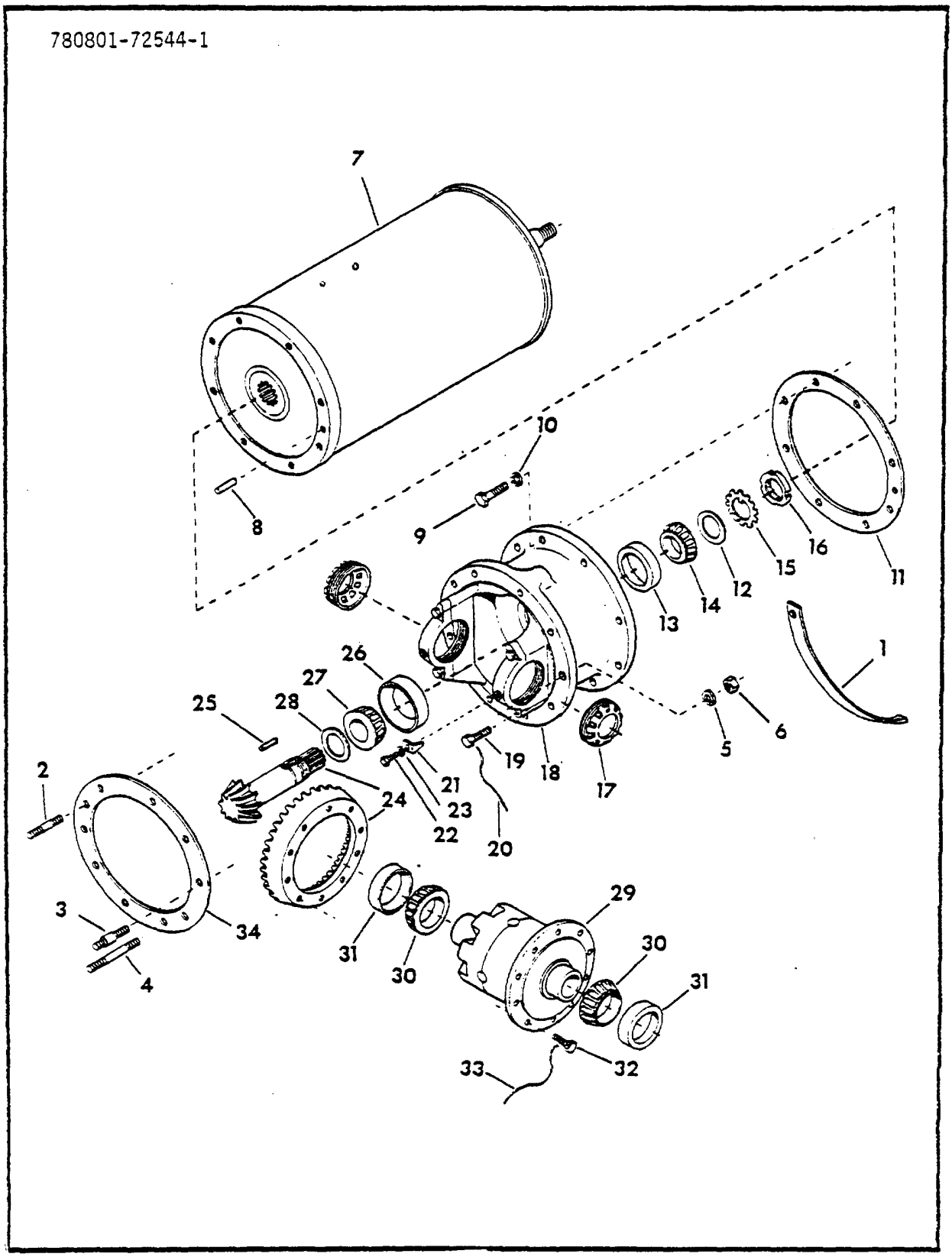
DRIVE AXLE

ITEM	PART NO	QTY	DESCRIPTION
1	4744948-3	1	HOUSING-AXLE
2	4501458-6	2	SEAL
3	4797274-0	2	SHAFT AY-JACK
		2	SHAFT AY-JACK
4	4795s84-8	1	.PINION
5	4707234-3	1	.CAP
6	4252297-8	1	.SEAL
7	4782199-6	1	.BEARING
8	4254773-7	1	.WASHER
9	4253299-4	1	.LOCKWASHER
10	4331040-8	1	.LOCKNUT
11	0921210-1	4	CPSC-.38- 16X1.00
12	0916965-7	4	LKW - .38
13	4787365-8	2	SPINDLE-DRIVE WHEEL
14	0918567-9	4	PIN-GRV-.44XX.88
15	4816184-8	1	PLUG-DRAIN
16	0922073-2	6	CPSC .88-9X3.25
17	0923462-6	6	NUT-.88-9
18	4816184-8	14	WASHER
19	47A7109-9	2	NUT
20	4716827-3	1	GASKET
21	4710053-2	1	COVER
22	0926594-3	8	SC .31-18X.75
23	0926593-5	2	SC-.31-18X.50
24	0917356-8	10	LKW-.31
25	4847694-9	2	PLATE-BRAKE-BACKING
26	0921332-3	10	CPSC-.31-18X.75
27	0917356-8	10	LKW-.31
28	4707060-2	2	SHIELD-DUST
29	0921958-5	4	CPSC- .25-20X.50
30	0916964-0	4	LKW-.25
31	0922519-4	2	CPSC- .88-9X2.00
32	4710092-0	1	BREATHER
33	4832944-5	2	PIN-SHEAR
34	4845678-4	2	WASHER NYLON
35	4347837-4	1	PLUG-DRAIN
36	4755930-7	2	WASHER


780801-72544-1
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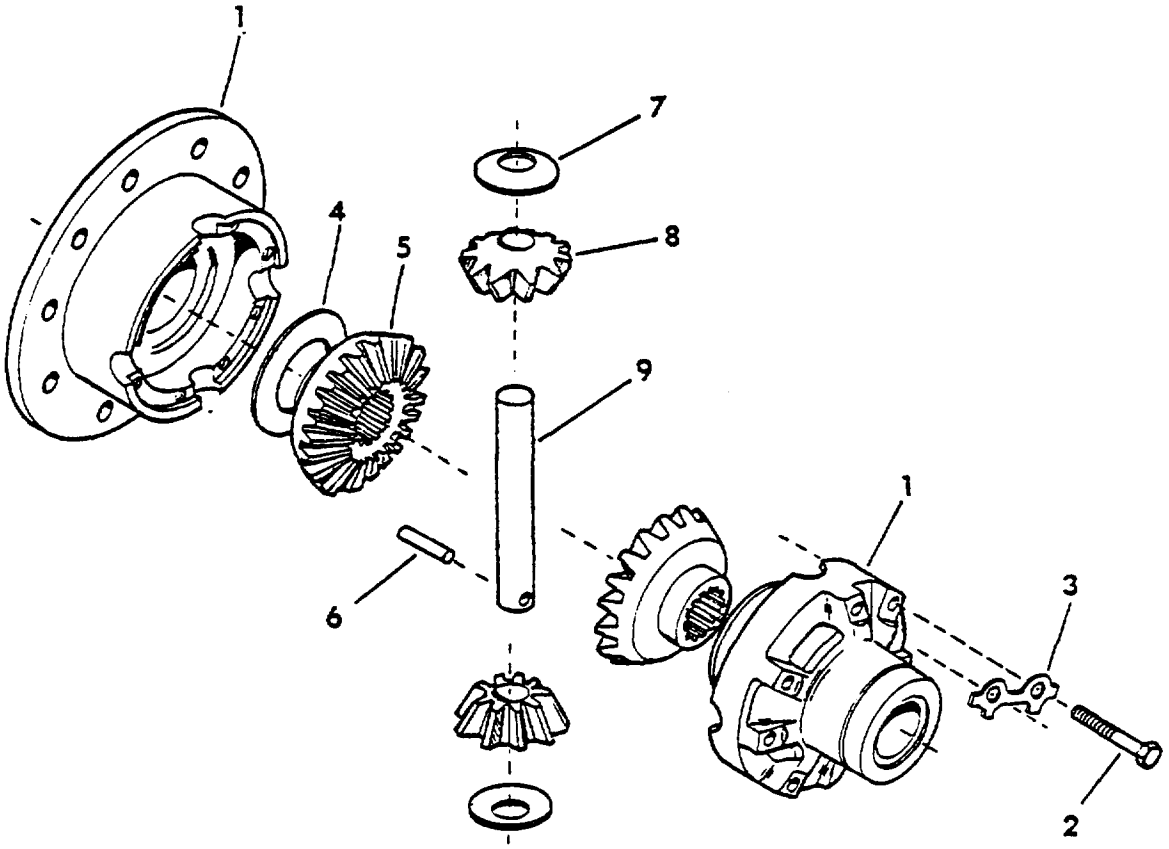
DIFFERENTIAL CARRIER

ITEM	PART NO	QTY	DESCRIPTION	
1	4807151-8	2	STRAP-GROUND	EE RATED
2	4802638-9	2	STUD	
3	4819542-2	2	STUD	
4	4802639-7	6	STUD	
5	0918199-1	10	LKW-.44	
6	0922180-5	10	NUT-.44-20	
7				
7	8614612-3	1	MOTOR-DRIVE-EE	SEE PAGE 37
8	0918405-2	1	PIN-DWL-.38X1.00	
9	0921966-8	8	CPSC- 3E-1- 6X.	
10	0916965-7	8	LKW-.38	
11	4827946-7	1	GASKET-DRIVE MOTOR	
12	4827950-9	1	AA SHEER-HARDENED	
13	4254699-4	1	CUP--BEARING-REAR	
14	4254700-0	1	CONE-BEARING-REAR	
15	0928675-8	1	LOCKWASHER-EXT-BEARING-2.00	
16	0928678-2	1	LOCKNUT--BALL BEARING-1.56-18	
17	4839703-8	2	ADJUSTER-DIFFERENTIAL BEARING	
18	4844238-8	1	HOUSING AY-DIFFERENTIAL	
19	4736866-7	10	CAPSCREW	
20	4737615-7	2	LOCKWIRE	
21	4838778-1	2	LOCK-ADJUSTER	
22	0925205-7	2	CPSC-31-1 8X.63	
23	0917356-8	2	LKW-.31	
24	4843709-9	1	GEAR SET-2.769/1 RATIO	
25	0917611-6	2	PIN-GRV-.38X.75	
26	0927091-9	1	CUP-BEARING-FRONT	
27	0927090-1	1	CONE-BEARING-FRONT	
28	4819517-6	*	SHIM-.002	)
28	4819518-4	*	SHIM-.003	)
28	4819519-2	*	SHIM-.005	)) USE AS REC
28	4819540-8	*	SHIM-.010	)
28	4819541-6	*	SHIM-.020	)
29	4839704-6	1	DIFFERENTIAL AY-2 PINION	SEE PAGE 43
30	0927270-9	2	CONE-BEARING-SIDE	
31	0927273-3	2	CUP-BEARING-SIDE	
32	0931130-9	10	BOLT .38-24X.62	
33	4737617-3	1	LOCKWIRE	
34	4707440-6	1	GASKET	

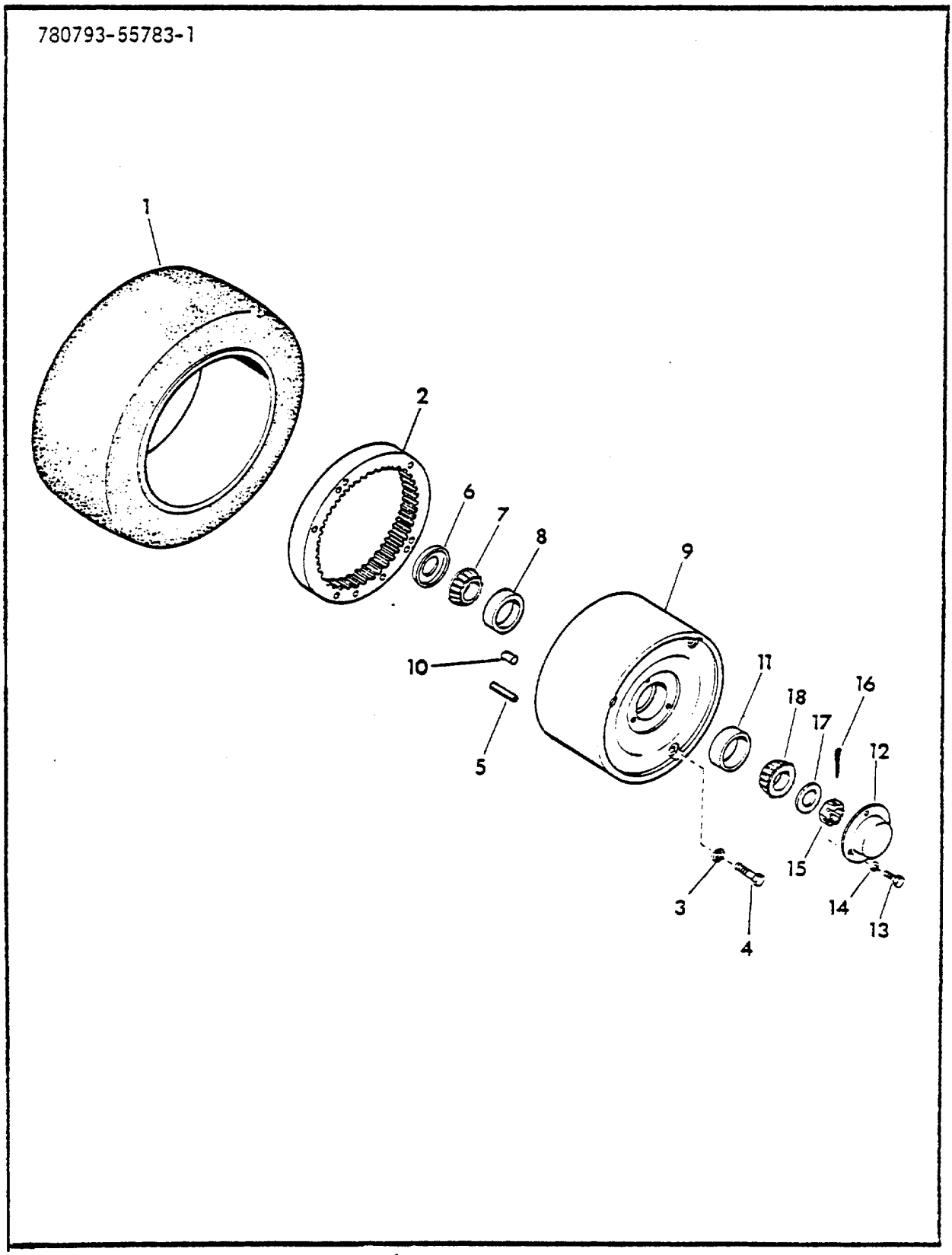
780987-54095-1



DIFFERENTIAL AY-4839704-6

ITEM	PART NO	QTY	DESCRIPTION
1	4908941-0	1	CASE KIT-DIFFERENTIAL
2	0913599-7	e	.CPSC-.31-18X2.50
3	4906404-1	4	.CLIP-RETAINING
4	*4707712-8	2	SPACER-SIDE GEAR
5	*4906401-7	2	GEAR-SIDE
6	*0917023-4	1	PIN-DOWEL-.25X1.00
7	*4707711-0	2	SPACER-PINION GEAR
8	*4906403-3	2	GEAR-PINION
9	*4906406-6	1	PIN-CROSS

*INCL IN KIT 4907245-7


780793-55783-1
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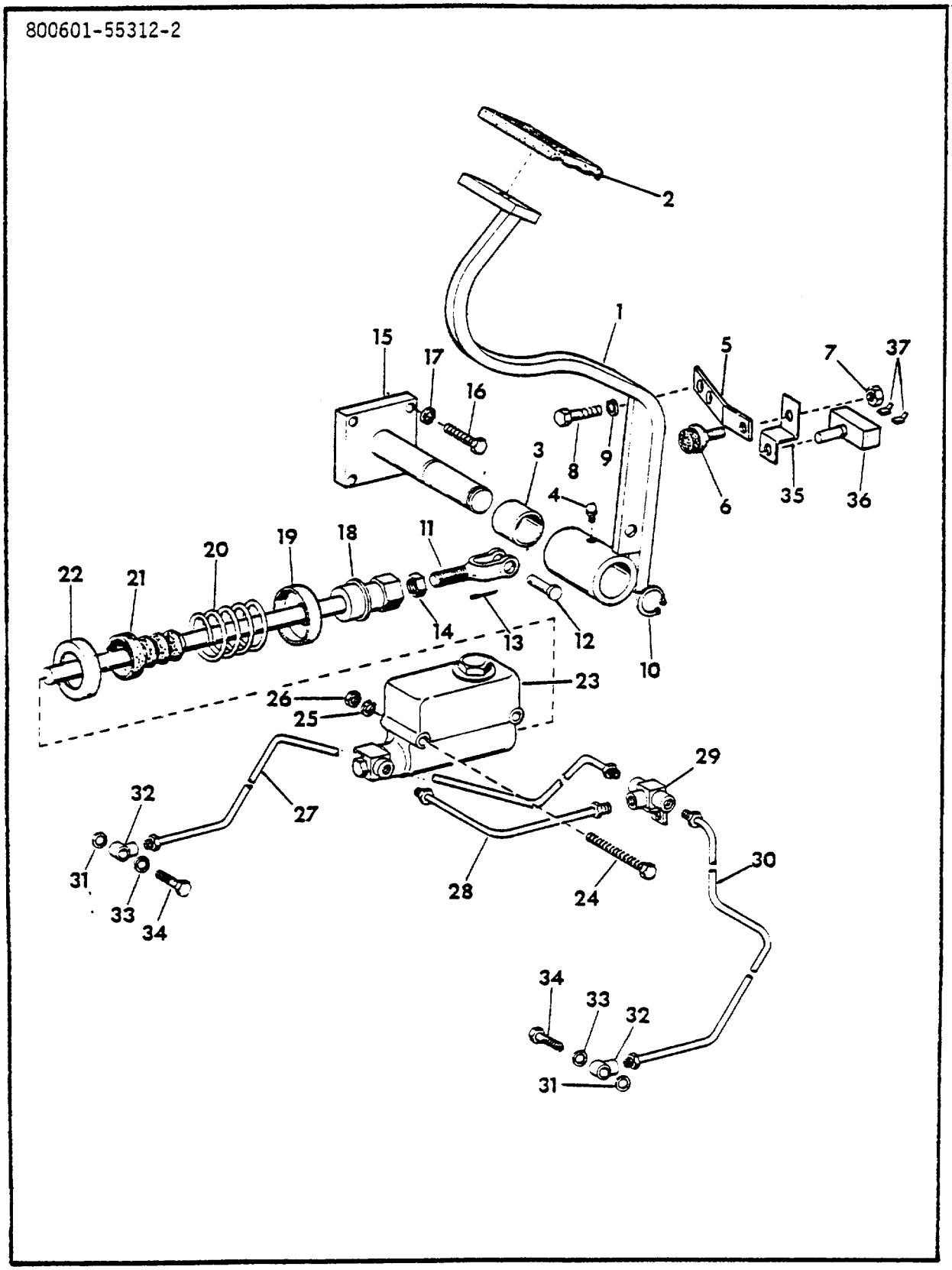
DRIVE WHEEL

ITEM	PART NO	QTY	DESCRIPTION
1	4789104-9	2	TIRE-18X8X12.13
2	4795693-3	2	GEAR
3	0916965-7	6	LKW-.38
4	0921973-4	6	CPSC-.38-16X2.75
5	0926146-2	6	PIN-.44X2.75
6	4707059-4	2	SHIELD-GREASE
7	4253050-1	2	CONE-BEARING-INNER
8	4250061-1	2	CUP-BEARING-INNER
9	4761006-8	2	WHEEL
10	0924060-7	6	PIN-.44X.25
11	4254038-5	2	CUP-BEARING-OUTER
12	4706891-1	2	CAP-HUB
13	0921965-0	6	CPS C-.38- 16X.75
14	0916803-0	6	LKW-IT-.38
15	0929607-0	2	NUT-JAM-1.25-12
16	0918464-9	2	PIN-COTTER-.25X2.25
17	4755930-7	2	WASHER
16	4254037-7	2	CONE-BEARING-OUTER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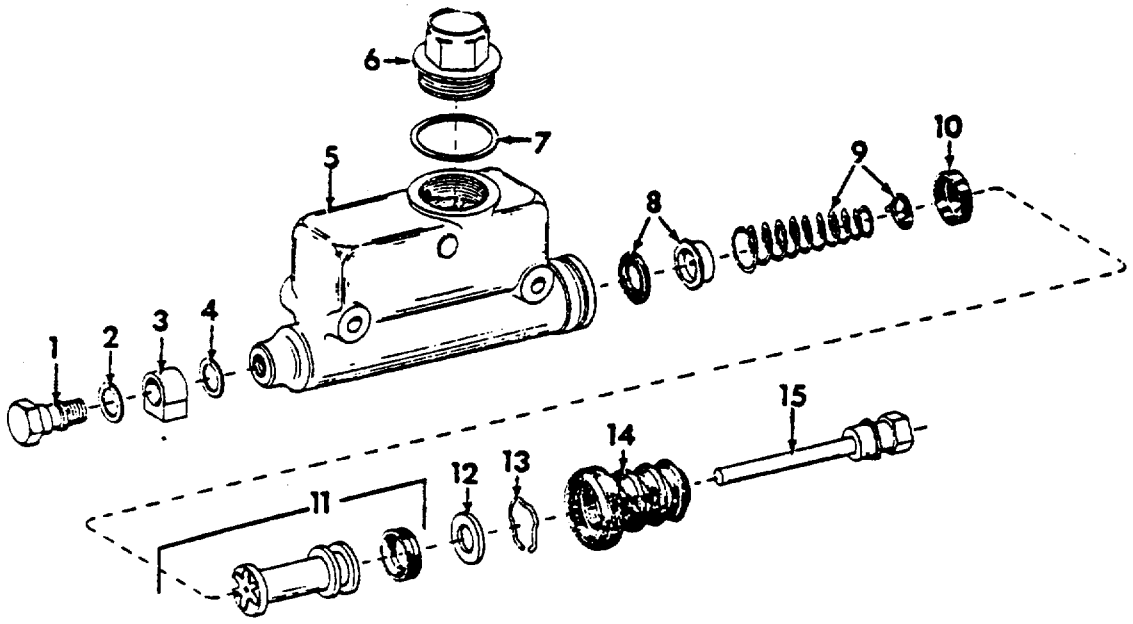
BRAKE PEDAL

ITEM	PART NO	QTY	DESCRIPTION	
1	4839214-6	1	BRAKE PEDAL AY	
2	4824664-9	1	.PAD RUBBER	
3	4752299-4	2	.BRUSHING-BRAKE PEDAL	
4	0915274-5	1	FTG-45DEG-.13-27	
5	4810562-1	1	BRACKET AY	
6	4782507-0	1	BUMPER	
7	0920161-7	2	NUT-JAM-.31-18	
8	0925205-7	2	CPSC-.31-18X.63	
9	0917256-8	2	LKW-.31	
10	4252791-1	2	RING-SNAP	
11	4784720-7	1	YOKE	
12	0929592-4	1	PIN-YOKE-.44	
13	0918447-4	1	PIN-.09X.75	
14	0922471-8	1	NUT-JA-.44-20	
15	4806694-8	1	SUPPORT AY	
16	0920415-7	4	CPSC-.38-16X1.25	
17	0916965-7	4	LKW-.38	
18	----------	1	PISTON	SEE PAGE 48
19	480727a-9	1	RETAINER-SPRING	
20	4806916-5	1	SPRING-BRAKE RETURN	
21	----------	1	BOOT	SEE PAGE 48
22	4807279-7	1	RETAINER-SPRING	
23	4713374-9	1	CYLINDER AY-MASTER	SEE PAGE 48
24	0922918-8	2	CPS375-16X3.25	
25	0920427-2	2	LKW-ET-.38	
26	0916950-9	2	NUT-.38-16	
27	4784167-1	1	TUBE AY-TEE TO RIGHT WHEEL	
28	4843240-5	1	TUBE AY-MASTER CYLINDER TO TEE	
29	4710934-3	1	TEE-BRAKE LINE	
30	4734177-0	1	TUBE AY-TEE TO LEFT WHEEL	
31	4708318-3	2	GASKET-FITTING	
32	4747156-6	2	FITTING-BRAKE LINE	
33	4708319-1	2	GASKET-BOLT	
34	4708313-4	2	BOLT-FITTING	

BRAKE MASTER CYLINDER-4713374-9

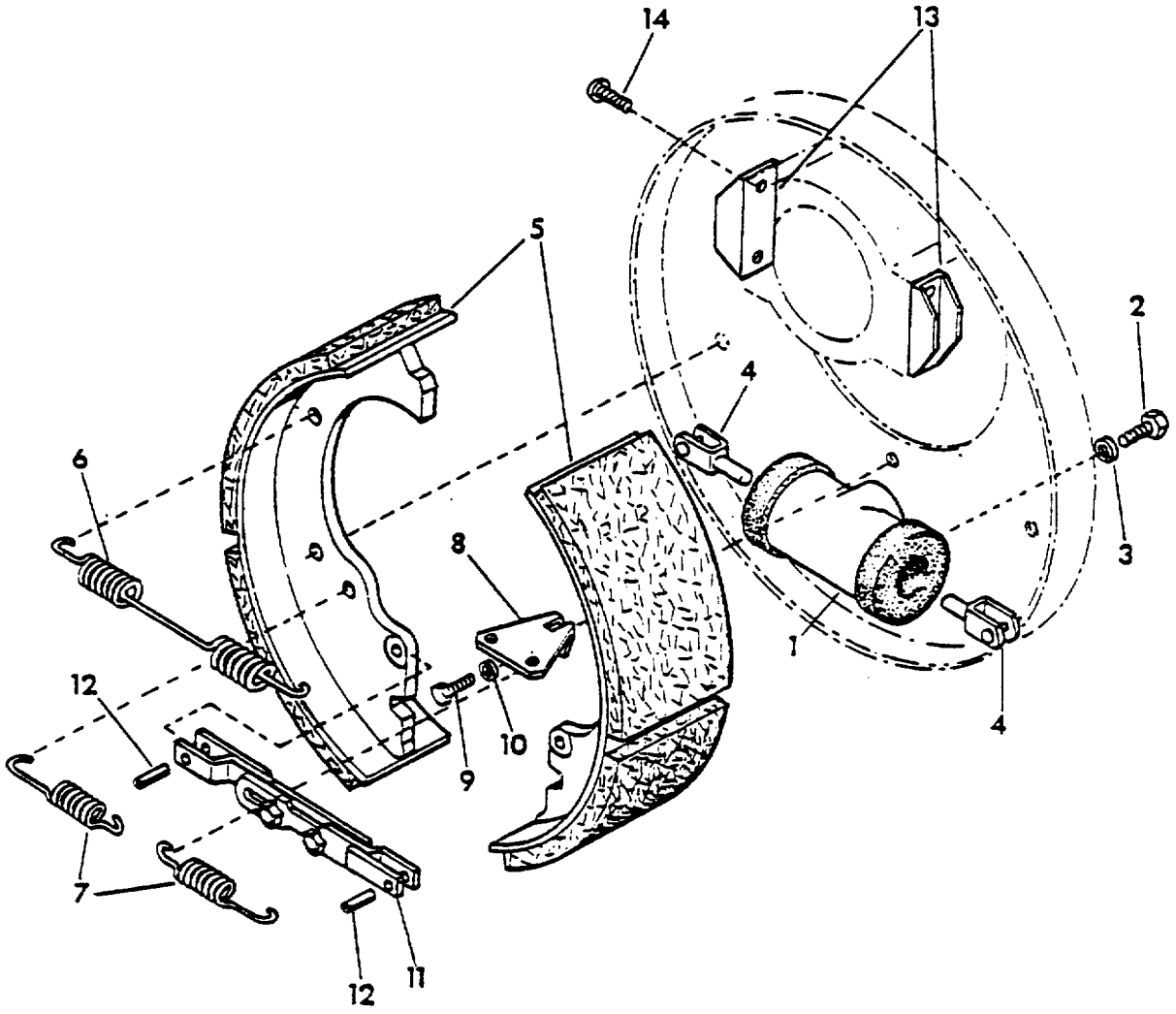
ITEM	PART NO.	DESCRIPTION	QTY.
1	4708313-4	BOLT-FITTING	1
2	4708319-1	GASKET-BOLT	1
3	4741699-6	FITTING-OUTLET	1
4	4708318-3	GASKET-FITTING	1
5	----------	BODY-CYLINDER	1 ORDER 4713374-9
6	4984159-6	CAP-FILLER	1
7	4981084-9	GASKET-CAP	1
8	4984141-4	*VALVE ASSY	1
9	4894142-2	SPRING-PISTON	1
10	4894152-1	*CUP-PISTON	1
11	4984153-9	*PISTON	1
12	4984155-4	*PLATE-STOP	1
13	4984156-0	*LOCK	1
14	4906749-9	*BOOT	1
15	4984158-8	ROD-PISTON	1

*INCL IN KIT-4984201-6



DRIVE WHEEL BRAKES

ITEM	PART NO	QTY	DESCRIPTION	
1	4717072-5	2	CYLINDER AY-WHEEL	SEE PAGE 51
2	0921966-3	4	CPSC-.38-16X.88	
3	0916965-7	4	LKW-.38	
4	4707255-7	4	LINK-CONNECTING	
5	4807349-8	4	SHOE & LINING AY	
6	4707255-8	2	SPRING-SHOE-UPPER	
7	4769885-7	4	SPRING-SHOE-LOWER	
8	4769886-5	2	BRACKET-SPRING	
9	0912264-9	2	CPSC-.31-18X1.00	
10	0917356-8	2	LKW-.31	
11	4769887-3	2	SLIDE AY-BRAKE ADJUSTER	
12	0916169-6	4	PIN-ROLL-.19X.75	
13	4808402-4	4	PLATE-WEAR	
14	0933231-8	8	SC-.25-20X.63	



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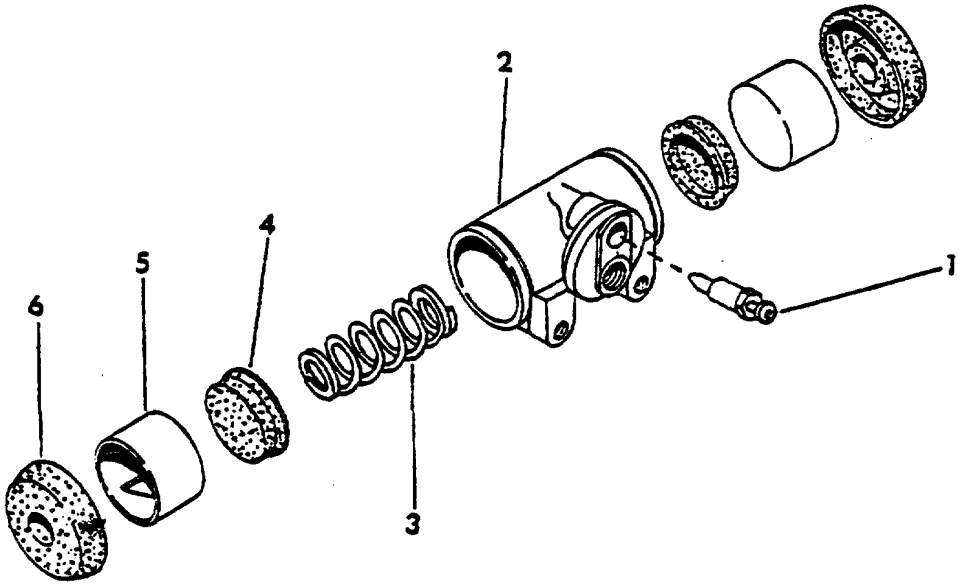
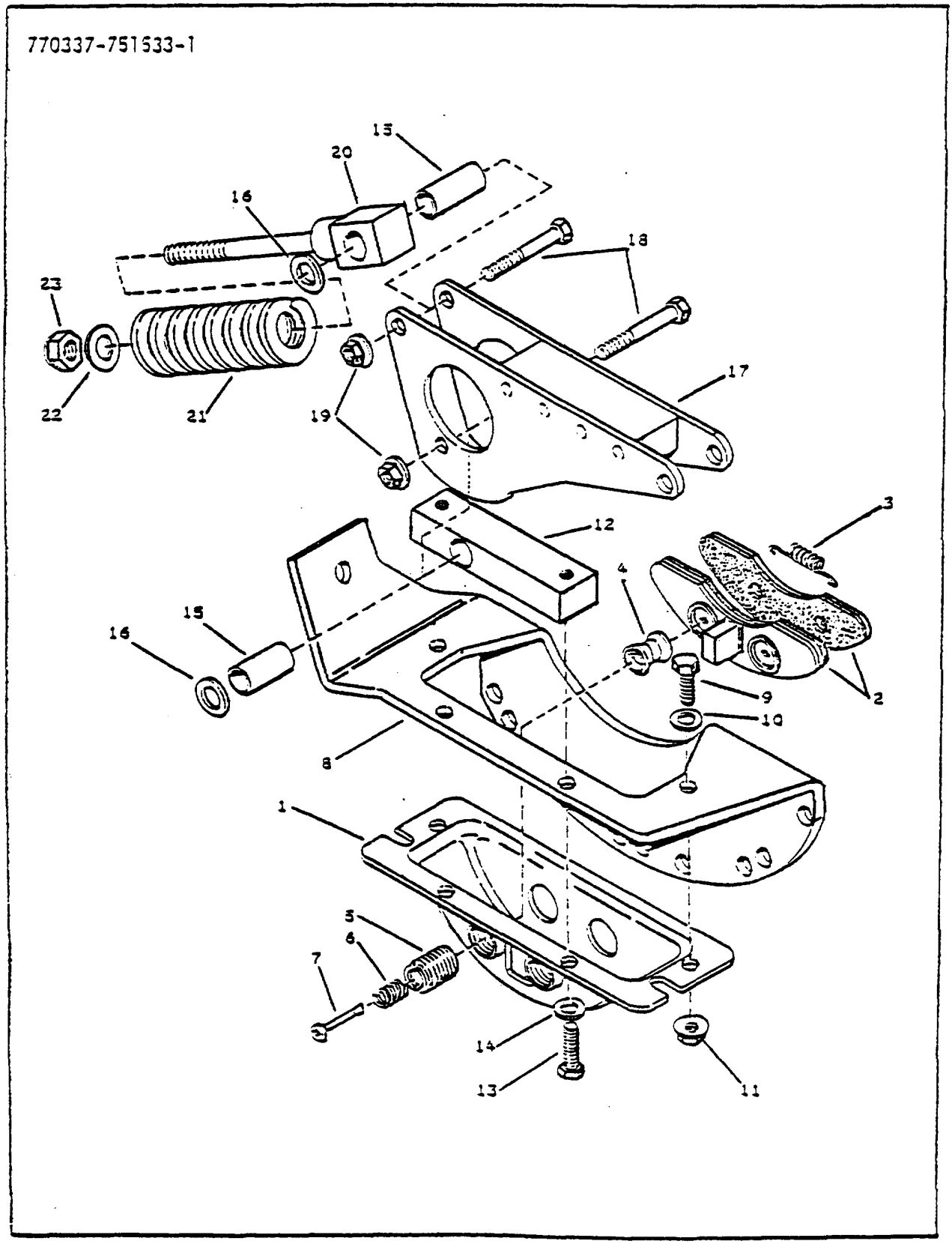


WHEEL CYLINDER-4717072-5

ITEM	PART NO	QTY	DESCRIPTION	
1	4981769-5	1	BLEEDER	
2	----------	1	BODY	ORDER ASSY
3	4981290-2	1	SPRING	
4	*4981291-0	2	CUP-PISTON	
5	4981292-8	2	PISTON	
6	*4987791-3	2	BOOT	

*INCL IN KIT 4987792-1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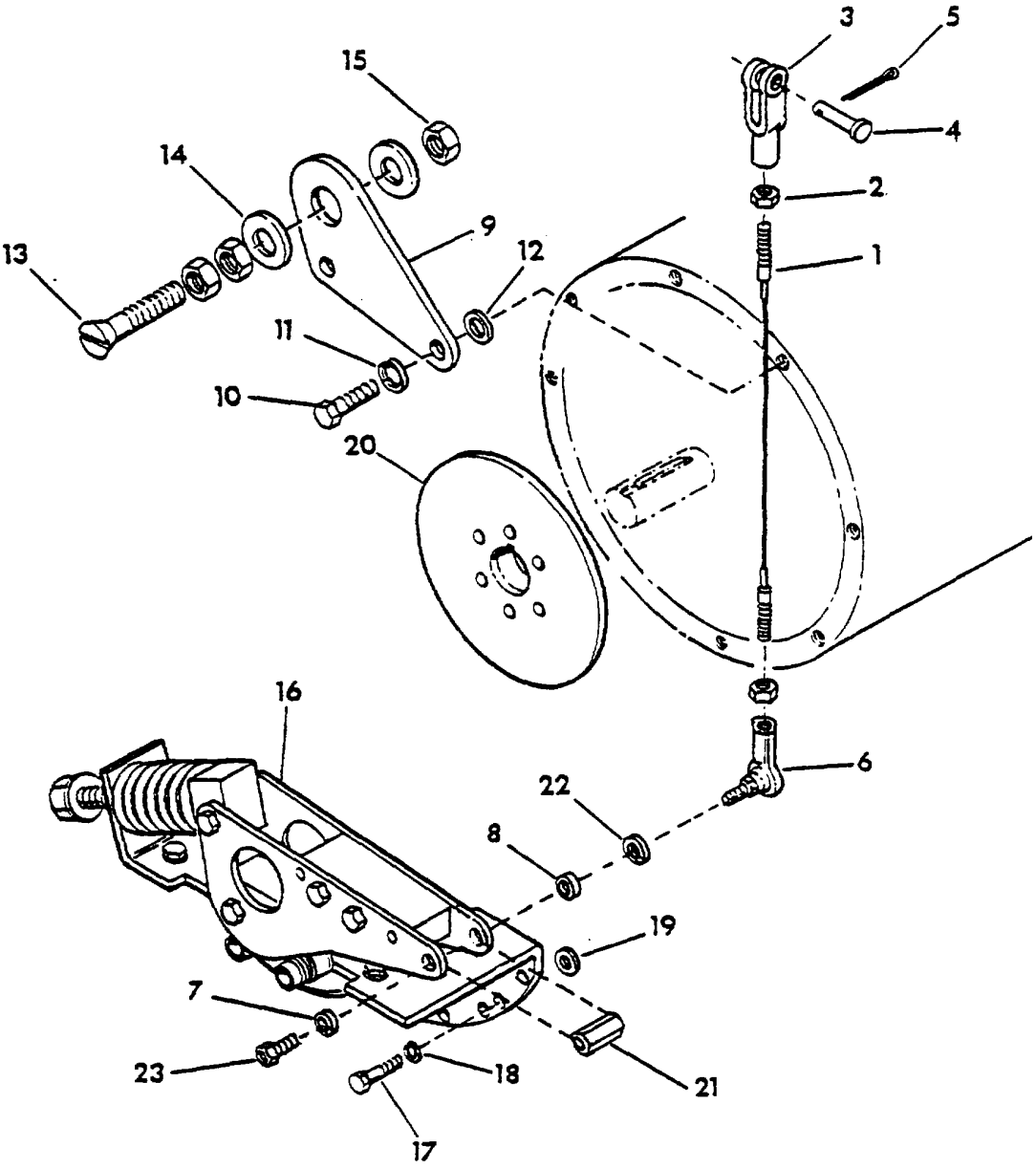
CALIPER AY-486716A-8

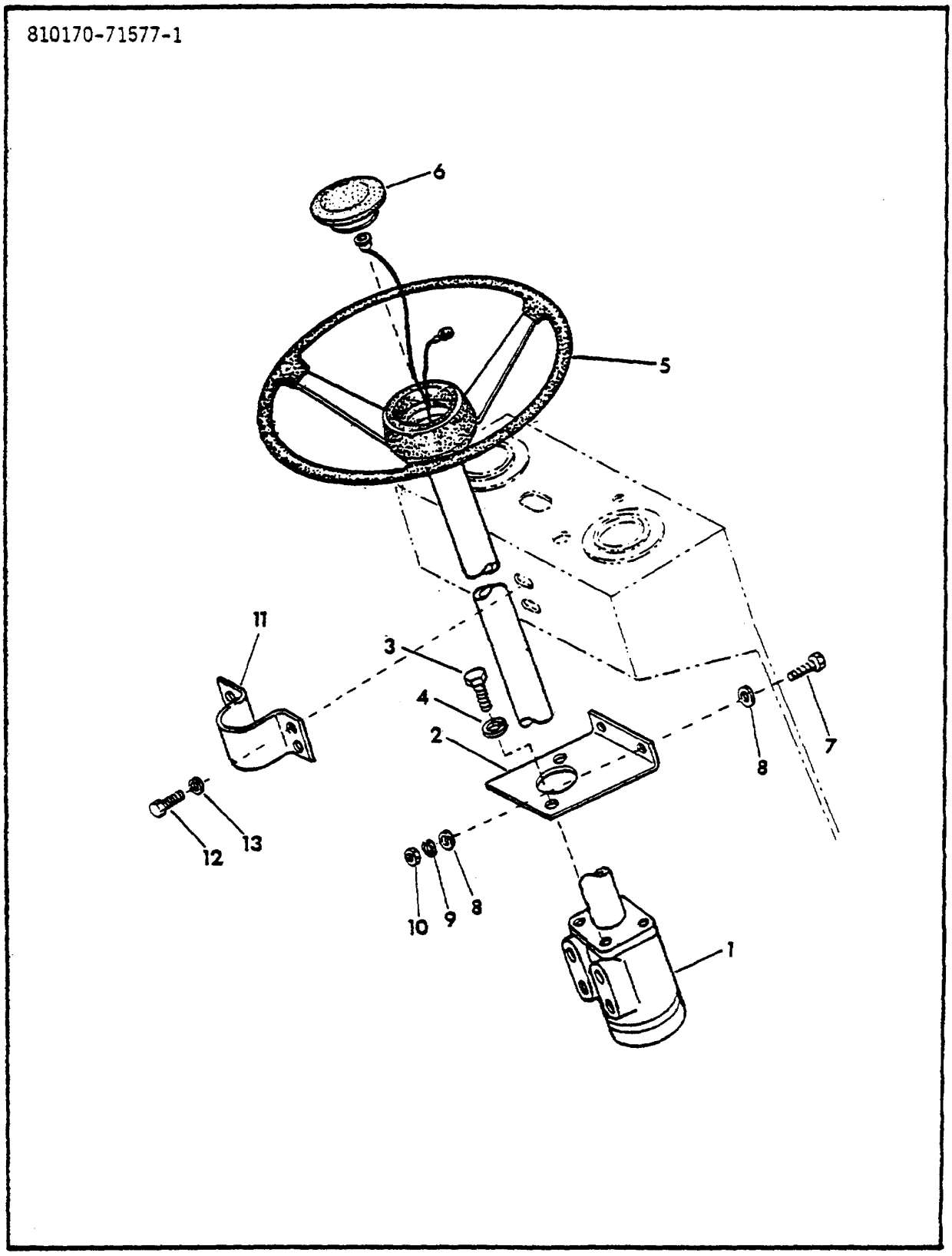
ITEM	PART NO	QTY	DESCRIPTION
1	4912180-9	1	HOUSING
2	4912197-3	1	PAC KIT-BRAKE
3	4912133-3	1	SPRING-CARRIER
4	4912184-1	2	PIN-TILT
5	4912185-8	2	SCREW-ADJUSTING
6	4912178-3	2	SPRING-ADJUSTER
7	4912179-1	2	PIN-RETAINER
8	4912188-2	1	BRACKET
9	0921333-1	2	CPSC-.31-18X1.00
10	0917356-8	2	LOCKWASHER-.31
11	0929001-6	2	NUT-FLANGE-.31-118
12	4912189-0	1	BLOCK-PIVOT
13	0921333-1	2	CPSC-.31-18X1.00
14	0917356-8	2	LOCKWASHER-.31
15	4912190-8	2	BUSHING
16	0917379-0	2	WASHER-.53X1.06
17	4912191-6	1	CAM
18	0921978-8	2	CPSC-.31-18X2.00
19	0929001-6	2	NUT-FLANGE-.31-18
20	4912192-4	1	RETAINER-SPRING
21	4912193-2	1	SPRING
22	0917379-0	1	WASHER-.53X1.06
23	0916951-7	1	NUT-.50-13

800143-751506-1



PARKING BRAKE

ITEM	PART NO	QTY	DESCRIPTION	
1	4867344-6	1	CABLE-BRAKE	
2	0918403-7	2	NUT-JAM-.38-24	
3	0924121-7	1	YOKE-.38-24	
4	0923087-1	1	PIN-YOKE-.38	
5	0918447-4	1	PIN-COTTER-.09X.75	
6	4857743-1	1	ROC-END	
7	0316965-7	1	LKW-.38	
8	4709116-0	1	SPACER	
9	4373288-7	1	BRACKET-MOTOR SUPPORT	
10	0921982-5	2	CPSC-.31-24X1.25	
11	0917356-8	2	LKW-.31	
12	0929362-2	2	WSHR-.41X1.81	
13	0930309-0	1	SC-.50-13X2-.50	
14	0920309-2	2	WSHR-.53X 1.75	
15	0913744-9	3	NUT-JAM-.50-13	
16	4367164-8	1	CALIPER-BRAKE	SEE PAGE 53
17	0921982-5	3	CPSC-.31-24X1.25	
18	0917356-8	3	LKW-.31	
19	0929362-2	3	WSHR--.41X.81	
20	4868939-2	1	DISC-BRAKE	
21	4888369-8	1	SPACER-BRKT LEVER	
22	0916965-7	1	LKW-.38	
23	0921984-1	1	CPSC-.38-24X.75	


810170-71577-1
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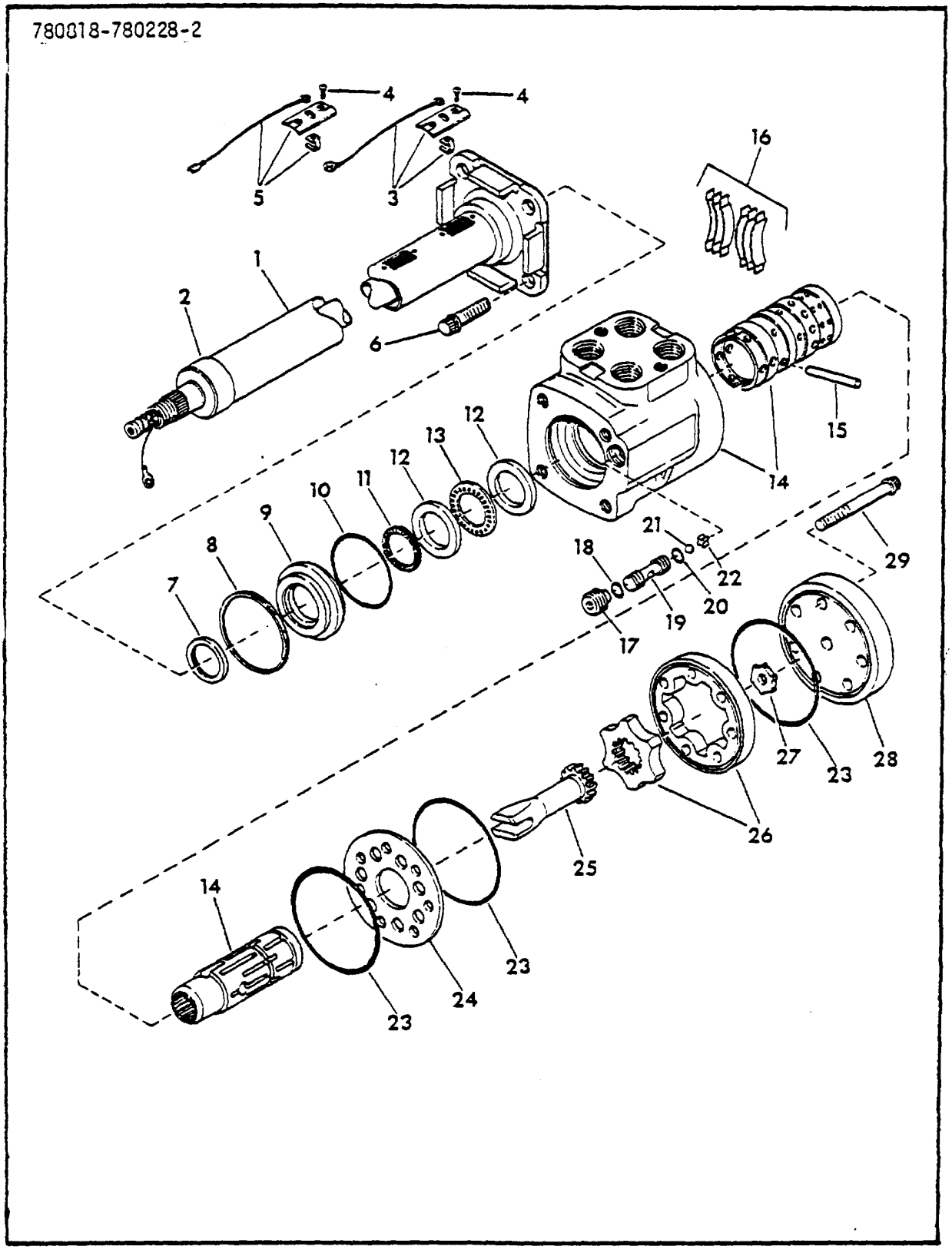
STEER GEAR

ITEM	PART NO	QTY	DESCRIPTION	
1	4889612-0	1	UNIT AY-STEER	SEE PAGE 59
2	4840493-3	1	SUPPORT	
3	0920415-7	2	CPSC-.38-16X1.25	
4	0916965-7	2	LKW-.23	
5	8616763-2	1	WHEEL-STEERING	
6	----------	1	BUTTON-HORN	SEE PAGE 67
7	0921221-8	2	CPSC-.31-18X1.38	
8	0924874-1	4	SHR-.34X1.00	
9	0917356-8	2	LKW-.31	
10	0917372-5	2	NUT-.31-18	
11	4852873-1	1	CLAMP-STEER COLUMN	
12	0923341-2	4	CAPSCREW-.25-20X.75	
13	0916964-0	4	LOCKWASHER-.25	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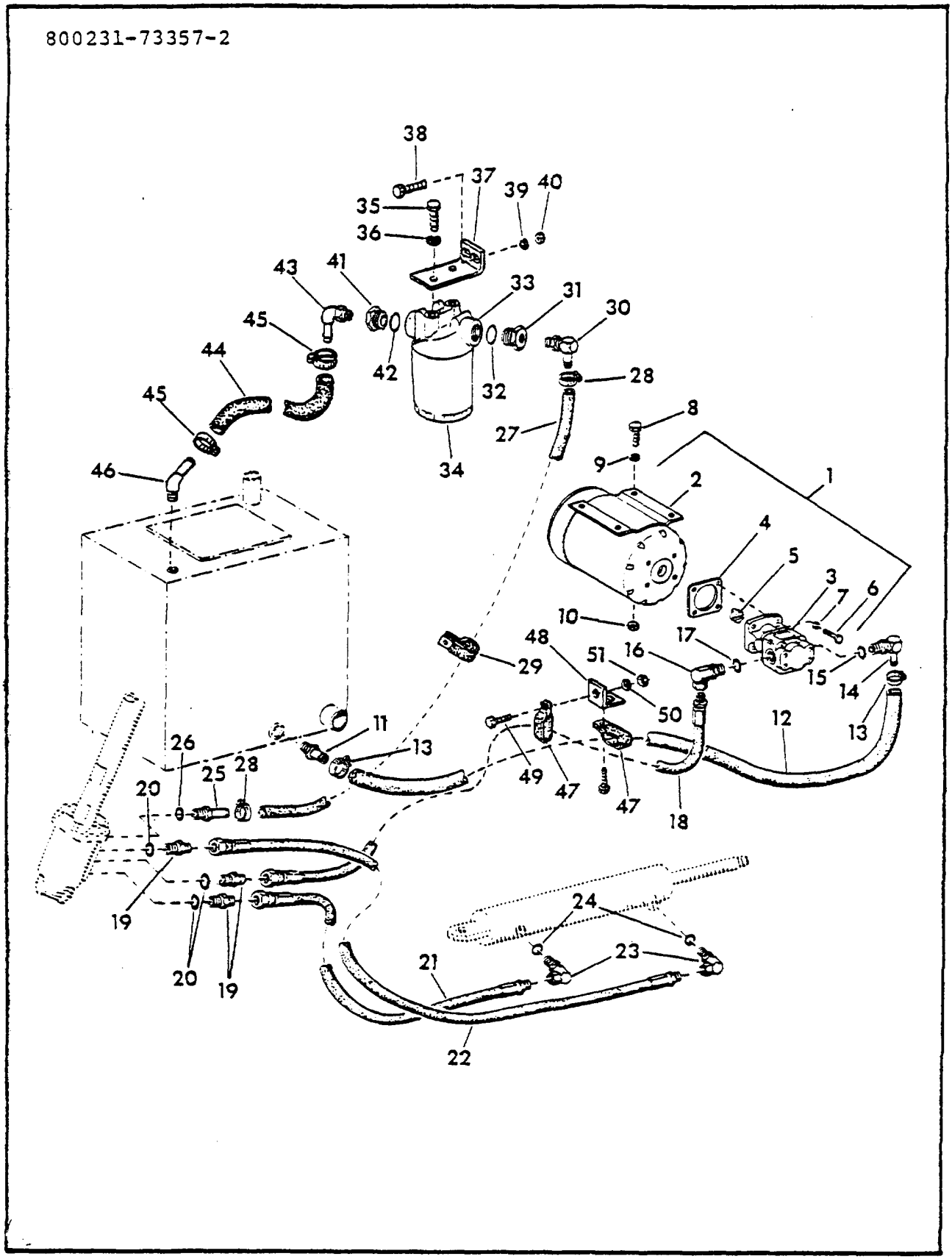
POWER STEER UNIT-4869612-0

ITEM	PART NO	QTY	DESCRIPTION	
1	4914222-7	1	COLUMN AY-STEER	
2	4914151-8	1	.CAP-OUTER TUBE	
3	4999469-2	1	.HORN BRUSH AY	
4	4995382-1	4	.SCREW	
5	4999470-0	1	.HORN BRUSH AY	
6	0922845-3	2	.SCREW-FLANGE-.38-16X.75	
7	* 4995372-2	1	SEAL-OIL	
8	4912468-8	1	R I NG- SNAP	
9	4912469-6	1	BUSHING-SEAL GLAND	
10	* 4912470-4	1	SEAL-O-RING	
11	* 0239191-0	1	SEAL-QUAD RING	
12	# 4914167-4	2	RACE-THRUST	
13	# 4912473-8	1	BEARING-NEEDLE	
14	4914160-9	1	CONTROL PARTS	
15	4994900-1	1	.PIN	
16	4994901-9	6	.SPRING-CENTERING	
17	4914166-6	1	SETSCREW	
18	* 4912968-7	1	SEAL-O-RING	
19	4914163-3	1	SEAT-CHECK BALL	
20	* 0923559-9	1	SEAL-O-RING-#011	
21	4914162-5	1	BALL-CHECK	
22	4914161-7	1	RETAINER-CHECK BALL	
23	* 4912459-7	2	SEAL-O-RING	
24	4914158-3	1	PLATE-SPACER	
25	1132770-7	1	DRIVE	
26	4914227-6	1	GEAR SET	
27	----------		SPACER	NCT RECD
26	4914155-9	1	CAP-END	
29	4998324-0	7	CAPSCREW	

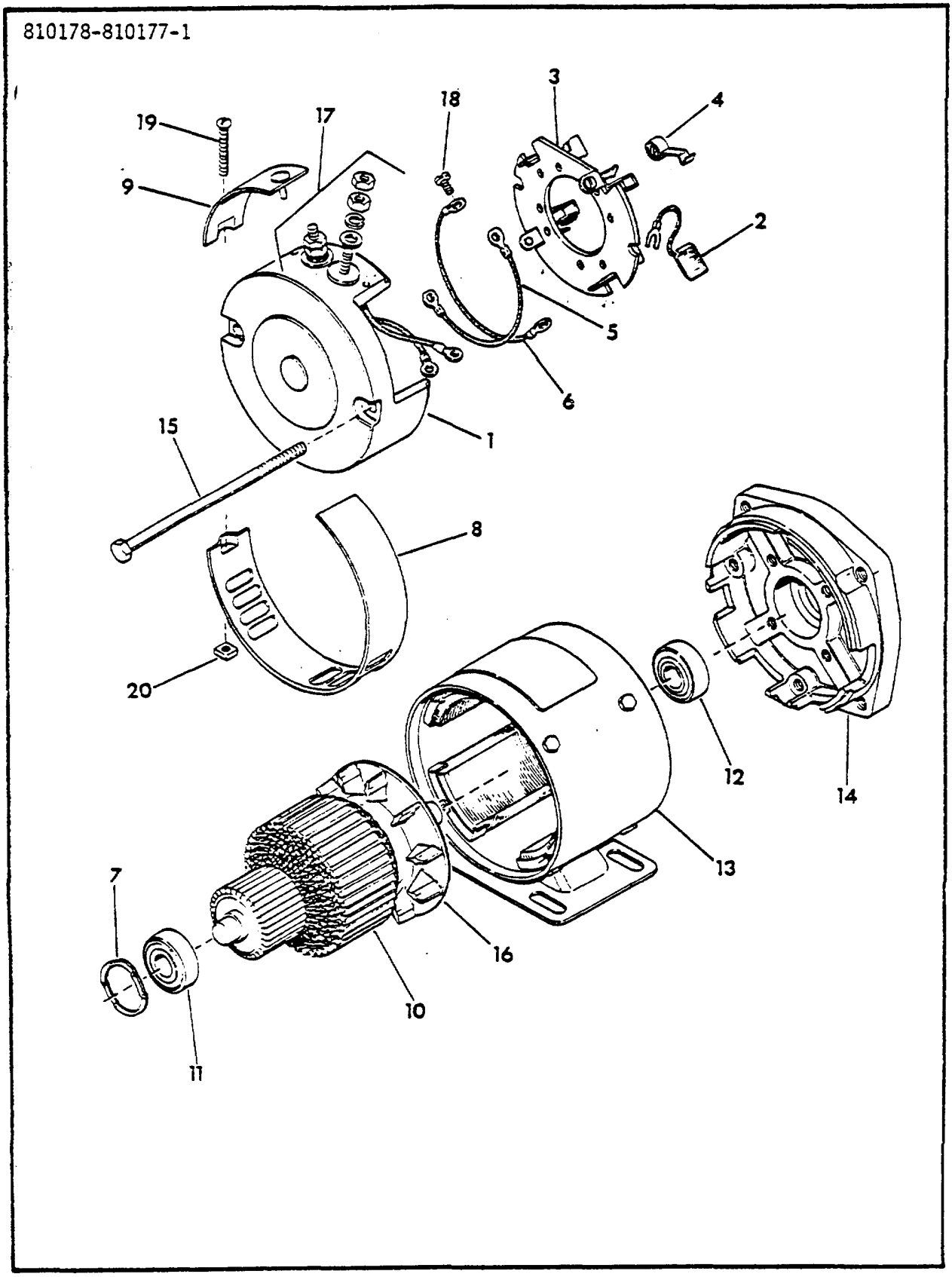
* INCL IN SEAL KIT 4914283-9
# INCL IN NEEDLE BEARING KIT 4912471-2

800231-73357-2



POWER STEER SYSTEM

ITEM	PART NO	QTY	DESCRIPTION	
1	8615907-6	1	PUMP & MOTOR UNIT-36	VOLT
				SEE PAGE 63
2	4911710-6	1	.MOTOR-POWER STEER	
3	4911376-4	1	.PUMP KIT-POWER STEER	
4	4907128-5	1	..GASKET	
5	4911497-8	1	..COUPLING	
6	0915808-0	4	..CPSC-.31-18X.75	
7	0917356-8	4	..LKW-.31	
8	0931066-5	4	CPSC-.31- l8X1.38	
9	0922713-3	4	LKW-ET- 31	
10	0928701-2	4	NUT	
11	0927476- 2	1	ELBOW-45 DEG-.75	
12	4822429-9	1	HOSE-40.00	
13	0922660-6	2	CLAMP- # l6	
14	4255761-1	1	FTG-BARB-90 DEG-.75-16	
15	0921349-7	1	.O-RING- # 908	
16	4758261-4	1	ADAPTOR-90 DEG-.56-18	
17	0921885-0	1	.O-RING- # 906	
18	4843255-3	1	HOSE AY-64.00	
19	4765069-2	3	CONNECTOR	
20	0921885-0	3	O-RING- # 906	
21	4800274-5	1	HOSE AY-37.00	
22	4805154-4	1	HOSE AY-46.00	
23	4758261-4	2	ADAPTOR-90 DEG-.56- 18	
24	0921885-0	2	.O-RING-.#.906	
25	0928886-1	1	FTG-BARB-.56- 18	
26	0921885-0	1	.O-RING- # 906	
27	4832965-0	1	HOSE-35.00	
28	0921910-6	2	CLAMP-#6	
29	0925619-9	1	CLAMP-INSULATED- .69	
30	0928887-9	1	FTG-BARB-90 DEG-.56-18	
31	0928885-3	1	RDCR-1.31- 12X .56- 18	
32	0921214-3	1	.O-RING- #916	
33	4845655-2	1	FILTER-RETURN LINE	
34	4905902-5	1	.CARTRIDGE	
35	0923114-3	2	CPSC-.50-13Xl.00	
36	0916966-5	2	LKW-.50	
37	4832960-1	1	BRACKET-FILTER	
38	0921960-1	2	CPSC-.25-20X1.00	
39	09 16964-0	2	LKW- . 25	
40	0916622-4	2	NUT-.25-20	
41	0928885-3	1	RDCR- I.31-12X.56- 18	
42	0921214-3	1	.O-RING- # 916	
43	0928887-9	1	FTG-BARB-9O DEG-.56-18	
44	4816964- 3	1	HOSE-17.50	
45	0921910-6	2	CLAMP- # 6	
46	0927019-0	1	NIPPLE-BARB-45DEG-.25	
47	4255066-5	2	CLAMP	
48	4811669-3	1	ANGLE	
49	0921221-8	2	CPSC-.31- 18X1.50	
50	0917356-8	2	LKW-.31	
51	3917372-5	2	NUT-.31- 18	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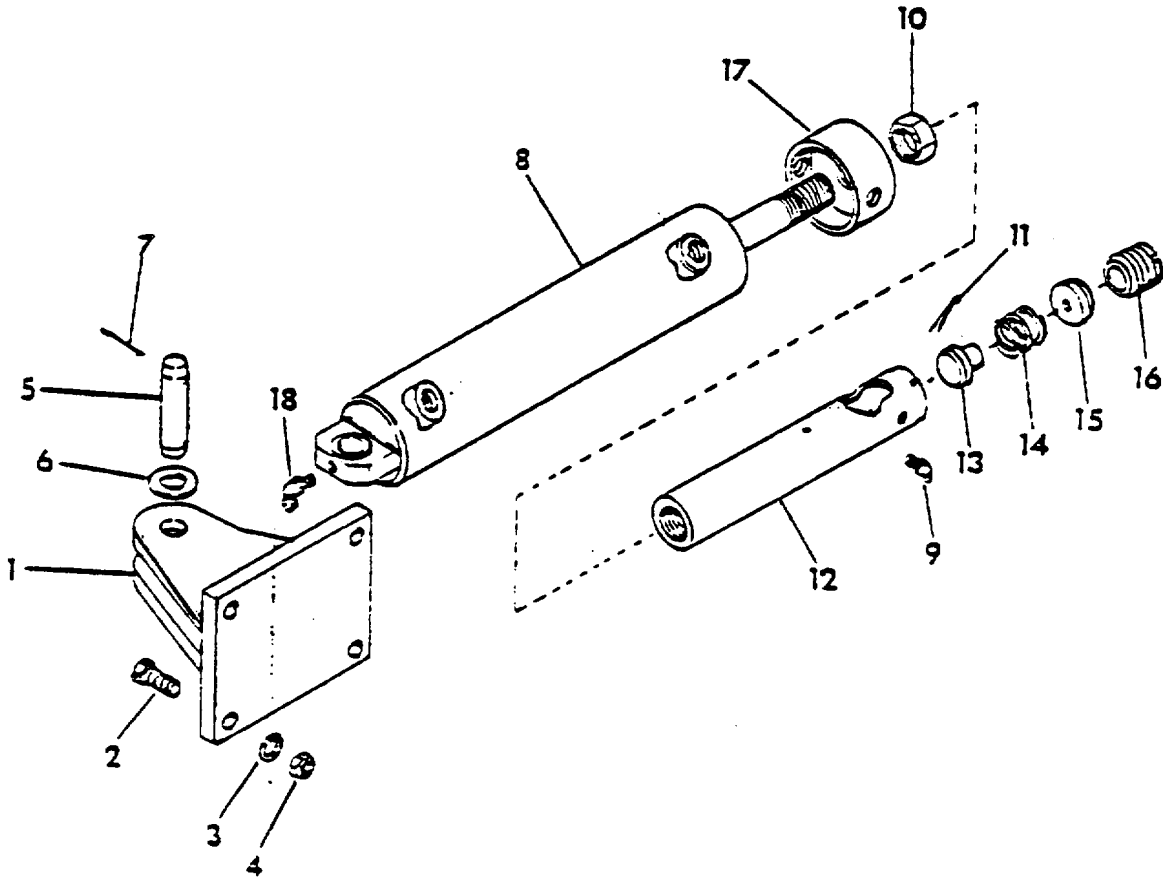
POWER STEER MOTOR (SEE NOTE)

ITEM	PART NO	QTY	DESCRIPTION
1	4911480-4	1	COVER-COMM END
2	4911481-2	4	BRUSH AY
3	4911482-0	1	BRUSH RING AY W/BRUSHES
4	4911483-8	4	BRUSH SPRINGS
5	4911484-6	1	LEAD AY
6	4911485-3	1	LEAD AY
7	4911486-1	1	BEARING SPRING WASHER
d	4911487-9	1	BRUSH INSPECTION COVER
9	4911488-7	1	BRUSH INSPECTION COVER
10	4911489-5	1	ARMATURE AY-36 V
10	4911490-3	1	ARMATURE AY-48 V
11	4911491-1	1	BEARING-COMM END
12	4911492-9	1	BEARING-PULLEY END
13	4911712-0	1	STATOR AY
14	4911494-5	1	COVER-PULLEY
15	4911758-7	2	BOLT-HEX HD-MOTOR
16	4911495-2	1	FAN
17	4911496-0	2	STUD KIT-TERMINAL
18	4914601-9	2	SPRINGTITES-PAN HD- # 10-32X.38
19	0929583-3	1	SC- # 10- 32X1.50
20	0917415-2	1	NUT- # 10- 32
----	8612611-7	1	KIT-ENCLOSURE-EE

NOTE-4911710-6 36 VOLT

POWER STEER

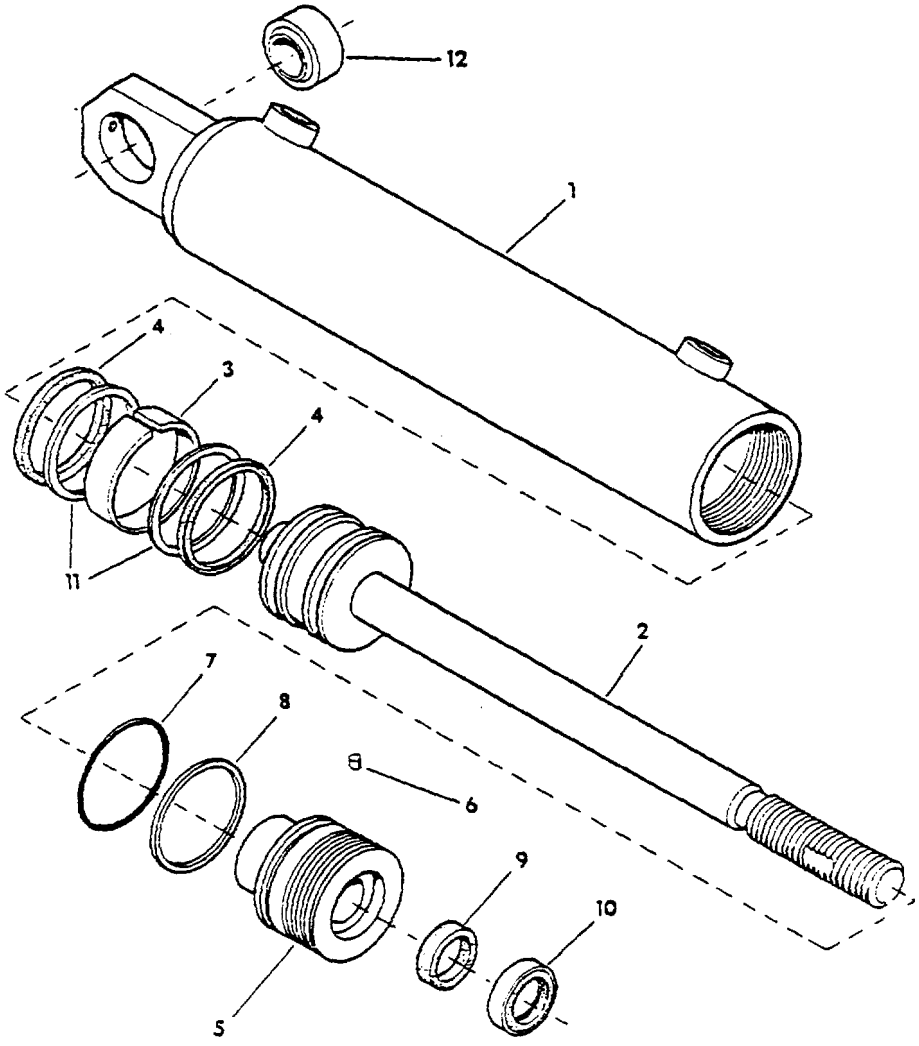
ITEM	PART NO.	DESCRIPTION	QTY.	
1	4812010-9	ANCHOR-CYLINDER	1	
2	0923888-2	SCREW	4	
3	0916966-5	LOCKWASHER	4	
4	0916951-7	NUT	4	
5	4879195-8	PIN-CYLINDER	1	
6	0923427-9	WASHER	2	
7	0900814-5	PIN-COTTER	2	
8	4883292-7	CYLINDER-POWER STEER	1	SEE PAGE 65
9	0912808-3	FITTING-LUBE	2	
10	0920439-7	NUT-JAM	1	
11	0918454-0	PIN-COTTER	1	
12	4831937-0	SOCKET-LINK	1	
13	----------	PLUG	1	ORDER 4831937-0
14	4781446-2	SPRING	1	
15	4981815-6	SEAT-BALL	1	
16	4769248-8	PLUG-ADJUSTING	1	
17	4862565-1	SPACER	1	
18	0918187-6	FITTING-LUBE	1	

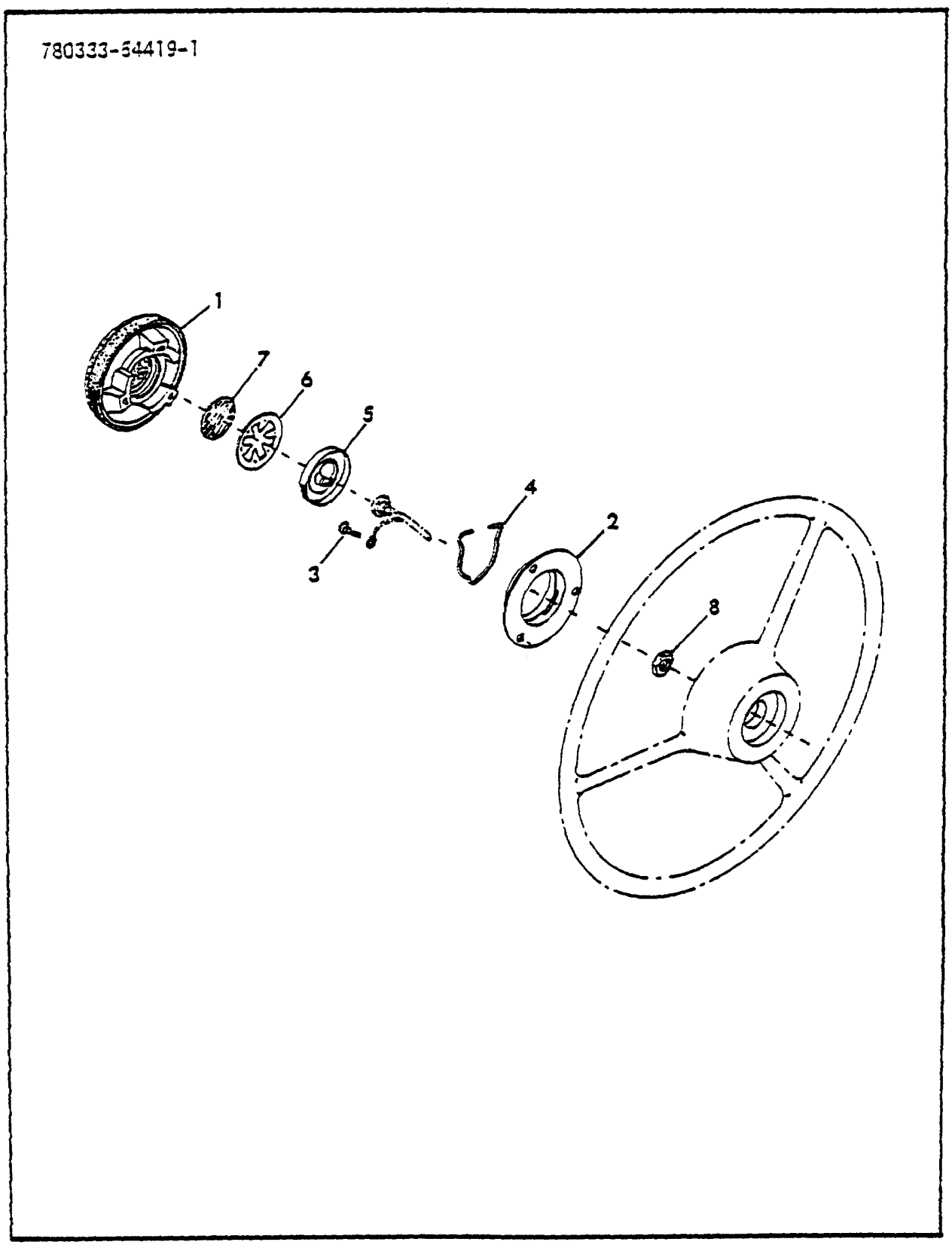


POWER STEER CYL-4883292-7

ITEM	PART NO.		DESCRIPTION	QTY.
1	4872762-2		TUBE	1
2	4883293-5		PLUNGER	1
3	4863192-3	*	BEARING	1
4	4883294-3	*	T-RING	2
5	4857708-4		NUT-GLAND	1
6	4816749-8		PELLET-NYLON	2
7	0923572-2	*	O-RING	1
8	0931433-7	*	RING-BACKUP	1
9	4875492-3	*	PACKING	1
10	4863194-9	*	RING-WIPER	1
11	4884424-5		RING-BACKUP	2
12	4829439-1		BUSHING-BALL	1

* INCL IN SEAL KIT-4913028-9




780333-54419-1
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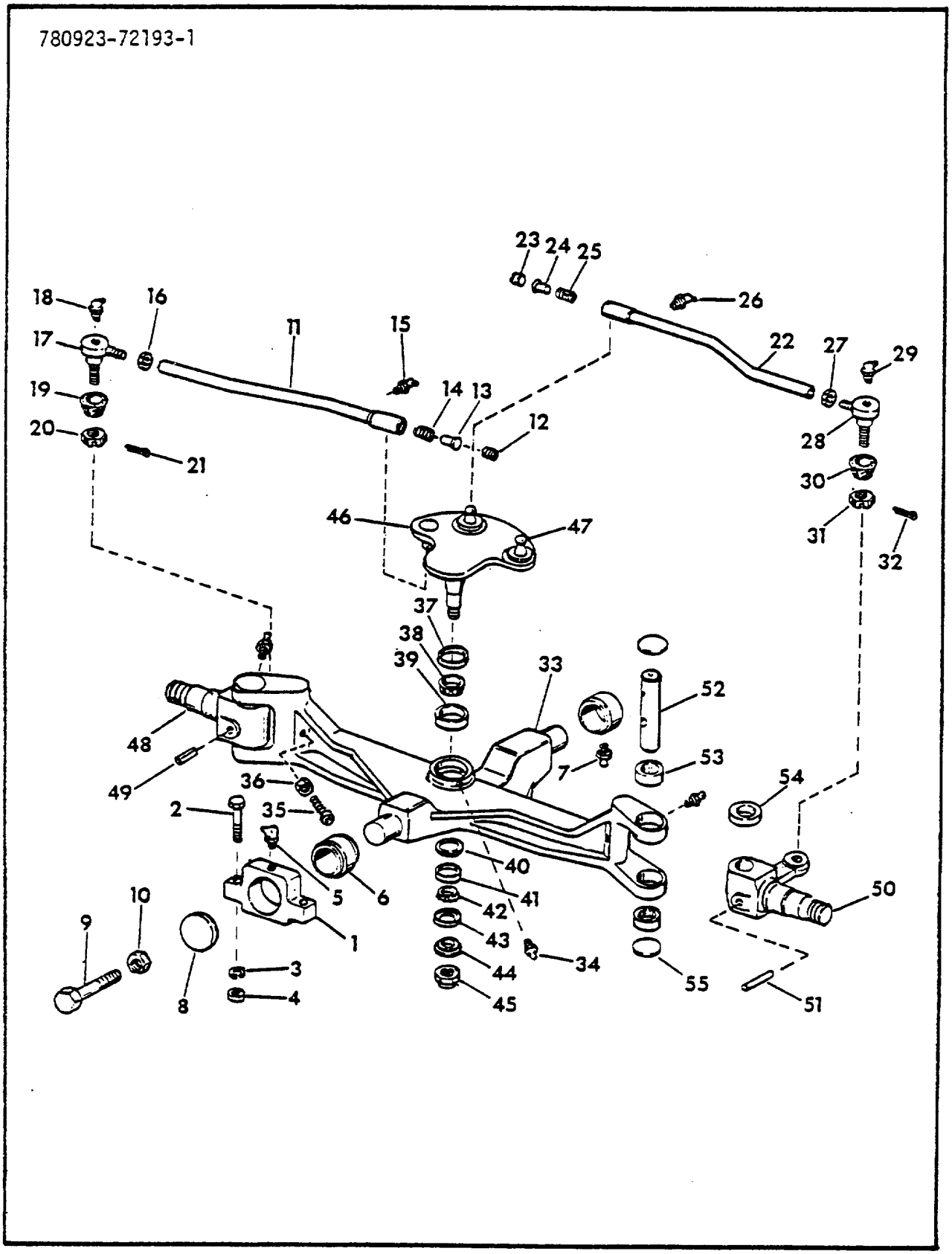
HORN BUTTON

ITEM	PART NO	QTY	DESCRIPTION
l	8621324-6	1	BUTTON-HORN
2	4801466-6	1	PLATE
3	0934748-5	3	SC-# 10-32x.63
4	4801474-0	1	LOCKWIRE
5	4801469-0	1	CUP-CONTACT
6	4801473-2	1	SPRING
7	4801471-6	1	DISC
8	4785070-6	1	NUT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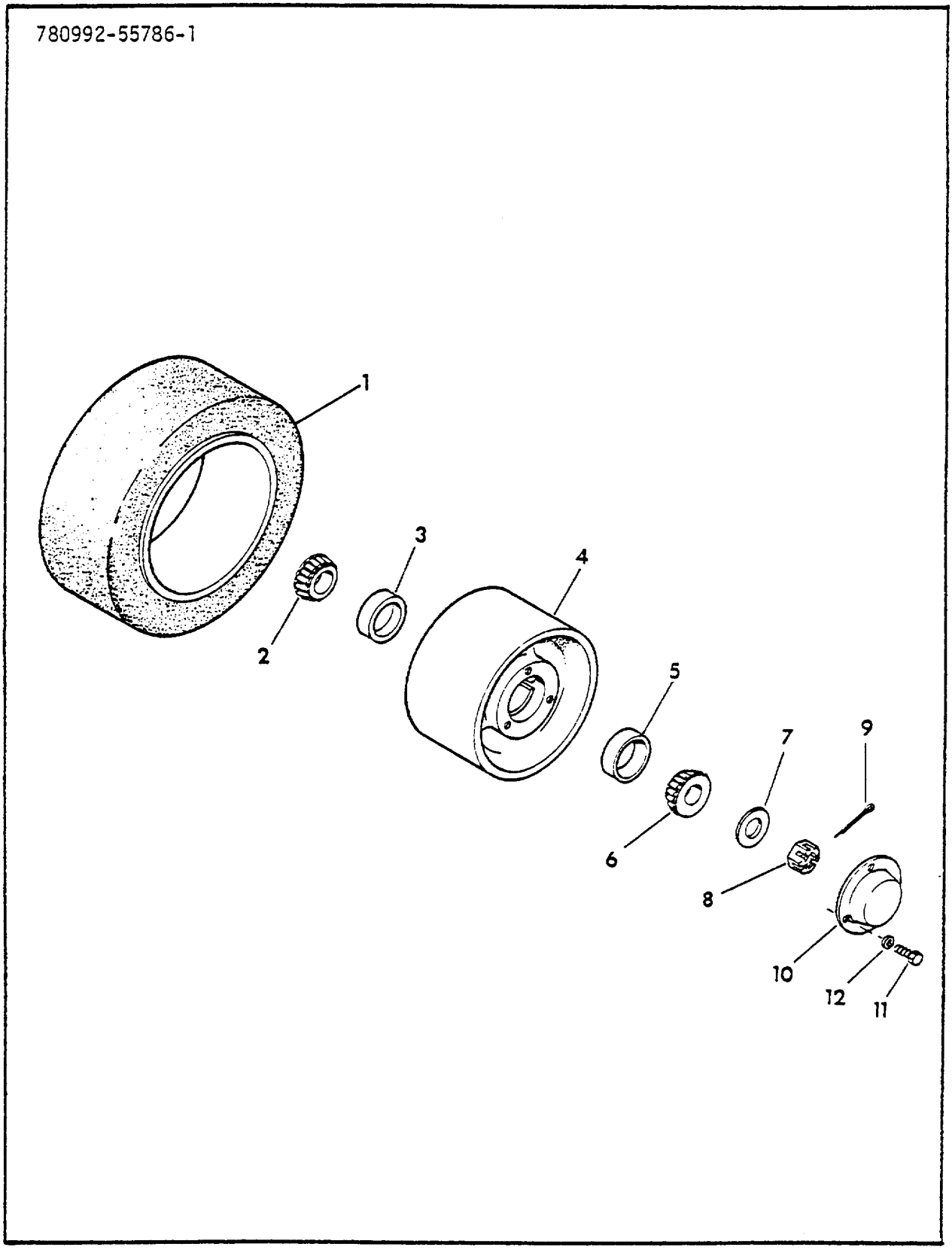
STEER AXLE

ITEM	PART NO	QTY	DESCRIPTION	
1	4828662-9	1	HOUSING-AXLE	
2	0929531-2	2	CPSC- 50-20X3.O0	
3	0916966-5	2	LOCKWASHER-.50	
4	0919423-4	2	NUT-.50-20	
5	0922212-6	1	FITTING-LUBE-90DEG-.12	
6	4808387-7	2	BUSHING-HOUSING	
7	0914687-9	1	FITTING-LUBE-STR-.25-28	
8	4823121-1	1	SPACER	
9	0933814-6	1	CPSC-.75-10X3.50	
10	0922037-7	1	NUT-JAM-.75-10	
11	4767763-8	1	ROD-TIE-RH	
12	4769248-8	1	.PLUG-ADJUSTING	
13	4769247-0	1	.SEAT-BALL	
14	4781446-2	1	.SPRING	
15	0915538-3	1	.FITTING-LUBE-65DEG- .25-28	
16	0922015-3	1	NUT-JAM-.75-16	
17	4992396-4	1	.SOCKET-BALL	
18	0915275-2	1	..FITTING-LUBE-65DEG-.12-27	
19	4992397-2	1	..COVER	
20	0917361-8	1	..NUT-SLOTTED-.56-18	
21	0918453-2	1	..PIN-COTTER-.13X1.25	
22	4767762-0	1	ROD-TIE-HL	
23	4769248-8	1	.PLUG-ADJUSTING	
24	4769247-0	1	.SEAT-BALL	
25	4781446-2	1	SPRING	
26	0915538-3	1	.FITTING-LUBE-65DEG-.25-28	
27	0922015-3	1	.NUT-JAM-.75-16	
28	4992396-4	1	.SOCKET-BALL	
29	0915275-2	1	..FITTING-LUBE-65DEG-.12-27	
30	4992397-2	1	..COVER	
31	0917361-8	1	..NUT-SLOTTED-.56-18	
32	0918453-2	1	..PIN-COTTER-.13-1.25	
33	4830998-3	1	AXLE AY-STEER	
34	0922887-5	5	FITTING-LUBE-.13	
35	0919350-9	2	SETSCREW-.50-13 X2.00	
36	0913744-9	2	NUT-JAM-.50-13	
37	0927933-2	1	SEAL-UPPER	
38	0927435-8	1	CONE-BEARING-UPPER	
39	0927434-1	1	CUP-BEARING-UPPER	
40	4811824-4	1	RING-SNAP	
41	0927436-6	1	CUP-BEARING-LOWER	
42	0927437-4	1	CONE-BEARING-LOWER	
43	0927932-4	1	SEAL-LOWER	
44	0931314-9	1	WASHER-.88XI.75	
45	4808392-7	1	NUT	
46	4831977-6	1	ARM AY-PIVOT	
47	4807683-0	3	.STUD-BALL	
46	4808396-8	1	SPINDLE-RH	
49	0926243-7	1	PIN-ROLL-.25X2.25	INCL IN ITEM 52
50	4808397-6	1	SPINDLE-LH	
51	0926243-7	1	PIN-ROLL-.25X2.25	INCL IN ITEM 52
52	4909730-6	2	PIN KIT-KING	
53	4253263-0	2	.BEARING-NEEDLE	
54	4844078-8	2	.BEARING-THRUST	
55	0910007-4	2	.PLUG-EXPN-1.38	


780992-55786-1
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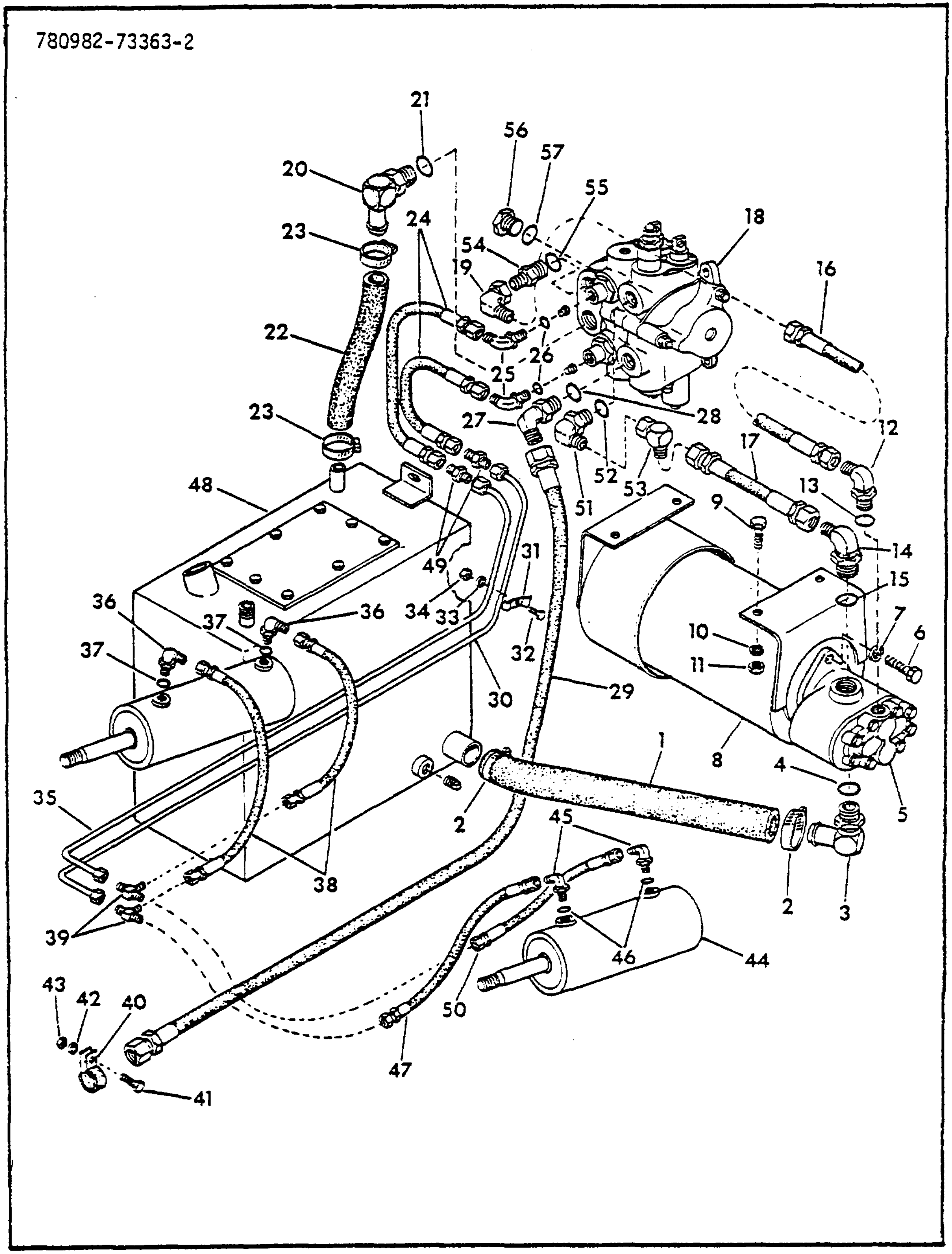
STEER WHEEL

ITEM	PART NO	QTY	DESCRIPTION
1	4784094-7	2	TIRE-15.5X5X10
2	0926702-2	2	CONE-BEARING-INNER
3	4254318-1	2	CUP-BEARING-INNER
4	4734042-6	2	WHEEL-STEER
5	4254704-2	2	CUP-BEARING-OUTER
6	4254703-4	2	CONE-BEARING-OUTER
7	0929369-7	2	WSHR-1.16X2.00
6	0929606-2	2	NUT-JAM-1.13-12
9	0925719-7	2	PIN-COTTER-.13 X2.00
10	4706891-1	2	CAP-HUB
11	0921965-0	6	CPSC-.38- 16X.75
12	0916803-0	6	LKW-I T-.38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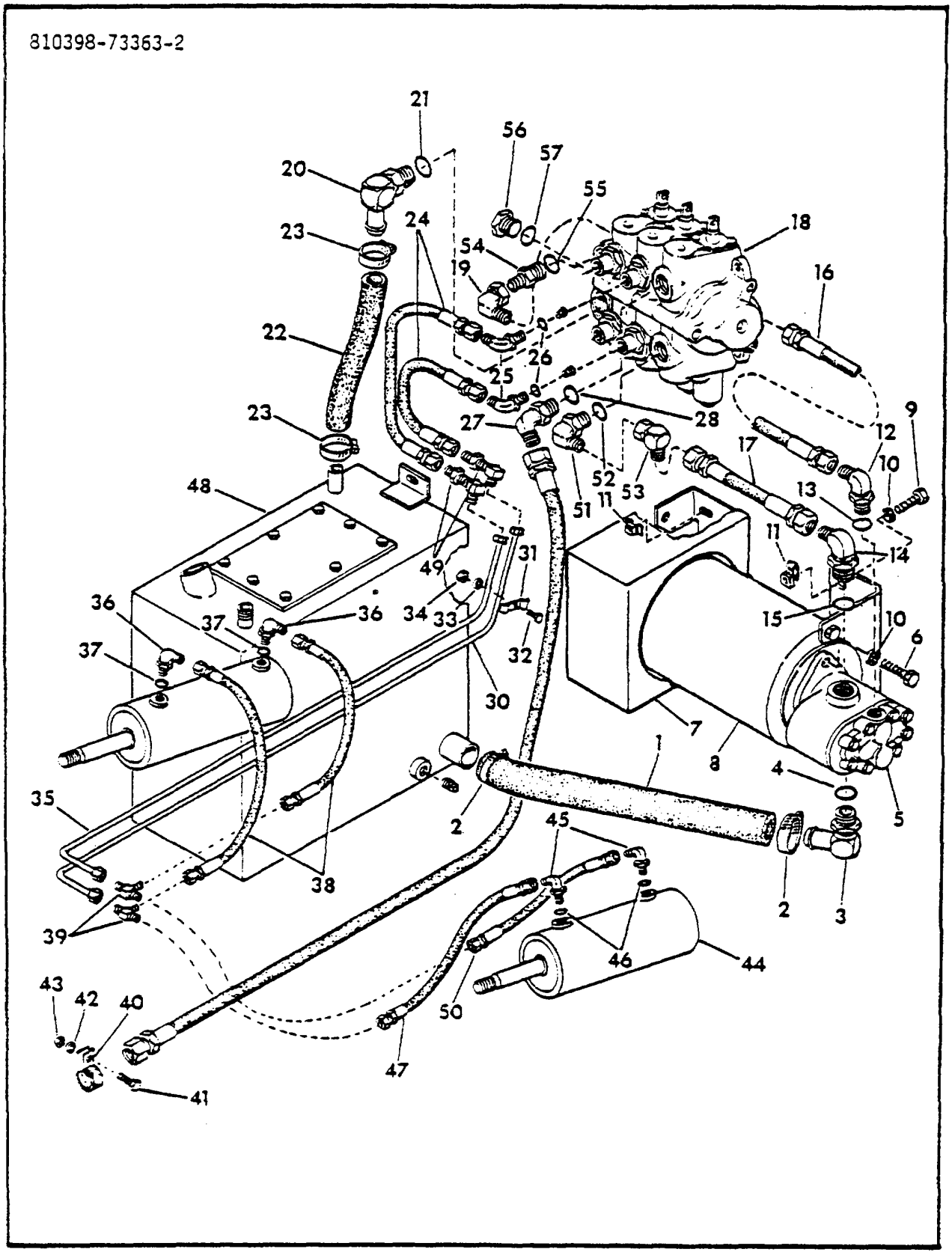
HYDRAULIC SYSTEM

ITEM	PART NO	QTY	DESCRIPTION	
1	4914222-7	1	COLUMN AY-STEER	
2	0922198-7	2	CLAMP-SAE #32	
3	4843257-9	I	FITTING-BARB-90 DEG	
4	0921214-3	1	.O-RING- #916	
5	----------	1	PUMP-HYDRAULIC	SEE PAGE 79
6	0920352-2		CPSC-.38-24X 1.25	
7	8621436-8	1	SHROUD-MOTOR	
8		1	MOTOR AY-HYDRAULIC	SEE PAGE 77
9	0920415-7	4	CPSC-.38- 16X 1.25	
10	0916965-7	6	LKW-.38	
11	0928234-4	2	NUT-RET-J-.38-16	FRONT MOTOR MTG
11	0923907-0	2	NUT-RET-.33-16	REAR MOTOR SHROUD
12	0924786-7	1	ELBOW-90 DEG-.75-16X.88-14	
13	0921205-1	1	.O-RING- #910	
14	0924046-6	1	ELBOW-90 DEG-.88-14X1.06-12	
15	0921206-9	1	O-RING-#912	
16	4822434-9	1	HOSE AY-40.00	
17	4852386-4		HOSE AY-30.00	
18	----------	1	VALVE AY-CONTROL	SEE PAGE 83
19	0921279-6	1	ELBOW-90 DEG-.75-16	
20	0932507-7	1	FTG-BARB-90 DEG-.88-14	
21	0921205-1	1	.O-RING- #910	
22	4847827-5	2	HOSE-9.25	
23	0922660-6	2	CLAMP-SAE #16	
24	4818828-8	2	HOSE AY-12.00	
25	0922571-5	2	ELBOW-90 DEG-.44-20	
26	0921883-5	2	.O-RING	
27	0921327-3	1	ELBOW-90 DEG-.88-14	
28	0921215-0	1	.O-RING- #910	
29	4858071-6	1	HOSE AY-40.00	
30	4892726-3	1	TUBE AY-HYD-BOTTOM	
31	4513552-2	1	CLAMP	
32	0921221-8	1	CPSC-.31-18X1.50	
33	0917356-8	1	LKW-.31	
34	0917372-5	1	NUT-.31-18	
35	4892725-5	1	TUBE AY-HYD-TOP	
36	0922571-5	2	ELBOW-90 DEG-.44-20	
37	0921883-5	2	O-RING- #904	
38	4818828-8	2	HOSE AY-12.00	
39	0928946-3	2	TEE-UNION-.44-20	
40	4254551-9	1	CLAMP	
41	0921960-1	1	CPSC- 25-20X1.00	
42	0916964-0	1	LKW-.25	
43	0916622-4	1	NUT-.25- 20	
44	----------	2	CYLINDER AY-TILT	SEE PAGE 91
45	0922571-5	2	ELB-90 DEG-.25	
46	0921883-5	2	.O-RING- #904	
47	4832052-7	1	HOSE AY-15.00	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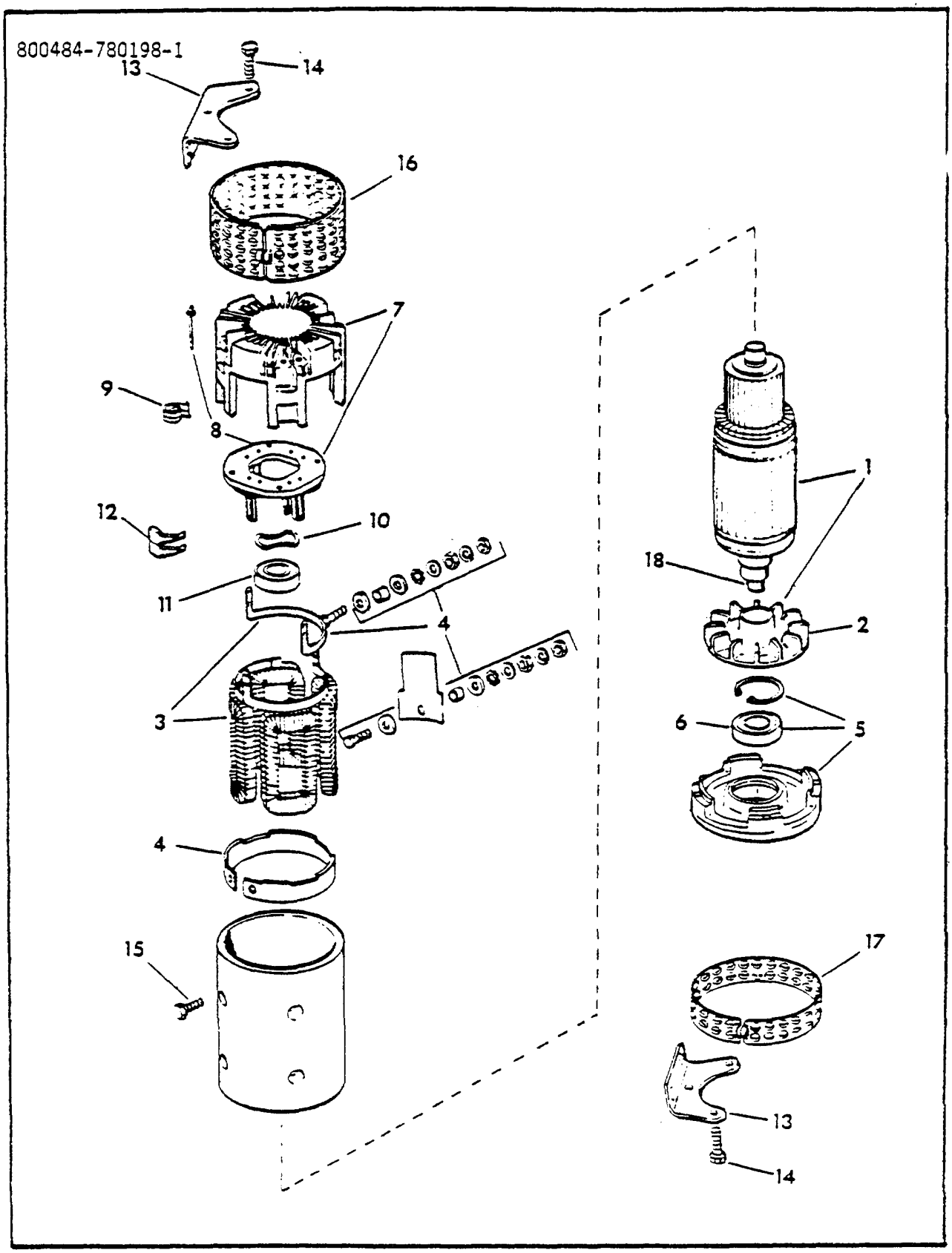
HYDRAULIC SYSTEM

ITEM	PART NO	QTY	DESCRIPTION	
41	----------	1	RESERVOIR	SEE PAGE 81
49	0928917-4	2	FTG-.44-20	
50	4827755-2	1	HOSE AY-19.O0	
51	0922974-1	1	ELB-90 DEG-1.06-12x.88-14	
52	0921205-1	1	.O-RING- #910	
53	0919624-7	1	ELB-90 DEG-1.06-12	
54	0923717-3	1	CONNECTOR-.75-16X.88- 14	
55	0921205-1	1	O-RING- #910	
56	4988887-8	1	PLUG	
57	0921206-9	1	O-RING-#912	
58	4255354-5	10	TY-WRAP	NOT ILLUSTRATED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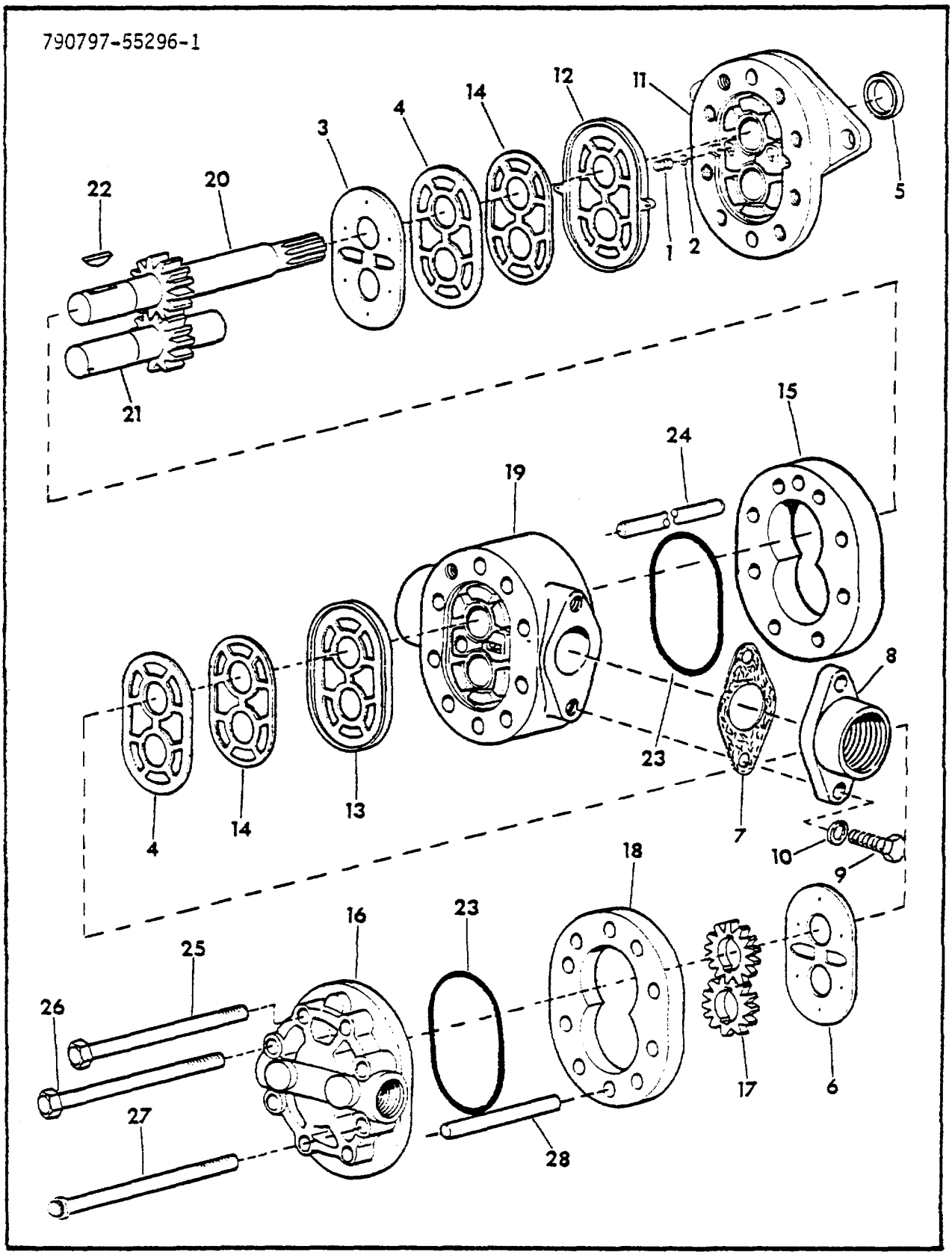
HYDRAULIC MOTOR-4883976-5

ITEM	PART NO	QTY	DESCRIPTION	800484-780198-1
1	4913405-9	1	ARMATURE & FAN AY	
2	4913415-8	1	.FAN-ARMATURE	
3	4910652-9	1	COIL AY-FIELD	
4	4910657-8	1	.STUD PKG-TERMINAL	
5	4910801-2	1	HEAD AY-DRIVE END	INCL ITEM 14
6	4913413-3	1	.BEARING-BALL	
7	4910800-4	1	HEAD AY-COMM END	INCL ITEM 14
8	4913414-1	1	.KIT-HOLDER-BRUSH	
9	4907766-2	1	.SPRING SET-BRUSH	
10	4910654-5	1	WASHER-SPRING	
11	0527933-6	1	BEARING-BALL	
12	4915652-4	1	BRUSH SET	
13	4910802-0	2	BRACKET-MTG	INCL ITEM 14
14	----------	-	SCREW-BRACKET MTG	
15	4913383-8	1	SCREW PKG-POLE SHOE	INCL ITEM 14
16	4897653-4	1	COVER-COMM END-	INCL ITEM 17
17	----------	1	COVER-DRIVE END-	
18	4911632-0	1	COUPLING-SPLINED	INCL PIN
19	4911661-9	4	POLE PIECE	NOT SHOWN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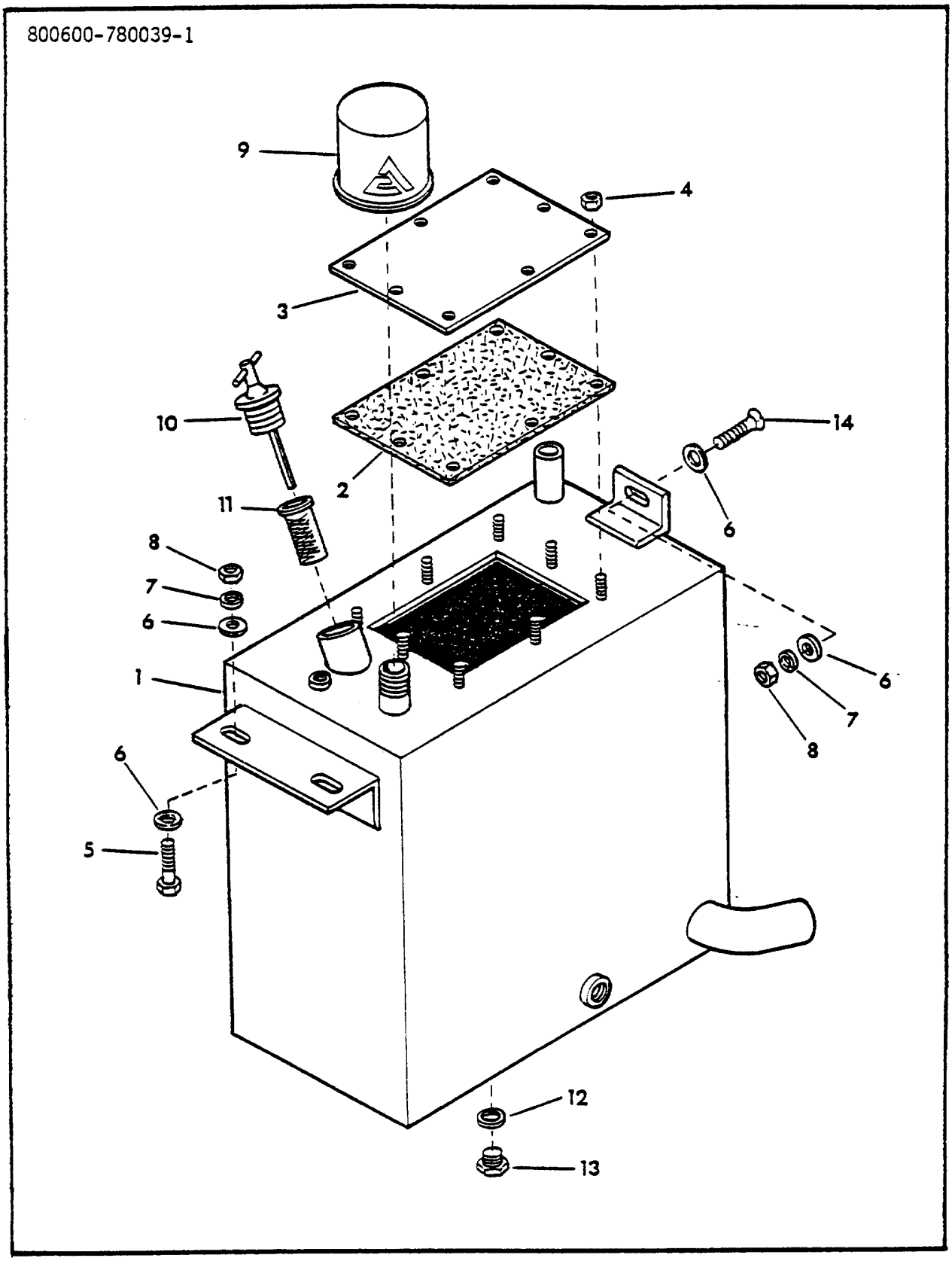
HYDRAULIC PUMP-4832303-4

ITEM		PART NO	QTY	DESCRIPTION
1	*	4992061-4	2	SPRING
2	*	0915903-5	2	BALL-STEEL-.22
3	*	4912836-6	1	DIAPHRAGM
4	*	4993848-3	1	GASKET-BACKUP
5	*	4993853-2	1	SEAL-SHAFT
6	*	4912838-2	1	DIAPHRAGM
7	*	4887067-9	1	GASKET
8	*	4999846-1	1	ADAPTOR
9		0921210-1	2	CPSC- .38-16X1 · 00
10		0916965-7	2	LKW -.38
11	*	4914213-6	1	PLATE AY-FRONT
12	*	1178407-1	1	SEAL
13	*	4908227-4	1	SEAL-DIAPHRAGM
14	*	1178408-9	2	GASKET-PROTECTOR
15		4908421-3	1	BODY
16		4907160-8	1	PLATE-BACK
17		4907163-2	2	GEAR-SLIP FIT
18		4907164-0	1	BODY
19		4906659-0	1	BODY-ADAPTOR
20		4907161-6	1	GEAR AY-DRIVE
21		4907162-4	1	GEAR AY-IDLER
22		----------	1	KEY-.12X.19X.28
23	*	0926216-3	2	O-R I NG- #- 041
24		4908420-5	2	PIN-DOWEL-. 31X2.25
25		0922873-5	4	CPSC-.31-18X4.75
26		0924227-2	2	CPSC-12 PT HD-.31-18X5.00
27		0924227-2	2	CPSC-12 PT HD-.31-18X5.00
28		4993856-6	2	PIN-DOWEL-.3I X1.50

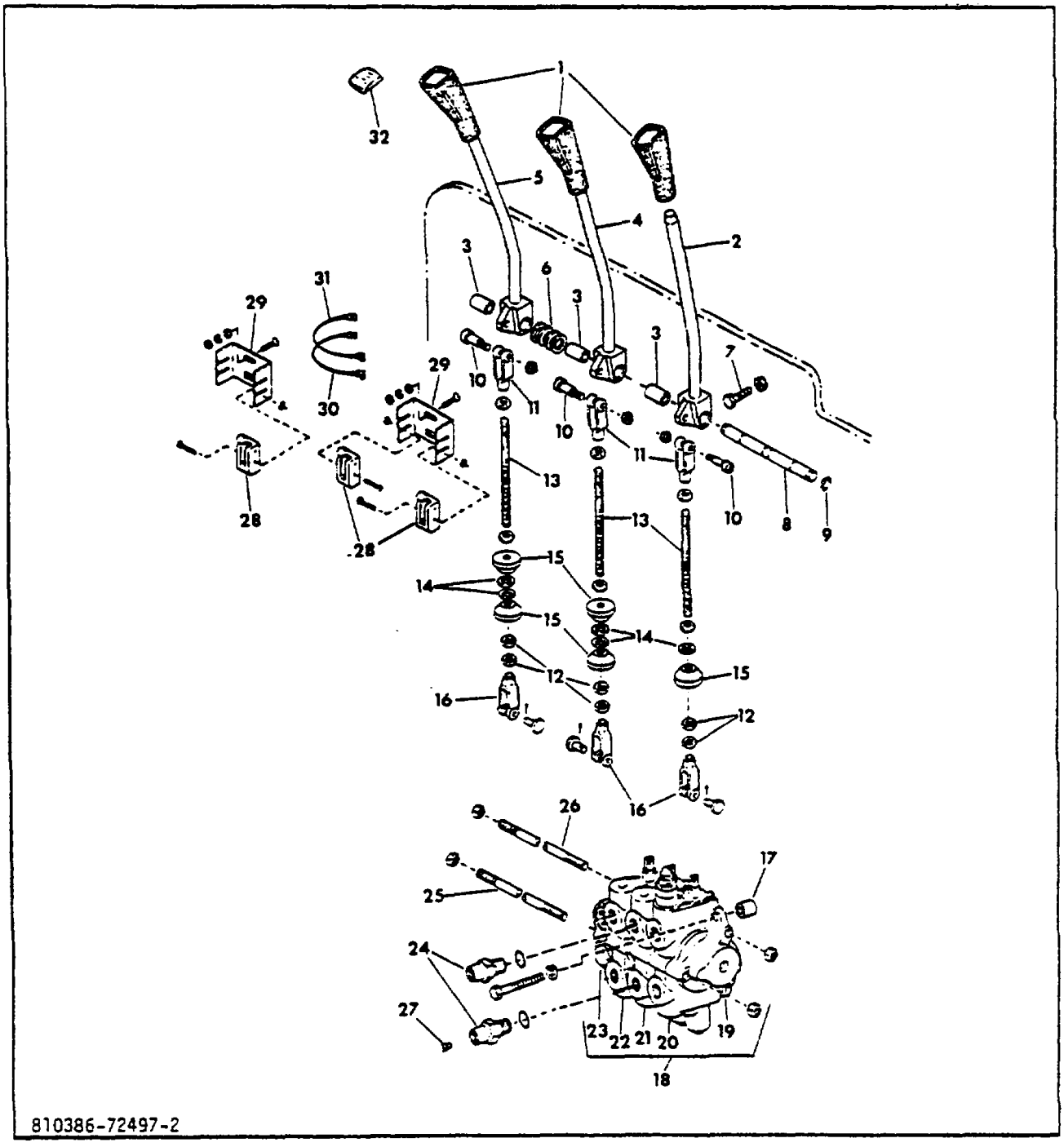
*INCL IN KIT 4905470-3

800600-780039-1



HYDRAULIC RESERVOIR

ITEM	PART NO	QTY	DESCRIPTION
1	4866791-9	1	RESERVOIR-HYDRAULIC
2	4829369-0	1	.GASKET
3	4829368-2	1	.COVER
4	0919438-2	8	.NUT-LOCK-.31 - 18
5	0920415-7	2	CPSC-.38- 16X1.25
6	0917378-2	5	WSHR-.43X.1.00
7	0916965-7	3	LKW- .38
8	0916950-9	3	NUT-.38- 16
9	4835378-3	1	FILTER-AIR
10	4828800-5	1	DIPSTICK
11	4806357-2	1	SCREEN
12	4845678-4	1	WASHER-NYLON
13	4855689-8	1	PLUG-DRAIN
14	0921351-3	1	SC-FL HD-.38- 16X1.25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810386-72497-2

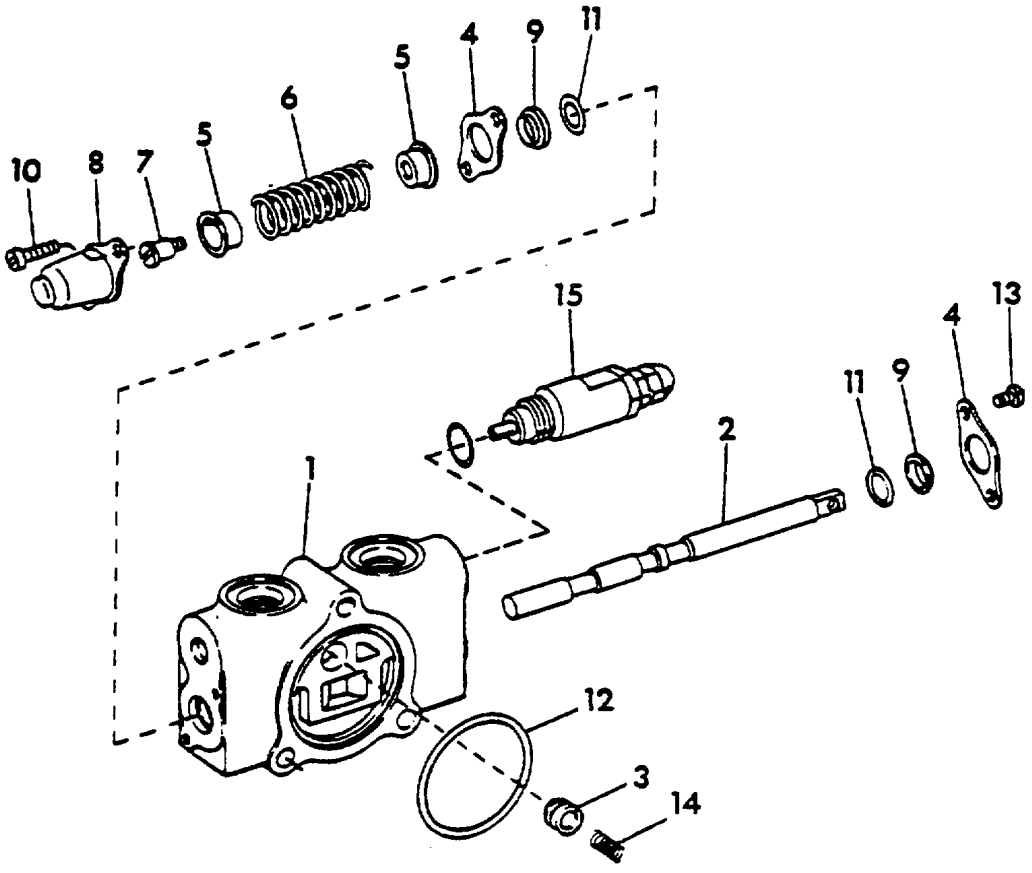
CONTROL VALVE

ITEM	PART NO.	DESCRIPTION	QTY.	
1	8615330-1	KNOB-CONTROL	3	
2	4850557-2	HANDLE-LIFT	1	INCL 1 OF ITEM 3
3	4879193-3	BUSHING	3	
4	4850800-6	HANDLE-TILT	1	INCL 1 OF ITEM 3
5	4850802-2	HANDLE-SIDE SHIFT	1	INCL 1 OF ITEM 3
6	0919327-7	WASHER	6	
7	0923341-2	CAPSCREW	3	
	0920435-5	NUT	3	
8	4829699-0	SHAFT	1	
9	4255345-3	E-RING	2	
10	4255879-1	SCREW-SHOULDER	3	
11	0923405-5	YOKE	3	
12	0920438-9	NUT-JAM	12	
13	4847512-3	ROD-ACTUATOR	3	
14	0918265-0	WASHER	5	
15	4805420-9	ACTUATOR	5	
16	4802823-7	YOKE	3	
	0925341-0	PIN-CLEVIS	3	
	0918448-2	PIN-COTTER	3	
17	4709110-3	SPACER	3	
18	4812665-0	VALVE-CONTROL	1	INCL ITEMS 19 THRU 26
	0921971-8	CAPSCREW	3	
	0916965-7	LOCKWASHER	3	
19	4895181-7	SECTION-OUTLET	1	
20	4999456-9	PLUNGER SECTION-LIFT	1	SEE PAGE 84
21	4995182-5	PLUNGER SECTION-TILT	1	SEE PAGE 85
22	4999937-8	PLUNGER SECTION-SIDE SHIFT	1	SEE PAGE 86
23	4907480-1	SECTION-INLET	1	SEE PAGE 87
24	4998881-9	PLUG	1	
	0921349-7	O-RING	1	
25	4997459-7	ROD-TIE	1	
	0916602-6	NUT-JAM	2	
26	4997458-7	ROD-TIE	2	
	0917372-5	NUT	4	
27	4811706-3	POPPET	1	
28	4828546-4	SWITCH	3	
	0910968-7	SCREW	6	
	0925152-1	WASHER	6	
	0917365-9	LOCKWASHER	6	
	0916621-6	NUT	6	
29	4879197-4	BRACKET-SWITCH	2	
	0932569-7	SCREW	4	
	0923212-5	WASHER	4	
	0917365-9	LOCKWASHER	4	
30	4796633-8	WIRE-GRAY	1	
31	4811017-5	WIRE-BLACK	1	
32	8617635-1	LENS-PLASTIC	3	

LIFT PLUNGER AY-4999456-9

ITEM	PART NO	QTY	DESCRIPTION	
1	----------	1	HOUSING	ORDER 4999456-9
2	----------	1	PLUNGER	ORDER 4999456-9
3	4999117-7	1	POPPET	
4	4995322-7	2	PLATE-SEAL	
5	4995323-5	2	SEAT-SPRING	
6	4995324-3	1	SPRING-PLUNGER	
7	4995325-0	1	CAPSCREW	
8	4995326-9	1	CAP-PLUNGER	
9	*4995327-6	2	WIPER	
10	0912261-5	2	CPSC-.25-16X.75	
11	*0923376-8	2	O-RING-#-113	
12	*0923814-8	1	O-RING-#-228	
13	0922026-0	2	SC-#10-24X.63	
14	4995328-4	1	SPRING	
15	4995186-6	1	VALVE AY-CHECK	SEE PAGE 88

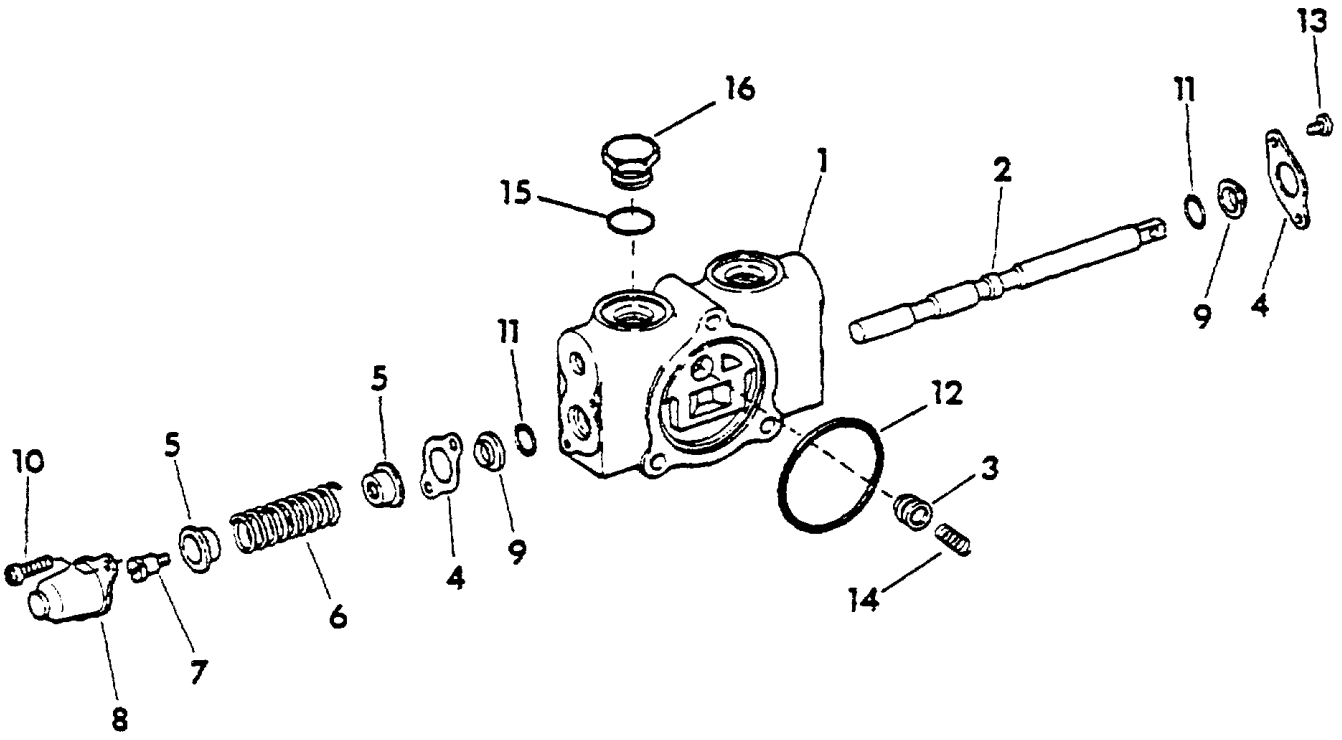
*INCL IN KIT 4787619-8



TILT PLUNGER-4 95 182-E

ITEM	PART NO	QTY	DESCRIPTION	
1	----------	1	HOUSING	ORDER 4995182-5
2	----------	1	PLUNGER	ORDER 4995182-5
3	4995321-9	1	POPPET	
4	4995322-7	2	PLATE-SEAL	
5	4995323-5	2	SEAT-SPRING	
6	4995324-3	1	SPRING-PLUNGER	
7	4995325-0	1	CAPSCREW	
3	4995326-8	1	CAP-PLUNGER	
9	*4995327-6	2	WIPER	
10	0912261-5	2	CPSC-.25-20X.75	
11	*0923376-8	2	O-RING-#-113	
12	*0923814-8	1	O-RING- #-908	
13	0922026-0	2	SC-# 10-24X.63	
14	4995328-6	1	SPRING	
15	0932459-7	1	O-RING-#-908	
16	0927457-2	1	PLUG-1.19-12	

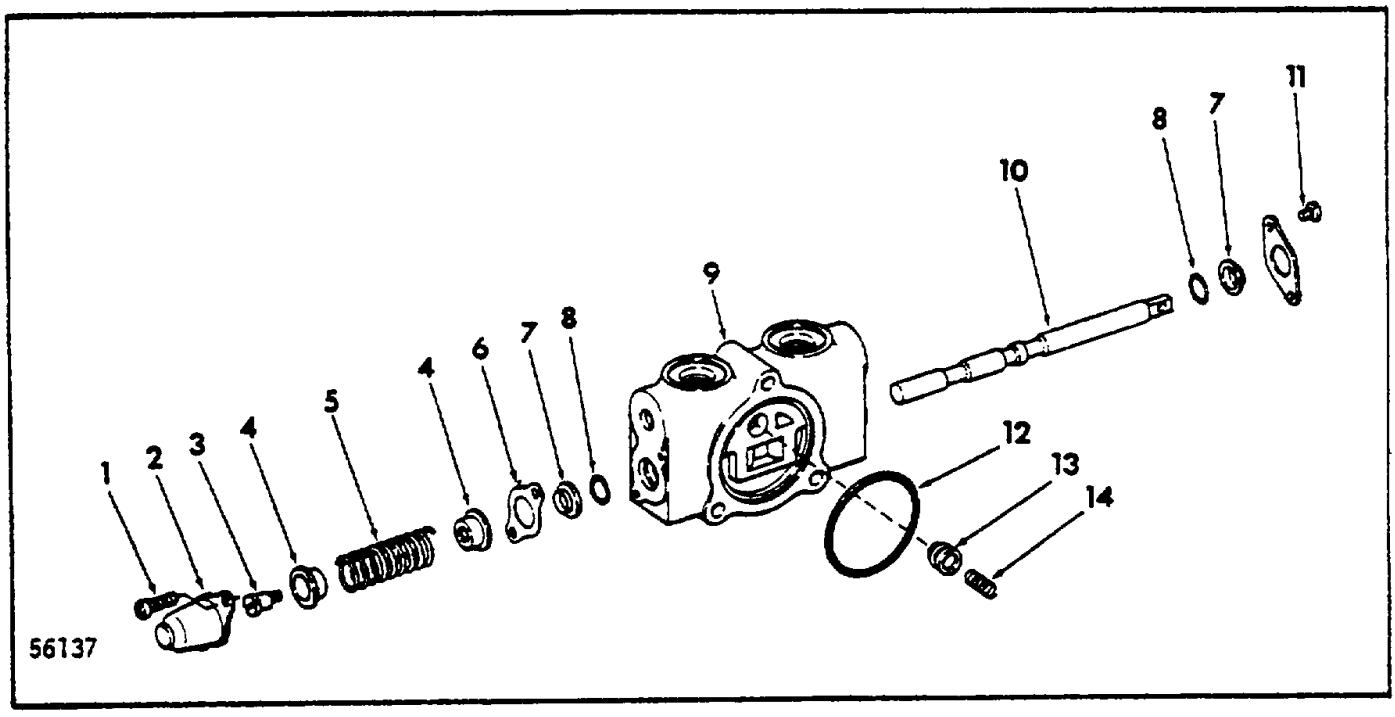
*INCL IN KIT 4787619-8



PLUNGER SECTION-TILT/ACC 4999937-8 ASSY

ITEM	PART NO.	DESCRIPTION	QTY.
1	0912261-5	CAPSCREW	4
2	4995326-8	CAP-PLUNGER	2
3	4995325-0	CAPSCREW	2
4	4995323-5	SEAT-SPRING	4
5	4995324-3	SPRING	2
6	4995322-7	PLATE	4
7	4995327-6	*WIPER	4
8	0923376-8	*O-RING	4
9	----------	HOUSING	2
10	----------	PLUNGER	2
11	0922026-0	SCREW	4
12	0923814-8	*O-RING	2
13	4995321-9	POPPET	2
14	4995328-4	SPRING	2

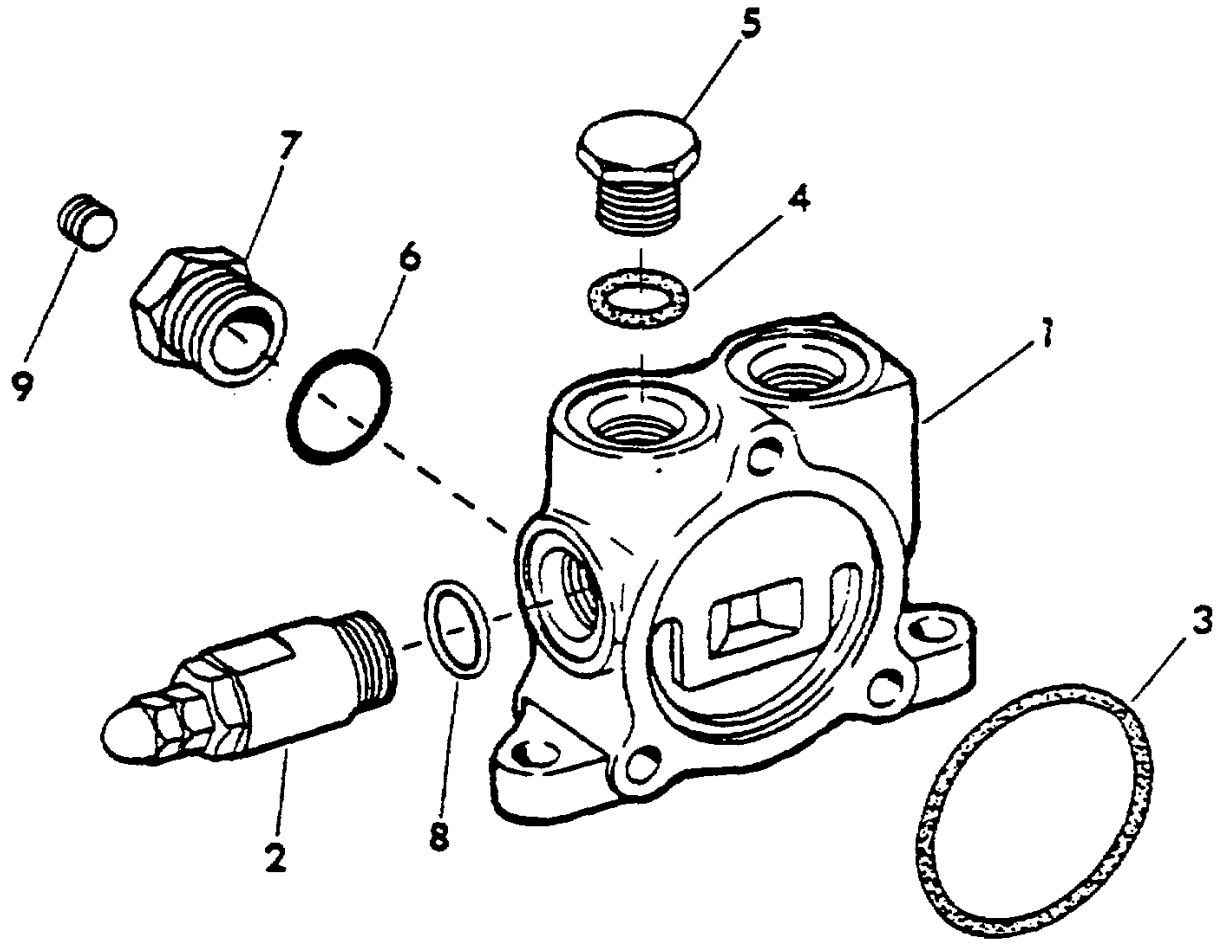
*INCL IN KIT 4906106-6.



INLET SECTION AY-490748--0

ITEM	PART NO	QTY	DESCRIPTION	
I	----------	1	HOUSING	ORDER 49074380-0
2	4995186-6	1	VALVE AY-CHECK	SEE PAGE 88
3	*0923814-8	1	O-RING-#-228	
4	*0921205-1	1	O-RING-#-910	
5	4993156-1	1	PLUG	
6	0921206-9	1	O-RING-#-912	
7	4907478-4	1	PLUG-.88-14	
8	0921205-1	1	O-RING-#-910	
9	0918850-9	1	PLUG-PIPE-.25	

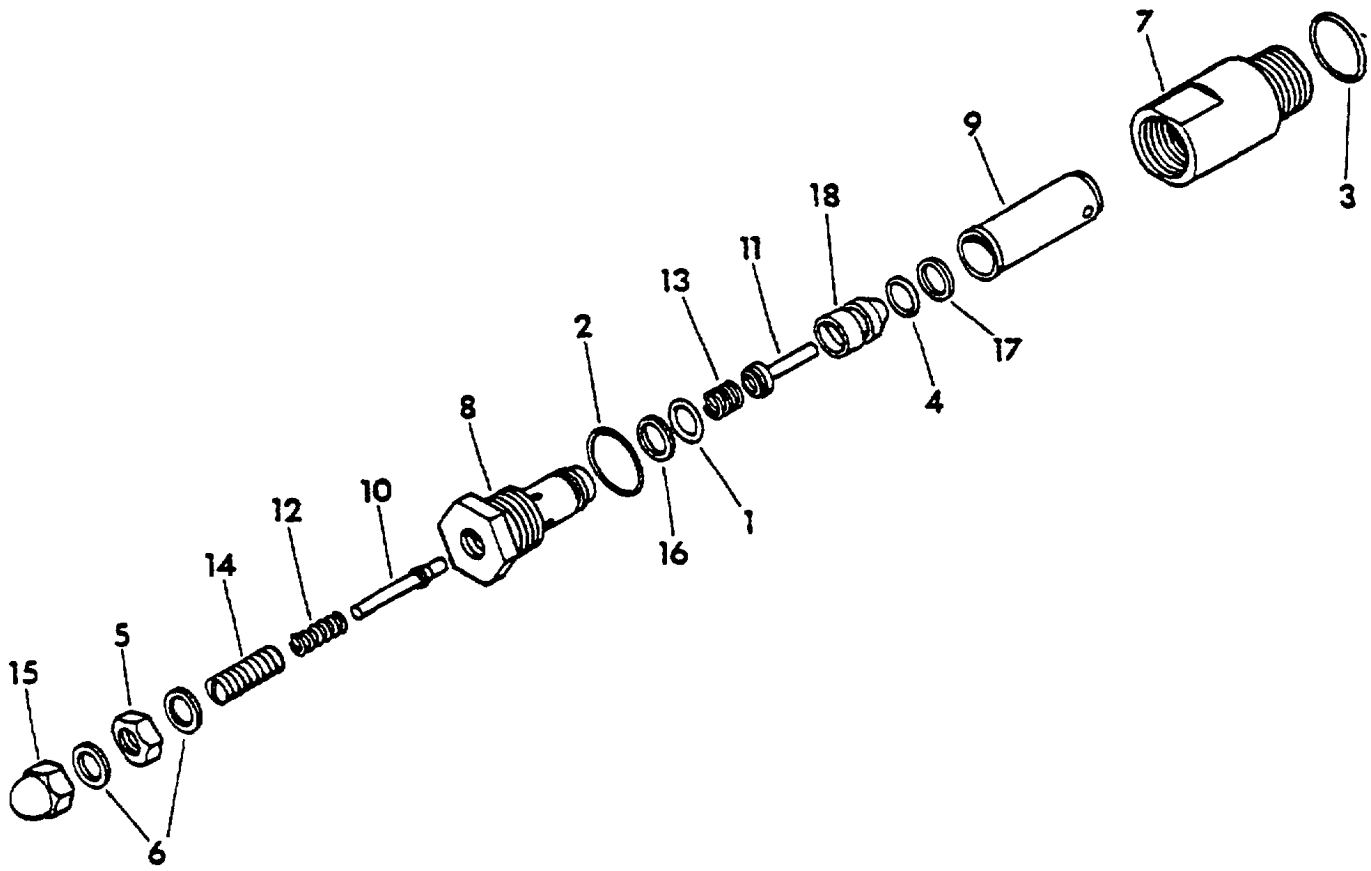
*INCL IN KIT 4787615-8

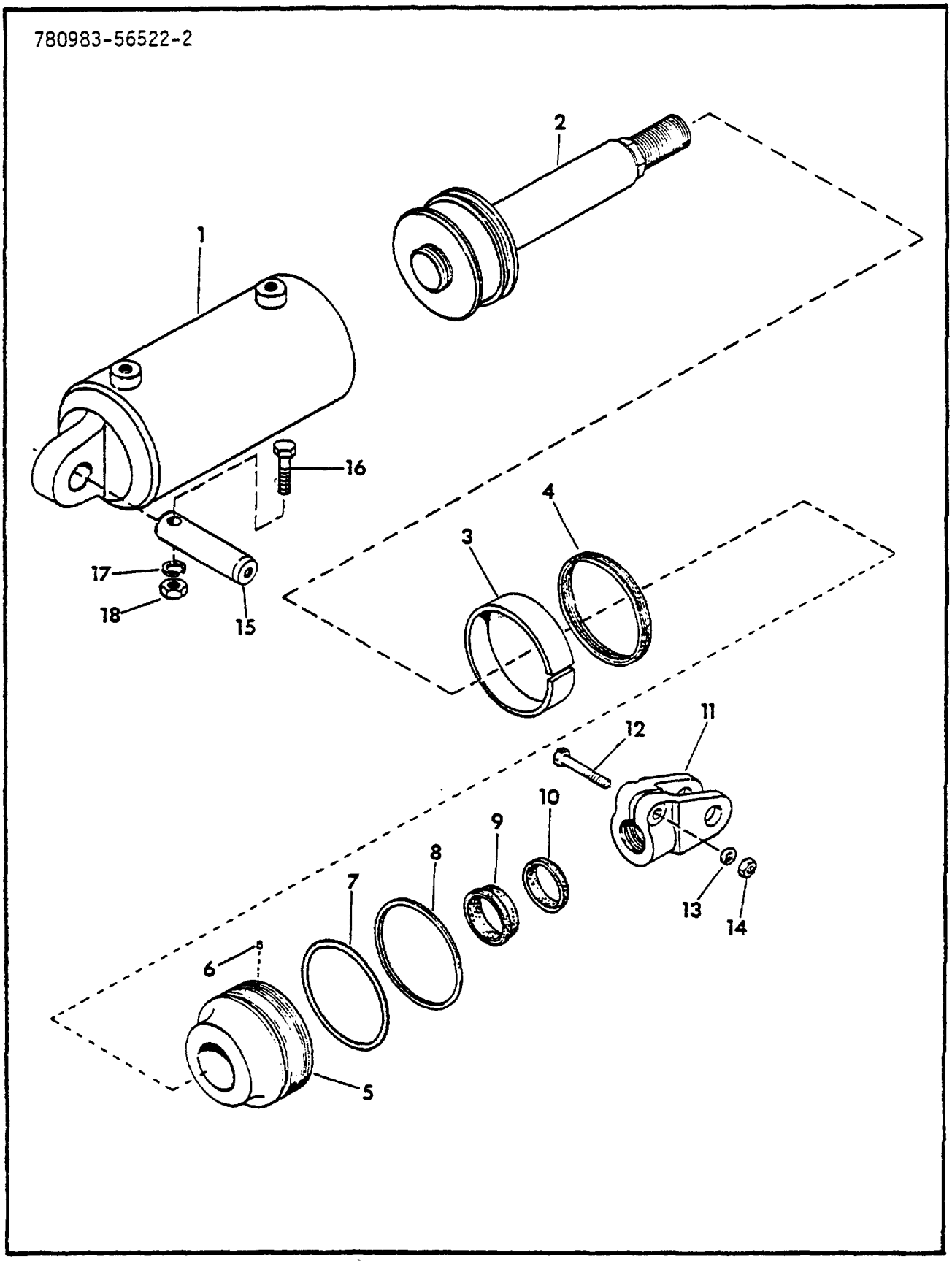


CHECK VALVE AY-4995186-6

ITEM	PART NO	QTY	DESCRIPTION
1	*0923560-7	1	O-RING-#-012
2	*0921349-7	1	O-RING-#-908
3	0921205-1	1	O-RING-#-910
4	*0923599-9	1	O-RING-#-011
5	4995188-2	1	NUT-JAM
6	4995189-0	2	WASHER
7	4995190-8	1	CAP
8	4995191-6	1	PLUG
9	4995192-4	1	POPPET
10	4995193-2	1	POPPET
11	4995194-0	1	PISTON
12	4995195-7	1	SPRING
13	4995196-5	1	SPRING
14	4995197-3	1	SCREW-ADJ
15	4131659-7	1	NUT-ACORN
16	*4995198-1	1	RING-BACKUP
17	*4995199-9	1	RING-BACKUP
18	4995320-1	1	POPPET

*INCL IN KIT 4787619-8

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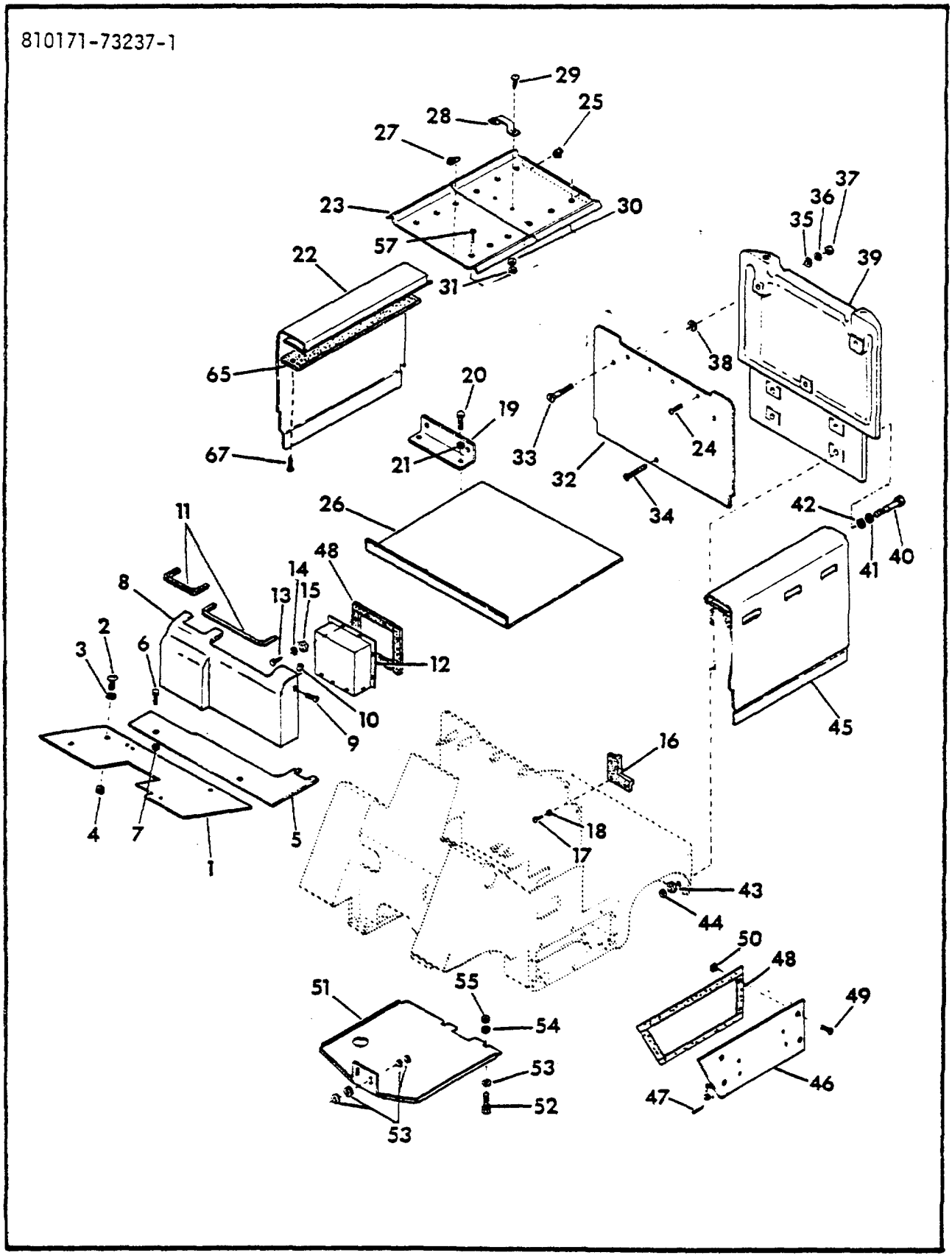
TILT CYLINDER

ITEM		PART NO	DESCRIPTION	QTY	
-		4851332-9	CYLINDER AY-TILT	2	INCL ITEMS 1 THRU 10
1		4809718-2	TUBE AY-CYLINDER	2	
2		4829335-1	PLUNGER AY-TILT	2	
3	*	4814109-7	BEARING	2	
4	*	4814133-7	T-RING	2	
5		4814134-5	GLAND	2	
6	*	4816749-8	PELLET-NYLON	4	
7	*	0923582-1	O-RING	2	
8	*	0926625-5	RING-BACKUP	2	
9	*	4814108-9	PACKING-GLAND	2	
10	*	4857829-8	RING-WIPER	2	
		4769567-1	SPACER	2	
		4769566-4	SPACER	2	
		0923649-8	O-RING	2	
11		4707394-5	YOKE	2	
12		0923293-5	CAPSCREW	2	
13		0916966-5	LOCKWASHER	2	
14		0919423-4	NUT	2	
15		4806693-0	SHAFT-CYLINDER MOUNTING	2	
16		0923240-6	CAPSCREW	2	
17		0916966-5	LOCKWASHER	2	
18		0916951-7	NUT	2	

*INCL IN KIT 4906332-4.

KIT CONTAINS QUANTITIES FOR 1 CYLINDER ONLY.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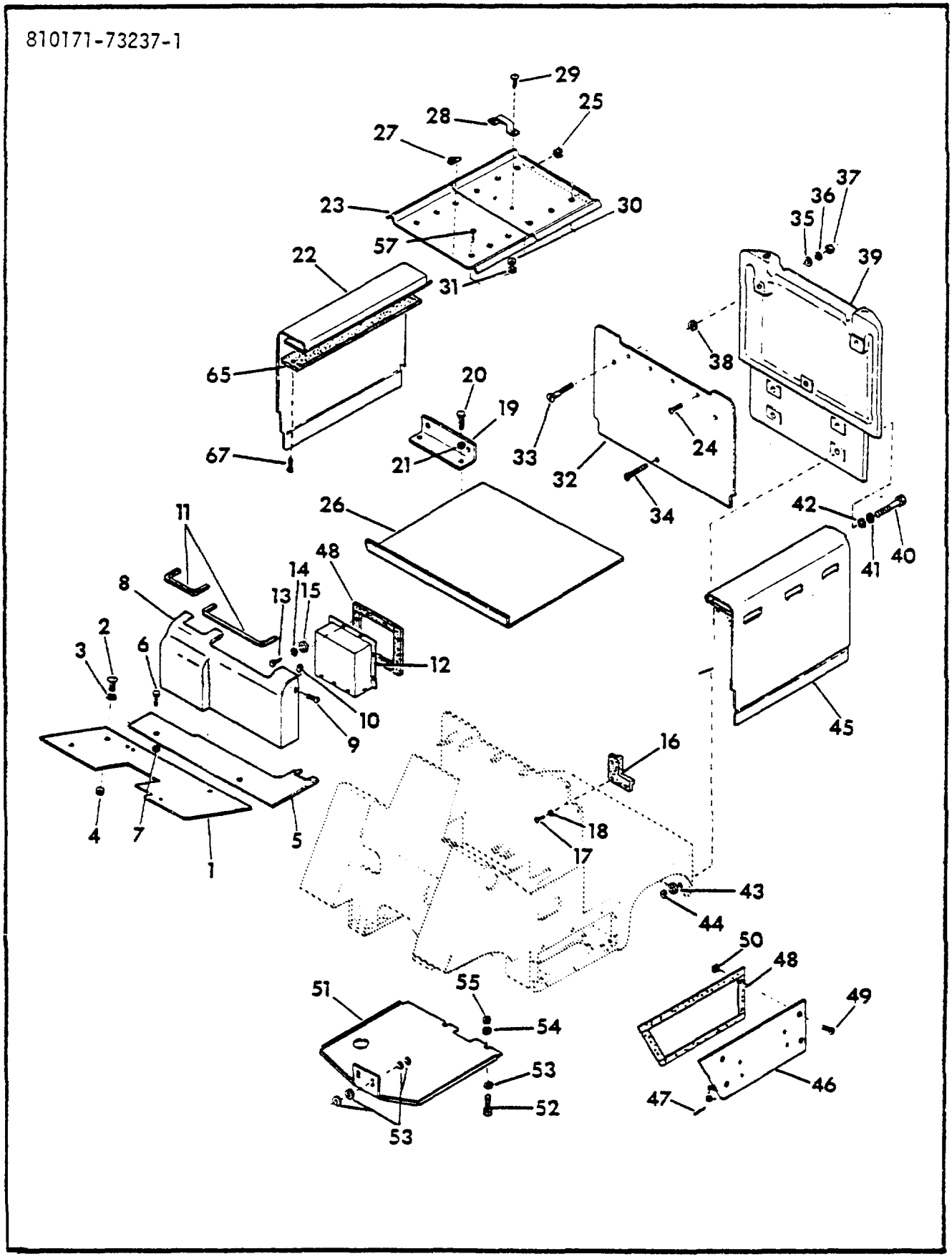
SHEET METAL

ITEM	PART NO	QTY	DESCRIPTION
1	4842018-6	1	PLATE-TOE
2	0921278-8	4	SC-.38-16X1.00
3	0918266-8	4	WSHR-.38
4	0921705-0	4	NUT-.38-16
5	4867809-0	1	PLATE-FLOOR
6	0921278-8	2	SC-.38- 6X1.00
7	0921705-0	2	NUT-.38-16
8	4867809-8	1	COVER-CENTER PLATE
9	0929580-9	3	SC- .38-16x.50
10	0926215-5	3	NUT-RTNR- .38-16
11	4800577-1	*	TRIM-CUT TO FIT AS REQD
12	4872130-7	1	COVER-CONTACTOR
13	0916081-3	12	SC-.25-20X.50
14	0916964-0	12	LKW-ET- .25
15	0918264-3	12	WSHR-.25
16	4842714-0	1	INSULATOR-BATTERY CABLE
17	0912843-0	3	SC-DRV-#12X.50
19	0921759-7	3	WSHR-.25X.56
19	4784158-0	1	RETAINER
20	0923114-3	2	CPSC-.50-13X1 00
21	0916665-5	2	LKW-.50
22	4867284-4	1	PANEL-SIDE RH
23	4811702-2	1	COVER AY-STD
24	0929548-6	4	SC-.31- 18X.88
25	0916159-7	4	NUT-RNTR-.31-18
26	4859907-0	1	PLATE-BASE-BTRY
27	4811765-9	2	LOCK
28	4734284-5	1	HANDLE
29	0917452-5	2	SC-#10-32X.50
30	0917365-9	2	LKW-#10
31	0917415-2	2	NUT-#10-32
32	4859906-2	1	PLATE-REAR-BTRY
33	0930977-4	2	SC-.50-13X4.75
34	0912218-5	1	CPSC-.50-13X5.75
35	0923290-1	6	WSHR-.52X1.25
36	0920428-0	3	LKW-ET-.50
37	0916951-7	3	NUT-.50-13
38	0922250-6	9	WSHR- .53X1.38
39	4839202-1	1	COUNTER WEIGHT AY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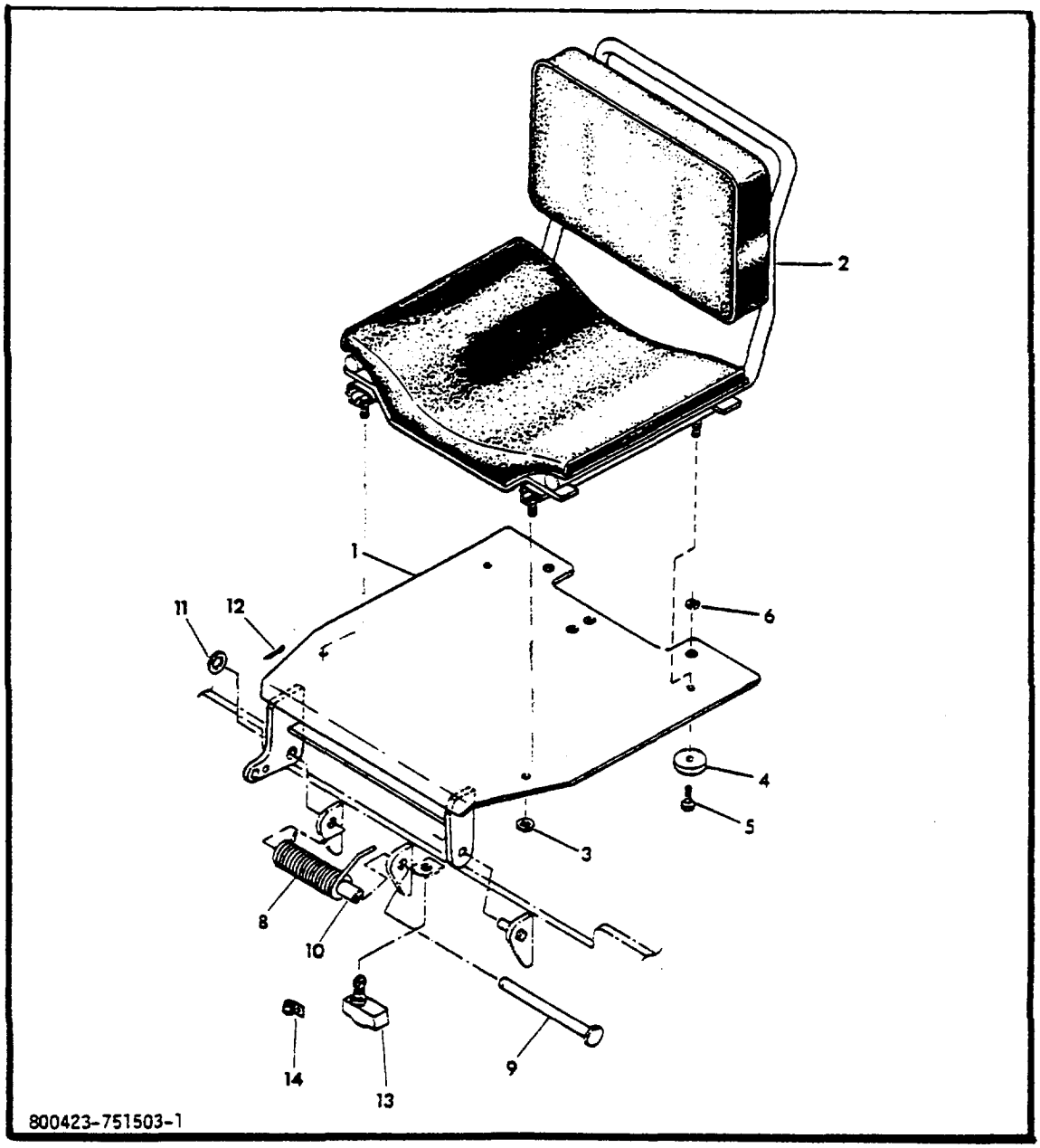
SHEET METAL

ITEM	PART NO	QTY	DESCRIPTION
40	0924763-6	4	CPSC- .75- 10X 3.50
41	0927226-9	4	WSHR-.78X1.75
42	0929366-3	2	WSHR-.78X2.00
43	0919332-7	4	LKW-.75
44	0913160-8	4	NUT-.75-10
45	4867283-6	1	PANEL-SIDE LH-STD
46	8614246-0	1	DOOR AY-COMPARTMENT
47	0918452-4	2	PIN-.13X1.00
48	4838004-2	5	GASKET-TAPE
49	0929555-1	4	SC-.38-16X1.00
50	0926215-5	4	NUT-RTNR-.38-16
51	4851208-1	1	PAN-DRIP-EE
52	0921960-1	2	CPSC-.25-20X1.00
53	0918266-8	12	WSHR- .41X.82
54	0916964-0	2	LKW-.25
55	0916622-4	2	NUT-.25-20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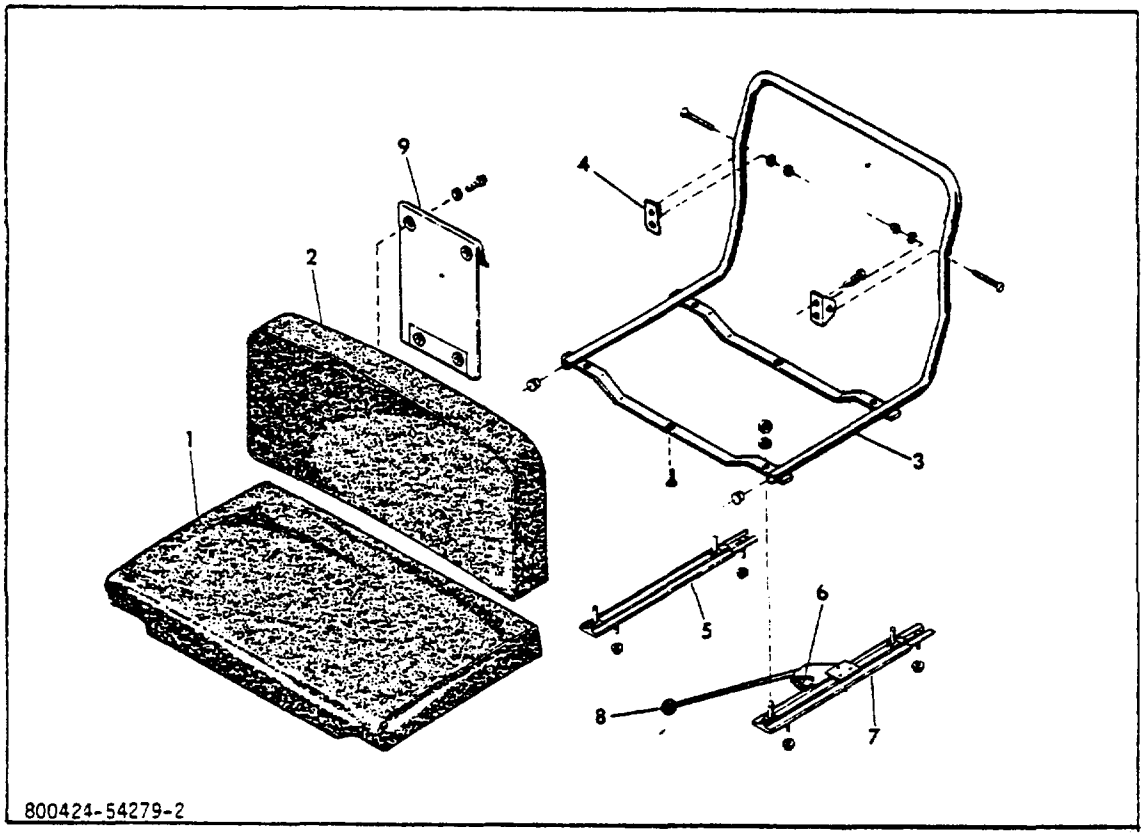
800423-751503-1

SEAT

ITEM	PART NO	DESCRIPTION	QTY	
1	4875221-6	HINGE AY-SEAT	1	
2	8610142-5	SEAT-ADJ BUCKET	1	SEE PAGE 99
3	0918265-0	WASHER	4	
4	4788327-7	BUMPER	2	
5	0920787-9	CAPSCREW	2	
6	0920426-4	LOCKWASHER	2	
8	8618632-7	SPRING-SEAT	1	
9	4867343-8	PIN-PIVOT	1	
10	4867952-6	SLEEVE-SPRING	1	
11	0917379-0	WASHER	1	
12	0918452-4	PIN	1	
13	4868204-1	SWITCH-SEAT	1	
14	4767130-0	CLAMP	1	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800424-54279-2

ITEM	PART NO	DESCRIPTION	QTY	

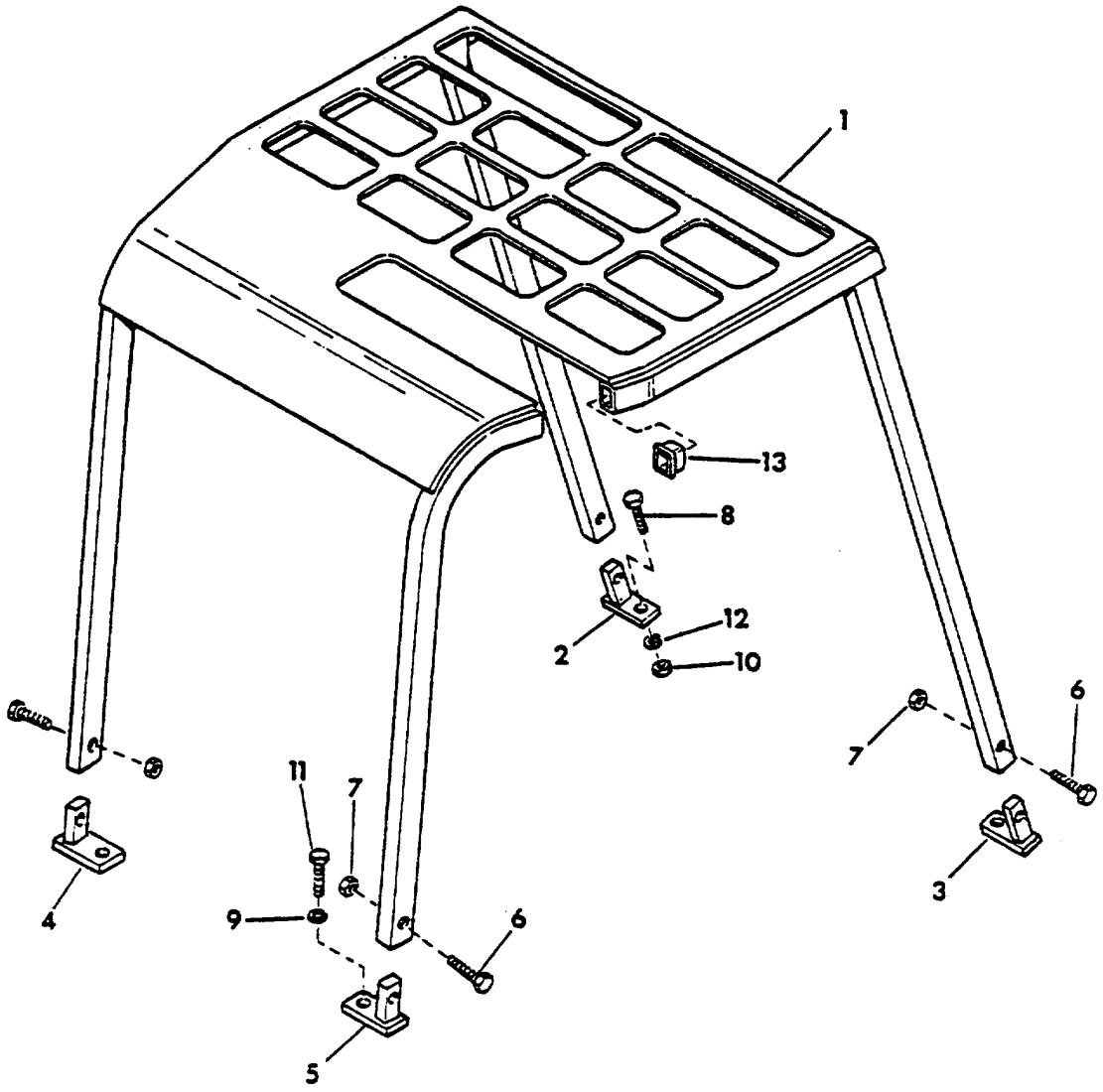
SEAT ASSY-OPERATOR

8610142-5

ITEM	PART NO	DESCRIPTION	QTY	
1	4805177-5	CUSHION-SEAT	1	
	0918222-1	SCREW-FH-.25"-20 X .75"	2	
2	4805176-7	CUSHION-BACKREST	1	INCL ITEM 4
	0914113-6	SCREW-FH-.25"-18 X 1.50"	2	
	0918264-4	WASHER-.28" X .63"	2	
	0916590-3	NUT-LOCK-.25"-18	2	
3	4805179-1	FRAME-SEAT	1	INCL PLASTIC TIPS
	4906408-2	TIP-PLASTIC-.88"	2	
	0911158-3	CAPSCREW-.31"-24 X .88"	2	
	0917356-8	LOCKWASHER-.31"	2	
	0920263-1	NUT-.31"-24	2	
4	4906618-6	HINGE	2	
	0900576-0	SCREW: RH-.25"-20 X .75"	4	
5	4907383-6	SLIDE-ADJ-RH		
	0917372-5	NUT-.31"-18	2	
6	4908145-8	SPRING-SEAT-LATCH		
7	4912444-9	SLIDE-ADJ-LH	1	INCL ITEMS 6 & 8
	0917372-5	NUT-.31"-18	2	
8	4992812-0	KNOB-ADJ-ARM		
9	8610337-1	POUCH	1	
	4911350-9	SCREW-#10 X .63"	4	
	0924353-6	WASHER-.20" X .50"	4	

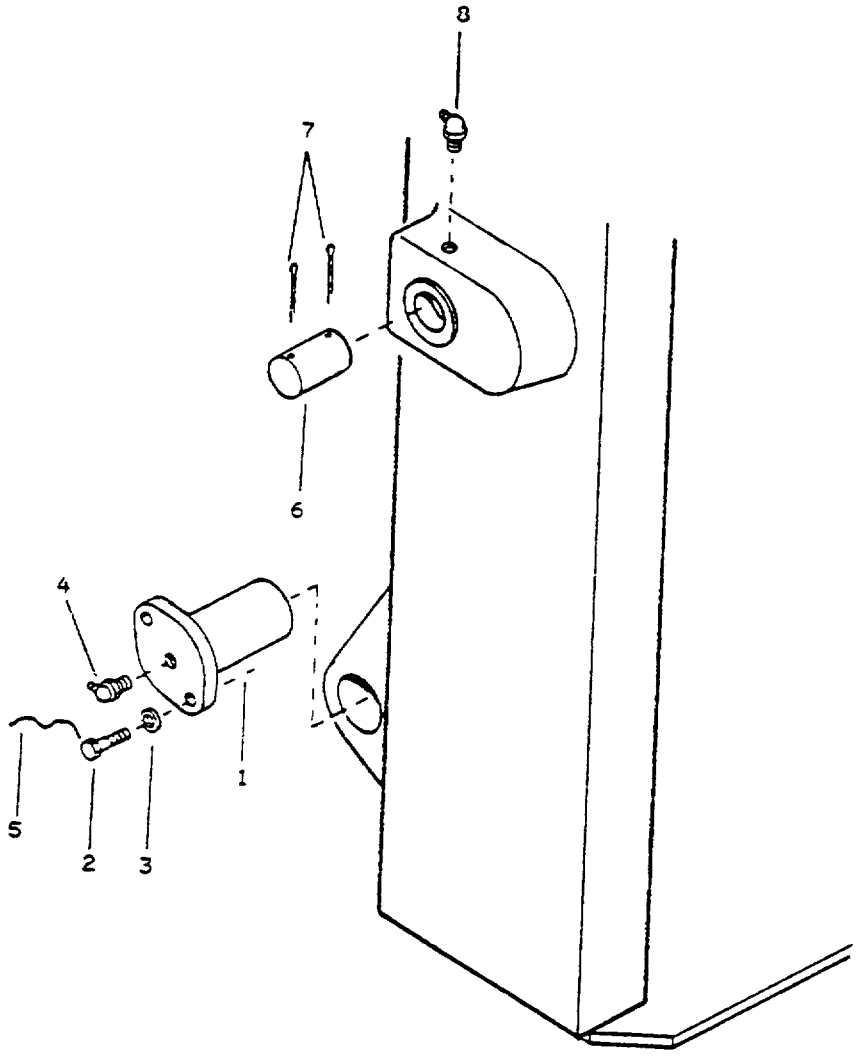
OVERHEAD GUARD

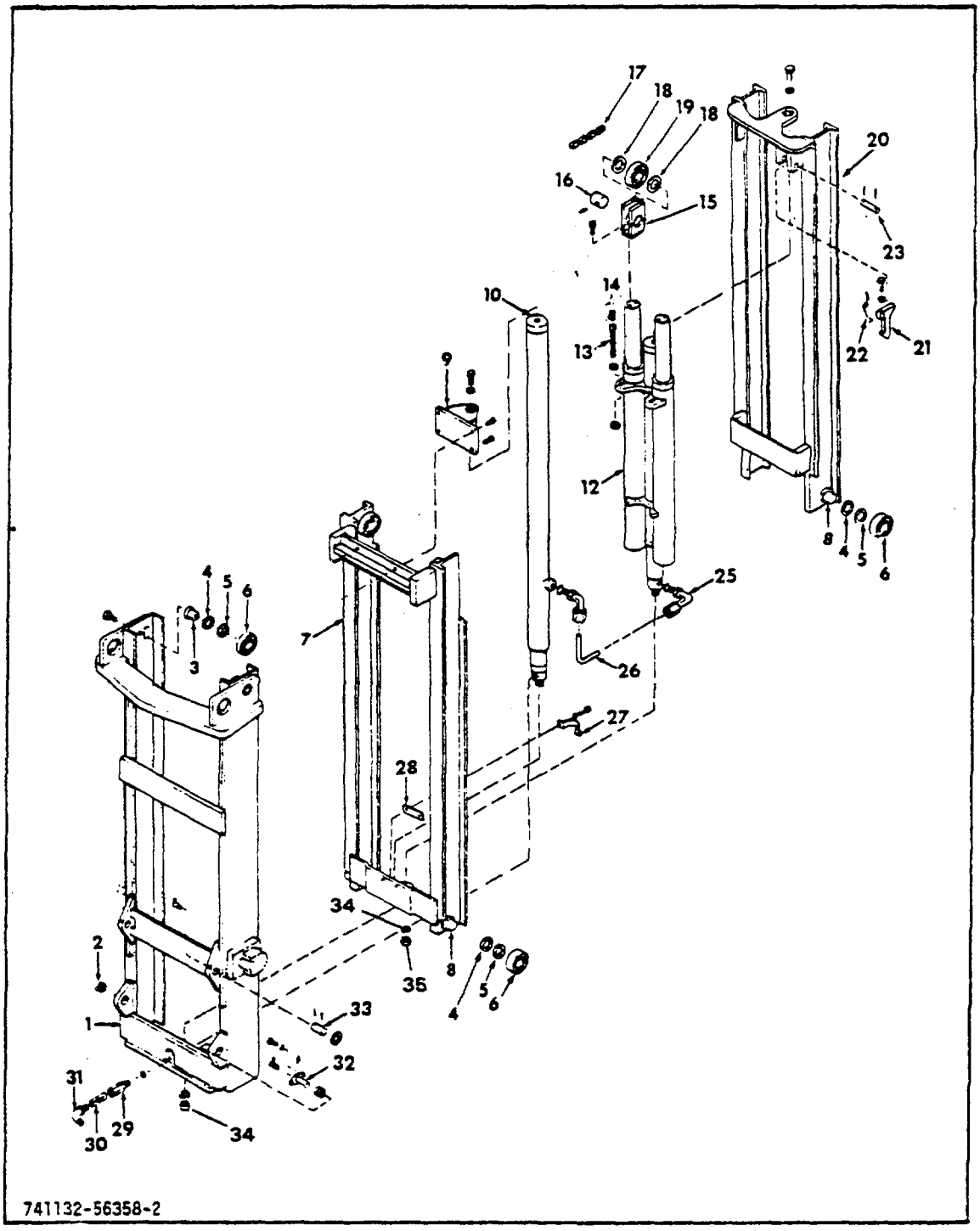
ITEM	PART NO	QTY	DESCRIPTION
1	8615358-2	1	GUARD AY-OVERHEAD
2	8615354-1	1	PAD AY-OHG-FRONT-LH
3	8615348-3	1	PAD AY-OHG-FRONT-RH
4	8615250-9	1	PAD AY-OHG-REAR-LH
5	8615349-1	1	PAD AY-OHG-REAR-RH
6	0924739-6	4	CPSC-.75-10X2.75
7	0924450-0	4	NUT-LOCK-.75-10
8	0923292-7	2	CPSC-.75-10X2.00
9	0919332-7	2	LKW-.75
10	0913160-8	2	NUT-.75-10
11	0923292-7	2	CPSC-.75-10X2.00
12	0919332-7	2	LK - .75
13	4846354-1	2	PLUG-1.50X2.00



MAST MOUNTING

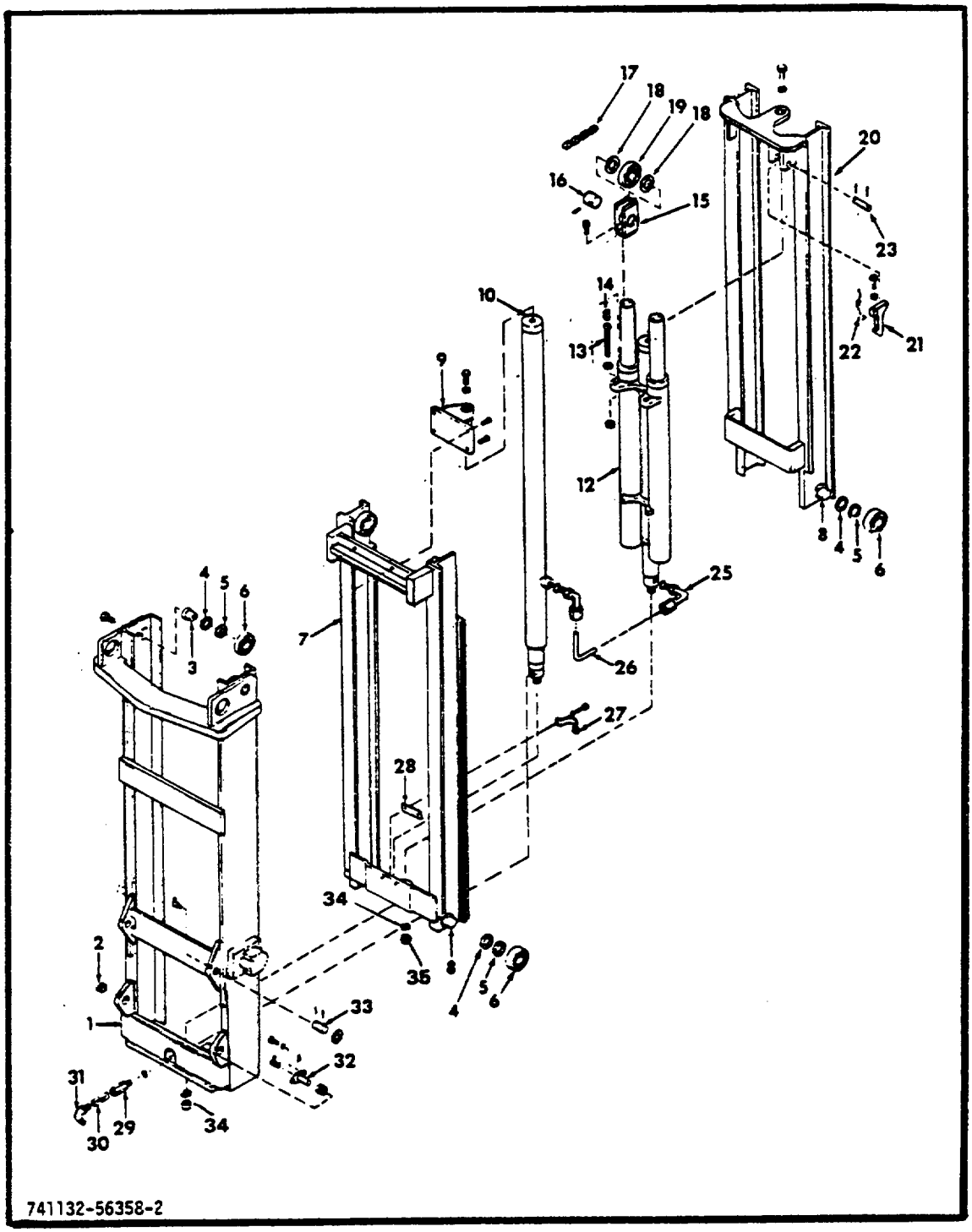
ITEM	PART NO	QTY	DESCRIPTION
1	4718482-5	2	PIN
2	4335601-3	4	CAPSCREW
3	0916965-7	4	LKW-.38
4	0915276-0	2	FTG-90DEG-.13-27
5	4742113-6	2	WIRE
6	4826276-0	2	PIN-UPPER
7	0919430-9	4	PIN-.16 X 1.25
8	0918187-6	2	FTG-45DEG-.25-28




741132-56358-2

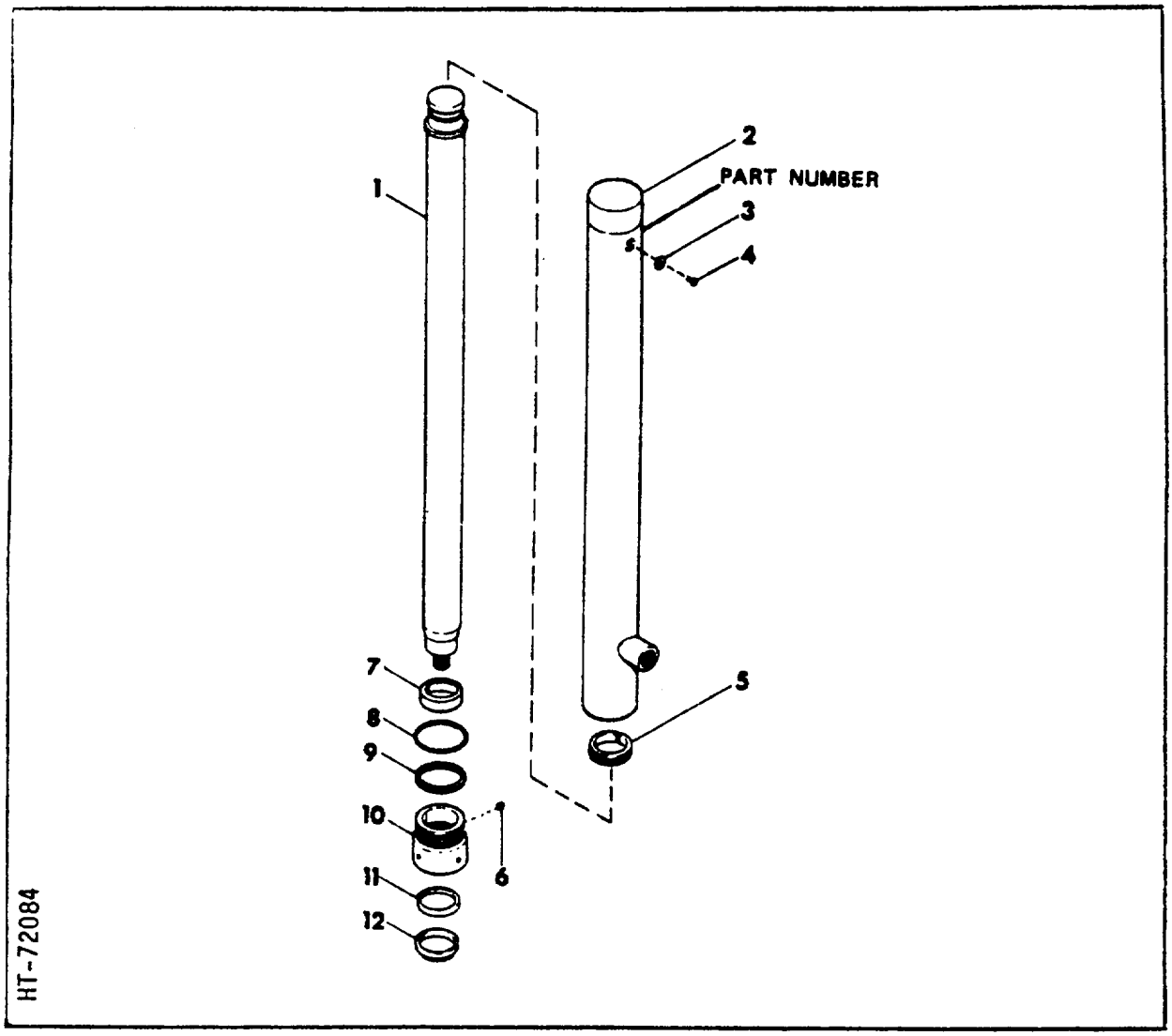
TRI-MAX LIFT ASSY - 144"

ITEM	PART NO	DESCRIPTION	QTY	
-	4881900-7	LIFT ASSY-TRI MAX	1	INCL ITEM 1 THRU 31
1	4867959-1	MAST ASSY-OUTER	1	INCL ITEM 2
2	4715712-8	BUSHING-MAST PIVOT	2	
3	4812974-6	STUD-ROLLER	2	
	0927519-9	CAPSCREW	2	
4	4812930-8	SHIM-015"	*	USE AS REQUIRED
5	4812929-0	SHIM-040"	*	USE AS REQUIRED
6	4812920-0	BEARING-ROLLER	8	
7	4856552-7	MAST ASSY-INTERMEDIATE	1	INCL 4 OF ITEM 8
8	4839752-5	STUD-ROLLER	6	
9	4829288-2	BRACKET-CYLINDER	1	
	0923293-5	CAPSCREW	2	
	0919433-7	CAPSCREW	2	
	0923805-6	NUT-LOCK	4	
10	4839271-6	CYLINDER ASSY-LIFT	1	SEE PAGE 105
	0921342-2	NUT-LOCK	1	
11	----------	ROD-PROTECTOR	1	NOT USED
12	4863123-8	CLUSTER-LIFT CYL	1	SEE PAGE 109
	0929533-3	CAPSCREW	1	
	0917373-3	LOCKWASHER	1	
	0921342-2	NUT-LOCK	1	
13	4765796-0	ANCHOR-CHAIN	2	
	0919333-5	NUT	4	
14	4701704-1	LINK-CHAIN CONNECTING	2	
15	4829757-6	CROSSHEAD	2	
	0926681-8	SCREW	4	
16	4812935-7	PIN-CROSSHEAD BRG	2	
	0921464-4	SETSCREW	2	
17	4719720-7	CHAIN-LIFT	2	
18	4813781-4	WASHER-SPACING	4	
19	4803599-2	BEARING-CROSSHEAD	2	
20	4867598-3	MAST ASSY-INNER	1	INCL 2 OF ITEM 8
21	4829621-4	INTERLOCK	1	
22	4828568-8	SPRING-INTERLOCK	1	
	0916713-1	SETSCREW	1	
	0920161-7	NUT	1	
23	4828179-4	PIN-PIVOT	1	
	0918448-2	PIN-COTTER	2	
24	NOT USED			
25	4816684-7	ELBOW	2	
	4905843-1	NUT UNIT	2	
	0921206-9	O-RING	2	
	0920787-1	CAPSCREW	2	
	0917356-8	LOCKWASHER	2	
	0917373-3	LOCKWASHER	2	
	8612719-6	GUARD-CHAIN	1	
	0921332-3	CAPSCREW	2	
	0917356-8	LOCKWASHER	2	


741132-56358-2

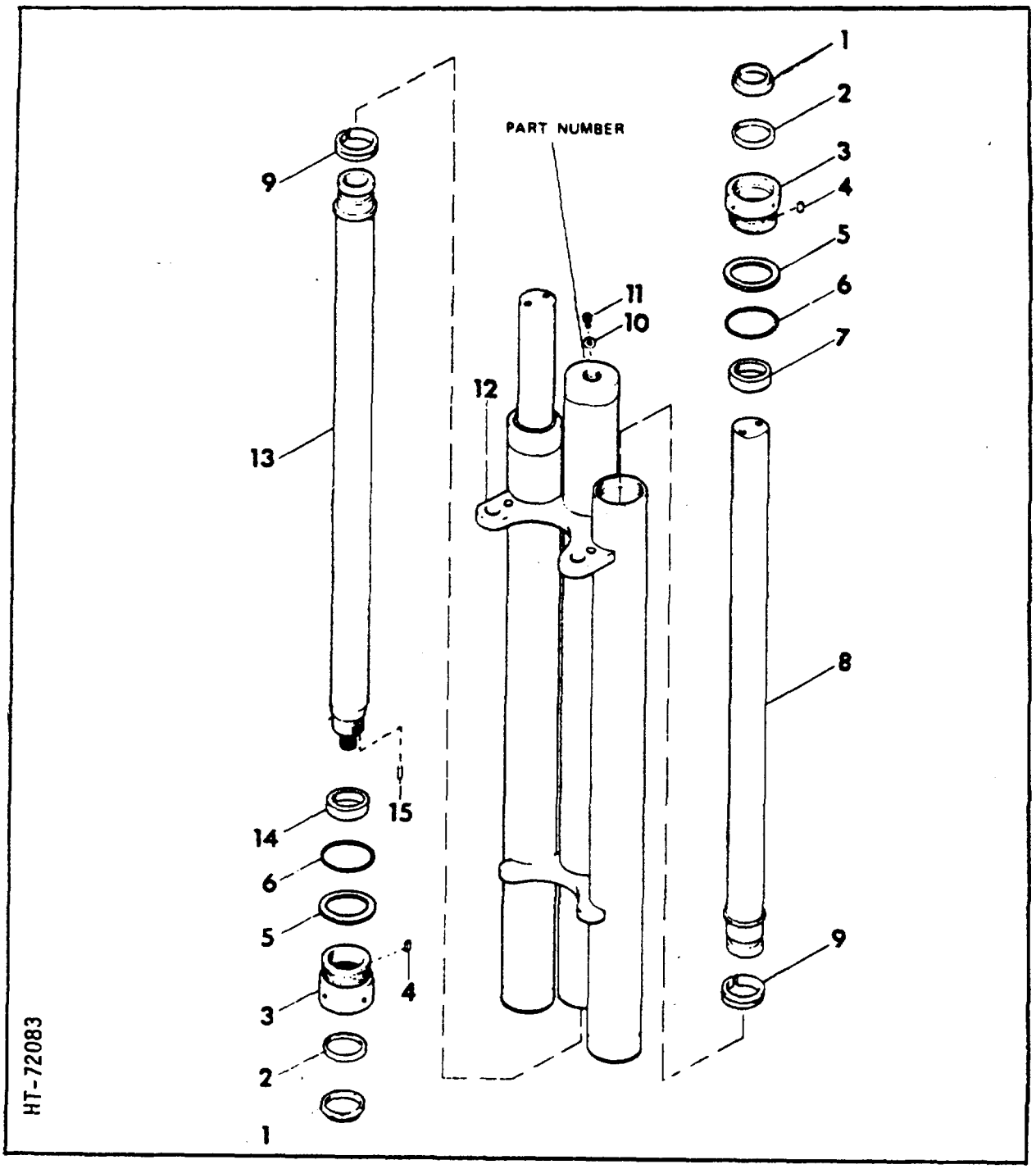
TRI-MAX LIFT ASSY - 144" (CONTINUED)

ITEM	PART NO	DESCRIPTION	QTY	
26	4817087-2	TUBE-LIFT CYL TO CYL-CLUSTER	1	
27	4816376-0	CLAMP-CYL	1	
	0925205-7	CAPSCREW-.31"-18 X .62"	2	
	0917356-8	LOCKWASHER-.31"	2	
28	4816375-2	SPACER-CLAMP	1	
29	4821743-4	BODY-FLOW REGULATOR	1	
	0921206-9	O-RING-#-912-93"ID-TYPE SAE 1	1	
30	4821902-6	REGULATOR-FLOW	1	
31	0921728-2	ELBOW 450-ADJ-.75"TUBE-1.12"-12 BOSS END	1	INCL O-RING
	0921206-9	O-RING-#-912-.93"ID-TYPE SAE 1	1	
32	----------	PIN-MAST PIVOT	2	SEE PAGE 101
33	----------	PIN-TILT CYL	2	SEE PAGE 101
34	0930450-2	NUT-.625-18	2	
35	0921342-2	NUT-LOCK	2	



ITEM	PART NO	DESCRIPTION	QTY
1	4839274-0	RAM	1
2	4839272-4	TUBE	1
3	4833571-5	WASHER-NYLON	1
4	0929652-6	SCREW-BLEED	1
5	4885085-3	*BEARING	2
6	4816749-8	*PELLET-NYLON	2
7	NOT USED		
8	0924093-8	*PACKING	1
9	0926624-8	*WASHER-BACKUP	1
10	4816708-4	NUT-GLAND	1
11	4816748-0	*PACKING-ROD	1
12	4816947-8	*RING-WIPER	1

*INCLUDED IN KIT 4906100-5

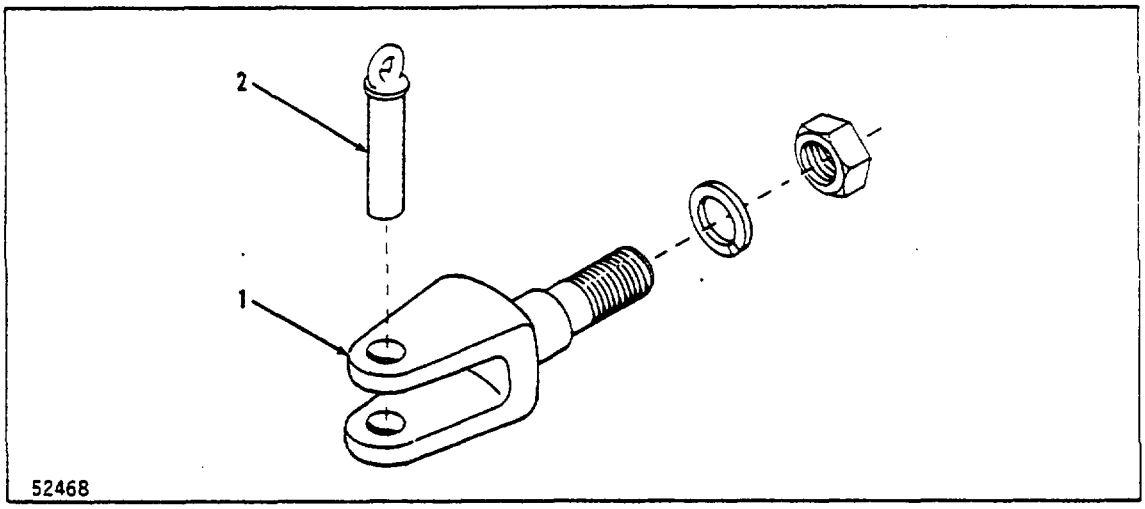


LIFT CYLINDER CLUSTER

LIFT CYLINDER CLUSTER - 4863123-8

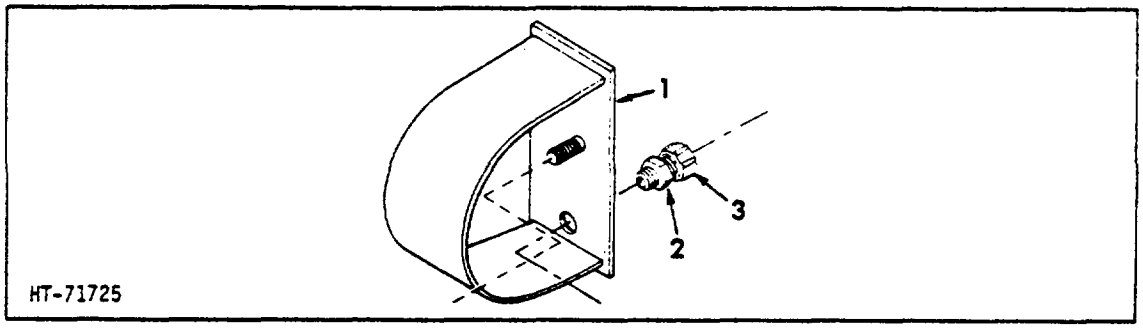
ITEM	PART NO	DESCRIPTION	QTY
1	4816947-8	*WIPER-ROD	3
2	4816748-0	*PACKING-ROD	3
3	4816708-4	NUT-GLAND	3
4	4816749-8	*PELLET-NYLON	6
5	092662 4-8	*WASHER-BACK-UP	3
6	0924093-8	*O-RING	3
7	NOT USED		
8	4848948-8	ROD-SHORT	2
9	4885085-3	*BEARING	6
10	4833571-5	WASHER-NYLON	3
11	0929652-6	SCREW-BLEED	3
12	4839277-3	TUBE-CLUSTER	1
13	4839404-3	ROD-LONG	1
14	NOT USED		
15	0922946-9	PIN-SPIROL-.25" X .75"	1

*INCLUDED IN KIT 4906099-9



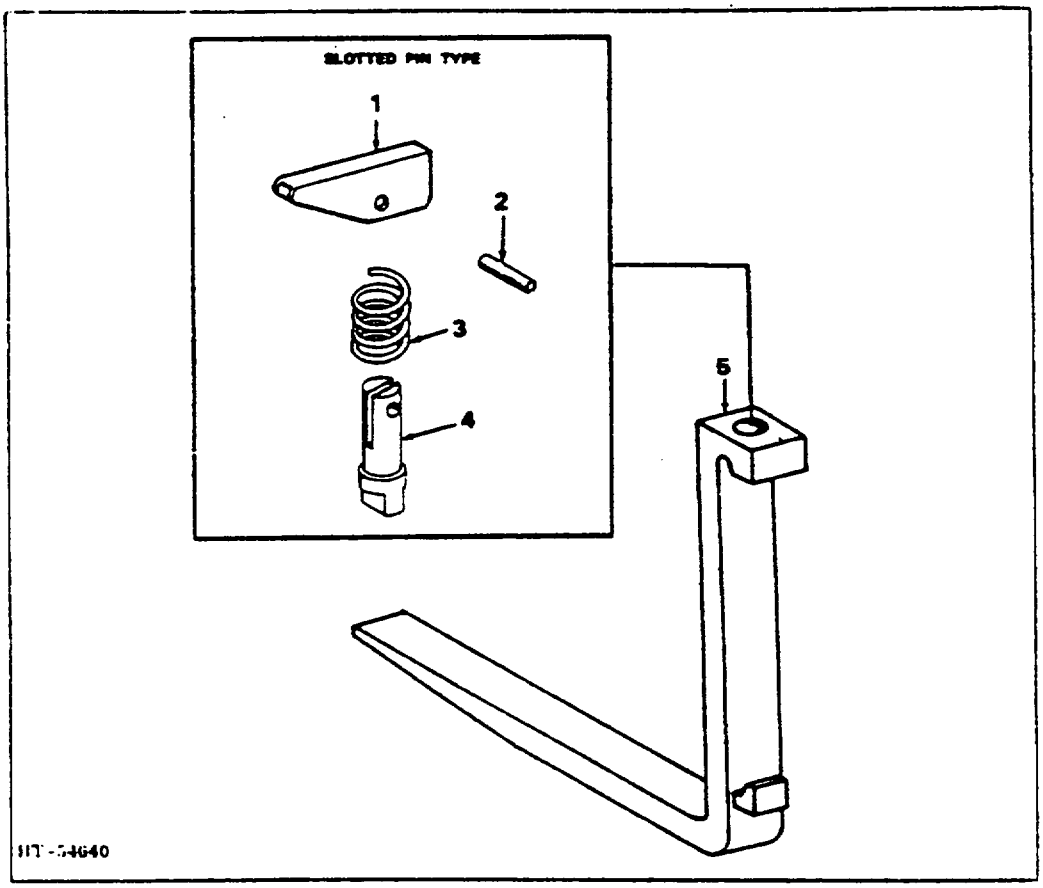
TOWING HITCH

ITEM	PART NO	DESCRIPTION	QTY
1	4849460-3	STUD-TOWING	1
	0929349-9	LOCKWASHER-1.25"	1
	0929603-9	NUT-1.25"-12	1
2	4255151-5	PIN-SHOULDER	1



LIGHT GUARD

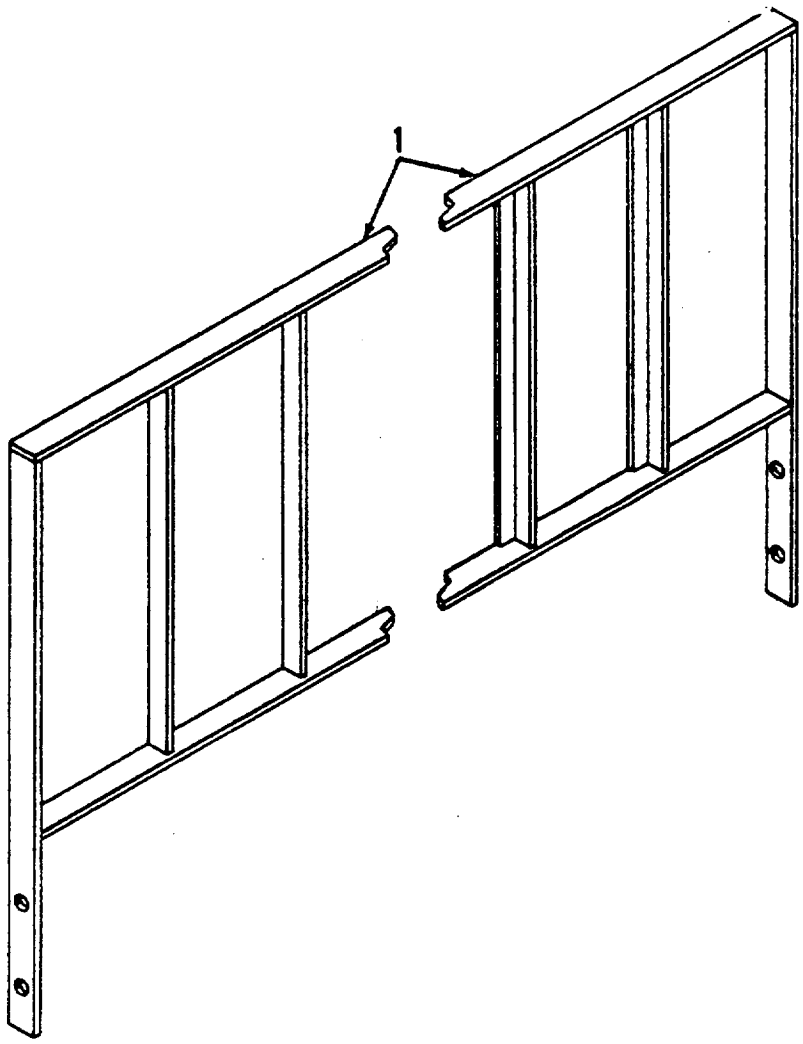
ITEM	PART NO	DESCRIPTION	QTY
1	4808088-3	GUARD ASSEMBLY - LIGHT	2
2	4803132-2	CONNECTOR	2
3	4460615-0	NUT-LOCK	2



FORK COMPONENTS

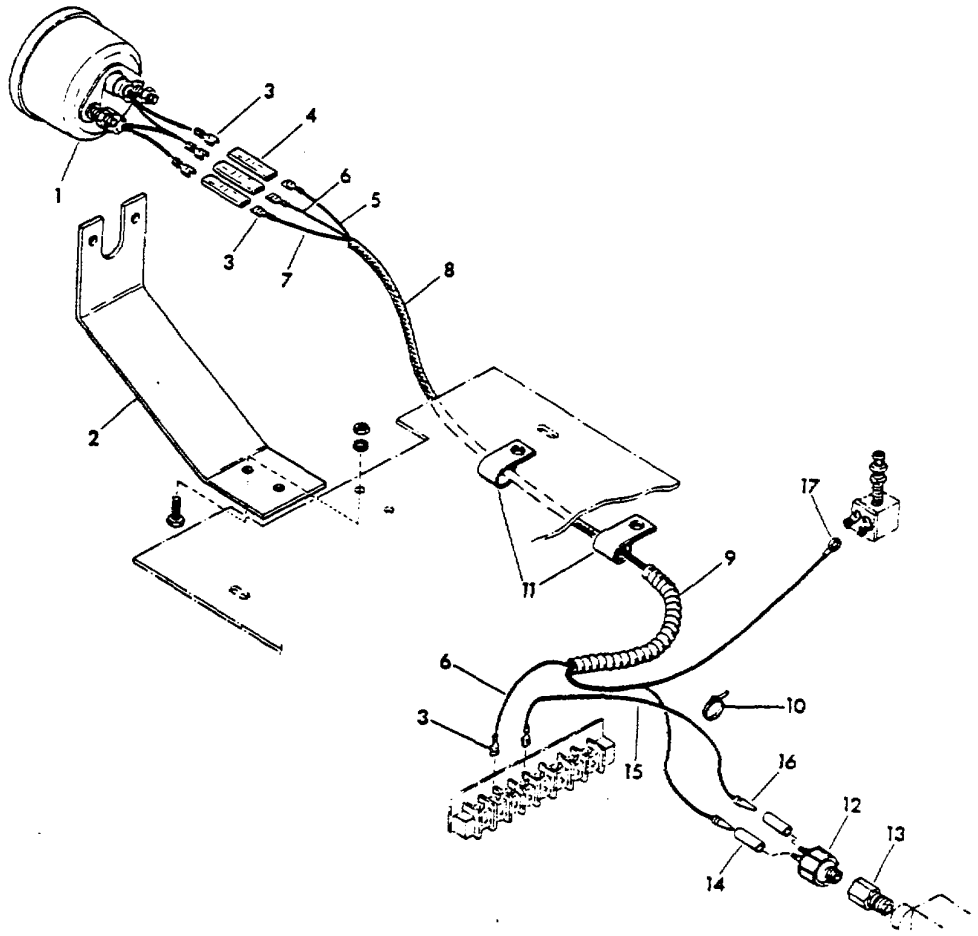
ITEM	PART NO	DESCRIPTION	QTY	
1	4894676-8	*LATCH	2	
2	0919169-6	*PIN-SPRING	2	
3	4894675-0	*SPRING-LOCK	2	
4	4894674-3	*PIN-LOCK	2	
5	4865947-9	FORK	2	INCL ITEMS 1 THRU 4

*INCL IN KIT 4910734-5



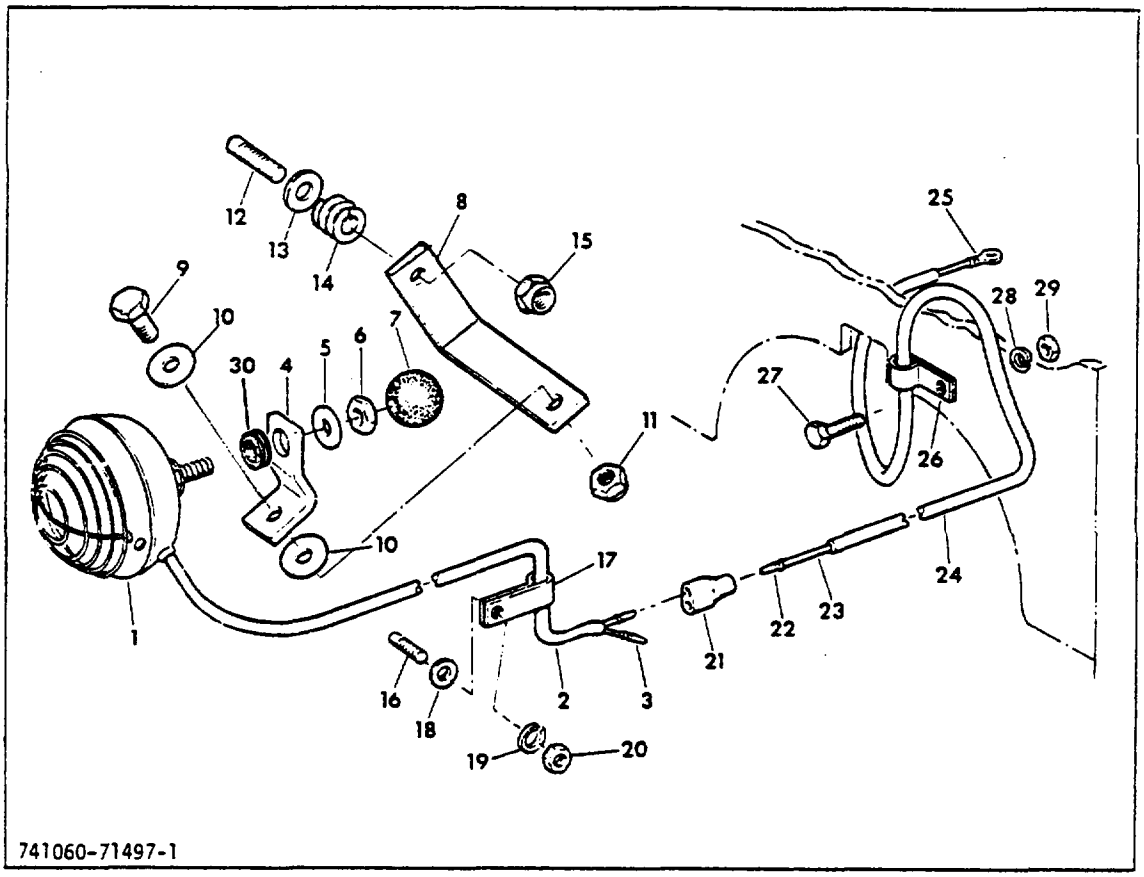
BACKREST

ITEM	PART NO	DESCRIPTION	QTY
1	8612596-0	BACKREST	1
	0933371-1	CAPSCREW	4



STOP & TAIL LIGHT

ITEM	PART NO	DESCRIPTION	QTY	
1	4803123-1	LIGHT-STOP & TAIL	1	
	1150	BULB-STOP	1	
	110	BULB-TAIL	1	
2	4892747-9	BRACKET	1	
	0923325-5	CAPSCREW	2	
	0917356-8	LOCKWASHER	2	
	0917372-5	NUT	2	
3	4255271-1	TERMINAL	8	
4	4255521-9	CONNECTOR	3	
5	4305465-4	WIRE	1	CUT TO LENGTH
6	4801762-8	WIRE	1	CUT TO LENGTH
7	4798032-1	WIRE	1	CUT TO LENGTH
8	4253048-5	LOOM	1	CUT TO LENGTH
9	4796888-8	WRAP-PLASTIC	I	CUT TO LENGTH
10	0925094-4	TY-WRAP	12	
11	4375953-9	CLAMP	2	
12	4726629-1	SWITCH-STOP LIGHT	1	
13	4735947-6	ADAPTER	1	
14	4736044-1	CONNECTOR	2	
15	4804793-0	WIRE	1	CUT TO LENGTH
16	4724667-3	TERMINAL	2	
17	0928628-7	TERMINAL	1	

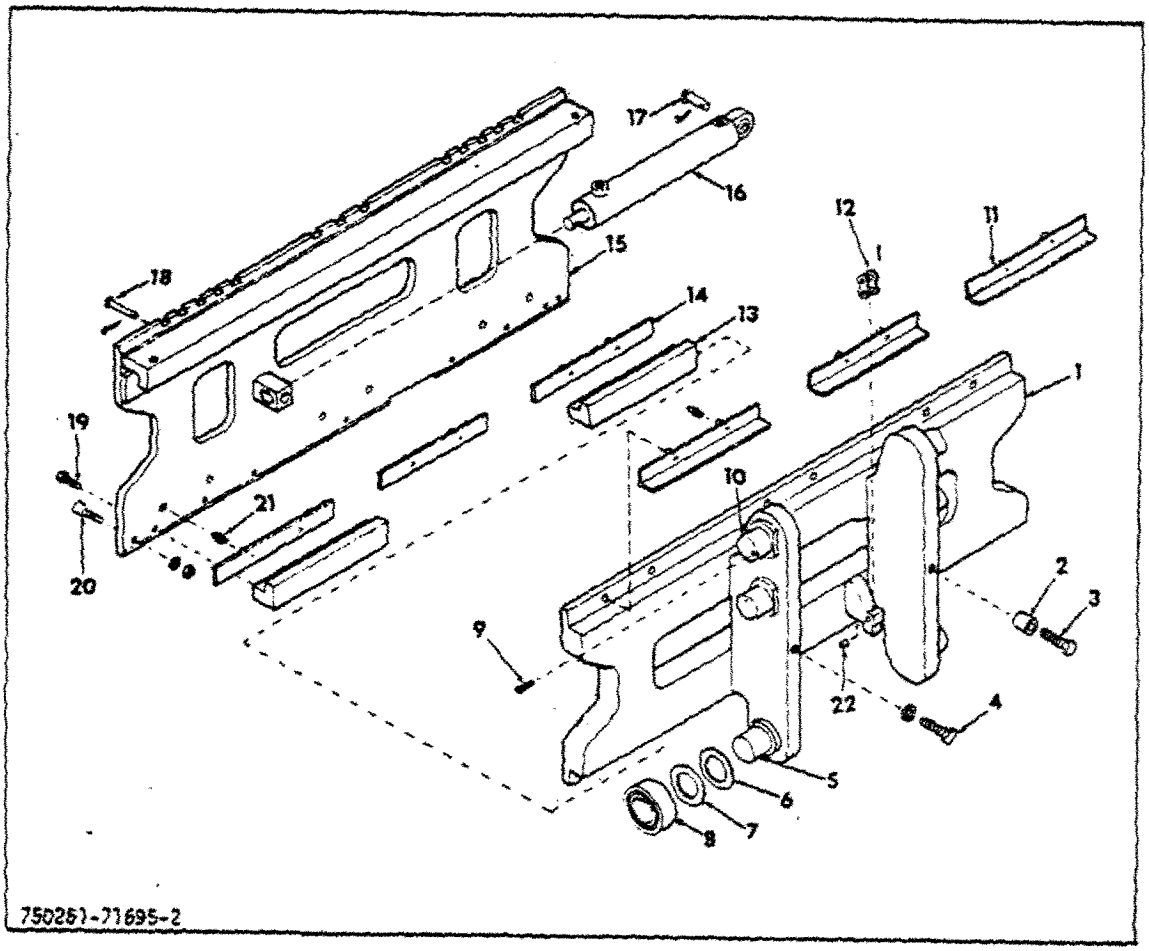


HEADLIGHT-MAST MOUNTED-SINGLE-36 VOLT

ITEM	PART NO	DESCRIPTION	QTY	
1	4846176-8	HEADLIGHT ASSY	1	INCL LAMP
	4912432-4	LAMP	1	
2	4737638-9	LOOM	1	CUT TO LENGTH
3	4724667-3	TERMINAL-TIP	2	
4	4775868-5	BRACKET	1	
5	0918266-8	WASHER	2	
6	0917421-0	NUT-JAM	1	
7	4811119-9	KNOB	1	
8	4775869-3	BRACKET	1	
9	0923092-1	CAPSCREW	1	
10	0901043-0	WASHER-BRASS	2	
11	4254976-6	NUT	1	
12	4255431-1	STUD-(WELDED)	1	
13	0927326-9	WASHER	1	
14	4781446-2	SPRING	1	
15	4254976-6	NUT	1	
16	4255195-2	STUD-(WELDED)	5	
17	4254481-7	CLAMP	6	
18	0923912-0	WASHER	5	
19	0917356-8	LOCKWASHER	5	

HEADLIGHT-MAST MOUNTED-SINGLE-36 VOLT

ITEM	PART NO	DESCRIPTION	QTY	
20	0920161-7	NUT	5	
21	4724666-5	CONNECTOR	2	
22	4724667-3	TERMINAL	2	
23	----------	WIRE-BLACK-16 GA	1	CUT TO LENGTH
24	----------	LOOM	-	SEE ITEM 2
25	4254846-1	TERMINAL	2	
26	4251846-1	CLAMP	2	
27	0921210-1	CAPSCREW	2	
28	0916965-7	LOCKWASHER	2	
29	0916950-9	NUT	2	
30	4251872-0	GROMMET	2	
31	4255355-2	TY-WRAP	4	NOT ILLUSTRATED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750251-71695-2

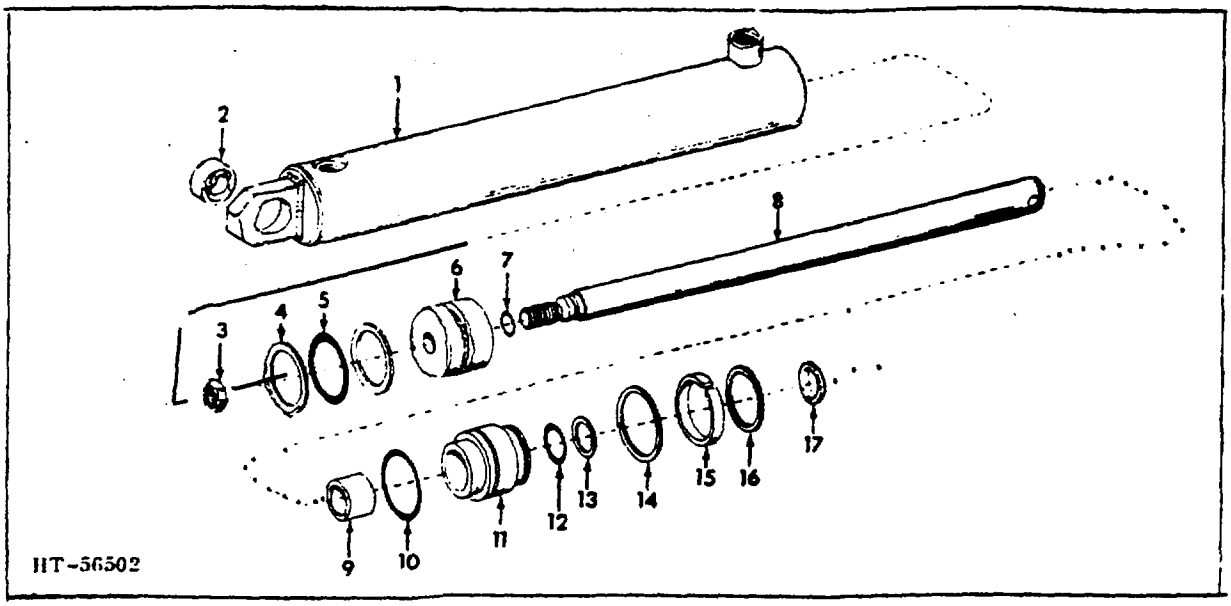
SIDE SHIFT CARRIAGE

ITEM	PART NO	DESCRIPTION	QTY	
1	4829479-7	FRAME ASSY	1	INCL ITEMS 5-10 & 22
2	4867850-2	SPACER	1	
3	0926705-5	CAPSCREW	1	
	0917373-3	LOCKWASHER	1	
4	0921672-2	CAPSCREW	1	
	0917373-3	LOCKWASHER	1	
5	4839752-5	STUD-ROLLER	4	WELDED
6	4812930-8	SHIM-.015"	*	AS REQUIRED
7	4812929-0	SHIM-.040"	*	AS REQUIRED
8	4812920-9	BEARING	6	
9	0926680-8	SCREW-FL. HD.	2	W/NYLOK INSERT
10	4839751-7	STUD-ROLLER	2	WELDED.
11	4822814-2	ANGLE-WEAR	3	
12	4701704-1	LINK-CHAIN	2	
13	4835376-7	BAR-HANGER-LOWER	2	
14	4822811-8	STRIP-WEAR	3	
15	4850688-5	PLATE ASSY	1	
16	4809524-4	CYLINDER-SIDE SHIFT	1	SEE PAGE 118
17	0929594-2	PIN-CYL FOOT	1	
	0918451-6	PIN-COTTER	1	
18	4809834-7	PIN-ROD END	1	
	0918451-6	PIN-COTTER	1	
19	0927449-9	SCREW	6	
20	0912279-7	CAPSCREW	2	
	0920428-0	LOCKWASHER-EXT	2	
	0913744-9	NUT-JAM	2	
21	0914687-9	FITTING-LUBE	12	
22	4834705-8	BUSHING-ANCHOR CHAIN	2	

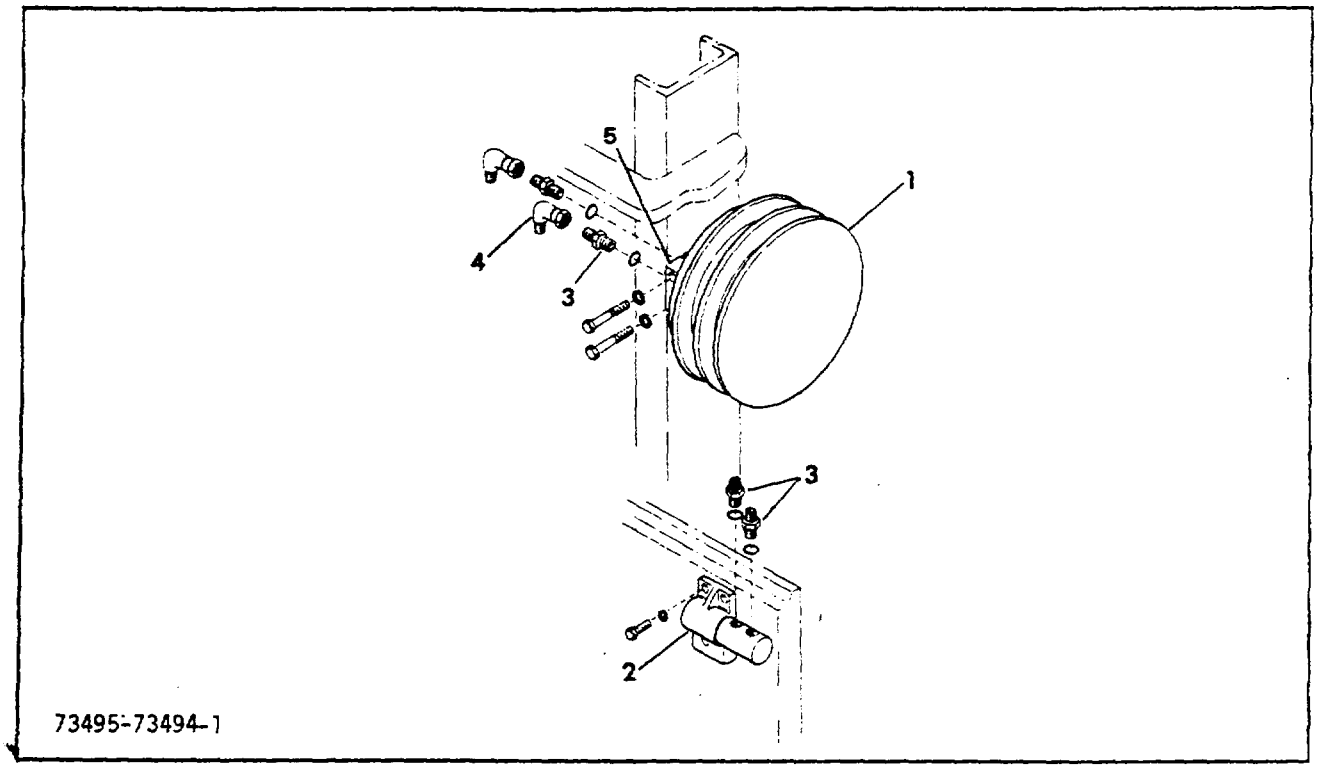
CYLINDER ASSEMBLY

ITEM	PART NO	DESCRIPTION	QTY
1	4999620-0	TUBE	1
2	4998682-1	BUSHING	1
3	0927587-6	NUT-JAM	1
4	4998612-8	*WASHER-BACKUP	2
5	0923826-2	*O-RING	2
6	4998178-0	PISTON	1
7	0923376-8	*SEAL-ROD	1
8	4999621-8	ROD	1
9	4906179-9	BUSHING	1
10	0924114-2	*SEAL-HEAD	1
11	49089600-	HEAD	1
12	0923810-6	*O-RING-ROD	1
13	4905864-7	*WASHER-BACKUP	1
14	0927814-4	*RING-LOCK	1
15	4998176-4	SPACER	1
16	0927849-0	RING-LOCK	1
17	4905864-7	*WASHER-BACKUP	1

*INCLUDED IN KIT 4908980-8

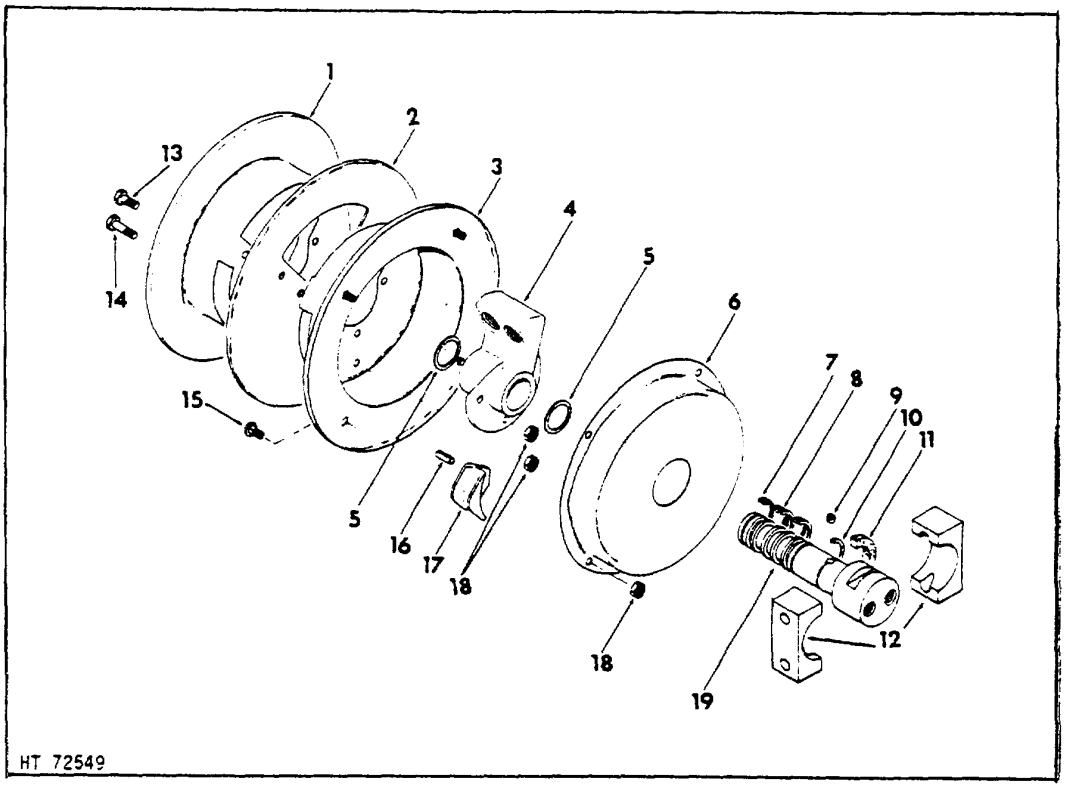


CYLINDER ASSY-4809524-4



REEL GROUP - R.H.

ITEM	PART NO.	DESCRIPTION	QTY.	
1	4844556-3	REEL	1	SEE PAGE 120
	0923320-6	CAPSCREW	2	
	0916966-5	LOCKWASHER	2	
2	4898150-0	BLOCK-JUNCTION	1	SEE PAGE 121
	0921333-1	CAPSCREW	2	
	0917356-8	LOCKWASHER	2	
3	0921409-9	CONNECTOR	4	
	0921349-7	O-RING	4	
4	0921279-6	ELBOW-900	2	
5	4844559-7	BLOCK, MOUNTING	1	
	0923191-1	CAPSCREW	2	
	0916966-5	LOCKWASHER	2	

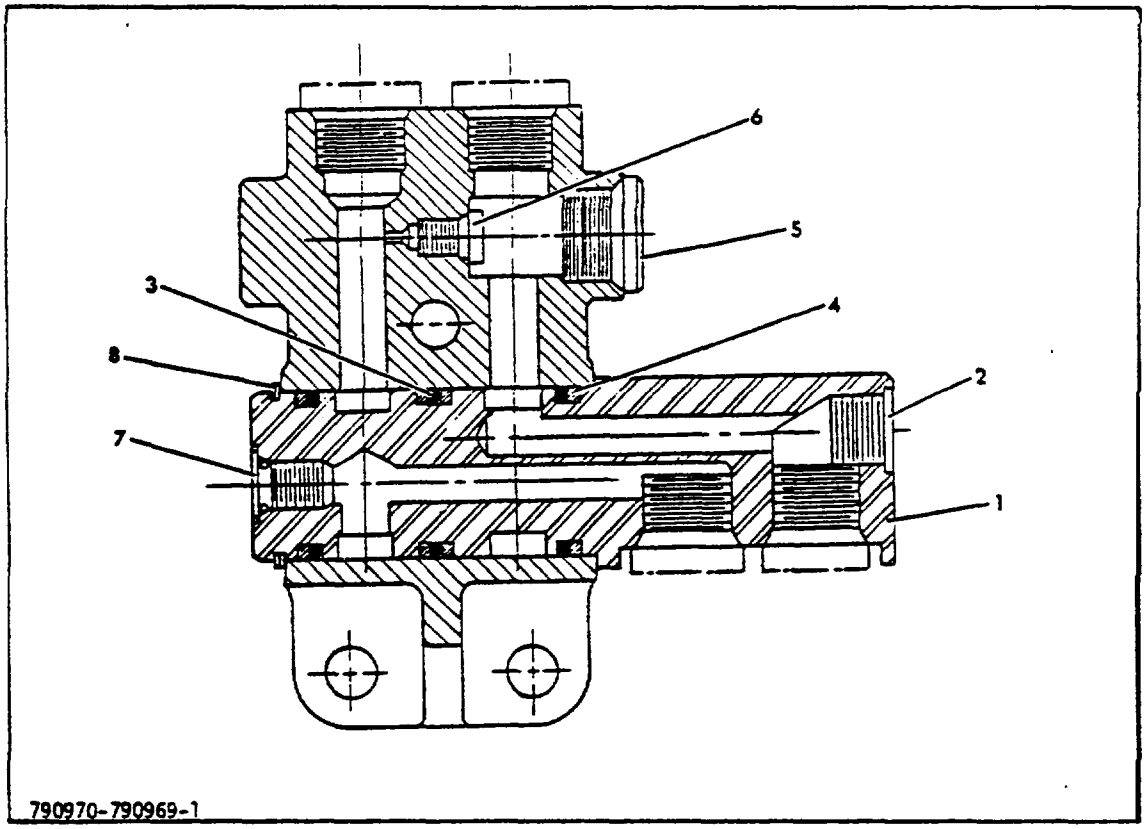


HOSE REEL ASSEMBLY-4844556-3

ITEM	PART NO.	DESCRIPTION	QTY.
1	C-645989	FLANGE	1
2	C-645977	DIVIDER	1
3	C-645978	FLANGE	1
4	C-646064	HUB	1
5	C-7194	RING-SNAP	2
6	C-646249	SPRING	1
7	C-648569	*RING-BACKUP	4
8	C-2715	*O-RING	3
9	C-645982	SPRING-RETAINING	1
10	C-653314	RING-SNAP	1
11	C-649055	SEAL-FELT	1
12	C-646246	BLOCK-MOUNTING	2
13	C-3552	CAPSCREW	3
14	C-3555	CAPSCREW	3
15	C-649106	CAPSCREW	4
16	C-7912	PIN-ROLL	4
17	C-646075	GUIDE-HOSE	2
18	C-645986	NUT	10
19	C-646079	SHAFT	1

*INCLUDED IN KIT C-646339

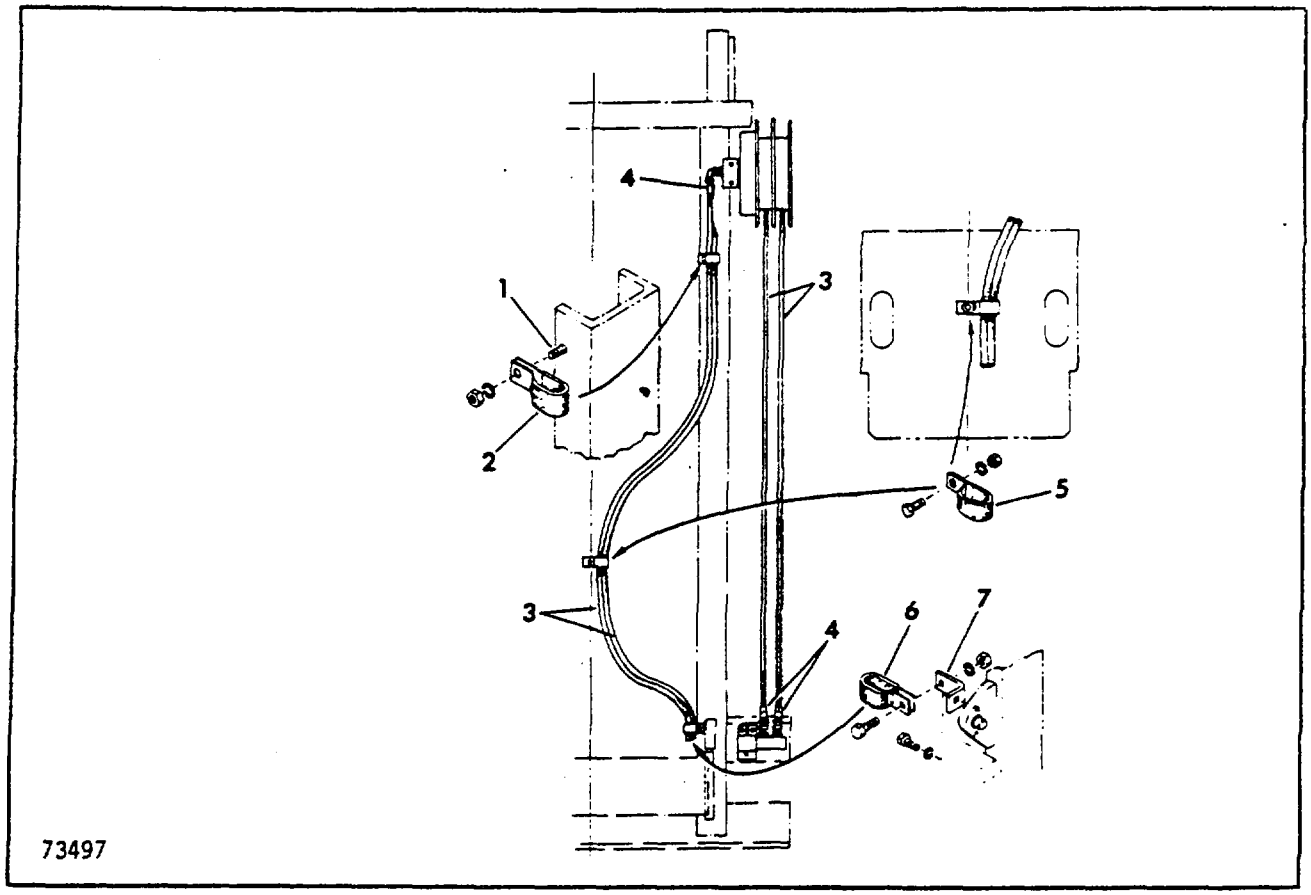
NOTE: ORDER COMPONENT PARTS FROM CASCADE (02614)



JUNCTION BLOCK-4898150-0

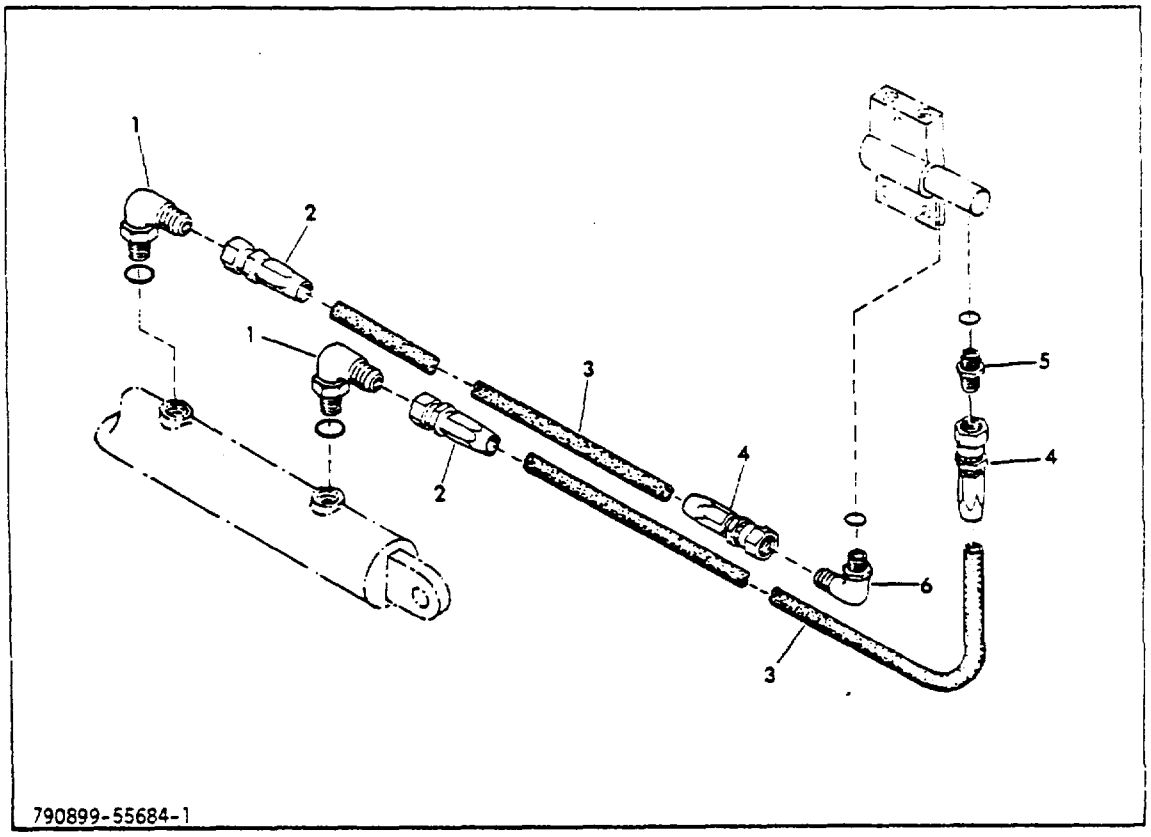
ITEM	PART NO.	DESCRIPTION	QTY.
1	4911171-9	SHAFT	1
2	4911172-7	PLUG	1
3	4911173-5	*O-RING	3
4	4911174-3	*RING-BACKUP	4
5	4911175-0	PLUG	1
6	4911176-8	PLUG	1
7	4911177-6	PLUG	2
8	4911178-4	RING-SNAP	1

*INCL IN KIT 4911179-2



HOSE GROUP

ITEM	PART NO.	DESCRIPTION	QTY.	
1	4255126-7	STUD	1	WELDED TO MAST
2	4810196-8	CLAMP	1	
	0919386-3	WASHER	1	
	0917356-8	LOCKWASHER	1	
	0917372-5	NUT	1	
3	4809161-5	HOSE	4	
4	0925984-7	COUPLING-HOSE END	8	
5	4810196-8	CLAMP-DOUBLE	1	
	0921977-5	CAPSCREW	1	
	0917356-8	LOCKWASHER	2	
	0917372-5	NUT	1	
6	4714624-6	CLAMP-DOUBLE	1	
	0921332-3	CAPSCREW	1	
	0917356-8	LOCKWASHER		
	0917372-5	NUT	1	
7	4714907-5	BRACKET	1	



HYDRAULIC ADAPTION

ITEM	PART NO.	DESCRIPTION	QTY.	
1	0922571-5	ELBOW-90°-ADJ-.44"-20	2	INCL O-RIG
	0921883-5	O-RING-#-904	2	
2	0925805-4	COUPLING-HOSE END-.44"-20	2	
3	4813026-4	HOSE-.25"ID X 36.00"	1	CUT TO LENGTH
4	0926058-9	COUPLING-HOSE END-.56"-18	2	
	0922457-7	CONNECTOR-.75"-16	1	INCL O-RING
	0921349-7	O-RING-4-908	1	
6	0923905-4	ELBOW-90-ADJ-.75"-16	1	
	0921349-7	O-RING-#-908	1	

PART NO.	PAGE	VENDOR CODE	VENDOR PART NO.
C-2715	124	02614	
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C-646079	124	02614	
C-646246	124	02614	
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C-649055	124	02614	
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C-653314	124	02614	
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C-7194	124	02614	
C-7912	124	02614	
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0239191-0	61	96151	20599
0527933-6	79	92563	305SZZ
0900576-0	103	96906	MS35206-281
0900814-5	68	96906	MS24665-623
0901010-9	21	96906	MS15795-814
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0901652-8	83	30612	
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0910968-7	30	96906	MS35006-267
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PART NO.	PAGE	VENDOR CODE	VENDOR PART NO.
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0921160-8	57	96906	MS90725-41
0921205-1	91	93784	MS28778-10
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0922845-3	61	30612	
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0922946-9	113	30612	
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0923427-9	68	30612	
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4912180-9	93	27767	14-06585
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4912184-1	53	27767	5-04190
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4914195-9	61	96191	8438
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4914162-5	61	96151	18001
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4995194-0	92	93784	5087
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Supplier information is listed in the form of the Federal Manufacturer's Code number and that manufacturer's part number.

The following is a list of the Federal Manufacturer's Code numbers that appear with their names and addresses.

CODE	NAME AND ADDRESS
00779	Amp, Inc. P. 0. Box 3608 Harrisburg, PA 17105
01212	Federal-Mogul Corp. Special Markets Replacement Sales- P. O. Box 1966 26555 Northwestern Hwy. Detroit, MI 48235
01276	Aeroquip Division - Industrial 1225 W. Main Street Van Wert, Ohio 45891
02295	General Electric Co. General Purpose Control Dept. P. O. Box 913 Bloomington, IL 61701
02329	The Glastic Corp. 4321 Glenridge At Green Cleveland, OH 44121
02660	Bunker Ramo Corp. Amphenol Connector Div 2801 S. 25th Avenue Broadview, IL 60153
02978	Teledyne Continental Motors General Products Div 76 N. Getty Street Muskegon, MI 49442
02989	General Electric Co. Industrial Control Dept. 1501 Roanoke Blvd. Salem, VA 24153
04065	Graybar Electric Co., Inc. 2045 Cornell Melrose Park, IL 60160
04424	Forsnas Engineering Co., Inc. Glendale, CA
04426	Illinois Tool Works, Inc. Licon Division 6615 W. Irving Park Road Chicago, IL 60634
04713	Motorola inc. Semiconductor Products Group 5005 E. Mc Dowell Road Phoenix, AZ 85008
06383	Panduit Corp. 17301 Ridgeland Tinley Park IL 60477
06499	General Battery Corp. 220 Eisenhower Lane Lombard, IL 60148
08108	Lamp Industry
08162	Federal-Mogul Corp. Bearing Group P. O. Box 1966 Detroit, MI 48235
09367	Allis-Chalmers Corp. Engine Division 151st & Halsted Harvey, IL 60426
09704	Seats, Inc. 350 N. Dewey Street Reedsburg, WI 53959
09990	Parker-Hannifin Corp. Industrial Hydraulic Div. 200 Perry Ct. Elyria, OH 44035
11314	Federal-Mogul Corp. Rubber & Plastics Group 11634 Patton Road Doweny, CA 90241 USE 01212
13445	Cole-Hersee Co. 20 Old Colony Avenue Boston, MA 02127
16476	Datcon Instrument Co. P. O. Box 128 East Petersburg, PA 17520
16764	Delco-Remy Division of General Motors Corp. 2401 Columbus Avenue Anderson, Indiana 46014
19728	Prestolite Co. The Division of Eltra Corp. P. O. Box 931 511 Hamilton Street Toledo, OH 43601

CODE	NAME AND ADDRESS
22031	Air Way Mfg. Co. 586 No. Main At Us 27 Olivet, MI 49076
22075	Use 27767
22599	ESNA Div. of Amerace Corp. 16150 Stagg Street Van Nuys, CA 91404
27007	Cessna Aircraft Co. Fluid Power Div. RFD#4-P. O. Box 1028 Hutchinson, KS 67501
27191	Cutler-Hammer. Inc. Power Distribution and Control Div. 4201 N. 27th Street Milwaukee, WI 53216
27767	Kelsey-Hayes Co/ 38481 Huron River Drive Romulus, MI 48174
28398	General Battery Corp. Hertner Div. 12690 Elmwood Avenue Cleveland, OH 44111
28478	Deltrol Controls Div. Deltrol Corp. 2745 S. 19th Street Milwaukee, WI 53215
30327	I-T-E Imperial Corp. 6300 West Howard Street Chicago, IL 60448
30612	Allis-Chalmers Corp. Industrial Truck Div. 21800 S. Cicero Avenue Matteson, IL 60443
30655	Elastic Stop Nut Corp. of America Fastener Div. Union, NJ 07083
30781	Parker-Hannifin Corp. Parker Packing Div. 2200 S. 3600 W. Salt Lake City, UT 84125
33544	Mercury Marine Div. of Brunswick Corp. 157 Western Avenue Cederburg, 'WI. 53012
38443	Marlin-Rockwell Div. of TRW, Inc. 402 Chandler Street Jamestown, NY i701

CODE	NAME AND ADDRESS
39428	Mc Master Carr Supply Co. 2828 N. Paulina Avenue Chicago, IL 60680
40931	Honeywell, Inc. Honeywell Plaza Minneapolis, MN 55408
43766	Nice Ball Bearing Co. 30th & Hunting Park Avenue Philadelphia, PA 19140
44655	Ohmite Mfg. Co. 3601 W. Howard Street Skokie, IL 60076
51588	Roller Bearing Of America Sullivan Way West Trenton, NJ 08628
56118	Sparton Corp. 2400 E. Ganson Jackson, MI 49202
56878	Standard Pressed Steel Co. Benson East Jenkinton, PA 19046
59730	Thomas & Betts Co. The 36 Butler Street Elizabeth, NJ 07207
60038	The Timken Co. 1835 Dueber Avenue SW Canton, OH 44706
60380	The Torrington Co. Bearing Div. Subsidiary of Ingersoll-Rand Corp. 59 Field Street Torrington, CT 07690
62983	Sperry-Vickers Div. of Sperry Rand Corp. 5353 Highland Drive Jackson, MS 39206
63477	Wagner Electric Corp. Wagner Division 6400 Plymouth Avenue St. Louis, MO 63133
63977	Use 62983
70026	Chicago Fittings Corp. 18th Avenue at 21st Street Broadview, IL 60153
70270	Stewart-Warner Alemite Sales Co., inc. 9250 Ivanhoe Street Schiller Park, 11 60176

CODE	NAME AND ADDRESS
70434	Anchor Coupling Corp. 507 N. Milwaukee Avenue Libertyville, IL 60048
70485	Atlantic India Rubber Works, Inc. 571 North Polk Street Chicago, IL 60607
70797	Arco Industries Corp. 432 N. Eliza Street Schoolcraft, MI 49087
70763	John S. Barnes Corp. 2330-23rd Avenue Rockford, IL 61125
71400	Bussman Mfg. Division of McGraw-Edison Company 502 Earth City Plaza Earth City, MO 63045
71400	Bussman Mfg. Division of McGraw-Edison Company 502 Earth City Plaza Earth City, MO 63045
71838	Standard Pressed Steel Company Cleveland Capscrew Div. 4444 Lee Road Cleveland, OH 44128
72210	Columbus Auto Parts Co. Hudson St. at North Freeway Columbus, OH 43211
72530	Deluxe Products Corp. 1201 Michigan Boulevard Racine, WI 53402
72625	Amsted Industries, Inc. Diamond Chain Co. Div. 402 Kentucky Avenue Indianapolis, IN 46225
73614	R. Cooper Jr., Inc. 25 E. Howard Avenue Des Plaines, IL 60018
73675	Hooker Chemicals & Plastics Corporation - Duress Div. 17 Walck Road North Tonawanda, NY 14120
73680	Garlock, Inc. Division Street Palmyra, NY 14522
73740	TRW, Inc. Ross Gear Div. Lebanon Works Lebanon, TN 37087

CODE	NAME AND ADDRESS
73974	Marlin-Rockwell Div. of TRW, Inc. Jamestown Works 402 Chandler Street Jamestown, NY 14701
75272	Kickhaefer Mfg. Company 1964 Wisconsin Avenue Grafton, WI 53024
75915	Little Fuse, Inc. 800 E. Northwest Highway Des Plaines, IL 60016
76871	Ohio Nut and Bolt Company Div. of Fastener Industries, Inc. 33 First Street Berea, OH 44017
77060	Packard Electric Division of General Motors Corporation 408 Dana Street, NE Warren, OH 44482
77313	Plastic Research Prod. Co. Beech & Thomas Streets Urbana, OH 43078
77640	TRW, Inc. Ross Gear Division 800 Heath Street Lafayette, IN 47902
77915	Sheller-Globe Corp. Portland Division So. Bridge Street Portland, III 47371
48189	Illinois Tool Works, Inc. Shakeproff Division St. Charles Road Elgin, IL 60120
78206	Star Expansion Mountainville, NY 10953
78422	J. W. Speaker Corp. 3059 W. Weil Street Milwaukee, WI 53212
78553	Eaton Corp. Engineering Fasteners Div-Tinnerman Plant 8700 Brookpark Road Cleveland, OH 44101
79136	Waldes Kohinoor, Inc. 47-16 Austel Place Long Island City, NY 11101
79187	USE 79410

CODE	NAME AND ADDRESS
79410	Warner Gear Div. of Borg-Warner 1106 Seymour Street Muncie, IN 47302
79470	Weatherhead Co. The 300 E. 131 St. Cleveland, OH 44108
79550	Whitaker Cable Corp. 2801 Rockcreek Pky. No. Kansas City, MO 64116
80201	Chicago Rawhide Mfg. Co. 900 N. State Street Elgin, I1 60120
80495	Anderson Power Products, Inc. 145 Newton Street Brighton, MA 02135
80648	USE 80657
80657	The Torrington Co. Bearings Div. 3705 W. Sample Street South Bend, IN 46634
80813	Dimco Gray Co. 8200 S. Suburban Road Centerville, OH 45459
80900	Eaton Corp. Spring Div. 9771 French Road Detroit, MI 48213
81223	USE 73614
81487	Square 0 Co. Systems Plant 4041 N. Richards Street Milwaukee, WI 53212
81912	Flooromatic, Inc. New York, NY
82465	Mac Lean Fogg Lock Nut Co. 1000 Allanson Road Mundelein, IL 60060
82807	Milwaukee Resistor Co. 700 W. Virginia Milwaukee, WI 53204
83907	Accurate Rubber Prod. Co. 123 N. Racine Chicago, I1 60607
87946	Triangle Mfg. Co. 720 Division Street Oshkosh, WI 54901
88044	Aeronautical Stds. Gro. Dept. of Navy & Air Force
88310	Allis-Chalmers Mfg. Co. Small & Medium Motor Div. 4620 Forest Avenue Norwood, OH 45212
91929	Honeywell, Inc. Micro-Switch Division Chicago & Spring Sts. Freeport, IL 61032
92850	Anchor Industries, Inc. 1725 London Road Cleveland, OH 44112
92863	Marvel Engineering Co. 2085 N. Hawthorne Avenue Melrose Park, IL 60160
92867	Osrscheln Brake Lever Mfg. Co. 1177 No. Morley Moberly, MO 65270
93608	USE 71838
93784	Husco Div. of Koehring Co. W239 N218 Pewauke Road P. O. Box 257 Waukesha, WI 53186
94004	USE 40931
95879	Alemite Div. of Stewart-Warner Corp. 1826 Diversey Pky. Chicago, IL 60614
96151	Eaton Corp. Fluid Power Div. Char-Lynn Plant 15151 Highway 5 Eden Prairie, MN 55343
96779	USE 30781
96906	Military Standards Logistic Services, OSA

APPENDIX A

PUBLICATION REFERENCES

A-1. FORMS

The following forms pertain to this material. (Refer to DA Pamphlet 310-2 for index of blank forms.)

Standard Form 46, U.S. Government Motor Vehicle Operator's Identification Card.

Standard Form 91. Operator's Report of Motor Vehicle Accident.

Recommended Changes to DA Publications and Blank Forms, DA Form 2028.

DA PAM 738-750, The Army Maintenance Management Systems (TAMMS). for instructions on the use of maintenance forms pertaining to this material.

A-2. OTHER PUBLICATIONS

The following publications contain information pertinent to the major item materiel and associated equipment.

The Army Equipment Maintenance Management System (TAMMS) applies as follows:

(1) Army Equipment Log Book Binder. NSN 7510-00-889-3494.

(2) Case, Maintenance and Operational Manuals, NSN 7520-00-559-5618.

(3) DA Form 2407, Maintenance Request.

(4) DA Form 2408, Equipment Log Book Assembly (Records)

(5) DA Form 2408-1, Equipment Daily and Monthly Log.

(6) DA Form 2408-5, Equipment Modification Record.

(7) DA Form 2408-9, Equipment Control Record.

(9) DA Form 2409, Equipment Maintenance Log (Consolidated).

The following publications contain information pertinent to the major item materiel and associated equipment.

a. Operating Vehicle.

Driver Selection and Training (Wheeled Vehicles)	FM 55-30
Manual for the Wheeled Vehicle Driver	FM 21-305
Prevention of Motor Vehicle Accidents	AR 385-55
Accident Reporting and Records	AR 385-40

b. Maintenance and Repair.

The Army Maintenance Management Systems (TAMMS)	DA PAM 738-750
Identification List for Fuels, Lubricants, Oils and Waxes	C 9100-IL
Description, Use, Bonding Techniques, and Properties of Adhesives Materials Used for Cleaning, Preserving, Abrading, and Cementing	TB ORD 1032
Ordnance Material and Related Materials, Including Chemicals	TM 9-247
Metal Body Repair and Related Operations	FM 43-2
Welding Theory and Application	TM 9-247
Painting Instructions for Field Use	TM 43-0139
Inspection, Care, and Maintenance of Anti-Friction Bearings	TM 9-214
Operator's, Organizational, Direct Support and General Maintenance Manual for Lead-Acid Storage Batteries; 4HN, 24 (NSN 6140-00-059-3528). MS 75047-1, 2HN, 12V (NSN 6140-00-057-2554); MS 35000-3.	TM 9-6140-200-14

c. Cold Weather Operation and Maintenance

Basic Cold Weather Manual	FM 31-70
Northern Operations	FM 31-71
Operation and Maintenance of Ordnance Materiel in Extreme Cold Weather (0°F to -65°F)	FM 9-207
Winterization Kits for Army Tank-Automotive Materiel	SB 9-16

d. Decontamination.

Chemical, Biological, and Radiological (CBR) Decontamination	TM 3-220
Chemical, Biological, Radiological, and Nuclear Defense (NBC)	FM 21-40

e. General.

Hand Portable Fire Extinguishers Approved for Army Users	TB 5-4200-200-10
Camouflage	FM 5-20
Procedures for Destruction of Equipment to Prevent Enemy Use (Mobility Equipment Command)	TM 750-244-3
Administrative Storage of Equipment	TM 740-90-1
Preservation of USAMECOM Mechanical Equipment for Shipment and Storage	TM 740-97-2

APPENDIX B
SUPPLEMENTAL OPERATING, MAINTENANCE AND REPAIR PARTS INSTRUCTIONS W/MAC FOR TRUCK, FORKLIFT, SRT: EMD ALLIS-CHALMERS MODEL ACE 45K EV EE 36V NSN 3930-01-126-7505

TABLE OF CONTENTS

SECTION I.

GENERAL

1.1. Purpose. To provide user and support personnel supplemental maintenance and repair parts instructions applicable to the 4,000 lb capacity Allis-Chalmers Model ACE 45K EV EE 36V Forklift Truck.

1.2. Scope. This SOMARPI applies to Department of the Army Units, Organizations and Activities that use and/or support the Truck, Forklift, 4000 lb, 144 inch lift, SRT, EMD, NSN 3930-01-126-7505.

1.3. Description. The 4,000 lb electric motor driven, solid rubber tire forklift truck is manufactured by Allis-Chalmers Corporation, Matteson, IL. The forklift has front wheel drive and rear wheel steer feature with lift height of 144 inches. The truck is equipped with hydraulic service brakes, a parking brake and a seat switch which operates a "deadman" brake and cuts off power to the control if and when the operator leaves the seat. Forklift has a roller type lift assembly with two independent lift chains. Control levers to operate the lift, tilt and accessory functions are located to the operators right. The instrument panel contains a key switch, hourmeter to indicate time truck has been in service, and to give the operator a means of scheduling maintenance, and a battery charge indicator to measure battery voltage. There are three colored areas on the dial: green, yellow and red. Whenever the pointer is in the red area during operation of the lift truck, the battery requires charging. The lifting mechanism is comprised of a three-stage mast. Single stage chrome plated displacement cylinder cluster arrangement is common on high free lift masts. All masts feature constant lift speeds. Built-in lifting eyes provide easy mast removal and installation. Carriages and forks are of the hook type.

1.4. Operational Concept. The 4000 lb Allis-Chalmers Model ACE 45K EV EE 36V forklift truck is a mobile, self-propelled machine intended to lift, stack and carry material within its rated capacity in and around plants, warehouses, yards, loading platforms, docks, railway cars and highway trailers over paved and well graded, semi-prepared surfaces for short distances.

1.5. Procurement Status. The procurement Contract Number is DAAE07-81-C-6161.

1.6. Equipment Publications.

a. Equipment publications will be the end item manufacturers commercial manual. The commercial manual includes operator and repair parts information, in addition to part numbers and associated FSCM (Federal Supply Code Manufacturers) identification. One Allis-Chalmers commercial manual, GTM-00-1349, will be overpacked with each vehicle.

Nomenclature	Publication Number	Date Available	Source of Supply
Technical Manual, Operation, Maintenance, Repair and Repair Parts List	Commercial GTM-00-1349	Apr 82	DCSC
SOMARPI	TM 10-3930-651	--	TACOM AMSTA-MV

b. Request for additional commercial publications should be made as part number requisitions through the Defense Construction Supply Center (DCSC), Columbus, Ohio.

1.7. Personnel and Training

a. MOS Requirements. Qualitative and Quantitative Personnel Requirements Information (QQPRI) will be disseminated IAW AR 611-1. The following MOSs can operate and maintain the forklift.

(1) Operator: 62F or 76V

(2) Organizational Maintenance: 63S

(3) Direct and General Support Maintenance: 63W, 52D

b. Training:

(1) New Equipment Training (NET): New Equipment Training is available to major field commands. Request for NET should be forwarded to: Commander, US Army Tank-Automotive Command, Attn: AMSTA-MLT, Warren, MI 48090. Training should be requested only when trained personnel are not available in the command to operate and/or maintain the truck.

(2) New Materiel Introductory Teams (NMIT): Major field commands requiring briefings to Command Staff and users should forward their requests to: Commander, US Army Tank-Automotive Command, Attn: AMSTA-MLT, Warren, MI 48090. Receiving Commands are responsible for the itinerary of NMITs.

(3) New Equipment Training Teams (NETT): New Equipment Training Teams will not be available for this equipment..

1.8. Logistics Assistance (AR 700-4). US Army Tank-Automotive Command's Field Maintenance Technicians, stationed at CONUS and OCONUS installations, are available to furnish on-site training and/or technical assistance. Assistance can be obtained by contacting the appropriate Logistics Assistance Office (LAO) listed in Appendix B, AR 700-4.

1.9. Warranty. See SECTION V.

1.10. Recommending Publication Improvements. You can improve this publication by recommending improvements using DA Form 2028 (Recommended Changes to Publications and Blank Forms) and mail to: Commander, US Army Tank-Automotive Command, Attn: AMSTA-MBP, Warren, MI 48090.

SECTION II.

MAINTENANCE

2.1. Maintenance Concept

a. The 4000 lb Allis Chalmers Model ACE 45K EV EE 36V Forklift Truck will not require special or new maintenance considerations. Maintenance operations can be accomplished within the current maintenance support concept for the Material Handling Equipment.

b. Nature and Extent of Maintenance:

(1) Maintenance Allocation Chart (MAC). Maintenance will be performed as necessary by the category indicated in the MAC (SECTION VI) to retain and/or restore serviceability. Units may exceed their authorized scope and function in the MAC when approved by the appropriate commander.

(2) Operator Maintenance. Operator maintenance is limited to daily preventive maintenance checks and routing servicing (see SECTION X).

(3) Organizational Maintenance. Organizational maintenance consists of scheduled preventive maintenance services, limited removal, minor repair adjustments (see SECTION X)

(4) Direct Support Maintenance. Direct Support Maintenance consists of repairs on-site and for return to the user of the end item/assemblies which can be maintained efficiently with a minimum of tools and equipment.

(5) General Support Maintenance. General Support will overhaul and repair for return to stock, items designated by the area support commander.

(6) Depot Maintenance. There is no scheduled depot maintenance on the 4000 lb Allis Chalmers Model ACE 45K EV EE 36V Forklift Truck.

c. Maintenance Expenditure Limit. The Maintenance Expenditure Limit is based on a life expectancy of 18 years. Limits on repairs are based upon 50% of replacement cost for the first 2/3 of life expectancy and 30% of replacement cost for the remainder.

2.2. Reliability and Maintainability. Reliability and Maintainability will be assessed through the field evaluation of current users. Specific numerical RAM requirements or objectives are not established.

2.3. Modifications. Modifications will be accomplished by the end item manufacturer after MERADCOM acceptance and TACOM approval.

2.4. REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR) If your front/sideloader forklift truck needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 (Quality Deficiency Report). Mail it to us at Commander, US Army Tank-Automotive Command, ATTN: AMSTA-MP, Warren, MI 48090. We'll send you a reply.

2.5. Shipment and Storage

a. Shipment and Storage. Refer to TB 7A9-94-2 for procedures covering preservation of equipment for shipment. General procedures for shipment are found in FM 55-15, with more specific information in TM 55-2200-001-12 for rail and TM 55-450 series for air transport.

b. Administrative Storage. Refer to TM 740-90-1 for instructions covering administrative storage of equipment.

c. Weight Classification. The weight classification of the end item is 6150 lbs (includes battery).

2.6. Destruction to Deny Enemy Use. Refer to TM 750-244-6 for instructions governing destruction of equipment to prevent enemy use.

2.7. Basic Issue Items List (BIIL). Basic Issue Items are as follows:

SMR	National Stock Number	Description	Unit of Measure	Qty. Auth.
PAOZZ	7530-01-065-0166	Equipment Record	1	1

2.8. Special Tools and Equipment. Special tools and equipment are not required for the 4000 lb Allis-Chalmers Model ACE 45K EV EE 36V Forklift Truck.

2.9. Maintenance and Operating Supply List. See SECTION VIII for a list of maintenance and operating supplies required for initial operation.

2.10. Maintenance Forms and Records. Operational. maintenance and historical forms/records will be IAW the current DA PAM 738-750.

2.11. Maintenance of New Vehicle. Make thorough inspection of the vehicle immediately upon delivery. In the event any damage or shortages are noted, have the delivering carrier's agent make a notation on the delivery receipt and file claim with the carrier. See SECTION IX for specific areas to be checked.

2.12. Preventive Maintenance Checks and Services (PMCS). See SECTION X PERSONNEL Military Occupational Specialty (MOS). Qualitative and Quantitative Personnel Requirements Information (QQPRI) will be disseminated in accordance with AR 611-1. The following MOS can operate and maintain the forklift:

(a) Operator, 57H and 76V

(b) Organizational Maintenance, 63B

(c) Direct Support and General Support, 63W, 52D, and 63G

LOGISTIC ASSISTANCE US Army Tank-Automotive Command Field Maintenance Technicians stationed at CONUS and OCONUS installations are available to furnish onsite training and or technical assistance. Assistance may be obtained by contacting the appropriate Logistics Assistance Office (LAO) listed in Appendix B, AR 700-4.

SECTION III.

REPAIR PARTS SUPPLY

3.1. General

a. The basic policies and procedures in AR 710-2 and AR 725-50 are generally applicable to repair parts management for Material Handling Equipment (MHE) items.

b. Manufacturers technical manual contains illustrated parts breakdown and lists of repair parts keyed to Federal Supply Code for Manufacturer (FSCM). The commercial technical manual does not reference repair parts to National Stock Numbers (NSN).

c. National Stock Numbers (NSN) are initially assigned only to PLL/ASL items and major assemblies. Additional NSNs are assigned as demands warrant.

d. Automated Processing (AUTODIN) of Federal Supply Code Manufacturer (FSCM) part number requisitions, without edit for matching NSNs, is authorized.

e. Weapon System Designator Codes on repair parts requisitions are not required.

f. Repair parts are available from commercial sources for CONUS units and may be locally purchased IAW AR 710-2 and AR 735-110.

g. Initial Prescribed Load List (PLL) and Authorized Stockage List (ASL) will be distributed by Tank-Automotive Command (TACOM), AMSTA-FHM.

3.2. Prescribed Load List (PLL). The PLL, distributed by TACOM, is an estimated 15 days supply recommended for initial stockage at organizational level. Management of PLL items will be governed by the provisions of AR 710-2 and local command procedures, A prepared list of PLL parts will be provided to OCONUS units before shipment of the end item. Selection of PLL parts for shipment to OCONUS units is based upon the receiving command's recommendations after their review of the TACOM prepared list. Organizations and activities in CONUS will establish PLL stocks through normal requisitioning process. NOTE: Local purchase of repair parts is authorized IAW AR 710-2 and AR 735-110.

3.3. Authorized Stockage List (ASL). The ASL, distributed by TACOM, is an estimated 45 days supply of repair parts for support units and activities. An initial list of ASL parts will be provided to designated support units (OCONUS) before shipment of the end items. The parts shipped will be selected according to the recommendations of the receiving commands. Receiving commands will make their recommendations after review of the initial list distributed by TACOM. Support units and activities in CONUS will establish ASL stocks through the normal requisitioning process. NOTE: Local purchase of repair parts is authorized by AR 710-2 and AR 735-110.

3.4. Requisitioning Repair Parts (MILSTRIP)

a. Preparation and transmittal.

(1) Requisitions will be prepared in the normal MILSTRIP format.

(2) Requisitions transmitted by AUTODIN for NSN repair Darts will be automatically routed by the Defense Automated Addressing System (DAAS) to the responsible Federal Supply Class Manager.

(3) Requisitions for non-NSN repair parts may be locally procured or requisitioned from the Defense Construction Supply Center (DCSC), Columbus, Ohio. These requisitions, when properly coded, will be forwarded by the DAAS to DCSC. When the manufacturer's Part Number and the Federal Supply Code for the Manufacturer (FSCM) exceed column 8-22 of the requisition format (DD Form 1348-1), prepare an AOE/A05 requisition (DD Form 1348-6) and mail to: Commander

Defense Construction Supply Center
ATTN: DCSC-OSR
Columbus, OH 43215

b. Project Codes (Cols. 57-59)

(1) Project codes have been assigned to identify non-NSN repair parts requisitions placed on the wholesale supply system.

(2) Hawaii, Alaska, and Panama, when submitting requisitions for non-NSN repair parts for this Material Handling Equipment, are considered as OCONUS and will use coding applicable to OCONUS.

(3) Refer to Tables 1 and 2 for applicable codes/formats.

c. Requisition Format. Unique or specific coding applicable to repair parts requisitions for this equipment is furnished in Tables 1 and 2. Other entries should conform to normal AR 725-50 MILSTRIP codes and formats.

TABLE I

Non-NSN Requisition Format

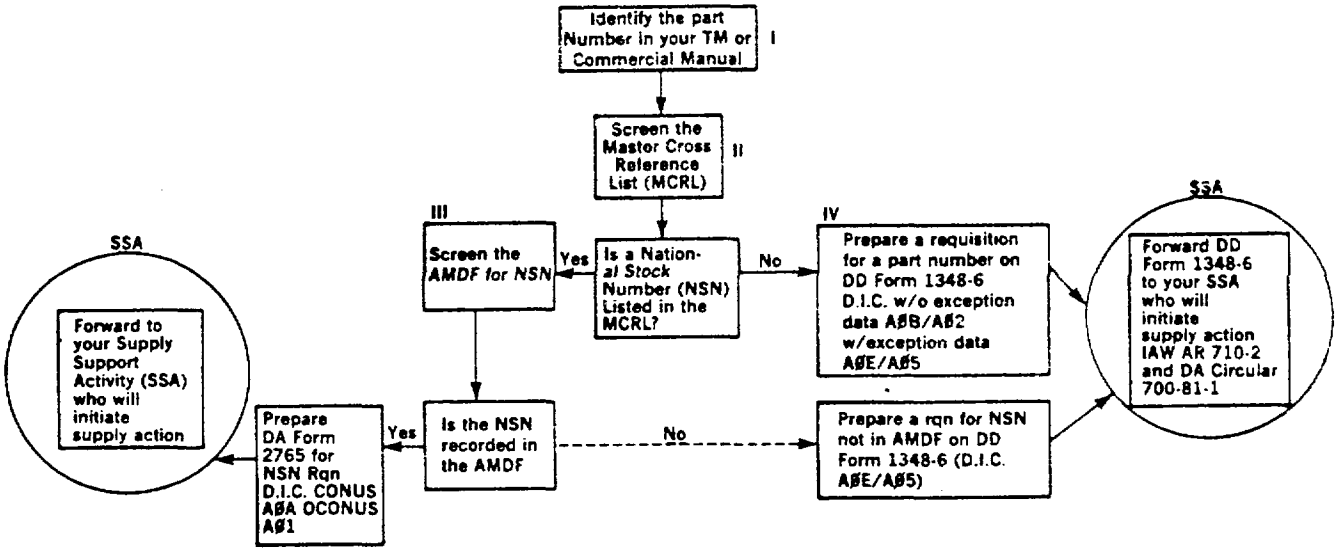
Card Column	Description	Entry CONUS	Entry OCONUS
1-3	Document Identifier Code	A0B	A02
4-6	Routing Identifier Code	S9C	S9C
8-22	Part Number	Enter the Federal Supply Code for Manufacturer (FSCM), followed by the Part Number (PN).	
54-56	Distribution Code:		
54	Control Activity	F	AR 725-50
55-56	Weapons System Designator Code	N/A	N/A
57-59	Project Code	BGX	JZM

TABLE II

NSN Requisition Format

Card Column	Description	Entry CONUS	Entry OCONUS
1-3	Document Identifier Code	A0A	A01
8-22	National Stock Number	Enter applicable 13 digit NSN.	
54-56	Distribution Code:	Same as Table I above.	
57-59	Project Code	Not required.	

DO YOU NEED A REPAIR PART
FOR
ONE OF YOUR COMMERCIAL CONSTRUCTION
OR
MATERIALS HANDLING EQUIPMENT ITEMS?
YES? THEN FOLLOW THESE 4 EASY STEPS.



NON-NSN REQUISITION (MANUAL)

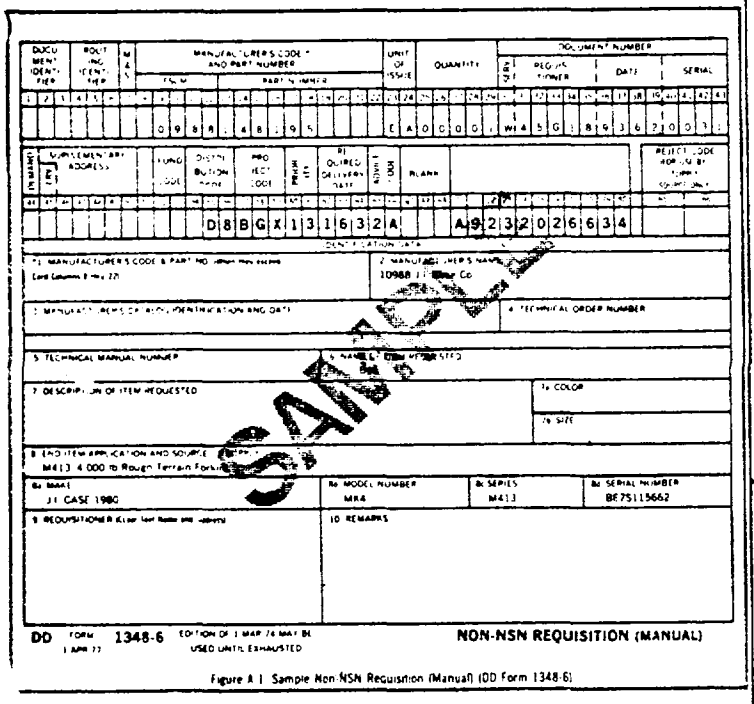


Figure A-1. Sample Non-NSN Requisition (Manual) (DD Form 1348-6)

LEGEND FOR 1348-6

CARD COLUMNS	CONUS	OCONUS
1-3 DOC Ident Code -		
PN w/o Exception Data	AØB	AØ2
PN w/Exception Date	AØE	AØ5
NSN Not in AMDF	AØE	AØ5

4-7 (LV Blank - SSA will complete)

8-22 For Non NSN: Fed Supply Code for Manufacturer (FSCM followed by Part Number (obtain from TM or Commercial Manual)

8-22 For NSN not in AMDF - enter NSN

57-59 Project Code:	MHE	CCE
CONUS	BGX	BGW
OCONUS	JZM	JZC

Reference Code for Cols 71-80:
- A - Technical Order or Tech Manual.
- B - End Item Application.
- C - Noun Description of Item.
- D - Drawing or Specification Number.

Identification of reference Data specified in Col. 70.

NOTE: All other entries will be made IAW AR 710-2/725-50. Project Codes are mandatory entries.

MANUAL BLOCKS:

BLOCK 1. Mfg Code & PN - Enter applicable FSCM and PN when they exceed Cols 8-22. (Cols 8-22 will be left blank).

BLOCKS 2-8. Enter applicable data (obtain from TM or Commercial Manual).

BLOCKS 8a-8d. Obtain data from vehicle data plate.

BLOCK 9. Self explanatory.

BLOCK 10. Enter any applicable exception data such as "NSN not in AMDF".

All NSN items not listed on the AMDF and part number requisitions will be forwarded to DCSC (RIC S9C) for supply support.

SECTION IV.

Special Notes and Corrections

Not Applicable

SECTION V.

Warranty Guidelines

1. The warranty period is 15 months after delivery to the Government and applies to all supplies furnished under the contract. (Note: Date of acceptance is on the data plate.)

2. Allis-Chalmers is required to extend to the Government the full benefits of the warranties granted by suppliers of major assemblies or components utilized in the end item.

3. The manufacturer's warranty is described in the service manual (on back of front cover, GTM-00-1349): "When a warranty circumstance arises, contact Allis-Chalmers Service Administration (313) 747-5151, extension 377, informing Model, Serial Number, Contract Number relating to the particular unit, and a summary as to the nature of the problem". Copies of the commercial manual are overpacked with each vehicle.

4. If Allis-Chalmers/Service Agency is not available, CONUS units notify the National Maintenance Point (NMP) by telephone, AUTOVON 786-7363. Units OCONUS, follow warranty reporting procedures in TM738-750.

5. All warranty claims, whether they are settled locally with a manufacturer's representative or processed through normal Army maintenance support channels, must be reported to: US Army Tank-Automotive Command, Attn: AMSTA-MVMJ Warren, Mich 48090,

WARRANTY INFORMATION

1. Do not attempt to conduct negotiations directly with the manufacturer in the event of warranty dispute. These negotiations are the responsibility of the contracting officer.

SECTION VI.

MAINTENANCE ALLOCATION CHART

INTRODUCTION

B-1. General

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance categories.

b. The Maintenance Allocation Chart (MAC) in section II designates overall authority and responsibility for the performance of maintenance functions on the identified end item or component. The application of the maintenance functions to the end item or component will be consistent with the capacities and capabilities of the designated maintenance categories.

c. Section III lists the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from section II.

d. Section IV contains supplemental instructions and explanatory notes for a particular maintenance function.

B-2. Maintenance functions. Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination (e.g., by sight, sound or feel).

b. Test. To verify serviceability by measuring the mechanical, pneumatic, hydraulic, or electrical characteristics al an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (includes decontaminate, when required), to preserve, to drain, to paint, or to replenish fuel, lubricants, chemical fluids, or gases.

d. Adjust. To maintain or regulate, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters.

e. Aline. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test, measuring, and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Remove/Install. To remove and install the same item when required to perform service or other maintenance functions. Install may be the act of emplacing, seating, or fixing into position a spare, repair part, or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

h. Replace. To remove an unserviceable item and install a serviceable counterpart in its place. "Replace" is authorized by the MAC and is shown as the 3d position code of the SMR code.

i. Repair. The application of maintenance services , including fault location/troubleshooting 4, removal/installation, and disassembly/assembly procedures, and maintenance actions to identify troubles and restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications (i.e., DMWR). Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours/miles, etc.) considered in classifying Army equipment/components.

B-3 Explanation of Columns in the MAC, Section II

a. Column 1, Group Number. Column I lists functional group code numbers, the purpose of which is to identify maintenance significant components, assemblies, subassemblies, and modules with the next higher assembly. End item group number shall be "00."

b. Column 2, Component/Assembly. Column 2 contains the names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

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1 Services inspect, test, service, adjust, aline, calibrate, and/or replace.

2 Fault locate/troubleshoot The process of investigating and detecting the cause of equipment malfunctioning; the act of isolating a fault within a system or unit under test (HUT).

3 Disassemble/assemble encompasses the step-by-step taking apart (or breakdown) of a spare/functional group coded item to the level of its least componency identified as maintenance significant (i.e., assigned an SMR code) for the category of maintenance under consideration.

4 Actions welding, grinding, riveting, straightening, facing, remachinery, and/or resurfacing.

c. Column 3, Maintenance Function. Column 3 lists the functions to be performed on the item listed in Column 2. (For detailed explanation of these functions, see paragraph B-2.)

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a work time figure in the appropriate subcolumn(s), the category of maintenance authorized to perform the function listed in Column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number of complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate work time figures will be shown for each category. The work time figure represents the average time required to restore an item (assembly, subassembly, component, module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time (including any necessary disassembly/assembly time), troubleshooting/fault location time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. The symbol designations for the various maintenance categories are as follows:

C	Operator or crew
O	Organizational maintenance
F	Direct Support Maintenance
H	General Support Maintenance

e. Column 5, Tools and Equipment. Column 5 specifies, by code, those common tool sets (not individual tools) and special tools, TMDE, and support equipment required to perform the designated function.

f. Column 6, Remarks. This column shall, when applicable, contain a letter code, in alphabetic order, which shall be keyed to the remarks contained in Section IV.

B-4. Explanation of Columns in Tool and Test Equipment Requirements, Section III.

a. Column 1, Reference Code. The tool and test equipment reference code correlates with a code used in the MAC, Section II, Column 5.

b. Column 2, Maintenance Category. The lowest category of maintenance authorized to use the tool or test equipment.

c. Column 3, Nomenclature. Name or identification of the tool or test equipment.

d. Column 4, National Stock Number. The National stock number of the tool or test equipment.

e. Column 5, Tool Number. The manufacturer's part number.

MAINTENANCE ALLOCATION CHART FOR
TRUCK, FORKLIFT, SRT, EMD, 4,000 LB, MHE 257

SECTION II - ASSIGNMENT OF MAINTENANCE FUNCTIONS

(1)	(2)	(3)	(4)					(5)	(6)
GROUP NUMBER	**COMPONENT/ASSEMBLY**	**MAINTENANCE FUNCTION**	**MAINTENANCE CATEGORY**					**TOOLS AND EQUIP**	**REMARKS**
			C	**O**	**F**	**H**	**D**		
06	ELECTRICAL SYSTEM								
0607	Panel Control (EV-1)	Test			3.5				(1)
		Replace			2.5				
		Repair				4.5			
	Contactors	Replace			1.5				
		Repair				1.5			
	Speed Box	Replace			1.5				
		Repair			2.5				
	Wiring, Control Panel	Replace			2.0				
0607	Panel Instrument	Replace		0.8					
		Repair		0.8					
	Hourmeter	Replace		0.3					
	Gauge, Battery Discharge	Replace		0.3					
0608	Switch, Light, Stop & Tail	Replace		0.3					
	Switch, Seat	Replace		0.3					
	Switch, Headlight	Replace		0.3					
0609	Lights, Assy Headlight Stop & Tail	Replace		0.2					
	Lamp, Light (Stop, Tail & Headlight)	Replace		0.2					
0611	Horn	Replace		0.4					
	Horn, Button Assy	Replace		0.3					
		Repair		0.5					
0612	Battery Storage	Test		0.2					(2)
		Service		8.0					
		Replace		0.5					
		Repair				12.0			
		Overhaul					19.0		

MAINTENANCE ALLOCATION CHART FOR
TRUCK, FORKLIFT, SRT, EMD, 4,000 LB, MHE 257

SECTION II - ASSIGNMENT OF MAINTENANCE FUNCTIONS

(1)	(2)	(3)	(4)					(5)	(6)
GROUP NUMBER	COMPONENT/ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE CATEGORY					TOOLS AND EQUIP	REMARKS
			C	O	F	H	D		
	Battery, Receptacle Charging	Replace		0.9					
		Repair			1.0				
	Battery, Cables	Replace		0.8					
		Repair		0.9					
0613	Hull or Chassis Wiring	Replace			2.5				
		Repair			2.5				
10	FRONT AXLE								
1000	Front Axle Assy Driving	Service		0.4					
		Replace				6.5			
		Repair				3.5			
	Bearings & Seals	Replace			2.5				
1002	Differential Assy	Service		0.4					
		Replace			5.5				
		Repair			5.0				
	Ring Gear & Pinion	Replace			16.0				
	Pinion Seal & Bearings	Replace			8.0				
11	REAR AXLE								
1100	Rear Axle Assy,								
	Steering	Service		0.4					
		Adjust		1.0					
		Replace			4.0				
		Repair			4.0				
1104	Spindle, Right or Left	Replace							
	Axle King Pin & Bearings	Service		0.3					
					2.0				
	Pivot Arm & Bearings	Service		0.3					
		Replace			2.0				

MAINTENANCE ALLOCATION CHART FOR
TRUCK, FORKLIFT, SRT, EMD, 4,000 LB, MHE 257

SECTION II - ASSIGNMENT OF MAINTENANCE FUNCTIONS

(1)	(2)	(3)	(4)					(5)	(6)
GROUP NUMBER	COMPONENT/ASSEMBLY	MAINTENANCE FUNCTION	MAINTENANCE CATEGORY					TOOLS AND EQUIP	REMARKS
			C	O	F	H	D		
	Tie Rods, Right & Left	Adjust		0.4					
		Replace			1.5				
12	BRAKES								
1201	Handbrake Assy	Adjust		0.5					
		Replace			2.0				
	Parking Brake	Replace			1.5				
		Repair			2.0				
1202	Service Brake	Adjust		2.0					
		Replace			4.0				
		Repair			5.0				
1204	Brake Master Cylinder	Service		0.3					
		Replace		1.2					
		Repair			1.6				
	Brake Wheel Cylinder	Replace		1.8					
1206	Brake Pedal & Linkage	Replace		1.0					
		Repair		0.8					
13	WHEELS								
1311	Wheel, Assy	Replace		1.6					
	Bearings & Seals	Replace			2.5				
1313	Tires, Solid Rubber	Inspect	0.1						
		Replace				1.7			
14	STEERING								
1407	Steering Wheel	Replace		0.5					
	Steering Column & Shaft	Replace			2.5				
	Cylinder, Steering	Replace		1.2					
		Repair		1.8					

MAINTENANCE ALLOCATION CHART FOR
TRUCK, FORKLIFT, SRT, EMD, 4,000 LB, MHE 257

SECTION II - ASSIGNMENT OF MAINTENANCE FUNCTIONS

(1)	(2)	(3)	(4)					(5)	(6)
GROUP NUMBER	**COMPONENT/ASSEMBLY**	**MAINTENANCE FUNCTION**	**MAINTENANCE CATEGORY**					**TOOLS AND EQUIP**	**REMARKS**
			C	**O**	**F**	**H**	**D**		
1411	Hoses, Lines & Fittings	Replace Repair			1.0 1.7				
	Hydraulic Filter Assy	Replace		0.3					
	Hydraulic Filter Element	Replace		0.3					
1414	Steering Control Valve	Replace Repair			2.0 4.0				
18	BODY, CAB, HOOD & HULL								
1801	Overhead Guard	Replace Repair		1.5	1.5				
	Body Panel & Hoods	Replace		1.0					
1806	Seat, Assy	Replace Repair		0.5	0.7				
24	HYDRAULIC LIFT COMPONENTS								
2401	Pump, Hydraulic	Replace Repair			1.5 2.5				
2402	Valve, Hydraulic								
	Control	Replace Repair			1.6 2.0				
2403	Levers &,Linkage, Hydraulic Controls	Replace Repair		1.0	2.0				
2404	Tilt Cylinder, Hyd	Replace Repair			3.5	4.0			
2405	Lift Cylinder	Replace Repair			4.0	6.0			
2405	Mast Carriage Assy	Service Replace Repair		0.3	3.5 5.5				

MAINTENANCE ALLOCATION CHART FOR
TRUCK, FORKLIFT, SRT, EMD, 4,000 LB, MHE 257

SECTION II - ASSIGNMENT OF MAINTENANCE FUNCTIONS

(1)	(2)	(3)	(4)					(5)	(6)
GROUP NUMBER	**COMPONENT/ASSEMBLY**	**MAINTENANCE FUNCTION**	**MAINTENANCE CATEGORY**					**TOOLS AND EQUIP**	**REMARKS**
			C	**O**	**F**	**H**	**D**		
2406	Lines & Fittings, Hyd	Replace			2.0				
2407	Side Shift Cylinder	Replace Repair			1.0 2.0				
2408	Oil Reservoir	Service Replace	0.1	0.3	 2.5				
2409	Reel, Assy Hose	Replace Repair			1.5 1.7				
40	ELECTRIC MOTORS								
4000	Motor Assy, Traction	Test Replace Repair			1.0 8.0 4.5				(3)
00	Motor Assy, Pump	Test Replace Repair			1.0 3.0 4.0				(4)
4000	Motor Assy, Steering	Test Replace Repair			1.0 3.0 4.0				(5)
4003	Holders, Brush								
	Electrical Contact	Replace			2.5				
4011	Fuse and Circuit Breakers - Fuse	Replace		0.1					

MAINTENANCE ALLOCATION CHART FOR
TRUCK, FORKLIFT, SRT, EMD, 4,000 LB, MHE 257

SECTION IV -REMARKS

REFERENCE CODES	REMARKS
(1)	Test and Adjustments. See GTM-00-1349, pg 2-25 (Allis Chalmers Commercial Manual).
(2)	Test. See GTM-00-1349, pg 2-47 (Allis Chalmers Commercial Manual).
(3)	Test. See GTM-00-1349, pgs.3-1 thru 3-12 (Allis Chalmers Commercial Manual). Manual).
(4)	Test. See GTM-00-1349, pgs 3-13 thru 3-25 (Allis Chalmers Commercial Manual).
(5)	Test. See GTM-00-1349, pgs 3-26 thru 3-32 (Allis Chalmers Commercial Manual).

SECTION VII.

Maintenance Expenditure Limits

NSN	Item Identification	Prod. Year	Serial No. Range	Year of Life Expectancy	Repair Limitations 50%	30%
3930-01-126-7505	Truck, Forklift SRT: EMD 4000 lb Capacity	1981	30503540 thru 30503569 and	18 yr	1993	1999
		1982	30508939 thru 30508976	18 yr	1994	2000

SECTION VIII.

EXPENDABLE SUPPLIES AND MATERIALS LIST

This SECTION lists expendable supplies and materials you will need to operate and maintain the forklift truck. These items are authorized to you by CTA 50-970, Expendable Items (Except Medical, Class V, Repair Parts, and Heraldic Item).

Maintenance and Operating Supply List
Application: Truck, Forklift, SRT: EMD, 4000 lb Capacity
Allis-Chalmers Model ACE 45K EV EE 36V
NSN 3930-01-126-7505

Component	Description	Unit/Measure	NSN
Various	Dry Cleaning Solvent SD-2, P-D-680	1 gal	6850-00-281-1985
Linkage, Pivot Points	Lubricating Oil OE50 MIL-L-2104C	1 qt 5 gal 55 gal	9150-00-188-9864 9150-00-188-9865 9150-00-188-9867
Oil Can Points	Lubricating Oil OE/HDO 10	1 qt 5 gal 55 gal	9150-00-189-6727 9150-00-186-6668 9150-00-191-2772
Battery	Sulphuric Acid	1 gal	6810-00-249-9354
Hydraulic Brake	MIL-B-46176	1 gal	9150-01-102-9455
Hydraulic System	OE/HDO 10	5 gal 55 gal	9150-00-186-6668 9150-00-191-2772
Wheel Bearings and Jack Shaft Bearings	Grease Automotive and Artillery (GAA)	1 lb 5 lb 35 lb	9150-00-190-0904 9150-00-190-0905 9150-00-190-0907
Ball Gear and Jack-shaft Pinion	Grease Automotive and Artillery (GAA)	1 lb 5 lb 35 lb	9150-00-190-0904 9150-00-190-0905 9150-00-190-0907
Mast	Grease Automotive and Artillery (GAA)	1 lb 5 lb 35 lb	9150-00-190-0904 9150-00-190-0905 9150-00-190-0907
Drive Unit and Steer Gear Oil	GO 80/90	5 gal	9150-01-035-5393

SECTION IX.

Maintenance of New Vehicle

1. Inspection upon delivery: For your protection, make a thorough inspection of the vehicle immediately upon delivery. In case of any damage or shortage, have the delivering carrier's agent make a notation on the delivery receipt and file your claim with the carrier. Check the following components before placing the Allis-Chalmers lift truck in service.

a. Battery: Check polarity of the battery with a voltmeter. Check polarity of the cables and the connector to insure that they agree.

CAUTION

Extreme caution should be exercised to insure that the polarity of the truck is not reversed when the battery is installed, or when the battery connectors are changed. Prior to removing the battery or battery connection, the cables should be carefully marked as to positive or negative polarity. If in doubt, check polarity with a voltmeter.

b. Battery Service:

WARNING

The electrolyte in the battery is a sulphuric acid solution. Extreme care should be exercised when working around the battery. Should any of the electrolyte come in contact with your clothing or skin, flush the area immediately with cold water. If the solution gets on your face or in your eyes, flush the area with cold water and get prompt medical attention.

The value of specific gravity of the electrolyte in a lead acid type battery should be approximately 1.275 with the battery fully charged. Do not discharge battery beyond the point where the specific gravity falls below 1.125. These readings are with the electrolyte at 80°F (27°C) and the electrolyte at the normal level in each cell.

To obtain "corrected specific gravity" readings when checking the electrolyte, add one point (0.001) of gravity for each 30F (1.7°C) above 80°F (27°C) (electrolyte temperature) or subtract one point for each 3°F (1.7°C) below 80°F (27°C). Also, subtract 15 points for 0.5" (12.7 mm) below the normal level of the electrolyte or add 15 points for each 0.5" (12.7 mm) above the normal electrolyte level.

Every 8 hours of operation, check the electrolyte level and specific gravity. The electrolyte level 0.25" (6.35 mm) below the vent well in each cell, and the specific gravity should be 1.260 (minimum at the beginning of each shift). When making the daily check, check all the cells. Fill the cells to the proper level with distilled water.

CAUTION

Never allow the plates to become exposed due to low electrolyte level. Do not overfill the cells as the electrolyte will expand and spill over as the battery is put into use and warms up.

The battery specific gravity readings with electrolyte at 80°F (27°C) are:

Hydrometer Indication	Charge Condition
1.110 - 1.135	Completely discharged
1.140 - 1.200	One-fourth charged
1.205 - 1.230	One-half charged
1.235 - 1.260	Three-fourths charged
1.265 - 1.290	Fully charged

The most important factor in battery service and life is proper charging. Make certain the proper method for each application is carefully followed.

In general, a battery may be charged at any rate in amperes that does not cause excessive gassing or produce temperatures above 110°F (43°C). 125°F (52°C) is acceptable for infrequent short periods.

WARNING

Do not smoke in the immediate vicinity of the battery, or expose the battery to any open flame or spark, especially during or immediately after charging.

Make certain the plug vent holes are open when charging to allow escape of hydrogen gas.

Keep battery top clean and dry to prevent offering of a conducting path to short out cells. Do not place metal objects on top of battery. Neutralize spilled acid with baking soda solution (1 lb soda to 1 gal water). Keep vent plugs in place when operating, cleaning or charging battery.

CAUTION

Do not flush top of battery when installed in truck, as water will seep into electrical compartment and cause severe damage.

c. Battery Connector: Located on left side of operator's compartment, connector is of the quick disconnect type. To disconnect power supply from components, flip handle up and remove connector. Check connector for foreign material before using lift truck.

WARNING

To prevent electrical shock and before performing any maintenance or repairs on the lift truck, disconnect the battery and discharge the truck capacitors as follows: disconnect battery and momentarily touch a suitable jumper wire across all capacitor terminals on the static panel.

d. Drive Axle: Jack shaft type drive axle (ACE 20 thru 80).

The oil level in drive axle housing should be checked at the filler plug located on the front side of the housing.

With truck on level surface, raise the forks and carriage sufficiently to expose the axle housing.

WARNING

Block the inner mast channel and carriage securely.

Remove filler plug from housing. The gear oil should be at the bottom of the filler plug hole. Add SAE 90EP (extreme pressure) as required.

Install filler plug, remove blocks from the inner mast channel and carriage. Lower carriage and forks.

e. Hydraulic System: Check hydraulic oil level by completely lowering carriage and forks. Operate tilt control until mast is in full rearward tilt position. Turn key switch off. Turn T-handle on filler cap counter clockwise and remove cap from hydraulic reservoir. Wipe off dipstick on filler cap and reinsert cap back into reservoir. Withdraw cap. Oil level should be on "Full" mark on dipstick with oil at 72°F (22°C). Install filler cap to reservoir and turn T-handle clockwise to tighten.

f. Brake Master Cylinder: The brake master cylinder is located under the floor plate on the right side of the lift truck. It should be filled to approximately 0.38" (9.65 mm) from the bottom of the filler neck. Check the brake lines and master cylinder for leaks.

CAUTION

Make sure dirt or other foreign material does not enter the master cylinder while the cover is removed.

g. Mast and Carriage: Check to insure that mast and carriage operate freely. Both should raise and lower smoothly and in direct response to the movement of the control lever. Mast should tilt forward and backward smoothly, and in direct response to the movement of the tilt control lever.

h. Lubrication: Insure truck has been properly lubricated. Check all lube points as shown in lube chart in commercial manual.

i. General Inspections: Have qualified serviceman check, correct, or report the following where applicable.

(1) Loose or disconnected electrical connections, wires, cables or terminals.

(2) Visually inspect control wires for grounds.

(3) Insure mounting hardware is present and secure.

(4) Insure there is grease in drive wheel bull gears (ACE 20 thru 80, ACET 20 thru 55).

(5) Insure there is grease in drive wheel bearings (ACE 20 thru 80, ACET 20 thru 55).

(6) Check speed control adjustments.

(7) Check brake adjustment for proper free play and pedal height.

(8) Steering should be smooth and immediate.

(9) Check lift chain adjustment for equal tension.

(10) Insure carriage and mast are properly centered, shimmed for side thrust, and operate freely.

(11) Inspect tires for wear and damage.

(12) Inspect lift chains for stretching: Measure 12 links of chain. Distance should be 12-3/8" maximum. If distance is not within limits, replace both chains.

SECTION X.

PREVENTIVE MAINTENANCE CHECKS AND SERVICES

NOTE

Use PMCS intervals as prescribed in Manufacturer's Manual during period of warranty. Upon expiration of warranty, use PMCS intervals in this SOMARPI.

1. Do your before (B) PREVENTIVE MAINTENANCE just before you operate the vehicle. Pay attention to the CAUTIONS and WARNINGS.

2. DURING checks and services (D) of PREVENTIVE MAINTENANCE will be performed while the equipment and/or its component systems are in operation.

3. Do your after (A) PREVENTIVE MAINTENANCE right after operating the vehicle. Pay attention to the CAUTIONS and WARNINGS.

4. Do your weekly (W) PREVENTIVE MAINTENANCE weekly.

5. Do your monthly (M) PREVENTIVE MAINTENANCE once a month.

6. If something doesn't work, troubleshoot it with the instructions in your commercial manual, or notify your supervisor.

7. Always do your PREVENTIVE MAINTENANCE in the same order so it gets to be a habit. Once you've had some practice, you'll spot anything wrong in a hurry.

8. If anything looks wrong and you can't fix it, write it on your DA Form 2404. If you find something seriously wrong, report it to organizational maintenance RIGHT NOW.

9. When you do your PREVENTIVE MAINTENANCE, take along a rag you'll always need at least one.

WARNING

DRY CLEANING SOLVENT, USED TO CLEAN PARTS IS POTENTIALLY DANGEROUS TO PERSONNEL AND PROPERTY. DO NOT USE NEAR OPEN FLAME OR EXCESSIVE HEAT. FLASH POINT OF THIS SOLVENT IS 138°F.

A - Keep it clean: Dirt, grease, oil, and debris only get in the way and may cover up a serious problem. Clean as you work and as needed. Use dry cleaning solvent (SD-2) on all metal surfaces. Use soap and water when you clean rubber or plastic material.

B - Bolts, nuts, and screws: Check them all for obvious looseness, missing, bent or broken condition. You can't try them all with a tool, of course, but look for chipped paint, bare metal, or rust around bolt heads. If you find one you think is loose, report it to organizational maintenance if you can not tighten it.

C - Welds: Look for loose or chipped paint, rust or gaps where parts are welded together. If you find a bad weld, report it to organizational maintenance.

D - Electric wires and connectors: Look for cracked or broken insulation, bare wires, and loose or broken connectors. Report loose connectors to organizational maintenance and make sure the wires are in good shape.

E - Hoses and fluid lines: Look for wear, damage, and leaks, and make sure clamps and fittings are tight. Wet spots show leaks, of course. But a stain around a fitting or connector can mean a leak. If a leak comes from a loose fitting or connector, report it to organizational maintenance. If something is broken or worn out, report it to organizational maintenance.

10. It is necessary for you to know how fluid leakage affects the status of your vehicle. The following are definitions of the types/classes of leakage an operator or crew member needs to know to be able to determine the status of your vehicle. Learn, then be familiar with them and REMEMBER WHEN IN DOUBT, NOTIFY YOUR SUPERVISOR!

Leakage Definitions for Crew/Operator PMCS

Class I	Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.
Class II	Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked/inspected.
Class III	Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

CAUTION

EQUIPMENT OPERATION IS ALLOWABLE WITH MINOR LEAKAGES (CLASS I OR II). OF COURSE, CONSIDERATION MUST BE GIVEN TO THE FLUID CAPACITY IN THE ITEM/SYSTEM BEING CHECKED/INSPECTED. WHEN IN DOUBT, NOTIFY YOUR SUPERVISOR.

WHEN OPERATING WITH CLASS I OR II LEAKS, CONTINUE TO CHECK FLUID LEVELS AS REQUIRED IN YOUR PMCS.

CLASS III LEAKS SHOULD BE REPORTED TO YOUR SUPERVISOR OR ORGANIZATIONAL MAINTENANCE.

Operator Preventive Maintenance Checks and Services

NOTE:
Within designated interval, these checks are to be performed in the order listed.

B - Before **D - During** **A - After** **W - Weekly** **M - Monthly**

Item No.	Interval B	D	A	W	M	Item To Be Inspected Procedure: Check for and have repaired, filled or adjusted as needed	Equipment is not ready/ available if:
						Important - Perform weekly as well as before operations PMCS if: 1. You are the assigned operator and have not operated the item since the last weekly. 2. You are operating the equipment for the first time.	
1.	•					Walk Around Checks	
						a. Check for fluid leaks or appearance of leaks (hydraulic and brake systems).	Class III leaks.
						b. Visually check overhead guard for obvious damage or cracks in weldments.	Cracked or failed welds.
						Batteries	
	•					Check electrolyte level in battery. Electrolyte must be level with split ring in cell filler hole.	
	•					Inspect condition of battery cables. Cables must not be frayed.	Frayed battery cables.
	•					Insure there is no foreign material in the battery connector.	Material in connector to preclude proper electrical contact or which would cause a short.
	•					Insure battery connector is locked in position.	
	•					Check hydraulic oil level on the oil level indicator. Should indicate 'Full".	Hydraulic oil low or tank empty.
			•			After battery is connected, make certain the horn operates when the horn button is depressed.	
		•				After key switch is turned on, make certain the hourmeter is energized and operating.	

NOTE:
Within designated interval, these checks are to be performed in the order listed.

B - Before **D - During** **A - After** **W - Weekly** **M - Monthly**

Item No.	Interval B	D	A	W	M	Item To Be Inspected Procedure: Check for and have repaired, filled or adjusted as needed	Equipment is not ready/ available if:
						NOTE **Hourmeter may not function until the drive motor or pump motor is operating.**	
3.						Tires	
	•					Inspect condition of tires. If tires are badly worn or have an excessive amount of breaks in them, they must be replaced. Steel chips or other foreign material should always be removed to prevent further damage. Tires that are worn unevenly or have sections of tread torn out can affect the stopping of the vehicle or can cause excessive truck vibration, hard steering, and rapid battery drain.	Tires unserviceable.
4.						Axle Stop	
		•				Turn steer wheels first to full right and then to full left position. Visually check to make sure the axle stop on each side is not bent, damaged or missing.	Axle stops bent, damaged or missing.
5	•					Inspect overhead guard mounting plates. Insure they are securely mounted. Visually inspect the welded joints and structure for possible cracks.	Plates loose, cracks in welded joints or on structure.
6	•					During operation, the lift truck should accelerate gradually and smoothly when the accelerator pedal is depressed slowly.	Jerky or erratic acceleration.
7.		•				Truck should stop with normal brake pressure. The brake pedal should have 1/2 inch free play as it is depressed. When the pedal is fully depressed, there should be a reserve distance of approximately 2 inches between the bottom of the pedal and the toe plate.	Improper free play or reserve distance.

Operator Preventive Maintenance Checks and Services

NOTE:
Within designated interval, these checks are to be performed in the order listed.

B - Before **D - During** **A - After** **W - Weekly** **M - Monthly**

Item No.	Interval B	D	A	W	M	Item To Be Inspected Procedure: Check for and have repaired, filled or adjusted as needed	Equipment is not ready/ available if:
8.		•				During operation, check the steering. It should be smooth and the steering wheel should operate freely.	Steering binds or is erratic.
9.		•				Check that lift and lowering speed of the mast is immediate and smooth.	Delay in lift or lowering when control activated. Jerky or erratic operation of mast.
10.		•				Check that forward and backward tilt operation is immediate and smooth.	Delay in forward or backward movement when control activated. Jerky or erratic operation of mast.
11.	•					If lift truck is equipped with a fire extinguisher, check seal, gage or pin (however equipped) to make sure it has not been used and left empty.	Broken seal, empty indication on gage or cylinder lighter than prescribed weight.
12.		•				Listen for and report any unusual noise during operation.	Unusual noises.
13.			•			Connect lift truck to battery charger.	

ORGANIZATIONAL
PREVENTIVE MAINTENANCE CHECKS AND SERVICES

1. Do your (Q) PREVENTIVE MAINTENANCE once each 3 months.

2. Do your (S) PREVENTIVE MAINTENANCE once each 6 months.

3. Do your (A) PREVENTIVE MAINTENANCE once each year.

4. Do)our (w) PREVENTIVE MAINTENANCE once each week.

5. Do your (H) PREVENTIVE MAINTENANCE at the hour interval listed.

6. Do your (MI) PREVENTIVE MAINTENANCE when the mileage of the vehicle reaches the amount listed.

7. If something doesn't work, troubleshoot it with the instructions in your commercial manual or notify your supervisor.

8. Always do your PREVENTIVE MAINTENANCE in the same order so it gets to be a habit. Once you've had some practice, you'll spot anything wrong in a hurry.

9. If anything looks wrong and you can't fix it, write it on your DA Form 2404. If you find something seriously wrong, report it to direct support maintenance RIGHT NOW.

10. When you do your PREVENTIVE MAINTENANCE, take along the tools you will need to make all the checks. Take along a rag, you'll always need at least one.

WARNING

DRY CLEANING SOLVENT, USED TO CLEAN PARTS IS POTENTIALLY DANGEROUS TO PERSONNEL AND PROPERTY. DO NOT USE NEAR OPEN FLAME OR EXCESSIVE HEAT. FLASH POINT OF THIS SOLVENT IS 1380F.

A - Keep it clean: Dirt, grease, oil, and debris only get in the way and may cover up a serious problem. Clean as you work and as needed. Use dry cleaning solvent (SD-2) on all metal surfaces. Use soap and water when you clean rubber or plastic material.

B - Bolts, nuts, and screws: Check them all for obvious looseness, missing, bent or broken condition. You can't try them all with a tool, of course, but look for chipped paint, bare metal, or rust around bolt heads. If you find one you think is loose, tighten it, or report it to direct support maintenance if you can not tighten it.

C - Welds: Look for loose or chipped paint, rust or gaps where parts are welded together. If you find a bad weld, report it to direct support maintenance.

D - Electric wires and connectors: Look for cracked or broken insulation, bare wires, and loose or broken connectors. Tighten loose connectors and make sure the wires are in good shape.

E - Hoses and Fluid Lines: Look for wear, damage, and leaks, and make sure clamps and fittings are tight. Wet spots show leaks, of course. But a stain around a fitting or connector can mean a leak. If a leak comes from a loose fitting or connector, tighten it. If something is broken or worn out, report it to direct support maintenance.

11. It is necessary for you to know how fluid leakage affects the status of your vehicle. The following are definitions of the types/classes of leakage an operator or crew member needs to know to be able to determine the status of your vehicle. Learn, then be familiar with them and REMEMBER WHEN IN DOUBT, NOTIFY YOUR SUPERVISOR!

Leakage Definitions for Organizational PMCS

Class I	Seepage of fluid (as indicated by wetness or discoloration) not great enough to form drops.
Class II	Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked/inspected.
Class III	Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

CAUTION

EQUIPMENT OPERATION IS ALLOWABLE WITH MINOR LEAKAGES (CLASS I OR II). OF COURSE, CONSIDERATION MUST BE GIVEN TO THE FLUID CAPACITY IN THE ITEM/SYSTEM BEING CHECKED/INSPECTED. WHEN IN DOUBT, NOTIFY YOUR SUPERVISOR.

WHEN OPERATING WITH CLASS I OR II LEAKS, CONTINUE TO CHECK FLUID LEVELS AS REQUIRED IN YOUR PMCS.

CLASS III LEAKS SHOULD BE REPORTED TO YOUR SUPERVISOR OR DIRECT SUPPORT.

ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES

Q - QUARTERLY S - SEMIANNUALLY A - ANNUALLY B - BIENNIALLY H - HOURS MI - MILES

ITEM NO	INTERVAL						ITEM TO BE INSPECTED PROCEDURE: CHECK FOR AND HAVE REPAIRED, FILLED OR ADJUSTED AS NEEDED PERFORM ALL OPERATOR PMCS FIRST
	Q	S	A	B	H	MI	
1.					50		Battery: Insure specific gravity of the electrolyte in each cell is between 1.265 and 1.290, with electrolyte at 80°F (27°C).
2.					50		Mast: Lubricate and check for adjustment. Adjust as required per commercial manual. (Ref. pages 2-120 and 2-121.)
3.					50		Carriage: Lubricate at grease fittings located at wear points.
4.					50		Oil Can Points: Lubricate. (Ref. pages 1-43 and 1-44.)
5.					50		Lift Truck: Inspect for hydraulic and brake system leaks.
6.					100		Pressure Gun Fittings: Lubricate.
7.					100		Lift Chains: Clean and inspect for bent or cracked links. Check for proper adjustment and lubricate.
8.					100		Check oil level in drive axle housing. Add oil as required.
9.					100		Remove, clean and reinstall differential breather.
10.					100		Parking Brake: Check for proper adjustment and check pads for lining weal.
11.					200		Replace hydraulic oil filter.
12.					200		Replace hydraulic oil reservoir breather.
13.					200		Contactor Panel: Inspect contactor tips for wear and check the air gap between the tips. Check for foreign material lodged between the contactor armature retainer. (Ref. page 2-47 in Commercial Manual for criteria.)

ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES

Q - QUARTERLY S - SEMIANNUALLY A - ANNUALLY B - BIENNIALLY H - HOURS MI - MILES

ITEM NO	INTERVAL						ITEM TO BE INSPECTED PROCEDURE: CHECK FOR AND HAVE REPAIRED, FILLED OR ADJUSTED AS NEEDED PERFORM ALL OPERATOR PMCS FIRST
	Q	S	A	B	H	MI	
14.				200			Check ball gear (Truck Models ACE 20 thru ACE 80) mounting hardware for tightness. (Ref. page 2-86 in Commercial Manual.)
15.		?					Electrical System: Perform ground checks and check tightness of terminals, wires, cables and electrical components.
16.		?					Check linkages and operation of microswitches on control valve.
17.		?					Fork Carriage: Check for side play and chain adjustment if the carriage is not level.
18.				500			Lift Chains: Remove, clean and inspect for wear and broken or cracked links. Reinstall, adjust and lubricate.
19.				500			Check fluid level in brake master cylinder. Add brake fluid as required.
20.		?					Inspect brakes and wheel cylinders for serviceability. (Ref. page 2-89.)
21.		?					Check tightness of all chassis mounting hardware. Tighten as required. Replace missing hardware.
22.		?					Inspect all hoses, tubes and fittings for tightness and serviceability. Replace as necessary. Correct any leaks that are evident.
23.		?					Clean and lubricate bull gears, jack shaft and drive wheel bearings (Truck Models ACE 20 thru 80).
24.		?					Clean and lubricate steer wheel bearings.
25.			?				Drain, flush and refill hydraulic oil reservoir.

ORGANIZATIONAL PREVENTIVE MAINTENANCE CHECKS AND SERVICES

Q - QUARTERLY S - SEMIANNUALLY A - ANNUALLY B - BIENNIALLY H - HOURS MI - MILES

ITEM NO	INTERVAL						ITEM TO BE INSPECTED PROCEDURE: CHECK FOR AND HAVE REPAIRED, FILLED OR ADJUSTED AS NEEDED PERFORM ALL OPERATOR PMCS FIRST
	Q	S	A	B	H	MI	
26.			?				Drain oil, flush and refill drive axle housing.
27.			?				Electric Motors: Check for brush wear and spring tension. (Ref. pages 3-2 thru 3-4 in Commercial Manual for Drive Motor; pages 3-14 thru 3-15 for hydraulic pump electric motor.)
28.			?				Verify torque and drive axle mounting bolts. Should be between 575 and 625 lb ft.
29.			?				Frame Stress Areas: Check weldments of' the frame, overhead guard, mast, tilt cylinder, steer axle, and drive axle mounting for cracks or deterioration. Check cross member weldments of the mast and carriage for evidence of' cracking or deterioration.
30.			?				Check tilt cylinder yokes for tightness. Tighten as necessary.

SECTION XI.

Prescribed Load List Authorized Stockage List

END ITEM: Truck, Lift, Fork, EMD, SRT, 4000 Lb		**MAKE**: Allis Chalmers			**MODEL**: ACE 45K-EV-EE-36V					
NSN: 3930-01-126-7505		**CONTRACT NO.** DAAE07-81-C-6161					**DATE**:			
SMR CODE	**NSN**	**PRIME P/N**	**FSCM**	**PART DESCRIPTION**	**UNIT PRICE**	**U/M**	**QTY OF PARTS REQ'D FOR NO. OF END ITEMS**			
							PLL	**ASL**		
							1-5	**1-5**	**6-20**	**21-56**
PAOZZ	6240-00-763-7744	387 4912751-7	08108 30612	Lamp, Discharge Indicator	.18	EA	1	1		
PAOZZ	6240-00-299-3985	1150	08108	Lamp, Stoplight	2.35	EA	1	1		
PAOZZ	6240-00-931-6679	110	08108	Lamp, Taillight	1.20	EA	1	1		
PAOZZ	6240-01-023-0399	4350 4912432-4	08108 30612	Lamp, Sealed Beam	6.61	EA	1	1		
PAFZZ	5920-00-424-8873	AGC15 4708378-7	71400 30612	Fuse, EV1 Contractor Panel	.07	EA		3		
PAFZZ	5920-00-138-5239	ALS400 4996841-5	71400 30612	Fuse, EV1 Contractor Panel	1.33	EA		2		
PAFZZ		AFS30 8614335-1	71400 30612	Fuse, EV1 Contractor Panel	9.51	EA		2		
PAOZZ	4330-00-136-1336	451217-5110 4905902-5	92863 30612	Filter, Power Steer System	12.81	EA	1	3		

By Order of the Secretary of the Army:

JOHN A. WICKHAM, JR.
General, United States Army
Chief of Staff

Official:

DONALD J. DELANDRO
Brigadier General, United States Army
The Adjutant General

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RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

SOMETHING WRONG WITH THIS PUBLICATION?

FROM (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE
TM 10-3930-651-14&P	Date of TM	Truck, Forklift, SRT, 4000 Lb.

BE EXACT PIN-POINT WHERE IT IS

PAGE NO	PARAGRAPH	FIGURE NO	TABLE NO
2-101	9	1-5	

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

Paragraph 9 says to install pump pressure hose to adapter securely. However, the illustration is drawn incorrectly. The pressure hose is backwards in figure 1-5. Please remedy the problem.

PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER

SIGN HERE

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Warren, MI 48397-5000

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DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE
TM 10-3930-651-14&P	MAY 1985	Truck, ForkLift, SRT, 4000 Lb.

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PAGE NO	PARA-GRAPH	FIGURE NO	TABLE NO

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THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter=10m Millimeters=0.01 Meters=0.3937 Inches
1 Meter=100 Centimeters=1000 Millimeters=39.37 Inches
1 Kilometer=1000 Meters=0.621 Miles

WEIGHTS

1 Gram=0.001 Kilograms=1000 Milligrams=0.035 Ounces
1 Kilogram=1000 Grams=2.2 Lb
1 Metric Ton=1000 Kilograms=1 Megagram=1.1 Short Tons

LIQUID MEASURE

1 Milliliter=0.001 Liters=0.0338 Fluid Ounces
1 Liter=1000 Millilters=33.82 Fluid Ounces

SQUARE MEASURE

1 Sq Centimeter=100 Sq Millimeters=0.155 Sq Inches
1 Sq Meter=10,000 Sq Centimeters=10.76 Sq Feet
1 Sq Kilometer=1,000,000 Sq Meter=0.0386 Miles

CUBIC MEASURE

1 Cu Centimeter=1000 Cu Millimeters=0.06 Cu Inches
1 Cu Meter=1,000 Cu Centimeters=35.31 Cu Feet

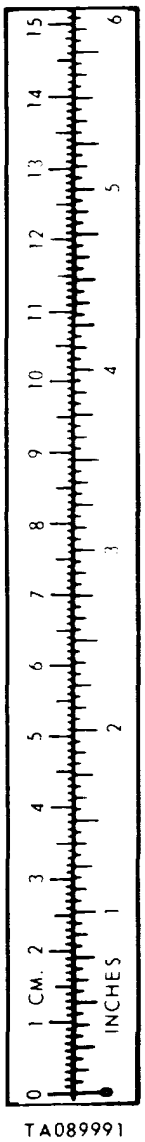
TEMPERATURE

5/9 (°F – 32) = °C
212° Fahrenheit is equivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
9/5 C° +32=F°

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.756
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	5.895
Miles per Gallon	Kilometers per Liters	0.425
Miles per hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.385
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric-Tons	Short Tons	1.102
Newton-Meters	Pound Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	Miles per Hour	0.621



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