

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

TECHNICAL MANUAL

DIRECT AND GENERAL SUPPORT

MAINTENANCE MANUAL

TRUCK, LIFT, FORK EMD, SOLID RUBBER TIRED

WHEELS, 4000LB. CAPACITY
144 and 180 INCH LIFT

ARMY MODEL MHE-227

ALLIS CHALMERS MODELS ACE40AEE144

NSN 3930-00-327-1603

AND ACE40AEE180 NSN 3930-00-327-1600

HEADQUARTERS, DEPARTMENT OF THE ARMY

APRIL 1975

WARNING

When servicing the battery, do not smoke or use a flame in the vicinity. Batteries generate hydrogen, a highly explosive gas. Always correct or report any faulty conditions that may result in further damage to the truck or cause injury to personnel. Check the operating area to be sure that it is clear of personnel and obstructions. Do not shift the forward and reverse control lever while the truck is in motion. Do not operate the truck with the load in a highly elevated position. When operating the truck, the mast should be tilted backwards slightly to prevent the load from falling off. Make sure that the forks are lowered to the ground when the truck is parked. Check seat controlled brake for proper operation and engagement. If the truck is parked on an incline, block at least two wheels to prevent the truck from moving in the event of a parking brake failure. Report or correct any faulty conditions that may result in damage to the truck or cause injury to personnel if operation of the truck is continued. Do not store or recharge nickel/ iron batteries and lead acid batteries in the same room. Do not mix hydrometers or battery acids (potassium hydroxide and sulfuric) in the process of servicing and/ or repairing nickel/ iron and lead acid batteries. Cleaning compound, solvent (Fed. Spec. P-D-680) is a potentially DANGEROUS CHEMICAL. Do not use near open flame.

CHANGE

NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D. C. , 22 November 1989

**TRUCK, LIFT, FORK, EMD, SOLID RUBBER
TIRED WHEELS, 4000 LBS. CAPACITY
144 AND 180 IN. LIFT
ARMY MODEL MHE 227
ALLIS-CHALMERS MODELS
ACE40AEE144 AND ACE40AEE180
NSN 3930-00-327-1603 (144 IN.)
NSN 3930-00-327-1600 (180 IN.)**

TM 10-3930-631-34, 30 April 1975 is changed as follows:

1. Remove old pages and insert new pages.
2. New or changed material is indicated by a vertical bar in the margin of the page and by a vertical bar adjacent to the TA number.

Remove Pages

i through iv
1-1 and 1-2
6-1 through 6-4
7-27 through 7-30
7-33 and 7-34
9-41 through 9-43
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I-1 and I-2

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i through iv
1-1 and 1-2
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TECHNICAL MANUALS

No. 10-3930-631-34



HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C. , 30 April 1975

DIRECT AND GENERAL SUPPORT MAINTENANCE MANUAL
TRUCK, LIFT, FORK, EMD, SOLID RUBBER TIRES
4000 LB CAPACITY, 144 and 180 INCH LIFT
ALLIS CHALMERS MODELS ACE40AEE144
NSN 3930-00-327-1603
AND ACE40AEE180 NSN 3930-00-327-1600.

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

This manual contains information necessary for the maintenance of the Truck, Lift, Fork, Electric, Solid Rubber Tired Wheels, 4000 pound capacity by Direct Support and General Support Maintenance personnel as allocated by the Maintenance Allocation Chart. The manual provides information on the maintenance of the equipment which is beyond the scope of tools, equipment, personnel or supplies normally available to Operator and Organizational Maintenance.

1-2. Maintenance Forms and Records

Maintenance Forms and Records that are required for use are explained in DA Pam 738-750.

1-3. Reporting Errors and Recommending Improvements

You can help improve this manual. If you find any mistakes, or 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, U. S. Army Tank-Automotive Command, ATTN: AMSTA-MB, Warren, MI 48397-5000. A reply will be furnished to you.

1-4. Equipment Serviceability Criteria

This equipment is not covered by an ESC.

1-5. Enemy Use

Procedures to be used for destruction of enemy equipment to prevent enemy use are defined in TM 750-244-6,

1-6. Administrative Storage

Refer to TM 740-90-1 for instructions pertaining to administrative storage of the fork lift truck.

1-7. Orientation

Throughout this manual the terms right, left, front and rear with respect to the truck and components are determined from the viewpoint of the operator sitting on the seat of the truck.

Section II. DESCRIPTION AND DATA

1-8. Description

A general description of the Fork Lift Truck and information pertaining to identification plates are contained in TM 10-3930-631-12. A more detailed description of components and assemblies is contained in the applicable sections of this manual. Detailed descriptions of the components of the truck are provided in the applicable paragraphs of this manual.

1-9. Identification and Tabulated Data

a. General. This paragraph contains the maintenance data pertinent to direct and general support maintenance personnel

b. Identification. The lift truck has two identification plates mounted on the right front of the truck.

(1) *Army data plate.* This plate includes the type of truck, type of tires and model number. It also includes the contract number, serial and registration numbers, federal stock number and capacity.

(2) *Shipping data plate.* The shipping plate includes capacity of lift, shipping weight and wheel loading weights. It also shows the center of gravity and applicable heights and distances for the important parts of the truck.

c. Drive Motor Classification and Rating.

Make	Allis Chalmers
Part Number	48494363 2
Horsepower	5. 1 HP
Current Draw	100 Amps
Voltage.....	36 Volts
Speed	1450 RPM
Winding Type.....	Series Wound
Cooling.....	Fan Cooled
Insulation	Class F
Rotation	Clockwise

d. Hydraulic Pump Motor Classification and

Rating.

Make Allis Chalmers

Part Number..... 450D3
Horsepower..... 10. 7 HP
Current Draw..... 260 Amps
Voltage..... 36 Volts
Speed..... 1950 RPM
Winding Type..... Series Wound
Cooling..... Fan Cooled
Insulation..... Class F
Rotation..... Counterclockwise
e. Steering Hydraulic Pump Motor Classification and Rating.
Make J. S. Barnes Corp.
Part Number..... MHR4004
Horsepower..... 1. 65 HP
Current Draw..... 36 Amps
Voltage..... 36 Volts
Speed..... 2700 RPM
Winding Type..... Series Wound
Cooling..... Fan Cooled
Insulation..... Class F
Rotation..... Clockwise
f. Steering Unit Classification and Rating.
Make Allis Chalmers
Part Number..... 4802629-8
Type Hydraulic
g. Hydraulic Control Valve Classification and Rating.
Make Hydraulic Unit Specialties

Part Number 5000-3-55
Control 3 Plunger
h. Hydraulic Pump Classification and Rating
Make Cessna Aircraft Co.
Part Number 24386 RAM
Capacities at 2015 RPM:
Primary Section:
Gallons per Minute 9.5 gpm (35. 9 lit/min.)
Pressure 1500 psi (105. 4 kg/m²)
Secondary Section:
Gallons per Minute . 2. 3 gpm (8. 7 lit/min.)
Pressure 1500 psi (105. 4 kg/m²)
Rotation Clockwise
i. Power Steering Pump Classification and Ratings.
Make John S. Barnes Corp.
Part Number..... GC5000A14BA
Rotation..... Clockwise
Relief Valve Setting..... 800-850 psi
(56. 2-59. 7 kg/m²)
j. Drive Axle Classification and Rating.
Make Allis Chalmers
Part Number..... 4849428-0
Type Full Floating:
..... Double Reduction
Ratio..... 3. 1875:1
Capacity 5 pints (2. 3 lit)

CHAPTER 2

DIRECT SUPPORT AND GENERAL SUPPORT

MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT

2-1. Repair Parts and Equipment

Repair parts and equipment are listed and covering direct and general support maintenance (TM 10-3930-631-34P) for this equipment.

2-2. Special Tools

There are no special tools and equipment issued with or authorized for the fork lift trucks.

Section II. TROUBLESHOOTING

2-3. General

a. This section contains troubleshooting information for locating and correcting most of the operating troubles which may develop in the fork lift truck.

b. This manual cannot list all malfunctions that may occur, nor all tests or inspection and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify performed your supervisor.

2-4. Troubleshooting Table

The troubleshooting table, Table 2-1, lists the

malfunction, test or inspection and corrective action for those that may occur. Each malfunction is followed by a list of tests or inspections which will help you to determine probable causes and corrective actions to take. You should perform the tests/inspections and corrective actions in the order listed.

Note

Before you use this table, be sure you have all the applicable operating checks.

Table 2-1. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION
1. NO POWER TO DRIVE OR PUMP MOTORS.
Step 1. Check for defective battery receptacle.
Test receptacle for continuity and inspect contacts for good condition. Repair or replace defective receptacle.
Step 2. Check for defective wiring harness.
Test harness for continuity. Test and inspect all contacts. Check for broken or frayed wires. Repair or replace defective harness.
Step 3. Check for open or defective thermal relay.
Test thermal relay and replace if defective.
Step 4. Check for damaged or defective drive motor.
Repair or replace damaged or defective motor.
Step 5. Check for damaged or defective accelerator control.
Repair damaged or defective acceleration control.
Step 6. Check for damaged or defective forward and reverse switch.
Repair or replace damaged or defective forward and reverse switch.
Step 7. Check operation of forward and reverse contactors.
Repair or replace contactors if not operating properly.
Step 8. Check operation of electrical control components.
Repair or replace electrical control components if not operating properly.
Step 9. Check for damaged or defective emergency cutout switch or contactor.
Repair or replace damaged or defective switch or contactor.

Table 2-1. Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
2. DRIVE AXLE IS NOISY WHEN DRIVING OR COASTING.		Step 1. Check ring gear and axle shaft for wear. Replace worn or damaged ring gear or axle shaft. Step 2. Check for worn or damaged pinion or side gears in differential case. Repair or replace worn or damaged differential.
3. NOISE IS CONTINUOUS IN DRIVE AXLE.		Step 1. Check for wear and damage in all parts of drive axle. Repair or replace worn or damaged parts in drive axle.
4. REAR STEERING AXLE SHIFTS WHEN TRUCK IS MOVED.		Step 1. Check for loose mounting bolts. Tighten axle mounting nuts to 90 to 100 pound feet (124. 2-138. 0 m-kg). Step 2. Check for proper adjustment of front spacer. Tighten spacer adjusting bolt to a torque of 10 to 15 pound feet (1. 3 - 2. 0 m-kg). Tighten jam nut to a torque of 90 to 100 pound feet (12. 4 to 13. 8 m-kg). Step 3. Check for worn axle mounting bearings. Replace worn bearings.
5. PARKING BRAKE DOES NOT HOLD PROPERLY.		Step 1. Check for worn or damaged brake calipers. Replace brake calipers if worn or damaged. Step 2. Check for worn or damaged brake disk. Replace worn or damaged brake disk. Step 3. Check for weak or broken spring. Replace weak or broken spring.
6. SERVICE BRAKE PEDAL GOES TO TOE PLATE.		Step 1. Check for leaking or defective master cylinder. Repair master cylinder if leaking or defective. Step 2. Check for leaking or defective wheel cylinder. Repair wheel cylinder if leaking or defective.
7. BOTH BRAKES DRAG.		Step 1. Check for foreign material in brake system. Clean system and refill with approved brake fluid (LO10-3930-631-12). Step 2. Check for dirty, damaged or defective cylinders. Clean and repair master and wheel cylinders, if necessary. Step 3. Check for clogged breather port in master cylinder. Clean out breather port if necessary.
8. ONE WHEEL BRAKE DRAGS.		Step 1. Check for obstructed brake line. Remove and clean brake line if obstructed. Step 2. Check for air in brake lines. Bleed brake lines if air is present. Step 3. Check for weak or broken return springs. Replace weak or broken return spring.
9. TRUCK PULLS TO ONE SIDE.		Step 1. Check for charred or damaged brake lining. Replace charred or damaged brake lining. Step 2. Check for scored or damaged brake drum. Repair or replace scored or damaged brake drum.
10. STEERING IS LOOSE OR DOES NOT RESPOND PROPERLY.		Step 1. Check steering drag link adjustment. Adjust drag link if necessary (TM10-3930-631-12). Step 2. Check for defective steering cylinder. Repair or replace defective steering cylinder. Step 3. Check power steering pump pressure. If pressure is not 900 to 1100 psi (63. 2-77. 3 kg/cm ²), repair or replace pump. Step 4. Check for defective steering valve. Repair or replace defective steering valve. Step 5. Check for damaged or defective power steering pump motor. Repair or replace damaged or defective motor. Step 6. Check for damaged or defective power steering contactor. Repair or replace damaged or defective contactor.
11. STEERING IS HARD OR SLOW.		Step 1. Check for dirt in hydraulic system. Drain, flush and refill system if necessary (LO10-3930-631-12).

Table 2-1. Troubleshooting-Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
		Step 2. Check power steering pump pressure. If pressure is less than 900-1100 psi (63. 2 - 77. 3 kg/cm') repair or replace pump. Step 3. Check for defective steering valve. Repair or replace defective steering valve.
12. STEERING WHEEL ROTATES CONTINUOUSLY.		Step 1. Check for dirt in hydraulic system. Drain, flush and refill system if necessary (LO10-3930-631-12). Step 2. Check for defective steering valve. Repair or replace defective steering valve.
13. CARRIAGE DOES NOT LIFT OR LOWER WHEN ACTUATED.		Step 1. Check for defective control valve switch. Replace defective switch. Step 2. Check hydraulic pump motor operation. Repair or replace motor if not operating. Step 3. Check hydraulic pump for proper operation. Repair or replace hydraulic pump if not operating properly. Step 4. Check for damaged or defective hydraulic lift cylinders. Repair or replace damaged or defective cylinders. Step 5. Check for damaged or defective mast assembly. Repair or replace defective or damaged mast assembly. Step 6. Check for damaged or defective control valve. Repair or replace damaged or defective control valve.
14. MAST DOES NOT TILT WHEN ACTUATED.		Step 1. Check for defective control valve switch. Replace defective switch. Step 2. Check hydraulic pump motor operation. Repair or replace motor if not operating. Step 3. Check hydraulic pump for proper operation. Repair or replace pump if not operating properly. Step 4. Check for damaged or defective tilt cylinders. Repair damaged or defective tilt cylinders. Step 5. Check for damaged or defective control valve. Repair or replace damaged control valve.
15. CARRIAGE DOES NOT SIDE SHIFT WHEN ACTUATED.		Step 1. Check for defective control valve switch. Replace defective control valve switch. Step 2. Check hydraulic pump motor operation. Repair or replace motor if not operation. Step 3. Check hydraulic pump for proper operation. Repair or replace pump if not operating properly. Step 4. Check for damaged or defective side shift cylinder. Repair defective side shift cylinder. Step 5. Check for damaged or defective side shift carriage. Repair damaged or defective carriage. Step 6. Check for damaged or defective control valve. Repair or replace damaged or defective control valve.

Note. Tests and inspections of the electrical control components are covered in Chapter 9, Section II.

Section III. GENERAL MAINTENANCE

2-5. General

a. As the fork lift truck is electrically powered, certain precautions must be followed.

b. The principal caution to observe is disconnection of the battery receptacle before attempting any repairs to the electrical system. All electrical current to the vehicle components is

stopped by this operation. This is for the protection of all maintenance personnel. After disconnecting battery receptacle, turn on master switch and depress horn button to discharge capacitors.

2-6. Cleaning

WARNING

Dry cleaning compound, solvent (Fed. Spec. P-D-680), used for cleaning, is potentially dangerous to personnel and property. Do not use near open flame. Flash point of solvent is 100°F to 138°F (38°C to 59°C).

a. Clean all mechanical parts in cleaning compound, solvent (Fed. Spec. P-D-680).

b. Dry all parts with clean, compressed air. Dry parts thoroughly.

c. Do not dry ball and roller bearings with compressed air. Spinning of bearings when dry can cause damage.

d. If parts are to be set aside for any length of time before assembling, coat parts with a thin film of oil.

e. Wrap bearings, after application of oil, in clean lint free cloth to prevent corrosion and rust.

f. Do not use solvent to clean armatures, field coils, rubber and insulated components, or any components that could be harmed by the solvent.

2-7. Welding

a. Many of the components of the lift truck are welded or can be repaired by welding.

b. Observe good welding practices when repairing by welding. Refer to TM9-237 for correct welding techniques.

c. When repair of a component of the lift truck requires special welding instructions, these instructions will be included in the applicable paragraphs.

Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND ASSEMBLIES

2-8. General

a. The major components of the fork lift truck consist of the front axle, rear axle, service brakes, steering pump, hydraulic pump, hydraulic control valve, masts, electric motors, accelerator control, forward and reverse switch, and electrical controls.

b. The paragraphs in this section contain instructions for the removal and installation of most of the above components.

2-9. Rear Steering Axle

a. Removal

Before any service is to be performed on

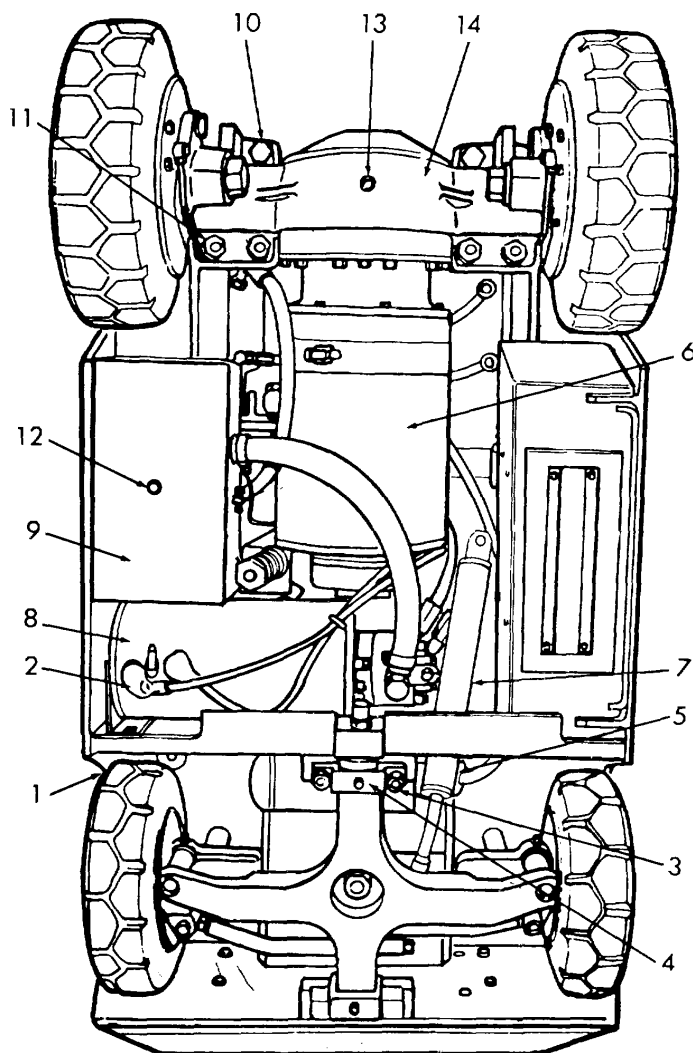
the vehicle make certain the battery receptacle has been disconnected and capacitors are discharged.

(1) Jack up the rear of the truck or lift with a hoist attached to the lifting eyes to raise rear end of truck. Securely block truck in raised position.

(2) Remove wheels from axle and disconnect drag link (TM10-3930-631-12).

(3) Place a suitable jack under steering axle and raise it slightly to relieve stress on mounting bearings.

(4) Loosen jam nut (1, fig. 2-1) and loosen adjusting screw (2) to free axle.



TS009134

- | | |
|----------------------------|-------------------------|
| 1. Jam nut | 8. Hydraulic pump motor |
| 2. Adjusting screw | 9. Hydraulic reservoir |
| 3. Nut | 10. Mounting screw |
| 4. Bearing housing | 11. Nut |
| 5. Steering hydraulic pump | 12. Drain plug |
| 6. Drive motor | 13. Drain plug |
| 7. Steering cylinder | 14. Drive axle |

Figure 2-1. Underside of truck.

(5) Remove two nuts (3), lock washers and screws. Remove bearing housing (4). Slide axle to rear and remove axle from truck.

b. Installation.

(1) Lift axle into position, with front shaft of axle and bearing in frame. Push entire axle against rear frame.

(2) Install bearing housing (4, fig. 2-1) and secure with nuts, lock washers and screws (3). Tighten nuts only enough to hold axle in position.

(3) Tighten adjusting screw (2) on front spacer to a torque of 10 to 15 pound feet (13. 8 - 20. 7 m-kG). Hold adjusting screw and tighten jam nut (1) to a torque of 90 to 100 pound feet (124. 2 - 138. 0 m-kG).

(4) Tighten nuts (3) to a torque of 90 to 100 pound feet (124. 2 - 138. 0 m-kG).

(5) Connect drag link to axle and install steering wheels (TM10-3930-631-12).

(6) Lubricate axle fittings (L010-3930-631- 12).

(7) Raise truck, remove blocks and lower truck to floor.

(8) Drivetruck(TM10-3930-631-12) and check steering operation.

2-10. Drive Axle

CAUTION

Before proceeding with drive axle removal, disconnect battery receptacle and discharge capacitors.

a. Removal.

(1) Remove the mast assembly as outlined in paragraph 2-15.

(2) Remove floor and toe plates.

(3) Attach a hoist to front of truck and raise truck to lift drive wheels from floor. Block truck securely.

(4) Remove drip pan from beneath truck.

(5) Disconnect cables from drive motor (6, fig. 2-1). Disconnect wires from thermal relay on drive motor. Tag all cables and wires to assure correct installation.

(6) Remove lock nut and shoulder screw and disconnect linkage from brake caliper.

(7) Remove screws attaching parking brake bracket to drive motor.

(8) Disconnect service brake lines from tee mounted at top of axle and from wheel cylinders.

(9) Place a jack or suitable lifting device under the drive motor and axle. Raise the jack enough to support the assembly. Remove the screws (10, fig. 2-1) and nuts (11) securing the drive unit to the frame.

(10) Check all brake lines, hoses, cables, wires and linkages to make certain none will be damaged during removal of drive unit.

(11) Attach a hoist securely to the front of the truck frame and raise the truck carefully. Make certain all lines and hoses remain clear of motor and drive unit.

(12) Raise the truck enough to allow the motor and drive unit to be removed from under the truck. Carefully pull the assembly out from under the truck.

b. Installation.

(1) Raise the truck with a suitable hoist and roll the drive unit into place under the truck.

(2) Using a suitable jack, raise the drive unit into position and lower the truck to mate mounting holes in frame with holes in axle supports.

(3) Install screws (10, fig. 2-1) and nuts (11) to secure drive unit to frame. Tighten screws and nuts to a torque of 350-400 pound feet (48. 3-55. 2 m-kG).

(4) Remove jack from truck. Connect service brake lines to wheel cylinders and to tee at top of axle.

(5) Install parking brake bracket on motor and secure with screws.

(6) Connect brake linkage to brake caliper with lock nut and shoulder screw.

(7) Connect cables to drive motor, checking tags on cables for correct installation. Connect wires to thermal relay.

(8) Refer to TM10-3930-631-12 and adjust parking brake linkage and bleed service brake hydraulic lines.

(9) Install floor and toe plates and drip pan.

2-11. Steering Hydraulic Pump

CAUTION

Before proceeding with steering pump removal, disconnect battery receptacle and discharge capacitors.

a. Removal. The steering hydraulic pump is mounted above the rear steering axle.

(1) Use a suitable hoist to raise the rear of the truck sufficiently to gain access to the steering hydraulic pump. Block truck in position with wooden blocks.

(2) Disconnect inlet and outlet hoses from pump (fig. 2-1). Cap or plug hoses and pump openings to prevent entrance of foreign matter.

(3) Tag and disconnect electrical leads from hydraulic pump motor.

(4) Remove screws, nuts and lock washers and remove pump and motor from truck.

(5) Remove screws (1, fig. 2-2) and lock-washers (2) and remove pump assembly (3) from electric motor (6).

(6) Remove coupling (4) and gasket (5) from pump.

b. Installation.

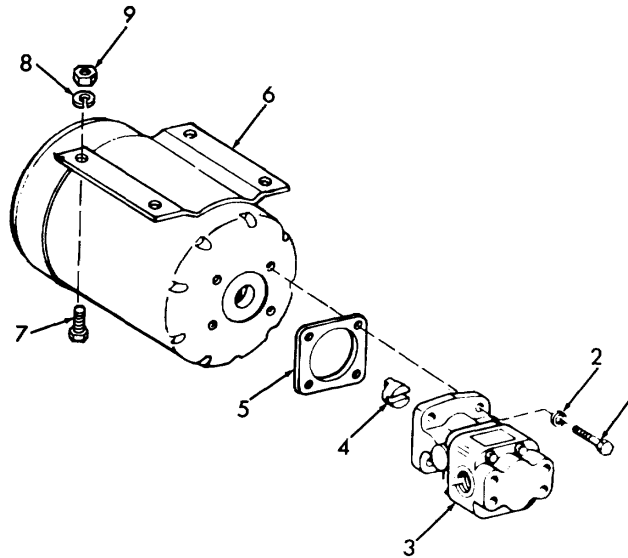
(1) Install coupling (4, fig. 2-2) and gasket (5) on pump and motor. Install pump in position on motor and secure with screws (1) and lock washers (2).

(2) Install pump and motor on truck frame and secure with screws, lock washers, and nuts. (3) Check tags on electrical leads and connect to electric motor.

(4) Remove plugs from pump and hoses and connect hoses to pump.

(5) Check hydraulic reservoir and fill to proper level if necessary.

(6) Connect battery receptacle. Refer to paragraph 5-2 and check pump pressure. Adjust pressure if necessary.



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1. Screw
2. Lock washer
3. Pump
4. Coupling
5. Gasket
6. Motor
7. Screw
8. Lock washer
9. Nut

Figure 2-2. Steering hydraulic motor and pump.

2-12. Steering Valve Unit

a. Removal.

CAUTION

Before proceeding with removal procedures, disconnect battery receptacle and discharge capacitors.

(1) Remove floor and toe plates to gain access to steering valve.

(2) Tag and disconnect hoses (fig. 2-3) from steering valve. Plug or cap ports in steering valve and ends of hoses to prevent entrance of foreign matter.

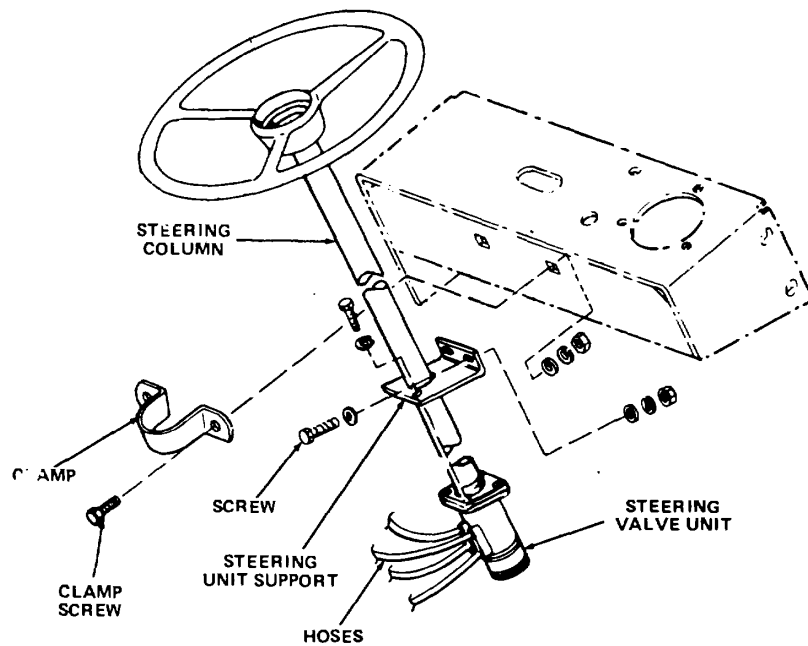


Figure 2-3. Steering valve unit.

- (3) Disconnect horn button wire at horn.
- (4) Remove two screws securing clamp (fig. 2-3) to instrument panel frame and remove clamp. Remove two screws securing shift lever clamp to steering column and remove clamp.
- (5) Remove two screws securing steering unit support to frame.
- (6) Remove two screws securing steering valve unit (fig. 2-3) to stationary bracket.
- (7) Lift steering valve unit, with steering wheel and shaft attached, carefully up and out of truck. Place unit on a clean work surface.
- b. Installation.*
- (1) Lift steering valve unit into position and support it against stationary bracket. Install screws and lock washers to secure unit to stationary bracket.
- (2) Position support against frame and install screws, lock washers, flat washers and nuts to support steering unit.
- (3) Install clamp (fig. 2-3) around steering post and secure clamp to instrument panel frame with screws and washers. Install shift lever clamp.

- (4) Connect horn button wire to horn terminals .
- (5) Remove plugs from steering unit and hoses. Check tags and connect hoses to steering unit.
- (6) Connect battery receptacle.
- (7) Check hydraulic reservoir and add oil if necessary.

2-13. Hydraulic Pump and Motor

a. Removal.

CAUTION

Before proceeding with removal of the hydraulic pump and motor, disconnect the battery receptacle and discharge the capacitors.

- (1) Raise truck, using a suitable hoist, sufficiently to gain access to hydraulic pump. Block truck securely.
- (2) Remove the drip pan from beneath truck. Remove floor and toe plates.
- (3) Remove the drain plug from the hydraulic oil reservoir and drain the hydraulic oil into a clean container of suitable size.

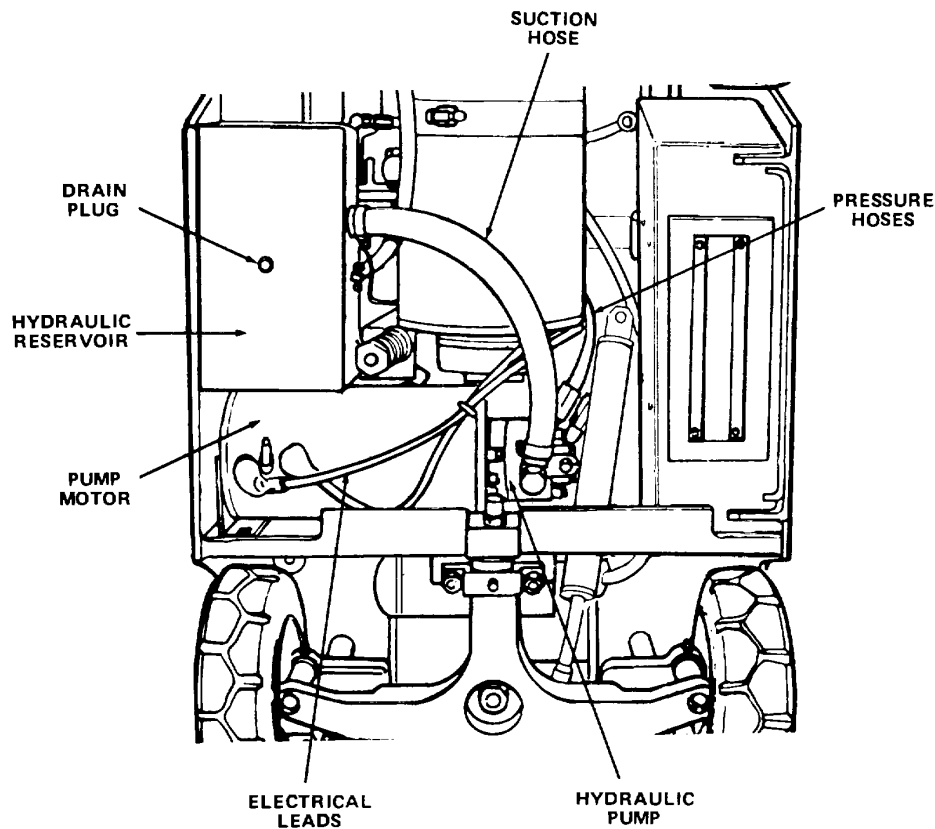


Figure 2-4. Hydraulic pump and motor.

(4) Tag and disconnect the electrical leads to the hydraulic pump motor (fig. 2-4) and to the thermal relay on the motor.

(5) Tag and disconnect the three hoses from the fittings in the hydraulic pump. Plug or cap fittings and hoses to prevent the entrance of foreign matter.

(6) Remove screws and lock washers securing hydraulic pump (fig. 2-4) and remove pump from motor. Pump shaft is splined to motor armature.

(7) Remove screws and lock washers securing pump motor to frame and remove pump motor from truck.

b. Installation.

(1) Position hydraulic pump motor (fig. 2-4) on frame and secure with screws.

Note

Hydraulic pump may be installed on pump motor before installation, if desired.

(2) Aline splines on pump shaft with pump

motor armature, with pump mounting bracket holes in line with mounting holes on motor.

(3) Install pump on motor and secure with screws and lock washers.

(4) Remove plugs and caps from hoses and fittings. Check tags and connect hoses to hydraulic pump.

(5) Connect electrical leads to hydraulic pump motor (fig. 2-4) and to thermal relay.

(6) Refer to lubrication order and fill hydraulic reservoir with oil.

(7) Connect battery receptacle and operate truck hydraulic system and check pump hoses for leaks. Tighten connections or replace hoses as necessary.

(8) Install drip pan and floor and toe plates.

2-14. Side Shift Carriage

a. Removal.

(1) Fully retract mast assembly and unlock and remove carriage forks.

(2) Attach a hoist to backrest, remove screws and lock washers and remove backrest from carriage.

(3) Raise the inner mast 24 inches from the floor and block in position.

CAUTION

Before proceeding with carriage removal disconnect battery receptacle and discharge capacitors.

(4) Disconnect hydraulic hoses (fig. 2-5) from side shift cylinder and swivel block on carriage.

Plug or cap hoses and cylinder fittings to prevent entrance of foreign matter.

(5) Remove spacer and screws from rear of carriage supports.

(6) Attach a hoist to the carriage frame. Lift frame to remove slack from chains and balance the load.

(7) Disconnect chains (fig. 2-5) from carriage frame.

(8) Slowly lower carriage frame and side shifter out of the bottom of the inner mast. Place frame on suitable supports.

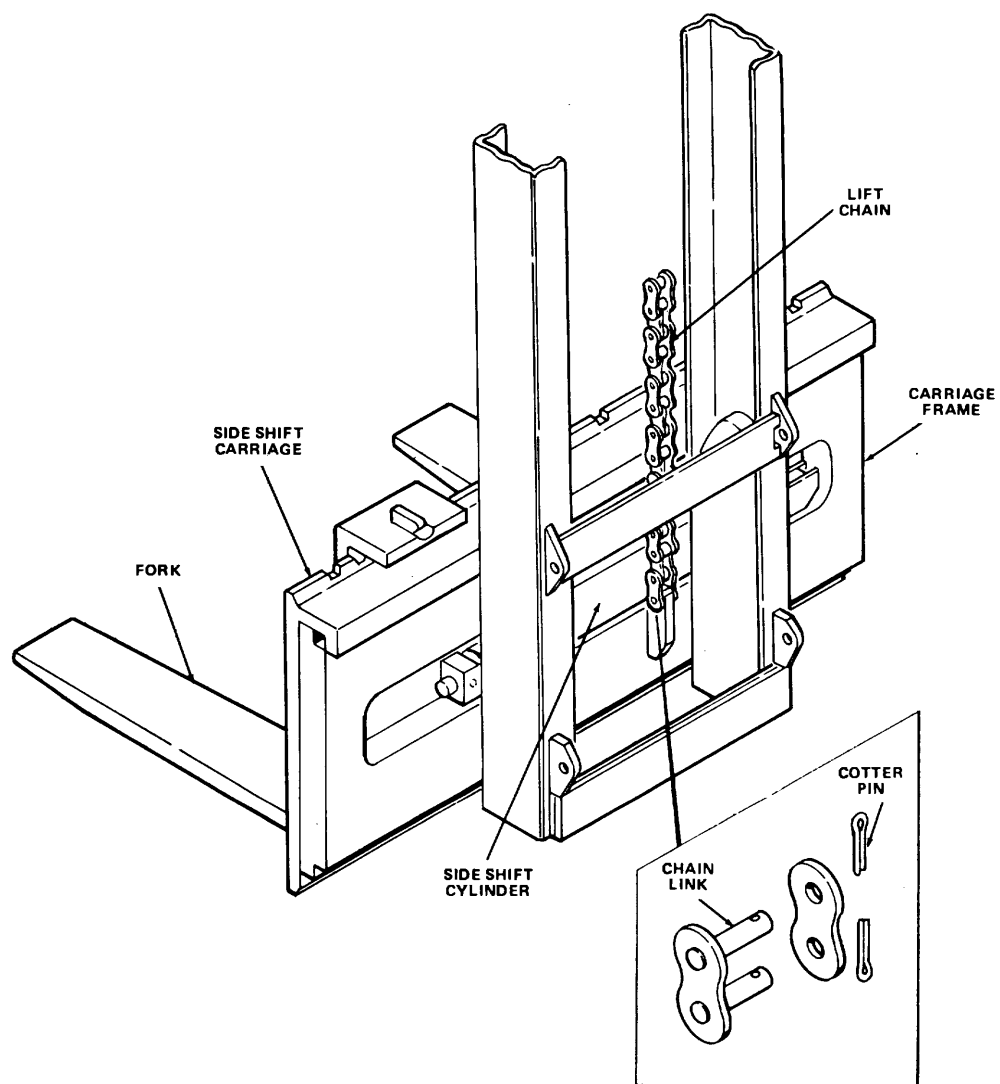


Figure 2-5. Side shift carriage.

b. Installation.

(1) Using a hoist, place carriage frame and side shifter in position below inner mast. Aline bearings with channels in inner mast.

(2) Using the hoist, raise and lower the carriage in the inner mast several times to check for free movement throughout entire range of travel. If bearings bind, refer to paragraph 7-10 and shim bearings for proper clearance.

(3) When carriage frame moves freely secure chains to frame. Before releasing the hoist check that chains are secure at the cylinder cluster and running evenly, with no twists, through the crosshead bearings. Adjust chain length for even lift, if necessary. Refer to TM10-3930-631-12.

(4) Install screws and spacer on rear of carriage supports.

(5) Remove blocks and lower inner mast to floor, using a suitable hoist.

(6) Remove plugs and caps and connect hydraulic hoses to side shift cylinder and swivel block on carriage.

(7) Connect battery receptacle and operate mast assembly through entire range of travel.

(8) Check carriage movement for sideplay and binding. Check operation of side shift.

(9) If bearings bind, refer to paragraph 7-15e. (7) to shim bearings and provide proper clearance.

(10) Lower the carriage to lowest point of travel and check the distance from the lowest horizontal fork support to the floor. Adjust to bring support to $2\frac{3}{4}$ - $3\frac{1}{4}$ inches (69.8 - 82.5 mm) from floor. Refer to TM10-3930-631-12 for adjustment procedures.

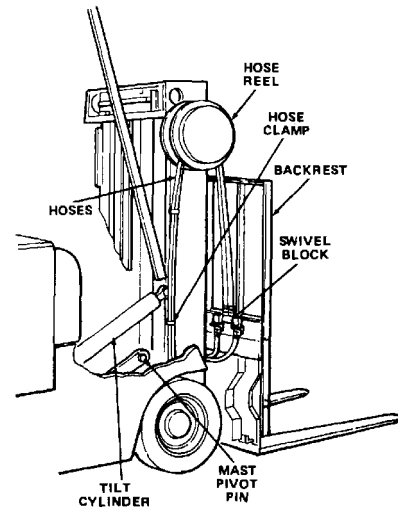
(11) Install carriage forks and lock in position.

2-15. Mast Assembly

a. Removal.

(1) Refer to paragraph 2-14 and remove side shift carriage from mast assembly.

(2) Disconnect hydraulic hoses from hose reel (fig. 2-6) and from junction block for hose reel. Plug or cap ends of hoses and fittings in junction block and hose reel to prevent entrance of foreign matter.



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Figure 2-6. Side shift hoses and hose reel.

(3) Remove nuts, screws and lock washers and remove clamps (fig. 2-6) and hoses from outer mast.

(4) Refer to TM10-3930-631-12 and disconnect tilt cylinders from mast.

(5) Disconnect hydraulic hose from flow regulator at rear of mast. Plug hose and hydraulic fitting to prevent entrance of foreign material.

(6) Connect a hoist to the mast assembly and raise the mast assembly enough to remove weight from mast pivot pin (fig. 2-6). Remove screws and lock washers and remove pivot pins.

(7) Using the hoist, lift the mast assemblies from the truck and place them on suitable supports with the cylinder cluster up.

b. Installation.

Note

When using a hoist, always be certain that the hoist has sufficient lifting capacity for the operation to be performed.

(1) Using a hoist lift mast assembly into place on front of truck. Use a drift pin to align pivot pin holes on mast and truck frame.

(2) Install pivot pins in mast and frame and secure with screws and lock washers.

(3) Remove plugs from hydraulic hose and flow regulator fitting and connect hose to flow regulator.

(4) Refer to TM 10-3930-631-12 and secure tilt cylinders to mast.

(5) Install hoses on outer mast and secure in place with clamps, screws, nuts and lock washers.

(6) Remove plugs from hoses, junction block and hose reel. Connect hoses to hose reel (fig. 2-6) and to junction block on hose reel. (7) Refer to paragraph 2-14 and install side shift carriage on mast.

2-16. Electrical Controls

a. General. The main electrical controls consist of the contactor panel mounted below the operator's seat and the static panel mounted in a compartment in the lower left side of the frame.

b. Removal.

1) Contactor panel.

CAUTION

Before attempting removal procedures, disconnect battery receptacle and discharge capacitors.

(a) Refer to TM 10-3930-631-12 and remove battery from truck.

(b) Remove sheet metal cover from contactor panel.

(c) Disconnect wiring harness at plugs (fig. 2-7). Tag and disconnect seven cables from posts on lower surface of contactor box.

(d) From forward wall of battery compartment remove screws, nuts and lock washers securing contactor panel to frame.

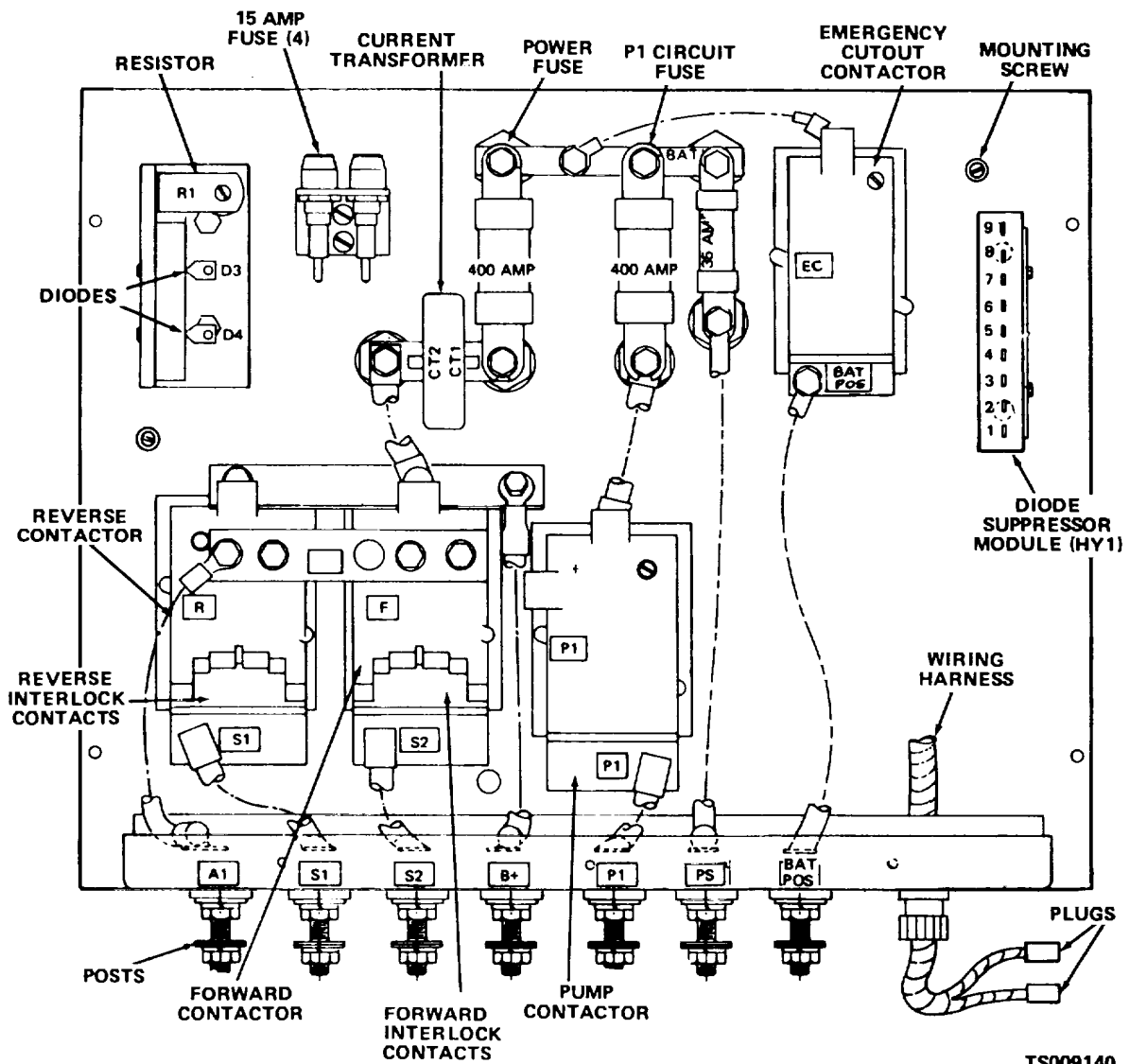


Figure 2-7. Contactor panel.

(e) Remove contactor panel from truck.
 2) Static panel.
 (a) Remove screws holding hinged door closed. Swing door out and down to expose static panel (fig. 2-8).

(b) Tag and disconnect cables from posts on terminal block. Disconnect connector plug (fig. 2-8) wiring harness.

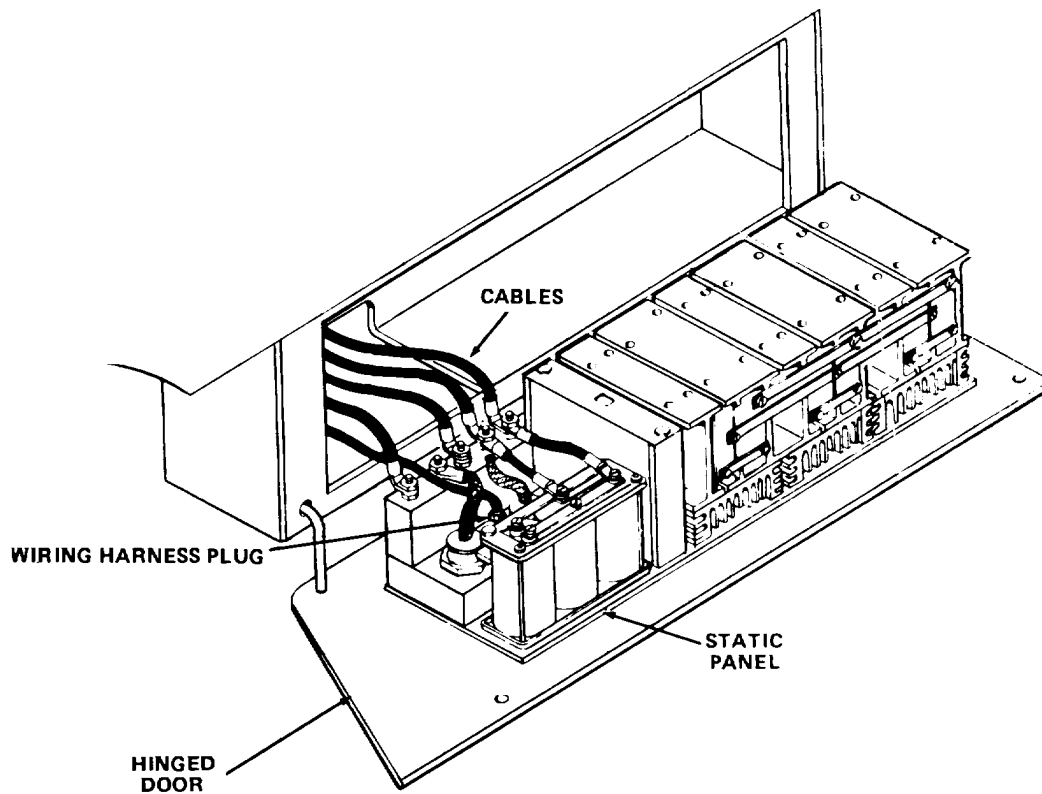


Figure 2-8. Static panel.

(c) Remove screws securing static panel to door from beneath door.

(d) Carefully remove static panel from door.

b. Installation.

(1) Static panel.

(a) Install static panel (fig. 2-8) on access door and secure with screws inserted through door.

(b) Connect wiring harness plug to static panel plug. Connect cables to correct posts on terminal block.

(c) Carefully lift door up and into position on frame. Be careful not to pinch wires and cables when closing door.

(d) Secure door in position with screws and lock washers.

(2) Contactor panel.

(a) Install contactor panel in position on truck frame. Secure panel to truck frame with screws, lock washers and nuts.

(b) Connect cables to posts on lower surface of contactor box.

(c) Connect two plugs to wiring harness.

(d) Install sheet metal cover on contactor box.

(e) Refer to TM10-3930-631-12 and install battery.

CHAPTER 3

REPAIR OF AXLES

Section I. REAR STEERING AXLE

3-1. Description

The cruciform trunnion mounted steering axle is mounted in self-aligning sleeve bearings. A hydraulic powered control unit operates a

hydraulic cylinder which pivots an arm. Two tie rods connected to the arm and wheel spindles, turn the wheels. Refer to figure 3-1 for a view of the power steering system.

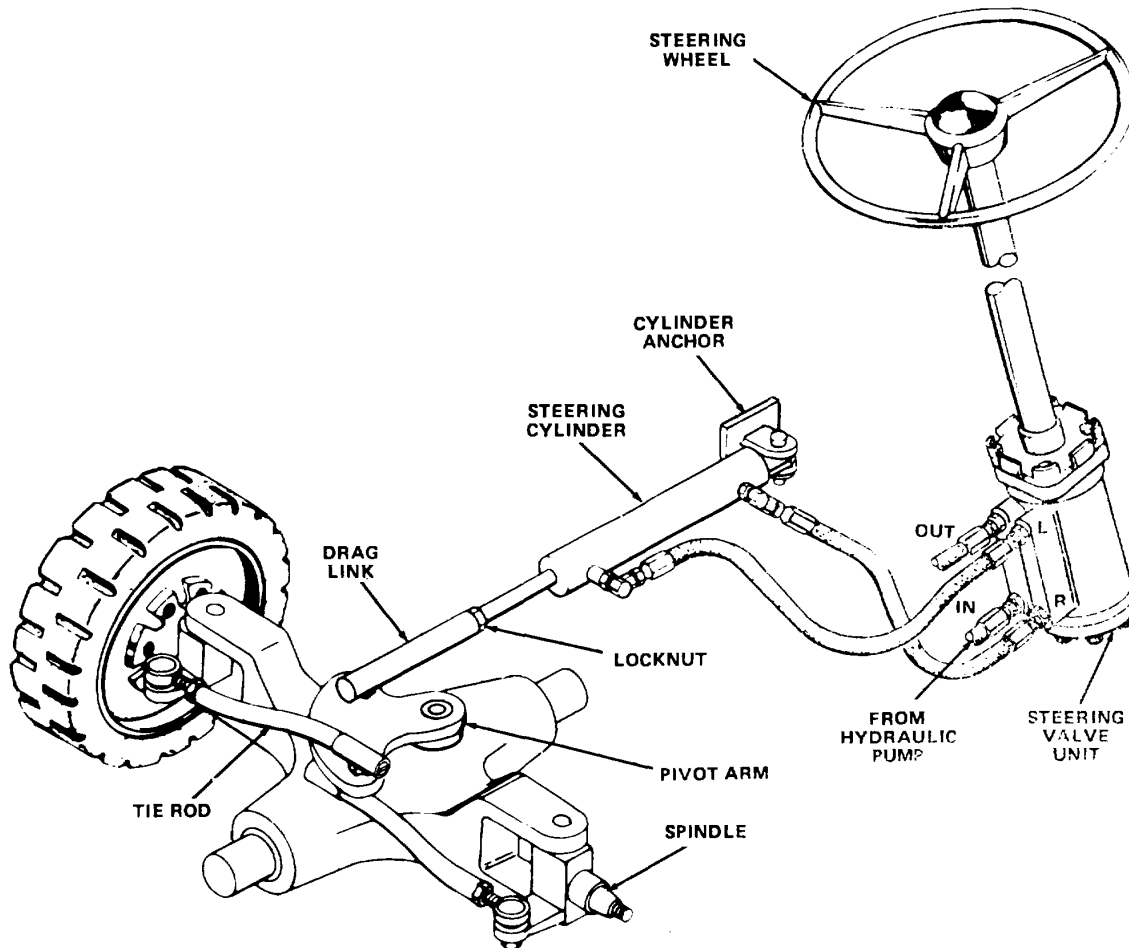


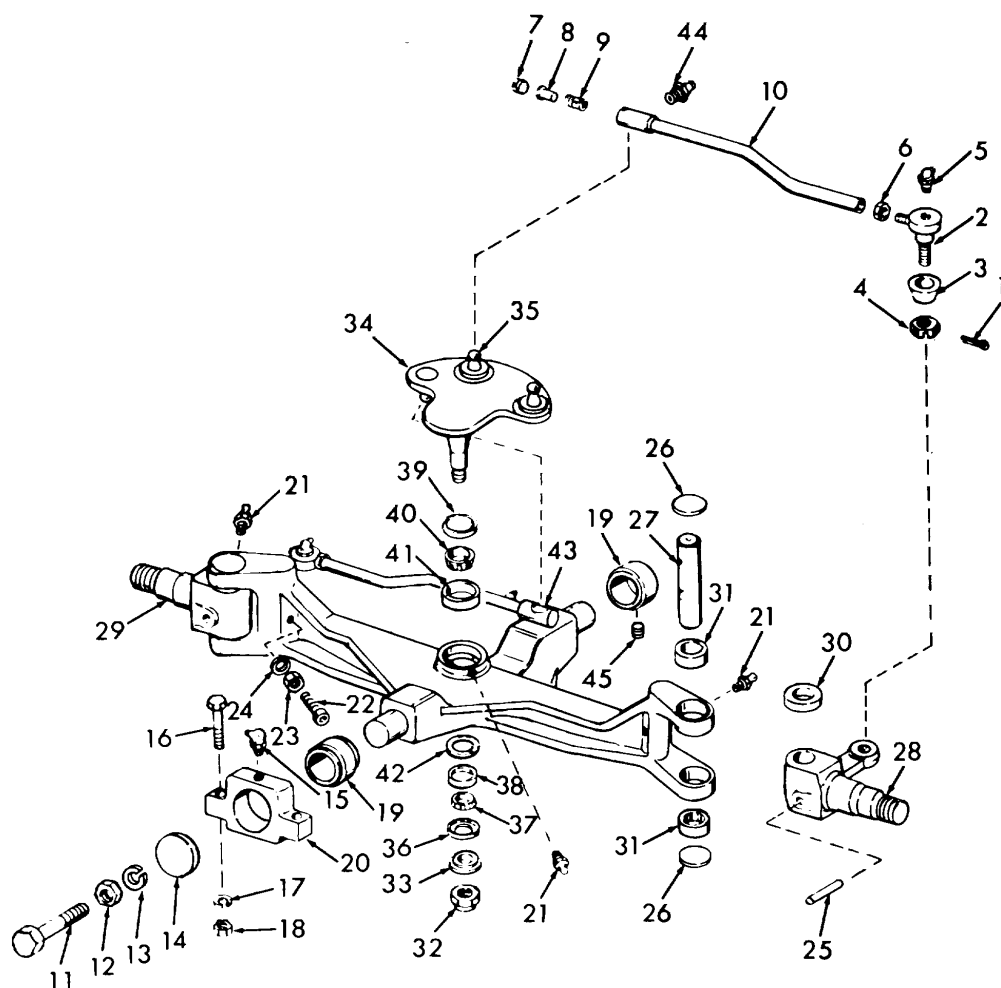
Figure 3-1. Power steering system.

3-2. Removal

Refer to paragraph 2-9 and remove the steering axle from lift truck.

3-3. Disassembly

- Remove cotter pin (1, fig. 3-2) and nut (4) securing tie rod to spindle (28).



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- | | | | |
|------------------------|-------------------------|-------------------------|-------------------------|
| 1. Cotter pin | 13. Lock washer | 24. Washer | 35. Ball stud |
| 2. Tie rod end | 14. Spacer | 25. Pin | 36. Lower seal |
| 3. Cover | 15. Lubrication fitting | 26. Plug | 37. Bearing cone |
| 4. Slotted nut | 16. Screw | 27. King pin | 38. Bearing cup |
| 5. Lubrication fitting | 17. Lock washer | 28. Left spindle | 39. Upper seal |
| 6. Jam nut | 18. Nut | 29. Right spindle | 40. Bearing cone |
| 7. Plug | 19. Bearing | 30. Plastic washer | 41. Bearing cup |
| 8. Seat | 20. Housing | 31. Roller bearing ring | 42. Retaining |
| 9. Spring | 21. Lubrication fitting | 32. Lock nut | 43. Steering axle |
| 10. Tube | 22. Adjusting screw | 33. Shoulder washer | 44. Lubrication fitting |
| 11. Adjusting screw | 23. Jam nut | 34. Pivot arm | 45. Lubrication fitting |
| 12. Nut | | | |

Figure 3-2. Steering axle, exploded view.

b. Loosen adjusting plug (7) and remove tie rod assembly from axle. Remove second tie rod in the same manner.

c. Remove plug (7), seat (8) and spring (9) from tube (10). Loosen jam nut (6) and remove jam nut and tie rod end (2) and cover (3) from tie rod.

d. Remove adjusting screw (11), nut (12) and spacer (13) from axle.

e. Remove expansion plugs (26) from axle. Drive spring pins (25) from spindles. Remove king pins (27), spindles (28 and 29) and roller bearing (31) from axle.

f. Using a punch, straighten out stake indentation in nut (32). Remove nut, washer (33), lower seal (36) and remove bearing cone (37) from axle.

g. Remove pivot arm (34) from axle and remove upper seal (39) and bearing cone (40) from axle. Using a brass drift, remove upper and lower bearing caps (38 and 41) from axle. Remove retaining ring (42).

3-4. Cleaning, Inspection, and Repair

a. Clean all parts with cleaning compound, solvent (Fed. Spec. P-D-680).

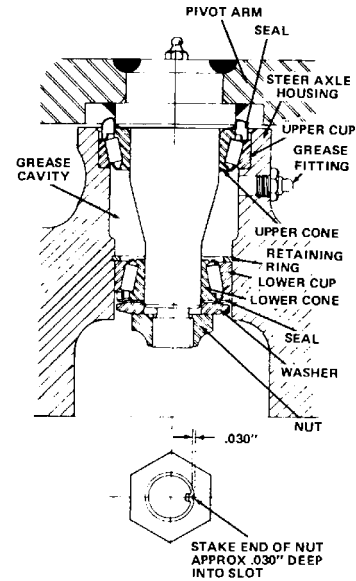
b. Inspect all moving parts for wear, corrosion or other damage.

c. Inspect all bearings for wear and damage.

d. Replace worn or deteriorated parts.

3-5. Assembly

a. Install retaining ring (fig. 3-3) and press lower bearing cup (38, fig. 3-2) in axle. Press upper bearing cup (41) in axle as shown in figure 3-3. Bearing cups must be firmly seated.



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Figure 3-3. Pivot arm bearings.

b. Install upper seal (39) on pivot arm and press upper bearing cone (40) on pivot arm against shoulder. Refer to L010-3930-631-12 and fill seal and bearing cone with proper grease.

c. Install pivot arm with assembled bearing in center of axle assembly. Pack lower bearing cone (37) with grease and install in axle. Fill seal (36) with grease and install in axle.

d. Install shoulder washer (33) in axle. Using a new nut (32) tighten washer against bearing cone with a torque wrench until cone begins to seat. Check torque as bearing begins to seat. Continue to tighten nut until torque is 15-25 pound feet (2. 0- 3. 4 m-kG) greater than when bearing began to seat.

e. Install roller bearings (31) in axle. Install spindles (28 and 29) and plastic washers (30) in axle and install king pins (27) through bearings and spindles. Align king pin hole with hole in spindle and drive spring pins (25) through spindle and king pin.

f. Install expansion plugs (26) and stake in place.

g. Install spring (9) and seat (8) in tie rod tube (10). Loosely install nut (7). Install tube and jam nut (6) on tie rod end (2). Install tie rod end through spindle and connect tie rod to ball stud

(35). Tighten nut (7) to hold tie rod in position. Install remaining tie rod in same manner. h. Rotate pivot arm (34) back and forth several times. Check rotating torque in bearings. A torque of 15-25 pound feet (2. 0-3. 4 m-kG) should be required to rotate pivot arm in either direction.

i. If rotating torque is less than 15 pound feet (2. 0 m-kG) tighten nut an additional 5 pound feet (. 690 m-kG) as in step d. above.

j. If rotating torque exceeds 25 pound feet (3. 4 m-kG) loosen nut one full turn. Strike end of pivot arm at nut with a soft headed mallet to unseat bearings.

k. Repeat step d. and steps i. and j. as necessary to provide correct rotating torque. Stake nut as shown on figure 3-3 after proper torque is obtained.

l. Install all lubrication fittings, bearings (19) and adjusting screws that were removed during disassembly.

3-6. Installation

a. Refer to 2-9 and install steering axle.

b. Refer to L010-3930-631-12 and grease steering axle.

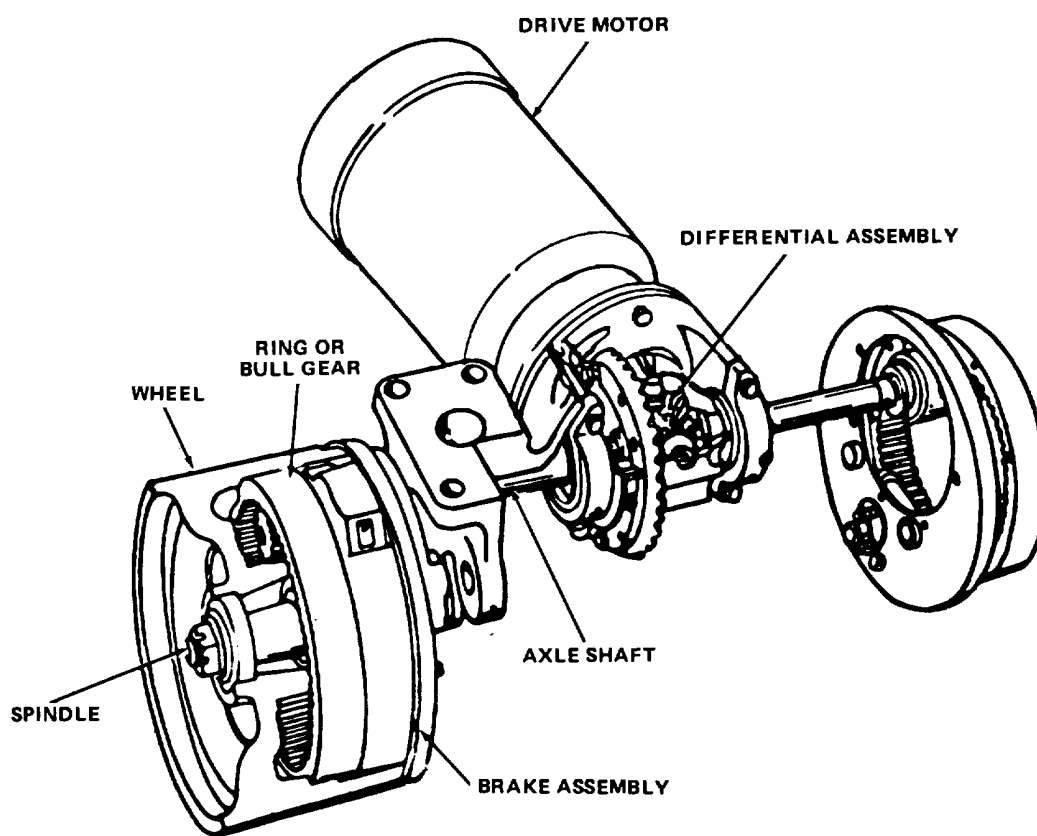
c. Refer to TM10-3930-631-12 and adjust steering axle, tie rods, and steering cylinder.

Section II. DRIVE AXLE

3-7. Description

The drive axle consists of a differential assembly, two axle shafts and two spindles (fig. 3-4). The axle shafts connect the differential assembly (first reduction) and the ring gear (second reduction) in the drive wheel. Drive spindles support the wheels, with the wheels rotating around the spindles. The spindles are mounted on the

axle housing. A carrier assembly and a case assembly compose the differential. The carrier assembly is mounted at the center of the drive axle and supports the case assembly which comprises the differential gears. A drive motor mounted and connected to the differential carrier provides motive force for the axle.



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Figure 3-4. Drive unit.

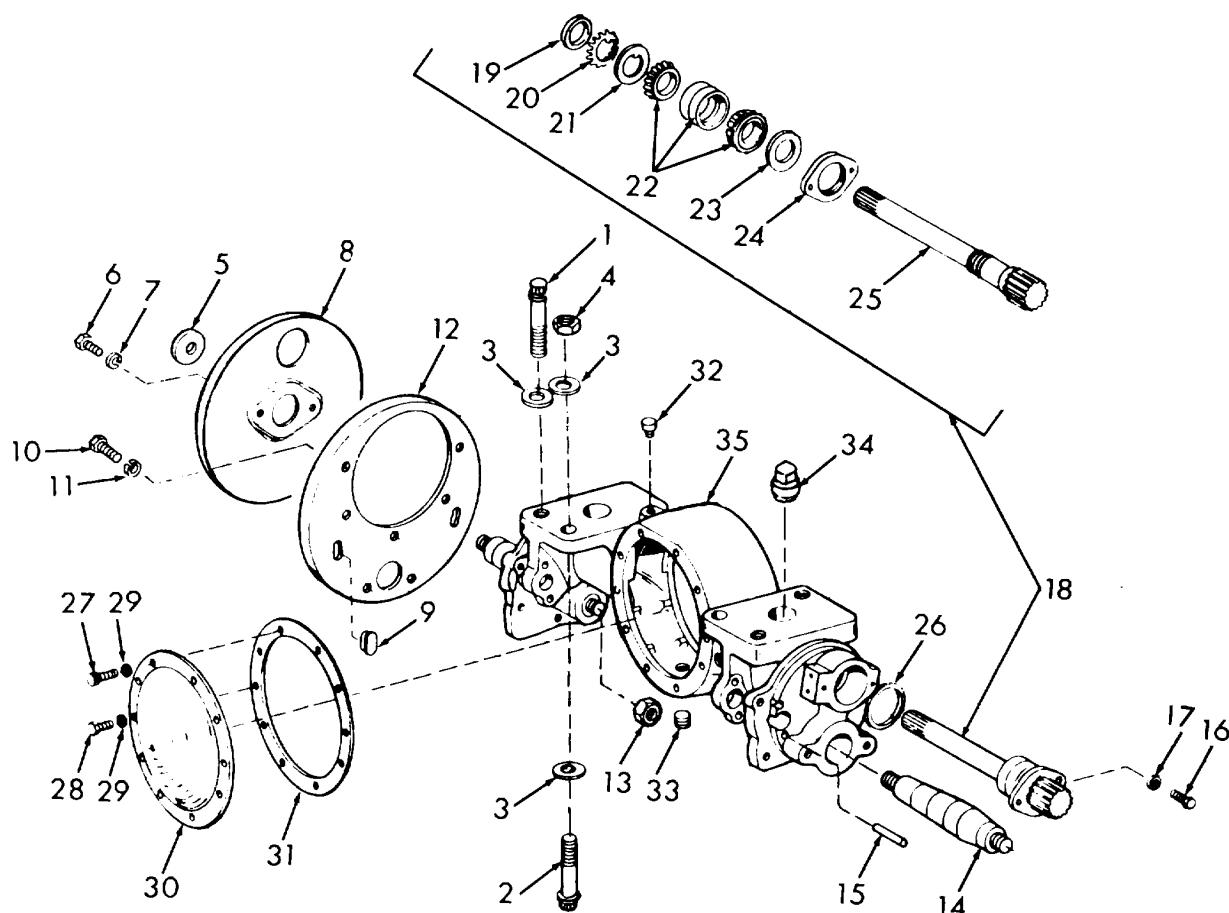
3-8. Axle Shaft

a. Removal and Disassembly.

(1) Remove drive wheel assembly, grease

shield and dust shield (TM 10-3930-630-12).

(2) Refer to figure 3-5 and remove screws (16) and lock washers (17).

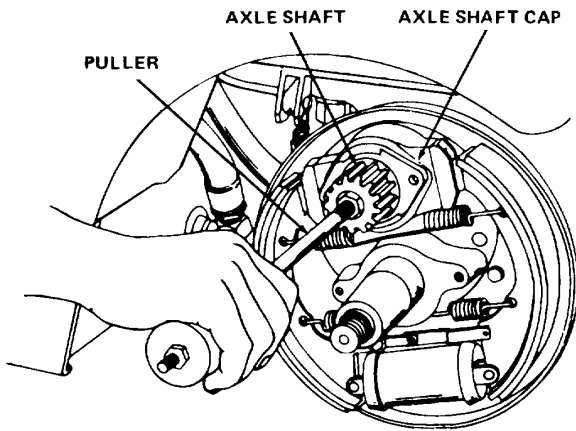


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- | | |
|-------------------------|--------------------|
| 1. Screw | 19. Bearing nut |
| 2. Screw | 20. Tab washer |
| 3. Washer | 21. Key washer |
| 4. Nut | 22. Roller bearing |
| 5. Grease shield | 23. Seal |
| 6. Screw | 24. Axle cap |
| 7. Lock washer | 25. Axle shaft |
| 8. Dust shield | 26. Seal |
| 9. Plug | 27. Screw |
| 10. Screw | 28. Screw |
| 11. Lock washer | 29. Lock washer |
| 12. Brake backing plate | 30. Housing cover |
| 13. Nut | 31. Gasket |
| 14. Wheel spindle | 32. Axle breather |
| 15. Pin | 33. Drain plug |
| 16. Screw | 34. Shear pin |
| 17. Lock washer | 35. Axle housing |
| 18. Axle shaft | |

Figure 3-5. Drive axle, exploded view.

(3) Install threaded puller (fig. 3-6) into threaded end of axle shaft and carefully remove shaft with axle cap and bearing attached.



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Figure 3-6. Removing axle shaft.

(4) Straighten locking prongs on tab washer (20, fig. 3-5) and remove nut (19) and washers (20 and 21) from shaft.

(5) Using a suitable press, press bearing assembly (22) from shaft. Remove oil seal (23) and axle cap (24) from shaft. Discard oil seal.

CAUTION

When removing bearing, exert pressure on inner race of bearing and not on rollers. Use care to prevent damage to axle cap.

(6) Remove oil seal (26) from axle housing. Discard seal.

b. Cleaning, Inspection and Repair.

(1) Clean all parts in cleaning compound, solvent (Fed. Spec. P-D-680).

(2) Inspect spindle and nut for wear and damage.

(3) Replace oil seals. Replace worn or damaged parts.

(4) Grease bearings and shaft pinion as noted on LO 10-3930-631-12.

c. Assembly and Installation.

(1) Refer to figure 3-5 and assemble and install axle shaft as follows:

(2) Use a seal driver and install new oil seal (26) in axle housing.

(3) Install axle cap (24) and new oil seal (23) on axle shaft (25).

(4) Install greased bearing assembly (22) on shaft. Align keyed washers (20 and 21) with groove in shaft and slide into position on shaft.

(5) Install nut (19) and tighten on shaft. Tighten enough to produce a slight pre-load on the bearings. Secure nut with tabs on washer (20).

(6) Position assembled axle shaft in housing. Use care when installing axle shaft to prevent damage to oil seal in housing. Align splines on shaft with splines in differential gears. Using a soft mallet drive axle splines into differential.

(7) Align holes in axle cap (fig. 3-6) with holes in axle housing and secure cap to axle with screws (16, fig. 3-5) and lock washers (17).

(8) Install dust shield, grease seal and drive wheel (TM10-3930-631-12).

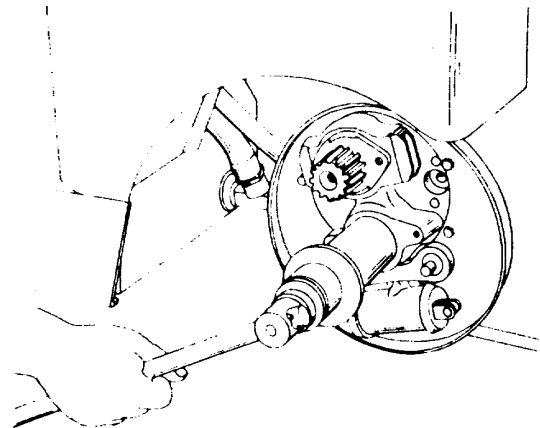
3-9. Spindle

a. Removal.

(1) Remove drive wheel, grease seal and dust shield (TM10-3930-631-12).

(2) Remove self-locking nut (13, fig. 3-5) from spindle (14).

(3) Install suitable puller (fig. 3-7) and remove spindle from housing. Use pipe spacer and large washer over spindle. Tighten nut (13) against washer to free spindle from housing.



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Figure 3-7. Removing spindle.

b. Cleaning, Inspection and Repair.

(1) Clean all parts in cleaning compound, solvent (Fed. Spec. P-D-680).

(2) Inspect spindle and nut for wear and damage.

(3) Replace worn or damaged parts.

c. *Installation.*

(1) Install spindle (14, fig. 3-5) in axle housing and install lock nut (13) on spindle.

(2) Tighten lock nut until spindle is completely seated in axle.

(3) Install dust shield, grease seal and drive wheel (TM10-3920-631-12).

3-10. Differential Assembly

a. *Removal.*

(1) Remove drive wheel (TM 10-3930-631-12).

(2) Remove axle shaft (para 3-8) far enough to clear differential. Drain lubricant from axle housing.

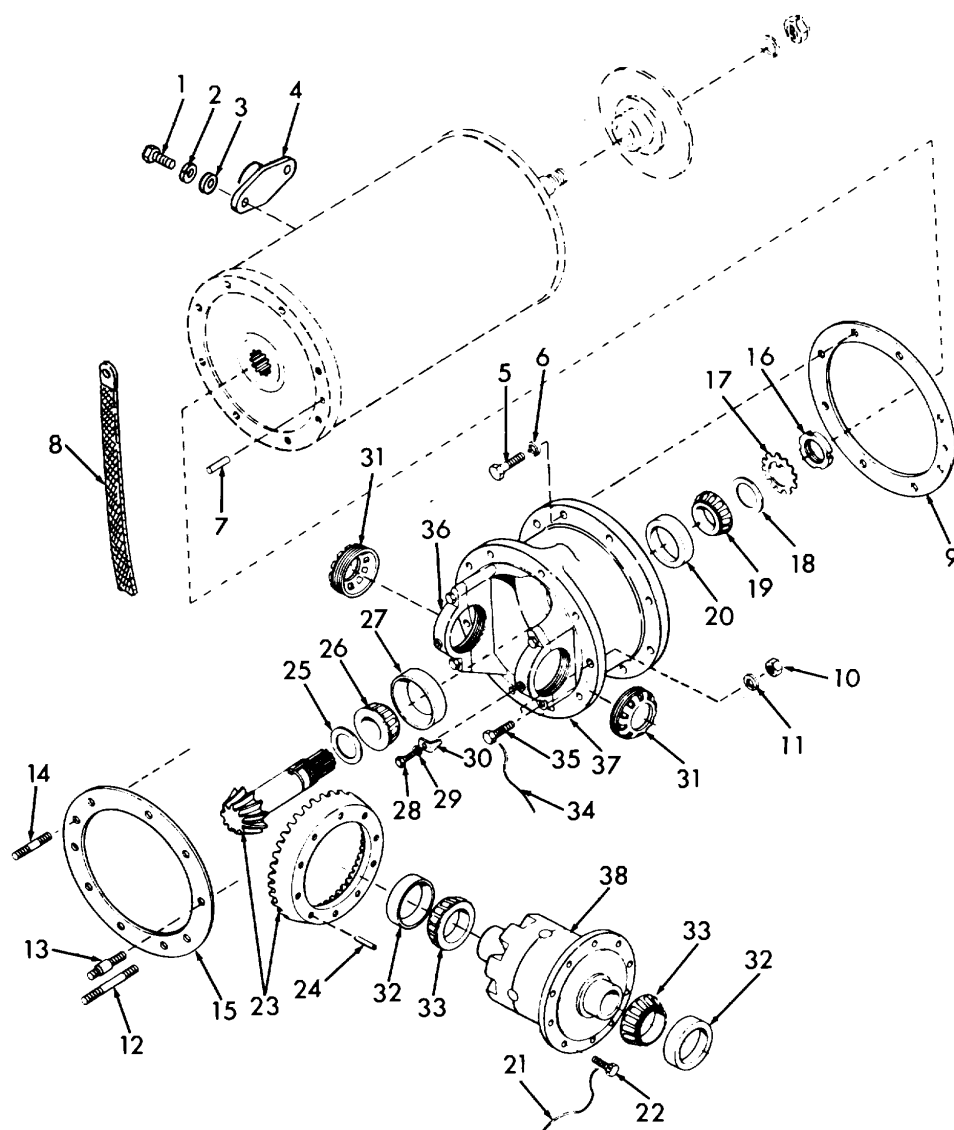
(3) If not raised sufficiently, use a hoist and raise front end of truck enough to provide clearance for drive motor. Block truck securely. Place a suitable jack under drive motor to support motor.

(4) Refer to paragraph 2-10 and disconnect wires and parking brake linkage from drive motor.

(5) Remove nuts (10, fig. 3-8) and lock washers (11) securing differential carrier and drive motor to drive axle. Remove motor and differential carrier from axle. Remove gasket (15).

KEY to fig. 3-8:

1. Screw
2. Lock washer
3. Washer
4. Terminal relay
5. Screw
6. Lock washer
7. Pin
8. Bonding strap
9. Gasket
10. Nut
11. Lock washer
12. Stud
13. Stud
14. Stud
15. Gasket
16. Bearing nut
17. Tab washer
18. Washer
19. Bearing cone
20. Bearing cup
21. Lock wire
22. Screw
23. Ring gear and pinion
24. Pin
25. Shims
26. Bearing cone
27. Bearing cup
28. Screw
29. Lock washer
30. Lock
31. Adjusting nut
32. Bearing cup
33. Bearing cone
34. Lock wire
35. Screw
36. Bearing cap
37. Differential carrier
38. Differential



TS009149

Figure 3-8. Differential carrier, exploded view.

(6) Remove screws (5) and lock washers (6). Carefully remove differential carrier from splines in drive motor. Remove gasket (9). Remove bonding straps (8).

(7) Mark bearing caps (36) and differential case (fig. 3-9) and differential carrier to assure proper assembly.

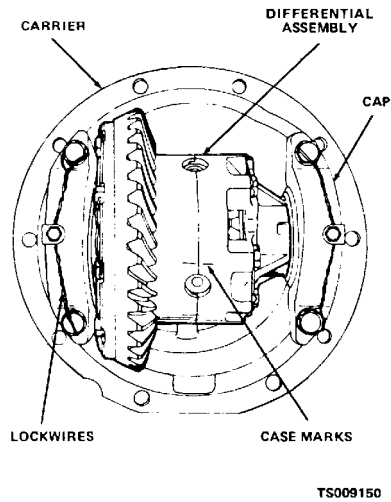


Figure 3-9. Differential carrier and differential case.

(8) Remove lock wire (34, fig. 3-8) and remove bearing cap screws (35), screws (28), lock washers (29) and bearing nut locks (30). Remove bearing caps (36).

(9) Lift differential assembly (fig. 3-10) from carrier and place in a clean area for disassembly. screws

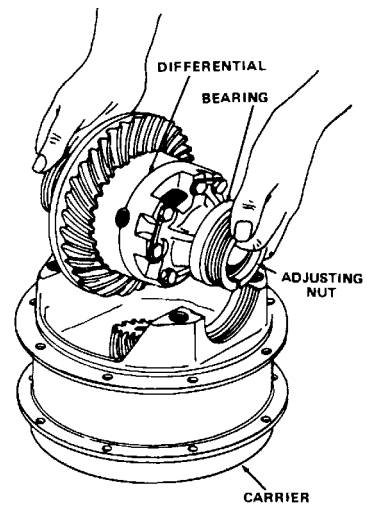


Figure 3-10. Removing differential from carrier.

b. Disassembly.

(1) Remove lock wire (21, fig. 3-8) and

(22) and remove ring gear from differential case. Remove pins (24) from ring gear.

Note

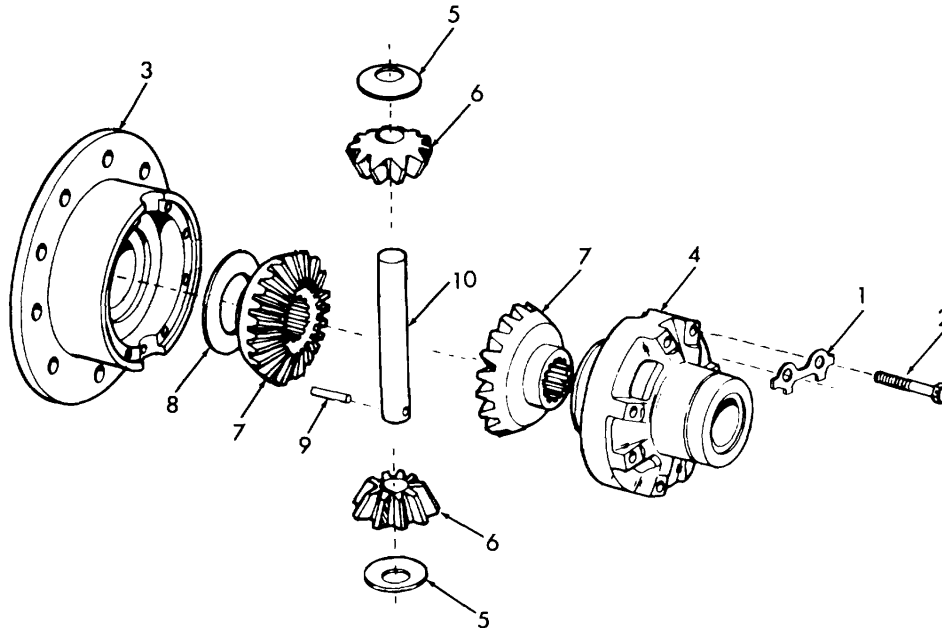
Ring gear and pinion (23) are a matched set.

(2) Remove adjusting nuts (31) and using a

suitable bearing puller remove bearing cones (33) from differential cases.

(3) Remove bearing cups (32).

(4) Remove locks (1, fig. 3-11) and screws (2) securing case halves (3 and 4) together and separate case halves.



TS009152

- | | |
|------------------|------------------|
| 1. Lock | 6. Pinion gear |
| 2. Screw | 7. Bevel gear |
| 3. Flanged case | 8. Thrust washer |
| 4. Plain case | 9. Dowel pin |
| 5. Thrust washer | 10. Pinion shaft |

Figure 3-11. Differential assembly, exploded view.

Note

One case half is flanged and the other plain. Case halves must be marked for proper assembly (fig. 3-9).

(5) Remove pinion gear thrust washers (5, Fig. 3-11) and pinion gears (6) from pinion shaft (10). Remove pin (9).

(6) Remove bevel gears (7) and thrust washers (8) and remove pinion shaft (10).

(7) Straighten tabs on tab washer (17, fig.

3-8) and remove nut (16) and washers (17 and 18). Place carrier in and arbor press and press pinion (23) from carrier. Drive bearing cone (19) and cups (20 and 27) from carrier using a brass drift. Pull bearing cone (26) from pinion gear and remove shims (25). Tag and record quantity of shims.

c. *Cleaning, Inspection and Repair.*

(1) Clean all parts in cleaning compound,

solvent (Fed. Spec. P-D-680). Dry thoroughly with compressed air.

(2) Inspect all parts for cracks, chips, wear and damage.

(3) Pinion and ring gear must be replaced as a set.

(4) Replace all oil seals and gaskets. Replace all damaged, worn, or cracked parts.

d. Assembly.

(1) Install pin (9, fig. 3-11) in flanged case half. Position pinion shaft (10), bevel gears (7) and thrust washers (8) in flange case half (3).

(2) Install pinion gears (6) and thrust washers (5) and pinion shaft (10). Mesh pinion gears with bevel gear and install on flanged case half.

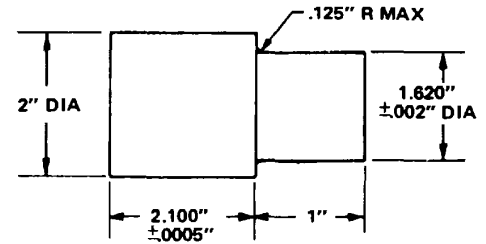
(3) Install thrust washer and bevel gear (7) in plain case half (4). Aline case halves and install plain case half on flanged case half.

(4) Secure case halves with screws (2) and lock (1). Tighten screws to a torque of 17-25 pound feet (2.3-3.4 m-kg). Lock screws with locks.

(5) Press front and rear bearing cups (20 and 27, fig. 3-8) in carrier. Cups must be firmly seated.

(6) Install bearing cups (32) in carrier. Install bearing cones (33) on differential case.

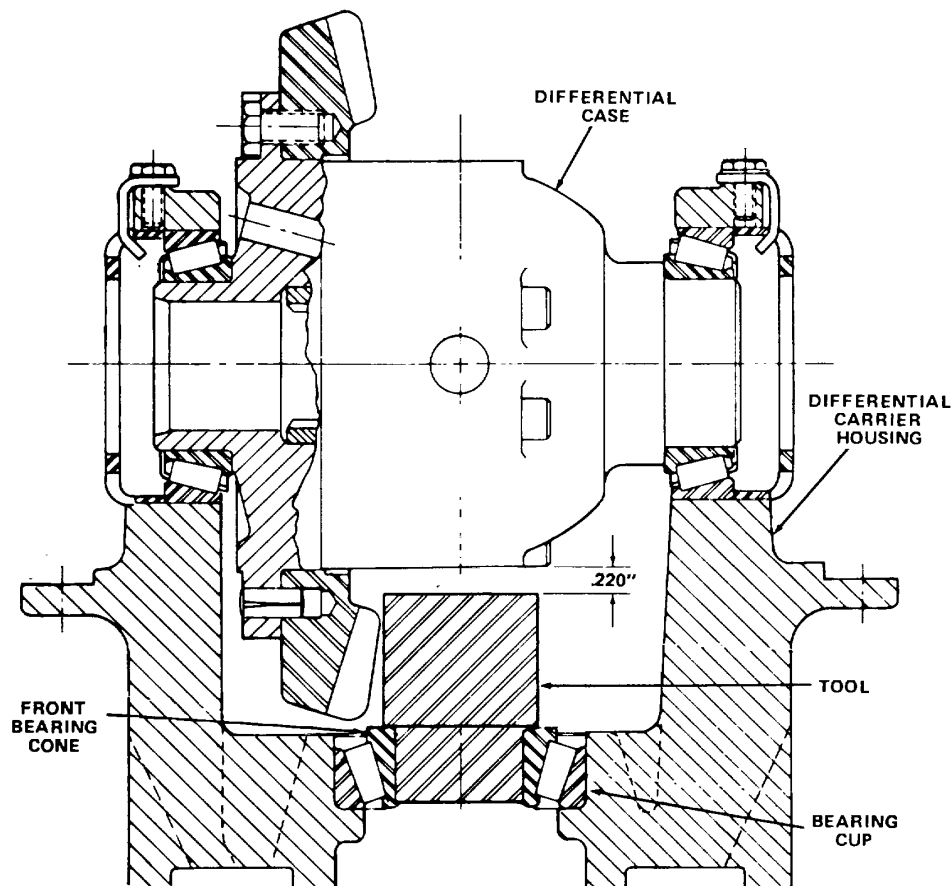
(7) Fabricate a tool as shown in figure 3-12.



TS009153

Figure 3-12. Fabricated tool for measuring shims.

(8) Install front bearing cup (26), without shims, on fabricated tool and install tool and bearing in cup in carrier as shown in figure 3-13.



TS009154

Figure 3-13. Measuring for bearing shims.

(9) Install pins (24) in flanged half and align holes in ring gear with pins. Install ring gear on flanged half and secure with screws (22). Tighten screws securely.

(10) Measure outside diameter of differential case at center of case, not ring gear pilot.

(11) Install differential case in carrier as shown in figure 3-13.

Note

Bearing caps do not have to be in place.

(12) Measure and record the distance between the outside of the differential case and the face of the tool.

(13) Add one-half the outside diameter of the case to the dimension taken in (12) above. Subtract 2.650 inches from the total to get the

amount of shims required to locate the theoretical exact pinion. Refer to the following example:

2.495 (one-half of differential case outside diameter)
+ .220 (distance from (12) above)

2.715 total

-2.650 (theoretical setting distance)

.065 thickness of shims required to locate an exact pinion (no manufacturing tolerance)

Note

All pinions are etched with manufacturing tolerances.

(14) If pinion is a plus .005 inches (etched 2.655) the .005 inches has already been added to the theoretical setting distance, therefore the amount of shims required is found as follows:

2.715 total

-2.655 (theoretical setting plus .005)

.060 thickness of shims required

(15) If pinion is a minus .005 inches (etched 2.645) the .005 inches has been subtracted from the theoretical setting therefore the amount of shims required is found as follows:

2.715 total
-2.645

.070 thickness of shims required

Note

The above dimensions are examples. Use the exact one-half outside diameter as measured plus the distance measured in (12) above. Subtract the dimension etched on the pinion to get the shim thickness required in the differential of the truck being repaired.

(16) Remove differential assembly from carrier and remove tool and bearing from carrier.

(17) Install proper amount of shims on pinion. Measure shim thickness with a micrometer for exact installation.

(18) Install pinion (23, fig. 3-8) in carrier housing. Install rear bearing cone (19), washer (18), tab washer (17) and nut (16) on pinion shaft. Tighten lock nut (16) so that 15-25 pound feet (2.0-3.4 m-kG) are required to rotate pinion shaft. Bend tabs on washer to secure nut.

Note

Install a $\frac{1}{2}$ -13 screw in threaded hole in end of shaft and rotate with a torque wrench to get proper reading. Remove screw from shaft.

(19) Place the differential assembly in the carrier. Move the ring gear toward the pinion so that all backlash is taken up.

(20) Install bearing caps (36, fig. 3-8) on carrier and secure with screws (35). Check marks to be sure bearing caps are installed properly. Secure screws with lock wire (34).

(21) Install bearing adjusting nuts (31) in carrier. Tighten both nuts until they contact the bearing caps. Loosen the adjusting nut on opposite side from ring gear until ring gear and differential are loose in the bearings (approximately two to three revolutions).

(22) Tighten other adjusting nut (nut next to ring gear) against bearing until all backlash between ring and pinion gear has been eliminated.

(23) Loosen ring gear side adjusting nut three to four notches.

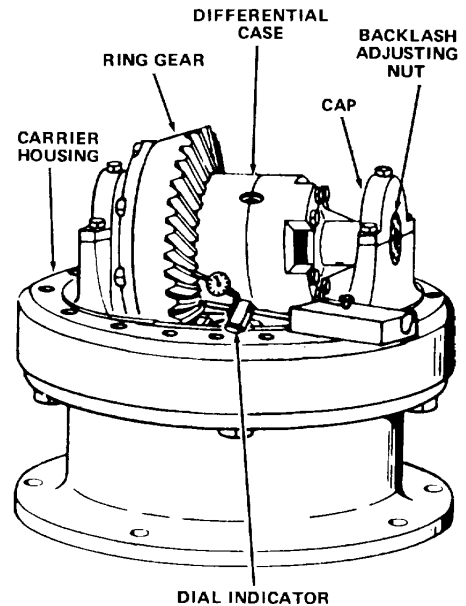
(24) Tighten other adjusting nut one to two notches more. Do not tighten adjusting nuts to a torque of more than 25 pound feet (3.4 m-kG). Do not exceed two notches of tightening.

(25) Wrap a cord around differential case and attach a spring scale to loose end. Start pulling on the scale and note effort to rotate case. Case should start and maintain rotation at less than 3 pounds (1.35 kg) pull.

(26) Make final backlash adjustment as follows:

(27) Install a dial indicator on carrier as

shown on figure 3-14. Backlash should be between .005 and .010 inch (0.127-0.254 mm).



TS009155

Figure 3-14. Adjusting backlash.

(28) Move ring gear by hand in a clockwise direction until all play or movement is eliminated between ring gear and pinion.

(29) With stem of dial indicator against the side (face flank) of ring gear tooth, move ring gear in opposite direction and read backlash on dial indicator. Backlash should be in tolerance shown above.

(30) Check backlash at four positions on ring gear approximately 90 degrees apart.

(31) If adjustment is required, turn adjusting nuts one notch at a time. Turn each adjusting nut exactly the same distance to preserve correct bearing preload.

(32) To increase backlash loosen adjusting nut on side of carrier nearest ring gear and tighten opposite adjusting nut. To decrease backlash, loosen adjusting nut on side away from ring gear and tighten opposite nut.

(33) When backlash is adjusted, install locks (30, fig. 3-8), lock washers (29) and screws (28) to securely lock adjusting nuts.

e. Installation.

(1) Align dowel pin and install carrier

assembly on drive motor, using a new gasket (9, fig. 3-8). Secure carrier with screws (5) and lock washers (6). Install bonding straps (8) under two of the screws.

(2) Install new gasket (15) on carrier. Move carrier and drive motor under truck and lift into position on drive axle.

(3) Install nuts (10) and lock washers (11) to secure carrier and drive motor on drive axle.

(4) Refer to paragraph 2-10 and connect parking brake linkage and wires to drive motor.

(5) Refer to paragraph 3-8 to install axle shaft and wheels.

(6) Install drain plug and fill drive axle to proper level with specified oil (LO 10-3930-631-12).

Section III. WHEELS AND TIRES

3-11. Drive Wheel

a. *Removal.* Refer to TM 10-3930-631-12 to remove the drive wheel and bearings.

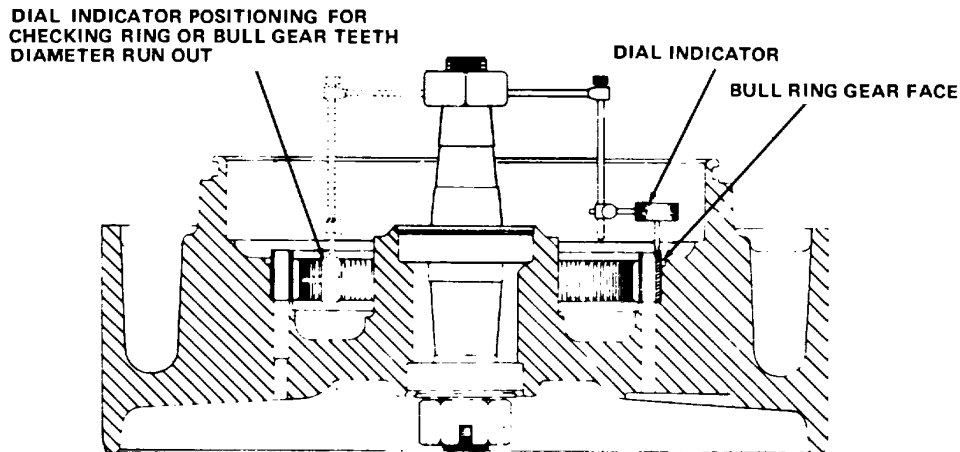
(1) Before removal, check runout of ring or bull gear face and inside diameter.

(2) Mount a dial indicator on the spindle as shown in figure 3-15.

(3) Runout on gear face must not exceed .010 inch (.254 mm).

(4) Maximum allowable runout on the inside diameter is .005 inch (.127 mm).

(5) If runout exceeds these tolerances replace gear.



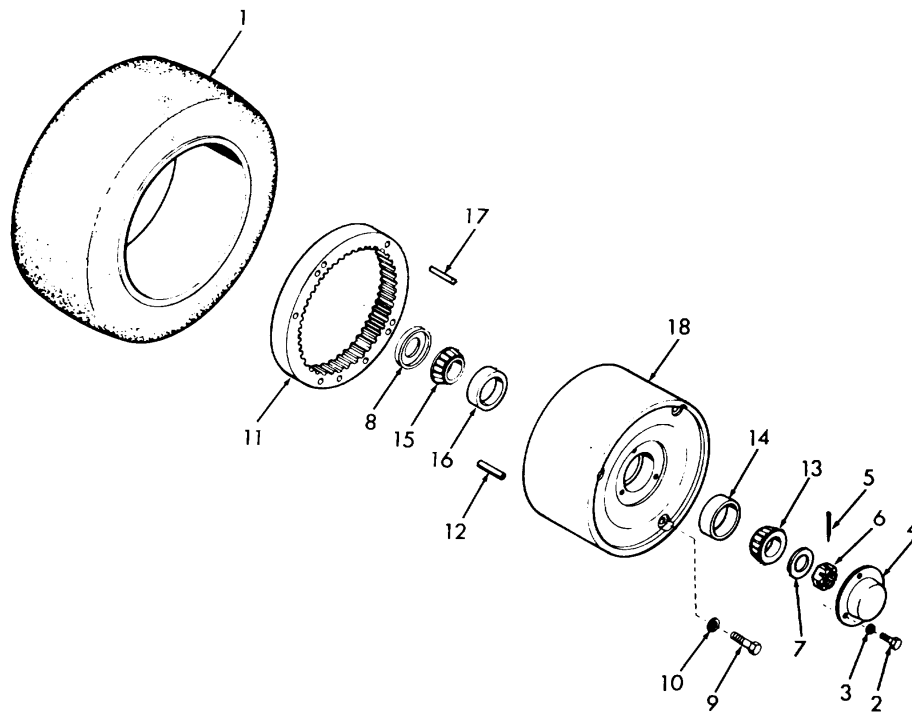
TS009156

Figure 3-15. Checking ring or bull gear runout.

b. *Disassembly.*

(1) Remove screws (9, fig. 3-16) and lock washers (10) and remove ring or bull gear (11) from wheel (18).

(2) Turn wheel over and use screws inserted in holes in gear to remove gear from wheel. Tighten screws alternately and evenly to remove 15 gear.



TS009157

- | | |
|------------------|-----------------------|
| 1. Tire | 10. Lock washer |
| 2. Screw | 11. Ring or bull gear |
| 3. Lock washer | 12. Spring pin |
| 4. Hub cap | 13. Bearing cone |
| 5. Cotter pin | 14. Bearing cup |
| 6. Nut | 15. Bearing cone |
| 7. Washer | 16. Bearing cup |
| 8. Grease shield | 17. Pin |
| 9. Screw | 18. Wheel |

Figure 3-16. Drive wheel, exploded view.

(3) Remove pins (12 and 17) from gear and wheel.

c. Cleaning, Inspection and Repair.

(1) Wash all parts in cleaning compound solvent (Fed. Spec. P-D-680) and dry thoroughly.

(2) Inspect for worn or damaged parts, chipped or cracked teeth and pitted surfaces.

(3) Replace ring or bull gear if teeth are worn to approximately one-half of original width.

(4) Replace cracked, worn or damaged parts.

d. Assembly.

(1) Install pins (12, fig. 3-16) in drive wheel. Install spring pins (17) in ring or bull gear. The

edge of outer circle should lie on the bolt circle as shown on figure 3-17.

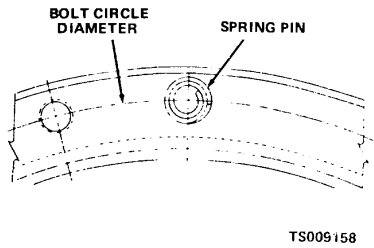


Figure 3-17. Spring pin installed.

(2) Install ear in wheel with the large chamfer down. Aline holes in drive wheel with spring pins. Place brass or bronze drive bar over spring pins and start gear evenly into drive wheel by tapping bar.

(3) Install screws (9) and lock washers (10) through drive wheel and into gear. Alternately tighten screws to draw gear evenly into drive wheel until gear seats flush in drive wheel. Screw ends must be recessed evenly in ring gear. (4) After gear is seated in drive wheel tighten screws evenly to a torque 28 to 32 pound feet (3.8- 4.4 m-kG).

(5) Fill all spaces between gear teeth with grease (GAA) approximately three-fourths of the height of the teeth (fig. 3-18).

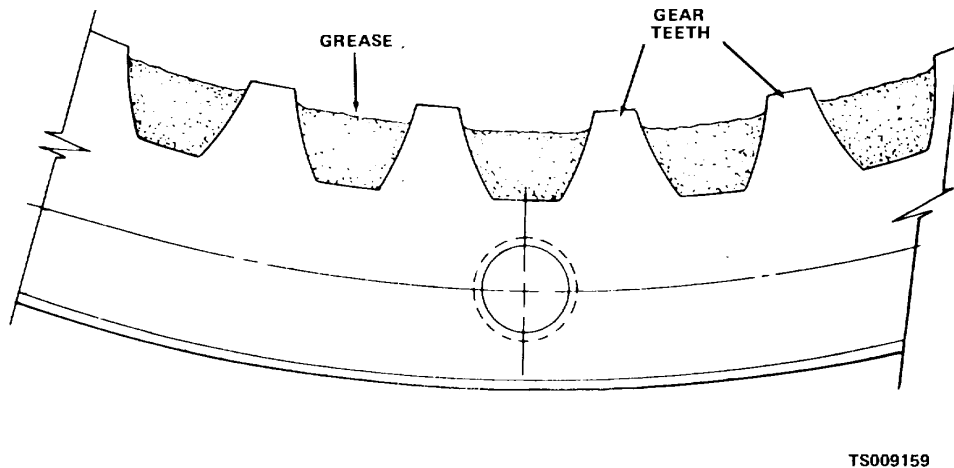


Figure 3-18. Lubricating ring or bull gear.

(6) Refer to TM 10-3930-631-12 and install drive wheel.

3-12. Steer Wheels

Refer to TM 10-3930-631-12 and for procedures applicable to the steer wheels.

3-13. Tires

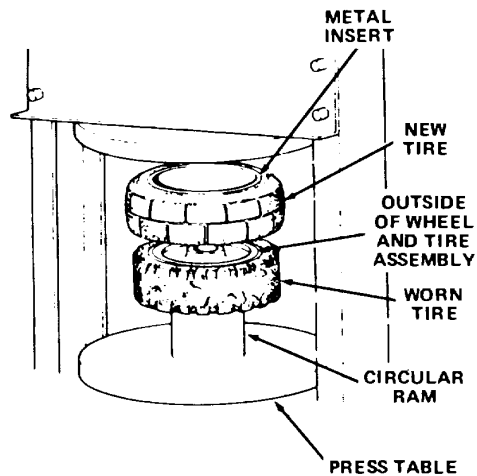
a. *Description.* The cushion tires are mounted on rims which are a press fit on the wheels.

b. *Removal.* Refer to TM 10-3930-631-12 to remove either the drive wheel or steer wheel from the truck.

c. Replacement of Tire.

(1) Check inside diameter of new tire. Remove any scale or rust with sandpaper. Clean inside of new tire and lubricate it with grease (GAA).

(2) Place a circular ram on a press table as shown in figure 3-19. The ram must be longer than the width of the old tire and small enough in outside diameter to fit loosely in the insert of the tire. The surface must be large enough to rest squarely on the flat surface of the ring or bull gear.



TS009160

Figure 3-19. Installing cushion tire.

(3) Check if edge of wheel is flush with edge of metal insert in old tire. If not flush, measure how far wheel is recessed inside the tire. New tire must be installed in same position on wheel. A

spacer slightly smaller in diameter than the inside diameter of the tire insert and of the same thickness of the recess can be used to obtain proper amount of recess.

(4) Position wheel and old tire on ram with outside of wheel upward. Outside edge of wheel has a chamfer to help guide new tire on wheel. Center the wheel on top of ram and make certain they match up squarely.

(5) Position new tire on top of wheel and tire assembly. Aline new tire and wheel so they are concentric with each other.

(6) Start pressing new tire on wheel. As tire is pressed on old tire will be forced off. Drive press slowly for first few inches. Check tire alinement. If tire is out of alinement with wheel and old tire, stop press and re-aline. A sharp jar with a soft mallet will generally aline tire.

(7) If it is to be recessed in tire, stop press after tire has started on wheel. Position spacer measured in (3) above inside of new tire to rest squarely on outer edge of wheel. Continue pressing operation until tire is correctly positioned on wheel.

(8) Release press and remove tire and wheel and old tire from press. Wipe off excess grease and inspect wheel and tire assembly.

d. *Installation.* Refer to TM 10-3930-631-12 and install wheel on lift truck.

CHAPTER 4

REPAIR OF BRAKES

Section I. PARKING BRAKE

4-1. Description

a. The parking brake on the lift truck is of the disk and caliper type. The disk is attached to the rear of the drive motor shaft. A caliper assembly containing the brake pads is mounted on the motor frame, with the disk rotating between the pads. Actuation of the brake is accomplished through linkage attached to the hinged operator's seat.

b. The brake is set through the action of a large spring mounted at the lower end of the linkage. When the seat is not occupied the spring forces the linkage down and the cam action of the actuating lever forces the pad against the disk, locking the drive train.

c. A seat switch, normally open, is actuated by the linkage. The switch, when open, prevents operation of electrical circuits on the truck. When the seat is occupied the parking brake is released

and the truck circuits are closed, allowing the truck to be operated.

4-2. Parking Brake Repair

a. Removal.

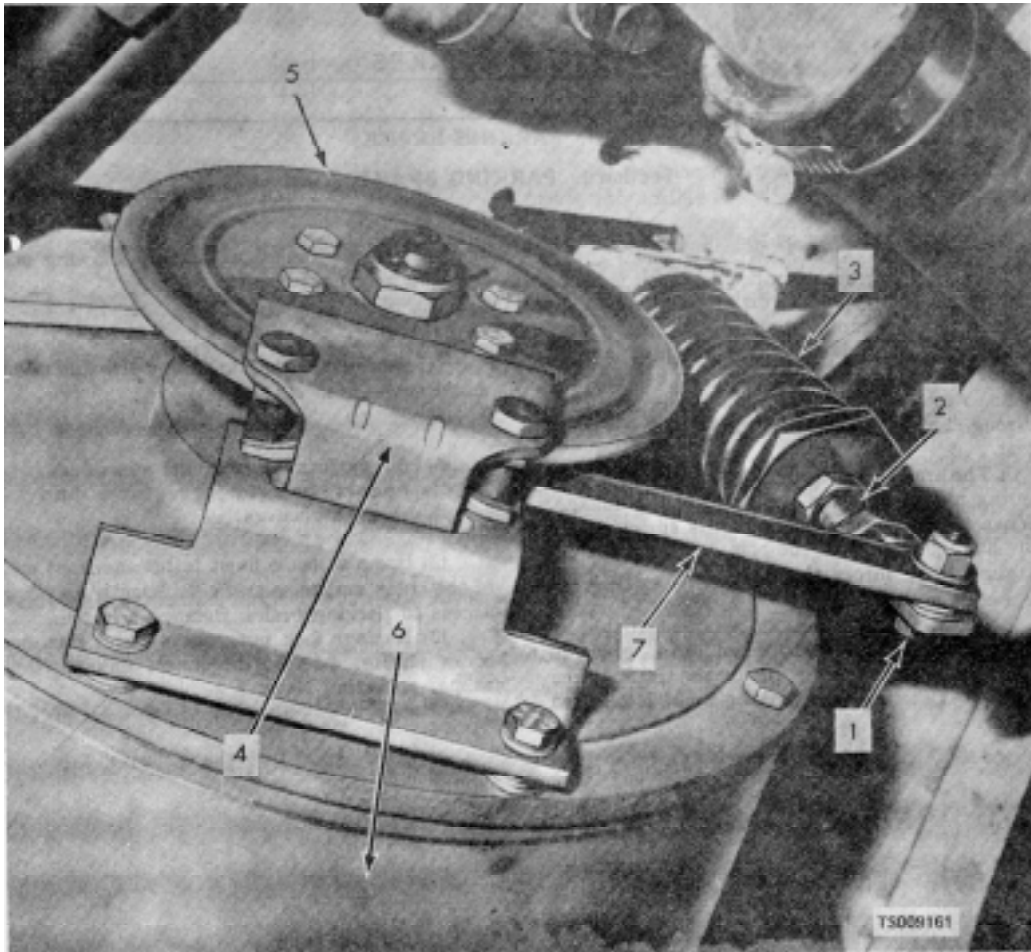
(1) Remove the floor and toe plates and sheet metal cover from below seat.

CAUTION

Before performing removal procedure, disconnect battery receptacle and discharge capacitors.

(2) Use a suitable hoist to lift the front end of the truck and raise truck sufficiently to allow access to parking brake. Remove drip pan.

(3) Remove lock nut, washer, and shoulder screw (1, fig. 4-1). to disconnect linkage from caliper actuating lever.



- | | |
|-------------------|--------------------|
| 1. Shoulder screw | 5. Brake disk |
| 2. Brake linkage | 6. Drive motor |
| 3. Spring | 7. Actuating lever |
| 4. Brake caliper | |

Figure 4-1. Parking brake, installed view.

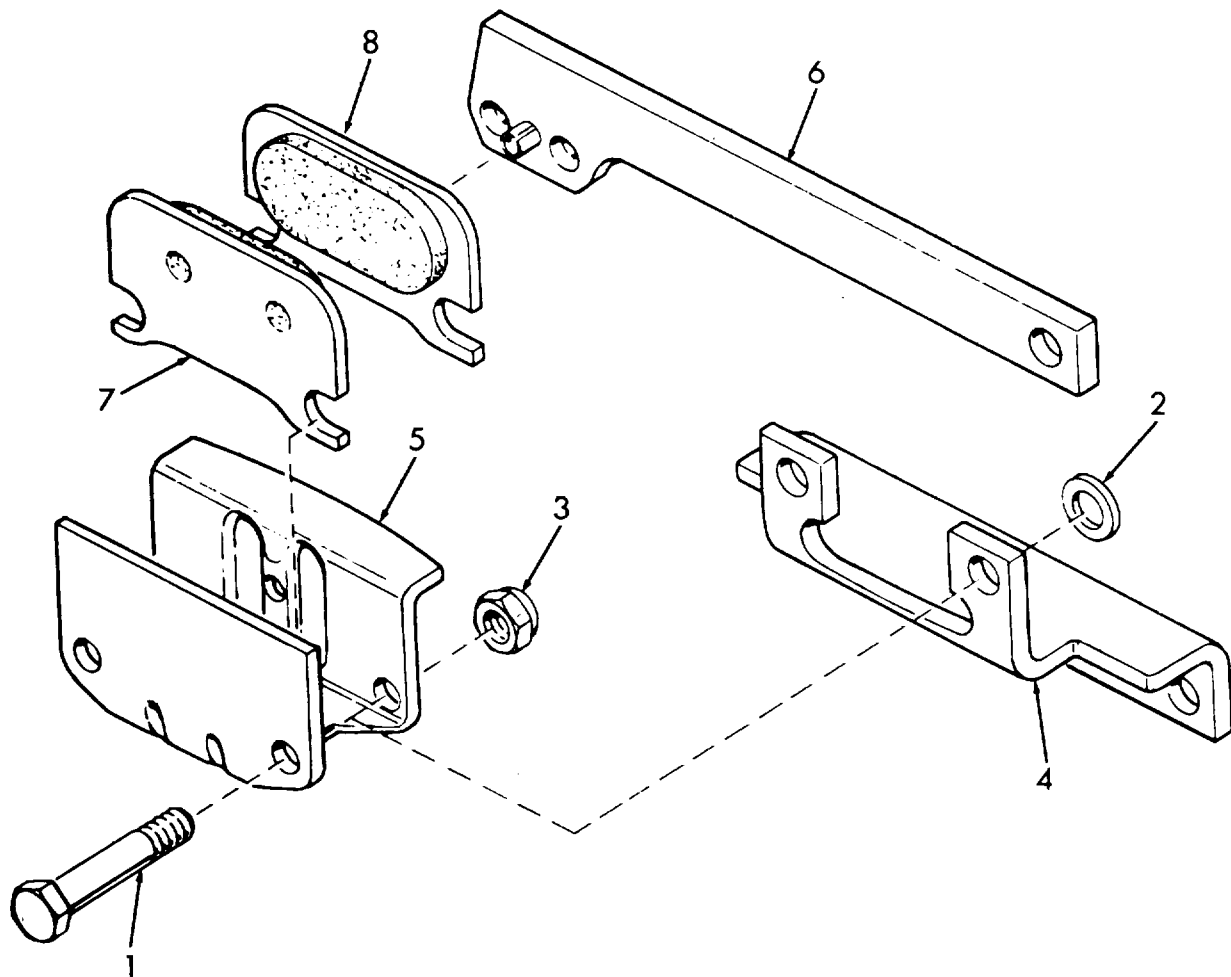
(3) Remove two screws securing brake caliper (4) to drive motor and remove caliper.

(4) Remove lock nut from drive motor shaft and remove disk (5) from motor.

(5) Refer to TM 10-3930-631-12 and remove linkage and bracket.

b. Disassembly.

(1) Remove lock nut (3, fig. 4-2), washer (2) and screw (1).



TS009162

1. Screw
2. Washer
3. Nut
4. Bracket

5. Secondary bracket
6. Actuating lever
7. Stator pad
8. Stator pad

Figure 4-2. Brake caliper assembly, exploded view.

(2) Separate brackets (4 and 5) and remove actuating lever (6) and pads (7 and 8).

c. Cleaning, Inspection and Repair.

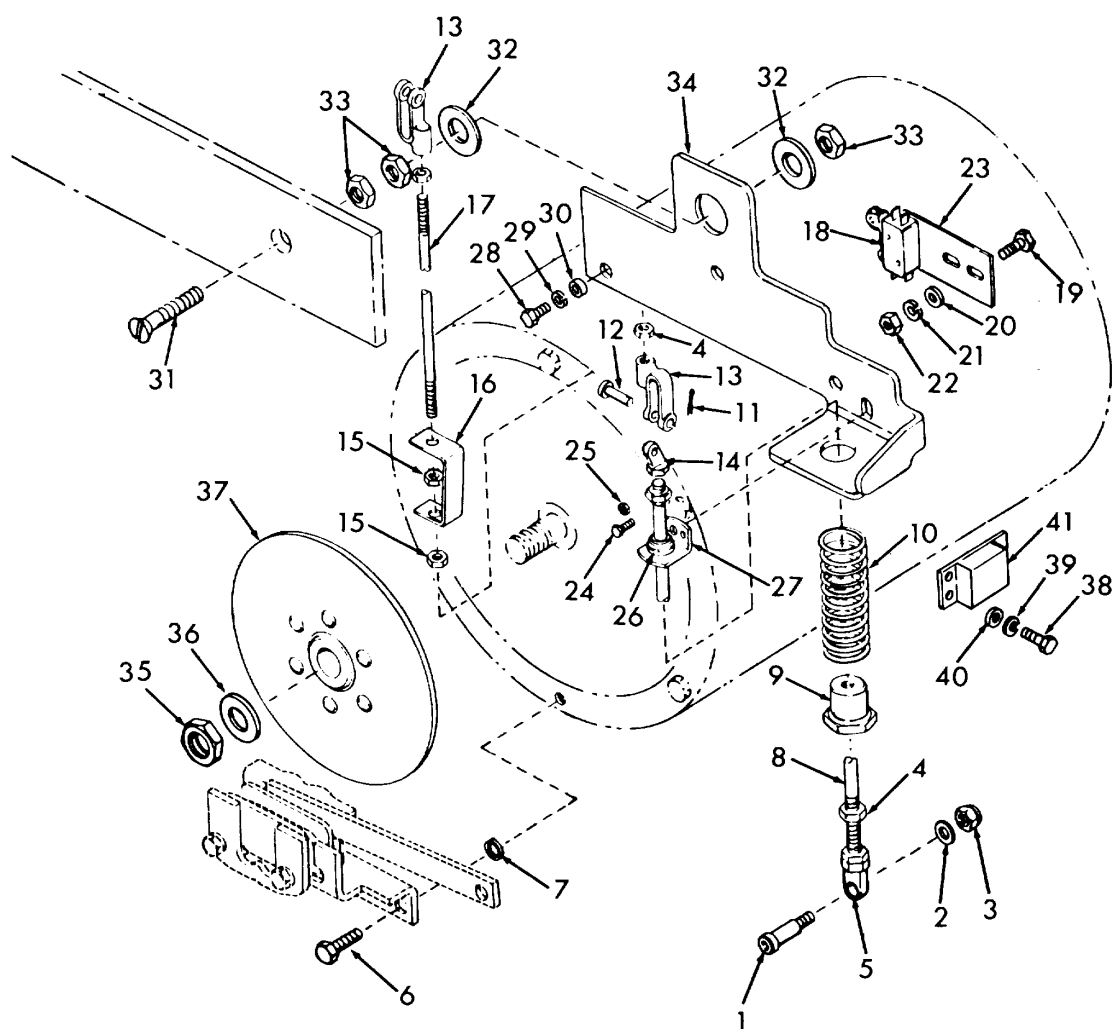
(1) Clean all parts except pads in cleaning compound, solvent (Fed. Spec. P-D-680). Dry thoroughly.

(2) Inspect stator pads and actuating lever for wear, damage and distortion.

(3) Inspect brake disk (37, fig. 4-3) for cracks, scoring and wear.

(4) Check spring (10, fig. 4-3) for cracks and evidence of stretching. Free length of spring should be 5-1/8 inches (130.1 mm). Solid height of spring should be 3 inches (76.2 mm).

(5) Replace worn, damaged or deteriorated parts.



TS009163

- | | | | |
|--------------------|---------------------|--------------------|--------------------|
| 1. Shoulder bolt | 12. Clevis pin | 22. Nut | 32. Spacing washer |
| 2. Washer | 13. Clevis | 23. Switch bracket | 33. Nut |
| 3. Lock nut | 14. Clevis | 24. Screw | 34. Bracket |
| 4. Jam nut | 15. Jam nut | 25. Nut | 35. Nut |
| 5. Clevis | 16. Switch actuator | 26. Bearing | 36. Washer |
| 6. Screw | 17. Rod | 27. Bracket | 37. Brake disk |
| 7. Washer | 18. Seat switch | 28. Screw | 38. Screw |
| 8. Rod | 19. Screw | 29. Lock washer | 39. Lock washer |
| 9. Spring retainer | 20. Washer | 30. Washer | 40. Washer |
| 10. Spring | 21. Lock washer | 31. Screw | 41. Thermal relay |
| 11. Cotter pin | | | |

Figure 4-3. Parking brake linkage, exploded view.

c. Assembly.

(1) Install stator pads (7 and 8, fig. 4-2) in secondary bracket (5).

(2) Install secondary bracket on bracket (4). Install screws (1), washers (2) and nuts (3) to secure parts. Do not tighten nuts.

(3) Insert disk (37) between stator pads.

(4) Tighten lock nuts (3) until stator pads almost make contact with disk but disk still moves freely between stators. Remove disk.

d. Installation.

(1) Install brake disk (5, fig. 4-1) on shaft of drive motor. Secure brake disk with nut (35, fig. 4-3) and washer (36).

(2) Install brake caliper (4, fig. 4-1) on drive motor housing and secure with screws (6, fig. 4-3). Install washer (7) between caliper and motor.

(3) Install shoulder screw (1, fig. 4-1) through actuating lever (7). Secure with washer and lock nut.

(4) Refer to TM 10-3930-631-12 and to install and adjust brake linkage

Section II. SERVICE BRAKES

4-3. Description

a. The hydraulic service brake system is of the full-floating, self-centering, self-adjusting type. Main components of the system are the brake pedal and linkage, master cylinder, wheel cylinders and brake assembly.

b. The mechanically actuated master cylinder transmits hydraulic pressure through heavy duty brake lines to wheel cylinders. The wheel cylinders are of the double ended type, with actuating links extending from each end. The links transmit movement from the cylinders to the brake shoes.

c. The top of each shoe rides freely in a wear plate while the bottom of the shoe is engaged by the wheel cylinder link.

d. Wear adjustment of brake linings is made automatically in normal use by the self-adjusting mechanism. The shoes are held against the brake wear plates, wheel cylinder links, and adjusting assemblies by tension springs which maintain the shoes in balance.

e. Two switches, actuated by hydraulic pressure, are mounted on the front of the master cylinder. The switches are normally open. When the brake pedal is depressed the master cylinder delivers hydraulic

pressure. This pressure closes the switches. One switch operates the stop and taillight mounted at the rear of the operator's seat to indicate the truck is stopping. The other switch is an interlock switch. When it is closed, current is bypassed from the potentiometer in the speed control box. Current to the control circuit module is cut off, no current is supplied to the drive motor and power movement is halted.

4-4. Brake Pedal and Linkage

a. Removal.

CAUTION

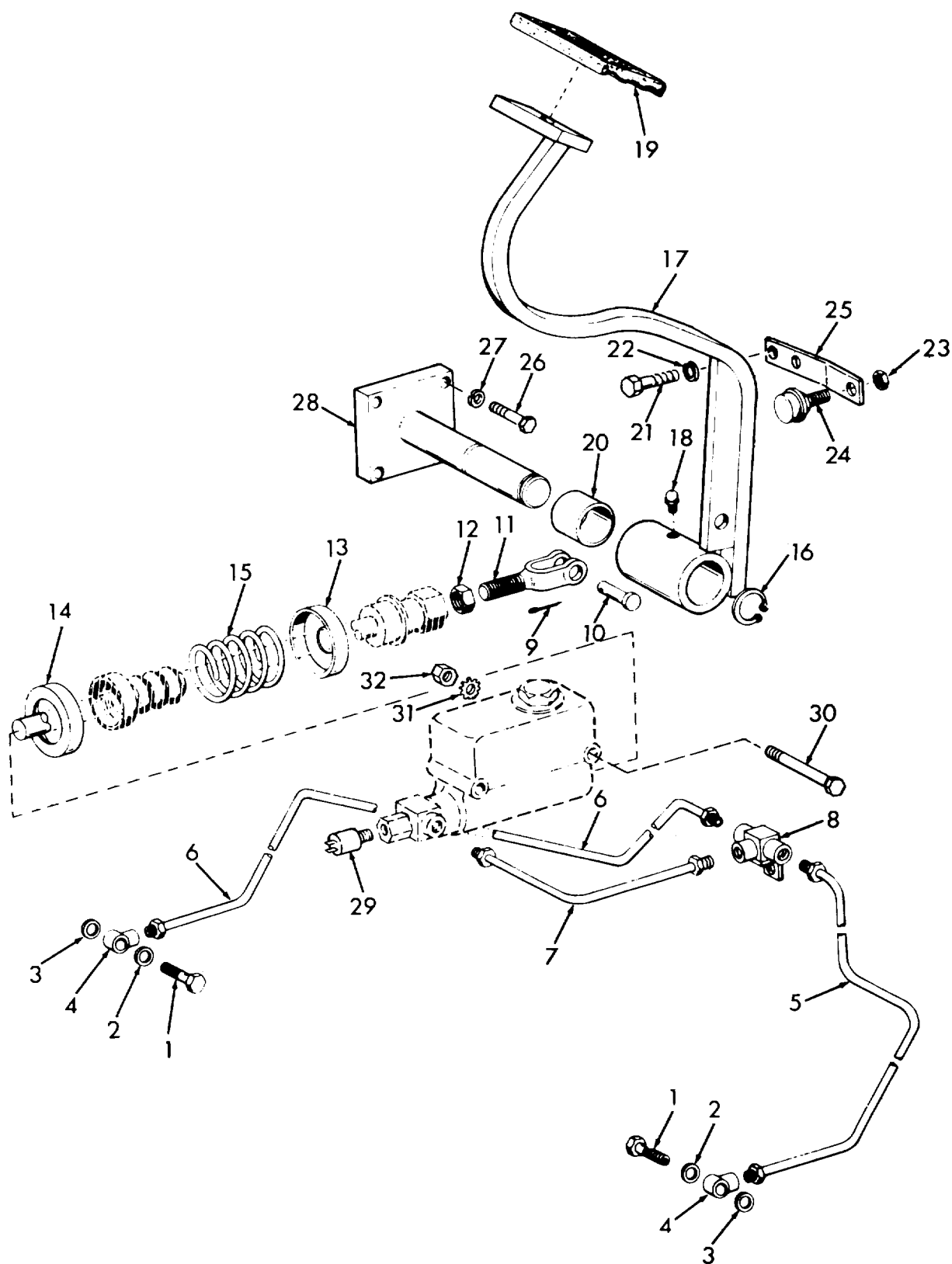
Before attempting any removal procedures, disconnect battery receptacle and discharge capacitors.

(1) Remove floor and toe plates to gain access to brake pedal and linkage.

(2) Refer to TM 10-3930-631-12 and remove brake master cylinder.

(3) Refer to paragraph 3-9 disconnect and remove brake lines from cylinder and wheels.

(4) Remove cotter pin (9, fig. 4-4) and clevis pin (10) to disconnect clevis (11) from brake pedal.



TS009164

Figure 4-4. Service brake linkage, exploded view.

KEY to fig. 4-4:

- | | |
|---------------------|-------------------------|
| 1. Fitting bolt | 17. Brake pedal |
| 2. Gasket | 18. Lubrication fitting |
| 3. Gasket | 19. Brake pad |
| 4. Fitting | 20. Sleeve bearing |
| 5. Brake line | 21. Screw |
| 6. Brake line | 22. Lock washer |
| 7. Brake line | 23. Nut |
| 8. Tee | 24. Bumper |
| 9. Cotter pin | 25. Bracket |
| 10. Clevis pin | 26. Screw |
| 11. Clevis | 27. Lock washer |
| 12. Jam nut | 28. Support |
| 13. Spring retainer | 29. Switch |
| 14. Spring retainer | 30. Screw |
| 15. Spring | 31. Lock washer |
| 16. Retaining ring | 32. Nut |

(5) Remove retaining ring (16) and remove pedal assembly from support.

(6) Remove nuts (23) and remove bumper (24). If necessary to replace bracket, remove screws (21) and lock washers (22) and remove bracket (25).

(7) Check support (28) and if worn or damaged remove screws (26) and lock washers (27) and remove support from frame.

b. Disassembly.

(1) Remove pedal pad (19, fig. 4-4) if worn or damaged.

(2) Remove lubrication fitting (18) from pedal.

(3) Use a suitable press and press two sleeve bearings (20) from pedal.

c. Cleaning, Inspection and Repair.

(1) Clean all parts except rubber bumper in cleaning compound, solvent (Fed. Spec. P-D-680) and dry thoroughly.

(2) Inspect parts for wear, cracks and other damage.

(3) Check return spring (15, fig. 4-4) for cracks and damage. Free length should be 4.25

inches (107.9 mm). Length with 20.85 pounds of pressure applied should be 2.812 inches (71.4 mm).

(4) Replace worn and damaged parts.

d. Assembly.

(1) Press new sleeve bearings (20, fig. 4-4) in bore of brake pedal. Install lubrication fitting (18).

(2) Install brake pad (19) on brake pedal.

e. Installation.

(1) Install support (28, fig. 4-4) in position on left wall of frame and secure support with screws (26) and lock washers (27).

(2) If removed, install one retaining ring (16) in groove of shaft. Slide brake pedal assembly on shaft and secure with second retaining ring.

(3) Install bracket (25) on front frame and secure with screws (21) and lock washers (22). Install bumper (24) in bracket and secure with two jam nuts (23).

(4) Align clevis (11) with holes in brake pedal and secure with clevis pin (10) and cotter pin (9).

(5) Refer to TM 10-3930-631-12 and install brake master cylinder.

(6) Refer to paragraph 2-9 and install brake lines.

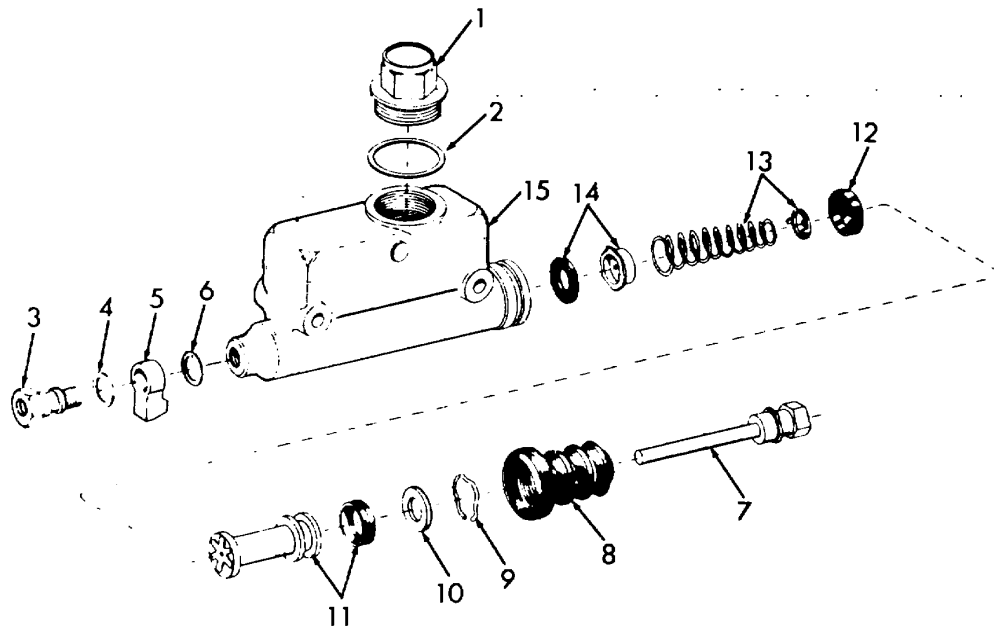
4-5. Master Cylinder

a. Removal. Refer to TM 10-3930-631-12 and remove the master cylinder.

b. Disassembly.

(1) Secure master cylinder assembly in a vise. To prevent damage or distortion of cylinder body do not overtighten vise.

(2) Remove filler cap (1, fig. 4-5) and gasket (2). Remove fittings (3 and 5) and gaskets (4 and 6).



TS009165

- | | | |
|---------------|-----------------------|---------------------|
| 1. Filler cap | 6. Gasket | 11. Piston assembly |
| 2. Gasket | 7. Piston rod | 12. Cup |
| 3. Fitting | 8. Boot | 13. Spring assembly |
| 4. Gasket | 9. Lock | 14. Valve assembly |
| 5. Fitting | 10. Piston stop plate | 15. Body |

Figure 4-5. Master cylinder, exploded view.

(3) Remove push rod (7) and boot (8). Carefully pry out lock (9).

CAUTION

When lock is removed, spring tension is released and parts may fly out if not held in place.

(4) Remove stop (10), piston assembly (11), cup (12) and spring and valve assemblies (13 and 14) from cylinder body (15).

e. Cleaning, Inspection and Repair.

(1) Wash parts thoroughly in denatured alcohol or clean brake fluid. Do not use mineral base solvents which will deteriorate rubber parts.

(2)

Inspect bore of cylinder body. Check intake and bypass ports, clean if necessary. Remove pressure marks and discoloration from bore with fine crocus cloth. Deep blemishes must be removed by honing as follows:

(a) Secure body securely in a bench vise.

(b)hone body as necessary, removing material in single passes. Remove hone and in-

spect bore after each pass. Remove only enough material to recondition cylinder bore.

(c) If master cylinder has been honed to an inside diameter greater than 1.007 inch (25.27 mm), replace body.

(d) After honing, wash body in warm water and a soap solution.

(e) Check intake and bypass ports to be certain they are open and free of burs.

(f) Rinse body in clean warm water and blow dry with compressed air. After drying immediately immerse body in clean hydraulic brake fluid.

(3) Inspect all parts for wear, corrosion and damage. Replace all unserviceable parts. Install all new parts contained in repair kit for cylinder.

d. Assembly.

(1) Lubricate all parts with clean hydraulic fluid.

(2) Install valve assembly (14, fig. 4-5) in bore in body (15). Install spring assembly (13) in

bore with large end of spring towards cylinder outlet.

(3) Depress spring and place cup (12) and piston assembly (11) in bore. Hold spring depressed and install stop (10) and secure parts in bore with lock (9).

(4) Install fittings (3 and 5) and new gaskets (4 and 6) at body outlet. Install filler cap (1) and new gasket (2).

(5) Install boot (8) and push rod (7).

e. *Installation.* Refer to TM 10-3930-631-12 to

install brakemaster cylinder, fill cylinder and bleed brake system.

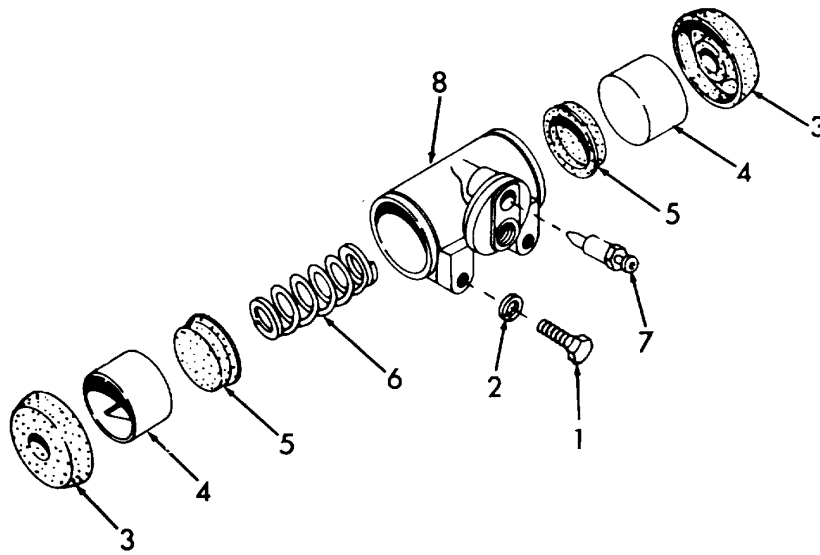
4-6. Wheel Cylinder

a. *Removal.* Refer to TM 10-3930-631-12 and remove the wheel cylinder.

b. *Disassembly.*

(1) Remove boots (3, fig. 4-6) and push pistons (4), cups (5) and spring (6) from body.

(2) Remove bleed screw (7) from body.



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- | | |
|----------------|----------------|
| 1. Screw | 5. Cup |
| 2. Lock washer | 6. Spring |
| 3. Boot | 7. Bleed screw |
| 4. Piston | 8. Body |

Figure 4-6. Wheel cylinder, exploded view.

c. *Cleaning, Inspection and Repair.*

(1) Wash parts thoroughly in denatured alcohol or clean brake fluid. Do not use mineral base solvents which will deteriorate rubber parts.

(2) Inspect bore of cylinder body. If bore is scratched, pitted or marked, remove imperfections by honing as follows:

(a) Secure body securely in a bench vise.

(b) Coat cylinder bore with hydraulic fluid. Hone body as necessary, removing material in single passes. Remove hone and inspect bore after each pass. Remove only enough material to recondition cylinder bore.

(c) If bore has been honed to an inside

diameter of more than 1.507 inches (38.3 mm), replace body.

(d) After honing, wash body in warm water and soap solution.

(e) Rinse body in clean warm water and blow dry with compressed air. After drying immediately immerse body in clean hydraulic brake fluid.

(3) Inspect all parts for wear, corrosion and damage. Replace all unserviceable parts. Install all new parts contained in repair kit for cylinder.

d. *Assembly.*

(1) Lubricate all parts and cylinder walls with hydraulic fluid.

(2) Install spring (6, fig. 4-6) in body (8) and install a cup (5) and a piston (4) in each end.

(3) Install boots (3). Boots must be properly located in grooves in body.

(4) Install bleed screw (7) in body.

e. *Installation.* Refer to TM 10-3930-631-12 and install wheel cylinder.

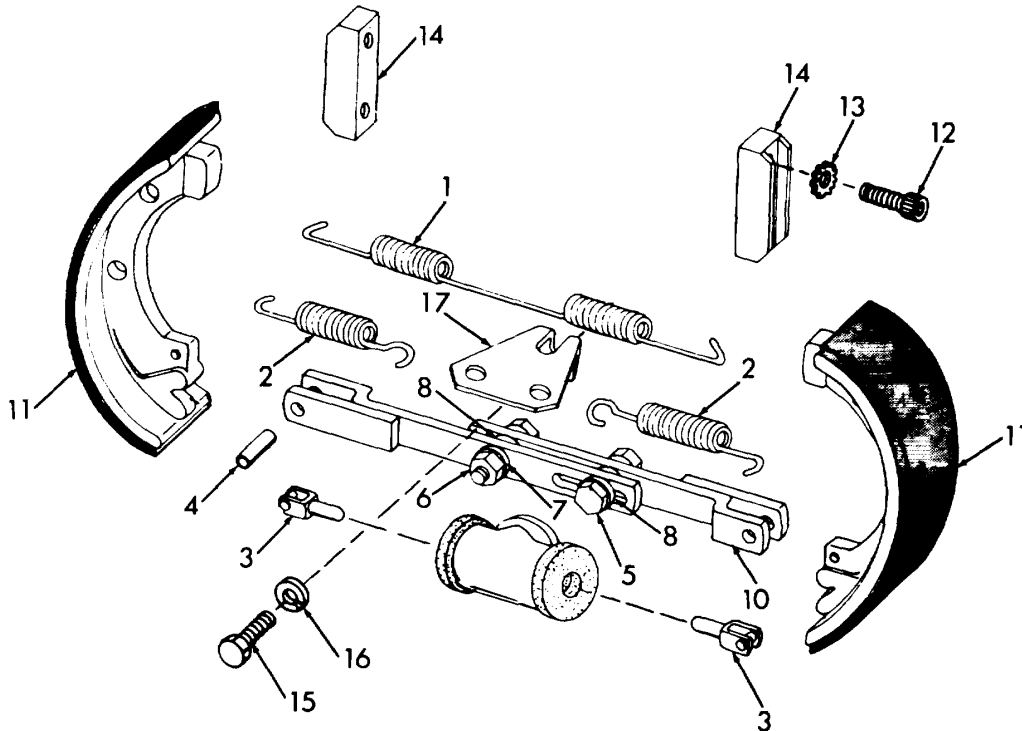
4-7. Brake Assembly and Brake Drum

a. *Removal.* Refer to TM 10-3930-631-12 and

remove front wheels, wheel cylinder, brake assembly and disassemble front wheel.

b. *Inspection and Repair.*

(1) Refer to TM 10-3930-631-12 for F procedures on repair and replacement for brake shoes (11, fig. 4-7) and brake adjuster assembly (10).



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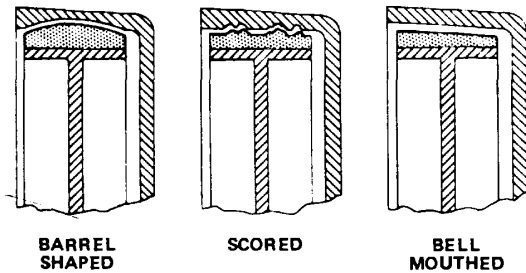
- | | | |
|------------------|-----------------------|-----------------|
| 1. Upper spring | 7. Lock washer | 13. Lock washer |
| 2. Lower spring | 8. Nylon washer | 14. Wear plate |
| 3. Cylinder link | 9. Slide | 15. Screw |
| 4. Pin | 10. Adjuster assembly | 16. Lock washer |
| 5. Screw | 11. Brake shoe | 17. Bracket |
| 6. Nut | 12. Screw | |

Figure 4-7. Service brake, exploded view.

(2) Inspect and repair brake drum (part of wheel 18, fig. 3-16) as follows:

(a) Check inside diameter of brake drum at points 45 degrees apart. Resurface drum if measurements differ more than 0.010 inch (0.254 mm).

(b) Inspect lining wear pattern (fig. 4-8). Resurface or replace bell mouthed or barrel shaped drums. Scored drums should be resurfaced if scoring is over 0.010 inch (0.254 mm) deep. Resurface drums that are heat checked.



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Figure 4-8. Improper lining wear.

(c) If drums do require resurfacing, resurface both drums. Finish grind or hone drums

to remove tool marks, to prevent excessive lining wear and to avoid runout when brakes are applied.

(d) Do not remove more than 0.050 inch (1.27 mm) from a drum. Replace drum requiring deeper resurfacing. Maximum inside diameter after resurfacing should not exceed 11.053 inches (280.74 mm).

(3) Check springs for cracks and brittleness. Upper return spring (1, fig. 4-7) should have a free length of 7.5 inches (190.5 mm) inside hooks, initial tension should be 30 pounds and initial stretch 0.5 inch (12.7 mm). Lower spring (2) should have a free length of 3.0625 (77.7 mm) inside hooks, initial tension of 30 pounds and initial stretch of 0.25 inch (6.35 mm). Replace unserviceable springs.

(4) Inspect links (3) for cracks or damage. Replace links if necessary.

c. *Installation.* Refer to TM 10-3930-631-12 and install wheel cylinders, brake assemblies and front wheels.

CHAPTER 5

REPAIR OF STEERING- SYSTEM

Section I. DESCRIPTION AND PRESSURE CHECK

5-1. Description

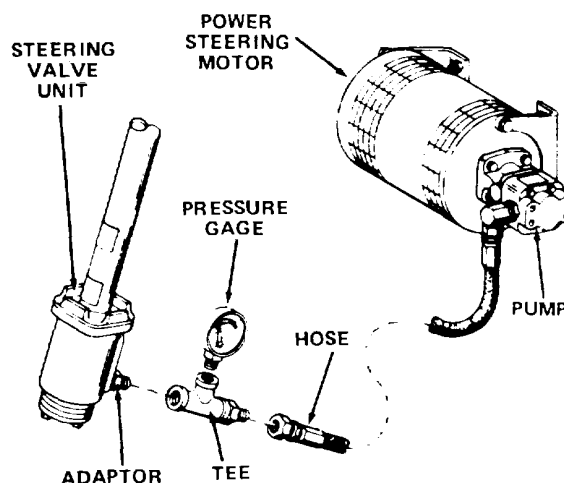
a. The steering system of the lift truck is hydraulically powered. A separate hydraulic pump supplies pressure to actuate the system (fig. 3-1).

b. Main components of the system are the steering hydraulic pump, the steering valve unit and the steering cylinder. Oil for the system is supplied from the main hydraulic reservoir. Rotation of the steering wheel opens ports in the steering valve unit and transmits pressure to the cylinder. The piston in the cylinder moves under the pressure, extending or retracting the cylinder rod. The cylinder rod is connected to a drag link which in turn actuates the steering axle pivot arm. Movement of the pivot arm pulls or pushes the tie rods which are attached to the spindles. As the wheels are mounted on the spindles the wheels turn guiding the truck in the direction desired.

5-2. Steering Pressure Check and Adjustment

a. *Pressure Check.* Check and adjust system pressure as follows:

- (1) Drive truck up on ramp or raise truck on a suitable lift to gain access to pump.
- (2) Remove floor and toe plates to gain access to the steering valve unit.
- (3) Disconnect the pressure hose from the pump to the adaptor in the steering valve unit at the adapter.
- (4) Install a suitable tee fitting as shown in figure 5-1 at the adapter. Install a pressure gage (0-3000 psi) (0-210.9 kg/cm²) in the tee.



TS009169

Figure 5-1. Pressure gage location.

(5) Connect the battery, depress the seat to close the switch and turn the master switch on. Pump motor will run continuously while master switch is on and seat is occupied.

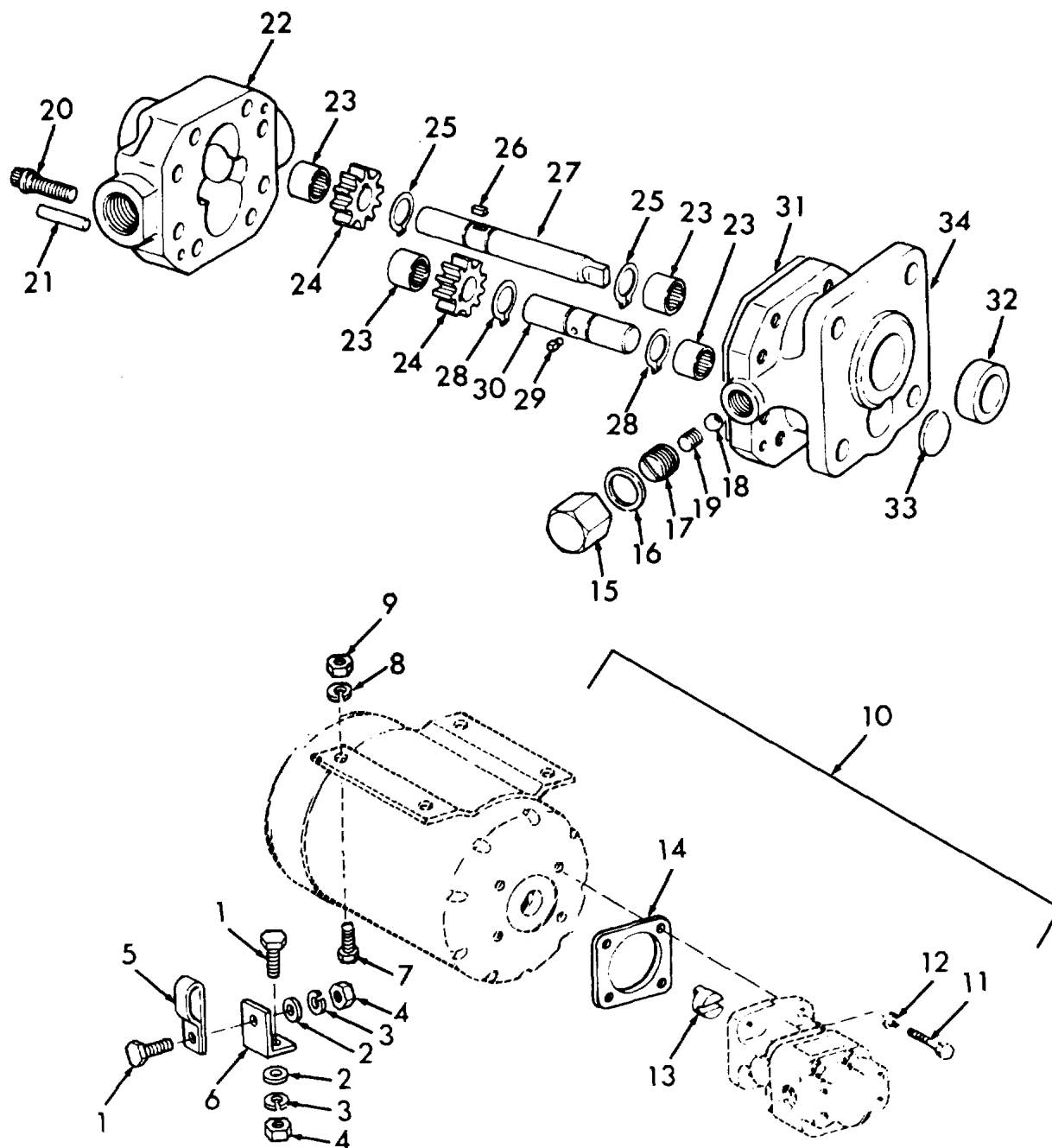
(6) Turn wheel right or left and place a block between spindle and steer axle. Turn steering wheel to force steering wheel against block. Observe needle on pressure gage. If pressure of

900-1100 psi (63.2-77.3 kg/m²) is not obtained, pump pressure relief valve must be adjusted.

b. Pressure Adjustment.

(1) The power steering pump is mounted on the frame forward and above the steering axle.

(2) Remove cap nut (15, fig. 5-2) to gain access to adjusting screw (17).



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Figure 5-2. Power steering pump, exploded view.

KEY to fig. 5-2:

- | | |
|-----------------------------|------------------------------|
| 1. Screw | 18. Spring |
| 2. Washer | 19. Spring and ball assembly |
| 3. Lock washer | 20. Screw |
| 4. Nut | 21. Pin |
| 5. Clamp | 22. Housing |
| 6. Bracket | 23. Bearing |
| 7. Screw | 24. Gear |
| 8. Lock washer | 25. Retaining ring |
| 9. Nut | 26. Key |
| 10. Pump and motor assembly | 27. Shaft |
| 11. Screw | 28. Retaining ring |
| 12. Lock washer | 29. Pin |
| 13. Coupling | 30. Shaft |
| 14. Gasket | 31. Shim |
| 15. Cap nut | 32. Seal |
| 16. Gasket | 33. Plug |
| 17. Adjusting screw | 34. Pump stator |

(3) Turn adjusting screw clockwise to increase pressure and counterclockwise to decrease pressure. Adjust screw until pressure is within limits described above.

(4) Install cap nut on pump and lower truck from lift or ramp. Remove block from spindle.

(5) Turn off master switch, disconnect battery receptacle and discharge capacitors.

(6) Remove gage and tee fitting from adapter on steering valve unit. Connect pressure hose to steering valve unit.

(7) Install floor and toe plates on truck.

Section II. STEERING PUMP AND CYLINDER

5-3. Power Steering Pump

a. *Removal.* Refer to paragraph 2-11. and remove the power steering pump from the truck.

b. *Disassembly.*

(1) Remove cap nut (15, fig. 5-2), gasket (16), adjusting screw (17), spring (18) and spring and ball (19) from pump stator.

(2) Place pump in a vise. Remove screws (20) and separate stator from housing. If necessary, break housing loose by tapping with a soft hammer. Remove shims (31).

(3) Remove retaining rings (25) from drive shaft (27) and remove gear (24) and key (26) from shaft. Remove drive shaft.

(4) Remove idler shaft (30), with gear attached, from gear housing. Remove retaining rings (28) and remove gear (25) and pin (29) from shaft.

(5) Use a suitable puller and pull oil seal (32) from stator (34). Discard oil seal.

c. *Cleaning, Inspection and Repair.*

(1) Clean all parts in cleaning compound, solvent, (Fed. Spec. P-D-680). Dry thoroughly.

(2) Inspect bearing (23, fig. 5-2) for wear and damage. Replace bearings if worn or damaged. Remove bearings with a suitable bearing puller.

(3) Inspect surfaces of gear pockets and gears for scoring and wear. Inspect gear teeth for wear and galling. Replace unserviceable gears. If gear pockets in housing or stator are worn or scored, replace entire pump.

(4) Inspect idler shaft and drive shaft for wear on bearing and oil seal surfaces. Inspect idler shaft pin and key for damage. Replace unserviceable parts.

(5) Inspect relief valve spring assembly for bent or damaged spring and worn or damaged ball. Check seating of ball in stator. If parts are

damaged or worn or ball does not seat properly, replace parts.

(6) Inspect coupling (13) for wear and damage. Replace worn or damaged coupling.

d. *Assembly.*

(1) Coat all parts with clean hydraulic oil (OE) before assembly.

(2) Press or install new oil seal (32, fig. 6-2) in stator.

(3) If bearings (23) were removed, install new bearings in housing and stator. Press bearings in with an arbor press. Apply pressure to bearing only on the end with bearing number stamped on it.

(4) Lubricate drive shaft (27) with oil (OE) and install drive shaft through oil seal in pump stator (34). Use extreme care to avoid damage to sealing lip of oil seal.

(5) Install one retaining ring (25) in groove on shaft. Install key (26) and gear (24) on shaft. Secure gear with remaining retaining ring (25).

(6) Install pin (29) in idler shaft (30) and install one retaining ring (28) in groove on shaft. Install gear (24) on shaft over pin and secure gear with remaining retaining ring (28).

(7) Position idler shaft assembly in gear housing (22) and mesh gear teeth with gear (24).

(8) Measure running clearance between gears and gear housing. Running clearance should be 0.0008 to 0.0013 inch (0.020-0.033 mm). Select the proper thickness of shims (31) to give correct clearance.

(9) Position shims (31) between gear housing and stator and install stator on housing. Secure stator to housing with screws (20). Tighten screws to a torque of 108 to 130 pound feet (14.9- 17.9 m/kg). Check pump drive shaft. Shaft should rotate freely.

(10) Install spring and ball assembly (19), spring (18), adjusting screw (17), new gasket (16) and cap nut (15).

e. Installation.

(1) Refer to paragraph 2-11 and install steering pump and motor.

(2) Refer to paragraph 5-2 and check and adjust steering pressure.

54. Power Steering Cylinder and Drag Link

a. Removal. Refer to TM 10-3930-631-12 and remove the power steering cylinder and drag link. Remove screws (4, fig. 5-3), lock washers (5) and nuts (6) and remove anchor (7) from frame.

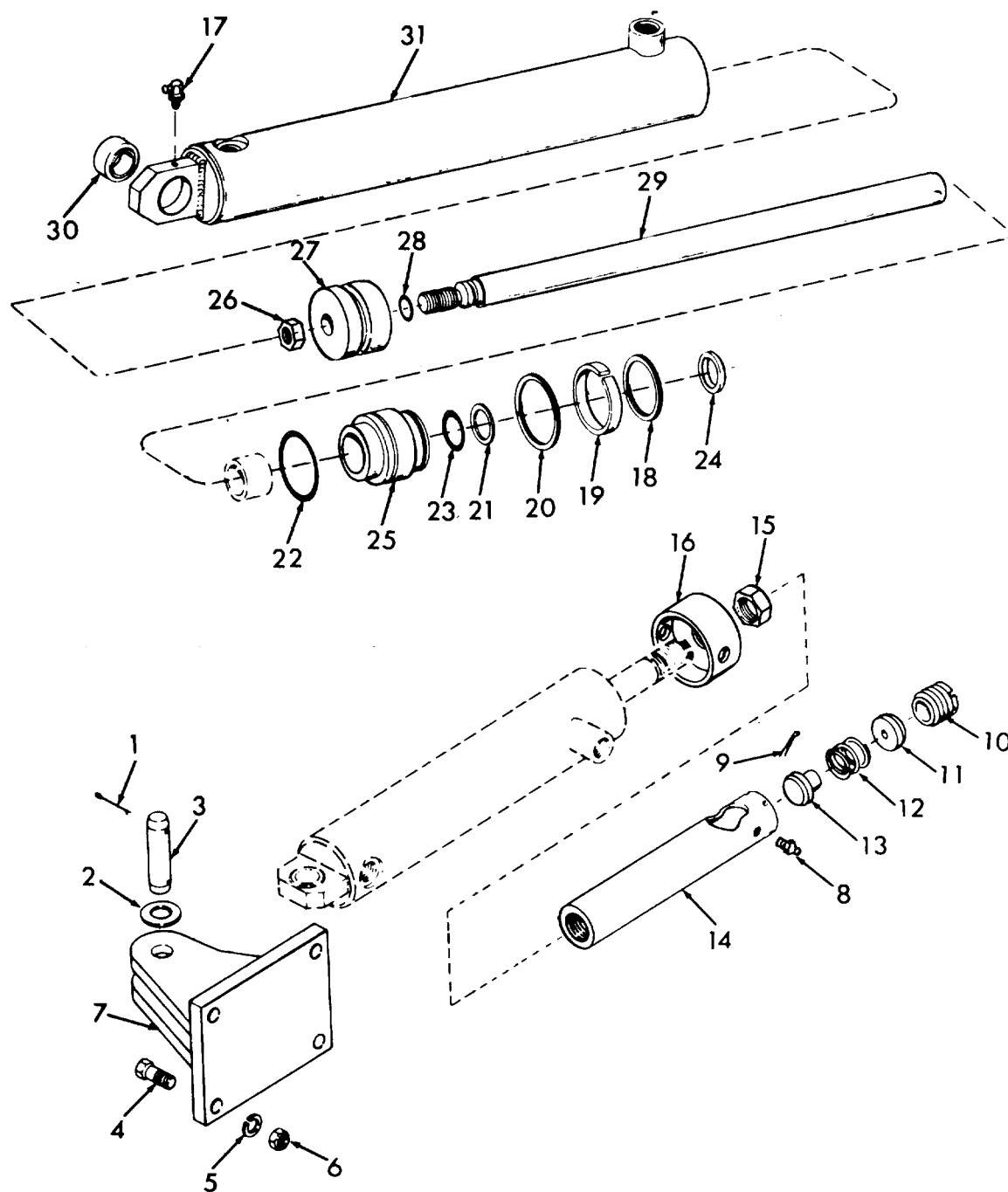
b. Disassembly.

(1) Remove nut (15, fig. 5-3) and remove spacer (16) from cylinder rod.

KEY to fig. 5-3:

1. Cotter pin
2. Washer
3. Pin
4. Screw
5. Lock washer

6. Nut
7. Anchor
8. Lubrication fitting
9. Cotter pin
10. Plug
11. Seat
12. Spring
13. Socket plug
14. Socket
15. Nut
16. Spacer
17. Lubrication fitting
18. Lock ring
19. Spacer
20. Lock ring
21. Seal
22. Packing
23. Backup washer
24. Wiper
25. Head
26. Nut
27. Piston
28. Seal
29. Rod
30. Bearing
31. Tube



TS009171

Figure 5-3. Steering cylinder and drag link.

(2) Remove lock ring (18), spacer (19) and lock ring (20). Pull piston rod, with attached parts from cylinder tube.

(3) Remove nut (26), piston (27) and seal (28) from rod (29). Be careful not to scratch piston or rod.

(4) Remove head (25) from rod and remove seal (21), packing (22), backup washer (23) and wiper (24) from head.

(5) If drag link has not been disassembled, remove plug (10), seat (11), spring (12) and socket plug (13) from socket. Remove lubrication fittings (8 and 17) from socket and tube.

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in cleaning compound, solvent (Fed. Spec. P-D-680) and dry thoroughly.

(2) Inspect tube bore, rod, head, and piston for cracks, scratches, scoring or other damage. Repair or replace damaged parts.

(3) Inspect socket for cracks, dents and other damage. Check spring. Spring should have a free length of 0.7031 inch (17.6 mm). At 210 to 260 pound load length should be 0.5156 inch (13.1 mm). Replace damaged or unserviceable parts.

(4) Inspect bearing (30, fig. 5-3) in tube flange for wear or damage. If bearing is worn or damaged, press old bearing from tube using new bearing as a pilot. Press new bearing in place.

(5) Replace all parts in cylinder which are contained in the cylinder repair kit.

d. Assembly.

(1) Install socket plug (13), spring (12), seat (11) and plug (10) in socket (14). Install cotter pin (9) and lubrication fitting (8).

(2) Install lubrication fitting (17) in tube (31). Install seal (28) on rod (29) and install piston (27) on rod. Secure piston on rod with nut (26).

(3) Install rod with piston in cylinder tube. Place packing (22), backup washer (23) and seal (21) in grooves in head. Install head in tube over rod.

(4) Secure head in tube with lock rings (18 and 20) and spacer (19).

e. Installation.

(1) Install cylinder anchor (7, fig. 5-3) in position on left side of frame and secure anchor with screws (4), lock washers (5) and nuts (6).

(2) Refer to TM 10-3930-631-12 and install steering cylinder and drag link.

Section III. STEERING VALVE UNIT AND HYDRAULIC LINES

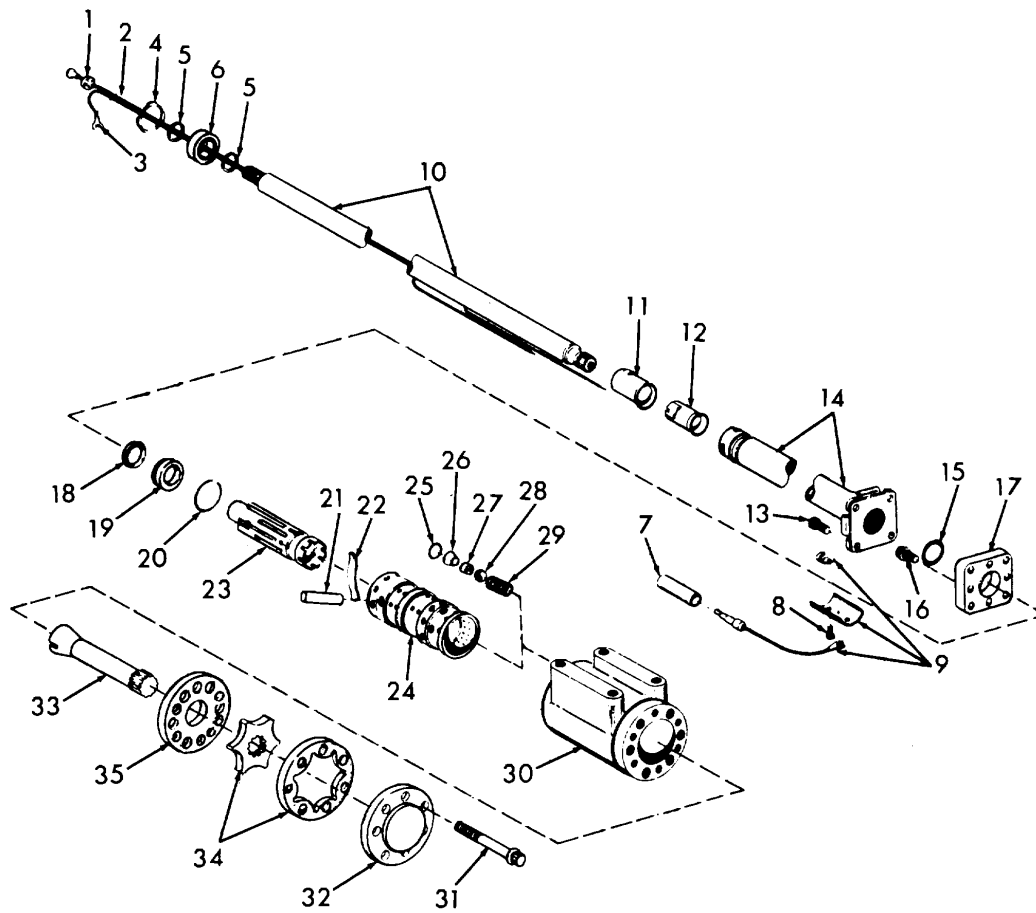
5-5. Steering Valve Unit

a. Removal. Refer to paragraph 2-11 and remove the steering valve unit from the truck.

b. Disassembly.

(1) Refer to TM 10-3930-631-12 and remove the steering wheel from the valve column.

(2) Remove insulator (1, fig. 5-4) and pull leads (2 and 3) from the steering column.



TS009172

- | | | | | |
|--------------------|-------------------|-------------------|----------------------|-------------------|
| 1. Insulator | 8. Screw | 15. Seal | 22. Centering spring | 29. Spring |
| 2. Electrical lead | 9. Brush assembly | 16. Screw | 23. Spool | 30. Housing |
| 3. Electrical lead | 10. Shaft | 17. Plate | 24. Sleeve | 31. Screw |
| 4. Retaining ring | 11. Contact ring | 18. Seal | 25. Packing | 32. Cap |
| 5. Retaining ring | 12. Insulator | 19. Bushing | 26. Plug | 33. Gear |
| 6. Bearing | 13. Screw | 20. Packing | 27. Seat | 34. Gerotor set |
| 7. Connector | 14. Flanged tube | 21. Centering pin | 28. Ball | 35. Gerotor plate |

Figure 5-4. Steering valve unit, exploded view.

(3) Remove retaining rings (4 and 5) and push shaft free of bearing. Remove bearing (6) and second retaining ring (5).

(4) Mark location of screws (13) and remove

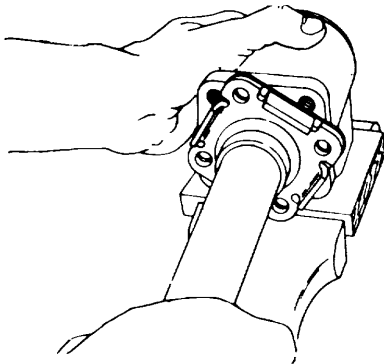
screws. Remove steering column from lower valve unit.

(5) Remove screws (8) and remove brush

assemblies (9). Remove ring (11) and insulator (12) from shaft (10) and flange (14).

(6) Clamp valve unit in a vise and remove screws (31). Remove cap (32), gerotor set (34), plate (35) and drive gear (33) as a unit.

(7) Remove unit from vise and insert splined end of column assembly into lower unit as shown in figure 5-5. Rotate shaft to check for free rotation of control spool and sleeve parts. Spool should rotate freely.



TS009173

Figure 5-5. Checking spool rotation.

(8) Place a wooden block in vise to support spool parts. Clamp unit across port face with control end up. Remove screws (16, fig. 5-4). Hold the spool assembly down against the wooden block and remove mounting plate (17). Remove seals (15 and 18) and discard seals. Remove bushing (19) and packing (20). Discard packing.

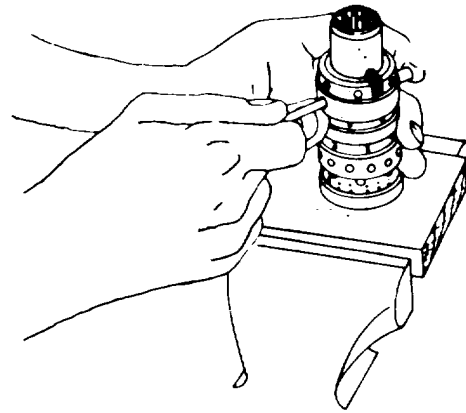
(9) Place housing securely on a solid surface with the port face down. Remove pin (21), spring (22), spool (23) and sleeve (24) as an assembly. Use care when removing assembly. Parts are closely fitted and must be rotated slightly as they are withdrawn.

(10) Use a small bent tool or wire and remove check valve plug (26) from housing. Do not pry against edge of hole in housing bore. Remove packing (25) and discard.

(11) Use a 3/16 inch (4.76 mm) hex wrench and remove check valve seat (27) from housing.

(12) Turn the housing over and tap lightly to remove ball (28) and spring (29) from bore in housing.

(13) Hold the spool assembly (fig. 5-6) and push the cross pin (21, fig. 5-4) to loosen it from the spool and sleeve. Remove pin.



TS009174

Figure 5-6. Loosening spool assembly.

(14) Push inside lower edge of spool so spool moves toward splined end and remove spool (23) carefully from sleeve.

(15) Push centering spring (22) out of spool.

(16) Remove gear (33), gerotor set (34) and plate (35) from end cap (32).

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in cleaning compound, solvent (Fed. Spec. P-D-680). Place parts on clean lint free cloth or paper and allow to air dry.

(2) Inspect surfaces of all moving parts for scoring and other damage.

(3) Slightly scored parts can be cleaned by hand rubbing with fine abrasive paper.

(4) Prepare surfaces of gerotor set and plates as follows:

(a) Place a sheet of fine (600 grit) abrasive paper, face up, on a piece of plate glass or similar smooth, flat surface.

(b) Clean ends of star gear (part of gerotor set) by stroking it across the abrasive. This will remove any sharp grit which could scratch other components.

(c) Stroke each side of ring gear (part of gerotor set), both sides of gerotor plate and mounting plate and the inner side of end cap.

(d) Hold parts as flat as possible against the abrasive. Small bright areas on the faces indicate burs which must be removed. After 6 to 10 strokes across abrasive check to see if part is polished. All parts should have smooth polished surfaces. After polishing each part, clean in solvent and blow dry with air. Place parts in absolutely clean area to await assembly.

(5) Replace any defective, damaged or scored parts. Replace all seals and packings from kit provided.

e. Assembly

(1) Lubricate all parts with engine oil (OE),

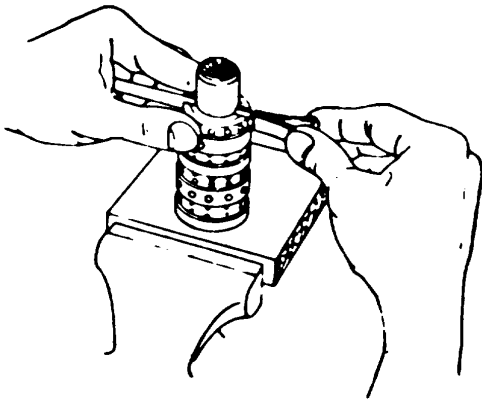
(2) Place housing (30) in a vise with upper end of housing facing up.

(3) Install check valve spring (20) in bore of housing with small end up. Install ball (28) into bore so that it rests on top of small end of spring. Check ball action by pressing ball against spring with a small pin.

(4) Place check valve seat (27) on hex wrench and install in housing. Machined counterbore of seat must seat on ball. Tighten seat to 150 pound inches (1.72 m/k).

(5) Install spool (23) into sleeve (24). Spring slots of both parts must be at the same end. Rotate spool carefully while sliding parts together. Check spool for free rotation. Spool must rotate freely.

(6) With spring slots in line, stand parts on end as shown in figure 5-7. Insert spring installation tool through slots in both parts.



TS009175

Figure 5-7. Installing centering spring set.

(7) Position three sets of centering springs on bench so that extended edge is down and arched center section are together. In this position install one end of spring set in installation tool.

(8) Compress extended end of centering springs and push into spool-sleeve assembly, withdrawing installation tool at the same time. Springs must be centered in parts so that springs

can be pushed down evenly and flush with upper surface of spool and sleeve.

(9) Install centering pin (21, fig. 5-4) and push into place until both ends are flush or slightly below sleeve diameter.

(10) Place housing on a solid surface with the port face down. Install spool assembly with splined end of spool entering fourteen hole end of housing first. Push parts into place with a slight rotating motion. Make certain parts do not cock out of position while installing.

(11) Install spool assembly into housing bore until flush with lower end of housing. When spool assembly is flush, check for free rotation by turning spool assembly. Hold parts in position and place on wooden block in vise. Clamp vise lightly on port face of housing.

(12) Install new packing (25) on check valve plug (26) and install plug in bore in housing. Press plug in with finger pressure, rocking it slightly to prevent cutting packing.

(13) Install bushing (19), large outside diameter of chamfer up, partially into housing. Rotate bushing to seat bushing flatly and smoothly against spool assembly.

(14) Install new seal (18) on bushing. Install new seal (15) in mounting plate (17). Push seals carefully into seal grooves. Install seal (15) with the seal lip up.

(15) Place mounting plate (17) over spool shaft and in place over cap locator bushing. Install carefully so as not to displace seals.

(16) Mounting plate must fit flush against housing assembly and locator bushing must not be cocked. Secure mounting plate with screws (13). Tighten screws to a torque of 250 pound inches (2.86 m/kg).

(17) Position housing in vise with lower end up. Spool assembly must be flush with surface of housing. Wipe surface of housing with hand to clean it. Install plate (35) on housing.

(18) Install gear ring (part of gerotor set (34)) on plate. Install splined end of drive gear (33) in splines of star gear with slot in splines aligned with valleys between star gear teeth.

(19) Push splined end of drive gear through star gear until approximately one-half of its length extends beyond star gear. Install star gear in gear ring and position parts so that drive gear remains in position with star gear. Rotate gear ring slightly to engage cross slot with centering pin in sleeve and splined end of drive gear against plate.

Note

Proper alignment of drive gear with valleys of star gear determines proper valve timing

(20) Place plate (35) on star gear. If plate

does not fit flush, drive is not properly aligned with centering pin. Adjust parts for proper installation.

(21) Install end cap (32) and loosely install screws (31). Gradually and evenly tighten screws to a torque of 150 pound inches (1.72 m/kg).

(22) Install ring (11) and insulator (12) on shaft. Install two brush assemblies (9) on tube and secure with screws (8). Install shaft (10) in tube and flange (14).

(23) Pull electrical leads (2 and 3) through shaft. Install tube and flange, with shaft, on housing with splines on shaft engaging splines of sleeve. Secure tube and flange with screws (16). Tighten screws to a torque of 280 pound inches (3.2 m/kg).

(24) Install one retaining ring (5) in groove of shaft. Install bearing (6) in position and secure with retaining rings (4 and 5). Install insulator (1) on electrical horn lead.

e. Installation.

(1) Refer to paragraph 2-11 and install steering valve unit on truck.

(2) Refer to TM 10-3930-631-12 and install steering wheel.

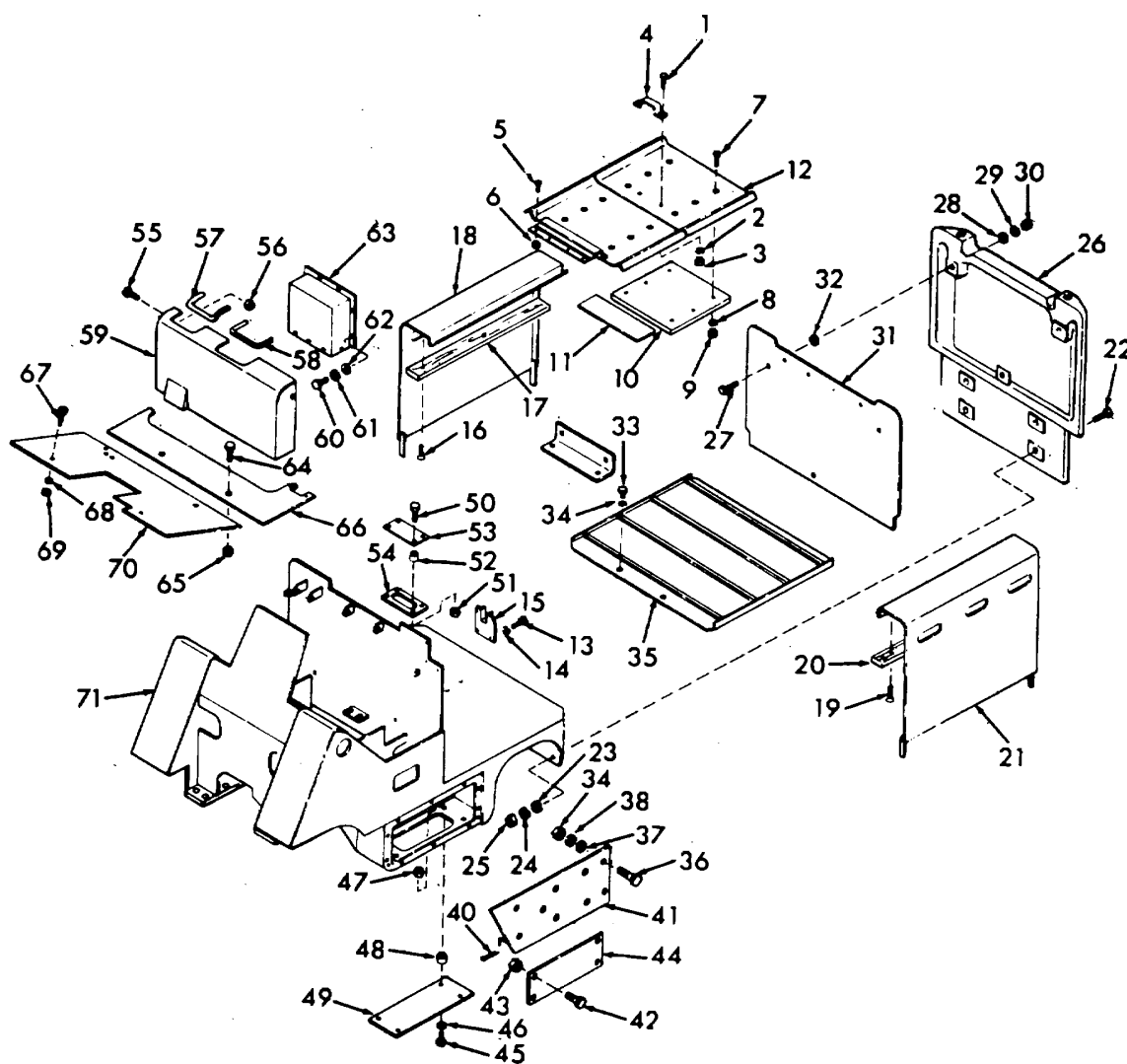
(3) If necessary, check steering system pressure (para 5-2).

5-6. Steering Hydraulic System

a. Description. The steering hydraulic system consists of the pump, steering valve unit and steering cylinder. Hydraulic oil is delivered to the components through hoses. The system is shown in figure 5-8.

KEY to fig. 5-8:

- | | |
|-------------------|--------------------|
| 1. Clamp | 12. Hose |
| 2. Hose | 13. Hose fitting |
| 3. Hose fitting | 14. Hose fitting |
| 4. Hose fitting | 15. Clamp |
| 5. Hose assembly | 16. Hose |
| 6. Hose fitting | 17. Screw |
| 7. Hose adapter | 18. Lock washer |
| 8. Packing | 19. Filter |
| 9. Hose assembly | 20. Filter element |
| 10. Hose assembly | 21. Bracket |
| 11. Clamp | |



TS009177

Figure 5-8. Steering hydraulic system, exploded view.

b. Removal.

CAUTION

Before attempting any removal procedures, disconnect battery receptacle and discharge capacitors. hydraulic system, exploded view.

(1) Remove hoses and fittings as necessary.

(2) To remove filter, remove screws (17, fig. 5-8) and lock washers (18).

c. Inspection and Repair.

(1) Inspect hoses for wear, damage, deteriorated condition and evidence of leakage.

(2) Inspect fittings for damage to body and threads.

(3) Replace unserviceable parts.

(4) Refer to TM 10-3930-631-12 to service hydraulic filter.

d. Installation.

(1) Install filter, if removed, and secure with screws (17, fig. 5-8) and lock washers (18).

(2) Install fittings and connect hoses.

CHAPTER 6

REPAIR OF FRAME AND COVERS

6-1. Description

a. The basic support of the lift truck components is the truck frame. The frame is of heavy duty steel and is of all welded construction. Compartments and brackets are built into the frame to contain and support the components.

b. Sheet metal covers and doors enclose the compartments to provide protection from weather and damage. The main covers are hinged or slip out with ease. Important covers are bolted to the frame.

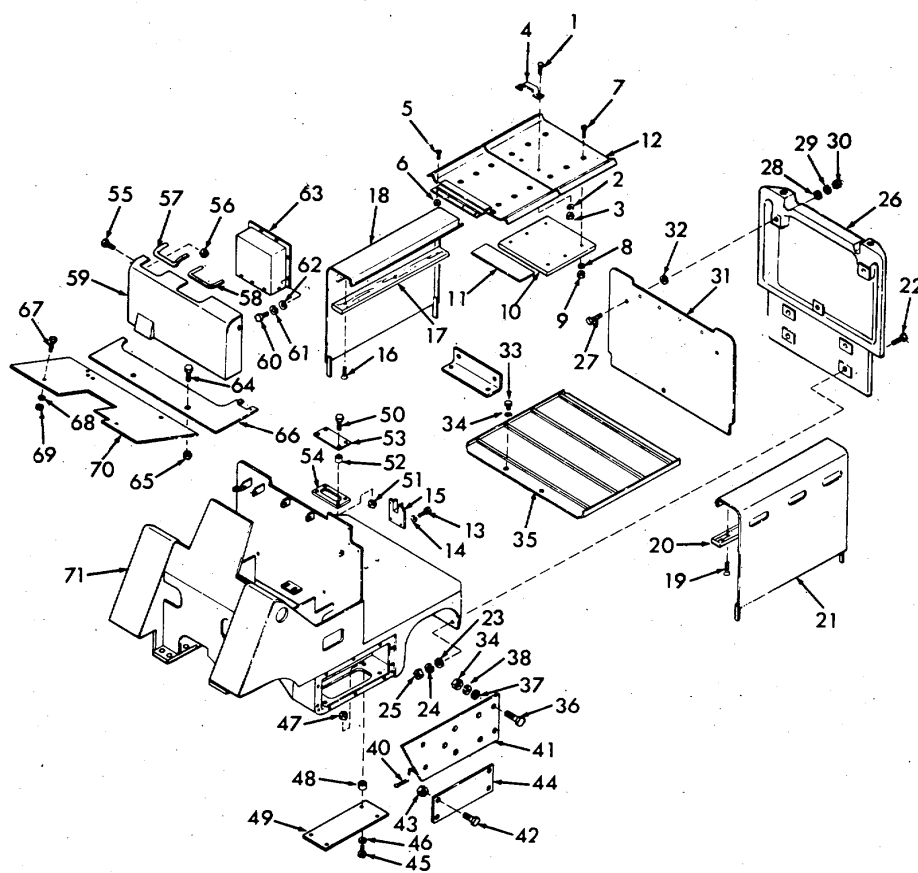
6-2. Sheet Metal Covers

a. *Removal.*

(1) Refer to figure 6-1 and remove covers required to gain access to components for repair.

(2) Refer to TM 10-3930-631-12 and remove drip pan to gain access to these components.

Change 1 6-1



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Figure 6-1. Frame and covers, exploded view.

KEY to fig. 6-1:

1. Screw	19. Screw	37. Washer	55. Screw
2. Lock washer	20. Insulation	38. Lock washer	56. Nut
3. Nut	21. Side panel	39. Nut	57. Trim
4. Handle	22. Screw	40. Cotter pin	58. Trim
5. Screw	23. Washer	41. Static panel door	59. Cover
6. Nut	24. Lock washer	42. Screw	60. Screw
7. Screw	25. Nut	43. Nut	61. Lock washer
8. Lock washer	26. Counterweight	44. Screen	62. Washer
9. Nut	27. Screw	45. Screw	63. Contactor cover
10. Cover insulation	28. Washer	46. Washer	64. Screw
11. Cover insulation	29. Lock washer	47. Nut	65. Nut
12. Battery cover	30. Nut	48. Spacer	66. Floor plate
13. Screw	31. Rear plate	49. Baffle	67. Screw
14. Washer	32. Spacing washer	50. Screw	66. Washer
15. Insulation	33. Screw	51. Nut	69. Nut
16. Screw	34. Lock washer	52. Spacer	70. Toe plate
17. Insulation	35. Acid tray	53. Top cover	71. Frame
18/ Side panel	36. Screw	54. Rubber block	

b. Inspection and Repair.

(1) Inspect covers for dents, cracks and other damage.

(2) Inspect covers for rust and other deterioration.

(3) Straighten dented covers if possible. Repair cracks by welding if possible.

(4) Sand and clean rust spots and paint covers as necessary.

(5) Replace unserviceable items.

c. Installation.

(1) Refer to figure 6-1 and install covers.

(2) Refer to TM 10-3930-631-12 and install drip pan.

6-3. Frame

a. Removal. Refer to figure 6-1 and

TM 10-3930-631-12 and remove covers and drip pan. Refer to pertinent chapters of this manual to remove components of the lift truck.

b. Inspection and Repair.

(1) Inspect frame (71, fig. 6-1) for dents, cracks, broken welds and other damage.

(2) Pay particular attention to welded brackets and mounting plates. If they are broken or damaged, replace by welding new ones in position.

(3) Repair broken welds. Weld cracks where necessary. Straighten bent or dented parts.

c. Installation.

(1) Refer to pertinent chapters of this manual to install components.

(2) Refer to figure 6-1 to install covers and TM 10-3930-631-12 to install drip pan.

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CHAPTER 7

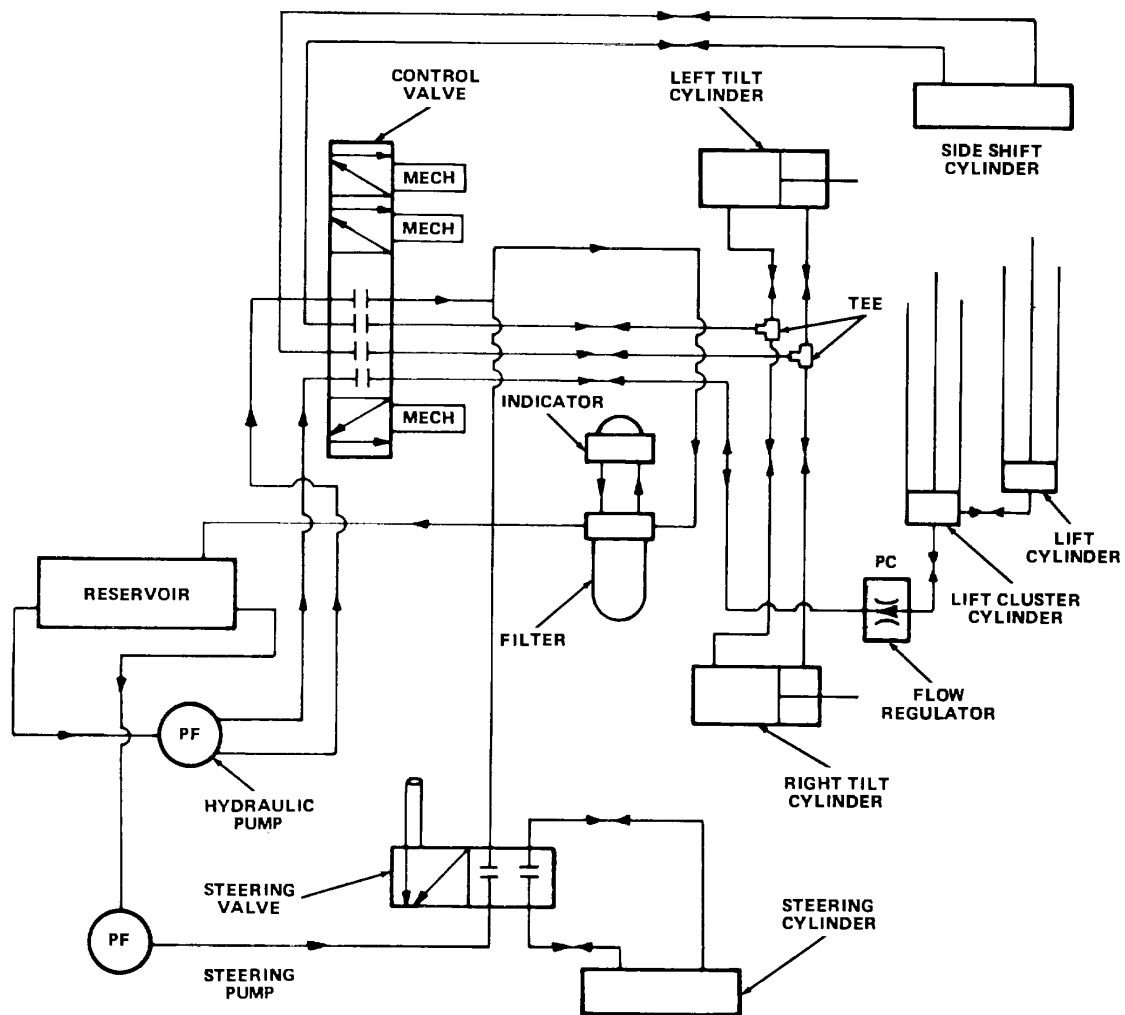
REPAIR OF HYDRAULIC LIFT COMPONENTS

Section I. HYDRAULIC PUMP

7-1. Description

a. The hydraulic lift system is composed of a hydraulic reservoir, a hydraulic pump, control valve, mast assembly, tilt cylinders, lift

cylinders, carriage, and side shift cylinder. Hydraulic hoses and tubes connect the components (fig. 7-1).



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Figure 7-1. Hydraulic lift system, schematic diagram.

b. Power to operate the pump is provided by an electric motor. Hydraulic oil is drawn from the

reservoir by the pump and delivered under pressure to the control valve.

c. When the lift control lever is pulled to the rear, oil is delivered through the control valve to the two outer cylinders of the cylinder cluster (fig. 7-1). Cylinder rams are forced upward, raising the chains and lifting the carriage up the mast. When outer cylinders have reached their limit of travel, oil is delivered to the center cylinder. The center cylinder ram is forced down, lifting inner mast, cluster cylinder, and carriage. At the center cylinder limit of travel, the inner mast will be fully extended. When this point is reached oil flows to the single lift cylinder, forcing its ram down. This action raises the intermediate mast. Full extension of the ram will raise the mast and carriage to the highest level. Placing the control lever in neutral will hold the mast in any position, with hydraulic pressure holding the mast at the required height. Pulling lever to rear will allow oil to flow back to the reservoir through the control valve and the masts will lower under their own weight. Rate of descent is controlled by a flow regulator. As the masts descend they telescope into each other and the carriage lowers to the ground.

d. Pulling the tilt control lever to the rear will actuate the tilt cylinders and pull the mast to a rearward tilt position. Pushing the lever forward

will bring the mast to an upright position. Continued forward movement will tilt the mast forward. On model ACE40AEE144 the mast will tilt 10 degrees forward and 3 degrees to the rear. Model ACE40AEE180 masts have a forward tilt of 6.5 degrees and a rearward tilt of 2 degrees. Placing lever in neutral will hold mast at degree of tilt required.

e. The carriage is equipped with a side shift cylinder. Pulling the control lever to the rear will send oil to the shift cylinder and move the carriage to the right. Pushing the lever forward will move the carriage to the left.

7-2. Hydraulic Pump

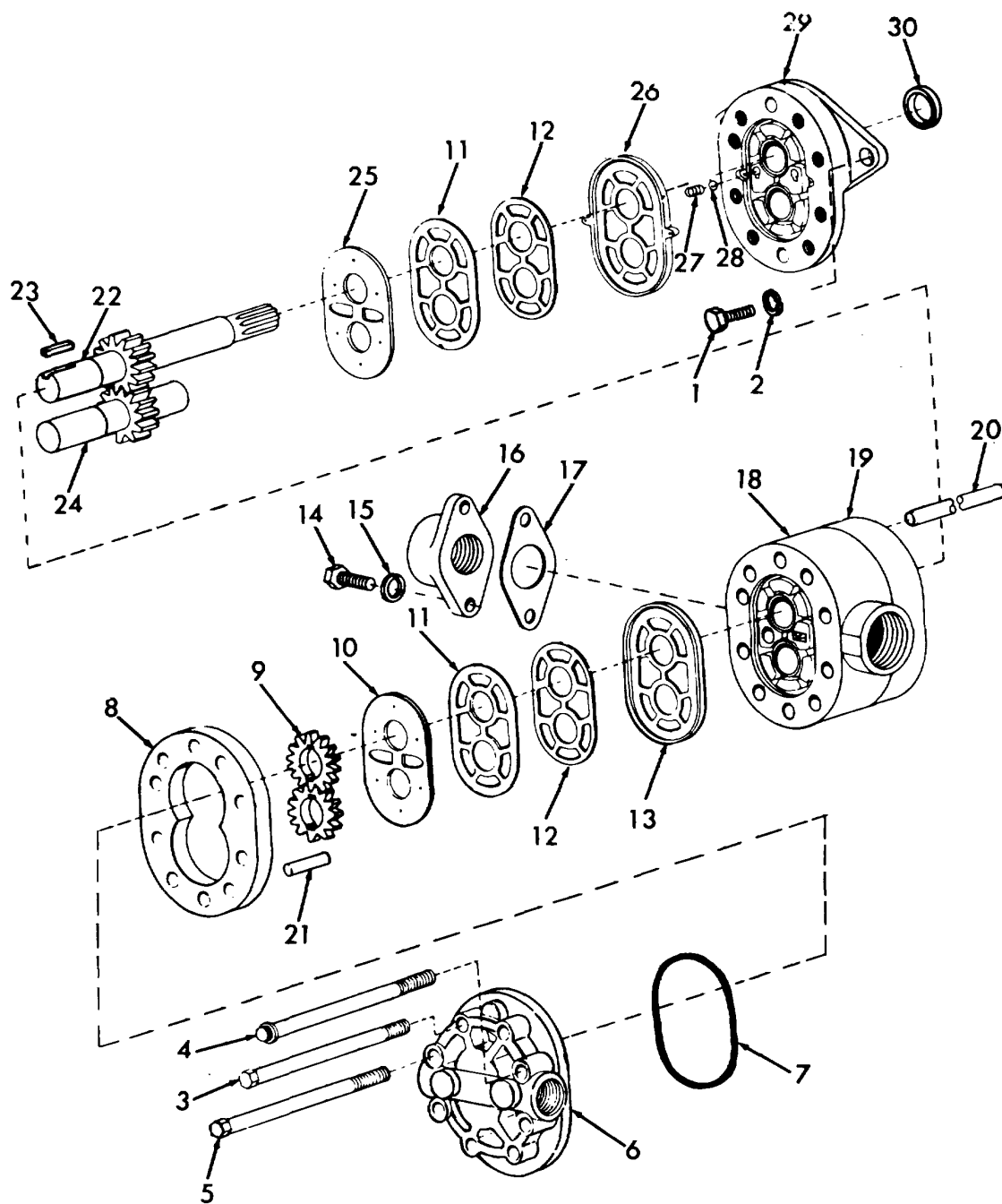
a. *Removal.* Refer to paragraph 2-13 and remove the hydraulic pump.

b. *Disassembly.*

(1) Clean outside of pump with cleaning compound, solvent (Fed. Spec. P-D-680).

(2) Scribe a mark across entire length of pump to assure proper positioning of parts at assembly.

(3) Cover splines of drive gear (22, fig. 7-2) with tape to protect splines while working on pump.



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Figure 7-2. Hydraulic pump, exploded view.

KEY to fig. 7-2:

- | | |
|----------------------|------------------|
| 1. Screw | 16. Adapter |
| 2. Lock washer | 17. Gasket |
| 3. Screw | 18. Body adapter |
| 4. Screw, 12 point | 19. Pump body |
| 5. Screw | 20. Dowel pin |
| 6. Back plate | 21. Dowel pin |
| 7. Packing | 22. Drive gear |
| 8. Rear body | 23. Key |
| 9. Pump gear | 24. Idler gear |
| 10. Diaphragm | 25. Diaphragm |
| 11. Backup gasket | 26. Seal |
| 12. Protector gasket | 27. Spring |
| 13. Seal | 28. Ball |
| 14. Screw | 29. Front plate |
| 15. Lock washer | 30. Seal |

(4) Secure pump in a vise. Remove screws (3, 4 and 5). Remove back plate (6), and packing (7). Discard packing.

(5) Remove pump from vise and turn pump shaft end up. Shake pump to remove gears (9) from rear body (8). Remove rear body and diaphragm (10), gasket (11), protector gasket (12) and seal (13). Discard diaphragm, gaskets and seal.

(6) Remove screws (14) and lock washers (15) and remove adapter (16) and gasket (17). Discard gasket.

(7) Remove key (23) from drive gear.

(8) Tap drive shaft with a rubber mallet to separate front plate (29) from pump body. Remove drive gear (22) and idler gear (24) from body.

(9) Remove diaphragm (25), backup gasket (11), protector gasket (12) and seal (26). Discard diaphragm, gaskets and seals.

(10) Remove springs (27) and balls (28) from front plate.

(11) Drive dowel pins (20 and 21) from body and adapter with a brass drift and separate body (19) from adapter (18). Remove and discard packing (7) from between body and adapter.

(12) Remove seal (30) from front plate using a suitable puller. Discard seal.

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in cleaning compound, solvent (Fed. Spec. P-D-680) and dry thoroughly with compressed air.

(2) Inspect parts for nicks and burs. Remove burs and nicks with emery cloth if possible.

(3) Inspect drive gear for broken keyway and damaged or worn splines and gear teeth. Check drive gear and idler shafts for wear in bearing and seal areas. Bearing areas measuring less than 0.685 inch (17.4 mm) must be replaced. If bearing area is less than indicated replace gear. Shafts and gears must be replaced as assemblies.

(4) Inspect drive, idler and pump gears for scoring and wear. If gears are worn or scored, replace gears.

(5) Measure inside diameter of bearings in front plate (6, fig. 7-2) and adapter (18). Replace front plate or adapter if inside diameter of bearings exceeds 0.691 inch (17.5 mm).

(6) Check gear pockets in gear bodies. If inside diameter of gear pockets exceed 1.719 inches (43.6 mm) replace body.

(7) Replace all parts contained in pump repair kit (TM10-3930-631-34P).

d. Assembly.

(1) Clean all metal parts with cleaning compound, solvent (Fed. Spec. P-D-680) and dry thoroughly. Coat all parts with engine oil (OE) before assembly.

(2) Drive dowel pins (20 and 21) in front and back plates (6 and 29).

(3) Tuck new diaphragm seal (26) into grooves of front plate (29) with open part of "V" section down.

(4) Press new protector gasket (12), backup gasket (11) and diaphragm (25) into diaphragm seal. Diaphragm must be installed with bronze face up.

(5) Install balls (28) and springs (27) in bores in front plate.

(6) Install new diaphragm seal (13), protector gasket (12), backup gasket (11) and diaphragm (10) in body adapter (18) in the same manner. Intake hole of diaphragm must be aligned with intake hole in the face of the body adapter. The entire diaphragm must fit within the raised rim of the diaphragm seal.

(7) Slide drive gear (22) and idler gear (24) through bearings in front plate (29).

(8) Apply a thin coat of heavy grease (GAA) to both milled faces of body (19). Place body over gears on front plate. Half moon port cavities in body must face away from front plate. The small drilled hole in one of the cavities must be on the pressure side of the pump opposite adapter (16).

(9) Install new packing (7) in groove in body adapter (18) and install adapter over gear shafts and on body. Tap adapter in place with a rubber hammer.

(10) Install key (23) in drive shaft and install gears (9) on shaft.

(11) Coat milled surfaces of rear body (8) with thin coat of grease (GAA). Half moon cavities of body must face away from adapter and drilled hole in one cavity must be on pressure side of pump.

(12) Install new packing (7) in groove of back plate (6) and install plate on body (8). Secure with screws (3, 4, and 5). The twelve point headed screws (4) are installed on each side of the pressure port (fig. 7-3). The longer hex head

screws (5, fig. 7-2) are installed directly opposite the twelve point screws (fig. 7-3). Tighten all screws to a torque of 25 to 28 pound feet (3.4-3.8 m-kp).

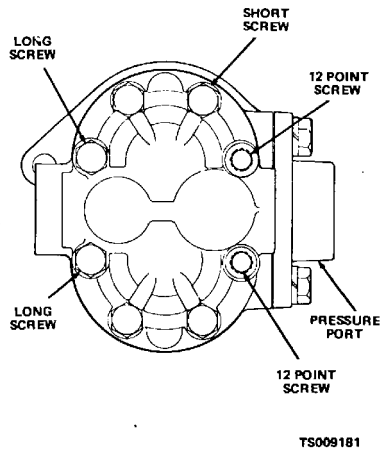


Figure 7-3. Pump screw location.

(13) Install port adapter (16) and new gasket (17) on adapter (18) and secure with screws (14) and lock washers (15). Tighten screws to a torque of 10 to 12 pound feet (1.38-1.73 m-kp).

(14) Coat new seal (30) liberally with oil (OE). Place tape over splines on drive shaft and install seal (30) in front plate over shaft. Install seal carefully to prevent damage to oil seal lip.

(15) Rotate pump shaft by hand or with pliers. Shaft will have small amount of drag but should rotate freely after a few turns.

e. *Installation.* Refer to paragraph 2-13 and install hydraulic pump. Before operating hydraulic system, check pressure and adjust control valve relief valves as described below.

Section II. CONTROL VALVE

7-3. Pressure Adjustment

a. Description.

(1) Two relief valves are incorporated in the control valve. One controls the low volume inlet pressure. The low volume pressure is used in the tilt and side shift circuits. The other relief valve controls the high volume pressure used in the lift circuit. Relief valves protect the hydraulic system from excessive hydraulic pressure.

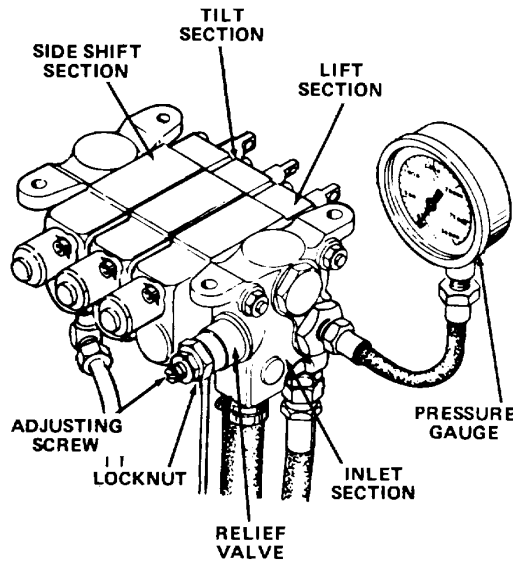
(2) Whenever a cylinder reaches full stroke position or when an excessive load is handled, hydraulic pressure will build up to beyond safe limits. This pressure opens relief valves and bypasses the hydraulic oil to the reservoir.

Pressures are preset but should be checked at regular intervals and whenever control valve or hydraulic pump has been replaced or repaired.

b. Low Volume Pressure Adjustment.

(1) Disconnect battery receptacle and discharge capacitors. Remove sheet metal cover and floor plate to gain access to hydraulic control valve.

(2) Remove pipe plug from large plug in side of inlet section. Install a pressure gage with a zero to 3000 psi (0-210.9 kg-cm²) range. A short length of high pressure hose may be installed between gage and valve to facilitate installation of gage (fig. 7-4).



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Figure 7-4. Checking low volume inlet pressure.

(3) Connect battery receptacle, sit on seat, place directional control lever in neutral and turn master switch on.

(4) Pull the tilt lever back to actuate the pump and retract the tilt cylinders. Hold lever all the way back.

(5) Observe pressure gage. When pressure reading of 2100 psi (147.6 kg-cm²) is reached needle should stop indicating relief valve opening.

(6) If relief valve opens below or above 2100 psi, relief valve must be adjusted.

(7) Remove acorn nut covering adjusting screw (fig. 7-4). Acorn nut is located on bottom of inlet valve section.

(8) Loosen jam nut on adjusting screw and hold lever in full rearward position as in (4) above. Turn adjusting screw clockwise to increase or counterclockwise to decrease pressure.

(9) When pressure is properly adjusted, hold adjusting screw and tighten jam nut to secure adjustment.

(10) Release tilt control lever and push lever forward to relieve pressure. Pull lever to rear and again check pressure setting. Relief valve should open at 2100 psi. Install acorn nut.

c. High Volume Pressure Adjustment.

(1) Do not remove pressure gage from inlet section.

(2) While sitting on operator's seat and with master switch on, pull lift control lever all the way to the rear. When mast reaches limit of extension, hold lever all the way to the rear and observe

pressure gage. When pressure reaches 1900 psi (133.5 kg-cm²) needle should stop indicating relief valve has opened.

(3) If relief valve opens above or below 1900 psi it must be adjusted.

(4) Remove acorn nut covering adjusting screw at top front of lift control section. Loosen jam nut securing adjusting screw.

(5) Hold lift control lever all the way to the rear and adjust pressure. Turn adjusting screw clockwise to increase pressure and counterclockwise to reduce pressure.

(6) After pressure is properly adjusted, hold adjusting screw and tighten jam nut to secure adjustment.

(7) Push lift control lever forward to lower carriage a short distance. Pull lever all the way to the rear and hold in this position. Check gage. Relief valve should open at 1900 psi. Install acorn nut.

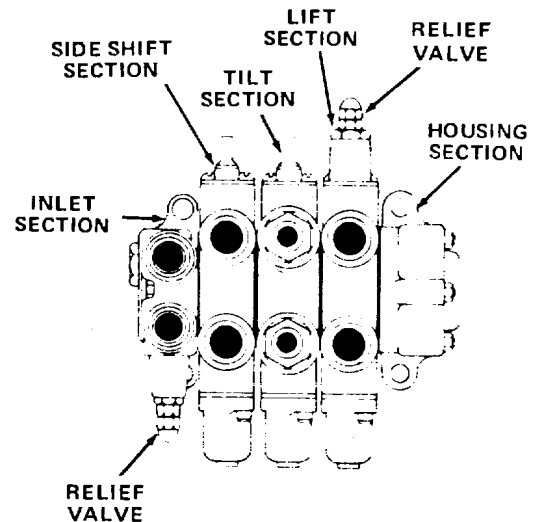
(8) Turn master switch off, disconnect battery receptacle and discharge capacitors.

(9) Disconnect pressure gage and install pipe plug in valve.

(10) Install floor plate and center cover panel.

7-4. Hydraulic Control Valve

a. Description. The hydraulic control valve (fig. 7-5) is made up of four sections. Inlet and housing sections enclose the three operating plunger sections. Three operating plunger sections are the side shift, tilt and lift sections. Relief valves are installed in the inlet and lift control sections.



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Figure 7-5. Control Valve.

b. Removal.

(1) Disconnect battery receptacle and discharge capacitors. Remove center cover panel and floor plate to gain access to control valve.

(2) Disconnect all hoses from the control valve (fig. 7-6). Plug hoses to prevent entrance of dirt.

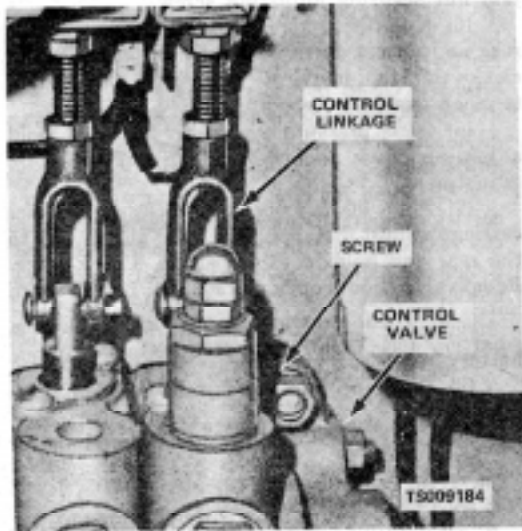


Figure 7-6. Control Valve, removal and installation.

(3) Remove cotter pins and clevis pins connecting control linkage devices (fig. 7-6) to control valve plungers.

(4) Remove screws (fig. 7-6), lock washers, nuts and spacers securing control valve to frame. Remove control valve.

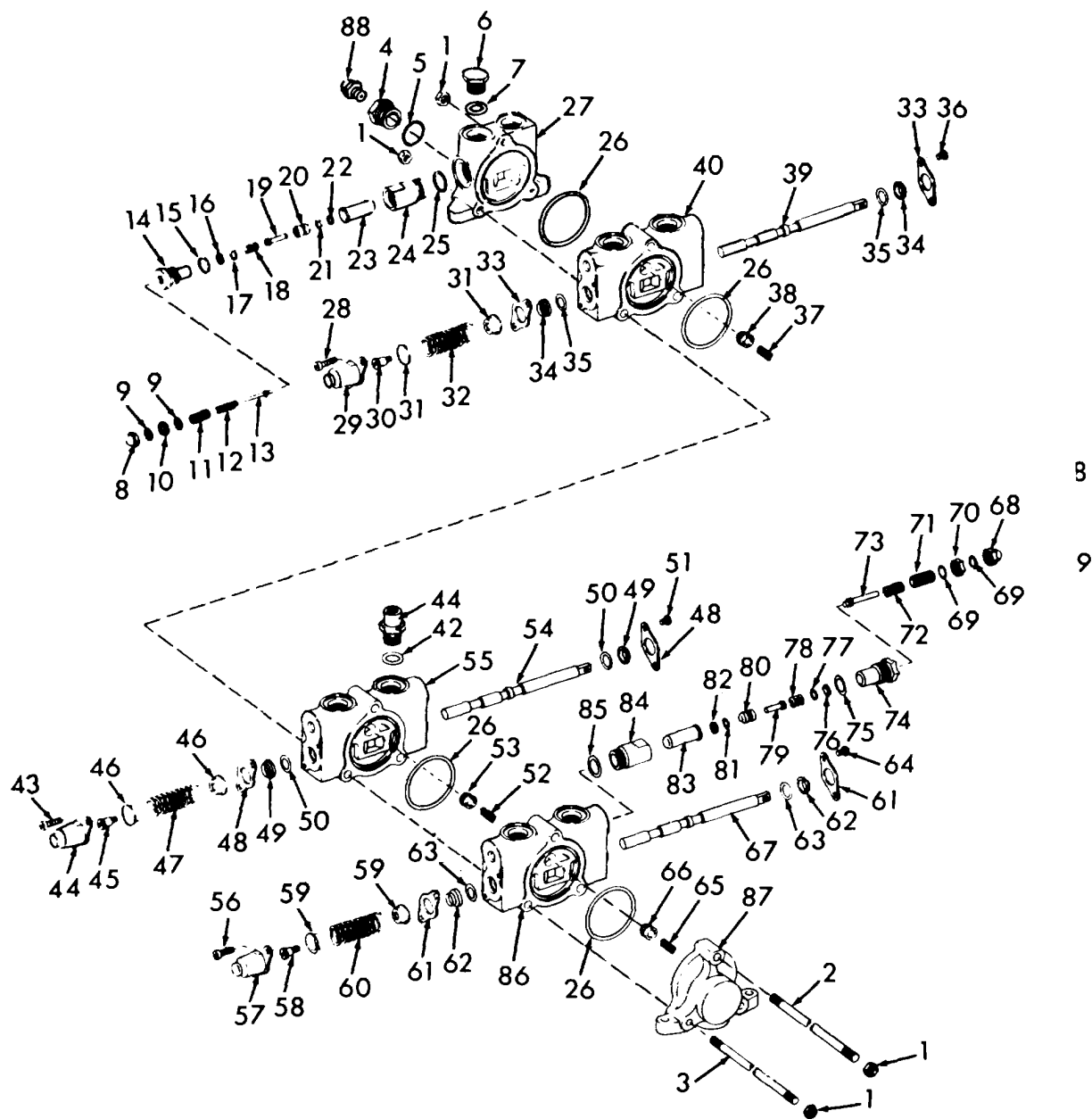
c. Disassembly.

(1) Stand control valve on inlet end and remove nuts (1, fig. 7-7). Lift housing (87) from tie rods.

KEY to fig. 7-7:

1. Nut
2. Tie rod
3. Tie rod
4. Pipe plug
5. Packing
6. Pipe plug
7. Packing
8. Acorn nut
9. Washer
10. Nut
11. Adjusting screw
12. Spring
13. Poppet
14. Plug
15. Packing
16. Backup ring
17. Packing
18. Spring
19. Piston

20. Poppet
21. Packing
22. Backup ring
23. Poppet
24. Cap
25. Packing
26. Packing
27. Inlet body
28. Screw
29. Cap
30. Screw
31. Seat
32. Spring
33. Plate
34. Wiper
35. Packing
36. Screw
37. Spring
38. Poppet
39. Plunger
40. Housing
41. Fitting
42. Packing
43. Screw
44. Cap
45. Screw
46. Seat
47. Spring
48. Plate
49. Wiper
50. Packing
51. Screw
52. Spring
53. Poppet
54. Plunger
55. Housing
56. Screw
57. Cap
58. Screw
59. Seat
60. Spring
61. Plate
62. Wiper
63. Packing
64. Screw
65. Spring
66. Poppet
67. Plunger
68. Acorn nut
69. Washer
70. Nut
71. Adjusting screw
72. Spring
73. Poppet
74. Plug
75. Packing
76. Backup ring
77. Packing
78. Spring
79. Piston
80. Poppet
81. Packing
82. Backup ring
83. Poppet
84. Cap
85. Packing
86. Housing
87. Housing
88. Plug



8

9

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Figure 7-7. Control valve, exploded view.

(2) Remove spring (65) and poppet (66) from housing (86). Remove packing (26).

(3) Slide lift plunger section housing (86) from tie rods. Remove screws (64) and remove plate (61) from housing.

(4) Remove screws (56) and remove cap (57) from other side of housing. Remove plate (61).

valve, exploded view. Remove plunger (67) from housing. Remove and tag wipers (62) and packings (63) from housing.

(5) Remove shoulder screw (58), seats (59) and spring (60) from plunger (67). Tag plunger to facilitate correct installation.

(6) Remove acorn nut (68), washers (69) and jam nut (70) from housing.

(7) Remove relief valve assembly (71 through 85) from housing. Remove adjusting screw (71), spring (72), poppet (73), packings (75 and 77) and backup ring (76) from plug (74). Remove spring (78). Check and note number of turns adjusting screw is set in plug.

(8) Remove poppet (83) and remove piston (79), poppet (80), backup ring (82) and packing (81) from poppet (83).

(9) Remove packing (85) from cap (84).

(10) Remove tilt cylinder section from tie rods. Remove fittings (4) and packings (42) from section. Remove packings (26) and spring (52) and poppet (53) from housing.

(11) Refer to steps (3) through (5) and disassemble tilt plunger section (41 through 55) in the same manner.

(12) Remove and disassemble side shift plunger section (28 through 40) in the same manner.

(13) Remove inlet section (27) from tie rods. Remove plugs (4 and 6) and packings (5 and 7) from housing. Refer to steps 6 through 9 and remove relief valve from inlet section.

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in cleaning compound, solvent (Fed. Spec. P-D-680) and dry thoroughly.

(2) Discard packings (5, 17, 26, 35 and 75) and backup rings (16 and 22). These parts are contained in a parts kit. Install new packings and rings.

(3) Inspect housings for cracks, damaged threads and worn plunger bores. Recondition plunger bores with a fine hone if necessary.

(4) Inspect plungers for scoring or damage. Lap slight scratches from plungers. Replace plunger if scored or damaged.

(a) Check clearance between plunger and bore. Allowable clearance is 0.0002 to 0.0005 inch (0.005 to 0.012 mm). If clearance exceeds these dimensions, replace plungers.

(b) Examine bores. Surfaces must be free of burs or pits. Resurface bores with fine lapping compound if necessary. Check clearance.

(c) After honing or lapping clean parts thoroughly.

(5) Replace all worn or damaged parts. Replace all parts in repair kit.

d. Assembly.

(1) Coat all parts with engine oil (OE) before assembly.

(2) Install plugs (4 and 6, fig. 7-7) and new packings (5 and 7) in inlet section housing (27).

(3) Install new packing (21) and backup ring (22) on poppet (20). Install poppet (23) in cap (24).

(4) Install piston (19) and spring (18) in poppet assembly.

(5) Install poppet (13) and spring (12) in plug (14). Secure poppet and spring with adjusting screw (11). Turn screw in the same number of turns required to remove screw. Install new packing (15 and 17) and backup ring (16) on plug (14).

(6) Install nut (10) on adjusting screw and cover with acorn nut (8).

(7) Install new wiper (34) and packing (35) on side shift plunger (39). Install plate (33), seat (31) and spring (32) on plunger and secure with shoulder screw (30).

(8) Slide plunger assembly into bore in housing (40). Apply a light coat of grease (GAA) to spring. Install plunger cap (29) over plunger and secure cap with screws (28).

(9) Install new packing (35) and wiper (34) over linkage end of plunger. Install plate (33) over plunger and secure with screws (36).

(10) Install new packing (26) in grooves on housing and install poppet (38) and spring (37) in bore in housing.

(11) Install new packings (42) and fittings (41) in tilt plunger housing (55).

(12) Refer to steps (7) through (11) and assemble tilt cylinder section in the same manner. Install new packing (26), poppet (53) and spring (52) in housing.

(13) Refer to steps (3) through (6) to install relief valve in lift plunger section (86). Refer to steps (7) through (11) to complete assembly of lift plunger section. Install new packing (26), poppet (66) and spring (65) in housing (86).

(14) Position inlet, side shift, tilt, and lift plunger sections and housing together. Packings (26) and internal poppets and springs must remain in place while assembling valve.

(15) Install tie rods (2 and 3) through valve sections and secure with nuts (1). Tighten nuts to a torque of 14 pound feet (1.93 m·kg).

e. Installation.

(1) Install control valve (fig. 7-6) in position on frame. Secure control valve with screws, nuts and spacers.

(2) Remove plugs from hoses and connect hoses to correct inlet and outlet fittings on control valve.

(3) Connect linkage and devices (fig. 7-6) to control valve plungers.

(4) Refer to paragraph 7-3 and check pressure at control valve if necessary.

(5) Refer to TM10-3930-631-12 and adjust linkage and switch.

7-5. Control Valve Linkage

a. *Removal.* Refer to TM10-3930-631-12 to remove the control valve linkage. Refer to figure 7-8.

b. *Cleaning, Inspection and Repair.*

(1) Clean all parts in cleaning compound, solvent (Fed. Spec. P-D-680) and dry thoroughly.

(2) Inspect threaded rods and devices for damage to threads.

(3) Check switch actuators for bent or damaged condition.

(4) Repair threads if possible. Straighten bent or damaged actuators.

(5) Replace unserviceable parts.

c. *Installation.* Refer to TM 10 3930-631-12 and install the control valve linkage.

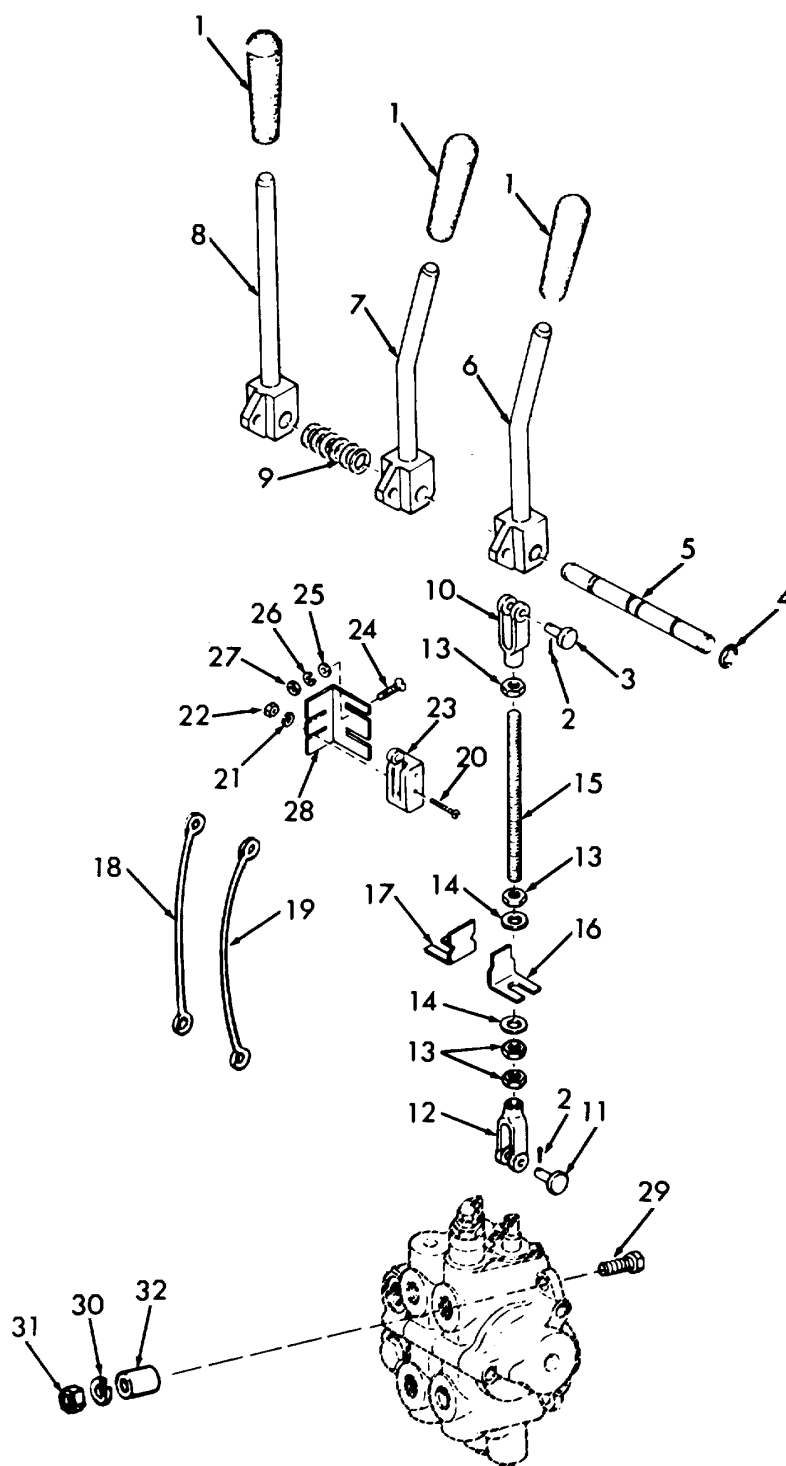


Figure 7-8. Control valve linkage, exploded view.

KEY to fig. 7-8:

- | | | | |
|-----------------------------|---------------------|---------------------|-----------------|
| 1. Knob. | 9. Spacing washer | 17. Switch actuator | 25. Washer |
| 2. Cotter pin | 10. Clevis | 18. Electrical lead | 26. Lock washer |
| 3. Pin | 11. Pin | 19. Electrical lead | 27. Nut |
| 4. Retaining ring | 12. Clevis | 20. Screw | 28. Bracket |
| 5. Shaft | 13. Nut | 21. lock washer | 29. Screw |
| 6. Lift control lever | 14. Washer | 22. Nut | 30. lock washer |
| 7. Tilt control lever | 15. Rod | 23. Switch | 31. Nut |
| 8. Side shift control lever | 16. Switch actuator | 24. Screw | 32. Spacer |

Section III. HYDRAULIC CYLINDERS

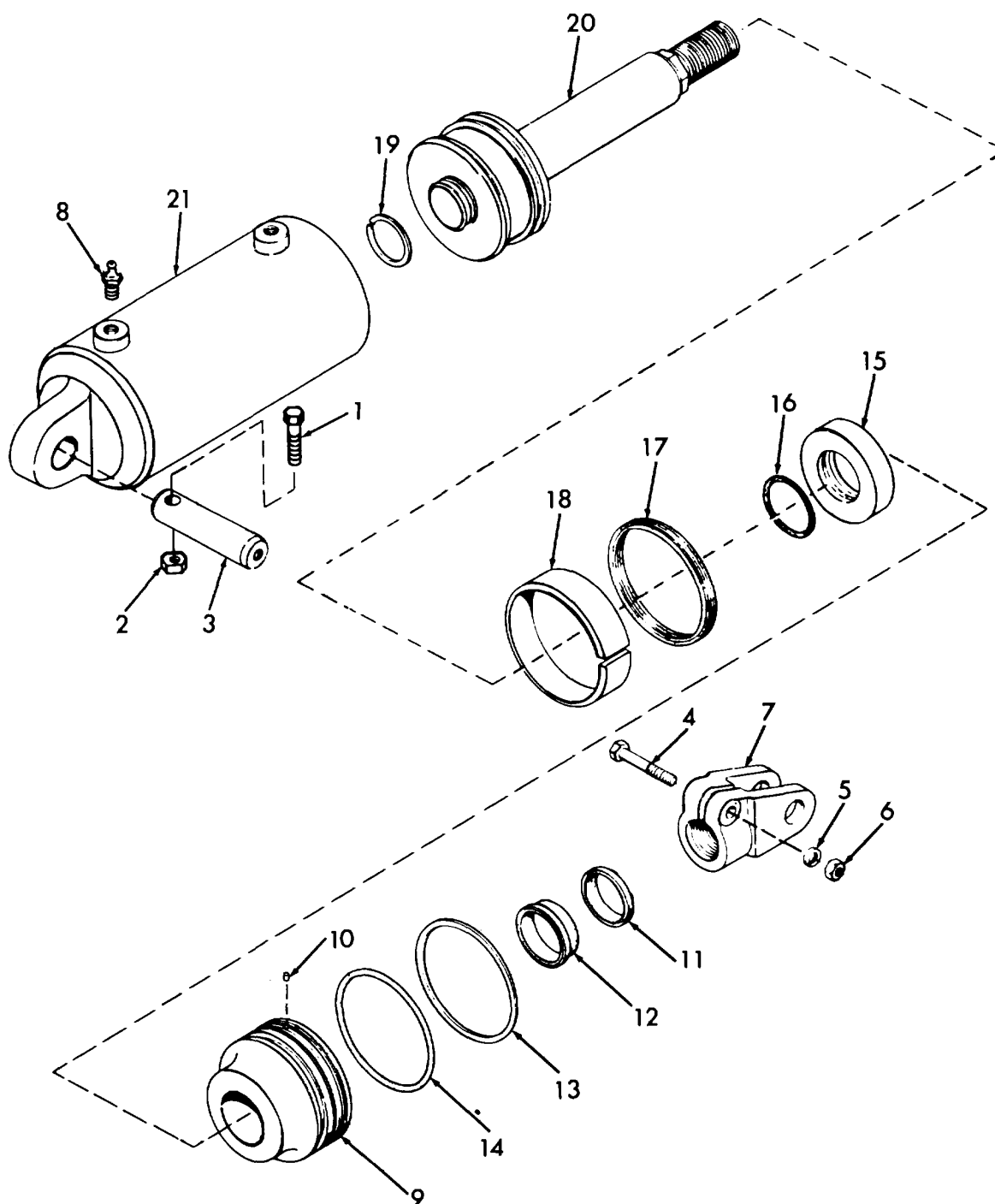
7-6. Tilt Cylinder

a. *Removal.* Refer to TM10-3930-631-12 and remove the tilt cylinders.

b. *Disassembly.*

(1) Clamp cylinder securely in a vise.

(2) Loosen screw (4, fig. 7-9) and count number of turns and remove yoke (7) from plunger rod. Remove lubrication fitting (8).



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Figure 7-9. Tilt cylinder, exploded view.

KEY to fig 7-9.

- | | |
|------------------------|--------------------|
| 1. Screw | 12. Packing |
| 2. Nut | 13. Backup ring |
| 3. Shaft | 14. Packing |
| 4. Screw | 15. Spacer |
| 5. Lock washer | 16. Packing |
| 6. Nut | 17. Piston packing |
| 7. Yoke | 18. Bearing |
| 8. Lubrication fitting | 19. Retaining ring |
| 9. Packing gland | 20. Plunger rod |
| 10. Nylon pellet | 21. Tube |
| 11. Wiper ring | |

(3) Remove packing gland (9). Remove nylon pellets (10). Remove backup ring (13) and packing (14) from outer circumference of packing gland.

(4) Inspect and remove rod wiper (11) and internal packing (12) from packing gland.

(5) Remove plunger rod (20) from tube. Remove bearing (18) and packing (17) from plunger rod (20).

c. Cleaning, Inspection and Repair.

(1) Clean metal parts in cleaning compound, solvent (Fed. Spec. P-D-680) and dry thoroughly.

(2) Check sliding surfaces of rod and tube. Surfaces must be smooth and polished. If surfaces are nicked or damaged replace parts.

(3) Inspect threads on rod and yoke. Replace parts if threads are damaged.

(4) Replace nylon pellet and all backup rings and packing with parts in cylinder repair kit.

d. Assembly.

(1) Install new packing (17, fig. 7-9) and bearing on plunger rod (20).

(2) Install new packing (16) in spacer (15) and install spacer on plunger rod.

(3) Install plunger rod in tube. Install new nylon pellets (10), packing (14) and backup ring (13) in grooves on outer circumference of packing gland (9).

(4) Position packing (12) and wiper ring (11) in grooves in inner circumference of packing gland.

(5) Install gland nut over plunger rod and thread into tube. Gland nut must be flush with outer edge of cylinder tube.

(6) Install yoke (7) on plunger rod same

number of turns as when removed. Install screw (4), lock washer (5) and nut (6) and tighten to secure yoke to plunger rod.

(7) Install lubrication fitting (8) in tube.

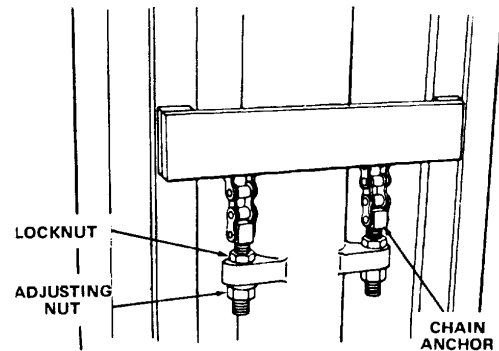
e. Installation. Refer to TM10-3930-631-12 to install and adjust tilt cylinders.

7-7. Hoist Cylinders

a. Removal of Cluster Cylinder.

(1) Refer to paragraph 2-14 and remove the side shift carriage from the mast.

(2) Loosen lock nut (fig. 7-10) and remove adjusting nut. Remove chain anchors (23) and chain guards (19, fig. 7-11).



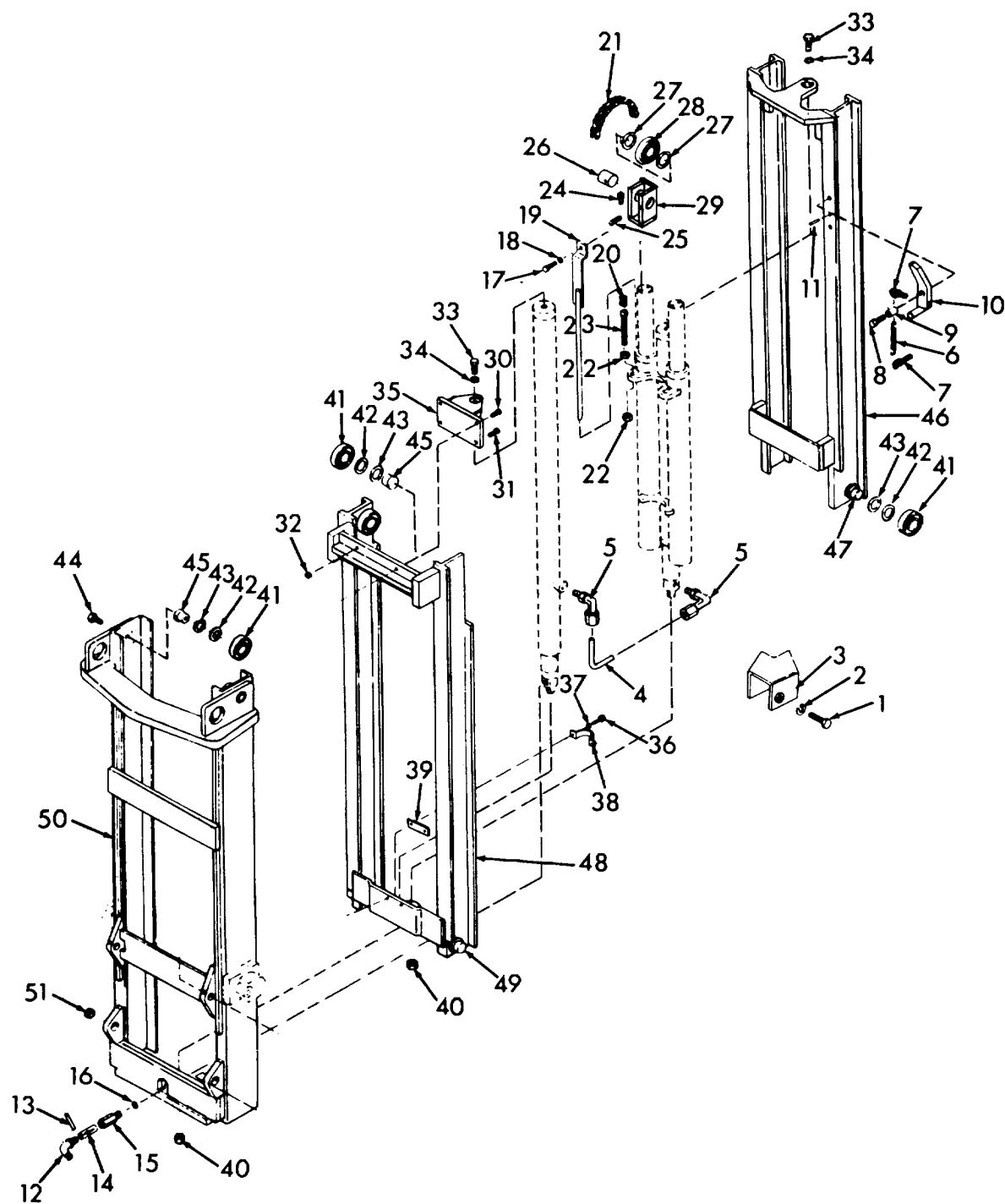
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Figure 7-10. Lift chains.

(3) Remove lift chains from crossheads on cylinders. Disconnect tube (4, fig. 7-11) from between cluster cylinder and single cylinder. Remove fittings (5).

(4) Attach a suitable hoist to cluster cylinder and support cylinder while removing attaching parts.

(5) Remove screw (33, fig. 7-11) and lock washer (34) from inner mast and cluster cylinder.



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Figure 7-11. Mast assembly, exploded view.

KEY to fig. 7-11:

- | | |
|---------------------|-----------------------|
| 1. Screw | 26. Pin |
| 2. Lock washer | 27. Washer |
| 3. Guard | 28. Chain bearing |
| 4. Tube | 29. Crosshead |
| 5. Tube fitting | 30. Screw |
| 6. Spring | 31. Screw |
| 7. Adjusting screw | 32. Nut |
| 8. Screw | 33. Screw |
| 9. Spacer | 34. Lock washer |
| 10. Interlock lever | 35. Bracket |
| 11. Pin | 36. Screw |
| 12. Elbow | 37. Lock washer |
| 14. Flow regulator | 38. Clamp |
| 15. Regulator body | 39. |
| 16. Packing | 40. Nut |
| 17. Screw | 41. Ball bearing |
| 18. Lock washer | 42. Shim |
| 19. Chain guard | 43. Shim |
| 20. Connecting link | 44. Screw |
| 21. Lift chain | 45. Stud |
| 22. Nut | 46. Inner mast |
| 23. Chain anchor | 47. Stud |
| 24. Screw | 48. Intermediate mast |
| 24. Screw | 49. Stud |
| 25. Setscrew | 50. Outer mast |
| | 51. Bearing |

(6) Remove nut (40) from cluster cylinder.

Using the hoist lift cluster cylinder from mast assembly.

b. Removal of Single Cylinder.

(1) Disconnect hydraulic hose and remove elbow (12, fig. 7-11), regulator (14), regulator body (15) and packings (13) and 15 from single cylinder.

(2) Attach a hoist to the single lift cylinder. Remove screws (33) and lock washers (34) securing top of single cylinder to bracket.

(3) Remove nut (40) securing bottom of single cylinder to outer mast. Remove screws (36) and lock washers (37) and remove clamp (38) and spacer (39).

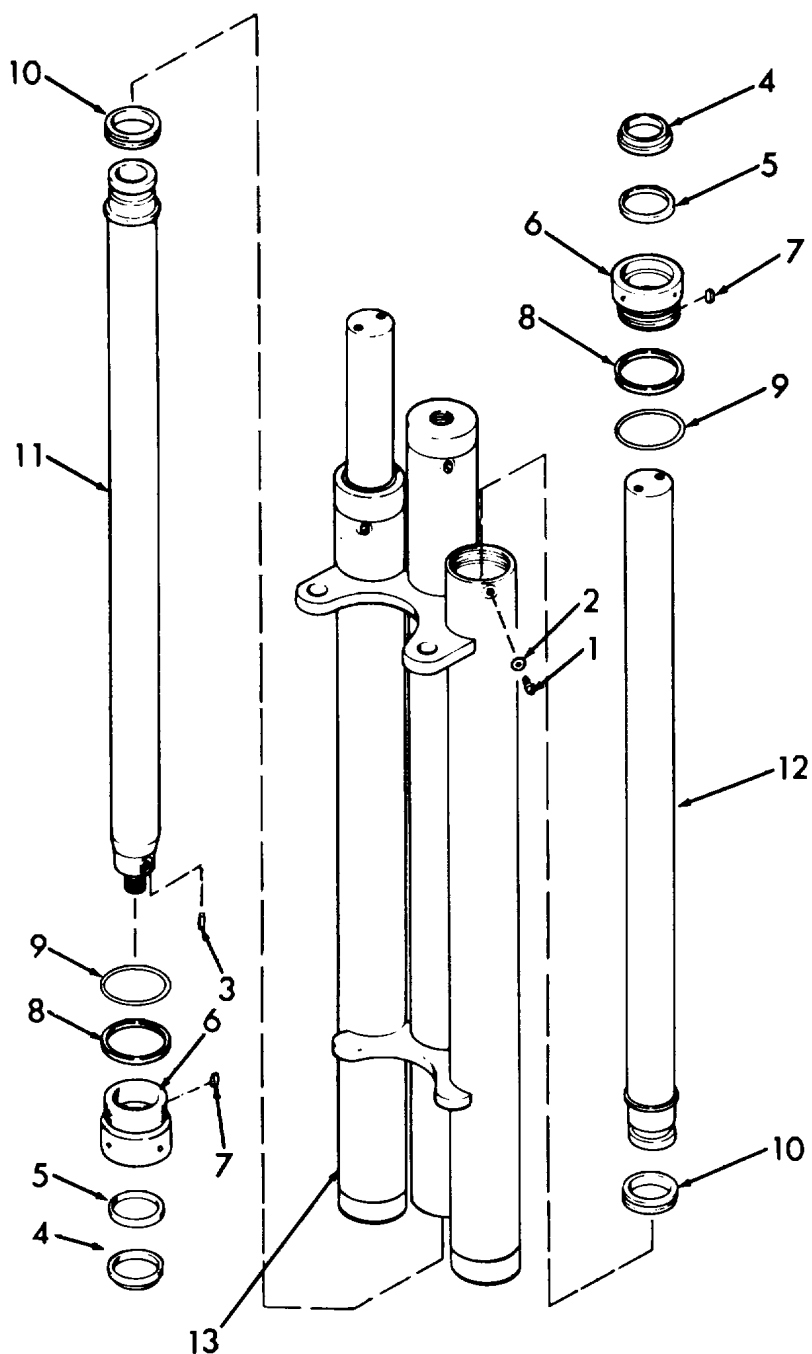
(4) Lift cylinder up and away from mast with the hoist.

c. Disassembly.

(1) Cluster cylinder.

(a) Remove screws (24, fig. 7-11) and remove crossheads from cluster cylinder.

(b) Remove bleed screw (1, fig. 7-12) and nylon washer (2) from cylinder tube.



- 1. Bleed screw
- 2. Nylon washer
- 3. Pin
- 4. Wiper
- 5. Packing

- 6. Gland nut
- 7. Pellet
- 8. Backup washer
- 9. Packing

- 10. Wear ring
- 11. Rod
- 12. Rod
- 13. Tube

Figure 7-12. Cluster cylinder, exploded view.

(c) Remove gland nut (6) from one cylinder tube. Remove wiper (4) and packing (5) from inner circumference of gland nut.

(d) Remove nylon pellet (7), packing (9) and backup washer (8) from outer circumference of gland nut.

(e) Slide rod (11) from tube. Remove wear ring (10) from rod.

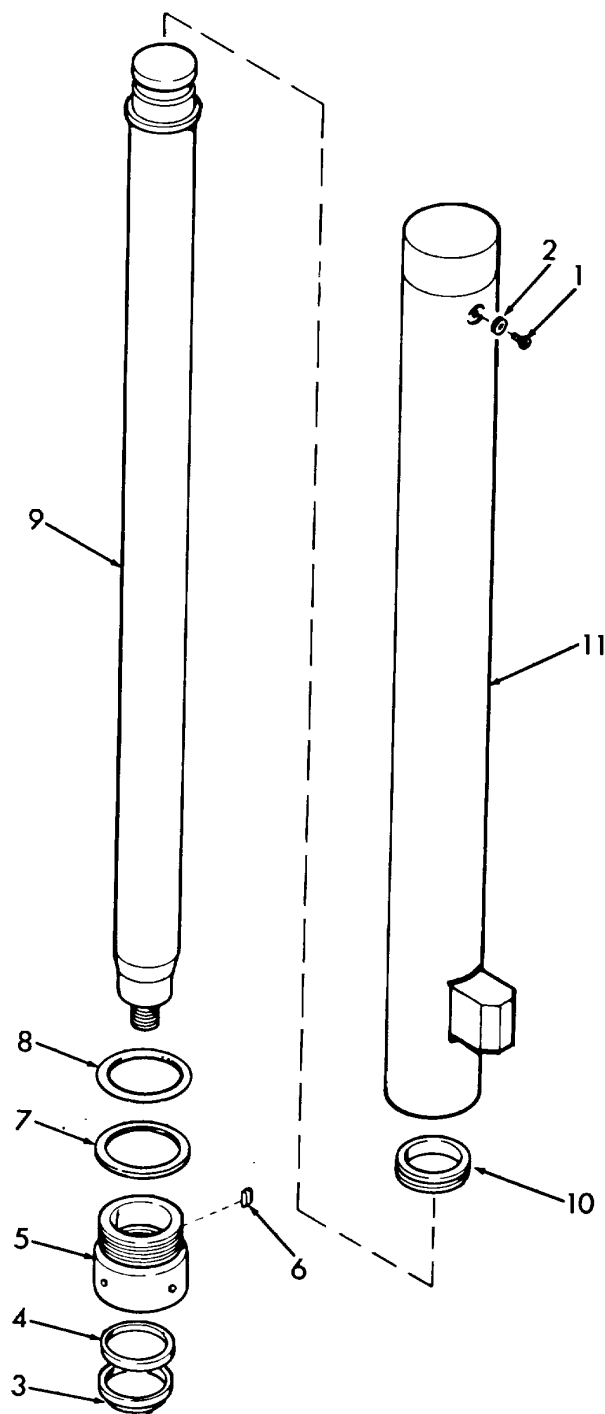
(f) Remove gland nut, packings and cylinder rods from outer tubes.

(g) Remove pin (3) from tube.

(2) Single cylinder.

(a) Remove bleed screw (1, fig. 7-13) and nylon washer (2) from tube.

(b) Remove gland nut (5). Remove pellets (6) from gland nut.



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- 1. Bleed screw
- 2. Nylon washer
- 3. Wiper

- 4. Packing
- 5. Gland nut
- 6. Nylon pellet

- 7. Backup washer
- 8. Packing
- 9. Rod

- 10. Wear ring
- 11. Tube

Figure 7-13. Single hoist cylinder, exploded view.

(c) Remove wiper (3) and packing (4) from inside of gland nut. Remove packing (8) and backup washer (7) from outer circumference of gland nut.

(d) Slide rod (9) from tube (11) and remove wear ring from rod.

d. Cleaning, Inspection and Repair.

Note

The two cylinders are very similar. The repair of each is identical.

(1) Clean all metal parts in cleaning compound, solvent (Fed. Spec. P-D-680).

(2) Inspect all parts for wear and damage. Pay particular attention to sliding surfaces on rods.

(3) Remove any nicks or scratches from rod with crocus cloth.

(4) Replace all unserviceable parts. Replace all packings, backup rings and washers and nylon pellets contained in repair kits for the cylinder.

e. Assembly.

(1) Single cylinder.

(a) Coat all parts with engine oil (OE) before assembly.

(b) Install wear ring (10, fig. 7-13) in groove on rod (9). Slide rod into tube (11).

(c) Install packing (4) and wiper (3) in gland nut (5). Install backup washer (7) and packing (8) on gland nut. Install nylon pellets (6).

(d) Install gland nut in tube, sliding rod through packing and wiper. Tighten gland nut securely into tube.

(e) Install bleed screw (1) and nylon washer (2) in tube. Install pin (3) in tube.

(2) Cluster cylinder.

Note

Assembly and installation of the rods in the three tubes of the cluster cylinder is identical. The two short rods go into the outer tubes. The long rod is installed in the center tube of the cluster cylinder.

(a) Install wear rings (10, fig. 7-12) on rods (11 and 12) and install rods in tubes.

(b) Install nylon pellets (7) in gland nuts (6). Install wipers (4) and packings (5) in gland nuts.

(c) Install backup washer (8) and packings (9) on gland nuts. Install gland nuts over rods and into tubes. Tighten gland nuts into tubes securely.

(d) Install bleed screws (1) and nylon washers (2) in tube.

(e) Install crossheads (29, fig. 7-11) on cluster cylinder and secure with screws (24).

e. Installation of Single Cylinder.

(1) Lift single cylinder into place on mast using a suitable hoist.

(2) Secure lower end of cylinder to outer mast with nut (40, fig. 7-11). Secure top of cylinder to mast with screws (33) and lock washers (34). Install clamp (38) and spacer (39) around cylinder. Secure clamp with screws (36) and lock washers (37).

(3) Install new packing (16) and regulator body (15) in single cylinder. Install regulator (14), new packing (13) and elbow (12). Remove plug from hydraulic hose and connect hose to elbow.

f. Installation of Cluster Cylinder.

(1) Using a suitable hoist lift cluster cylinder into position on the mast.

(2) Secure lower end of cluster cylinder with nut (40). Secure upper end of center tube to inner mast with screw (33) and lock washer (34).

(3) Install fittings (5) in cylinders. Connect tube (4) between cluster and single cylinders.

(4) Install chain anchors (23) in brackets on cluster cylinder and install nuts (22). Connect chains (21) to anchors using links (20). Install chain guards (19) and secure with screws (17) and lock washers (18).

(5) Refer to paragraph 2-14 and install side shift carriage and forks.

g. Bleed Cylinders.

(1) Connect battery receptacle and operate truck. Raise and lower mast a few times and tilt mast to operate tilt cylinders.

(2) Check oil level in hydraulic reservoir and fill to proper level.

(3) Raise mast until forks are approximately three feet above floor.

(4) Open bleed screws (1, figs. 7-12 and 7-13).

(5) Check oil flowing from bleed screws. Allow oil to flow until all bubbles are gone from oil and a clear stream of air-free oil flows from bleed screw hole.

(6) Close bleed screws.

(7) Check oil level in reservoir and fill to proper level, if necessary.

Section IV. SIDE SHIFT INSTALLATION

7-8. Description

a. The fork lift truck is equipped with a side shift carriage. Hydraulic power will shift the

carriage to the right or left, allowing ease and accuracy of positioning loads.

b. Operation of the side shift is controlled by

the outer lever of the control valve. Pushing the lever forward will move the carriage to the left. Rearward movement of the lever shifts the carriage to the right.

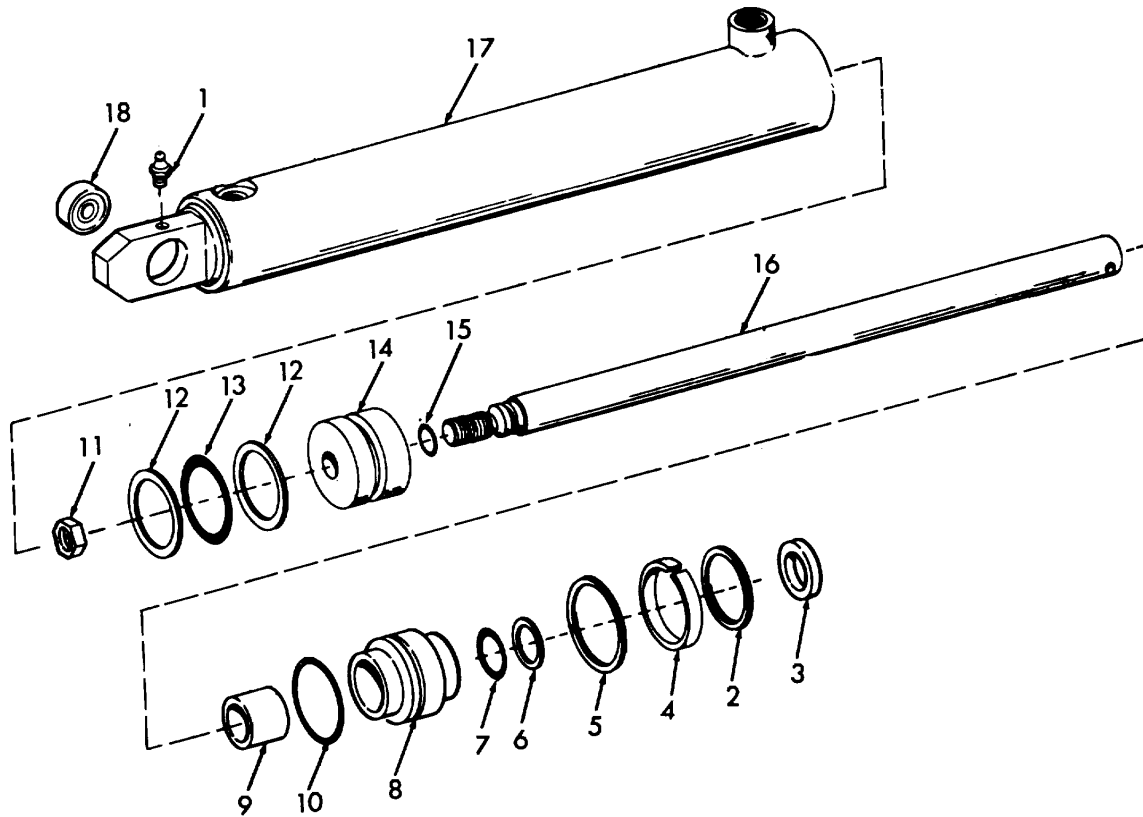
c. The side shift cylinder is connected at one end to the carriage plate and the other end is anchored to the frame. Hydraulic hoses leading to the cylinder are connected to a reel attached to the outer mast. As the carriage is raised and lowered the hoses reel and unreel.

7-9. Side Shift Cylinder

a. *Removal.* Refer to TM10-3930-631-12 and remove the side shift cylinder.

b. *Disassembly.*

(1) Remove lubrication fitting (1, fig. 7-14) from the tube.



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- | | |
|------------------------|-------------------|
| 1. Lubrication fitting | 10. Seal |
| 2. Lock ring | 11. Nut |
| 3. Wiper | 12. Backup washer |
| 4. Spacer | 13. Packing |
| 5. Lock ring | 14. Piston |
| 6. Backup washer | 15. Seal |
| 7. Packing | 16. Rod |
| 8. Head | 17. Tube |
| 9. Bearing | 18. Bearing |

Figure 7-14. Side shift cylinder, exploded view.

(2) Remove lock ring (2) and spacer (4). Compress lock ring (5) and remove lock ring and head and rod from tube.

(3) Remove rod, with remaining parts attached, from tube.

(4) Slide head (8) from rod. Remove wiper (3), backup washer (6) and packing (7) from head. Remove seal (10) from head.

(5) Remove nut (10) and slide piston from rod. Remove backup washers (12) and packing (13) from piston. Remove seal (15) from rod (16).

c. Cleaning, Inspection and Repair.

(1) Clean all metal parts in cleaning compound, solvent (Fed. Spec. P-D-680) and dry thoroughly.

(2) Inspect tube bore, head and piston for cracks, scratches, scoring and other damage. Replace worn or damaged parts.

(3) Inspect bearings in head and tube. If bearings are worn or damaged press bearings from head.

(4) Replace all packings, backup washers and seals contained in repair kit for cylinder.

d. Assembly.

(1) Coat all cylinder parts with engine oil (OE) before assembly.

(2) If bearings (9 and 18, fig. 7-14) were removed, press new bearings in head and tube.

(3) Install seal (15) in groove on rod (16). Install backup washers (12) and packing (13) in groove on outside of piston. Install piston (14) on rod and secure with nut (11).

(4) Slide rod assembly into tube (17), piston first.

(5) Install packing (7) and backup washer (6) in head. Install seal (10) in groove in outside of head. Place lock ring (5), spacer (4) and lock ring (2) in position on head. Install wiper (3) in groove in inside of head.

(6) Slide head into tube around rod, with lock ring compressed, until lock ring (5) snaps into place in tube.

(7) Install lubrication fitting (1) in cylinder.

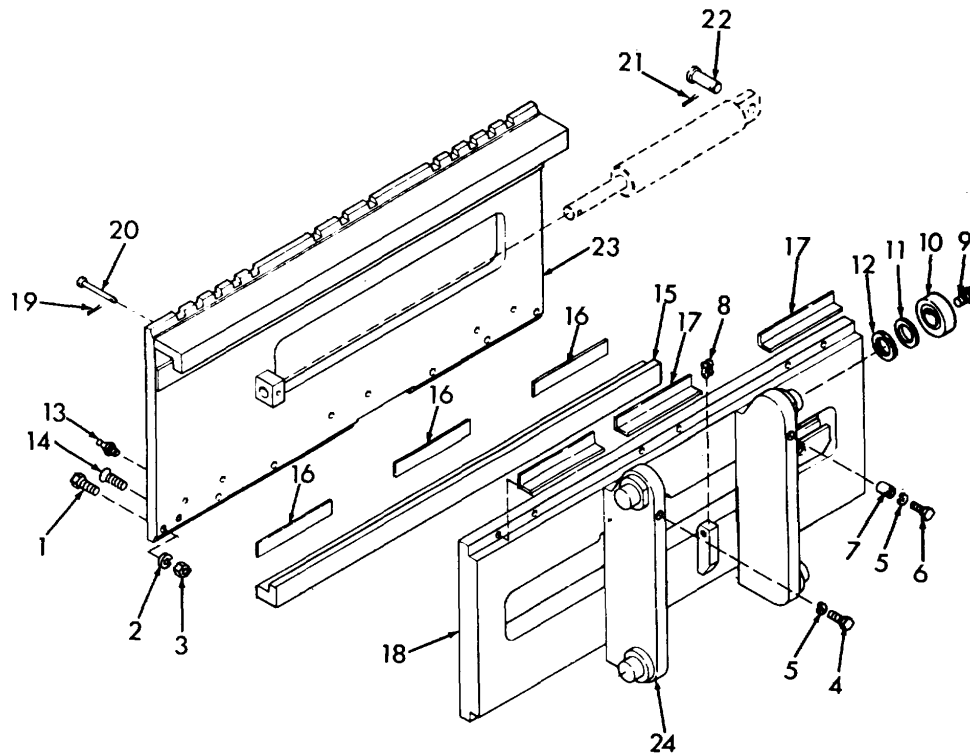
e. Installation. Refer to TM10-3930-631-12 and install side shift cylinder in carriage.

7-10. Side Shift Carriage

a. Removal. Refer to paragraph 2-14 and remove side shift carriage from mast.

b. Disassembly.

(1) Remove screws (4 and 6, fig. 7-15), lock washers (5) and spacers (7) from carriage frame.



TS009193

- | | |
|----------------|-------------------------|
| 1. Screw | 13. Lubrication fitting |
| 2. Lock washer | 14. Screw |
| 3. Nut | 15. Lower hanger |
| 4. Screw | 16. Wear strip |
| 5. Lock washer | 17. Wear angle |
| 6. Screw | 18. Carriage frame |
| 7. Spacer | 19. Cotter pin |
| 8. Chain link | 20. Pin |
| 9. Screw | 21. Cotter pin |
| 10. Bearing | 22. Pin |
| 11. Shim | 23. Plate |
| 12. Shim | 24. Stud |

Figure 7-15. Side shift carriage, exploded view.

(2) Attach a suitable hoist to plate (23) and lift plate to clear frame. Slide plate off right side of frame (when facing frame) and remove from frame.

(3) Remove screws (1), lock washers (2) and nuts (3) from plate. Remove screws (14) and remove lower hanger bar (15).

(4) Remove lubrication fittings (13). Pry off wear strips (16).

(5) Pry off wear angles (17) from carriage frame.

(6) Remove screws (19) and remove bearings (10) from top studs. Use a suitable puller to remove bearings from studs. Note size and quantity of shims (11 and 12) used.

c. Cleaning, Inspection and Repair.

(1) Clean all parts in cleaning compound, solvent (Fed. Spec. P-D-680) and dry thoroughly.

(2) Inspect all parts for cracks, broken welds and other damage.

(3) Replace wear strips and wear angle if wear surface has worn to a thickness of 0.063 inch (1.60 mm).

(4) Inspect bearings for wear and damage. Inspect for cracked inner or outer races. Replace worn or damaged bearings.

(5) Inspect bearings studs for wear and damage. If studs are worn or damaged, remove studs and weld new studs on supports as follows:

Note

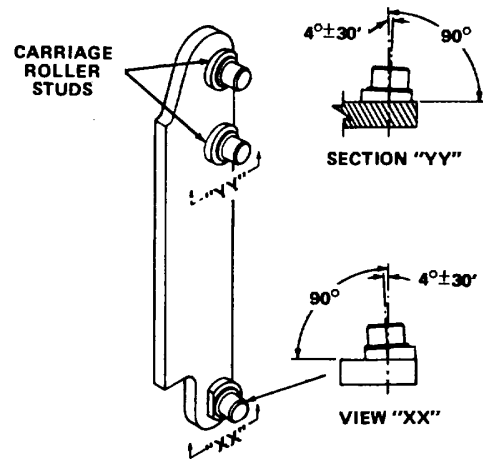
The following procedures apply to carriage and mast bearing studs.

(a) Remove the filler metal from around the stud using a small, round grinder. Do not make any passes into the mast channel or carriage supports. Remove the stud from the channel or support.

(b) Prepare the 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.

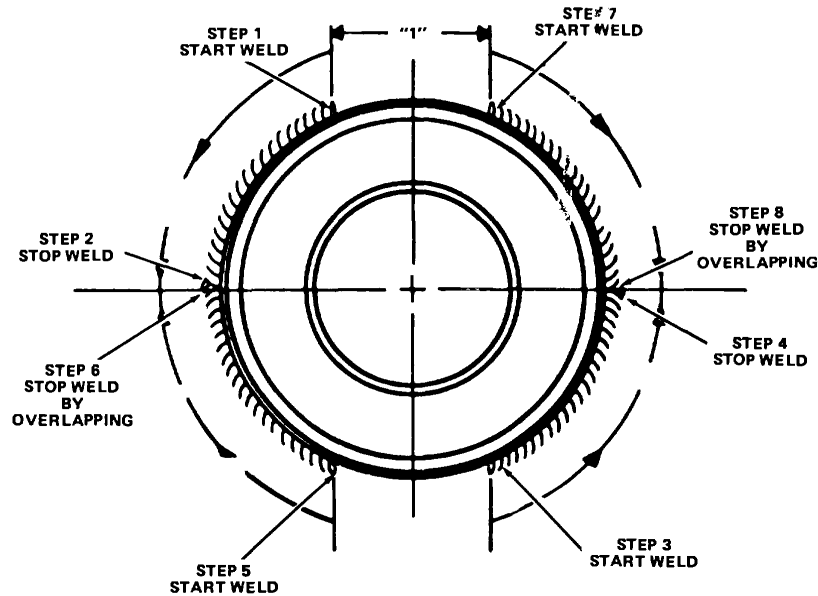
(c) Locate, tilt and align the new stud on mast channel or support. Refer to figure 7-16 and 7-21 for dimensions and stud locations.

(d) Comply with the following welding specifications using bearing stud welding procedure (fig. 7-17).



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Figure 7-16. Carriage roller stud locations.



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Figure 7-17. Bearing stud welding procedure.

Process	Shielded Metal Arc
Equipment	Manual
Settings:	
Current	A.C.
Amps	275/325
Volts	31/33
Base Metals	(1) AC 1035-P-1
	(2) AC 86L20H (roller stud)
Plate Thickness Range ...	3/8" - 1" (9.5 - 25.4 mm)
Electrode:	
Type	Stick
Class	E 7018 (hydrogen free)
Size	3/8" (9.5 mm)
Flux	Electrode Covering
Weld Type and Size	1/4" Fillet
Number of Passes	1
Position	Horizontal
Preheat	400 degrees F (205°C)
Interpass	250 degrees F (121°C)
Postheat	None

(e) When welding is completed, remove all slag, weld spatter, and excessive weld material.

(f) Remove the defective material with a small, round grinder in 0.010-0.020 of an inch passes and visually inspect for defects after each pass.

d. Assembly.

(1) Install bearings (10, fig. 7-15) and same amount of shims (11 and 12) as were removed in

disassembly. Secure upper bearings with screws (9).

(2) Install wear angles (17) and carriage frame.

Install screws (4 and 6), lock washers (5) and spacer (7).

(3) Install wear strip (16) on plate (23). Install lubrication fittings (13) in plate. Lubricate wear strips and wear angles with a light coat of grease (GAA).

(4) Use a hoist and move assembled plate into position at right side of carriage frame. Carefully slide side shift plate into position on frame. Lift plate into position over wear angles.

(5) Install lower hanger bar (15) and secure with screws (14). Tighten screws to a torque of 28 to 33 pound feet (3.86-4.55 m-kg).

(6) Lubricate all lubrication fittings (13) with grease (GAA).

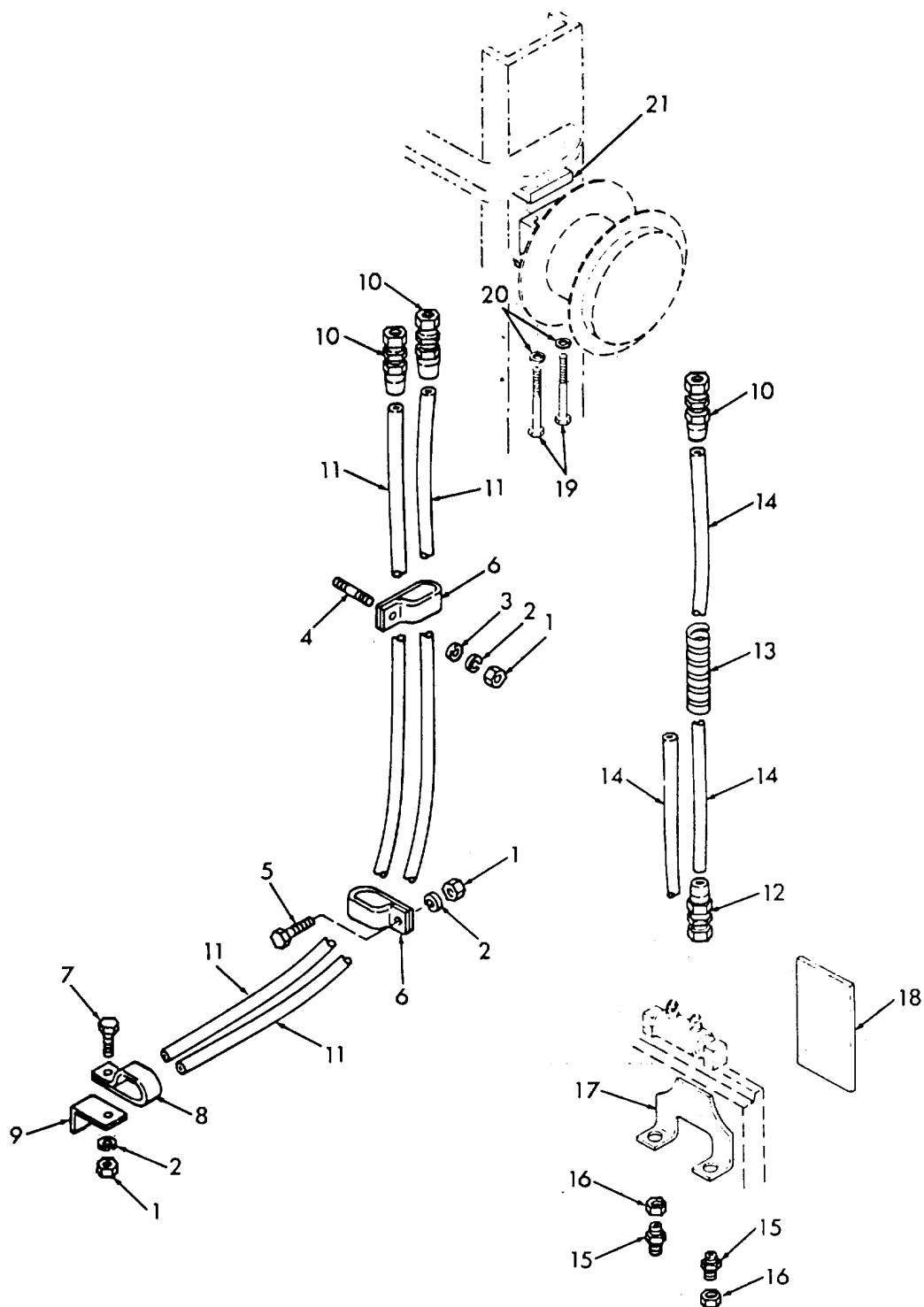
e. Installation. Refer to paragraph 2-14 and install side shift carriage.

7-11. Side Shift Hoses

a. Removal.

(1) Refer to figure 7-18 and remove side shift hoses from mast, reel and swivel block.

(2) Remove screws and nuts as necessary to remove hoses.



- | | | | | |
|----------------|------------|------------------|------------------|-----------------|
| 1. Nut | 6. Clamp | 10. Hose fitting | 14. Hose | 18. Support |
| 2. Lock washer | 7. Screw | 11. Hose | 15. Hose fitting | 19. Screw |
| 3. Washer | 8. Clamp | 12. Hose fitting | 16. Nut | 20. Lock washer |
| 4. Stud | 9. Bracket | 13. Hose guard | 17. Bracket | 21. Block |
| 5. Screw | | | | |

Figure 7-18. Side shift hoses, exploded view.

b. Inspection.

- (1) Inspect all hoses for damage and deterioration. Replace unserviceable hoses.
- (2) Inspect hoses and fittings for evidence of leakage.
- (3) Inspect bracket for damage. Replace bracket by welding if unserviceable.
- (4) Inspect hose guards for damage, evidence of pinching hose, and wear. Replace unserviceable hose guards.

c. Installation. Refer to figure 7-18 and install side shift hoses on fork lift truck.

7-12. Hose Reel

Paragraph 7-12 has been rescinded. See TM 10-3930-631-12.

7-13. Swivel Block

Paragraph 7-13 has been rescinded. See TM 10-3930-631-12.

Section V. MAST 7-14. Description

a. The mast contains three sections: an inner mast, intermediate mast, and outer mast. The inner mast moves within the intermediate mast channels and is guided by bearings at the top of the intermediate mast and bottom of the inner mast. Bearings in the outer mast channels and at the bottom of the intermediate mast guide the intermediate mast. The outer mast is attached to the front of the frame.

b. The masts and carriage are raised by hydraulic cylinders. An interlock assembly, mounted on the inner mast, locks all three sections in the lowered position. When the carriage and forks rise to the top of the free lift through lift chain action, the interlock is engaged by the carriage stop screw. The interlock lever is moved out of engagement with the mast, allowing the telescoping masts to rise.

7-15. Mast Assembly

a. Removal. Refer to paragraph 2-15 and remove the mast assembly as a unit. If desired the mast sections can be removed while mounted on the truck. Refer to paragraph 7-7 and remove the hoist cylinders. Refer to paragraph 7-11 and TM 10-3930-631-12 and disconnect side shift hoses and remove reel and swivel block.

(1) Attach a suitable hoist to inner mast (46, fig. 7-11). Trip interlock lever (10) and hold lever away from mast. Carefully lift inner mast from intermediate mast.

(a) Slowly raise inner mast until notch at bottom of inner mast clears the intermediate mast upper bearing.

(b) Check to see that inner mast bearing clears notch in intermediate mast upper channel. If both bearings are clear, remove inner mast from intermediate mast.

(2) Attach hoist to intermediate mast and carefully lift intermediate mast (48) from outer mast.

(3) Disconnect tilt cylinders from outer mast. Attach a suitable hoist to outer mast (50) and remove mounting pins securing outer mast to frame. Carefully lift mast from truck frame.

b. Disassembly.

(1) Disconnect spring (6, fig. 7-11) from interlock lever and screws (7). Remove screw (8) and spacer (9) and remove interlock lever (10) from inner mast.

(2) Remove bearings (41) and record number and remove shims (42 and 43) from masts using a bearing puller. Remove screw (44) and remove stud (45) from outer mast.

(3) Remove setscrews (25) and remove washers (27) and bearing (28) from crosshead (29).

(4) Remove screw (1) and lockwasher (2) and remove guard (3) from intermediate mast.

c. Cleaning, Inspection and Repair.

WARNING

Cleaning compound, solvent (Fed. Spec. P-D-680), used for cleaning, is potentially dangerous to personnel and property. Do not use near open flame. Flash point of solvent is 100°F to 138°F (38°C to 59°C).

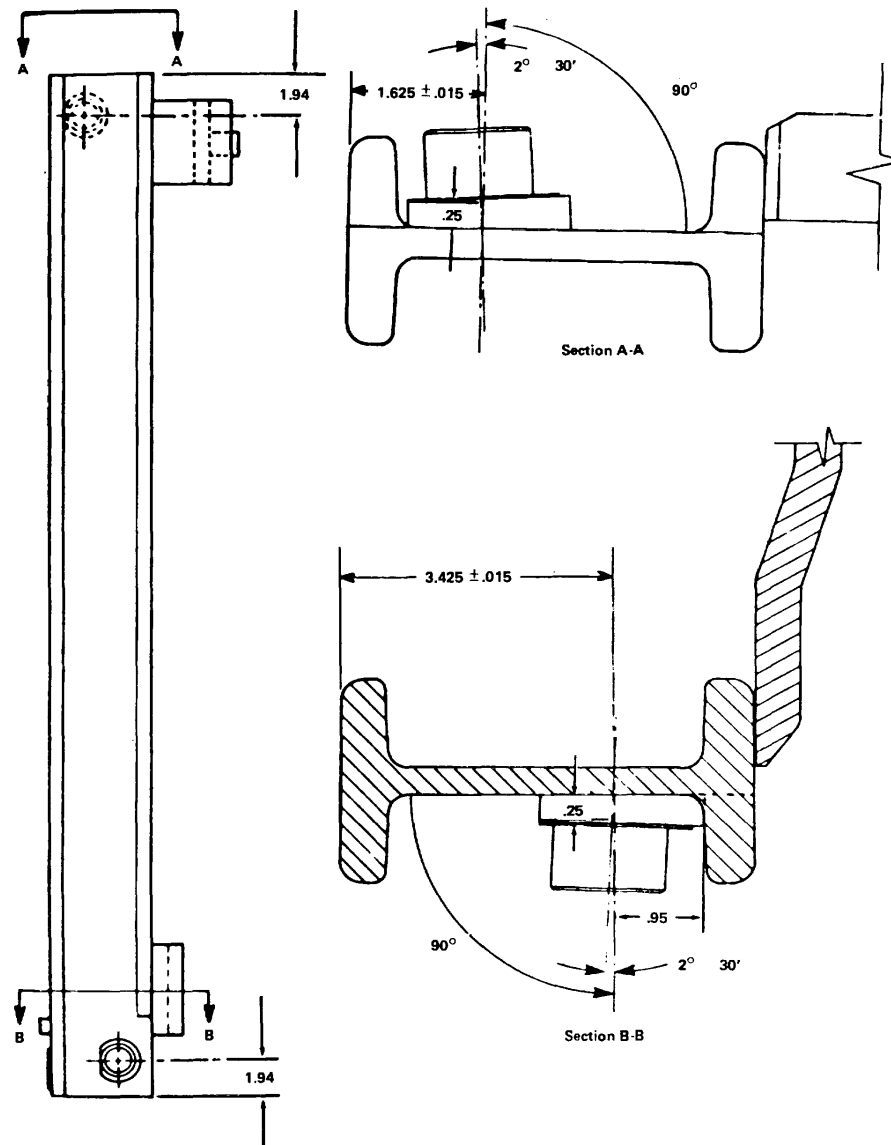
(1) Clean all parts in cleaning compound, solvent (Fed. Spec. P-D-680) and dry thoroughly.

Pages 7-29 and 7-30 rescinded.

(2) Inspect masts and channels for broken and cracked welds. Repair welds. Check masts for bent condition. Straighten if possible.

(3) Inspect crosshead bearing for wear and damage. Replace if unserviceable.

(4) Inspect bearing studs for wear and damage. Replace studs if worn or damaged. Refer to paragraph 7-10 for stud welding procedure. Refer to figure 7-21 for location of mast studs.



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Figure 7-21. Mast bearing stud locations.

(5) Inspect mast bearings for wear and damage. Replace unserviceable bearings.

(6) Inspect interlock spring for cracks and damage. Spring should be 5.9375 inches (23.812 mm) long between hooks. Replace unserviceable springs.

(7) Inspect bearings in outer mast ears for wear and damage. Press out old bearings and install new bearings if bearings are worn or damaged.

d. Assembly.

(1) Install bearing (28, fig. 7-11) and washers (27) in crosshead and secure with setscrew (25).

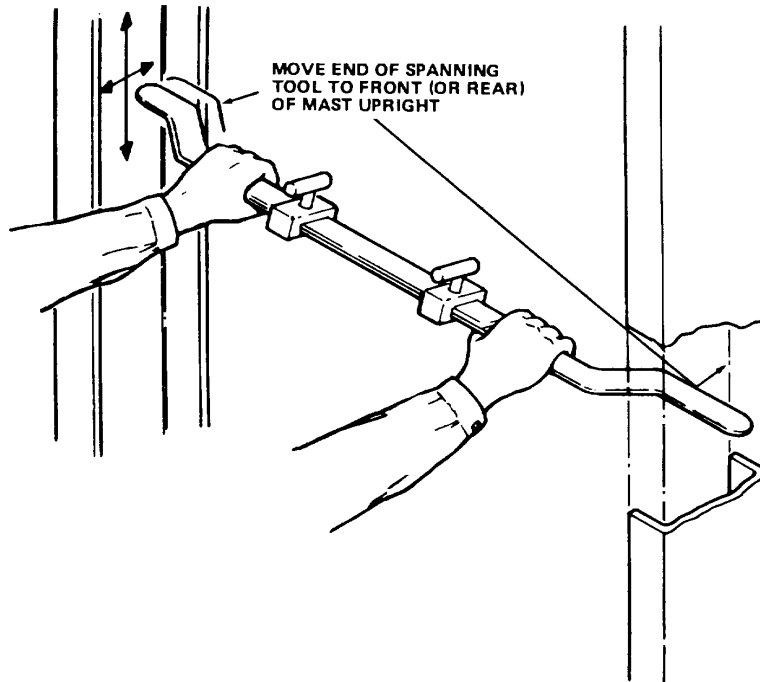
(2) Install bearings (41) and same amount of

shims (42 and 43) as were removed in disassembly. Secure upper bearing stud (45) on outer mast with screw (44). Torque screw to 245 pound-feet (18.1 m-kp). Adjust bearings as follows:

CAUTION

Whenever stud is replaced, install new screw (44) and apply proper torque.

(a) Use a spanning tool (fig. 7-22) and check inside width of mast channels of all masts. Check entire length of mast to locate narrowest distance between uprights. Lock inside -spanning tool at this distance.



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Figure 7-22. Mast bearing adjustment.

(b) Set distance between ends of outside spanning tool with inside spanning tool.

(c) Place inside spanning tool between ends of outside spanning tool and lock tool. Measure distance between ends. Add or delete shims (42 and 43, fig. 7-11) to obtain a maximum of 0.015 inch (0.38 mm) between bearings and outside spanning tool. Divide shims equally between bearings.

(d) If odd number of shims is required,

install extra shim on same side of all mast sections and carriage so mast will be balanced.

(e) Repeat steps above to adjust all bearings on inner and intermediate masts.

(3) Install guard (3) on intermediate mast and secure with screw (1) and lock washer (2).

(4) Install interlock lever (10) on inner mast and secure with screw (8) and spacer (9). Install adjusting screws (7) and attach spring (6) to screws.

e. Installation.

(1) Use a suitable hoist and install outer mast (50, fig. 7-11) on truck. Install mast mounting pins and secure with washers and cotter pins.

(2) Connect tilt cylinders to outer mast and secure with pins and cotter pins (TM10-3930-631-12).

(3) Lift intermediate mast (48) with hoist and lower mast into outer mast channels.

(4) Lift inner mast (46) and install mast into intermediate mast channels.

(5) Refer to paragraph 7-7 and install hoist cylinders.

(6) Refer to paragraph 7-11 and TM 10-3930-631-12.

and install hose reel, swivel block and side shift hoses.

(7) Before installing carriage check bearing clearance for carriage bearings in inner mast as described in d. (2) above. Clearance should be A 0.015 inches (0.38 mm) between bearings and inside channels of inner mast.

f. Adjustment Check.

(1) Operate truck and raise and lower mast and carriage several times. Check for free movement throughout entire range of travel.

(2) Adjust bearings and shims, if necessary, on masts and carriage (e. (2) above) to provide free movement.

Section VI. HYDRAULIC RESERVOIR AND HOSES

7-16. Description

a. The hydraulic system (fig. 7-1) is connected together by hydraulic tubes and hoses. Oil is filtered through a full flow filter before returning to the reservoir.

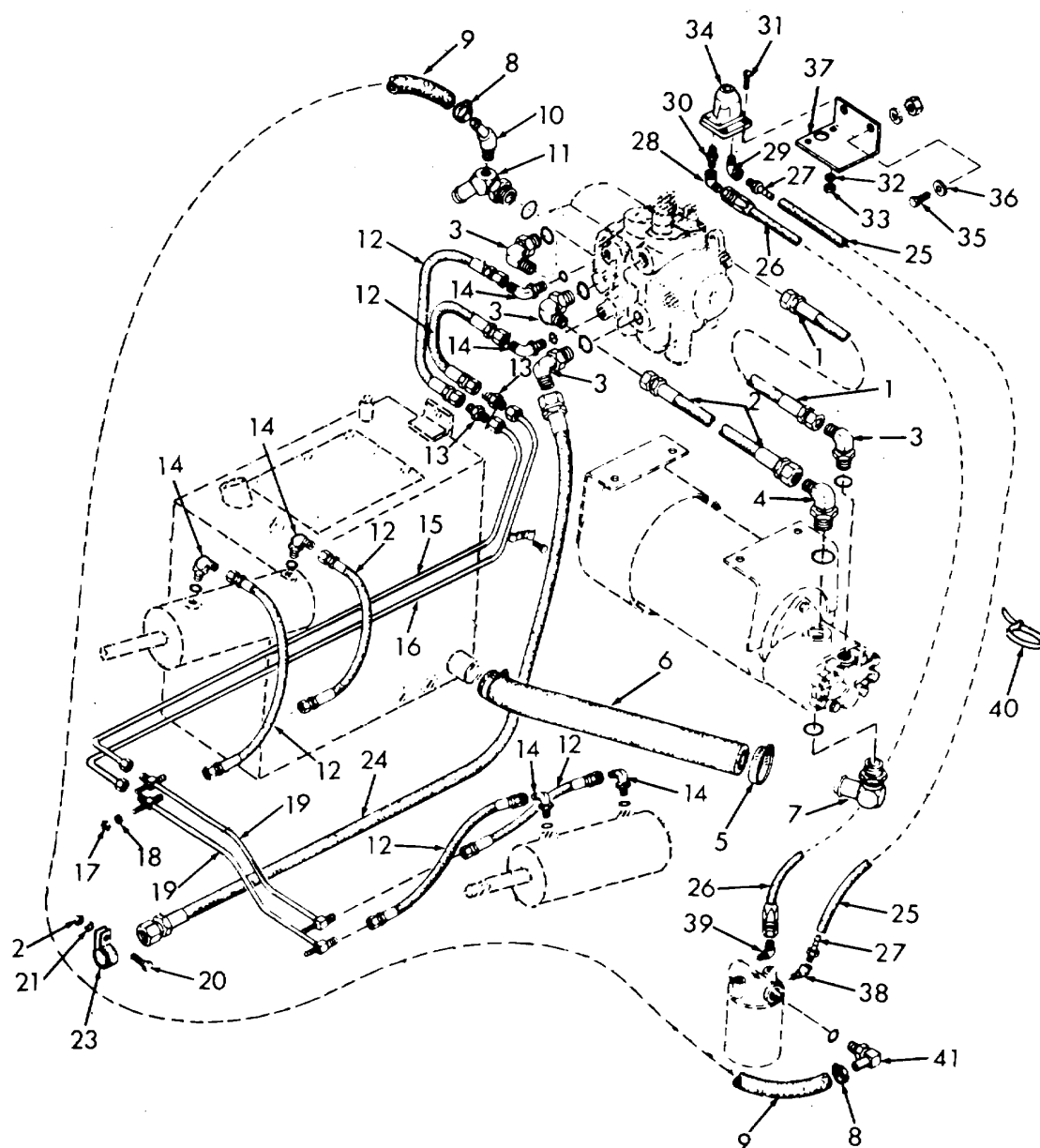
b. A reservoir stores the oil and is connected to the hydraulic pump by a suction hose. The

steering hydraulic system also receives oil from the reservoir.

7-17. Hydraulic Hoses and Tubes

a. Removal. Refer to figure 7-23 and disconnect hoses and remove hydraulic system components as necessary to service or replace items.

Change 1 7-33



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Figure 7-23. Hydraulic hoses, exploded view.

KEY to fig. 7-23:

- | | |
|---------------------|-------------------|
| 1. Hose assembly | 21. Lock washer |
| 2. Hose assembly | 22. Nut |
| 3. Elbow | 23. Clamp |
| 4. Elbow | 24. Hose assembly |
| 5. Clamp | 25. Hose |
| 6. Hose | 26. Hose assembly |
| 7. Hose fitting | 27. Hose fitting |
| 8. Clamp | 28. Elbow |
| 9. Hose | 29. Elbow |
| 10. Hose fitting | 30. Nipple |
| 11. Drilled fitting | 31. Screw |
| 12. Hose assembly | 32. Lock washer |
| 13. Union | 33. Nut |
| 14. Elbow | 34. Indicator |
| 15. Tube assembly | 35. Screw |
| 16. Tube assembly | 36. Lock washer |
| 17. Nut | 37. Bracket |
| 18. Lock washer | 38. Elbow |
| 19. Tube assembly | 39. Elbow |
| 20. Screw | 40. Tie |
| | 41. Elbow |
- b. *Cleaning, Inspection and Repair.*
- (1) Clean all metal parts in cleaning corn-

pound, solvent (Fed. Spec. P-D-680) and dry thoroughly.

(2) Inspect all hoses for evidence of leakage, deterioration and damage. Replace unserviceable hoses.

(3) Inspect all fittings for leakage and damage to threads. Many fittings include packings. Replace all damaged fittings and all packings.

c. *Installation.* Refer to figure 7-23 and install hoses and tubes.

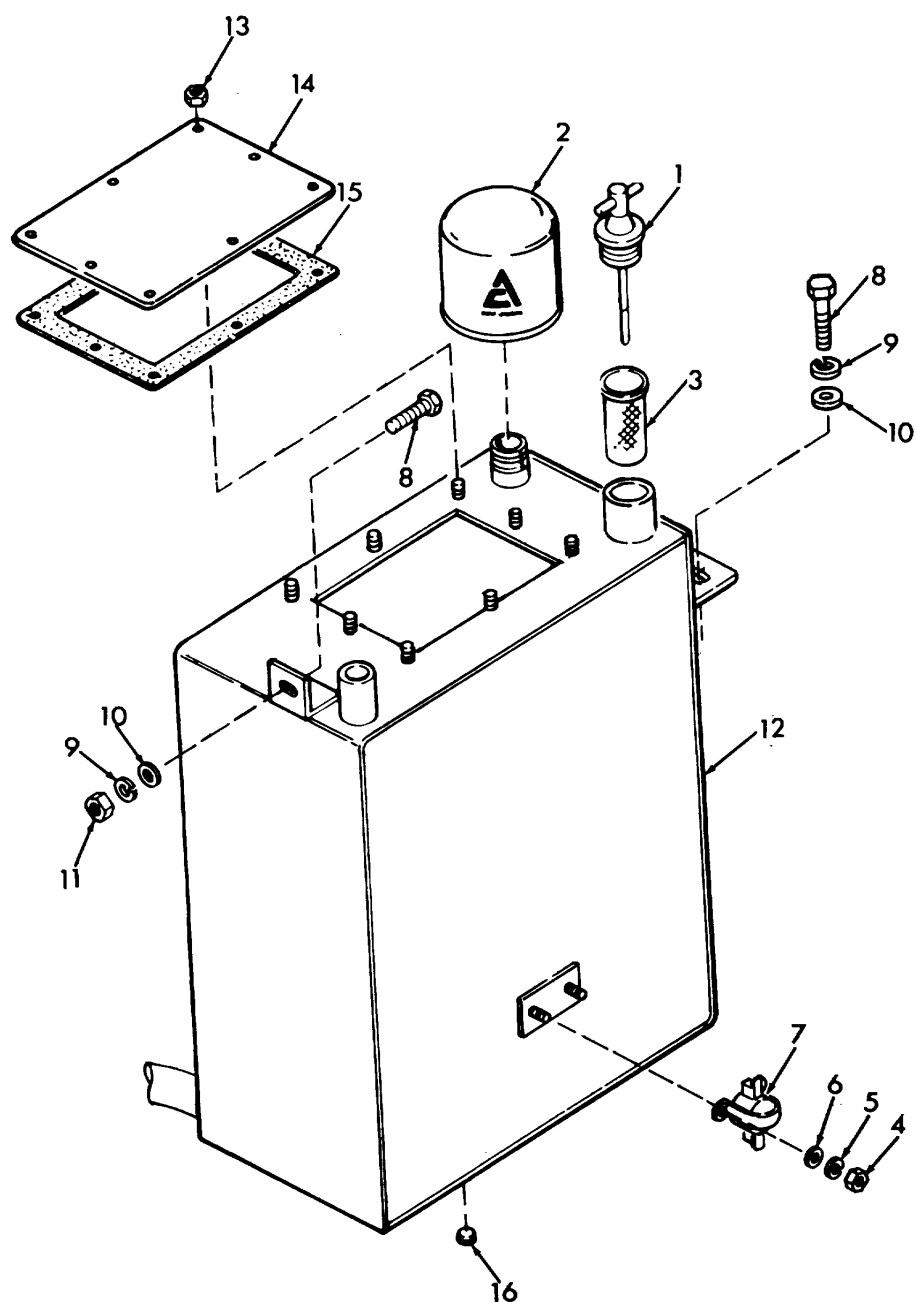
7-18. Hydraulic Reservoir

a. *Removal.*

(1) Refer to TM10-3930-631-12 and drain hydraulic reservoir.

(2) Remove toe and floor plates and drip pan.

(3) Disconnect wires from thermal relays (7, fig. 7-24).



TS009202

- | | | | |
|-----------------|------------------|----------------|----------------|
| 1. Level gage | 5. Lock washer | 9. Lock washer | 13. Nut |
| 2. Breather | 6. Washer | 10. Washer | 14. Cover |
| 3. Inlet screen | 7. Thermal relay | 11. Nut | 15. Gasket |
| 4. Nut | 8. Screw | 12. Reservoir | 16. Drain plug |

Figure 7-24. Hydraulic reservoir, exploded view.

(4) Remove screws (8), lock washers (9), washers (10) and nuts (11).

(5) Loosen hose clamps and disconnect hose (6, fig. 7-23). Loosen hose clamps and disconnect hoses (2 and 16, fig. 5-8) from reservoir.

(6) Carefully lift reservoir (12, fig. 7-24) from truck.

b. Disassembly.

(1) Remove breather (2, fig. 7-24), gage (1) and inlet screen (3) from reservoir.

(2) Remove nuts (13) and remove cleanout cover (14) and gasket (15) from top of reservoir.

(3) Remove nuts (4), lock washers (5), washers (6) and thermal relays (7) from reservoir.

c. Cleaning, Inspection and Repair.

(1) Replace breather after 200 hours of operation.

(2) Clean inlet screen in cleaning compound, solvent (Fed. Spec. P-D-680) and dry thoroughly.

(3) Flush the inside of the reservoir with solvent and allow to dry thoroughly.

(4) Inspect reservoir for evidence of leakage. Check welds for cracks and damage. Repair if necessary.

d. Assembly.

(1) Install thermal relays (7, fig. 7-24) on reservoir and secure with nuts (4), lock washers (5) and washers (6).

(2) Install new gasket (15) on reservoir and install cover (14). Secure cover with nuts (13).

(3) Install inlet screen (3) and gage (1). Install new breather (2) on reservoir.

e. Installation.

(1) Install reservoir in truck and secure with screws (8), lock washers (9), washers (10) and nuts (11). Install drain plug (16).

(2) Connect hoses (2 and 16, fig. 5-8) to reservoir and tighten clamps.

(3) Connect suction hose (6, fig. 7-23) to reservoir and tighten clamp.

(4) Refer to TM10-3930-631-12 and fill hydraulic reservoir.

(5) Operate truck and bleed hydraulic lift cylinders (para. 7-7). Replenish oil as necessary.

(6) Install floor and toe plates and drip pan.

CHAPTER 8

REPAIR OF ELECTRIC MOTORS

Section I. DRIVE MOTOR

8-1. Description

a. The drive motor is a flange mounted, direct current series wound motor. The armature has a replaceable shaft with a sealed bearing at the commutator end and a double row thrust bearing at the drive end.

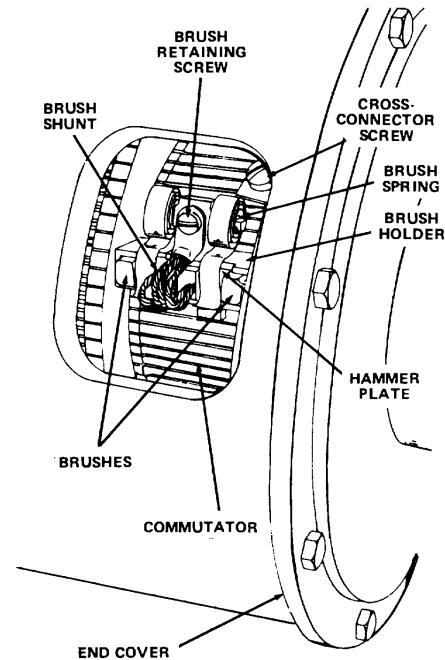
b. Dual metal graphite brushes are supported in fixed box type holders to assure proper brush alinement. A metal clip on top of each brush forms a stop device that prevents commutator scoring.

8-2. Repair of Drive Motor*a. Brush Replacement.*

(1) Remove the floor and toe plates. Remove drip pan.

(2) Disconnect the battery receptacle and discharge the capacitors.

(3) Remove rear cover from drive motor. Remove brush retaining screws (fig. 8-1). Lift brush springs (fig. 8-1) and remove brushes from holders.



TS009204

Figure 8-1. Drive motor brush location.

(4) Clean brushes, holders and wipe commutator with a dry, lint-free cloth.

(5) Check appearance of commutator and brush contact surfaces. Signs of good commutation are a dark brownish highly polished commutator and uniform glossy brush contact surfaces.

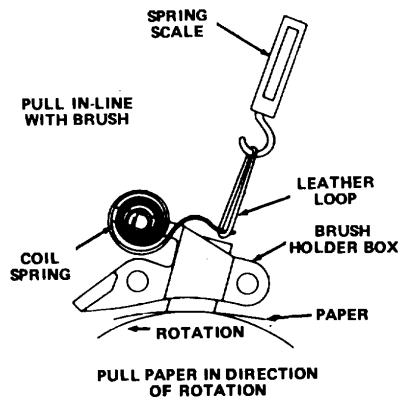
(6) Check brush wires for good contact with brush holder. Wires must not be damaged or burned.

(7) Check brush length. Replace brushes when metal clips on brushes clear the bottom of the holder indent by less than 0.125 inch (3.175 mm).

(8) Before installing new brushes, contour brush contact surfaces on a sanding drum the same diameter as commutator. Hold brushes on drum to obtain same radius and brush angle on contact surface as old brushes. Clean brushes after sanding.

(9) Install brushes by lifting end of brush spring (fig. 8-1) and place brushes in brush holder. Check brush spring for good contact with brush flange. Connect brush wires to brush holder.

(10) Check brush spring for proper pressure. Install thin strong paper between brush and contact surface of commutator (fig. 8-2).



TS009205

Figure 8-2. Checking brush spring pressure.

(11) Attach a loop to pressure end of coil spring and connect a spring scale to loop. Pull on scale and check spring pressure reading. Total spring pressure should be 40 ounces (1.08 kg). Replace spring if pressure does not reach this amount.

(12) Remove spring scale. Install rear cover on drive motor.

(13) Install drip pan and floor and toe plates.

b. Removal.

(1) Disconnect battery receptacle and discharge capacitors. Lift front of truck high enough to gain access to drive motor. Block in position. Remove floor and toe plates and drip pan.

(2) Tag and disconnect drive motor cables. Disconnect wires from thermal relay attached to drive motor. Remove screws and remove thermal relay from motor housing.

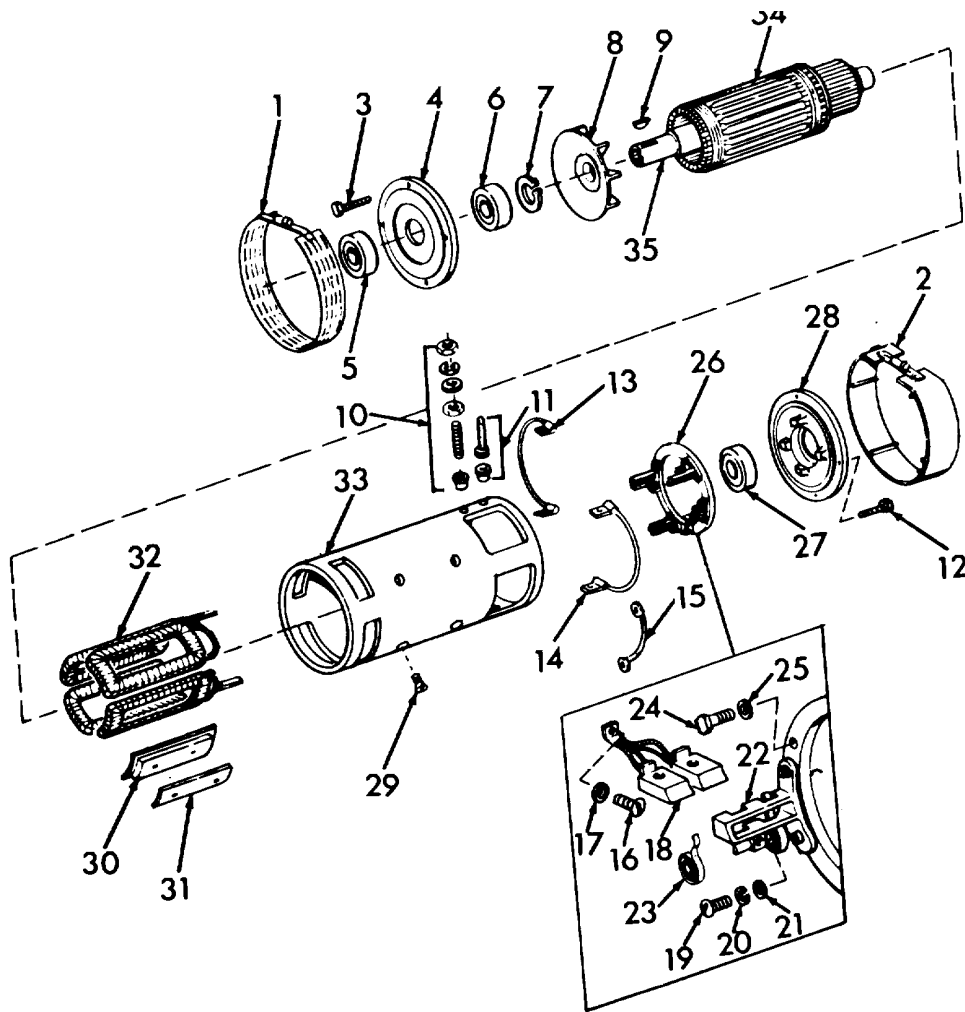
(3) Refer to paragraph 4-2 and disconnect pin from parking brake actuating lever and remove brake calipers, bracket and brake disk from drive motor.

(4) Place a jack or other suitable support under drive motor and raise enough to support motor. Drain oil from differential carrier. (5) Remove screws (5, fig. 3-8) and lock washers (6) and remove drive motor from differential carrier. Remove gasket (9).

c. Disassembly.

(1) Clean exterior of motor with cleaning compound, solvent (Fed. Spec. P-D-680) and dry thoroughly.

(2) Remove rear cover (2, fig. 8-3) and remove brushes (a. above) from motor.



TS009206

- | | | |
|--------------------|--------------------|-------------------|
| 1. Front cover | 13. Lead | 25. Lock washer |
| 2. Rear cover | 14. Lead | 26. Rocker arm |
| 3. Screw | 15. Lead | 27. Bearing |
| 4. Bearing housing | 16. Screw | 28. Housing |
| 5. Seal | 17. Lock washer | 29. Screw |
| 6. Bearing | 18. Brush assembly | 30. Pole shoe |
| 7. Retaining ring | 19. Screw | 31. Shim |
| 8. Fan | 20. Lock washer | 32. Field winding |
| 9. Key | 21. Washer | 33. Housing |
| 10. Stud assembly | 22. Brush holder | 34. Armature |
| 11. Stud assembly | 23. Brush spring | 35. Shaft |
| 12. Screw | 24. Screw | |

Figure 8-3. Drive motor, exploded view.

(2) Place motor on end with drive end up.

(3) Remove screws (3) securing housing (4) to motor. Attach a chain and hoist to housing and lift armature, bearings, retainer and housing from field housing (33).

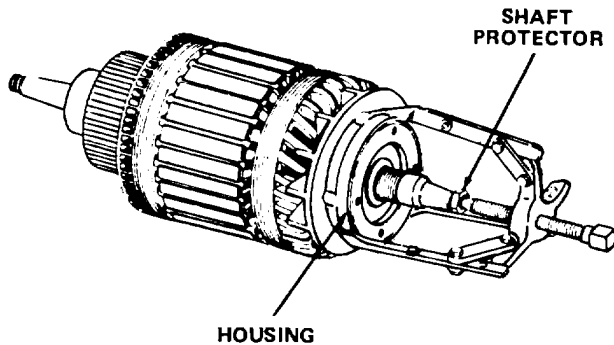
Note

Lift armature straight up to prevent damage to commutator, pole shoes and windings.

(4) Wrap commutator with heavy paper to

protect surface. Place armature on blocks to protect it from damage.

(5) Use a puller (fig. 8-4), remove housing (4) from armature shaft. Press seal (5) and bearing (6) from housing.



TS009207

Figure 8-4. Removing bearing housing.

6) Remove retaining ring (7) and remove fan (8) and key (9) from armature shaft.

(7) Remove screws (12) and remove housing (28) with attached brush rocker arm (26), brush holders and bearing (27). Pull housing out far enough, tag and disconnect leads (13, 14 and 15) from brush holders and windings.

(8) Remove rocker arm (26) from housing and remove brush springs and brush holders.

(9) Press bearing (27) from housing.

(10) If not removed, remove nuts, washers, insulation and stud assemblies (10 and 11).

(11) Remove pole shoe screws (29). Count and remove shims (31). Remove pole shoes and field winding (32).

CAUTION

Handle field windings carefully so as not to damage insulation.

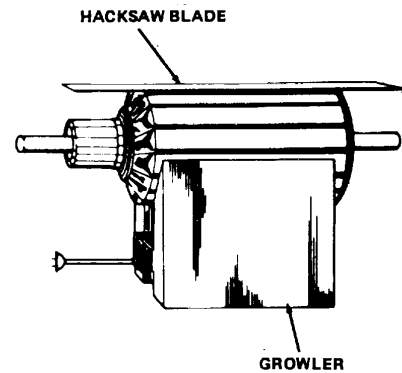
d. Cleaning. Inspection and Repair.

(1) Clean all parts except field windings and armature in cleaning compound solvent (Fed. Spec. P-D-680) and dry thoroughly.

(2) Wipe armature and windings with a cloth saturated in solvent. Do not soak, dip or wash.

(3) Inspect bearings for wear and damage. Replace unserviceable bearings.

(4) Check armature for shorts by placing it on a growler (fig. 8-5).



TS009208

Figure 8-5. Testing armature for shorts.

(a) Hold a steel strip or hacksaw blade on armature core and rotate armature.

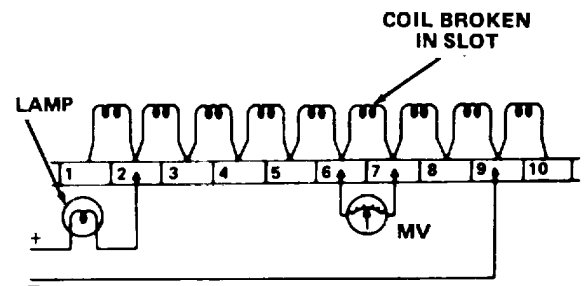
(b) If strip or blade vibrates armature is shorted in area below vibrating blade.

(c) Clean out slots in armature and check again on growler.

(d) Shorts at the crossover of coils at core end can be eliminated by bending the wire slightly and insulating exposed base wire.

(e) If shorts cannot be eliminated, replace armature.

(5) Place the armature in blocks and connect a source of direct current to the commutator as shown in figure 8-6.



TS009209

Figure 8-6. Check for open coils.

(a) Use a milli-voltmeter and touch voltmeter probe to adjacent bars as shown.

(b) The meter will not show a reading unless the coil is open. If coils are open replace armature.

(6) Inspect the commutator. If commutator is burned, rough or out of round it must be resurfaced and undercut.

(a) Place armature in a lathe and turn commutator down until true. Do not damage commutator riser bars at rear of commutator when resurfacing.

(b) Undercut mica between bars to a depth not to exceed 0.030 inch (0.752 mm). Undercut must be full width of mica and flat at the bottom. Undercut mica as shown in figure 8-7.

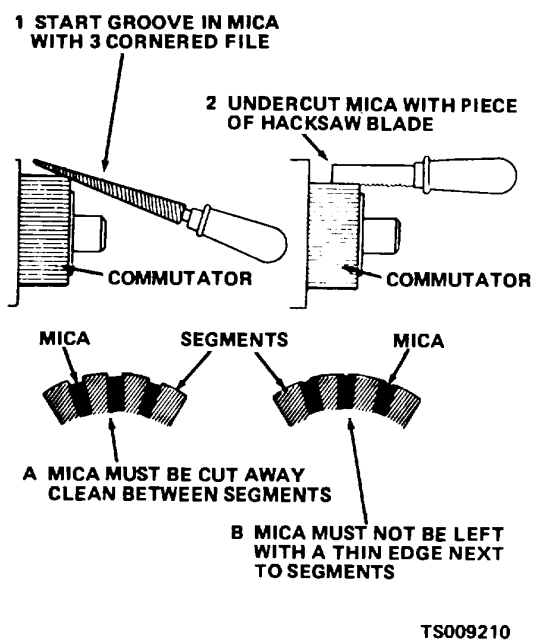


Figure 8-7. Undercutting mica.

(c) After undercutting clean out slots to remove any dirt and copper dust.

(d) Lightly rub the commutator with sandpaper to remove any burrs left from undercutting.

(7) Inspect armature shaft for wear and damage. If shaft requires replacement proceed as follows:

(a) Place drive end of shaft in a heavy duty pipe 2.25 inches (57.1 mm) inside diameter by 18 inches (457.2 mm) long. Pipe must be in complete contact with core above shaft but within the radius of the core rivets.

(b) Place another piece of pipe 1.5 inches

(31.7 mm) inside diameter by 4.0 inches (101.6 mm) long over commutator end against bearing shoulder on shaft.

(c) Place armature in a press and apply vertical pressure on short pipe at commutator end and press shaft from armature. Pressure to remove or install shaft may exceed 20 tons (18120 kg).

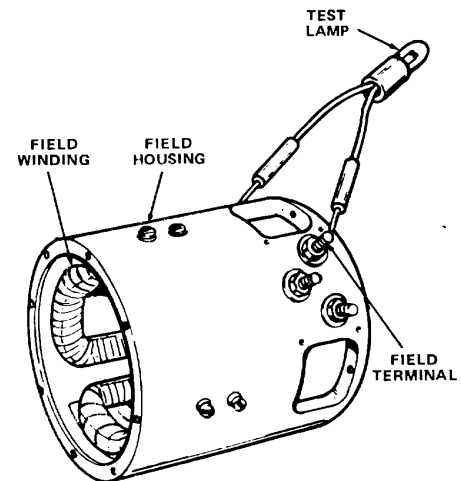
(d) To install new shaft, place a piece of pipe 1.5 inches (38.1 mm) inside diameter, 2.25 inches (57.1 mm) outside diameter against commutator end. Insert shaft as far as it will go. Place a piece of pipe 1.625 inches (41.2 mm) inside diameter by 3.0 inches (76.2 mm) long against bearing shoulder on shaft and apply vertical pressure to press shaft into armature. Shaft must bottom against core support.

e. Assembly.

(1) Heat fan (8, fig. 8-3) in an oven to 200 degrees F (93 degrees C). Position key (9) on shaft and press fan into place. Install retaining ring (7) to secure fan.

(2) Position pole shoes (30) and shims (31) in housing. Install field windings (32) and connect stud assemblies (10 and 11) to frame and windings. Install pole shoes screws (29).

(3) Connect a test lamp between the field terminal and the housing as shown in figure 8-8.

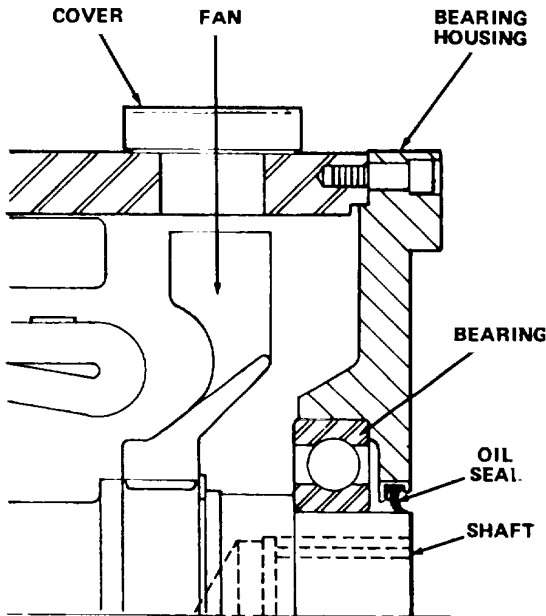


TS009211

Figure 8-8. Checking field winding for grounds.

(4) If lamp lights, field winding is grounded. Remove winding and check to locate short. If short cannot be located and repaired replace field windings.

(5) Pack bearing (6) half full of grease (GA). Install seal (5) and bearing (6) in bearing housing (4). Install bearing housing on housing (33) with seal as shown in figure 8-9.



TS009212

Figure 8-9. Installing bearing housing.

(6) Secure bearing housing with screws (3).

(7) Place motor housing in a vertical position. Use a hoist and carefully lower armature assembly with housing. Do not damage commutator, core or field windings.

(8) Install brush holders (22) and springs (23) on rocker arm (26). Connect leads (13,14 and 15) to windings and rocker arm.

(9) fill bearing (27) half full of grease (GAA) and install bearing in housing (28). Install assembled rocker arm in housing and secure with screws (24) and lock washers (25).

(10) Install bearing housing over commutator and secure with screws (12).

(11) Refer to paragraph a. above and install brushes.

(12) Install covers (1) and (2) on drive motor.

f. Installation.

(1) Place drive motor in position under truck. Install new gasket (9, fig. 3-8) on carrier. Use a suitable jack and lift drive motor into position in line with differential carrier. Guide motor shaft to engage splines of pinion gear in carrier and align motor mounting holes with holes in differential carrier.

(2) Secure motor to carrier with screws (5) and lock washers (6). Install disk (5, fig. 4-1) on motor shaft and secure with nut.

(3) Install parking brake bracket and calipers on drive motor (para 4-1) and connect parking brake linkage. Refer to TM10-3930-631-12 and adjust parking brake linkage.

(4) Connect electric cables to drive motor. Connect leads to thermal relay on motor.

(5) Install drip pan and floor and toe plates. Fill axle and differential with proper grade of oil (LO10-3930-631-12).

Section II. HYDRAULIC PUMP MOTOR

8-3. Description

a. The hydraulic pump and motor are mounted horizontal to the frame to the rear of the drive motor. As the motor drives the pump, hydraulic oil is delivered under pressure to the control valve. From the control valve the oil is sent to actuate lifting, tilting and shifting cylinders.

b. The pump motor is a ventilated, sealed ball bearing type motor. The motor is supported at each end on brackets attached to the truck frame. Current is supplied to the motor when the key switch is on and either lift, tilt or side shift control valve levers are actuated. Movement of the levers

closes micro-switches allowing the current to flow to the pump motor.

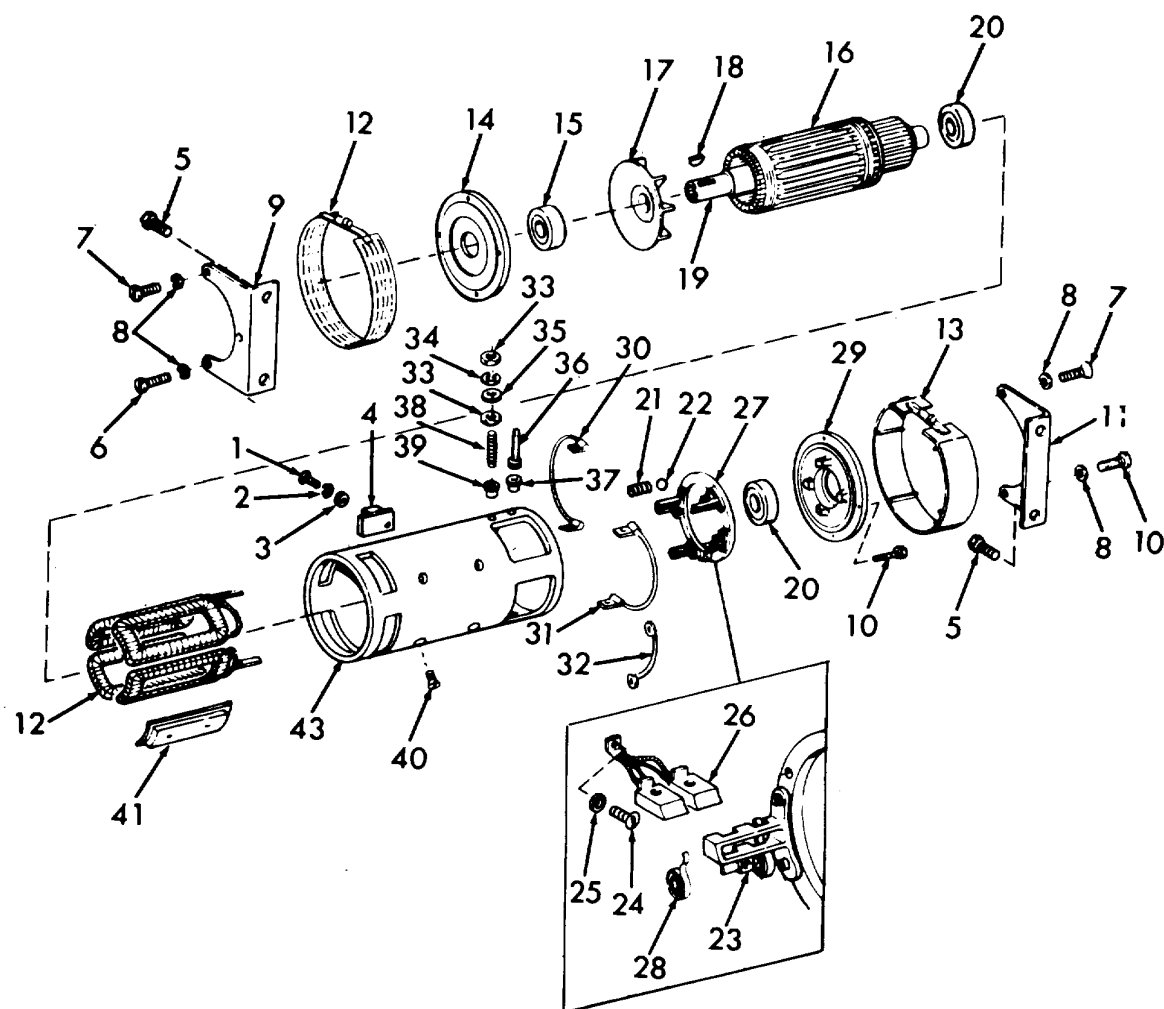
8-4. Repair of Hydraulic Pump Motor

a. Brush Replacement.

(1) Disconnect battery receptacle and discharge capacitors.

(2) Raise front end of truck and securely block truck. Remove drip pan to gain access to hydraulic pump and motor.

(3) Remove rear cover (13, fig. 8-10) to gain access to brushes.

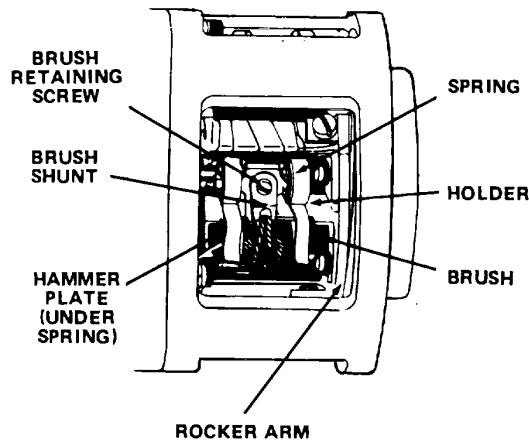


TS009213

- | | | |
|-------------------|------------------|-------------------|
| 1. Screw | 16. Armature | 31. Lead |
| 2. Lock washer | 17. Fan | 32. Lead |
| 3. Washer | 18. Key | 33. Nut |
| 4. Thermal relay | 19. Shaft | 34. Lock washer |
| 5. Screw | 20. Bearing | 35. Washer |
| 6. Screw | 21. Screw | 36. Screw |
| 7. Screw | 22. Lock washer | 37. Insulator |
| 8. Lock washer | 23. Rocker arm | 38. Stud |
| 9. Front bracket | 24. Screw | 39. Insulator |
| 10. Screw | 25. Washer | 40. Screw |
| 11. Rear bracket | 26. Brush | 41. Pole shoe |
| 12. Front cover | 27. Brush holder | 42. Field winding |
| 13. Rear cover | 28. Spring | 43. Housing |
| 14. Front housing | 29. Rear housing | |
| 15. Bearing | 30. Lead | |

Figure 8-10. Hydraulic pump motor, exploded view.

(4) Remove brush screw (fig. 8-11) and washer and lift spring to slide brushes from brush holder.



TS009214

Figure 8-11. Hydraulic pump motor brush location.

(5) Refer to paragraph 8-2a. steps (4) through (12) and replace brushes.

Note

In step (11) brush spring pressure should be 25 ounce, (0.695 kg).

(6) Install rear cover (13, fig. 8-10) on motor.

(7) Install drip pan.

b. *Removal.* Refer to paragraph 2-13 and remove pump motor.

c. *Disassembly.*

(1) Remove screws (6, 7, and 10, fig. 8-10) and lock washers (8) and remove brackets (9 and 11) from motor.

(2) Remove front and rear covers (12 and 13) from motor. Refer to a. above and remove brushes.

(3) Remove remaining screws and remove front housing (14) from motor. Carefully remove armature assembly, with attached bearings and fan, from motor housing.

CAUTION

Use care when removing armature to prevent damage to commutator, core and pole faces. Remove armature by lifting straight up out of housing.

(4) Use a suitable puller and remove bearings (15 and 20) from armature shaft. Remove fan (17) and key (18) from shaft.

(5) Remove remaining screws and remove rear housing (29) far enough to disconnect leads from rocker arms and studs. Remove rear

housing, with attached rocker arm assembly, from motor.

(6) Remove nuts, washers and insulators and remove studs from housing.

(7) Remove screws (21) and lock washers (22) and remove rocker arm assembly from rear housing. Press bearing (20) from rear housing.

(8) Remove pole shoe screws (40) and remove pole shoes (41) and field winding (42) from housing.

d. *Cleaning, Inspection and Repair.*

(1) Refer to paragraph 8-2 d. and clean, inspect and repair the hydraulic pump motor in the same manner.

(2) Inspect fan for damage to blades and wear in shaft diameter. Replace unserviceable fans.

(3) Inspect mounting brackets for bent or damaged condition. Straighten brackets if possible. Replace damaged brackets.

e. *Assembly.*

(1) Install terminal studs (36 and 38, fig. 8-10) in housing and torque studs to 107 pound-inches (.92 m-kp). Install nuts, washers and insulators.

(2) Install field windings (42) and pole shoes (41) in housing and secure with pole shoe screws (40).

CAUTION

Handle field windings carefully to avoid damage to insulation.

(3) Fill bearing (20) half full of grease (GAA) and press into rear housing (29). Install rocker arm assembly (27) on rear housing and secure with screws (21) and lock washers (22).

(4) Move rear housing (29) into position and connect leads (31, 32, and 33) to rocker arms and field windings. Install rear housing and bracket (11) and secure with screws (7 and 10) and lock washers (8).

(5) Install key (18) in slot in shaft. Heat fan (17) in oven to 200°F (93°C) and press fan into place over key.

(6) Press bearings (15 and 20) on armature shaft.

(7) Place assembled housing (43) in a vertical position and carefully lower armature assembly into position in bearings. Install armature carefully to avoid damage to commutator and field windings.

(8) Position front housing (14) and bracket (9) on motor and secure with screws (6 and 7) lock washers (8).

(9) Refer to a. above and install brushes in pump motor.

f. *Installation.* Refer to paragraph 2-13 and install pump motor.

Section III. POWER STEERING PUMP MOTOR

8-5. Description

a. The power steering pump motor is the smallest of the three motors. It is rated at 1.65 horsepower (0.122 kw) at 2700 rpm. The motor operates continuously when the key switch, seat switch and the emergency cutout switches are closed.

b. The motor and pump are mounted forward of the steering axle below the battery. Pressure

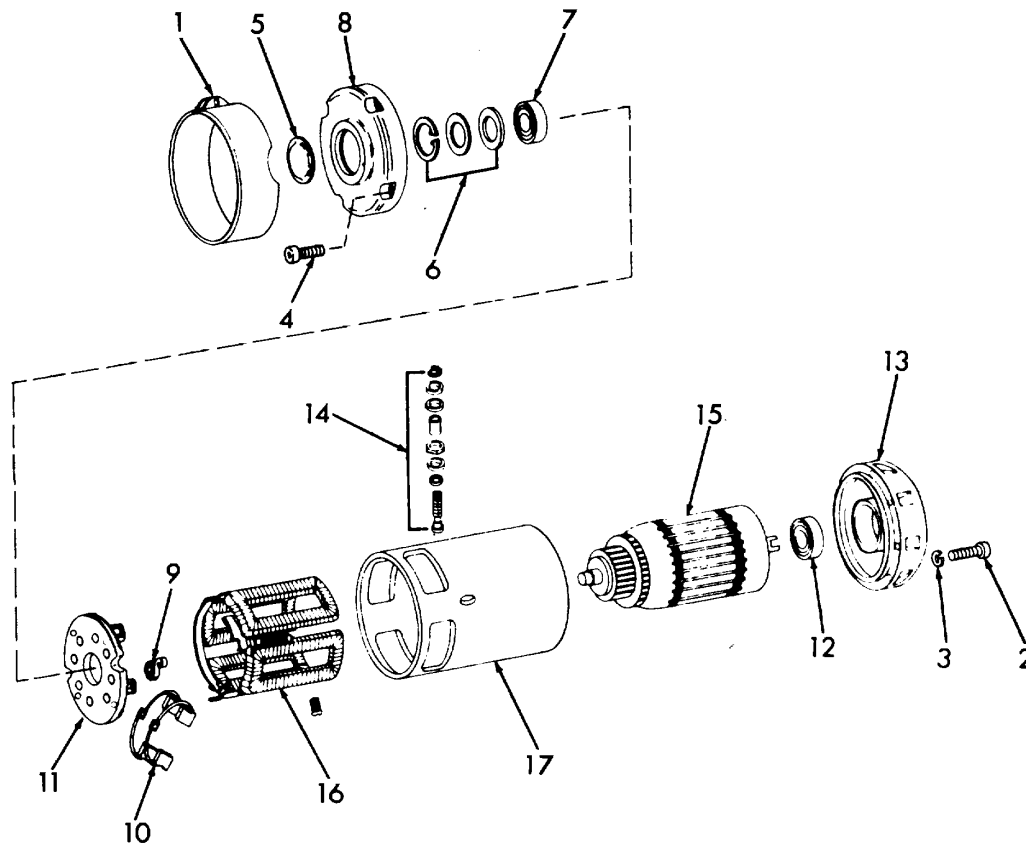
for operation of the power steering is supplied by the single pump coupled to the motor.

8-6. Repair of Power Steering Pump Motor

a. *Removal.* Refer to paragraph 2-11 and remove the steering pump motor.

b. *Brush Replacement*

(1) Remove cover band (1, fig. 8-12) to gain access to brushes.



TS009215

- | | | |
|-------------------|--------------------|--------------------|
| 1. Cover band | 7. Ball bearing | 13. Drive end head |
| 2. Screw | 8. Commutator head | 14. Terminal group |
| 3. Lock washer | 9. Brush spring | 15. Armature |
| 4. Screw | 10. Brush assembly | 11. Field winding |
| 5. Bearing cover | 11. Brush plate | 17. Field frame |
| 6. Retainer group | 12. Bearing | |

Figure 8-12. Power steering motor, exploded view.

(2) Remove screws attaching brush assemblies (10) to brush plate (11). Lift brush springs (9) and remove brush assemblies from motor.

(3) Refer to paragraph 8-2a steps (4) through (12) and replace brushes.

Note

In step (11) brush spring pressure should be 33 ounces (0.089 kg).

(4) Install cover band (1, fig. 8-12) on motor.

c. Disassembly.

(1) Remove cover band (1, fig. 8-12) and remove brush assembly (10) from motor (b above).

(2) Remove screws (4) and remove commutator head (8) from field frame.

(3) Remove springs (9) and brush plate (11) from head.

(4) Pry bearing cover (5) from head. Remove retainer group (6) by removing retaining ring and thrust washers. Remove bearing (7).

(5) Carefully remove armature assembly (15) from field frame.

CAUTION

Use care when removing armature assembly to prevent damage to core and commutator.

(6) Use a suitable puller and remove bearing (12) from armature shaft.

(7) Remove screws (2) and lock washers (3) and remove drive end head (13) from field frame.

(8) Remove nuts, washers and insulators and remove terminals group (14) from field frame.

(9) Remove screws securing pole shoes and field winding (16) and carefully remove field winding from frame. Be careful when handling field frame. Do not damage insulation.

d. Cleaning, Inspection and Repair.

(1) Refer to paragraph 8-2d and clean, inspect and repair the power steering pump motor in the same manner.

(2) Inspect bearings for wear and damage. Replace bearings if damaged.

(3) Inspect coupling lugs on armature shaft for wear and damage. Replace armature if shaft is unserviceable.

e. Assembly.

(1) Install terminal group (14) with stud, nuts, washers and insulator in field frame. Tighten to a torque of 80 pound inches.

(2) Install field windings (16, fig. 8-12) and pole shoes in field frame and secure with pole shoe screws.

CAUTION

Handle and install field windings carefully to prevent damage to insulation.

(3) Install drive end head (18) on field frame and secure with screws (2) and lock washers (3).

(4) Fill bearings (7 and 12) half full of grease (GAA) and install bearings on armature shaft.

(5) Place field frame in a vertical position and carefully lower armature into field frame.

(6) Install thrust washers and retaining ring of retainer group (6) in commutator head (8) and pack grease in cavity. Install bearing cover (5) in head.

(7) Install brush plate (11) and brush springs (9) on commutator end head. Install end head on field frame and secure with screws (4). Refer to a above and install brush assembly (10).

(8) Install cover band (1) on motor.

f. Installation. Refer to paragraph 2-11 and install power steering motor.

CHAPTER 9

REPAIR OF DRIVE CONTROL COMPONENTS

Section I. DESCRIPTION

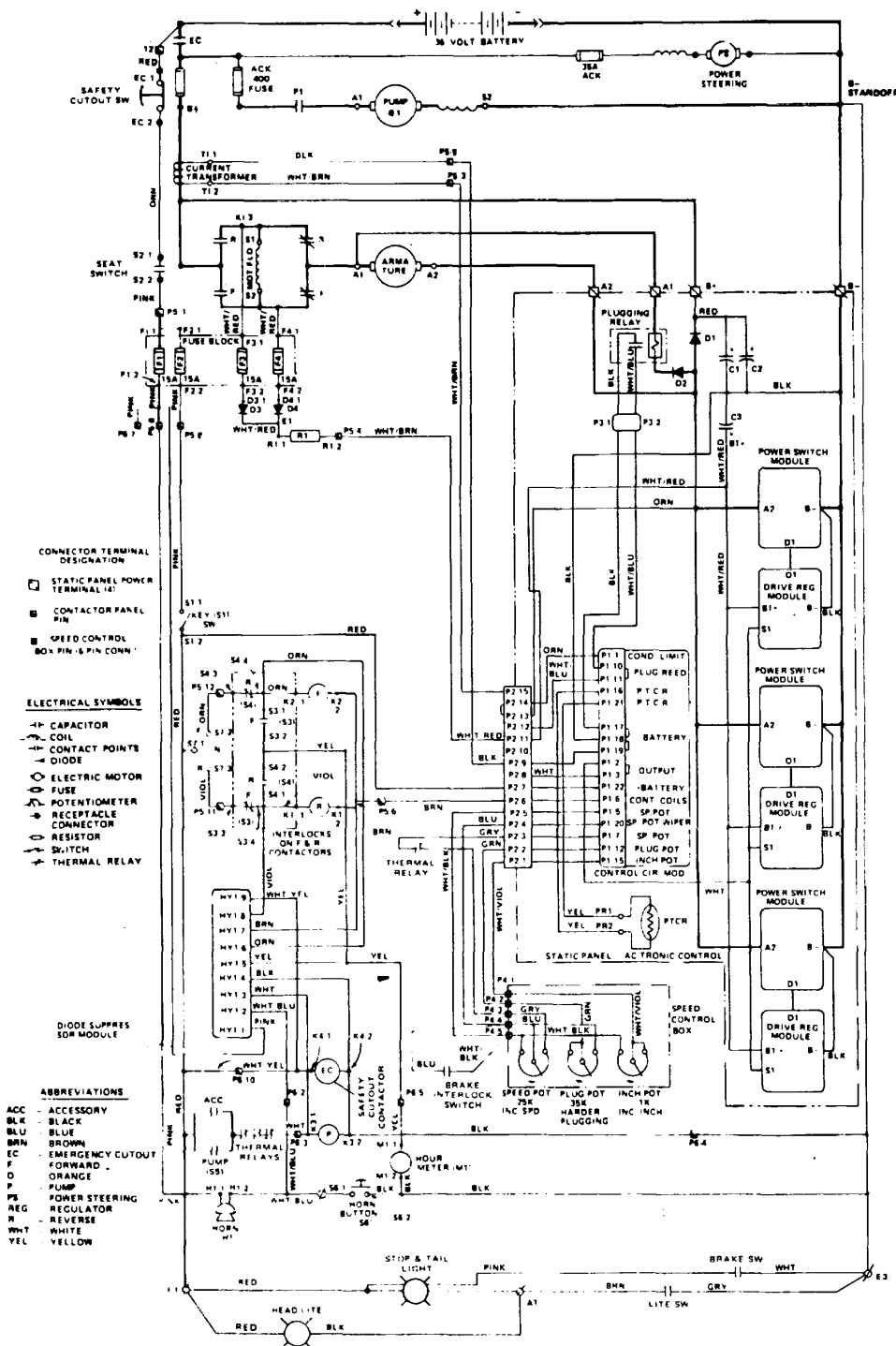
9-1. Description

a. The drive control of the electric fork lift truck is a solid state control. The control is built in modules to control the direct current motor load with a battery powered source. Current rating of the control is 225 amps for each power switch module. The control consists of three power switch modules which are directly connected in parallel to give current ratings of 450 amps and upward in steps of 225 amps. The ratings represent peak current in the control and

are not indicated as continuous ratings. Drive requirements for the power switch modules are supplied by the constant current switching drive regulator modules.

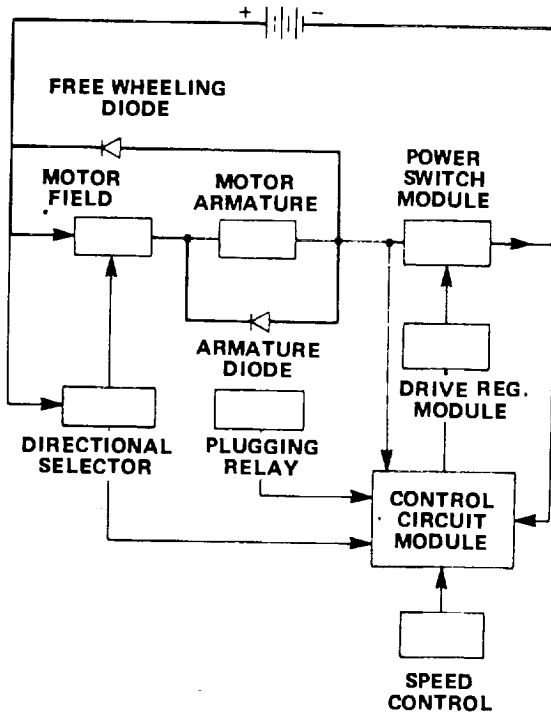
b. Protection for the control circuits is provided by the control circuit module and a temperature sensing device mounted on the heat sink of the static panel.

c. Refer to figures 9-1 and 9-2 for wiring diagram and the block diagram of the system.



TS009216

Figure 9-1. Wiring diagram.



TS009217

Figure 9-2. Block diagram.

9-2. Drive Control Components

a. *Description.* The following paragraphs

locate and describe the main components of the drive control. Refer to figures 9-1 and 9-2 for further clarity and interconnection of the components.

b. *Forward and Reverse Control.*

(1) The forward and reverse control is mounted beneath the instrument panel. A shaft extending from the top of the control is connected to the forward and reverse control lever.

(2) The control lever has three positions F (forward), N (neutral) and R (reverse). Movement of the lever to F (forward) position sets the contact fingers in the control to deliver current flow to the motor to drive the truck forward.

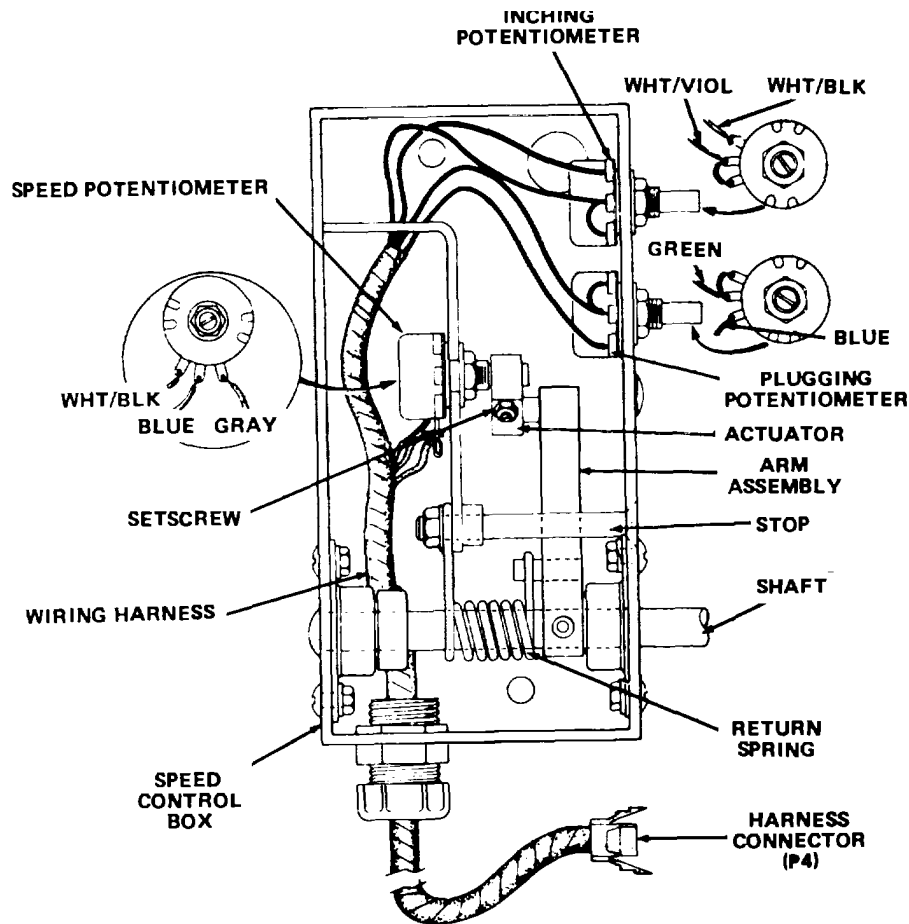
(3) In N (neutral) the current flow is halted and the drive motor cannot operate.

(4) In R (reverse) the contact fingers are set to deliver current to the drive motor to rotate the differential for reverse movement of the truck.

(5) When the drive motor is actuated the hourmeter mounted on the instrument panel operates. The meter records operating time of the truck.

c. *Accelerator Control.*

(1) The accelerator control (fig. 9-3) is mounted below the instrument panel. A foot pedal or accelerator is connected to the accelerator control through a linkage.



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Figure 9-3. Accelerator control.

(2) As the accelerator is depressed it increases resistance in the speed potentiometer (fig. 9-3). This action results in an increased voltage to the drive motor and increases speed of the truck. Decreasing the amount of pressure on the accelerator lowers the voltage and decreases speed of truck. Releasing the accelerator completely halts current flow to drive motor.

(3) If the truck is moving and the accelerator is released and the direction of travel is reversed, a plugging mode is required to supply retarding torque for deceleration. The severity of the plugging action on the motor can be adjusted with the plugging potentiometer (fig. 9-3).

(4) An inching control is built into the accelerator. By slightly depressing the accelerator the operator can slowly inch the truck into position. The inching speed can be adjusted through the inching potentiometer (fig. 9-3).

d. Contactor Panel

(1) The contactor panel (fig. 2-7) is mounted on the frame below and to the left of the seat. Wiring harness circuits are connected to terminals on the bottom of the contactor box.

(2) Electrical contactors in the panel control operation of the drive motor, hydraulic pump motor and emergency cutout. When the forward and reverse control contacts are set in the F (forward) position, current flows through the closed key, seat and emergency cutout switches, through the forward and reverse switch to the contactor panel and through contactor coil. From the contactor panel it flows to the static panel control circuit module and back to the battery negative post.

(3) When a forward or reverse contactor coil is energized, the circuits to the speed and inching potentiometers are closed. Current also flows

from the positive side of the battery through the 400 amp power fuse, the closed forward contactor contacts to the drive motor. When the drive motor operates, the truck moves in the direction selected.

(4) The forward and reverse contactors are equipped with interlocks to prevent current flow to both sides of the drive motor simultaneously. The interlocks are mechanically operated whenever the applicable contactor opens or closes.

(5) The hydraulic pump contactor (fig. 2-7) operates in much the same manner. With the key switch, seat switch and emergency cutout switches closed, movement of the control valve levers will close a pump switch. Current then flows from the positive side of the battery through the 400 amp power fuse, 15 amp control fuse, to the contactor panel and the pump contactor coil to the negative side of the battery. A set of normally open contacts on the pump contactor close and send current to the pump motor. Current flows through the pump motor back to the negative side of the battery.

(6) The contactor panel also contains the diode suppressor module. The suppressor module contains hash filters to suppress voltage spikes when the hydraulic pump coil, horn button, contactor coils and hourmeter are de-energized.

(7) All fuses are mounted in the contactor panel. The four 15 amp control fuses are mounted in the upper left corner of the contactor panel.

e. Static Panel

(1) The static panel (fig. 9-6) is mounted in a compartment on the left side of the frame. For easy access the panel is mounted on a hinged door. When the door is opened and swung down into place, the static panel components are accessible for maintenance procedures.

(2) Mounted on the static panel are the control circuit module, three power switch modules, three drive regulator modules, the plugging relay and three large capacitors. The armature diode and free wheeling diode are mounted in the front portion of the static panel. A positive temperature coefficient resistor is mounted in the heat sink.

(3) The control circuit module sends the current through the power switch and drive regulator modules. Circuits within the module

provide additional inputs to the contactor logic to open if an improper condition is detected.

(4) The power switch and drive regulator modules regulate operation of the drive motor through the armature and free wheeling diodes.

(5) The plugging circuit and plugging relay reduce the control cycles to prevent damage to the control and motor when direction of travel is reversed.

(6) The temperature coefficient resistor monitors the temperature of the control heat sink. When temperature rises excessively the resistor will reduce the on time of the power switch module.

(7) Additional safeguards are supplied by four thermal relays. If the operating temperature of the drive motor rises above a safe operating point, the thermal relay will open and halt motor operation. After allowing the relay to cool the points will close and operation can be resumed.

(8) Another thermal relay protects the hydraulic pump motor in the same manner. Two thermal relays monitor the temperature of the hydraulic oil in the reservoir and will shut down the hydraulic pump circuit if the temperature becomes too high.

9-3. Operation

a. General. The following is a more detailed description of the control operation. By using the wiring diagram (fig. 9-1) and the block diagram (fig. 9-2) the operation can be followed in detail. The points below are general and will aid in understanding the operation.

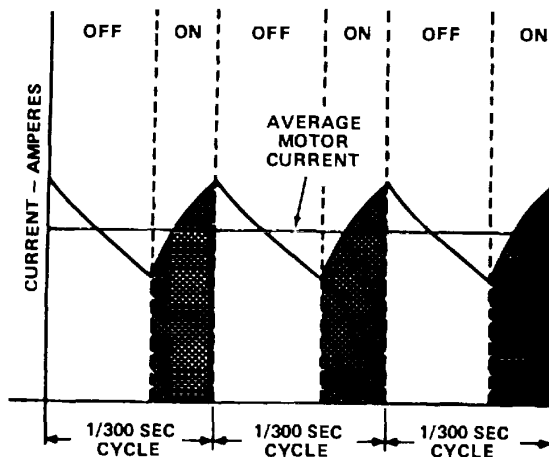
(1) Any connections, junctions or terminals with the same identification are electrically common.

(2) All contacts and components are illustrated (fig. 9-1) in a normally de-energized condition unless otherwise specified.

(3) Location of components on the schematic diagram will have no bearing on their physical location within the fork lift truck.

b. General Operation.

(1) The basic time-ratio control is a fixed-frequency type. The frequency is non-adjustable and is approximately 300 Hz. The on time of the control, which is determined by the position of the speed potentiometer, is controlled by the operator's accelerator pedal. The on time is controllable from zero to 100 % (fig. 9-4).



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Figure 9-4. Control cycles.

(2) To provide smooth motor operation, the on-off cycle of the system is kept very short. Cycle times in the order of milliseconds are used. Mechanical switches cannot accomplish this fast switching; however, transistors offer very efficient high speed switching.

(3) Transistors in the system are turned on and off to convert the steady power from the battery into pulses that are supplied to the drive motor at a rate of 300 pulses per second. The on time of the transistors can be varied from zero to maximum. This variable on time controls the motor speed. At slow speeds the on time is very short. Increasing the on time through the range increases the motor speed until at high speed the on time is the full duration of the cycle.

(4) The on time of the transistors in the power switch module (fig. 9-2) is varied by the speed control which causes the control circuit module to turn the transistors on and off.

(5) During the off time of the control circuit module, induced motor current is allowed to flow through the motor in the proper direction. This current flow is through the free wheeling diode. The armature diode allows rapid reversals of the directional selector and prevents the motor from acting as series generator.

(6) The forward and reverse switch determines the path of current flow through the motor field to provide the desired directional travel.

c. Drive Power Circuit. Current flow during the on time is from the positive side of the battery

through the power fuse, the now closed normally open forward contacts (forward direction selected), S2 and S1 motor field terminals, normally closed reverse contacts, and A1 and A2 drive motor armature terminals to the A2 terminal stud of the static panel. From A2 terminal stud, current flows to the A2 terminals of the power switch modules. Load current leaves the power switch modules from terminal B- to the static panel B- terminal stud; from there it flows back to the negative side of the battery.

d. Basic Power Circuit with Free Wheeling Diode. During the off time of each pulse, induced current from the field windings flows to A1 terminal of the drive motor armature. Current leaves motor A2 terminal and flows to the A2 terminal stud of the static panel. From there it flows through D1 free wheeling diode, the B + static panel terminal stud, and back through the motor field in the proper direction.

e. Forward and Reverse Control Circuit.

(1) When the battery is connected and the key switch, emergency cutout switch and seat switch are closed, the control circuit module will energize. Current flow is from the positive side of the battery through the power fuse and F2 16 amp control fuse to terminal P5-8 of the contactor panel. Current flow continues from terminal P6-8 through S1 key switch, S2 seat switch, and terminal P2-7 of plug P2 on the static panel to terminal P1-22 of the control circuit module. The current path continues out of control circuit module terminal P1-18 through the capacitor B- bus bar to the B-terminal of the static panel, and from there back to the negative side of the battery.

(2) With a forward direction selected, current flows from the closed key switch (S1-2) through the directional switch to terminal P5-12 of the contactor panel. In the contactor panel, the path is from terminal P5-12 through the normally closed reverse interlock contacts, the forward contactor coil, contactor panel terminal P5-6, and terminal P2-6 of plug P2 on the static panel to terminal P1-6 of the control circuit module.

Note

The directional interlock contacts are physically mounted on the forward and reverse contactors and are mechanically operated whenever the applicable contactor closes or opens. The forward interlock contacts are mounted on the forward contactor and the reverse interlock contacts are mounted on the reverse contactor.

(3) The current path continues out terminal P1-18 of the control circuit module, through the B- terminal of the static panel, and back to the negative side of the battery.

(4) When the forward coil is de-energized,

induced current flows from the forward coil to terminal HY1-7 of the diode suppressor module and out terminal HY1-6 back to the normally closed reverse interlock contact (terminal designation S4-4). Conversely, when the reverse coil is de-energized, current flows from the reverse coil to the terminal HY1-7 of the diode suppressor module and out terminal HY1-8 back to the normally closed forward interlock contact (terminal designation S3-4). These circuits provide a path to dissipate induced current and suppress voltage whenever a directional coil is de-energized.

(5) After a directional coil is energized, all circuits between the speed and inching potentiometers and the P1-5, P1-20, P1-7, and P1-15 terminals of the control circuit module become energized. As the resistance of the speed potentiometer is increased (accelerator pedal depressed), the resistance of the speed potentiometer circuit within the control circuit module increases to cause greater on time of the control.

(6) After the forward contactor coil is energized, current will flow from the positive side of the battery through the power fuse, the now closed forward directional contacts, S2 and S1 motor field terminals, normally closed reverse directional contacts, and A1 and A2 drive motor armature terminals to A2 terminal of the static panel. From the A2 terminal, current flows to the A2 terminals of the power switch modules. To complete the circuit, current flows out of the power switch module B- terminals to the B- terminal of the static panel, and from there back to the negative side of the battery.

(7) As the directional contacts around the drive motor field change position, current will also flow from the now closed directional contact through a 15 amp fuse, D3 and D4 diode (depending upon which direction was selected), and R1 resistor to terminal P5-4 current flows through terminal P2-11 of plug P2 to the static panel and back to the negative side of the battery. At this same time, control current flows from P1- 2 terminal of the control circuit module to the S1 terminals of the drive regulator modules. To complete the circuit, current flows out of the B- terminals of the drive regulator modules through the B- terminal stud to the negative side of the battery.

f. Plugging Circuit.

(1) If the lift truck is moving, the accelerator pedal is released, the forward and reverse level is moved from one direction to the opposite direction, and the accelerator pedal is depressed again, the motor field is reversed. To accomplish a plugging mode, the directional lever must move through its neutral position, the plugging relay

must pick up, and there must be a reduction in the control cycles from approximately the normal 300 Hz to the plugging 3 to 50 Hz. The severity of the plugging mode is determined by the setting of the plugging potentiometer.

(2) The plugging circuit is from the cathode of D2 armature (plugging) diode, and through the bus bar to the A1 terminal of the static panel. The path continues through A1 and A2 drive motor armature terminals, and through static panel A2 terminal back to the anode of D2 diode. When the plugging relay contacts close, due to the induced current, the circuit path for the plugging relay is from terminal P1-10 of the control circuit module, through P3-2 of plug P3, the now closed plugging relay contacts, and back through P3-1 of plug P3 to terminal P1-17 of the control circuit module.

g. Hydraulic Pump Circuit.

(1) With the key switch in ON position, the operation of any of the parallel pump contacts will energize the pump contactor coil. Current flows from the positive side of the battery through the power fuse, F2 15 amp control fuse, contactor panel terminal P5-8, key switch and the now closed pump contacts and thermal relays to contactor panel terminal P6-3. From terminal P6- 3, current flows through the pump contactor coil and terminal P6-4 to the negative side of the battery. A set of normally open pump contactor contacts now closed to complete the circuit for the pump motor. This allows current to flow through the pump motor and from there back to the negative side of the battery.

(2) A hash filter, which is located inside the diode suppressor module and wired in parallel with the pump coil, is used to suppress voltage spikes whenever the pump coil is de-energized. At the instant the pump coil is de-energized, induced current flows from the negative side of the pump coil (K3-2) to terminal HY1-4 of the diode suppressor module. The current path continues through the hash filter inside the module and out module terminal HY1-3 to the positive side of the pump coil (K3-1).

h. Power Steering Circuit.

(1) The power steering pump is energized by closing the key switch, emergency cutout switch and seat switch to complete the power steering circuit. The current path is from the positive side of the battery through the power fuse, F2 15 amp control fuse, contactor panel terminal P5-8, key switch, to contactor panel terminal P6-10. From terminal P6-10, the path continues through the emergency cutout contactor coil and terminal P6- 4 to the negative side of the battery. Current flows from the positive side of the battery through the 35 amp fuse, and through the ar-

mature and field windings back to the negative side of the battery.

(2) A diode and resistor located inside the diode suppressor module, which are used to suppress voltage spikes, are wired in parallel with the emergency cutout contactor coil. At the instant the coil is de-energized, the path for induced current is from the negative side of the coil to terminal HY1-4 of the diode suppressor module. The path continues through the diode and resistor inside the module and out terminal HY1-9 to the positive side of the power steering coil.

i. Horn and Hourmeter Circuits.

(1) Current flow for the horn is from the positive side of the battery through the power fuse, F1 15 amp accessory fuse, contactor panel terminal P6-8 and the horn to the horn button. From the horn button, current flows back to the negative side of the battery.

(2) Another hash filter, located in the diode suppressor module, is wired in parallel with the horn and is used to suppress voltage spikes. When the horn button is released and the horn vibrator is in the make position, the path for induced current is from the negative side of the

horn (H1-2) through contactor panel terminal P6- 2 to terminal HY1-2 of the diode suppressor module. The path continues through the hash filter inside the module and out module terminal HY1-1 through contactor panel terminal P6-8 to the positive side of the horn (H1-1).

(3) With the battery connected, key switch closed, and a normally open directional contact closed, the hourmeter will operate. Current flows from the now closed directional interlock- contact (S3-2 or S4-2) to terminal P6-5 of the contactor panel. From terminal P6-5, current flows through the hourmeter and back to the negative side of the battery.

(4) The hourmeter will also operate whenever the pump contactor coil is energized by the operation of any of the parallel pump contacts. Current flows from the pump contactor coil (K3-1) to terminal HY1-3 of the diode suppressor module, through a diode inside the module, and out terminal HY1-5 of the module to terminal P6- 5 of the contactor panel. From terminal P6-5, current flows through the hourmeter and from there back to the negative side of the battery.

Section II. DRIVE CONTROL TESTS AND ADJUSTMENTS

9-4. General

a. Safety Precautions. Observe the following precautions throughout all tests and adjustments.

(1) Always check battery polarity.

(2) Disconnect battery and discharge capacitors before taking resistance readings, performing ground tests, or replacing components or modules. Discharge capacitors as follows:

(a) Disconnect battery.

(b) Turn key switch to on position and depress horn button.

(3) Do not ground or short any heat sinks as they are integral parts of circuits. Never eliminate or modify heat sinks.

(4) Make certain battery is fully charged prior to any testing. Specific gravity reading at 80 °F (27 °C) should be 1.265 to 1.290.

(5) Check operation of any newly installed component or module to be certain problem has been corrected.

(6) Do not wear jewelry such as wrist watches and rings, if possible, while performing tests and adjustments.

b. Identification. Always tag and identify location of wires and cables before they are disconnected from any terminals. Identification

will assure correct installation after check or test is completed. After connecting wires or cables, make certain all connections are tight.

9-5. Preparation

a. Disconnect the battery and discharge the capacitors. Remove the cover over the contactor panel, toe and floor plates, and the speed control box cover. Open the static panel compartment door, located on lower left side of lift truck, and carefully swing static panel assembly to the full out position.

b. Check all fuses to ensure proper value and continuity.

c. Inspect the lay of all cables, harness, and control wires to assure that there is no chafing of these items against sharp edge of the equipment.

d. Inspect all terminals to assure that all wires and cables are properly crimped and all connections are tight.

e. Inspect speed control box to assure that potentiometers and operating shaft are mounted securely.

f. Check the tightness of all mounting screws and nuts. Make certain there are no broken or missing cotter pins and replace any broken or missing lockwashers.

g. Inspect the forward and reverse switch to assure that terminal connections are tight.

h. Check the seat switch to assure that it closes when the seat is depressed.

i. Inspect all contactors to assure that there is no interference to operation and that the units have satisfactory overtravel. The microswitches on the contactors should operate when the normally open contacts close.

j. Inspect contactor tips for wear. If the contacts are worn to the point where copper is showing through in the contact area, replace the contactor tips (TM 10-3930-631-12).

k. Clean all electrical components and electrical component compartments with an industrial type vacuum cleaner. Remove all foreign material or objects from all compartments.

l. Use a volt-ohm-millimeter (VOM) with a 20,000 ohms-per volt direct current sensitivity and 6,000 ohms per-volt alternating current sensitivity.

m. A jumper wire, approximately 18 inches (456.2 mm) long with alligator clips on each end should be used.

9-6. Ground Test

CAUTION

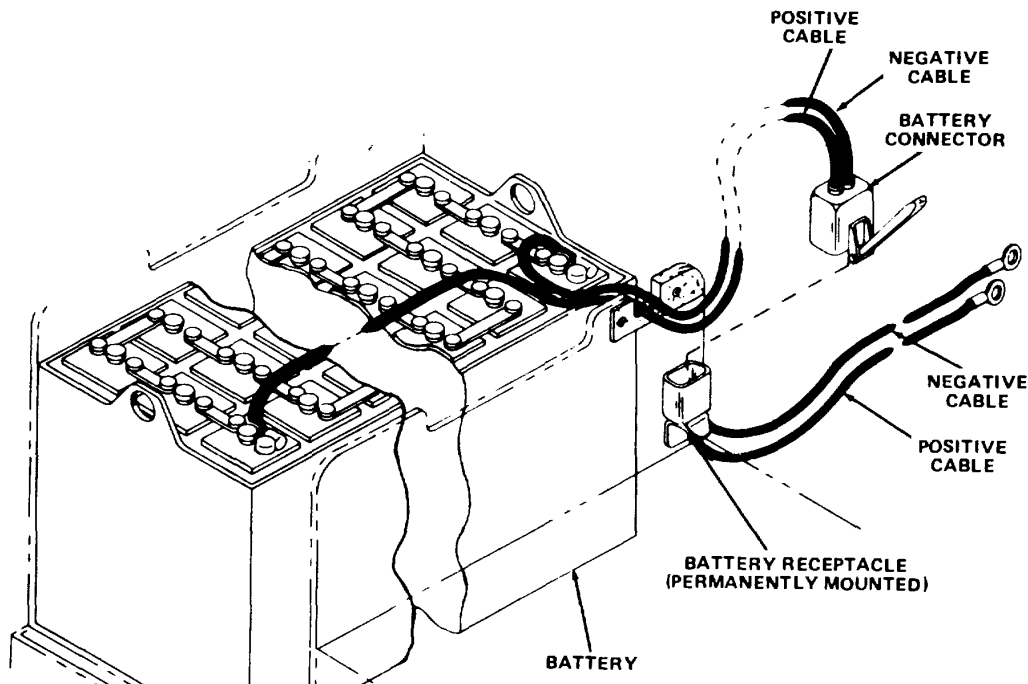
Make certain capacitors are discharged before beginning the following tests.

a. Set multimeter on low ohms scale. Connect one lead from meter to frame of lift truck at location where paint will not insulate the frame. Touch other lead to another good ground point on frame to assure that proper ground connection has been obtained. Meter readings should be zero. If zero reading is not obtained, check calibration of meter by connecting the two leads together.

b. With the key switch in the ON position, and multimeter set on high ohms scale, 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. Resistance readings must be greater than 50,000 ohms.

CAUTION

This is the receptacle (fig. 9-5) that is permanently mounted on the lift truck, not the connector on the cables from the battery.



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Figure 9-5. Battery Cables and Receptacle.

c. Now touch the second lead of the meter to all terminals on the contactor panel, instrument panel, static panel, and control valve pump switches. Resistance readings must be greater than 50,000 ohms.

d. Touch the second lead of the meter to all current carrying parts of the contactors, motor terminals, and static panel. Resistance readings must be greater than 50,000 ohms.

e. If a noticeably low resistance reading or zero resistance is obtained at any terminal, remove the wire or cable from that terminal. Check the resistance of wires or cables and continue through

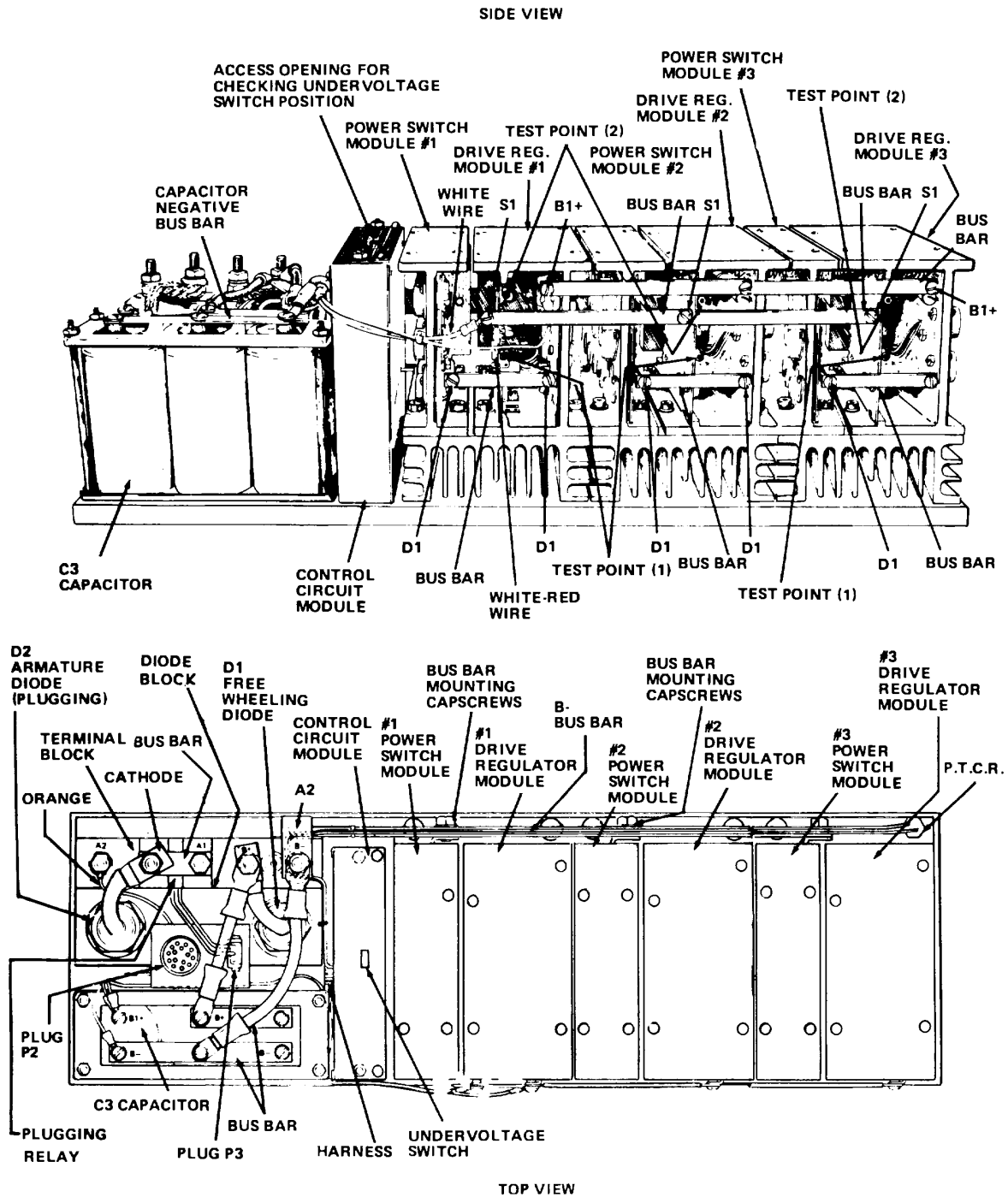
the individual circuits from that point until the ground has been located. After the ground has been located and corrected, connect all wires and/or cables securely to the proper terminals. Then check for ground at battery receptacle poles to make certain the ground has been eliminated.

9-7. Power Switch Module Test

Note

To perform the following, refer to figure 9-1, wiring diagram for location of terminals.

a. Disconnect the main truck harness from static panel plug P2, (fig. 9-6).



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Figure 9-6. Static panel, top and side view.

b. Disconnect the cable which connects the B + stud and free wheeling diode cathode to B + of the capacitors from the capacitors.

c. Utilize a multimeter to make this check:

(1) Use the high ohms scale on multimeter. Touch positive lead to diode block (fig. 9-6) or power switch module frame and negative lead to B- stud. Reading should be greater than 50K ohms.

(2) Use low ohms scale. Touch positive lead to B-- stud and negative to diode block or power switch module. Reading should be less than 100 ohms.

d. If the above readings are not obtained the power switch modules are open, one or more are shorted or the control board is defective. Replace components as necessary.

e. The following checks may be used to determine the problem:

(1) To determine which power switch module is shorted remove the bus bar mounting cap- screws and insulate the B- bus bar from the power switch modules. Perform the VOM check above and if the faulty condition remains proceed to following step (2). If the shorted condition no longer exists connect B- with a jumper wire to each B- connection on the power switch module and repeat the above VOM check until the faulty module is found. Replace the shorted module and repeat the VOM check.

(2) Disconnect the orange wire from the A2 terminal. Repeat the VOM test. If the test is satisfactory replace the control circuit module and repeat the VOM test.

Note

Connect all wires and cables before continuing with further tests.

9-8. Control Board Output Test

Note

The control board is a component of the control circuit module (fig. 9-6).

a. Connect the positive lead of an oscilloscope to the white wire lead S1 (fig. 9-6) on the drive regulator. Connect the negative lead of the oscilloscope to B--.

(1) Connect battery.

(2) Sit on the operator's seat.

(3) Turn the key switch to ON.

(4) Put the forward and reverse lever into a direction.

(5) Depress the accelerator pedal slightly to energize the contactor.

b. The contactor should energize after a small amount of pedal depression. As soon as the contactor energizes an audible buzzing should be heard from the drive current regulators. The waveform observed on the oscilloscope should be

as shown on figure 9-7. The pulse width should increase with increased pedal depression. The maximum on time will be approximately 33 percent.

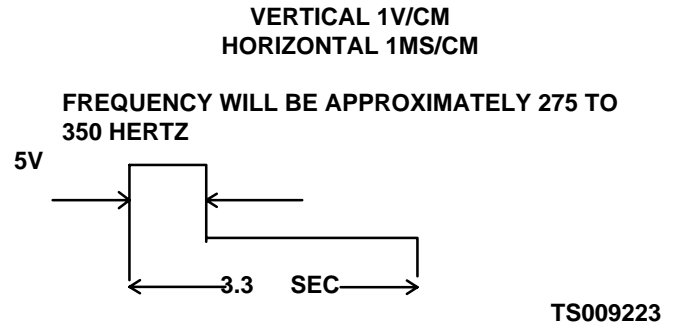


Figure 9-7. Waveform for control board output.

c. If the above conditions do not occur, check as follows.

(1) Contactors do not energize.

(a) Faulty wiring-check continuity.

(b) Shorted diode suppressor module. Check the module (para. 9-17), and replace if necessary (para 9-24).

(c) Improperly adjusted or faulty speed potentiometer. Adjust or replace if necessary. (para 9-12).

(2) No buzzing from regulators. If the contactors, energize and no audible buzzing is heard from the drive regulators, check the continuity from the F or R contactor contacts thru fuses F3 to F4, diodes D3 to D4 (fig. 2-8), and resistor R1 (fig. 2-8) to control plug pin P2-11. Check from P2-11 to the B + input (white/red wire) (fig. 9-6) on the drive regulator modules. If the fuses were blown, check diodes D3 and D4 on the contactor panel (fig. 2-8) and capacitor C3 on the static panel for shorts. The drive regulator may be defective. Replace as necessary.

(3) Waveform is not as indicated.

(a) Defective positive temperature coefficient resistor. Check the resistor (para 9-19).

(b) Undervoltage switch (fig. 9-6) on the control board is in the incorrect position. Place in correct position. (36 volts).

(c) Defective wiring harness or poor connections on the static panel. Check and repair or replace defective connections or harness.

(d) Defective control board. Disconnect the white wire (fig. 9-6) from the S1 terminal of the #1 drive regulator. Connect the positive lead of the scope to the white wire and observe the

waveshape (fig. 9-7). Replace defective circuit control module (para 9-28).

(e) Shorted drive regulator input. Disconnect the white wire from the S1 terminal of the #1 drive regulator. Remove the S1 bus bar (fig. 9-6) from between the drive regulator modules. Connect one end of a jumper to the white wire and connect the other end to each drive regulator terminal and individually observe wave form (fig. 9-7) to determine if the module is shorted. Replace defective drive regulator module (para 9-28).

c. If the pulse width does not vary with accelerator depression, a defective conduction limit circuit in the control board, defective power

switch module or defective conduction limit circuit in the control board, defective power switch module or defective drive regulator could exist.

9-9. Drive Regulator Module Test

a. Connect the positive lead of a voltmeter or oscilloscope to the test point (1) (fig. 9-6) on the first drive regulator module. Connect the negative lead to the test point (2).

(1) Sit on the operator's seat.

(2) Turn the key switch to ON.

(3) Place the forward and reverse switch into a direction.

(4) Depress the accelerator sufficiently to energize the contactor.

b. The meter should read 1.0 ± 0.1 volts or the wave form should be as shown on figure 9-8. Repeat this check on all drive regulator modules and replace defective modules (para. 9-28).

VERTICAL 0.1V/CM
HORIZONTAL 0.1MS/CM
SWITCH:
VERTICAL 0.5V/CM OR 1.0V/CM
HORIZONTAL 1MS/CM

S1 NOT CONNECTED

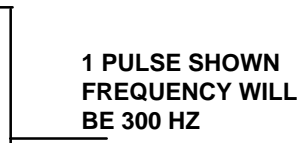
0.3V-
0.2V-0.1V-
0.1V-
0V-



2 PULSES SHOWN
FREQUENCY WILL
BE 3 TO 5 KHZ

S1 CONNECTED

2.0V
0V



1 PULSE SHOWN
FREQUENCY WILL
BE 300 HZ

Figure 9-8. Wave forms for drive regulator module.

c. Connect the positive lead of a voltmeter or oscilloscope to the D1 terminal (fig. 9-6) on the first drive regulator. Connect the negative lead to B-. Disconnect the white wire from the S1 terminal and the S1 bus bar from the drive regulator. Connect a jumper wire to the white wire.

(1) Sit on the operator's seat.

(2) Turn the key switch to ON.

(3) Place the forward and reverse lever into a direction.

(4) Depress the accelerator sufficiently to energize the contactor.

d. The voltage on the meter should be less than 0.40 volts or the wave form should be as shown on figure 9-8. Apply the white wire jumper to the S1 terminal. The magnitude will be approximately 2.0 volts, the frequency will be the control board

frequency, and it will be pulse width modulated. Repeat this check for each drive regulator module and replace defective drive regulator modules.

9-10. Drive Current Test

a. Connect a current shunt on the battery leads. Use a scope to measure the peak locked motor current as follows:

(1) Sit on operator's seat.

(2) Turn key switch to ON.

(3) Set the forward and reverse lever into a direction.

(4) Apply the brake.

(5) Depress the accelerator completely.

(6) The peak current should be 600 amperes minimum.

b. When using an oscilloscope to check current limit the prime consideration is the peak of the

typical waveform and its relationship to the zero reference line. The shape of the waveform is unimportant. To check peak current set the vertical input at .01 V/cm. Connect oscilloscope signal lead to terminal on shunt towards power fuse. Connect oscilloscope common or ground lead to terminal on shunt towards battery negative cable.

c. If the peak current is less than the minimum, disconnect the white wire from the S1 terminal and the S1 bus bar and apply a jumper to the white wire and connect to each drive regulator individually. The minimum peak current of each power switch should be 200 amperes. Replace any defective power switch modules (para 9-28).

9-11. Mechanical Switching Tests

a. The following tests are conducted with the battery connected and the normally open contacts on the forward and reverse directional contactor with thin cardboard between contacts.

b. Turn key switch to the ON position and depress the seat switch, the emergency cutout contactor (fig. 2-8) should close when the switch is activated. The lift truck should show no other evidence of being turned on.

c. Check for operation of the horn by depressing horn button. Move valve control lever and check pump contactor. Both should operate. Make certain that definite pressure is applied to the control valve levers and noticeable motion occurs before the pump contactor contact closes. When the contact closes, the pump motor should start operating under no hydraulic load and with no movement of any of the hydraulic cylinders.

d. With the key switch in the ON position and the seat switch closed, move the forward and reverse lever to select a forward direction. Depress the accelerator pedal slightly; the forward contactor should energize and its normally open contacts should close.

e. Check directional interlocking by manually operating (bringing in) the reverse contactor. The forward contactor should deenergize (drop out).

f. Repeat steps d and e with the forward and reverse lever in the reverse position. The reverse contactor should energize when the accelerator pedal is depressed and the reverse contactor should drop out when the forward contactor is manually operated.

g. Turn the key switch OFF. Try to operate the pump contactor and directional contactors by use of the control levers. Also depress the accelerator pedal. Nothing should operate electrically.

h. Remove the cardboard from all of the contactors.

9-12. Speed Potentiometer Adjustment

Note

Make certain battery is disconnected and capacitors are discharged. Isolate potentiometer leads by disconnecting speed control wiring harness connector P4 (fig. 9-3).

a. Remove nuts and lockwashers that secure cover to accelerator control box (fig. 9-3) which is located on the frame beneath the instrument panel, and remove the cover.

b. Set VOM on RX1 scale and connect meter leads to the two potentiometer terminals. Where the white/black and the blue leads are soldered or to P4-4 and P4-5 pins of the harness connector (P4).

c. Meter reading should be less than 30 ohms with accelerator pedal in the released position.

d. Depress accelerator pedal fully to the lowest position: meter reading should be approximately 7K to 10K ohms.

e. If speed potentiometer requires adjustment, loosen locknut on setscrew (fig. 9-3) in actuator and loosen setscrew. Turn potentiometer shaft until less than 30 ohms resistance value is obtained with the accelerator pedal in the released position. Tighten setscrew in actuator and tighten locknut on setscrew.

Note

To aid in the speed potentiometer adjustment, remove button plug from side of speed control box so potentiometer shaft can be turned with a screwdriver.

f. When accelerator pedal is depressed fully to the lowest position, meter reading should be approximately 7K to 10K ohms.

g. Remove meter leads and connect wiring harness connectors.

h. Check operation of speed control shaft (fig. 9-3) and accelerator pedal. Make certain shaft bearing bracket is securely mounted to frame.

i. Install cover on speed control box with lockwashers and nuts; tighten nuts securely.

Note

After speed potentiometer is adjusted, it may be necessary to adjust the inching potentiometer (para. 9-13).

9-13. Inching Potentiometer Adjustment

a. Make certain drive wheels are blocked up and are clear of blocks and floor. Check to make certain directional contactors are not isolated.

b. Sit on the operator's seat and turn the key switch to the ON position. Move the forward and reverse lever to forward. Depress the accelerator pedal slightly until the forward contactor closes.

c. Slowly continue to depress the accelerator pedal. Wheels should begin to turn and pick up speed slowly and smoothly.

d. Adjust inching potentiometer to desired performance or so lift truck inches along with accelerator pedal slightly depressed. To adjust potentiometer, loosen locknut and turn inching potentiometer shaft (fig. 9-3) clockwise to increase inching or counterclockwise to decrease it. After adjustment is completed, hold potentiometer shaft in place and tighten locknut to prevent shaft from turning out of adjustment.

9-14. Plugging Potentiometer Adjustment

a. Slowdown is accomplished when a direction is reversed by providing a small amount of retarding torque for deceleration. If the lift truck is moving, the accelerator pedal is released, the forward and reverse lever is moved from forward to reverse, and the accelerator pedal is then depressed again, the motor field is reversed. The distance or severity of the reversal is adjustable by means of a plugging potentiometer.

b. After tests are completed and drive wheels are lowered to the floor, operate lift truck and plug it at full speed. If stopping distance is too short or too long, adjust plugging potentiometer until desired stopping distance is obtained.

c. Adjust the plugging with the plugging potentiometer (fig. 9-3) located on the side of the speed control box.

d. Loosen locknut just enough so potentiometer shaft can be turned. Turn plugging potentiometer shaft clockwise for a severe plugging condition or counterclockwise for a soft plugging condition. After adjustment is completed, hold potentiometer shaft in place and tighten locknut to prevent shaft from turning out of adjustment.

CAUTION

Plugging is a performance adjustment. It can be adjusted for a severe or soft plug and will not harm the control. However, if it is set too severe, damage to the drive motor or the drive axle may result.

9-15. Dynamic Test

a. Make certain the drive wheels are completely clear of blocks and floor and the cardboard is removed from the contactors.

b. Sit on the operator's seat and turn the key switch to the ON position. Move the forward and reverse lever to forward. Depress the accelerator pedal slightly until the forward contactor closes.

c. Slowly continue to depress the accelerator pedal. Wheels should begin to turn and pick up speed slowly and smoothly.

9-16. D1 and D2 Diode Test

a. Disconnect the battery and discharge capacitors. Before D1 free wheeling and D2 armature diodes (located on the static panel) are

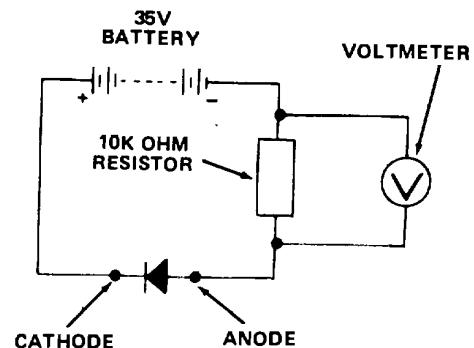
tested, remove braided cathode lead of diodes (fig. 9-6) from terminal studs to isolate the diodes. Use diode block as anode for testing D1 and D2 diodes.

b. The following ohmmeter test for a diode will determine if it is blocking and in proper polarity. Touch positive lead of multimeter to anode and negative lead to cathode. Reading should be low resistance. Touch positive lead to cathode and negative lead to anode. Reading should be infinity. If above reading are not obtained, replace diode (para. 9-28).

c. Whenever stud type D1 and D2 diodes are replaced, it is recommended that a heat transfer grease (silicon compound, or an equivalent) is used between the stud of the diode and the diode block. Diodes should be screwed into the diode block and tightened to a torque of 275-325 pound-inches (2.30-2.79 m·kg).

d. The diodes can be checked further to assure the diode does not conduct current in the reverse direction of battery voltage.

e. Connect battery, a 10K ohm resistor, voltmeter and diode as illustrated in figure 9-9.



TS009225

Figure 9-9. Diode Test.

f. If diode is good, meter should read zero voltage. If reading shows a voltage, replace diode (para 9-28).

9-17. Diode Suppressor Module Test

a. The diode suppressor module (fig. 9-10) is located in the upper portion of the contactor panel (fig. 2-7). To check the diode suppressor module, connect ohmmeter leads as indicated in the following table.

b. Meter reading is 20K initially and then indicator should move towards infinity.

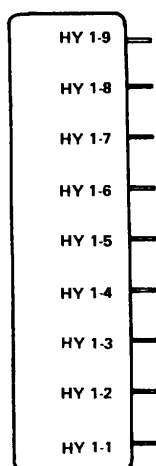
Note

If any of the readings are not obtained, the diode suppressor module must be replaced (para. 9-24).

Table 9-1. Diode Suppressor Module Tests

VOM Connection (RX1 scale)		Reading
Positive lead	Negative lead	
HY1-3	HY1-5	Low resistance
HY1-5	HY1-3	High resistance
HY1-7	HY1-8	Low resistance
HY1-8	HY1-7	High resistance
HY1-7	HY1-6	Low resistance
HY1-6	HY1-7	High resistance
HY1-4	HY1-9	45-120 ohms
HY1-9	HY1-4	High resistance

VOM Connection (RX1 scale)		Reading
Positive lead	Negative lead	
HY1-1	HY1-2	20K to infinity
HY1-2	HY1-1	20K to infinity
HY1-3	HY1-4	20K to infinity
HY1-4	HY1-3	20K to infinity



TS009226

Figure 9-10. Diode suppressor module.

9-18. D3 and D4 Diode Test

- a. D3 and D4 diodes are located at the upper

left corner of the contactor panel (fig. 2-7). Disconnect the battery and discharge capacitors. Disconnect the wires from the top (anode) of the diodes to isolate them. Connect ohmmeter leads as follows to determine if diodes are blocking and are in proper polarity.

b. Set the multimeter on the RX1 scale. Touch the positive lead to the anode and the negative lead to the cathode. Reading should be low resistance. Touch the positive lead to the cathode and the negative lead to the anode. Reading should be infinity.

c. Refer to paragraph 9-14 and figure 9-9 and check diode for blocking capability.

9-19. Positive Temperature Coefficient Resistor Test

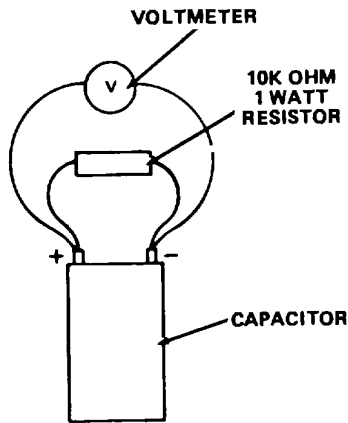
a. The positive temperature coefficient resistor is mounted on the heatsink at the end of the static panel. It is a temperature sensitive device which increases in resistance with an increase in temperature. As the temperature of the heatsink increases, the resistance of the resistor increases. Since the resistor is wired into the circuit of the control module, this increased resistance decreases the speed of the lift truck. The lift truck will operate at a reduced speed until the heatsink temperature drops to a normal value; then once again full speed is available.

b. Disconnect yellow wires from the resistor and connect a VOM set on RX1 scale to the resistor terminals (PR1 and PR2). Reading should be less than 200 ohms if heatsink is at room temperature (approximately 700F (21 C). Set VOM on highest ohms scale and check each terminal to heatsink resistance; both readings should be infinity.

9-20. Capacitors

a. One method of checking C1 thru C5 capacitors to determine if they are good is as follows:

b. Connect a fully charged test battery or lift truck battery, a 10K ohm resistor in series, and a voltmeter to the capacitor (fig. 9-11), but do not connect the negative lead to the battery. Use a watch with a sweep second hand to time the period of charging. Now connect the negative lead to the battery and begin timing. After 37 seconds, the capacitor voltage should be approximately 22 volts (± 4 volts).



TS009227

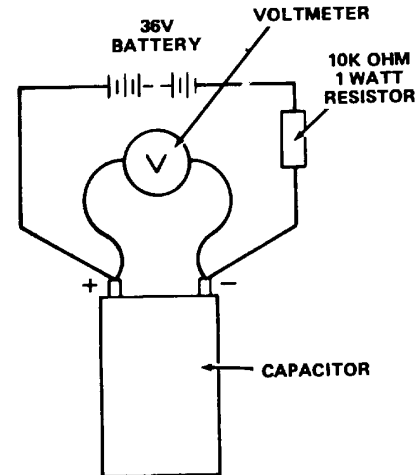
Figure 9-11. Charging the capacitor.

c. If capacitor charges too fast, it has lost its capacity.

d. If capacitor charges too slow, it is leaking. If it is leaking, it will not charge to full battery voltage with a 10K ohm resistor in series.

e. Discharge capacitor as follows:

f. Remove the resistor from the circuit and continue to charge the capacitor to full battery voltage. Then disconnect battery leads and immediately connect voltmeter and 10K ohm resistor as illustrated in (fig. 9-12). After resistor is connected, begin timing the discharging period with the watch. Capacitor should discharge in 37 seconds to 14 volts (± 3 volts).



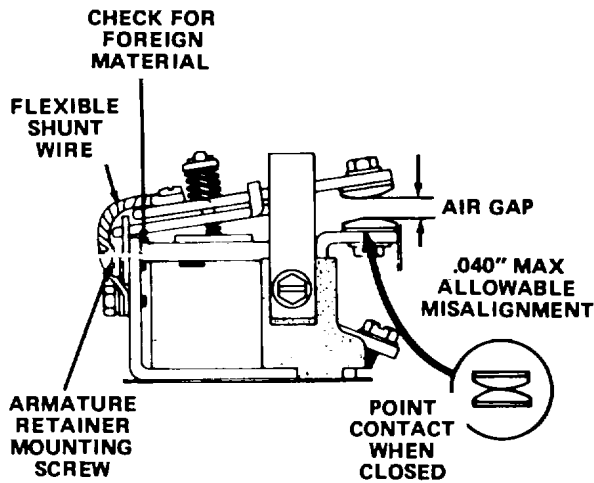
TS009228

Figure 9-12. Discharging the capacitor.

9-21. Pump Contactor Point Check

a. To help extend the lift of pump contactor, check for the following:

b. Check the air gap between the contactor tips. It should not be greater than $\frac{3}{8}$ inch (9.5 mm). Adjust contactor tips to reduce air gap, if necessary. (fig. 9 - 13).



TS009229

Figure 9-13. Contactor and points.

Section III. REPAIR OF DRIVE CONTROL COMPONENTS

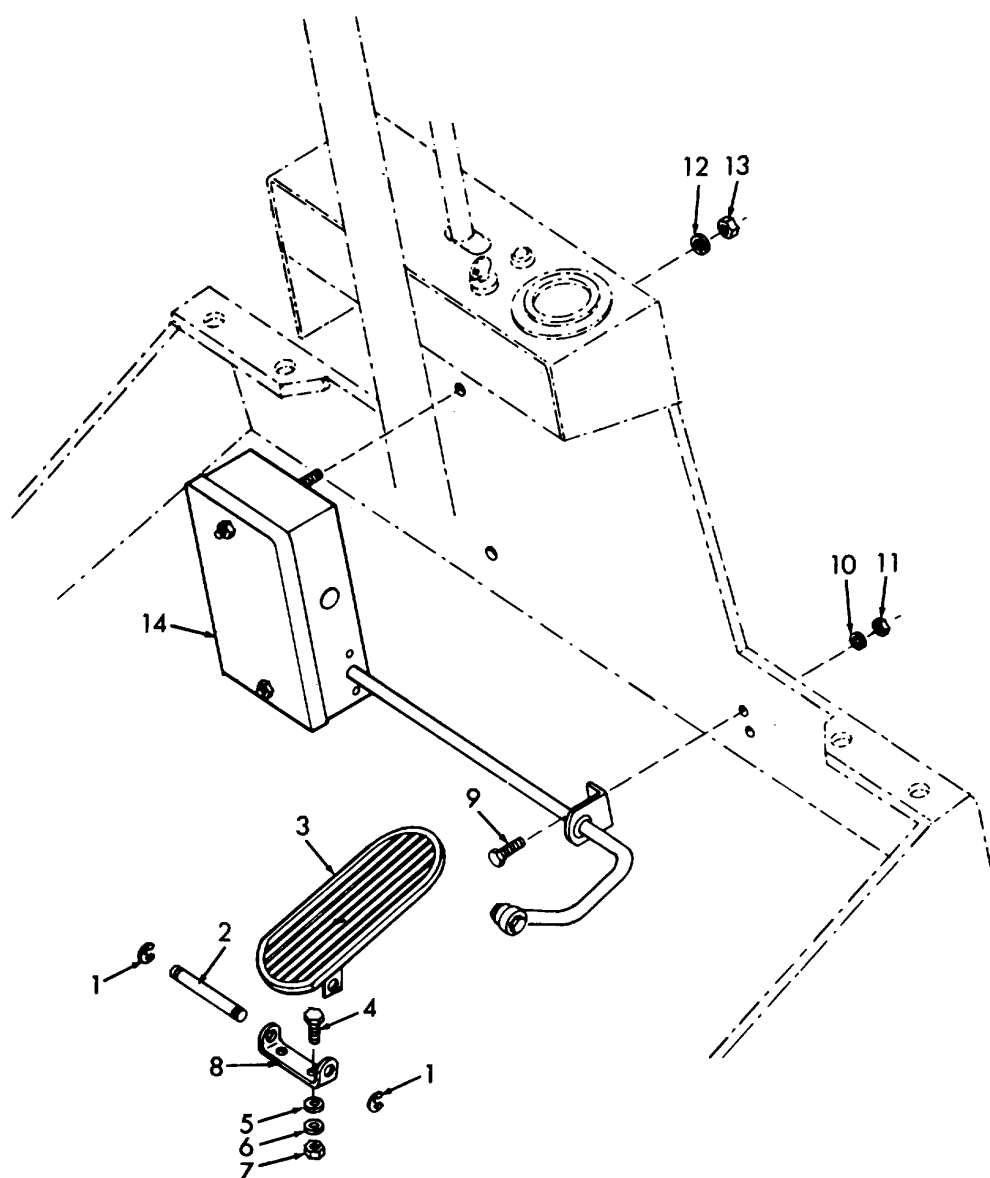
9-22. Accelerator Control

a. *General.* The accelerator control box is mounted below the instrument panel on the front frame of the truck.

b. Removal.

(1) Disconnect the wiring harness connector fig. 9-3) from wiring harness.

(2) Remove screw (9, fig. 9-14), nut (11) and lock washer (10) securing bearing to frame.



TS009230

- | | | | |
|----------------------|----------------|-----------------|-----------------------------|
| 1. Retaining ring | 5. Washer | 8. Bracket | 11. Nut |
| 2. Shaft | 6. Lock washer | 9. Screw | 12. Lock washer |
| 3. Accelerator pedal | 7. Nut | 10. Lock washer | 13. Nut |
| 4. Screw | | | 14. Accelerator control box |

Figure 9-14. Accelerator control, exploded view.

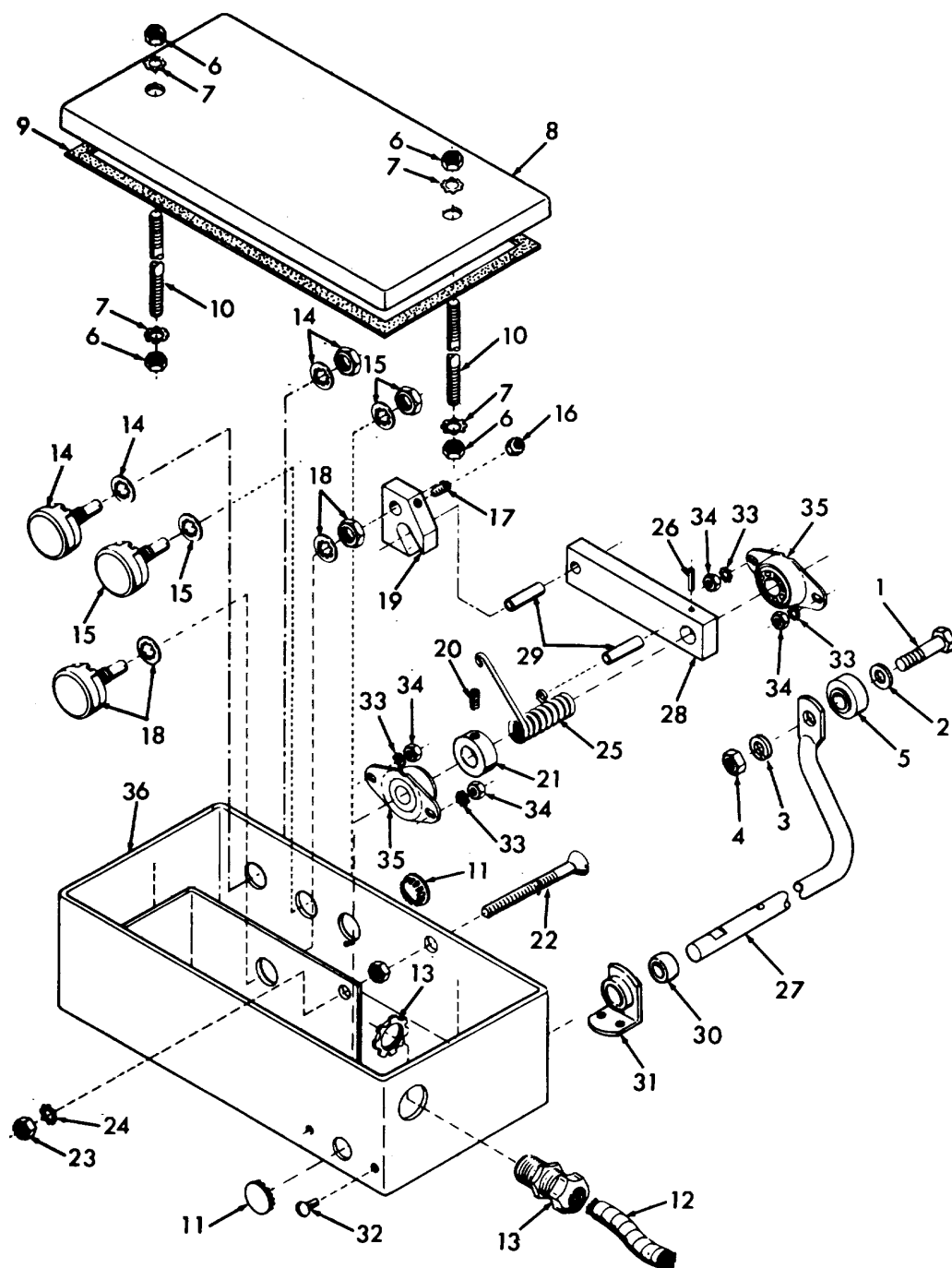
(3) Remove nuts (13) and lock washers (12) and remove accelerator control box (14) from frame.

(4) Remove retaining rings (1) and shaft (2) and remove accelerator pedal (3) from truck.

(5) If bracket (8) is worn or damaged, remove screws (4), washers (5), lock washers (6) and nuts (7) and remove bracket.

c. *Disassembly.*

(1) Remove nuts (6, fig. 9-15) and lock washers (7) and remove cover (8) and gasket (9) F from control box. Remove rods (10) from control box. Remove expansion plug (11) from control box.



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Figure 9-15. Accelerator control box, exploded view.

KEY to fig. 9-15:

1. Screw
2. Washer
3. Lock washer
4. Nut
5. Bearing
6. Nut
7. Lock washer
8. Cover
9. Gasket
10. Rod
11. Expansion plug
12. Wiring harness
13. Harness connector
14. Inching potentiometer
15. Plugging potentiometer
16. Nut
17. Setscrew
18. Speed potentiometer
19. Actuator
20. Setscrew
21. Collar
22. Stop screw
23. Nut
24. Washer
25. Return spring
26. Pin
27. Accelerator shaft
28. Arm
29. Pin
30. Bearing
31. Bracket
32. Screw
33. Lock washer
34. Nut
35. Flange bearing
36. Box

(2) Tag harness leads (fig. 9-3) and cut off leads at potentiometers. Remove nut and harness connector (13) and remove harness (12).

(3) Remove nut (23), lock washer (24) and screw (22) to release end of spring (25). Drive pin (26) from arm and loosen setscrew (20) in collar. Remove shaft (27). Remove screw (1), washer (2), lock washer (3) and nut (4) and remove bearing (5) from shaft. Remove bearing bracket (31) from shaft and press bearing (30) from bracket.

(4) Remove collar (21), spring (25) and arm (28) from control box.

(5) Remove nut (16) and setscrew (17) and remove actuator (19) from speed potentiometer. Remove nuts and lock washers securing potentiometer to control box bracket and remove speed potentiometer (18) from control box.

(6) Remove nuts and lock washers and remove inching potentiometer (14) and plugging potentiometer (15) from control box.

(7) Remove screws (32), nuts (34) and lock washers (33) and remove flange bearings (35) from control box.

d. Cleaning, Inspection and Repair.

WARNING

Cleaning compound solvent (Fed. Spec.

P-D-680) used for cleaning is potentially dangerous to personnel and property. Do not use near an open flame. Flash point of solvent is 1000 F to 138 o F (38 · C to 59° C).

(1) Clean parts in cleaning compound solvent (Fed. Spec. P-D-680) and dry thoroughly.

(2) Check screws and rods for stripped or worn threads and other damage.

(3) Check spring for bent or damaged condition.

(4) Inspect actuator and arm for wear or damage.

(5) Inspect bearings for wear and damage.

(6) Inspect potentiometers for damaged threads and terminals. Rotate potentiometer shafts. Shafts should rotate smoothly without binding.

(7) Replace damaged or unserviceable parts.

e. Assembly.

(1) Install potentiometers (14, 15 and 18, fig. 9-15) in control box and secure with nuts and lock washers. Install actuator (19) on speed potentiometer shaft and secure with setscrew (17) and nut (16). Install wiring harness (12) and secure with connector (13). Solder correct leads to potentiometers (fig. 9-3).

(2) Install flange bearings (35, fig. 9-15) on control box and secure with screws (32), lock washers (33) and nuts (34). Press bearing (30) into bracket (31). Install bracket on shaft.

(3) Install bearing (5) on end of shaft and secure with screw (1), washer (2), lock washer (3) and nut (4).

(4) Start end of assembled shaft through flange bearing. Slide arm (28), spring (25) and collar (21) on shaft and slide end of shaft into other flange bearing.

(5) Install pin (26) through arm and shaft. Install stop screw (22) and secure with nut (23) and lock washer (24). Attach end of spring to stop screw between lock washer, nut and control box bracket.

(6) Connect other end of spring to pin on arm.

(7) Check operation of shaft assembly in flange bearings. Slide collar against flange bearing and tighten collar setscrew to hold shaft in position. Install expansion plugs (11) in holes in box.

f. Installation.

(1) Install accelerator control box (14, fig. 9-14) on frame. Start threaded rods (10, fig. 9-15) through holes in frame. Install nuts (13, fig. 9-14) and lock washers (12) on rods but do not tighten. Install two nuts (6, fig. 9-15) and lock washers (7) on threaded rods inside of box.

(2) Align holes in bearing bracket on shaft with holes in frame and secure with screws (9, fig. 9-14), lock washers (10) and nuts (11).

(3) Tighten nuts (13) to secure control box to frame. Connect harness plug (fig. 9-3) to truck wiring harness.

(4) Refer to paragraphs 9-12, 9-13, and 9-14 to adjust speed, inching and plugging potentiometers.

(5) Install cover (8, fig. 9-15) and gasket (9) on control box and secure with nuts (6) and lock washers (7).

(6) Operate truck and check accelerator control for proper response. Adjust potentiometers (paras. 9-12, 9-13 and 9-14) if necessary.

9-23. Forward and Reverse Switch

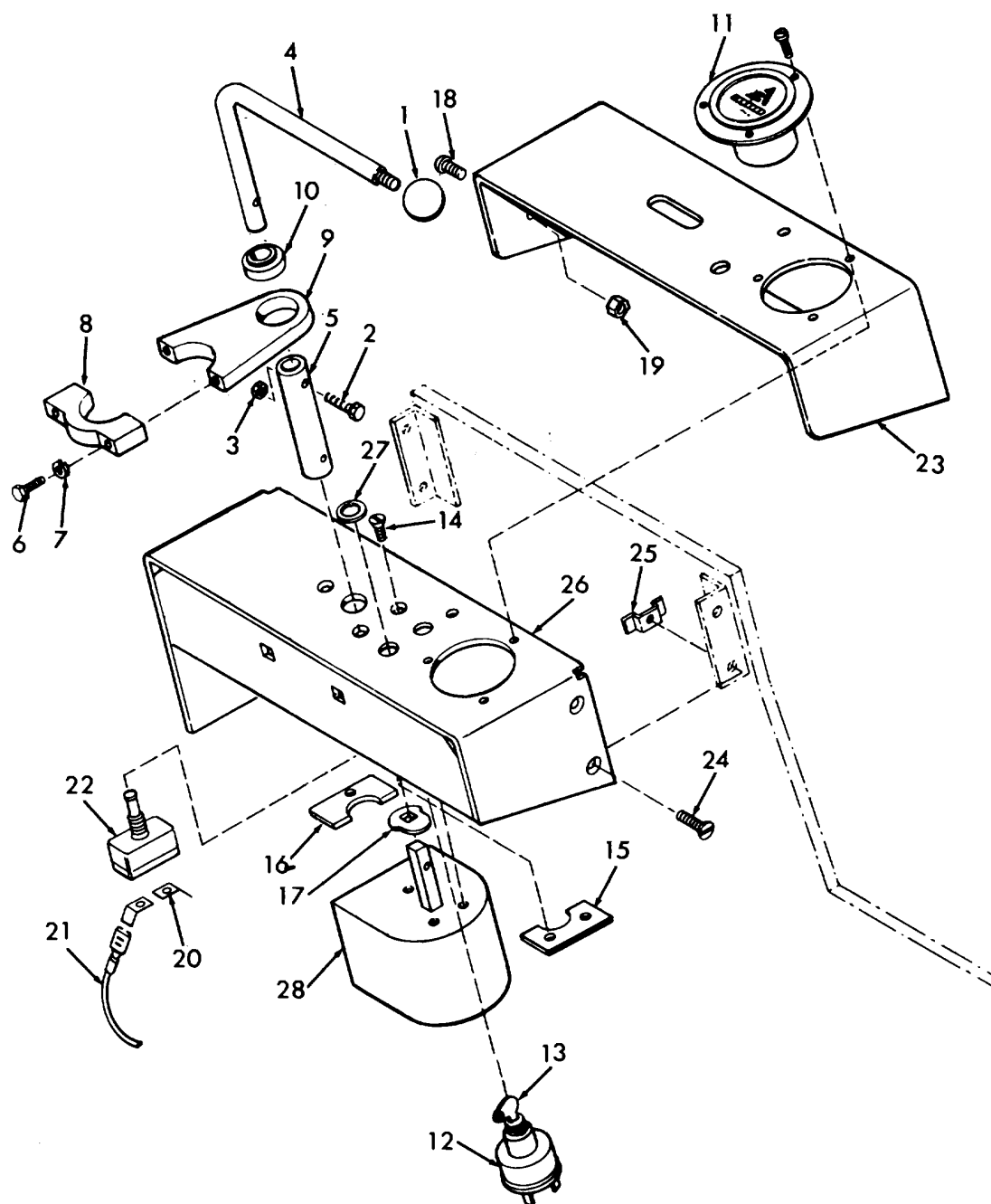
a. General. The forward and reverse switch is mounted below the instrument panel. Refer to TM-10-3930-631-12 and disconnect and remove hourmeter from instrument panel.

b. Removal.

(1) Remove screws (2, fig. 9-16) and nuts (3) and remove control lever (4) and tube (5). Remove screws (18) and nuts (19) and remove cover (23) from instrument panel.

KEY to fig. 9-16:

- | | |
|------------------|--------------------------------|
| 1. Knob | 15. Spacer |
| 2. Screw | 16. Spacer |
| 3. Nut | 17. Stop |
| 4. Control lever | 18. Screw |
| 5. Tube | 19. Nut |
| 6. Screw | 20. Terminal |
| 7. Lock washer | 21. Wire |
| 8. Clamp | 22. Light switch |
| 9. Bracket | 23. Cover |
| 10. Bearing | 24. Screw |
| 11. Hourmeter | 25. Nut |
| 12. Key switch | 26. Instrument panel |
| 13. Key | 27. Key switch plate |
| 14. Screw | 28. Forward and reverse switch |



TS006232

Figure 9-16. Instrument panel and control lever, exploded view.

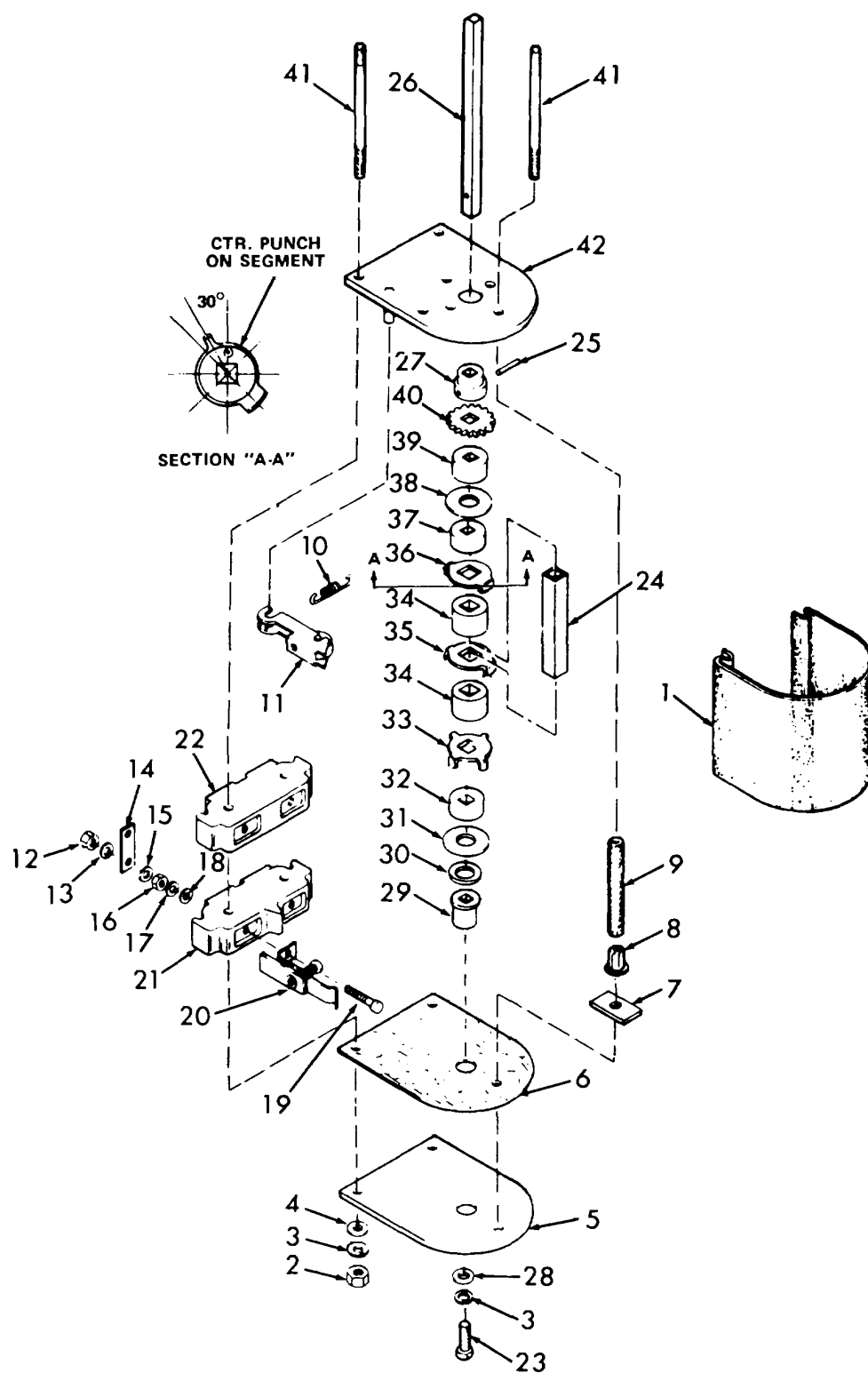
(2) Tag and disconnect leads from switch terminals. Remove screws (14) and remove forward and reverse switch (28) from truck. Remove spacers (15 and 16) and lever stop (17).

c. Disassembly.

(1) Remove cover (1, fig. 9-17) from switch. Remove nuts (2), lock washers (3) and washers (4). Remove screw (23), lock washer (3) and washer (28) from bottom of shaft.

KEY to fig. 9-17:

1. Cover
2. Nut
3. Lock washer
4. Washer
5. Plate
6. Insulator
7. Nut
8. Stud
9. Tube
10. Spring
11. Roller arm
12. Nut
13. Washer
14. Bus bar
15. Washer
16. Nut
17. Lock washer
18. Washer
19. Screw
20. Contact assembly
21. Contact block
22. Contact block
23. Screw
24. Insulator
25. Pin
26. Shaft
27. Bushing
28. Washer
29. Bushing
30. Washer
31. Spacer
32. Bushing
33. Contact segment
34. Bushing
35. Contact segment
36. Contact segment
37. Bushing
38. Spacer
39. Bushing
40. Gear wheel
41. Stud
42. Frame



TS009233

Figure 9-17. Forward and reverse switch, exploded view.

(2) Remove bottom plate (5) and insulator (6). Remove nut (7) and tube (9) from stud (8).

(3) Remove bushing (29), washer (30), and spacer (31) from shaft (26).

(4) Remove blocks (21) and (22) with attached contact assemblies (20) from studs. Remove nuts (12) and washers (13) and remove bus bars (14) and nuts (16), washers (15, 17, 18), and screws (19) and contact assemblies (20) from blocks (21 and 22).

(5) Remove remaining parts from shaft (26). Note position of center punch marks on segments (35 and 36) and wheel (40) for identification and direction. Check position of pin (25) in bushing (27) and on wheel. Mark and locate the above for proper assembly.

(6) Drive pin (25) from bushing (27) and shaft (26). Remove bushing.

(7) Remove springs (10) and roller arms (11) from upper frame (42). Remove shaft (26) and studs (41).

d. Cleaning, Inspection and Repair.

WARNING

Cleaning compound, solvent (P-D-680) used for cleaning is potentially dangerous to personnel and property. Do not use near an open flame. Flash point of solvent is 100 ° F to 138 ° F (38 ° C to 590 C).

(1) Clean all metal parts in cleaning compound, solvent (P-D-680) and dry thoroughly.

(2) Check screws and studs for worn threads and other damage.

(3) Check bushings for wear and scoring.

(4) Inspect springs for wear and lack of tension.

(5) Inspect contact assemblies and contact segments for wear and damage to contact surfaces. Dress surfaces with crocus cloth if possible.

(6) Inspect control lever, knob and tube for wear and damage.

(7) Replace damaged and unserviceable parts.

e. Assembly.

(1) Install roller arms (11, fig. 9-17) and springs (10) on pins on under side of upper frame.

(2) Position bushing (27) on shaft (26) and secure bushing with pin (25). Install shaft in upper frame (42).

(3) Install gear wheel (40) on shaft. Wheel pin must be in same position as when removed. Center punch mark on underside of wheel must be located on center line of pin hole in shaft and wheel pin must be positioned between the two stops. Make certain wheel is positioned between two rollers on roller arms.

(4) Install items (24 and 32 through 39) or shaft. When segments (33, 35 and 36) are installed, make certain that center punch marks on underside of segments are aligned with center punch mark on gear wheel. Bent edges of contacts must point down when installed.

(5) Install contact assemblies (20) on blocks (21 and 22) and secure with screws (19), nuts (12 and 16) and washers (13, 15, 17 and 18). Install blocks on studs (41). Install bus bar (14) on blocks against inner nuts.

(6) Install spacer (31), washer (30) and bushing (29) on shaft. Install tube (9) and nut (7) on stud (8).

(7) Position insulator (6) and lower plate (5) on studs. Align shaft assembly in upper frame and lower plate. Secure plates with nuts (2), lock washers (3) and washers (4). Tighten nuts securely.

(8) Install washer (28), lock washer (3) and screw (23) in shaft. Tighten screw securely.

(9) Rotate shaft and observe operation of contact segments and contact assembly. Contact points should meet and disengage smoothly and securely.

(10) Install cover (1) on switch.

f. Installation.

(1) Position spacers (15 and 16, fig. 9-16) and lever stop (17) on switch. Install forward and reverse switch beneath instrument panel and secure switch with screws (14). Tighten screws securely.

(2) Connect wires to forward and reverse switch terminals. Check to be certain all connections are tight.

(3) Install cover (23) on instrument panel and secure with screws (18) and nuts (19).

(4) Refer to TM10-3930-631-12 and install hourmeter on instrument panel.

(5) Operate truck and check switch operation. Truck should move in forward or reverse direction smoothly. No movement should occur with switch in N (neutral) position.

9-24. Contactor Panel

a. General. Many of the removal and repair procedures listed below can be performed with the contactor panel installed in the truck. For clarity the following are performed with the contactor panel removed.

b. Removal. Refer to paragraph 2-16 and remove contactor panel from truck.

c. Disassembly.

(1) Tag and identify the location of all leads and cables before they are disconnected from terminals in the panel. Refer to figures 2-7, 9-1 and 9-18 to identify harness, leads and cable connections in the panel. Disconnect and remove wiring harness and cables

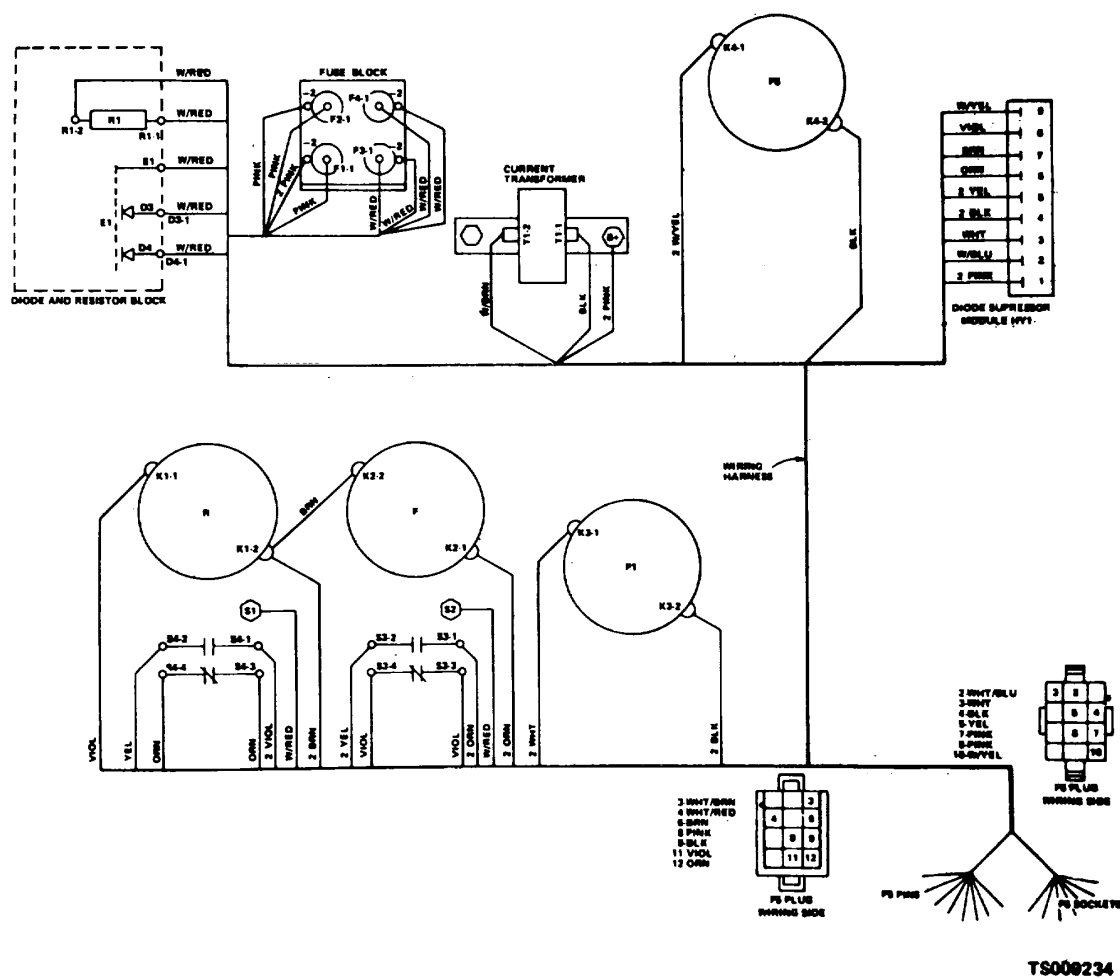
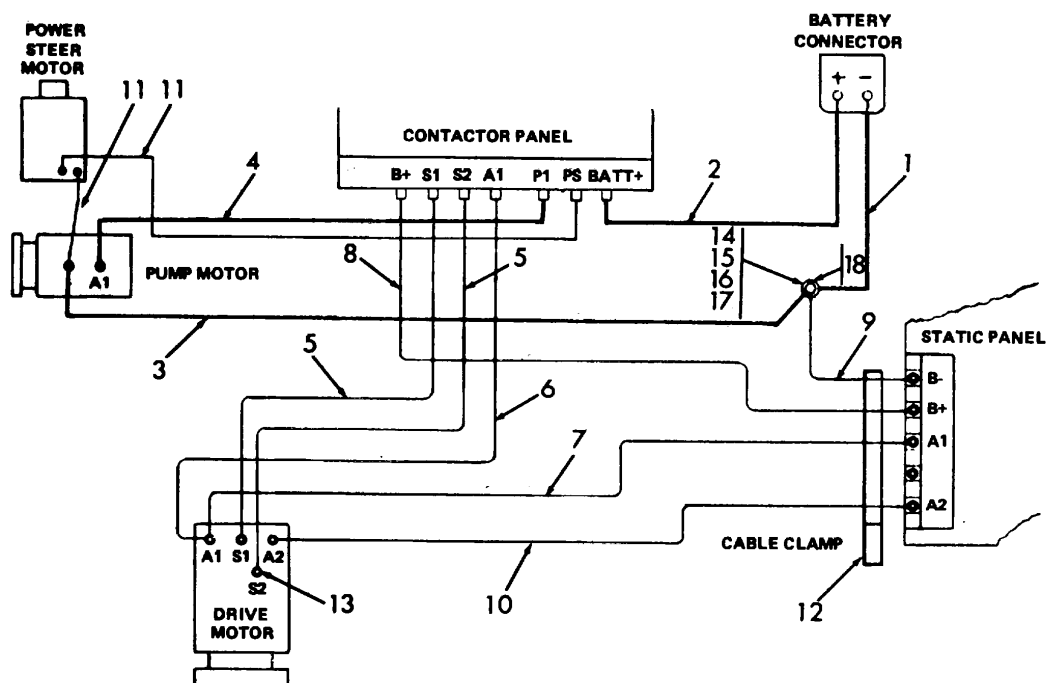


Figure 9-18. Contactor panel harness wiring diagram.

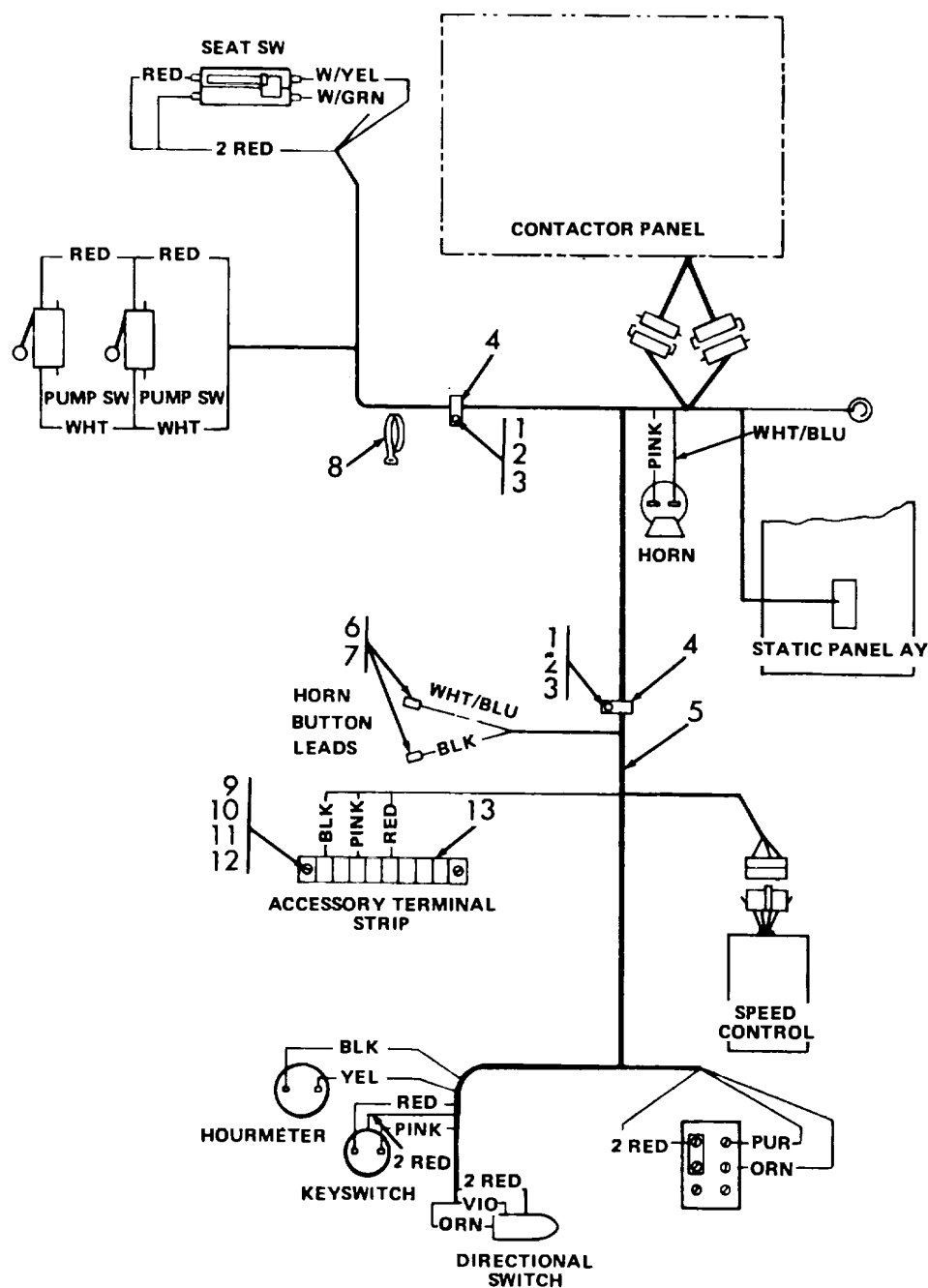
- (2) Refer to figures 9-19 and 9-20 for the cable diagram and the wiring harness for the lift truck.



TS009235

- | | |
|-----------------------|--------------------------|
| 1. Battery cable | 10. Drive motor cable |
| 2. Battery cable | 11. Steering motor cable |
| 3. Pump cable | 12. Clamp |
| 4. Pump cable | 13. Boot |
| 5. Drive motor cable | 14. Screw |
| 6. Drive motor cable | 15. Lock washer |
| 7. Static panel cable | 16. Standoff |
| 8. Static panel cable | 17. Stud |
| 9. Static panel cable | 18. Nut |

Figure 9-19. Cable diagram.



TS009236

- | | |
|-------------------|--------------------|
| 1. Screw | 8. Tywrap |
| 2. Lock washer | 9. Screw |
| 3. Nut | 10. Lock washer |
| 4. Clamp | 11. Washer |
| 5. Wiring harness | 12. Nut |
| 6. Connector | 13. Terminal board |
| 7. Terminal | |

Figure 9-20. Wiring harness.

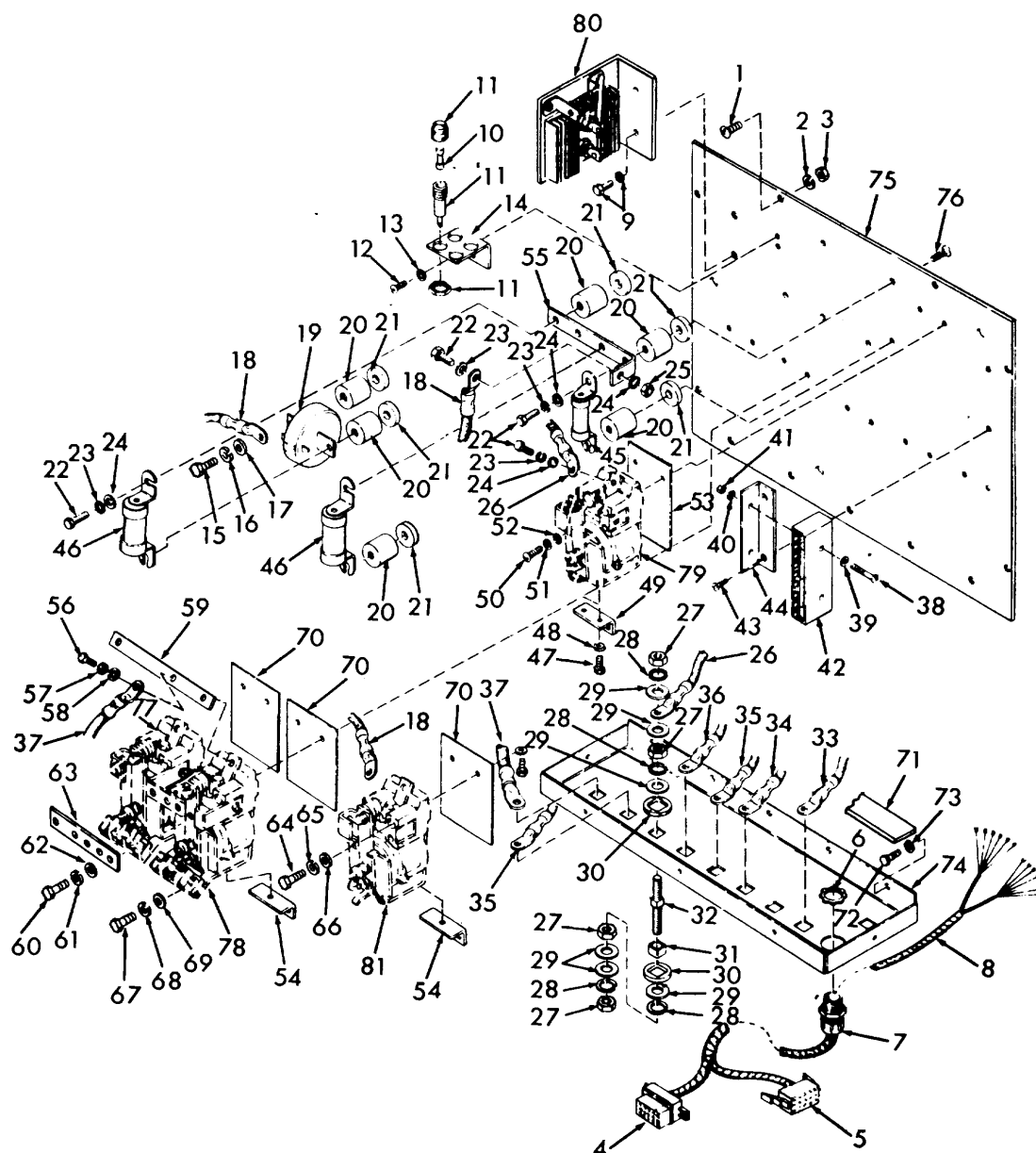
(3) Remove screws (22, fig. 9-21), lock washers (23), washers (24) and remove fuses (45

and 46). Remove screws (76) and remove bus bar (55) and standoffs (20) and spacers (21).

KEY to fig. 9.21:

1. Screw
2. Lock washer
3. Nut
4. Connector
5. Connector
6. Nut
7. Connector
8. Wiring harness
9. Screw
10. Fuse (15 amp)
11. Fuseholder
12. Screw
13. Lock washer
14. Support
15. Screw
16. Lock washer
17. Washer
18. Cable
19. Transformer
20. Standoff
21. Spacer
22. Screw
23. Lock washer
24. Lock washer
25. Nut
26. Cable
27. Nut
28. Lock washer
29. Washer
30. Insulator
31. Insulator
32. Stud
33. Cable
34. Cable
35. Cable
36. Cable
37. Cable
38. Screw
39. Washer
40. Lock washer

41. Nut
42. Diode suppressor module
43. Screw
44. Support
45. Fuse (35 amp)
46. Fuse (400 amp)
47. Screw
48. Washer
49. Terminal
50. Screw
51. Washer
52. Lock washer
53. Insulation
54. Terminal
55. Bus bar
56. Screw
57. Lock washer
58. Washer
59. Bus bar
60. Screw
61. Lock washer
62. Washer
63. Bus bar
64. Screw
65. Lock washer
66. Washer
67. Screw
68. Lock washer
69. Washer
70. Insulator
71. Plate
72. Screw
73. Lock washer
74. Shelf
75. Panel
76. Screw
77. Forward contactor
78. Reverse contactor
79. Emergency cutout contactor
80. Diode and resistor assembly
81. Pump contactor



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Figure 9-21. Contactor panel, exploded view.

(4) Remove transformer (19), standoffs and spacers.

(5) Remove fuses (10) and fuseholders (11). Remove screws (12) and lock washers (13) and remove support (14).

(6) Remove screws (9) and remove resistor and diode assembly (80). Refer to paragraph 9-27 for repair of diode and resistor assembly.

(7) Remove screws (38), washers (39), lock washers (40) and nuts (41) and remove diode suppressor module (42). Remove screws (43) and remove support (44).

(8) Remove screws, washers and lock washers and remove bus bars (59 and 63) and terminals (54) from forward and reverse contactors (77 and 78).

(9) Remove screws (67), washers (68) and lock washers (69) and remove forward and reverse contactors. Remove insulators (70). Refer to paragraph 9-26 for repair of contactors.

(10) Remove screw (50), washers (51) and lock washers (52) and remove emergency cutout contactor (79). Refer to paragraph 9-25 for repair of contactor.

(11) Remove screws (64), lock washers (65) and washers (66) and remove pump contactor (81).

(12) Harness, cables, and items 27 through 32 are removed when wires are disconnected.

(13) Remove plate (71) and remove screws (72) and lock washers (73) and remove shelf (74) from panel (75).

d. Cleaning, Inspection and Repair.

WARNING

Cleaning compound, solvent (Fed. Spec. P-D-680), used for cleaning, is potentially dangerous to personnel and property. Do not use near open flame. Flash point of solvent is 100° F to 138° F (38° C to 59° C).

(1) Clean all metal parts in cleaning compound, solvent (Fed. Spec. P-D-680) and dry thoroughly.

(2) Inspect all components for wear and damage which may impair or prevent normal operation.

(3) Inspect harness and cables for cracked or frayed wires or cables. Repair by taping or insulating, if possible. Replace unserviceable components.

(4) Check all fuses with a test lamp. Replace blown fuses.

(5) Test diode suppressor module as outlined in paragraph 9-17. If readings are not as indicated, replace diode suppressor module.

(6) Replace all unserviceable components.

e. Assembly.

(1) Install shelf (74, fig. 9-21) on panel (75) and secure with screws (72) and lock washers (73). Install plate (71).

(2) Install insulator (70) and emergency cutout contactor (79 fig. 9-21) and secure to panel (75) with screws (50), washers (51) and lock washers (52). Tighten screws securely.

(3) Install insulators (70) and forward and reverse contactors (77 and 78) on plate and secure with screws (67), washers (68) and lock washers (69). Tighten screws securely.

(4) Install insulator (70) and install pump contactor (81). Secure contactor with screws (64), lock washers (65) and washers (66).

(5) Install bus bars (59 and 63) and terminals (54) on forward and reverse contactors and secure with screws.

(6) Install support (44) on panel and secure with screws (43). Install diode suppressor module (42) on support and secure with screws (38), washers (39), lock washers (40) and nuts (41). Tighten nuts securely.

(7) Install diode and resistor assembly (80) on panel and secure with screws (9). Tighten screws securely.

(8) Install fuse support (14) on panel and secure with screws (12) and lock washers (13). Install fuse holders (11) and fuses (10) in support.

(9) Install standoffs (20) and spacers (21) and install bus bar (55) on panel. Secure standoffs with screws (76).

(10) Install standoffs (20) and spacers (21) and install transformer (19) on standoffs. Secure transformer and one 400 amp fuse (46) to bus bar. Install remaining 400 amp fuse on bus bar.

(11) Install standoffs (20) and spacers (21) and connect 35 amp fuse (45) to bus bar.

(12) Install studs (32), insulators, nuts and washers in shelf.

(13) Install wiring harness (8) through shelf and secure with connector (7).

(14) Refer to figures 9-19 and 9-20 and connect contactor panel cables and wiring harness to components.

f. Installation. Refer to paragraph 2-16 and install contactor panel on truck. Operate truck and check contactor and control operation. Truck should operate smoothly and properly through all phases of movement.

9-25. Hydraulic Pump and Emergency Cutout Contactors

a. General. Contactors control operation of the drive motor, pump motor and emergency cutout. The contactors are mounted in the contactor panel (fig. 2-7).

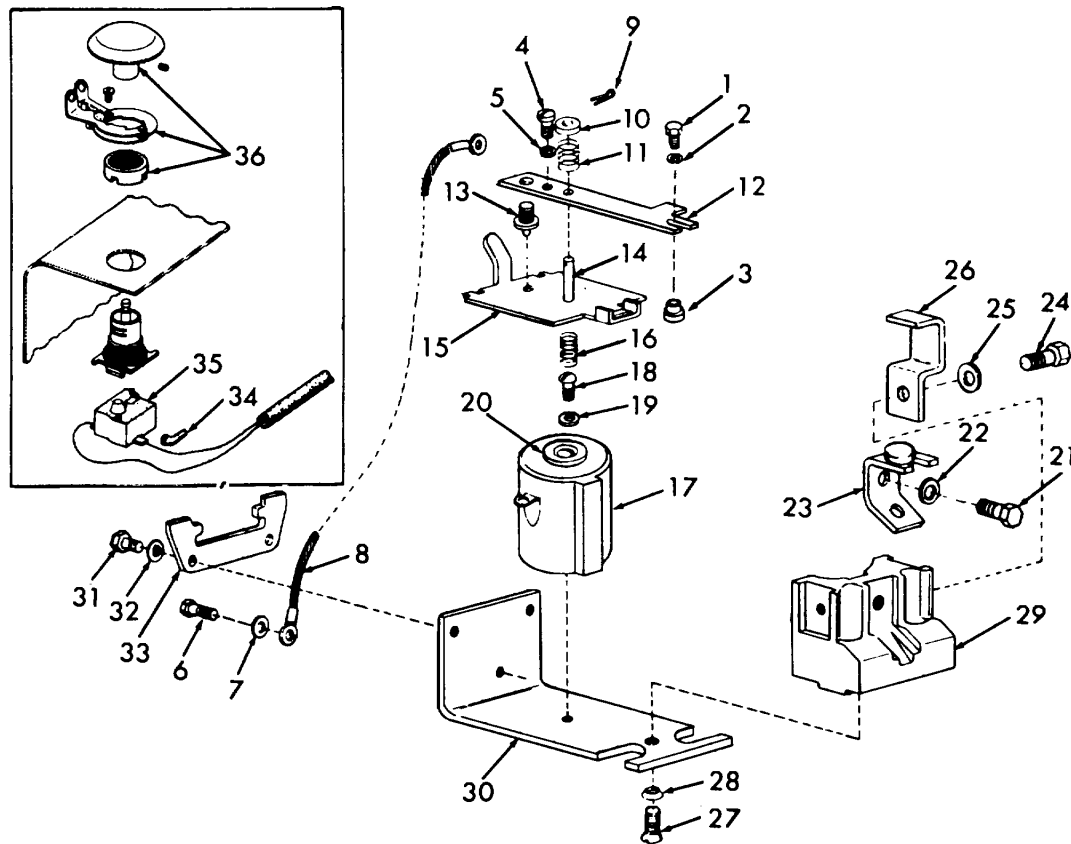
b. Removal. Refer to paragraph 9-24 and remove contactors from contactor panel.

c. Disassembly. The hydraulic pump and

emergency cutout contactors are identical except for the coil (20, fig. 9-22).

(1) Remove screws (1, fig. 9-22), lock

washers (2) and remove contacts (3) from carrier and support (23).



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- | | | | |
|----------------|-------------------|-------------------|--------------|
| 1. Screw | 10. Cup | 19. Lock washer | 28. Washer |
| 2. Lock washer | 11. Spring | 20. Core | 29. Block |
| 3. Contact | 12. Carrier | 21. Screw | 30. Yoke |
| 4. Screw | 13. Pivot bearing | 22. Washer | 31. Screw |
| 5. Washer | 14. Shoulder pin | 23. Support Screw | 32. Washer |
| 6. Screw | 15. Armature | 24. Screw | 33. Retainer |
| 7. Lock washer | 16. Spring | 25. Washer | 34. Boot |
| 8. Lead | 17. Coil | 26. Bracket | 35. Block |
| 9. Cotter pin | 18. Screw | 27. Screw | 36. Switch |

Figure 9-22. Pump and emergency cutout contactors, exploded view.

(2) Remove screws (4 and 6), lock washers (7) and washers (5) and disconnect electrical lead (8) from carrier and yoke.

(3) Remove screws (31) and washers (32) and remove armature retainer (33) and remove armature and carrier from contactor.

(4) Remove screw (27) and washer (28) and remove block from yoke. Remove screws (24) and washers (25) and remove brackets (26). Remove screws (21) and washers (22) and remove support (23).

(5) Remove cotter pin (9), cup (10) and

spring (11) and remove carrier (12) from armature. Remove pivot bearing (13).

(6) Remove spring (16) from coil (17). Remove screw (18) and washer (19) and remove coil (17) from yoke.

d. Cleaning, Inspection and Repair.

WARNING

Cleaning compound; solvent (Fed. Spec. P-D-680), used for cleaning, is potentially dangerous to personnel and property. Do not use near open flame. Flash point of solvent is 100°F to 138°F (38°C to 59° C).

(1) Clean all metal parts in cleaning compound, solvent (Fed. Spec. P-D-680) and dry thoroughly.

(2) Inspect components for wear or damage that may prevent or impair normal operation. Replace unserviceable parts.

(3) Check for cracked or frayed electrical leads. Repair or replace as necessary.

(4) Check contactor points for signs of arcing and pitting. Replace worn or pitted contacts.

(5) Check springs for cracks, damage and lack of tension. Replace unserviceable springs.

e. Assembly.

(1) Install core (20, fig. 9-22) in coil (17). Install coil (17) on yoke (30) and secure with screw (18) and washer (19). Install spring (16) in core.

(2) Install block (29) on yoke (30) and secure with screws (27) and washers (28). Install bracket (26) and support (23) on block and secure with screws (21 and 24) and washers (22 and 25).

(3) Install pivot bearing (13) in armature (15). Install carrier (12) on armature and secure with spring (11), cup (10) and cotter pin (9).

(4) Install armature over coil on yoke and install armature retainer (33) and secure with screws (31) and washers (32).

(5) Install contacts (3) in carrier and support and secure with screws (1) and lock washers (2).

f. Check Contact Point Gap.

(1) Refer to figure 9-13 and check contact point gap.

(2) Pump contactor normally open contacts should have an air gap of 0.280 to 0.400 inch (7.11 to 10.1 mm).

(3) Emergency cutout contactor points should have an air gap of 0.160 to 0.280 inch (4.06 to 10.1 mm).

(4) Loosen screws and adjust contact point air gaps to tolerances shown.

(5) Refer to paragraph 9-26 g and check contactor coil operation.

g. Installation. Refer to paragraph 9-23 and install pump and emergency cutout contactors on contactor panel.

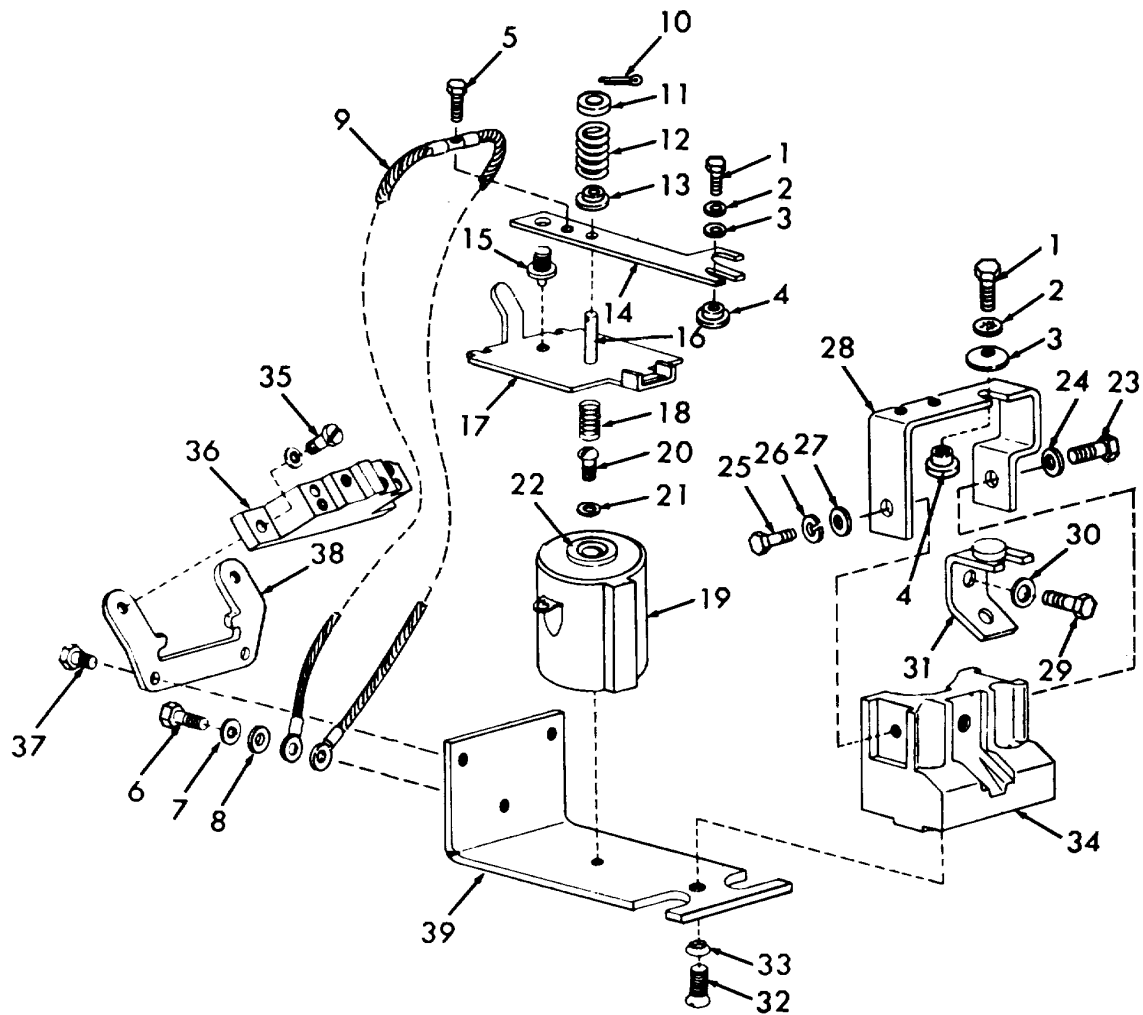
9-26. Forward and Reverse Contactors

a. General. The forward and reverse contactors each have two sets of contacts, four contacts in all. Two are normally closed and two normally open. The two contactors are connected together with a bus bar (69, fig. 9-21).

b. Removal. Refer to paragraph 9-24 and remove forward and reverse contactors from contactor panel.

c. Disassembly.

(1) Remove screws (1, fig. 9-23), lock washers (2) and dished washers (3) and remove contacts (4) from carrier and supports.



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- | | | |
|--------------------|-------------------|--------------|
| 1. Screw | 14. Carrier | 27. Washer |
| 2. Lock washer | 15. Pivot bearing | 28. Support |
| 3. Dished washer | 16. Pin | 29. Screw |
| 4. Contact | 17. Armature | 30. Washer |
| 5. Screw | 18. Spring | 31. Support |
| 6. Screw | 19. Coil | 32. Screw |
| 7. Lock washer | 20. Screw | 33. Washer |
| 8. Washer | 21. Washer | 34. Block |
| 9. Electrical lead | 22. Core | 35. Screw |
| 10. Cotter pin | 23. Screw | 36. Switch |
| 11. Cup | 24. Washer | 37. Screw |
| 12. Spring | 25. Screw | 38. Retainer |
| 13. Washer | 26. Lock washer | 39. Yoke |

Figure 9-23. Forward and reverse contactor, exploded view.

(2) Remove screws (5 and 6), lock washer (7) and washer (8) and disconnect electrical lead (9) from carrier and yoke.

(3) Remove screws (35) and remove switch (36) from retainer. Remove screw (37), remove retainer (38) and remove armature from coil.

(4) Remove cotter pin (10), cup (11), spring (12) and washer (13) and remove carrier (14).

(5) Remove pivot bearing (15) from armature.

(6) Remove screws (23 and 25), lock washer (26) and washers (24 and 27) and remove support (28) from block.

(7) Remove screw (29) and washer (30) and remove support (31) from block. Remove screw (32) and washer (33) and remove block (34) from yoke.

d. Cleaning, Inspection and Repair.

WARNING

Cleaning compound, solvent (Fed. Spec. P-D480), used for cleaning, is potentially dangerous to personnel and property. Do not use near open flame. Flash point of solvent is 100°F to 138°F (38°C to 59° C).

(1) Clean all metal parts in cleaning compound, solvent (Fed. Spec. P-D-680) and dry thoroughly.

(2) Inspect all parts for wear or damage that may prevent or impair normal operation. Replace unserviceable parts.

(3) Check for cracked or frayed electrical leads. Repair or replace as necessary.

(4) Check contactor points for signs of arcing and pitting. Replace worn or pitted contacts.

(5) Check springs for cracks, damage and lack of tension. Replace unserviceable springs.

e. Assembly.

(1) Install block (34, fig. 9-23) on yoke (39) and secure with screw (32) and washer (33). Install support (31) on block and secure with screw (29) and washer (30).

(2) Install support (28) on block and secure with screws (23 and 25), lock washers (26) and washers (24 and 27).

(3) Install core (22) in coil (19) and install coil on yoke. Secure coil and core to yoke with screw (20) and washer (21). Install spring (18) in core.

(4) Install carrier (14) on armature and secure with washer (13) spring (12), cup (11) and cotter pin (10).

(5) Install assembled armature on coil and install retainer (38) and screws (37). Install switch (36) on retainer and secure with screws (35).

(6) Connect electrical lead (9) to yoke and carrier with screws (5 and 6), lock washer (7) and washer (8).

(7) Install contacts (4) in carrier and supports and secure with screws (1), lock washers (2) and dished washers (3).

f. Check Contact Point Gap.

(1) Refer to figure 9-13 and check contact point gap.

(2) Normally open contacts on contactor should have an air gap of 0.280 to 0.400 inch (7.11 to 10.1 mm).

(3) Normally closed contacts which open when the normally open contacts close should have an air gap of 0.130 to 0.250 inch (3.3 to 6.3 mm).

(4) Loosen screws and adjust contact point air gaps to tolerances shown.

(5) Connect a multimeter across contactor coil terminals and apply voltage to check electrical coil.

(6) Contactor should pick up and armature seal points at 19.8 volts.

(7) Contactor must remain picked up at 9.0 volts.

(8) Contactor must drop out at 2 volts minimum.

(9) If contactor does not operate as noted, disassemble and replace coil and springs.

g. Installation. Refer to paragraph 9-24 and install forward and reverse contactors.

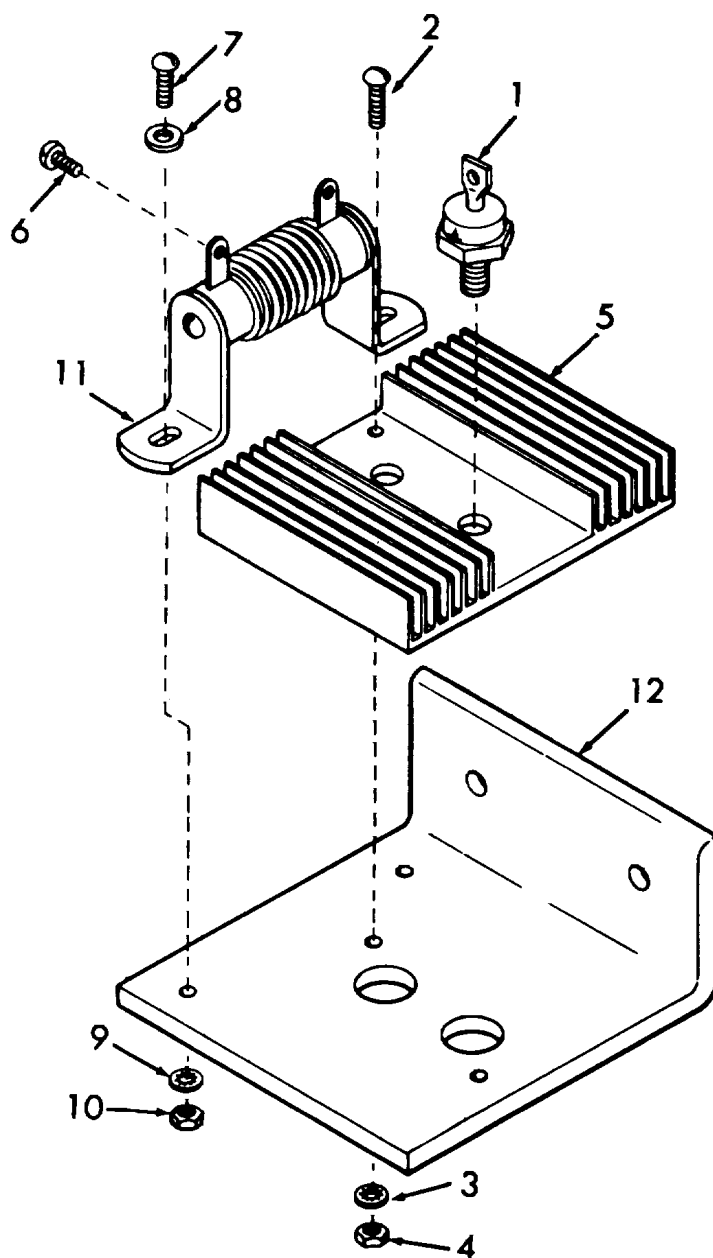
9-27. Diode and Resistor Assembly

a. General. The diode and resistor assembly (fig. 2-7) is mounted in the upper left corner of the contactor panel.

b. Removal. Refer to paragraph 9-24 and remove the diode and resistor assembly from the contactor panel.

c. Disassembly.

(1) Remove diodes (D3 and D4) (1, fig. 9-24) from heat sink.



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- | | |
|-----------------|----------------|
| 1. Diode. | 7. Screw |
| 2. Screw. | 8. Washer |
| 3. Lock washer. | 9. Lock washer |
| 4. Nut. | 10. Nut |
| 5. Heat sink. | 11. Resistor |
| 6. Screw. | 12. Bracket |

Figure 9-24. Diode and resistor assembly, exploded view.

(2) Remove screws (2), lock washers (3) and nuts (4) and remove heat sink (5) from bracket.

(3) Remove screws (7), washers (8), lock washers (9) and nuts (10) and remove resistor (11) from bracket (12).

d. Cleaning, Inspection and Repair.

WARNING

Cleaning compound, solvent (Fed. Spec. P-D-680), used for cleaning, is potentially dangerous to personnel and property. Do not use near open flame. Flash point of solvent is 100°F to 138° F (38°C to 59°C).

(1) Clean all parts in cleaning compound, solvent (Fed. Spec. P-D-680) and dry thoroughly.

(2) Inspect heat sink for cracks, chips and damage.

(3) Inspect resistor for cracks and damage.

(4) Refer to paragraph 9-18 and check diodes for correct properties.

(5) Replace unserviceable components or components that do not pass electrical test.

e. Assembly.

(1) Install resistor (11, fig. 9-24) on bracket (12) and secure with screws (7), washers (8), lock washers (9) and nuts (10).

(2) Install heat sink (5) on bracket and secure with screws (2), lock washers (3) and nuts (4).

(3) Install diodes (1) in heat sink.

f. Installation. Refer to paragraph 9-24 and install diode and resistor assembly in contactor panel.

9-28. Static Panel

a. General. The static panel (fig. 2-8) is mounted on the door which encloses the lower left side of the frame. The panel consists of three power switch modules, three drive regulator modules, a diode and switch assembly and capacitors.

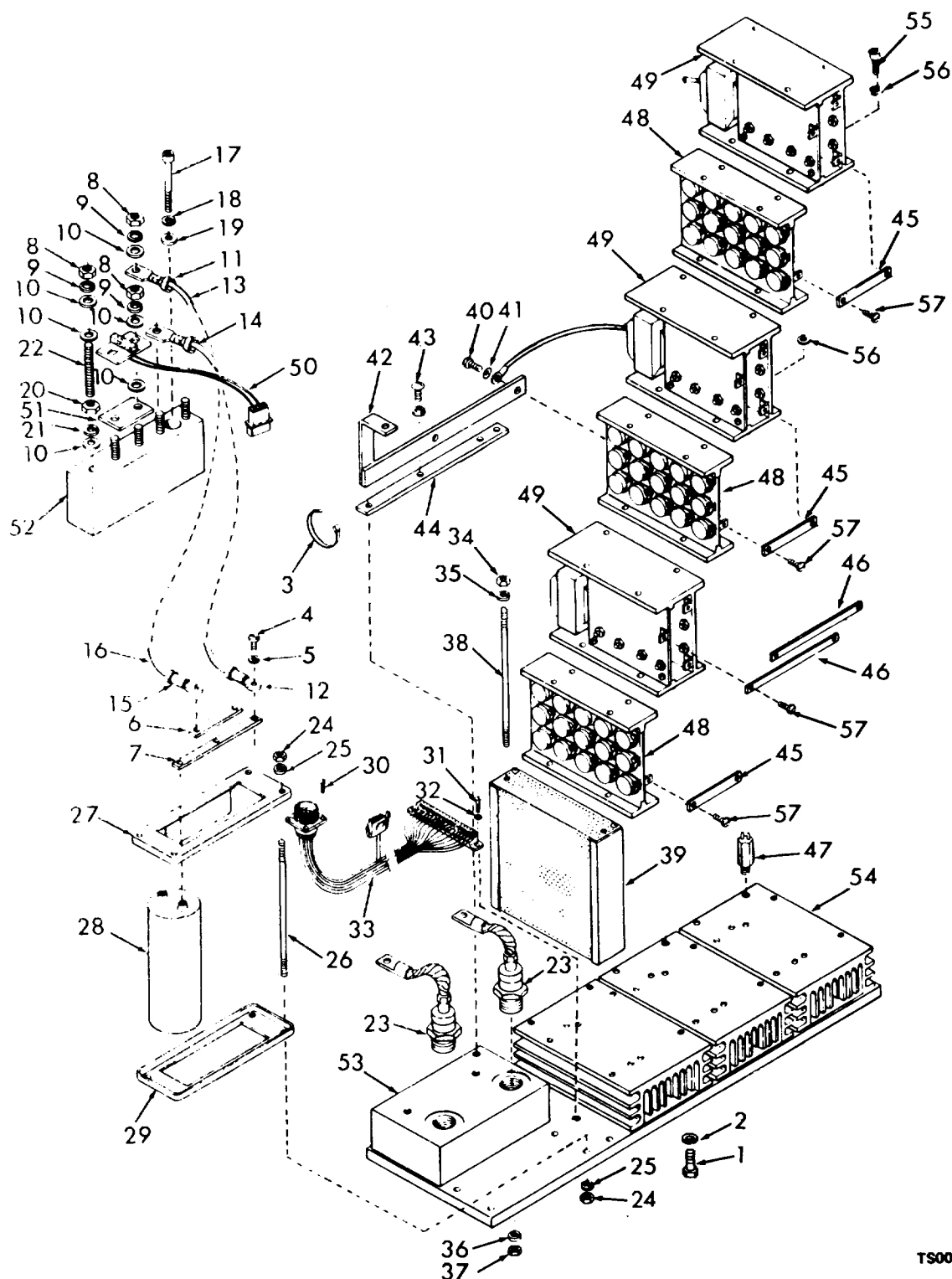
b. Removal. Many of the disassembly procedures (c below) can be performed without removing the static panel from the truck. For clarity the disassembly is performed with the panel removed from the truck. Refer to paragraph 2-16 and remove the static panel from the truck.

c. Disassembly.

(1) Remove wrap (3, fig. 9-25) from harness and wires. Remove screws (4) and lock washers (5) and disconnect cables and remove bus bars (6 and 7).

KEY to fig. 9-25:

1. Screw
2. Washer
3. Wrap
4. Screw
5. Lock washer
6. Bus bar
7. Bus bar
8. Nut
9. Lock washer
10. Washer
11. Terminal lug
12. Terminal lug
13. Wire
14. Terminal lug
15. Terminal lug
16. Wire
17. Screw
18. Lock washer
19. Washer
20. Nut
21. Lock washer
22. Stud
23. Diode
24. Nut
25. Lock washer
26. Stud
27. Bracket
28. Capacitor
29. Bracket
30. Screw
31. Screw
32. Lock washer
33. Wiring harness
34. Nut
35. Lock washer
36. Washer
37. Nut
38. Stud
39. Control circuit module
40. Screw
41. Lock washer
42. Bus bar
43. Screw
44. Bus bar
45. Bus bar
46. Bus bar
47. Resistor
48. Power switch module
49. Drive regulator module
50. Reed switch
51. Bus bar
52. Block
53. Diode block
54. Base
55. Screw
56. Washer
57. Screw



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Figure 9-25. Static panel assembly, exploded view.

(2) Remove nuts (8), lock washers (9) and washers (10) and disconnect cables, reed switch (50) and diodes (23) from block. Remove diodes from diode block. Remove studs (22).

(3) Remove nuts (24) and lock washers (25) and remove brackets (27 and 29), capacitors (28) and studs (26).

(4) Remove screws (30 and 31) and lock washers (32) and disconnect wiring harness (33).

(5) Remove nuts (34 and 37) and washers (35 and 36) and remove control circuit module (39) from base (54). Remove studs (38).

(6) Remove screws (40 and 43) and lock washers (41) and remove bus bars (42 and 44) from power switch (48) and drive regulator modules (49). Remove screws (57) and remove bus bars (45 and 46) from modules.

(7) Remove screws (55) and washers (56) and remove three power switch modules (48) and drive regulator modules (49) from base.

(8) Remove positive temperature coefficient resistor (47) from base assembly (54).

(9) Remove bus bar (51) and blocks (52 and 53) from base (54).

d. Cleaning, Inspection and Repair.

(1) Wipe all parts with a clean, dry lint-free cloth.

(2) Inspect all parts for damage. Replace damaged parts.

(3) Replace all parts found to be defective in tests performed in paragraphs 9-7, 9-8, 9-9, 9-16 and 9-20.

(4) Inspect wiring harness, cables and electrical leads for fraying, damaged terminals and cracked wires. Repair or replace harness, cables, or electrical leads if necessary.

e. Assembly.

(1) Install blocks (52 and 53, fig. 9-25) on base assembly (54). Secure blocks with screws (17), lock washers (18) and washers (19). Install positive temperature coefficient resistor (47) in base assembly (54).

(2) Install three power switch modules (48) and drive regulator modules (49) and secure with screws (55) and washers (56).

(3) Install bus bars (45 and 46) between modules and secure with screws (57). Install bus bars (42 and 44) and secure with screws (40 and 43) and washers (41).

(4) Install control circuit module (39) on base and install studs (38) through control circuit module and base. Secure module with nuts (34 and 37) and washers (35 and 36).

(5) Install bracket (29) on base and install capacitors (28) in bracket. Secure capacitors with bracket (27). Install studs (26). Secure brackets with nuts (24) and lock washers (25).

(6) Install bus bars (6 and 7) on contactors and connect cables to bus bars. Secure bus bars and cables to capacitors with screws (4) and lock washers (5).

(7) Install diodes (23) in block on base assembly. Install bus bar (51), reed switch (50) and cables on studs (22) and secure with nuts (8), lock washers (9) and washers (10). Connect diode leads to studs.

(8) Install wiring harness (33) on static panel and secure with screws (30 and 31) and lock washers (32). Connect reed switch plug to plug on wiring harness. Connect tagged wires to bus bars and modules.

(9) Perform tests listed in paragraphs 9-7, 9-8, 9-9, 9-16 and 9-20 to check static panel. Replace any components that do not check out.

f. Installation. Refer to paragraph 2-16 and install static panel. Operate truck and check operation.

9-29. Battery Receptacle

Paragraph 9-29 has been rescinded. See TM 10-3930-631-12.

Pages 9-42 and 9-43 rescinded.

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APPENDIX A

REFERENCES

- A-1. Fire Protection
TM 5-4200-200-100 Hand Portable Fire Extinguishers Approved for Army Users
- A-2. Lubrication
C9100IL Fuels, Lubricants, Oils and Waxes
LO 10-3930-631-12 Lubrication Order for Truck, Lift, Fork, Electric, Solid Rubber Tires, 4000 Lb. Capacity, 144 and 180 Inch Lift, Allis-Chalmers Models ACE40AEE144 and ACE40AEE180
- A-3. Painting
TM 43-0139 Painting Instructions for Field Use
- A-4. Radio Interference Suppression
FM 11-65 High Frequency Radio Communications
- A-5. Maintenance
DA Pam 738-750 The Army Maintenance Management System (TAMMS)
TM 10-6140-200-14 Installation, Use, Maintenance, and Repair of Industrial Motive Power Storage Batteries for Materials Handling Equipment
TM 10-3930-631-12 Organizational Maintenance Manual for Truck, Lift, Fork, Electric, Solid Rubber Tires, 4000 Lb. Capacity, 144 and 180 Inch Lift, Allis-Chalmers Models ACE40AEE and ACE40AEE180
TM 10-3930-631-20P Organizational Maintenance Repair Parts and Special Tools Lists for Truck, Lift, Fork, Electric, Solid Rubber Tires, 4000 Lb. Capacity, 144 and 180 Inch Lift, Allis-Chalmers Models ACE40AEE and ACE40AEE180
TM 10-3930-631-34P Direct Support and General Support Maintenance Repair Parts and Special Tools Lists for Truck, Lift, Fork, Electric, Solid Rubber Tires, 4000 Lb. Capacity, 144 and 180 Inch Lift, Allis-Chalmers Models ACE40AEE144 and ACE40AEE180
- A-6. Shipment and Storage
TB 740-97-2 Preservation of USAMECOM Mechanical Equipment for Shipment and Storage
TM 740-90-1 Administrative Storage of Equipment
- A-7. Destruction of Army Material to Prevent Enemy Use
TM 750-244-6 Procedures for Destruction of Tank-Automotive Equipment to Prevent Enemy Use

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