DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DIRECT SUPPORT, GENERAL SUPPORT AND DEPOT MAINTENANCE MANUAL
TRUCK, FORK, LIFT, ELECTRIC, SOLID RUBBER TIRES,
2,000 LBS. CAPACITY, 144 in. LIFT,
BAKER MODEL FTD-020-EE-SS, ARMY MODEL MHE-204,
FSN 3930-935-7864

HEADQUARTERS, DEPARTMENT OF THE ARMY
JULY 1969

SAFETY PRECAUTIONS

BEFORE OPERATION

Disconnect battery charging connector by releasing arm clamp and pulling receptacle off before performing any maintenance operations, except when battery power is required to support maintenance functions performed on installed equipment.

Do not allow SD (solvent, dry-cleaning) to come in contact with rubber parts. SD will cause rubber to swell and rot.

Use care when removing wormshaft and ball nut from housing to prevent ball nut from running down to either end of worm. Damage to ends of ball guides will result if ball nut is allowed to rotate until stopped at end of worm.

Do not use wire or metallic rod or pick to clean fluid passages since such procedure could result in irreparable damage to parts.

Do not apply a voltage greater than 12 volts dc to motor unless motor has a load applied. Motor will overspeed if operated at a higher voltage without load.

Do not allow motor to operate at 36 volts with torque loading. Motor will overspeed and may be irreparably damaged.

Do not apply voltage greater than 12 volts dc to pump motor terminals unless load is applied to motor. Motor will overspeed if higher voltage is applied without motor loadings.

DURING OPERATION - None

AFTER OPERATION

Disconnect battery charging connector by releasing arm clamp and pulling receptacle off before performing any maintenance operations, except when battery power is required to support maintenance functions performed on installed equipment.

Do not allow SD (solvent, dry-cleaning) to come in contact with rubber parts. SD will cause rubber to swell and rot.

Use care when removing wormshaft and ball nut from housing to prevent ball nut from running down to either end of worm. Damage to ends of ball guides will result if ball nut is allowed to rotate until stopped at end of worm.

Do not use wire or metallic rod or pick to clean fluid passages since such procedure could result in irreparable damage to parts.

Do not apply a voltage greater than 12 volts dc to motor unless motor has a load applied. Motor will overspeed if operated at a higher voltage without load.

Do not allow motor to operate at 36 volts with torque loading. Motor will overspeed and may be irreparably damaged.

Do not apply voltage greater than 12 volts de to pump motor terminals unless load is applied to motor. Motor will overspeed if' higher voltage is applied without motor loadings.

CHANGE
NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., *28 November 1989*

Direct Support, General Support, and Depot Maintenance Manual

**TRUCK, FORK LIFT, ELECTRIC, SOLID RUBBER TIRES,
2,000-LB CAPACITY, 144-INCH LIFT,
BAKER MODEL FTD-020-EE-SS,
ARMY MODEL MHE-204,
NSN 3930-00-935-7864**

TM 10-3930-609-35, 22 July 1969, is changed as follows:

Cover and *page i*. The manual title is changed to read as shown above.

Page 1-1.

Paragraph 1-1a. Change "Federal Stock Number 3930-935-7864" to "National Stock Number 3930-00-935-7864".

Paragraph 1-lb. Change "TM 10-3930-609-35P" to "TM 10-3930-609-34P".

Paragraph 1-2 is superseded as follows:

1-2. Maintenance Forms, Records, and Reports

Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by DA Pam 738-750.

Paragraphs 1-2.1 and 1-2.2 are added after paragraph 1-2.

1-2.1. Reporting Errors and Recommending Improvements

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to: Commander, U.S. Army Tank-Automotive Command, ATTN: AMSTA-MB, Warren, MI 48397-5000. A reply will be furnished to you.

1-2.2. Reporting Equipment Improvement Recommendations (EIRs)

If your fork lift needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 (Quality Deficiency Report). Mail it to us at: Commander, U.S. Army Tank-Automotive Command, ATTN: AMSTA-MP, Warren, MI 48397-5000. We'll send you a reply.

Page 2-1. Paragraph 2-2 is superseded as follows:

2-2. Direct Support and General Support Maintenance Repair Parts

Direct support and general support maintenance repair parts are listed and illustrated in TM 10-3930-609-34P.

Page 2-7, Table 2-1, Brakes.

Malfunction 2, Corrective action a. Change "Repair wheel cylinder (para 3-32)." to "Replace wheel cylinder (TM 10-3930-609-12).".

Malfunction 3, Corrective action b. Change "Repair wheel cylinder (para 3-32)." to "Replace wheel cylinder (TM 10-3930-609-12).".

Page 2-20. Paragraph 2-24.1 is added after paragraph 2-24.

2-24.1. Relay Contact Replacement

Relay contacts can be removed without removing the entire relay. Contacts require replacement when the silver has worn down to the steel support.

Page 2-22. Paragraph 2-30.1 is added after paragraph 2-30.

2-30.1. Identification Plates

Note. Replace identification plates when damaged or illegible.

a. *Removal*. Remove mounting screws and identification plate.

b. Installation. Using mounting screws, install identification plate.

Page 3-11. The NOTE after paragraph 3-27f is superseded as follows:

Note. If wheel cylinders show evidence of fluid leakage, replace.

Page 3-12. Paragraph 3-32 is rescinded.
Page 3-13. Paragraph 3-33 is rescinded.

References, page 1. Appendix A is superseded as follows:

APPENDIX A
REFERENCES

A-1. Fire Protection

TB 5-4200-200-100	Hand Portable Fire Extinguishers Approved for Army Users

A-2. Lubrication

LO 10-3930-609-12	Lubrication Order

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 9-6140-200-14	Operator's, Organizational, Direct Support and General Support Maintenance Manual for Lead-Acid Storage Batteries
TM 10-6140-200-14	Installation, Use, Maintenance, and Repair of Industrial Motive Power Storage Batteries for Materials Handling Equipment
TM 10-3930-609-34P	Direct Support and General Support Maintenance Repair Parts and Special Tools Lists
TM 5-764	Electric Motor and Generator Repair

A-6. Shipment and Storage

TB 740-93-2	Preservation of USAMEC Mechanical Equipment for Shipment and Storage
TM 740-90-1	Administrative Storage of Equipment
MIL-STD-129	Marking for Shipment and Storage

Index, page 2. Change "Direct support, general support and depot maintenance repair parts" to "Direct support and general support maintenance repair parts".
Index, page 3.

Delete the entry for "Forms and records".

After *Hydraulic pump parts*, add "Identification plates, paragraph 2-30.1, page 2-22".

Before *Mast*, add "Maintenance forms, records, and reports, paragraph 1-2, page 1-1".
Index, page 4.

After *Reinstallation of motor brake shoes and drum*, add "Relay contact replacement, paragraph 2-24.1, page 2-20".

Delete the entry for "Repair of master cylinder".

Delete the entry for "Repair of wheel cylinder".

After *Replacement of wiring harness, general*, add "Reporting equipment improvement recommendations, paragraph 1-2.2, page 1-1" and "Reporting errors and recommending improvements, paragraph 1-2.1, page 1-1".

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

WILLIAM J. MEEHAN II
Brigadier General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA form 12-25F (Block 2118), Direct Support and General Support maintenance requirements for Fork Lift, 2000 LB Capacity, Solid Tire, Electric, Light (Model MHE-204).

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TECHNICAL MANUAL

No. 10-3930-609-35

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *22 July 1969*

DIRECT SUPPORT, GENERAL SUPPORT AND DEPOT MAINTENANCE MANUAL

TRUCK, FORK, LIFT, ELECTRIC, SOLID RUBBER TIRES,

2,000 LBS CAPACITY, 144 in. LIFT, BAKER MODEL FTD-020-EE-SS,

ARMY MODEL MHE-204, FSN 3930-935-7864

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

a. This manual contains instructions for the use of Direct Support, General Support and Depot Maintenance personnel maintaining the Truck, Lift, Fork, Electric, Solid Rubber Tires, 2,000Pound Capacity, Baker Model FTD-020-EE-SS, Army Model MHE-204, Federal Stock Number 3930-935-7864 as allocated by the Maintenance Allocation Chart. It provides information on the maintenance of the equipment which is beyond the scope of the tools, equipment, personnel, or supplies normally available to the using organization.

b. The appendix contains a list of references. TM 10-3930-609-12 contains the maintenance allocation chart. The list of repair parts required by direct and general support, and depot maintenance facilities for support of the equipment is contained in TM 10-3930-609-35P.

1-2. Forms and Records

a. The DA forms and records used for equipment maintenance will be only these prescribed in TM 38-750.

b. Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to Commanding General, U. S. Army Mobility Equipment Command, ATTN: AMSME-MPP, 4300 Goodfellow Boulevard, St. Louis, Mo. 63120.

Section II. DESCRIPTION AND DATA

1-3. Description

A general description of the fork lift truck and information pertaining to the identification plates are contained in TM 10-3930-609-12. A more detailed description of specific components and assemblies is contained in the applicable section(s) of this manual. Detailed descriptions of the components of the fork lift truck are provided in the applicable maintenance paragraphs of this manual.

1-4. Tabulated Data

a. General. This paragraph contains all maintenance data pertinent to direct support, general support, and depot maintenance personnel.

b. Electrical Components Characteristics and Ratings.

Pump motor voltage (nominal)	36 volts
Pump motor horsepower rating at 36 volts	2.2 hp
Pump motor speed at 86 volts with 14 foot pound load	3,265 rpm ±5%
Pump motor current at 36 volts with 14 foot pound load	204 amps ±5%
Pump motor stalled rotor torque at 36 volts	42 foot pounds min.
Pump motor field coil resistance at 70°F	0.00109 ohms ±10%
Travel motor voltage (nominal)	36 volts
Travel motor horsepower rating at 36 volts	3.5 hp approx.
Travel motor speed at 36 volts with 15 foot pound load	2,940 rpm ±5%
Travel motor current at 36 volts with 15 foot pound load	120 amps ±5%
Travel motor stalled rotor torque at 36 volts	100 foot pounds min.
Travel motor field coil resistance at 70°F	0.0366 ohms ±10%
Accelerator controller potentiometer resistance	0 to 600,000 ohms

Accelerator controller potentiometer resistance with second switch actuated (shaft rotated approximately 7 degrees)	3,500 to 6,000 ohms
Accelerator controller potentiometer resistance with second switch actuated (shaft rotated approximately 27 degrees)	200 ohms max.
Directional control switch type	double pole-double throw
Pump relay type	single pole-single throw
Pump relay coil resistance at 70°F	28.2 ohms ±10%
Master switch relay type	single pole-single throw
Master switch relay coil resistance at 70°F	46.9 ohms ±10%
Forward and reverse relay type	two single pole-double throw
Forward and reverse relay coil resistance at 70°F (each coil)	28.2 ohms ±10%
Accelerator relay type	single pole-single throw
Accelerator relay coil resistance at 70°F	46.9 ohms ±10%

c. Hydraulic Components Characteristics and Ratings.

Hydraulic fluid type	per MIL-H-606
Hydraulic fluid capacity	5 gallons
Hydraulic system pressure relief setting	1400 psig
Hydraulic pump capacity at 1,200 rpm and 1,000 psig	3.40 gpm
Hydraulic pump rotation (facing shaft)	counterclockwise
Direction control valve type	2 spool
Tilt cylinder bore	3 inches
Tilt cylinder stroke	3.250 inches
Tilt cylinder closed length	13.531 inches
Lift cylinder extended length	109.250 inches
Lift cylinder closed length .	48.375 inches

d. Mechanical Components Characteristics and Ratings.

Steering gear ratio	21.3:1
Steering wheel rotation (lock to lock)	5.44 turns
Drive axle type	single reduction, ring and pinion
Drive axle overall reduction (including adapter)	20.8:1
Drive axle pinion gear backlash	0.004 to 0.012 inch
Drive axle bevel gear reduction	5.062:1
Drive axle brake type	hydraulic drum type

e. Repair and Replacement Standards. Table 1-1 lists wear limits and clearances applicable during overhaul of components.

Table 1-1. Applicable Wear Limits and Clearances

Drive axle-axle shaft runout	0.010 inch maximum, total indicator reading.
Drive axle-differential bearings	15 foot pounds drag due to preloading.
Adapter-input gear backlash	0.019 to 0.046 inch.
Drive axle- axle bearings	0.000 to 0.006 inch preload.
Motor brake shoes	1/16 inch minimum thickness.
Service brake shoes	1/16 inch minimum thickness.
Steering gear - lash adjuster	0.002 inch end play maximum.
Travel motor-brushes	3/4 inch minimum length.
Travel motor-armature commutator	2.375 inches minimum diameter, 16 microinch rms surface roughness, 3/64 inch deep by 0.030 inch wide undercutting.
Pump motor-brushes	3/4 inch minimum length.
Pump motor-armature	2.125 inches minimum diameter, 16 microinch rms surface roughness, 3/64 inch deep by 0.025 inch wide undercutting.

CHAPTER 2

GENERAL MAINTENANCE INSTRUCTIONS

Section I. SPECIAL TOOLS AND EQUIPMENT

2-1. Special Tools and Equipment
No special tools or equipment are required to perform the repair operations described in this equipment publication.

2-2. Direct Support, General Support and Depot Maintenance Repair Parts
Direct Support, General Support and Depot Maintenance repair parts are listed and illustrated in TM 10-3930-60935P.

2-3. Specially Designed Tools and Equipment
No specially designed tools and equipment are required to perform maintenance on this equipment.

Section II. TROUBLESHOOTING

2-4. General
This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the fork lift truck and its components. Malfunctions which may occur are listed in table 2-1. Each malfunction stated is followed by a list of the probable causes of the trouble. The corrective action recommended is described opposite the probable cause. Refer to figure 2-1 for schematic diagram and to figure 2-2 for wiring diagram.

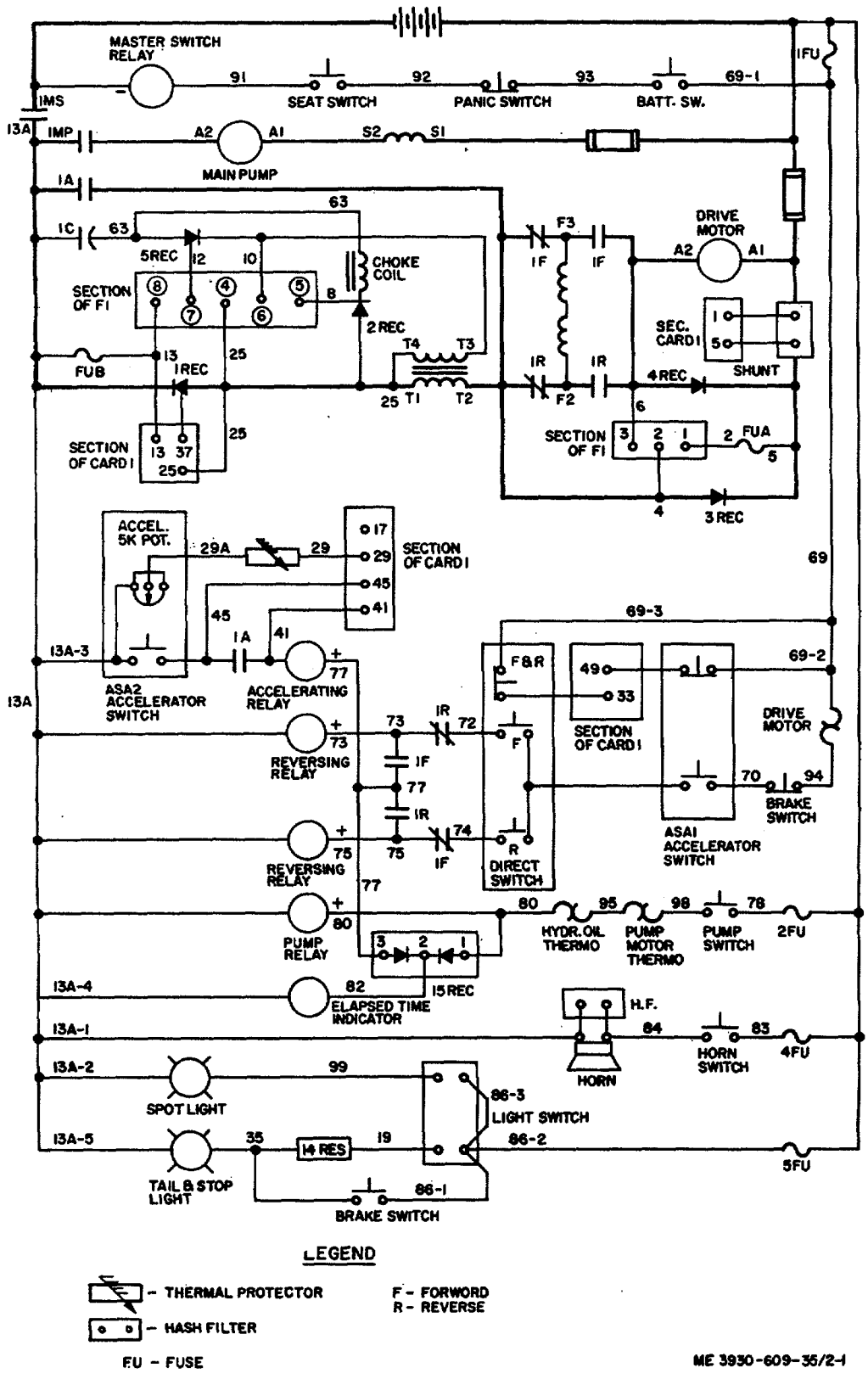

Figure 2-1. Schematic diagram.

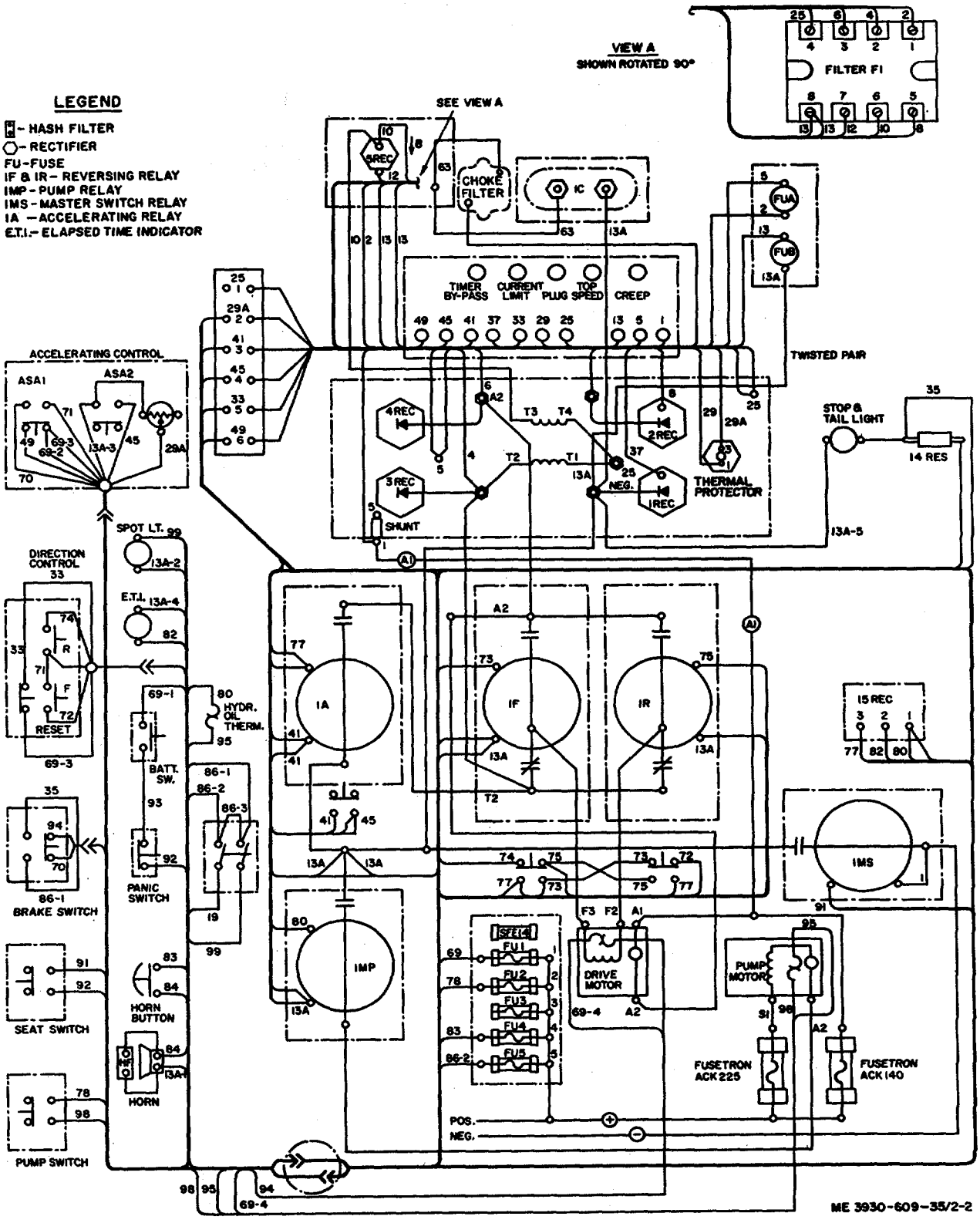

Figure 2-2. Wiring diagram.

Table 2-1. Troubleshooting

Malfunction	Probable cause	Corrective action
Electrical 1. No travel motor torque, with SCR control (relay 1A open).	*a*. Neither relay IF nor IR will pick up-no control voltage from wire 69-2 to wire 13A.	*a*. Make the following checks in order: (1) Check fuse IFU and replace if burned out. (2) With fuse IFU removed, use an ohmmeter to check continuity through the battery switch, panic switch, seat switch and relay IMS coil. Check IMS contacts. Replace defective components (para 3-108 through 3-114).
	b. Either relay IF or IR will not pick up with control voltage present.	*b*. With drive wheels of truck off the floor, make the following tests as required: (1) Connect jumper from battery positive to positive side of F or R coil. If relay does not pick up, check coil continuity with an ohmmeter and replace if open (fig. 3-23) (para 3-115 through 3-121). If coil is not open, also jumper to negative side of coil to check for open circuit. (2) With jumper on battery positive, connect other end to wire 74 on F interlock or 72 on R interlock. If coil does not pick up interlock is defective. Interlocks (fig. 3-23) can be replaced without removing relay. (3) If trouble is not found, use jumper to continue checking coil energizing circuit components.
	c. Relays IF and IR close but there is no power or SCR hum with accelerating control depressed to SCR range.	*c*. With drive wheels of truck off the floor, make the following tests as required: (1) With IF or IR picked up and wire 45 disconnected at SCR terminal board, use voltmeter to check for positive control voltage between wire 41 and SCR terminal board and wire 13A (negative). If voltage is zero, check IF or IR normally open interlocks and 1A coil for continuity. (2) With IF or IR picked up and wire 4-5 disconnected at SCR terminal board, use voltmeter to check for positive control voltage between 1REC heat sink (wire 25) and wire 13A (negative). If voltage is zero, check fuse FUB, continuity of wiring from battery positive to 1REC heat sink, and F or R main contacts. Repair or replace relay contacts if defective and inspect

Malfunction	Probable cause	Corrective action
		relay for other possible defects (para 3-115 through 3-121) (3) With 1F or 1R picked up and wire 45 disconnected at SCR terminal board, measure approximately 6 volts from wire 29 to wire 13A (negative) with acceleration control near creep speed. Voltage should drop to zero as accelerating control is moved toward full speed. If readings are not correct, first connect a jumper wire between wire 29 and 29A which bypasses the thermal protector. Depress the accelerating control and check for the preceding voltages. If voltage readings are now correct, replace thermal protector TP. (4) If test (3) shows no voltage. change between the two steps, connect jumper between wires 29A and 13A. This bypasses the accelerating control and the truck should run at top speed. If top speed is obtained, check accelerating potentiometer (para 2-6). (5) Check 1 REC for open circuit or Open gate (para 2-7). (6) Test oscillator section of Card 1 (para 2-8).
	d. Relays IF and IR close but there is very little power and high-pitch SCR hum.	*d.* Check 2 REC for a shorted condition in the conducting direction (para 2-7).
	e. Relays IF and IR close but very little or no power with low SCR hum, even when accelerating control is in top SCR position.	*e.* With drive wheels of truck of the floor, make the following tests: (1) Disconnect wires 1 and 5 from SHUNT (sensor). Reapply power. If accelerating control now operates normally, replace Card 1. Remove card from panel (fig. 2-3) by loosening two screws at bottom and pulling box straight up to disengage from receptacle. (2) If accelerating control does not operate normally in test (1), check oscillator section of Card 1 (para 2-8A).
	f. Check 3 REC for open condition normal, but there is very little power.	*f.* Relays IF and IR close, SCR hum is (para 2-6). If 3 REC is found open, check 1, 2, and 5 REC for proper operation (para 2-7). If 3 REC is satisfactory, check 4 REC for shorted condition (para 2-6).
2. No travel motor torque in SCR range or with relay 1A closed.	If none of the preceding travel motor may be defective.	Check motor, remove and repair as required (para 3-80 through 3-86)
3. Full travel motor torque with SCR control (relay 1A open).	*a*. Relays IF and IR close with full SCR speed immediately and audible hum.	(1) Check potentiometer for proper resistance (para 2-5).

Malfunction	Probable cause	Corrective action
		(2) Check for grounds in wires 29 and 29A or shorted accelerating potentiometer, connecting ohmmeter at thermal protector TP.
	b. Relays IF and IR close with full speed immediately but no audible hum.	(1) Check for welded contacts on relay 1A. Replace if unserviceable and inspect relay for other possible defects (para 3-122 through 3-128). (2) Check timer section of Card 1 (para 2-8b).
	c. Relays IF and IR close with full speed immediately, no audible hum, and capacitor 1C not charged. (Check voltage across 1C to determine condition-wire 63 negative.)	*c.* Make the following checks in sequence as required: (1) Check 5REC for open gate and shorted condition (para 2-7). If shorted, also check transformer filter (para 2-9c). (2) Check for open gate circuit to 5 REC (para 2-9a). (3) Check continuity of wiring from 1C to 5REC and from 5REC through TS, T4 to T1 and wire to 1 REC anode. (4) Disconnect battery discharge capacitor 1C and check resistance with an ohmmeter, using the RX 10,000 scale. Meter should read zero at first, then swing to above 100,000 ohms. Replace capacitor if final reading is not at least 100,000 ohms. (5) Check 1REC for short (para 2-7).
	d. Relays IF and 1R close with full speed immediately, no audible hum, and *capacitor 1C charged*. (Check voltage across 1C to determine condition-wire 63 negative.)	*d.* In order, check 2REC for open, open gate, and open gate circuit (para 2-7 and 2-9b).
4. Control circuit remains in SCR range with accelerating control fully depressed.	Relay 1A fails to operate.	With drive wheels of truck off the floor, make the tests as required (1) With switches closed for operation, connect jumper from battery negative to wire 41 at SCR terminal board. Relay 1A should pick up immediately unless coil is open. Replace coil if open (para 3-122 through 3-128). (2) Move jumper to connect wire 41 to wire 45 at SCR terminal board. Relay 1A should pick up when the directional control switch is closed and the accelerating control is fully depressed to close switch ASA2. This test checks switch ASA2 and wiring. (3) If the two preceding tests check good, check timer section of Card 1 (para 2-8b).
5. Plugging action of truck too severe or too soft.	*a.* Plugging trim-pot on Card 1 requires adjustments.	*a*. Turn PLUGGING trimpot counterclockwise to lengthen stopping

Malfunction	Probable cause	Corrective action
		distance, clockwise to shorten stopping distance. Run truck on ground at top speed, reverse truck, and measure stopping distance. Readjust PLUGGING control as required to obtain desired plugging action, observing that control is never set to the extreme counter-clockwise position.
	b. Defective 4 REC.	*b.* Check 4 REC and replace if defective (para 2-6).
	c. Fuse FUA blown.	*c.* Replace.
6. Pump motor does not start.	*a*. Open circuit through relay IMP coil.	*a.* (1) Check for blown fuse 2 FU. (2) With an ohmmeter check continuity of relay IMP energizing circuit and check IMP coil. See para 3-108 through 3-114 for coil replacement.
	b. Contacts of relay IMP defective.	*b.* Repair or replace contacts and inspect relay for other possible defects (para 3-108 through 3-114).
	c. Defective pump motor.	*c.* Check motor, remove and repair as required (para 3-87 through 3-93).
Brakes		
1. Brakes dragging.	Master cylinder compensating port plugged.	Overhaul brake master cylinder (para 3-33).
2. Brake pedal goes to floor, no resistance.	*a*. High rate of fluid leakage at wheel cylinder.	*a.* Repair wheel cylinder (para 3-32).
	b. High rate of fluid leakage from master cylinder.	*b.* Repair brake master cylinder)para 3-33).
3. Brake pedal under force gradually goes to floor.	*a*. Scored master cylinder barrel or defective cup in master cylinder.	*a.* Repair brake master cylinder (para 3-33).
	b. High rate of fluid leakage from cylinder.	*b.* Repair wheel cylinder (para 3-32).
	c. High rate 6f fluid leakage from master cylinder.	*c.* Repair brake master cylinder (para 3-33).
4. Heavy braking action.	Brake backing plate loose on axle housing.	Tighten or replace brake backing plate (para 3-27 through 3-31).
5. Truck pulls to one side.	Brake backing plate loose on axle housing.	Tighten or replace brake backing plate (para 3-27 through 3-31).
Steering		
1. Steering difficult.	*a*. Bent steering column.	*a.* Overhaul steering gear (para 3-87 through 3-43).
	b. Broken spindle pin or steering axle.	*b.* Overhaul steering axle (para 3-16 through 3-22).
	c. Jammed ball nut in steering gear.	*c.* Overhaul steering gear (para 3-7 through 3-43).
2. Excessive looseness in steering.	*a*. Steering gears worn.	*a.* Overhaul steering gear (para 3-37 through 3-43).
	b. Tie rod ends worn.	*b.* Overhaul steering axle (para 3-16 through 3-22).
Hydraulic		
1. Lift carriage will not lift load.	*a*. Hydraulic pump defective.	*a.* Overhaul hydraulic pump (para 3-45 through 3-51).
	b. Defective seals in hoist cylinder.	*b.* Repair hoist cylinder (para 3-67 through 3-72).
	c. Hydraulic pump motor defective.	*c.* Overhaul pump motor (para 3-83 through 3-93).
	d. Hydraulic control valve defective.	*d.* Overhaul hydraulic direction control valve (para 3-53 through 3-58).
2. Load creeps down from raised position.	*a*. Leakage past rings in hoist cylinder.	*a.* Repair hoist cylinder (para 3-67 through 3-72).

Malfunction	Probable cause	Corrective action
	b. Hydraulic direction control valve defective.	*b.* Overhaul hydraulic direction control valve (para 3-53 through 3-58).
3. Hoisting speed erratic.	Bent or distorted mast assembly.	Overhaul mast assembly (para 3-74 through 3-79).
4. control valve plungers will not return to neutral.	*a.* Sticking plungers in control valve.	*a.* Overhaul control valve (para 3-53 through 3-58).
	b. Broken springs or dirt lodged in seats.	*b.* Overhaul control valve (para 3-53 through 3-58).
5. No operation of hydraulic system when first started up.	*a.* Defective hydraulic pump.	*a.* Overhaul hydraulic pump (para 3-45 through 3-51).
	b. Defective relief valve in control valve or control valve plunger stuck.	*b.* Overhaul direction control valve para 3-53 through 3-58).
6. Slow operation of hydraulic system.	*a.* Defective hydraulic pump.	*a.* Overhaul hydraulic pump (para 3-45 through 3-51).
	b. Pump rpm too low.	*b.* check pump motor operation. Over. haul pump motor if required (para 3-83 through 3-93).
	c. Improper operation of direction control valve due to defective parts or foreign matter.	*c.* Overhaul direction control valve (para 3-53 through 3-58).
	d. Worn or scored hoist cylinder packings.	*d.* Overhaul hoist cylinder (para 3-67 through 3-72).
7. Jerky operation of hydraulic system.	Hoist cylinder misalined due to distortion or deformation of mast assembly.	Overhaul mast assembly (para 3-74 through 3-79).
8. Noisy operation of hydraulic system.	*a.* Defective hydraulic pump.	*a.* Overhaul hydraulic pump (para 3-45 through 3-61).
	b. chattering relief valve in direction control valve.	*b.* Overhaul direction control valve (para 3-53 through 3-58).
9. Speed of operation slows down after usage.	*a.* Defective hydraulic pump.	*a.* Overhaul hydraulic pump (para 3-45 through 3-51).
	b. Defective direction control valve.	*b.* Overhaul direction control valve (para 3-53 through 3-58).
10. Oil heats up rapidly.	*a.* Defective direction control valve.	*a.* Overhaul direction control valve (para 3-53 through 3-58).
	b. Defective hydraulic pump.	*b.* Overhaul hydraulic pump (para 3-45 through 3-51).
11. Hoist cylinder packing leaks.	*a.* Worn packings.	*a.* Overhaul hoist cylinder (para 3-67 through 3-72).
	b. Piston scored.	*b.* Overhaul hoist cylinder (para 3-67 through 3-72).
12. Hoist or tilt cylinder lowers or tilts while truck is idle.	*a.* Worn packing in hoist cylinder or tilt cylinder.	*a.* Overhaul hoist cylinder (para 3-67 (para 3-67 through 3-72) or tilt cylinder (para 3-61 through 3-65).
	b. Defective hydraulic direction control valve.	*b.* Overhaul hydraulic direction control valve (para 3-53 through 3-58).
13. Mast will not tilt.	*a.* Defective hydraulic pump.	*a.* Overhaul hydraulic pump (para 3-45 through 3-51).
	b. Defective direction control valve.	*b.* Overhaul direction control valve para 3-53 through 3-58).
	c. Defective tilt cylinder.	*c.* Overhaul tilt cylinder (para 3-61 through 3-65).
Forward and Reverse Travel		
1. Axle noise while under power or while coasting.	*a.* Defective gears or bearings in drive axle.	*a.* Overhaul drive axle (para 3-5 through 3-14).
	b. brake shoe retainer defective.	*b.* Overhaul brake system (para 3-27 through 3-31).
2. Adapter noise while under power or coasting.	*a.* Defective gear or pinion in adapter.	*a.* Overhaul adapter (para 3-5 through 3-12).
	b. Defective bearing in adapter.	*b.* Overhaul adapter (para 3-5 through 3-12).

2-5. Test of Accelerating Control Potentiometer
Operation of the potentiometer can be checked without disassembling the control. Proceed as follows:

a. Disconnect battery and disconnect wire 29A from either the thermal protector TP or the SCR terminal board (fig. 2-2 and 2-3).

b. Connect ohmmeter from wire 29A and wire 13A negative and set meter to the RX100 range.

c. With the accelerating control depressed to the creep speed position (switch ASA1 just actuated), the resistance reading should be between 3,500 and 6,600 ohms.

d. With the accelerating control depressed to the top SCR speed position (switch ASA2 just ready to close), the resistance reading should be 200 ohms or less.

e. The resistance between either wire 29A or 13A to the truck frame should be 1 megohm or higher.

f. If any of the resistance tests are unsatisfactory the accelerating control should be disassembled and adjusted or repaired as indicated (para 104 and 105).

2-6. Test of Rectifiers 3 REC and 4 REC
These two diode rectifiers are identical. Before

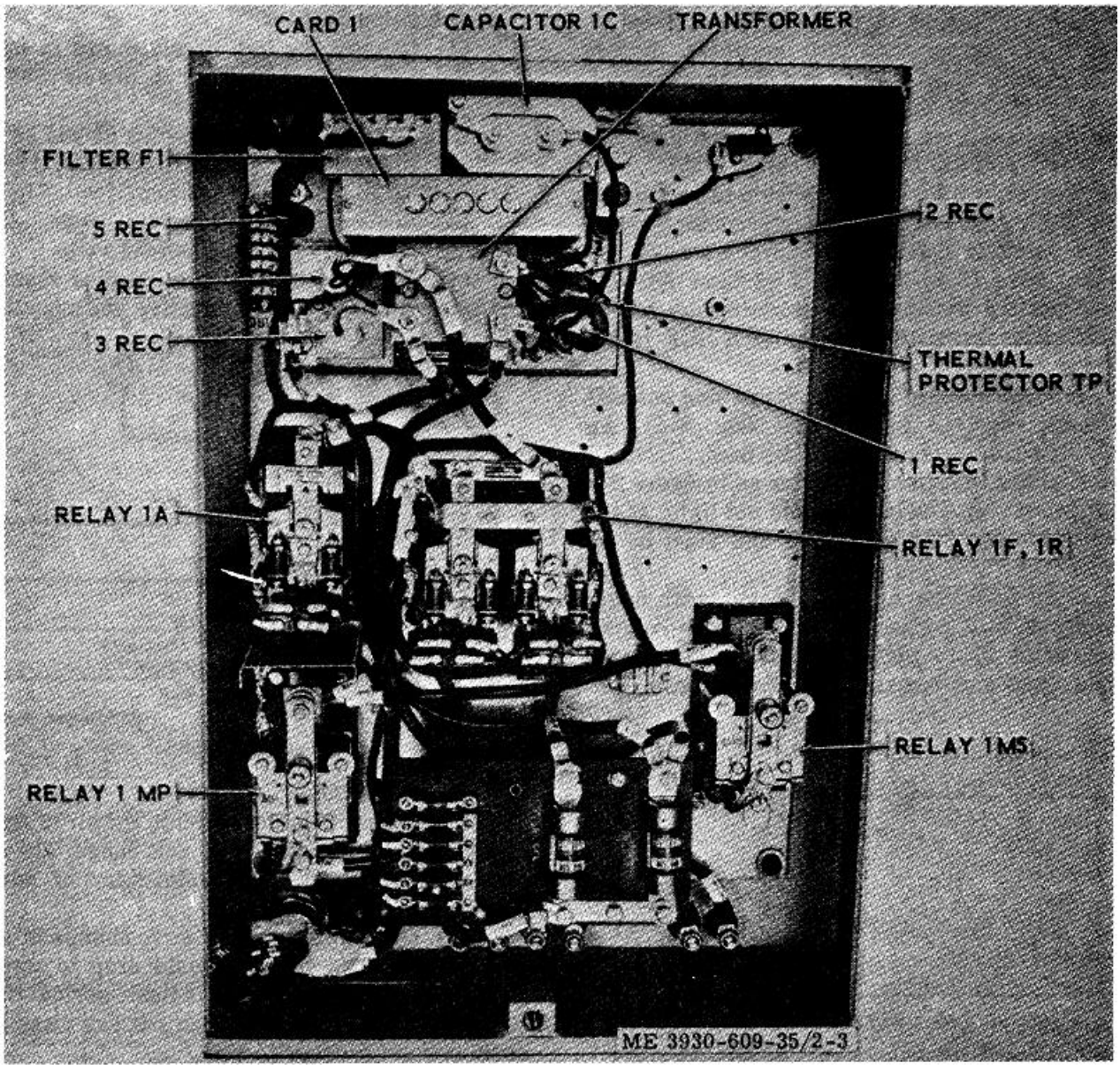

Figure 2-3. Control and SCR panel.

testing, disconnect battery, discharge capacitor IC to prevent burning out ohmmeter, and disconnect pigtail of rectifier to be tested. With the ohmmeter set to the RX1 scale, the resistance in the forward or conducting direction should be about 7 to 12 ohms. Measured on the RX10,000 ohm range, the back resistance (nonconducting direction) should be infinite. Allowing for meter and reading errors, replace any diode with resistance readings which are definitely outside the specified values. When replacing a diode, apply thermal joint compound or grease to mounting stud threads to improve heat sinking (GE Versilube G-350-M or equivalent is recommended). Tighten to a snug fit.

2-7. Test of SCR's (1 REC, 2 REC, 5 REC)

These are silicon controlled rectifiers. Before checking, disconnect battery and discharge capacitor 1C to prevent burning out ohmmeter. Before checking 1 REC remove Card 1 to open gate and disconnect pigtail. Before checking 2 REC, disconnect gate lead by opening wire 8 to terminal 5 of filter Fl (fig. 2-3), and disconnect the pigtail. Before checking 5 REC, disconnect gate lead by opening wire 12 to terminal 7 of filter Fl, and disconnect the power lead to terminal on top of 5 REC. The test procedure for each SCR is the same, as follows:

a. A 3 volt battery, a 3 volt lamp, and suitable leads are required for the test (fig. 2-4). An equivalent continuity test may be used.

b. Connect the circuit or tester as in figure 2-4 for the first test. The lamp should not light. If the lamp lights the SCR is shorted and must be replaced.

c. If the SCR does not test shorted, with figure 2-4 circuit still connected, momentarily connect gate (point 2) to pigtail (point 3). The lamp should light and remain lit when the gate con

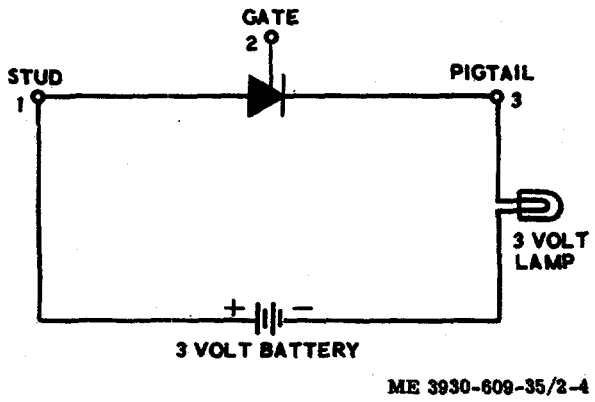

Figure 2-4. SCR test circuit.

nection is removed. If this does not occur the gate is inoperative and the SCR must be replaced.

d. When replacing an SCR, apply thermal joint compound or grease to mounting stud threads to improve heat sinking (GE Versilube G-350-M or equivalent is recommended). Tighten to a snug fit.

2-8. Test of Card 1

The oscillator and timer sections of Card 1 may be tested with simple test equipment after removal from the panel. Remove card from panel by loosening two screws at bottom of box and pulling box straight up to disengage from receptacle (fig. 2-3). Connections for the two tests may be made to card pins with insulated clips.

a. Oscillator Section.

(1) Connect the test circuit shown in figure 2-5. Voltmeter should be on 10 or 15 volt range to start.

(2) The initial voltage reading should be less than 10 volts. Adjust CREEP SPEED trimpot until voltmeter reads 0.5 volts.

(3) Remove capacitor across meter. Voltmeter should then read less than 0.1 volts.

(4) Failure to obtain the specified readings indicates that Card 1 is defective and should be replaced.

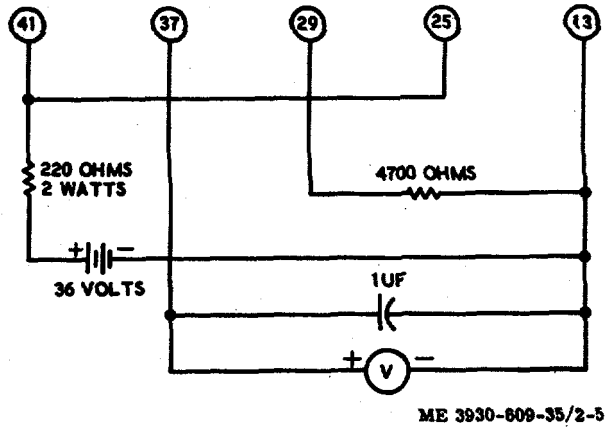

Figure 2-5. Test circuit for oscillator section of card 1.

b. Timer Section.

(1) Connect the test circuit shown in figure 2-6 with voltmeter set on 50 volt range. The battery switch should be a momentary of spring return type.

(2) Close switch and observe change in voltage reading. The voltage should drop to zero in approximately one second to indicate normal timer action. Release switch .to open battery circuit as soon as voltage drops to zero.

(3) If the timer operates, but the time required

for voltage drop to zero after the battery switch is closed is much less or greater than one second, adjust 1A TIME trimpot to obtain approximately one second timer action. A finer adjustment may be made later, if necessary, during a checkout of truck performance.

Note

The timer controls the delay in the pick up of relay 1A, which cuts out the SCR control system and applies full battery voltage to the travel motor for full-speed operation. This occurs when the accelerating control is fully depressed to close switch ASA2. If the timer closes relay 1A too early, truck operation will be jerky; if timer closes 1A too late, truck operation will be sluggish.

(4) If the timer does not operate at all, or cannot be adjusted properly with the 1A TIME trimpot, replace Card 1.

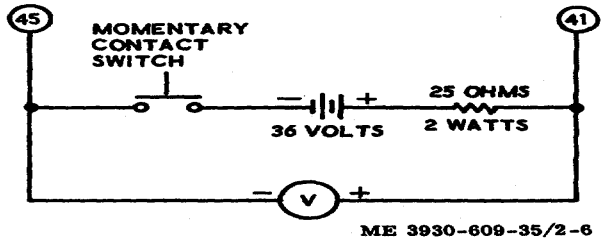

Figure 2-6. Test circuit for times section of card 1.

2-9. Test of Fl Filter and SCR Firing Circuits.

Both the filter and SCR firing circuits contained in filter F1 (fig. 2-2 and 2-3) can be tested with an ohmmeter. - Disconnect battery and filter leads as required for the tests.

a. Test of 5 REC Firing Circuit. Disconnect lead to terminal 7 of F1. With ohmmeter set to RX100 range, connect positive lead to terminal 8 and negative lead to terminal 7. The resistance reading should be between 1,700 and 2,100 ohms. With the leads reversed an infinity reading should be obtained.

b. Test of 2 REC Firing Circuit. Disconnect lead to terminal 5 of F1. With ohmmeter set to RXi00 range, connect positive lead to terminal 6 and negative lead to terminal 5. The resistance reading should be between 1,170 and 1,430 ohms. With the leads reversed an infinity reading should be obtained.

c. Test of Transformer Filter. Disconnect lead to terminal 4 of F1. With ohmmeter set to RX100 range, connect positive lead to terminal 6 and negative lead to terminal 4. The resistance reading should be between 2,050 and 2,750 ohms. With the leads reversed an infinity reading should be obtained.

d. Allowing for Meter and Reading Errors. If any reading in the three preceding tests on F1 is definitely outside the specified values, filter F1 should be replaced.

Section III. RADIO INTERFERENCE SUPPRESSION

2-10. General

Refer to TM 11-483 for definitions, purposes, source and methods used to obtain proper radio suppression.

2-11. Testing of Radio Interference Suppression Components

If the radio suppression component is suspected of being defective, proceed as follows:

a. Disconnect leads 13A-1 and 84 from screw-type terminals on component.

b. Take out two screws, flatwashers, and lockwashers which secure component to master cylinder support to remove component.

c. Check component on a capacitor tester for leak and short. Replace component if defective.

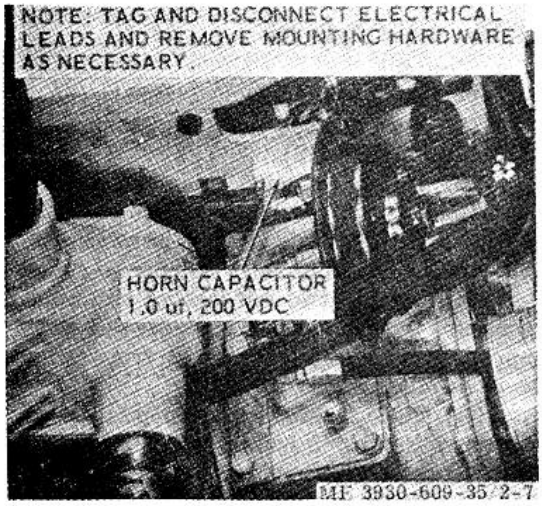

Figure 2-7. Interference, suppre8sion component, removal and installation.

2-12. Interference Suppression Components

All electrical contractors are located in a heavy steel enclosure which provides effective shielding against electromagnetic radiation. The electric motors (travel motor and pump motor) are spark enclosed types-the enclosure providing effective electromagnetic radiation shielding. Other switches which open and close at frequent intervals are enclosed behind steel covers. The only component requiring suppression is the electric horn. This suppression component is mounted adjacent to the brake master cylinder (fig. 2-7).

2-13. Replacement of Suppression Components

Reinstall and reconnect component by reversing removal procedure.

Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND AUXILIARIES

2-14. General

This section contains detailed instructions for removal and installation of assemblies and auxiliaries within the fork lift truck. Each major assembly is covered individually, with its component subassemblies, as a related series of instructions. In many cases a subassembly can be removed without removing or dismantling the major assembly. In this case, select only the applicable steps from the complete instructions for servicing the next higher assembly. Always tag or in some other manner identify such parts as horses and wiring leads to facilitate reassembly. When possible, replace attaching parts such as nuts, bolts, flatwashers, lockwashers and clamps on the part they attach. This should prevent loss or misplacement.

Warning

Disconnect battery charging connector by releasing arm clamp and pulling receptacle off before performing any maintenance operations, except when battery power is required to support maintenance functions performed on installed equipment.

2-15. Hoist Cylinder

a. Removal.

(1) Fully lower upright assembly (fig. 2-8).

(2) Remove load backrest from carriage (TM 10-3930-609-12).

(3) Disconnect, and plug hose at hoist cylinder fitting to prevent entrance of dirt.

(4) Remove two screws, lockwashers, and flatwashers, securing hoist cylinder to crosshead.

(5) Remove two self-locking nuts and flatwashers securing hoist cylinder to base of uprights and slide hoist cylinder from uprights.

b. Installation.

(1) Place hoist cylinder in position on uprights with studs in hoist cylinder base engaging slots on hoist cylinder.

(2) Secure hoist cylinder to base with two self-locking nuts and flatwashers.

(3) Secure hoist cylinder to crosshead with two screws, lockwashers, and flatwashers.

(4) Remove protection covers from hoist cylinder fitting and hose, and connect hose securely to fitting.

(5) Place load backrest in position on carriage.

(6) Operate hoist and tilt controls to purge air from hydraulic system.

2-16. Mast

a. Removal. Removal of the complete mast is required when removing the drive axle. In most cases the mast can be maintained by removal and replacement of its individual components. Remove complete mast as follows:

(1) Slide backrest from carriage and lift from truck. Remove forks from truck.

(2) Attach a hoist to assembly (or use the forks of another fork lift truck), and relieve the weight of the assembly on its supporting parts. Arrange to brace the mast against tipping as disconnections are made.

(3) Disconnect hose at hoist cylinder fitting (fig. 2-8) and plug hose to prevent entrance of dirt.

(4) Disconnect headlight at uprights (TM 10-3930-609-12).

(5) Disconnect both tilt cylinders at uprights by removing pivot pins and attaching screws (TM 10-3930-609-12).

(6) Remove bearing caps (fig. 2-8) holding mast to axle each attached with two screws and lockwashers. Hoist mast from truck and lay it on floor for disassembly.

b. Installation.

(1) Position mast on bearing area of drive axle and secure with bearing caps, lockwashers and screws.

(2) Connect tilt cylinders to mast (TM 10-3930-609-12).

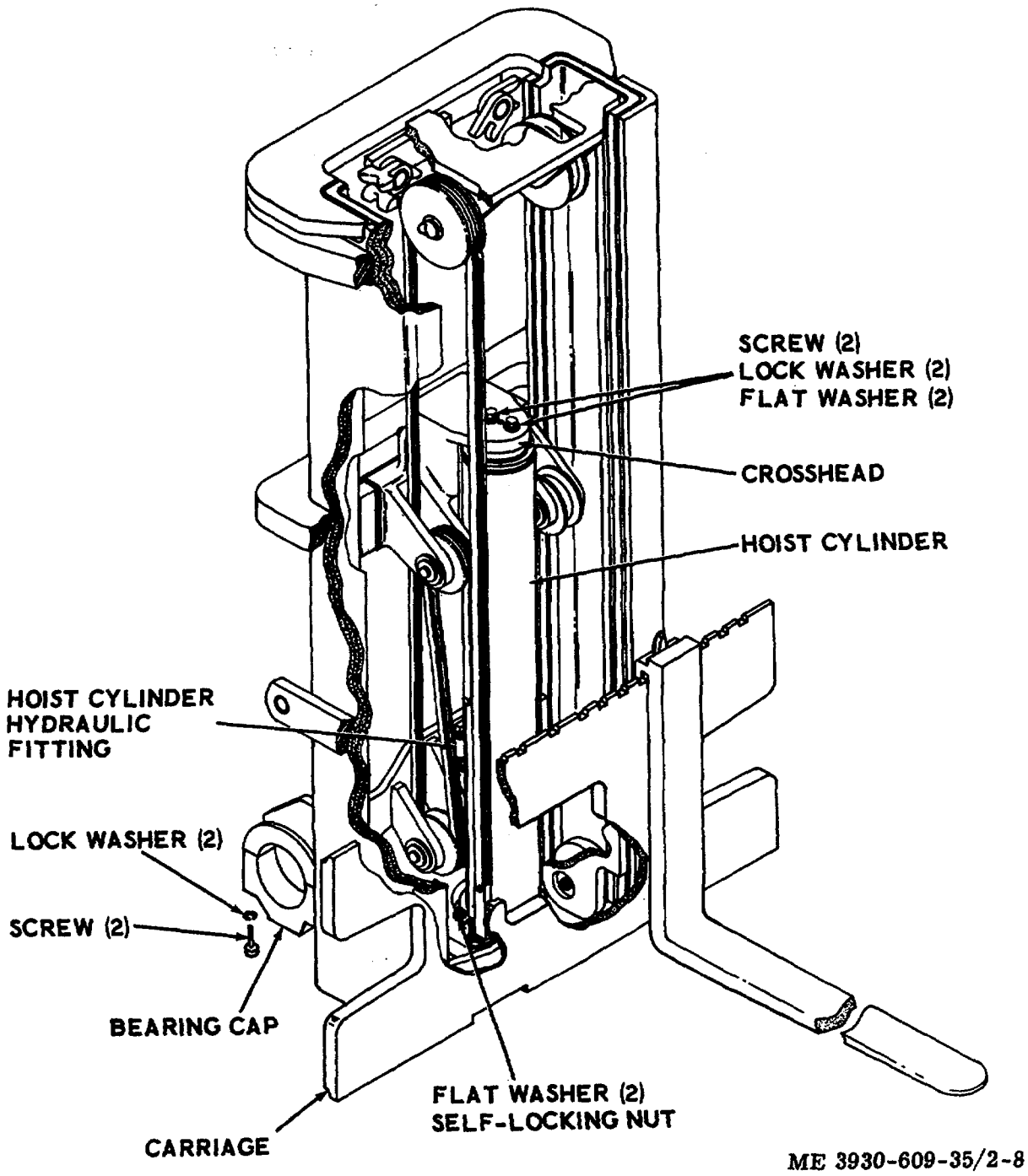

Figure 2-8. Upright assembly.

(3) Connect headlight (TM 10-3930-609-12).

(4) Attach hoist cylinder hose to fitting.

(5) Attach forks to carriage and install load backrest.

(6) Operate system while gradually increasing loads to check for proper operation and hydraulic fluid leakage.

2-17. Control Valve

a. Removal.

(1) Disconnect control valve linkage at control valve (TM 10-3930-609-12).

(2) Tag hoses for identification and disconnect from control valve (fig. 2-9). Cap or plug hose ends and valve ports to prevent entrance of dirt.

(3) Remove three screws, nuts and lockwashers securing control valve to truck body and remove control valve. Screws are removed from battery compartment side.

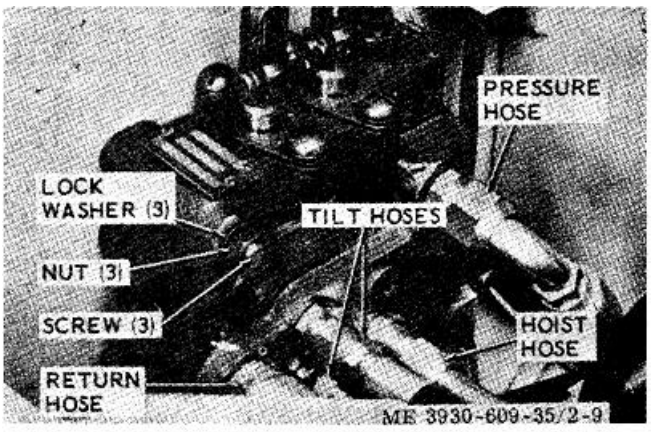

Figure 2-9. Control valve removal.

b. Installation.

(1) Install three control valve mounting screws through. truck body from battery compartment side and mount control valve on screws. Secure with removed, nuts and lockwashers.

(2) Reinstall removed hoses according to tags attached at removal. Be certain hoses are tight.

(3) Attach control valve linkage to control valve (TM 10-3930-609-12).

(4) Operate system while gradually increasing loads to check for proper operation and hydraulic fluid leakage. At completion of operational check-out, install cowl (TM 10-3930-609-12).

2-18. Hydraulic Oil Tank

a. Removal.

(1) Drain hydraulic oil from tank (LO 10-3930-609-12).

(2) Remove cowl and floor plate (TM 10-3930-609-12) and pull hinge pin securing seat to hydraulic tank.

(3) Loosen hose clamp (fig. 2-10) and disconnect return hose between control valve and filter.

(4) Loosen hose clamp and disconnect suction hose at hydraulic tank.

(5) Unscrew filters from hydraulic tank.

(6) Remove four screws and lockwashers securing hydraulic tank to truck body and lift hydraulic tank from truck.

b. Installation.

(1) Position hydraulic tank on truck body and secure with four screws and lockwashers.

(2) Screw filters on hydraulic tank.

(3) Install return -hose to filter fitting and tighten hose clamp securely.

(4) Install suction hose to bottom of hydraulic tank and tighten hose clamp securely.

(5) Position seat on hydraulic tank and secure with hinge pin.

(6) Fill hydraulic tank with oil (LO 10-3930-609-12) and operate system to check for hydraulic fluid leakage.

(7) At completion of operational test, install cowl and floor plate (TM 10-3930-609-12).

2-19. Directional Control Switch

a. Removal.

(1) Remove directional control switch cover (fig. 2-11) and tag and disconnect internal electrical leads.

(2) Remove return to neutral cable by loosening attaching screw.

(3) Remove four screws securing directional control switch and clamp to steering gear column and remove clamp.

(4) Unscrew directional control switch off conduit coupling and remove from truck.

b. Installation.

(1) Install directional control switch on conduit coupling with lever oriented to right of steering gear column.

(2) Secure switch to steering gear column with clamp and four screws.

(3) Secure return to neutral cable to switch with attaching screw.

(4) With no pressure on operator's seat, switch should return to neutral from either the forward or reverse directions.

(5) Reinstall electrical leads to switch according to tags attached at removal and attach switch cover.

2-20. Steering Gear

a. Removal.

(1) Remove floor plate (TM 10-3930-609-12).

(2) Remove directional control switch (para 2-19a).

(3) Remove two covers (fig. 2-11) mounted on steering gear column secured with two screws each and disconnect and tag horn leads at connector.

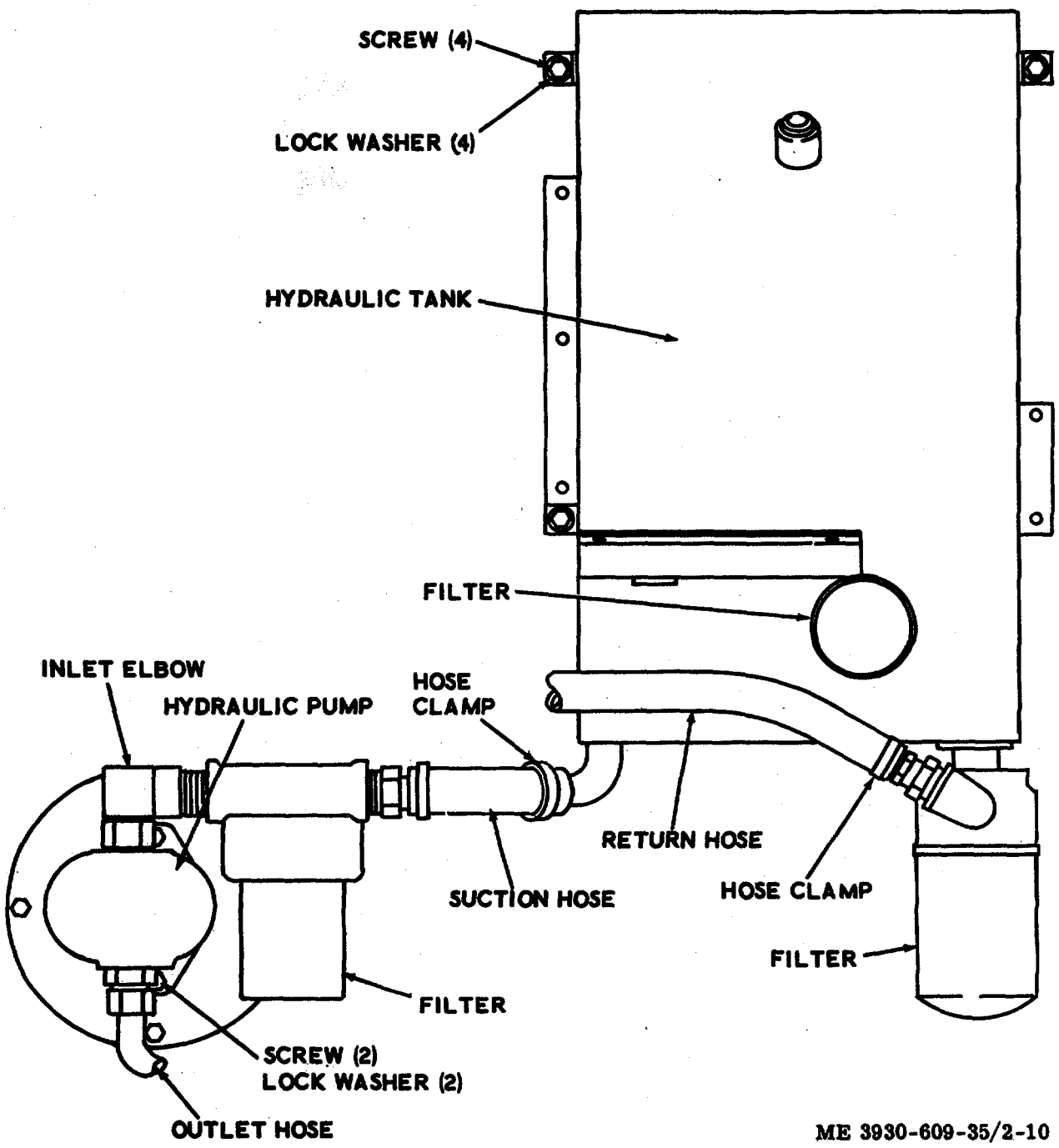

Figure 2-10. Hydraulic tank.

(4) Disconnect draglink at steering gear arm (TM 10-3930-609-12).

(5) Raise lift carriage for easier access and remove three screws and lockwashers securing steering gear to truck body.

(6) Support steering gear and remove two clamps securing steering gear to directional control switch conduit and instrument panel by removing attaching nuts and lockwashers. Pull steering gear out of truck.

b. Installation.

(1) With lift carriage raised for access, position steering gear in truck and secure to body with three screws and lockwashers.

(2) Attach steering gear column to instrument panel and directional control switch conduit with clamps, nuts and lockwashers.

(3) Connect draglink to pitman arm and check steering linkage adjustment (TM 10-3930-609-12).

(4) Connect horn leads to connector and install covers. Secure each cover with two screws.

(5) Install directional control switch (para 2-19b).

(6) Install floor plate (TM 10-3930-609-12).

2-21. Hydraulic Pump

a. Removal.

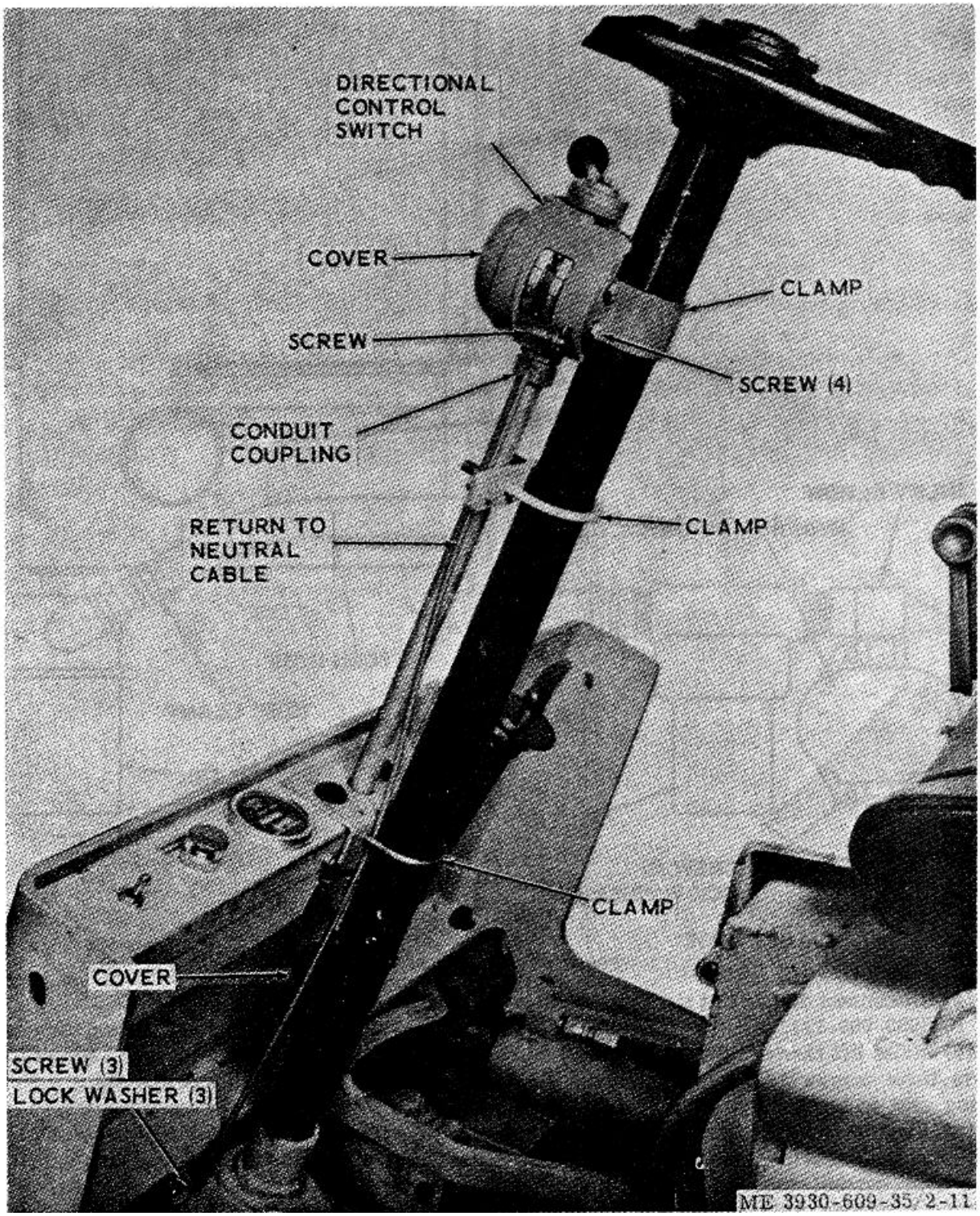

Figure 2-11. Directional control switch and steering gear.

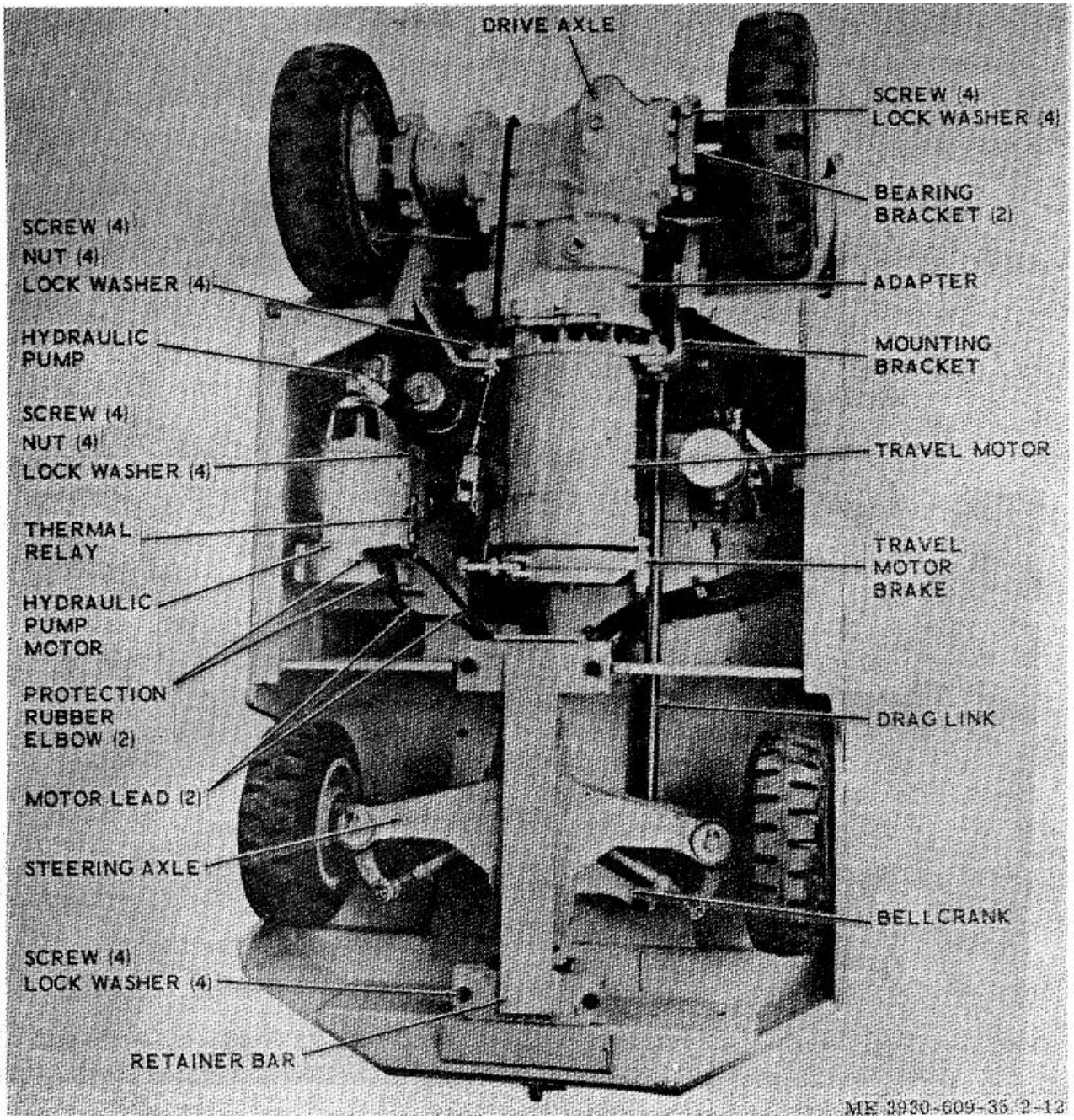

Figure 2-12. Hydraulic pump motor, drive axle and steering axle.

(1) Remove floor plate (TM 10-3930-609-12).

(2) Disconnect inlet elbow (fig. 210) and outlet hose at hydraulic pump and cap ends to prevent entrance of dirt.

(3) Remove two screws and lockwashers securing hydraulic pump to pump motor and remove hydraulic pump with attached coupling half.

b. Installation.

(1) Position hydraulic pump on pump motor, being certain coupling halves engage properly and secure in place with two screws and lockwashers.

(2) Securely connect outlet hose and inlet elbow to hydraulic pump. Operate hydraulic system and check for hydraulic fluid leakage.

(3) Install floor plate (TM 10-3930-609-12).

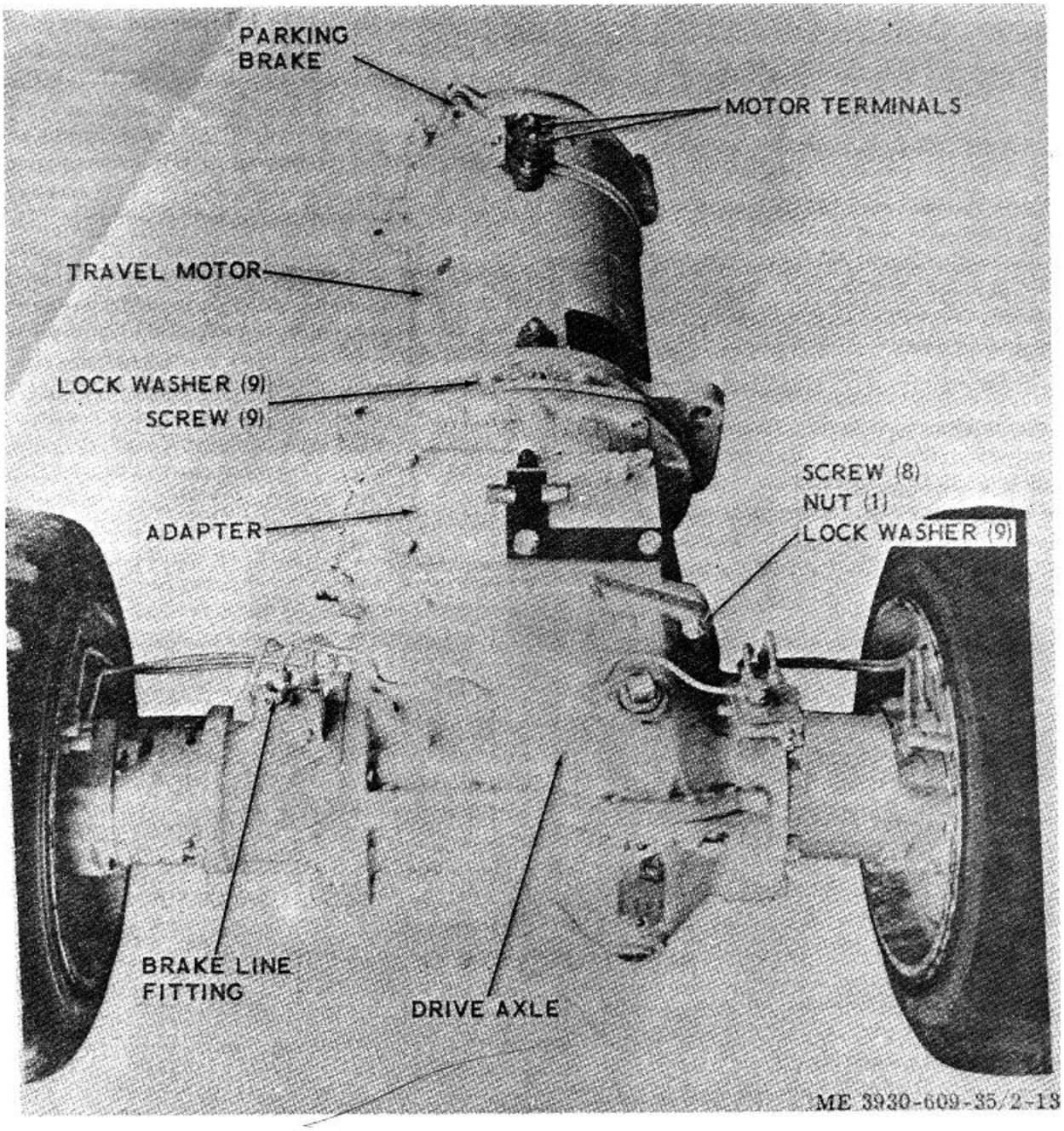

Figure 2-13. Drive axle, adapter and travel motor.

2-22. Hydraulic Pump Motor

a. Removal.

(1) Remove truck floor plate (TM 10-3930-609-12).

(2) Remove two screws (fig. 2-10) and lockwashers securing hydraulic pump to hydraulic pump motor.

(3) Remove protective cover and static straps from bottom of truck exposing hydraulic pump motor and drive motor by removing attaching screws, nuts and lockwashers.

(4) Slide protective rubber elbows (fig. 2-12) up electrical leads and disconnect leads from motor terminals.

(5) Remove screw and lockwasher securing thermal relay to motor housing.

(6) While supporting motor, remove four screws, nuts and lockwashers securing motor mounting bracket to truck body and remove motor from under truck.

b. Installation.

(1) Working from under truck, position hydraulic pump motor on body and secure motor mounting bracket to body with four screws, nuts and lockwashers.

(2) Connect thermal relay to motor housing with screw and lockwasher.

(3) Secure electrical leads to terminals tagged at removal and push protective rubber elbows over terminals.

(4) Install protective cover and static drag straps.

(5) Connect hydraulic pump (fig. 2-10) to hydraulic pump motor with two screws and lockwashers, making certain coupling halves properly engage.

(6) Install truck floorplate (TM 10-3930-609-12).

2-23. Steering Axle

a. Removal.

(1) Tilt mast back. Lift rear of truck high enough to provide enough space in which to work. Block truck so it cannot fall after being raised.

(2) Disconnect draglink from steering axle bellcrank (TM 10-3930-609-12).

(3) If rear axle is raised from ground, support it against falling when attaching parts are removed. Remove four screws (fig. 2-12) and lockwashers from retainer bar and remove retainer bar.

(4) Lower axle, or hoist truck, to get clearance and roll axle from beneath truck.

b. Installation.

(1) Roll axle under jacked up truck and jack up axle until axle blocks enter recesses in truck body.

(2) Install retainer bar on truck body to secure steering axle in position and secure retainer bar with four screws and lockwashers.

(3) Connect draglink to steering axle bellcrank (TM 10-3930-609-12).

(4) Remove axle support and lower truck to floor.

(5) Adjust tierods and steering linkage as required (TM 10-3930-609-12).

2-24. Drive Axle, Adapter and Travel Motor

a. Removal.

(1) Remove entire mast assembly, including carriage, forks, and lift cylinder as a unit (para 2-16a).

(2) Disconnect and remove brake line from master cylinder at fitting (fig. 2-18) on drive axle (TM 10-38980-609-12). Protect line against kinking, or entry of dirt while disconnected.

(3) Remove floor plate (TM 10-3930-609-12) and remove thermal relay from travel motor. Remove horn attached to adapter. Disconnect rod and cable at brake (fig. 2-12) on rear of motor. Drain lubricant from axle and adapter (LO 10-3930-609-12).

(4) Remove protective cover from under truck. Support motor from below with wheeled dolly, or floor jack. Disconnect and tag four leads from terminals of travel motor.

(5) Disconnect hydraulic tee fitting from adapter by removing attaching screw and lockwasher.

(6) Remove screws, nuts and washers securing motor to mounting bracket. Remove screws, lockwashers and bearing brackets securing axle to frame. Lift front end of truck from axle, and draw axle, adapter and travel motor from under truck.

(7) Remove screws, lockwashers and nut (fig. 2-13) attaching adapter to axle and take motor and adapter, as a unit, from axle.

(8) Remove screws and lockwashers attaching adapter to motor, and draw motor from adapter.

b. Installation.

(1) Place gasket between travel motor and adapter, aline holes and secure motor to adapter (fig. 2-13) with screws and lockwashers.

(2) Place gasket between drive axle and adapter, aline holes and gears and secure with screws, nut and lockwashers.

(3) Position drive unit on a wheeled dolly and roll unit under raised front end of truck. Lower front end of truck until axle alines with bearing bracket halves on frame (fig. 2-12) and travel motor mounting flange holes aline with holes in mounting brackets. Secure axle with bearing brackets, screws and lockwashers and travel motor with screws, nuts and washers.

(4) Secure hydraulic tee fitting (fig. 2-9) to adapter with screw and lockwasher.

(5) Attach tagged electrical leads to travel motor terminals. Secure protective cover to underside of truck.

(6) Lubricate drive axle and adapter (LO 10-3930-609-12). Connect rod and cable at brake (fig. 2-12) on rear of motor. Install thermal relay

on travel motor. Attach horn to adapter. Replace floor plate (TM 10-3930-609-12).

(7) Connect master cylinder brakeline at brakeline fitting (fig. 2-13) on drive axle.

(8) Install mast assembly on truck (para 2-16b).

2-25. Fuse Holder

a. Removal.

(1) Remove cover from control panel compartment (TM 10-3930-609-12).

(2) Disconnect positive battery jumper from bus bar at right side of fuse holder (fig. 2-14).

(3) Disconnect lead 86 from fuse FU5 terminal, disconnect lead 83 from fuse FU4 terminal, disconnect lead 78 from fuse FU2 terminal, and disconnect leads 69-1 and 69-2 from fuse FU1 terminal.

(4) Remove screws which secure fuse holder to fuse panel; then, withdraw fuse holder.

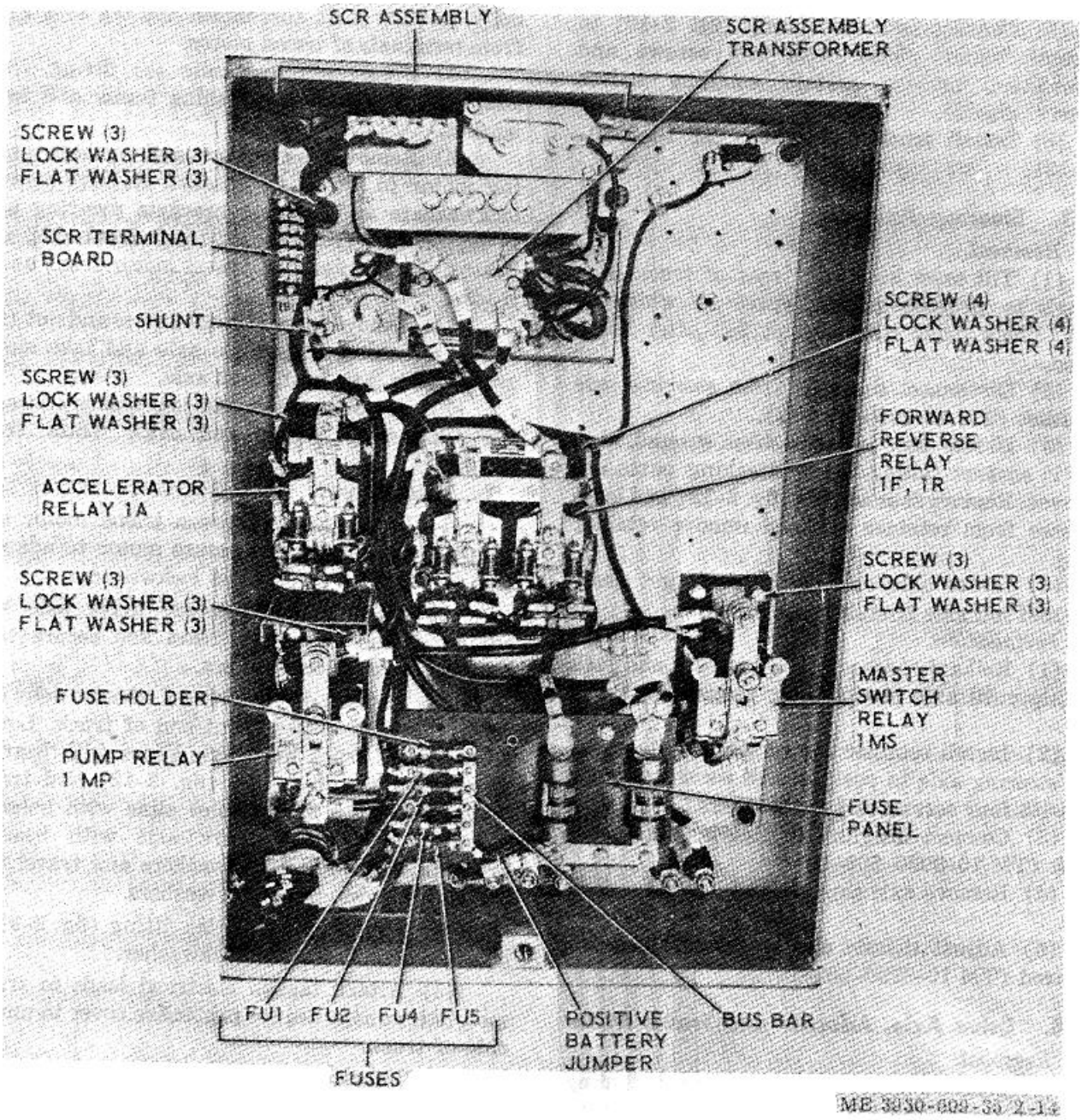

Figure 2-14. Parts location on control panel.

b. Installation.

(1) Aline mounting holes in fuse holder with holes in fuse panel and secure fuse holder with screws.

(2) Reconnect leads (disconnected during disassembly) to screw-type fuse terminals.

(3) Reconnect battery jumper to bus bar on right side of fuse holder.

(4) Reinstall cover (TM 10-3930-609-12).

2-26. Pump Relay

a. Removal.

(1) Remove cover from control panel compartment (TM 10-3930-609-12).

(2) Remove capscrews, flatwashers, and lockwashers which secure base of pump relay (fig. 2-14) to mounting panel; then, withdraw relay for access to terminals.

(3) Disconnect leads NEG, MP1-1MS, 13A2, 13A-3 and 13A-4 from contact support on pump relay.

(4) Disconnect lead MP1-A2 from relay frame.

(5) Disconnect leads 13A and 80 from relay coil terminals.

(6) Withdraw pump relay from compartment.

b. Installation.

(1) Connect two 13A leads and lead 80 to screw-type terminals on relay coil.

(2) Connect lead MP1-A2 to relay frame; and, connect leads NEG, MP1-1MS, 13A-2, 13A-8 and 13A-4 to front contact bracket on relay.

(3) Aline mounting holes in relay base with holes in mounting panel, and secure relay in place with three cap screws, lockwashers, and fiat washers.

2-27. Master Switch Relay

a. Removal.

(1) Remove cover from control panel compartment (TM 10-3930-609-12).

(2) Remove capscrews, lockwashers, and flatwashers which secure base of master switch relay to mounting panel (fig. 2-14); then withdraw relay from mounting panel for access to terminals.

(3) Disconnect lead MP1-LMS from stationary contact support, disconnect lead 91 from relay coil terminal, and disconnect lead NEG from moving contact support.

(4) Withdraw master switch relay from compartment.

b. Installation.

(1) Connect lead NEG to moving contact support on master switch relay, being sure to include lug of coil lead at same terminal.

(2) Connect lead 91 to other coil terminal.

(3) Connect lead MP1-1MS to stationary contact support.

(4) Aline mounting holes in base of relay with tapped holes in mounting panel; and, secure relay to panel with three capscrews, lockwashers, and flatwashers.

(5) Reinstall cover on control panel compartment (TM 10-3930-609-12).

2-28. Accelerator Relay

a. Removal.

(1) Remove cover from control panel compartment (TM 10-3930-609-12).

(2) Remove capscrews, lockwashers and flatwashers which secure base of accelerator relay to mounting panel (fig. 2-14). Withdraw relay slightly from panel for access to terminals.

(3) Disconnect leads 77 and leads 41 from relay coil terminals.

(4) Disconnect leads NEG from relay moving contact support.

(5) Disconnect leads T2 and T2-1 from stationary contact support.

(6) Disconnect leads 45 from terminal B on relay interlock switch.

(7) Withdraw accelerator relay from compartment.

b. Installation.

(1) Connect two leads 45 to terminal B on accelerator relay interlock switch.

(2) Connect leads T2 and T2-1 to stationary contact bracket on relay.

(3) Connect two NEG leads to moving contact bracket on relay.

(4) Connect two leads 77 to one coil terminal and connect two leads 41 (one lead 41 is also connected to the interlock switch) to the other coil terminal.

(5) Aline holes in base of relay with tapped holes in mounting panel; and, secure relay to panel with three cap screws, lockwashers and flatwashers.

(6) Reinstall cover on control panel compartment (TM 10-3930-609-12).

2-29. Forward and Reverse Relay

a. Removal.

(1) Remove cover from control panel com-

partment (TM 10-3930-609-12).

(2) Remove machine screws, lockwashers and flatwashers which secure forward and reverse relay to mounting panel (fig. 2-14). Withdraw relay from mounting panel slightly for access to terminals.

(3) Disconnect two leads 18A from forward control coil (left hand coil).

(4) Disconnect two A2 leads from bus connecting two lower contact supports.

(5) Disconnect lead T2 from upper contact support.

(6) Disconnect leads F2 and F8 from relay busses.

(7) Disconnect two leads 77 and lead 74-from left hand interlock switch; and, disconnect lead 72 from right hand interlock switch.

(8) Withdraw relay from control panel compartment.

b. Installation.

(1) Connect lead 72 to terminal A on right hand interlock switch; connect lead 74 to terminal A on left hand interlock switch; and, connect two leads 77 to terminal B on left hand interlock switch.

(2) Connect leads F2 and F8 to relay busses.

(3) Connect lead T2 to left side of upper contact support.

(4) Connect two leads A2 to bus. connecting two lower contact supports.

(5) Connect two leads 13A to terminal on forward control coil (left hand coil).

(6) Aline holes in relay base with tapped holes in mounting panel and secure relay to panel with three machine screws, lockwashers and flat washers.

(7) Reinstall cover on control panel compartment (TM 10-3930-609-12).

2-30. SCR Assembly

a. Removal.

(1) Remove cover from control panel compartment (TM 10-3930-609-12).

Note

When disconnecting leads from terminals at which two or more leads terminate, replace the screw and the leads not requiring disconnecting immediately after removing the required lead.

(2) Disconnect leads A2, T2-1, and NEG from terminals A2, T2 and NEG on SCR assembly transformer (fig. 2-14).

(3) Disconnect lead A1 from shunt on SCR assembly.

(4) Remove three capscrews, lockwashers and flat-washers which secure SCR assembly to mounting panel. Withdraw SCR assembly slightly for access to terminal board on left hand side.

(5) Disconnect leads 49, 33, 45, 41 and 29A from terminal board.

(6) Withdraw SCR assembly from control panel compartment.

b. Installation.

(1) Connect control panel leads 29A, 41, 45, 83 and 49 to SCR assembly terminal board terminals 2, 3, 4, 5, and 6 respectively.

(2) Aline three slots in base of SCR assembly with tapped holes in mounting panel and secure SCR assembly to panel with three capscrews, lockwashers and flatwashers.

(3) connect leads NEG, T2-1 and A2 to SCR assembly transformer terminals NEG, T2 and A2 respectively.

(4) Connect lead Al to shunt on SCR assembly.

(5) Reinstall cover on control panel compartment (TM 10-3930-609-12).

CHAPTER 3

REPAIR INSTRUCTIONS

Section I. REPLACEMENT OF WIRING HARNESS

3-1. General

Removal of the wiring harness is not ordinarily required during overhaul of the truck. Usually, repair of the harness can be accomplished with the harness in place. However, if repair is required in an inaccessible place, the harness may be removed from the truck and reinstalled as described in paragraphs 3-2 and 3-3.

3-2. Removal of Wiring Harness

a. Release handle on battery connector and disengage battery connector.

b. Remove floor plate- (TM 10-3930-609-12).

c. Remove valve cover (TM 10-3930-609-12).

d. Remove four screws, nuts, and flatwashers which secure cover to bottom of truck frame below battery compartment and withdraw cover.

e. Disengage terminals on harness leads 99 and 13A-2 from terminals on wires extending from headlight flexible conduit.

f. Remove two terminal covers from steering column and disconnect harness lead 83 and 84 from screw-type horn button terminals.

g. Disengage plug on harness (containing leads 33, 69-3, 71, 72, and 74) from receptacle on cable extending from direction control switch.

h. Disengage harness terminals on leads 92 and 93 from push-on terminals of panic switch.

i. Disengage harness terminals on leads 13A-4 and 82 from push-on terminals on hourmeter.

j. Disconnect harness leads 19, 86-1, 86-2, and 99 from screw-type terminals on light switch.

k. Disengage plug on wiring harness (containing leads 13A-3, 29A, 45, 49, 69-2, 69-3, 70, and 71) from recptacle on cable extending from accelerator master switch.

I. Disengage plug on wiring harness (containing leads 35, 70, 86-1, and 94) from plug on cable extending from brake and stoplight switch.

m. Disconnect wiring harness leads 13A-1 and 84 from screw-type terminals on horn.

n. Disconnect wiring harness leads 91 and 92 from screw-type terminals on seat switch.

o. Disconnect wiring harness leads 78 and 98 from screw-type terminals on pump switch.

p. Disconnect wiring harness leads 69-1, 69-4, and 93 from screwtype terminals on battery connecting switch.

q. Remove three clamps which secure thermal relays to hydraulic oil tank, to travel motor frame, and to pump motor frame. After disengaging thermal relays, replace clamps to prevent loss of parts.

r. Starting at front of truck, remove all clamps and clips which secure wiring harness branches and main trunk to structural members. After disengaging harness from clamps and clips, reattach clamps and clips to prevent loss of parts.

s. Remove control panel cover (TM 10-3930-609-12).

t. Disengage two plugs on wiring harness from receptacles connected to internal wiring of control panel.

u. Unscrew conduit fitting (through which wiring harness passes) from front wall of control panel compartment. Fitting is located in lower left hand corner of control panel compartment.

v. Carefully withdraw wiring- harness from control panel compartment. Straighten out branches in harness as required and work bulky items through holes and around corners as. required. Avoid undue strain on plugs, terminals, and thermal relays.

3-3. Installing Wiring Harness

Installation of the wiring harness is essentially the reverse of the removal procedure. Plugs are keyed to prevent improper orientation. After securing

harness with clips and clamps, assure that sufficient clearance is maintained between harness and all moving parts. Hand form harness where required to obtain clearance. Apply silicone rubber to exposed screw-type terminals on seat switch, pump motor switch and on brake stoplight switch. Insulate other exposed terminals with vinyl tubing.

Section II. OVERHAUL OF DRIVE AXLE AND ADAPTER

3-4. Description of Adapter and Drive Axle

The adapter provides a gear reduction between the travel motor and pinion and the drive axle pinion gearshaft. The gears are mounted in a gear case with flanges for mounting the travel motor and for mounting to the drive axle differential housing. The travel motor drives a bearing-mounted gear cluster which in turn drives an input driven gear. The pinion gearshaft is spline engaged in the input driven gear.

The drive axle contains a differential gear arrangement which is driven by the adapter pinion gearshaft. The pinion gearshaft engages a ring gear secured to the differential case. The two axle shafts are spline engaged in the two side gears. The two axle housings provide mounting for the front wheel brake assemblies.

3-5. Removal of Adapter

Removal of the adapter is required prior to disassembly. Refer to paragraph 2-24 for removal procedure.

3-6. Removal of Drive Axle

Many parts which comprise the drive axle can be removed without removal of the axle from the truck. However, for general overhaul, remove the axle as described in paragraph 2-24.

3-7. Disassembly of Adapter (fig. 3-1)

a. Remove cover screws and washers. Then remove cover and gasket from case.

b. Remove cotterpin from pinion gearshaft. While holding outer toothed end of gearshaft with a padded wrench, unscrew nut from threaded end of gearshaft.

c. Tap pinion gearshaft forward while holding input driven gear and withdraw gearshaft with front cone and rollers.

d. Lift input driven gear out of case.

e. Remove shims and spacer, rear bearing cup and rear cone and rollers.

f. Remove retaining ring from groove in case.

g. Press front bearing cone and rollers from pinion gearshaft.

h. Remove packing, spacer, and seal from front of case.

i. While holding gear cluster, push out shaft; then, lift out gear cluster (with bearings and spacer) and washers.

j. Remove bearings and spacer from bore in gear cluster.

3-8. Disassembly of Drive Axle (fig. 3-2)

a. Drain lubricant from axle (LO 10-3930-609-12).

b. Remove front wheels (TM 10-3930-609-12).

c. Remove hub cap, cotterpin, nut and hub, and key from outer end of each axle shaft. Use a wheel puller to withdraw hubs from tapered ends of axle shafts.

d. Disconnect brake tubing at adapters, being careful not to dent or kink tubing. Protect ends of tubing to prevent entrance of foreign matter.

e. Remove nuts and washers from studs holding brake assemblies to axle housings and withdraw brake assemblies. Oil seals will be retained in bores of brake assemblies. Remove oil seals.

f. Pull axle shafts out of axle housings; then, remove both bearing cone and rollers and outer bearing cup from each axle shaft.

g. Pull inner bearing cups from recesses in axle housings.

h. Remove screws and washers holding axle housings to differential housing; then, withdraw axle housings and shims.

i. Measure and note thickness of shims removed from each side of differential housing for reference at reassembly and adjustment.

j. Remove screws and nuts holding differential housing halves together, then separate halves, removing differential assembly, differential case bearings, and gaskets.

k. If no match marks are visible on differential case halves, lightly match mark parts with a punch or chisel before proceeding.

l. Remove screws which secure case halves together; then, separate case halves, removing side gears, thrust washers, spider pinions and cross.

m. Remove screws which secure ring gear to differential case half and withdraw ring gear.

n. Use a bearing puller to remove cones and rollers from differential case halves.

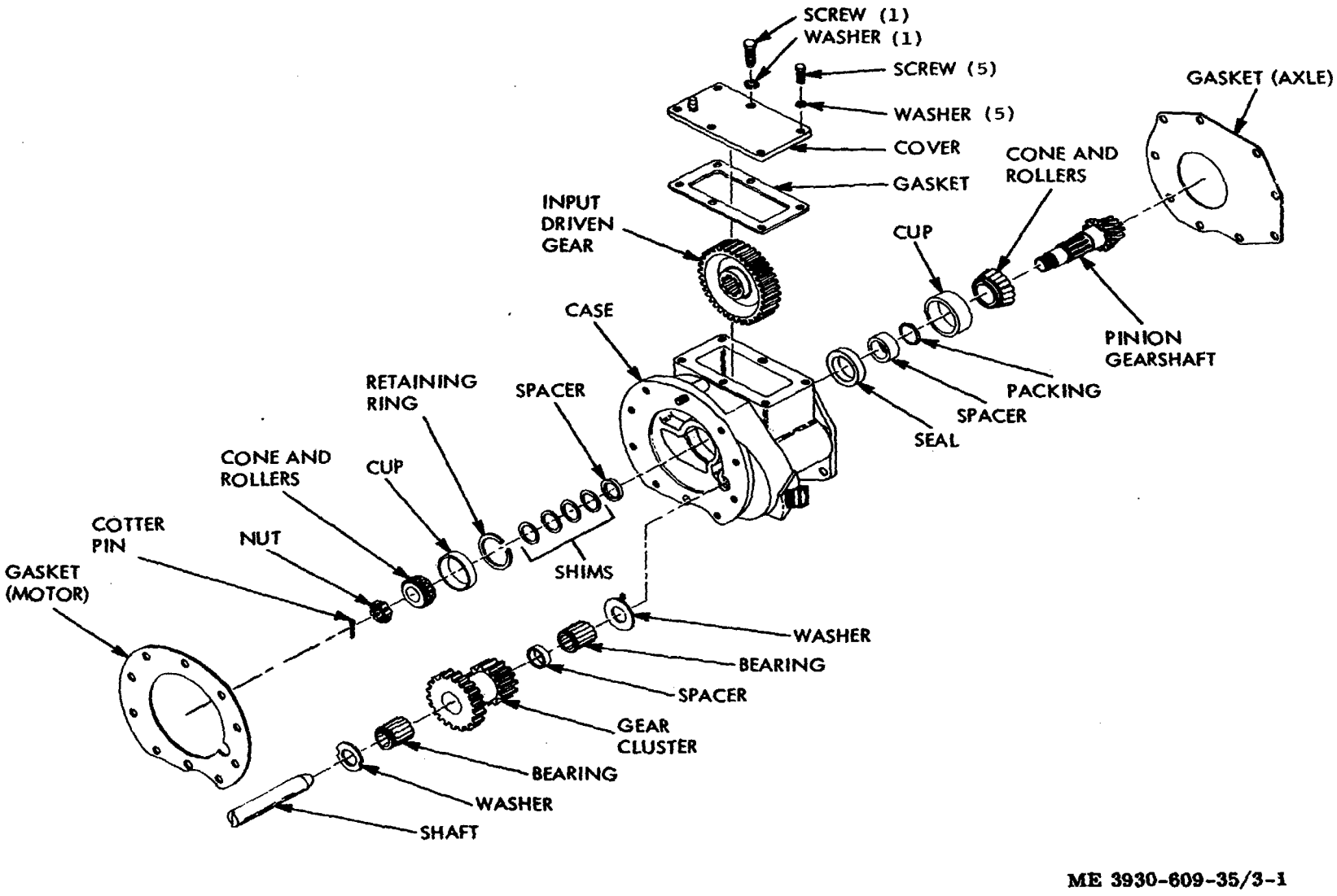

Figure 3-1. Adapter, exploded view.

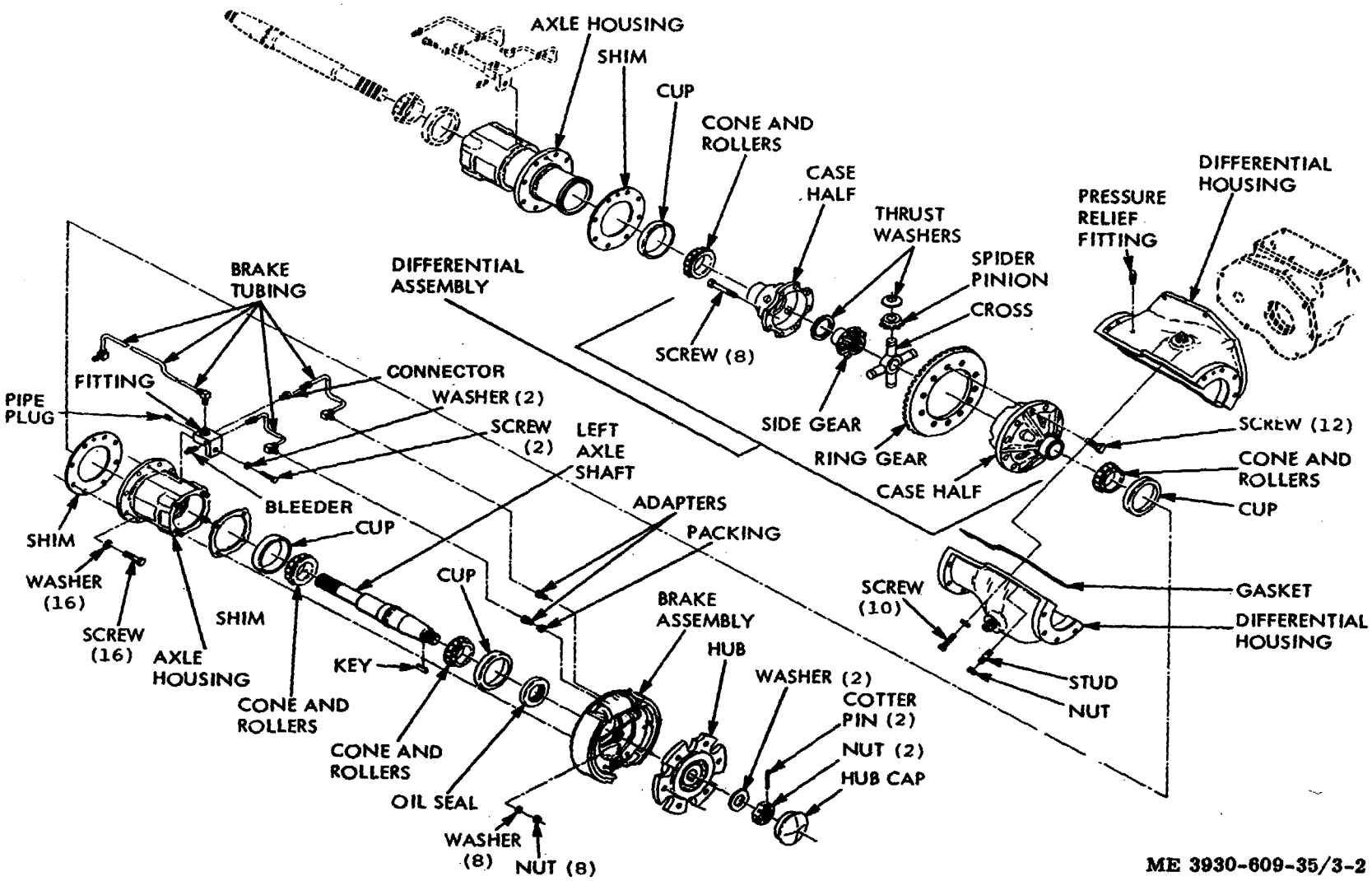

Figure 3-2. Drive axle, exploded view.

3-9. Cleaning Disassembled Parts of Adapter and Drive Axle

a. Clean all housings, shafts, gears and shims with SD and dry with compressed air under moderate pressure. Be sure to clean parts thoroughly to facilitate inspection.

b. Clean brake assemblies with compressed air under moderate pressure.

c. Clean bearing cups and cones and rollers in SD. Do not rotate cones and rollers prior to cleaning. Dry parts with compressed air under moderate pressure.

3-10. Inspecting Parts Removed from Adapter and Drive Axle

a. Inspect all bearings for roughness, pitting of rollers, cones, and cups, cracked cones or cups. To inspect for roughness, place cones and rollers in associated cups and rotate cups slowly with axis of bearing vertical. If roughness is detected, check for metallic chips or other foreign matter between cones and rollers.

b. Inspect all threaded parts and tapped holes for stripping or other damage.

c. Check axle shafts for runout in excess of 0.010 inch total indicator reading.

d. Inspect bearing mounting surfaces on axle shafts, on differential case halves and on pinion gearshaft for wear as a result of bearing failure. Also check bearing cone bores in adapter case, in axle housings and in differential housing for wear as a result of bearing failure e. Inspect all gears and pinions for worn, chipped or rough teeth.

f. Inspect adapter case, axle housings, differential housing and differential case halves for cracks and distortion.

g. Inspect bearing surfaces on cross and bearing bores in spider pinions for scoring and for wear resulting in loose fit.

3-11. Repair of Adapter and Drive Axle Parts

a. Repair slight thread damage with tap or thread chaser. Repair stripped threads in castings by installing thread inserts.

b. Repair slight axle shaft runout by pressing or hammering to bring runout within limits of 0.010 inch total indicater reading.

3-12. Replacement of Adapter and Drive Axle Parts

a. Replace all damaged, worn or defective parts that cannot be made serviceable by applying procedures in paragraph 3-11.

b. Replace all seals with new parts at each overhaul.

c. Always replace thrust washers in sets only.

3-13. Reassembly of Adapter (fig. 3-1)

a. Place spacer and both needle roller bearings in bore of gear cluster.

b. Insert tapered end of shaft into case just far enough to retain washer on end of shaft.

c. Place washer on end of shaft.

d. Aline gear cluster with shaft and push shaft through bearings in gear cluster.

e. As shaft emerges from gear cluster, place front washer on shaft, then position shaft to full depth in case.

Note

With case mounted on drive axle and with travel motor mounted on case, shaft is retained between flanges. If adapter will not be installed immediately, provide retention for shaft.

f. Press front bearing cone and rollers on pinion gearshaft.

g. Place packing in groove of spacer, enter spacer in seal, and position this assembly in bore of case.

h. Install retaining ring in internal groove in case.

i. Press cup of rear bearing into recess in case as far as retaining ring.

j. Hold input driven gear in position inside case and insert splined end of pinion, gearshaft through gear.

k. Install spacer and shims (same thickness as shims removed during disassembly) on end of pinion gearshaft.

l. Install rear bearing cone and rollers on end of pinion gearshaft and secure with nut and cotterpin.

m. After final adjustment, install cover gasket and cover with screws and washers.

3-14. Reassembly of Drive Axle (fig. 3-2)

Note

If differential parts have been replaced, checks and adjustments will be required during assembly to obtain accurate alinement. At assembly, refer to shim thickness noted at disassembly and install same thickness of shims to provide a starting point from which to make adjustments. If no new differential parts are being used, the original thickness of shims should restore axle to original adjustment.

a. Assemble ring gear to differential case half with screws and secure screws with lockwire.

b. Place thrust washers and side gears in case halves.

c. Place spider pinions and thrust washers on cross and insert into either case half.

d. With match marks alined, assemble case halves together and secure with screws. Lockwire screws.

e. Press bearing cones and rollers onto trunnions of case halves, assuring that cones bottom against case shoulders.

f. Place bearing cups on cones and rollers and aline differential in half of differential housing.

Aline second half of differential housing (including gasket between halves) and secure with screws and nuts.

g. Install axle housings on differential housing, including shims. Secure axle housings with screws and washers.

h. Check and if necessary adjust differential bearing preload as follows:

Note
Ring gear and pinion backlash adjustment and tooth contact adjustment are interrelated so that a change in either affects the other.

(1) Install both axle housings with same thickness of shims at each side as was removed at disassembly.

(2) Turn ring gear by hand, testing for noticeable drag due to preload on bearings. If no drag exists, reverse procedure in (1) above and remove shims and repeat test until drag is noticed. Shims 0.003 inch thick, 0.005 inch thick, and 0.020 inch thick are used. Decrease total shim thickness in 0.001 inch steps by removing two 0.003 inch shims and adding one 0.005 inch shim.

(3) If drag is noticeable on first trial, reverse procedure for decreasing shim thickness in (2) above until no drag is present, then decrease total shim thickness until drag is felt. Using axle shaft and nut as adapter, check for 15 ft-lb drag caused by preload. Add or remove shims to obtain this value.

i. Check pinion and ring gear backlash adjustment as follows:

(1) Install adapter-to-axle gasket and install adapter assembly to assembled axle. If motor is attached to adapter, remove screws, nut and washer and remove motor from adapter at this time.

(2) Remove drain plug from differential housing. Install plug with slightly longer reach to contact and lock ring gear rotation.

(3) Remove cover screws and cover from adapter. Install a dial indicator on adapter cover boss, to take a reading at a point 1/16 inch below top of one of the teeth of input gear. Rotate input driven gear through freedom permitted by pinion and ring gear backlash. Reading is to be 0.019 inch to 0.046 inch. Adjustment to correct is given in j below.

j. Determine and adjust ring gear and pinion relationship, after performing g and h above, as follows:

Note
Several adjustments of both pinion and ring gear position may be necessary in the following procedures before correct adjustment is achieved. It is not possible to specify the exact thickness of shims to be added, - removed, or exchanged at any stage. This must be determined by trial and error.

(1) Remove adapter assembly. Apply a thin coating of red lead to drive face of ring gear teeth, and install adapter to axle.

(2) Engage input driven gear with a pry bar or large screwdriver, and turn it until side gears have made one revolution in the forward direction.

(3) Remove adapter assembly from axle. Examine teeth of ring gear, and compare marks in red lead from pinion gear contact with examples shown in figure 3-3.

Note
Ring gear is on left side of pinion when installed. References to follow will be on this basis.

(4) If marks in red lead compare with those shown in view A or C, figure 3-3, indicating high, narrow tooth contact (pinion too far out), adjust by adding one or more shims to the pinion gear shaft to move pinion in direction indicated in view A, and transfer one or more axle housing-to-differential housing shims from- left side of differential housing to right side.: Repeat procedures in (1) through (3) above to check results of adjustment.

Note
Do not change total thickness of side gaskets used; merely transfer them from one side to the other as needed, so differential bearing preload will not be changed.

(5) If marks in red lead compare with those in view B or D, figure 3-3, reverse adjustment procedure given in (4) above, and repeat (1) through (3) above to check results of adjustment.

k. Press inner axle bearing cups into axle housing to bottom (fig. 3-2).

I. Press both axle shaft bearing cones and rollers onto each axle shaft.

m. Insert axle shafts splined ends through axle housings and engage in splined bores of side gears. With axle shafts in proper alinement, insert cone and rollers on axle shafts will be seated in bearing cups previously pressed into axle housings.

n. Install outer bearing cups.

o. Install oil seals in brake assemblies.

p. Install brake assemblies on axle housings with nuts and washers, including shims as required to obtain 0.000 inch to 0.006 inch preload to axle

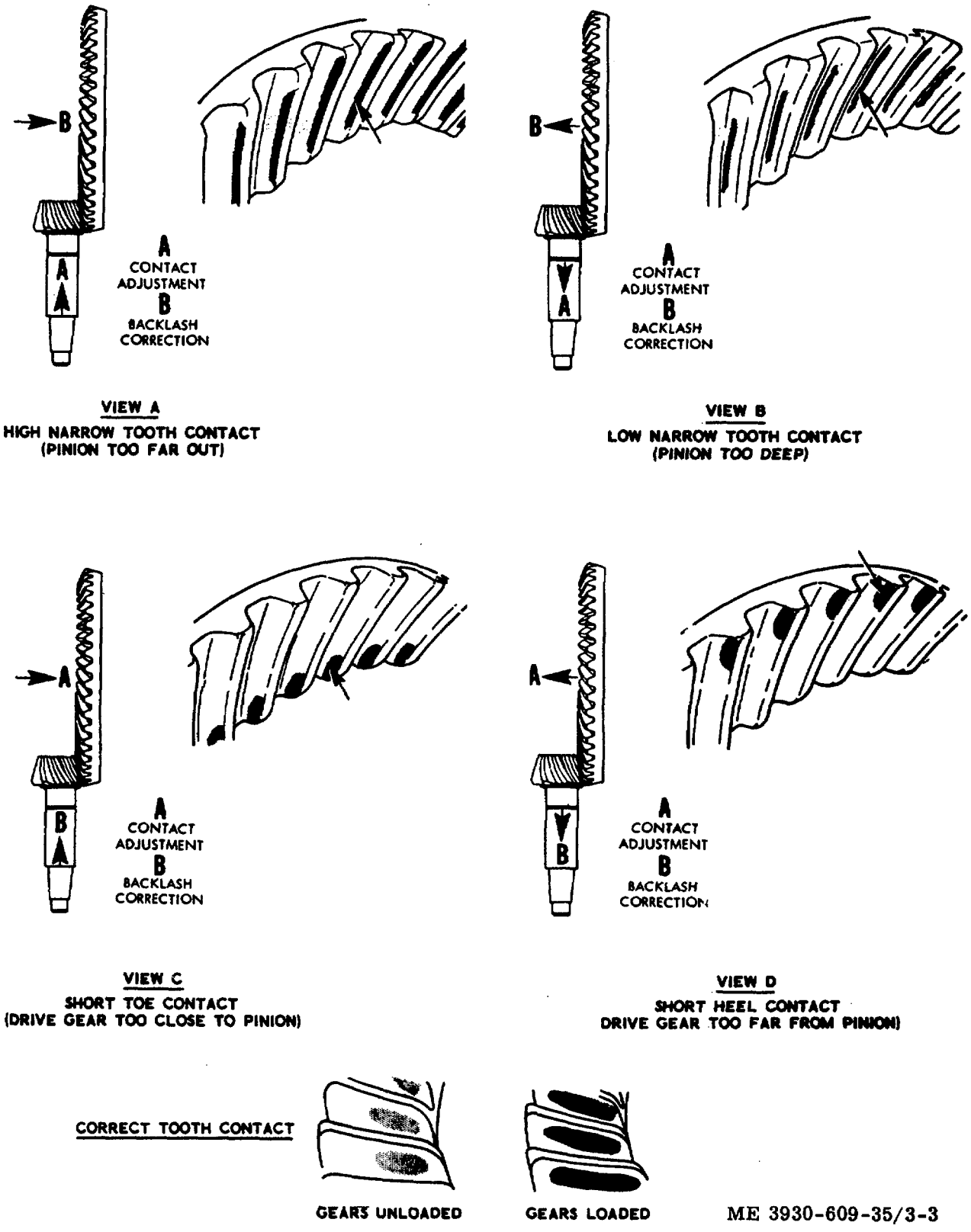

Figure 3-3. Ring and pinion gear tooth contact indications.

for axle shaft endplay with a dial indicator. If no endplay is indicated, add shims until endplay can be measured; then, remove shims to obtain required bearing preloading.

q. Install brake tubing between fitting on axle housing and adapter on brake assembly at each end of drive axle.

r. Install hubs on axle shafts, using keys. Secure hubs with washers and nuts. Tighten nuts securely and insert cotter pins through ends of axle shafts.

s. Install hub caps.

t. Install front wheels (TM 10-3930-609-12).

u. Lubricate drive axle and adapter after reinstallation on truck (LO 10-3930-609-12).

Section III. OVERHAUL OF STEERING AXLE

3-15. Description of Steering Axle (fig. 3-4)

The steering axle comprises a forged axle, two steering arms (to which the rear truck wheels mount), a bellerank and axle mounting blocks. The bellcrank connects to the steering gear by means of a draglink. Conventional tierods connect the bellcrank to the two steering arms.

3-16. Removal of Steering Axle

Overhaul of the steering axle required removal of the axle from the truck. Refer to paragraph 2-23 for removal of steering axle.

3-17. Disassembly of Steering Axle (fig. 3-4)

a. Remove two neoprene axle blocks from trunnions on axle.

b. Remove rear wheels (TM 10-3930-609-12).

c. Remove cotterpins and nut from outer ends of tierods, and disengage tierod end from steering arms and bellcrank.

d. Remove retaining ring which secures bellcrank to axle; then, remove washer and lift bellcrank with bearings and lower washer off axle.

e. Press bearings out of bellcrank only if replacement is Tequired.

f. Remove nuts, washers and screws which secure spindle pins; then, drive out spindle pins and remove steering arms from axle.

g. If spindle bearings require replacement, press bearings out of axle.

3-18. Cleaning Parts Removed from Steering Axle

a. Wash all metallic parts in SD and dry with compressed air under moderate pressure. Be sure to clean parts thoroughly to facilitate inspection.

b. Clean neoprene axle blocks with cloth or cotton waste moistened with SD.

3-19. Inspecting Parts Removed from Steering Axle

a. Inspect neoprene axle blocks for cracking, deformation, splitting and deterioration.

b. Inspect threaded parts for stripped or damaged threads.

c. Inspect tierods for damaged ends. Also check that tierods are not bent or deformed.

d. Inspect axle, bellcrank, spindle pins and steering arms for cracks and distortion.

e. Inspect bearings in bellcrank and bearings in steering arms and bearings in axle forging for wear.

3-20. Repair and Replacement of Parts Removed from Steering Axle

a. If practicable, repair damaged threads with a tap or thread chaser.

b. Replace all parts that are cracked, worn, distorted or deteriorated.

3-21. Reassembly of Steering Axle

a. Install spindle bearings in axle forging; then, pack spindle bearings with grease, GAA (LO 10-3930-609-12).

b. Position steering arms in yokes of axle and insert spindle pins. Secure spindle pins with screws, washers and nuts.

c. Press bearings into bearing hole in bellcrank.

d. Place washer on trunnion of axle, then, install bellcrank on trunnion. Secure bellcrank with washer and retaining ring.

e. Lubricate bellcrank with grease, GAA, using lubrication fitting in bellcrank (LO 10-3980-609-12).

f. Insert ends of tierods into steering arms and bellcrank and secure tierod ends with nuts. Secure nuts with cotterpins.

g. Place axle blocks on axle trunnions.

h. Install rear wheels (TM 10-3930-609-12).

3-22. Installation and Adjustment of Steering Axle

Install steering axle as described in paragraph 2-23. After installation, adjust tierods (TM 10-3930-609-12).

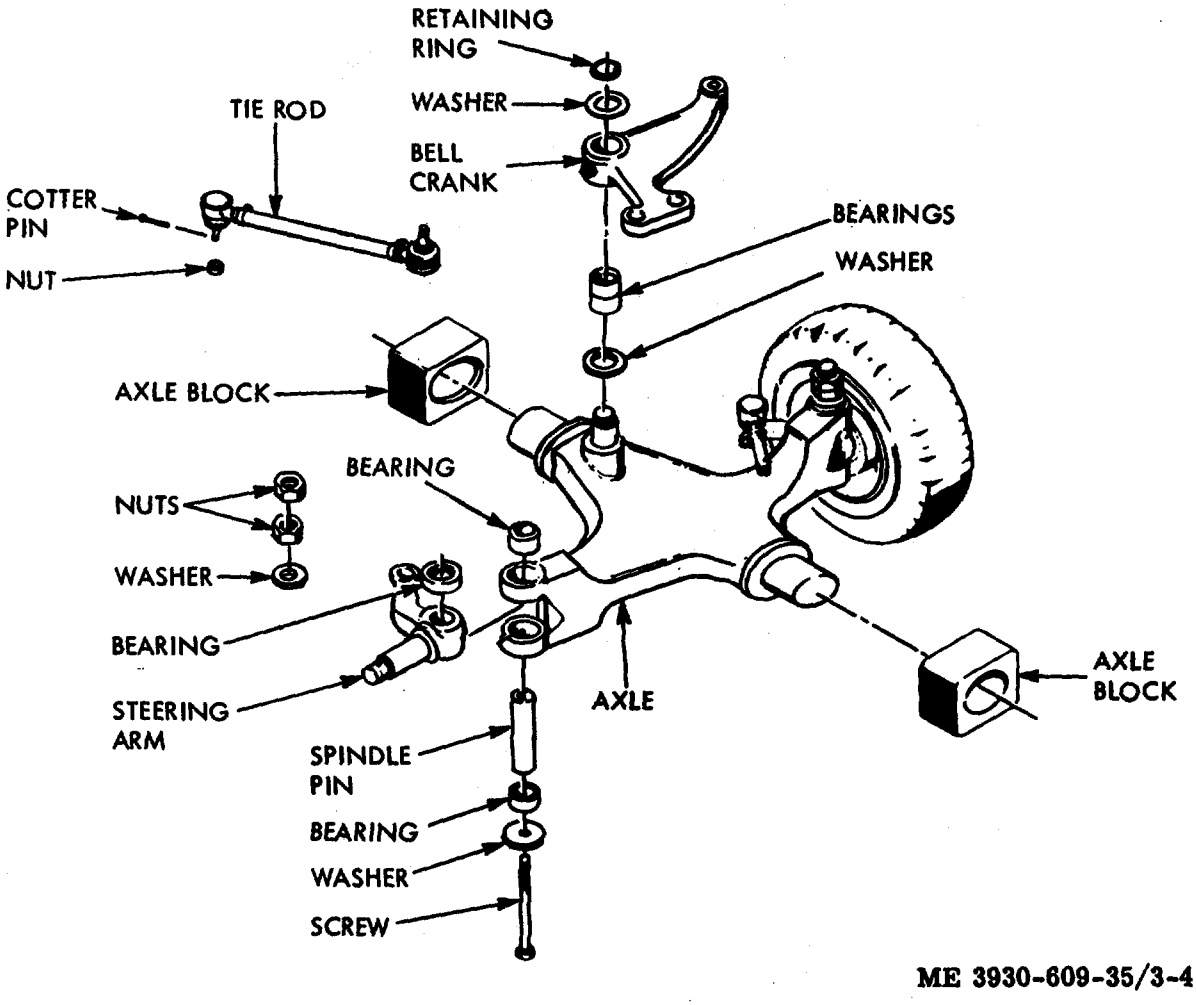

Figure 3-4. Steering axle, exploded view.

Section IV. REMOVAL AND REPAIR OF BRAKE SYSTEMS

3-23. Description of Brake Systems

Two brake systems are used on the fork lift truck, the hand-motor brake system and the service brake system. The hand-motor brake system incorporates a hand brake lever and a mechanical seat linkage to apply brakeshoes to a brake drum attached to the travel motor armature shaft. This braking system is applied automatically when the operator leaves the seat and may be applied by the operator by means of the brake lever. The service brake system is a conventional automotive type wheel brake system incorporating a brake pedal, master cylinder, wheel cylinders at the front wheels, and brakeshoes.

3-24. Removal of Motor Brakeshoes and Drum (fig. 3-5).

a. Remove floor plate for access to motor brakeshoes and drum (TM 10-3930-609-12).

b. Disconnect control linkage from link (TM 10-3930-609-12).

c. Remove cotterpin from linkpin and remove linkpin.

d. Remove cotterpin from anchor pin; then, remove anchor pin and link.

e. Remove self-locking nut from rod; then, remove rod and two compression springb.

f. Remove nut and washer from stud; then, withdraw brakeshoes from stud.

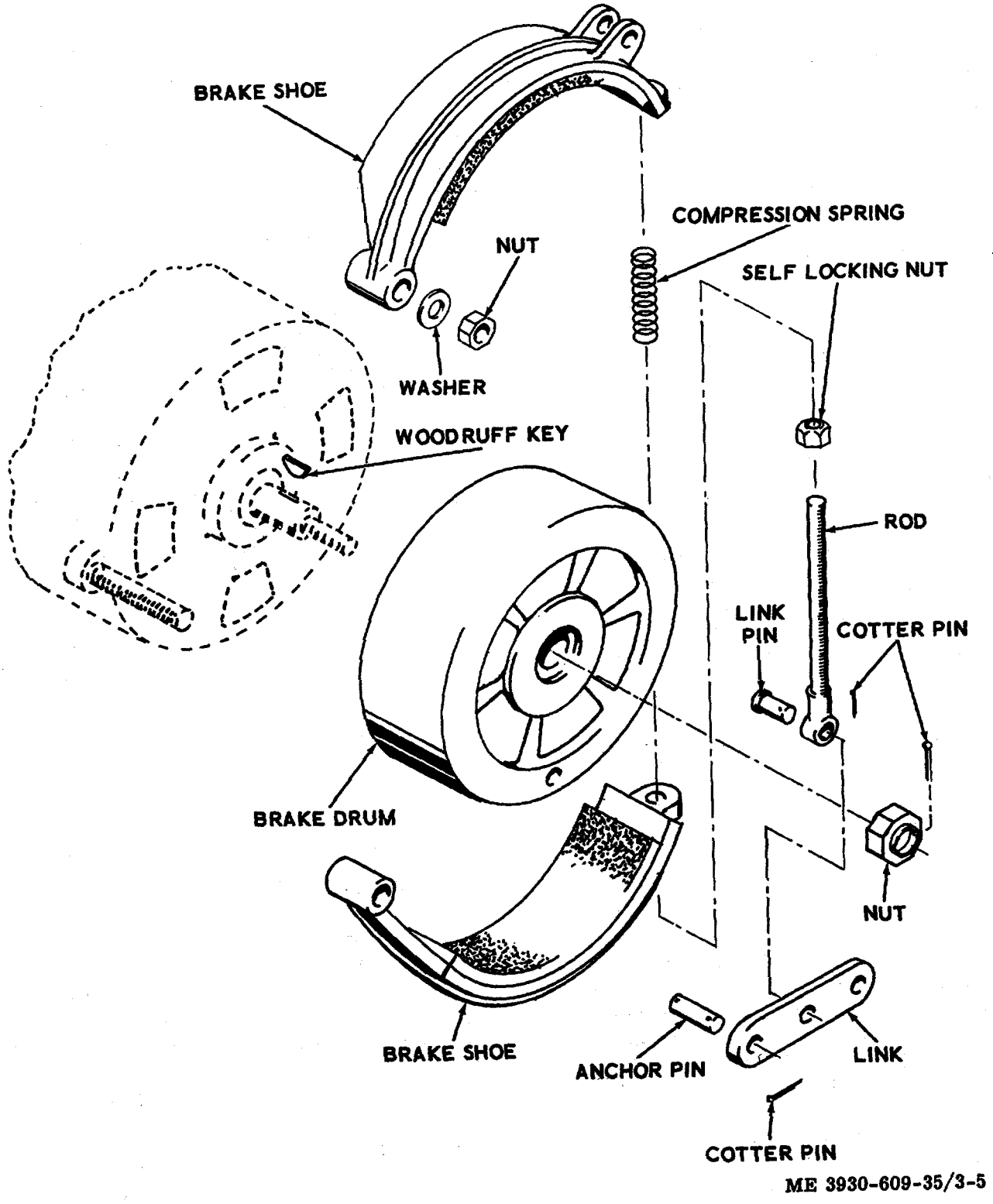

Figure 3-5. Motor brake shoes and drum.

g. Press bushings out of brakeshoes: only if bushings are worn and require replacement.

h. Remove cotterpin and nut from end of travel motor shaft; then, withdraw brake drum and woodruff key from motor shaft.

3-25. Repair and Replacement of Motor Brake Parts

Repair of motor brake parts is limited to removal and replacement of bushings in brakeshoes. Press bushings out of shoes and install new bushings. Replace brakeshoes. If brake linings are worn to less than 1/16 inch at any point, replace brakeshoes. Replace brakedrum if scored, corroded or pitted. Replace any other parts that are distorted or excessively worn.

3-26. Reinstallation of Motor Brakeshoes and Drum (fig. 3-5)

a. Place motor brake drum with woodruff key on motor shaft and secure with nut and cotterpin.

b. Place brakeshoes on mounting stud and secure with washer and nut.

c. Place compression springs between ends of brakeshoes; then, insert rod cup through brakeshoes and springs. Secure rod in place with self.locking nut.

d. Secure link between lugs on lower brakeshoe with anchor pin. Insert cotterpin through end of anchor pin to secure anchor pin.

e. Insert linkpin through clevis on rod and through link; then, insert cotterpin through linkpin to secure linkpin.

f. Reconnect control linkage to link (TM 10-3930-609-12).

g. Adjust control linkage (TM 10-3930-609-12).

h. Reinstall floor plate (TM 10-3930-609-12).

3-27. Removal and Disassembly of Service Brakes (fig. 3-6).

a. Remove front wheels from drive axle (TM 10-3930-609-12).

b. Remove wheel hubs (para 3-8).

c. Disconnect both brake tubing from adapters on each wheel cylinder. Use care to prevent kinking or denting tubing and to avoid entrance of foreign matter.

d. Remove nuts and washers securing brake assemblies to axle housings and withdraw brake assemblies and shims.

e. Use brake servicing tools to remove retaining spring and return spring; then, lift off brakeshoes.

f. Remove bolts and washers which secure wheel cylinders to backing plates; then, withdraw wheel cylinders.

Note

If wheel cylinders show evidence of fluid leakage, repair cylinder as described in paragraph 3-32.

g. Remove oil seal from backing plate only if replacement is required.

3-28. Cleaning Service Brake Parts

Remove dust from parts with compressed air and a stiff bristle brush. If brake fluid has leaked onto brakeshoe linings, replace linings as described in paragraph 3-30 and clean other parts with alcohol. If grease from axle has contaminated parts, wash parts (except wheel cylinders) in SD, and replace linings on brakeshoes.

Caution

Do not allow SD to come in contact with rubber parts. SD will cause rubber to swell and rot.

3-29. Inspection of Service Brake Parts

a. Inspect wheel cylinders for evidence of fluid leakage.

b. Inspect linings on brakeshoes for excessive wear.

c. Inspect backing plates for distortion or other damage.

d. Inspect tapped holes and threaded parts for stripping of threads or other thread damage.

3-30. Repair and Replacement of Service Brake Parts

a. If linings on brakeshoes are worn to less than 1/16 inch at the thinnest point, install new bonded linings. Install linings in accordance with good practice and instructions for use of equipment available.

b. Repair minor thread damage (if practicable) with tap or thread chaser.

c. Replace all distorted or damaged parts.

3-31. Assembly and Installation of Service Brakes (fig. 3-6)

a. Install wheel cylinders on backing plates with bolts and washers.

b. Place brakeshoes on backing plate studs and install return springs and retaining springs with brake service tools.

c. Install oil seals in backing plates.

d. Install backing plates on axle housings and secure with nuts and washers, being sure to include same shims removed at disassembly between backing plates and axle housings.

e. Connect brake tubings to adapters in wheel cylinders.

f. Reinstall wheel hubs (para 3-14).

g. Reinstall wheels (TM 10-3930-609-12).

h. Bleed brakelines and adjust brakes (TM 3930-609-12).

3-32. Repair of Wheel. Cylinders

a. Removal. Refer to paragraph 3-27.

b. Disassembly (fig. 3-6).

(1) Remove rubber boots from ends of wheel cylinder.

(2) Remove pistons, cups and spring from wheel cylinder.

c. Cleaning, Inspecting and Repairing Wheel Cylinder Parts.

(1) Clean metal parts in alcohol. Wipe rubber parts with a clean soft lint-free cloth.

(2) Inspect bore in cylinder and pistons for scoring or pitting.

(3) Remove minor pitting or scoring by honing. If piston or cylinder cannot be made serviceable by honing, replace entire wheel cylinder assembly.

(4) Discard parts for which new parts are supplied in wheel cylinder repair kit.

d. Reassembly of Wheel Cylinder (fig. 3-6).

(1) Insert spring, cups, and pistons into bore in wheel cylinder.

(2) Snap boots onto ends of wheel cylinder.

e. Reinstallation of Wheel Cylinder. Refer to paragraph 3-31.

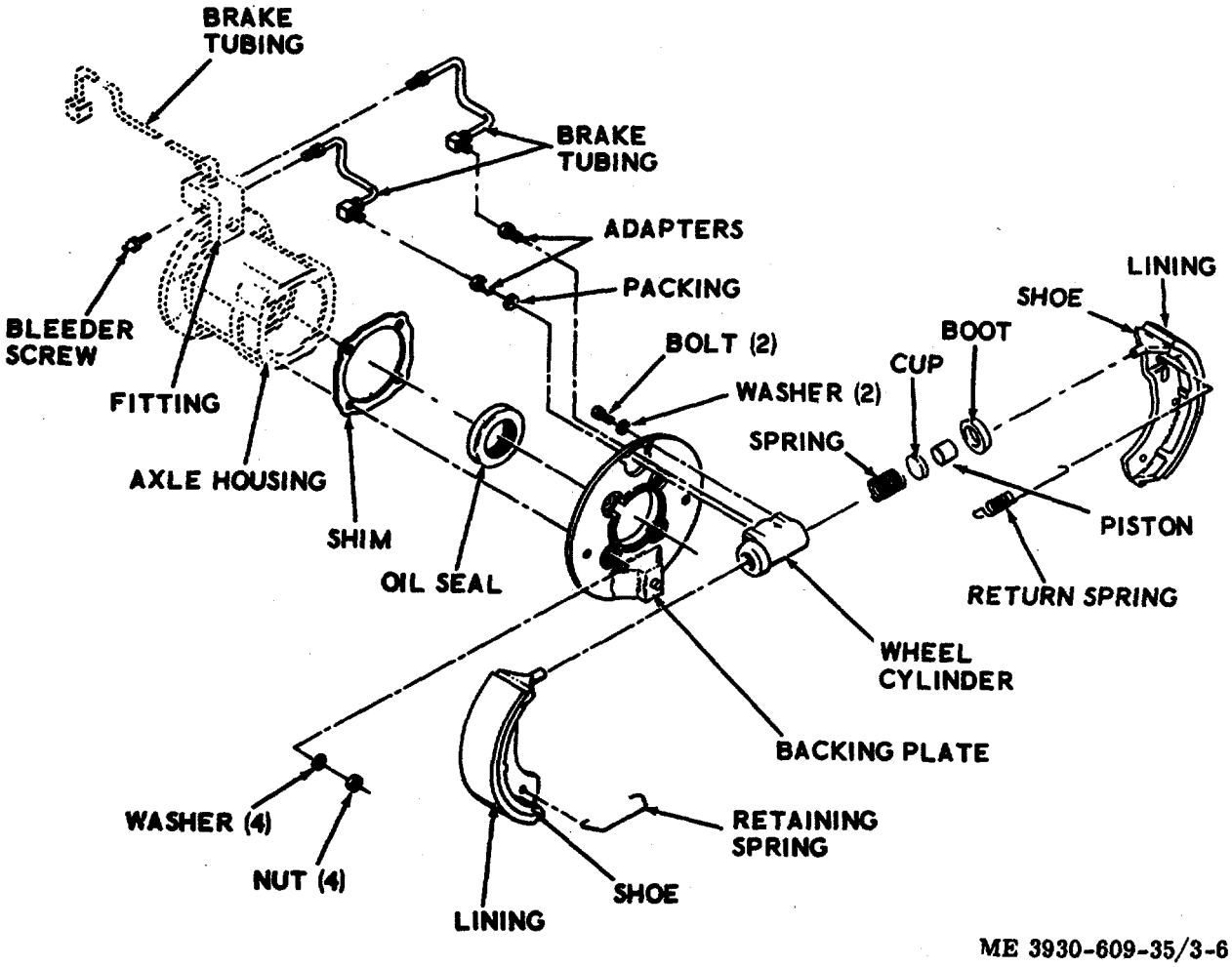

Figure 3-6. Service brakes, exploded view.

3-33. Repair of Master Cylinder (fig. 3-7)

a. Removal. Refer to TM 10-3930-609-12.

b. Disassembly.

(1) Remove cap and gasket from cylinder.

(2) Remove pushrod and boot from cylinder.

(3) Remove retaining ring from internal groove in cylinder and take out plate, piston, cup, spring and check valve.

c. Cleaning, Inspection, Repair and Replacement of Master Cylinder Parts.

(1) Clean all reusable parts with alcohol. Flush reservoir in cylinder thoroughly and ensure that all fluid passages are free of obstructions.

(2) Inspect bore in cylinder for any surface roughness, particularly in the area of piston travel.

(3) Hone cylinder bore to remove minor roughness. If cylinder cannot be made serviceable by this method, replace entire master cylinder.

(4) Replace any parts found to be defective and discard all parts for which replacements are provided in master cylinder repair kit.

d. Reassembly of Master Cylinder (fig. 3-7).

(1) Insert check valve, spring, cup, piston and plate into bore of cylinder and install retaining ring to secure parts.

(2) Snap boot over end of cylinder and install push rod.

(3) Install cap and gasket in cylinder.

e. Installation of Master Cylinder. Refer to TM 10-3930-609-12.

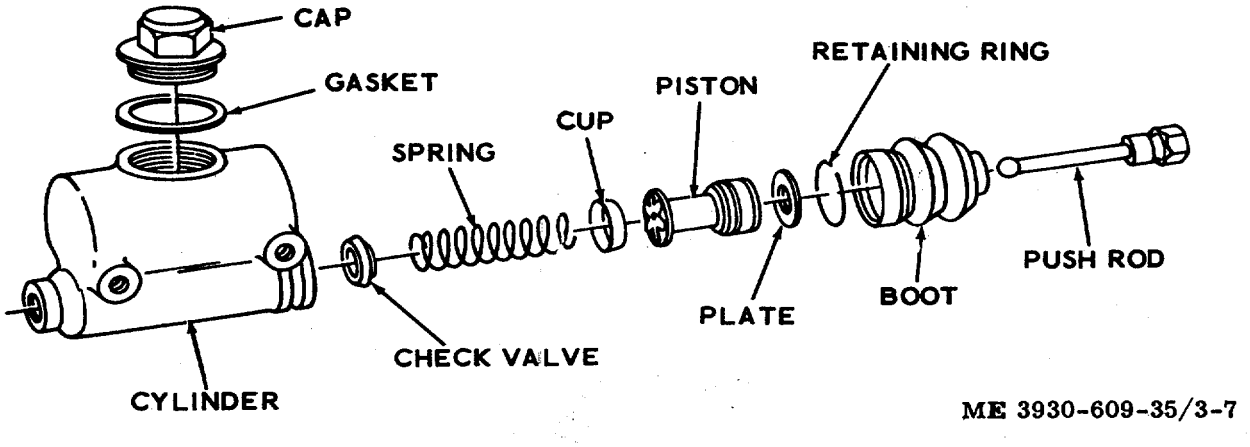

Figure 3-7. Master cylinder, exploded view.

Section V. TIRE REPLACEMENT

3-34. General

Replacement of tires is usually made by pressing off old tire simultaneously with pressing on new tire. Force required to replace a tire is 5,000 pounds for each inch of wheel diameter. For example, a tire used on a wheel 18 inches in diameter requires 18 x 5,000 pounds or 90,000 pounds (45 tons) press capacity.

3-35. Tire Replacement Procedure

a. Remove wheel from truck (TM 10-3930-609-12).

b. As shown in fig. 3-8, support felloe of wheel with a ring slightly smaller in diameter than wheel felloe and at least as wide as tire to be pressed off.

c. Place new tire over old and center carefully.

d. Slowly lower press ram, check alinement, and proceed with pressing operation.

e. Be sure that force is always applied through metal base band and that there is no interference with the rubber. Never hamper tire. Use ring rather than block for supporting wheel and applying force to tire.

Note

In some cases removal of old tire may be difficult due to peened-over condition of base band or felloe. In such cases, remove old tire by burning or cutting through base band. In mounting tires on wheels without old tires, use care to insure that felloes are smooth and free of burrs. Also carefully check alinement to assure that new tire starts on squarely and is not cocked on wheel.

g. Reinstall wheel on truck (TM 10-3930-609-12).

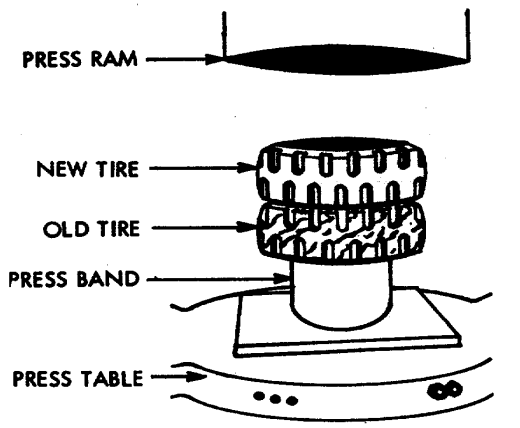

Figure 3-8. Solid rubber tire replacement.

Section VI. STEERING GEAR OVERHAUL

3-36. Description of Steering Gear

The steering gear consists of a worm shaft, ball nut, pitman shaft gear and associated parts mounted in a housing (fig. 3-9). Turning the wormshaft by means of the steering wheel moves the ball nut along the lower end of the wormshaft. Teeth in the wormshaft are engaged with teeth in the pitman shaft gear, thus causing the shaft to rotate as the ball nut moves. The pitman arm is spline engaged on the projecting pitman shaft gear and rotates with the shaft. The pitman arm is connected to the bellerank on the steering axle through the steering draglink.

3-37. Removal of Steering Gear

Removal of the steering gear is required for overhaul. Refer to paragraph 2-20 for removal procedure.

3-38. Disassembly of Steering Gear (fig. 3-9)

Note

Prior to start of disassembly, clean exterior of steering gear with SD.

a. Remove nut and washer from threaded end of pitman shaft gear; then, use a puller to remove pitman arm from pitman shaft gear.

b. Remove screw and washer securing bracket to housing and separate bracket from housing.

c. Remove locknut from end of pitman shaft gear and turn lash adjuster a few turns counterclockwise to remove load from worm bearings.

d. Loosen locknut on worm bearing adjuster and turn adjuster a few turns counterclockwise.

e. With a container placed under housing to catch lubricant, remove three screws and washers which attach side cover to housing.

f. Pull side cover, gasket and pitman shaft gear from housing.

Note

If pitman shaft gear does not clear opening in housing, turn wormshaft by hand until pitman shaft gear will pass through opening.

g. Unscrew locknut from adjuster and unscrew adjuster from end cover.

h. Remove four screws and washer securing end cover to housing and withdraw end cover, gasket and bearing from housing.

Caution

Use care when removing wormshaft and ball nut from housing to prevent ball nut from running down to either end of worm. Damage to ends of ball guides will result if ball nut is allowed to rotate until stopped at end of worm.

i. Withdraw wormshaft and ball nut assembly from housing.

j. Remove upper bearing from wormshaft.

k. Unscrew lash adjuster from side cover and slide lash adjuster and shim out of slot in end of pitman shaft gear.

l. Remove seal from housing.

m. If sleeve bearing in housing requires replacement, support housing in an arbor press and press out bearing with a driver from lower end of housing.

n. Do not disassemble ball nut from wormshaft unless binding, roughness or excessive looseness is detected when ball nut is rotated. from end to end of worm. If disassembly is required, proceed as follows:

(1) Remove screw and clamp which retain ball guides in ball nut.

(2) Carefully withdraw ball guides from ball nut.

(3) With ball guide holes in ball nut facing downward, rotate ball nut over a pan or other container until all balls have dropped out.

(4) Remove ball nut endwire from wormshaft.

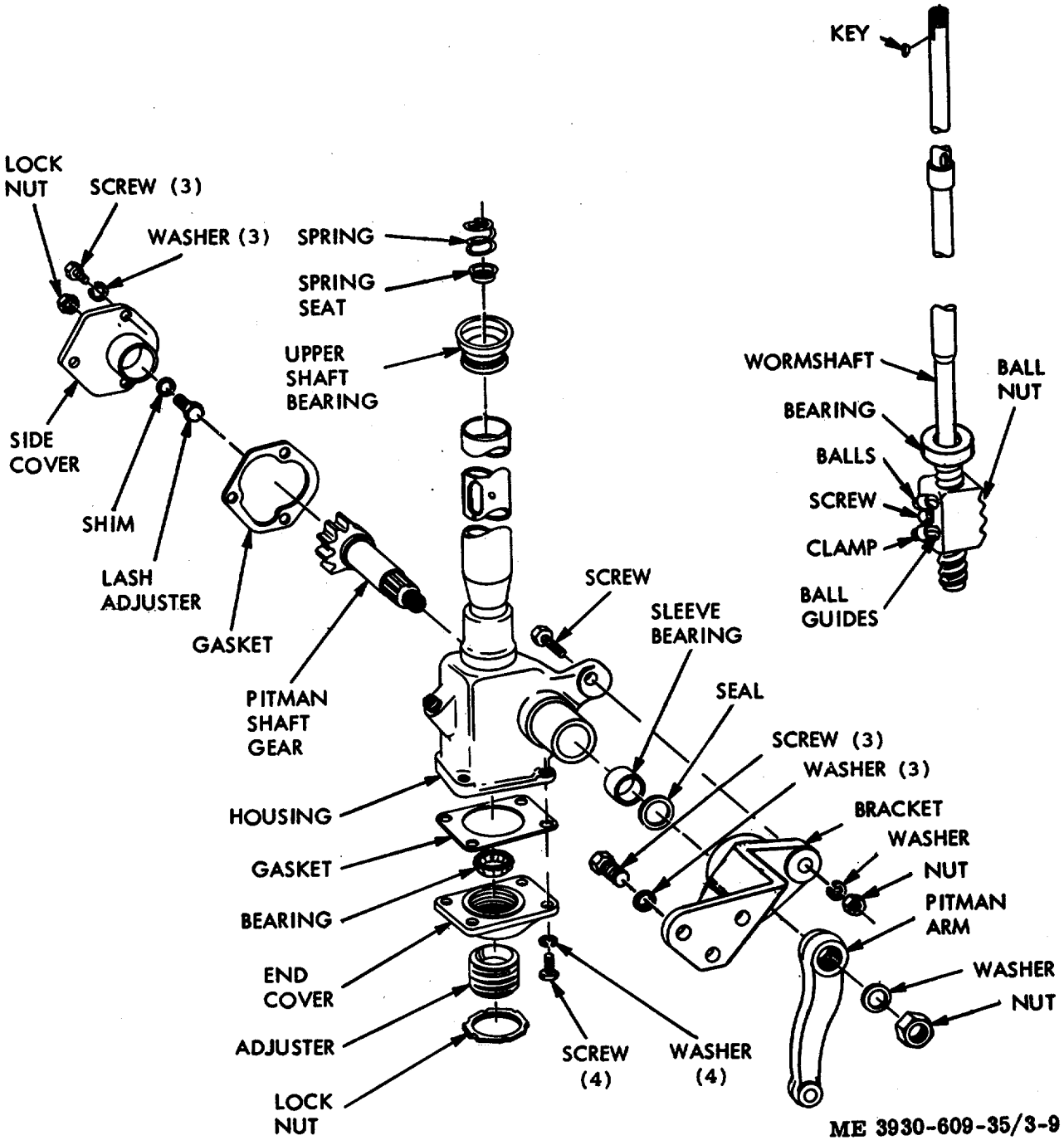

Figure 3-9. Steering gear, exploded view.

3-39. Cleaning Disassembled Parts of Steering Gear
Clean all parts by washing in SD. Dry parts with clean cloth or with compressed air under moderate pressure. Clean parts thoroughly to facilitate inspection.

3-40. Inspecting Parts of Steering Gear

a. Inspect teeth on pitman shaft gear for wear, pitting, or other damage. Also check fit of pitman shaft gear in sleeve bearing mounted in housing and check fit of pitman shaft gear pilot in bushing of side cover.

b. Check housing, wormshaft, bracket, end cover, side cover and pitman arm for cracks and distortion.

c. Check all threaded parts and tapped holes for stripped threads or other thread damage.

d. Inspect bearings under magnification for damage to surfaces of balls and for cracked, chipped or worn cones and cups.

e. Check ball guides for damage at ends which deflect or pick up balls. Check balls and surfaces of worm for roughness or surface damage.

3-41. Repair and Replacement of Steering Gear Parts

a. Repair minor thread damage if practicable with tap or thread chaser.

b. Replace all cracked or distorted parts.

c. Replace gaskets and seal at each reassembly.

d. Replace bearings if defective in any way.

3-42. Reassembly of Steering Gear (fig. 3-9)

a. If ball nut has been disassembled, reassemble ball nut as follows:

(1) Place wormshaft flat on bench and slip slip nut over worm with shallow end of rack teeth to the left from steering wheel position and with holes facing upward.

(2) Aline grooves in worm with grooves in ball nut by sighting through holes in ball nut.

(3) Count out 27 balls (sufficient for one half of circuit). Place these balls into one of the holes in ball nut while turning worm slowly away from that hole. Continue until ball circuit is filled from bottom of one guide hole to bottom of other guide hole or until ball nut reaches end of worm.

Note

If nut reaches end of worm before holes are filed, hold down balls with blunt end of a rod or punch and turn worm in reverse direction a few turns; then, continue filling circuit. Working ball nut back and forth several times may be necessary to close up spaces between balls and fill circuit solidly. Always hold balls down while turning down.

(4) Lay one half of a ball guide groove up on bench and place remaining balls from 27 count in groove.

(5) Close above half of ball guide with second half of ball guide. While holding two halves of ball guide together, plug each open end with petroleum jelly to prevent balls from falling out. Push guide into guide holes in ball nut to complete one circuit.

Note

If guide does not push all the way in easily, tap guide lightly into place with small block of wood.

(6) Fill second ball circuit in same manner as described above.

(7) Assemble ball guide clamp to ball nut with screw and lockwasher.

(8) Check assembly by rotating ball nut on worm to determine that nut moves freely without binding or roughness. Do not rotate ball nut to end of worm as damage to ends of ball guides may result. If binding or roughness is detected, some slight damage to ends of ball guides, to worm grooves, or to balls may have been overlooked.

b. Carefully press sleeve bearing into housing, using an arbor press.

c. Install seal in recess of housing.

Note

During assembly, apply small quantity of nondrying, oil-resistant sealing compound (such as Permatex No. 2) to male threads of adjuster, side cover screws and lash adjuster. Use care in applying compound to adjuster to prevent fouling of wormshaft bearing.

Note

During assembly apply grease GAA to worm bearings, pitman shaft gear bearings in housing and side cover and to ball nut teeth.

d. Install bearing on wormshaft and insert wormshaft with ball nut into housing, guiding end of wormshaft through upper shaft bearing cup and seal.

e. Screw adjuster into end cover and place ball bearing on end of adjuster. Assemble end cover to housing with four screws and washers, using gasket between end cover and housing.

f. Screw locknut onto exposed threads of adjuster.

g. Assemble lash adjuster with shim in slot in end of pitman shaft gear. Check end clearance which should not be greater than 0.002 inch. If necessary, change thickness of shim to obtain specified clearance.

h. Start pilot on pitman shaft gear into bushing in side cover. Then, using a screwdrive inserted through hole in side cover, turn lash adjuster counterclockwise to pull pitman shaft gear into bushing as far as possible.

i. Rotate wormshaft until ball nut is about in center of travel.

j. Place side cover gasket on housing.

k. Insert pitman shaft gear into housing, ensuring that center tooth engages center tooth space of ball nut.

I. Secure side cover to housing with screws and washers, ensuring that there is some lash between pitman shaft gear and ball nut as screws are tightened.

m. Mount bracket on housing with screw, washer and nut.

n. Fill housing with lubricant (LO 10-3930-609-12).

o. Install pitman arm on splined end of pitman shaft gear with washer and nut.

3-43. Installation and Adjustment of Steering Gear

a. Install steering gear as described in paragraph 2-20.

b. After installation, adjust steering gear (TM 10-3930-609-12).

Section VII. REPAIR OF HYDRAULIC PUMP

3-44. Description of Hydraulic Pump

The hydraulic pump is driven by the electric pump motor and provides hydraulic fluid pressure for extending the tilt cylinders and the hoist cylinder. The pump is a positive displacement type having a rated capacity of 3.400 gallons per minute at 1,200 rpm and 1,000 psi.

3-45. Removal of Hydraulic Pump

Removal of the dydraulic motor is required for repair as described in these instructions. Refer to paragraph 2-21 for removal procedure.

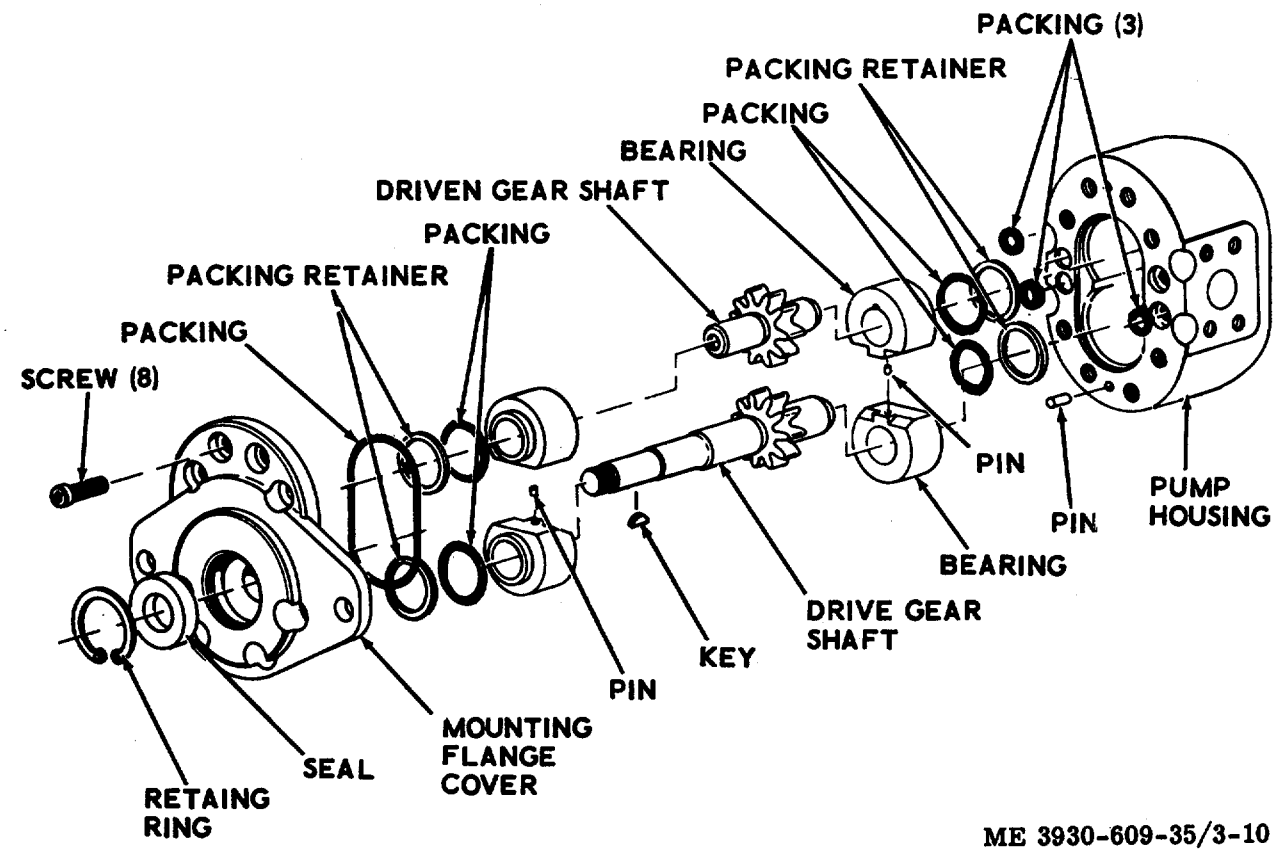

Figure 3-10. Hydraulic pump, exploded view.

3-46. Disassembly of Hydraulic Pump (fig. 3-10).

a. Remove retaining ring from internal groove in mounting flange cover; then, take out capscrews which secure mounting flange cover to pump housing.

b. Carefully separate mounting flange cover from pump housing and take out seals, packings, drive gear shaft, driven gear shaft, bearings and packing retainer.

c. Do not remove pins from pump housing unless replacement is required.

3-47. Cleaning Disassembled Parts of Hydraulic Pump

a. Wash all parts in SD and dry with soft cloth or with compressed air under moderate pressure.

b. Ensure that all fluid passages in housing are free of obstructions.

3-48. Inspection of Hydraulic Pump Parts

a. Inspect all threaded parts and tapped holes for stripped threads or other damage.

b. Inspect mounting flange cover, housing, drive gear shaft and driven gear shaft for cracks and distortion.

c. Inspect bores in bearings for scoring and pitting and for excessive wear as indicated by loose fit on bearing surfaces of drive gear shaft and driven gear shaft.

d. Inspect teeth on drive gear shaft and driven gear shaft for pitting, chipping and excessive wear.

e. Inspect interior surfaces of pump housing for scoring, pitting and other damage.

3-49. Repair and Replacement of Hydraulic Pump Parts

a. Repair minor thread damage with tap or thread chaser.

b. Replace parts that are cracked or distorted or that are excessively worn.

c. Replace all packings and' seals at each reassembly.

3-50. Reassembly of Hydraulic Pump (fig. 3-10)

a. Press pins into holes in pump housing until pins bottom.

b. Install large packing in recess in mounting flange cover.

c. Install packings on flanges of bearings and secure with packing retainers.

d. Install small packings in recesses of pump housing.

e. Assemble bearings on both ends of drive gear shaft and driven gear shaft; then, insert shafts into pump housing.

f. Carefully aline mounting flange cover with pump housing and shafts; then, secure to pump housing with capscrews.

g. Insert seal into mounting flange cover around end of drive gear shaft and secure with retaining ring.

3-51. Installation of Hydraulic Pump

After hydraulic pump has been reassembled, reinstall pump on truck. Refer to paragraph 2-21 for installation procedure.

Section VIII. REPAIR OF HYDRAULIC DIRECTION CONTROL VALVE

3-52. Description of Control Valve

The hydraulic direction control valve is a two-spool fluid control valve with a spring loaded control handle for each spool. The inboard control handle and spool control fluid flow to and from hoist cylinder for raising and lowering the forks. The outboard handle and spool control fluid flow to the two tilt cylinders. Each control handle has two actuating positions and a center neutral position.

3-53. Removal of Control Valve

Removal of control valve from truck is required for overhaul as described in the following instructions. Refer to paragraph 2-17 for removal procedure.

3-54. Disassembly of Control Valve (fig. 3-11)

a. Remove relief valve cap nut, loosen jamnut in adjustment setscrew; then, unscrew adjustment setscrew from relief valve plug.

b. Unscrew relief valve plug from valve body and take out spring seat, spring and poppet. Remove packing from groove in poppet.

c. Remove plug from valve body opposite relief valve and take bearing out of valve body.

d. Remove plugs from valve body opposite plungers; then, remove gaskets from plugs.

e. Take out spring retaining screws, spring retainers, springs and washers.

f. Remove plungers from valve body.

g. Remove packings and remaining plugs from valve body.

3-55. Cleaning Parts of Control Valve

a. Wash parts thoroughly in SD. Dry parts with soft lintfree cloth or with compressed air under moderate pressure.

b. Assure that all fluid passages are free of obstructions.

Caution

Do not use wire or metallic rod or pick to clean fluid passages since such procedure could result in irreparable damage to parts.

3-56. Inspection of Control Valve Parts

a. Inspect Valve body for cracks and for scoring or other damage to plunger bores.

b. Inspect threaded parts and tapped holes for stripping or other damage to threads.

c. Carefully inspect plungers for surface defects such as scoring, pitting or excessive wear.

d. Inspect poppet and bearing for wear and scoring.

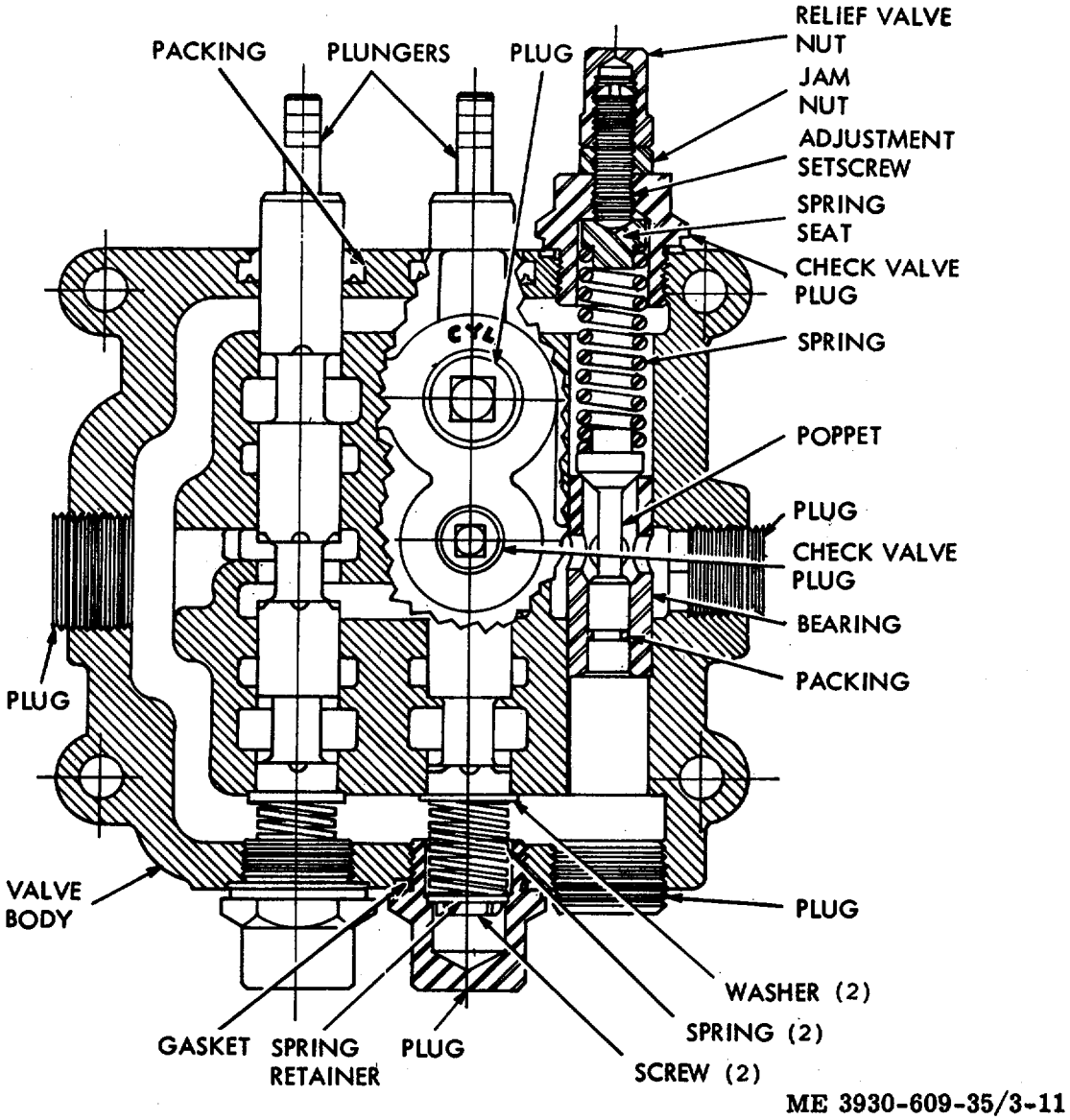

Figure 3-11. Control valve, sectional view.

3-57. Repair and Replacement of Control Valve Parts

a. Replace all parts found to be defective during disassembly and inspection.

Note

If either of the plungers or the valve body is defective to extent of being unserviceable, replace entire control valve assembly.

b. Repair minor thread damage with tap or thread chaser.

c. Remove minor surface defects from parts with crocus cloth (Specification P-C-458).

d. Replace all packings with new parts at each reassembly.

3-58. Reassembly of Control Valve (fig. 3-11)

a. Install packings for plungers in valve body bores; then, insert plungers.

b. Place washers on ends of plungers. Then, install springs using spring retainer and screws.

c. Screw plugs to which gaskets have been applied into valve body to cover springs and tighten securely.

d. Insert bearing into valve body and screw associated plug into valve body.

e. Place packing in groove of poppet and insert poppet into bearing. Place spring on poppet and spring seat on spring.

f. Screw relief valve plug into valve body and screw adjusting setscrew into relief valve plug. Install jamnut on adjusting setscrew but leave loose.

g. Install remaining plugs in valve body.

h. Adjust relief valve portion of control valve as follows:

(1) Connect pressure part of control valve to a hydraulic test pressure source of 2,000 psig with a flow rate of 4 gallons per minute (or greater).

(2) Connect hydraulic test source return hose to return port on control valve and temporarily plug unused ports in valve body.

(3) Raise either plunger and note test pressure. If test pressure is not within the range of 1,600 to 1,700 psig, turn adjusting setscrew clockwise to increase pressure or counterclockwise to decrease pressure.

(4) When relief valve pressure is properly set, tighten jamnut on adjusting setscrew and install relief valve nut over end of setscrew.

(5) Disconnect control valve from test pressure source and remove temporary plugs.

3-59. Installation of Control Valve

Refer to paragraph 2-17 for installation procedure.

Section IX. REPAIR OF TILT CYLINDER

3-60. Description of Tilt Cylinder

The tilt cylinder is a double-acting type hydraulic cylinder having a three inch bore and a 31/4 inch stroke. Two cylinders are used on the truck to tilt the upright assembly.

3-61. Removal of Tilt Cylinders

Removal of tilt cylinders from the truck will be required for repair as described in the following instructions (TM 10-3930-609-12).

3-62. Disassembly of Tilt Cylinder (fig. 3-12)

a. Remove screw, nut and lockwasher and unscrew rod end from piston and rod.

b. Remove two screws and washers which secure packing retainer to stuffing box, slide packing retainer off piston and rod and pry wiper ring out of packing retainer.

c. Unscrew stuffing box from cylinder; then, remove packing and backup ring from groove in stuffing box and remove packing from recess in stuffing box.

d. Carefully pull piston and rod out of cylinder and remove spacer, piston packings and piston guide from piston and rod.

3-63. Cleaning Disassembled Parts of Tilt Cylinder

a. Wash metallic parts in SD and dry with compressed air under moderate pressure or with clean cloth.

b. Be sure to clean parts thoroughly to facilitate inspection.

3-64. Inspection of Tilt Cylinder Parts

a. Inspect all threaded and tapped parts for stripped threads or other thread damage.

b. Inspect packing retainer, stuffing box, piston and rod, and cylinder for cracks and distortion.

c. Inspect bore in cylinder for scratches, scoring, pitting and other surface defects.

3-65. Repair and Replacement of Tilt Cylinder Parts

a. Repair minor thread damage with tap, thread file or thread chaser.

b. Remove minor surface defects from bore of cylinder by carefully honing. Remove all traces of abrasive after honing.

c. Replace all cracked or distorted parts with serviceable parts.

d. Replace wiper ring, packings, backup ring, piston packings and piston guide with new parts at each reassembly.

3-66. Reassembly of Tilt Cylinder (fig. 3-12)

a. Install piston guide and piston packings on piston and rod and carefully insert piston and rod into cylinder.

b. Place spacer on piston and rod.

c. Install backup ring and packing in groove of stuffing box and screw stuffing box into cylinder.

d. Position packing in stuffing box around piston and rod; then, install wiper ring in packing retainer and install packing retainer on stuffing box with two screws and washers.

Note

Tighten packing retainer screws on moderately. Screws can then be further tightened after installation if required to stop fluid leakage.

e. Install rod end on piston and rod and secure with screw, nut and lockwasher.

3-67. Installation of Tilt Cylinder

Refer to TM 10-3930-609-12.

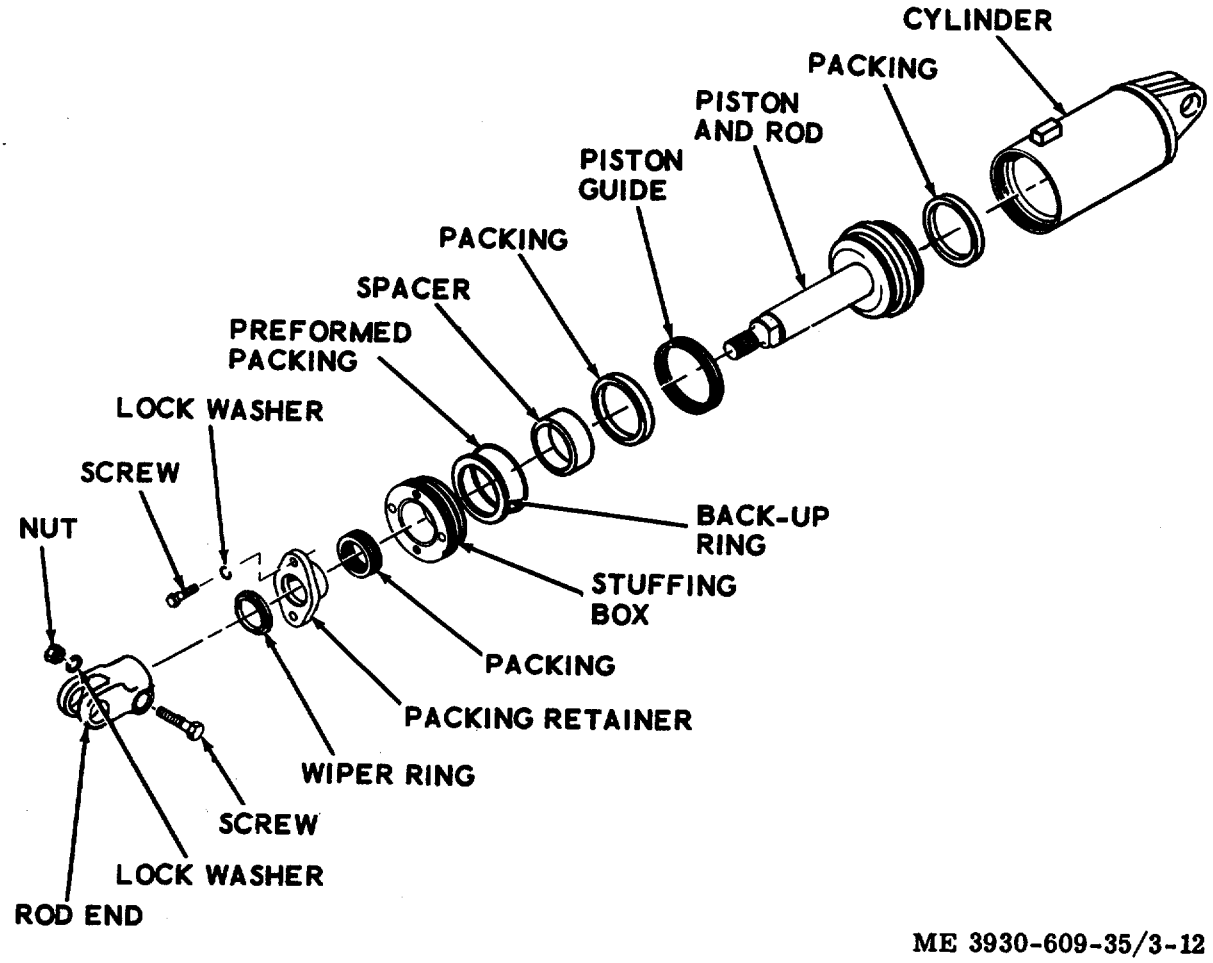

Figure 3-12. Tilt cylinder, exploded view.

Section X. REPAIR OF HOIST CYLINDER

3-68. Description of Hoist Cylinder

The hoist cylinder is a two-stage single-acting hydraulic cylinder having a 35 5/8 inch primary stroke and a 36 1/4 inch secondary stroke. The hoist cylinder raises the forks on the truck when hydraulic fluid is applied to the cylinder.

3-69. Removal of Hoist Cylinder

Removal of the hoist cylinder from the truck is required for repair as described in the following instructions. Refer to paragraph 2-15 for removal procedure.

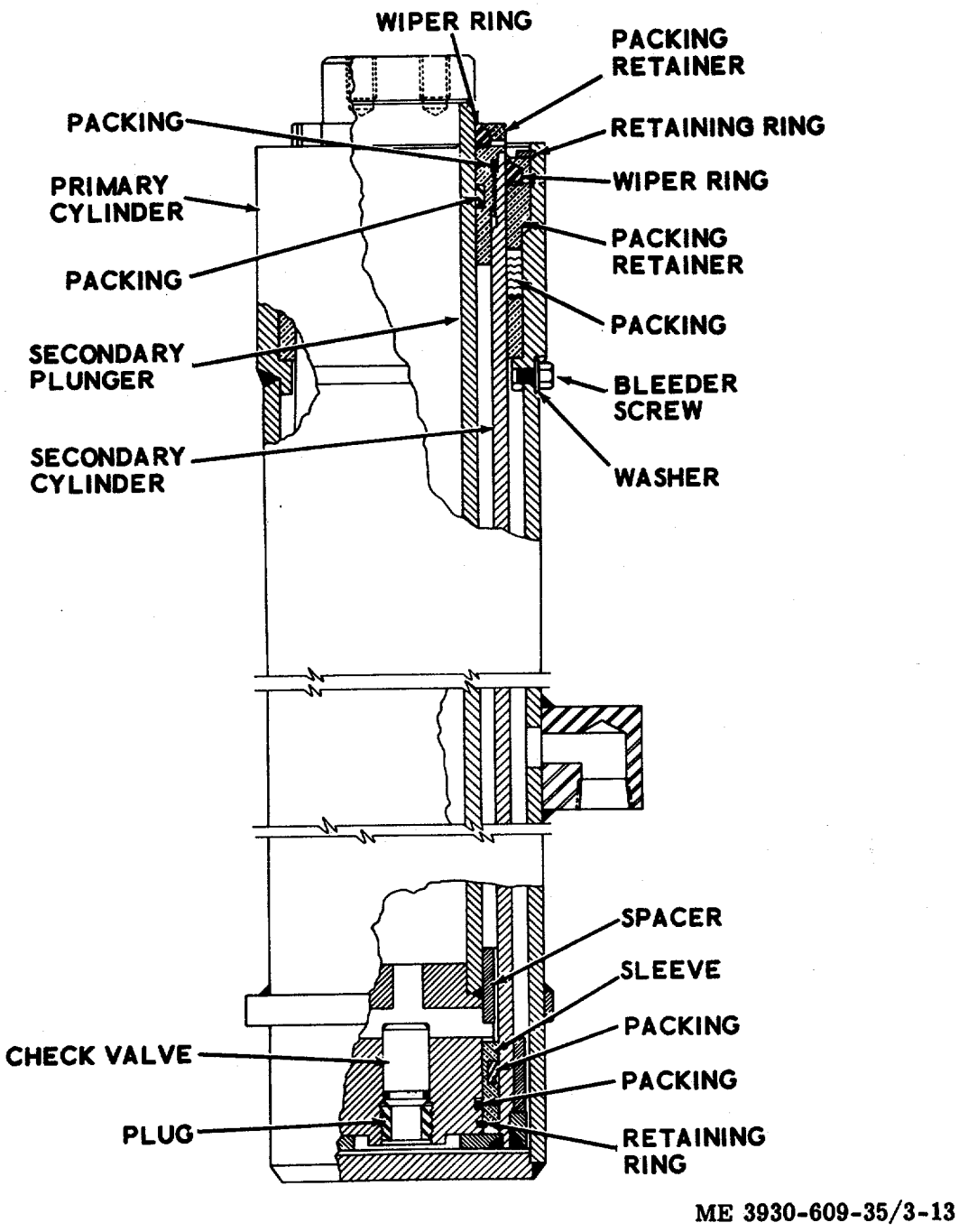

Figure 3-13. Hoist cylinder, sectional view.

3-70. Disassembly of Hoist Cylinder (fig. 3-13)

a. Remove bleed screw and washer.

b. Withdraw secondary cylinder approximately 12 inches from primary cylinder; then, unscrew and remove packing retainer from secondary cylinder, being careful not to scratch or otherwise damage surface of secondary cylinder.

c. Remove wiper ring and two packings from packing retainer.

d. Carefully withdraw and remove secondary plunger from secondary cylinder.

e. Remove spacer from bore in secondary cylinder or from secondary plunger.

f. Unscrew plug from end of secondary plunger and take out check valve.

g. Remove retaining ring from groove in secondary plunger; then, remove sleeve from end of secondary plunger.

h. Remove packing from groove in sleeve and remove packing from groove in secondary plunger.

i. Remove retaining ring from internal groove in primary cylinder and withdraw packing retainer from primary cylinder.

j. Remove wiper ring from packing retainer.

k. Continue to slide secondary cylinder out of primary cylinder. Remove packing-from secondary cylinder. If packing does not emerge from primary cylinder as secondary cylinder is being withdrawn, slide secondary cylinder back into primary cylinder; then, using a pick, carefully pry out packing, being careful not to scratch or otherwise damage surface of secondary cylinder.

Note

Secondary cylinder cannot be completely removed from primary cylinder.

3-71. Cleaning Disassembled Parts of Hoist Clyinder

a. Clean all .removed metallic parts with SD and dry with soft lint-free cloth.

b. Slide secondary cylinder out of primary cylinder as far as possible and carefully clean exposed surface of secondary cylinder with cloth moistened with SD.

3-72. Inspection of Hoist Cylinder Parts

a. Inspect all threaded parts and parts with tapped holes for stripped threads or other thread damage.

b. Inspect packing retainers for scratches, burrs and upset metal.

c. Inspect cylinders and plunger for cracks and distortion.

d. Inspect external surfaces of secondary cylinder and secondary plunger for scratches, pitting, scoring, upset metal and other surface damage.

e. Inspect check valve for free return flow.

3-73. Repair and Replacement of Hoist Cylinder Parts

a. Replace all cracked or distorted parts.

b. Repair minor thread damage with a tap, thread file or thread chaser.

c. Remove minor surface defects on surfaces of secondary cylinder and secondary plunger with crocus cloth or with minor honing.

d. Replace all packings and wiper rings with new parts at each assembly.

3-74. Reassembly of Hoist Cylinder (fig. 3-13)

Note

Apply grease GAA to rubber packings and wiper rings before assembly.

a. With secondary cylinder inserted into primary cylinder as far as possible, install packing in recess between primary cylinder and secondary cylinder.

b. Place wiper ring in packing retainer.; then, carefully pass packing retainer over end of secondary cylinder and press into primary cylinder. Install retaining ring in internal groove of primary cylinder to retain packing retainer.

c. Place packing in groove at lower end of secondary plunger and install packing in external groove of sleeve.

d. Install sleeve on lower end of secondary plunger and secure with retaining ring.

e. Insert check valve into lower end of secondary plunger and secure with plug.

f. Carefully slide secondary plunger all the way into secondary cylinder.

g. With partially assembled cylinder in vertical position, pour one pint of rust preventive oil (MIL-C-16173) into space between secondary cylinder and secondary plunger.

h. Install packing in internal groove of packing retainer, install packing on shoulder of packing retainer and install wiper ring in recess of packing retainer.

i. Carefully place packing retainer over end of secondary plunger. and engage threads on packing retainer with internal threads in secondary cylinder.

j. Withdraw secondary cylinder from primary cylinder approximately 12 inches; then, while holding secondary cylinder, tighten packing retainer

securely. Use care to avoid scratching surface of secondary cylinder.

k. Install bleed screw and washer in tapped hole of primary cylinder.

3-75. Installation of Hoist Cylinder

Refer to paragraph 2-15 for installation procedure.

Section XI. REPAIR AND OVERHAUL OF MAST ASSEMBLY

3-76. Description of Mast Assembly

The mast assembly comprises three channels which nest together, the hoist cylinder, rollers, chain, crosshead, carriage assembly and related parts (fig. 3-14). The outer channel mounting facilitates securing the mast to the truck and also provides mounting for the hoist cylinder. The carriage is equipped with rollers which engage the inner channel.

3-77. Removal of Mast Assembly

Removal of the mast assembly will be required for repair and overhaul as described in the following instructions. However, many parts can be replaced without removal of the mast assembly. For removal procedure, refer to paragraph 2-16.

3-78. Disassembly of Mast (fig. 3-14)

a. Remove chains (TM 10-3930-609-12).

b. Remove hoist cylinder (para 2-15).

c. Remove eight capscrews and lockwashers which secure guides to crosshead; then, withdraw guides and shims from crosshead.

d. Withdraw crosshead from between guides on intermediate channel.

e. Remove lockscrews from crosshead; then, pull out roller shafts and withdraw chain rollers from crosshead.

f. Remove bearings from crosshead chain rollers only if replacement is required.

g. Remove lubrication fittings from crosshead roller shafts and remove two capscrews and lockwashers from crosshead only if replacement is required.

h. Remove four lockscrews from inner channel; then, remove four pins and withdraw rollers from inner channel.

i. Remove bearings from rollers and remove lubrication fittings from pins only if replacement is required.

j. Unhook and remove latch springs from between both sets of latches; then, remove screws and lockwashers which secure two pin retaining bars and remove bars, latches and latch pins from upper end of intermediate channel and inner channel. Remove lubrications fittings from latch pins only if replacement is required.

k. Remove eight setscrews from channels and remove latch actuating capscrews and lockwashers from intermediate and outer channels.

l. Slide inner channel out of engagement with intermediate channel; then, withdraw carriage as sembly from inner channel.

m. Remove two capscrews and lockwashers which secure striker bar to carriage weldment if removal of striker bar is required.

n. Remove setscrews from side plates of carriage weldment; then, remove bolts and lockwashers which secure brackets to carriage side plates and withdraw brackets and side thrust washers.

o. Remove four rollers, bearings and washers from trunnions on carriage weldment.

p. Remove lubrication fittings from carriage weldment only if replacement is required.

q. Carefully slide intermediate channel out of engagement with outer channel.

r. Remove inserts from channels only if replacement is required.

s. Remove nuts and washers from chain anchors and remove chain anchors from outer channel.

t. Remove lubrication fittings from outer channel only if replacement is required.

3-79. Cleaning Disassembled Parts of Mast

a. Remove accumulation of grease from mast parts by scraping with a dull putty knife.

b. Wash parts with SD, using a stiff bristle brush on large fiat surfaces. Clean smaller parts by soaking in SD. Dry parts with clean cloth.

c. Be sure to clean all parts thoroughly to facilitate inspection.

3-80. Inspection of Disassembled Mast Parts

a. Inspect channels and carriage weldment carefully for distortion and for broken welds.

b. Inspect all bearings removed from chain rollers and from carriage for wear or other damage.

c. Inspect all threaded parts and tapped holes for stripped threads and other thread damage.

d. Inspect crosshead for cracks and distortion.

e. Inspect latches and associated latch pins for excessive wear or other damage.

f. Inspect inserts on channels for excessive wear, roughness or other damage.

g. Inspect lubrication fittings for damage and for good fit in associated parts.

h. Inspect latch springs for distortion or broken ends.

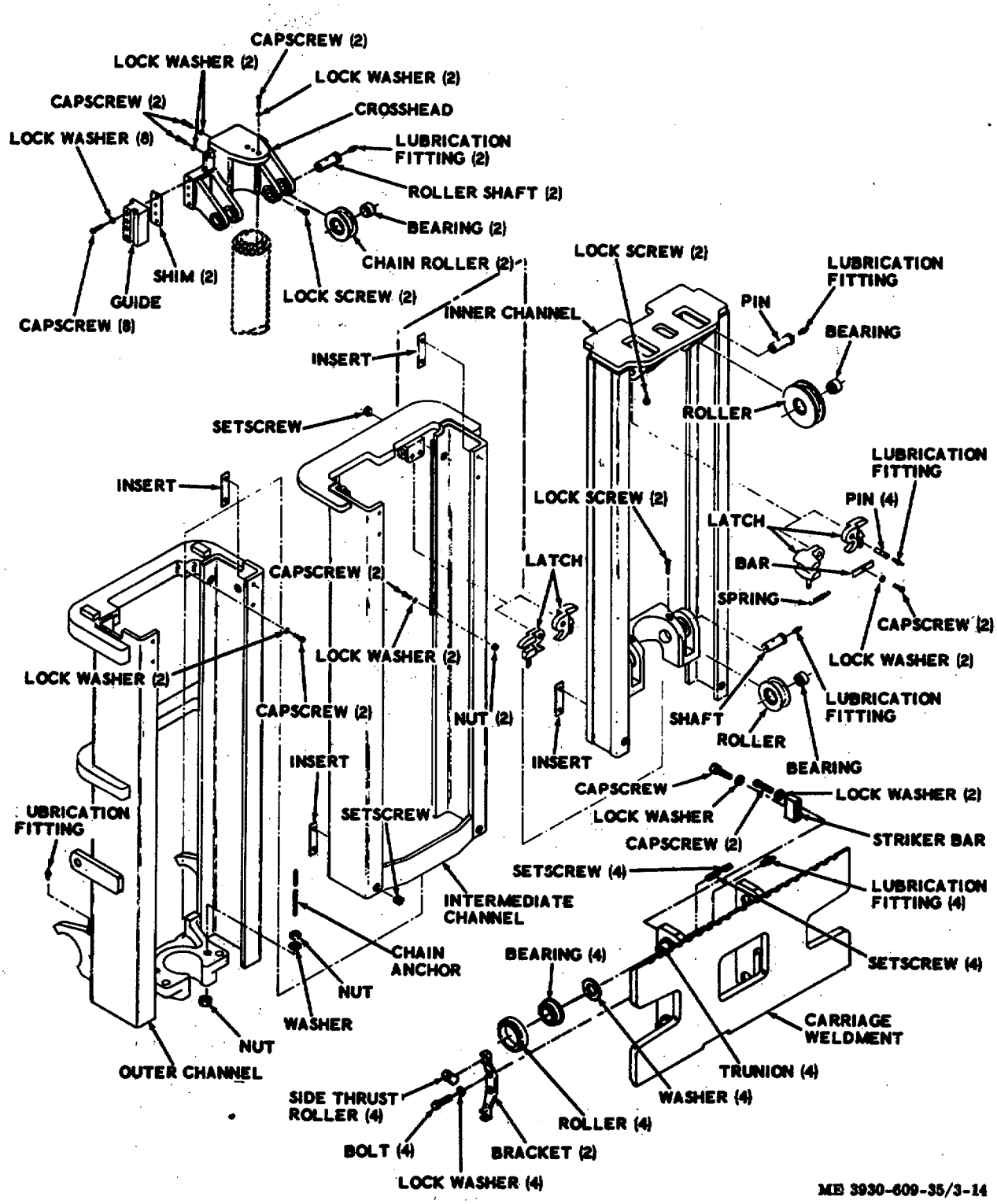

Figure 3-14. Mast assembly, exploded view.

3-81. Repair and Replacement of Mast Parts

a. Reweld parts where welds have broken only if parts are not distorted. Use gas or electric arc welding equipment. Repaint welded surfaces.

b. Replace all broken or distorted or worn parts with serviceable parts.

3-82. Reassembly of Mast Assembly (fig. 3-14)

a. Install lubrication fittings in outer channel, in roller pins, in latch pins, in crosshead roller shafts and in trunnions of carriage weldment.

b. Attach inserts to outer, intermediate and inner channels.

c. Install chain anchors in bracket of outer channel, using nuts and lockwashers.

d. Slide intermediate channel into outer channel.

e. Install bearings in rollers; then, place rollers into position in inner channel and insert roller pins. Secure roller pins in position with lockscrews.

f. Install bearings in carriage rollers and place washers and rollers on carriage weldment trunnions.

g. Secure brackets to carriage weldment with bolts and washers; then, install setscrews in carriage weldment side plate but do not tighten setscrews against brackets.

h. Install striker bar on carriage weldment side plate with capscrews and lockwashers.

i. Install side thrust rollers in brackets in carriage weldment.

j. Insert rollers on carriage weldment in inner channel; then, engage inner channel in intermediate channel.

k. Install latch pins and latches on inner channel and intermediate channel, using bars secured with capscrews and lockwashers to retain latch pins. Hook latch springs to latches.

l. Install latch operating capscrews in outer and intermediate channels.

m. Install bearings in chain rollers; then, aline chain roller in crosshead and insert roller shafts. Secure roller shafts in crosshead with lockscrews.

n. Install latch operating capscrews in crosshead.

o. Aline crosshead with guides in intermediate channel and install guides on crosshead with capscrews and lockwashers, including quantity of shims between guides and crosshead that will center crosshead. Use sufficient shims to eliminate side play -of crosshead without binding in guides.

p. Install hoist cylinder as described in paragraph 2-15.

q. Install setscrews in channels.

r. With channels horizontal, tighten setscrews in carriage side plates to tension side thrust rollers lightly but not tightly against inner channel. Tighten short setscrews against long setscrews to lock the adjustment.

s. With channels vertical, install setscrews in inner, intermediate and outer channels to eliminate play between channels and inserts. Do not tighten to point of causing binding of channels.

t. Apply grease GAA to lubrication fittings in roller pins, in latch pins, in crosshead roller shafts and in carriage trunnions (LO 10-3930-609-2).

v. Apply grease GAA to points of contact between all three channels (LO 10-3930-609-12).

w. Install chain (TM 10-3930-609-12).

Section XII. OVERHAUL AND REPAIR OF TRAVEL MOTOR

3-83. Description of Travel Motor

The travel motor is a four-pole, series connected, reversible, spark enclosed dc motor capable of approximately 3.5 horsepower output when energized at 36 volts. The armature shaft is splined on one end for mounting the pinion used to drive the power axle. The opposite end of the armature shaft is designed for mounting the parking brake drum. The armature shaft is ball-bearing mounted at both ends. Bearings are grease packed and require no additional lubrication.

3-84. Removal of Travel Motor

Removal of the travel motor is required for overhaul as described in the following instructions. To remove travel motor, refer to paragraph 2-24.

3-85. Disassembly of Travel Motor (fig. 3-15)

a. Remove screw, nut and lockwasher which secure two yoke covers around motor front yoke; then, disengage yoke covers from shouldered pins in yoke and remove yoke covers. Do not remove shouldered pins from yoke unless replacement is required.

b. Disengage eight brush springs from brush-holders and remove springs from motor front yoke.

c. Remove four screws and lockwashers which secure shunts on brush assemblies to brushholders; then, withdraw brush assemblies from brushholders.

d. Carefully examine front motor yoke, rear motor yoke and motor ring for match marks. If no match marks are visible, use a punch or chisel to lightly match mark these parts.

e. Remove four screws and lockwashers which secure front motor yoke to motor ring; then, carefully remove front motor yoke from motor ring.

f. Remove screws, washers and insulating bushings which secure brushholders in front yoke; then, remove brushholders and insulators from front yoke.

g. Remove nuts, lockwashers, flatwashers, external insulator and insulating washers from threaded portion of brush connector assemblies; then, remove brush connector assemblies, insulating washers, internal insulator, flatwashers and two-hole insulator from inside front yoke.

h. Remove nuts and lockwashers from eight studs securing rear yoke to motor ring; then, carefully remove rear yoke.

i. Remove retaining ring, rear bearing and oil seal from rear yoke.

j. Withdraw armature from motor ring and remove front bearing from armature shaft.

k. Remove nuts, lockwashers, flatwashers and insulating washers from stud terminals; then, remove stud terminals from motor ring and remove insulating bushings, insulating washers and flatwashers from stud terminals.

l. Remove field coils from motor ring only if replacement is required by taking out screws which secure pole pieces in motor ring.

3-86. Cleaning Disassembled Parts of Travel Motor

a. Wash all metallic parts with SD and dry with compressed air under moderate pressure.

b. If field coils have not been removed from motor ring, blow dust from coils and inside motor ring with compressed air.

c. Be sure to clean all parts thoroughly to facilitate inspection.

3-87. Inspection of Travel Motor Parts

a. Inspect motor ring and yokes for cracks and distortion.

b. Inspect all threaded parts and tapped holes for stripped threads or other damage.

c. Check field coils with an ohmmeter for continuity. Check that field coils in series have a resistance of 0.0366 ±10 percent ohms at 70°F.

d. Check armature on a growler for shorted and open windings.

e. Inspect commutator on armature for grooving, pitting, scoring and for metallic slivers between segments.

f. Inspect brush springs for distortion and loss of tension due to overheating. Check brush springs for proper tension during reassembly of motor as described in paragraph 3-89.

g. Inspect brush assemblies for excessive wear and for security of shunts and terminals. Check that brushes slide freely in brushholders without binding or excessive looseness.

h. Inspect brush connector assemblies for frayed insulation and for damage due to overheating.

i. Inspect brushholders for distortion or other damage.

k. Inspect field coil assembly for frayed wrapping and for damage to winding insulation due to overheating. Also inspect sleeving on field coil leads for damage.

l. Inspect bearing mounting surfaces on armature shaft and bearing bores in yokes for scoring, wear or other damage due to bearing failure.

3-88. Repair and Replacement of Travel Motor Parts

a. Replace all distorted or cracked parts and any parts that have been damaged due to overheating.

b. Replace oil seal and both ball bearings at each reassembly.

c. Repair minor damage to field coil wrapping by rewrapping with glass fiber tape and applying electrical insulating varnish to repaired areas.

d. Replace brush connector assemblies if damaged in any way.

e. Replace brush assemblies if worn to less than 3/4 inch in length or if shunts are damaged.

f. Repair minor thread damage with tap or thread chaser.

g. If required, true up commutator on armature by chucking in a lathe. Do not remove more metal from commutator than necessary to produce a smooth, bright, continuous surface on all segments. Minimum allowable diameter of commutator after turning is 2.375 inches. Maximum allowable surface roughness of commutator segments after

turning is 16 microinches rms. After turning, undercut insulation between segments to a depth of 3/64 inch, using a 0.030 inch wide saw. Clean all chips from between segments.

3-89. Reassembly and Testing Travel Motor (fig. 3-15)

a. Insert pole pieces in field coil assembly and install in motor ring. Secure pole pieces with eight screws.

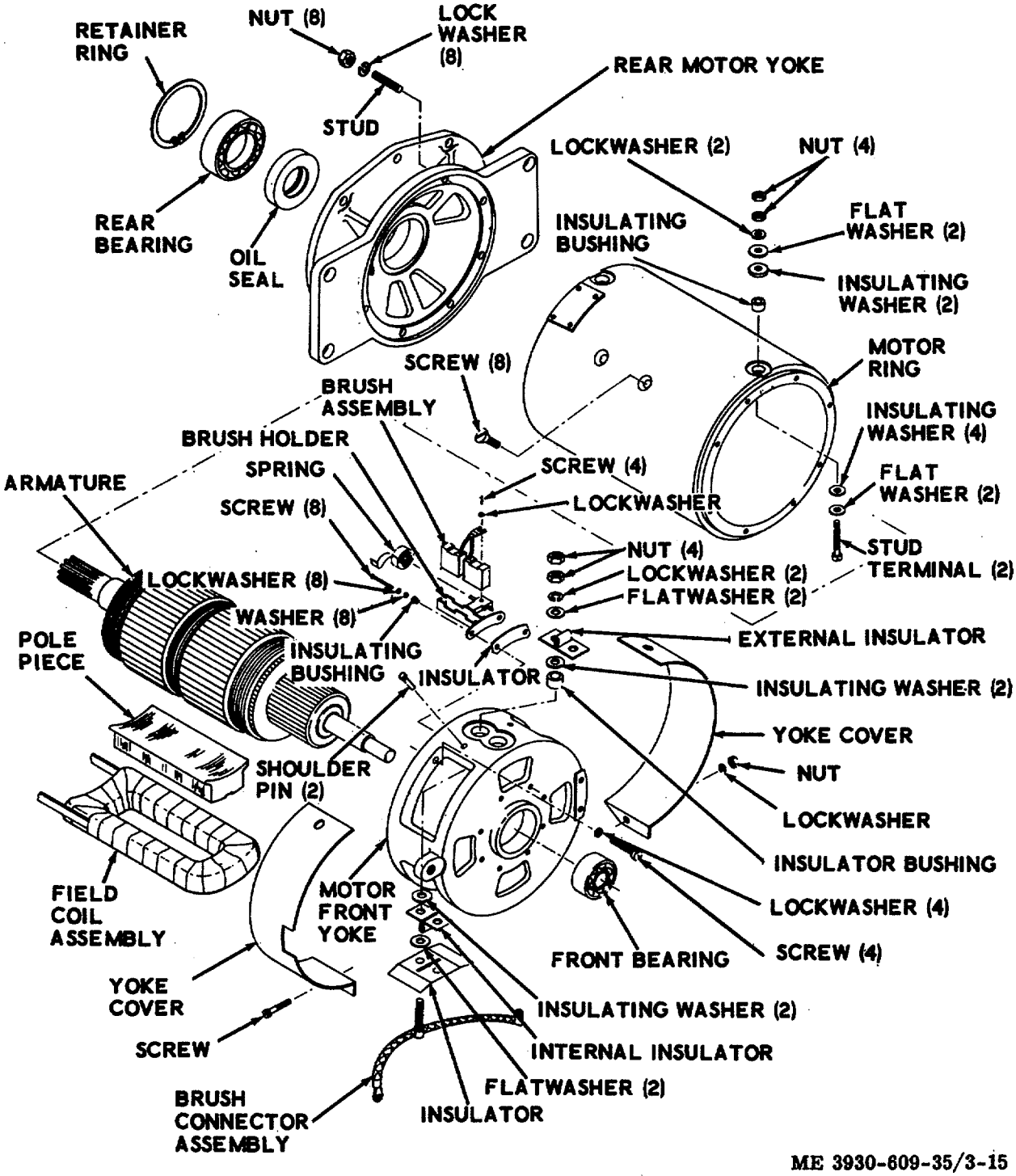

Figure 3-15. Travel motor, exploded view.

b. Insert stud terminals through terminals on field coil assembly; apply flatwashers and insulating washers to stud terminals and insert stud terminals in holes of motor ring. Place insulating bushing on stud terminals and complete installation with insulating washers, flatwashers, lockwashers and nuts.

c. Press front bearing onto armature shaft and insert armature into motor ring.

d. Press oil seal into rear yoke, install rear bearing in yoke and install retaining ring in groove of yoke.

e. Carefully slide rear yoke onto end of armature shaft and aline match marks with match marks on motor ring. Secure rear yoke to motor ring with studs, lockwashers and nuts.

f. Place insulator, flatwashers, internal insulator and insulating washer on threaded end of terminal stud on both brush connector assemblies; assuring that projection on internal insulator projects through slot in flat insulator. Then insert both brush connector assembly stud terminals through holes in front yoke and apply insulating bushings, external insulator, flatwashers, lockwashers and nuts to both terminal studs. Tighten nuts securely.

g. Install brushholders in front yoke with screws, lockwashers, flatwashers and insulating bushings, including an insulator between each brushholder and yoke.

h. Assemble front yoke to motor ring, aline match marks and secure with four screws and lockwashers.

i. Check that armature rotates freely without any evidence of binding before continuing assembly. If binding is detected, determine cause and correct trouble before proceeding.

j. Insert brush assemblies in brushholders and install brush springs to retain brush assemblies. Attach terminals on brush shunts and terminals on brush connector assemblies to brushholders with screws and lockwashers.

k. Using a spring balance, check force of brush springs against brushes by slowly applying force to ends of brush springs that bear on brushes. At point where end of spring is raised off brush, spring balance should read 3 to 4 pounds.

Caution

Do not apply a voltage greater than 12 volts dc to motor unless motor has a load applied. Motor will overspeed if operated at a higher voltage without load.

l. With motor securely clamped to bench, apply 12 volts dc to field terminals and 12 volts dc to brush terminals (brush terminal A1 positive and A2 negative). Check that motor rotation is clockwise when viewed from commutator end of armature when field terminal F2 is negative. Stop motor and reverse field polarity to check that motor rotation reverses.

m. Lightly stone commutator if excessive sparking is noted between brushes and commutation.

n. Drive shouldered studs into front yoke.

o. Attach yoke covers to shouldered studs and secure opposite ends with screw, nut and lockwasher.

Caution

Do not allow motor to operate at 36 volts without torque loading. Motor will overspeed and may be irreparably damaged.

p. Install brake drum on motor shaft and clamp motor securely to bench top. Apply a torque arm to brake drum. Torque arm must be capable of applying increasing load to brake drum. Connect motor electrically as shown in figure 3-16. Test motor first at no load; then, gradually apply torque load to armature stall. Motor performance characteristics must be shown in the following chart.

Voltage	*Loading*	*Applied torque*	*Motor speed*	*Current (steady)*
36 volts de	Equivalent to truck speed of 7 miles per hour with 2,000 pound load on forks	15 foot pounds	2,940 rpm ±5%	120 amps ±5%
36 volts de	Stalled rotor	100 foot pounds minimum	0	500 amps ±5%

3-90. Installation of Travel Motor

Refer to paragraph 2-24 for installation procedure.

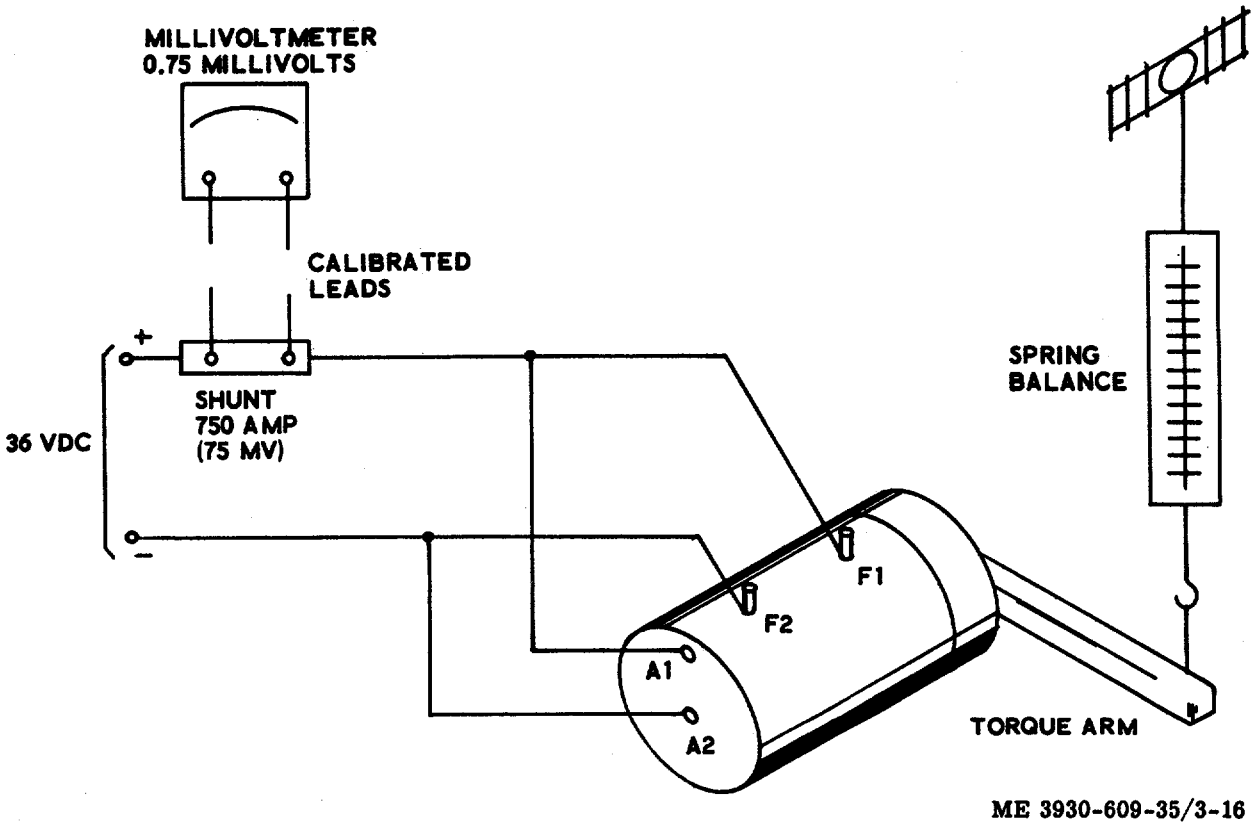

Figure 3-16. Travel motor test setup.

Section XIII. OVERHAUL AND REPAIR OF PUMP MOTOR

3-91. Description of Pump Motor

The pump motor is a four-pole, series parallel connected, spark enclosed, dc motor capable of approximately 2.2 horsepower output when energized at 36 volts. The armature shaft is ball bearing mounted at both ends.

3-92. Removal of Pump Motor

Removal of the pump motor from the truck will be required for overhaul and repair as described in the following instructions. Refer to paragraph 2-22 for removal procedure.

3-93. Disassembly of Pump Motor (fig. 3-17)

a. Remove capscrew, nut and lockwasher which secure covers to front yoke; then, disengage covers from studs in front yoke and remove covers.

b. Remove cotterpins from brushholders; then, remove machine screws, lockwashers and flatwashers which secure brush shunts and jumpers to brushholders and remove brush springs and brushes from brushholders.

c. Remove machine screws and lockwashers which secure bearing retainer in rear yoke and withdraw bearing retainer from yoke.

d. Carefully examine front yoke, motor ring and rear yoke for match marks. If no match marks are evident, lightly mark parts with punch or chisel before proceeding.

e. Remove retaining ring from groove in rear end of armature shaft.

f. Remove capscrews and lockwashers which secure rear yoke to motor ring; then, carefully withdraw rear yoke and remove ball bearing from rear yoke.

g. Remove retaining -ring from groove in front end of armature shaft and carefully remove armature from motor ring.

h. Remove jamnuts, insulating washers and flatwashers from field terminal and armature terminal; then, remove external insulator, insulating washers and bushings from terminals.

i. Remove field terminal, insulating plate and insulating washer from inside front yoke.

j. Remove armature terminal, insulating washer, internal insulator and jumper from inside front yoke.

k. Remove capscrews and lockwashers which secure front yoke to motor ring and disengage front yoke from motor ring.

l. Remove ball bearing from front yoke.

m. Remove machine screws, lockwashers, nuts and flatwashers which secure rocker plate and brush mounting ring to inside of front yoke and separate these parts.

n. Remove flathead screws which secure rocker plate to brush mounting ring and separate brush mounting ring, insulator and rocker plate.

o. If brushholders require replacement, remove eight screws which secure brushholders to brush mounting ring to remove brushholders.

p. If field coils require removal, take out eight hex head capscrews which secure pole pieces to inside of motor ring and withdraw pole pieces and field coil assembly from motor ring. Separate pole pieces from field coils.

3-94. Cleaning Disassembled Parts of Pump Motor

a. Wash front yoke, rear yoke, covers, motor ring (from which field coils have been removed), pole pieces, rocker plate; brush mounting ring, brushholders, bearing retainer and miscellaneous small metallic parts in SD. Dry parts with compressed air under moderate pressure.

b. If field coils have not been removed from motor ring, use compressed air to blow dust from coils, pole pieces and inside of motor ring. Clean outer surfaces with cloth moistened with SD.

c. Use compressed air to blow dust from crevices and surfaces of armature.

3-95. Inspecting Parts of Pump Motor

a. Inspect front yoke, rear yoke, motor ring, rocker plate and brush mounting ring for cracks and distortion.

b. Inspect all threaded parts and tapped holes for stripped threads or other thread damage.

c. Inspect field coils for damage due to overheating and for damage to wrapping. Also, using a resistor bridge, check that total resistance of field coils in series is 0.00109 ±10 percent ohms at 70°F.

d. Check that brushes slide freely in brushholders without binding or excessive looseness.

e. Check brush springs for distortion and for damage due to overheating. Also check brush springs for proper tension after installation as described in paragraph 3-97.

f. Inspect bearing mounting surfaces on armature and bearing bores in yokes for enlargement, scoring or other damage due to bearing failure.

g. Inspect armature for damage to conductors due to overheating. Check armature on a growler for opens and shorts. Also check for foreign matter between segments of armature commutator and check commutator for grooving and pitted segments. Blackening of commutator if grooving, pitting or other damage is not apparent does not impair motor operation.

h. Inspect brushes for excessive wear and for security of shunts and terminals.

3-96. Repair and Replacement of Pump Motor Parts

a. Replace all cracked or distorted parts and all parts damaged by overheating.

b. Repair minor thread damage with a tap or thread chaser.

c. Repair wrapping on field coils by rewrapping loose or damaged areas with glass fiber tape. Then apply electrical insulating varnish to rewrapped areas.

d. Replace brushes if worn to a length less than 3/4 inch or if shunts, or terminals are loose or damaged.

e. Replace both ball bearings at each reassembly.

f. Replace armature or either yoke if bearing mounting surfaces are damaged to extent that bearings cannot be properly installed.

g. If commutator on armature is grooved or pitted, chuck armature in a lathe and reface commutator segments. Do not remove more metal than is required to produce a clean, bright, continuous surface on all segments. Minimum allowable diameter of commutator after turning is 2.125 inches. Maximum allowable surface roughness of segments after turning 16 microinches rms. After turning, undercut insulation between segments to a depth of 3/64 inch using a 0.025 inch wide saw. Clean all chips and slivers from between segments.

3-97. Reassembly and Testing Pump Motor (fig. 3-17)

Note

Ball bearings are greased packed, therefore, no lubrication is required during assembly.

a. Insert pole piece assemblies into field coils and assemble field coils and pole piece assemblies

inside motor ring. Orient field coils so that terminal for connecting field coils in external terminal is located at terminal hole "S1" in front yoke when match marks on yoke and motor ring are alined. Secure each pole piece assembly with two hex head capscrews.

b. Mount brushholders on brush mounting ring with eight flat head screws.

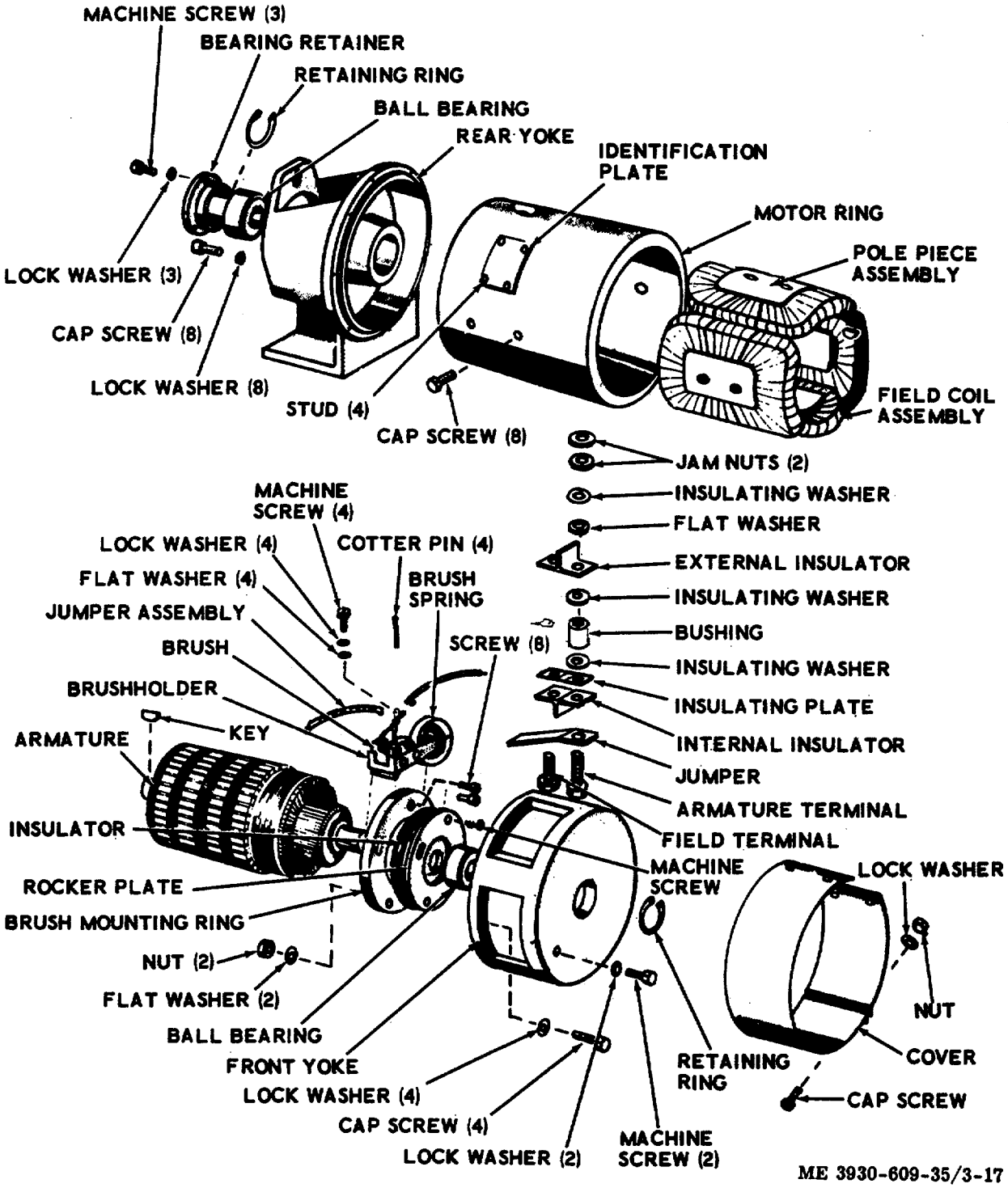

Figure 3-17. Pump motor, exploded view.

c. Attach insulator and rocker plate to brush mounting ring with flathead screws.

d. Mount rocker plate and brush mounting ring inside front yoke with two machine screws, lockwashers, flatwashers and nuts. Before tightening nuts, position brush mounting ring so that machine screws are centered in slots in brush mounting ring.

e. Insert ball bearing in bearing bore of front yoke.

f. With match marks on front yoke and motor ring alined, secure front yoke to motor ring with four capscrews and lockwashers.

g. Insert threaded end of field terminal through terminals of field coils, through insulating washer, through one hole of internal insulator, through one hole in insulating plate and through "S1" hole in front yoke. Apply bushing, insulating washer, external insulator, flatwasher, insulating washer and two jamnuts to exposed end of field terminal.

h. Insert threaded end of armature terminal through jumper, through second hole in internal insulator and insulating plate and through "A2" hole in front yoke. Then apply insulating washer, bushing, insulating washer, second hole of external insulator, flatwasher, insulating washer and two jamnuts to exposed end of armature terminal.

i. Carefully insert armature commutator end first) into motor ring, guiding armature shaft into bearing in front yoke; then, install retaining ring in groove at front end of armature shaft.

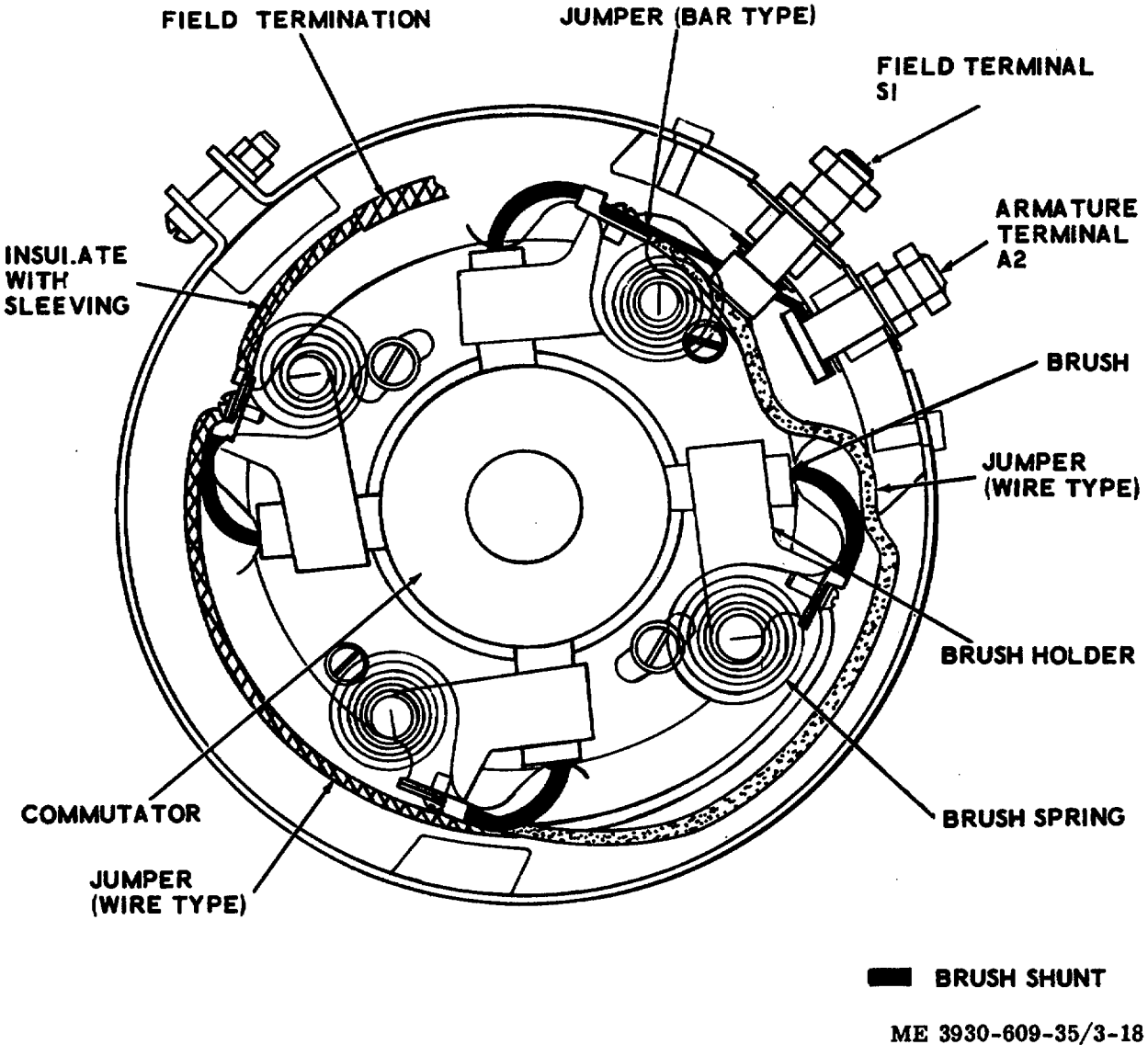

Figure 3-18. Pump motor brushholder and field connections.

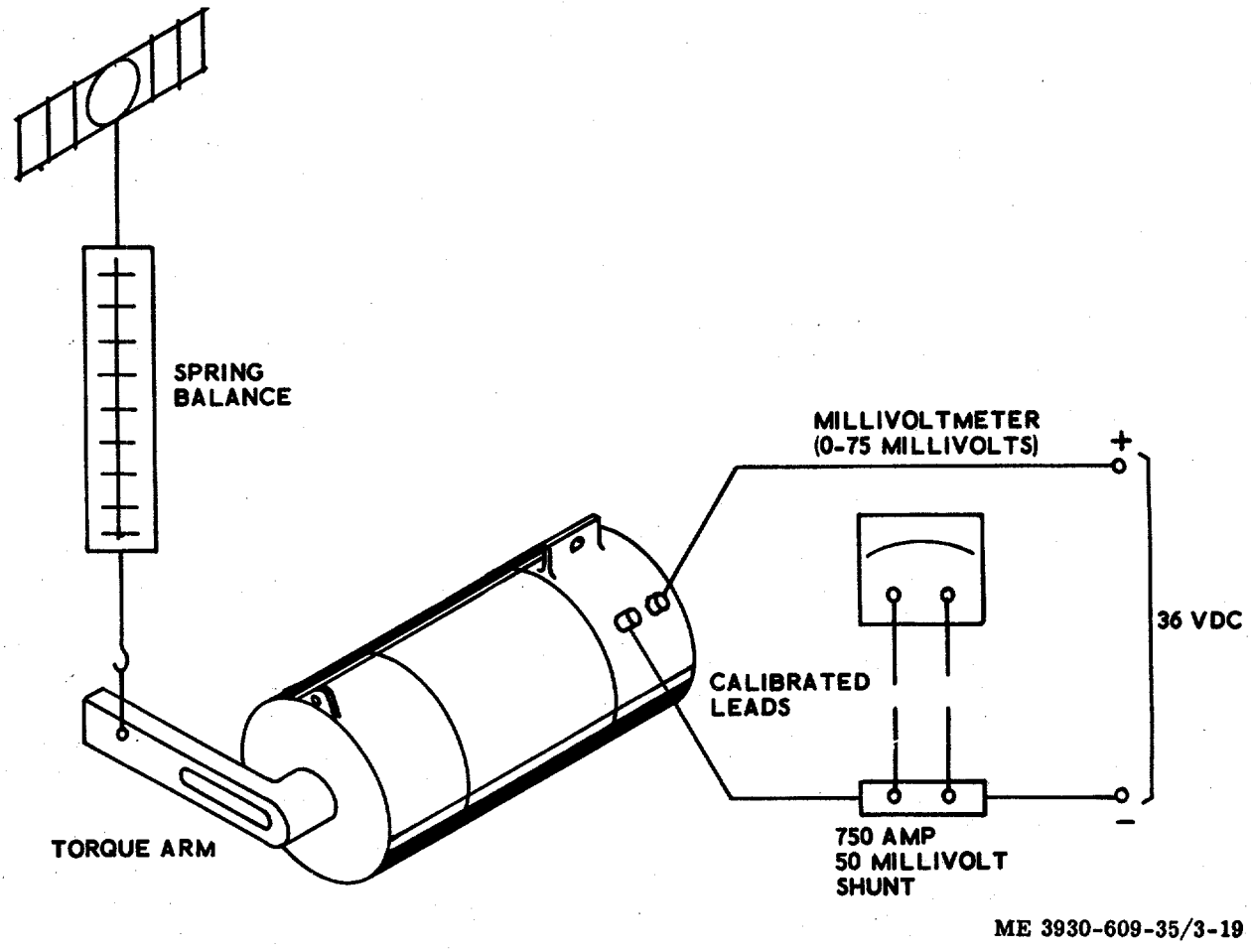

Figure 3-19. Setup for bench testing pump motor.

j. Insert ball bearing into bearing bore of rear motor yoke.

k. Carefully aline match marks on rear motor yoke with match marks on motor ring, guiding rear end of motor shaft into ball bearing in rear yoke. Secure rear yoke to motor ring with eight capscrews and lockwashers.

l. Install retaining ring in groove at rear end of armature shaft.

m. Install bearing retainer in rear yoke with three screws and lockwashers.

n. Before continuing assembly of motor, check that armature rotates freely without binding or dragging at any point. If binding or dragging is detected, locate and correct cause of trouble before proceeding.

o. Insert brushes into brushholders and secure shunts and jumpers to brushholders with machine screws, flatwashers and lockwashers. The proper internal connections are shown in figure 3-18.

p. Install brush springs on brushholders and secure with cotterpins.

q. Using a spring balance, check force of brush springs against brushes, brush springs must bear against brushes with 2.5 to 3 pound force. Replace brush springs if tension requirements are not met.

Caution

Do not apply voltage greater than 12 volts dc to pump motor terminals unless load is applied to motor. Motor will overspeed if higher voltage is applied without motor loadings.

r. Clamp motor to bench and apply 12 volts dc to terminals S1 (positive) and A2 (negative). Check that rotation is clockwise as viewed from commutator end of armature shaft.

s. While motor is running, lightly stone commutator if excessive sparking at brushes is observed. Disconnect motor from power source.

t. Install covers on front yoke and secure with cap screw, nut and lockwasher.

u. Using a high potential test set, apply 500 volts ac rms between terminal A2 and motor frame for one minute. There must be no evidence of insulation breakdown.

v. Clamp motor securely to top of bench and connect a torque arm (capable of applying no load to stall load) to armature shaft and to a spring balance. Connect motor electrically as shown in figure 3-19. Check motor at no load and at stalled rotor load for characteristics shown in the following chart.

3-98. Installation of Pump Motor
Refer to paragraph 2-22 for installation procedure.

Voltage	*Loading*	*Applied torque*	*Motor speed*	*Current (steady)*
36 volts dc	Equivalent to raising 2,000 pound load on forks	14 foot pounds	3,265 rpm ±5%	200 amps ±5%
36 volts dc	Stalled rotor	42 foot pounds minimum	0	525 amps ±5%

Section XIV. REPAIR OF ACCELERATOR CONTROLLER

3-99. Description of Accelerator Controller
The accelerator controller comprises a metal switch enclosure mounted on a welded steel bracket. The bracket provides the mounting for the controller below the accelerator pedal. A shaft extending from the enclosure is mechanically connected to the accelerator pedal through a lever and control rod. A return spring-(attached to the lever) returns the controller mechanism to the off position when the operator removes force from the accelerator pedal. Inside the enclosure, two cams attached to the shaft operate sensitive switches as the shaft is rotated through the accelerator pedal linkage. A sector gear mounted on the shaft rotates the shaft of a potentiometer mounted in the enclosure. A mechanical stop secured to the shaft limits shaft rotation in both directions.

3-100. Removal of Accelerator Controller
Removal of the accelerator controller from the truck is required for repair as described in the following instructions. Refer to TM 10-3930-609-12 for removal procedure.

3-101. Disassembly of Accelerator Controller (fig. 3-20)

a. Loosen nut on rod and unscrew rod from ball joint.

b. Remove screw and lockwasher which secure ball joint to lever and remove ball joint.

c. Disconnect' spring from capscrew inside of lever and remove capscrew and nut from lever.

d. Remove capscrew, nut and lockwasher which secure lever to shaft of controller and disengage lever from shaft.

e. Remove screws and lockwashers which secure controller to mounting bracket and separate controller from bracket.

f. Remove screws and lockwashers which secure cover to controller box assembly; then, remove cover to expose parts inside box assembly.

g. Remove screws which mount support to box assembly; then, lift out support with potentiometer and terminal block.

h. Disconnect potentiometer leads from terminal board; then, remove clamp and pinion from potentiometer shaft. Remove nut from hub of potentiometer and withdraw potentiometer from potentiometer bracket.

i. Ordinarily, removal of terminal boards, terminal board bracket and potentiometer bracket will not be required.

j. Remove screws which secure switch supports to box assembly; then, remove screws which secure, switches to switch supports and withdraw switches.

k. Loosen setscrew in stop, in gear sector hub and in collar and remove screws and lockwashers from cams; then, withdraw shaft from box assembly and remove two keys.

I. Remove collar, hub, gear sector, cams and stop from box assembly.

3-102. Cleaning Disassembled Parts of Accelerator Controller

a. Wash metallic non-electrical parts, if required, in SD and dry with compressed air under moderate pressure.

b. Clean electrical parts by wiping with a soft cloth.

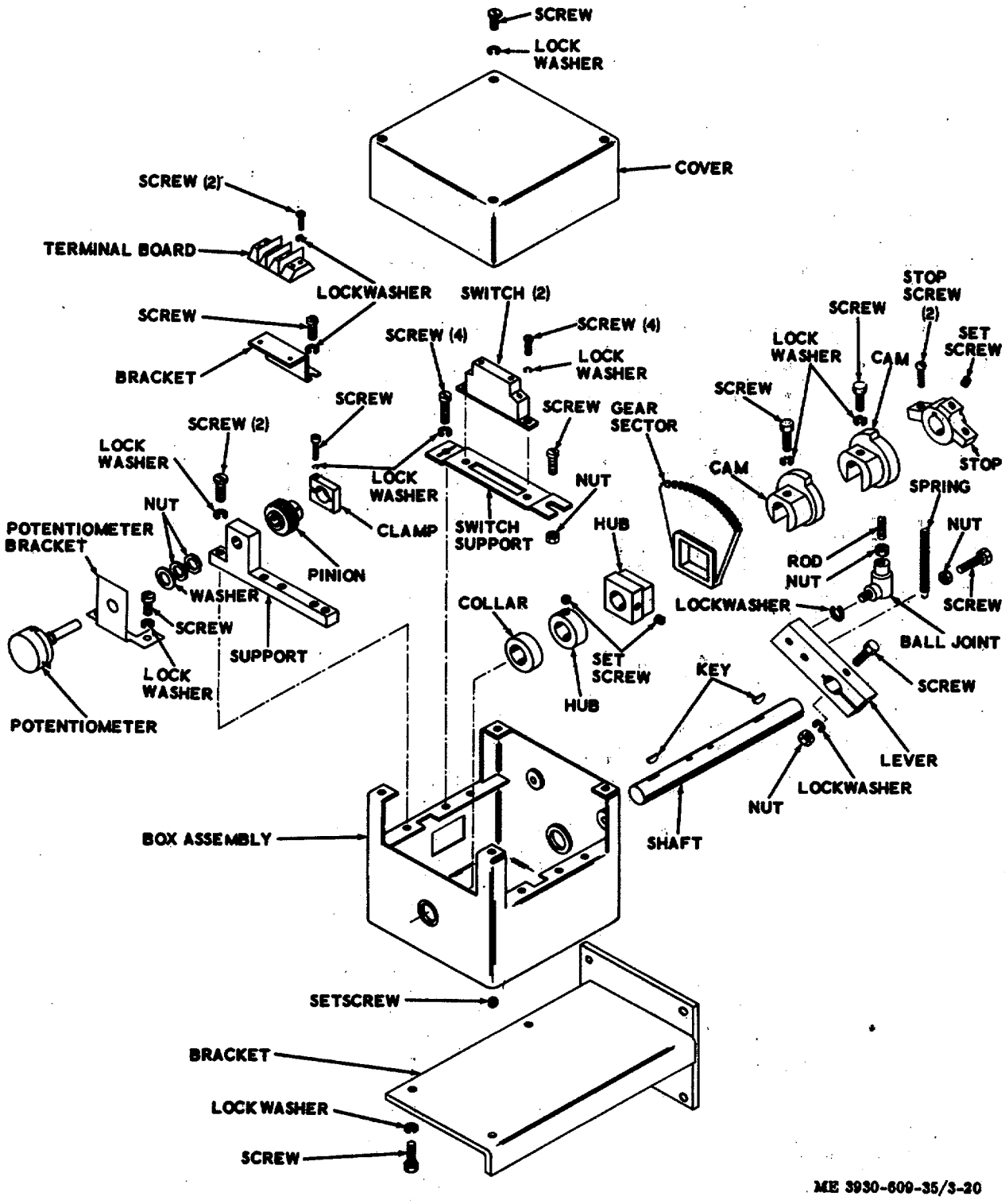

Figure 3-20. Accelerator controller, exploded view.

3-103. Inspecting Disassembled Parts of Accelerator Controller

a. Inspect all structural parts (brackets, supports, cover and box assembly) for cracks and deformation.

b. Using an ohmmeter, check switches for contact closure when operated manually.

c. Using an ohmmeter, check potentiometer for resistance variation of 600,000 to zero ohms when shaft is rotated through full range.

d. Check that resistance between either terminal of potentiometer and potentiometer case is one megohm minimum.

e. Inspect gear sector and pinion for worn or chipped teeth.

f. Inspect bearings in box assembly for excessive wear, causing looseness of shaft.

g. Inspect all threaded parts and tapped holes for stripped threads or other damage.

3-104. Repair and Replacement of Accelerator Controller Parts

a. Repair minor thread damage with tap or thread chaser.

b. Replace all distorted or worn parts with serviceable parts.

c. Replace switches or potentiometer if improper operation is detected while checking.

3-105. Reassembly of Accelerator Controller (fig. 3-20)

a. Insert shaft into box assembly bearing and place collar, hub and gear sector, cams and stop on shaft while inserting shaft, using keys in keyways in shaft. Secure collar, hub and stop to shaft with setscrews and secure cams to shaft with screws and lockwashers. Adjust stop screws to limit rotation of shaft to 30 degrees.

b. Mount switches on switch supports with screws; then, attach switch supports to box assembly with screws, nuts and fulcrums.

c. Attach terminal board to bracket on support with screws.

d. Mount potentiometer on potentiometer bracket with nut; then, mount pinion and clamp on potentiometer shaft and connect potentiometer leads to terminals board.

Note

If potentiometer has three terminals, select pair of terminals across which resistance decreases as shaft is rotated clockwise.

e. Rotate main shaft fully counterclockwise and rotate potentiometer shaft fully clockwise as seen from outer end of potentiometer shaft; then, back off two to three degrees. Mount support on box assembly with pinion gear on potentiometer shaft meshed with gear sector on shaft.

f. Adjust first switch support so that first switch actuates as main shaft is rotated approximately seven degrees clockwise. With first switch just actuated, resistance across potentiometer must be 3,500 to 6,600 ohms. If necessary, readjust timing of potentiometer by loosening shaft clamp and rotating potentiometer shaft in pinion. Tighten clamp after adjusting.

Note

Plunger in switches must have 1/32 inch overtravel after switch actuation. Adjust switch brackets using screw and nut. Ensure that nut is tight when making final check.

g. Adjust second switch to actuate when shaft is rotated to 27 degree position (corresponding to full speed of truck). With second switch just actuated, resistance across potentiometer must be 200 ohms or less.

h. Secure cover on box assembly with screws and lockwashers.

i. Mount box assembly on bracket with screws and lockwashers.

j. Mount lever on main shaft with screw, nut and lockwasher; mount screw and locknut for spring in lever; mount ball joint on lever with screw and lockwasher; and, screw rod into ball joint and lock with nut.

Section XV. REPAIR OF DIRECTIONAL CONTROL SWITCH

3-106. Description of Directional Control Switch

The directional control switch is a lever-operated, double-pole, double-throw switch with center off position. Detents are provided to maintain contacts in closed position when lever is released. A special trip mechanism returns the switch to the center off position from either on position when the operator rises from the seat.

3-107. Removal of Directional Control Switch

Removal of the directional control switch from the truck is recommended for repair as described in the following instructions. Refer to paragraph 2-19 for removal procedure.

3-108. Disassembly of Directional Control Switch (fig. 3-21)

a. Remove screw and lockwasher and disengage lever from shaft.

b. Remove screws which secure cover to housing and remove cover and washers.

c. Squeeze contact fingers together; then, rotate 1/4 turn and withdraw contact fingers and spring from .carrier.

d. Remove screws securing terminal boards in housing and lift out terminal boards.

e. Unhook springs from pins in arms and remove springs.

f. Remove screws securing clips to housing and remove clips and arm from housing.

g. Remove screw, lockwasher and flatwasher securing carrier to end of shaft; then, remove carrier, bushing and shaft from housing.

h. Remove nut, lockwasher and flatwasher; then, remove trip shaft trip lever housing.

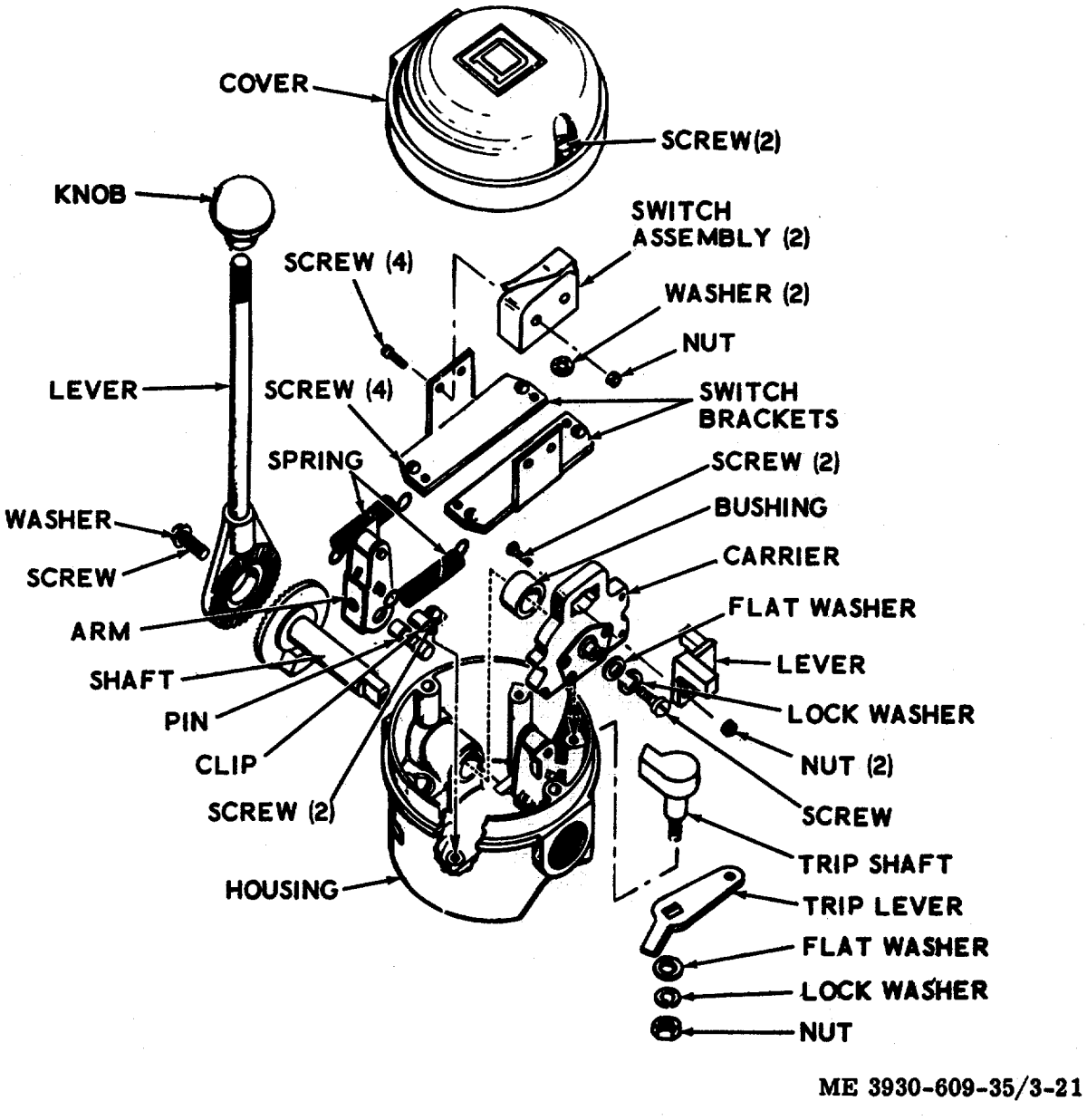

Figure 3-21. Directional control switch, exploded view.

3-109. Cleaning Disassembled Parts of Directional - Control Switch

a. Blow dust from parts with compressed air under moderate pressure.

b. If additional cleaning is required, wash parts in SD and dry with compressed air.

3-110. Inspection of Directional Control Switch Parts

a. Inspect threaded parts and tapped holes for stripped threads or other thread damage.

b. Inspect cover, housing, lever, arms, clips, carrier, contact fingers and terminal boards for cracks, distortion, corrosion or other damage.

c. Inspect contacts on terminal boards and on contact fingers for pitting, burning or other damage.

d. Inspect springs for excessive stretch.

3-111. Repair and Replacement of Directional Control Switch Parts

a. Repair minor thread damage with a tap or thread chaser.

b. Replace all cracked, distorted or corroded parts.

c. Replace springs if damaged in any way.

d. Replace terminal boards and contact fingers if contact points are pitted or burned.

3-112. Reassembly of Directional Control Switch (fig. 3-21)

a. Position trip lever in housing, install trip shaft and secure with flatwasher, lockwasher and nut.

b. Insert shaft through side of housing, then through bushing and carrier. Secure carrier to shaft with screw, lockwasher and fiatwasher.

c. Insert pins through arms; then, place arms in housing and secure with clips and screws.

d. Hook ends of springs to studs in arms. Rotate shaft and check for proper detent action.

e. Install terminal boards in housing with screws.

f. With spring inserted between contact fingers, squeeze fingers together and insert in carrier; then, rotate fingers 1/4 turn to lock, in carrier.

g. Secure cover to housing with screws and washers and attach lever to shaft with screw and lockwasher.

Section XVI. REPAIR OF PUMP AND MASTER SWITCH RELAYS

3-113. Description of Pump and Master Switch Relays

Two single pole relays of similar design are used in the electrical control system. Each relay has a single normally open set of contacts. One contact of the set is mounted on the relay armature which is spring loaded in the open position. The other contact is mounted on a fixed contact support.

3-114. Removal of Pump and Master Switch Relays

Removal of the pump and master switch relays from the control panel is required for repair as described in the following instructions. Refer to paragraph 226 or 227 as appropriate for removal procedures.

3-115. Disassembly of Pump and Master Switch Relays (fig. 3-22)

a. Remove capscrew and lockwasher at each end of shunt and withdraw shunt and terminal from contact support and terminal from contact support and frame assembly.

b. Remove self-locking nut, cup washer and spring from screw extending through fulcrum, guide and support; then, remove screw and fulcrum.

c. Remove screws securing guide to armature and screws securing support to frame assembly and withdraw these parts.

d. Remove retaining ring, cup washers and spring from pin, and separate pin and contact support from armature.

e. Remove self-locking nuts and lockwashers from threaded studs on contacts and remove contacts from both contact supports.

f. Remove screws and flatwashers which secure U-shaped contact support to base and withdraw contact support and shims.

g. Remove screws and flatwashers from posts; then, unscrew posts from frame assembly and remove spacers.

h. Remove retaining ring from frame assembly and lift coil and spring washer from frame assembly.

i. To separate frame assembly from base, take out screws and flatwashers which secure frame assembly to base.

3-116. Cleaning Disassembled Parts of Pump Relay and Master Switch Relay

a. Blow dust from parts with compressed air under moderate pressure.

b. If additional cleaning is required, wipe parts with cloth moistened with SD.

3-117. Inspecting Parts of Pump Relay and Master Switch Relay

a. Inspect all threaded parts for stripped or damaged threads.

b. Inspect terminals, support, armature, guide, contact supports and frame assembly for distortion, cracks or other damage.

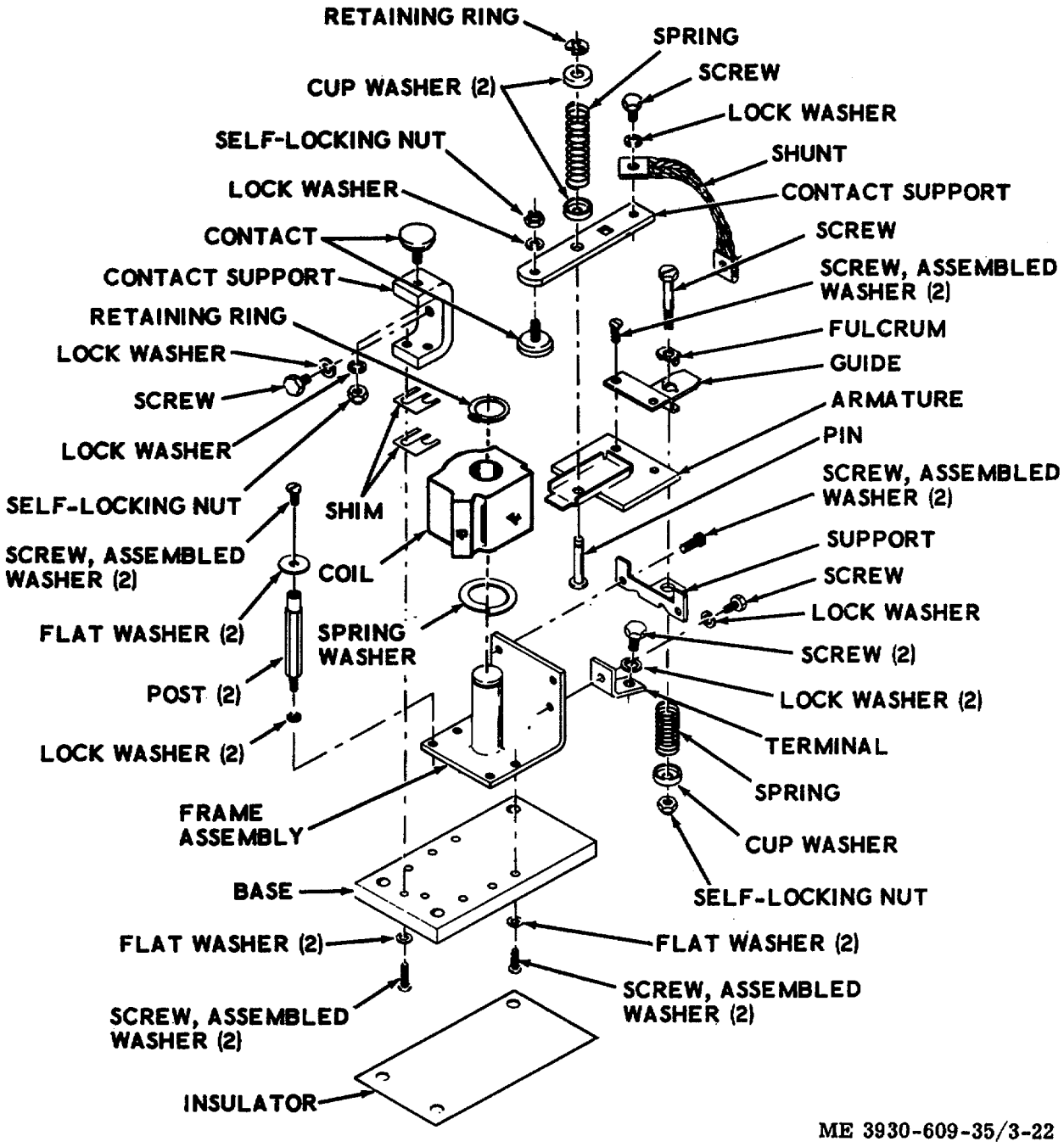

Figure 3-22. Pump relay and master witch relay, exploded view.

c. Inspect contacts for wear, pitting and burning.

d. Inspect shunt for fraying and for security of terminations.

e. Inspect springs for elongation or other distortion.

f. Using an ohmmeter, check that resistance of pump relay coil is 28.2 ± 2.8 ohms and that resistance of master switch relay coil is 46.9 ± 4.7 ohms at 70°F. Also inspect coil for damage due to overheating.

3-118. Repair and Replacement of Pump Relay and Master Switch Relay Parts

a. If contacts are slightly pitted or burned, smooth up surfaces with a file. Do not use emery cloth or sandpaper. Do not remove more metal than required to obtain smooth contact surfaces.

b. Repair minor thread damage with a tap' or thread chaser.

c. Replace all cracked or distorted parts.

3-119. Reassembly of Pump and Master Switch Relays (fig. 3-22)

a. Assemble frame assembly to base with screws and washers.

b. Place spring washer and coil on frame assembly and secure with retaining ring.

c. Screw threaded ends of posts into frame assembly; then, secure flatwashers to upper ends of posts with screws.

d. Mount U-shaped contact support on base with screws and flatwashers.

e. Mount contacts on U-shaped contact support and on flat contact support with lockwashers and self-locking nuts.

f. Assemble flat contact support on armature; insert pin through armature and contact support; and, assemble cup washer, spring, cup washer and retaining ring on pin.

g. Mount guide on armature with two screws and secure support to frame assembly with two screws.

h. Insert screw through fulcrum, through guide and through support; then, install spring and cup washer on screw and secure with self-locking nut.

i. Secure one end of shunt together with terminal to frame assembly with screw and lockwasher; and, secure other end of shunt to flat contact assembly with screw and lockwasher.

Section XVII. REPAIR OF FORWARD AND REVERSE RELAY

3-120. Description of Forward and Reverse Relay

The forward and reverse relay comprises two coils and two armatures and two sets of form C contacts. The two armatures operate independently; however, interlock switches are mounted on the magnet frames and are used in the circuit to prevent both coils from being energized simultaneously.

3-121. Removal of Forward and Reverse Relay

Removal of the forward and reverse relay from the control panel is recommended for repair in accordance with the following instructions. Refer to paragraph 2-29 for removal procedure.

3-122. Disassembly of Forward and Reverse Relay (fig. 3-23)

a. Remove screws, and lockwashers which secure upper contact support and two lower contact supports to molded contact support. Remove screws and lockwashers which secure bus to lower contact supports if separation of lower contact supports is required.

b. Remove screws, lockwashers and flatwashers which secure shunts to contact arms, and remove screws and lockwashers which secure shunts and busses to magnet frame; then, remove shunts and busses.

c. Remove cotterpins, cup washers and springs from studs on armatures and lift off right hand and left hand contact arms.

d. If contacts on contact arms or on contact supports require replacement, remove nuts from threaded studs on contacts and withdraw contact from arms and supports.

e. Remove screws, lockwashers and flatwashers which secure switches to brackets and remove switches.

f. Remove selflocking nuts, cup washers and springs from studs on armature supports; and, withdraw armatures from armature supports.

g. Remove screws, lockwashers and flatwashers which secure brackets and armature supports to magnet frames; and, withdraw brackets and armature supports.

h. Remove screws and lockwashers from center of coil cores; then, remove coil cores, spring washers and coils from magnet frames.

i. Remove flat head screws and lockwashers to separate magnet frames from molded contact supports.

3-123. Cleaning Disassembled Parts of Forward and Reverse Relay

a. Blow dust from parts with compressed air under moderate pressure.

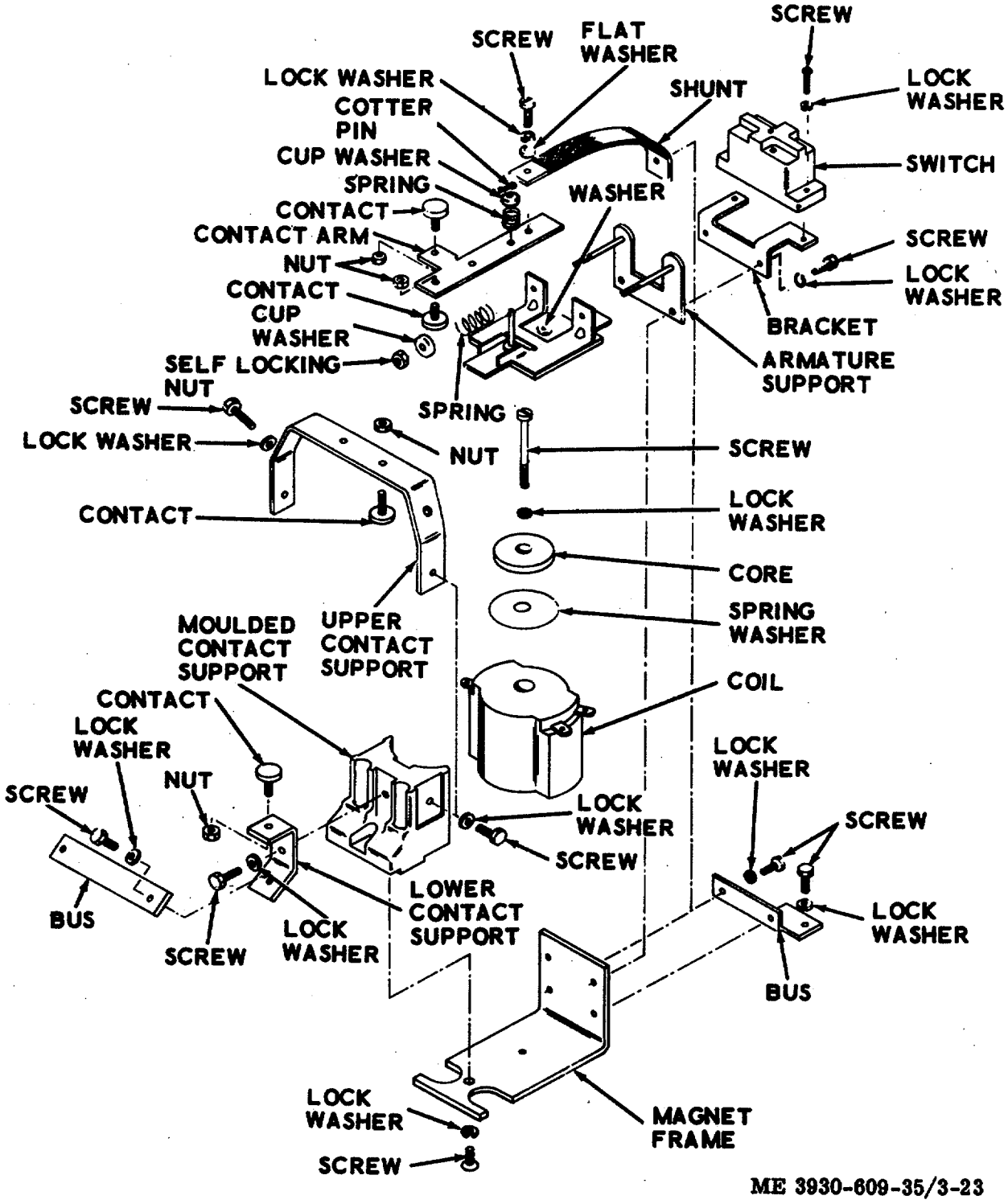

Figure 3-23. Forward and reverie relay, exploded view.

b. If additional cleaning is required, wipe parts with cloth moistened with SD.

3-124. Inspecting Parts of Forward and Reverse Relay

a. Inspect all threaded parts and tapped holes for stripping or other thread damage.

b. Inspect busses, contact arms, contact supports, armature supports, switch brackets, magnet frames and armatures for distortion or other damage.

c. Inspect contacts on contact arms and on contact supports for wear, pitting or burning.

d. Inspect shunts for fraying and for security of terminations.

e. Inspect molded contact supports for cracks or other damage.

f. Inspect all springs for distortion.

g. Using an ohmmeter or test light, check switches for operation as switch plungers are depressed.

h. Using an ohmmeter, check that each coil has a resistance of 28 ±2.8 ohms at 70°F. Also inspect coils for damage due to overheating.

3-125. Repair and Replacement of Forward and Reverse Relay Parts

a. If contacts are slightly pitted or burned, smooth up surfaces with a file. Do not use emery cloth or sandpaper. Discoloration on contacts does not affect proper operation and need not be removed if contacts are not pitted or burned. Do not remove more metal than necessary to obtain smooth contact surfaces.

b. Repair minor thread damage with a tap or thread chaser.

c. Replace all cracked or distorted parts.

d. Replace coils if damaged due to overheating or if resistance measured is not within specified limits.

3-126. Reassembly of Forward and Reverse Relay (fig. 3-23)

a. Mount molded contact supports on magnet frames with flat head screws and lockwashers.

b. Insert coil cores through spring washers and through coils and secure to magnet frames with screws and lockwashers.

c. Mount brackets and armature supports to magnet frames with screws, flatwashers and lockwashers.

d. Install armatures on armature supports; then, apply springs, cup washers and self-locking nuts to studs of armature supports.

e. Mount switches on switch brackets with screws, flatwashers and lockwashers.

f. Install contacts on contact supports and on contact arms and secure with nuts.

g. Place contact arms on studs in armatures; then, place spring and cup washer on each stud, and insert cotterpin through holes in studs. Spread prongs of cotterpins just sufficiently to retain cotterpins.

h. Secure one end of each shunt to each contact arm with a screw, flatwasher and lockwasher. Use a screw and lockwasher to secure other end of each shunt and bus to magnet frame.

i. Mount upper contact support on molded contact supports with screws and lockwasher.

j. Mount lower contact supports on molded contact supports with screws and lockwashers; then, attach both ends of bus to lower contact supports with screws and lockwashers.

Section XVIII. REPAIR OF ACCELERATOR RELAY

3-127. Description of Accelerator Relay

The accelerator relay comprises a coil and an armature and a form A contact. An interlock switch is mounted on the magnet frame.

3-128. Removal of Accelerator Relay

Removal of the accelerator relay from the control panel is recommended for repair in accordance with the following instructions. Refer to paragraph 2-28 for removal procedure.

3-129. Disassembly of Accelerator Relay (fig. 3-24)

a. Remove screws and lockwashers which secure stop and lower contact bracket to molded contact support.

b. Remove screw, lockwasher and flatwasher which secure shunt to contact arm and remove screw and lockwasher which secure shunt and bus to magnet frame; then, remove shunt and bus.

c. Remove cotterpin, cup washer and spring from stud on armature and lift off contact arm.

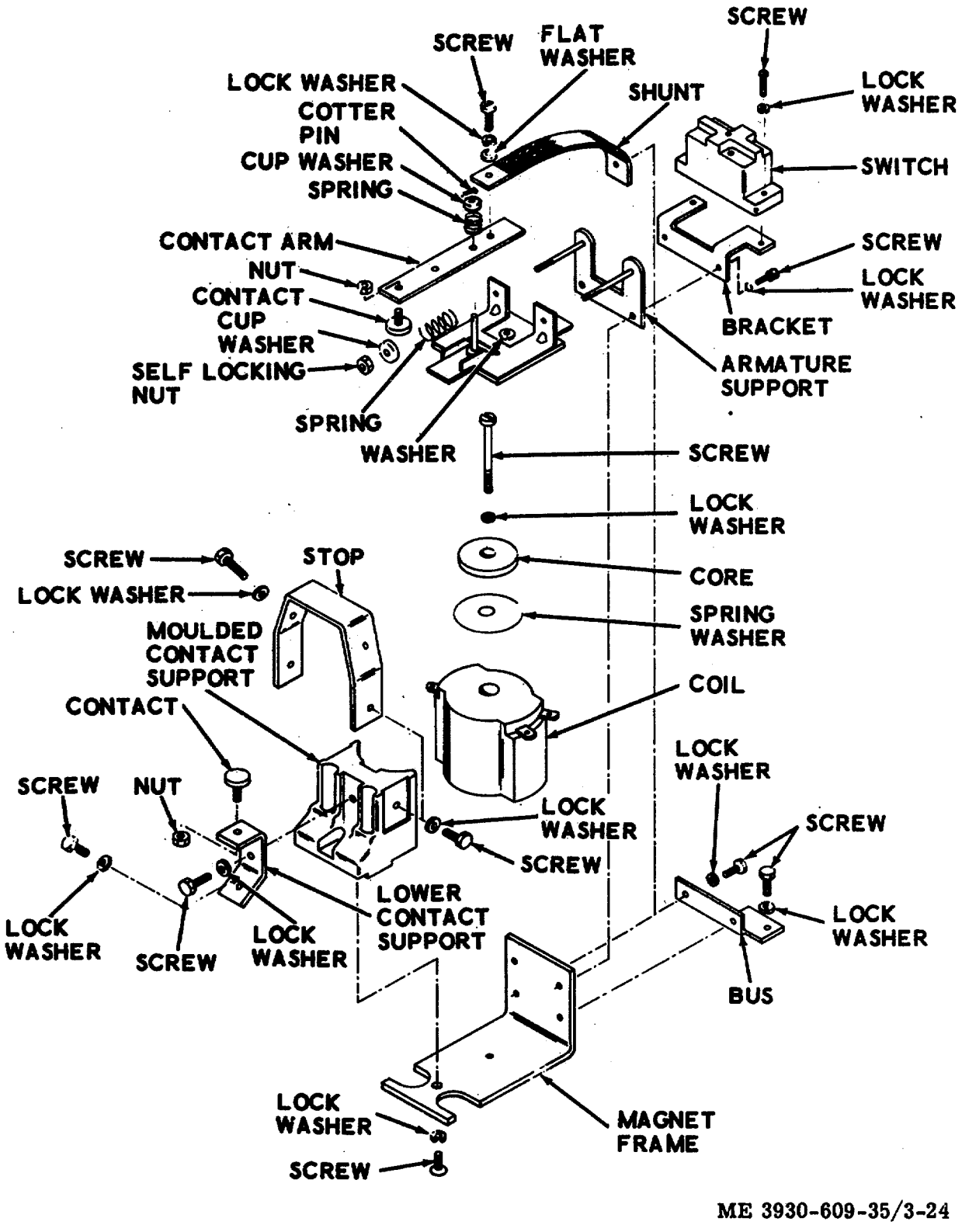

Figure 3-24. Accelerator relay, exploded view.

d. If contacts on contact arm or on contact bracket require replacement, remove nuts from threaded studs on contacts and withdraw contacts from arm and bracket.

e. Remove screws, lockwashers and flatwashers which secure switch to bracket, and remove switch.

f. Remove self-locking nuts, cup washers and springs from studs on armature support; and, withdraw armature from armature support.

g. Remove screws, lockwashers and flatwashers which secure bracket and armature support to magnet frame; and, withdraw bracket and armature support.

h. Remove screw and lockwasher from center of coil core; then, remove coil core, spring washer and coil from magnet frame.

i. Remove flathead screw and lockwasher to separate magnet frame from molded contact support.

3-130. Cleaning Disassembled Parts of Accelerator Relay

a. Blow dust from parts with compressed air under moderate pressure.

b. If additional cleaning is required, wipe parts with cloth moistened with SD.

3-131. Inspecting Parts of Accelerating Relay

a. Inspect all threaded parts and tapped holes for stripping or other thread damage.

b. Inspect bus, contact arm, contact bracket, armature support, switch bracket, magnet frame and armature for distortion or other damage.

c. Inspect contacts on contact arm and on contact bracket for wear, pitting or burning.

d. Inspect shunt for fraying and for security of terminations.

e. Inspect molded contact supports for cracks or other damage.

f. Inspect springs for distortion.

g. Using an ohmmeter or test light, check switch for operation as switch plunger is depressed.

h. Using an ohmmeter, check that coil has a resistance of 46.9 ± 4.7 ohms at 70° F. Also inspect coil for damage due to overheating.

3-132. Repair and Replacement of Accelerator Relay Parts

a. If contacts are slightly pitted or burned, smooth up surfaces with a file. Do not use emery cloth or sandpaper. Discoloration on contacts does not affect proper operation and need not be removed if contacts are not pitted or burned. Do not remove more metal than necessary to obtain smooth contact surfaces.

b. Repair minor thread damage with a tap or thread chaser.

c. Replace all cracked or distorted parts.

d. Replace coil if damaged due to overheating or if resistance measured is not within specified limits.

3-133. Reassembly of Accelerator Relay (fig. 3-24)

a. Mount molded contact support on magnet frame with flathead screw and lockwasher.

b. Insert coil core through spring washer and through coil and secure to magnet frame with screw and lockwasher.

c. Mount bracket and armature support to magnet frame with screws, flatwashers and lockwashers.

d. Install armature on armature support; then, apply springs, cup washers and self-locking nuts to studs of armature support.

e. Mount switch on switch bracket with screws, flatwashers and lockwashers.

f. Install contacts on contact bracket and on contact arm and secure with nuts.

g. Place contact arm on stud in armature; then, place spring and cup washer on stud, and insert cotterpin through hole in studs. Spread prongs of cotterpin just sufficiently to retain cotter-pin.

h. Secure one end of shunt to contact arm with a screw, flatwasher and lockwasher. Use a screw and lockwasher to secure other end of shunt and bus to magnet frame.

i. Mount stop on molded contact support with screws and lockwashers.

j. Mount contact bracket on molded contact support with screw and lockwasher.

APPENDIX A

REFERENCES

A-1. Fire Protection

TB 5-4200-200-10	Hand Portable Fire Extinguishers Approved for Army Users

A-2. Lubrication

C9100IL	Fuels, Lubricants, Oils and Waxes
LO 10-3930-609-12	Truck, Lift, Fork, Electric, Solid Rubber Tires, 2,000-Pound Capacity, Army Model MHE-204, Baker Model FTD-020-EE-SS, FSN 3930-935-7864

A-3. Painting

TM 9-213	Painting Instructions for Field Use

A-4. Radio Suppression

TM 11-483	Radio Interference Suppression

A-5. Maintenance

TM 38-750	Army Equipment Procedures
TM 9-6140-200-15	Operation and Organizational Field and Depot Maintenance Storage Batteries, Lead Acid Type
TM 5-764	Electric Motor and Generator Repair

A-6. Shipment and Storage

TB 740-93-2	Preservation of USAMEC Mechanical Equipment for Shipment and Storage
TM 740-901	Administrative Storage of Equipment

INDEX

INDEX

INDEX

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

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