

**TECHNICAL MANUAL**  
**DIRECT SUPPORT AND GENERAL SUPPORT**  
**MAINTENANCE MANUAL**  
**TRUCK, LIFT, FORK, GED, SOLID RUBBER WHEELS**  
**4000 LBS CAPACITY 180 IN. LIFT (ARMY MODEL**  
**MHE209) (ALLIS CHALMERS MODEL F40-24PS)**  
**FSN 3930-459-5948**

**This copy is a reprint which includes current  
pages from Changes I through 4.**

**HEADQUARTERS, DEPARTMENT OF THE ARMY**  
**DECEMBER 1970**

## **SAFETY PRECAUTIONS**

### **Before Operation**

When servicing battery, do not smoke or use flame in the vicinity. Batteries generate hydrogen, a highly explosive gas.

Check to be sure there is sufficient engine coolant and engine lubricant before starting the engine.

Do not fill fuel tank while engine is running. Provide metallic contact between the fuel container and fuel tank to prevent a static spark from igniting the fuel.

Always correct or report any faulty conditions that may result in further damage to the truck or cause injury to personnel.

Check the operating area to be sure it is clear of personnel and obstructions.

### **During Operation**

Do not fill fuel tank while engine is running as fuel vapors may be ignited.

Do not remove the radiator cap from an overheated radiator; stop engine and allow radiator to cool before removing cap to avoid injury by scalding. Allow the engine to cool before filling the radiator, otherwise there is danger of cracking the cylinder head for block.

Do not operate the truck in a closed building without providing adequate ventilation as the exhaust contains carbon monoxide, a colorless, odorless, poisonous gas.

Do not work on the engine while in operation, except for designated adjustments which must be made with the engine operating.

Do not shift directional shift lever while truck is in motion.

### **After Operation**

Make sure forks are lowered to the ground when truck is parked and engage parking brake firmly.

If the truck is parked on an incline, block at least two wheels in the event of parking brake failure.

If engine cooling system or any lubricating oil sump is drained, make certain appropriate warning tags are attached to the steering wheel.

Report or correct any faulty condition that may result in damage to the truck or cause injury to personnel if operation of the truck is continued.

CORRECTED COPY  
Changes In force: C 1, C 2, C 3 and C 4 TM 10-3930-621-34

CHANGE

NO. 4

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
Washington D.C., 30 September 1991

**DIRECT SUPPORT AND GENERAL SUPPORT  
MAINTENANCE MANUAL  
TRUCK, LIFT, FORK; GED; SOLID RUBBER TIRED WHEELS;  
4, 000-LB CAPACITY; 180-INCH LIFT (ARMY MODEL MHE209)  
ALLIS CHALMERS MODEL F40-24PS, NSN 3930-00-459-5948;  
100-INCH LIFT (ARMY MODEL MHE224)  
ALLIS CHALMERS MODEL F40-24PS100, NSN 3930-00-165-4102**

TM 10-3930-621-34, 3 December 1970, is changed as

Page 1-1, the following paragraph is added after Section H. "DESCRIPTION AND DATA".

A decal has been developed that warns of NBC exposure.: It is to be positioned in a noticeable place on or near the air cleaner or air filter housing. You may order the decal using part number 12296626, CAGEC 19207. Refer to TB 43-0219 for further information. Add the decal to the to the air cleaner (page 3-5, figure 3-2).

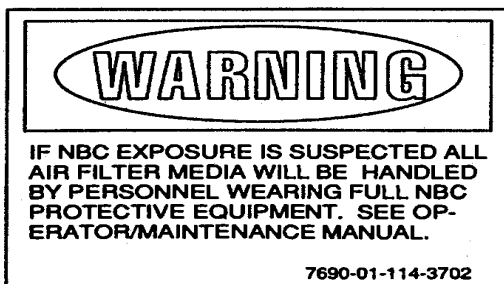
Add the following WARNING to the following locations;

inside *front cover*';

page 1-1, after Section II. "DESCRIPTION AND DATA":

**WARNING**

If NBC exposure is suspected, all air filter media should be handled by personnel wearing protective equipment. Consult your unit NBC Officer or NBC NCO for appropriate handling or disposal instructions.



By Order of the Secretary of the Army:

GORDON R. SULLIVAN  
General, United States Army  
Chief of Staff

Official:

PATRICIA P. HICKERSON  
Brigadier General, United States Army  
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-25-E ( Block 2193) Direct Support and General Support maintenance requirements for TM10-3930621-34.

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CORRECTED COPY  
Changes in force: C 1, C 2, and C 3

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, DC 28 June 1984

**DIRECT SUPPORT AND GENERAL SUPPORT  
MAINTENANCE MANUAL  
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4, 000-LB CAPACITY; 180-INCH LIFT (ARMY MODEL MHE 209)  
ALLIS CHALMERS MODEL F40-24PS, NSN 3930-00459-5948;  
100-INCH LIFT (ARMY MODEL MHE 224)  
ALLIS CHALMERS MODEL F40-24PS100, NSN 3930-00-1654102**

TM 10-3930-621-34, 3 December 1970, is changed as follows:

*Inside front cover.* The title Safety Precautions is changed to read WARNINGS.

*Inside front cover, Paragraph Before Operation.* At the end of line 6 add wipe or flush any spillage.

*Paragraph Before Operation following line 9 add line 10 as follows:* Make sure fire extinguisher (Class B) is on the truck.

*Paragraph During Operation.* Lines 2, 3, 4 and 5 are superseded as follows:

Remove radiator cap slowly to relieve pressure before completely removing when engine is hot. Do not remove radiator cap from an overheated radiator. Stop engine and allow radiator to cool before removing cap to avoid injury by scalding. Allow the engine to cool before filling the radiator, otherwise there is danger of cracking the cylinder head or block. Should you be scalded, seek medical aid immediately.

*Paragraph During Operation.* Lines 6, 7, and 8 are superseded as follows:

**WARNING**

**CARBON MONOXIDE (EXHAUST GAS) CAN KILL YOU**

Carbon monoxide is without color or smell, but it can kill you. Breathing air with carbon monoxide produces symptoms of headache, dizziness, loss of muscular control, a sleepy feeling, and coma. Brain damage or death can result from heavy exposure. Carbon monoxide occurs in the exhaust fumes of fuel-burning heaters and internal combustion engines. Carbon monoxide can become dangerously concentrated under conditions of no air movement. Precautions must be followed to ensure crew safety when the personnel heater, main, or auxiliary engine of any vehicle is operated for any purpose.

DO NOT operate personnel heater or engine of vehicle in a closed place unless the place has a lot of moving air.

DO NOT idle engine for long periods without ventilator blower operating. If tactical situation permits, open hatches.

DO NOT drive any vehicle with inspection plates, cover plates, or engine compartment doors removed unless necessary for maintenance purposes.

BE ALERT at all times during vehicle operation for exhaust odors and exposure symptoms. If either is present, IMMEDIATELY VENTILATE personnel compartments. If symptoms persist, remove affected crew to fresh air and keep warm, DO NOT PERMIT PHYSICAL EXERCISE; if necessary, give artificial respiration.

FOR ARTIFICIAL RESPIRATION, REFER TO FM21-11.

BE AWARE; the field protective mask for chemical-biological-radiological (CBR) protection will not protect you from carbon monoxide poisoning.

THE BEST DEFENSE AGAINST CARBON MONOXIDE POISONING IS GOOD VENTILATION.

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**WARNING**

Death or severe injury may result if forklift truck engine is operated in an enclosed area without providing adequate ventilation. Exhaust fumes contain carbon monoxide, a color- less, odorless, poisonous gas.

Paragraph After Operation. Lines 3 and 4 are superseded as follows: If truck is parked on an incline, set brakes and block at least two wheels in the event of parking brake failure.

*After inside front cover*, before page i, the following warnings are added:

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**WARNING**

**FIRE HAZARD**

Diesel fuel and combustible materials are used in operation and maintenance of this equipment. Do not smoke or allow open flames or sparks into areas where diesel fuel and combustible materials are used or stored. Death or serious injury could result if personnel fail to observe this precaution. If you are burned, seek medical aid immediately.

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**WARNING**

**OIL UNDER PRESSURE**

2500 psi pressure is used to operate this equipment. Never disconnect any hydraulic lines or fittings without checking manual to see how to drop the pressure to zero. Failure to follow this precaution could cause severe injury. Should you be struck by a high pressure oil stream, seek medical help immediately.

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**WARNING**

**ELECTRIC SHOCK HAZARD**

Always disconnect battery ground cable before working on electrical components of this equipment. Death or severe injury could result if you fail to observe this precaution. If you receive an electric shock, seek medical help immediately.

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**WARNING**

**FALLING EQUIPMENT HAZARD**

Never crawl under equipment when performing maintenance unless equipment is blocked securely. Keep clear of equipment when it is raised or lowered. Do not allow heavy components to swing while suspended by lifting device. Exercise extreme caution when working near a cable or chain under tension. Death or severe injury could result if personnel fail to observe this safety precaution. If you are hurt by a falling object, or chain or cable under tension, seek medical aid.

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**WARNING**

**RETAINING RINGS UNDER SPRING TENSION**

Exercise care when removing snap rings/retaining rings. Some of these parts are under spring tension. Severe injury could result by the part striking your eye if you don't observe this precaution. If your eye is struck by a foreign object, seek medical aid immediately.

---

**WARNING**

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

**WARNING**

**TOXIC/FLAMMABLE**

Drycleaning solvent SD II, used to clean parts, is toxic and flammable. Wear protective goggles and gloves, and i e only in a well-ventilated area. Avoid contact with skin, eyes, and clothes, and do not breathe vapors. Do not use near open flame or excessive heat, and do not smoke when using it. Failure to do so could result in serious injury or loss of life. If you become dizzy while using cleaning solvent SD II, get fresh air immediately, and get medical attention. If contact with skin or clothes is made, flush with large amounts of water. If contact with eyes is made, wash with water immediately, and obtain medical aid immediately.

**WARNING**

NBC-(Nuclear, Biological, Chemical) contaminated filters must be handled using adequate precautions, (FM 21-40), and must be disposed of by trained personnel.

**WARNING**

When working on the brake system or asbestos fiber pad removal, use the wet process only. The wet process involves the use of running water to rinse away asbestos dust. Using com- pressed air to remove asbestos creates dust extremely dangerous to your health. Inhaled asbestos dust is carcinogenic and remains permanently in your breathing system.

**WARNING**

If you sustain any injuries, no matter how slight, follow first aid procedures outlined in FM 24-11.

**WARNING**

Particles blown by compressed air are hazardous. Make certain the airstream is directed away from user and other personnel in the area. To prevent injury, user must wear eye goggles or face shield when using compressed air.

**WARNING**

Operation of this equipment presents a noise hazard to personnel in the area. The noise level exceeds the allowable limits for unprotected personnel. Wear ear muffs or ear plugs.

Page i. Title is changed to read as follows:

**DIRECT SUPPORT AND GENERAL SUPPORT  
MAINTENANCE MANUAL  
TRUCK, LIFT, FORK; GED; SOLID RUBBER TIRED WHEELS;  
4, 000-LB CAPACITY; 180-INCH LIFT (ARMY MODEL MHE 209)  
ALLIS CHALMERS MODEL F40-24PS NSN 3930-00-459-5948  
100-INCH LIFT (ARMY MODEL MHE 224)  
ALLIS CHALMERS MODEL F40-24PS100, NSN 3930-00-1654102**

Page i. Reporting of errors and recommending improvements statement is added after the title as follows:

**REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS**

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

Page i, table of contents. Chapter 3, section V "Cylinder head" is added.

Chapter 6, "section V Propeller shaft, paragraph 6-24 and 6-25, page 6-20" is added after section IV.

Page iii, list of illustrations. The following changes are made.

Line 6, 3-5 flywheel assembly."3-5.1 Cylinder head, exploded view page 3-7" and "3-5.2 Cylinder head tightening sequence page 3-7" are added after line 6.

Line 7, 3-6 Camshaft, valves, and tappets. "3-6.1 Flywheel timing marks, page 6-9" and "3-6.2 loosening valve tappet locknut, page 3-9" and "3-6.3 Checking valve clearance, page 3-9" are added after line 7.

Line 47, 6-12 "Inching control pedal, page 6-17" is rescinded.

Line 48, 6-13 "Inching control adjustment, page 6-19" is rescinded.

Line 48, 6-13 Inching control adjustment."6-14 Propeller shaft, installed view, page 6-20" and "6-15 Propeller shaft, exploded view, page 6-20" are added after line 48.

Line 60,"8-3 Brake pedal and parts, page 8-4" is rescinded.

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

**1-2. Maintenance Forms and Records**

Equipment maintenance forms and procedures for their use are contained in DA PAM 738-750.

Page 2-1, paragraph 2-2, line 2 "TM 10-3930-621-35P" is changed to read "TM 10-3930-621-34P".

Table 2-1 Troubleshooting. Malfunction 1, probable cause column, add the following: c. Cylinder head gasket leaking. In corrective action column add the following: c. Replace gasket (para 3.16.1).

Page 2-2. Table 2-1, corrective action column, item 13c "Tighten or replace (TM 10-3930-621- 12)" is changed to read "'Tighten or replace (para 6-24)".

Malfunction 18, probable cause column, add the following: c. Cylinder head gasket leakage. In corrective action column add the following:  
c. Replace gasket (para 3.16.1).

Page 24, paragraph 2-5a (9) "(TM 10-3930-621- 12)" is changed to read "(para 6-24)".

Paragraph 2-6a (4) "(TM 10-3930-621-12)" is changed to read "(para 6-24)".

Page 2-5. Paragraph 2-6b (7) "in accordance with TM 10-3930-621-12." is changed to read "(para 6-24)".

Page 3-3, paragraph 3-3d "(TM 10-3930-621-12)" is changed to read "(para 3-16.1)".

Paragraph 3-6h is superseded as follows:

h. Install cylinder head and torque to 60-62 foot pounds (para 3-16.1).

(1) Install the following (TM10-3930-621-12)

(a) Manifold, carburetor, and fuel pump.

(b) Water pump and water pump lines



(c) Fan, belt, and pulley.  
Page 3-6. Change "(Spec P-S-661)" to read "SD- II" in all paragraphs listed below.

Page	Paragraph	Line
3-6	3-9a	2
3-7	3-14a	2
3-9	3-19b (1)	2
3-12	3-27a	2
3-16	3-38a	2
3-17	3-40c (1)	2
3-20	3-41c (1)	2
4-1	4-2 NOTE	2
4-2	4-4a (1)	2
4-4	4-10a	2
4-6	4-16b	2
4-8	4-17a	2
4-8	4-17c	3
5-6	5-12a	2
6-9	6-4a	2
6-14	6-13c	2
6-14	6-15a	2
6-17	6-21a	2
7-2	7-2b (1)	2
7-4	7-3b (1)	2
7-7	7-4b (1)	2
7-11	7-8a	2
8-8	8-14b	2
9-5	9-4a	2
9-10	9-10a	2
10-3	10-6a	2
10-3	10-6.la	2
10-8	10-13a	2
10-14	10-19a	2
10-18	10-30a	2
10-19	10-34a	2
10-21	10-39b	2
10-23	10-40a (1)	2
10-24	10-44g	2
10-25	10-46a	2
10-28	10-49.4a	2
10-29	10-52a	2

Page 3-7. Paragraph 3-14a (1) "(TM 10-3930-621- 12)" is changed to read "(Para 3-16.1)".

Paragraph 3-16.1 is added as follows:

#### 3-16.1.Cylinder Head

- a. Removal. Remove cylinder head as follows:
- (1) Drain radiator (TM 10-3930-621-12) to lower water level below cylinder head.
  - (2) Remove the thermostat housing and thermostat (TM 10-3930-621-12).

(3) Remove spark plugs and ignition cables (TM 10-3930-621-12).

(4) Refer to figure 3-5.1 and remove the cylinder head and gasket as follows:

(5) Remove one bolt (1) and lifting eye (2). Remove ten bolts (3) and two bolts (15). Remove two nuts (4) and lockwashers (5).

(6) Remove cylinder head (16) and gasket (17).

#### b. Cleaning and Inspection.

(1) Clean all carbon from combustion areas on cylinder head and engine block. Scrape carbon from surfaces with a scraper or wire brush.

(2) Clean cylinder head with cleaning compound, solvent SD-II and dry thoroughly.

(3) Clean all gasket surfaces on cylinder head and block and inspect for nicks or cracks that could cause leaks. Check surfaces with a straight- edge for warpage.

#### c. Installation.

(1) Refer to figure 3-5.1 and install new gasket (17) on engine block and install cylinder head (16). Secure cylinder head (16), cable support (8), and lifting eye (2) with bolts (1, 3, and 15), nuts (4), and lockwashers (5).

(2) Following sequence shown in figure 3-5.2, apply 20 foot pounds of torque to all bolts and nuts. Repeat procedure applying 40 foot pounds of torque. Repeat procedure applying final torque 60-62 foot pounds to all bolts and nuts.

(3) Install thermostat housing and thermostat (TM 10-3930-621-12).

(4) Install spark plugs and cables (TM 10-3930-621-12).

(5) Replenish coolant in radiator before starting engine (TM 10-3930-621-12).

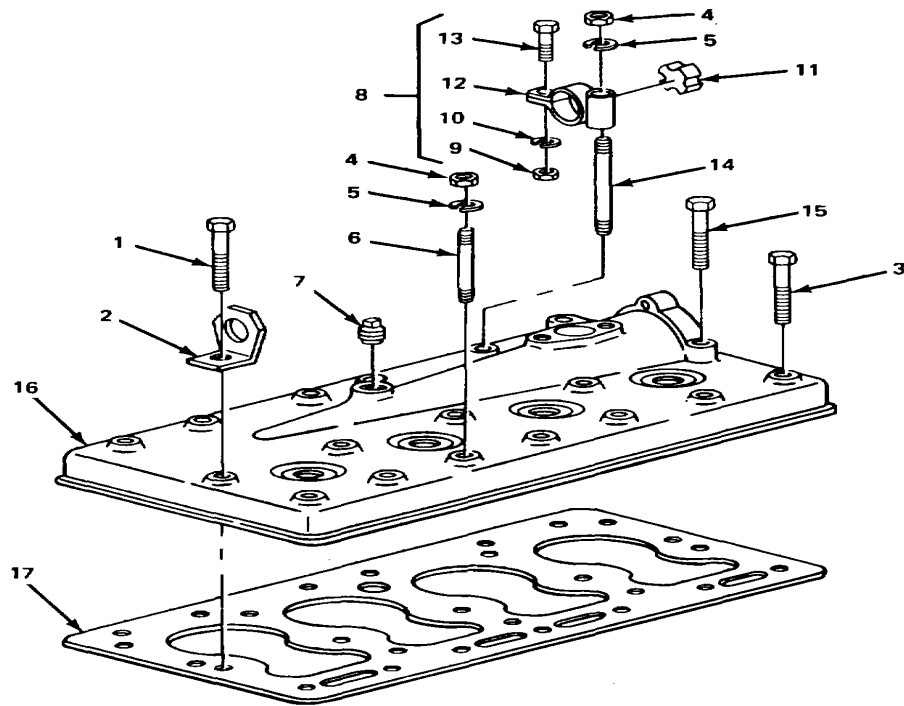
Paragraph 3-17a (1) "(TM 10-3930-621-12)" is changed to read "(para 3-16.1)".

Paragraph 3-17a (2) is superseded as follows: (2) Remove valve covers on side of engine block.

(a) Remove PCV hose.

(b) Refer to TM 10-3930-621-12, disconnect fuel lines and remove carburetor.

(c) Refer to TM 10-3930-621-12, remove hourmeter actuating transmitter.



- |                |                           |                          |
|----------------|---------------------------|--------------------------|
| 1. BOLT        | 7. PIPE PLUG              | 13. SCREW                |
| 2. LIFTING EYE | 8. CABLE SUPPORT ASSEMBLY | 14. STUD                 |
| 3. BOLT        | 9. NUT                    | 15. BOLT                 |
| 4. NUT         | 10. LOCK WASHER           | 16. CYLINDER HEAD        |
| 5. LOCK WASHER | 11. SUPPORT BLOCK         | 17. CYLINDER HEAD GASKET |
| 6. STUD        | 12. CABLE SUPPORT         |                          |

Figure 3-5.1. Cylinder head, exploded view.

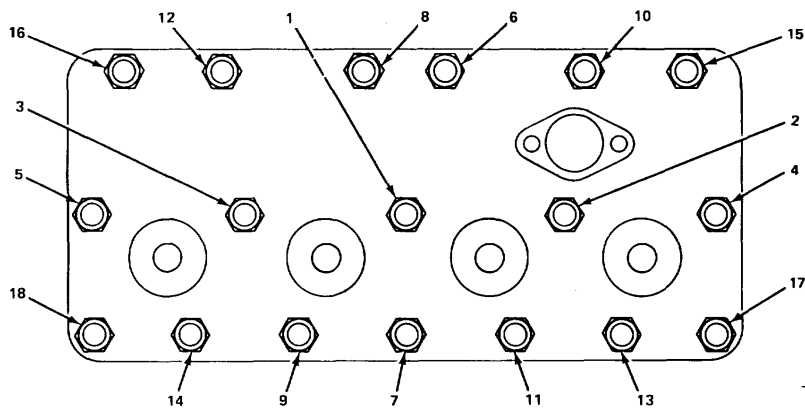


Figure 3-5.2. Cylinder head tightening sequence

(d) Remove nut and washer securing front cover.

(e) Refer to TM 10-3930-621-12, disconnect fuel lines from fuel pump and remove fuel pump.

(f) Remove capscrew and washer securing rear cover.

Page 3-9. Paragraph 3-17d (4) is superseded as follows:

(4) Adjust valves (para 3-20.1).

Paragraph 3-18b "TM 10-3930-621-12" is changed to read "(para 3-16.1a)".

Paragraph 3-18c (3) "TM 10-3930-621-12" is changed to read "(para 3-16.1c)".

Page 3-10. Paragraph 3-20c (3), line 2 "madrel" is changed to read "mandrel".

Paragraph 3-20.1 is added as follows:

### 3-20.1. Valve Adjustment.

a. *General.* Valve clearance settings must be correct to ensure good engine performance and prolonged life. Damage to tappets, cam, and valves can result if clearance and timing are out of adjustment.

b. *Preparation.*

(1) Remove front valve cover by:

(a) Remove PCV hose.

(b) Refer to TM 10-3930-621-12, disconnect fuel lines and remove carburator.

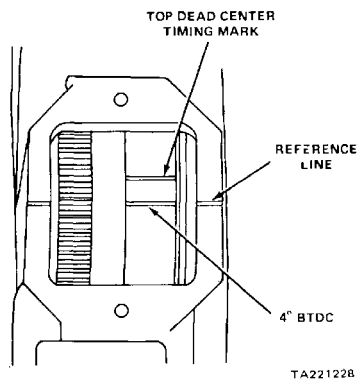


Figure 3-6.1. Flywheel timing marks,

(c) Refer to TM 10-3930-621-12, remove hourmeter actuating transmitter.

(d) Remove nut and washer securing front cover.

(2) Refer to TM 10-3930-621-12, disconnect fuel lines from fuel pump and remove fuel pump.

(3) Remove capscrew and washer securing rear cover

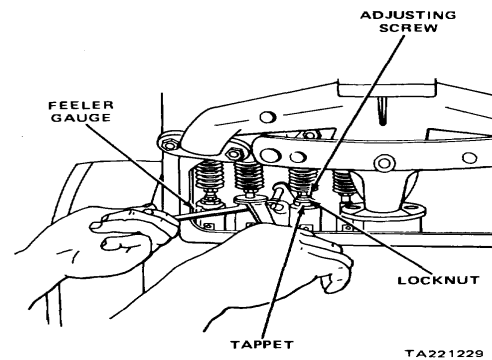


Figure 3-6.2. Loosening valve tappet locknut

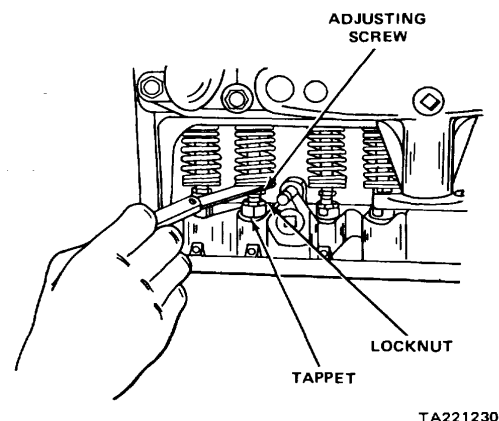


Figure 3-6.3. Checking valve clearance.

*c. Clearance Adjustment.*

(1) Disconnect high tension wire leading from coil to distributor to prevent accidental starting.

(2) Refer to TM 10-3930-621-12 and remove spark plugs. Remove the timing cover and clamp from flywheel housing.

(3) Place thumb over number one cylinder spark plug opening. Have someone crank engine slowly by hand until an outward pressure can be felt on thumb indicating that number one piston is moving toward top dead center.

(4) Continue cranking until timing mark on flywheel is aligned with reference line on flywheel housing. Refer to figure 3-6.1. At this point both valves of number one cylinder are closed.

(5) Use two thin open-end wrenches as shown in figure 3-6.2 and make adjustment as follows:

(6) Loosen the locknut.

(7) Hold the tappet with the lower wrench and raise or lower the tappet adjusting screw.

(8) Continue adjusting the clearance until a feeler gage of proper thickness fits snugly between the valve stem and tappet adjusting screw (fig. 3-6.3). For the intake valve use a 0.007- to 0.009- inch feeler gage, and for the exhaust valve, a 0.011- to 0.013-inch feeler gage.

Paragraph 3-22e. The caution is superseded as follows:

**Section V. PROPELLER SHAFT**

**6-24. General**

a. A short propeller shaft connects the transmission to the front drive axle. The propeller shaft is attached to flanges at the transmission output shaft and the parking brake.

b. The propeller shaft transmits torque from the transmission to the front drive axle.

**6-25. Propeller Shaft**

*a. Removal.* Refer to figure 6-14 and remove the propeller shaft as follows:

(1) Remove lock wires and eight screws attaching propeller shaft universal joints to transmission and parking brake flange.

(2) Slide output shaft into transmission to allow room for removal of propeller shaft (4). Remove propeller shaft.

*b. Disassembly.* Refer to figure 6-15 and disassemble the propeller shaft as follows:

**CAUTION**

Do not allow sleeve bearing and cam lobes to catch or be scratched.

(9) Tighten the locknut when the correct clearance is obtained. Recheck clearance. (10) Crank the engine one-half revolution at a time and adjust remaining sets of valves in succession according to the firing order (1-3-4-2).

*d. Install Valve Chamber Covers.*

(1) Install new gasket and valve chamber covers over holddown studs. Secure covers with nuts and lockwashers.

(2) Covers must make an oil-tight seal with crankcase. Check for leaks after starting engine.

(3) Refer to TM 10-3930-621-12, install fuel pump, fuel lines, and hourmeter actuating transmitter.

(4) Install timing mark cover and clamp on flywheel housing.

(5) Connect high-tension wire to coil and distributor.

(6) Refer to TM 10-3930-621-12 and install spark plugs.

Page 3-12. Paragraph 3-26a "(TM 10-3930-621- 12)" is changed to read "(para 3-16.1)".--

Page 3-14. Paragraph 3-30h "(TM 10-3930-621- 12)" is changed to read "(para 3-16.1)".

PAGE 6-20. Section V is added as follows:

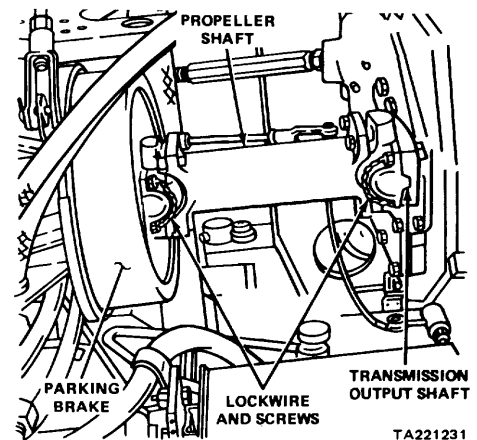


Figure 6-14. Propeller shaft, installed view

(1) Bend back tabs on lock plates (6) and remove eight screws (7). Remove cross and bearings (1 and 5) from drive shaft (4).

(2) Remove output shaft from transmission.

*c. Inspect and Repair.*

(1) Inspect all bearings and surfaces in cross and bearing for wear and damage.

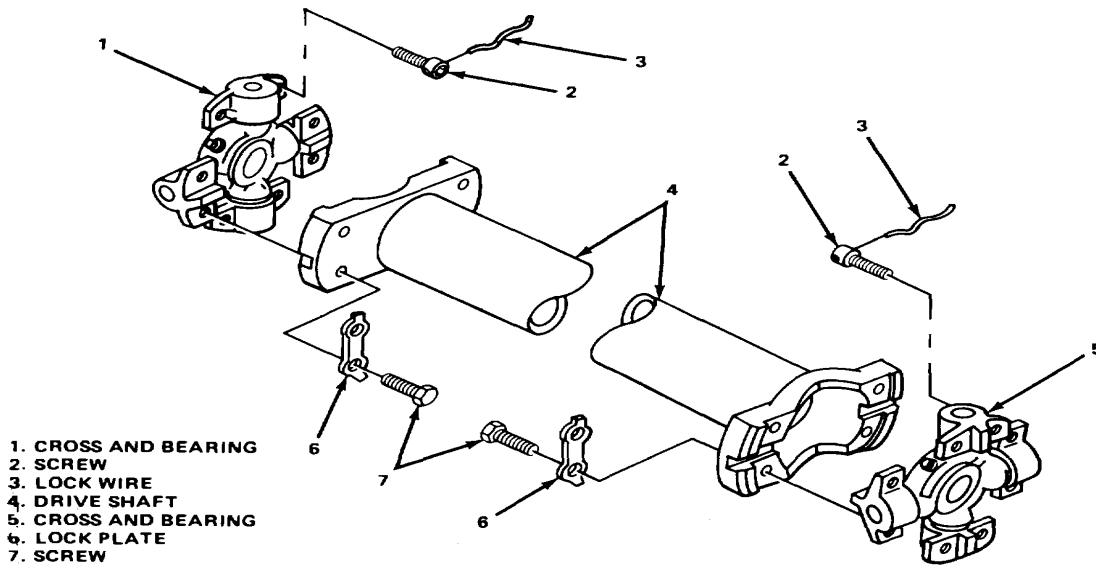
(2) Pack bearings with grease (GAA). Grease must cover all bearing surfaces.

(3) Inspect drive shaft for cracks, bends, and damage.

*d. Assembly.* Refer to figure 6-15 and assemble the propeller shaft as follows:

(1) Install the output shaft in transmission.

(2) Install cross and bearings (1 and 5) on drive shaft (4) and secure with eight screws (7) and lock plates (6). Bend tabs on lock plates over heads of screws to lock.



TA221232

Figure 6-15. Propeller shaft, exploded view

*e. Installation.* Refer to figure 6-14 and install propeller shaft as follows:

(1) Slide output shaft into transmission to clear propeller shaft and install propeller shaft between transmission and parking brake.

(2) Secure propeller shaft to parking brake and output shaft with eight screws, lock screws with locking wires.

Page 8-1. The warning below is added before paragraph 8-2b (2).

**WARNING**

When working on the brake system or asbestos fiber pad removal, use the wet process only! The wet process involves the use of running water to rinse away asbestos dust. Using compressed air to remove asbestos creates dust extremely dangerous to your health. Inhaled asbestos dust is carcinogenic and remains permanently in your breathing system.

Paragraph 8-2b (2) is superseded as follows:  
(2) Clean shoes using the wet process only, and thoroughly dry.

Page 8-4. Paragraph 8-6 is rescinded.

Figure 8-3 and key to figure 8-3 are rescinded.

Page 10-20. The warning below is added before paragraph 10-38e:

Page A-1. Appendix A is superseded as follows:

**WARNING**

Oil under pressure, 2500 psi pressure, is used to operate this equipment. Never disconnect any hydraulic lines or fittings without checking manual to see how to drop the pressure to zero. Failure to follow this precaution could cause serious injury. Should you be struck by a high pressure oil stream, seek medical help immediately.

**APPENDIX A  
REFERENCES**

**A-1. Lubrication**

Fuels, Lubricants, Oils, and Waxes .....	C9100-IL
Lubrication Order .....	LO 10-3930-621-12

**A-2. Maintenance**

The Army Maintenance Management System .....	DA PAM 738-750
Use of Antifreeze Solution and Cleaning Compounds in Engine Cooling Systems .....	B 750-651
Operator's, Organizational, Direct Support, and General Support Maintenance Manual for Lead Acid Storage Batteries .....	TM 9-6140-200-14
Operator and Organizational Maintenance Manual .....	TM 10-3930-621-12
Organizational Maintenance Repair Parts and Special Tool List .....	TM 10-3930-621-20P
Direct Support, General Support, and Depot Maintenance Repair Parts and Special Tool List .....	TM 10-3930-621-35P

**A-3. Shipment and Storage**

Administrative Storage of Equipment .....	TM 740-90-1
Preservation of USAMEC Mechanical Equipment for Shipment and Storage .....	TB 740-97-2

**A-4. Fire Protection**

Hand Portable Fire Extinguishers Approved For Army Use .....	TB 5-4200-200-10
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**A-5. Painting;**

Painting Instructions for Field Use .....	TM 43-0139
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Page I-1. B, line 33 "Pedal paragraph 8-6 page 8-4"  
is rescinded.

Page I-3.P, the following is added after line 26.

	Paragraph	Page
Propeller shaft:		
Assembly	6-25d	6-20
Disassembly	6-25b	6-20
Inspection and repair	6-25c	6-20

Installation  
Removal

Paragraph	Page
6-25e	6-20
6-25a	6-20

By Order of the Secretary of the Army:

JOHN A. WICKHAM, JR.  
*General, United States Army*  
*Chief of Staff*

Official:

ROBERT M. JOYCE  
*Major General, United States Army*  
*The Adjutant General*

Distribution:

To be distributed in accordance with DA Form 12-25, Section I, (qty rqr block no. 195) Direct and General Support maintenance requirements for Truck, Fork Lift: Gasoline.

Changes in force: C 1 and C 2

CHANGE

No. 2

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D.C., 22 August 1972

DIRECT SUPPORT AND GENERAL SUPPORT  
MAINTENANCE MANUAL  
TRUCK, LIFT, FORK; GED; SOLID RUBBER TIRED WHEELS;  
4, 000 LBS. CAPACITY; 180 IN. LIFT (ARMY MODEL MHE 209)  
(ALLIS CHALMERS MODEL F40-24PS)  
FSN 3930-459-5948  
100 IN. LIFT (ARMY MODEL MHE 224)  
(ALLIS CHALMERS MODEL F40--24PS 100)

FSN 3930-165-4102

TM 10-3930-621-34,3 December 1970, is changed as follows:

*Cover.* The nomenclature is changed to read as shown above.

*Page i.* The nomenclature is changed to read as shown above.

*Page 1-1.* Paragraph 1-3 is superseded as follows:

### 1-3. Description

A general description of Army Model MHE-209 and Army Model MHE-224 fork lift trucks, and information pertaining to identification plates are contained in TM 10-3930-621-12. A more detailed description of specific components and assemblies is contained in the applicable section(s) of this manual.

*Page 1-1.* In paragraph 1-4b, line 2, data pertaining to Model is superseded as follows: Model FCBG5943 (Army Model MHE-209), FCB (Army Model MHE-224).

*Page 1-1.* Paragraph 1-4e is superseded as follows:

*e. Hydraulic Control Valve Classification and Rating.*

Make Hydraulic Unit Specialities (Army Model MHE-209), Husco Div. of Koehring Co. (Army Model MHE-224).

*Page 1--6.* In table 1-1, Line 8, (Army Model MHE-209) is added after the words, "Single Cylinder."

*Page 2-1.* All references to Model MHE-209 Fork Lift Truck are changed to read, "Model MHE-209 and Model MHE-224 fork lift trucks."

*Page 3-1.* Paragraph 3-1a is superseded as follows:

a. The model FCB G5943 and Model FCB engines (only difference in engine models is in the flywheel) are four-stroke cycle engines of the 133 cubic-inch range. The cylinders are cast integrally into the cylinder block and crankcase which comprise the main body of the engine.



Refer to paragraph 1--4 for specific engine data and to figure 3-1 for the location of major components.

*Page 4-4.* In paragraph 4-7, line 1, 41/2 gallon capacity is changed to read, "6 gallon capacity."

*Page 4-4.* In the paragraph title of paragraph 4-9, (Army Model MHE-209) is added after the word, "Disassembly."

*Page 4-4.* Paragraph 4-9.1 is added after paragraph 4-9.

a. Refer to figure 4-2.1 and disassemble fuel tank as follows:

b. Remove plug (8) to drain any residual fuel. Remove elbow (9) and nipple (10) from bottom of tank.

c. Remove shutoff valve (11), elbow (12), and nipple (13).

d. Remove filler cap (22) by unscrewing from top of tank.

e. Remove vent plug (21) from top of tank.

f. Disconnect electrical lead (16) to transmitter (19) by removing the attaching nut (14) and lockwasher (15).

g. Remove transmitter mounting screws (17) and washers (18). Carefully lift the transmitter (19) from the tank.

**CAUTION**

Do not bend transmitter float arm during disassembly or assembly.

h. Discard gasket (20).

*Page 4-5.* Legend line of figure 4-2 is superseded as follows:

*Figure 4-2. Fuel tank and associated parts, exploded view (Army Model MHE-209).*

*Page 4-5.* Figure 4-2.1 is added after figure 4-2.

*Page 4-6.* In the paragraph title of paragraph 4-12, (Army Model MHE-209) is added after the word, "Assembly."

*Page 4-6.* Paragraph 4-12.1 is added after paragraph 4-12.

**4-12.1 Assembly  
(Army Model MHE-224)**

a. Assemble new transmitter gasket (20, figure 4-12.1) on fuel tank.

b. Install transmitter (19) in tank, and secure with screws (17) and washers (18).

c. Secure electrical lead (16) to transmitter (19) with nut (14) and washer (15).

d. Install nipple (10), elbow (9), and plug (8) in bottom of tank.

e. Install vent plug (21) and screws on filler cap (22).

f. Install nipple (13), elbow (12), and valve (11) in bottom of tank.

*Page 6-3.* Paragraphs 6-3a. (1) through 6-3a. (6) are superseded as follows:

(1) Place transmission in suitable working area.

(2) Remove bolts and lock washers from valve block, and remove control valve assembly from transmission.

(3) Remove oil pump (Army Model MHE- 209 fork lift truck) as follows:

(a) Mark collector ring ((11) fig. 6-3) and converter housing (17) to insure proper pump installation.

(b) Remove bolts (9) and lock washers (10) holding collector ring (11) to converter housing (17), and remove pump assembly from housing. If necessary tap pump assembly with rawhide hammer to free it from gasket (28). Discard gasket.

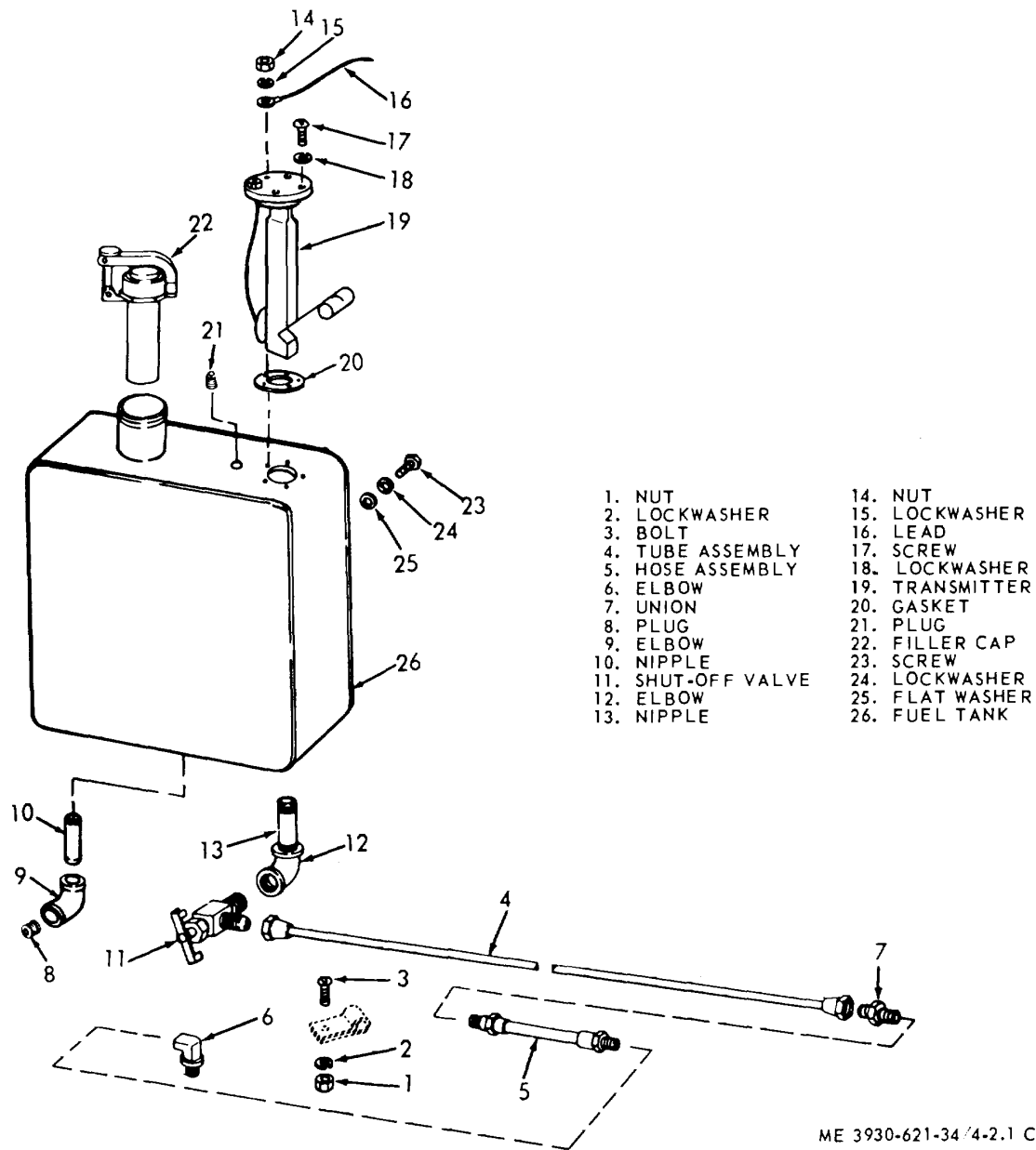


Figure 4-2.1. Fuel tank and associated parts, exploded view ( Army Model MHE-224).

(4) Remove oil pump (Army Model MHE- 224 fork lift truck) as follows:

(a) Remove bolts ((9), fig. 6-3.1) and lock washers (10), and remove pump (7) from housing.

(b) Remove packing (11) and oil seal (8).

(5) Remove converter housing (Army Model MHE-209 fork lift truck) as follows:

(a) Lay transmission on case, and remove screws ((18) fig. 6-3) and lock washers (19) which mount converter housing (17) to transmission ease ((32) fig. 6-6). Attach chain to converter housing, and remove converter housing

and disc and drum assembly as a unit (fig. 6-4), being careful not to damage sealing rings ((14) fig. 6-7) and reverse shaft needle bearing ((42) fig. 6-6).

(b) Remove converter housing from disc and drum assembly by removing retainer ring ((7) fig. 6-7) on turbine input shaft (8), and sliding housing from disc and drum assembly (fig. 6-5). Remove bearing ((27) fig. 6-3) from housing.

(6) Remove converter housing (Army Model "TIE- 224 fork lift truck) as follows:

(a) Lay transmission on case and remove the screws and lockwashers which mount the converter housing adapter plate (17) to the transmission case ((32) fig. 6-6). Attach chain to converter housing, and remove converter housing and disc and drum assembly as a unit (fig. 6-4), being careful not to damage sealing rings ((14) fig. 6-7), and remove reverse shaft needle bearing (42) fig. 6-6.

(b) Remove converter housing from disc and drum assembly by removing retainer ring ((7) fig. 6-7) on turbine input shaft (8), and sliding housing from disc and drum assembly (fig. 6-5).

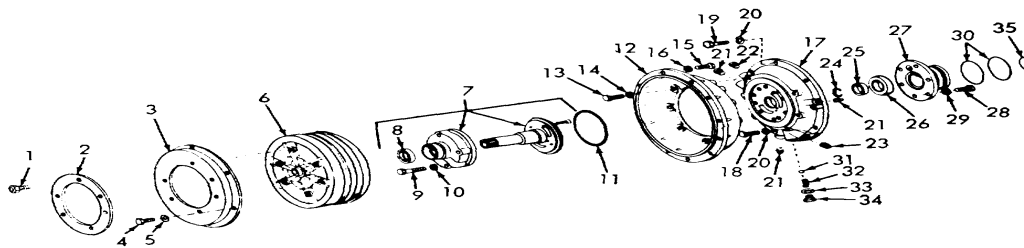
(c) Remove the bolts ((13) fig. 6-3.1) and lock washers (14), and remove the adapter plate (17) from the converter housing (12).

(d) Remove the bolts (28) and lockwashers (29), and remove the support (27). Remove packings (30) and (35), snap ring (24), and seals (25) and (26).

Page 6-4. Legend line of figure 6-3 is superseded as follows:

Figure 6-3. Torque converter assembly, exploded view (Army Model MHE-209).

Page 6-4. Figure 6-3.1 is added after figure 6-3



- |                       |                   |                |
|-----------------------|-------------------|----------------|
| 1. BOLT               | 13. BOLT          | 25. SEAL       |
| 2. REINFORCING PLATE  | 14. LOCKWASHER    | 26. SEAL       |
| 3. DRIVE PLATE        | 15. BOLT          | 27. SUPPORT    |
| 4. BOLT               | 16. LOCKWASHER    | 28. BOLT       |
| 5. LOCKWASHER         | 17. ADAPTER PLATE | 29. LOCKWASHER |
| 6. TORQUE CONVERTER   | 18. BOLT          | 30. PACKING    |
| 7. PUMPP ASSEMBLY     | 19. BOLT          | 31. BALL       |
| 8. OIL SEAL           | 20. LOCKWASHER    | 32. SPRING     |
| 9. BOLT               | 21.PLUG           | 33. SEAL       |
| 10. LOCKWASHER        | 22. PLUG          | 34. PLUG       |
| 11. PACKING           | 23. PLUG          | 35. PACKING    |
| 12. CONVERTER HOUSING |                   | 24. SNAP RING  |

Figure 6-3.1. Torque converter assembly, exploded view (Army Model MHE-224).

Page 6-9. In the paragraph title of paragraph 6-3c., (Army Model MHE-209) is added after the words, *Oil Pump*.

Page 6-9. Paragraph 6-3d. is added after subparagraph 6-3c.

d. *Oil Pump (Army Model MHE-224)*. Disassembly is not authorized.

Page 6-9. In the paragraph title of paragraph 6-5a, (Army Model MHE-209) is added after the words, *Oil Pump*.

Page 6-10. Paragraph 6-5c. (7) (e) is added after paragraph 6-5c. (7) (d).

(e) On Army Model MHE-224 fork lift truck, assemble the pump support ((27) fig. 6-3.1) using new packings (30) and (35) and seals (25) and (26). Assemble the adapter plate (17) to the converter housing (12).

Page 6-10. Paragraph 6-5c. (10) is superseded as follows:

(10) Refer to figure 6-3 or 6-3.1, and install pump assembly on converter housing. Aline match marks on ring and housing.

Page 7-9. Paragraph 7-7d. (1) is superseded as follows:

(1) Remove nut (27), washer (26), seal (26A) (applicable on Army Model MHE-224), and bearing cone (25).

Page 7-9. Paragraph 7-7d. (2) is superseded as follows:

(2) Remove pivot arm (40) from axle and bearing cup (42). Remove bearing cone (41), and seal (40A) (applicable on Army Model MHE- 224) from pivot arm (40).

Page 7-10. Figure 7-9 is superseded as follows:

Figure 7-9. *Steering axle, exploded view.*

Page 7-11. In the KEY to fig. 7-9, add the following items in proper numerical sequence.

26A. Seal

40A. Seal

Page 7-11. Paragraph 7-9c. (3) is superseded as follows:

(3) Seat the seal (40A) (applicable on Army Model MHE-224) on pivot arm (40). Fill seal with grease (GAA). Press bearing cone (41) on pivot arm (40).

Page 7-11. Paragraph 7-9c. (6) is superseded as follows:

(6) Slide seal (26A) (applicable on Army Model MHE-224) and washer (26) on pivot arm (40). Start retaining nut (27) on pivot arm (40). To preload bearings, proceed as follows:

(a) Continue tightening nut (27), using torque wrench, and note the torque reading while advancing the cone towards the seated position. An increase in nut torque will be noted when the bearing cone starts to seat. Continue until torque is 15 to 25 foot-pounds greater than the previously noted nut-tightening torque.

(b) Check rotational bearing torque by rotating the pivot arm assembly back and forth several times while taking rolling torque reading. This reading must be in the range of 15 to 25 inch-pounds as the pivot arm is being rotated.

(c) If rolling torque is lower than 15 inch-pounds, torque the retaining nut an additional 5 foot-pounds, and repeat step (b) above. Continue this procedure until proper rolling torque is reached.

(d) If rolling torque exceeds 25 inch-pounds, back off the retaining nut one full turn, stroke the shaft end with a mallet to unseat bearings, and repeat steps (b) and (c) until the proper torque range is reached.

(e) Stake the retaining nut to hold it in position.

Page 10-2. Figure 10-1 is superseded as follows:

Figure 10-1. *Hydraulic lift system, schematic.*

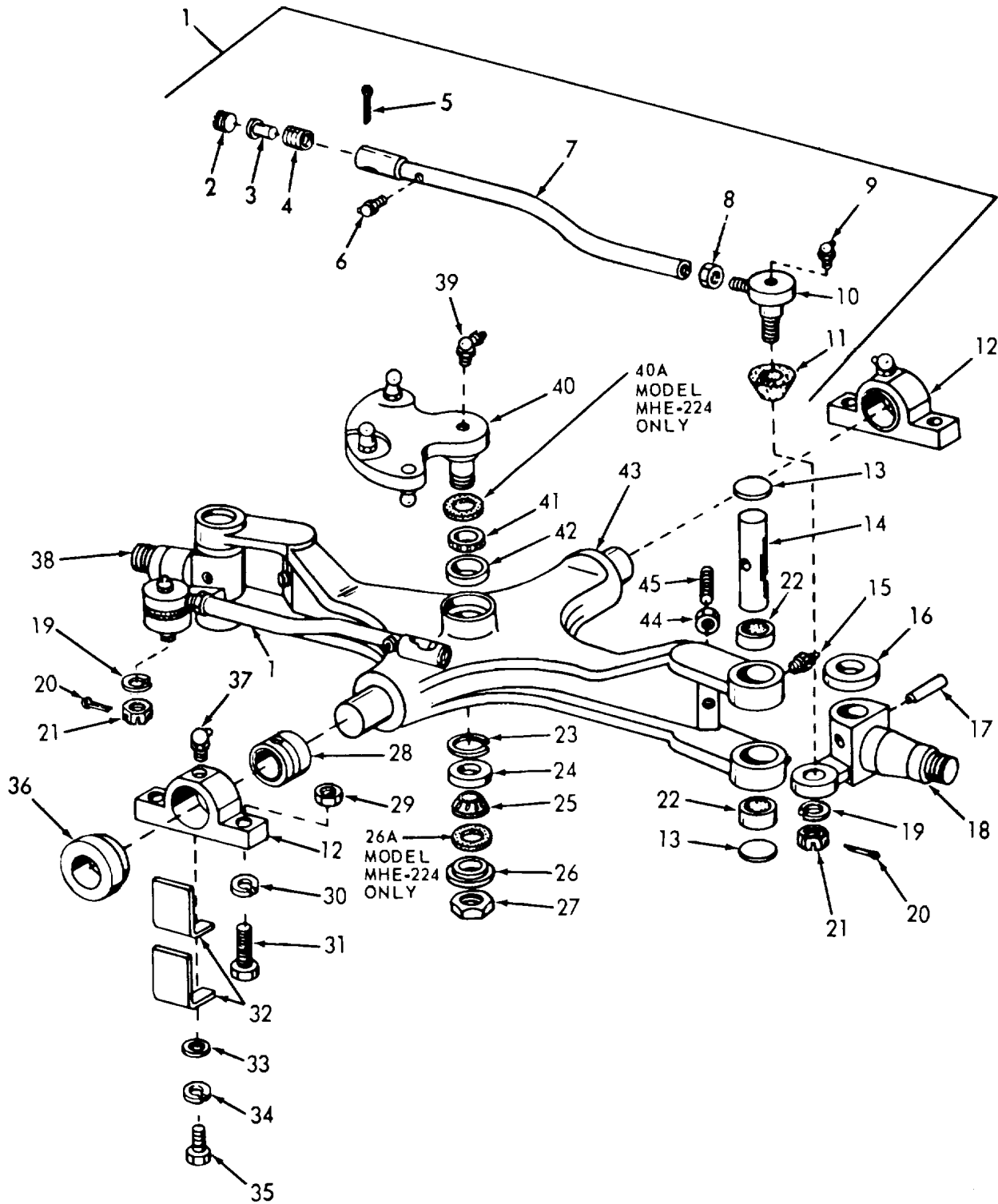
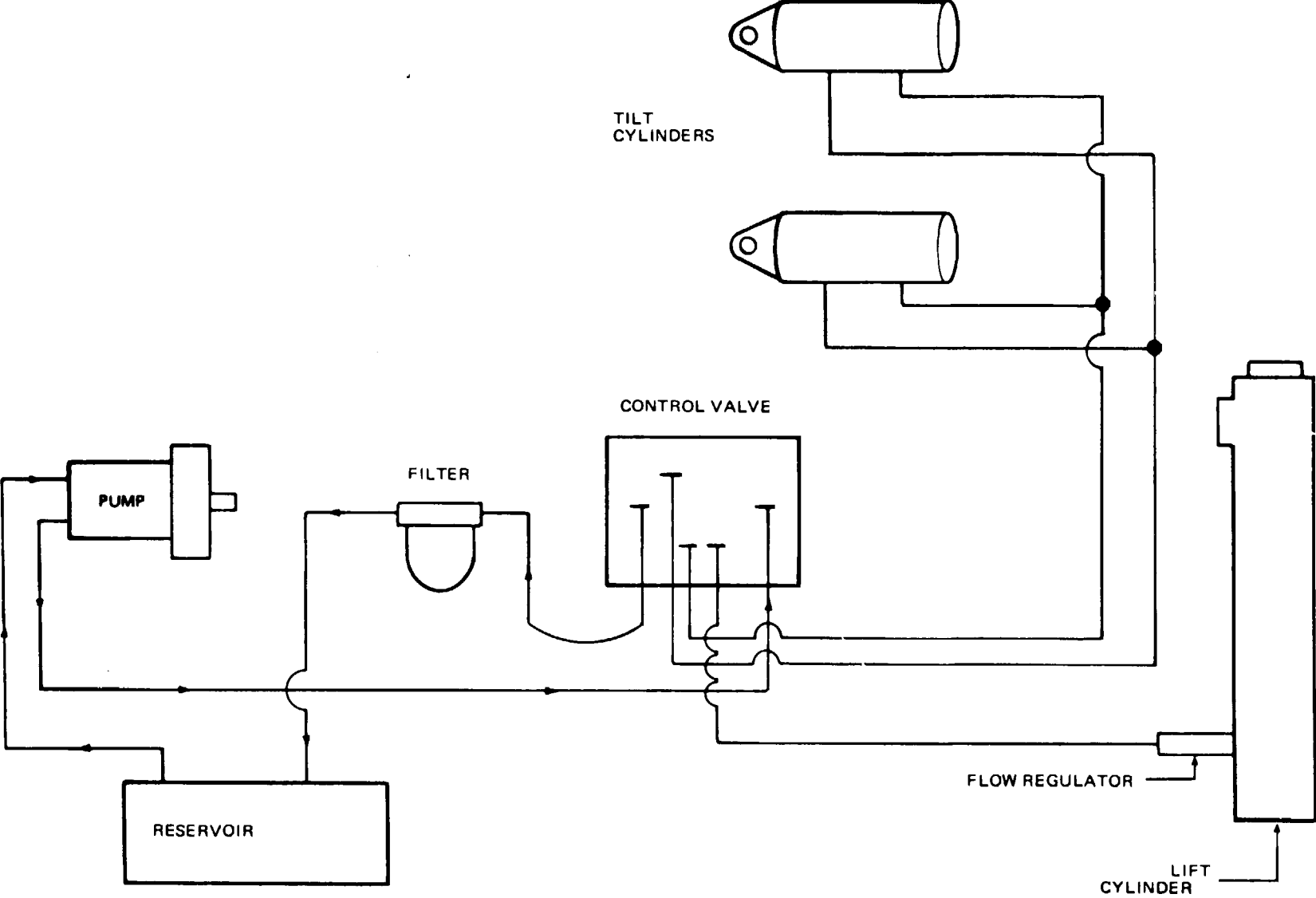


Figure 7-9. Steering axle, exploded view.



Page 10-3. Paragraph 10-3 is superseded as follows:

### 10-3. Description

The two double-acting tilt cylinders serve to tilt the mast assembly. They are located under the toe plate, and pivot at the frame and mast brackets. Action of the tilt cylinder is a straight line motion. Any misalignment of the tube assembly will cause rapid wear of internal parts and may break the tube assembly weld.

Page 10-3. In the paragraph title of paragraph 10-5, (Army Model MHE-209) is added after the word, "Disassembly."

Page 10-3. Paragraph 10-5.1 is added after paragraph 10-5.

#### 10-5.1 Disassembly (Army Model MHE-224)

a. Refer to figure 10-2.1, and disassemble as per *b.* through *h.* below.

*b.* Secure cylinder tube (21) in vise, being careful not to deform.

*c.* Remove nut (5), lock washer (6), screw (7), and unscrew yoke (8) from rod and plunger assembly (18).

*d.* Remove gland nut (14) from tube (21), and discard locking pellet (13).

*e.* Remove ring (11) and packing (12) from groove in outside diameter of gland nut (14); and wiper (9) and packing (10) from inside diameter.

*f.* Withdraw rod and plunger assembly (18) with assembled parts from tube (21).

*g.* Remove packing (15) and spacer (16) from plunger rod (18).

*h.* Remove snapping (17), plunger bearing (19), and plunger packing (20) from rod and plunger assembly (18).

Page 10-3. In the paragraph title of paragraph 10-6, (Army Model MHE-209) is added after the word, "Replacement."

Page 10-3. Paragraph 10-6.1 is added after paragraph 10-6.

#### 10-6.1 Cleaning, Inspection, and Replacement (Army Model MHE-224)

*a.* Clean all metal parts with cleaning compound, solvent (Spec. P-S-661). Dry parts thoroughly with compressed air.

*b.* Check tube bore for scores or nicks.

*c.* Check plunger bearing ((19) fig. 10-2.1) sliding surface for scores, nicks, and irregularities.

*d.* Check bores of plunger (18) and gland nut (14), and mating surfaces of plunger rod for damage which could cause faulty seating, leaks, or damage to other parts.

*e.* Check all backup rings for cracks, bends, deformation, and other damage.

*f.* Replace all packing, wiper rings, and damaged mating or sliding surface parts.

Page 10-4. Legend line of figure 10-2 is superseded as follows:

Figure 10-2. Tilt cylinder exploded view  
(Army Model MHE-209).

Page 10-4. Figure 10-2.1 is added after figure 10--2.

Page 10-5. In the paragraph title of paragraph 10-7, (Army Model MHE-209) is added after the word, "Assembly."

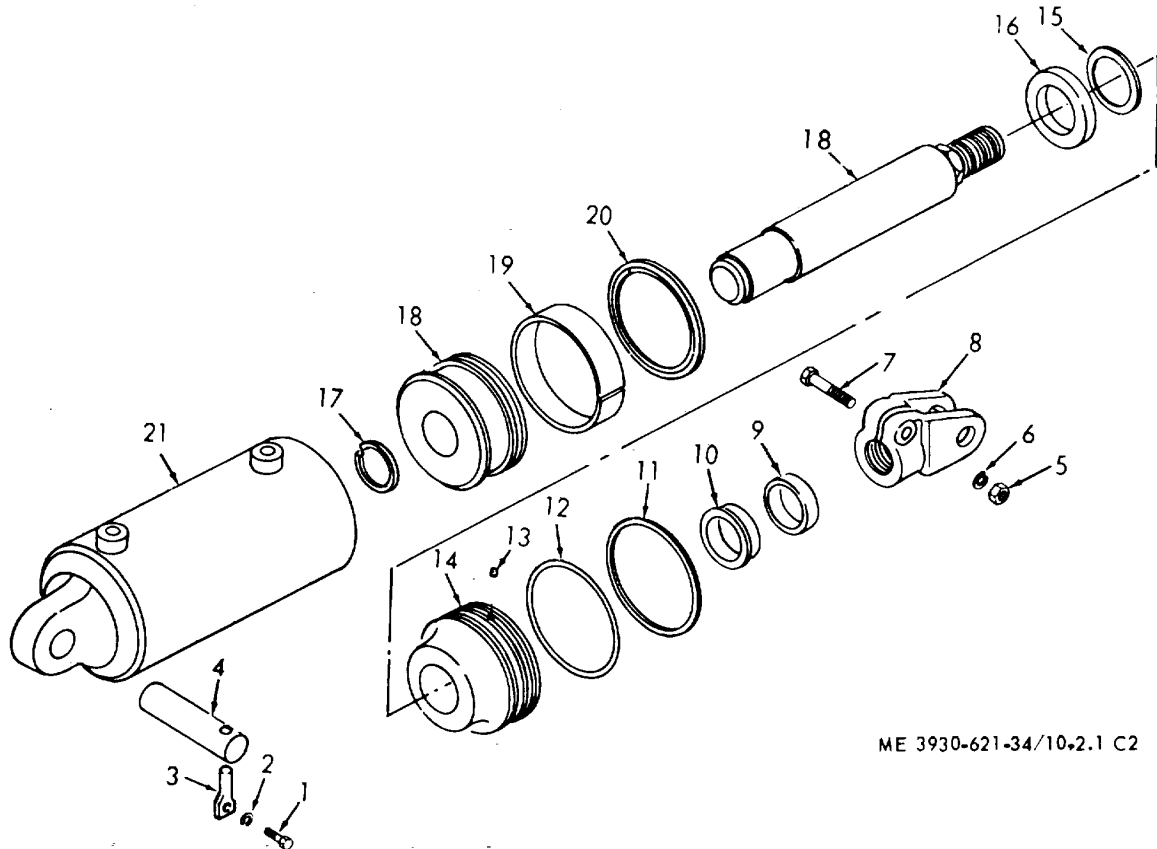
Page 10-5. Paragraph 10-7.1 is added after paragraph 10-7.

#### 10-7. 1 Assembly (Army Model MHE-224)

*a.* Refer to figure 10-2.1, and assemble per *b.* through *h.* below.

*b.* Dip all packings (10) (12) (15) and (20), wiper (9) and plunger rod (18) in hydraulic system oil before each is installed.

- |                  |                 |                     |
|------------------|-----------------|---------------------|
| 1. SCREW         | 11. BACKUP RING | 18. ROD AND PLUNGER |
| 2. LOCKWASHER    | 12. PACKING     | 19. BEARING         |
| 3. RETAINING PIN | 13. PELLET      | 20. PACKING         |
| 4. PIN           | 14. GLAND NUT   | 21. TUBE            |
| 5. NUT           | 15. PACKING     |                     |
| 6. LOCKWASHER    | 16. SPACER      |                     |
| 7. SCREW         | 17. RING        |                     |
| 8. YOKE          |                 |                     |
| 9. WIPER RING    |                 |                     |
| 10. PACKING      |                 |                     |



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Figure 10-2.1. Tilt cylinder explored view (Army Model MHE-224.)

c. Install plunger bearing (19) and plunger packing (20) on plunger. Secure plunger to rod with snapping (17).

d. Install spacer (16) and packing (15) on rod and plunger assembly (18).

**CAUTION**

Never use sharp tools or instruments when installing rings or packings.

e. Insert rod and plunger assembly (18) with assembled parts into tube (21).

**NOTE**

Be certain all parts are clean, and that those which require soaking in hydraulic system oil have been so serviced.

f. Install packing (12) and ring (11) in groove on the outside diameter of gland nut (14), and packing (10) and wiper (9) in the inside diameter.

g. Using riew locking pellet (13), secure gland nut (14) to tube (21).

h. Screw on yoke (8), and install screw (7), lockwasher (6), and nut (5).

Page 10-5. In the paragraph title of paragraph 10-9, (Army Model MHE 209) is added after the word, "Description."

Page 10-5. Paragraph 10-9.1 is added after paragraph 10-9.



### 10-9.1 Description (Army Model MHE-224)

a. The mast assembly consists of two sections designed to provide lifts to a height of 100 inches. The unit is comprised of an inner mast and an outer mast with roller bearings provided for maximum ease of movement.

b. A carriage, designed to mount lifting forks, is supported by chains leading from the outer cylinders of the cylinder cluster. Action of the chains, cylinder, and mast raise and lower the carriage.

c. Power to raise and lower the carriage and mast is provided by hydraulic oil pressure to the cylinder cluster.

d. The cylinder cluster consists of three cylinders. Rams from the outer cylinders lift and lower the carriage along the length of the inner mast by means of the chains. The ram from the center cylinder raises and lowers the inner mast along the length of the outer mast.

e. An interlock assembly, spring actuated, is mounted on the right beam of the inner mast. The interlock assembly locks the mast section in the lowered position until full, free lift is accomplished. When full, free lift is reached, the carriage stop screw strikes the interlock to release it, allowing the mast section to function completely.

*Page 10-6.* Paragraph 10-10c. is superseded as follows:

c. As the center cylinder ram reaches its farthest extent of travel, the inner mast will be fully extended. On army Model MHE-209 fork lift truck, continued operation will cause the ram of the single cylinder to force downward against the outer mast, raising the intermediate mast. Full extension of the ram will raise the carriage to the highest level.

*Page 10-6.* In paragraph 10-10d., line 8, The regulator is installed in the single lift cylinder hose \* \* \*, is changed to read, "The regulator is installed in the lift cylinder hose \* \* \*."

*Page 10-6.* In the paragraph title of paragraph 10-11, (Army Model MHE-209) is added after the word, "Removal."

*Page 10-6.* Paragraph 10-11.1 is added after paragraph 10-11.

### 10-11.1 Removal (Army Model MHE-224)

a. Fully retract mast and unlock and remove carriage forks. Cylinder cluster must be completely collapsed.

b. Raise and block truck 24 inches from mast to floor.

c. Remove screws ((11) and (13) fig. 10-8), spacer (9), and lock washers (10) from carriage supports.

d. Remove carriage forks.

e. Remove elbow ((1) fig. 10-3.1), flow regulator (2), regulator body (3), and packing (4) from bottom of cylinder cluster. f. Attach hoist to backrest frame ((1) fig. 10-8), and disconnect chains from carriage.

g. Remove backrest and carriage assembly through bottom of inner mast ((31) fig. 10-3.1).

h. Disconnect tilt cylinders from outer mast (para 10-4).

i. Using hoist, raise mast assemblies enough to remove weight on mast pivot pins ((7) fig. 10-3.1). Remove screws (5), lock washers (6), and mast pivot pins.

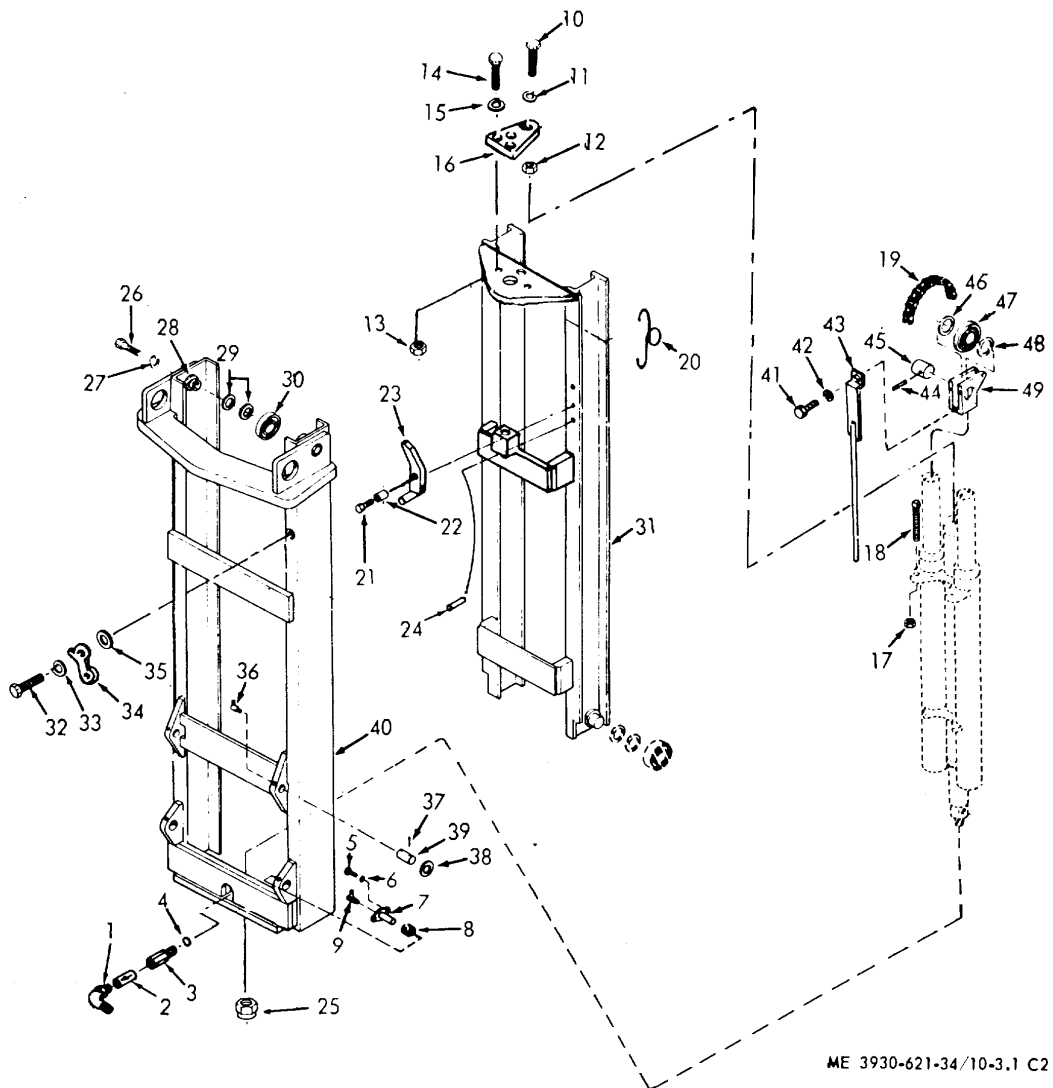
j. Using hoist, lift mast assemblies from truck, and place them on suitable supports with cylinder cluster facing up.

*Page 10-7.* The legend line of figure 10-3 is superseded as follows:

*Figure 10-3. Mast assemblies, exploded view (Army Model MHE-209).*

*Page 10-7.* Figure 10-3.1 is added after figure 10-3, and the key to figure 10-3.1 is added.

*Page 10-8.* In the paragraph title of paragraph 10-12, (Army Model MHE-209) is added after the word, "Disassembly."



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- |                       |               |                        |                |
|-----------------------|---------------|------------------------|----------------|
| 1 Elbow               | 14 Screw      | 27 Lockwasher          | 40 Outer mast  |
| 2 Flow regulator      | 15 Lockwasher | 28 Stud                | 41 Screw       |
| 3 Regulator body      | 16 Bracket    | 29 Shim                | 42 Lockwasher  |
| 4 Packing             | 17 Nut        | 30 Bearing             | 43 Chain guard |
| 5 Screw               | 18 Anchor     | 31 Inner mast          | 44 Pin         |
| 6 Lockwasher          | 19 Chain      | 32 Screw               | 45 Pin         |
| 7 Pivot pin           | 20 Spring     | 33 Lockwasher          | 46 Washer      |
| 8 Bushing             | 21 Screw      | 34 Striker             | 47 Bearing     |
| 9 Lubricating fitting | 22 Spacer     | 35 Flat washer         | 48 Washer      |
| 10 Screw              | 23 Interlock  | 36 Lubrication fitting | 49 Crosshead   |
| 11 Lockwasher         | 24 Pin        | 37 Cotter pin          |                |
| 12 Spacer             | 25 Locknut    | 38 Washer              |                |
| 13 Nut                | 26 Screw      | 39 Pin                 |                |

Figure 10-3.1. Mast assemblies, exploded view (Army Model MHE-224)

Page 10-8. Paragraph 10-12.1 is added after paragraph 10-12.

**10-12.1. Disassembly  
(Army Model MIIIE-224)**

a. Refer to figure 10-3.1, and remove the inner mast (31) as follows:

(1) Remove screw (10), lockwasher (11), and spacer (12) connecting cylinder cluster to bracket (16).

(2) Remove chain adjustment nuts (17) from chain anchors (18), and remove chains (19) from cylinder cluster and inner mast (31). Match- mark location of nuts (17) on anchors (18).

(3) Remove interlock spring (20), screw (21), spacer (22), and interlock (23). Tap out pin (24).

(4) Remove locknut (25), and remove the cylinder cluster.

(5) Remove screws (26) and lockwashers (27), and remove the bearings (30), shims (29), and bearing studs (28) from the top of the outer mast.

(6) Using hoist, slowly raise inner mast (31) out of the top of the outer mast (40).

(7) Remove bearings, shims, and studs remaining on the mast section.

b. Remove screw (32), lockwasher (33), inter- lock striker (34), and flat washer (35) from outer mast (40).

c. Remove lubrication fittings (36), cotter pins (37), washers (38), and tilt-cylinder pins (39).

Page 10-8. The *Note*. contained in paragraph 10-13c. is superseded as follows:

**NOTE**

All bearing studs are welded into position except the outer mast bearing studs which, reattached by screws.

Page 10-8. Paragraph 10-13c.(1) is superseded is follows:

(1) Press bearings from studs and remove shims. Note size and quantity of shims used.

Page 10-10. Paragraph 10-13h. is superseded as follows:

h. If studs on outer mast bearings are replaced, attaching screws must also be replaced and torqued to 245 ft.-lbs.

Page 10-10. In the paragraph title of paragraph 10-14, (Army Model MHE-209) is added after the word, "Assembly."

Page 10-11. Paragraph 10-14.1 is added after paragraph 10-14.

**10-14.1 Assembly  
(Army Model MHE-224)**

**NOTE**

Prior to assembly, lubricate all parts as per TM 10-3930-621-12.

a. Refer to figure 10-3.1 and assemble as per b. through d. below.

b. Install lubrication fittings (9) and (36) and bearings (8) in outer mast (40).

c. Install interlock striker (34) with screw (32), lockwasher (33), and flat washer (35).

d. Assemble inner mast (31) as follows:

(1) Install bearings, and install same size and quantity of shims on inner mast welded bearing stud if bearings and shims were removed during disassembly.

(2) Using hoist, lower inner mast (31) into the top of the outer mast (40).

(3) Install outer mast bearings (30), shims (29), and bearing studs (28). Torque screws (26) to 245 ft.- lbs.

(4) Attach cylinder cluster to outer mast with locknut (25).

(5) Install pin (24), interlock (23), spacer (22), screw (21), and spring (20)

(6) Attach chains (19) to cylinder cluster with adjusting nuts (17) and chain anchors (18), noting match-mark nut locations on screws. Final adjustments of chains will be made after mast is installed.

(7) Secure cylinder cluster to inner mast (31) with screw (10), lockwasher (11), and spacer (12).

*Page 10-11.* In the paragraph title of paragraph 10-15, (Army Model MHE-209) is added after the word, "Installation."

*Page 10-12.* Paragraph 10-15.1 is added after paragraph 10-15.

### 10-15.1 Installation (Army Model MHE-224)

a. Using hoist, install mast assembly on truck, and insert pivot pin ((7) fig. 10-3.1). Secure pins with screw (5) and lockwasher (6).

b. Connect hydraulic line to flow regulator.

c. Connect tilt cylinders to outer mast (para 10-8).

d. Using hoist, slide backrest and carriage assembly up inner mast, and secure to chains with chain anchors. Before releasing hoist, check that chains are secure at cylinder cluster and running evenly, with no twists, through the crosshead bearings.

e. Remove hoist from carriage, and install screws ((11) and (13) fig. 10-8), spacer (9), and lockwashers (10) in carriage roller supports.

f. Remove blocks and lower truck to floor.

g. Install carriage forks, making sure fork is locked in position.

h. Check for complete lubrication of mast assembly per TM 10-3930-621-12.

i. Check lift for proper operation as follows:

(1) Lower carriage to lowest point of travel. Bottom of carriage lower bar should be adjusted from <sup>23A</sup> to 31/4 in. from floor. Refer to TM 10-3930-621-12 for adjustment of chains.

(2) Using extreme care, very slowly extend mast to full lift, checking all moving parts for binding, interference, or excessive looseness or play.

(3) Check operation of interlock assembly. Interlock must contact stop screw on carriage roller support and disengage smoothly when lifting carriage.

*Page 10-12.* In the paragraph title of paragraph 10-16, (Army Model MHE-209) is added after the word, "Description".

*Page 10-12.* Paragraph 10-16.1 is added after paragraph 10-16.

### 10-16. 1 Description (Army Model MHE-224)

The cylinder cluster consists of three cylinder assemblies and is mounted in the outer mast. The rams of the two outer cylinders mount two crosshead and chain bearing assemblies, with the chains attached to chain anchors in mounting brackets on the cylinders. The outer rams lift and lower the carriage along the length of the inner mast. The center cylinder is anchored at the bottom of the outer mast, and the cylinder is attached to the inner mast. Forcing downward, the center ram raises the inner mast and carriage to their fullest extent.

*Page 10-12.* In the paragraph title of paragraph 10-17, (Army Model MHE-209) is added after the word "Removal."

*Page 10-12.* Paragraph 10-17.1 is added after paragraph 10-17.

### 10-17.1 Removal (Army Model MHE-224)

To remove the cylinder cluster without removing the inner mast, refer to figure 10-3.1 and proceed as follows:

#### CAUTION

When removing, disassembling or reassembling cylinders, use extreme care to avoid damaging the finish of ram surfaces.

a. Raise inner mast (31) approximately 24 inches from floor, and block in this position.

b. Remove carriage as follows:

(1) Remove screws and spacer from carriage roller supports.

(2) Remove carriage forks.

(3) Attach hoist to carriage, remove chain anchor pins, and disconnect chains (19) from carriage.

(4) Lower carriage out bottom of inner mast.

c. Disconnect lift chains (19) from chain anchors (18) on top of cylinder cluster and remove chains through bottom of mast. Match- mark nut positions on anchors.

d. With cylinders completely collapsed, disconnect hydraulic line and fittings from center cylinder of cluster.

e. Remove nut (25) securing cluster center cylinder to outer mast.

f. Remove nut (13), screw (14), and lockwasher (15) securing bracket (16) to inner mast. Remove screw (10), lockwasher (11), and spacer (12) securing bracket to cylinder cluster. Using a hoist, carefully lift cylinder cluster from mast assembly.

g. Remove nuts (17) and chain anchors (18) from cluster.

h. Remove screws (41), lockwashers (42), and chain guards (43) from crossheads (49).

i. Tap out pins (44) from bearing pins (45); and remove bearing pins, washers (46) and (48), and bearings (47) from crossheads (49).

j. Remove screws and crossheads from top of cylinder cluster.

*Page 10-12.* Paragraph 10-18c. is superseded as follows:

c. Remove and discard wiper ring (3) and packing (4) from gland nut (6). Remove spacer (13) if center cylinder on Army Model MHE-209 is being disassembled.

*Page 10-13.* Figure 10-6 is superseded as follows:

*Figure 10-6.* Cylinder cluster, exploded view.

*Page 10-14.* Paragraph 10-20f. is superseded as follows:

f. Install new wiper ring (3) and packing (4) in gland nut (6). Install spacer (13) on Army Model MHE-209.

*Page 10-14.* In the paragraph title of paragraph 10-21, (Army Model MHE-209) is added after the word, "Installation:"

*Page 10-14.* Paragraph 10-21.1 is added after paragraph 10-21.

#### **10-21.1 Installation (Army Model MHE-224)**

To install the cylinder cluster without installing the inner mast, refer to figure 10-3.1 and proceed as follows:

a. Install crossheads (49) on top of cylinder cluster and secure with screws.

b. Install bearings (47), washers (46) and (48), and bearing pins (45) in crossheads (49), and secure by tapping pins (44) into bearing pins.

c. Install chain guards (43) on crossheads with rods through holes in cylinder brackets. Secure guards to crossheads with screws (41) and lock washers (42).

d. Install bracket (16) on cylinder cluster, and secure with screw (10), lock washer (11), and spacer (12). Using a hoist, carefully install cylinder cluster on outer mast and secure with nut (25). Secure bracket (16) to inner mast with screw (14), lockwasher (15), and nut (13).

e. Attach chains (19) to chain anchors (18) and install anchors and nuts (17), noting match- mark of previous adjustment.

f. Run chains evenly around bearings (47), allowing them to hang free

PACKING  
 STOP RING  
 BLEED SCREWS  
 OUTER RAM  
 TUBE ASSEMBLY  
 SPACER

- |                   |     |
|-------------------|-----|
| 1. CENTER RAM     | 8.  |
| 2. WEAR BLOCK     | 9.  |
| 3. WIPER RING     | 10. |
| 4. PACKING        | 11. |
| 5. LOCKING PELLET | 12. |
| 6. GLAND NUT      | 13. |

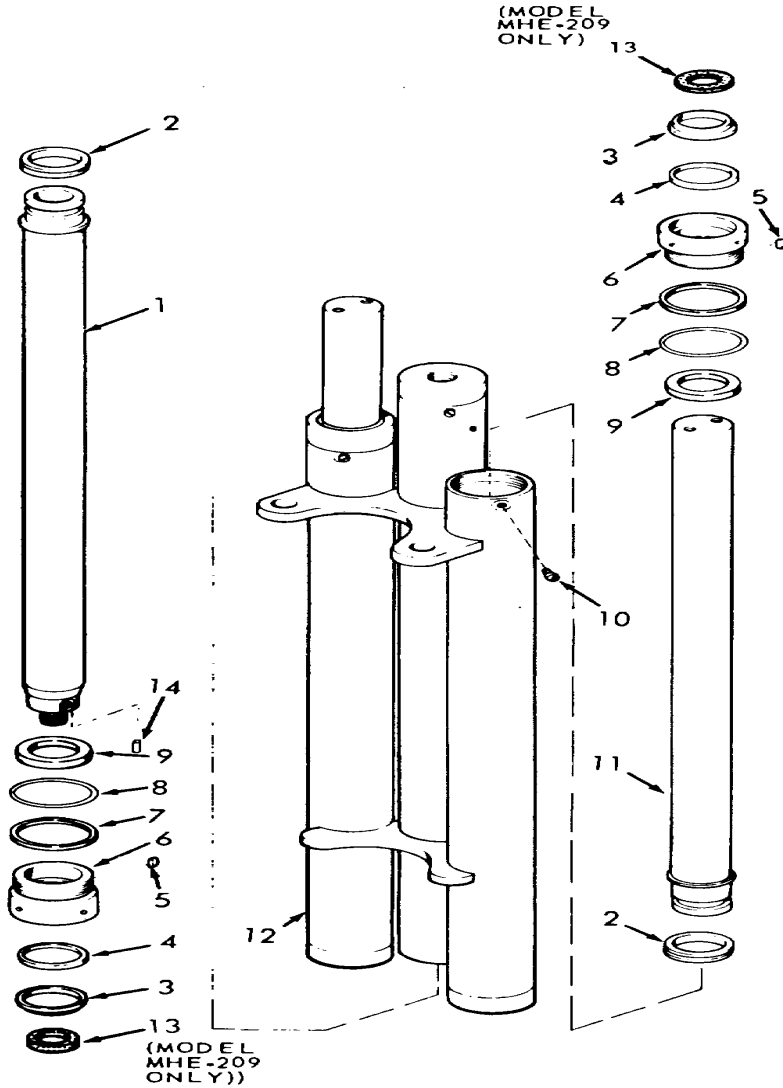


Figure 10-6. Cylinder cluster, exploded view.

g. Connect hydraulic line and fittings at bottom of center cylinder.

h. Using hoist, raise carriage into inner mast (31), and attach chains to chain anchors.

i. Lower inner mast, and install screws and spacer on carriage roller supports and carriage forks. Install and lock forks in position.

j. Using chain anchors (18) and nuts (17), adjust carriage to 23/4 to 31/4 inches from floor (TM 10-3930-621-12). Adjust both anchors to equal chain tension.

k. Check to see if bleeder screws are loose. Operate control valve to actuate cylinders, and slowly raise and lower mast. When clear, bubble-free oil flow from bleeder screw hole is obtained, tighten bleeder screws.

*Page 10-14.* In the title of Section V, (Army Model MHE-209) is added after the word, "Assembly."

*Page 10-15.* The legend line of figure 10-7 is superseded as follows:

*Figure 10-7. Single cylinder assembly, exploded view (Army Model MHE-209).*

*Page 10-19.* In the paragraph title of paragraph 10-33, (Army Model MHE-209) is added after the word, "Removal."

*Page 10-19.* Paragraph 10-33.1 is added after paragraph 10-33.

### **10-33. 1 Removal (Army Model MHE-224)**

a. Refer to figure 10-10.1 and remove as per b. through i. below.

b. Remove floor plates(TM10-3930- 621-12). Drain reservoir and remove breather (1), gage (2), and screen (3) from top of reservoir (15).

c. Disconnect suction lines and return hydraulic lines on top of reservoir.

d. Lift front end of truck, and block in position to permit removal of reservoir.

e. Disconnect power steering hydraulic return line at elbow (5), and allow line to drain. Remove elbow (5) from reservoir.

f. Remove nuts (16), cover (17), and packing (18) from bottom of reservoir. Discard packing.

g. Block reservoir for support during removal.

h. Remove screws (6 and 7), lockwashers (8), flat washers (9), nuts (10), and bushings (11) attaching reservoir to frame.

i. Remove screws (12), lockwashers (13), and flat washers (14), and slowly lower and remove reservoir.

*Page 10-20.* The legend line of figure 10-10 is superseded as follows:

*Figure 10-10. Hydraulic reservoir, exploded view (Army Model MHE-209).*

*Page 10-20.* Figure 10-10.1 is added after figure 10-10.

*Page 10-20.* In the paragraph title of paragraph 10-36, (Army Model MHE-209) is added after the word, "Installation."

*Page 10-20.* Paragraph 10-36.1 is added after paragraph 10-36.

### **10-36. 1 Installation (Army Model MHE-224)**

a. Refer to figure 10-10.1 and install as per b. through j. below.

b. Using care not to damage tubing, lift reservoir (15) into position and secure with screws (12), lockwashers (13), and flat washers (14). Complete mounting of reservoir by installing nuts (10), screws (6 and 7), lockwashers (8), flat washers (9), and bushings (11).

c. Secure drain cover (17) and new packing (18) to bottom of reservoir, and install drain plug (4).

d. Secure elbow (5) in coupling at side of reservoir, and attach power steering hydraulic line to elbow.

1. BREATHER
2. GAGE
3. SCREEN
4. PLUG
5. ELBOW
6. SCREW
7. SCREW
8. LOCKWASHER
9. FLAT WASHER
10. NUT
11. BUSHING
12. SCREW
13. LOCKWASHER
14. FLAT WASHER
15. RESERVOIR
16. NUT
17. COVER
18. PACKING

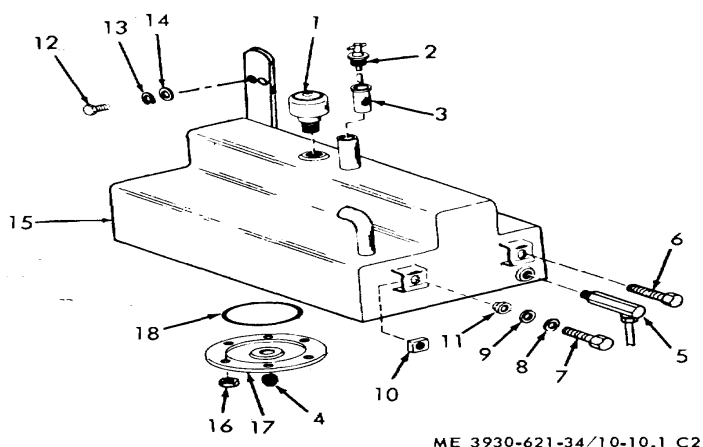


Figure 10-10.0. hydraulic reservoir, exploded view (Army Model MHE-224).

- e. Check that reservoir is securely mounted, and then lower truck to floor.
- f. Connect suction and return line hydraulic lines to connections at top of reservoir.
- g. Install breather (1) and screen (3) in reservoir.
- h. Refer to TM 10-3930-621-12 and fill reservoir with specified hydraulic oil.

**CAUTION**

Never use brake fluid. When filling tank, make sure containers and surrounding parts are clean, to prevent oil contamination.

i. Install gage (2) in tank.

j. Install floor plates (TM 10-3930-621-12).

Page 10-24. In the title of Section IX, (Army Model MHE-209) is added after VALVE.

Page 10-26. The legend line of figure 10-12 is superseded as follows:

Figure 10-12. Hydraulic control valve, exploded view (Army Model MHE-209).

Page 10-28. Section IX.1 is added after Section IX

**Section IX. 1. HYDRAULIC (CONTROL VALVE (ARMY MODEL MHE-224)**

**10-49.1 Description**

The function of the hydraulic control valve is to direct the flow of hydraulic fluid, under pressure, from the hydraulic pump to the tilt or lift cylinders. It contains two operating plungers, two

check valves, and an adjustable relief valve. The relief valve protects the system against damage resulting from excessive pressure that builds up when the lift or tilt cylinders reach full stroke. If pressures rise above the relief valve pressure adjustment (2100 + 25 psi), the valve unseats and



allows oil to bypass the plungers and return, through a filter, to the reservoir.

### 10-49.2 Removal

a. Make sure lift cylinders are collapsed and mast is tilted all the way forward.

b. Remove right side cowl from truck (TM 10-3930-621-12).

c. Remove cotter pins ((1) fig. 10-13.1), straight pins (2), and attaching links (3) connecting handles (8) and (9) to lift plunger ((44) fig. 10-12.1) and tilt plunger (26).

d. Tag all hydraulic lines so they can be reconnected to their proper ports when valve is installed.

e. Disconnect and cap all hydraulic lines.

f. Remove nuts ((11) fig. 10-13.1), lock-washers (12), and screws (13) and (16) attaching valve to support (20).

g. Clean valve exterior with cleaning compound, solvent (Spec. P-S-661), and dry with compressed air.

h. Remove all fittings and place control valve in a suitable work area.

### 10-49.3 Disassembly

a. Refer to figure 10-12.1 and disassemble valve as follows:

#### CAUTION

Hydraulic system components must be repaired in a clean work area to keep parts free of dirt and contaminants during reassembly. Lay out parts in order of disassembly, and do not mix parts that are common between sections. Tag parts for reassembly identification.

b. Stand control valve on inlet end (21), and remove nuts from tie rods (52) and (53).

c. Lift outlet section (51) off tie rods (52) and (53).

d. Remove spring (50), poppet (49), and packing (48) from lift plunger section (43). If poppet does not come out easily, turn plunger section (43) over and tap housing gently; poppet (49) will fall out.

e. Slide lift plunger section (43) off tie rods (52) and (53).

f. Remove seal plate (47) from plunger end of section.

g. Remove plunger cap (39) and seal plate (47) at opposite end of housing and pull plunger (44) from housing.

h. Wiper ring (46) and packing (45) can be removed from plunger end of section. Be sure to identify the end (plunger or spring) from which rings were removed.

i. Remove special screw (40), plunger spring (42), spring seats (41), wiper ring, and packing from plunger (44).

#### CAUTION

Plunger must be identified with correct plunger section. Intermixing of plungers will result in incorrect clearance and possible binding or sticking of plungers, or excessive leakage of spool.

j. Remove acorn nut (1), jamnut (3), and copper washers (2) from adjusting screw (4).

k. Turn relief valve assembly out of inlet housing (21). Flats are provided on cap (17) to remove valve assembly.

l. Remove adjusting screw (4), spring (5), and poppet (6) from plug (7). Count and record the number of turns required to remove adjusting screw (4).

m. Remove plug (7) from cap (17), and remove packing (8) and backup ring (9) from plug (7).

n. Remove poppet (16) from cap (17), and remove poppet (13), back-up ring (15), and packing (14) from poppet (16).

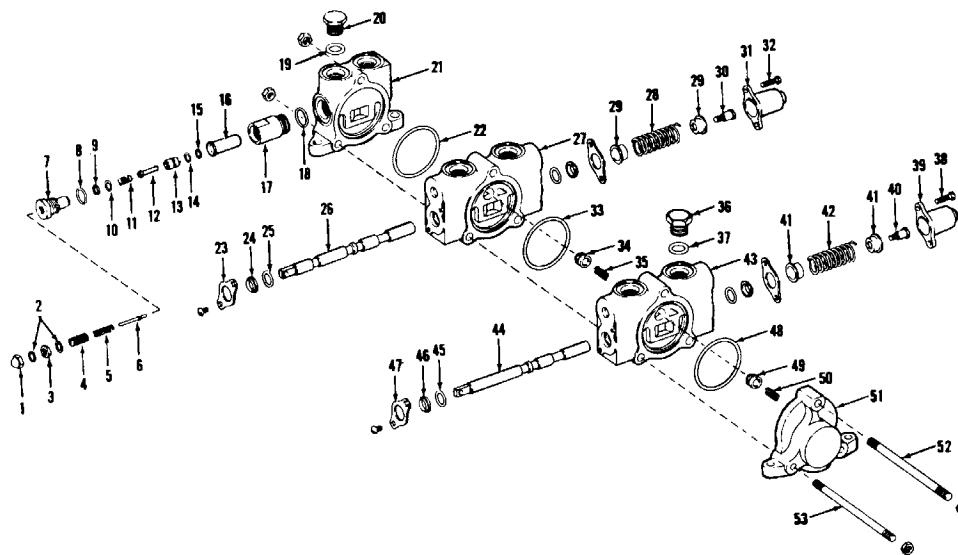


Figure 10-12.1. Hydraulic control valve, exploded view (Army Model MHE-224).

- |                   |                         |                  |                         |
|-------------------|-------------------------|------------------|-------------------------|
| 1 Acorn nut       | 27 Tilt plunger section | 15 Backup ring   | 41 Spring seat          |
| 2 Washer          | 28 Spring               | 16 Poppet        | 42 Spring               |
| 3 Jamnut          | 29 Spring seat          | 17 Cap           | 43 Lift plunger section |
| 4 Adjusting screw | 30 Screw                | 18 Packing       | 44 Plunger              |
| 5 Spring          | 31 Plunger cap          | 19 Packing       | 45 Packing              |
| 6 Poppet          | 32 Screw                | 20 Plug          | 46 Wiper                |
| 7 Plug            | 33 Packing              | 21 Inlet section | 47 Seal plate           |
| 8 Packing         | 34 Poppet               | 22 Packing       | 48 Packing              |
| 9 Backup ring     | 35 Spring               | 23 Seal plates   | 49 Poppet               |
| 10 Packing        | 36 Plug                 | 24 Wiper         | 50 Spring               |
| 11 Spring         | 37 Packing              | 25 Packing       | 51 Outlet section       |
| 12 Piston         | 38 Screw                | 26 Plunger       | 52 Tie rod              |
| 13 Poppet         | 39 Plunger cap          | 53 Tie rod       |                         |
| 14 Packing        | 40 Screw                |                  |                         |

*o.* Remove spring (35), poppet (34), and packing (33) from tilt plunger section (27). Slide tilt plunger section off of tie rods (52) and (53).

*p.* Remove plugs and packings from tilt plunger section housing.

*q.* Refer to steps *f.* through *i.* and disassemble tilt plunger section (27).

*r.* Remove packing (22), and tie rods (52 and 53) from inlet plunger section (21).

*s.* Remove plug (20) and packing (19) from inlet housing.

#### 10-49.4 Cleaning, Inspection, and Replacement

*a.* Clean all parts with cleaning compound, solvent (Spec. P-S-661), and dry thoroughly with compressed air.

*b.* Inspect springs for cracks, wear, deformation or signs of weakness.

*c.* Inspect machined surfaces for chips, scratches, or other damage which could cause internal or external leakage.

*d.* Inspect housing for cracks, stripped threads, or other damage.

*e.* Inspect plungers and plunger bores for scoring, cracks, or other damage which could result in leaks.

*f.* Replace all seals and packing. Replace all defective parts as authorized.

#### 10-49.5 Assembly

*a.* Refer to figure 10-12.1 and assemble as follows:

##### NOTE

Before assembling control valve parts, lubricate each part with clean hydraulic oil.

*c.* Install plug (20) and packing (19) into inlet section (21).

*c.* Install packing (14) and backup ring (15) on poppet (13). Packing is installed on top of backup ring. Place poppet (13) in poppet (16).

*d.* Position piston (12) and spring (11) in poppet (13). Piston is installed first.

*e.* Place poppet (6) and spring (5) in plug (7). Secure poppet and spring with adjusting screw (4). Turn screw in same amount of turns required for removal.

*f.* Install backup ring (9) and packing (8) on plug (7). Backup ring is positioned toward the adjusting screw (4) end of plug (7). Install plug (7) in cap (17).

*g.* Install packing (18) on plug (17) and assemble plug (17) and cap assembly (1), (2), and (3) to complete the relief valve. Secure relief valve in inlet housing (21).

*h.* Install plugs and packings on tilt section.

*i.* Install wiper and packing on spring (28) end of plunger (26). Position seal plate, spring seats (29), and spring (28) on plunger (26), and secure with special screw (30).

*j.* Slide plunger assembly (26) into housing (27) bore, and coat spring (28) with a light coat of multipurpose grease. Position plunger cap (31) over spring (28) end of plunger (26) and secure with screws (32).

*k.* Install packing (25), then wiper (24), on linkage end of plunger (26). Secure seal plate (23) to housing (27) with screws.

*l.* Install packing (33), poppet (34), and spring (35) on plunger section housing (27).

*m.* Refer to steps *i.* through *h.* and assemble the lift plunger section (43).

*n.* Position inlet section (21), tilt section (27), and lift section (43), along with outlet section (51), together. Be sure packing (22), (33), and (48), poppets (34) and (49), and springs (35) and (50) remain in position.

*o.* Connect control valve sections together with tie rods. Note the two 5/16-inch (53), and one 3/8 inch (52) tie rods. Install nuts on each

end of tie rods. Torque 3/8-inch nuts to 26 ft.-lbs., and the 5/16-inch nuts to 14 ft.-lbs.

#### 10-49.6 Installation

- a) Insure that all fitting ; have been replaced and properly tightened.
- b) Place control valve assembly in its relative mounting location and install screws ((13) and (16) fig. 10-13.1), lockwashers (12), and nuts (11).
- c) Uncap and connect the tagged hydraulic lines.
- d) Attach connecting links ((3) fig. 10-13.1) with straight pins (2) and cotter pins (1).
- e) After complete reassembly and installation has been assured, run the hydraulic system (operate the lift and tilt controls) for about five minutes to eliminate any air present in the system. The internal construction of the hydraulic reservoir will bleed-off any trapped air in the hydraulic oil as it flows through the reservoir. Check the hydraulic oil level in the reservoir after operating the system, and refill, if necessary.

#### 10-49.7 Adjustment

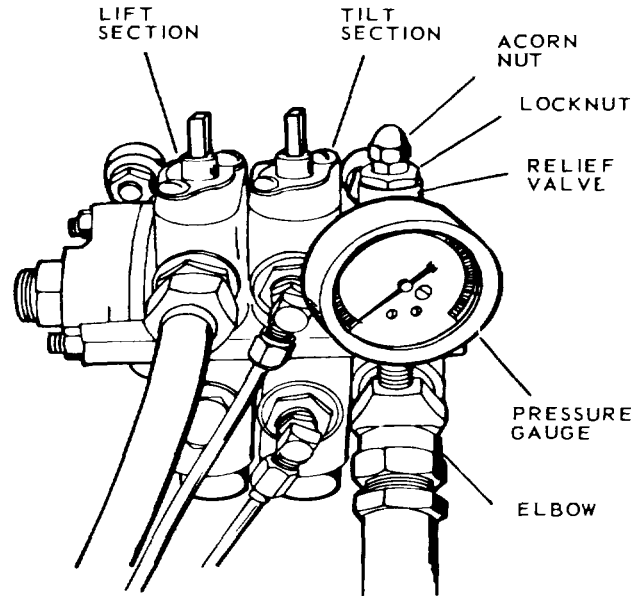
- a) *Linkage.* Improperly adjusted linkage can result in binding or bending of the control valve linkage.
  - (1) Insure that tilt and lift control levers and associated linkage travels freely and smoothly through forward and backward movement of each lever, and that the control valve plungers respond accordingly. Adjust, bend, repair, or replace as necessary.
  - (2) Be certain that pivot points or other mating surfaces are free of dirt and remain lightly lubricated to function smoothly.
- b) *Relief Valve Adjustment.* Whenever the control valve or hydraulic pump has been repaired or replaced, check the relief valve and adjust to open at specified pressure. Refer to figure 10-12.2; check and adjust the relief valve located

in the inlet section of the control valve as follows:

- (1) If necessary, gain access to the control valve by removing right side cowl from truck (TM 10-3930-621-12).
- (2) Remove hexagon recess plug from elbow and install a 0-3000 psi range pressure gage.
- (3) Place shift lever in neutral position and start engine.
- (4) Pull the tilt lever back to retract the tilt cylinders and hold lever in this position.
- (5) While holding lever, observe the needle on the pressure gage. When pressure reading of 2, 100 psi is attained, the needle will stop, indicating relief valve opening.
- (6) If the relief valve opens below or above 2, 100 ± 25 psi, it must be adjusted as in (a) through (g) below.
  - (a) Remove acorn nut covering adjusting screw directly underneath the inlet section of the control valve and loosen the jamnut.
  - (b) While holding tilt lever back, turn adjusting screw in to increase, or out to decrease relief pressure.
  - (c) After pressure is properly adjusted, tighten jamnut to lock adjusting screw in position.
  - (d) Recheck relief valve setting described in steps (4) and (5) above. Then replace acorn nut.
  - (e) Turn engine off.
  - (f) Remove pressure gage and replace hexagon recess plug.
  - (g) Install right side cowl on truck (TM 10-3930-621-12).

*Page 10-28.* In the paragraph title of paragraph 10-51 (Army Model MHE-209) is added after the word, "Removal."

*Page 10-28.* Paragraph 10-51.1 is added after paragraph 10-51.



ME 3930-621-34/10-12.2 C2

Figure 10-12.2. Inlet section relief valve adjustment.

#### 10-51.1 Removal (Army Model MHE-224)

- a. Refer to figure 10-13.1 and disassemble as in b. through e. below.
- b. Remove right side cowl from truck (TM 10-3930-621-12).
- c. Remove cotter pins (1), straight pins (2), and attaching links (3) from control handles (8 and 9) and control valve plungers.
- d. Remove spring pins (4) from support (20).
- e. Remove shaft (5), spacer (7), tilt handle (8), spacer (6), and lift handle (9). Remove knobs (10) from handles.

Page 10-29. The legend line of figure 10-13 is superseded as follows:

Figure 10-13. Control levers, exploded view  
(Army Model MHE-209).

Page 10-29. Figure 10-13.1 is added after figure 10-13.

Page 10-29. In the paragraph title of paragraph 10-53 (Army Model MHE-209) is added after the word, "Installation."

Page 10-29. Paragraph 10-53.1 is added after paragraph 10-53.

#### 10-53.1 Installation (Army Model MHE-224)

- a. Refer to figure 10-13.1, and install as in b. through e. below.
- b. Install knobs (10) on handles (8 and 9).
- c. Slide shaft (5) through opening in support (20). Being careful to install correct handle in proper position, install lift handle (9), spacer (6), tilt handle (8), and spacer (7). Secure shaft to support with spring pins (4).
- d. Install attaching links (3) on control handles (8) and (9) and control valve plungers, using straight pins (2) and cotter pins (1).
- e. Install right side cowl on truck (TM 10-3930-621-12).

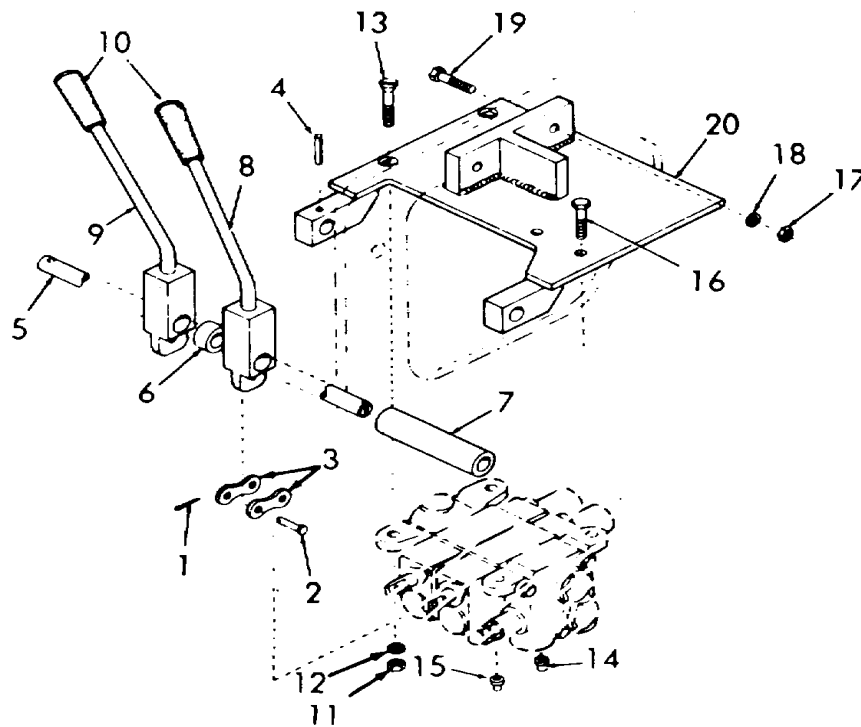


Figure 10-13.1. Control levers, exploded view (Army Model MHE-224).

- |                |                |
|----------------|----------------|
| 1. COTTER PIN  | 11. NUT        |
| 2. PIN         | 12. LOCKWASHER |
| 3. LINK        | 13. SCREW      |
| 4. PIN         | 14. FITTING    |
| 5. SHAFT       | 15. FITTING    |
| 6. SPACER      | 16. SCREW      |
| 7. SPACER      | 17. NUT        |
| 8. TILT HANDLE | 18. LOCKWASHER |
| 9. LIFT HANDLE | 19. SCREW      |
| 10. KNOB       | 20. BRACKET    |

ME 3930-621-34/10-13.1 C2

Figure 10-13.1. Control levers, exploded view (Army Model MHE - 224)

By the Order of the Secretary of the Army:

BRUCE PALMER, JR.  
*General, United States Army,  
Acting Chief of Staff*

Official:

VERNE L. BOWERS  
*Major General, United States Army,  
The Adjutant General.*

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HEADQUARTERS  
DEPARTMENT OF THE ARMY  
Washington, D.C., 22 October 1971

Change |  
} |  
No. 1 |

**Direct Support and General Support Maintenance Manual**

**TRUCK, LIFT, FORK; GED; SOLID RUBBER TIRED WHEELS; 400 LB CAPACITY;**

**180 IN LIFT (ARMY MODEL MHE 209) ALLIS-CHALMERS MODEL F40-24PS**

**FSN 3930-459-5948**

TM 10-3930-621-34; 3 December 1970, is change as follows: TM number is changed to read a shown above.

*Page 1-1.* Paragraph 1-4b line 10. No-load speed should read: 2400 rpm.

*Page 2-4.* Paragraph 2-5a (6) (i) is added: (i) Remove battery and battery box.

*Page 2-4.* Paragraph 2-6a (1) is superseded: (1) Remove floor plates, seat deck assembly battery case and battery, crossbar, one corner post and disconnect electrical leads to starter solenoid and voltage regulator.

*Paragraph 2-6a(3)* is superseded: (3) Disconnect pedal return spring, cooler lines and clutch and selector control linkage.

*Page 2-5.* Paragraph 2-6a (7) is superseded: (7) Carefully slide transmission forward shaft from torque converter and lift engine with transmission from truck.

**CAUTION**

Use extreme care so as not to damage steering column.

*Page 2-5.* Paragraph 2-6b (11) is superseded: (11) Install electrical leads to starter solenoid and voltage regulator, corner post, crossbar, batter3 case and battery, seat deck assembly, and floor boards.

*Page 3-12.* Paragraph 3-25, line 9. Delete "0.010" Paragraph 3-28b is rescinded. Sub-paragraph "c" is reidentified as "b"

*Page 3-15,* paragraph 3-37a(1.1) is added: (1.1) (Added) Remove radiator grill; drain and remove radiator (TM10-3930-621-12).

*Page 3-16.* Paragraph 3-39b (7) is added. (7) (Added) Replace radiator (TM 10-3930-621- 12) and refill. Replace radiator grill.

*Page 4-6.* Paragraph 4-15b.1 is added: *b.1* (Added). Remove electrical leads from hourmeter actuating transmitter and remove the transmitter.

*Page 4-10.* Paragraph 4-19d and e are added: *d.* (Added) Install hourmeter actuating transmitter.

*e.* (Added) Connect electrical leads to hourmeter actuating transmitter.

*Page 5-5.* Paragraph 5-11b. Add the following:

**CAUTION**

When removing the brushes and brush holders, mark to assure correct assembly as they can be reassembled incorrectly. *Page 5-8.* Paragraph 5-18d is superseded:

*d.* If pressure cap is suspected of being defective, replace.



Page 6-11. Paragraphs 6-7b, c, d and e are superseded. Paragraph f is added.

*b. Pump pressure.*

(1) Install pressure gage, calibrated to 300 PSI in port "P" (fig. 6-8) on transmission forward of fly wheel housing inspection cover.

(2) Place transmission in NEUTRAL and start engine.

(3) Accelerate to full governed speed (2000 FIPM) and note gage pressure.

(4) If pressure is between 130-to 150-PSI, converter pump is in normal operation condition.

(5) If pressure is over 150 PSI, check the following:

(a) Regulator valve spring (20, fig. 6-11) gasket (12) and spool (21). Replace gasket.

(b) Cooler bypass valve.

(c) Restricted lines and passages.

(6) If pressure is under 300 PSI, check the following:

(a) Low oil level.

(b) Faulty pump.

(c) Excessive line leakage.

(d) Faulty regulator valve.

(e) Enlarged clutch cylinder orifices.

*c. Converter Pressure*

(1) Install pressure gage, calibrate to 300 PSI in port "C" on transmission (fig. 6-8) forward and Above flywheel housing inspection cover.

(2) Place transmission in NEUTRAL and start engine.

(3) Accelerate to full governed speed and note gage pressure.

(4) If pressure is 80-to 105-PSI, converter is in normal operating condition.

(5) If pressure is above 105 PSI, when engine is accelerated, check the following:

(a) Excessive pump pressure (para. 6-7b

(5)

(b) Enlarged metering orifices.

(c) Restricted converter return passages.

(6) If pressure is below 80 PSI when engine is accelerated, check the following:

(a) Low oil level.

(b) Restricted oil strainer.

(c) Faulty pump.

(d) Clogged converter orifice in pump collector ring.

(e) Faulty cooler bypass valve.

(7) Bring engine to idling speed.

(8) If pressure is 80-to 105-PSI converter is in normal operating condition.

*d. Clutch Pressure at Stall.*

(1) Install a pressure gage, calibrate to 300 PSI, in the clutch pressure port. See figure 6-8.1.

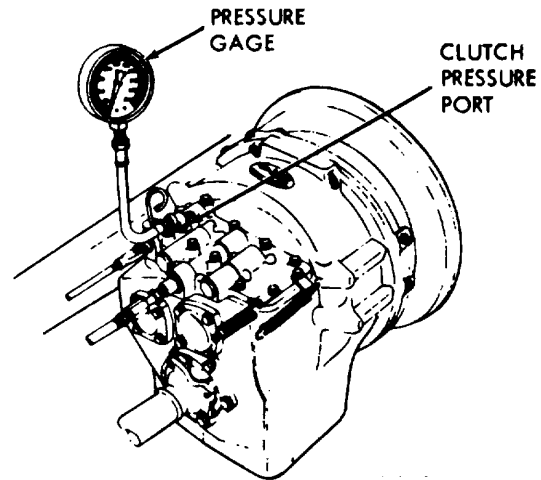


Figure 6-8.1 Checking pump, and converter pressure

(2) Start the engine and position the truck against a wall. Apply both the parking brake and the foot brake. The drive wheels must be locked. With the truck in this position, place the selector lever in the FORWARD position and accelerate the engine momentarily to wide open throttle. Do not allow engine RPM to exceed 1400 RPM. Note the pressure indicator on the gage. Place the selector lever in the REVERSE position and repeat the procedure. Note the pressure indicator on the gage.

(3) If the pressure indicated are above 80 PSI, and do not exceed normal pump pressure rated in (b) above, the pressure in the clutch circuit is normal.

(4) If the pressure is below 80 PSI, check for low oil level, restricted lines or passages, damaged seal rings, defective or incorrectly adjusted selector valve, defective pump, or excessive leaks in the disc and drum assembly.

(5) When the engine is idling, and either clutch is engaged, the clutch circuit pressure should be 15-to-30 PSI.

e. Check the forward and reverse clutch pressure with the wheels free-running.

(1) Install pressure gages, calibrated to 300 PSI in the pump pressure port and the converter port (fig. 6-8) and clutch pressure port (fig. 6-8.1)

(2) Raise the truck so that both drive wheels are off the floor. Block the truck securely with both wheels free to rotate. Secure the inching pedal up so the inching valve plunger cannot move. Bring oil temperature to 2000F.

(3) Run the engine at full governed speed and check the pressures with the selector lever in both

FORWARD and REVERSE positions. Table 6-1 indicates the normal pressure (in PSI) at the specified engine speeds.

(4) At a speed of 2000 RPM, release the inching pedal. Clutch pressure should drop to zero in both FORWARD and REVERSE positions.

(5) Disconnect the cooler return hose at the return on the left side of the adapter. Plug the port. Install a 200 PSI pressure gage in the hose, With the clutch engaged and the oil sump temperature at 120' to 170'F, run the engine at governed speed. The relief valve which protects the cooling oil circuit must open at 80 PSI to 105 PSI, It should open near 100 PSI and never under 80 PSI. Increase the pressure, if necessary, by adding a spacer between the spring and the box head plug on the lower right of the adapter. Cut off a small portion of the spring (or remove washers, if any) to reduce pressure.

f. (Added). *Regulating Valve Adjustment.*

(1) Remove the floor plate.

(2) Install the 0-to-160 PSI pressure gage at the pressure port on the top right of the control cover. (fig. 6-8.2).

(3) Engage the parking brake.

(4) Start the engine and allow the oil to warm up to 80 to 100F. Operate at idle.

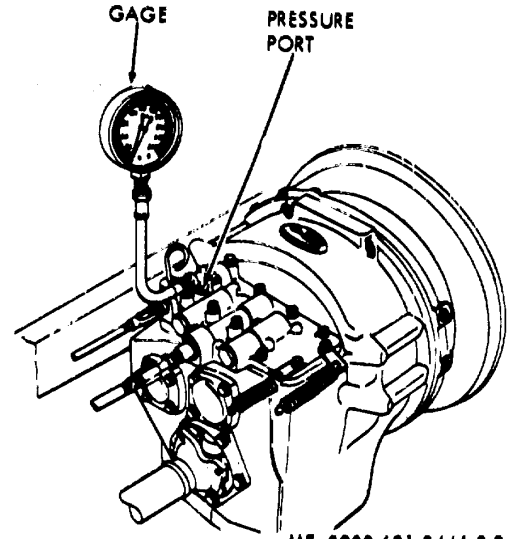
(5) Place the transmission In FORWARD or REVERSE.

(6) The pressure gage should indicate 25 to 28 PSI. If necessary, slowly turn the adjusting screw on the regulating valve to correct the gage reading.

(7) Shut down the engine, remove the pressure gage and close the pressure port. Install the floor plate.

Table 6.1 Hydraulic Pressure (Added)

Engine RPM	Main line (Pump Press PSI)		Converter (PSI)		Forward/Reverse Clutch (PSI)	
	Min.	Max.	Min.	Max	Min.	Max
500	18	30	15	25	15	80
2000	130	150	80	105	80	105



ME 3930-621-34/6-8.2 C1

Figure 6-8.2 Regulating Valve Adjustment

Page 9-1. Paragraph 9-2e is superseded:

e. Remove screws, lockwashers and flat washers attaching steering gear to the bracket which is welded to the truck frame,

By the Order of the Secretary of the Army:

W.C. WESTMORELAND,  
*General, United States Army,*  
*Acting Chief of Staff*

Official:

VERNE L. BOWERS  
*Major General, United States Army,*  
*The Adjutant General.*

Distribution:

To be distributed in accordance with DA Form 12-25A (qty rqr block No. 895) Direct and General Support Maintenance Requirements for Warehouse.

**DIRECTSUPPORT AND GENERAL SUPPORTMAINTENANCE MANUAL**

**TRUCK, LIFT, FORK, GED, SOLID**

**RUBBER WHEELS, 4000 LBS CAPACITY**

**180 IN. LIFT (ARMY MODEL MHE 209)**

**(ALLIS CHALMERS MODEL F40-24PS)**

**FSN 3930-459-5948**

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CHAPTER 1

INTRODUCTION

Section I. General

1-1. Scope

This manual contains instructions for the use of Direct Support and General Support Maintenance personnel maintaining the Truck, Lift, Fork, Gasoline, Solid Rubber Tired Wheels, 4, 000 pound capacity 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 Operator and Organizational Maintenance.

1-2. Forms and Records

- a. DA forms and records used for equipment maintenance will be only those 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 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 Model MHE-209 Fork Lift Truck and information pertaining to the identification plates are contained in TM 10-3930- 621-12. 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 Model MHE- 209 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 and General Support maintenance personnel. Refer to TM 10-3930-621-12 for the wiring diagram.

b. *Engine Classification and Rating.*

Make.....	Waukesha
Model.....	FCB4-G5943
Valve arrangement.....	Valve in block
Number of cylinders and arrangement.....	4, L-head
Piston stroke.....	4 in.
Piston displacement.....	133 cu. in.
Compression ratio.....	6.5:1
Firing order.....	1-3-4-2
Under load speed.....	2000 rpm
No-load speed.....	2200 rpm
Idle speed.....	600 rpm
Main crankshaft bearings.....	3
Connecting rod hearings.....	4
Piston type.....	Aluminum
Piston pin type.....	Full floating
Connecting rod type.....	Forged I section

c. *Steering Unit Classification and Rating.*

Make.....	Char-Lynn
Type.....	Hydraulic

d. *Hydraulic Unit Classification and Rating.*

Make.....	Cesna Aircraft Co.
rpm.....	1400
psi.....	1000
gpm.....	2.5

e. *Hydraulic Contol Valve Classification and Rating.*

Make.....	Hydraulic Unit Specialities
Control.....	2 plunger

f. *Distributor Classification and Rating.*

Make.....	Delco-Remy
Model.....	111712
Voltage.....	12
Rotation.....	Clockwise viewed at rotor end.
Type.....	Grounded
Timing range.....	22 ° automatic

g. *Starter Motor Classification and Rating.*

Make.....	Delco-Remy
Model.....	1107324
Type.....	Bendix drive
Voltage.....	12
No load test:	
Volts.....	11.6
Max., amperes.....	70.0
Min., RPM.....	6,000

h. *Voltage Regulator Classification and Rating.*

Make.....	Delco-Remy
Model.....	1116381
Type.....	150 (transistor)
Voltage.....	L2
Ground polarity.....	Negative



Voltage setting ranges (suggested):

65c° .....	13.5 to 15.5 volts
850° .....	13.3 to 15.3 volts
105° .....	13.1 to 15.1 volts
1250° .....	12.9 to 14.9 volts
1450° .....	12.8 to 14.8 volts

*i. Alternator Classification and Rating.*

Make .....	Delco-Remy
Model .....	1100877

Rotation (drive-end) .....	Either
Ground .....	Negative
Amps .....	22
Volts .....	12

*j. Repair and Replacement Standards.* Table 1- 1 lists manufacturer's sizes, tolerances, desired clearances, and maximum allowable wear and clearances.

Table 1-1. Repair and Replacement Standards

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
<b>ENGINE:</b>					
Crankcase:					
Cylinder bore .....	3.2503	3.2507	.....	.....	0.0004
Main bearing journal bore .....	2.2810	2.2815	.....	.....	0.0005
Camshaft bushing bore:					
Front .....	2.2535	2.2545	.....	.....	0.0010
Center .....	2.0035	2.0045	.....	.....	0.0010
Rear .....	1.6285	1.6295	.....	.....	0.0010
Crankshaft end play .....	0.0045	0.0085	.....	.....	.....
Connecting rod bearing:					
Running clearance .....	.....	.....	0.0005	0.0030	0.0025
Journal diameter .....	1.749	1.750	.....	.....	0.001
Journal undersize diameters .....	1.739	1.740	.....	.....	0.001
.....	1.729	1.730	.....	.....	0.001
Main bearing:					
Running clearance .....	.....	.....	0.0005	0.0030	0.0025
Journal diameter .....	2.124	2.125	.....	.....	0.001
Journal undersize diameters .....	2.114	2.115	.....	.....	0.001
.....	2.104	2.105	.....	.....	0.001
Piston pin:					
Diameter .....	0.8743	0.8744	.....	.....	0.0001
Length .....	2.697	2.701	.....	.....	0.004
Clearance .....	.....	.....	0.0002	0.0006	0.0004
Piston:					
Top land:					
Diameter .....	3.225	3.229	.....	.....	0.004
Clearance .....	.....	.....	0.021	0.025	0.004
2nd, 3rd and 4 th lands:					
Diameter .....	3.231	3.235	.....	.....	0.004
Clearance .....	.....	.....	0.015	0.019	0.004
Pin hole bore .....	0.8746	0.8747	.....	.....	0.0001
Skirt diameter .....	3.2485	3.2505	.....	.....	0.0020
Skirt clearance .....	.....	.....	0.0018	0.0037	0.0019
Groove width:					
1st land .....	0.095	0.096	.....	.....	0.001
2nd, 3rd lands .....	0.094	0.095	.....	.....	0.001
4th land .....	0.187	0.189	.....	.....	0.002
Piston rings:					
Top, 2nd, 3rd ring gap .....	0.010	0.020	.....	.....	0.010
4th ring rail gap .....	0.015	0.055	.....	.....	0.040
1-3					

Table 1-1. Repair and Replacement Standards

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
ENGINE: Continued					
Top, 2nd, 3rd ring diameter .....	3.250	.....	.....	.....	.....
4th ring rail diameter .....	3.250	.....	.....	.....	.....
4th ring spacer diameter .....	3.304	.....	3.329	.....	0.025
Top, 2nd, 3rd ring wall .....	0.137	0.147	.....	.....	0.010
4th ring rail wall .....	0.135	0.141	.....	.....	0.006
4th ring spacer wall .....	0.136	.....	.....	.....	.....
Top, 2nd, 3rd ring width .....	0.0930	0.0935	.....	.....	0.0005
4th ring rail width .....	0.0252	.....	.....	.....	.....
4th ring spacer width .....	0.1715	0.1815	.....	.....	0.0100
Top side clearance .....	.....	.....	0.0015	0.0030	0.0015
2nd, 3rd side clearance .....	.....	.....	0.0005	0.0020	0.0015
4th ring total side clearance .....	.....	.....	0.002	0.004	0.002
Cylinder bore diameter .....	3.2503	3.2507	0.0004	.....	.....
Main bearing running clearance .....	.....	.....	0.0005	0.0030	0.0025
Camshaft:					
Front bushing bore .....	2.1255	2.1260	.....	.....	0.0005
Center bushing bore .....	1.8760	1.8765	.....	.....	0.0005
Rear bushing bore .....	1.5005	1.5010	.....	.....	0.0005
Front journal diameter .....	2.1230	2.1240	.....	.....	0.0010
Center journal diameter .....	1.8730	1.8740	.....	.....	0.0010
Rear journal diameter .....	1.4980	1.4990	.....	.....	0.0010
Front running clearance .....	0.0015	0.0030	.....	.....	0.0015
Center running clearance .....	0.0020	0.0035	.....	.....	0.0015
Rear running clearance .....	.....	.....	0.0015	0.0030	0.0015
End play .....	0.002	0.006	.....	.....	.....
Connecting rod length (center to center) .....	7.240	7.250	.....	.....	.....
Valve (intake and exhaust):					
Stem diameter .....	0.309	0.310	.....	.....	0.001
Guide outside diameter .....	0.501	0.502	.....	.....	0.001
Guide inside diameter (new) .....	0.312	0.313	.....	.....	0.001
Guide inside diameter (pre-sized) .....	0.313	0.314	.....	.....	0.001
Insert outside diameter .....	1.4405	1.4415	.....	.....	0.0010
Insert inside diameter .....	1.2140	1.2240	.....	.....	0.0100
Insert depth .....	0.187	0.189	.....	.....	0.002
Guide ram in block .....	0.49950	0.50005	.....	.....	0.00055
Insert counterbore depth .....	0.199	0.202	.....	.....	0.003
Insert counterbore diameter .....	1.4365	1.4375	.....	.....	0.0010

Table 1-1. Repair and Replacement Standards - Continued

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
<b>ENGINE: Continued</b>					
Spark plug gap.....	0.018	0.020	.....	.....	.....
Distributor breaker point gap.....	0.018	0.020	.....	.....	.....
Oil pump:					
Drive shaft running clearance.....	.....	.....	0.0010	0.0025	0.0015
Drive shaft end play .....	0.003	0.007	.....	.....	.....
Idler shaft outside diameter .....	0.4970	0.4975	.....	.....	0.0005
Idler gear:					
Inside diameter .....	0.4985	0.4995	.....	.....	0.0010
Running clearance.....	.....	.....	0.0010	0.0025	0.0015
Running clearance on shaft.....	.....	.....	0.0010	0.0018	0.0008
End play.....	0.002	0.004	.....	.....	.....
Gear backlash .....	.....	.....	.....	0.020	.....
Timing gear backlash.....	.....	.....	0.002	0.004	.....
<b>TRANSMISSION:</b>					
Output shaft spline:					
Outside diameter .....	1.2665	1.2777	.....	.....	0.0112
Inside diameter .....	1.1250	1.1300	.....	.....	0.0050
Input shaft splines:					
Inside diameter .....	0.386	0.389	.....	.....	0.003
Outside diameter .....	0.780	0.790	.....	.....	0.010
Outside diameter .....	1.486	1.489	.....	.....	0.003
Inside diameter .....	1.386	1.390	.....	.....	0.004
Spline backlash.....	.....	.....	0.0040.008	0.004	.....
<b>DRIVE AXLE ASSEMBLY:</b>					
Axle shaft:					
Spline outside diameter .....	1.175	1.180	.....	.....	0.005
Spline inside diameter .....	0.970	0.990	.....	.....	0.020
Spline tooth thickness.....	0.180	0.182	.....	.....	0.002
Gear diameter over 0.250 balls .....	2.305	2.255	.....	.....	.....0.050
Gear backlash .....	.....	.....	0.008	0.012	0.004
Bull gear:					
Gear diameter over .....	0.3125	.....	.....	.....	.....
balls .....	8.795	8.807	.....	0.012	.....
Gear backlash .....	.....	.....	0.008	0.012	0.004
Outside diameter .....	10.749	10.750	.....	.....	0.001
Inside diameter .....	9.000	9.010	.....	.....	0.010
Drive wheel:					
Bearing bore.....	3.263	3.264	.....	.....	0.001

Table 1-1. Repair and Replacement Standards - Continued

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
<b>DRIVE AXLE ASSEMBLY: Continued</b>					
Bearing bore .....	3.498	3.499	.....	.....	0.001
Outside diameter.....	12.125	12.130	.....	.....	0.005
<b>Differential:</b>					
Ring gear backlash .....			0.0060.....	0.0100	0.0040
Ring gear outside diameter.....	1.2420	1.2500	.....	.....	0.0080
<b>HYDRAULIC LIFT CYLINDERS:</b>					
<b>Single cylinder:</b>					
Tube inside diameter .....	2.6205	2.6295	.....	.....	0.0090
Rod outside diameter.....	2.2460	2.2480	.....	.....	0.0020
<b>Cylinder cluster:</b>					
Rod outside diameter.....	2.2460	2.2480	.....	.....	0.0020
Tube inside diameter .....	2.6205	2.6295	.....	.....	0.0090

CHAPTER 2

GENERAL MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPEMENT

2-1. Special Tools and Equipment

There are no special tools and equipment required to perform Direct Support and General Support Maintenance on the Model MHE-209 Fork Lift Truck.

2-2. Direct Support and General Support Repair Parts

Direct and General Support maintenance repair parts are listed in TM 10-3930-621-35P.

2-3. Specially Designed (Fabricated) Tools and Equipment.

There are no specially designed tools and equipment required to perform Direct and General

Support maintenance on , he Model MHE-209 Fork Lift Truck.

Section II. TROUBLESHOOTING  
2-4. General

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the MHE-209 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 probable causes of the trouble. The corrective action recommended is described opposite the probable cause.

Table 2-1. Troubleshooting

Malfunction	Probable cause	Corrective action
1. Engine misses b. Stuck valve	a. Warped valves. b. Clean stem and guide. Grind valve if necessary.	a. Replace (para 3-17).
2. Engine knocks.	a. Loose connecting rod bearings (sharp knock, low oil pressure). b. Loose main bearings (heavy knock, low oil pressure). c. Loose piston pins sharp double knock). d. Piston and cylinder wear.	a. Replace bearings (para 3-31). b. Replace main bearings (para 3-31). c. Replace pins, or bushings (para 3-26). d. Replace pistons and rings (para 3-26).
3. Loss of power. b. Leaky valves c. Worn piston rings.	a. Sticking oil relief valve. replace. Do not stretch spring. b. Adjust or grind valve as necessary (para 3-17). c. Replace rings (para 3-26).	a. Remove oil relief valve, clean and
4. Explosion in exhaust	a. Partially open exhaust valve. defective spring.	a. Clean, adjust, or replace broken or
5. Engine runs irregularly.	a. Warped exhaust valve. b. Leaky valves. necessary.	a. Replace valve. b. Adjust, grind, or replace as
6. Transmission does not shift, or, truck	a. Transmission control valve linkage will not move. b. Transmission control valve dirty or defective. c. Dirty transmission fluid.  d. Transmission fluid low. 3930-621-12.	a. Adjust control valve linkage (para 6-out of adjustment. 23). b. Clean, repair or replace dirty or defective valve (para 6-13). c. Check transmission fluid and replace with fluid specified in Lubrication Order. (TM 10-3930-621-12). d. Fill with fluid as specified in LO 10-

Table 2-1. Troubleshooting - Continued

Malfunction	Probable cause	Corrective action
6. Transmission does not shift. or, truck will not move. Continued	<ul style="list-style-type: none"> <li>e. Faulty transmission pressure pump.</li> <li>f. Incorrect forward and reverse clutch pressures.</li> <li>g. Incorrect converter pressure.</li> </ul>	<ul style="list-style-type: none"> <li>e. Check pump pressure and repair (para 6-7).</li> <li>f. Check transmission and clutch pressures and repair (para 6-71).</li> <li>g. Check converter pressure and repair (para 6-7 1).</li> </ul>
7. Smoky exhaust	<ul style="list-style-type: none"> <li>a. Worn pistons, out-of-round and tapered cylinders (blue smoke).</li> </ul>	<ul style="list-style-type: none"> <li>a. Replace rings (para 3-26).</li> </ul>
8. Ammeter not registering.	<ul style="list-style-type: none"> <li>a. Dirty alternator commutator.</li> <li>b. Worn alternator brushes.</li> <li>c. Grounded or open alternator rotor.</li> <li>d. Grounded or open alternator stator. 12) or repair (para 5-4).</li> <li>e. Shorted or open alternator diode.</li> </ul>	<ul style="list-style-type: none"> <li>a. Clean commutator</li> <li>b. Replace (para 5-5).</li> <li>c. Test and replace (TM 3930-621-121 or repair (para 5-4, 5-5, and 5-61.</li> <li>d. Test and replace (TM 10-3930-621-12) or repair (para 5.4).</li> </ul>
9. Starter motor failure.	<ul style="list-style-type: none"> <li>a. Commutator dirty.</li> <li>b. Worn brushes.</li> <li>c. Broken drive unit.</li> <li>d. Broken teeth on flywheel ring gear.</li> </ul>	<ul style="list-style-type: none"> <li>a. Clean (para 5-10).</li> <li>b. Replace (para 5-12).</li> <li>c. Replace.</li> <li>d. Replace ring gear (para 3-13).</li> </ul>
10. Failure to move.	<ul style="list-style-type: none"> <li>a. Broken axle pinion shaft.</li> <li>b. Teeth broken on axle pinion shaft or bull gear.</li> <li>c. Broken teeth on differential ring gear or pinion.</li> </ul>	<ul style="list-style-type: none"> <li>a. Replace (para 7-2).</li> <li>b. Replace (para 7-2).</li> <li>c. Replace both ring gear and pinion; they are a matched set (para 7-4).</li> </ul>
11. Axle noise on drive or coast.	<ul style="list-style-type: none"> <li>a. Excessive wear on ring gear or pinion.</li> <li>b. Worn pinion gears or side gears in differential case.</li> </ul>	<ul style="list-style-type: none"> <li>a. Adjust if possible, or replace (para 7-4c).</li> <li>b. Replace worn gears (para 7-4).</li> </ul>
12. Continuous axle noise.	<ul style="list-style-type: none"> <li>Excessive wear in gear train.</li> </ul>	<ul style="list-style-type: none"> <li>Replace worn parts (para 7-4).</li> </ul>
13. Excessive backlash in drive unit.	<ul style="list-style-type: none"> <li>a. Worn splines on axle pinion shaft.</li> <li>b. Worn pinion, ring gear or differential case pinion.</li> <li>c. Loose or worn propeller shaft cross assemblies.</li> </ul>	<ul style="list-style-type: none"> <li>a. Replace axle pinion shaft (para 7-21).</li> <li>b. Replace (para 7-4).</li> <li>c. Tighten or replace (TM 10-3930-621-12).</li> </ul>
14. Brake pedal goes to toe board.	<ul style="list-style-type: none"> <li>a. External leak in system or leak past master cylinder piston cup.</li> </ul>	<ul style="list-style-type: none"> <li>a. Check system and master cylinder for leak, and repair (para 8-5).</li> </ul>
15. Both brakes drag	<ul style="list-style-type: none"> <li>a. Mineral oil in brake system.</li> <li>b. Breather port in master cylinder clogged.</li> </ul>	<ul style="list-style-type: none"> <li>a. Clean out system, replace cups in cylinders (para 8-4) and refill with approved brake fluid (TM 10-3930-621-12).</li> <li>b. Clean out breather port (para 8-5).</li> </ul>
16. One wheel drags.	<ul style="list-style-type: none"> <li>a. Obstructed brake line.</li> <li>b. Swollen wheel cylinder piston cups, or piston binding.</li> </ul>	<ul style="list-style-type: none"> <li>a. Remove obstruction or repair line.</li> <li>b. Replace defective or damaged parts (para 8-4).</li> </ul>
17. Truck pulls (one side).	<ul style="list-style-type: none"> <li>lining charred or drum scored.</li> </ul>	<ul style="list-style-type: none"> <li>Replace lining. Repair or replace drum (TM 10-3930-621-12).</li> </ul>
18. Loss of coolant.	<ul style="list-style-type: none"> <li>a. Cracked engine block.</li> <li>b. Leaking radiator.</li> </ul>	<ul style="list-style-type: none"> <li>a. Replace damaged part (para 3-3).</li> <li>b. Repair or replace (para 5-18).</li> </ul>
19. Loss steering.	<ul style="list-style-type: none"> <li>a. Bent or loose linkage and knuckle pins.</li> </ul>	<ul style="list-style-type: none"> <li>a. Repair, replace or adjust (TM 10-3930-621-12).</li> </ul>

Table 2-1. Troubleshooting - Continued

Malfunction	Probable cause	Corrective action
19. Loose steering. Continued	<ul style="list-style-type: none"> <li>b. Steering gear bending or out of adjustment.</li> <li>c. Loose steering arm.</li> </ul>	<ul style="list-style-type: none"> <li>b. Adjust, repair or replace (para 9-2).</li> <li>c. Tighten (Para 9-5).</li> </ul>
20. Low hydraulic oil pressure.	<ul style="list-style-type: none"> <li>a. Worn pump.</li> <li>b. External leakage.</li> </ul>	<ul style="list-style-type: none"> <li>a. Inspect and replace (para 10-38).</li> <li>b. Tighten or replace fittings, hoses or seals (TM 10-3930-621-12).</li> </ul>
21. Unable to lift or tilt load.	<ul style="list-style-type: none"> <li>a. Load too heavy.</li> <li>b. Damaged or worn pump.</li> <li>c. Broken lift chain.</li> <li>d. Damaged lift cylinders.</li> <li>e. Control valve inoperative.</li> </ul>	<ul style="list-style-type: none"> <li>a. Check capacity on Serial No. Plate (TM 10-3930-621-12).</li> <li>b. Test and repair or replace as required (para 10-38).</li> <li>c. Repair or replace (TM 10-3930-621-12).</li> <li>d. Check for bending or plunger malfunction (para 10-17 and 10-23).</li> <li>e. Test and repair or replace as required (para 10-44).</li> </ul>
22. Lift and tilt too slow.	<ul style="list-style-type: none"> <li>a. Internal leakage at pump.</li> <li>b. Excessive leakage at cylinder packing.</li> <li>c. Air leaks in system.</li> <li>d. Misalignment.</li> </ul>	<ul style="list-style-type: none"> <li>a. Disassemble and inspect for leakage or damaged parts. Repair as required (para 10-38).</li> <li>b. Repair or replace packing (para 10-17 and 10-23).</li> <li>c. Tighten connections.</li> <li>d. Check masts, carriage or tilt linkage for binding (para 10-5J).</li> </ul>
23. Load creepstiling or lowering.	<ul style="list-style-type: none"> <li>a. Internal leakage in cylinders.</li> <li>b. Oil leak at packing glands.</li> <li>c. Leak in control valve.</li> <li>d. Leaks in oil lines.</li> </ul>	<ul style="list-style-type: none"> <li>a. Repair or replace packing (para 10-17 and 10-23).</li> <li>b. Repair or replace packing (para 10-17 and 10-23).</li> <li>c. Check for worn or damaged plungers (para 10-44).</li> <li>d. Tighten all connections or replace damaged lines.</li> </ul>
24. Noisy pump.	<ul style="list-style-type: none"> <li>a. Coupling misalignment.</li> <li>b. Pump head loose.</li> <li>c. Worn or broken parts.</li> </ul>	<ul style="list-style-type: none"> <li>a. Re-align.</li> <li>b. Tighten.</li> <li>c. Replace (para 3-41).</li> </ul>
25. Oil overheating.	<ul style="list-style-type: none"> <li>a. Internal oil leakage.</li> <li>b. Pump too tight after overhaul</li> <li>c. Restricted lines.</li> </ul>	<ul style="list-style-type: none"> <li>a. Repair or replace pump (para 3-41).</li> <li>b. Remove and repair (para 3-41).</li> <li>c. Check and repair.</li> </ul>

**Section III. REMOVEAL AND INSTALLATION OF MAJOR COMPONENTS AND AUXILIARIES.**

**2-5. Engine Assembly**

*a. Removal.*

(1) Place rear wheels on four to six inch blocks and block front wheels.

(2) Remove seat, hood, rear fenders and grill, and counter-weight.

(3) Drain cooling system and oil from engine and transmission.

(4) Remove upper and lower radiator hose clamps and disconnect both hoses from engine.

(5) Disconnect oil filter, transmission oil cooler

and hydraulic pump lines and remove associated clamps.

(6) Disconnect the following electrical components, tagging each terminal or lead to show installed position:

- (a) Battery ground cable
- (b) Starter cable
- (c) Coil to distributor cable
- (d) Alternator (plug and two terminals)
- (e) Hourmeter wires
- (f) Coolant temperature transmitter



- (g) Oil pressure transmitter
- (h) Master cylinder ground wire.
- (7) Shut off fuel supply at shut off valve below fuel tank and disconnect fuel line from fuel pump.
- (8) Disconnect all accelerator and inching pedal linkages (TM 10-3930-621-12).
- (9) Disconnect propeller shaft at both ends and remove (TM 10-3930-621-12).
- (10) Disconnect exhaust pipe at manifold.
- (11) Support engine and transmission assembly with a suitable hoist and sling.
- (12) Remove engine mounting bolts from front and rear engine mounts.

(13) Using hoist, raise engine enough to clear mounts. Maneuver engine free of compartment and truck.

(14) If transmission assembly interferes with projected work on engine, remove it from the engine (para 2-6 a).

*b. Installation.*

(1) If work on the engine necessitated the removal of the transmission, install it (para 2-6 b) before replacing the engine in the truck.

(2) Using hoist, slowly lower engine with transmission down on rubber engine mounts. Maneuver until mounting bolts can be installed.

**Caution: Use extreme care in maneuvering the engine and transmission into the truck to prevent damage.**

(3) When engine mounting bolts have been tightened securely on both front and rear mounts, remove the hoist.

(4) Connect both ends of propeller shaft and all accelerator and inching pedal linkages (TM 10-3930-621-12).

(5) Connect exhaust pipe to manifold outlet flange.

(6) Connect fuel line to fuel pump and open fuel supply valve below fuel tank.

(7) Referring to tagged leads and terminals, connect the following electrical components:

- (a) Master cylinder ground wire
- (b) Oil pressure transmitter
- (c) Coolant temperature transmitter
- (d) Hourmeter wires
- (e) Alternator (plug and two terminals)
- (f) Coil to distributor cable
- (g) Starter cable
- (h) Battery ground cable.

(8) Connect oil filter, transmission oil cooler and hydraulic pump lines. Install associated clamps.

(9) Install upper and lower radiator hoses and clamps on radiator and engine.

(10) Clean and flush radiator before refilling (TM 10-3930-621-12).

(11) Refill radiator with soft water, if available, and add anti-freeze or corrosion inhibitor to the water as applicable.

(12) Check to see if engine and transmission drain plugs are in position and secure.

(13) Move truck rear wheels off blocks and replace counter-weight, rear fenders and grille.

(14) Fill engine and transmission with proper grade of oil (LO 10-3930-621-12).

**Caution: Do not overfill transmission.**

(15) Before starting engine, check oil levels on dipsticks.

(16) Start and run engine. Check transmission oil level with engine at idle speed.

(17) Perform hot oil level check and hydrometer check of coolant (TM 10-3930-621-12).

(18) If engine is performing satisfactorily, install seat assembly and side panels.

## 2-6. Transmission Assembly

### a. Removal.

*Note.* The transmission assembly consists of torque converter and pump assembly, clutch pack, gear train, and control valve components. All of these components, except the torque converter, may be removed from the truck as a unit. The torque converter, without pump assembly and housing, can only be removed from the flywheel after the unit is removed.

(1) Remove floor plates, seat deck assembly, battery case and battery, and one corner post (TM 10-3930-621-12).

(2) Drain oil from transmission by removing drain plug at bottom of case.

(3) Disconnect cooler lines and clutch and selector control linkages (TM 10-3930-621-12).

(4) Disconnect output flange from propeller shaft cross assembly in accordance with (TM 10-3930-621-12).

(5) Install lifting hooks on top of transmission case and attach a suitable hoist to each. Remove slack from hoist.

(6) Remove 12 screws and lock washers attaching converter housing to flywheel housing (fig. 2-1).

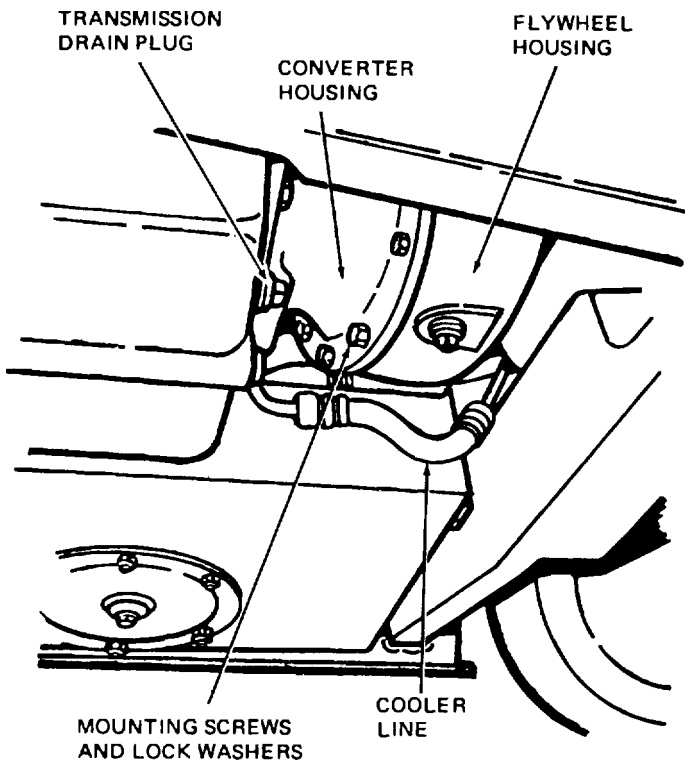


Figure 2-1. Transmission, installed view.

- (7) Carefully slide transmission forward shaft from torque converter and remove unit from truck,
- (8) Remove six bolts and lock washers attaching converter drive and reinforcing plates to flywheel and remove plates from flywheel.
- (9) Remove six bolts attaching drive plate to reinforcing plate and remove reinforcing plate from drive plate.

(10) Remove six screws and flat washers attaching converter to flywheel and remove converter from flywheel.

(11) Discard converter shim if it is damaged.

*b. Installation.*

(1) Check clearances (para 6-11) and install shim of equal thickness on converter.

(2) Secure converter to flywheel with six screws and flat washers.

(3) Attach converter reinforcing plate to drive plate with six bolts.

(4) Secure reinforcing and drive plate assembly to flywheel with six screws and flat washers.

(5) Using hoist, carefully insert transmission forward shaft of assembled unit, into converter.

**Caution: Use extreme care in aligning splines of forward shaft and converter, so as not to damage spline edges.**

(6) Secure converter housing to flywheel housing with 12 screws and lock washers (fig. 2-1).

(7) Install propeller shaft cross assembly on output flange in accordance with TM 10-3930-621-12.

(8) Install cooler lines and control linkages (TM 10-3930-621-12).

(9) Install drain plug.

(10) Remove transmission oil level gage and fill transmission with internal combustion engine lubricating oil OE until a full reading can be obtained on the gage.

**Caution: Do not overfill transmission.**

(11) Install corner post, battery and battery case, seat deck assembly, and floor plates (TM 10-3930-621-12).

(12) Operate transmission for a few minutes and recheck oil level and connections.

## CHAPTER 3

ENGINE REPAIR INSTRUCTIONS

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## Section I. ENGINE

**3-1. Description**

a. The FCB4-G5943 engine is a four-stroke cycle engine of 133 cubic inch range. The cylinders are cast integrally into the cylinder block and crankcase, which comprise the main body of the engine. Refer to paragraph 1-4 for specific engine

data and to the following figure 3-1 for the location of major components.

b. Parts identification and location on the engine are determined by standing at the flywheel end facing the engine. The flywheel end is the rear of the engine and the fan end is the front.

## KEY to fig. 3-1:

- |                       |                            |
|-----------------------|----------------------------|
| 1. Engine block       | 12. Fan drive pulley       |
| 2. Manifold           | 13. Starting crank jaw     |
| 3. Cylinder head      | 14. Timing gear cover      |
| 4. Valve tappet cover | 15. Camshaft               |
| 5. Piston rings       | 16. Crankshaft             |
| 6. Piston             | 17. Connecting rod bearing |
| 7. Connecting rod     | 18. Main bearing           |
| 8. Intake valve       | 19. Oil pump               |
| 9. Exhaust valve      | 20. Oil pan                |
| 10. Valve tappet      | 21. Flywheel               |
| 11. Fan hub           | 22. Flywheel housing       |

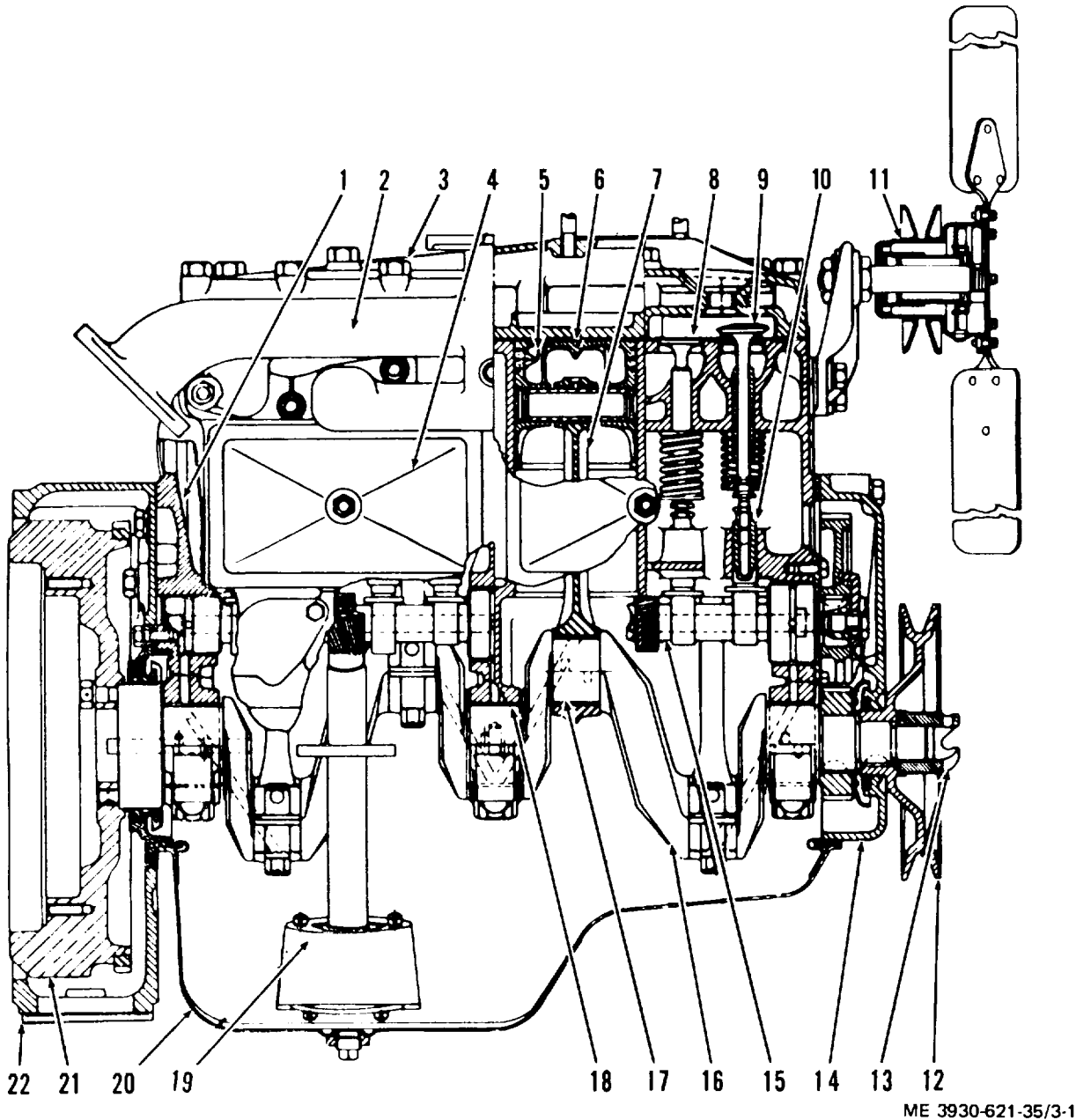


Figure 3-1. Engine components sectional view.

**Section II. ENGINE BLOCK**

**3-2. Description**

a. The engine block is cast as a unit and contains filleted bearing cross vials and water baffles. The cylinder bores are exposed to coolant for their entire lengths. Intake and exhaust ports are arranged along the upper right side of the engine over the valve cover openings. The block is ribbed length-

wise along the lower portion of the same side to incorporate a rifle drilled oil passage. A spring loaded pressure relief valve is mounted just below the center of this oil passage. An outlet to supply oil to the governor is provided toward the front end of the oil passage.

b. The rear end of the block provides a machined surface for mounting the fly wheel housing. A semi-circular groove in the flywheel face of the block contains a seal gasket and receives a circular bearing plate, which seals off the block and main bearings.

**3-3. Removal**

**Caution: Do not mix or confuse engine parts. Mark for position on disassembly and tag assemblies and attaching parts.**

- a. Remove engine assembly from truck (para 2 5) and transmission (para 2-6).
- b. Remove fan, belt, and pulley; water pump and lines (TM 10-3930-621-12).
- c. Remove manifold, fuel pump, and carburetor (TM 10-3930-621-12).
- d. Remove cylinder head (TM 10-3930-621- 12).
- e. Remove crankshaft pulley (14, fig. 3-3), engine front support and timing gear assembly (para 3-37).
- f. Remove governor (para 4-15) and disconnect the lubrication line at the block.
- g. Remove flywheel (para 3-13) and crankshaft bearing plate (3, fig. 3-3), gasket (4), seal (5), and deflector (6).
- h. Remove crankshaft (para 3-8) using caution to prevent damage to journals.
- i. Remove camshaft (para 3-22) using caution not to scratch bushings.
- j. Remove valves and springs (para 3-17), guides (para 3-18), and tappets (para 3-19).
- k. Remove oil pump (para 3-41 b).

**3-4. Disassembly**

Remove all associated parts (fig. 3-2).

**3-5. Inspection, Replacement and Repair**

a. Inspect engine block for cracks, holes or damage to wear surfaces, particularly in the exhaust valve areas.

b. Examine all block associated parts for wear. Replacement parts must be the same as those removed.

c. Replace all gaskets, using same material and size as those removed.

d. Measure cylinders with a dial gage or micrometer and record bore measurements. Bore diameter should be 3.2503 - 3.2507 inches with a maximum allowable wear limit of 0.0004 of an inch.

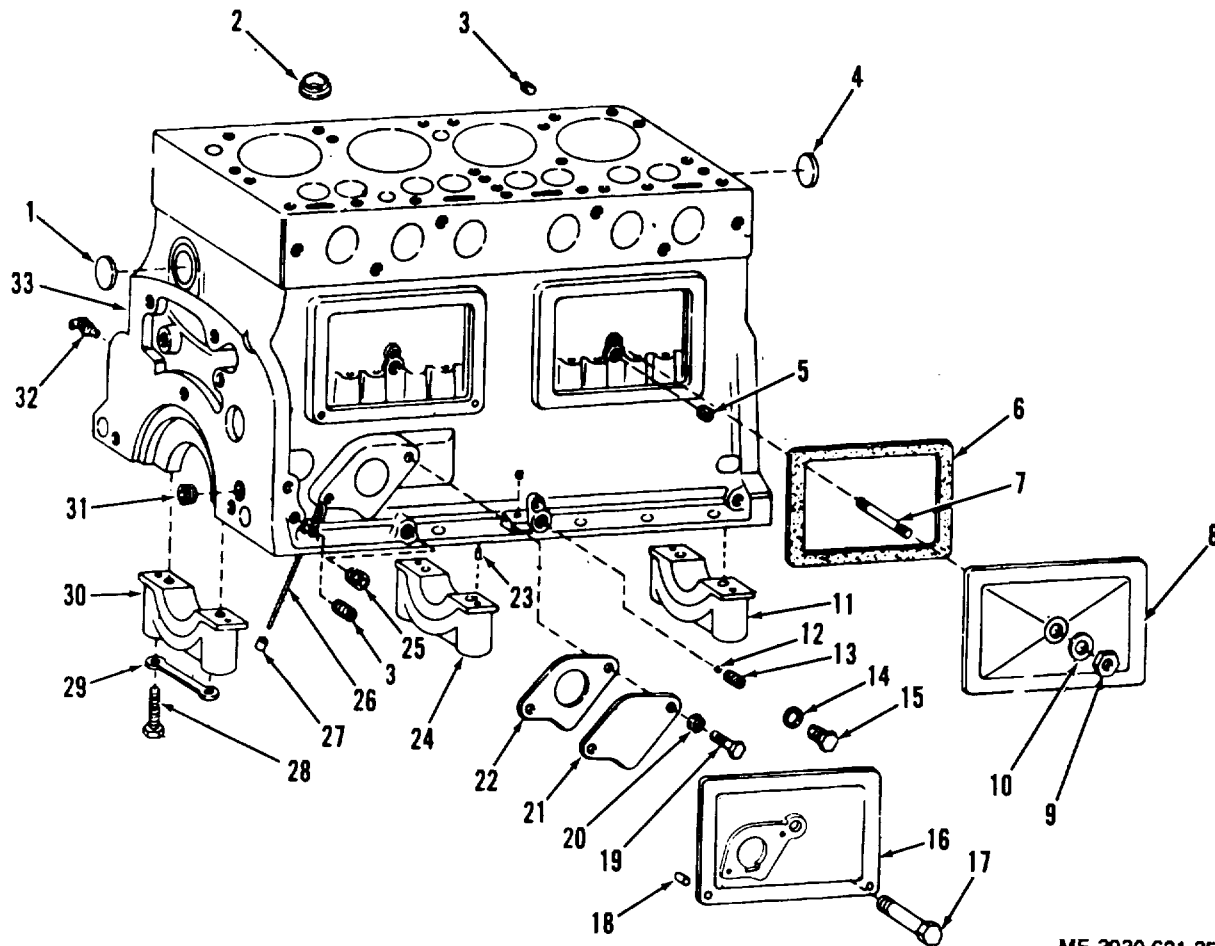
e. Determine the oversize to which cylinders can be resized. When reboring, allow 0.002" for finishing by honing.

**3-6. Assembly and Installation**

- a. Install oil pump (para 3-41 d).
- b. Install valve and springs (para 3-17), guides(para 3-18), and tappets (para 3-19).
- c. Install camshaft (para 3-24), using caution not to scratch bushings.
- d. Insert crankshaft (para 3-11), using caution to prevent damage to journals.
- e. Install flywheel (para 3-1.), and crankshaft bearing plate (3, fig. 3-3), gasket (4), seal (5), and deflector (6).
- f. Connect the governor lubrication line at the block and install the governor (para 4-19).
- g. Install timing gear assembly and front support (para 3-18), and crankshaft pulley (14, fig.3-3).
- h. Install the following per TM 10-330-621-12.
  - (1) Cylinder head. Torque to 60-62 foot pound values.
  - (2) Manifold, carburetor, and fuel pump.
  - (3) Water pump and water pump lines.
  - (4) Fan, belt and pulley.
- i. Install transmission assembly (para 2-6) and engine assembly in truck (para 2-51).
- j. Adjust all accessories for efficient operation as instructed in the appropriate paragraphs of TM 10-3930-621-12 and TM 10-3930-621-35.

KEY to fig. 3-2:

- |                         |                        |
|-------------------------|------------------------|
| 1. Expansion plug       | 17. Screw              |
| 2. Valve seat           | 18. Pin                |
| 3. Pipe plug            | 10. Bolt               |
| 4. Expansion plug       | 20. Lock washer        |
| 5. Pipe plug            | 21. Pad cover          |
| 6. Valve cover gasket   | 22. Pad cover gasket   |
| 7. Valve cover stud     | 23. Pin                |
| 8. Valve chamber cover  | 24. Center bearing cap |
| 9. Nut                  | 25. Pipe plug          |
| 10. Valve cover gasket  | 26. Gage               |
| 11. Front bearing cap   | 27. Bushing            |
| 12. Bearing ball        | 28. Screw              |
| 13. Compression spring  | 29. Lock plate         |
| 14. Relief valve gasket | 30. Rear bearing cap   |
| 15. Relief valve screw  | 31. Pipe plug          |
| 16. Valve chamber cover | 32. Drain cock         |
|                         | 33. Engine block       |



ME 3930-621-35/3-2

Figure 3-2. Engine block and associated parts, exploded view.

### Section III. CRANKSHAFT, BEARING, AND TIMING GEAR

#### 3-7. Description

The crankshaft is a heat treated steel forging, drilled for rod and bearing pressure lubrication. End thrust is controlled by the flanges of the center main bearing 19, fig. 3-3). The timing gear (11) is keyed and pressed in place. The crankshaft pulley(14) is keyed, supports a deflector (12), and is pressed on the portion of the crankshaft protruding through the timing gear. Another deflector (6) is pressed into place on the flywheel end of the crankshaft. The precision type main bearings (8, 9, and 10) consist of thin wall bearing shells held in place by precision machined bearings seats and caps.

#### 3-8. Removal

a. Remove engine assembly (para 2-5) and transmission assembly (para 2-6), from truck.

b. Remove engine accessories (TM 10-3930-621-12) and hydraulic pump (para 10-38).

c. Remove governor (para 4-15).

d. Remove flywheel (para 3-13).

e. Drain oil remove oil pan. Turn engine upside down only if more convenient.

**Caution: Protect machined surfaces, moving parts, and openings from dirt and damage.**

f. Remove bearing plate (3, fig. 3-3), gasket(4), oil seal (5), and deflector (6).

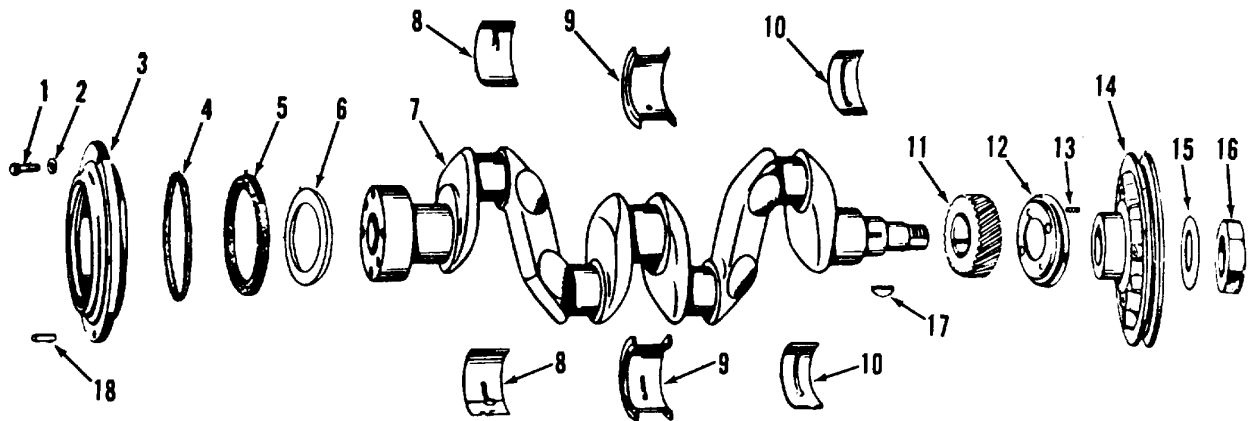
g. Remove crankshaft pulley (14) with attached deflector (12) by removing nut (16) and washer(15) and using a suitable gear puller to remove the pulley.

h. Remove drive gear (11) and key (17) using suitable gear puller.

i. Remove timing gear cover (para 3-37).

- j. Remove connecting rod bearing caps (para 3-26).
- k. Remove main bearing cap lock plates (29, fig.

- 3-2), main bearing screws (28), and bearing caps(1, 1, 24 and 30).
- l Remove thin walled outer bearings (8, 9 and 10, fig. 3-3).



ME 3930-621-3513-3

- 1. Bolt
- 2. Lock washer
- 3. Bearing plate
- 4. Bearing plate gasket
- 5. Oil seal
- 6. Rear deflector
- 7. Crankshaft
- 8. Rear main bearing
- 9. Center main bearing

- 10. Front main bearing
- 11. Crankshaft timing gear
- 12. Front deflector
- 13. Drive screw
- 14. Crankshaft pulley
- 15. Recessed washer
- 16. Self-locking nut
- 17. Key
- 18. Pin

Figure 3-3. Crankshaft exploded view.

- m. Carefully lift crankshaft from bearing seats.

Avoid nicking or bumping the bearings or journal surfaces (fig. 3-4).

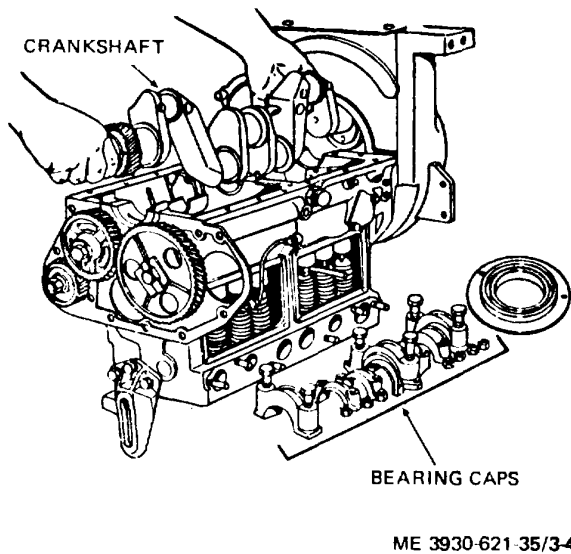


Figure 3-4. Crankshaft removal.

### 3-9. Cleaning

- a. Clean all parts with a cleaning compound, solvent (Spec. P-S-661). Dry thoroughly with compressed air.
- b. Remove all dirt and foreign matter from inside bearing caps.
- c. Using a soft wire probe, clean all passages.

### 3-10. Inspection and Repair

- a. Inspect crankshaft journals and bearings for excessive wear, scoring, taper, out-of-round, and other possible damage.
- b. Mount the crankshaft in "V" blocks at the front and rear main bearing journals. To avoid marring shaft, insert paper strips soaked in lubricating oil in "V" blocks.

c. Take a dial indicator reading at center main bearing journal. Maximum taper or out-of-round allowable during one revolution is 0.002 of an inch.

d. Check remaining connecting rod and main bearing journals for out-of-round and tapered condition. Maximum variation allowable from center main bearing journal reading is 0.0005 of an inch.

e. The crankshaft shall be examined for alignment, cracks, and breaks. If none of the above damages are found, the crankshaft may be rehabilitated. The crankshaft may be rebuilt to standard size by Hard Chrome Plating or sub-merged arc welding, or the crankshaft may be ground to undersize 0.010 or 0.020 of an inch. The method of repair used shall be by the availability of facilities, and the cost factor.

f. Replace parts as authorized.

### 3-11. Installation

- a. Insert key (1., fig. 3-3) in crankshaft (7) and tap gear (11) in place with rubber mallet.
- b. Slowly lower crankshaft on bearing seats, avoiding any bumping of bearing or journal surfaces.
- c. Install bearings (8, 9 and 10).
- d. Install main bearings (11, 24, 30, fig. 3-2) and rod bearing caps (para 3-30). Torque main bearings 88 to 92 and rod bearings 44 to 46 foot-pounds.
- e. Initial main bearing lock plates (29).
- f. Install timing gear cover (para 3-39).
- g. Insert gear key (17, fig. 3-3) into crankshaft and press on drive gear (11). Aline "C" marks on crankshaft and camshaft gears and mesh gears.
- h. Insert pulley key and press on pulley-deflector assembly (12, 14).
- i. Secure gear and pulley with nut (16) and washer (15).
- j. Install deflector (6), oil seal (5), gasket (4) and closure plate (3) on other end of crankshaft.
- k. Secure oil pan in plate (para 3-40) and fill with specified oil.
- l. Install flywheel (para 3-15) and governor (para 4-19).
- m. Install engine accessories (TM 10-3930-621-12) and hydraulic pump (para 10-42).
- n. Install engine assembly (para 2-5) and transmission assembly (para 2-6) in truck.

## Section IV. FLYWHEEL ASSEMBLY AND HOUSING

### 3-12. Description

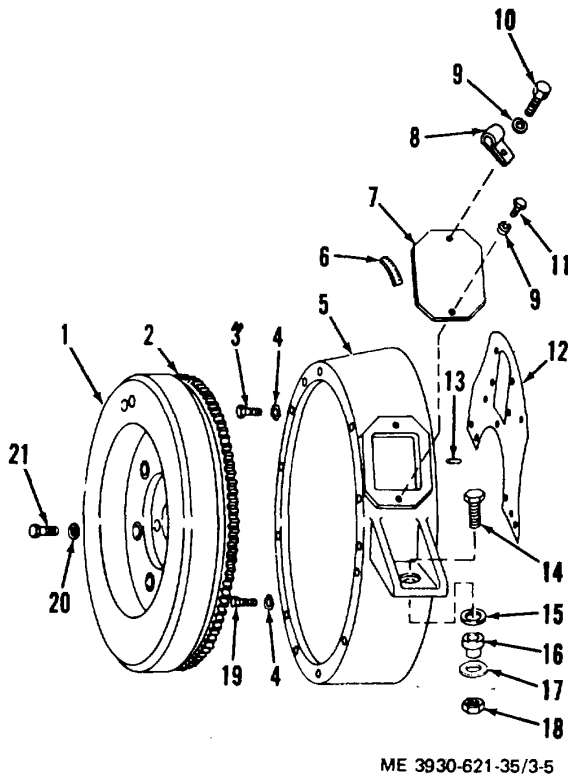
a. Flywheel Assembly. The flywheel assembly consists of a flywheel (1, fig. 3-5) and a ring gear (2), which is shrunk fit to the flywheel. The flywheel assembly is secured to a flange on the

rear end of the crankshaft. A timing strip is secured to the flywheel for more accurate engine timing.

b. Flywheel Housing. The flywheel housing is attached to a machined surface on the rear of the engine block. An opening, with access cover, is



provided through which the timing marks on the timing strip may be seen. Two engine mounting



- |                     |                          |
|---------------------|--------------------------|
| 3. Screw            | 14. Mounting cap screw   |
| 4. Lock washer      | 15. Alining washer       |
| 5. Flywheel housing | 16. Mount                |
| 6. Timing strip     | 17. Flat washer          |
| 7. Access cover     | 18. Self-locking nut     |
| 8. Loop clamp       | 19. Closure machine bolt |
| 9. Lock washer      | 20. Flywheel lock washer |
| 10. Machine bolt    | 21. Flywheel bolt        |
| 11. Machine bolt    |                          |

Figure 3-5. Flywheel assembly, exploded view.

**Section V. VALVES, SPRINGS, GUIDE, SEATS AND TARPET ASSEMBLIES**

**3-16. Description**

The valve tappets and valves are of the mushroom type. Valve springs are held to the valve stem by a pair of wedge shaped locks (6, fig. 3-6) between the stem and spring retainer (5). The valves operate in replaceable guides (2) and (3) and seats.

**3-17. Valves and Springs**

- a. Removal.
  - (1) Remove cylinder head (TM 10-3930-621-12).

**3-13. Removal**

- a. Remove engine assembly from truck (para 2-5).
- b. Remove transmission from engine (para 2-6).
- c. Remove the lockwires from the four bolts (21, fig. 3-5) and remove screws and lock washers (20) holding flywheel to flange.

**Caution: Do not mix special fly wheel retaining bolts (21) with others. Do not use ordinary bolts, since flywheel bolts are under great stress in normal use.**

- d. Remove flywheel (1).
- e. If necessary to remove starter ring gear (2), heat gear and cut out with chisel.
- f. Remove the three bolts (9) and lock washers (4) holding the main bearing assembly closure plate (3, fig. 3-3) and remove plate.
- g. Remove the five screws (3, fig. 3-5) and lock washers (4) holding the flywheel housing (5) to the cylinder block and remove housing.

**3-14. Cleaning and Inspection**

- a. Clean all parts with a cleaning compound, solvent (Spec. P-S-661). Dry thoroughly using compressed air.
- b. Check ring gear for cracks, chipped teeth, and other damage or wear.
- c. Replace damaged parts as authorized.

**3-15. Installation**

- a. Install flywheel housing (5, fig. 3-5) on engine block with screws (3) and lock washers (4).
- b. Install bearing closure plate (3, fig. 3-3) with bolts (19, fig. 3-5) and lock washers (4).
- c. Heat starter ring gear (2) and press gear on flywheel.
- d. Install flywheel (1) and secure with bolts (21) and lock washers (20). Be sure to use special flywheel bolts.
- e. Install lockwires on bolts (21).
- f. Install transmission on engine (para 2-6) and engine assembly in truck (para 2-5).

(2) Remove valve covers on side of engine block (TM 10-3930-621-12).

(3) Raise spring retainer (5, fig 3-6) until the two wedge shaped lock, (6, drop out from between the cap (7) and retainer.

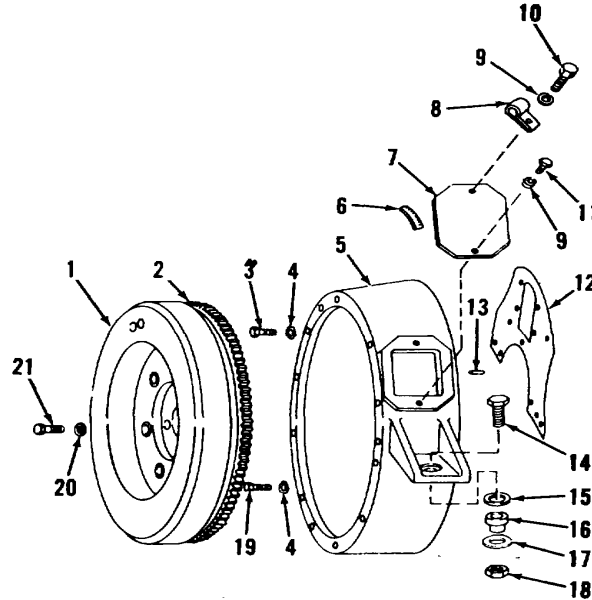
(4) Lift valves (1), retainer caps (7), retainers (5), and springs (4) out of engine.

(5) Place valves in numbered holes., in a board to make sure of reinstallation in their original positions.

b. Inspection and Cleaning.

- (1) Examine valve carefully for fit in guide, excessive wear, warping or burning.
- (2) Remove all carbon and burnt oil.
- (3) Inspect spring coils for bright spots that may be an indication of weakness when found

- (4) Check tension of each valve spring with a suitable spring scale.
- (5) Tension of all springs should be equal. Spring free length is 2.250 inch. Compressed to 1.938 inch the scale should read approximately 36 pounds.
- (6) Replace defective parts as authorized.



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- |                          |                          |
|--------------------------|--------------------------|
| 1. Poppet valve          | 12. Flat washer          |
| 2. Intake valve guide    | 13. Cotter pin           |
| 3. Exhaust valve guide   | 14. Machine bolt         |
| 4. Spring                | 15. Screw                |
| 5. Spring retainer       | 16. Gear                 |
| 6. Valve spring lock     | 17. Retaining ring       |
| 7. Retainer cap          | 18. Lock plate           |
| 8. Valve tappet          | 19. Thrust plate         |
| 9. Center sleeve bearing | 20. Key                  |
| 10. Front sleeve bearing | 21. Camshaft             |
| 11. Nut                  | 22. Rear sleeve bearing? |

Figure 3-6. Cam shaft, valves and tappets, exploded view

c. Grinding.

(1) The accuracy of grinding valve seats depends upon the condition of the valve guide and the pilot mandrel's fit, both in the guide itself, and the hub of the grinder stone. It is vitally important to make sure that the mandrel is a snug fit in the valve guide, and does not wobble at the upper end.

If it does have any upper end movement the seat not be ground true.

(2) Guides that are worn too much to give the mandrel solid support should be replaced before grinding is attempted. The manufacturers instructions for dressing the grinding wheel must be owed to secure smooth, accurate seats.

(3) Before grinding valves, make sure the valve stems and guides are a good fit, within tolerances, to ensure a concentric seat and a tight valve.

(4) Apply a good, medium grinding compound sparingly around the entire valve seat. Slip a light lifting spring over the stem, lubricate the stem and place the valve in its original position. The spring should just barely hold the valve off its seat.

(5) Place the grinding tool cup on the head of the valve. Press down until the valve is seated. Turn the valve until all the grinding compound is rubbed off the valve seat. Release the pressure on the valve and the light spring will lift it clear of its seat.

(6) Withdraw the valve and put on fresh grinding compound and repeat the grinding operation. Valve seat angle must be 45° and the valve face diameter must not be less than the seat inside diameter of 1.214 to 1.224 inches.

(7) Clean the valve and its seat occasionally to see how the grinding is progressing. When all the pits and grooves have disappeared, clean the valve and valve seat, and place eight or ten equally spaced marks with a soft lead pencil on the seat. Insert the valve, give it a quarter turn, and remove it. A perfect seat will be indicated if every pencil mark shows where the valve has rubbed it. If any of the pencil marks are left untouched, continue the grinding.

(8) When the grinding is completed, check the valve seat in relation to the valve guide for concentricity with a dial indicator. Total run out of the seat from the valve guide should not exceed 0.0020 inch total indicator reading.

(9) Clean all traces of grinding compound from the valve chamber and ports, oil the valve stem and install. Remember to install each valve in the same position from which it was removed.

d. Installation.

(1) Insert valve in guide (2, 3, fig. 3-6) and cap to which it has been fitted.

(2) Install spring (4) and retainer cap (7), compress spring and insert wedge shaped locks (6) between concave side of retainer cap and groove in valve stem.

(3) Releasing the spring holds the locks (6) in place and holds the spring on the stem. (4) Install valve covers and cylinder head (TM 10-3930-621-12).

**3-18. Guides**

a. Description. Valve guides are tubular inserts designed for press fit insertion into the engine block.

b. Removal. Refer to TM 10-3930-621-12 and remove cylinder head. Refer to paragraph 3-17 and remove valves. The guide may be reamed to leave only a thin shell. Collapse the shell to remove the

old guide. Break off old guides as they are forced out to allow clearance. If required, the valve seat should be removed prior to guide removal (para 3- 20).

c. Installation.

(1) Press new guides into place with a suitable arbor press and mandrel.

(2) Press guide in until upper end is 1.0 inch from the face of the engine block.

Note. Special notice should be taken of the exhaust valve guide and valve stem shoulder. The guide should not project into the gas passage and the stem shoulder should be sharp and located slightly below the end of the guide when the valve is seated. Thus any accumulation of carbon around the guide and stem running surfaces will be sheared away each time the valve is lifted.

(3) Refer to TM 10-3930-621-12 and install cylinder head.

**3-19. Valve Tappets**

a. Removal.

(1) Remove camshaft (para 3-22).

(2) Remove valve tappets (8,fig.3-6), through bottom of crankcase.

b. Inspection and Cleaning.

(1) Soak tappets in a cleaning compound, solvent (Spec. P-S-661), and remove any foreign material. Dry thoroughly with compressed air.

(2) Inspect for warping, cracks, wear or other damage.

(3) When worn or damaged tappet is found, always check camshaft lobe (para 3-19). Valve tappet running clearance in the crankcase is from 0.002 to 0.0005 of an inch.

(4) Replace damaged parts as authorized.

c. Installation. Oil the tappet and install, checking it for free movement in the block. Install camshaft (para 3-24).

**3-20. Valve Seats**

a. Removal.

(1) If seat is peened in position, use a suitable cutter to remove the metal from the block that is peened over the seat.

(2) Using a seat puller, remove seat from the engine block. Discard seat.

b. Cleaning. Using a suitable cutter with a radius of 0.015 to 0.020 of an inch smaller than counterbore, clean up the counterbore. There must be no sharp break where the counterbore wall meets the bottom surface.

c. Installation.

(1) Enlarge the seat counterbore as follows to obtain the correct size or crush for the new over- sized seat.

**Caution: The crush for any given seat and engine combination is a very critical dimension. Attempts to over-crush seats frequently result in the seat loosening during service.**

(a) Subtract the original counterbore diameter from the original seat diameter.

(b) Measure the diameter of the new seats and subtract the figure obtained for the crush ( (a) above).

(c) Set cutting diameter of cutter at dimension obtained above and enlarge the counterbore.

(2) Place seat in a container filled with alcohol or gasoline and several chunks of dry ice.

(3) Slip a sturdy washer-like driving plate, somewhat larger than the seat, over the mandrel pilot of a seat driving tool.

(4) Check counterbore for cleanliness and freedom from burr edges.

(5) Using a pair of forceps or a hooked wire, quickly lift the chilled seat from the dry ice bath and locate it over the counterbore so the chamfer of the seat lower edge is entered squarely.

(6) Start the driving mandrel pilot in the valve guide, bring the driving face against the seat upper surface accurately, and tap the mandrel firmly with a medium weight hammer.

(7) If severe hammering is required, the counterbore is not the correct size, the seat was not chilled enough, or the seat was not started into the counterbore straight.

Note. Peening seats in position is no longer a standard production procedure, and therefore is not necessary.

## Section VI. CAMSHAFT, BUSHINGS, AND DRIVE GEAR

### 3-21. Description

The camshaft runs in steel backed babbit shells located in the three main crankshaft bulkheads. The camshaft drive gear is pressed and keyed on the front end of the camshaft. Two spiral gears are provided, one to drive the oil pump and the other to drive the distributor. An eccentric, toward the rear of the camshaft, actuates the diaphragm type fuel pump. Camshaft end play is controlled by a thrust plate (19, fig. 3-6) located between the shoulder of the rear cam journal and the face of the drive gear hub (16). The drive gear is secured to the camshaft by a retaining ring (17).

### 3-22. Removal and Inspection

- a. Remove oil pan (para 3-40), oil pump (para

3-41), timing gear cover (para 3-37a), and distributor, fuel pump and valve covers (TM 10- 3930-621-12).

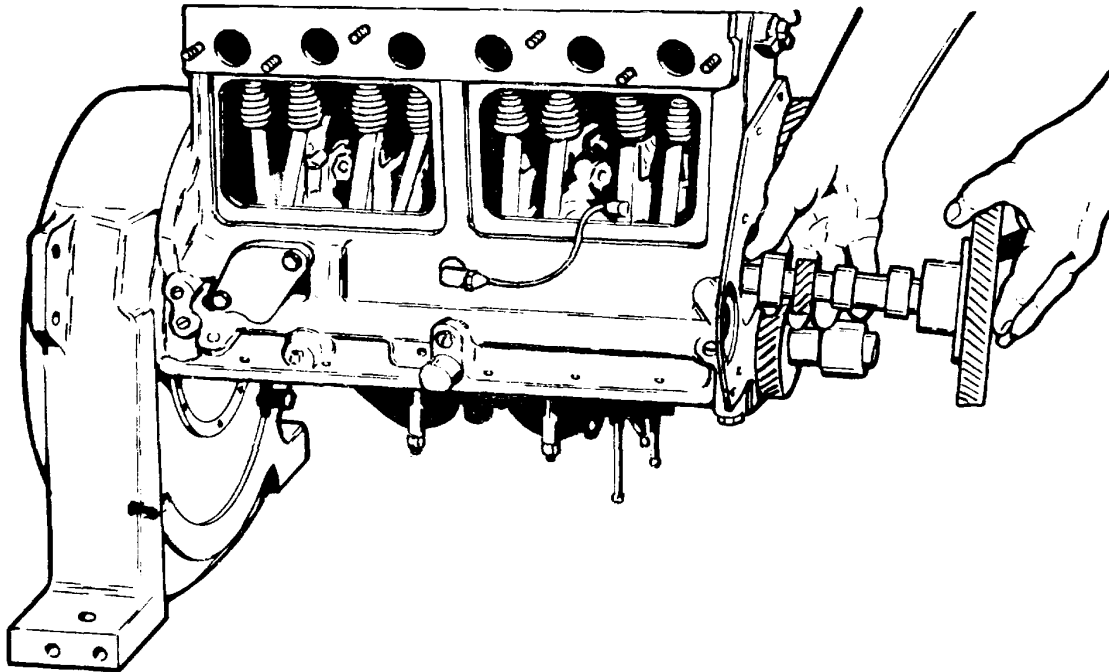
- b. Raise valves and springs (1, 4, fig. 3-6), and keep them raised with wooden blocks or other suitable means.

- c. Raise tappets (8) to clear cam lobes on shaft. Keep tappets raised with tape, wire, cord or by other suitable means.

- d. Remove the two thrust plate screws (15) through holes in drive gear (16).

- e. Gently withdraw camshaft from its sleeve bearings (9, 10 and 22). See figure 3-7.

**Caution: Do not allow cam lobes to catch or, be scratched by, or scratch, sleeve bearings.**



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Figure 3-7. Removing Camshaft

f. Remove sleeve bearings (9,10, and 22, fig. 3- 6) from engine block by reaming the bearings until they are thin enough to collapse and remove. Press sleeve bearings out, using new sleeve bearings, if possible.

g. If removal of the drive gear (16) is necessary, proceed as follows:

(1) Remove retaining ring (17).

(2) Press the gear from the camshaft (21) using a suitable arbor press and support plate. Lock plate (18) and thrust plate (19) may now be removed from the camshaft.

h. The camshaft should be inspected for wear, scoring, and alignment.

i. The bearings should be inspected for wear, scoring, or burnt condition. Damaged bearings should be replaced.

### 3-23. End Play Adjustment

a. Check camshaft end play by mounting thrust plate (19, fig. 3-6) and lock plate (18) on shaft (21) and measuring distance between shaft journal and thrust plate with feeler gauge.

b. If measurement exceeds 0.006 inch, replace thrust plate with one of suitable thickness to provide 0.002 to 0.006 inch clearance between journal and thrust plate.

c. If a condition of insufficient end play is found (less than 0.002 inch), use one or two thin shims between the journal shoulder and the face of the drive gear.

### 3-24. Installation

a. If drive gear (16, fig. 3-6) was removed and disassembled, reassemble as follows:

(1) Clean out gear and camshaft (21) oil passages.

(2) Install lock plate (18) and thrust plate (19) on camshaft.

(3) Press fit drive gear on shaft, 0.002 press maximum, using suitable arbor press and support plate.

(4) Install retaining ring (17) on camshaft.

b. Install the sleeve bearings (9, 10 and 22) in engine block by pressing bearings in place.

c. Slowly insert camshaft assembly in sleeve bearings, using caution not to damage any parts. Align "C" marks on crankshaft and camshaft gears and mesh gears.

d. Insert thrust plate screws (15) through drive gear (16) holes and tighten securely.

e. Slowly lower valves (1), springs (4), and tappets (8) that were raised for removal procedure.

f. Install fuel pump, valve covers, and distributor (TM 10-3930-621-12).

g. Install oil pan (para 3-40), oil pump (para 3-41) and timing gear cover (para 3-39b).

**Section VII. PISTON AND CONNECTING RODS**

**3-25. Description**

The engine has four aluminum pistons. Each piston has three scraper rings and one oil ring. The piston is attached to a connecting rod by a piston pin. The forged connecting rods are precision ground at the large end to receive precision type thin wall sleeve bearings (5, fig. 3-8). Another sleeve bearing (9) is diamond bored and burnished, in place, in the upper end of the connecting rod. Pistons and rings are available in 0.010, 0.020, and 0.040 inch

**3-26. Removal and Disassembly**

- a. Remove engine (para 2-5) and cylinder head from engine (TM 10-3930-621-12).
- b. Using a suitable reamer, remove ridge from top of cylinder walls before removing pistons. Failure to remove ridge will result in damage to piston ring lands.
- c. Remove reamer cuttings.
- d. Drain and remove oil pan (para 3-40).
- e. Turn crankshaft until one of the pistons is at the top of its stroke.
- f. Remove nuts and bolts (7 and 8, fig. 3-8), then remove bearing caps and bearings (5).

Caution: Be certain to mark caps and connecting rods (6) for accurate rematching during assembly. Mismatching can cause serious damage.

g. Remove piston (2) and connecting rod (6) through top of engine block. Be certain not to damage rings or grooves.

h. Remove ring set (1) from piston.

i. Remove piston pin retainers (3), piston pin (4), and piston from connecting rod. 3-27. Cleaning

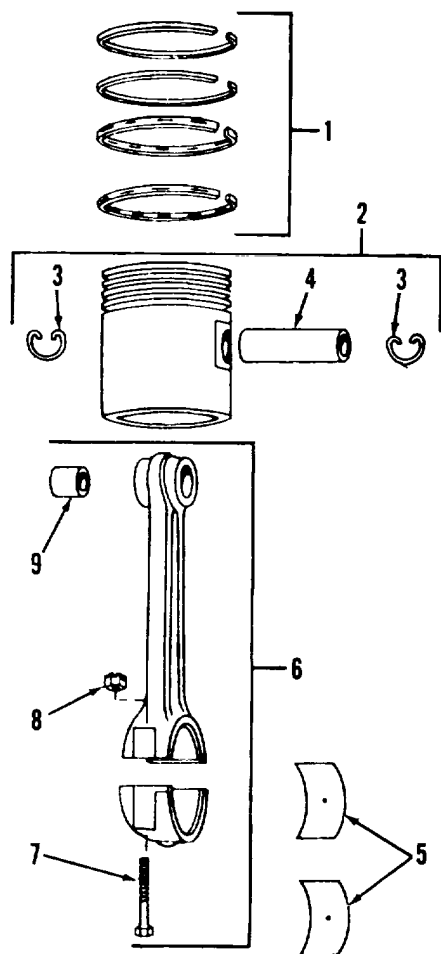
- a. Soak pistons in a cleaning compound, solvent (Spec. P-S-661). Dry thoroughly with compressed air.
- b. Clean all carbon from piston top and ring grooves.
- c. Use a drill of appropriate size to clean carbon from the oil return holes in the grooves.

**3-28. Inspection**

- a. Inspect pistons for score marks, ring land fractures, cracks, or other damage.
- b. Measure each piston with a micrometer to determine size.
- c. Inspect pins, rods, and rings for cracks, scores, distortion and other damage.

**3-29. Piston Fitting**

- a. Description. Proper fitting of pistons requires at least four different precision checks. These are ring gap, ring side clearance, pin clearance in piston, and piston skirt to cylinder clearance,
- b. Checking Ring Gap. Place each ring individually in bore of cylinder, invert piston and use it to push the ring to within two inches of the top of the cylinder.
- c. Measuring Gap. Measure gap with feeler gage (fig. 3-9). The gap should be 0.010 to 0.020 of an inch for the top and second rings. The third and



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- 2. Piston assembly
- 3. Retaining rings
- 4. Piston pin
- 5. Bearing
- 7. Bolt
- 8. Nut
- 9. Pin bearing sleeve

Figure 3-8. Piston and connecting rod, exploded view.

fourth rings should measure 0.015-0.055 of a inch. If the gap is smaller than the minimum specified, file ends of ring until the desired gap obtained.

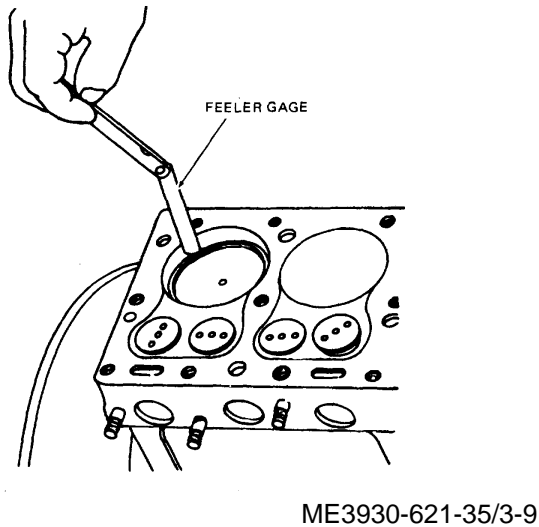


Figure 3-9. Checking ring gap.

d. Checking Ring Side Clearance

(1) Install fitted rings (1, fig. 3-8) on the pistons to be used in the specific bore in which the ring gap test was performed.

(2) Check rings for the proper side clearance between rings and sides of the piston grooves. The clearance tolerance should be as specified in table 1-1. If the side clearance is less than minimum clearance exceeds the specified tolerance, lay a piece of fine emery cloth on a flat surface and rub the ring lightly until desired clearance is obtained. If side clearance exceeds the specified tolerance, replace the ring.

e. Checking Pin Clearance In Piston.

(1) Measure piston pin clearance in piston. Design tolerance is from 0.0002 to 0.0004 inch loose. If too tight ream out pin holes.

(2) measure piston pin clearance in the connecting rod bushing. The desired clearance is from 0.0002 to 0.0006 inch loose, replace bushing.

f. checking piston Skirt to Cylinder Clearance

(1) Pistons must be allowed reach room

temperature before the following clearance checks are made.

(2) Select a piece of 0.5 inch wide feeler gage stock 8 to 10 inches long and 0.0003 inch thick. This feeler stock must be perfectly flat and free of nicks or scratches. Attach a feeler gage to an accurate spring scale having a 10 pound full scale reading.

(3) Hold feeler gage along the side of cylinder bore then insert piston and rod assembly in to bore in normal running position. Gage must be positioned 90° from piston pin (fig. 3-10).

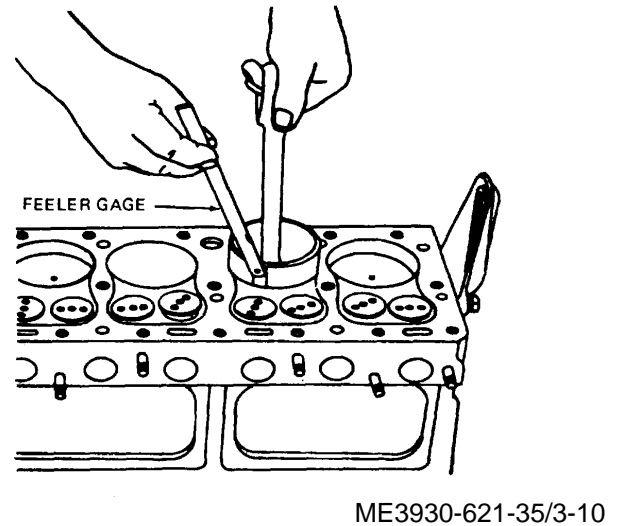


Figure 3-10. Checking piston clearance.

(4) A maximum pull of eight pounds should withdraw the feeler gage from between piston and bore.

(5) Repeat steps (3) and (4) above at three more points 90° apart around the cylinder bore.

(6) Repeat steps (3), (4), and (5) above at both ends of the cylinder bore to insure equal diameters at top and bottom of bore.

**3-30. Assembly and Installation**

a. Oil cylinder wall and piston with internal combustion engine lubricating oil (OE).

b. Be certain that ring gaps are equally spaced around the circumference of the pistons.

c. Compress rings with ring compressor, tapping the compressor lightly around the rings to allow the rings to close evenly.3-13

d. Use a wooden hammer handle to force piston through the ring compressor into the cylinder bore. Keep the ring compressor tight against the cylinder block to prevent ring damage.

e. Oil crankshaft journal with internal combustion engine lubricating oil (OE). Install upper half of bearing into connecting rod, and seat bearing on crankshaft journal.

f. Install lower half of connecting rod bearing in connecting rod bearing cap and install cap, nuts, and cotter pins.

g. Tighten connecting rod bearing cap nuts to 44-46 foot-pounds of torque. h. Install oil pan (para 3-40), cylinder head (TM 10-3930-621-12), and engine (para 2-5).

## Section VIII. BEARINGS

### 3-31. Replacement

a. General. Both the connecting rod and main bearings are of the steel-backed, precision type. Due to the close machining of this type of bearing, not fitting, filing, scraping, boring or other adjustment is required or permissible. Replacement must be in complete bearings units. Never replace (only one half of a bearing. Service bearings are available in standard size only. Never attempt to adjust a bearing by filing, grinding, or lapping the bearing cap. The bearing seats are precision ground with the caps in place. Any metal removed from neither side prevents the proper fit of a connecting rod bearing in the rod and, makes the entire engine block unsuited for use.

b. Emergency Replacement of Main Bearings. In an emergency a main bearing may be replaced without removing the crankshaft. This type of repair is to be confined to emergency field conditions only. Disassemble engine as necessary.

(1) Remove the bearing cap and its bearing shell.

(2) Place a soft brass or aluminum strip against an exposed edge of the upper bearing and firmly push the bearing around the crankshaft journal.

(3) Inspect and replace both bearings as necessary. Never replace one alone.

(4) Inspect journal surface for roughness, out-of-round, or undersize; any of which greatly reduce bearing life. For best performance and reliability it is recommended that the crankshaft be removed so that adequate inspection and checks, for conformance to design tolerance may be preformed.

### 3-32. Cleaning

Be sure the bearings seat on absolutely clean surfaces and that the back of the bearings are wiped clean. The slightest bit of dirt or carbon squeezed between the back of a bearing and its seat can cause rapid bearing failure by developing a localized high spot.

### 3-33. Torquing

Equally important in obtaining maximum bearing life is the correct tension on the connecting rod

bearing cap nuts. Pull down on all nuts evenly, going from one side of the bearing to the other. Apply final tension with a torque wrench, using a slow steady pull and holding the wrench "on torque" for a few seconds when the proper value is reached. It is preferable to go to a slightly higher tension if necessary. Previous over-torquing or some other damage to the bolt or nut is sometimes encountered and will be felt by the torque "softening up" so that the nut can be turned without any appreciable increase in wrench tension. Never allow a bolt or a nut in this condition to remain on the engine.

### 3-34. Main Bearing Crush

The term "crush" is generally understood to mean the projection of the bearing edges above flush with the mating surfaces of the bearing seat and cap. This crushing action forces the bearing halves into close contact with their seats for greater rigidity and good heat conduction. The correct amount of crush has been allowed during the manufacture of the bearings and no attention to that detail is necessary at the time of replacement. The use of a torque wrench for tightening bearings is necessary to insure sufficient "crush" on the bearings to force the shells against the engine block metal without distortion.

### 3-35. Running Clearance Tests

a. Connecting Rod. The test of connecting rod bearing clearance consists of manually gripping the rod cap, after the bearing bolts are tightened, and attempting to move the rod from side to side in the direction of end clearance. A well fitted bearing is usually loose enough to be "snapped" from side to side without actually feeling so loose as to push easily. Sometimes a slightly snug bearing will not move under pressure, but will move readily under light blows from a soft-faced hammer. This test usually is considered satisfactory, providing the engine has been given adequate break-in time.

b. Main Bearing. Generally the test on main bearings consists of tightening each bearing cap in turn and turning the crankshaft to detect binding. one accurate test is:



(1) Use fuse wire or a special crushing gage material (do not use acid or rosin core solder).

(2) Place crushing gage material between shaft and bearing, then tighten bearing in place using the normal torques of 88-92 foot-pounds for main bearings.

(3) Remove cap and bearing. Gently remove crushing gage material and use a micrometer to check for correct clearance. Any unusual bending

or runout in a crankshaft makes it impossible to fit bearings accurately. For this reason, the time spent in making this test is well worth while.

c. Crankshaft. If the proper equipment is available, a magnetic inspection of the crankshaft and other stressed parts is recommended.

Note. When installing, coat all bearing running surfaces with clean, fresh engine oil (OE).

## Section IX. TIMING GEARS AND COVER

### 3-36. Description

The timing gear group consists of crankshaft, camshaft and governor gears. These gears are located under a gear cover behind the fan belt drive pulley.

### 3-37. Removal

#### a. Timing Gear Cover.

(1) Remove the hydraulic pump assembly with mounting plate (para 10-38).

(2) Remove crankshaft drive pulley (14 fig. 3-3) by removing the self-locking nut (16) and using a suitable gear puller.

(3) Support front portion of engine with suitable hoist.

(4) Remove two screws (26, fig. 3-11) and lock washers (22) attaching engine front support (16) to the timing gear cover (13).

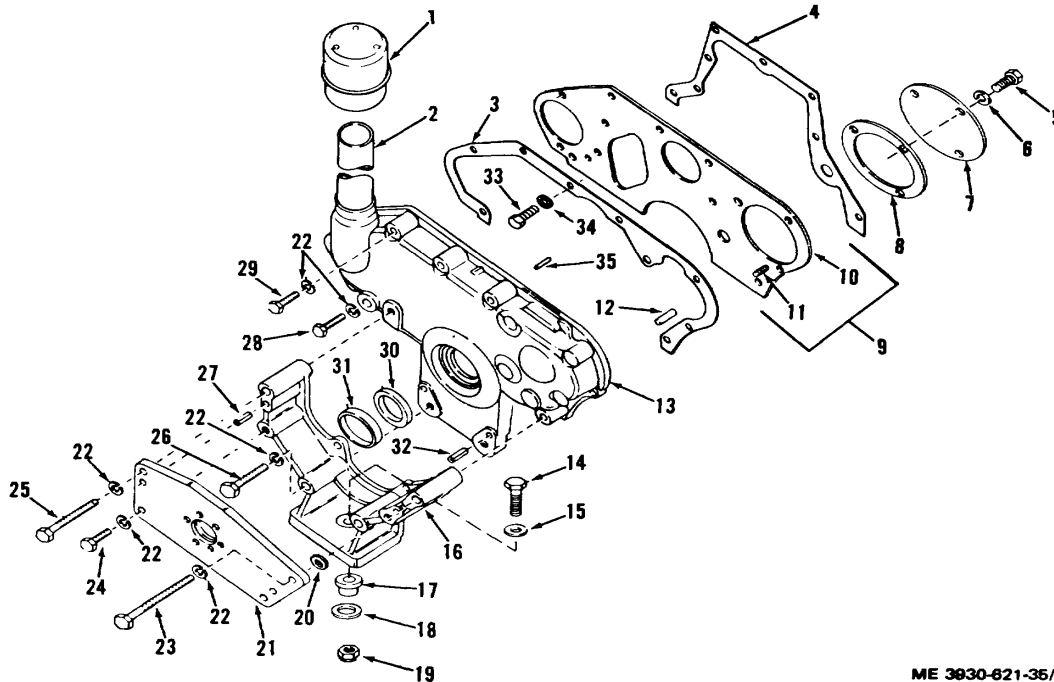
(5) Remove remaining engine support attaching parts (14, 15, 17, 18 and 19) and remove support.

(6) Remove oil breather cap (1), oil seal (30), and oil seal retainer (31) from timing gear cover.

(7) Remove timing gear cover (13) by removing screws (28 and 29) and lock washers (22). Tilt cover and remove spring pin (32) and gasket (3).

#### KEY to fig. 3-11:

1. Breather cap	19. Self-locking nut
2. Oil filler tube	20. Shim
3. Gear cover gasket	21. Pump plate
4. Front plate gasket	22. Lock washer
5. Screw	23. Screw
6. Lock washer	24. Screw
7. Cover	25. Screw
8. Gasket	26. Screw
9. Plate assembly	27. Dowel pin
10. Front plate	28. Cap screw
11. Stud	29. Cap screw
12. Pin	30. Oil seal
13. Gear cover	31. Oil seal retainer
14. Screw	32. Spring pin
15. Flat washer	33. Screw
16. Support	34. Lock washer
17. Mount	35. Dowel pin
18. Alining washer	



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Figure 3-11. Timing gear cover, exploded view.

b. Crankshaft, Camshaft and Governor Gears.

(1) Remove camshaft retaining ring (17, fig. 3-6) and, using a suitable gear puller, remove camshaft gear (16).

(2) Remove front deflector (1,; fig. 3-3) with attaching drive screws (13).

(3) Using a suitable gear puller remove crankshaft gear (11).

Note. If suitable gear puller is not available, gear may be removed by drilling at the keyway and splitting the gear. Drill directly above key to avoid damage to shaft.

(4) Remove governor gear (para 4-15).

**3-38. Cleaning and Inspection**

a. Clean all parts with cleaning compound, solvent (Spec. P-S-661). Dry thoroughly with compressed air.

b. Inspect gears for cracks, chips or other signs of excessive wear and damage.

c. Inspect cover for cracks, dents, breaks and other damage.

d. Replace defective parts as authorized.

**3-39. Installation**

a. Crankshaft, Camshaft and Governor Gears.

(1) Install governor gear (para 4-19).

(2) Heat carp and crankshaft gears to approximately 450°0 F. in an oil bath. Use a driving sleeve to tap gear snugly in place. Hard driving is not normally necessary and indicates the gear is too cold or cocked on shaft. Aline "C" marks on gears and mesh gears for proper timing.

(3) Install deflector (12,fig.3-3) on crankshaft and secure with screws (13).

(4) Secure camshaft gear (16, fig. 3-6) to camshaft with retaining ring (17).

(5) Check gears for backlash of 0.002 to 0.004 inch. Looser fits are tolerable provided looseness is not so excessive as to cause chatter. A slightly loose fit is preferable over a tight fit.

b. Timing Gear Cover.

(1) Insert spring pin (32, fig. 3-11) and cover (13) and install cover and gasket (3) on front plate (10) and secure with screws (28 and 29) and lock washers (22).

(2) Install oil breather cap (1), oil seal (30), and oil seal retainer (31) on timing gear cover.

(3) Aline and attach engine support (16). Check condition of engine mounts (17) and replace if necessary.

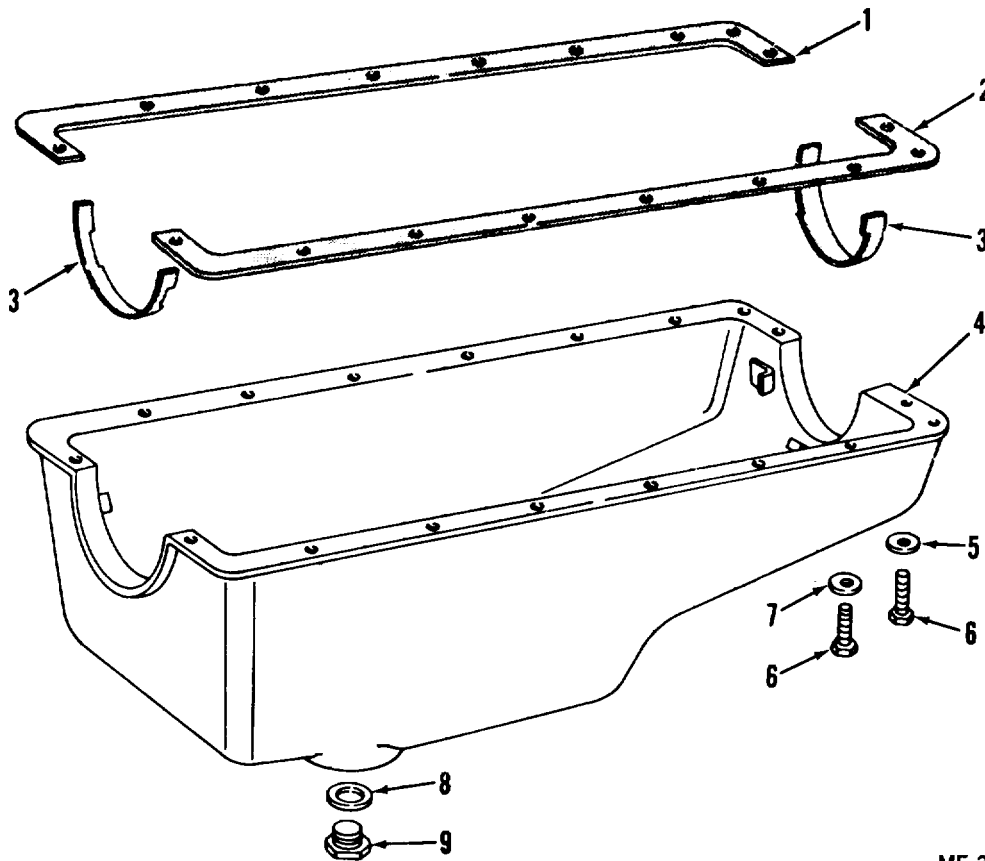
(4) When engine has been secured on the front support, remove hoist.

(5) Press on crankshaft drive pulley (14, fig. 3-3). Secure pulley with nut (16) and washer (15).

(6) Install hydraulic pump assembly with mounting plate (para 10-42).

**Section X. LUBRICATING OIL PAN AND PUMP**

**3-40. Lubricating Oil Pan**



- 1. Gasket
- 2. Gasket
- 3. End gasket
- 4. Oil pan
- 5. Lock washer

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- 6. Machine bolt
- 7. Copper washer
- 8. Gasket
- 9. Magnetic plug

Figure 3-12. Lubricating oil pan, exploded view.

b. Removal.

- (1) Remove engine from truck (para 2-5).
- (2) Drain oil pan by removing drain plug (9, fig. 3-12).
- (3) Remove bolts (6) from the oil pan flange.
- (4) Remove oil pan from block.

**Caution: Do not use screw driver or other prying tool to loosen oil pan from block. If normal pressure does not loosen pan, several sharp raps with a rawhide or**

**plastic mallet will do the job. Prying may damage the flange and probably cause leaks around the gasket.**

(5) Discard damaged gaskets.

c. Inspection and Cleaning.

(1) Clean all parts with cleaning compound, solvent (Spec. P-S-661). Dry thoroughly with compressed air.

(2) Inspect for dents, cracks, tears, nicks in

flange, or warping which would interfere with oil pan remaining leak proof.

(3) Repair or replace as authorized.

d. Installation.

(1) Install new gaskets.

(2) Position and support oil pan on flange.

(3) Secure pan to flange with bolts (6, fig. 3-12).

(4) Insert and tighten drain plug (9).

(5) Install engine in truck (para 2-5).

**3-41. Lubricating Oil Pump.**

a. Description.

(1) The lubricating oil pump is of the positive driven gear type, consisting of a single cast oil pump body (4, fig. 3-13) with a precision cavity to receive the two pump gears. An idler gear shaft is pressed in place in the pump body. The driver gear

shaft extends the length of the pump body extension and carries a gear at its upper end to mesh with the spiral drive gear towards the front of the cam shaft.

(2) The oil is picked up by the set of gears, is passed around the gears, and forced up the oil pump body. The oil enters the engine shortly above the point where the body enters the engine block on the left side of the engine. The lower section of the pump is surrounded by a baffle to provide protection to the gears.

b. Removal

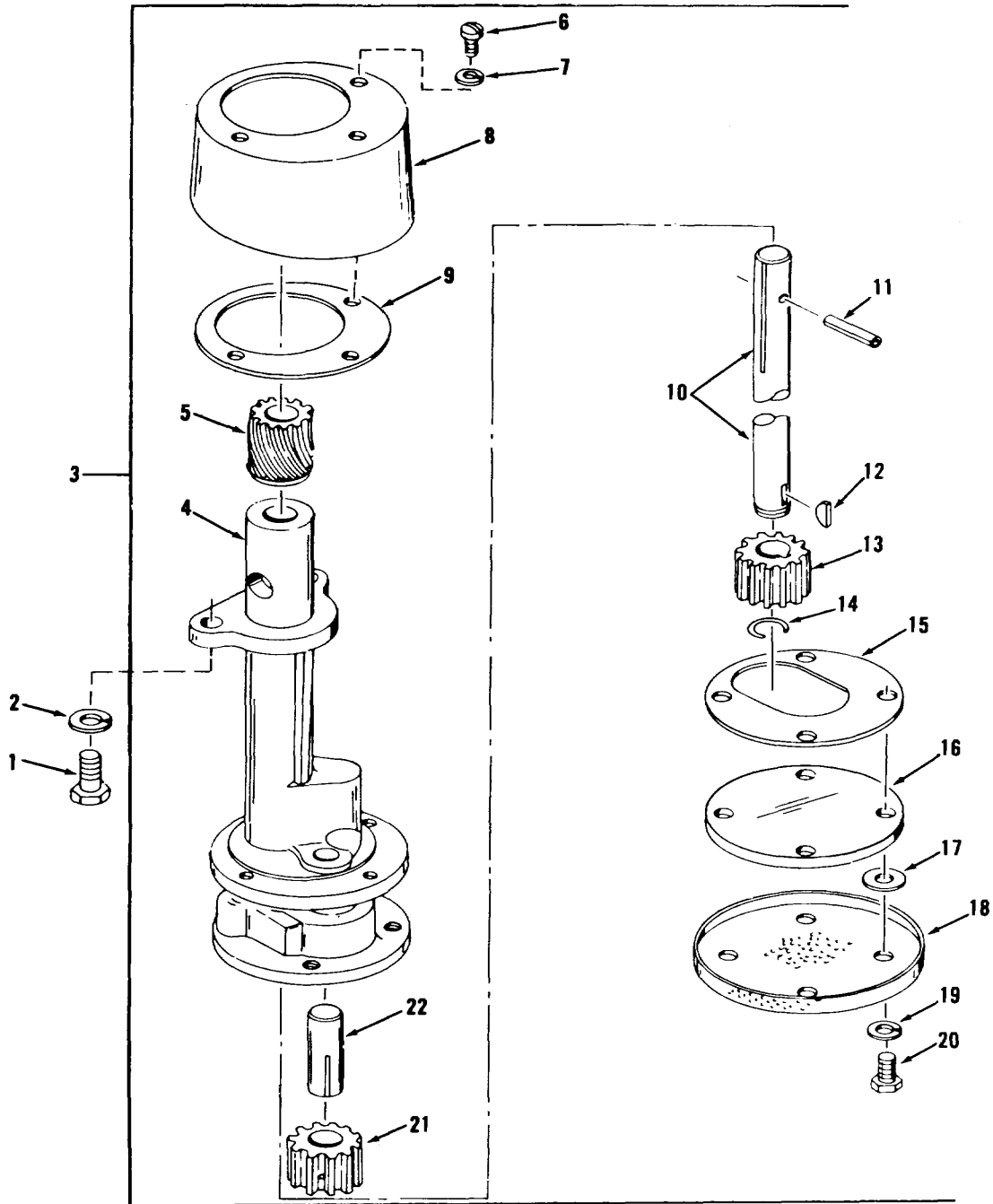
(1) Drain oil from oil pan by removing drain plug (9, fig. 3-12).

(2) Remove oil pan (para 3-40).

(3) Remove the two bolts (1, fig. 3-13) holding the oil pump to the flange of the engine block, and withdraw pump.

KEY to fig. 3-13:

- |                      |                    |
|----------------------|--------------------|
| 1. Machine bolt      | 12. Key            |
| 2. Lock washer       | 13. Gear           |
| 3. Oil pump assembly | 14. Retaining ring |
| 4. Oil pump body     | 15. Gasket         |
| 5. Drive gear        | 16. Cover          |
| 6. Machine screw     | 17. Spacing washer |
| 7. Lock washer       | 18. Screen         |
| 8. Cover baffle      | 19. Lock washer    |
| 9. Gasket            | 20. Screw          |
| 10. Drive shaft      | 21. Gear           |
| 11. Spring pin       | 22. Idler shaft    |



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Figure 3-13. Lubricating oil pump, exploded view.

c. Cleaning and Inspection.

(11) Clean all parts with cleaning compound, solvent (Spec. P-S-661). Dry thoroughly with compressed air.

Note. The principal wearing parts of the oil pump are the gears. If dirt or sludge have been allowed to accumulate in the lubricating system, the oil pump' gear wear may be rather pronounced in a comparatively short time. When the oil has been kept clean and oil filter has been properly serviced, the wear on these parts will be very slow.

(2) Both the spiral drive gear on the pump drive shaft and the mating gear on the camshaft, should be checked for proper contact and evidence of the excessive wear, pitting or chipping.

(3) Backlash between pump gears should not exceed 0.020 of an inch.

d. Installation.

(1) Install pump to flange of engine block with two bolts (1, fig. 3-13). Drive gear must be properly meshed with camshaft gear.

**Caution: If pump is not seated correctly, it is possible to break the retaining lugs in the casting body when tightening bolts (1). Check pump position carefully before tightening.**

(2) Install oil pan (para 3-40).

(3) Check to see if drain plug (9, fig. 3-12) is secure and add oil as specified.

## CHAPTER 4 FUEL SYSTEM REPAIR INSTRUCTIONS

### Section I. CARBURATOR

#### 4-1. Description

a. The carburetor used in this fuel system is a single venturi, updraft type with fixed jets covering all speeds except idle. The flow of fuel through the main jet system is controlled by the size of the jet. The idle adjusting screw controls the fuel mixture for the idle system.

b. It has an air-bleed well method of compression, and idle fuel adjusting screw, and an idle throttle stop screw. The air intake of the carburetor is provided with a choke valve.

#### 4-2. Removal

Refer to TM10-3930-621-12 for remove procedures.

#### 4-3. Disassembly

Note. Before disassembling, clean carburetor with cleaning compound, solvent (Spec. P-S-661). Dry thoroughly with compressed air.

a. Refer to figure 4-1 and disassemble carburetor as follows:

b. Remove two mounting bolts (50) and lock washers (51) from body (48).

c. Remove four screws (25) which attach throttle body to fuel bowl (20).

d. Separate throttle body from fuel bowl and discard bowl gasket (16).

e. Remove float mounting axle (17) and remove float (13) as follows:

(1) Press screwdriver against axle (17) at slotted side of float hinge bracket and force through hinge bracket.

(2) Remove axle completely with fingers from opposite side and remove float.

f. Remove main jet plug (23), washers (22 and 24) and jet (21).

g. Remove venturi I-4F.

h. Remove idle jet (47).

i. Remove idle adjusting screw (9) and spring (8).

j. Remove throttle plate (6) shaft (49) and stop lever assembly (2) as follows:

(1) Unscrew throttle stop screw (4) until threaded end is flush with lever.

(2) Make match marks with center punch on throttle body and all levers, to act as a guide to reassemble these parts in the same position as removed.

(3) File off the riveted or peened end of the throttle plate screws (7).

Note. When such screws are riveted or peened the threaded end of the too screws must be filed flat before removal to avoid breakage or stripping of threads in the shaft. In some cases it may be necessary to use a small ( $\frac{1}{4}$ " round file and cut slightly below the surface of the shaft because of a slight counterbore around the screw hole.

**Caution: Avoid striking and cutting the side of the throttle body (47) bore or the throttle plate (6) when filing the screws.**

(4) Remove the screws and pull out the throttle plate (6).

(5) Loosen clamping screws (46) on levers (38 and 42).

(6) Remove cotter pin (36) from spring retainer (37) and remove retainer from shaft (49).

(7) Remove pins (3) from shaft (49).

(8) Slowly slide shaft (49) from throttle body (48), using caution in removing levers (38 and 42), spring (39) and drivers (40) as they fall from the shaft.

k. Remove the throttle shaft retainers (45) and seals (5) from the throttle body shaft holes as follows:

(1) Screw a fine thread taper tap into the retainer and seal until it is firmly seated.

(2) Insert long punch or rod through opposite shaft hole and drive the punch against the end of the tap until the retainer and seal are free. Repeat operation for other retainer and seal.

l. Remove drain plug (26) from outside bottom of fuel bowl.

m. Remove main discharge jet (11) and washer (12) from center of large opening in machined surface of fuel bowl.

n. Remove well vent jet (15) from center of large opening in machined surface of the fuel bowl with a small screwdriver.

o. Remove valve and seat (19) and washer (18).

p. Disassemble the choke as follows:

(1) Remove the return spring (33) from choke shaft (31) and bracket (28).

(2) Make match marks with a center punch or file on choke bracket, air intake bore and lever to act as a guide to reassemble these parts in same position as when removed.

(3) Remove stop screws (4) attaching choke plate to shaft (31) and remove plate.

(4) Slide shaft (31) from bowl and bracket.

(5) Press out washer (41) and retainer (27) from shaft holes.

(6) Remove machine screw (32) from shaft. q. Remove plug (10) and drain disk (43) from fuel bowl.

r. Remove bracket tube clip (30) from bracket (28) by removing screw (34) and nut (35).

s. Remove bracket screw (29) from bracket (28) on boss of air intake and remove bracket.

**4-4. Cleaning and Inspection**

a. General.

(1) Clean all parts with cleaning compound, solvent (P-S-661). Dry thoroughly with compressed air.

(2) Blow out all passages in the air intake and fuel bowl casting. Be sure all carbon deposits have been removed from the throttle bore and idle discharge holes. It is advisable to reverse the flow of compressed air in all passages to insure that all dirt has been removed. Never use a wire or drill to clean out jets.

b. Float Assembly. Inspect top side of float lever for wear where it contacts fuel valve needle. Such wear can affect the float level.

c. Float Mounting Pin. Replace if any wear can be visually detected on the bearing surface.

d. Fuel Valve Seat and Needle. Always replace valve seat and needle because both parts wear and may cause incorrect float level.

e. Idle Adjusting Needle. Inspect point of needle. Must be smooth and free of ridges or score marks.

f. Throttle and Choke Plates. Inspect plate for burrs or damaged edges. Never clean plates with a buffing wheel or a sharp instrument.

g. Throttle and Choke Shafts. Check bearing surfaces for wear.

h. Gaskets. Replace all gaskets and fibre washers any time the carburetor is disassembled.

i. Check Specifications. Check correctness of following jet sizes:

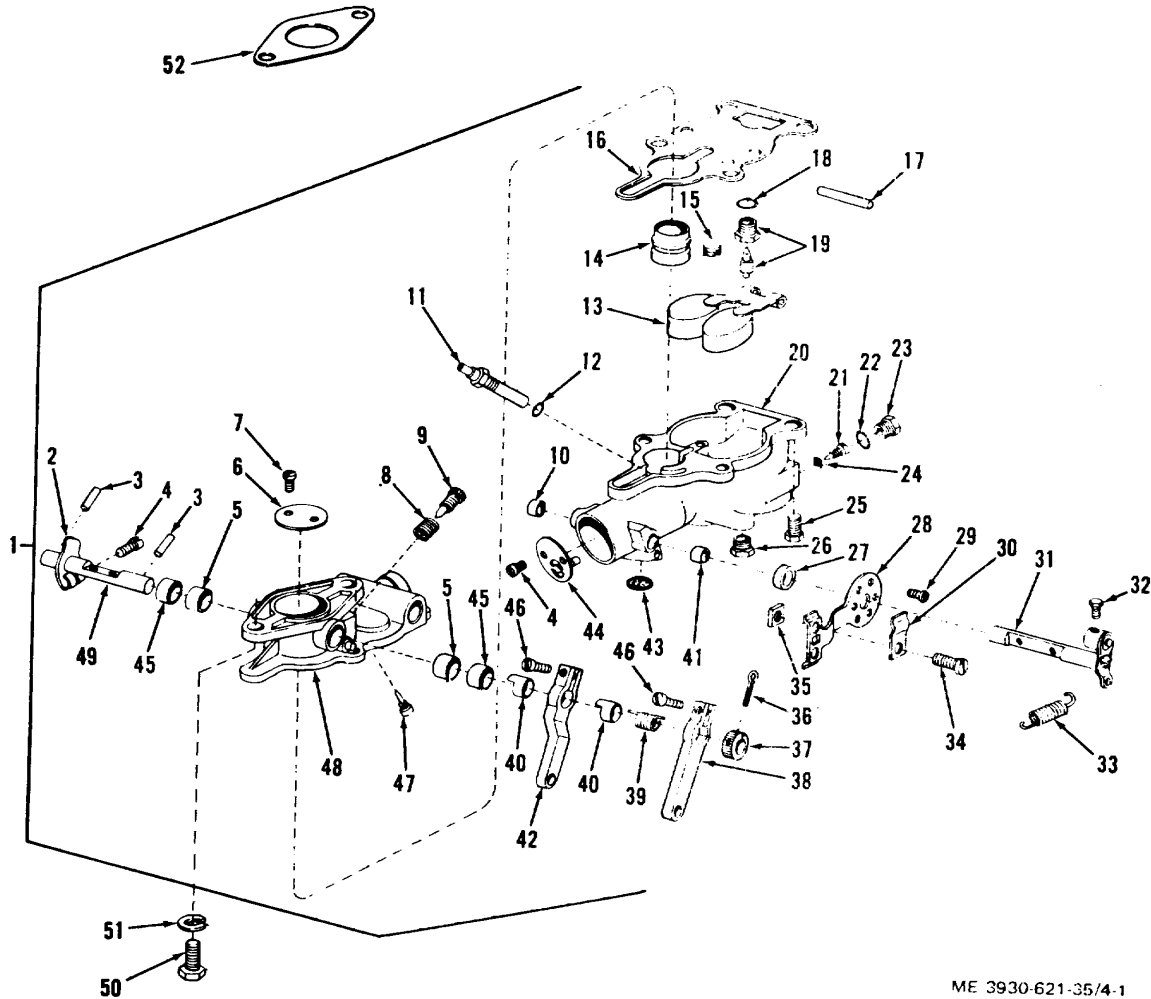
Idle Jet.....	No. 11
Fuel Valve .....	No. 35
Main Jet.....	No. 19
Discharge Jet .....	No. 50
Well Vent Jet.....	No. 23
Venturi.....	No. 16

j. Replacement. Replace only those parts available in the carburetor repair parts kit. Damage to any other parts will require replacement of the entire carburetor assembly.

KEY to fig. 4-1:

- |               |                    |                 |
|---------------|--------------------|-----------------|
| 1. Carburetor | 19. Valve w / seat | 36. Cotter pin  |
| 2. Stop lever | 20. Fuel bowl      | 37. Retainer    |
| 3. Pin        | 21. Jet            | 38. Lever       |
| 4. Screw      | 22. Washer         | 39. Spring      |
| 5. Seal       | 23. Plug           | 40. Driver      |
| 6. Plate      | 24. Washer         | 41. Washer      |
| 7. Screw      | 25. Screw          | 42. Lever       |
| 8. Spring     | 26. Plug           | 43. Disk        |
| 9. Screw      | 27. Retainer       | 44. Plate       |
| 10. Plug      | 28. Bracket        | 45. Retainer    |
| 11. Jet       | 29. Screw          | 46. Screw       |
| 12. Washer    | 30. Clip           | 47. Jet         |
| 13. Float     | 31. Shaft          | 48. Body        |
| 14. Venturi   | 32. Screw          | 49. Shaft       |
| 15. Jet       | 33. Spring         | 50. Bolt        |
| 16. Gasket    | 34. Screw          | 51. Lock washer |
| 17. Axle      | 35. Nut            | 52. Gasket      |
| 18. Washer    |                    |                 |





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Figure 4-1. Carburetor assembly. Exploded view.

#### 4-5. Assembly and Adjustment

Note. All inspection and checks must be completed before assembling carburetor.

- a. Refer to figure 4-1 for all item numbers.
- b. Install bracket on air intake boss with screw (29).
- c. Install clip (30) loosely on bracket.
- d. Insert plug (10) and drain disk (43) in fuel bowl.
- e. Install choke assembly as follows:
  - (1) Install screw (32) several turns into shaft (31).
  - (2) Press choke shaft washer (41) and

retainer (27) into bores until retainer is flush with machined surface of fuel bowl.

(3) Insert choke shaft (31) into air intake.

(4) Insert choke plate (6) into air intake making certain plate is located in same position in the intake in regards to the poppet valve as when removed.

(5) Install throttle stop screws (4) and secure choke plate (44).

f. Install shaft return spring (33) to shaft (31) and bracket (28).

g. Install the drain plug (26), main discharge jet (11) and well vent jet (15).

h. press throttle shaft retainers (45) and seals

(5) into position on both sides of throttle body (48) Retainers must be flush to avoid striking throttle lever (42).

i. Install throttle levers (38 and 42) and plate (6) as follows:

(1) Align spring (39), levers (38 and 42) and drivers (40) with shaft (49) and then slowly insert shaft into throttle body (48). Tighten lever clamping screws (46).

(2) Insert pins (3) in shaft and install spring retainer (37) on shaft, securing it with a cotter pin (36).

(3) Rotate shaft (49) to wide open position, insert throttle plate (6), and then rotate shaft to close position, holding plate in place.

(4) Install plate screws (7) and tighten securely, making certain plate is correctly centered in body bore.

Note. The screw holes in the throttle plate are off center. Start the side of the throttle plate with the shortest distance between the screw holes and beveled edge into the shaft first. The throttle plate is made with two opposite edges beveled, fit the throttle plate bore when the plate is closed. The throttle plate will not close tightly if installed upside down. To properly center the plate in the bore, the screws should be started in the shaft and then with the plate closed, and pressure maintained with the fingers, tighten the screws. When correctly installed the edge of the plate farthest away from the mounting flange will be aligned with the idle discharge holes when the plate is closed.

j. Install idle adjusting screw (9) and spring (8). Seat lightly, then back out 1/4 turns.

k. Install idle jet (47).

l. Install fuel valve and seat (19) and washer (18).

m. Install main jet plug (23), washers (22 and 24) and jet (21).

n. Install float mounting axle (17) and float (13).

o. Set float level at  $1-15 / 32 \pm 3 / 64$  of an inch from float top to machined surface of throttle body (48). If necessary, bend float lever with long nosed pliers to obtain correct level.

p. Insert venturi (14) in throttle body bore, large opening first. Venturi flange must be set in throttle body recess below the bowl gasket.

q. Attach completed throttle body (48) to fuel bowl (20) with new gasket. Tighten the four screws (25) evenly and firmly.

r. Hold the throttle lever (42) in closed position and turn throttle stop screw (4) until it contacts stop on body; then turn screw 1/2 additional turns.

s. Place new gasket (52) over mounting bolts (50) and lock washers (51).

4-6. Installation and Operational Adjustment

Refer to TM 10-3930-621-12 for installation and operational adjustment procedures.

## Section II. Fuel Tank

### 4-7. Description

The fuel tank is of 4 1/2 gallon capacity with associated parts consisting of a fuel level transmitter, a locked fuel tank cap, and a needle shut-off valve with tubing.

### 4-8. Removal

Refer, TM 10-3930-621-12 for removal procedure.

#### 4-9. Disassembly

a. Refer to figure 4-2 and disassemble fuel tank b. Open shut-off valve (22) to drain any residual fuel and remove valve with tubing from elbow.

c. Remove elbow (13), nipple (23) and plug (24) from bottom of tank (12).

d. Remove filler cap (7), assembly by unscrewing from top of tank.

e. Remove plug (8) from top of tank.

f. Disconnect electrical lead (3) to transmitter (6) by removing the attaching nut (1) and lock washer (2).

g. Remove transmitter screws (4) and flat washers (5), which mount the transmitter (6) to the

fuel tank (12), and carefully lift the transmitter from the tank.

**Caution: Do not bend transmitter float arm during disassembly or assembly.**

h. Discard gasket (25).

### 4-10. Cleaning and Inspection

a. Flush fuel tank with cleaning compound, solvent (Spec P-S-661). Dry thoroughly with compressed air.

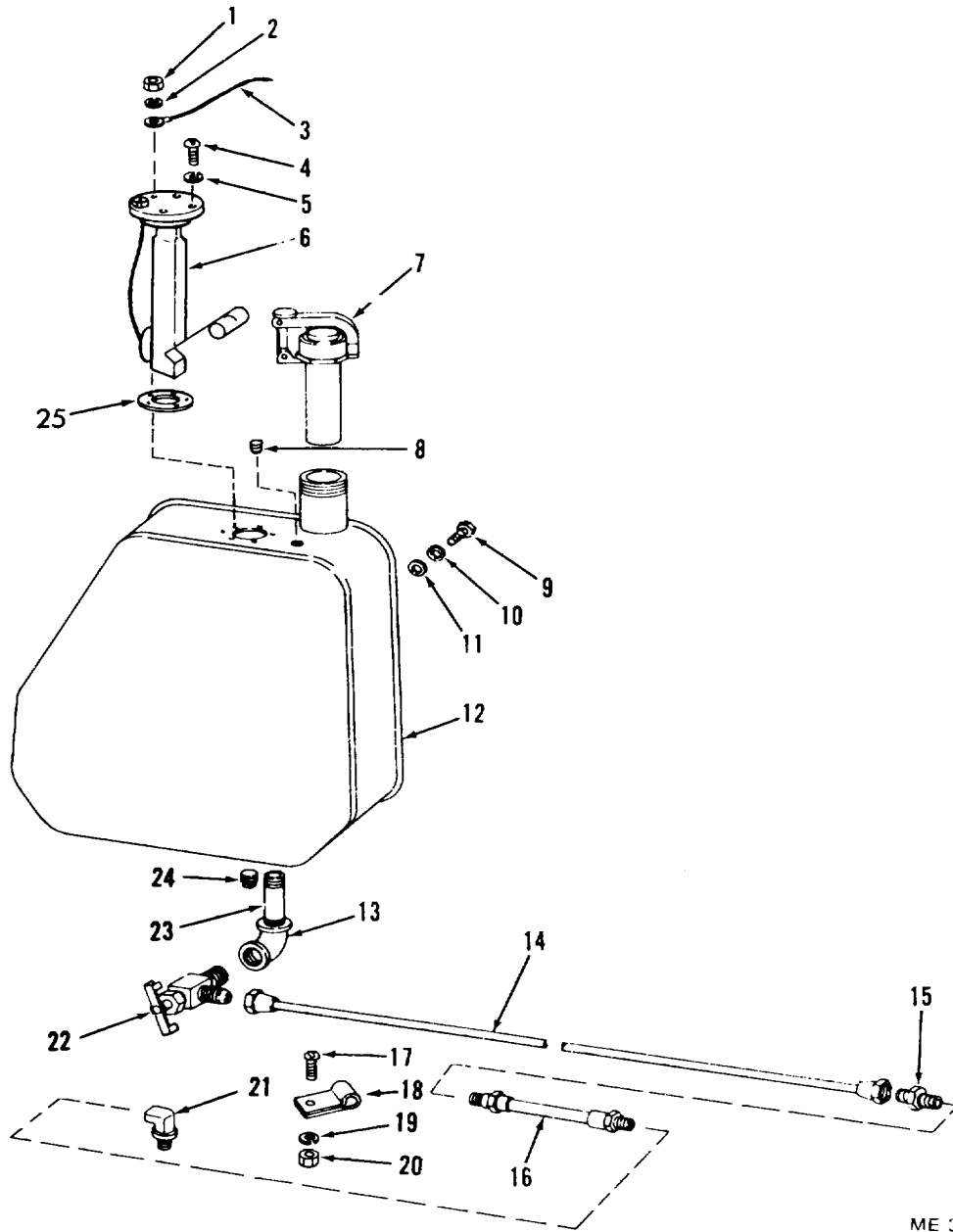
b. Inspect tank for rust, cracked seams or damaged threads.

c. Inspect all associated parts for damage or corrosion.

### 4-11. Repair

**Warning: If damage to the fuel tank is such that welding is necessary, flush tank thoroughly to remove all traces of explosive solvents and fuel. Both liquid and vapor must be completely removed before any welding attempt is made.**

If damage is beyond reasonable welding repair, replace tank and associated parts as authorized.



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- |                      |                   |                    |
|----------------------|-------------------|--------------------|
| 1. Nut               | 10. Lock washer   | 18. Clamp          |
| 2. Lock washer       | 11. Flat washer   | 19. Lock washer    |
| 3. Fuel level lead   | 12. Fuel tank     | 20. Nut            |
| 4. Screw             | 13. Elbow         | 21. Elbow          |
| 5. Flat washer       | 14. Tube assembly | 22. Shut off valve |
| 6. Level transmitter | 15. Union         | 23. Nipple         |
| 7. Tank cap          | 16. Hose assembly | 24. Drain plug     |
| 8. Vent plug         | 17. Bolt          | 25. Gasket         |
| 9. Screw             |                   |                    |

Figure 4-2. Fuel tank and associated parts, exploded view.

**4-12. Assembly**

- a. Install new transmitter gasket (25) on fuel tank.
- b. Install transmitter (6) in tank (12) and secure with screws (4) and flat washers (5).
- c. Secure lead /31 to transmitter (6) with nut (1) and lock washer (2).
- d. Install drain (24) and vent (8) plugs.

- e. Screw on filler cap assembly (7).
- f. Install nipple (23) and elbow (13) in bottom of tank.
- g. Install valve (22) and tubing on elbow (13).

**4-13. Installation**

Refer to TM 10-3930-621-12 for installation procedures.

**Section III. Governor****4-14. Description**

The governor is a centrifugally actuated weight type driven directly from the timing gear train in the front of the engine. The governor shaft runs on ball bearings at each end of a cast iron housing. The weight carrier is retained on the shaft by a press fit and a taper pin. The action of the weights against the governor shifter sleeve is transmitted through a ball thrust bearing of the governor shifter and lever. The weights are opposed and balanced by an adjustable spring, which should not be changed unless authorized. If surging arises, a bumper screw may be adjusted from outside the governor cover.

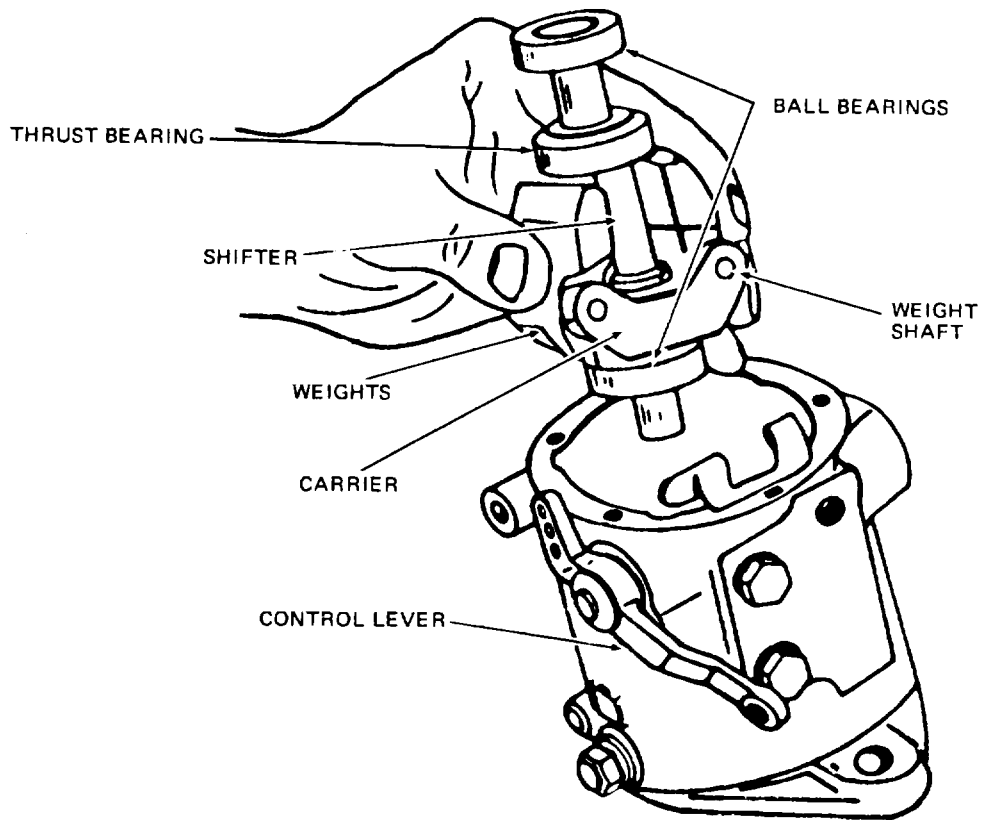
**4-15. Removal**

- a. Remove control rod from governor lever by removing the cotter pin and clevis pin. Do not disturb the length of the control rod.
- b. Remove lubricating oil line from top of governor housing.
- c. Remove the two cap screws and lock washers which mount the governor to the timing gear cover. Remove governor and packing (22, fig. 4-5) from the engine.

**4-16. Disassembly**

- a. Refer to figure 4-5 and disassemble as follows:

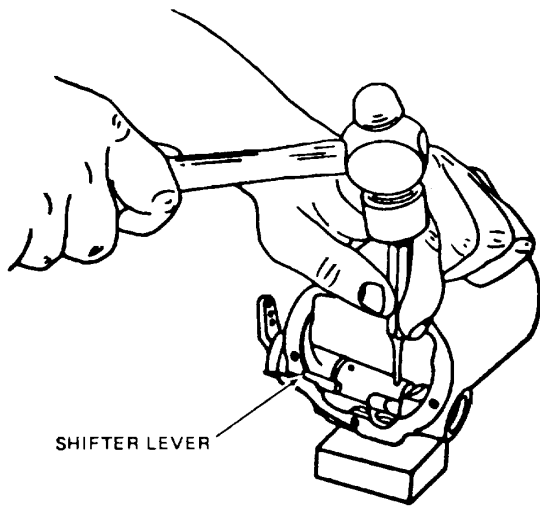
- b. Wash governor with cleaning compound, solvent (Spec. P-S-661), and dry thoroughly with compressed air.
- c. Mark the position of spring (34) on lever (37) and position of adjusting nut (30) on tension adjusting screw (33). This marking is necessary to reassemble parts with their original adjustment.
- d. Remove tension adjusting nut (30), adjusting screw (33) and spring from the spring bracket (29).
- e. Remove screw (35), nut (32), and lock washers (31) to remove spring bracket (29) from governor housing.
- f. Drive out groove pin (23) which holds governor drive gear (21) on shaft (24).
- g. Install gear puller and remove drive gear (21). Remove key (20) from shaft (24).
- h. Remove end cover (6) and gasket (7) from housing by first removing cap screws (3) and lock washer (4).
- i. Discard the gasket.
- j. Loosen locknut (1) and remove surge adjusting screw (2) to check for broken or damaged spring (5).
- k. Rotate shifter lever (15) outward and remove internal governor parts as an assembly. See figure



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Figure 4-3. Internal governor parts.

I. Drive pins (14) from shifter lever (15). See figure 4-4.



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Figure 4-4. Driving out governor shifter lever pins.

m. Drive pin (40) from control lever (37) and drive out shifter lever shaft (36). Shaft plug (8) will also be driven out on opposite side of housing.

n. After shaft (36) and lever (37) with washer (38) are removed, the oil seal (39) and two roller bearings (9) must be removed from the housing. Discard oil seal.

o. If the governor internal parts assembly is to be inspected and repaired, disassemble it as follows:

(1) Remove ball bearings (12).

(2) Remove snap ring (13) from shaft (24) and slide thrust bearing (16) and shifter (17) from shaft.

(3) Remove pins (26), weight shaft (27), and weights (18) from carrier (25).

(4) Remove groove pin (19) attaching shaft (24) to carrier and remove carrier (25).

**4-17. Cleaning, Inspection and Replacement**

a. Wash all parts with cleaning compound, solvent (Spec. P-S-661). Dry each thoroughly with compressed air.

b. Inspect governor weights (18, fig. 4-5) and weight carrier (25) for excessive wear and looseness.

c. Replace ball bearings if they show evidence of sticking or excessive wear or roughness. If they are satisfactory, wash them carefully in solvent (Spec. P-S-661), oil, and wrap in paper until ready to reassemble on governor.

d. Replace shaft bearings if they are sticky or feel rough and gritty.

e. Use new oil seal, end plug and gaskets when assembling.

f. Replace spring when rust is noticeable.

g. Inspect housing for cracks and worn or damaged bearing surfaces.

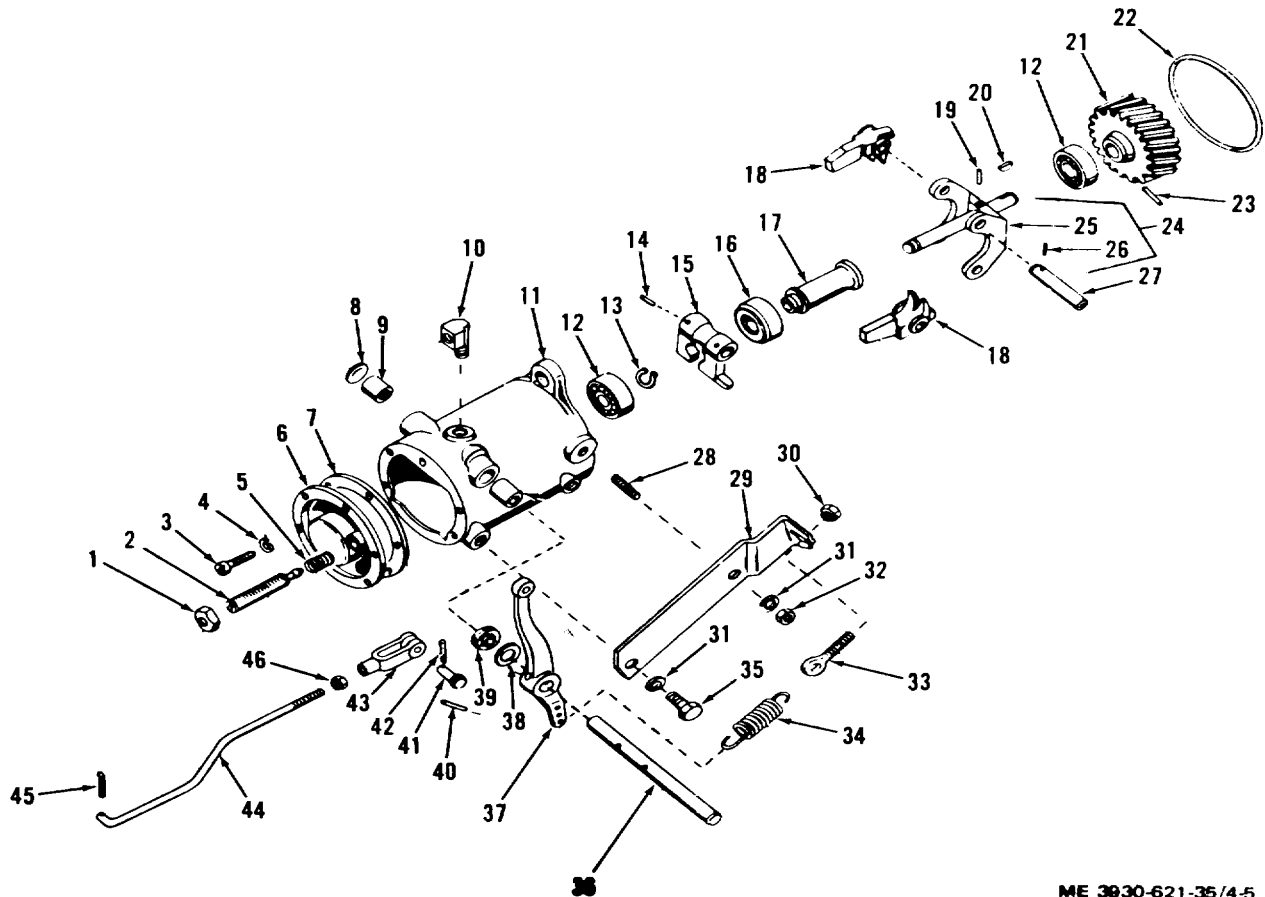
h. Check lubricating oil line for kinks, cracks, dirt or blocking.

KEY to fig. 4-5:

- i. Lock nut
- 2. Adjusting screw
- 3. Screw
- 4. Lock washer
- 5. Spring
- 6. End cover
- 7. Gasket
- 8. Plug
- 9. Bearing
- 10. Elbow
- 11. Housing
- 12. Bearing
- 13. Snap ring
- 14. Drive pin
- 15. Shifter lever
- 16. Thrust bearing

- 17. Shifter
- 18. Weight
- 19. Pin
- 20. Key
- 21. Drive gear
- 22. Packing
- 23. Pin
- 24. Shaft assembly
- 25. Carrier
- 26. Pin
- 27. Weight shaft
- 28. Stud
- 29. Bracket
- 30. Adjusting nut
- 31. Lock washer

- 32. Nut
- 33. Adjusting screw
- 34. Spring
- 35. Screw
- 36. Shaft
- 37. Control lever
- 38. Washer
- 39. Oil seal
- 40. Drive pin
- 41. Pin
- 42. Pin
- 43. Rod end
- 44. Rod
- 45. Cotter key
- 46. Nut



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Figure 4-5. Governor exploded view.

**4-18. Assembly**

Refer to figure 4-5 and assemble as follows:

a. Reassemble the governor internal parts assembly as follows:

- (1) Install carrier (25) on shaft (24) and secure with groove pin (19).
- (2) Install weight shafts (27) on carrier (25) and secure weights (18) on shafts with pins (26).
- (3) Slide shifter (17) and thrust bearing (16), in that order, on carrier and secure with snap ring (13).
- (4) Install ball bearings (12) and press in new preformed packing on carrier shaft (24).

- b. Install two roller bearings (9) in housing (11).
- c. Install shaft plug (8) and new oil seal (39) in housing.
- d. Aline washer (38), control lever (37), and shifter lever (15) and insert lever shaft (36).

- e. Aline shifter lever holes with shaft holes and drive in shifter lever pins (fig. 4-4).
- f. Rotate shifter lever (15) outward and slide in governor internal parts assembly (fig. 4-3).
- g. Install surge adjusting spring (1) and screw (2) in end cover (6), securing it with locknut (1).
- h. Using new gasket (7), install end cover (6) and secure it with screws (3) and lock washers (41).
- i. Install key (20) on shaft (24) and press on gear (21).
- j. Drive in groove pin (23) holding gear to shaft.
- k. Install spring bracket (29) on housing with screw (35), nut (32), and lock washers (13).
- l. Check installation marks and install adjusting nut (30), screw (33), and spring (34) on bracket. Also using mark, position spring (in it r 1: 7).

**4-19. Installation**

a. Install governor in gear train housing and secure it with two cap screws and lock washers.

b. Install lubricating oil line on top of housing.

c. Install control rod on control lever with cotter and clevis pins.



**CHAPTER 5  
ELECTRICAL AND COOLING SYSTEMS REPAIR INSTRUCTIONS**

**Section I. ALTERNATOR**

**5-1. Description**

The alternator consists of two end frames, a stator and a rotor. The rotor is mounted on a roller bearing at the retainer end. Two brushes carry current through two rotor slip rings to a field coil mounted on the rotor. The stator windings are assembled inside a laminated core and are connected to six semiconductor device diodes, which are mounted in the slip ring end frame. The diodes function in changing the stator-rotor AC voltage to battery usable DC voltage. A capacitor is also mounted on the slip ring end frame and serves to protect the diodes from high voltage input.

**5-2. Removal**

Refer to TM 10-3930-621-12 for alternator removal procedures.

**5-3. Disassembly**

- a. Refer to figure 5-1 and disassemble as follows:
- b. Remove four thru-bolts (23) from alternator assembly.
- c. Scribe a mark on the stator (11) and drive (27) and slip ring (2) frames to aid in positioning parts during assembly.
- d. Using a screwdriver, pry the drive end frame

(27) and rotor assembly (13) from the stator assembly (11) at the stator slot.

*Note.* Separation is made between stator assembly frame (11) and drive end frame (27), not between stator assembly and slip ring frame (2).

e. Separate stator assembly frame (11) from slip ring frame (2). The fit between these frames is not tight and separation may be accomplished without prying.

f. Remove bearing (24) and retainer (1) from slip ring frame (2).

g. Place a piece of tape over bearing (24) and over slip ring end of rotor shaft (13) to prevent entry of dirt and other foreign material.

**Caution: Use pressure sensitive tape. Friction tape will leave a gummy deposit on shaft, resulting in bearing drag and wear.**

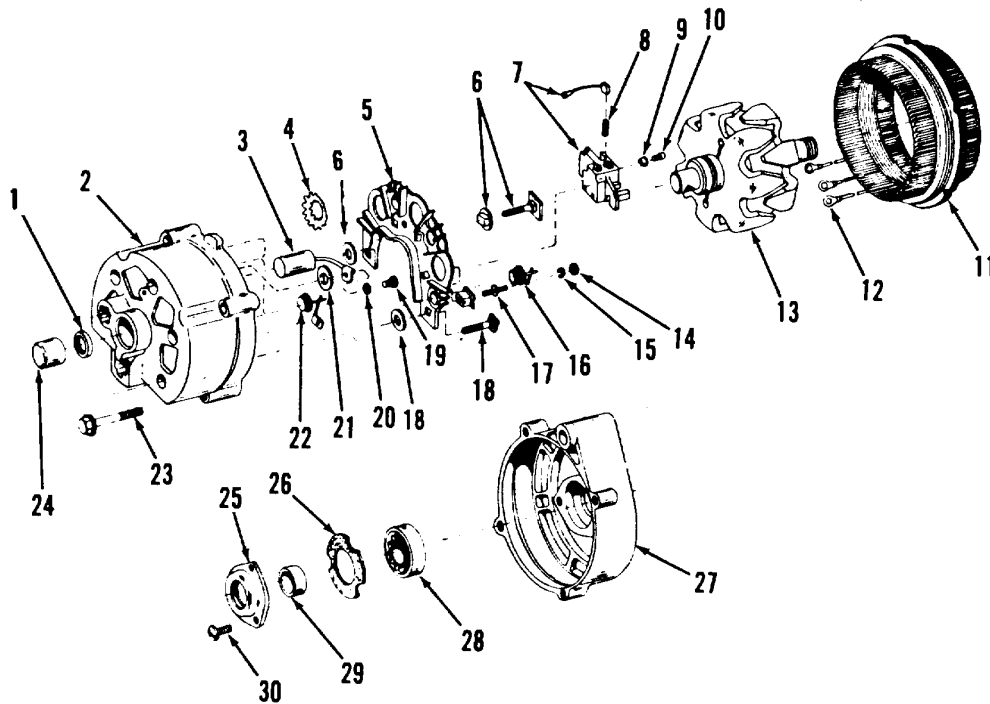
h. Place rotor assembly (13) in vise and tighten only enough to hold assembly secure.

**Caution: Do not tighten excessively as this could distort the rotor.**

i. Remove rotor shaft nut, lock washer, fan pulley, and spacer and separate drive end frame (27) from rotor shaft (113).

KEY to, fig. 5-1:

- |                              |                                 |
|------------------------------|---------------------------------|
| 1. Bearing retainer          | 16. Semiconductor device, diode |
| 2. Slip ring frame           | 17. Terminal                    |
| 3. Capacitor                 | 18. Terminal package, ground    |
| 4. Retaining spring          | 19. Screw                       |
| 5. Heat sink                 | 20. Flat washer                 |
| 6. Terminal package, battery | 21. Nonmetallic washer          |
| 7. Brush holder with brushes | 22. Semiconductor device, diode |
| 8. Spring                    | 23. Thru bolt                   |
| 9. Insulator                 | 24. Bearing                     |
| 10. Screw                    | 25. Bearing retainer            |
| 11. Stator assembly          | 26. Gasket                      |
| 12. Terminal lug             | 27. Drive frame                 |
| 13. Rotor assembly           | 28. Bearing                     |
| 14. Nut                      | 29. Collar                      |
| 15. Lock washer              | 30. Screw                       |



ME 3930-621-36/5-1

Figure 5-1. Alternator, exploded view.

**5-4. Testing**

a. Use table 5-1 and the referenced figures found on it to test alternator components.

Table 5-1. Alternator Testing

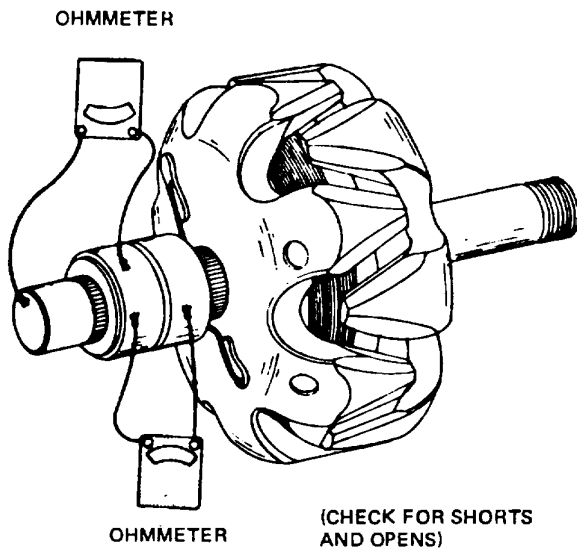
Component	Ref. fig	Connection	Reading	Result
Rotor	5-2	Ohmmeter from slip ring to shaft. 110 volt test lamp from slip ring to shaft Ohmmeter across slip rings. 110 volt test lamp across slip rings. Battery and ammeter to slip rings, voltmeter across slip rings.	Very low Lamp lights Very high Lamp fails to light	Grounded Grounded Open Open
Stator	5-3	Ohmmeter from lead to frame. 110 .volt test lamp from lead to frame. Ohmmeter across each pair of leads. 110 volt test light across each pair of leads.	Observe voltmeter and ammeter readings. Very low Lamp lights Any reading very high Fails to light	Compare w/specifications for shorts Grounded Grounded Open Open

Table 5-1. Alternator Testing - Continued

Component	Ref fig.	Connection	Reading	Result
Diode	5-4	Ohmmeter across diode, then reverse connections.	Both readings very low	Shorted
			Both readings very high	Open
		12 volt test lamp across diode, then reverse connections.	Lamp fails to light in both checks	Open
			Lamp lights in both checks	Shorted

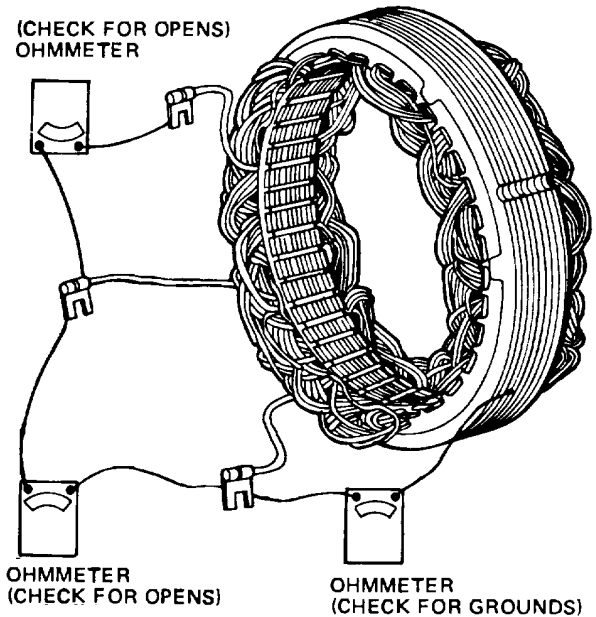
Caution: Do not use 110 volt test lamps to test diodes.

(CHECK FOR GROUNDS)



ME 3930-621-35/5-2

Figure 5-2. Rotor testing



ME 3930-621-35/5-3

Figure 5-3. Stator testing.

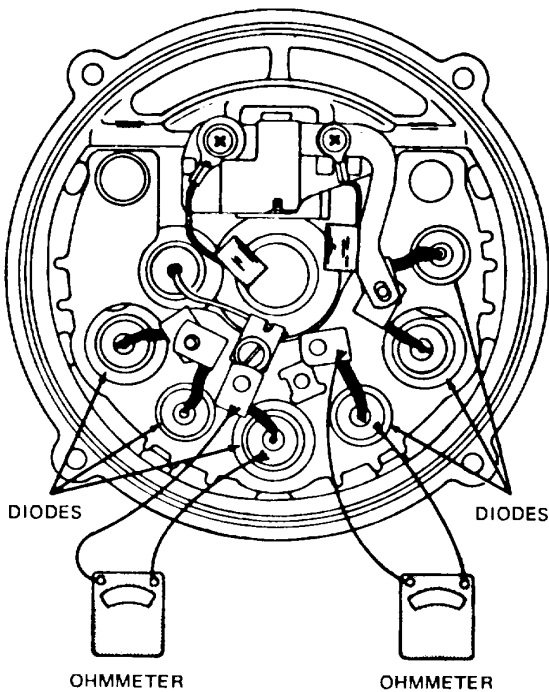


Figure 5-4. Diode testing.

b. Test rotor first, if not defective, then proceed to the stator and then finally the diodes.

### 5-5. Repair

a. *Reference Items.* Refer to figure 5-1 for items referenced.

b. *Semiconductor Device, Diode.*

(1) Support slip ring end frame (2) or heat sink (5) and push out old diodes (16 and 22) with an arbor press or vice.

(2) Press in new diode with a special tool which fits over the outer edge of the diode while supporting the heat sink or slip ring end frame.

**Caution: Do not hammer diodes into position as the shock will damage them.**

c. *Slip Ring.*

(1) To clean dirty slip rings, use 400 grain or finer polishing cloth. Spin the rotor in a lathe or by other means and hold the polishing cloth against the slip rings until they are clean.

**Caution: The rotor must be rotated so the slip rings will be cleaned evenly. Trying to clean the slip rings by hand without spinning the rotor could result in flat spots on the slip rings, resulting in brush noise.**

(2) Out of round or rough slip rings should be

turned in a lathe to 0.002 inch maximum indicator readings. Remove just enough material to make the rings smooth and round. Polish with 400 grain or finer polishing cloth and blow away all dust.

d. *Bearing.*

(1) The drive end frame bearing (28) can be removed by detaching the retainer plate screws and then pressing the bearing from the end frame. Check the bearing and if it is in satisfactory condition, it can be reused. Lubricate bearing. It should be filled 1/4 full before reassembly.

**Caution : Do not overfill or bearing will overheat.**

(2) If a new bearing is required, press it in with a tube or collar that just fits over the outer race. If the felt seal is worn excessively or hardened, it is recommended that a new retainer plate be installed.

(3) The slip ring end frame bearing (24) should be replaced if its grease supply is exhausted. Never attempt to relubricate and reuse the bearing. Press the bearing out from the slip ring end frame with a tube or collar that fits inside the end frame housing. Press the bearing out from outside the housing toward the inside. Press in the new bearing with a flat plate. Press in from outside the end frame until the bearing is flush with the outside of the end frame. To prevent breakage of the end frame, support it on the inside with a hollow cylinder. When installing the new bearing, use extreme care to avoid misalignment or other undue stress on the bearing. Saturate the felt seal with engine oil (OE 20), then reassemble the felt seal and steel retainer.

e. *Brush.*

(1) When separating the slip ring end frame from the rotor and drive end frame assembly, the brushes will drop down onto the shaft and come into contact with the lubricant. If brushes are to be reused, they must be thoroughly cleaned with a soft dry cloth. Brushes are 0.500 of an inch in length new and must be replaced when 0.375 of an inch in length. Also, clean the shaft thoroughly before beginning reassembly.

(2) Inspect the brush springs for evidence of any damage or corrosion. Be sure to replace the brush springs if there is any doubt as to their condition. Use a spring scale and check spring tension, which should be 8-12 ounces. Replace spring if tension is less than 8 ounces.

(3) When new brushes are required, install them as follows:

(a) Remove two brush holder screws and brush holder assembly from slip ring end frame.

(b) After installing springs and brushes in brush holder, insert a piece of straight wire or a pin

into the holes at the Bottom of the holder to retain the brushes.

(c) Install brush holder assembly on the slip ring end frame, noting carefully, proper alinement of parts. Allow wire to protrude through hole in end frame.

**5-6. Output Testing**

Refer to TM 10-3930-621-12 for testing the voltage output of the alternator.

**5-7. Assembly**

- a. Refer to figure 5-1 and assemble as follows:
- b. Place rotor assembly (13) in vise, avoiding excessive tightening.
- c. Install rotor shaft assembly (13) on drive end frame (27).
- d. Install fan pulley assembly tightening shaft nut to 50-60 foot-pounds.

e. Remove tape from bearing (24) and slip ring end of rotor shaft (13). Make sure bearing and shaft are completely clean.

f. Install bearing (24) and retainer (1) in slip ring frame (2).

g. Using scribe marks as a guide, install stator assembly (11) on slip ring frame (2).

h. Using scribe marks as a guide, install stator and slip ring frame assembly on the drive end frame (27).

i. Secure all frames with four thru-bolts (23).

j. Withdraw the brush retaining wire through a hole in the end frame, allowing the brushes to contact the slip rings.

**5-8. Installation**

Refer to TM 10-3930-621-12 for alternator installation procedures.

**Section II. STARTER MOTOR**

**5-9. Description**

Starter motor is a two field, four brush unit, with armature supported by three bushings one each at drive end, center and commutator end. These bushings are graphite and oil impregnated and are lubricated only when motor is disassembled. The two brushes connected to field coil leads are insulated in commutator end frame and the two armature brushes are grounded. The starter motor is designed to operate under overload and produce high torque. The starter drive assembly incorporates a locking feature, which prevents demeshing of drive pinion from flywheel ring gear until a specific flywheel speed is reached.

**5-10. Removal**

Refer to TM 10-3930-621-12 for starter motor removal procedures.

**5-11. Disassembly**

- a. Disassembly should proceed only as far as is

necessary to make repair or replacement of defective parts.

b. Refer to figure 5-5 for referenced item numbers.

c. Secure starter motor in bench vise at drive end of unit. Be careful not to damage drive end housing.

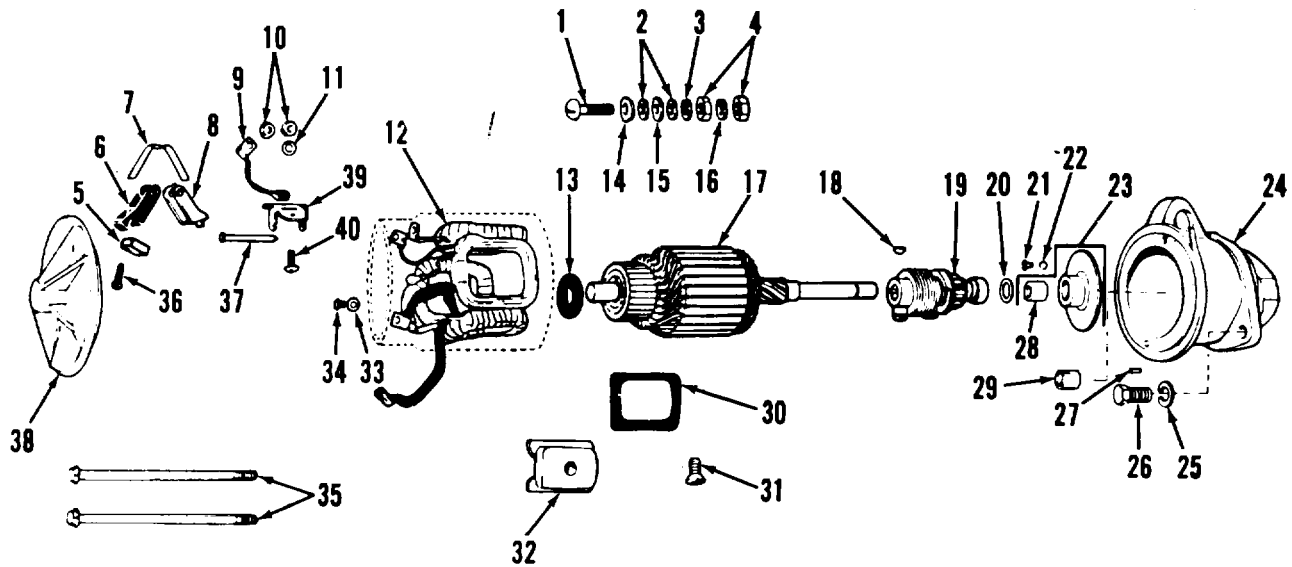
d. Remove the two thru-bolts (35) and slide commutator end frame (38) and field frame from armature.

e. Disconnect field lead from brush holder (6) and remove commutator end frame from field frame.

f. Brushes, brush holders and springs can now be removed from commutator end frame.

g. Remove screws (21) which mount center bushing (28) on drive end housing (24) and remove housing from armature shaft.

h. Drive assembly (19) is keyed onto armature shaft and is removed by pressing off or using a puller.



- |                  |                      |                    |
|------------------|----------------------|--------------------|
| 1. Stud          | 15. Lock washer      | 28. Center bushing |
| 2. Flat washer   | 16. Terminal bushing | 29. Drive bushing  |
| 3. Flat washer   | 17. Armature         | 30. Insulator      |
| 4. Nut           | 18. Key              | 31. Screw          |
| 5. Brush         | 19. Drive assembly   | 32. Pole           |
| 6. Brush holder  | 20. Thrust washer    | 33. Lock washer    |
| 7. Brush spring  | 21. Screw            | 34. Screw          |
| 8. Brush holder  | 22. Lock washer      | 35. Thru-bolt      |
| 9. Lead          | 23. Center bearing   | 36. Screw          |
| 10. Nut          | 24. Housing          | 37. Support        |
| 11. Lock washer  | 25. Lock washer      | 38. Frame          |
| 12. Fieldwinding | 26. Cap screw        | 39. Support        |
| 13. Washer       | 27. Pin              | 40. Screw          |
| 14. Flat washer  |                      |                    |

Figure 5-5. Starter, exploded view

**5-12. Inspection and Repair**

a. Clean starter motor parts with cleaning compound, solvent (Spec. P-S-661). Do not use cleaning solvents on drive mechanism or armature and field coils. Dry parts with compressed air.

b. Check bushings for roughness, scoring or excessive clearance. Bushing running clearances are as follows: commutator end frame 0.0013" - 0.0090", center bushing and drive housing bushing 0.0015" - 0.0050"

c. Check brush holders to be sure they will properly hold brushes against commutator. Check spring tension which should be 35 ounces. Check condition of brushes; if pitted or worn, replace.

d. Carefully inspect armature commutator. If burned, rough or out-of-round, turn down as follows:

(1) Place armature in lathe and turn down commutator until true. Make certain cut is not made on commutator riser bars as solder will be removed, thus weakening coil connections at this section. Remain approximately 3/16" from riser bars. Remove no more than 0.03 of an inch from the face of the commutator.

(2) Check armature on a growler for shorts. Refer to 5-13a

**5-13. Testing**

*a. Armature.*

(1) Place armature on "growler" and with a steel strip or hack saw blade held on armature core, rotate armature. If blade vibrates, armature is shorted in area of the core below the vibrating blade. Eliminate short by either cleaning out slots or bending shorting wire slightly and reinsulating it. If short cannot be eliminated armature should be replaced.

(2) Place one probe of test lamp on armature core or shaft and place other probe on each commutator bar in turn. If lamp lights, armature is grounded and should be replaced.

*b. Coils.*

(1) Using a test lamp, place probes on each of the field leads of starter motor. If lamp does not light, coils are open and starting motor must be replaced.

(2) Place one probe of test lamp on field frame and other probe on a field coil lead. If test lamp lights, starter motor terminal or one of field coils forming a pair are grounded, and starting motor must be replaced.

*c. Brush Holder.* Using test lamp, place probe on each of insulated brush holders in turn and other lead on commutator end frame. If lamp lights, brush holder is grounded due to defective insulation.

**5-14. Assembly**

a. Refer to figure 5-5 for referenced item numbers.

b. Secure cranking motor in bench vise and slide armature (17) into field coil housing.

c. Install brush holders (6), brushes (5) on commutator end frame (38). Place end frame on field frame and connect ungrounded brush leads to field coil terminals.

d. Install bearing assembly (23) on armature shaft (17) with long side towards commutator end of armature.

e. Install key (18) in armature shaft and press on drive mechanism. Apply thin coating of grease before pressing on drive assembly.

*Note.* If drive assembly is rotated to a fully extended lock position on screw shaft during replacement or during overhaul of cranking motor, do not attempt to force it in the reverse direction. Proceed to install drive even though it is fully extended. After starter motor is installed on engine and the engine starts, centrifugal force will disengage drive pinion from flywheel ring gear in the usual manner.

f. Place drive end housing (24) on armature shaft after placing a few drops of oil on bushing (28). Fasten center bearing on drive housing.

g. Place washer (13) on commutator end of armature shaft and install armature complete with drive housing in field frame assembly. While installing armature, pull commutator end frame away from field frame and make certain brushes are seated correctly on commutator.

h. Replace end frame and position drive end housing on field frame. Make certain both commutator end frame and drive housing are correctly positioned on field frame dowels. Then insert the thru-bolts and tighten securely.

**5-15. Installation**

Refer to TM 10-3930-621-12 for starter motor installation procedures.

**Section III. RADIATOR**

**5-16. Description.**

a. The engine cooling system consists of the water pump, radiator, thermostat, cooling fan, water passages in the cylinder block and head, and necessary hoses and lines to complete the system.

b. The water pump draws water from the bottom of the radiator and circulates it through the water passages in the engine. It then passes from the cylinder head of the engine through the thermostat and the upper radiator hose, to the upper part of the radiator. The water is cooled as it passes from the top to the bottom of the radiator by air drawn through the radiator core by the cooling fan.

c. The radiator core is of the conventional tubular type consisting of an upper and lower tank and side members. It is mounted to the truck frame

inside the counterweight and is protected by a grille mounted in the back of the counterweight. A power shift transmission oil cooler is an integral part of the bottom tank of the radiator to prevent overheating of the transmission oil.

d. The thermostat, located at the top of the water pump housing, operates automatically to maintain a normal operating temperature of approximately 165° F.

**5-17. Removal**

Refer to TM 10-3930-621-12 for radiator removal procedures and figure 5-6.

**5-18. Inspection and Repair**

a. Clean air passages in core and test for leaks as follows:

(1) Dry radiator core thoroughly. Water in the core will prevent air from passing out a small leak.

(2) Completely immerse radiator in water.

(3) Apply no more than 10 psi of compressed air and note any air leakage.

(4) Repair any leaks by soldering.

b. Test for clogging as follows:

(1) Check core tube inlet passages for obstructions.

(2) Fill radiator with water and seal upper water passages.

(3) Inspect for a steady and full stream of water flowing out of lower passage. If stream is small or erratic, the core tubes are restricted or plugged.

(4) A plugged radiator must be boiled out.

c. Straighten any bent cooling fins, being careful not to puncture tubes.

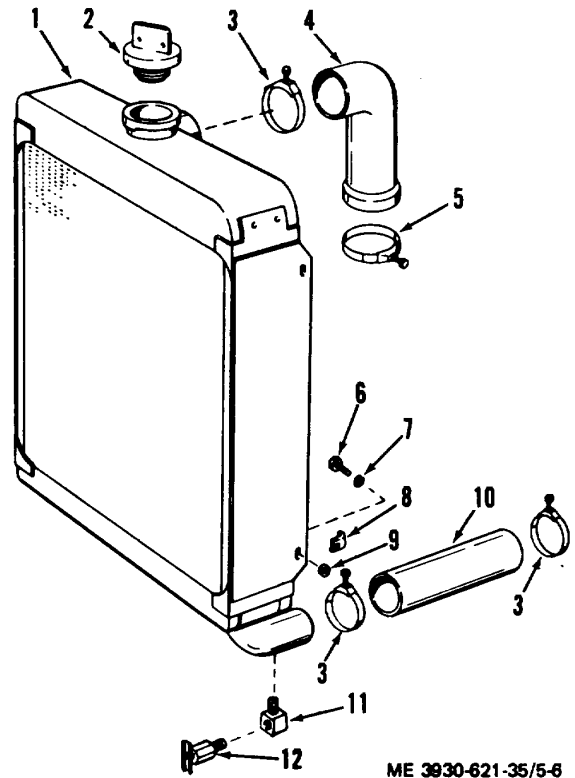
d. Test pressure caps for leaks and replace if faulty.

e. Check hoses for cracks or deterioration and replace as authorized.

f. Check tank for damage. If damage cannot be repaired by brazing, replace radiator and accessories as authorized.

**5-19. Installation**

Refer to TM 10-3930-621-12 for radiator installation procedures.



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- |                 |                |
|-----------------|----------------|
| 1. Radiator     | 7. Flat washer |
| 2. Pressure cap | 8. Spacer      |
| 3. Hose clamp   | 9. Nut         |
| 4. Hose         | 10. Lower hose |
| 5. Hose clamp   | 11. Elbow      |
| 6. Cap screw    | 12. Drain cock |

Figure 5-6. Radiator and connections exploded view



## CHAPTER 6

## TRANSMISSION REPAIR INSTRUCTIONS

---

**Section I. TRANSMISSION ASSEMBLY****6-1. Description**

a. *Components.* The transmission assembly consists of a single speed constant mesh transmission, drum and disc assembly, and a gear type oil pump assembly. Components attached to, and functioning with, the transmission assembly are a control valve assembly and torque converter.

b. *Mechanical Operation.*

(1) Power from the engine is transmitted to a torque converter which drives a pump and disc and drum assembly. The disc and drum assembly contains a drum, forward and reverse discs, pistons, and cylinders. Discs are engaged by oil pressure

applied behind the disc pistons, causing engagement with the drum. The assembly operates in oil for cooling and lubrication.

(2) If the reverse disc is activated, power is delivered to the transmission through a hollow shaft, which connects the reverse gear and reverse clutch. If the forward disc is actuated, power is delivered to the transmission through a solid shaft, which rotates inside the hollow reverse shaft, connecting the forward gear and forward clutch disc.

c. *Hydraulic Operation.*

(1) Refer to figure 6-1 for system schematic.

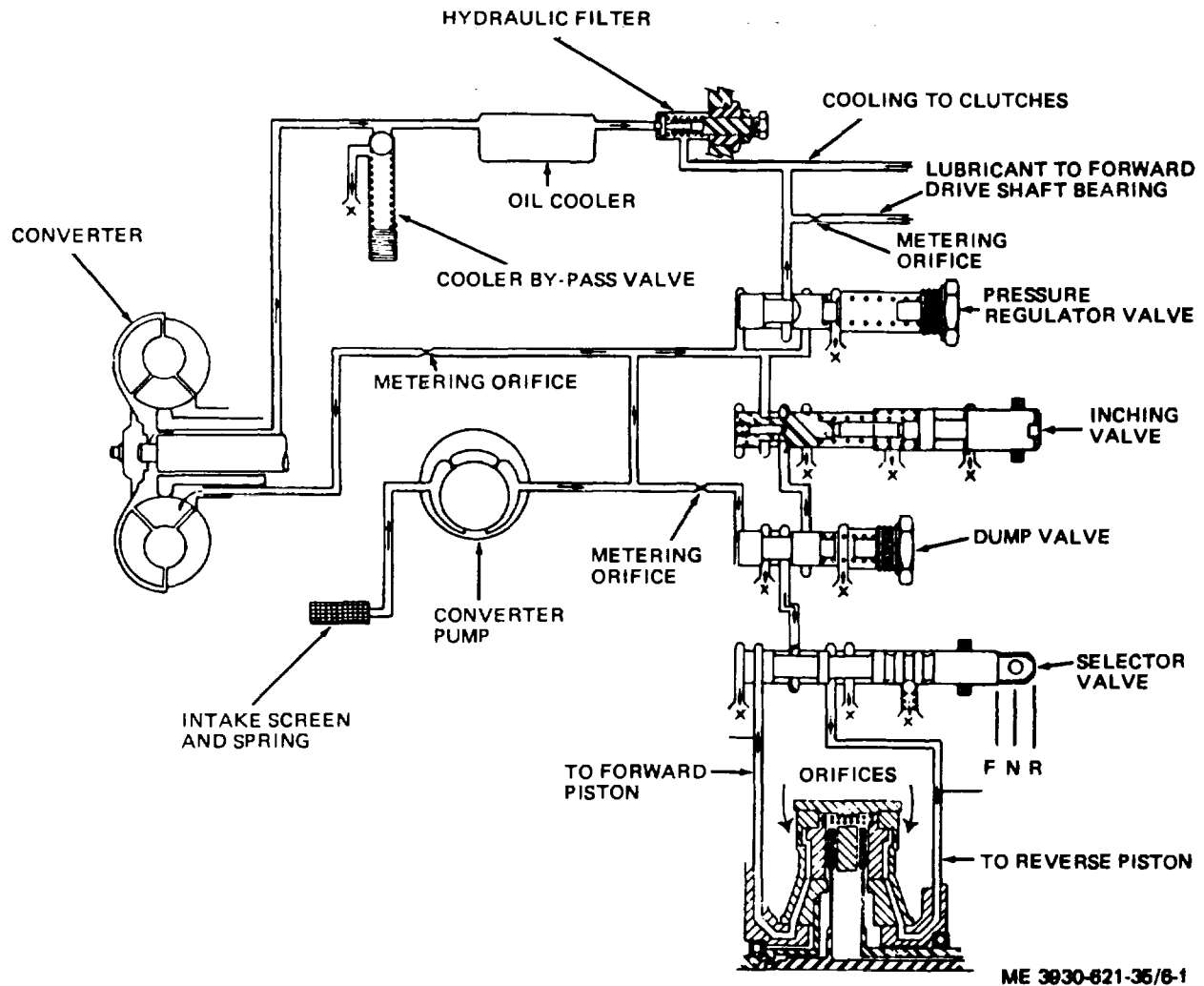


Figure 6-1. Transmission hydraulic system schematic line.

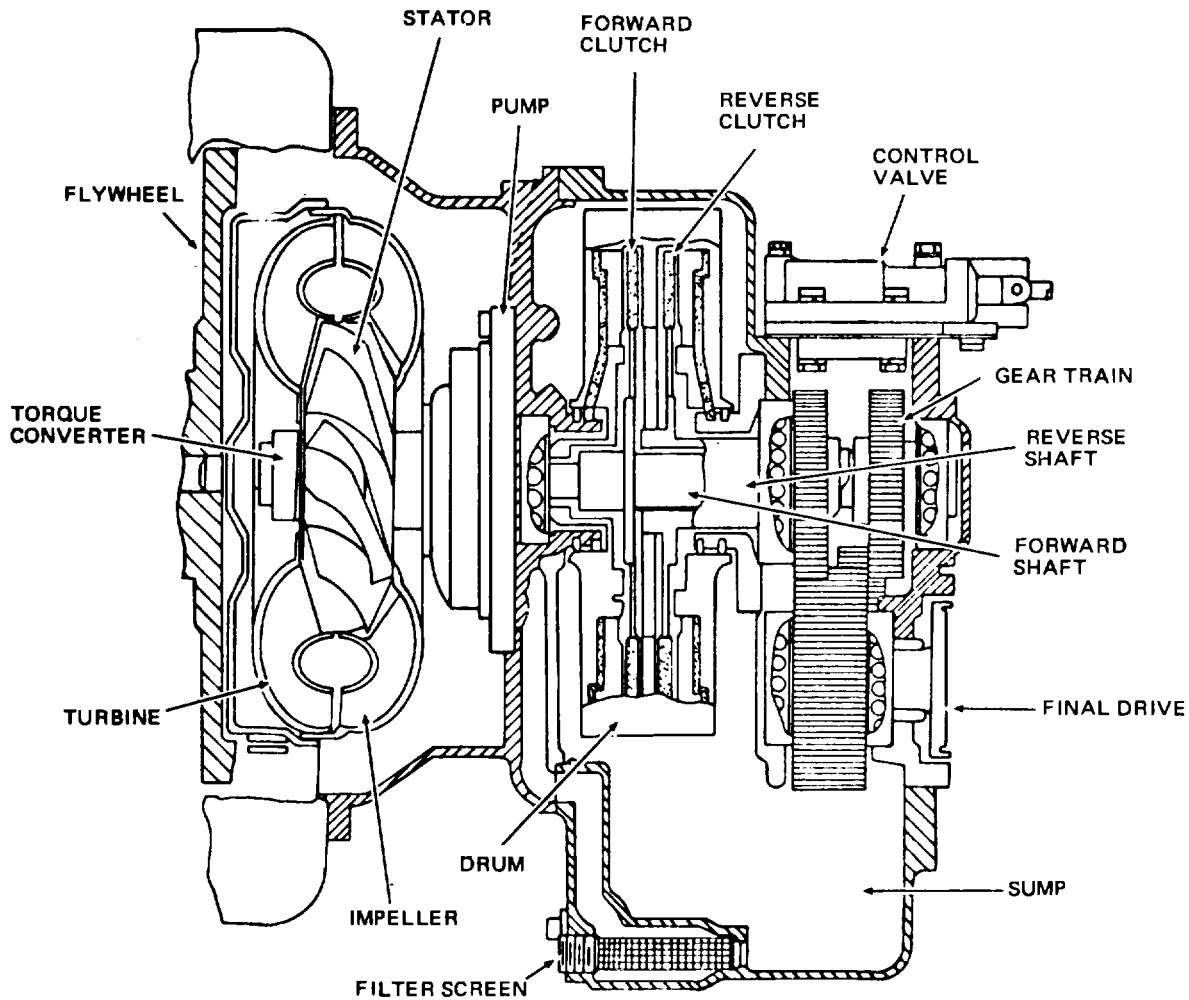
(2) The hydraulic system consists of the torque converter, a pump driven by the converter, control valve assembly and a disc drum assembly.

(3) The control valve assembly is mounted on the transmission housing and forms the top closure of the gear case. Machined porting plates are attached to the bottom of the valve to eliminate external piping. Passages in the plates align with passages drilled or cast into the transmission housing.

(4) The gear type oil pump provides hydraulic

pressure for the converter and the disc and drum assembly. It is directly driven from the input side of the converter. Since the converter is mounted on the engine flywheel, the pump is in operation whenever the engine is running. This means that there is a hydraulic pressure even with the engine idling.

(5) With the converter pump operating, the oil is taken from the sump and pumped under a pressure of between 100 to 150 P.S.I., to the converter and to the pressure regulator of the control valve.



ME 3930-621-35/6-2

Figure 6-2. Transmission assembled cutaway view.

**6-2. Removal**

Refer to paragraph 2-6 for removal procedures.

**6-3. Disassembly**

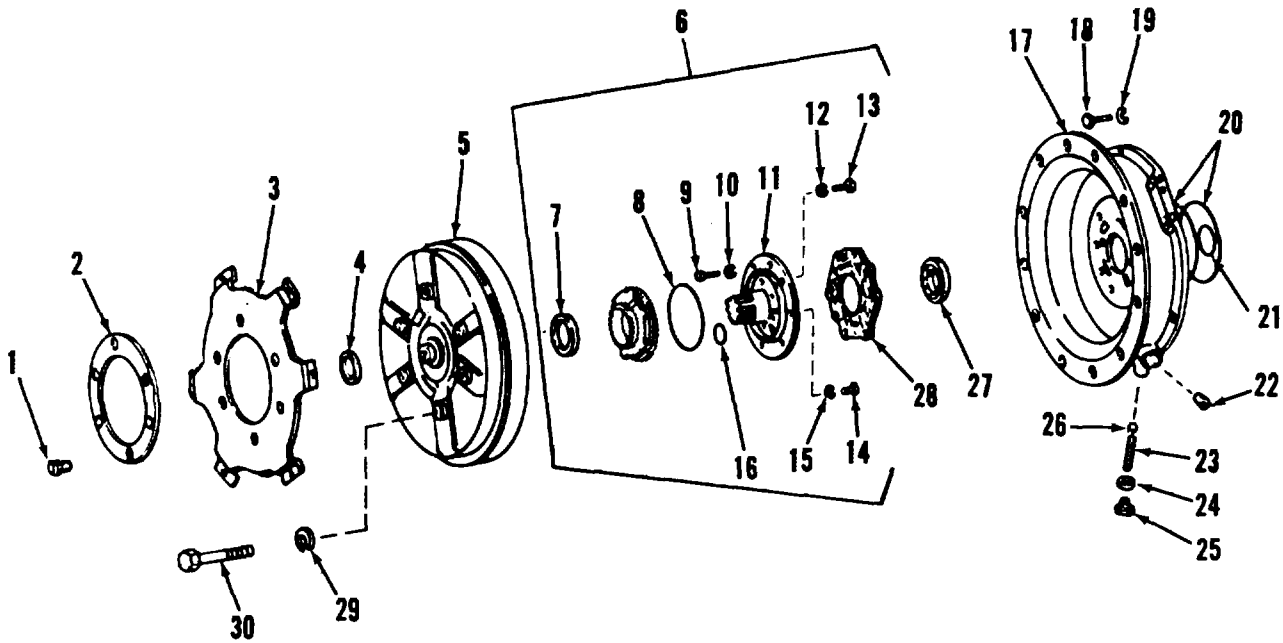
*a. Transmission.*

- (1) Place transmission in suitable working area.
- (2) Remove bolts and lock washers from valve block and remove control valve assembly from

transmission.

(3) Mark collector ring (11, fig. 6-3) and converter housing (17) to insure proper pump installation.

(4) Remove bolts (9) and lock washers (10) holding collector ring (11) to converter housing (17) and remove pump assembly from housing. If necessary, tap pump assembly with rawhide hammer to free it from gasket (28). Discard gasket.



- |                      |                       |
|----------------------|-----------------------|
| 1. Bolt              | 16. Packing           |
| 2. Reinforcing plate | 17. Converter housing |
| 3. Drive plate       | 18. Screw             |
| 4. Shim              | 19. Lock washer       |
| 5. Torque converter  | 20. Ring              |
| 6. Pump assembly     | 21. Seal ring         |
| 7. Oil seal          | 22. Pipe ping         |
| 8. Packing           | 23. Spring            |
| 9. Bolt              | 24. Flat washer       |
| 10. Lock washer      | 25. Spring seat       |
| 11. Collector ring   | 26. Ball              |
| 12. Lock washer      | 27. Bearing           |
| 13. Screw            | 28. Gasket            |
| 14. Bolt             | 29. Flat washer       |
| 15. Lock washer      | 30. Screw             |

(5) Lay transmission on case and remove screws (18) and lock washers (19) which mount converter housing (17) to transmission case (32 fig. 6-6). Attach chain to converter housing and

remove converter housing and disc and drum assembly as a unit (fig. 6-4), being careful not to damage sealing rings (14, fig. 6-7) and reverse shaft needle bearing (42, fig. 6-6).

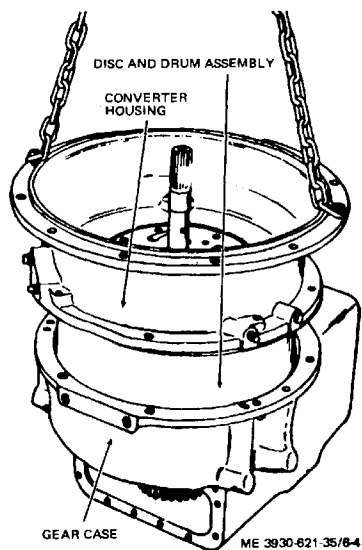


Figure 6-4. Removing housing and drum.

(6) Remove converter housing from disc and drum assembly by removing retainer ring (7, fig. 6-7) on turbine input shaft (8) and sliding housing from disc and drum assembly (fig. 6-5). Remove bearing (27, fig. 6-3) from housing.

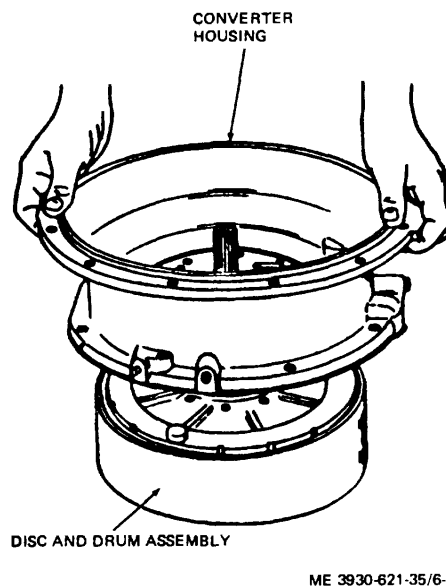
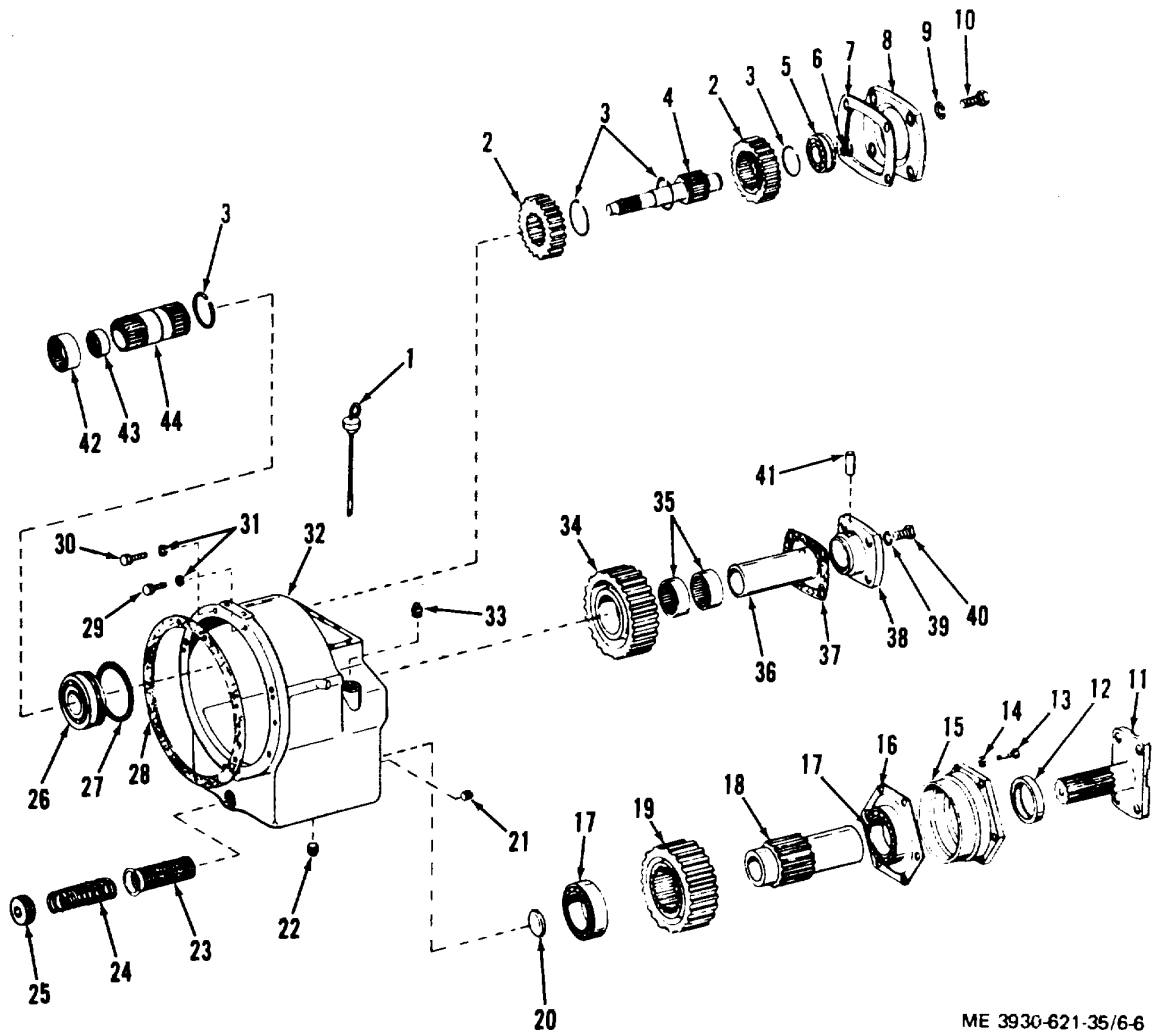


Figure 6-5. Removing disc and drum assembly

(7) Remove forward gear and shaft as follows (fig. 6-6):

(a) Remove bolts (10) and lock washers (9) holding bearing retainer (8) and gasket (7) to case and remove retainer with gasket. Discard gasket.

- (b) Remove bearing retaining ring (6), depress retaining ring on bearing, and slide bearing.(5) from forward shaft (4).
- (c) Reaching through valve control opening, remove forward gear retaining ring (3).
- (d) Using a rawhide hammer and holding forward gear (12) in place, tap forward shaft (4) out through bearing retainer opening. Remove forward gear (2) from case.
- (8) Remove reverse gear and shaft as follows:
  - (a) Match mark disc assembly retainer (11, fig. 6-7) and remove retainer attaching lock washers (13) and bolts (12) and retainer.
  - (b) Remove sealing rings (14) from retainer (11).
  - (c) Remove needle bearings (42 and 43, fig. 6-61) from reverse shaft (44).
  - (d) Remove retaining ring (3) and reverse gear (2) from reverse shaft (44).
  - (e) Tap shaft (44) out disc and drum assembly side of transmission and remove bearing retaining ring (3).
  - (f) Remove bearing (26) with retaining ring (27).
- (9) Remove idler gear and shaft as follows (fig. 6-6):
  - (a) Remove retainer cap (38) by removing attaching bolts (40) and lock washers (39). Discard gasket (37).
  - (b) Mark position of pin (41) holding shaft in retainer cap (38) to insure proper assembly and remove pin.
  - (c) Remove idler shaft (36) and idler gear assembly. *Note.* Idler gear assembly consists of two needle bearings (35) and a gear (34).
- (10) Remove the output gear and shaft as follows (fig. 6-6):
  - (a) Remove output flange (11) and oil seal (12).
  - (b) Remove retainer (15) by removing attaching bolts (13) and lock washers (14). Discard gasket (16).
  - (c) While holding output gear (19) in gear box, remove output shaft (18).
  - (d) Remove output gear (19) and both ball bearings (17).
  - (e) Remove expansion plug (20).
- (11) Remove plug (25, fig. 6-6), spring (24), and screen (23) from bottom portion of transmission case (321).



ME 3930-621-35/6-6

- |                    |                    |                       |
|--------------------|--------------------|-----------------------|
| 1. Gage            | 16. Gasket         | 32. Lock washers      |
| 2. Gears           | 17. Ball bearings  | 32. Transmission case |
| 3. Retaining rings | 18. Output shaft   | 33. Plug              |
| 4. Forward shaft   | 19. Output gear    | 34. Idler gear        |
| 5. Bearing         | 20. Plug           | 35. Needle bearings   |
| 6. Retaining       | 21. Plug           | 36. Idler shaft       |
| 7. Gasket          | 22. Drain plug     | 37. Gasket            |
| 8. Retainer        | 23. Screen         | 38. Cap               |
| 9. Lock washer     | 24. Spring         | 39. Lock washer       |
| 10. Bolt           | 25. Plug           | 40. Bolt              |
| 11. Flange         | 26. Ballbearing    | 41. Pin               |
| 12. Oil seal       | 27. Retaining ring | 42. Needle bearing    |
| 13. Bolt           | 28. Gasket         | 43. Needle bearing    |
| 14. Lock washer    | 29. Screw          | 44. Reverse shaft     |
| 15. Retainer       | 30. Screw          |                       |

Figure 6-6. Single speed transmission, exploded view.

b. Disc and Drum Assembly.

(1) Remove disc and drum assembly from transmission assembly (para 6-3 a).

(2) Refer to figure 6-7 and disassemble as follows.

(3) Place assembly in arbor press. Apply pressure on input shaft (8) until forward cylinder (3) is depressed enough to remove retaining ring (2) from drum (22).

(4) Slowly release pressure on input shaft (8) and remove forward cylinder (3) with input shaft attached, keeping it in alignment to prevent binding in the drum (22). If forward cylinder (3) binds, tap with rawhide hammer until released.

(5) Separate input shaft (8) from forward cylinder (3) by removing attaching eight screws (9)

(6) Remove needle bearing (10) and sealing ring (16) from input shaft (8).

(7) Remove forward piston (17), four drive pins (21), 24 springs (19), and forward disc assembly (20).

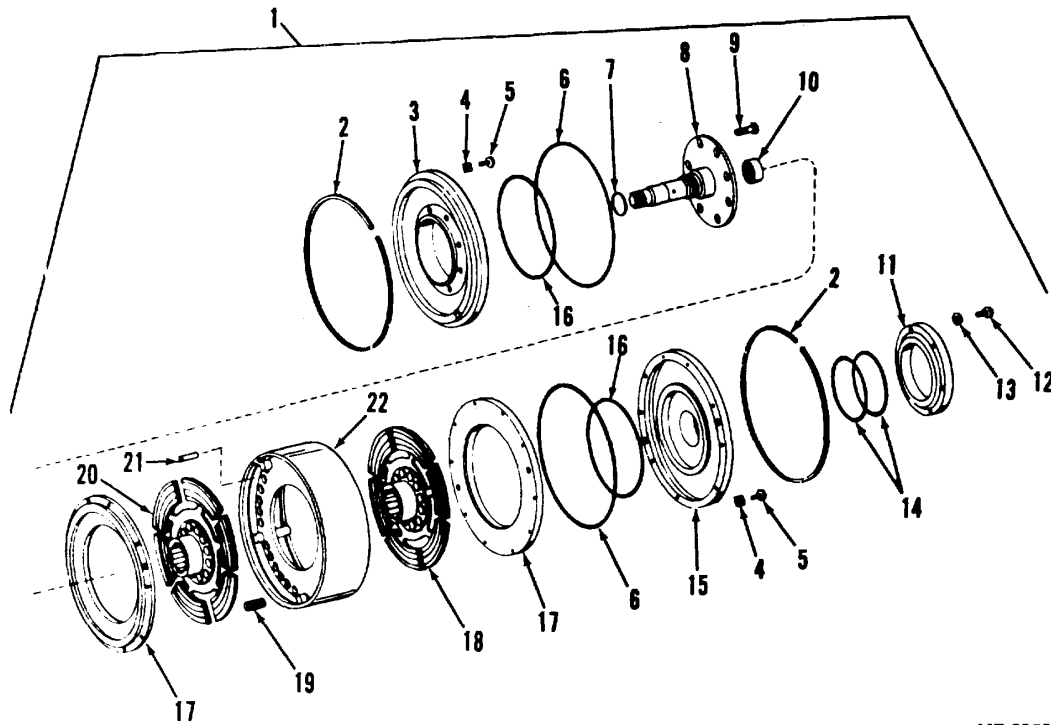
(8) Remove forward piston sealing ring (6).

(9) Turn drum (22) over and remove large retaining ring (2).

(10) Remove reverse cylinder (15) and sealing ring (16) which is located on the small inside hub of the cylinder.

(11) Remove reverse piston (17) and sealing ring (6).

(12) Remove reverse disc assembly (18) from



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- |                     |                      |                           |
|---------------------|----------------------|---------------------------|
| 1. Clutch assembly  | 9. Screw             | 16. Sealing rings         |
| 3. Forward cylinder | 11. Retainer         | 18. Reverse disc assembly |
| 4. Locking plate    | 12. Bolt             | 19. Springs               |
| 5. Screw            | 13. Lock washer      | 20. Forward disc assembly |
| 6. Sealing ring     | 14. Sealing rings    | 21. Pins                  |
| 7. Retaining ring   | 15. Reverse cylinder | 22. Drum                  |
| 8. Input shaft      |                      |                           |

Figure 6-7. Disc and drum assembly, exploded view.



*c. Oil Pump.*

- (1) Remove oil pump assembly from transmission assembly (para 6-3 a ).
- (2) Refer to figure 6-3 and disassemble as follows:
- (3) Remove screws (13), bolts (14), and lock washers (12 and 15) holding pump support to collector ring (11). Separate support from ring.
- (4) Remove oil seal (7) and packings (8 and 16).
- (5) Remove collector ring (11) bushing if worn or damaged.

**6-4. Cleaning, Inspection, and Replacement**

- a. Clean all parts with cleaning compound, solvent (P-S-661). Blow out all passages and dry all components with compressed air.
- b. Inspect bearings, packing, splined shafts, gears, and attaching parts for wear and damage.
- c. Inspect screen for clogging or damage.
- d. replace all gaskets, packing, and oil seals.
- e. Replace worn or damaged parts as authorized.
- f. Replace entire oil pump if gear bushings and housing are excessively damaged
- g. Refer to paragraph 1-4 for Transmission Repair and Replacement Standards.

**6-5. Assembly**

*a. Oil Pump.*

- (1) Refer to figure 6-3 and assemble as follows:
- (2) Install new preformed packings (8 and 16) and oil seal (7).
- (3) Lubricate all parts with engine oil (OE 10). See lubrication order (LO 10-3930-621-12).
- (4) Install pump support on collector ring (11) and secure with lock washers (12 and 15), bolts (14) and screws (13).
- (5) Install pump assembly on converter housing (para 6-5 c ). Use new gasket (28).

*b. Disc and Drum Assembly.*

- (1) Refer to figure 6-7 and assemble as follows:
- (2) Install reverse disc assembly (18), reverse piston (17) and sealing ring (6), and reverse cylinder (15) and sealing ring (16) in drum (22).

**Caution: Make sure cylinder and piston do not bind in plate assembly or on pins (21).**

- (3) Holding reverse cylinder in place, install large retaining ring (2).
- (4) Turn drum (22) over and install four drive pins (21) and 24 springs (19) in drum. Install forward disc assembly (20) and position forward piston (17) with sealing ring (6) in drum.
- (5) Install input shaft (8J) on forward cylinder (3) with eight screws (9)

- (6) Install sealing ring (16) and needle bearing (10) on input shaft (8).

- (7) Place assembly in arbor press. Apply pressure to input shaft (8), making sure forward cylinder (3) does not bind.

- (8) Install large snap ring (2) to secure forward cylinder in place and slowly release pressure of arbor press.

- (9) Install disc and drum assembly on converter housing (para 6-5 c).

*c. Transmission.*

- (1) Unless otherwise noted, refer to figure 6-6 when assembling the transmission gear train.

- (2) Install screen (23), spring (24), and plug (25) in sump of transmission case (32).

- (3) Coat all gears and bearings with oil (OE 10) and make sure they rotate freely.

- (4) Install the output gear and shaft as follows:

- (a) Install expansion plug (20).

- (b) Holding and alining two ball bearings (17) and output gear (19) in gear box, install output shaft (18) through the three parts.

- (c) Install new gasket (16) and retainer (15) on transmission case and secure with bolts (13) and lock washers (14).

- (d) Install output flange (11) and oil seal (12). Output shaft must be installed with internal splines to outside of gear case.

- (5) Install idler gear and shaft as follows:

- (a) Install two needle bearings (35) in idler gear (34).

- (b) Install idler shaft (36) in idler gear assembly and install the unit in transmission case.

- (c) Install pin (41) in shaft (36), noting position marked on retainer, during disassembly.

- (d) Position new gasket (37).

- (e) Install retainer cap (38) and secure with bolts (40) and lock washers (39), noting pin (41) position. Machined reliefs in idler retainer must be in the down position so that oil in retainer will drain into housing.

- (6) Install reverse gear and shaft as follows:

- (a) Install bearing (26) and secure with retaining ring (27).

- (b) Holding reverse gear (2) in transmission case, install reverse shaft (44), from drum assembly side, through bearing and gear. Secure gear to shaft with retaining ring (3).

**Caution: Retaining rings must be seated firmly for both bearing (26) and reverse gear (2) or destructive shaft movement will result.**

- (c) Install lubricated needle bearings (42 and 43) on in and out side of reverse shaft (44).

(d) Install sealing rings (14, fig. 6-7) in retainer (11). Rings must rotate free of ring and be securely hooked together at ring ends.

(e) Aline retainer match marks made in disassembly and install retainer (11) and secure with lock washers (13) and bolts (12).

(7) Install forward gear and shaft as follows:

(a) Holding forward gear (2, fig. 6-6) in transmission case, install forward shaft through retainer opening, forward gear, and into hollow reverse shaft (44). Check position of needle bearings (42 and 43) on shafts.

(b) Secure forward gear (2) to shaft (4) with two retaining rings (3).

**Caution: Retaining rings must be seated firmly.**

(c) Secure bearing (5) on shaft with retaining ring (7). Lateral movement of this bearing depends on the firm seating on both retaining rings. Check each before proceeding.

(d) Using a new gasket (7), install retainer (8) and gasket to transmission case (32) and secure with lock washers (9) and bolts (10).

(8) Install disc and drum assembly on converter housing as follows:

(a) Install lubricated bearing (27, fig. 6-3) in converter housing.

(b) Slide converter housing on disc and drum assembly, and secure with a retaining ring (7, fig. 6-7) on the input shaft (8).

**Caution: Use care when installing converter housing on input shaft (8) of disc and drum assembly, so that misalignment does not occur. Retaining ring (7) must be firmly seated.**

(9) Using suitable hoist, aline converter housing screw holes with those in transmission case and slowly lower converter housing and disc and drum assembly on transmission case.

**Caution: Use care not to damage retainer sealing rings (14) fitting into disc and drum, as damage to rings will cause reverse piston and disc to be inoperative. Avoid any damage to needle bearing (42, fig. 6-6) on outside of reverse shaft.**

(10) Using new gasket (28, fig. 6-3), install pump assembly on converter housing (17) by installing collector ring (11) and securing ring with

bolts (9) and lock washers (10). Aline match marks on ring and housing.

(11) Using new gasket, install control valve assembly on transmission case.

### 6-6. Installation

Refer to paragraph 2-6 for installation procedures.

### 6-7. Testing

*a. General.* Since the transmission is dependent upon correct operating pressures for efficient operation, the pressure should be checked for the following:

- (1) Pump pressure
- (2) Converter pressure
- (3) Clutch pack pressures at stall and free running.

*Note.* Oil temperature should be 80 to 100°F when checking pressures.

#### *b. Pump Pressure.*

(1) Install pressure gage, calibrated to 300 psi in port "P" (fig. 6-8) on transmission forward of flywheel housing inspection cover.

(2) Place transmission in neutral and start engine.

(3) Accelerate to full governed speed and note gage pressure.

(4) If pressure is between 100 to 150 psi, converter pump is in normal operating condition.

(5) If pressure is over 150 psi, check the following:

(a) Regulator valve spring (20, fig. 6-11), gasket (12) and spool (21). Replace gasket.

(b) Cooler by-pass valve.

(c) Restricted lines and passages.

(6) If pressure is under 100 psi, check the following:

(a) Low oil level.

(b) Faulty pump.

(c) Excessive line leakage.

(d) Faulty regulator valve.

(e) Enlarged clutch cylinder orifices.

#### *c. Converter Pressure.*

(1) Install pressure gage, calibrated to psi, in port "C" on transmission (fig. 6-8) forward and above flywheel housing inspection cover.

(2) Place transmission in neutral and start engine.

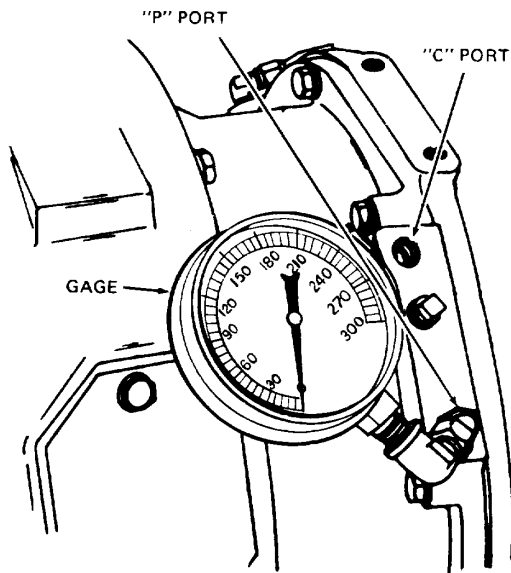


Figure 6-8. Checking pump and converter pressure.

(3) Accelerate to full governed speed and note gage pressure.

(4) If pressure is 65 to 80 psi, converter is in normal operating condition.

(5) If pressure is above 80 psi, when engine is accelerated, check the following:

- (a) Excessive pump pressure (para 6-2 b (5)).
- (b) Enlarged metering orifices.
- (c) Restricted converter return passages.

(6) If pressure is below 65 psi, when engine is accelerated, check the following:

- (a) Low oil level
- (b) Restricted oil strainer
- (c) Faulty pump
- (d) Clogged converter orifice in pump collector ring
- (e) Faulty cooler by-pass valve.

(7) Bring engine to idling speed.

(8) If pressure is 40 to 60 psi, converter is in normal operating condition.

d. Clutch Pressure at Stall.

(1) Install a pressure gage in front on top of control valve.

(2) Check clutch pressure in forward direction as follows:

(a) Position truck against wall and apply parking and foot brake. Drive wheels must be locked.

(b) Accelerate engine momentarily to wide open throttle and note pressure indication on gage.

(c) If gage reading is not below 65 psi. or does not go above normal pump pressure, the pressure in the forward circuit is normal. Pressure should never be below 65 psi.

(d) If pressure is above normal pump pressure, check for incorrect or faulty regulator spring (20, fig. 6-11) tension, inoperative inching valve, or a restricted orifice in the forward cylinder (3, fig. 6-7).

(e) If pressure is below 65 psi, check for low oil level, restricted lines or passages, damaged collector rings, faulty or incorrectly adjusted selector valve spool (9, fig. 6-11), faulty pump 16, fig. 6-3), or excessive leaks in the transmission drum (22, fig. 6-7).

(3) Check clutch pressure in reverse direction as follows:

(a) Install pressure gage in rear port on top of control valve.

(b) Idle engine and engage clutch in reverse direction.

(c) If gage reading is 25±2 1/2 psi, the pressure in the reverse circuit is normal.

(d) If pressure reading is not within tolerance, adjust regulator valve and replace spring (20, fig. 6-11) if necessary.

e. Clutch-Pressure at Free Running.

(1) Raise both drive wheels off floor and block securely. Both wheels must be free to rotate.

(2) Install pressure gage in front port on top of control valve.

(3) Hold inching pedal up so inching valve plunger cannot move.

(4) Run engine at full governed speed forward and check pressures. If pressure is below 65 psi or above normal pump pressure, inspect in accordance with d above.

(5) Install pressure gage in rear port on top of control valve.

(6) With transmission in reverse, idle engine and check pressure. If reading is not within 25±2 1/2 psi, adjust oil cooler pressure regulator valve and replace spring (20, fig. 6-11), if necessary.

## Section II. TORQUE

### 6-8. Description

a. The torque converter is composed of three members: the impeller, the turbine and the stator. The impeller forms the outer shell of the converter, and the turbine and stator operate within the impeller, but turn free of the impeller. The complete unit is mounted on the engine flywheel and always turns at engine speed. See figure 6-2.

b. The torque converter is filled with oil and when the impeller is rotated by the engine, the oil in the impeller vanes also rotates; and being subjected to centrifugal force, causes the oil to flow outward.

### 6-9. Removal

Refer to paragraph 2-6 for removal procedure. Note number of shims on converter pilot.

### 6-10. Inspection and Repair

a. Inspect converter for excessive wear, warping, cracks, or other damage.

b. Since the torque converter is a welded assembly, it must be replaced as a unit as authorized.

### 6-11. Installation Checks

The following checks should be made when installing converter (para 2-6):

#### a. Tang Depth.

- (1) Install converter on flywheel with no shims on pilot.
- (2) Place scale across tangs of converter and another scale from flywheel housing face to first scale (fig. 6-9).

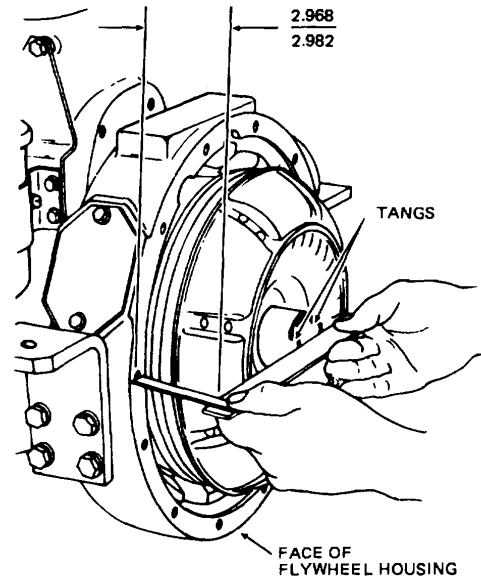


Figure 6-9. Checking converter tang depth.

(3) Record measurement from face of tangs to housing face.

(4) If measurement is less than 2.968 inches, remove converter and add shims at converter pilot to obtain specified dimension.

(5) If measurement is more than 2.982, insert suitable gasket between converter housing and flywheel housing to obtain specified dimension.

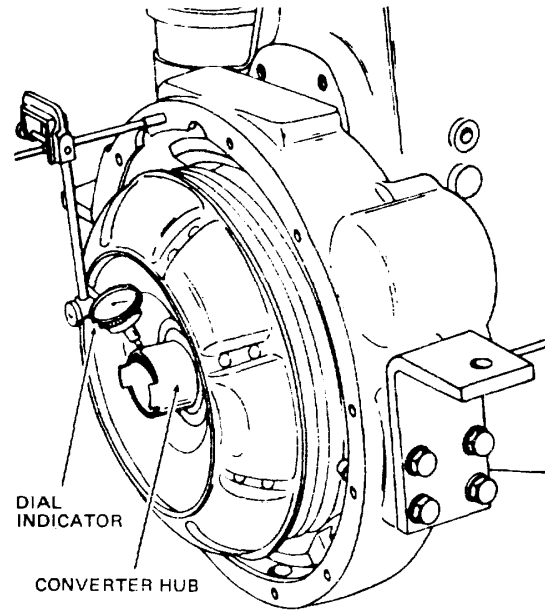
*b. Alinement.*

(1) Mount dial indicator as shown in figure 6-10.

(2) Rotate converter and note indicator readings. Hub runout should not exceed 0.005 inch (0.01 inch TIR).

(3) bend drive plate (3, fig. 6-3) to adjust to specified dial reading. Do not use shims between plate and flywheel.

(4) After correct alinement has been attained, recheck tang depth as described in a above.



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Figure 6-10. Checking converter alinement.

### Section III. TRANSMISSION CONTROL VALVE

#### 6-12. Description

*a. Pressure Regulator Valve.* When oil is being pumped to the converter and cooling circuit, it is also being delivered, under full pump pressure, to the pressure regulator valve in the transmission control valve. The regulator controls the oil pressure delivered by the pump. The spring is calibrated to provide between 80 and 100 psi, so that oil under controlled pressure is ready for delivery to the clutch pack. At the same time the regulator controls the amount of oil being delivered for clutch cooling. Also, a portion of the cooling oil is delivered for lubricating the front bearing of the forward drive shaft. Pressure is reduced by forcing the oil through a metering orifice.

*b. Inching Valve.* From the regulator valve, oil passes to the inching valve. This valve is a variable regulator, which permits the operator to vary pressure on the clutch plate from zero to 80 psi. When an "inching" operation is performed, actuating the inching pedal relieves spring pressure

on the inching valve spool. This action allows oil pressure in back (of the spool to move it far enough to restrict the flow of oil to the selector valve, thus controlling pressure on the clutches. This allows a "feathering" effect during inching.

*c. Dump Valve* The forward and reverse clutch supply or dump valve is placed in the circuit to control the flow of oil to the selector valve. The valve spool is pressurized by the converter pump through a metering orifice in a branch circuit from the main supply line. Pump pressure at this orifice is reduced to 3 psi, maximum with the engine at full governed speed.

*d. Selector Valve.* Oil flowing through the dump valve enters the selector valve. With the selector valve plunger in the neutral position, oil is blocked at this point and the truck will not move. When the directional lever is moved to either forward or reverse, the selector valve plunger opens and ports to either the forward or reverse clutch pistons. Movement of the piston, due to the oil pressure in

the circuit, causes the clutch to engage the rotating clutch drum, thereby moving the truck. The orifices in the clutch drum cylinders accelerate at the release of pressure whenever the operating pressure to the clutches is blocked off or lowered.

#### **6-13. Removal**

- a. Disconnect inching and selector control valve linkage from their respective valves.
- b. Remove bolts and washers attaching transmission control valve to transmission case.
- c. Clean valve exterior with cleaning compound, solvent (Spec. P-S-661). Dry thoroughly with compressed air.

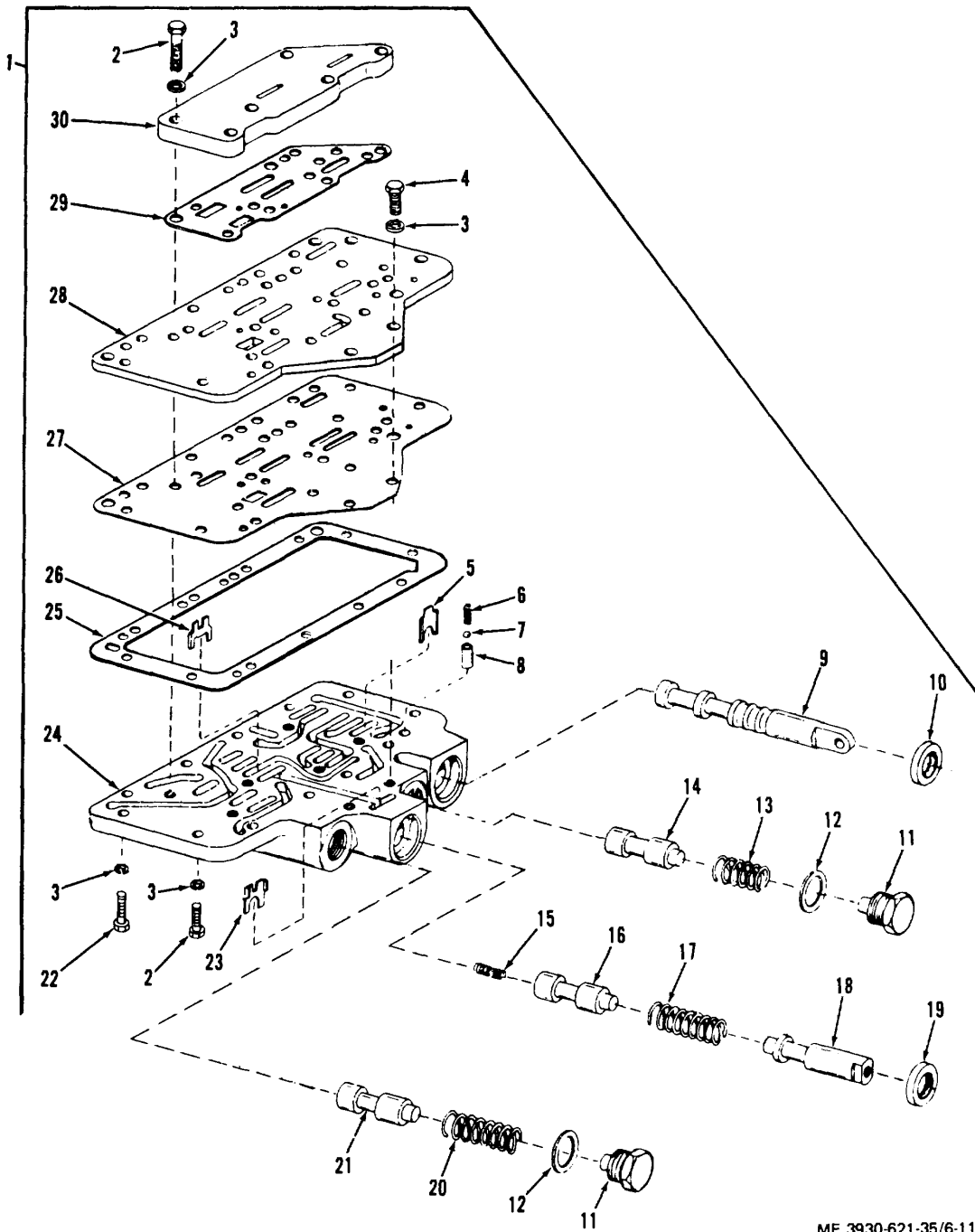
#### **6-14. Disassembly**

- a. Refer to figure 6-11 and disassemble as follows
- b. Remove valve cover bolts (2) and lock washers (3), valve cover (30), and gasket (29). Discard gasket.
- c. Remove separator plate bolts (4) and lock washers (3), separator plate (28), and gaskets (25 and 27). Discard gaskets.
- d. Remove selector valve ball (7), spring (6) and bushing(8).

- e. Remove selector valve stop (5) and slide selector spool (9) from valve body assembly (24).
- f. Remove and discard oil seal (10).
- g. Remove inching valve plunger stop (23) and slide plunger (18) and spring (17) from valve body assembly (24).
- h. Remove and discard oil seal (19).
- i. Remove inching valve spool stop (26), spool (16), and spring (15) from inside spool.
- j. Slowly remove regulator and dump valve retaining screws (11) and gaskets (12). Discard gaskets.
- k. Remove regulator valve spring (20) and spool (21), and dump valve, spring (13) and spool (14).

#### **6-15. Cleaning and Inspection**

- a. Clean all parts with cleaning compound, solvent (Spec. P-S-661). Dry thoroughly with corn pressed air.
- b. Blow out valve body assembly (24) passages.
- c. Inspect plungers and spools for score marks. Clean up with crocus cloth if possible.
- d. Check springs for weakness and damage.
- e. Replace oil seals and gaskets. Replace other worn or damaged parts as authorized.



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Figure 6-11. Transmission control valve, exploded view.

KEY to fig. 6-11:

1. Valve assembly
2. Bolt
3. Lock washer
4. Bolt
5. Selector stop
6. Selector spring
- 7..Selector ball
8. Selector bushing
9. Selector spool
10. Oil seal
11. Retaining screw
12. Gasket
13. Dump spring
14. Dump spool
- 15 Inching spool spring

16. Inching spool
17. Inching plunger spring
18. Inching plunger
19. Oil seal
20. Regulator spring
21. Regulator spool
22. Bolt
23. Plunger stop
24. Body assembly
25. Gasket
26. Inching stop
27. Gasket
28. Separator plate
29. Gasket
30. Cover

**6-16. Assembly**

- a. Refer to figure 6-11 and assemble as follows:
- b. Install regulator valve spool (21 ) and spring (20), and dump valve spool (14) and spring (13) in valve body assembly (24).
- c. Place new gaskets (12) on regulator valve retaining screws ( 11 ) and, holding springs in place, secure retaining screws in valve body assembly (24).
- d. Install spring (15) inside inching valve spool (16) and secure inside valve body assembly (24) with stop (26).
- e. Install inching valve plunger spring (17) and plunger (18) on secured inching valve spool (16). Make sure spring is firmly seated on spool, the secure plunger with stop (23).
- f. Install new oil seal (19) to a snug fit around plunger 118).
- g. Install selector spool (9) in valve body assembly (21) and secure with stop (5).
- h. Install new oil seal (10) to a snug fit around selector spool (9).
- i. Install selector valve ball (7), spring (6), and bushing (8), making sure ball seats easily when positioning spool.

- j. Check inching plunger and all spools for free operation.
- k. Check all stops for proper installation. They must be installed with angled edges facing back of valve body.
- l. Position new valve body gasket (25) and separator plate gasket (27) on valve body assembly (24).
- m. Secure separator plate (28) to valve body assembly (24) with bolts (4) and lock washers (3).
- n. Position new valve cover gasket (29) on separator plate (28) and secure valve cover (30) on gasket with bolts (2) and lock washers (3).

**6-17. Installation**

- a. Attach transmission control valve assembly to transmission case with bolts and washers.
- b. Torque bolts 5 to 10 foot-pounds.

**Caution: Do not exceed 10 foot-pounds**

**torque.**

- c. Connect inching and selector control valve linkages.

**6-18. Testing**

Refer to paragraph 6-7 for testing procedures noting how each valve is to function in the control system (para 6-12).

**Section IV. INCHING CONTROL**

**6-19. Description**

Inching operation is controlled by the inching pedal. The pedal is installed on the same shaft as the brake pedal and is connected to an actuating rod. The rod actuates the inching valve plunger located in the transmission control valve assembly. The transmission and braking functions are combined to provide simultaneous transmission disengagement and position braking.

**6-20. Removal**

- a. Remove floor plates, toe plates (TM 10-3930-621-12) and inching plate assembly (1, fig. 6-12).
- b. Remove cotter pin and clevis pin and disconnect master cylinder clevis from brake pedal shaft (10, fig. 8-3).
- c. Disconnect inching pedal spring (19, fig. 6-12) and brake pedal spring (4, fig. 8-3).
- d. Holding pin (8, fig. 6-12i) and spring (9) in a



compressed position, depress treadle assembly slightly and carefully slide pin and spring from sleeve (10).

e. If necessary, remove sleeve (10) from transmission inching valve.

f. Remove screw (11, fig. 8-3) holding pedal shaft in position and screw (12, fig. 6-12) and lock washer (11). Install 3A8-24 x 1 1/2 inch screw in tapped hole in end of shaft. Remove bracket (13, fig. 6-12).

g. Holding inching treadle assembly (20, fig. 6-12) and brake pedal assembly (16, fig. 8-3) in position and using screw installed in end of pedal shaft (10), pull pedal shaft out from steering support bracket.

h. Slowly remove inching treadle assembly (20, fig. 6-12) and brake pedal assembly (16, fig. 8-

3) from shaft.

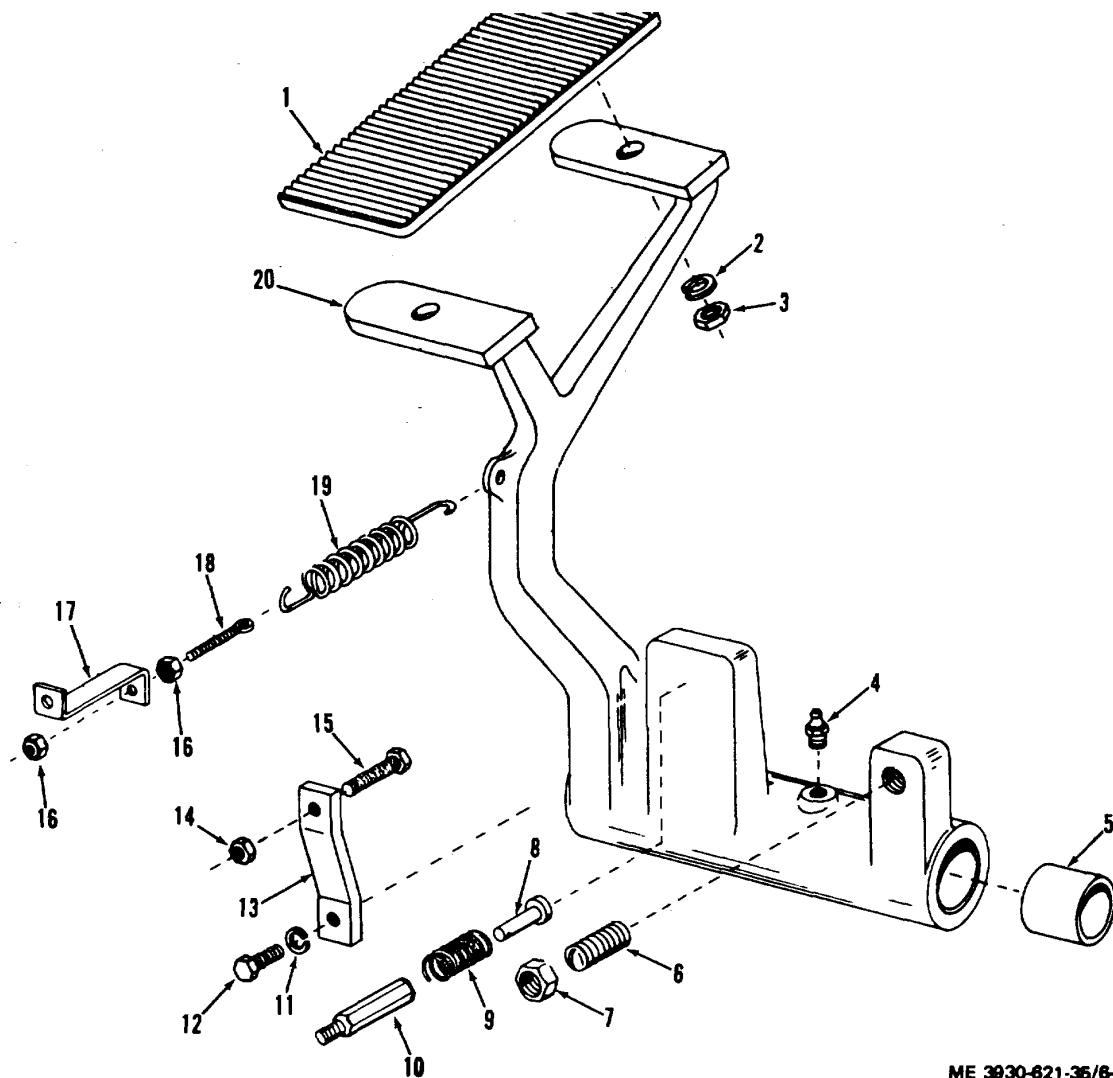
i. Remove adjusting nut (7, fig. 6-12) and setscrew (6), and lubrication fitting (4) from treadle assembly (20). If the adjusting nut is to be removed from setscrew, mark location for proper assembly.

**6-21. Cleaning, Inspection, and Replacement**

a. Clean all parts with cleaning compound, solvent (Spec. P-S-661). Dry thoroughly with compressed air.

b. Inspect bearings (5, fig. 6-12) and shaft for excessive wear.

c. Inspect treadle assembly (20) for cracks, deformation or other damage.



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Figure 6-12. Inching pedal, exploded view  
6-17

KEY to fig. 6-12:

1. Plate assembly
2. Lock washer
3. Nut
4. Lubrication fitting
5. Bearing
6. Setscrew
7. Nut
8. Pin
9. Spring
10. Sleeve

11. Lock washer
12. Screw
13. Bracket
14. Nut
15. Screw
16. Nut
17. Anchor
18. Eyebolt
19. Spring
- 20 Treadle assembly

**6-22. Installation**

- a. Install lubrication fitting (4, fig. 6-12) and adjusting nut (7) and setscrew (6) in treadle assembly (20). If the adjusting nut was removed from the setscrew, note disassembly mark, and install nut on setscrew.
- b. Install screw in end of pedal shaft.
- c. Install brake pedal assembly (16, fig 8-3) and treadle assembly (20, fig 6-12) on pedal shaft and, using screw installed in end of pedal shaft press shaft through steering support bracket.
- d. Using screw installed in end of pedal shaft, align support brackets and pedal shaft holes. Remove screw from end of pedal shaft.
- e. Install bracket (13, fig 6-12) and secure to shaft with screw (12) and lock washer (11). Secure end of shaft with screw (11, fig 8-3) and lock washer (12).
- f. If previously removed, install sleeve (10 fig, 6-in transmission inching valve.
- g. Depress treadle assembly (20) slightly and install spring (9) and pin (8) in sleeve (10).
- h. Connect inching pedal spring (19) and brake pedal spring (4, fig. 8-3)
- i. Install master cylinder clevis on pedal shaft and secure with clevis pin and cotter pin.
- j. Install plate assembly (1, fig 6-12), toe plates and floor plates (TM 10-3930-621-12).

**6-23. Adjustment**

Refer to, figure 6-13 and adjust inching control as follows:

- a. Remove toe plate and floor plate (TM 10-3930-621-12).
- b. Check to be sure that inching plunger is completely bottomed and that inching pedal stop presents inching plunger from piercing back of control valve before making any adjustment.
- c. Adjust return spring to length specified on figure 6-13. If toe plate touches the return spring, the spring anchor (17, fig. 6-12) must be removed one bolt down on the transmission housing.
- d. Adjust inching pedal stop so plunger spring is compressed 0.09 to 0.12 of an inch.
- e. With the brake pedal against the brake pedal stop. set adjusting screw for 0.06 to 0.25 gap between brake pedal lug and lock.
- f. To check adjustments, raise drive wheels off the floor and bring the engine to a high idle. Shift into FORWARD or REVERSE. The inching pedal plunger should not move forward. If it does, repeat operations d and e above.
- g. To check transmission output, engine should approach stall when parking brake is locked, throttle is at low idle, and engine is in gear.
- h. Install toe plate and floor plate (TM 10-3930-621-12).

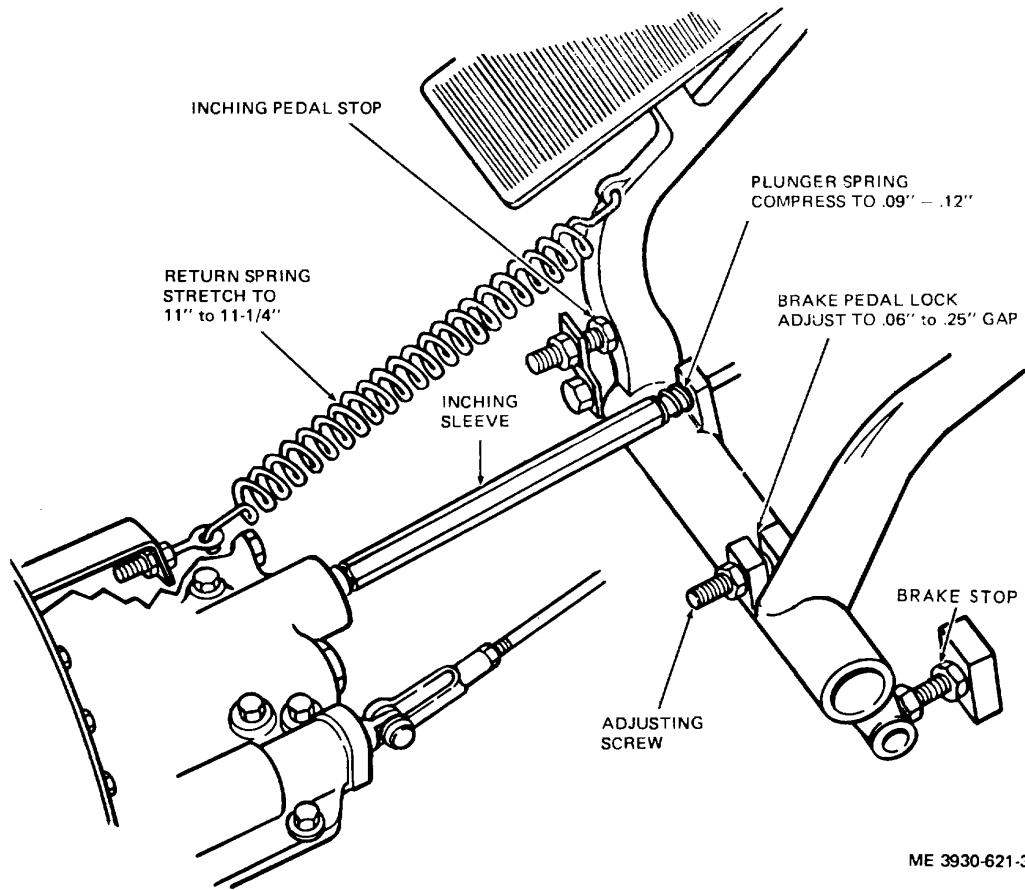


Figure 6-13. Inching control adjustment

CHAPTER 7

AXLE REPAIR INSTRUCTIONS

Section I. DRIVE AXLE ASSEMBLY

**7-1. Description**

The drive axle assembly consists of a differential assembly, two axle shafts, and two spindles (fig. 7- 1). The axle shafts connect the differential assembly (first reduction) and the bull gear (second reduction) in the drive wheel. The drive wheel rotates around a spindle,

which is mounted to the axle housing. The differential assembly consists of a carrier assembly and a case assembly. The carrier assembly is mounted at the center of the drive axle housing and supports the case assembly.

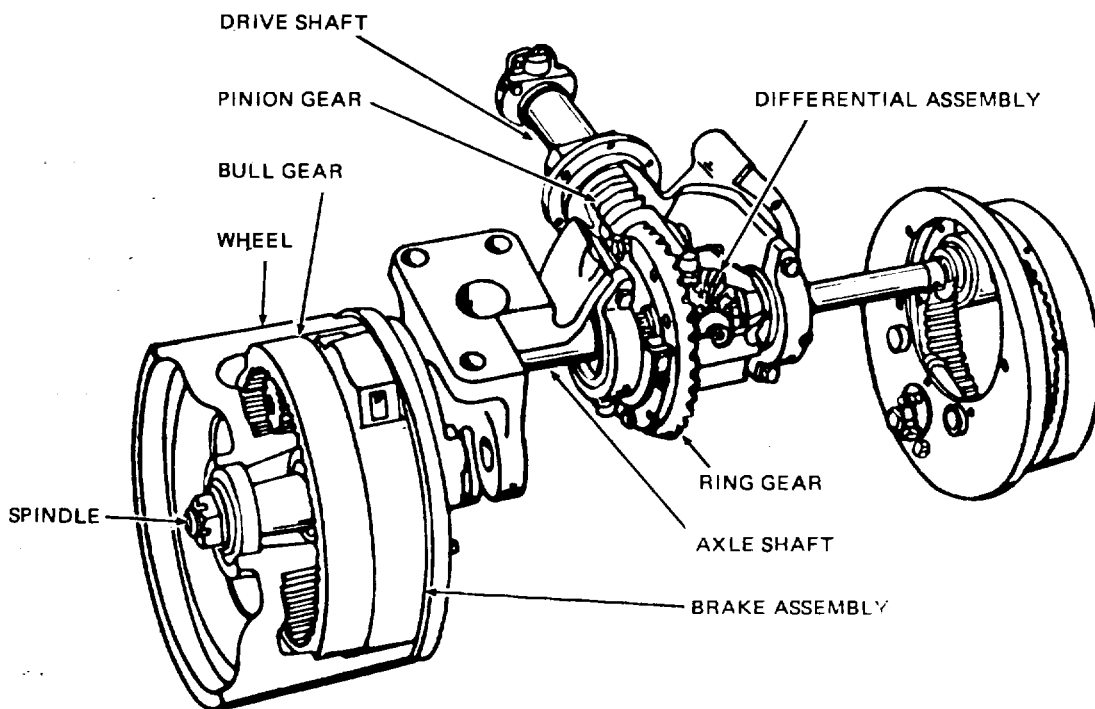
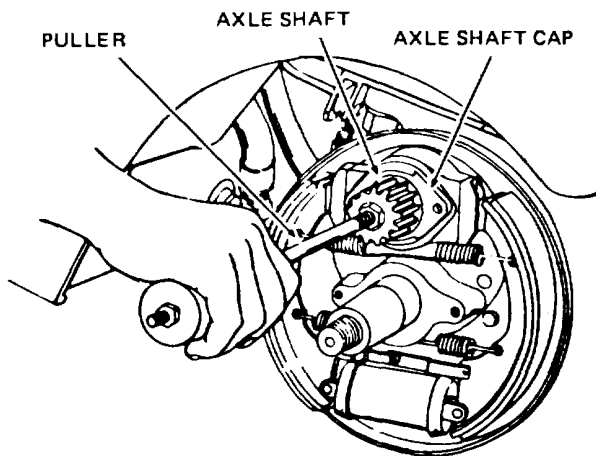


Figure 7-1. Drive unit

**7-2. Axle Shaft**

*a. Removal and Disassembly.*

- (1) Remove drive wheel (TM 10-3930-621-12).
- (2) Remove screws (14, fig. 7-3) and lock washers (15) attaching dust shield (13) and remove shield.
- (3) Remove screws (17) and lock washers (18) attaching bearing retainer (19).
- (4) Install threaded puller (fig. 7-2) in threaded end of axle shaft and carefully remove shaft with bearing cap and bearing attached.



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Figure 7-2. Pulling axle shaft.

- (5) Straighten locking prongs on, key washer (24, fig. 7-3).
- (6) Remove nut (25) and slide washers (23 and 24) from axle shaft (16).
- (7) Using suitable press, remove bearing cone assembly (21) and cup (22) from shaft.

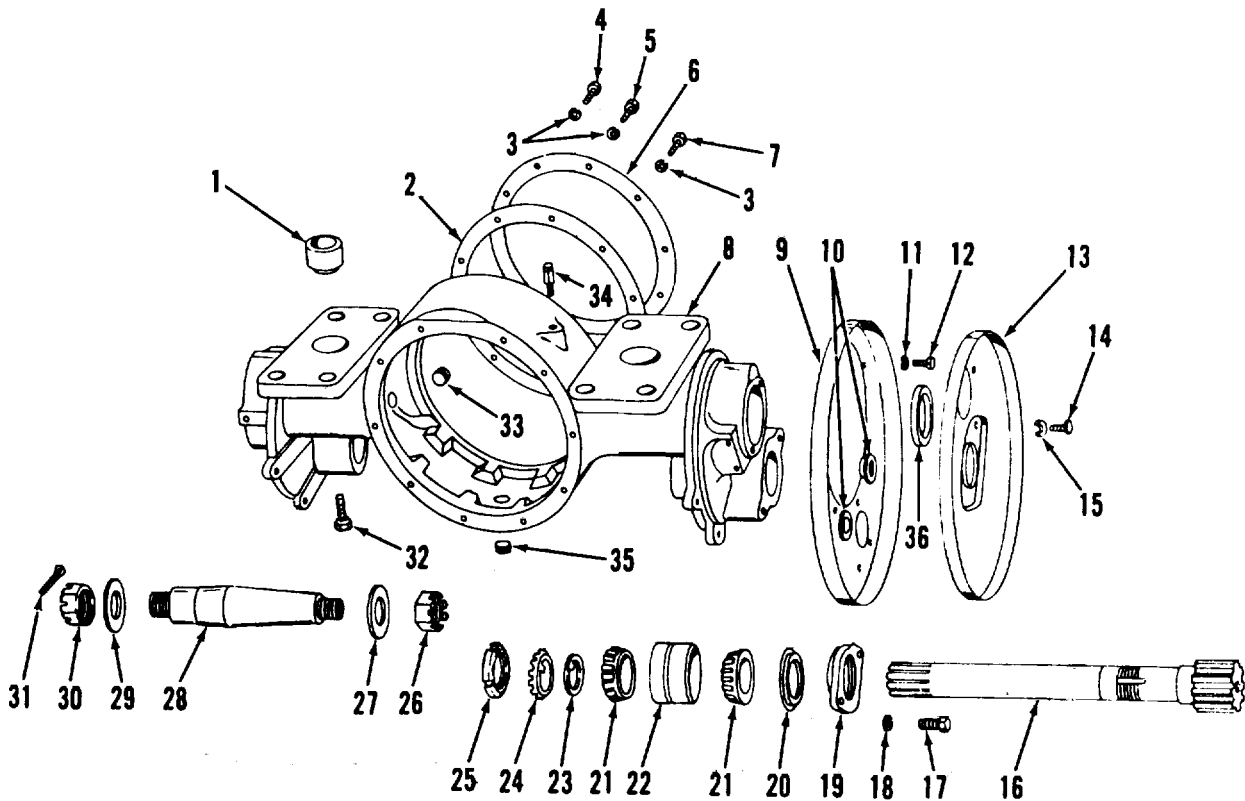
- (8) Remove oil seal (20) and retainer (19) from shaft. Discard oil seal.

*b. Cleaning, Inspection, and Repair.*

- (1) Clean all parts with cleaning compound, solvent (Spec. P-S-661). Dry thoroughly with compressed air.
- (2) Inspect all parts for excessive wear or damage.
- (3) Replace oil seal. Replace other worn or damaged parts as authorized.
- (4) Grease bearings and shaft pinions (TM 10-3930-621-12).
- (5) Refer to paragraph 1-4 for Repair and Replacement Standards.

*c. Assembly and Installation.*

- (1) Refer to figure 7-3 and assemble and install axle shaft as follows:
  - (2) Slide retainer (19), new oil seal (20), and greased bearing assembly (21 and 22) on axle shaft (16).
  - (3) Aline keyed washers (23 and 24) with groove in shaft (16) and slide into position on shaft.
  - (4) Tighten nut (25) on shaft until the bearing cup (22) binds slightly when rotated.
  - (5) Back nut (25) off one locking position and secure nut in this position by bending the key of washer (24) into the slots of nut (25).
  - (6) To assure that cone assembly (21) backs up to keyed washer (23), hold bearing cup (22) in a fixed position and tap the splined end of the axle shaft (16) with a wooden mallet.
  - (7) Check cone assembly (21) for free rotation without drag.
- Note.* A slight amount of end play (0.005 of an inch maximum) is permissible.
- (8) Position axle shaft (16) in housing (8) against differential. Aline splines and, using a soft mallet, drive axle shaft splines into differential.
- (9) Install retainer (19) to drive housing (8) and secure with lock washers (18) and screws (17).
- (10) Install dust shield (13) with lock washers (15) and screws (14).
- (11) Install drive wheel (TM 10-3930-621-12).



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- |                 |                                   |                   |
|-----------------|-----------------------------------|-------------------|
| 1. Pin          | 13. Dust shield                   | 25. Nut           |
| 2. Gasket       | 14. Screw                         | 26. Nut           |
| 3. Lock washer  | 15. Lock washer                   | 27. Grease shield |
| 4. Bolt         | 16. Axle shaft                    | 28. Spindle       |
| 5. Bolt         | 17. Screw                         | 29. Flat washer   |
| 6. Cover        | 18. Lock washer                   | 30. Nut           |
| 7. Screw        | 19. Bearing retainer              | 31. Cotter pin    |
| 8. Housing      | 20. Oil seal                      | 32. Bolt          |
| 9. Plate        | 21. Cone assembly                 | 33. Plug          |
| 10. Plug        | 22. Bearing cup                   | 34. Breather      |
| 11. Lock washer | 23. Keyed washer                  | 35. Plug          |
| 12. Bolt        | 24. Keyed, external tooth, washer | 36. Oil seal      |

Figure 7-3. Drive axle housing and shaft, exploded view.

### 7-3. Spindle

#### a. Removal

(1) Remove drive wheel assembly (TM 10-3930-621-12).

(2) Refer to figure 7-3 and remove spindle from housing as follows:

(3) Remove screws (14, fig. 7-3) and lock washers (15) attaching dust shield (13) and remove shield.

(4) Loosen self-locking nut (26) approximately three turns.

(5) Install suitable puller (fig. 7-4) and remove spindle (28) from axle part away until spindle is loose in housing.

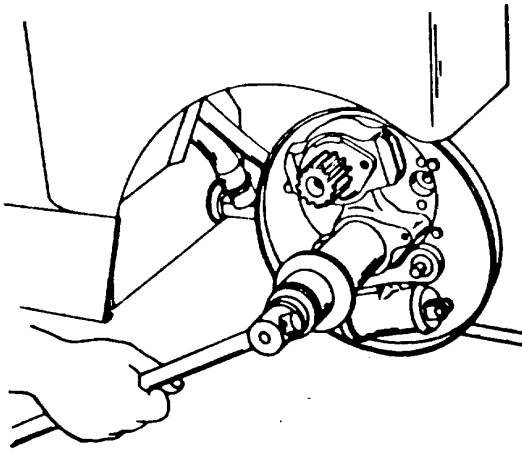


Figure 7-4. Removing spindle

(6) Remove self-locking nut and grease shield (27) from spindle. Using puller, pull spindle from axle.

#### b. Cleaning, Inspection, and Repair.

(1) Clean all parts with cleaning compound, solvent (Spec. P-S-661). Dry thoroughly with compressed air.

(2) Inspect spindle and attaching parts for damage.

(3) Replace damaged parts as authorized.

(4) Refer to paragraph 1-4 for Repair and Replacement Standards.

#### c. Installation.

(1) Refer to figure 7-3 and install spindle as follows:

(2) Align spindle (28) in housing (8) and secure it to inside of housing with washer (27) and self-locking nut (26). Tighten nut until spindle is completely seated in axle.

(3) Install dust shield (13) and secure with lock washers (15) and screws (14).

(4) Install drive wheel (TM 10-3930-621-12).

### 7-4. Differential Assembly

#### a. Disassembly.

(1) Remove drive wheel assemblies (TM 10-3930-621-12).

(2) Remove axle shafts (para 7-2 a) and drain lubricant from axle housing.

(3) Remove cover mounting bolts (4 and 5, fig. 7-3), screw (7), and lock washers (3).

(4) Remove housing cover (6) and gasket (2). Discard gasket.

(5) Refer to figure 7-6 and disassemble carrier assembly as follows:

(a) Mark caps and axle housing to provide identification for proper installation.

(b) Remove bolts (25), screws (22), lock washers (24) and lock (23) from carrier. Remove bearing caps from carrier.

(c) Remove differential assembly (27) with attached adjusting nuts, bearings, and bearing cups (fig. 7-5) and place in clean area for further disassembly.

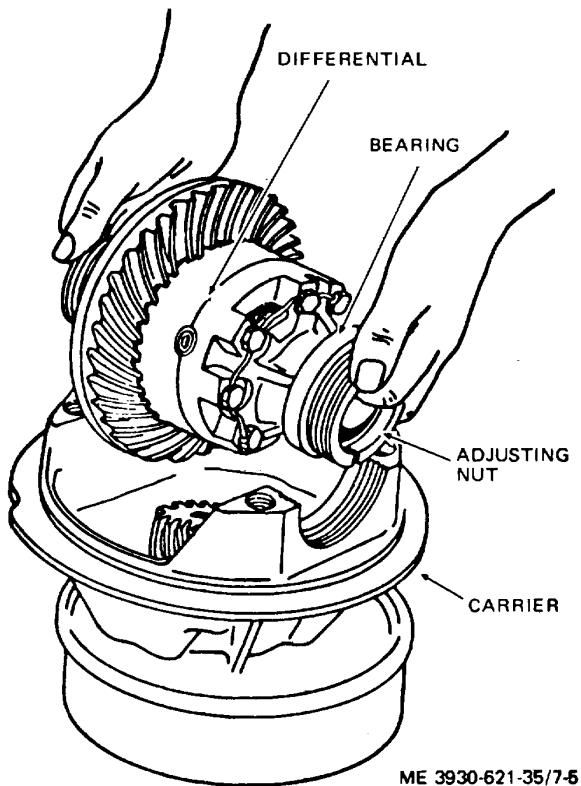


Figure 7-5. Removing differential from carrier.

KEY to fig. 7-6:

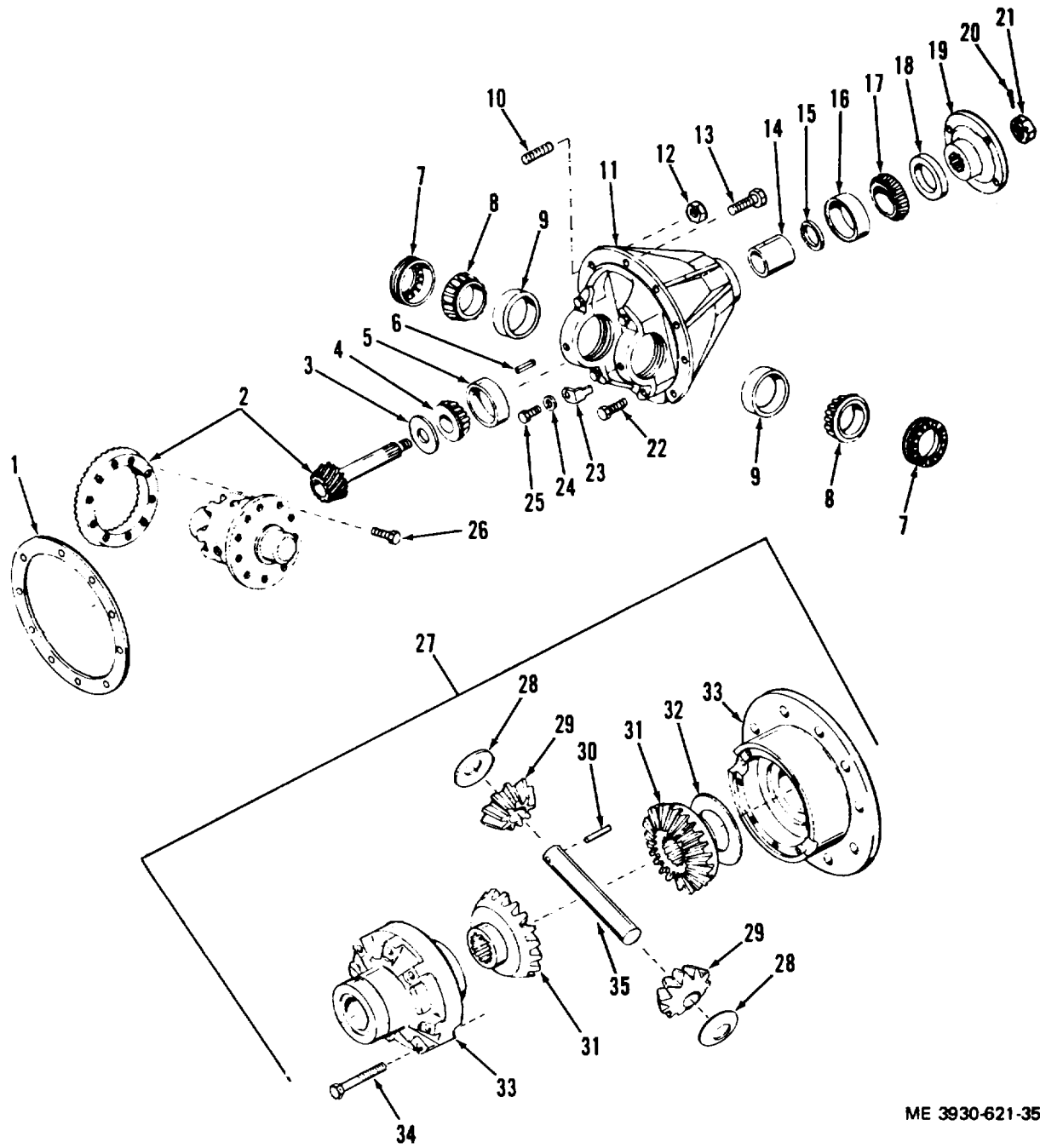
- |                       |                           |
|-----------------------|---------------------------|
| 1. Gasket             | 19. Flange                |
| 2. Gear assembly      | 20. Cotter pin            |
| 3. Front shim(s)      | 21. Nut                   |
| 4. Front bearing cone | 22. Screw                 |
| 5. Front bearing cup  | 23. Adjusting nut lock    |
| 6. Pin                | 24. Lock washer           |
| 7. Adjusting nut      | 25. Bolt                  |
| 8. Side bearing cone  | 26. Screw                 |
| 9. Side bearing cup   | 27. Differential assembly |
| 10. Stud              | 28. Thrust washer         |
| 11. Carrier           | 29. Pinion gear           |
| 12. Nut               | 30. Pin                   |
| 13. Bolt              | 31. Side gear             |
| 14. Spacer            | 32. Thrust washer         |
| 15. Rear shim(s)      | 33. Case assembly         |
| 16. Rear bearing cup  | 34. Screw                 |
| 17. Rear bearing cone | 3.5. Cross pin            |
| 18. Oil seal          |                           |

- (d) Disconnect drive shaft from parking brake drum.
- (e) Disconnect linkage from parking brake lever.
- (f) Disassemble parking brake assembly (TM 10-3930-621-12), removing it from pinion shaft flange (19).
- (g) Remove cotter pin (20) and slotted nut (21) from end of pinion shaft flange (19).
- (h) Press gear assembly pinion (2) from flange (19) and remove it from carrier (11).
- (i) Remove oil seal (1\*), rear bearing cone (17), rear shims (15) and spacer (14). Discard oil seal.

*Note.* If carrier housing is to be used again, do not lose or damage shims. Bearing cones may be removed using brass drift and hammer.

- (j) Remove front bearing cone (4) and front shims (3) from gear assembly pinion shaft (2).
- (k) Press bearing cups (5 and 16) from carrier (11).
- (l) Remove screws (26) attaching gear assembly ring gear (2) to flanged case half (33). Remove ring gear from differential assembly (21).





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Figure 7-6. Differential assembly, exploded view.

(6) Refer to figure 7-6 and disassemble differential assembly (27) as follows:

(a) Remove adjusting nuts (7) and, using bearing puller, remove side bearing cones (8) from case halves (33).

(b) Remove side bearing cups (9).

(c) Remove screws (34) holding case halves (33) together and remove plain case half. Note. One case half is flanged and the other plain. Case halves must be marked for proper assembly.

(d) Remove pin (30), pinion gear thrust washers (28), and pinion gears (29) from cross pin (35).

(e) Remove side gear thrust washers (32), side gears (31), and cross pin (35).

(7) Remove carrier attaching nuts (12), threaded to axle housing studs (10), and self-locking bolts (13).

(8) Remove differential carrier (11) from axle housing. Discard carrier gasket (1). b. Cleaning, Inspection, and Repair.

(1) Clean all parts with cleaning compound, solvent (Spec. P-S-661). Dry thoroughly with compressed air.

(2) Inspect all parts for cracks, chips, excessive wear or other damage.

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

(4) Replace all oil seals and gaskets. Replace all other parts as authorized.

(5) Refer to paragraph 1-4 for Repair and Replacement Standards.

c. Assembly and Adjustment.

(1) Refer to figure 7-6 and assemble differential assembly as follows:

(2) Assemble differential assembly (27) as follows:

(a) Position cross pin (35), side gears (31), and side gear thrust washers (32) in flanged case half.

(b) Install pinion gears (29), pinion gear thrust washers (28), and pin (30) on cross pin (35). Check for proper gear mesh.

(c) Aline plain and flanged case (33) match marks and joint cases with screws (34).

(d) Press side bearing cups (9) and side bearing cone (8) in both halves of case (33) and install, but do not tighten, adjusting nuts (7). (3) Assemble and adjust carrier assembly as follows:

(a) Install gear assembly ring gear (2) on flanged case half (33) and secure with screws (26).

(b) Press bearing cups (5 and 16) into carrier (11). Be sure they are firmly seated.

(c) Install front bearing cone (4) on gear assembly pinion shaft (2).

(d) Install shaft with bearing cone in carrier, firmly seating front bearing cone (4) in its cup (5).

(e) Install rear bearing cone (17) on gear assembly pinion shaft (2), firmly seating rear bearing cone in its cup (16).

(f) Press pinion flange (19) on shaft (2) and secure with slotted nut (21). Torque nut to 15 to 25 inch-pounds and spin gear to seat bearings.

(g) Position differential assembly (27) on carrier housing.

(h) Using feeler gage, check dimension between face of pinion gear (2) and outside diameter of the case (33). Tolerance for pinion etched with 0.000 is 0.154 to 0.158 of an inch. Tolerance for pinion etched with 0.004 is 0.158 to 0.162.

(i) Determine difference between feeler gage dimension and required dimension as stated in (h) and make up a compressed shim pack, consisting of an equal amount of rear shims (15) and front shims. Measure compressed pack with micrometer.

(j) Remove differential assembly (27) and pinion shaft (2) from carrier (11).

(k) Remove bearing cones (4 and 17) from shaft (2).

(l) Install front shim pack (3) on shaft next to pinion gear, press on front bearing cone (4), and install assembly in carrier.

(m) Install new oil seal (18), rear bearing cone (17), rear shim pack (15), and spacer (14) on pinion shaft (2).

(n) Torque slotted nut (21) to 15 to 25 inch-pounds and install cotter pin (20).

(o) Position case assembly on carrier and recheck dimensions per operation (h) above.

(4) Install and adjust case assembly in carrier as follows:

(a) Position case assembly on carrier engaging ring gear and pinion (2), and install, but do not tighten bearing caps.

**Caution: Side bearing cups(9) must be in original position and caps must be installed as marked.**

(b) Using a dial indicator and spanner tool on adjusting nut as illustrated in figure 7-7, adjust ring gear laterally for a backlash of 0.005 to 0.010 of an inch. To increase backlash, loosen adjusting nut nearest ring gear, and tighten the one opposite. To decrease backlash, reverse operation.

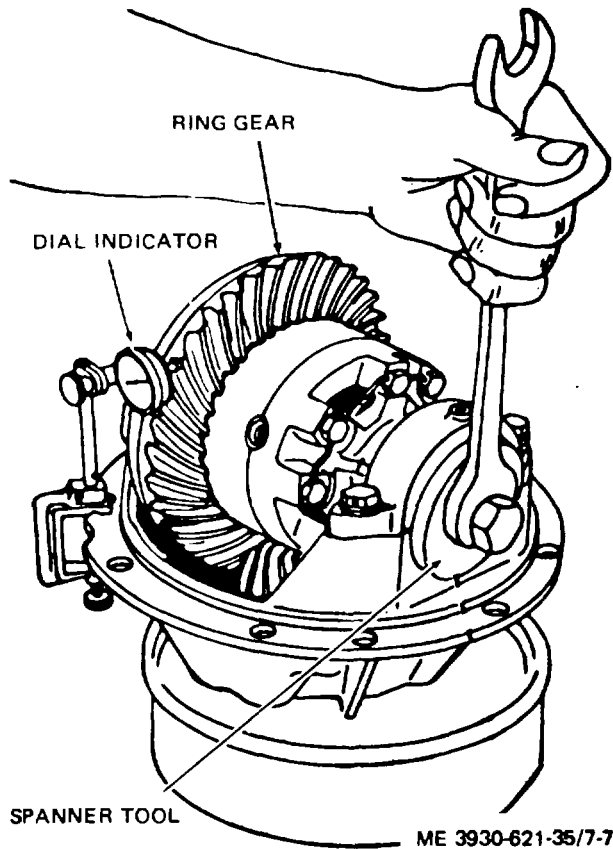


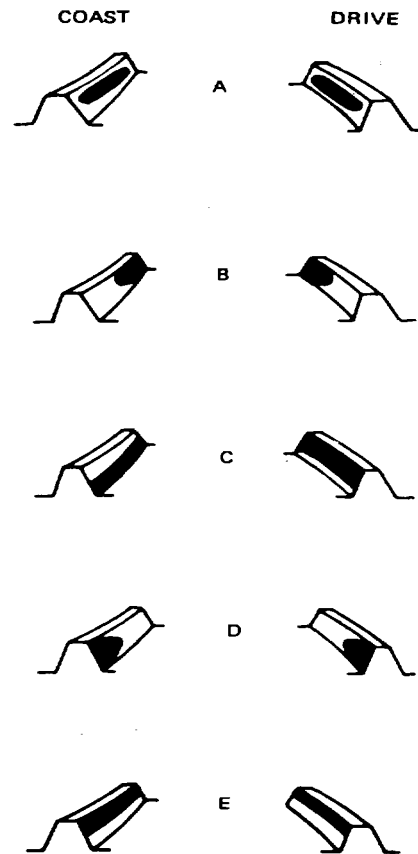
Figure 7-7. Adjusting backlash line.

(c) Coat entire ring gear with Prussian Blue or white lead.

(d) Rotate ring gear (2) several times, holding back on pinion to create load effect.

(e) Inspect teeth of pinion and compare with figure 7-8. Tooth bearing should start 1 / 32 to 1 / 16 of an inch from the top of the tooth and continue down to an equivalent distance from the bottom of the tooth.

Note. Do not be concerned about the amount of paint removed. This will vary with load applied.



A - CORRECT ADJUSTMENT.

B - HEAVY CONTACT ON TOE OF TOOTH. TO CORRECT MOVE RING GEAR AWAY FROM PINION. MOVE PINION TOWARDS RING GEAR TO AGAIN SECURE CORRECT BACKLASH.

C -- BEARING TOO LOW. HEAVY CONTACT ON FLANK OF TOOTH. TO CORRECT THIS MOVE PINION AWAY FROM RING GEAR UNTIL CONTACT COMES TO FULL WORKING DEPTH OF GEAR TOOTH WITHOUT BREAKING CONTACT AT FLANK. MOVE RING GEAR TOWARDS PINION TO SECURE PROPER BACKLASH.

D -HEAVY CONTACT AT HEEL OF TOOTH. TO CORRECT MOVE RING GEAR TOWARDS PINION. MOVE PINION AWAY FROM GEAR TO OBTAIN CORRECT BACKLASH.

E - SHOWS HEAVY CONTACT ON TOOTH FACE. MOVE PINI ON TOWARDS GEAR UNTIL CONTACT COVERS FLANK OF TOOTH WITHOUT BREAK- ING CONTACT AT FACE. MOVE GEAR AWAY FROM PINION TO SECURE CORRECT BACKLASH.

Figure 7-8. Differential gear tooth patterns.

(f) Secure caps with lock (23), lock washers (24) and screws (22 and 25).

(5) Position new gasket (1) on mounting flange of axle housing and coat with a leak proof adhesive.

(6) Aline carrier housing stud holes with studs (10) on axle housing. Proper alinement will prevent damage to the threaded studs.

(7) Install carrier (11) on axle housing and

secure with self-locking bolts (13) and nuts (12).

(8) Install new housing cover gasket (2, fig. 7- 3) and secure drive axle housing cover (6) to housing (8) with bolts (4 and 5), screws (7) and lock washers (3).

(9) Install axle shafts (para 7-2 c)and lubricate (TM 10-3930-621-12)

(10) Install drive wheel assemblies (TM 10- 3930-621-12).

## Section II. STEERING AXLE

### 7-5. Description

The cruciform, trunnion mounted steering axle is mounted in lubricated self-alining sleeve bearings. A hydraulically operated control unit pivots an arm that moves tie rods connected to the spindles, on which the steering wheels are mounted.

### 7-6. Removal

a. Refer to figure 7-9 and remove axle as follows:

b. Raise rear end of truck with suitable hoist to a height at which access can be obtained to the steering axle. Support in this position with blocks or other authorized safe means.

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

d. Disconnect steering cylinder (TM 10-3930- 621-12) from ball stud on pivot arm (40) by removing cotter pin at end of cylinder yoke assembly and loosening adjusting plug.

e. Remove screws (31) lock washers (30), and nuts (29) attaching bearing housings (12) to trunnion blocks.

f. Slowly lower axle assembly, with tie rods attached, to ground.

g. Remove bearing housings from axle.

### 7-7. Disassembly

a. Refer to figure 7-9 and disassemble axle as follows:

b. Remove and disassemble both tie rod assemblies (1) as follows:

(1) Remove cotter pin (20), nut (21), and flat washer (19) from bottom of tie rod end (10).

(2) Remove cotter pin and loosen adjusting plug (2).

(3) Remove tie rod assemblies (1).

(4) Remove adjusting plug (2), ball seat (3), spring (4) from tie rods (7).

(5) Slip cover (11) from tie rod end (10).

(6) Loosen jam nut (8) on tie rod end (10) and remove tie rod end from tie rods (7).

(7) Remove lubrication fittings (6 and 9) from rods (7) and tie rod end (10).

c. Disassemble bearing housing (12) as follows:

(1) Remove bolts (35), lock washers (33), flat washers (34), and shims (32) from bearing housing (12). Tag and count number of shims for correct installation.

(2) Remove spacers (36) and bearings (28) from housing.

(3) Remove lubrication fitting (37) from top of housing.

d. Remove pivot arm (40) from steering axle (43) as follows:

(1) Remove nut (27), washer (26) and bearing cone (25).

(2) Remove pivot arm (40) from axle and bearing cup (42) and remove bearing cone (41) from pivot arm (40).

(3) Remove bearing cups (24 and 42) and retaining ring (23) from axle if replacement is necessary.

(4) Remove lubrication fitting (39). e. Remove king pins (14) and spindles (18 and 38) as follows:

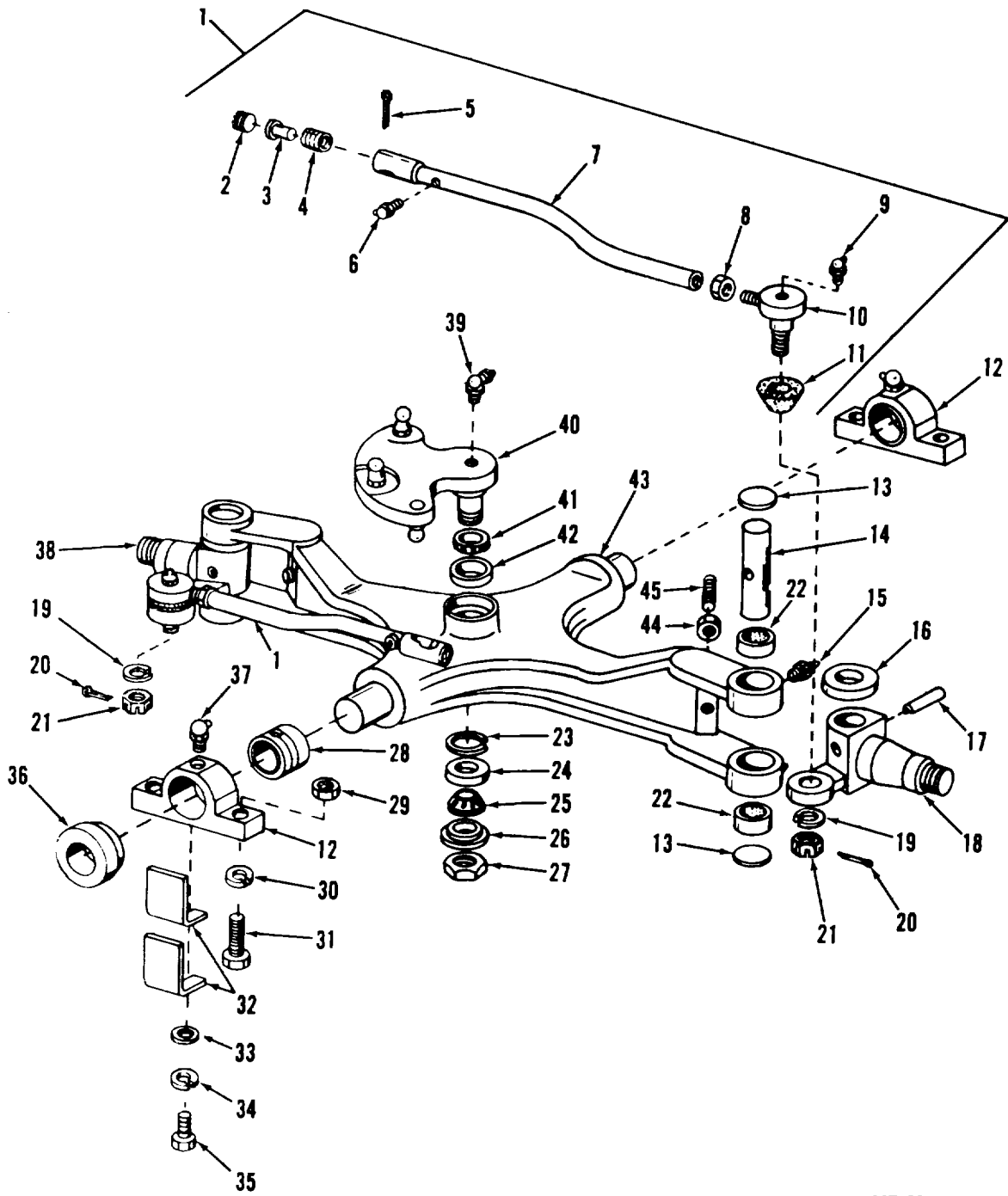
(1) Remove expansion plugs (13J).

(2) Remove pins (17) and tap king pins (14) from spindles (18 and 38).

(3) Remove spindles (18 and 38) from axle. Remove four nylon thrust washers (16).

(4) Press out needle bearings (22) from axle.

(5) Remove lubrication fitting (15).



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Figure 7-9. Steering axle, exploded view.

KEY to fig. 7-9:

- |                         |                    |                         |
|-------------------------|--------------------|-------------------------|
| 1. Tie rod assemblies   | 17. Spring pin     | 33. Lock washer         |
| 2. Adjusting plug       | 18. Right spindle  | 34. Flat washer         |
| 3. Seat                 | 19. Flat washer    | 35. Bolt                |
| 4. Spring               | 20. Cotter pin     | 36. Spacer              |
| 5. Cotter pin           | 21. Slotted nut    | 37. Lubrication fitting |
| 6. Lubrication fitting  | 22. Needle bearing | 38. Left spindle        |
| 7. Tie rods             | 23. Retaining ring | 39. Lubrication fitting |
| 8. Jam nut              | 24. Bearing cup    | 40. Pivot arm           |
| 9. Lubrication fitting  | 25. Bearing cone   | 41. Bearing cone        |
| 10. Tie rod ends        | 26. Washer         | 42. Bearing cup         |
| 11. Cover               | 27. Nut            | 43. Axle                |
| 12. Housing             | 28. Bearing        | 44. Nut                 |
| 13. Expansion plug      | 29. Nut            | 45. Setscrew            |
| 14. King pin            | 30. Lock washer    |                         |
| 15. Lubrication fitting | 31. Screw          |                         |
| 16. Thrust washer       | 32. Shim(s)        |                         |

**7-8. Cleaning, Inspection, and Repair**

- a. Clean all parts with cleaning compound, solvent (Spec. P-S-661).
- b. Inspect all moving parts, bearings, and attaching parts for wear, corrosion or other damage.
- c. Worn or deteriorated parts must be replaced as authorized.

**7-9. Assembly**

- a. Refer to figure 7-9 and assemble and install as follows:
  - b. Install king pins (14) and spindles (18 and 38) as follows:
    - (1) Install lubrication fitting (15) and needle bearings (22) in axle.
    - (2) Aline spindles (18 and 38) and thrust washers (16) in axle and tap in king pins(14).
    - (3) Aline king pins (14) in spindle (18 and 38) and tap in pins (17) to secure king pins.
    - (4) Install expansion plugs (13).
    - (5) Lubricate assembly (TM 10-3930-621- 12).
  - c. Install pivot arm (40) in axle (43) as follows:
    - (1) Install lubrication fitting (39) and pack bearing cones (25 and 41) with grease (GAA).
    - (2) Install retaining ring (23) and bearing cups (24 and 42) in axle (43), if they are removed.
    - (3) Press bearing cone (41) on pivot arm (40).
    - (4) Install pivot arm (40) in axle (43), firmly seating bearing cone (41) in bearing cup (42).
    - (5) Press bearing cone (25) into bearing cup (24) at bottom of axle.
    - (6) Slide washer (26) on pivot arm (40) and secure assembly with nut (27). To preload bearings, torque nut to 20-30 foot-pounds. Stake nut to hold in position.
    - (7) Using fitting (39), lubricate cavity with grease (TM 10-3930-621-12).

- d. Install lubrication fitting (37). bearings (28), and spacers (36) in housings (12)
- e. Lubriate housing (12) per (TM - 0-3930-621- 12).
- f. Assemble and install tie rods (7 ) as follows:
  - (1) Install lubrication fittings (6 and 9) on rods (7) and tie rod ends (10).
  - (2) Install tie rod ends (10) in rods i7) and tighten jam nuts (8).
  - (3) Install covers (11) on tic re)d ends (10).
  - (4) Install adjusting springs i4), hall seats (3) and plugs (2) in tie rods (7).
  - (5) Install tie rods on spindles 18 and 38) and pivot arm (40).
  - (6) Tighten adjusting plugs 12). then back off enough so there is some end play secure plugs with cotter pins.
  - (7) Secure tie rod ends (10) to axle with flat washers (19), nuts (21), and cotter pins (20).
  - (8) Lubricate tie rod ends (10) and rods (7) (TM 10-3930-621-12).

**7-10. Installation**

- a. Install axle assembly in place and secure bearing housings (12) to trunnion blocks with screws (31), lock washers (30), and nuts (29). Leave nuts loose.
- b. Install shims (32), same quantity and size as removed, and secure with screws (35.), lock washers (33), and flat washers (34). Tighten nuts: (29) securely.
- c. Refer to TM 10-3930-621-12: and connect steering cylinder to steering axle.

**7-11. Adjusting**

- a. Refer to TM 10-3930-621-12 for adjustment procedures.
- b. After adjustment, remove block, and lower truck to ground.

## CHAPTER 8

## BRAKE, WHEEL, AND TIRE REPAIR INSTRUCTIONS

## Section I. SERVICE BRAKE

**8-1. Description**

The hydraulic brake system is of the full floating, selfcentering, self-adjusting type which consists of a mechanically actuated master cylinder transmitting hydraulic pressure through heavy duty brake lines to wheel cylinders. The wheel cylinders are of the double-ended type, with actuating links extending from each of the cylinders. The links transmit movement from the cylinders to the brake shoes. The top of each shoe moves freely in a wear plate, while the bottom of the shoe transfers movement from the hydraulic wheel cylinders. Wear adjustment for brake linings is made automatically in normal use by the self-adjusting mechanism. The shoes are held against the brake wear plates, wheel cylinder links, and adjusting eccentrics by tension springs, which maintain the shoes in equilibrium.

**8-2. Brake Shoes**

a. Removal. Refer to TM 10-3930-621-12 for removal procedures.

b. Repair.

(1) Minor charring, dirt, or grease on brake linings (not grease soaked) should be remedied by buffing with sand paper or grinding.

(2) Clean shoes with compressed air and dry cloth to prevent damaging shoes or linings.

**Caution: Whenever handling brake shoes, be careful not to get grease or dirt on brake linings as serious damage will result.**

c. Replacement. Brake shoes employ bonded lining. When replacement becomes necessary, a similar type of lining must be installed. Replace shoes (TM 10-3930-621-12) when the following have occurred:

(1) Drums are resurfaced

(2) Lining is worn to shoe table

(3) Grease or hydraulic fluid has soaked linings, causing brakes to grab or pull to one side.

(4) Charred or burned linings.

(5) Lining scored deeply.

(6) Brake shoe table worn, twisted or out-of-round.

(7) Shoe is cracked.

d. Installation. Refer to TM 10-3930-621-12 for installation procedures.

**8-3. Brake Drum**

a. Removal and Cleaning. Refer to TM 10-3930-621-12 for removal and cleaning procedures.

b. Inspection and Repair.

(1) Check inside diameter of brake drum at 45° intervals, around circumference, using a micrometer or diameter bar and thickness gages. If diameter difference exceeds 0.010 inch or radius difference exceeds 0.005 inch, resurface drum.

(2) Examine drum for scoring or 'it, at checking. Resurface drum if score marks can be felt or any heat checking can be seen. Heat check cracks form cutting edges, which quick shave off lining surfaces.

(3) Check drums for "bell mounted" or "barrel shaped" wear by placing drum on drum lathe and advancing tool until it contacts drum at its high points. Then advance tool to contact low) points. Measure the difference and resurface the drum, if difference exceeds 0.005 inch (radius).

(4) If drum requires resurfacing, proceed as follows:

(a) Resurface in pairs

(b) Machine to same diameter

(c) Finish grind or hone to remove tool marks, which will cause rapid wear if they remain

(5) If drum does not require resurfacing, polish with fine emery cloth to remove discolorations or old lining residue.

c. Installation. Refer to TM 10-3930-2 1-12 for installation procedures.

**8-4. Wheel Cylinder**

a. Description. The hydraulic wheel cylinder houses two opposed pistons, which actuate t, t. opposed brake shoes. Pistons, rubber ('.-l, , arid springs are held in the cylinder by pressure from the brake shoes. Open ends of the cylinder are protected by rubber boots.

b. Removal. Refer to TM 10-3930-621-12 for removal procedures.

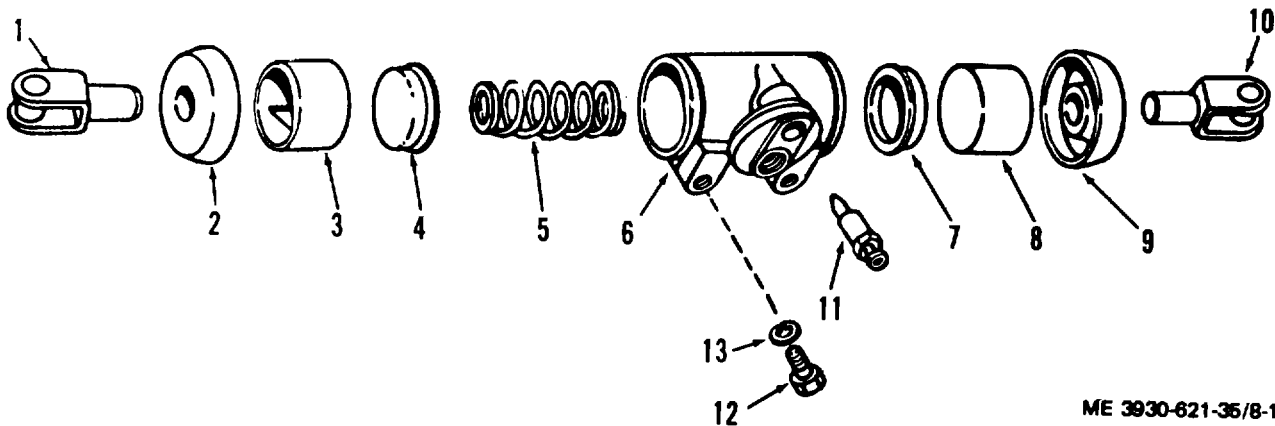
c. Disassembly.

(1) Refer to figure 8-1 and disassemble as follow-:

(2) Remove, rubber , boots (2 and 9) and ,connecting link (1 and 10) from cylinder ends.

(3) Push out pistons (3 and 8), piston cups (4 internal and 7), and spring (5) from cylinder body (6). Low pressure air at fluid inlet can also be used to remove

internal parts.  
(4) Remove bleeder (11).



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Figure 8-1. Brake wheel cylinder exploded view.

- 1. Connecting link
- 2. Boot
- 3. Piston
- 4. Piston cup
- 5. Spring
- 6. Cylinder body
- 7. Piston cup

- 8. Piston
- 9. Boot
- 10. Connecting Link
- 11. Bleeder
- 12. Capscrew
- 13. Lockwasher

d. Cleaning and Inspection.

(1) Clean all parts thoroughly and keep them clean until unit is ready for assembly. Use lint free cloth for cleaning.

**Caution: Wash parts thoroughly it denatured alcohol or clean brake fluid Never use gasoline, kerosene, paint thinner or other mineral base solvents as they will damage rubber components.**

(2) Thoroughly inspect all parts for wear, corrosion or other conditions which might impair cylinder action.

(3) Replace defective parts as authorized. e. Assembly).

(1) Refer to figure 8-1 and assemble as follows:

(2) Lubricate all parts and cylinder walls with clean brake fluid.

(3) Insert spring (5) and piston cups (4 and 7) in cylinder body.

(4) Insert each piston (3 and 8) in its respective end. Never attempt to push piston through length of cylinder.

(5) Install boots (2 and 9), being sure they are properly located in grooves provided.

f. Installation. Refer to TM 10-3930-621-12 for installation procedures.

**8-5. Master Cylinder**

a. Description. The brake master cylinder and fluid reservoir are combined in one casting, and are joined by intake and by-pass ports in the cylinder wall. Internal parts are removable through the push rod end.

b. Removal. Refer to TM 10-3930-621-12 for removal procedures.

c. Disassembly.

(1) Refer to figure 8-2 and disassemble as follows:

(2) Secure cylinder in vise, using care not to distort or crack casting.

(3) Remove boot (12) and piston rod (11).

(4) Holding piston assembly (15) in cylinder, gently pry off lockwire (13).

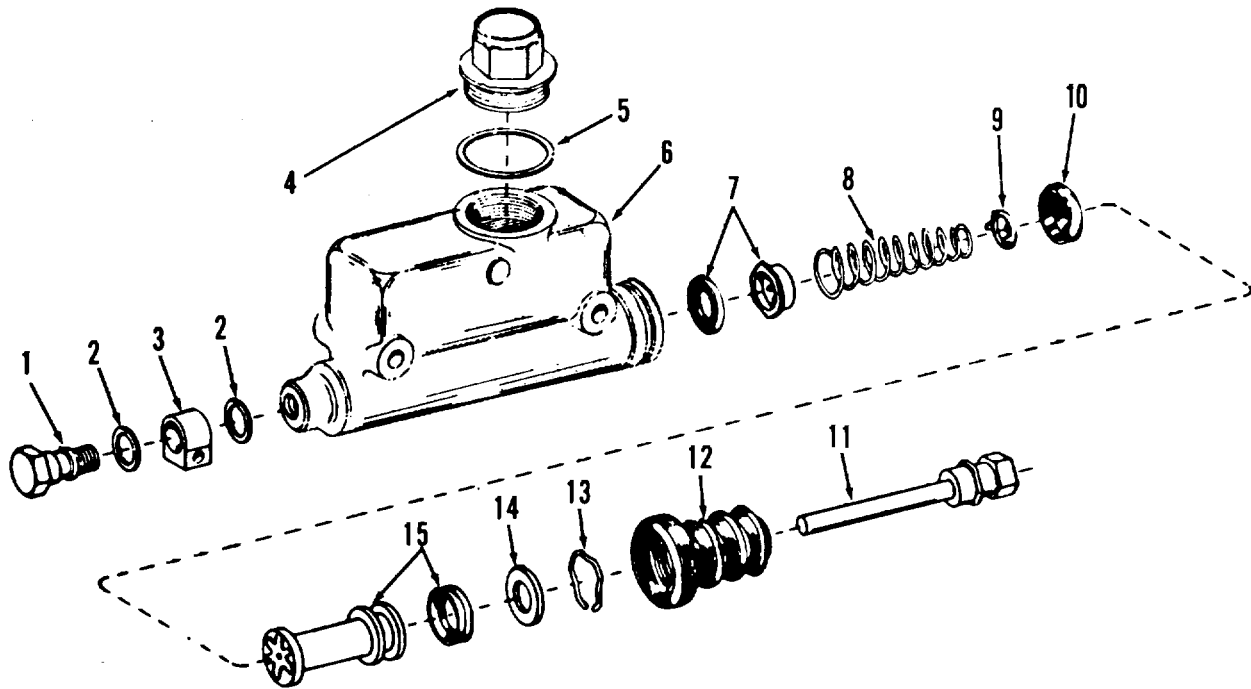
**Caution: When lockwire removed, continue holding piston in place or entire assembly will spring out.**

(5) Slowly relax hold on piston and carefully remove stop plate (14), piston assembly (15), rubber piston cup (10), retainer (9), spring (8), and check valve (7).

(6) Remove bolt (1), gaskets (2), and fitting (3).

(7) Remove filler plug (4) and gasket (5).





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Figure 8-2. Master brake cylinder exploded view

- |                      |                     |
|----------------------|---------------------|
| 1. Outlet bolt       | 9. Retainer         |
| 2. Gasket            | 10. Piston cup      |
| 3. Fitting           | 11. Piston rod      |
| 4. Plug              | 12. Boot            |
| 5. Gasket            | 13. Lockwire        |
| 6. Cylinder and tank | 14. Stop plate      |
| 7. Check valve       | 15. Piston assembly |
| 8. Spring            |                     |

d. Cleaning and Inspection.

(1) Clean all parts with denatured alcohol or brake fluid, and keep clean in all following operations.

**Warning: Dirty parts or internal rubber parts which become swollen, tacky, and otherwise deteriorated by mineral base cleaning solvents can lead to brake failure and possible injury to the operator.**

(2) Inspect cylinder bore. Deep blemishes require boring to resurface the cylinder wall. Do not bore beyond manufacturer's specifications. Pressure marks may be polished out with crocus cloth.

**Caution: Do not use emery cloth or sand paper.**

(3) Make sure intake and by-pass ports are open. By-pass ports may be probed with soft iron wire.

(4) If it is necessary to resurface the cylinder wall, use the following procedure:

(a) Coat walls of cylinder bore with hydraulic brake fluid.

(b) Secure master cylinder body in a bench vise.

(c) Using honing equipment, remove material from cylinder bore in single passes.

(d) After each pass is completed, remove hone and inspect for scratches and pitting. Remove only enough material to recondition cylinder bore. Do not hone cylinder oversize.

Note. If the master cylinder has been honed oversize or greater than 1.007 of an inch it must be replaced.

(e) Wash master cylinder body in a clean warm water and soap solution.

(f) Check to be certain intake and by-pass ports are open and free of burrs, which may damage piston cups.

(g) Final rinse cylinder in clean warm water and blow dry with compressed air. Immediately submerge master cylinder body in clean hydraulic brake fluid.

(5) Before assembly, inspect parts for corrosion, scratched or pitted piston bearing surfaces, rubber deterioration, and defective spring action.

(6) Replace worn, damaged, corroded or deteriorated parts as authorized.

(7) Replace all gaskets.

e. Assembly. Refer to figure 8-2 and assembly as follows:

(1) Lubricate parts and cylinder bore with clean brake fluid.

(2) Using new gasket (5) install plug (4) and gasket.

(3) Install fitting (3) and bolt (1) with new gaskets (2).

(4) Install check valve (7) and spring (8) with largest ends toward outlet end of cylinder. Hold in place.

(5) While holding spring in place, insert retainer (9), piston cup (10), piston assembly (15), and stop plate (14).

(6) Firmly seat lockwire (13) in groove and install boot (12) and piston rod (11).

f. Installation. Refer to TM 10-3930-621-12 for installation procedure.

**8-6. Brake Pedal.**

a. Removal Refer to paragraph 6-20 for removal procedures of brake pedal assembly (15, fig. 8-3) and associated parts.

b. Disassembly.

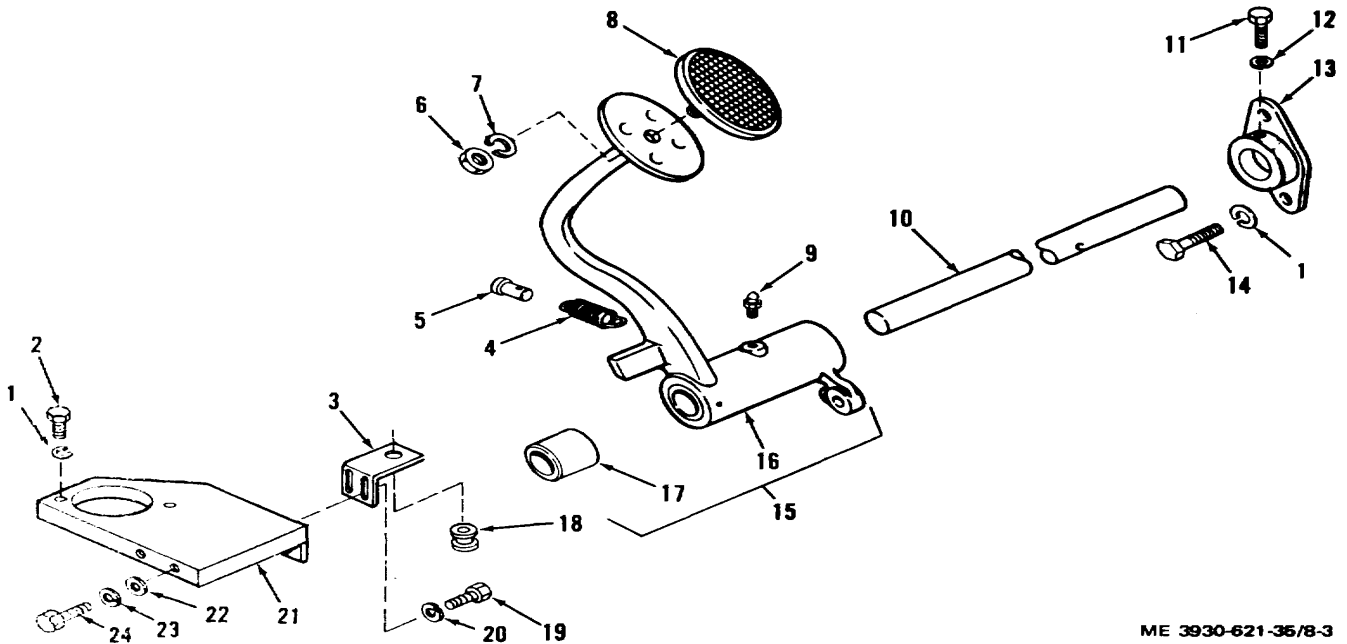
(1) Refer to figure 8-3 and disassemble as follows:

(2) Remove nut (6), lock washer (7) and pedal pad (8).

(3) Remove lubrication fitting (9).

(4) Remove bearing (17) from pedal (16).

(5) Remove steering gear support (21), brake pedal stop (3) and shaft support (13) only if necessary for repair or replacement.



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Figure 8-3. Brake pedal and associated parts, exploded view.

KEY to fig. 8-3:

- |                        |                           |
|------------------------|---------------------------|
| 1. Lock washer         | 13. Shaft support         |
| 2. Screw               | 14. Screw                 |
| 3. Stop                | 15. Pedal assembly        |
| 4. Spring              | 16. Pedal                 |
| 5. Pin                 | 17. Bearing               |
| 6. Nut                 | 18. Grommet               |
| 7. Lock washer         | 19. Bolt                  |
| 8. Pad                 | 20. Lock washer           |
| 9. Lubrication fitting | 21. Steering gear support |
| 10. Pedal shaft        | 22. Flat washer           |
| 11. Screw              | 23. Lock washer           |
| 12. Lock washer        | 24. Screw                 |

c. Inspection. Inspect all parts for damage and wear. Replace defective parts as authorized.

d. Assembly.

- (1) Refer to figure 8-3 and assemble as follows:
- (2) Press bearing (17) into pedal (16).
- (3) Install lubrication fitting (9).

(4) Install pedal pad (8) with lock washer (7) and nut (6).

e. Installation. Refer to paragraph 6-22 for installation procedures.

f. Adjustment and Lubrication. Refer to TM 10-3930-621-12 for adjustment and lubrication procedures.

**Section II. PARKING BRAKE ASSEMBLY**

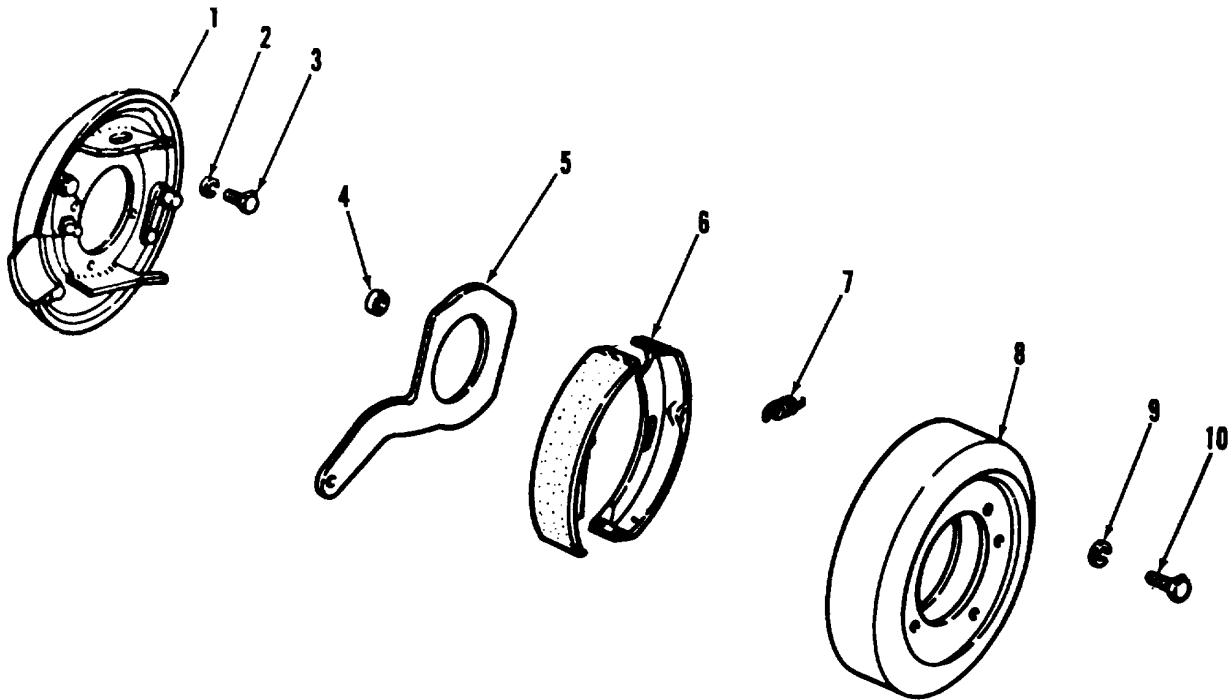
**8-7. Description**

The parking brake is a fully enclosed, two-shoe mechanical brake, mounted between the differential housing and the drive shaft. Braking action is initiated through a brake cable that rotates a lever inside a brake drum. This rotation forces the spring retained brake shoes outward; causing the lining of both shoes to contact the brake drum. When brake drum movement is stopped, differential movement is also stopped and the vehicle cannot be moved until parking brake is released.

**8-8. Disassembly**

a. Refer to figure 8-4 and disassemble as follows:

- b. Remove floor and toe plates
- c. Disconnect parking brake cable.
- d. Disconnect drive shaft from differential pinion shaft flange (para 6-3). Remove brake drum (8).
- e. Remove cam lever (5) and rollers (4) from backing plate (1).
- f. Remove brake shoe return springs (7) and slide shoe and lining assembly (6) off backing plate (1).
- g. Remove screws (3), lock washers (2), and backing plate (1) from differential carrier housing.



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- 1. Backing plate
- 2. Lock washer
- 3. Screw
- 4. Roller
- 5. Lever

- 6. Brake shoes
- 7. Spring
- 8. Drum
- 9. Lock washer
- 10. Screw

Figure 8-4. Parking brake assembly exploded view.

**8-9. Inspection**

- a. Refer to figure 8-4 and inspect as follows:
- b. Check backing plate (1) for distortion, loose or sheared rivets, and worn pawls.
- c. Check brake lining (6) for wear or grease saturated- Wear limit for parking brake lining is 0.0625 of an inch.
- d. Check brake shoes (6) for worn pawl holes, lever contact areas, or wear pads.
- e. Check brake drum (8) for cracks, scoring or other damage.
- f. Replace damaged parts as authorized.
- g. Always replace shoe return springs (7) during reassembly.

**8-10. Assembly**

- a. Refer to figure and assemble as follows:

- b. Lightly coat backing plate (1) wear pads and pawls, cam lever (5), and brake shoe (6), wear points with brake lubricant. Avoid excessive lubricant as grease soaked linings are dangerous.
- c. Attach backing plate (1) to differential carrier housing with screws (3) and lock washers (2).
- d. Slide brake shoes (6) on backing plate (1) and install return springs (7).
- e. Install cam lever (5) and rollers (4) on backing plate (1).
- f. Position brake drum (8) and install differential pinion shaft flange on drive shaft (para 6- 5).
- g. Connect parking brake cable and install floor and toe plates (TM 10-3930-621-12).
- h. Adjust parking brake cable (TM 10-3930- 621-12).

Section III. WHEEL AND TIRE ASSEMBLIES

8-11. Description

Drive wheel assemblies consists of a wheel, which serves as a brake drum, a bull gear, a tire, and inner and outer tapered roller bearings. Steering wheel assemblies contain a wheel, a tire, and inner and outer tapered roller bearings. Each wheel assembly is secured to its respective axle by a nut and cotter pin located under a hub cap.

8-12. Removal

Refer to TM 10-3930-621-12 for removal procedures or either steering or drive wheel assemblies.

8-13. Disassembly

(1) If inspection indicates replacement is necessary, remove tire (1) from wheel (4) (para 8-17).

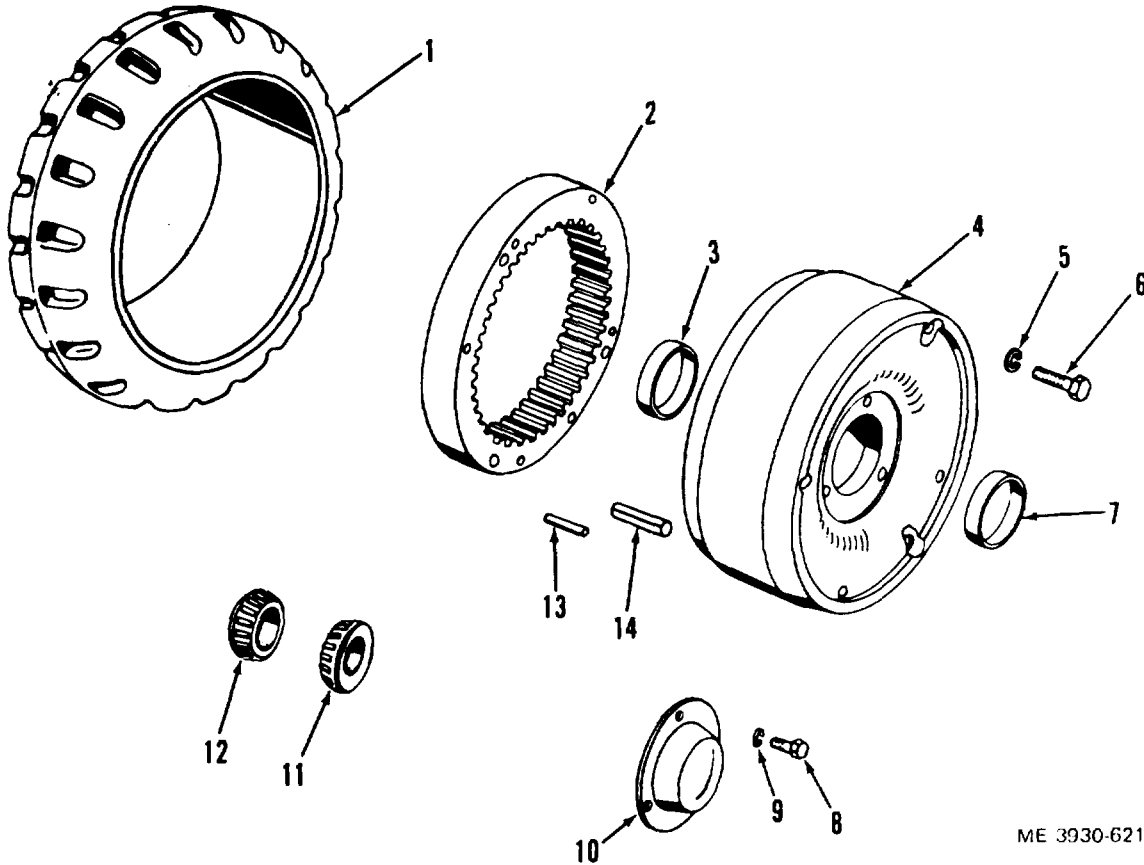
(2) Remove hub cap (10), cotter pin and wheel nut, inner bearing cone (12), outer bearing cone (11), and grease shield (TM 10-3930-621-12).

(3) Remove screws (6), lock washers (5), and bull gear (2) from wheel (4).

(4) Turn wheel (4) over, and drive bull gear (2) from wheel using same screws (6). Tighten screws evenly.

(5) Remove pins (13 and 14) from bull gear (2).

(6) Using bearing cup puller, remove bearing cups (3 and 7) from wheel (4).



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- 1. Tire
- 2. Bull gear
- 3. Inner bearing cup
- 4. Drive wheel
- 5. Lockwasher
- 6. Screw
- 7. Outer bearing cup

- 8. Screw
- 9. Lock washer
- 10. Hub cap
- 11. Outer bearing cone
- 12. Inner bearing cone
- 13. Pin
- 14. Spring pill

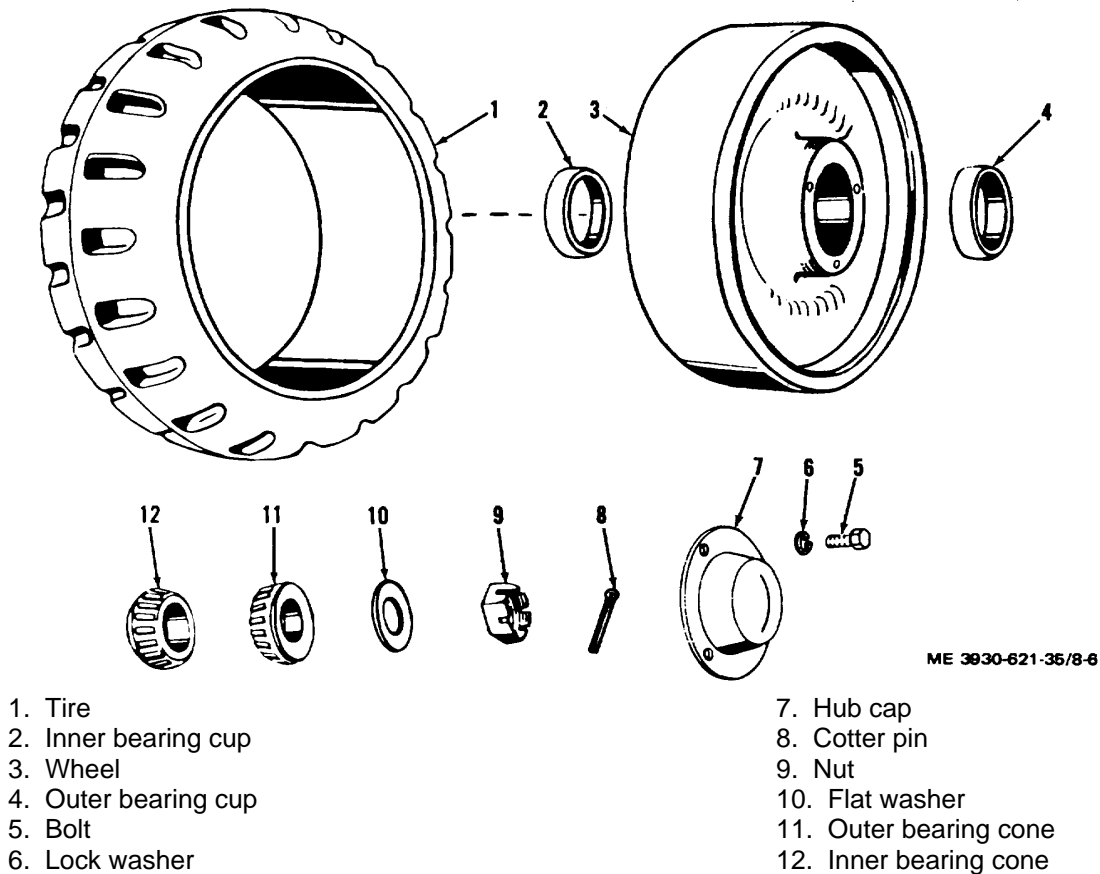
Figure 8-5. Drive wheel assembly, exploded view.

b. Steering Wheel Assembly. Refer to fig and disassemble as follows:

(1) If inspection indicates replacement is necessary, remove tire (1) from wheel (3) (para 8 17).

(2) Remove hub cap (7), cotter pin (8), wheel nut (9), washer (10), inner bearing cone (12), ax outer bearing cone (11) (TM 10-3930-621-12

(3) Using bearing cup puller, remove bearing cups (2 and 4) from wheel (3).



- 1. Tire
- 2. Inner bearing cup
- 3. Wheel
- 4. Outer bearing cup
- 5. Bolt
- 6. Lock washer

- 7. Hub cap
- 8. Cotter pin
- 9. Nut
- 10. Flat washer
- 11. Outer bearing cone
- 12. Inner bearing cone

Figure 8-6. Steering wheel assembly exploded view.

#### 8-14. Cleaning, Inspection, and Replacement

- a. Inspect tire for wear (TM10-3930-621-12) replace if necessary (para 8-17).
- b. Clean all parts with cleaning compound solvent (Spec. P-S-661). Dry thoroughly with compressed air.
- c. Inspect bearing cones and cups, wheels, bull gear for damage and excessive or uneven wear.
- d. Replace all parts as authorized.
- e. Repack bearings (TM 10-3930-621-12).

#### 8-15. Assembly

a. Drive Wheel Assembly. Refer to figure 8-5 and assemble as follows:

(1) Press bearing cups (3 and 7) in wheel hub with paper taper to outside of wheel. Tap in place evenly around edge of cup.

Caution : Pressure must be evenly distributed on cups to avoid damage and cocking.

(2) Install pins (11 and 12) in bull gear (2).

- (3) Aline pins and install bull gear (2) to wheel (4) using screws (6) from other side of wheel. Tighten screws evenly and in sequence. (4) Remove screws (6) and secure bull gear (2) to wheel (4) with screws (6) and lock washers (5) as originally installed. Torque screws to 28 to 32 foot-pounds.
- (5) Lubricate bull gear (TM 10-3930-621-12).
- (6) Install hub cap (10), cotter pin and wheel nut, inner bearing cone (13), outer bearing cone (14) and grease shield (TM 10-3930-621-12).

(7) Mount new tire (1) on wheel (4) (para 8- 17), if replacement is necessary. b. Steering Wheel Assembly. Refer to figure 8-6 and assemble as follows:

- (1) Press bearing cups (2 and 4) in wheel hub.

**Caution: Pressure must be evenly distributed on cups to avoid damage and cocking.**

- (2) Install hub cap (7), cotter pin (8), wheel nut (9), washer (10), and bearing cones (11 and 12) (TM 10-3930-621-12)}.

- (3) Mount new tire (1) on wheel (3) (para 8- 17), if replacement is necessary.

**8-16. Installation**

Refer to TM 10-3930-621-12 for installation procedures of either steering or drive wheel assemblies.

Note: Wheels must rotate freely, with no bearing end-play.

**8-17. Tire Replacement**

Refer to figure 8-7 and the following procedure for the removal:

- a. Remove wheel and tire assembly (TM 10- 3930-621-12).

- b. Check inside diameter of new tire. Remove any signs of scale or rust with sandpaper. Lubricate inside of new tire with bearing grease (GAA).

- c. Place a circular ram on the press table. The length of the ram must be greater than the width of the tire to allow complete removal of the old tire. The outside diameter of the ram must be large enough to rest squarely on the bull gear's flat surface (drive wheels) or on the flat surface provided around the wheel hub (steer wheels).

- d. If the outside edge of the wheel is not flush with the edge of the metal insert in the old tire, measure how far wheel is recessed inside the tire. New tires must be installed in the same position as the worn tire. A spacer, slightly smaller in diameter than the inside diameter of the tire and the same thickness as the depth of the recess can be used to obtain the proper amount of recess.

- e. Center worn tire and wheel assembly over ram. Be sure ram and wheel match squarely.

- f. Position new tire on top of wheel and old tire assembly. Aline new tire and the wheel and old tire assembly so that they are concentric with each other (fig. 8-7).

Note. Make certain the outside of the wheel is positioned upwards, because the outside edge of the wheel has a slight chamfer to help guide the wheel into the new tire. The tire can only be installed in one direction to prevent damage to the wheel.

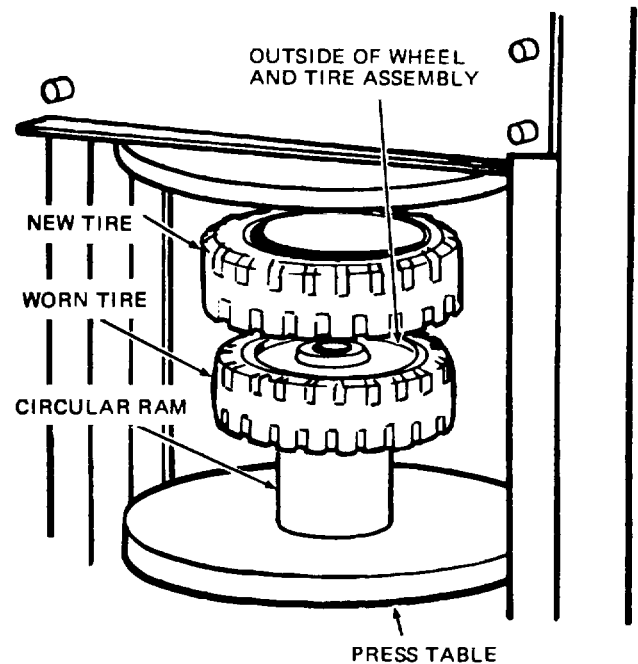


Figure 8-7. Tire positioning for replacement.

- g. Start pressing new tire on the wheel and worn tire off the wheel. Run press slowly for the first inches of travel. If tire begins to cock, stop press and realine wheel and tires. A sharp jar with a mallet will normally realine wheel and tire. If the wheel is to be recessed in the tire, stop the press after the wheel has started into the new tire and position a spacer on the inside diameter of the new tire. The spacer must rest squarely on the outer edge of the wheel. Continue pressing the new tire on wheel until tire is correctly positioned.

- h. Release press and remove tires. Inspect new wheel and tire assembly.

- i. Install new wheel and tire assembly (para 8- 15 a or 8-15 b).

## CHAPTER 9

## STEERING SYSTEM REPAIR INSTRUCTIONS

## Section I. STEERING GEAR ASSEMBLY

**9-1. Description**

The power steering system consists of a steering gear assembly, power steering cylinder (sec. II), and a steering axle assembly (ch 7, sec. II). Major components of the steering gear assembly are a wheel, shaft, and control assembly. When the wheel and shaft are turned, hydraulic fluid is ported from the control assembly, through tubing, to either the front or rear of the power steering cylinder.

**9-2. Removal**

- a. Remove floor and toe plates (TM 10-3930-621-12).
- b. Tag hydraulic hoses and disconnect from steering gear assembly. Plug hoses immediately to prevent loss of fluid or entrance of foreign material.
- c. Disconnect horn button wire at brush assembly connector (13, fig. 9-1).
- d. Remove clip at the upper part of column.
- e. Remove screws (25, fig. 8-2), lock washers (24), and flat washer (23) attaching steering gear support (22) to a bracket which is welded to the track frame.
- f. Lift steering gear assembly with support up and out of truck and place in clean working area for disassembly.

**9-3. Disassembly**

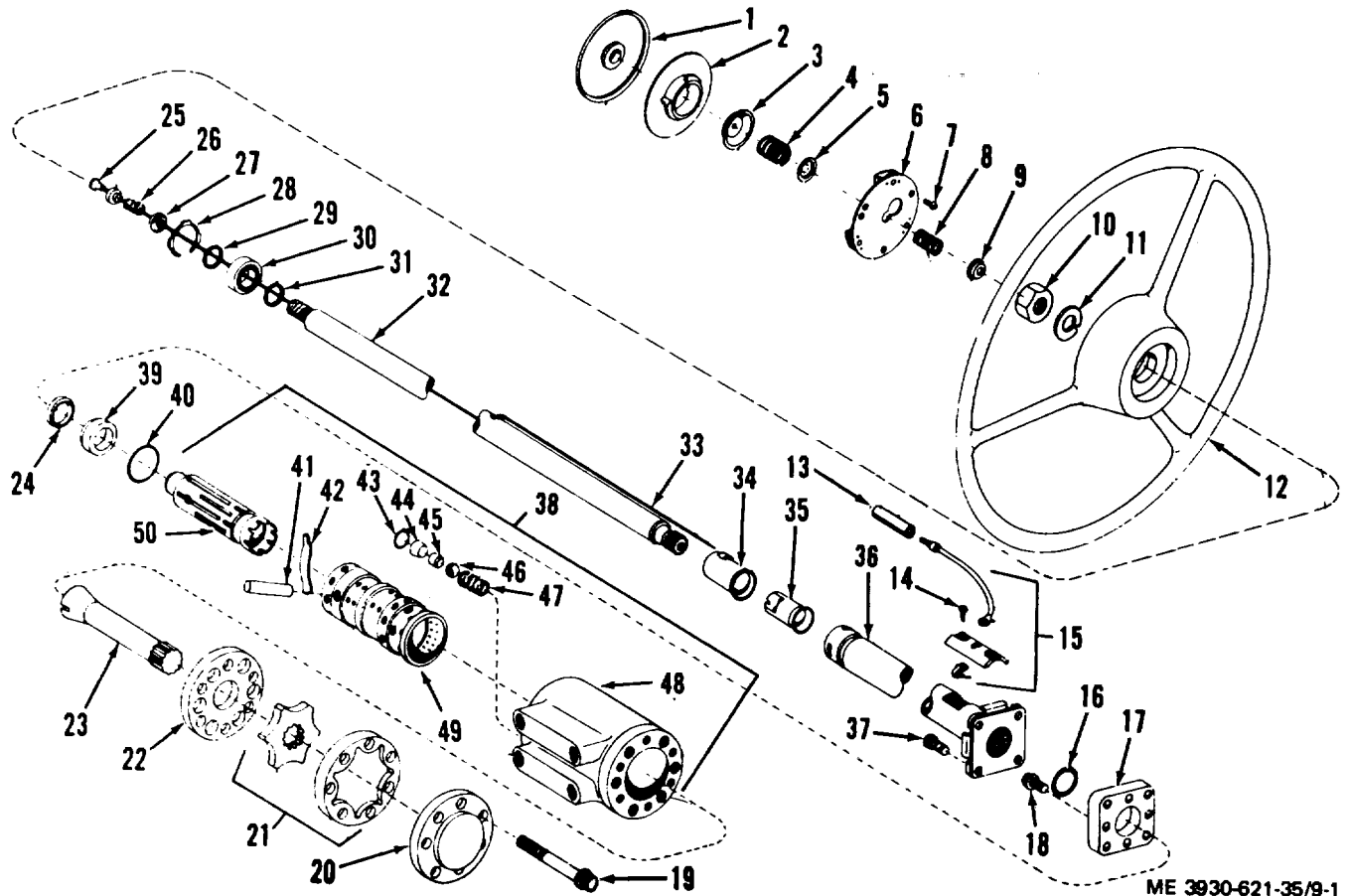
- a. General. Refer to figure 9-1 with applicable

figures when disassembling. Disassembly should proceed only as far as necessary for repair and replacement.

## b. Horn Button.

- (1) Place steering gear assembly in vise, steering wheel up.
- (2) Push down on horn button cover (1) and turn to right.
- (3) Remove horn button cover (1), button (2), contact cup (3), spring (4), and contact cap (5).
- (4) Separate horn button wire (33) from base plate (6).
- (5) Remove screws (7) from base plate (6) and remove base plate, contact spring (8), and contact washer (9).
- (6) Remove steering wheel nut (10) and lock washer (11) from steering shaft (32).
- (7) Using wheel puller, remove steering wheel (12) from shaft (32).
- (8) Remove two screws (2, fig. 8-3) and lock washers (1) attaching steering gear support (22) to steering gear assembly.
- (9) Remove steering gear support (22) with brake pedal stop (3) attached from steering column (36, fig. 9-1).





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- |                    |                    |                      |
|--------------------|--------------------|----------------------|
| 1. Horn cover      | 18. Bolt           | 35. Insulator        |
| 2. Horn button     | 19. Screw          | 36. Column           |
| 3. Contact cup     | 20. End cap        | 37. Bolt             |
| 4. Spring          | 21. Rotor          | 38. Control assembly |
| 5. Contact cap     | 22. End plate      | 39. Bushing          |
| 6. Base plate      | 23. Drive          | 40. Packing          |
| 7. Screw           | 24. Seal           | 41. Pin              |
| 8. Spring          | 25. Ferrule        | 42. Spring           |
| 9. Contact washer  | 26. Contact spring | 43. Packing          |
| 10. Nut            | 27. Contact washer | 44. Plug             |
| 11. Lock washer    | 28. Retaining ring | 45. Seat             |
| 12. Steering wheel | 29. Retaining ring | 46. Ball             |
| 13. Connector      | 30. Bearing        | 47. Spring           |
| 14. Screw          | 31. Retaining ring | 48. Housing          |
| 15. Brush assembly | 32. Shaft          | 49. Control sleeve   |
| 16. Oil seal       | 33. Wire assembly  | 50. Control spool    |
| 17. Plate          | 34. Contact ring   |                      |

Figure 9-1. Steering gear assembly, exploded view.

## c. Column.

(1) Remove screws (14), brush assembly (15), and connector (13) from column (36).

(2) Working through brush plate opening, disconnect horn wire (33) from contact ring (34).

(3) Remove horn wire (33), ferrule (25), spring (26) and washer (27) by slowly pulling wire from shaft (32).

(4) Remove retaining ring (28) from column (36) and slide shaft and bearing from column (36).

(5) Remove bearing retaining ring (29), press off bearing (30), and remove other bearing retaining ring (31) from shaft (32).

(6) Mark two bolt hole locations on column, so ports will be in proper direction when assembled.

(7) Remove column bolts (37) and column (36) from mounting plate (17).

## d. End Plate.

(1) Clamp assembly in vise with end cap (20) up and remove screws (19).

(2) Remove end cap (20), rotor (21), plate (22), and drive (23) from control assembly housing (48).

e. Control Spool Rotation. Remove control assembly (38) from vise and check for free rotation of control spool (50) and sleeve (49), using shaft (32). See figure 9-2.

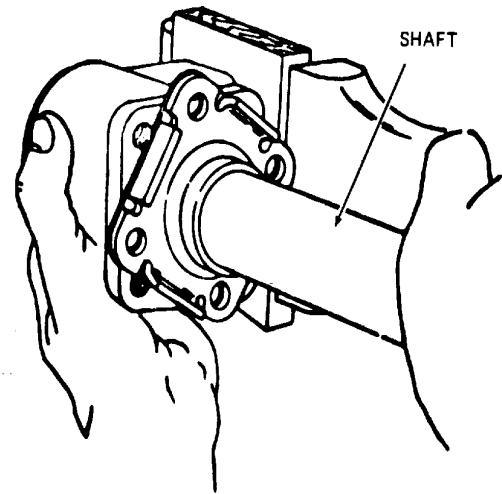


Figure 9-2. Checking control spool rotation.

f. Mounting Plate.

(1) Place wooden block across vise throat to support spool parts.

(2) Clamp control assembly (38) across port face with control end up and remove mounting plate attaching bolts (18).

(3) Hold spool assembly down against wooden block and lift off mounting plate (17).

(4) Inspect mating surfaces for obvious leakage path and wear. Remove and discard quad ring shaft seal (24) and oil seal (16) in mounting plate (17).

g. Control Assembly.

(1) Remove cap locator bushing (39), and packing (40). Discard packing.

(2) Place port face of housing (48) on a solid surface and remove control spool and sleeve from 14-hole end of housing.

**Caution: Use extreme care when removing control spool and sleeve, as they are very closely fitted and must be rotated slightly as they are withdrawn.**

(3) Using a small bent tool or wire, remove check valve seal plug (44) from housing (48) by reaching it through "out" port and pushing upwards. See figure 9-3. Remove and discard packing (43).

**Caution: Do not pry against edge of hole in housing bore.**

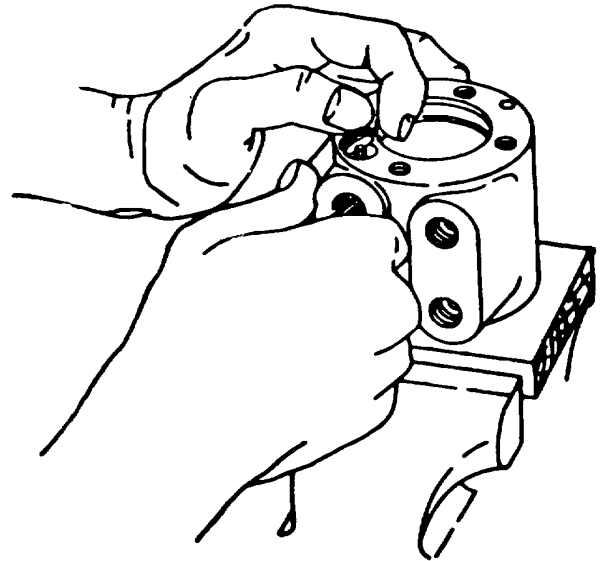


Figure 9-3. Removing check valve seal plug

(4) With housing in vise, control end up, unscrew check seat (45) with 3/16 inch hex wrench.

(5) Remove housing from vise and up end it. Tapping it lightly with palm of hand, allow check valve seat (45), ball (46), and spring (47) to fall into other hand.

(6) Remove centering pin (41) from control spool and sleeve.

(7) Push inside lower edge of spool (50) so spool moves toward splined end and remove spool carefully from sleeve (49).

(8) Push the centering spring set (42) out of spring slot in spool (50).

#### 9-4. Cleaning, Inspection and Replacement

a. Clean all parts with cleaning compound, solvent (P-S-661). Cleaning may be done during disassembly and parts set to dry on clean paper towel.

b. Inspect all moving parts to make sure they have not been scored or damaged by dirt particles. Smooth burnished surfaces are normal in many areas. Any slightly scored parts may be cleaned by hand rubbing with 600-grit abrasive paper.

c. Prepare all surfaces of control assembly for assembly as follows:

(1) Place a piece of 600-grit abrasive paper face up on a piece of plate glass or similar material.

(2) Clean the ends of the star gear first to remove any sharp grit from the paper which could produce scratches.

(3) Clean both sides of the ring gear, both sides of the plate, the 14-hole end of the housing, and the flat side of the end cap.

(4) Stroke each surface across the abrasive several times and check the results. Any small bright areas indicates a burr which must be removed. When polishing the parts, hold them as flat as possible against the abrasive. After 6 to 10 strokes across the abrasive, check the part to see if it is polished. After each part is polished, rinse clean in solvent, blow dry with air, and place it where it can remain absolutely clean until assembly. d. Replace all packing and oil seals. Replace all other parts as authorized.

#### 9-5. Assembly and Adjustment

a. General. Refer to figure 9-1 with applicable figures when assembling and adjusting.

b. Control Assembly.

(1) Install clean wooden block in vise to provide platform for assembly operations.

(2) Place housing (48) on wood platform and drop check valve spring (47) into check hole with large end down.

(3) Drop check ball (46) into check hole making sure it rests on top of small end of spring (47).

(4) Place check valve seat (45) on 3 / 16 inch hex wrench and screw into a check hole so machined counterbore of seat is towards ball (46).

(5) Lower wood platform in vise and place housing (48) on platform control end up. Clamp vise jaws lightly across housing port surface.

(6) Torque seat (45) to 150 inch-pounds and test ball (46) action by pushing against it with small, clean pin.

Note. Ball need not be snug against seat to function properly.

(7) Carefully install the spool (50) into the sleeve (49). Be sure that spring slots of both spool and sleeve are at the same end. Rotate spool carefully while sliding parts together. Test for free rotation.

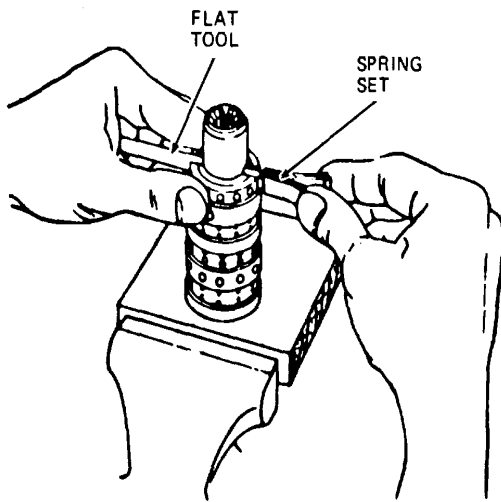
**Caution: Spool must rotate smoothly in sleeve with finger tip force applied at splined end.**

(8) Clamp wooden platform in jaws, set control spool and sleeve on platform and aline spring slots of both.

(9) Stand control spool and sleeve on end and insert a flat tool through slots of both parts.

(10) Position three pairs of centering springs (42), or two sets of three each, on bench so extended edge is down and center section is together.

(11) Install one end of positioned spring set (42) on flat tool. Compress extended end of spring set and push it into control spool and sleeve, with- drawing flat tool at same time. See figure 9-4.



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Figure 9-4. Install centering spring set.

(12) Center spring set (42), aligning each spring so the entire set is flush with upper surface of control spool and sleeve.

(13) Install the cross pin (41) through the spool and sleeve and push into place until pin is flush or slightly below the sleeve diameter at both ends.

(14) Place the housing (48) on a solid surface with the port face down. Install the spool assembly with the splined end of the spool (50) entering the 14-hole end of the housing first. Push parts gently into place with a slight rotating motion.

**Caution: Use extreme care so control assembly (38) does not lose alignment when entering housing (48).**

(15) Install control assembly (38) in housing bore until flush with 14-hole end of housing.

**Caution: Do not pull control assembly beyond flush position or cross pin (41) will drop into housing discharge groove.**

(16) Turn splined end of control assembly (38), checking for free rotation.

(17) Install new packing (43) and check plug (44) in check plug hole. Use steady pressure on plug and rock it slightly so packing feeds in smoothly without cutting.

(18) Install new packing (40) and seal (24) on spool (50).

(19) Seat cap locator bushing (39), large outside diameter up, against spool (50) evenly.

c. Mounting Plate.

(1) Check mounting plate seal grooves for cleanliness and smooth condition.

(2) Install and smooth down new quad ring shaft seal (24) and oil seal (16) into mounting plate (17) seal grooves.

Note: Oil seal (16) lip must face away from unit.

(3) Place the mounting plate subassembly over the spool shaft and slide it down smoothly in place over the cap locator bushing (39) so that seals will not be damaged.

(4) Align the bolt holes in the cover (17) with the tapped holes in the housing (48). Be sure the mounting plate rests fairly flush against end of housing assembly so that the cap locator bushing is not cocked.

(5) Install mounting plate attaching bolts (18) and torque each to 150 inch-pounds. d. End Plate.

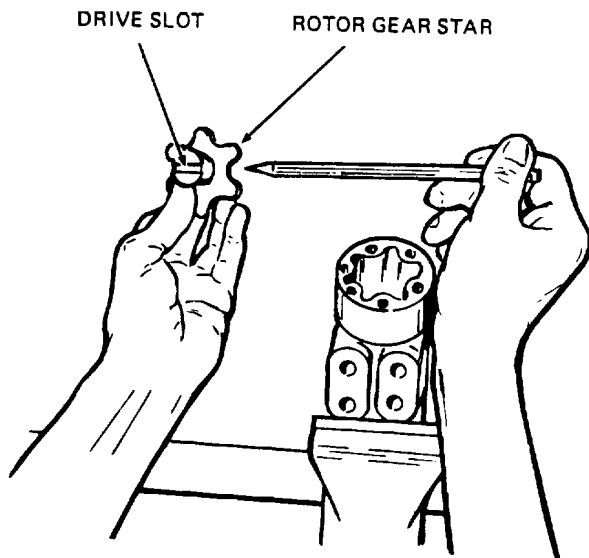
(1) Reposition control housing (48) in vise, clamping the mounting plate with 14-hole surface up.

(2) Check that control spool and sleeve are flush or slightly below 14-hole surface and that surface is clean.

(3) Place end plate (22) over control spool and sleeve, aligning bolt holes in plate with tapped holes in housing (48).

(4) Place rotor ring (21) on assembly and align bolt holes.

(5) Place splined end of drive (23) in rotor gear star so slot at control end of drive is aligned with outside diameter valleys of gear. See figure 9-5.



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Figure 9-5. Drive-gear alignment.

(6) Push splined end of drive (23) through the gear until spline extends about one-half its length beyond gear star. Hold it in this position while installing it in the unit. Note position or direction of cross pin (41) within the unit.

(7) Install gear-drive assembly into rotor ring (21), drive (23) first, and slowly rotate it to engage cross slot in drive (23) with cross pin (41). Splined end of drive will drop down against rotor ring (21) when slot engages.

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

(8) Place end cap (20) over assembly and install screws (19) finger tight, to maintain alinement of parts.

(9) Secure assembly in vise and torque screws to 150 inch-pounds.

e. Column.

(1) Note match-marks on column (36) and secure column to mounting plate (17) with bolts (37). Torque bolts to 280 inch-pounds.

(2) Install retaining ring (31), bearing (30), and retaining ring (26) on shaft (32).

(3) Insert horn wire (33) through washer (27), spring, ferrule (25), and partially through shaft (32). Bring wire out from shaft and attach to contact ring (34).

(4) Insert insulator (35) in contact ring (34) and slide both, gradually pulling back on horn wire, on shaft (32).

(5) Insert shaft (32) in column (36) and secure with retaining ring (28). Rotate shaft to engage shaft and spool splines.

(6) Install brush assembly (15) on column (36) securing with screws (14).

(7) Install connector (13) on brush wire.

(8) Install steering gear support (22, fig. 8-3) with brake pedal stop on steering column and secure it to steering gear with two screws (2) and lock washers (1).

f. Horn Button.

(1) Thread horn wire (33, fig. 9-1) through steering wheel (12), lock washer (11), nut (10), washer (9), and spring (8) and attach wire to base plate (6).

(2) Press on steering wheel (12) on shaft and secure with lock washer (11) and nut (10).

(3) Install base plate (6) and secure with screws (7) making sure horn wire (33) is securely attached to plate.

(4) Install cap (5), spring (4), cup (3) and button (2) on base plate (6).

(5) Install horn button cover (1) by pressing down on cover and turning right.

**9-6. Installation**

a. Install steering gear and secure steering gear support (22, fig. 8-3) in place on truck bracket with flat washers (23), lock washers (24), and screws (25).

b. Install clip on upper part of column (36), fig. 9-1).

c. Connect brush assembly connector (13).

d. Note identification marks on hydraulic hoses and attach hoses to proper ports in control housing (48).

e. Install floor and toe plates (TM 10-3930- 621-12).

**Section II. POWER STEERING CYLINDER**

**9-7. Description**

When oil is under regulated hydraulic pressure from the steering gear enters the power steering cylinder, the piston moves either forward or back within a tube, depending upon which side of the piston hydraulic fluid is forced. The movement of the piston rod, with attached yoke, moves the steering axle pivot arm and attached tie rods.

**9-8. Removal**

Refer to TM10-3930-621-12 for removal procedures.

**9-9. Disassembly**

a. Refer to figure 9-6 and disassemble as Follows:

- b. Remove cotter pin (1) and adjusting plug (30) from end of steering line (3).
- c. Remove lubrication fitting (2) and plug (31) from steering link and remove link (3) and nut (4) from rod (13).
- d. Tap out seat (29) and spring (28) from link (3).
- e. Remove elbows (5) from tube assembly (12).
- f. Remove lock ring (15) holding spacer (16) in position and remove spacer.
- g. Compress lock ring (17) holding head (20) to tube (12) and remove actuating rod (13), with remaining components attached from tube assembly (12).

KEY to fig. 9-6:

- |                        |                         |
|------------------------|-------------------------|
| 1. Cotter pin          | 17. Lock ring           |
| 2. Lubrication fitting | 18. Backup washer       |
| 3. Link                | 19. Packing             |
| 4. Nut                 | 20. Head                |
| 5. Elbow               | 21. Head seal           |
| 6. Pin                 | 22. Nut                 |
| 7. Lock washer         | 23. Backup washer       |
| 8. Screw               | 24. Packing             |
| 9. Spacer              | 25. Piston              |
| 10. Cylinder assembly  | 26. Seal                |
| 11. Sleeve bearing     | 27. Lubrication fitting |
| 12. Tube assembly      | 28. Spring              |
| 13. Rod                | 29. Ball seat           |
| 14. Wiper              | 30. Plug                |
| 15. Lock ring          | 31. Plug                |
| 16. Spacer             |                         |

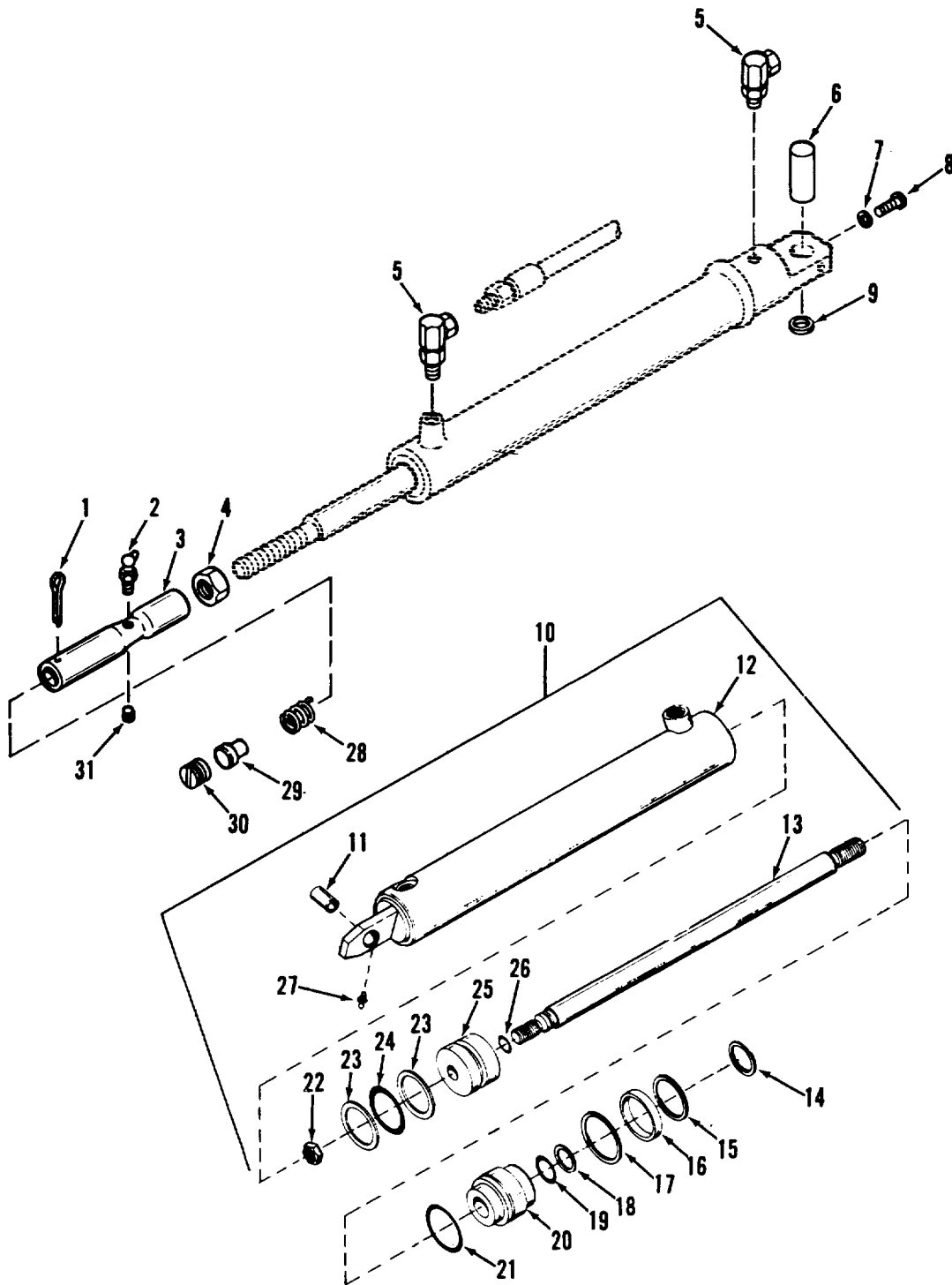


Figure 9-6. Power steering cylinder, exploded view.



h. Carefully slide head (20) off rod (13) end and remove head seal (21), wiper (14), backup washer (18), and packing (19) from head. Discard packing.

i. Remove nut (22) securing piston (25) to rod end and slide piston off rod.

j. Remove two backup washers (23) and packing (24) from piston (25). Discard packing.

k. Remove rod seal (26) from rod (13).

l. Check bearing (11) and lubrication fitting (27) at tube end. If damaged, replace parts. Press bearing from cylinder to remove.

**9-10. Cleaning, Inspection, and Replacement**

a. Clean all parts with cleaning compound, solvent (Spec. P-S-661).

b. Inspect tube bore, rod head, and piston for cracks, scratches, scoring, and other damage. Repair or replace damaged components.

c. Replace all seals and packing.

d. Prior to assembling, coat all components with clean hydraulic oil to aid in installation and provide initial lubrication.

**9-11. Assembly**

a. Refer to figure 9-6 and assemble as follows:

**Caution: Be careful not to damage seals and packing during assembly.**

b. Install rod seal (26) on rod (13).

c. Position backup washers (23) and packing (24) on piston (25).

d. Install piston (25) on rod (13) and secure with nut (22).

e. Install packing (19), backup washer (18), wiper (14) in head (20).

f. Position head seal (21), lock ring (17), spacer (16) and lock ring (15) on head.

g. Carefully slide piston and rod assembly into tube (12).

h. Position head assembly over rod (13) and compress lock ring (17).

i. With lock ring (17) compressed, slide head assembly into tube until lock ring snaps into tube groove.

j. Install elbows (5) in cylinder.

k. Install spring (28), seat (29), and adjusting plug (30) in link (3).

l. Install nut (4) and link (3) on rod (13).

m. Install lubrication fitting (2), plug (31), and cotter pin (1) in link (3).

n. If bearing (11) was removed, press new bearing into bore at end of cylinder.

**9-12. Installation and Adjustment**

Refer to TM 10-3930-621-12 for installation and adjustment procedures.

## CHAPTER 10

HYDRAULIC SYSTEM REPAIR INSTRUCTIONS

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## Section I. HYDRAULIC SYSTEM

**10-1. Description**

The hydraulic system is comprised of a hydraulic reservoir, a hydraulic pump, control valve, three section mast assembly, tilt cylinders, and associated hydraulic hoses and hose connections. Refer to figure 10-1.

**10-2. Operation**

*a. Pump Action.* The hydraulic pump draws oil from the hydraulic reservoir and supplies oil under pressure to the control valve.

*b. Lift control.*

(1) When the -lift control handle is pulled back, hydraulic oil is delivered through the control valve to the two outer cylinders on the cylinder cluster (12, fig.10-3). Oil pressure forces the two outer cylinder rams upward, raising the chains and lifting the carriage up the mast. Continued raising actuates the center cylinder of the cluster and the single lift cylinder.

(2) When the lift control handle is released to neutral, hydraulic oil pressure will hold the carriage stationary.

(3) When the lift control handle is pushed

forward, hydraulic oil pressure is released and the carriage and masts are lowered by their own weight.

*c. Tilt Control.*

(1) When the tilt control handle is pushed forward, hydraulic oil pressure is applied through the control valve to the rear of the tilt cylinders. The cylinder plunger rods move forward and tilt the masts forward. At the same time, hydraulic oil in the front of the tilt cylinders is recirculated through the control valve.

(2) When the tilt control handle is centered, hydraulic oil pressure is equalized in both sides of the tilt cylinders and the masts remain in the desired tilt.

(3) When the tilt control handle is pulled back, hydraulic oil pressure is applied through the control valve to the front of the tilt cylinders. The cylinder plunger rods move backward, resulting in a backward tilt of the masts. At the same time, hydraulic oil in the rear of the tilt cylinders is recirculated through the control valve.

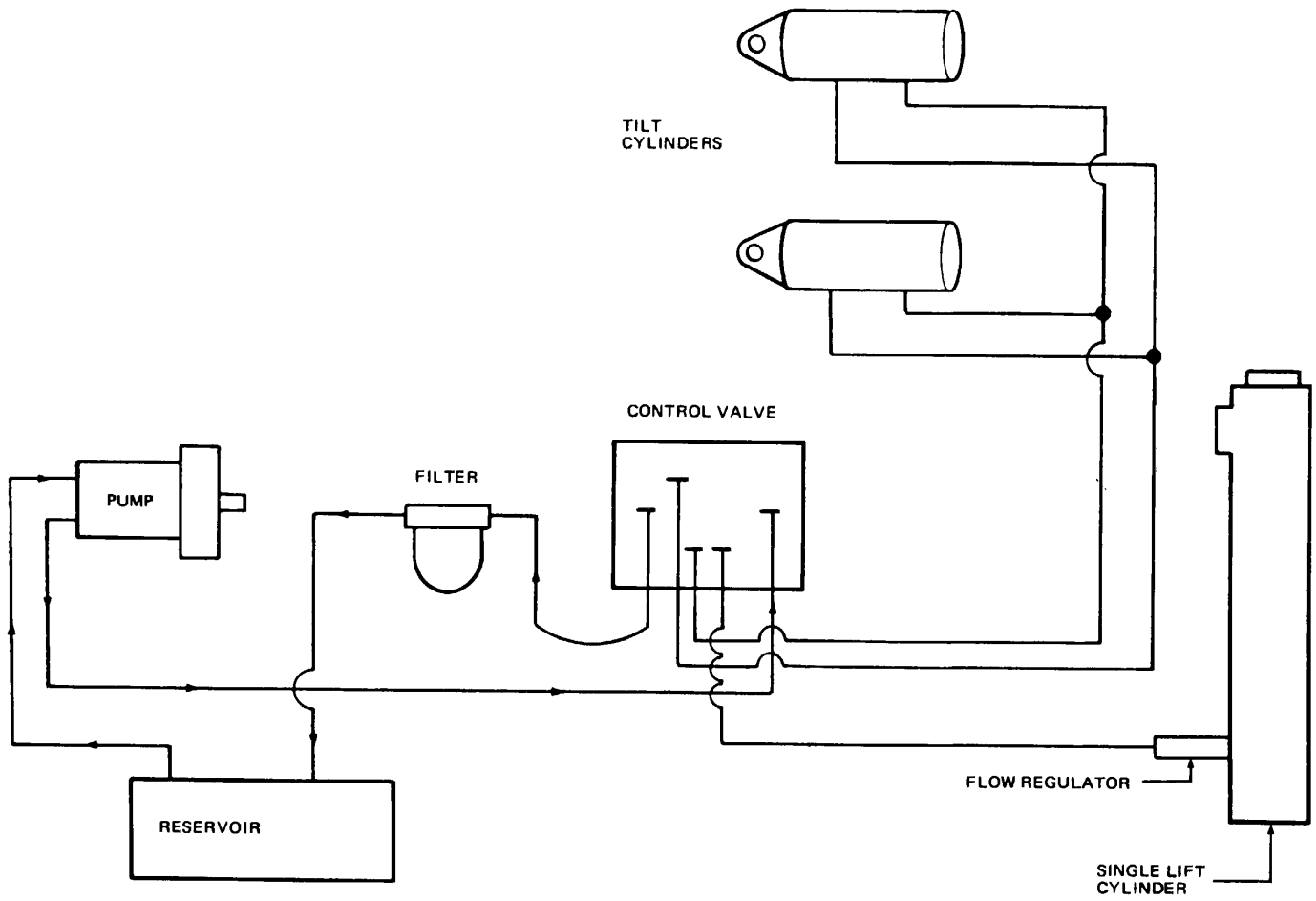


Figure 10-1. Hydraulic lift system, schematic

## Section II. TILT CYLINDER

### 10-3. Description

The two double-acting tilt cylinders serve to tilt the mast assembly. They are located under the toe plate and pivot at frame and mast brackets. Action of the tilt cylinder is a straight line motion. Any misalignment of tube assembly (10, fig. 10-2) and guide ring (12) will cause rapid wear of internal parts and may break the tube assembly weld.

### 10-4. Removal

Refer to TM10-3930-621-12 for removal procedure.

### 10-5. Disassembly

- a. Refer to figure 10-2 and disassemble as follows:
  - b. Secure cylinder tube (10) in vise, being careful not to deform.
  - c. Remove screw (5), lock washer (7), and nut and unscrew yoke (6) from plunger rod (31).
  - d. Remove screw (22) and packing retainer (25).
  - e. Withdraw plunger rod (31) with assembled parts from tube assembly (10).
  - f. Remove wiper (23), nut (24) and stuffing box assembly.
  - g. Remove ring (28) and packing (29) from groove in outside diameter of stuffing box (30), and packing set (27) and adapter (26) from inside diameter.

- h. Remove cotter pin (32), nut (11), and guide ring (12) from rod (31).

- i. Remove packing (13) and backup ring (14) from groove around outside diameter of guide ring (12), and packing (15) from bore.

- j. Remove cup (17) and follower (18) from rod (31).

- k. Remove ring (16) and packing (15) from follower (18).

- l. Remove spacers (19 and 20) and packing (21) from rod (31).

### 10-6. Cleaning, Inspection, and Replacement

- a. Clean all metal parts with cleaning compound, solvent (Spec. P-S-661). Dry parts thoroughly with compressed air.

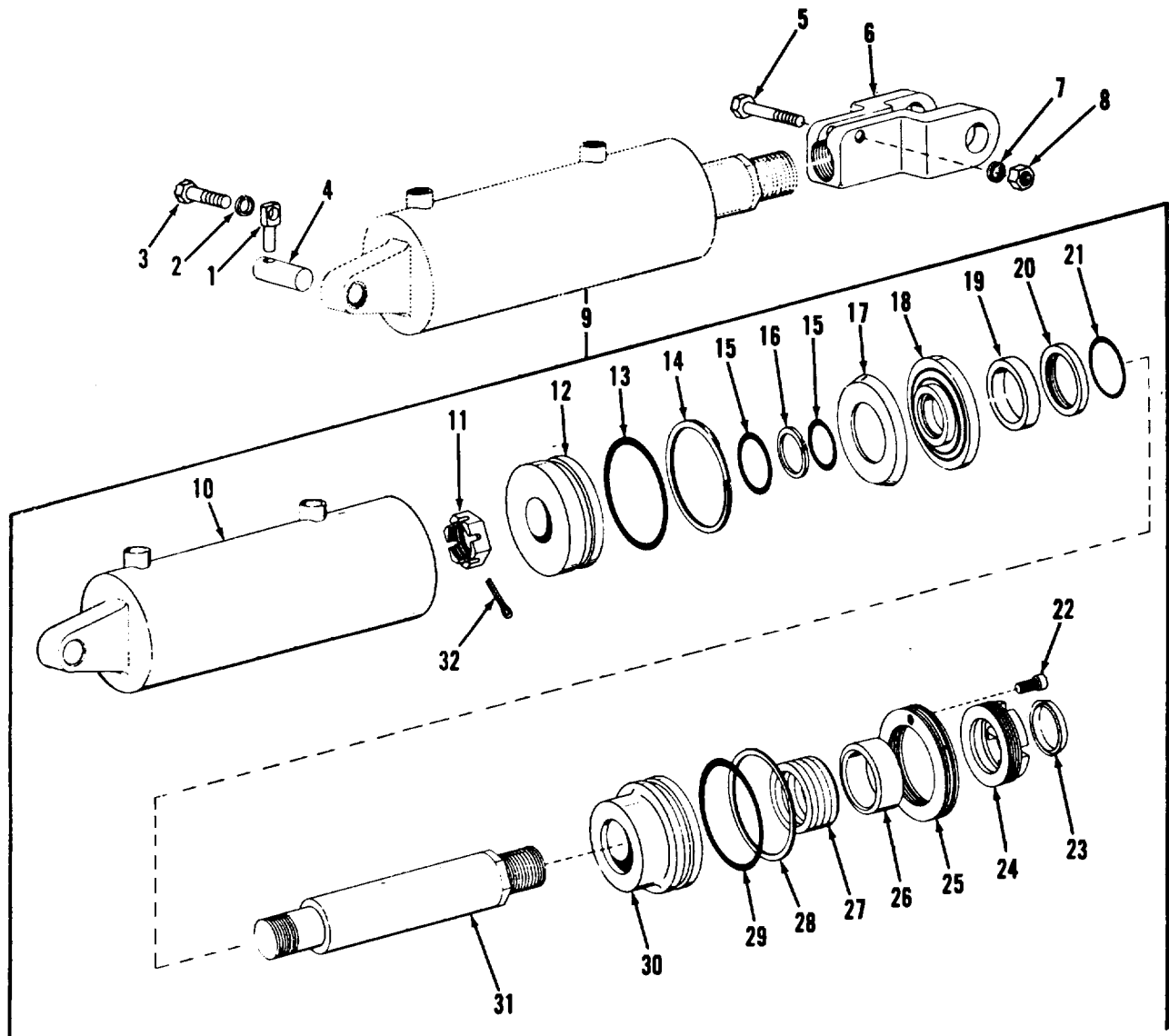
- b. Check tube bore for screws or nicks.

- c. Check guide ring (12) sliding surfaces for scores, nicks, or irregularities.

- d. Check bores of guide ring (12) and stuffing box (30) and mating surfaces of guide ring for damage which could cause faulty seating, leaks or damage to other parts.

- e. Check all backup rings for cracks, bends, deformation, stripped threads, and other damage.

- f. Replace all packing, wiper rings, and damaged mating or sliding surface parts.



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- |                           |                  |
|---------------------------|------------------|
| 1. Retainer               | 17. Cup          |
| 2. Lock washer            | 18. Follower     |
| 3. Screw                  | 19. Spacer       |
| 4. Pin                    | 20. Spacer       |
| 5. Screw                  | 21. Packing      |
| 6. Yoke                   | 22. Screw        |
| 7. Lock washer            | 23. Wiper        |
| 8. Nut                    | 24. Nut          |
| 9. Tilt cylinder assembly | 25. Retainer     |
| 10. Tube assembly         | 26. Adapter      |
| 11. Nut                   | 27. Packing set  |
| 12. Guide ring            | 28. Ring         |
| 13. Packing               | 29. Packing      |
| 14. Backup ring           | 30. Stuffing box |
| 15. Packing               | 31. Rod          |
| 16. Ring                  | 32. Cotter pin   |

Figure 10-2. Tilt cylinder exploded view.

**10-7. Assembly**

- a. Refer to figure 10-2 and assemble as follows:
- b. Dip all packings (13, 15, 21, 27 and 29), wiper ring (23), guide ring (12), plunger rod (31), and nut (24) in hydraulic system oil before each is installed.
- c. Install ring (16) and packing (15) in follower (18) and install cup (17), follower, spacers (19 and 20), and packing (21) on rod (31).
- d. Install packing (15) in guide ring (12) bore and packing (13) and backup ring (14) in groove on outside diameter of guide ring. Do not overexpand backup ring.

**Caution: Never use sharp tools or instruments when installing rings or packings.**

- e. Install guide ring (12) on plunger rod (31).
- f. Install nut (11) on rod (31) and torque nut to 300 foot-pounds. Install cotter pin (32).

g. Install adapter (26) and packing set (27) in stuffing box (30) bore and install packing (29) and ring (28) in outside groove of stuffing box.

h. Install stuffing box assembly, nut (24), and wiper (23) on rod (31). Tighten nut (24) securely, then back off approximately 1/8 turn.

i. Insert plunger rod (31) with assembled parts in tube assembly (10).

Note. Be certain all parts are clean and those which require soaking in hydraulic system oil have been so serviced. Be sure no dirt or water is in tube assembly.

- j. Install packing retainer (25) with screw (22).
- k. Screw on yoke (6) on rod (31).

**10-8. Installation and Adjustment**

Refer to TM 10-3930-621-12 for installation and adjustment procedures.

**Section III. MAST ASSEMBLY****10-9. Description**

a. The mast assembly is a three section mast assembly designed to provide lifts up to 180 inches. Three units, nested together, comprise the unit; an outer mast, intermediate mast, and an inner mast. Each mast consists of a structural steel frame, with mounting brackets and blocks welded to it to support the cylinders, chains, and bearings.

b. The intermediate and inner masts ride on roller bearings, enabling them to telescope up and down. Alinement of the mast channels is accomplished by adjusting the roller bearings.

c. A carriage, designed to mount lifting forks, is supported by chains leading from the outer cylinders of the cylinder cluster. Action of the chains, cylinders, and mast raise and lower the carriage.

d. Power to raise and lower the carriage and masts is provided by hydraulic oil pressure to a cylinder assembly and cylinder cluster. The cylinder assembly is a single cylinder attached to the inner portion of the intermediate mast with the cylinder ram extending through an opening in the intermediate mast and anchored at the lower part of the outer mast.

e. The cylinder cluster, consisting of three cylinders, is mounted forward of the cylinder assembly in the intermediate mast. The rams of the two outer cylinders mount the two crosshead and chain bearing assemblies, with the chains attached to adjusting bolts in mounting brackets on the cylinders. The chains extend over the bearings and attach at the other end to anchors on the carriage.

Chain guards, mounted on the crossheads and cylinders, keep the chains from sticking the cylinder plungers and packing. Rams from the, outer cylinders lift and lower the carriage along the length of the inner mast by means of the chains. The center cylinder of the cluster has the ram anchored at the bottom of the intermediate mast and the top of the cylinder attached to the inner mast.

f. The bottom of the outer mast has pivot blocks, with bearings, for mounting to the truck. Pivot blocks are also provided on the outer mast to connect the tilt cylinders to the mast.

g. An interlock assembly, spring actuated, is mounted on the right beam of the inner mast. The interlock assembly locks all three mast sections in the lowered position until full free lift is accomplished. When full free lift is reached, the carriage stop screw strikes the interlock assembly to release it, allowing all mast sections to function completely.

**10-10. Operation**

a. When the lift handle on the control valve is pulled to the rear, hydraulic oil pressure is delivered to the two outer cylinders of the cylinder cluster. Pressure forces the cylinder rams to extend upward raising the chains and lifting the carriage up the mast. Speed of lift is controlled by engine speed and by valve opening.

b. As the carriage reaches the top of the inner mast the two outer cylinder rams will be extended to their farthest point of travel. With the handle pulled to the rear, the hydraulic oil pressure will

then force the center cylinder ram of the cylinder cluster from the cylinder, raising the inner mast and carriage.

c. As the center cylinder ram reaches its farthest extent of travel the inner mast will be fully extended above the other two masts with carriage at the top. Continued operation will cause the ram of the single cylinder to force downward against the outer mast, raising the intermediate mast. Full extension of the ram will raise the carriage to the highest level.

d. When the lift handle on the control valve is released to neutral, hydraulic oil pressure will hold the carriage at the required height. To lower the carriage, push the handle forward. The hydraulic oil pressure will be released allowing the carriage and masts to lower to the desired height. A flow regulator holds lowering speed to a maximum of 40-80 fpm. The regulator is installed in the single lift cylinder hose connection at the bottom of the outer mast.

e. Tilting action of the mast is controlled by movement of the tilt handle on the control valve. The mast will tilt rearwards when tilt handle is pulled back and forwards when pushed forward.

KEY to fig. 10-3:

1. Outer mast assembly
2. Bearing
3. Stud
4. Shim(s), 0.015 inch
5. Shim(s), 0.040 inch
6. Bearing
7. Intermediate mast assembly
8. Stud
9. Bracket
10. Single lift cylinder
11. Chain guard
12. Cylinder cluster
13. Chain anchor
14. Chain connecting link
15. Crosshead
16. Pin
17. Chain
18. Washer
19. Bearing
20. Inner mast assembly
21. Spacer
22. Interlock
23. Spring
24. Adjusting screw
25. Guard
26. Elbow
27. Tube
28. Clamp
29. Spacer
30. Connector
31. Elbow
32. Clamp
33. Flow regulator  
Spacer

**10-11. Removal**

a. Fully retract mast and unlock and remove carriage forks. Cylinders must be completely collapsed.

b. Raise and block truck 24 inches from mast to floor.

c. Remove screws (11 and 13, fig. 10-8), spacer (9), and lock washers (10) from carriage supports.

d. Remove carriage forks.

e. Remove connector (30, fig. 10-3), elbows (31 and 35), flow regulator (33), and packings (59, 60 and 63) from bottom of single lift cylinder (10). Discard packings.

f. Attach hoist to backrest frame (1, fig. 10-8) and disconnect chains from carriage.

g. Remove backrest and carriage assembly through bottom of inner mast (20, fig. 10-3).

h. Disconnect tilt cylinders from outer mast (para 10-4).

i. Using hoist. raise mast assemblies enough to remove weight on mast pivot pins (36, fig 10-3). Remove screws (64), lock washers (65), and mast pivot pins.

j. Using hoist, lift mast assemblies from truck and place them on suitable supports with cylinder cluster facing up.

35. Elbow
36. Pin
37. Pin
38. Screw
39. Nut
40. Screw
41. Screw
42. Lock washer
43. Screw
44. Lock washer
45. Nut
46. Screw
47. Lock washer
48. Lock washer
49. Nut
50. Nut
51. Screw
52. Pin
53. Pin
54. Screw
55. Screw
56. Lock washer
57. Screw
58. Lock washer
59. Preformed packing
60. Preformed packing
61. Screw
62. Lock washer
63. Preformed packing
64. Screw
65. Lock washer
66. Lubrication fitting
67. Lubrication fitting





**10-12. Disassembly**

- a. Refer to figure 10-3 and disassemble as follows:
- b. Remove inner mast (20) as follows:

- (1) Remove screw (43) and lock washer (42) connecting inner mast to center cylinder of cylinder cluster (12).

- (2) Remove bottom adjustment nuts (50) from chain anchors (13) and remove chains (17) from cylinder cluster (12) and inner mast (20). Match-mark location of nuts (50) on anchors (13).

- (3) Remove interlock spring (23) from screws (24) and remove screws.

- (4) Remove screw (54) and spacer (21) from interlock (22) and remove interlock from inner mast (20). Tap out pin (53).

- (5) Using hoist, slowly raise inner mast (20) until notch at bottom of inner mast channel clears upper intermediate mast bearing(6).

**Caution: Do not raise inner mast beyond clearance point or inner mast bearing (6) will contact upper intermediate mast bearing, which may result in damage to the bearings.**

- (6) Check to see that the inner mast bearing (6) will clear the notch in the upper intermediate mast channel. If both bearings are clear, remove inner mast (20) from intermediate mast (7) by carefully moving hoist in a horizontal direction.

- (7) Remove bearings (6) and shims (4 and 5) from inner mast (20), if necessary.

- c. Remove intermediate mast (7) as follows:

- (1) Disconnect elbows (26) and tube (27) from cylinder cluster and single lift cylinder.

- (2) Remove screws (46), lock washers (47), and chain guards (11) from crossheads (15).

- (3) Remove small spring pins (52), bearing pins (16), washers (18), and bearings (19) from crossheads.

- (4) Remove screws (51) and crossheads (15) from cylinder cluster (12).

- (5) Remove nut (45) and lock washer (44) securing center cylinder of cylinder cluster to intermediate mast (7).

- (6) Using hoist, remove cylinder cluster (12) from intermediate mast (7).

**Caution: Always handle cylinder in fully collapsed position to avoid scratching or nicking ram surface.**

- (7) Remove spacer (34) and clamp (32) from outer mast (1).

- (8) Remove screw (57), lock washer (58), clamp (28), and spacer (29) securing bottom of single lift cylinder (10) to intermediate mast (7).

- (9) Remove screw (43) and lock washer (42) attaching upper part of single lift cylinder (10) to bracket (9), and screws (40 and 41) and nuts (39) attaching bracket to intermediate mast (7).

- (10) Remove bracket (9) from intermediate mast (7).

- (11) Remove nut (49) and lock washer (48) securing bottom of cylinder assembly (10) through intermediate mast (7) to outer mast (1).

- (12) Remove single lift cylinder (10) from intermediate mast (7).

- (13) Remove screws (38), studs (3), shims (4 and 5), and bearings (6) at top of outer mast (1). Note size and quantity of shims used.

- (14) Using hoist, slide intermediate mast (7) from outer mast (1).

- (15) Remove bearings (6) and shims from intermediate mast (7), if necessary.

- d. Remove lubrication fittings (66 and 67) and bearings (2) from outer mast (1).

**10-13. Cleaning, Inspection, Replacement and Repair**

- a. Clean all parts with cleaning compound, solvent (Spec. P-S-661).

- b. Inspect all parts for wear or damage.

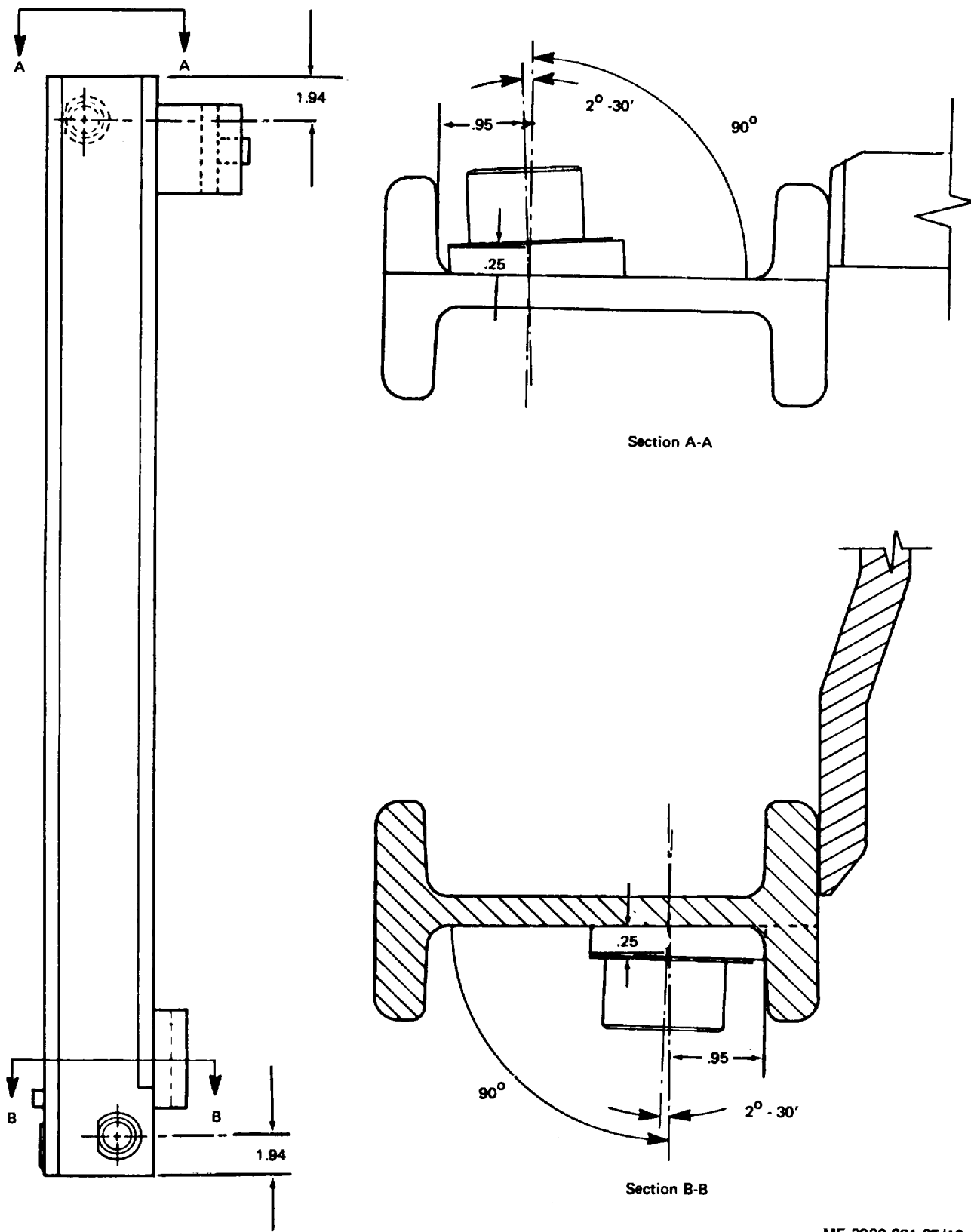
- c. If inner race of bearing is fractured, examine bearing stud for nicks. Replace bearing and stud if damaged as follows: Note. All bearing studs (8, fig. 10-3) are welded into position except outer mast bearing stud (3), which is attached to a screw 138i.

- (1) Press bearings (6, fig. 10-3) from studs (8) and remove shims (4 and 5). Note size and quantity of shims used.

- (2) Remove filler metal from around stud using a pencil grinder. Do not make any passes into mast channel. Remove stud from channel.

- (3) Prepare welding surface by removing all foreign material such as rust, scale, grease, etc. Any part that may be damaged by heat should be removed before welding.

- (4) Locate, tilt, and aline new stud on mast channels (fig. 10-4). Use Section B-B of figure 10-4 for dimensions of inner mast bearing stud location. Sections A-A and B-B of figure 10-4 apply to intermediate mast bearing stud locations.



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Figure 10-4. Mastbearing stud locations.

(5) Comply with the following welding specifications using bearing stud welding procedure (fig. 10-5):

Process ..... Shielded Metal Arc  
 Equipment ..... Manual  
 Settings:  
 Current..... A.C.  
     Amps ..... 275 / 325  
     Volts..... 31/33  
 Base Metal..... (1) AC 1035-D  
                   ..... (2) AC 41L40-HT (roller stud)

Plate Thickness Range .....  $\frac{3}{8}$ " - 1"  
 Electrode:  
     Type ..... Stick  
     Class ..... E 7018 (hydrogen free)  
     Size .....  $\frac{3}{8}$ "  
     Flux ..... Electrode Covering  
 Weld Type and Size ..... 1/4" Fillet  
 Number of Passes ..... 1  
 Position ..... Horizontal  
 Preheat..... 400 ° F  
 Interpass ..... 250 ° F  
 Postheat ..... None

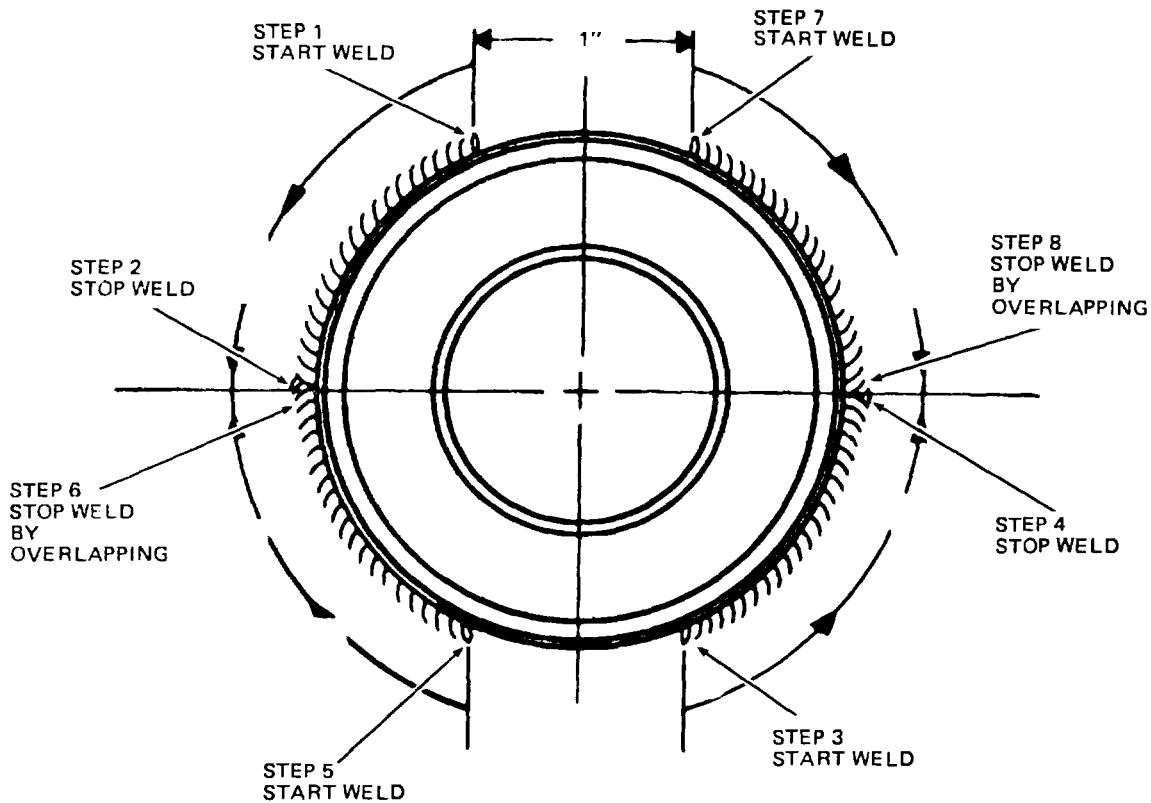


Figure 10-5. Bearing stud welding procedure

(6) When welding is completed remove all slag, weld spatter, and excessive weld material.

(7) Finished weld must be magnafluxed for defects.

(8) Remove defective material with a pencil grinder in 0.010-0.020 of an inch passes and visually inspect for defects after each pass. Magnaflux is to confirm disappearance of defect.

d. Inspect mast channels for misalignment, broken welds, excessive wear, worn or damaged wear strips.

e. Inspect pivot and tilt cylinder brackets on outer mast for wear or damage. Check pivot bearing.

f. Repair by welding if practical, provided heat distortion is avoided.

g. Replace defective parts as authorized.

h. If studs (3, fig. 10-3) or outer mast bearings (6) are replaced, attaching screws (38) must also be replaced.

**10-14. Assembly**

Note. Prior to assembly, lubricate all parts per TM 103930-621-12.

a. Refer to figure 10-3 and assemble as follows: b. Install lubrication fittings (66 and 67) and bearings (2) in outer mast (1).

c. Assemble intermediate mast (7) as follows:

(1) Install bearings (6) and same size and quantity of shims (4 and 5) on welded intermediate mast bearing studs (8), if bearings and shims were removed during disassembly.

(2) Using hoist, slide intermediate mast (7) into outer mast (1).

(3) Using same size and quantity of shims used when removed, install studs (3), shims (4 and 5), and bearings (6) at top of outer mast. Secure studs to mast with screws (38).

(4) Check clearance between outer mast bearings (6) and mating intermediate mast channels and intermediate mast lower bearings (6) and mating outer mast channels. Clearance should be no more than 0.015 of an inch.

(5) If clearance is more than 0.015 of an inch, remove bearing assembly and install additional shims (4 or 5).

Note. Divide shims as equally as possible between bearings. Shims are available in 0.015 and 0.040 inch thicknesses.

(6) When proper shimming is completed, install bearings on outer mast (1) and torque screws (38) to 245 foot-pounds.

(7) Secure bracket (9) to intermediate mast (7) with screws (40 and 41) and nuts (39).

(8) Install single lift cylinder (10) on intermediate mast (7) and secure to top bracket with lock washer (42) and screw (43); and to bottom of mast with spacer (29), clamp (28), lock washer (58), and screw (57).

(9) Attach clamp (32) to bottom of outer mast with spacer (34).

(10) Install new packings (59, 60 and 63), flow regulator (33), elbows (31 and 35), and connector (30) on bottom of single lift cylinder (10).

(11) Using hoist, install cylinder cluster (12) on intermediate mast (7).

(12) Secure center cylinder of cylinder cluster to bottom of intermediate mast with lock washer (44) and nuts (45).

(13) Attach crossheads (15) to outer cylinders of cylinder cluster with screws (51).

(14) Install bearings (19), washers (18), and pins (16) in crossheads and secure with spring pins (52).

(15) Install chain guards (11 on crossheads with lock washers (47) and screws (46).

(16) Connect elbows (26) and tube (27) from cylinder cluster (12) to single lift cylinder (10).

d. Assemble inner mast (20) as follows: (1) Install bearings (6) and same size and quantity of shims (4 and 5) on inner mast welded bearing stud (8), if bearings and shims are removed during disassembly.

(2) Using hoist, install inner mast (20) on intermediate mast (7) being careful that bearings (6) clear notches.

(3) Lower inner mast (20) slightly into intermediate mast (7). Check clearance between intermediate mast upper bearings and inner mast channel and inner mast bearings (6), and intermediate mast channel. Clearance should not be more than 0.015 of an inch.

(4) If clearance is more than 0.015 of an inch, install additional shims (4 or 5). See operation c (4) note.

(5) When proper shimming is completed, install bearings (6) and slide inner mast completely into intermediate mast.

(6) Install pin (53) into middle hole on inner mast (20) and secure interlock (22) in upper hole with spacer (21) and screw (54).

(7) Install both screws (24) and connect interlock spring (23) to them.

(8) Attach chains (17) to cylinder cluster (12) with adjustment nuts (50) and anchors (13), noting match-mark nut locations on screws. Final adjustment of chains to be made after carriage is installed.

(9) Secure cylinder cluster (12) to inner mast with lock washer (42) and screw (43) attached to center cylinder of cluster.

#### 10-15. Installation

a. Using hoist, install mast assembly on truck and insert pivot pin (36, fig. 10-3). Secure pins with lock washer (65) and screw (64).

b. Connect hydraulic line to flow regulator.

c. Connect tilt cylinders to outer mast (para 108).

d. Using hoist, slide backrest and carriage assembly up inner mast and secure to chains with chain anchors. Before releasing hoist, check that chains are secure at cylinder cluster and running evenly, with no twists, through the crosshead bearings.

e. Remove hoist from carriage and install screws (11 and 13, fig. 10-8), spacer (9), and lock washers (10) in carriage roller supports.

f. Remove blocks and lower truck to floor.

g. Install carriage forks making sure fork is locked in position.

h. Check for complete lubrication of mast assembly per TM 10-3930-621-12.

i. Check lift for proper operation as follows: (1) Lower carriage to lowest point of travel. Bottom of carriage lower bar should be adjusted from 2-3/4 to 31/4 inches from floor. Refer to TM 103930-621-12 for adjustment of chains.

(2) Using extreme care, very slowly extend mast to full lift checking all moving parts for binding, interference, or excessive looseness or play.

(3) Check operation of interlock assembly.  
Interlock must contact stop screw on carriage roller

support and disengage smoothly when lifting carriage.

#### Section IV. CYLINDER CLUSTER

##### 10-16. Description

The cylinder cluster consists of three cylinder assemblies and is mounted forward of the single cylinder assembly in the intermediate mast. The rams of the two outer cylinders mount two crossheads and chain bearing assemblies, with the chains attached to chain anchors in mounting brackets on the cylinders. The outer rams lift and lower the carriage along the length of the inner mast by means of chains. The center cylinder has its ram anchored at the bottom of the intermediate mast and its cylinder attached to the inner mast. Forcing downward, the center ram raises the carriage and mast to their fullest extent.

##### 10-17. Removal

To remove the cylinder without removing the inner mast, refer to figure 10-3 and proceed as follows:

**Caution;: When disassembling or reassembling cylinders use extreme care to avoid damaging the finish of ram surfaces.**

- a. Raise inner mast (20) approximately 24 inches from floor and block in this position.
- b. Remove carriage as follows:
  - (1) Remove screws and spacer from the carriage roller supports.
  - (2) Remove carriage forks.
  - (3) Attach hoist to carriage, remove chain anchor pins, and disconnect chains (17) from carriage.
  - (4) carriage out bottom of inner mast.
- c. Disconnect lift chains (17) from chain anchors (13) on top of cylinder cluster and remove chains through bottom of mast. Match-mark nut positions on anchors.

d. With cylinders completely collapsed disconnect center cylinder of cluster at elbow (26)

e. Remove nut (45) and lock washer (44) securing cluster center cylinder to intermediate mast (7).

f. Using a hoist carefully lift cylinder cluster (12) from intermediate mast (7).

g. Remove chain anchors (13) and nuts (50) from cluster.

h. Remove screws (46), lock washers (47), and chain guards (11) from crossheads (15).

i. Tap out pins (52) from bearing pins (16) in crossheads (15) and remove bearing pins, washer (18) and bearings (19) from crossheads.

j. Remove screws (51) and crossheads (15) from top of cylinder cluster (12).

##### 10-18. Disassembly

- a. Refer to figure 10-6 and disassemble as follows:

Note. Disassembly applies to both outer and center cylinder assemblies unless otherwise specified.

b. Remove gland nut (6) from tube (12) with spanner wrench and discard locking pellets (5).

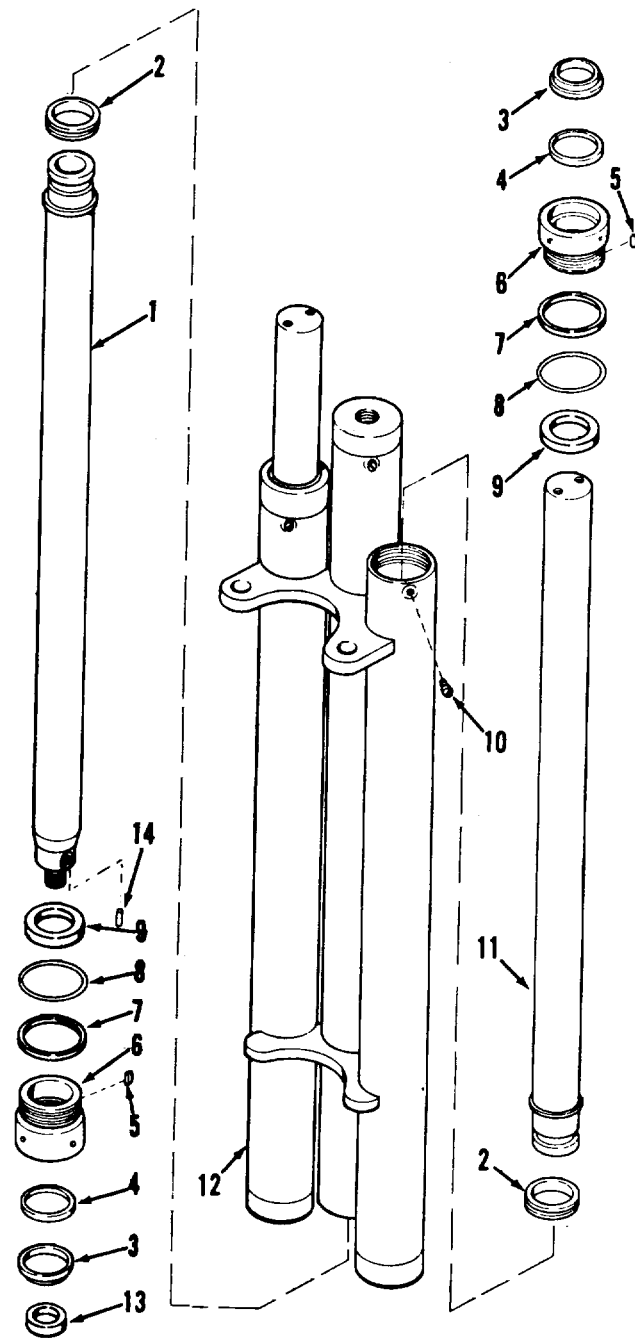
c. Remove wiper ring (3) and packing (4) from gland nut (6). If center cylinder is being disassembled, also remove spacer (13). Discard wiper ring and packing.

d. Remove backup ring (7), packing (8), and stop ring (9) from ram (1 and 11). Discard backup ring and packing.

e. Remove spring pin (! it from center ram (1).

f. Carefully slide rams (1 and 11) from tube (12) and remove wear block (2) from ram.

g. Remove bleed screws(10).



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- |                   |                   |
|-------------------|-------------------|
| 1. Center ram     | 8. Packing        |
| 2. Wear block     | 9. Stop ring      |
| 3. Wiper ring     | 10. Bleed screws  |
| 4. Packing        | 11. Outer ram     |
| 5. Locking pellet | 12. Tube assembly |
| 6. Gland nut      | 13. Spacer        |
| 7. Backup ring    | 14. Pin           |

Figure 10-6. Cylinder cluster exploded view.

**10-19. Cleaning, Inspection, and Replacement**

a. Clean all metal parts with cleaning compound, solvent (Spec. P-S-661). Dry thoroughly with dry, compressed air.

b. Inspect parts for wear or damage. See paragraph 1-4 for wear allowances. Remove nicks and scratches with fine emery paper.

c. Replace all packing, wiper rings, and backup rings regardless of condition. Replace all other unserviceable parts as authorized.

**10-20. Assembly**

a. Refer to figure 10-6 and assemble as follows:

Note. Assembly applies to both other and center cylinder assemblies unless otherwise specified.

b. Loosely install bleeder screws (10) in tubes {121.

c. Install wear blocks (2) on rams (1 and 11) and carefully slide rams into tubes (12).

d. Insert spring pin (14) in center ram (1).

e. Install stop ring (9), new packing (8), and backup ring (7) on ram (1 and 11).

f. Install new wiper ring (3) and packing (4) in gland nut (6). Install spacer (13), if center cylinder is being assembled.

g. Using new locking pellets (5), secure gland nut (6) to tube (12) with spanner wrench.

**10-21. Installation**

To install the cylinder cluster without installing the inner mast, refer to figure 10-3 and proceed as follows:

a. Install crossheads (15) on top of cylinder cluster and secure with screws (51).

**10-22. Description**

The single cylinder assembly is installed on the inner portion of the intermediate mast, with the cylinder ram extending through an opening in the intermediate mast and anchoring at the lower part of the outer mast. The upper portion of the cylinder is secured in a bracket and the lower portion by a clamp. Forcing the single cylinder ram downward against the outer mast will raise the intermediate mast. Full extension of the ram will raise the carriage to its highest level.

**10-23. Removal**

To remove the single cylinder assembly without removing the inner mast, proceed as follows:

b. Install bearings (19), washers (18), and bearing pins (16) in crossheads (15) and secure assemblies to crossheads by tapping pins (52) into bearing pins.

c. Install chain guards (11) on crossheads, with rods through holes in cylinder brackets. Secure guards to crossheads with screws (46) and lock washers (47).

d. Using a hoist, carefully install cylinder cluster (12) on intermediate mast and secure at bottom with nut (45) and lock washer (44).

e. Attach chains (17) to chain anchors (13) and install anchors and nuts (50), noting match-mark of previous adjustment.

f. Run chains evenly around bearings (19), allowing them to hang free.

g. Connect tube assembly (27) to center cylinder at elbow (26).

h. Using hoist, raise carriage into inner mast (20) and attach chains to chain anchors.

i. Lower inner mast and install screws and spacer on carriage roller supports and carriage forks. Install and lock forks in position.

j. Using chain anchors (13) and nuts (50) adjust carriage to 23/4 to 31/4 inches from floor (TM 10-3930-621-12). Adjust both anchors to equal chain tension.

k. Check to see if bleeder screws are loose. Operate control valve to actuate cylinders and slowly raise and lower mast. When clear, bubble free oil flow from bleeder screw hole is obtained, tighten bleeder screws.

**Section V. SINGLE CYLINDER ASSEMBLY**

**Caution: When disassembling or reassembling cylinders, use extreme care to avoid damaging the ram surface finish.**

a. Remove cylinder cluster (para 10-17).

b. Refer to figure 10-3 and continue removal as follows:

c. Remove lock washer (58), screw (57), clamp (28), and spacer (29) securing cylinder (10) to intermediate mast (7).

d. Remove screw (43) and lock washer (42) attaching cylinder to bracket (9) at top of intermediate mast.

e. Remove nut (49) and lock washer (48) securing cylinder to bottom of outer mast (1).

f. Using a hoist, remove cylinder assembly from intermediate mast (7) and place on supports to prevent rolling during disassembly.

**10-24. Disassembly**

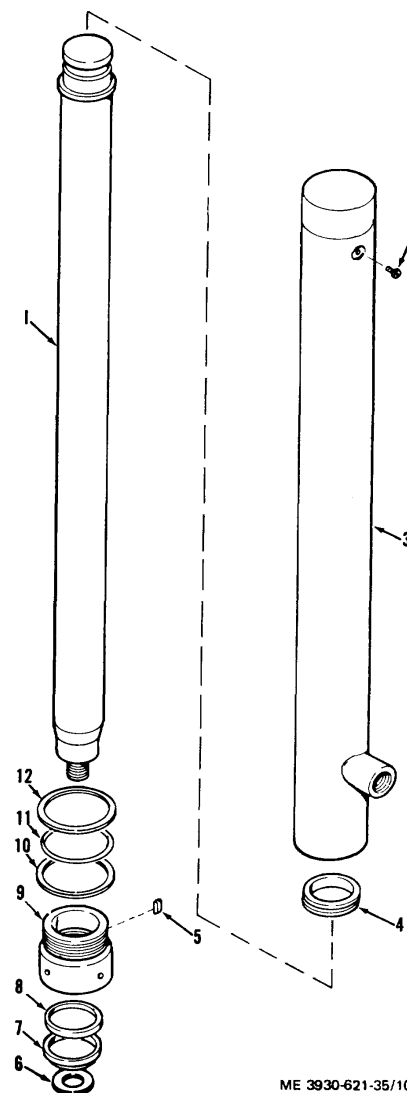
- a. Refer to figure 10-7 and disassemble as follows:
- b. Remove gland nut (9) from tube (3) with spanner wrench and discard locking pellets (5).
- c. Remove spacer (6), wiper ring (7), and packing (8) from gland nut (9). Discard wiper ring and packing.
- d. Remove backup ring (10), packing (11), and stop ring (12) from ram (1). Discard backup ring and packing.
- e. Carefully slide ram (1) from tube (3) and remove wear block (4) from ram.
- f. Remove bleed screw (2).

**10-25. Cleaning, Inspection, and Replacement**

Refer to paragraph 10-19.

KEY to fig. 10-7

- |                  |                 |
|------------------|-----------------|
| 1. Ram           | 7. Wiper ring   |
| 2. Bleed screw   | 8. Packing      |
| 3. Tube assembly | 9. Gland nut    |
| 4. Wear block    | 10. Backup ring |
| 5. Pellet        | 11. Packing     |
| 6. Spacer        | 12. Stop ring   |



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Figure 10-7. Single cylinder assembly, exploded view.



**10-26. Assembly**

- a. Refer to figure 10-7 and assemble as follows:
- b. Loosely install bleeder screw (2) in tube (3).
- c. Install wear block (4) on ram (1) and carefully slide ram into tube (3).
- d. Install stop ring (12) and new packing (11) and backup ring (10) on ram.
- e. Install spacer (6) and new packing (8) and wiper ring (7) in gland nut (9).
- f. Using new locking pellets (5), secure gland nut (9) to tube (3) with spanner wrench.

**10-27. Installation**

To install the single cylinder assembly without removing the mast, refer to figure 10-3 and proceed as follows:

- a. Using a hoist, remove single cylinder assembly from supports and install cylinder through intermediate mast (7) and secure to outer mast (1) with lock washer (48) and nut (49).
- b. Secure cylinder assembly to bracket at top of intermediate mast (7) with lock washer (42) and screw (43).
- c. Secure bottom of cylinder assembly to intermediate mast (7) with spacer (29), clamp (28), screw (57), and lock washer (58).
- D Install cylinder cluster as described in paragraph 10-21, being sure to tighten bleeder screw (2, fig. 10-7) when clear, bubble free oil flow is obtained.

**Section VI. CARRIAGE AND BACKREST ASSEMBLIES**

**10-28. Description**

The fork lift carriage frame assembly is a welded assembly having two horizontal fork supports and two vertical carriage supports. The carriage supports each carry two welded stud bearing assemblies, which ride in the inner mast channels. The backrest assembly is a welded frame attached to the upper fork support. It serves to prevent loads from resting against the mast when the mast is tilted back.

**10-29. Removal and Disassembly**

- a. Fully retract mast assembly and unlock and remove carriage forks.
- b. Refer to figure 10-8 and remove and disassemble as follows:
- c. Using hoist, remove screws (3) and lock washers (2) attaching backrest (1) to carriage

KEY to fig. 10-8:

- 1. Backrest
- 2. Lock washer
- 3. Screw
- 4. Bearing
- 5. Shim
- 6. Shim
- 7. Frame assembly

- frame assembly (7). Remove backrest.
- d. Raise inner mast 24 inches from mast to floor and block in position.
- e. Remove screws (11 and 13), spacer (9), and lock washers (10) from carriage supports.
- f. Attach hoist to carriage frame assembly (7), remove slack and balance load.
- g. Disconnect chains (12) from carriage frame assembly (7).
- h. Slowly lower carriage frame assembly out bottom of inner mast and place on suitable supports, bearing assemblies up.
- i. Noting size and quantity of shims (5 and 6), remove bearings (4) and shims from welded studs (8) on carriage supports.

- 8. Stud
- 9. Spacer
- 10. Lock washer
- 11. Screw
- 12. Chain link
- 13. Screw

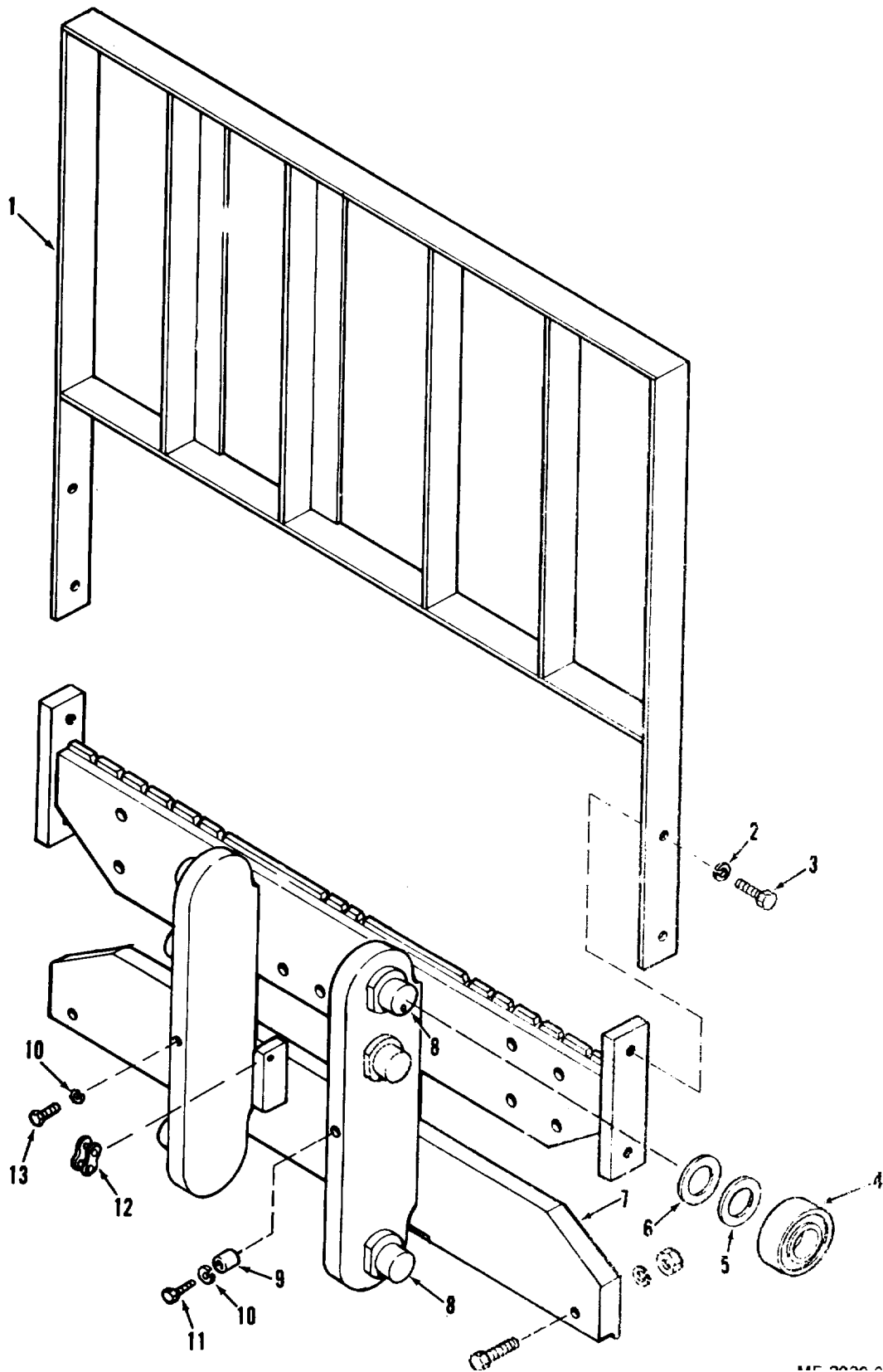


Figure 10-8. Backrest and carriage assembly exploded view.

**10-30. Cleaning, Inspection and Replacement**

- a. Clean parts with cleaning compound, solvent (Spec. P-S-661).
- b. Inspect backrest for cracked or broken welds, and any wear or bends which could interfere with heavy use.
- c. Inspect frame assembly for cracked or broken

weldments, unusual wear or bends, and misalignment of vertical carriage supports.

Note. Examine stud weldments closely.

d. Repair parts by welding if practical. When welding bearing studs use the procedure outlined in paragraph 10-13. Refer to figure 10-9 for stud location.

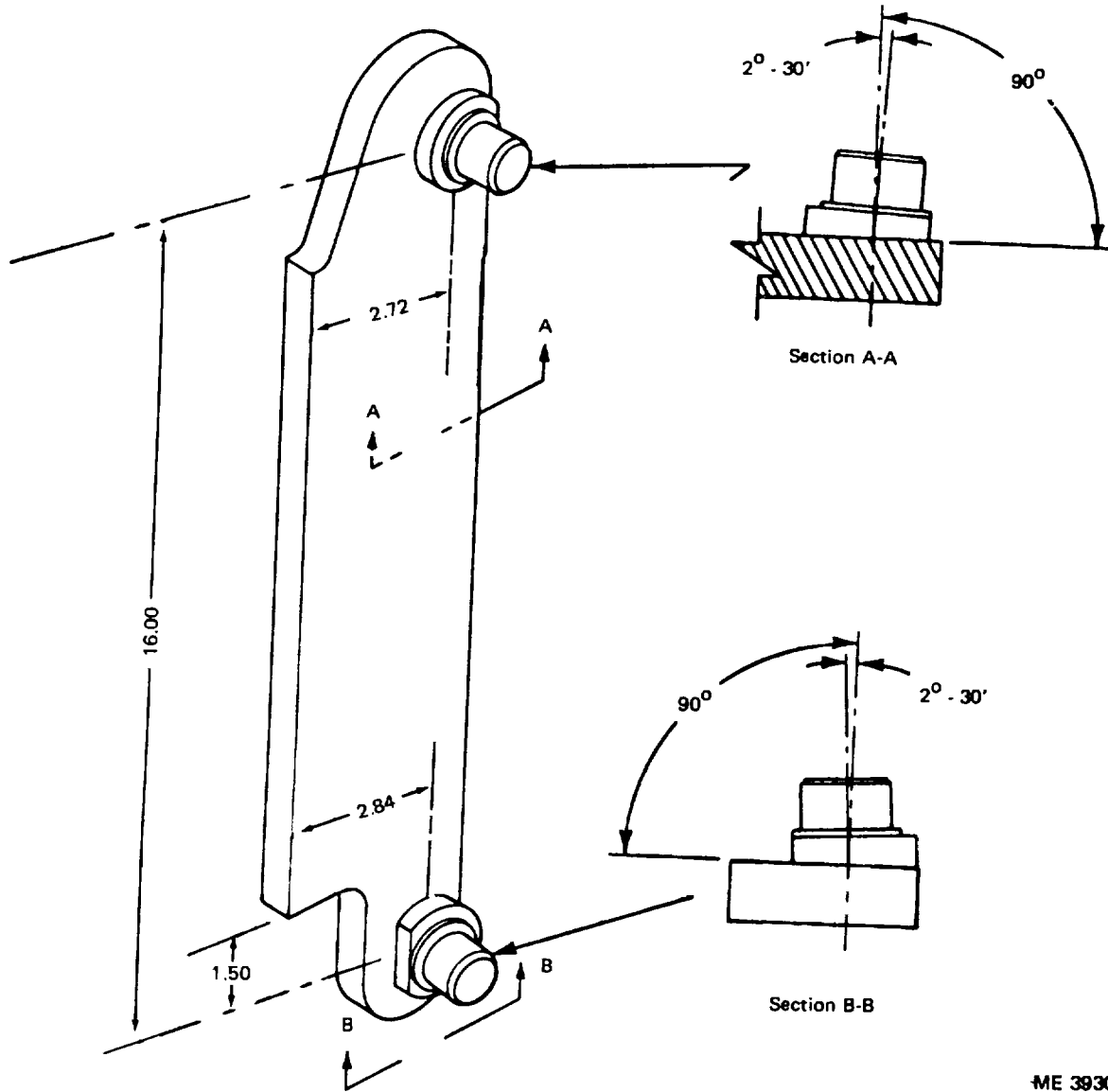


Figure 10-9. Carriage Roller Stud location.

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- e. Replace defective parts as authorized.

**10-31. Assembly and Installation**

a. Refer to figure 10-8 and assemble and install as follows: b. Install same size and quantity of shims (5) and 6) as found in disassembly. Install bearings (4).

c. Using hoist, raise and lower carriage frame assembly in inner mast channels several times to check for free movement throughout entire range of travel. If bearings bind, reshim to 0.015 of an inch clearance between bearings and mast channel.

Note. Divide shims as equally as possible between bearings. Shims are available in 0.015 and 0.040 inch thicknesses.

d. When carriage frame moves freely within clearance specified, secure chains with anchor pins to frame. Before releasing hoist, check that chains are secure at cylinder cluster and running evenly, with no twists, through the crosshead bearings.

e. Install screws (11 and 13), spacer (9), and lock washers (10) in carriage supports.

f. Remove blocks and lower inner mast to floor using a suitable hoist.

g. Using hoist, install backrest (1) on carriage frame (7) with lock washers (2) and screws (3).

h. Operate mast assembly and check carriage movement for side play and binding. If necessary, remove carriage and backrest assembly again and reshim. Alinement of inner mast channels and bearings should also be checked, if a second removal is necessary.

i. Lower carriage to lowest point of travel, check distance from lower horizontal fork support to floor. Distance should be adjusted within the 23/4 to 31/4 inch range. Refer to TM 10-3930-621-12 for adjustment procedure.

j. Install and lock carriage forks.

**Section VII. HYDRAULIC RESERVOIR**

**10-32. Description**

A hydraulic reservoir, located under the floor plate in the driver's compartment, contains sufficient oil for the entire hydraulic and power steering systems. The tank is of welded construction. Oil is added through a gage opening and measured on a screened gage installed in the tube. The reservoir is drained through a pipe plug installed in a cover at the bottom of the tank. Oil is withdrawn by the pump and returned from the control valve through tubing connected at diagonal corners of the tank. Hydraulic oil is returned to the tank from the power steering gear through a coupling at the bottom of the tank.

**10-33. Removal**

a. Refer to figure 10-10 and remove as follows:

b. Remove floor plates (TM 10-3930-621-12). Drain reservoir and remove breather (2), gage (3), and screen (4) from top of reservoir (1).

c. Disconnect suction and return hydraulic lines on top of reservoir (1).

d. Lift front end of truck and block in position to permit reservoir to be removed.

e. Disconnect power steering hydraulic return line at elbow (5) and allow line to drain. Remove elbow (5) from tank.

f. Remove nuts (14), cover (13), and packing (15) from bottom of reservoir (1). Discard packing.

g. Block reservoir (1) to support during removal.

h. Remove short screws (7), lock washers (9), flat washers (8), bushings (10), and nuts (11) attaching reservoir to mounting plate near front wheel.

i. Remove long screws (6), lock washers (9), flat washers (8), bushings (10), and nuts (11) attaching reservoir to rear crossmember of frame.

i. Slowly lower and remove reservoir (1).

**10-34. Cleaning and Inspection**

a. Flush reservoir (1) with cleaning compound, solvent (Spec. P-S-661). Dry thoroughly with compressed air.

b. Inspect tank for rust, cracked seams or damaged threads.

c. Clean breather and gage screen with reverse flow of hydraulic fluid or compressed air.

d. Inspect all parts for damage and replace as authorized.

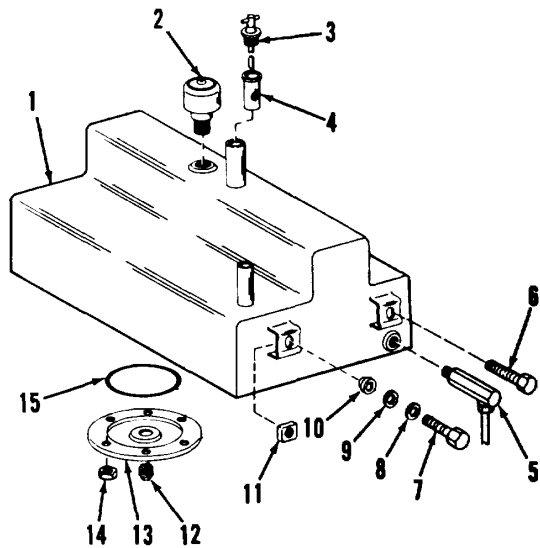
e. Replace packing.

**10-35. Repair**

a. If damage is such that repair by welding is possible, flush tank thoroughly to remove all traces of explosive solvents, both liquid and vapor.

Note. Reservoir must be thoroughly cleaned and flushed after repair.

b. If damage is beyond reasonable welding repair, replace tank as authorized.



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- |                 |                |
|-----------------|----------------|
| 1. Reservoir    | 9. Lock washer |
| 2. Breather     | 10. Bushing    |
| 3. Gage         | 11. Nut        |
| 4. Screen       | 12. Plug       |
| 5. Elbow        | 13. Cover      |
| 6. Screw, long  | 14. Nut        |
| 7. Screw, short | 15. Packing    |
| 8. Flat washer  |                |

Figure 10-10. Hydraulic reservoir, exploded view.

### 10-36. Installation

- a. Refer to figure 10-10 and install as follows:
- b. Using care not to damage tubing, lift reservoir (1) into position at bottom of truck and secure it with long screws (6), short screws (7), lock washers (9), flat washers (8), bushings (10), and nuts (11). Use long screws (6) on frame crossmember side of reservoir.
  - Note. Mounting clips are on lower portion of tank on crossmember side.
- c. Secure drain cover (13) and new packing (15) to bottom of reservoir (1) and install drain plug (12) in cover.
- d. Secure elbow (5) in coupling at side of reservoir and attach power steering hydraulic line to elbow.
- e. Check that reservoir is securely mounted and then lower truck to floor.
- f. Connect suction and return hydraulic lines to connections at top of reservoir (1).

Note. Suction line is the larger of the two lines and fits the bent tubing on the crossmember end of the reservoir.

- g. Install breather (2) and screen (4) in reservoir.
- h. Refer to TM 10-3930-621-12 and fill reservoir with specified hydraulic oil.

**Caution: NEVER USE BRAKE FLUID. When filling tank, make sure containers and surrounding parts are clean, to prevent oil contamination. Any hydraulic oil used must contain a rust preventative and an oxidation inhibitor. The oil should not foam.**

- i. Install gage (3) in tank.
- j. Install floor plates (TM 10-3930-621-12).

## Section VIII. HYDRAULIC PUMP

### 10-37. Description

The hydraulic pump is a gear type unit, driven directly through a coupling from the engine crankshaft. Reservoir oil is drawn through a suction port and directed by a spool to the power steering port at a maximum pressure of 1200 to 1300 psi with engine speed at 1400 rpm. When a specified flow is reached, the relief valve spring in the control valve compresses, allowing the spool to reposition and direct flow to the control valve port. A check valve on the power steering port of the pump maintains a steady 1000 to 1300 psi to the

power steering gear when the steering gear is operated. If pressure above 2000 psi develops when control levers are operated, it is by-passed at the control valve.

### 10-38. Removal

- a. Refer to figure 10-11 and remove as follows:
- b. Remove radiator grille guard (TM 10-3930-621-12).
- c. Disconnect hydraulic lines to power steering gear, control valve, and suction ports (TM 103930-621-12).

d. Remove screws and lock washers attaching pump plate to pump bracket and timing gear cover.

e. Remove pump with attached plate from coupling (3). Pull straight out so as not to damage splines.

f. Remove screws (38) and lock washers (37) attaching pump plate to pump assembly and remove plate.

g. Remove bolts (1), lock washers (2), and coupling (3) from crankshaft pulley.

**10-39. Disassembly**

a. Refer to figure 10-11 and disassemble as follows:

b. Clean outside of pump thoroughly with cleaning compound, solvent (Spec. P-S-661).

c. Place pump in vise, shaft up, and remove bolts (32) and flat washers (31).

d. Separate back plate assembly (44), body assembly (24), drive gear (25), idler gear (36), and front plate assembly (30).

e. Gently pry off diaphragm (26) from front plate (30) and remove gaskets (27 and 28), seal

(29), and packing (23). Discard diaphragm, gaskets, seal, and packing.

f. Remove springs (35), balls (34), and shaft seal (33) from front plate (30). Discard seal.

g. Disassemble back plate assembly (44) as follows:

(1) Slowly remove relief valve plug (6), shim (7), packing (8), spring (9), and poppet assembly (10). Discard packing. Remove poppet seat (11) from poppet assembly.

(2) Remove suction line elbow (39).

(3) Remove spool plug (22), packing (19 and 21), and spring (20). Discard packing.

(4) Remove spool plug (14), disks (12 and 15), packing (16), and spring (13). Discard packing.

(5) Carefully slide relief valve spool (17) and sleeve (18) from back plate.

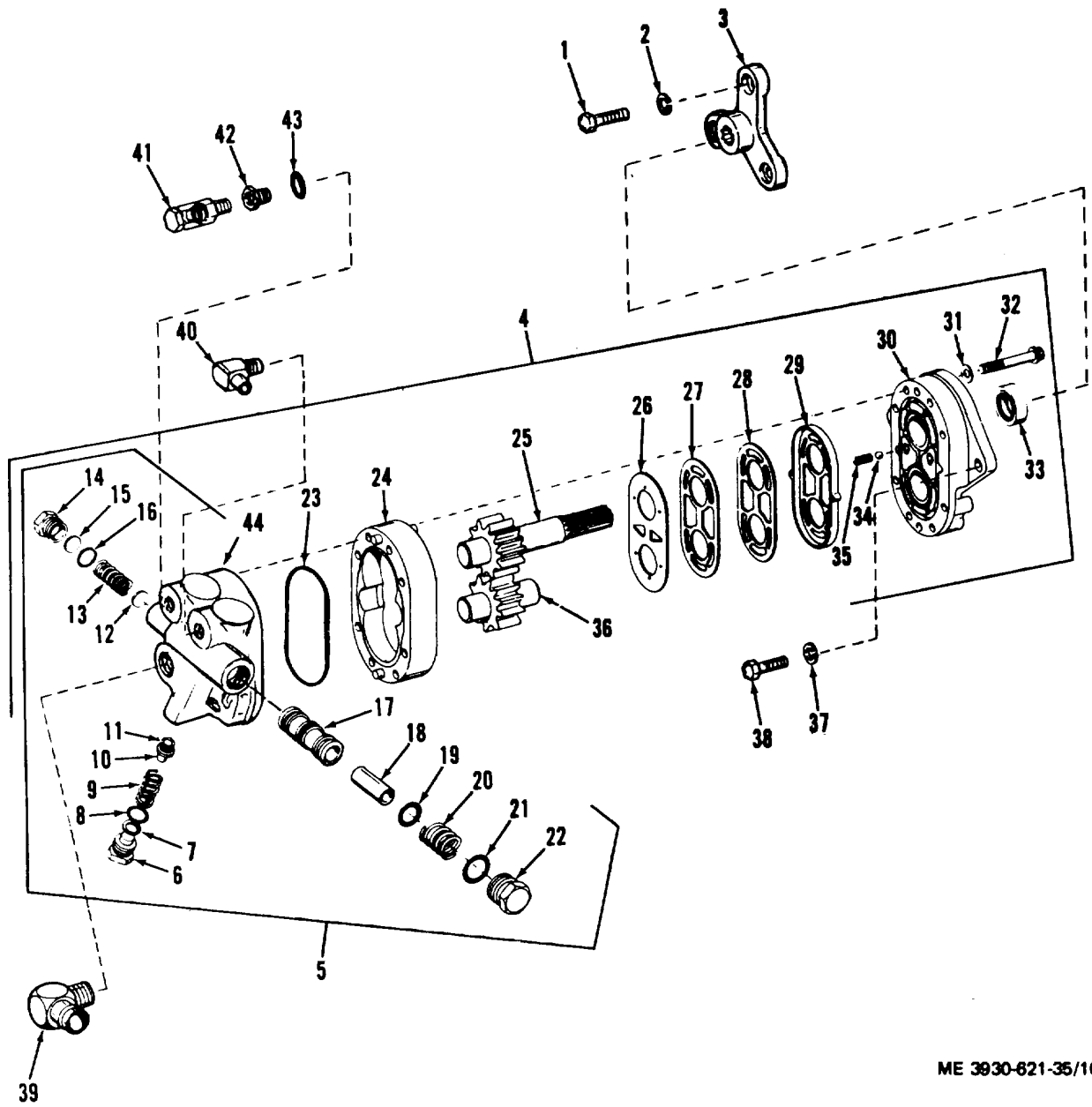
(6) Remove power steering port check valve (41), adapter (42), and packing (43) from port at top of back plate. Discard packing.

(7) Remove elbow (40) from control valve port.

KEY to fig. 10-11:

1. Bolt
2. Lock washer
3. Coupling
4. Pump assembly
5. Plate assembly
6. Plug
7. Shim
8. Packing
9. Spring
10. Poppet assembly
11. Poppet seat
12. Disk
13. Spring
14. Plug
15. Disk
16. Packing
17. Spool
18. Sleeve
19. Packing
20. Spring
21. Packing
22. Plug

23. Packing
24. Body assembly
25. Drive gear assembly
26. Diaphragm
27. Gasket
28. Gasket
29. Seal
30. Front plate assembly
31. Flat washer
32. Bolt
33. Seal
34. Ball
35. Spring
36. Idler gear assembly
37. Lock washer
38. Screw
39. Elbow
40. Elbow
41. Check valve
42. Adapter
43. Packing
44. Back plate assembly



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Figure 10-11. Hydraulic pump, exploded view

**10-40. Cleaning, Inspection, and Replacement**

Refer to figure 10-11 and clean, inspect, and replace as follows:

- a. General.
  - (1) Clean all parts with cleaning compound, solvent (Spec. P-S-661). Dry thoroughly with compressed air.
  - (2) Remove nicks and burrs from all parts with emery cloth.
- b. Drive and Idler Gears.
  - (1) Inspect drive gear shaft (25) for worn splines.
  - (2) Inspect both drive gear (25) and idler gear (36) at bearing and seal contact points for rough surfaces and excessive wear.
  - (3) Inspect both drive and idler gear faces for scoring and excessive wear. If edges of teeth are sharp, break edges with emery cloth.
- c. Bearings.
 

Note. Bearings are part of plate assemblies (30 and 44) and are not available separately.

  - (1) Inspect all bearing oil grooves. Grooves should be half way between horizontal and vertical on pressure side of pump.
  - (2) Check to see if front plate assembly (30) bearings are flush with islands in groove pattern.
- d. Back Plate Assembly. Check for scoring on face of back plate assembly (31). If wear exceeds 0.0015 of an inch, plate should be replaced.
- e. Body Assembly. Check inside of gear pockets in pump body for excessive scoring or wear.
- f. Spool and Poppet Seat. Carefully examine flow divider spool (17), sleeve (18) and poppet seat (11) for wear or damage.

**10-41. Assembly**

- a. Refer to figure 10-11 and assemble the pump unit as follows:
    - b. Use the following procedure to assemble back plate assembly.
      - (1) Install elbow (40) in control valve port and new packing (43), adapter (42), and check valve (41) in power steering port.
- Note. All ports are marked for correct installation.
- (2) Carefully insert spool (17) and sleeve (18) into back plate and center.
  - (3) Install poppet seat (11) and poppet assembly (10) in back plate so that seat is firmly seated in proper groove in the spool (17).
  - (4) Holding the back plate (44) in the upright position to insure proper seating of poppet, install spring (9), new packing (8), shim (7), and plug (6). Adjust spool (17) accordingly, before tightening plug.

- (5) Insert disk (12), long spring (13), new packing (16), and disk (15) on power steering port side of spool.
- (6) Insert new packing (19), short spring (20), and new packing (21) on control valve port side of spool.
- (7) Install plugs (14 and 22) on both ends of spool chamber, being careful not to disturb pop jet seating in spool.
- (8) Install suction line elbow (39).
- c. Install new packing (23) in back plate recess and diaphragm seal (29) into recess of front plate (7). Install new gaskets (27 and 28) into lip of diaphragm seal.
- d. Install and hold ball (34) and springs (35) in position in front plate (30).
- e. Install new diaphragm (26) into lip of diaphragm seal (29) on top of gaskets, ball and spring. Check to be sure diaphragm fits securely into diaphragm seal lip.
- f. Dip gear assemblies (25 and 36) in hydraulic oil and slip them into front plate (30) bearings. Turn gears and check for free rotation.
- g. Aline body assembly (24) dowels with front plate dowel holes and tap body with nonmetal object until body is firmly seated against front plate (30).
- h. Aline back plate (44) dowel holes with body assembly (24) dowels and install back plate on body.
- i. Place pump in vise, shaft up, and secure plate assemblies (30 and 44) and body assembly (24) with flat washers (31) and bolts (32). Torque bolts to 25 foot-pounds.
- j. Oil drive shaft seal (33) and install carefully over drive shaft (25) splines.
- k. Rotate pump shaft by hand. Pump should have some drag, but should turn freely after a short period of use.

**10-42. Installation**

- a. Be sure hydraulic system contains clean oil before installing pump.
- b. Refer to figure 10-11 and install pump as follows:
  - a. Install coupling (3) to crankshaft pulley with lock washers (2) and bolts (1).
  - d. Attach pump plate to pump assembly with lock washers (37) and screws (38).
  - e. Insert pump shaft into coupling (3). Shaft should slide easily into coupling. If it binds, remove pump and inspect coupling and shaft for burrs or other damage.



**Caution: Do not force pump into position as this will damage the bearings, resulting in poor operation and short pump life.**

f. Secure pump plate to pump bracket and timing gear cover with screws and lock washers.

g. Connect hydraulic tubes to power steering, control valve, and suction ports.

h. Run the pump at no load as follows: (1) Check for required reservoir oil level.

(2) Run pump for one minute at no load to allow system to fill. Check for pressure or air leaks in the system during run.

(3) Shut off engine and recheck reservoir oil level. If h/w, fill to proper level. If severe foaming is noted, it indicates a suction leak or improper oil and must be corrected.

i. Check pump pressures as follows:

(1) Install a 2000 psi pressure gage in the pressure side of the power steering circuit.

(2) Start engine and run pump under no load conditions.

(3) With engine running at 1400 rpm, turn steering wheels to their limit and observe pressure gage. Opening pressure should be between 1000 and 1200 psi.

(4) If opening pressure is above 1200 psi, remove shim(s) (7, fig. 10-11) from relief valve, and if pressure is below 1000, add shim(s).

**Caution: Pressure should never exceed 2000 psi, as higher pressures severely reduce pump life.**

## Section IX. HYDRAULIC CONTROL VALVE

### 10-43. Description

The hydraulic control valve serves to direct pressurized hydraulic oil from the hydraulic pump to tilt or lift cylinders. It contains two operating plungers, two check valves, and an adjustable relief valve. The single acting plunger operates the lift cylinders and the double acting plunger the tilt cylinders. When over 1200 psi oil pressure is applied, the check valves allow oil flow to either lift or tilt cylinders when levers are activated. The adjustable relief valve is a protective device that prevents damage to the hydraulic system due to pressures over 2000 psi. Such pressures are normally caused when lift or tilt cylinders reach full stroke and continued pump operation builds up pressure. If pressures rise above the relief valve pressure adjustment (1850 to 1950 psi), the valve unseats and allows oil to by-pass the plungers and return, through a filter, to the reservoir.

### 10-44. Removal

a. Make sure lift cylinders are collapsed and mast is tilted all the way forward.

b. Remove right side cowl from truck (TM 1030)30-621-12).

c. Remove cotter pins (13, fig. 10-13), flat washers (14) and, pins (10) attaching lift lever links (11) and tilt lever links (12) to lift plunger (38, fig. 10-12) and tilt plunger (10).

d. Tag all hydraulic lines so they will be reconnected to proper ports when the valve is installed.

e. Disconnect all hydraulic lines and remove fittings from valve housing (37) connections. Remove poppets from valve.

f. Remove screws (1, fig. 10-13), flat washers (15), and nuts (16) attaching valve to truck and remove valve.

g. Clean valve exterior with cleaning compound, solvent (Spec. P-S-661) and dry with compressed air.

### 10-45. Disassembly

a. Refer to figure 10-12 and disassemble as follows. Only components requiring service need be removed, unless complete overhaul is necessary.

**Caution:** It is extremely important to keep all parts clean at all times. Machined surfaces must be protected from nicks, scoring, gouging and other damage.

b. Remove end plugs (6) and packings (7 and 22). Discard packing.

c. Disassemble tilt plunger as follows: (1) Place valve in vise in horizontal position.

(2) Remove socket head screws (32) and remove plunger cap (33).

(3) Place a drift pin through eye of tilt plunger (10) and install drive head socket adapter on plunger sleeve screw (34).

(4) While holding adapter, strike drift pin with hammer. Blow should loosen sleeve screw (34) from plunger (10). If sleeve screw does not loosen, remove adapter and insert brass pin through either valve port into plunger holes. Strike brass pin with hammer.

**Caution:** To prevent damage to plunger holes, use brass pin only.

(5) Remove screw (34), seats (35), and spring (36) from tilt plunger (10).

(6) Remove upper seal plate screws (12) and upper seal plate (11).

(7) Slowly pull plunger (10) up and out from housing (37) with upper seal (9) and upper ring (8) attached. Remove upper seal and ring. Discard seal.

(8) Remove lower seal plate screws (12) and lower seal plate (11).

(9) Remove lower seal (9) and lower ring (8) from housing. Discard seal.

d. Disassemble lift plunger as follows: (1) Secure valve in vise horizontally.

(2) Remove socket head screws (32) and remove plunger cap (29) with adjusting screw (31) and nut (30). Mark position of nut on adjusting screw.

(3) Place a drift pin through eye of lift plunger (38) and remove lift plunger as instructed in procedure c.

e. Disassemble relief valve as follows: (1) Secure valve in vise horizontally.

(2) Remove cap nut (13), lock nut (15), and two copper washers (14 and 16) from adjusting screw (17).

(3) Slowly remove adjusting screw (17) from adjusting plug (18), and remove pilot spring (20).

(4) Remove adjusting plug (18) from pilot plug (19) and remove pilot plug with packing (7) from valve housing. Discard packing.

(5) Tilt valve housing and tap out spring guide (21).

(6) Remove plug(28) from bottom of housing and remove and discard packing (7).

(7) Remove spring (27) and slide sleeve (23) with poppet from bottom opening in housing.

(8) Remove poppet (26) from sleeve (23) and packing (25) from poppet groove. Discard packing.

(9) Tap or gently pry backup ring (24) from sleeve (23).

f. Remove check valve plugs (2), packings (3), springs (4), and poppets (5). Discard packings.

**10-46. Cleaning, Inspection, and Replacement**

a. Clean all parts with cleaning compound, solvent (Spec. P-S-661) and dry thoroughly with compressed air.

b. Inspect springs for cracks, wear. Deformation or signs of weakness.

c. Inspect machined surfaces for nicks, scratches, gouges, or other damage which would cause internal or external leakage.

d. Inspect housing for cracks, stripped threads, or other damage.

e. Inspect plungers and, plunger boxes for scoring, chips, nicks, cracks or other damage which could result in leaks.

f. Replace all seals and packing. Replace all defective parts as authorized.

KEY to fig. 10-12:

1. Control valve assembly
2. Check valve plug
3. Packing
4. Check valve spring
5. Poppet
6. End plug
7. Packing
8. Ring
9. Seal
10. Tilt plunger
11. Seal plate
12. Screw
13. Cap nut
14. Washer
15. Lock nut
16. Washer
17. Adjusting screw
18. Adjusting plug
19. Pilot plug

20. Pilot spring
21. Spring guide
22. Packing
23. Sleeve
24. Backup ring
25. Packing
26. Poppet
27. Spring
28. Plug
29. Plunger cap
30. Nut
31. Adjusting screw
32. Socket screw
33. Plunger cap
34. Sleeve screw
35. Seat
36. Spring
37. Housing
38. Lift plunger

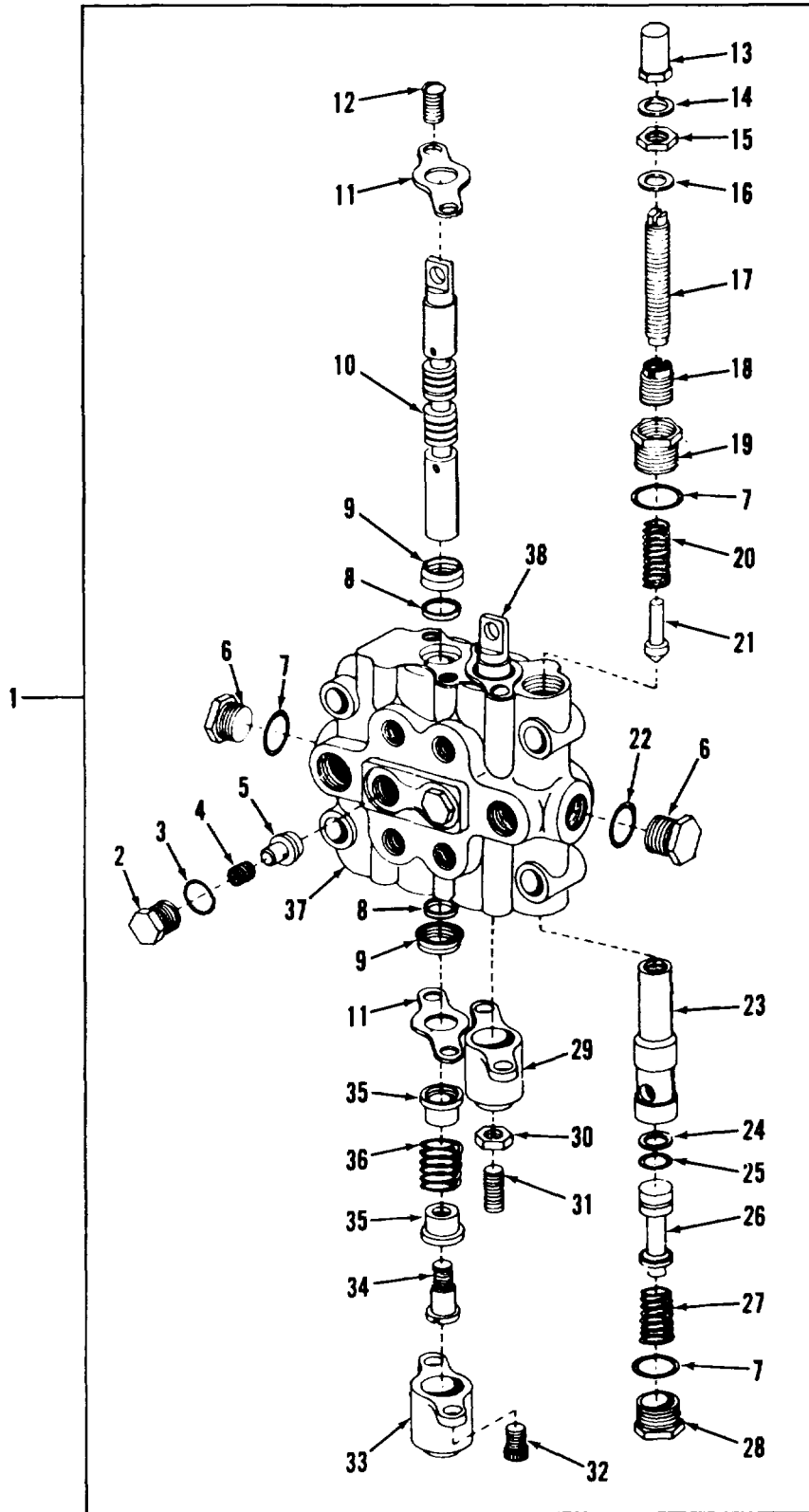


Figure 10-12. Hydraulic control valve, exploded view.

**10-47. Assembly**

- a. Refer to figure 10-12 and assemble as follows:
- b. Install check valve poppets (5), springs (4), new packings (3), and plugs (2). Reaching through inlet and outlet ports, press on face of check valve poppet to insure poppet is not binding.
- c. Assemble relief valve as follows: (1) Secure valve housing in vise, taking care not to damage machined surfaces.
  - (2) Install new packing (25) on barrel end of poppet (26).
  - (3) Install backup ring (24) and poppet, barrel end first, into hole end of sleeve. Poppet barrel end must seat firmly into sleeve against backup ring. Barrel must not block sleeve hole opening.
  - (4) Install assembled sleeve in bottom of housing, tapered end of poppet last, until sleeve opening can be seen through the inlet port.

**Caution: Although adjustment of the sleeve will move the sleeve opening within the inlet passage, the opening at no time should be blocked completely by moving it out of the inlet passage; or proper pressure relief will not be made, resulting in damage to the entire hydraulic system.**

- (5) Install new packing on plug (28) and firmly seat spring (27) in plug.
- (6) Carefully place plug assembly spring (27) up against tapered end of poppet (26) and partially tighten plug (28) in housing. Note position of sleeve hole through inlet opening. If hole moves above inlet passage, loosen plug (28).
- (7) Install pilot spring (20) on guide (21) and seat guide firmly in top end of sleeve.
- (8) Install new packing (7) on pilot plug (19) and screw plug into housing.
- (9) Screw adjusting plug (18) into pilot plug (19) until it seats lightly on sleeve (23). Completely tighten bottom plug (28). Check sleeve opening from inlet port and adjust plug (18) to maintain opening in passage.
- (10) Install adjusting screw (17) in adjusting plug (18) until it is snug against pilot poppet.

**Caution: Do not turn adjusting screw too tight against poppet, as entire valve sleeve may turn when it becomes necessary to loosen screw.**

Note. Final adjustment of relief valve is made after control valve is installed on truck. Refer to paragraph 10-49.

- (11) Install two copper washers (14 and 16), lock nut (15), and cap nut (13) on adjusting screw (17).
- d. Assemble tilt plunger as follows: (1) Place valve in vise in horizontal position, taking care not to damage housing.

(2) Install sleeve screw (34) into tilt plunger (10) until firmly seated.

(3) Slide lower spring seat (35), spring (36), and upper spring seat (35) on plunger (10) making sure spring is seated evenly on seal lips.

(4) Place sleeve screw end of plunger in plunger cap (33) and slide lower seal plate (11) on plunger cap, alining mounting holes.

(5) Install lower ring (8) and lower seal (9) in bottom of housing and insert plunger assembly slowly through ring, seal, and housing.

(6) Aline mounting holes of housing (37), seal plate (11), and tilt plunger cap (33) and secure plunger assembly to housing with two socket head screws (32).

(7) Install upper ring (8) and upper seal (9) on plunger (10) and seat firmly in housing.

(8) Install upper seal plate (11) and secure with two screws (12).

e. Assemble lift plunger as follows:

(1) Place valve in vise in horizontal position, taking care not to damage housing.

(2) Using lift plunger (38) and plunger cap (29), assemble lift spool parts as instructed in procedure d.

(3) Install adjusting screw (31) and nut (30) in plunger cap (29). Lock nut in place on adjusting screw as marked during disassembly.

f. Install end plugs (6) and new packings (7 and 22).

**10-48. Installation**

a. Install valve assembly on truck and secure with screws (1, fig. 10-13), flat washers (15), and nuts (16).

b. Install hydraulic line fittings and poppets on housing and, noting tags on lines, connect hydraulic lines.

c. Secure lever links (11 and 12, fig. 10-13) to respective plungers (10 and 38, fig 10-12) with pins (10, fig. 10-13), flat washers (14), and cotter pins (13).

d. Adjust relief valve (para 10-49).

e. Install right side cowl on truck (TM 10-3930621-12).

**10-49. Relief Valve Adjustment**

a. Description. Two relief valve adjustments are necessary to properly adjust the control valve. The overpressure adjustment must be made prior to the final adjustment. The overpressure adjustment is at a reduced speed and partial load. It compresses the poppet spring, requiring pressure above the normal setting to open the poppet. The final adjustment is at high speed and full load. It moves the sleeve and poppet assembly gradually up, relaxing the poppet

spring and allowing more pressure relief at a finer adjustment.

b. Overpressure Adjustment.

(1) Remove right side cowl on truck (TM 103930-621-12).

(2) Remove cap nut (13, fig. 10-12), washers (14 and 161, and lock nut (15).13) Turn down adjusting screw (17) until it is snug against sleeve 123).

Caution: Do not turn adjusting screw too tightly or entire valve sleeve may turn during further readjustment.

(4) Remove inlet plug from housing adjacent to inlet port.

(5) Connect a 3000 psi calibrated oil pressure gage to inlet plug opening.

(6) Start engine and run at approximately 1/4 of full rpm.

(7) Place adjusting tool over adjusting screw (117) and engage slots in adjusting plug (18).

(8) Operate tilt cylinder to end of stroke and hold long enough for pressure gage to register.

(9) Adjust plug until gage reads 2050 to 2150 psi.

c. Final Adjustment.

(1) Being careful not to disturb position of adjusting plug (18, fig. 10-12), loosen adjusting screw (17) several turns.

(2) Install washer (16) and lock nut (15) on adjusting screw (17). Do not tighten lock nut.

(3) With screw driver in slot of adjusting screw (17), accelerate engine to high rpm and actuate tilt and lift cylinders to the ends of their strokes.

(4) Adjust adjusting screw (17) until pressure gage reads 1850 to 1950 psi.

(5) While holding adjusting screw, tighten lock nut (15).

(6) Install washer (14) and cap nut (13).

(7) Install right side cowl on truck (TM 103930-621-12).

## Section X. CONTROL LEVERS AND LINKAGE

### 10-50. Description

The lift and tilt hydraulic system control levers are located in the operator's compartment to the right of the instrument panel. They operate lift and tilt plungers in the lift control valve. Motion is transmitted from the levers to lever controls and links.

### 10-51. Removal

a. Refer to figure 10-13 and disassemble as follows:

b. Remove right side cowl from truck (TM 10-3930-621-12).

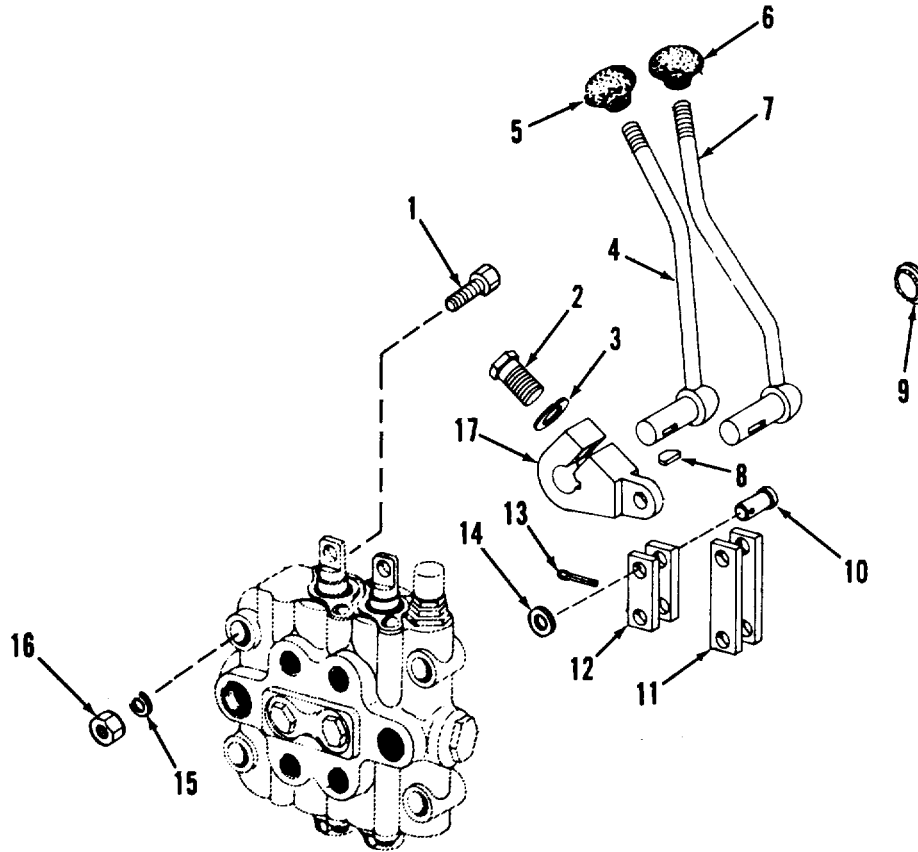
c. Remove cotter pins (13), washers (14), pins (10) attaching links (11 and 12) to lever controls (17) and control valve lift and tilt plungers. Remove links.

d. Remove control lever bolts (2) and lock washers (3) from control levers (17) and slide levers from handles (4 and 7).

e. Remove woodruff keys (8) from handle shafts.

f. Slide handles from cowl panel and remove cowl plugs (9).

g. Remove red tilt handle knob (5) and black lift handle knob (6), noting which color goes to each handle.



ME 3930-621-35/10-13

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>1. Screw</li> <li>2. Bolt</li> <li>3. Lock washer</li> <li>4. Tilt handle</li> <li>5. Red tilt knob</li> <li>6. Black lift knob</li> <li>7. Lift handle</li> <li>8. Key</li> <li>9. plug</li> </ul> | <ul style="list-style-type: none"> <li>10. Pin</li> <li>11. Lift link</li> <li>12. Tilt link</li> <li>13. Cotter pin</li> <li>14. Flat washer</li> <li>15. Flat washer</li> <li>16. Nut</li> <li>17. Lever</li> </ul> |
|--|---|

Figure 10-13. Control levers, exploded view

**10-52. Cleaning, Inspection, and Replacement**

- a. Clean all parts with cleaning compound, solvent (Spec. P-S-661) and dry thoroughly with compressed air.
- b. Inspect all contact surfaces for cracks, bends, corrosion, or other damage which could impair valve return spring action.
- c. Replace defective parts as authorized.

**10-53. Installation**

- a. Refer to figure 10-13 and install as follows:
  - b. Being careful to install correct knob color on handle, install red (tilt) handle knob (5) and black (lift) handle knob (6) on respective handles.

- c. Place cowl plugs (9) on handle shafts and insert handles (4 and 7) in cowl. Press cowl plugs in place.
- d. Install woodruff keys (8) in slot in handle shafts and slide on control levers (17).
- e. Secure levers (17) to handle shafts with bolts (2) and lock washers (3).
- f. Place handles in forward position and install links (11 and 12) on control levers (17) and control valve plungers and secure with pins (10), washers (14), and cotter pins (13).
- Note. Tilt link (12) is shorter than lift link (11).
- g. Install right side cowl on truck (TM 10-3930-621-12).

## APPENDIX A

REFERENCES

---

**A-1. Lubrication**

C9100IL  
LO 10-3930-621-12

Fuels, Lubricants, Oils, and Waxes  
Lubrication Order

**A-2. Maintenance**

TM 38-750  
TB Ord 651

Army Maintenance Management System  
Use of Antifreeze Solutions and Cleaning Com-  
pounds in Engine Cooling Systems  
Operator and Organizational Maintenance Manual  
Organizational Maintenance Repair Parts and  
Special Tool List  
DS, GS, and Depot Maintenance Repair Parts and  
Special Tool List

TM 10-3930-621-12  
TM 10-3930-621-20P

TM 10-3930-621-35P

**A-3. Shipment and Storage**

TM 740-90-1

Administrative Storage of Equipment

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