DEPARTMENT OF THE ARMY TECHNICAL MANUAL

# TECHNICAL MANUAL

# DIRECT SUPPORT AND GENERAL SUPPORT

# MAINTENANCE MANUAL

# CRANE, WHEEL MOUNTED: 20 TON AT 10 FOOT RADIUS;

# 2 ENGINES, DIESEL ENGINE DRIVEN, 4X4;

# AIR TRANSPORTABLE, PHASE III; W/BLADE, BULLDOZER,

# EARTHMOVING; W/BLOCK, TACKLE, 20-TON; W/BOOM,

# CRANE, 30 FOOT (AMERICAN HOIST AND DERRICK

# MODEL 2380) FSN 3810-763-7728
# (AMERICAN HOIST AND DERRICK MODEL 2385)

# FSN 3810-043-5354

This reprint includes all changes in effect at the time of publication - Change 2.

HEADQUARTERS, DEPARTMENT OF THE ARMY
MAY 1971

WARNING

**EXPLOSION AND FIRE HAZARD**
is present when servicing batteries and filling fuel tank.

**DEATH**
or severe injury may result if personnel fail to observe safety precautions. Do not smoke or use open flame around flammable material or when servicing the batteries. Do not fill the fuel tank while the engine is running. Be sure there are no open flames or exposed heated parts that can ignite fuel vapors while tank is being filled. Keep fuel container and funnel in contact while tank is being filled, or provide a ground to prevent static sparks from igniting the fuel. Do not attempt to weld a fuel tank unless the tank has been purged of all combustible vapors. Refer to TM 9-237 for safety precautions for welding containers that have held combustibles.

**HIGH VOLTAGE HAZARD**
is present if the boom accidentally contacts a power line.

**DEATH**
or severe injury may result if personnel fail to observe safety precautions. Keep the boom away from power lines. If the boom accidentally contacts a power line, jump from the machine; do not step off.

**TM 5-3810-232-34**
**C3**

CHANGE

NO.3

HEADQUARTERS
DEPARTMENT OF THE ARMY
*Washington D. C., 14 December 1990*

**Direct Support and General Support Maintenance Manual**
**CRANE, WHEEL MOUNTED: 20-TON AT 10-FOOT RADIUS, 2 ENGINES;**
**DIESEL ENGINE DRIVEN, 4 x 4; AIR TRANSPORTABLE,**
**PHASE III W/BLADE, BULLDOZER, EARTHMOVING;**
**W/BLOCK, TACKLE, 20-TON; W/BOOM, CRANE, 30-FOOT**
**(AMERICAN HOIST AND DERRICK MODEL 2380)**
**NSN 3810-00-763-7728 AND**
**(AMERICAN HOIST AND DERRICK MODEL 2385)**
**NSN 3810-00-043-5354**

TM 5-3810-232-34, 5 May 1971, is changed as follows:

Cover. The manual title is changed to read as shown above.

Page i.
The manual title is changed to read as shown above.

Table of Contents.

Chapter 3.
Delete entry for Section IV.
Delete entry for Section XXI.

Chapter 4. Delete entry for Section IV.

Page ii, Table of Contents.

Chapter 4. Delete entry for Section XVII.

Chapter 5. Delete entry for Section II.

Chapter 6.
Delete entry for Section V.
Delete entry for Section XII.

Page iii, List of Illustrations.
Delete entry for Number 2-2.

Delete entry for Number 3-9.
Delete entry for Number 3-16.
Delete entry for Number 3-17.

Delete entry for Number 3-18.
Add "Number 3-37.1, Double lubricating oil pump (Model 2385), disassembly and reassembly, page 3-60".
Delete entry for Number 3-38.

Page iv, List of Illustrations.
Delete entry for Number 4-19.
Delete entry for Number 5-3.
Delete entry for Number 5-40.

Page v, List of Illustrations.
Add "Number 5-54, Pintle hook, disassembly and reassembly, page 5-109".
Add "Number 6-8.1, Measuring gradual bends in bent lacing, page 6-11".
Delete entry for Number 6-10.
Delete entry for Number 6-11.

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

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

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

Add paragraph 1-2.1 as follows:

**1-2.1. Reporting Errors and Recommending Improvements**

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

Page 2-1, paragraph 2-2. Change "TM 5-3810-232-35P" to "TM 5-3810-232-34P".

**Approved for Public release; distribution is unlimited.**

Page 2-12. Add the following:

2-13. Steering Oscillation Problems on the Model 2380 and 2385 Cranes

a. Some steering oscillation is inherent in the model 2380 and 2385 cranes. Following the attached procedures will help to eliminate all or most oscillation. If oscillation cannot be completely eliminated, it must be reduced as to not affect the controllability of the crane or cause a safety problem. A slight oscillation is tolerable as long as it does not cause a safety problem. Steering oscillation while idling, stopped, or parked is not a problem. Oscillation becomes a problem only when the crane becomes uncontrollable while driving.

b. Many problems in the hydraulic steering system arise because of a contaminated hydraulic system. Before any checks or adjustments are accomplished the hydraulic system should be cleaned.

c. Cleaning of the hydraulic system can be accomplished by the use of the Tool Outfit, Hydraulic Systems Test and Repair (HSTRU) trailer or by use of the vehicle's own hydraulic filters. Best results are accomplished by use of the HSTRU filter.

d. Cleaning of the hydraulic system should be accomplished by installing the HSTRU filter at the hydraulic return line on the hydraulic tank or installing new vehicle hydraulic filters. After filter installation, the vehicle should be operated at 800 to 1000 RPMs for a period of 45 minutes to 1 hour while operating all hydraulic functions.

**CAUTION**

**If the filters should bypass, they should be replaced with a new filter and/or the RPMs should be reduced.**

After completion of the cleaning run, the HSTRU filter should be removed and new vehicle filters installed.

e. If hydraulic problems still exist the following checks and adjustments should be tried.

**CAUTION**

**If hydraulic lines or components are removed or replaced, the hydraulic system should be recleaned to prevent contamination**.

*Table 2-2. Troubleshooting Instructions for the Steering System on the Model 2380 and 2385 Cranes*

| Malfunction | Probable cause | Corrective action |
|---|---|---|
| 1. Does not respond | a. No/low/dirty oil | a. Fill/add/clean/replace. |
| | b. Clogged restrictor-check valves or in-line filters in front control cylinder lines | b. Clean and reinstall. |
| | c. Malfunctioning tow valve | c. Repair/replace. |
| | d. Jammed or bent control or steering cylinders | d. Repair/replace. |
| | e. Hydraulic component malfunction | e. Trouble diagnose and repair (para 2-15). |
| Erratic (jerky or oscillates) | a. Low/dirty oil | a. Add/clean/replace. |
| | b. Clogged restrictor-check valves or in-line filters in front control cylinder lines | b. Clean and reinstall. |
| | c. Worn/loose/out of adjustment linkage, mounts, and gearing | c. Check and adjust (para 2-14). |
| | d. Hydraulic component malfunction | d. Trouble diagnose and repair (para 2-15). |

## 2-14. Checks and Adjustment of Linkage, Mounts and Gearing

a. Check the centering cylinder boot on both the front and rear centering cylinders. The boots should be checked to be sure that they haven't been pinched between the outer cylinder wall and the inner cylinder. If this should happen, the centering cylinder will only work one way. At the same time, the cylinder snaprings should also be checked to be sure that they haven't slipped off, causing the same symptoms.

b. Check for wear, looseness and excessive play in all steering linkage, pivots, mounts, tie rods, and

gearing. Tighten, repair, or replace as necessary. The adjustment plug on the draglink valve and the tandem steering cylinder valves (both front and rear) should be torqued to 45 to 50 pound-inches.

c. Check alignment between right and left wheels on front axle. If the alignment is other than 0 to +A inch toe-in, adjust the tie rod length accordingly.

d. Axle Stop Clearance Checks and Adjustments.

(1) Raise the crane on outriggers until the weight of the crane is removed from all 4 wheels.

(2) With the engine off, screw in the pitman arm stops so that the front wheels can be turned against the axle stops in both directions.

(3) With the engine running and four-wheel steering engaged, check for axle stop contact in both directions and equal thread engagement between the two adjustable ends of the steering cylinders on all four wheels. It is important that there be equal thread engagement to preclude the bottoming out of the piston in the cylinder before axle stop contact.

(4) Starting first with the tandem steering cylinder on each axle, adjustment is made to the cylinder length or thread engagement by removing the cylinder to axle mounting bolt, loosening the clamping bolt(s), and turning the mounting socket in or out.

(5) With the wheel turned against the axle stop, the correct length is obtained when it is necessary to retract the rod into the cylinder, approximately Yie inch before the mounting bolt can be installed.

(6) When the adjustment is complete, retorque the clamping bolts and the steering cylinder to axle mounting bolts.

(7) Adjust the pit-man arm stops so that the clearance between the axle stops in both directions is between Y6 and $^{1}$ inch.

e. Control Cylinder Adjustments.

(1) Adjust the rear steer control cylinder length as follows:

(a) On a large level firm surface, such as a parking lot, and with the steering selector control in the front wheel steering position, drive the carrier straight ahead 10 to 15 feet allowing the rear steering to center itself.

(b) Check alignment of rear steer lockout bar holes. If the holes line up so that the pin can be installed, the rear control cylinder is the proper length. If the pin cannot be installed, adjust the cylinder length.

(c) Repeat subparagraphs (a) and (b) until the pin easily drops into place.

(2) Adjust the front steer control cylinder length as follows:

(a) Disconnect the draglink valve from the pitman arm and insure that the valve is in the neutral position. Insure that the rear steer lockout bar has been installed.

(b) Drive the carrier back and forth several times a distance approximately equal to the length of the carrier in order to allow the front axle to center itself.

(c) Check alignment of front wheels relative to the rear wheels. If the front and rear wheels do not line up adjust the front control cylinder length.

(d) Repeat subparagraphs (a) through (c) until the front and rear wheels are aligned.

f. Draglink Check and Adjustment.

(1) After adjusting the front control cylinder length, secure the steering wheel in the center of its total range of rotation.

(2) Adjust the length of the draglink(s) such that the draglink valve stud easily slides into the pitman arm hole. Ensure that all of the rod ends on the draglinks have adequate thread engagement.

g. Steering Gear Assembly Check and Adjustment.

(1) With the steering wheel in the center position, wedge the pitman arm to prevent any movement of the arm.

(2) Rotate the steering wheel. If movement at the rim exceeds 3 inches, check for looseness in the universal joints and gear boxes. Adjust the steering gear assembly according to the appropriate technical manual.

(3) Remove the wedges from the pitman arm. With the crane on outriggers and the engine off, rotate the steering wheel through several full right and left turns. If the steering gear assembly is properly adjusted, the maximum resistance to rotation is felt when the wheels are in the straight ahead position.

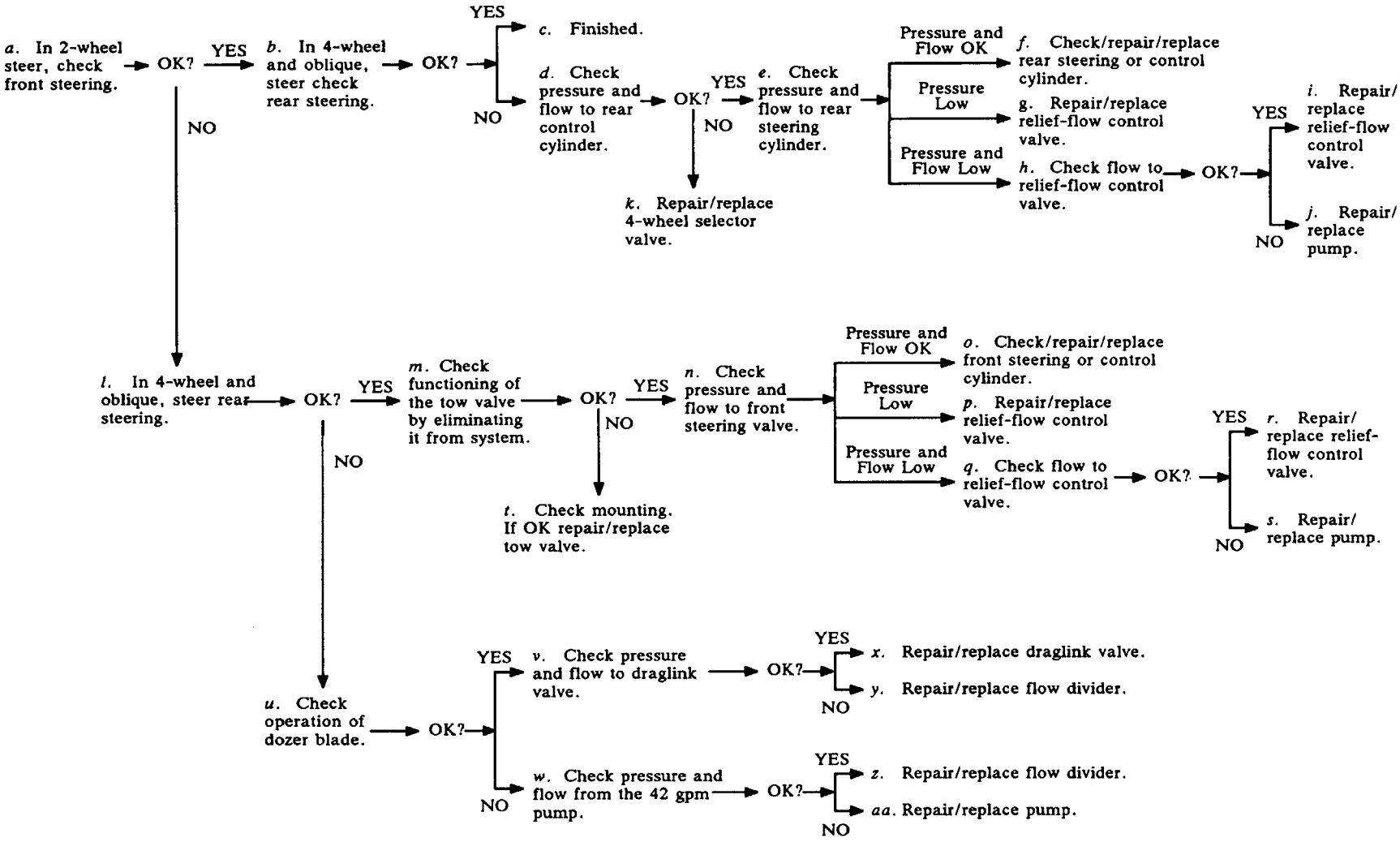
**2-15. Hydraulic System Trouble Diagnosis Procedures**

**NOTE**

**The following trouble diagnosis procedures are illustrated in Table 2-3.**

a. With the rear steer lock installed and the steering selector in 2-wheel steer, drive the carrier through various radii turns in both directions at various speeds in order to thoroughly check the operation of the front steering. If the front steering is acceptable, proceed to step b. If the front steering is not acceptable, proceed to step I.

*Table 2-3. Hydraulic system trouble diagnosis flow chart.*




NOTE: After repair or replacement of any component, restart procedure at step a.

b. With the crane stopped remove, the rear steer lock and engage 4-wheel steer. Drive the crane a sufficient distance in both modes (4-wheel and oblique) to check the operation of the rear steering. If the rear steering is functioning properly, proceed to step c. If the rear steering is not functioning properly, proceed to step d.

c. The steering system is functioning properly and the steering system trouble diagnosis has been completed. If the crane is intended to be driven mainly over the highway, the rear steer lock should be reinstalled. If the crane will be driven over rough terrain, the rear steer lock should remain removed.

d. By the best means available, check the pressure and flow of the supply to the rear control cylinder (centering cylinder or lower of the tandem cylinders). The pressure should be 625 to 675 psi at low (700 rpm) idle and the flow rate should be 9 to 11 gallons per minute (gpm) at both low and high (2600 rpm) idle. If the pressure and flow rate are within limits, proceed to step e. If the pressure and flow rate are not within limits, proceed to step k.

e. Check the pressure and flow of the supply to the rear steering cylinder valve. The pressure should be 1475 to 1525 psi at low idle and the flow rate should be 7 to 9 PM at both low and high idle. If both the pressure and flow are within limits, proceed to step f. If the flow rate is within limits but the pressure is low, proceed to step g. If both the pressure and flow are low, proceed to step h.

f. The problem is either the rear control cylinder or the rear steer cylinder. Check the control cylinder for jamming by the centering spring. Check both cylinders for bent rods. Repair or replace as necessary.

g. The relief valve in the flow control and relief valve for the rear steer circuit is malfunctioning. The relief valve is adjustable. If the problem cannot be corrected by cleaning and adjustment, the valve should be replaced.

h. Check the pressure and flow of the supply to the rear steer circuit flow control and relief valve. The pressure should be 2100 psi at low idle. The flow rate should be 5 to 7 gam at low idle and 20 to 22 gam at high idle. If the flow rates are within the limits, proceed to step i. If the pressure and flow are low, proceed to step j.

i. The flow control and relief valve for the rear steer circuit is defective or malfunctioning, and the valve must be repaired or replaced.

j. The pump or pump drive for the rear steer circuit is defective. To check the pump drive, remove the pump and inspect the drive mechanism. If the drive is in good condition, the pump must be repaired or replaced.

k. The steering selection valve (hand and pilot operated) is malfunctioning or defective. It should be repaired or replaced.

L. With the crane stopped, remove the rear steer lock and engage 4-wheel steer. Drive the crane a sufficient distance in both modes (4-wheel and oblique) to check the operation of the rear steering. If the rear steering is functioning properly, proceed to step m. If the rear steering is not functioning properly, proceed to step u.

m. Check the functioning of the tow valve by removing the valve, capping the lines, and operating the front steering to check for any change. If there is no change in the operation of the front steering, the tow valve is functioning properly. Proceed to step n. If there is an improvement in the front steering, the tow valve is malfunctioning. Proceed to step t.

n. Check the pressure and flow of the supply to the front steering cylinder valve. The pressure should be 1475 to 1525 psi at low idle and the flow rate should be 7 to 9 gpm at both low and high idle. If both the pressure and flow are within limits, proceed to step o. If the flow rate is within limits but the pressure is low, proceed to step p. If both pressure and flow are low, proceed to step q.

o. The problem is either the front control cylinder or the front steer cylinder. Check the control cylinder for jamming by the centering spring. Check both cylinders for bent rods. Repair or replace as necessary.

p. The relief valve in the flow control and relief valve for the front steer circuit is malfunctioning. The relief valve is adjustable. If the problem cannot be corrected by cleaning and adjustment, the valve should be replaced.

q. Check the pressure and flow of the supply to the front steer circuit flow control and relief valve. The pressure should be 2100 psi at low idle. The flow rate should be 5 to 7 gam at low idle and 20 to 22 gam at high idle. If the pressure and flow rate are within limits, proceed to step r. If the pressure and flow are low, proceed to step s.

r. The flow control and relief valve for the front steer circuit is defective or malfunctioning, and the valve must be repaired or replaced.

s. The pump or pump drive for the front steer circuit is defective. To check the pump drive, remove the pump and inspect the drive mechanism. If the drive is in good condition, the pump must be repaired or replaced.

t. The tow valve mounting may be distorting the valve body, thus causing it to malfunction. Place two YB inch washers on the mounting caps crews between the valve body and the mount. If this does not correct the tow valve problems, the valve must be repaired or replaced.

u. Operate the dozer blade at 1000 rpm engine speed. If the blade functions properly, proceed to step v. If the blade does not function properly, proceed to step y.

v. Check the pressure and flow of the supply to the draglink valve. The pressure should be 625 to 675 psi at low idle. The flow rate should be 9 to 10 gpm at both low and high idle. If the pressure and flow are within limits, proceed to step w. If the pressure and flow are low, proceed to step x.

w. The draglink valve is malfunctioning or defective. Check for jamming or worn or broken parts. Repair or replace as necessary.

x. The flow divider is malfunctioning or defective. Repair or replace as necessary.

y. Check the pressure and flow of the supply to the flow divider valve. The pressure should be 2100 psi at low idle and 41 to 43 gam at high idle. If the pressure and flow are within limits, proceed to step z. If the pressure and flow are low, proceed to step aa.

z. The flow divider valve is malfunctioning or defective. Repair or replace as necessary. a. The pump or pump drive for the steering control and dozer blade circuit is defective. To check the pump drive, remove the pump and inspect the drive mechanism. If the drive is in good condition, the pump must be repaired or replaced.

Page 3-16. Section IV, CARRIER BATTERY BOX ASSEMBLY is rescinded.

Page 3-17. Figure 3-9 is rescinded.

Page 3-18. Add paragraph 3-14.1.

**3-14. Repair**

Repair defective wires in wiring harness.

Page 3-33. Section X, CARRIER RADIATOR AS-SEMBLY is rescinded.

Page 3-34. Figure 3-16 is rescinded.

Page 3-35. Figure 3-17. (1) is rescinded.

Page 3-36. Figure 3-17. (2) is rescinded.

Page 3-37. Figure 3-18 is rescinded.

Page 3-60. Add paragraph 3-63.1.

**3-63. Double Lubricating Oil Pump With Pressure Regulator (Model 2385)**

**NOTE**

Model 2385 carrier engine assembly does NOT have an external pressure regulator. The regulator is a component of the lubricating pump mounted in the oil pan compartment. This procedure only applies to the Model 2385 Crane.

a. Removal.

(1)Remove oil pan assembly (para 3-58).

(2) Remove oil pump as illustrated in figure 3-36.

b. Disassembly.

(1) Remove suction tubes from pump assembly if not previously removed.

(2) Remove pressure regulator cap, spring, plunger, and shim (fig. 3-37.1).

(3) Remove capscrews and lockplates securing scavenger body to main pump body. Remove body by tapping with soft hammer; discard gasket.

(4) Remove idler gear from scavenger body and press shaft from body.

(5) Pull drive gear from back side of pump body.

(6) Remove capscrews securing cover plate to front of pump; remove cover plate., (7) Remove capscrews and lock-plates securing cover to pump body. Remove cover with main drive gear and shaft.

(8) Pull main drive gear from shaft; remove shaft and gear from cover.

(9) Remove driven gear and shaft from body.

c. Cleaning and Inspection.

(1) Clean all parts in an approved cleaning solvent and dry thoroughly.

(2) Inspect pump drive gear; discard if teeth are chipped, cracked, scored, or worn.,

(3) Inspect all pump gears; discard gears if chipped, cracked, scored, or worn smaller than 2.397 inch outside diameter.

(4) Inspect drive shaft. Mark for replacement if scored or worn smaller than 0.8740 inch outside diameter.

(5) Inspect idler shafts. Mark for replacement if scored or worn smaller than 0.8750 inch outside diameter.

(6) Inspect all bushings for distortion and wear. Mark for replacement if worn larger than 0.8785 inch inside diameter.

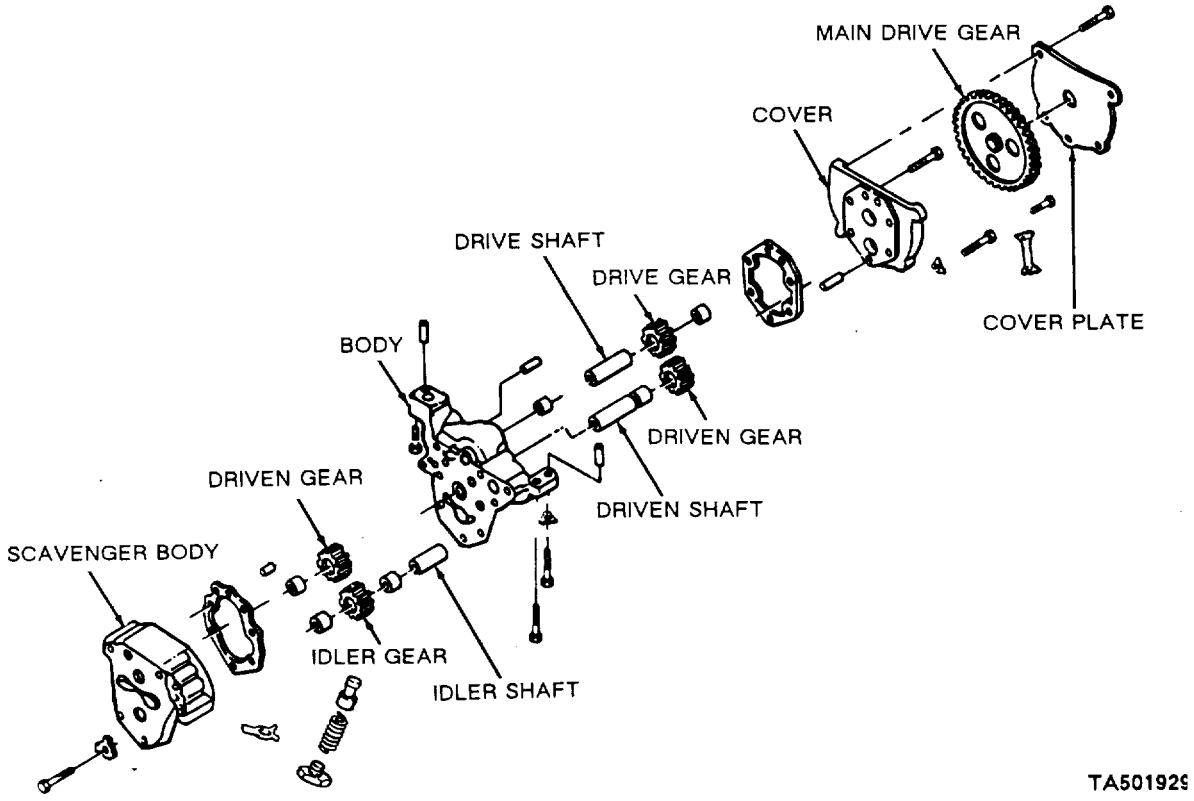



*Figure 3-37.1. Double lubricating oil pump (Model 2385), disassembly and reassemble*

(7) Check gear pockets. If finished surfaces are damaged or pocket inside diameter is worn larger than 2.4105 inch, or if depth is worn deeper than 1.252 inch, discard bodies.

d. Repair.

(1) If bushings in bodies or covers were marked for replacement, remove and press in new bushings 0.020/0.030 inch below surface.

(2) Bore new bushings to 0.8770/0.8775 inch inside diameter.

**CAUTION**

**Clean thoroughly to remove all burrs, chips, and foreign particles.**

e. Reassemble.

(1) If dowels were removed from bodies, press in new dowels.

(2) Press driven gear on shaft to 0.545/0.575 inch from end.

(3) Install gear and shaft assembly into body.

(4) Press scavenger drive gear on shaft to 0.002/0.004 inch from body.

(5) Press drive gear on shaft 1.290/1.232 inch from end.

(6) Place drive gear and shaft in body.

(7) Install gasket and cover to body; secure with capscrews and lockplates.

(8) Press main drive gear on shaft flush to 0.020 inch below end of shaft.

(9) Install cover plate with capscrews; stake capscrews in three places.

(10) Press idler shaft into scavenger body. Install idler gear on shaft.

(11) Install body and gasket; secure with capscrews and lock-plates.

(12) Install pressure regulator spacer, plunger, and spring in pump body; secure with pressure regulator cap.

(13) Suction tubes may be installed on pump to permit installation of complete unit during assembly.

f. Installation.

(1) Install oil pump assembly as illustrated in figure 3-36.

(2) Install oil pan assembly (para 3-61).

Section XXI, CARRIER ENGINE OIL COOLER is rescinded.

Figure 3-38 (1) is rescinded.

Page 3-61. Figure 3-38 (2) is rescinded.

Page 4-5.

Section IV, CRANE BATTERY CASE ASSEMBLY is rescinded.

Paragraph 4-15. Change "TM 5-3810-232-35P" to "TM 5-3810-232-34P"

Page 4-26.

Section XVII, CRANE ENGINE OIL COOLER is rescinded.

Figure 4-19 (1) is rescinded.

Page 4-27. Figure 4-19 (2) is rescinded.

Page 5-9. Section II, CARRIER PROPELLER SHAFTS is rescinded.

Page 5-10. Figure 5-3 is rescinded.

Page 5-36, paragraph 5-166. Delete reference to "TM 9-1870-1".

Page 5-83.

Paragraph 5-31a is superseded as follows:

a. Removal. Refer to TM 5-3810-232-12.

Figure 5-40 is rescinded.

Page 5-90. Paragraph 5-31f is superseded as follows:

f. Installation. Refer to TM 5-3810-232-12.

Page 5-103, paragraph 5-41a. Delete reference to "TM 9-3810-232-12".

Page 5-104, paragraph 5-41e. Delete reference to "TM 5-3810-232-12".

Page 6-1. Paragraph 6-2a is superseded as follows:

a. Removal.

(1) Remove the primary drive chain guard and drive chain (TM 5-3810-232-12).

(2) Remove the master clutch control assembly (TM 5-3810-232-12).

(3) Remove the engine clutch assembly as instructed in figure 6-1.

Page 6-3. Figure 6-1. (3) is rescinded.

Page 6-5. Paragraph 6-2e is superseded as follows:

e. Installation.

(1) Install the engine clutch assembly as instructed in figure 6-1.

(2) Install the master clutch control assembly (TM 5-3810-232-12).

(3) Install the primary drive chain and chain guard (TM 5-3810-232-12).

(4) Adjust clutch (TM 5-3810-232-12).

Page 6-11. Paragraph 6-8 is superseded as follows:

6-8. Inspection and Repair

**WARNING**

**Boom repair is limited only to component parts replacement. Main chord angles shall not be repaired or straightened below Depot level. Lacing members may be cold straightened at DS level. Cutting and welding of lacing and chord angles is not permitted below Depot level.**

Repairs authorized at direct support level are cold straightening of gradual bends and replacing bolts, sheaves, and bearings. A "gradual bend" is determined by laying a straightedge across the bend (fig. 6-8.1). Measure the length of the straightedge between both points of contact, and measure the maximum gap between the angle iron (lacing) and the straight edge. Multiply the distance between the contact points by 0.025. If the product is equal to or less than the maximum gap, the bend is considered "gradual" and may be cold straightened. If the product exceeds the maximum gap, the lacing should be replaced. However, replacement of lacing is only authorized at depot level and will not be attempted by a lower maintenance level. Repairs to chord angles are not authorized below depot level. During boom inspection, if it is determined that more than one third of the lacing is damaged on any one side, per boom section, it will render the boom not mission capable (deadlined) and will not be used until the deficiency is corrected.

Page 6-13. Section V, CRANE HOIST DRUM SHAFT is rescinded.

Page 6-14. Figure 6-10 is rescinded.

Page 6-15. Figure 6-11 (1) is rescinded.

Page 6-16. Figure 6-11 (2) is rescinded.

Page 6-33.

Section XII, CRANE GANTRY FRAME is rescinded.

Figure 6-23 is rescinded.

Page A-1.

Paragraph A-1. Change "TB 5-4200-200-10" to "TM 5-4200-200-100".

Paragraph A-2. Change the title of LO 5-3810232-12 to "Crane, Wheel Mounted: 20-Ton at 10-Foot Radius; 2 Engines, Diesel Engine Driven, 4 x 4; Air Transportable, Phase III w/Blade, Bulldozer, Earthmoving; w/Block, Tackle, 20-Ton; w/Boom, Crane, 30-Foot (American Hoist and Derrick Model 2380) NSN 3810-00-763-7728 and (American Hoist and Derrick Model 2385) NSN 3810-00-043-5354".

A = Distance between straight edge contact points.
B = Maximum distance between straight edge and bent lacing.
C = A x 0.025
If C is equal to or less than B, the bend may be cold straightened.
If C is greater than B, the lacing should be replaced by depot level maintenance.

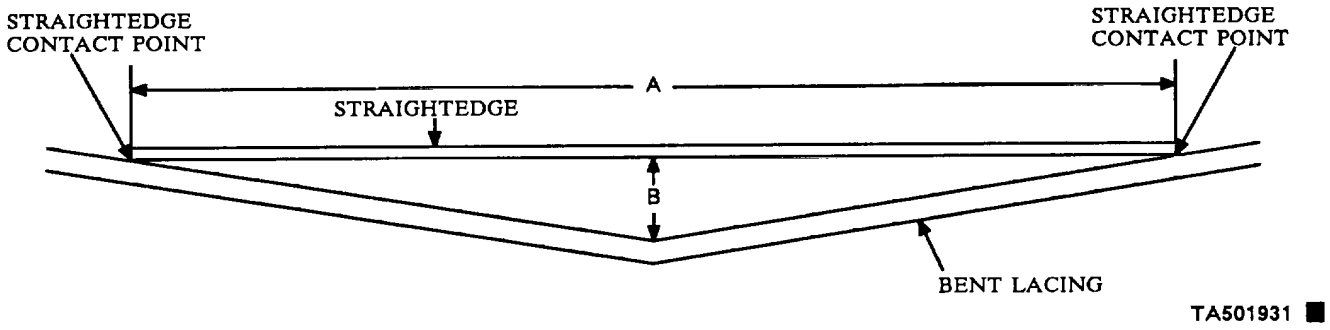



*Figure 6-8.1. Measuring gradual bends in bent lacing.*

Paragraph A-3. Change "TM 9-213" to "TM 43-0139".
Paragraph A-4.Change"TM 11-483" to "FM 11-65".
Paragraph A-5.

Change the title of TM 5-3810-232-12 to "Operator and Organizational Maintenance Manual, Crane, Wheel Mounted: 20-Ton at 10-Foot Radius; 2 Engines, Diesel Engine Driven, 4 x 4; Air Transportable, Phase III w/Blade, Bulldozer, Earth moving; w/Block, Tackle, 20-Ton; w/Boom, Crane, 30-Foot (American HoistandDerrickModel2380) NSN 3810-00-763-7728 and (American Hoist and Derrick Model 2385) NSN 3810-00-043-5354".

Change "TM 9-207" and its title to "FM 9-207, Operation and Maintenance of Ordnance Materiel in Cold Weather (0° to -650F)".

Change "TM 9-6140-200-15" and its title to "TM 9-6140-200-14, Operator's, Organizational, Direct Support and General Support Maintenance Manual for Lead-Acid Storage Batteries".

Change "TM 38-750" and its title to "DA Pam 738-750, The Army Maintenance Management System (TAMMS)".

Change "TM 5-3810-232-35P" and its title to "TM 5-3810-232-34P, Direct Support and General Support Maintenance Repair Parts and Special Tools Lists (Including Depot Maintenance Repair Parts and Special Tools Lists), Crane, Wheel Mounted: 20-Ton at 10-Foot Radius; 2 Engines, Diesel Engine Driven, 4 x 4; Air Transportable, Phase III w/Blade, Bulldozer, Earth moving; w/Block, Tackle, 20-Ton; w/Boom, Crane, 30-Foot (American Hoist and Derrick Models 2380) NSN 3810-00-0763-7728 and (American Hoist and Derrick Model 2385) NSN 3810-00-043-5354".

Page I-1.

Following Carrier transmission excessively noisy, add "Checks and adjustment of linkage, mounts and gearing, paragraph 2-14, page 2-12".

Delete entry for Crane hoist drum shaft assembly. Page 1-2. After Direct support and general support and depot maintenance repair parts, add "Double lubricating oil pump with pressure regulator, paragraph 3-63.1, page 3-60".

Page 1-3.

Following Hydraulic reservoir tank, add "Hydraulic system trouble diagnosis procedures, paragraph 2-15, page 2-12".

Delete entry for Propeller shaft.

Following Steering gear boxes, carrier, add "Steering oscillation problems on Model 2380 and Model 2385 cranes, paragraph 2-13, page 2-12".

By Order of the Secretary of the Army:

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

Official:
THOMAS F. SIKORA
Brigadier General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-25-E. Block 0582, Direct Support and General Support requirements for TM 5-3810-232-34.

*U.S. GOVERNMENT PRINTING OFFICE: 1990 543-016/40038

**Change in force: C 2**

**TM 5-3810-232-34**
***C 2**

CHANGE

No. 2

HEADQBARTIRS
DEPARTMENT OF THE ARMY
*WASHINGTON, DC, 30 December 1980*

**Direct Support and General Support**
**Maintenance Manual**
**CRANE, WHEEL MOUNTED: 20 TON AT 10 FOOT RADIUS;**
**2 ENGINES, DIESEL ENGINE DRIVEN, 4X4; AIR**
**TRANSPORTABLE, PHASE III; W/BLADE, BULLDOZER,**
**EARTHMOVING; W/BLOCK, TACKLE, 20-TON; W/BOOM**
**CRANE, 30 FOOT (AMERICAN HOIST AND DERRICK**
**MODEL 2380) NSN 3810-00-763-7728 (AMERICAN HOIST AND**
**DERRICK MODEL 2385) NSN 3810-00-043-5354**

TM 5-3810-232-34, 5 May 1971, is changed as follows:
Inside Front Cover add the following warnings:

**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 which were fitted by a trained professional.

**WARNING**

Dry-cleaning solvent, SD-2, used to clean parts, is potentially dangerous to personnel and property. Do not use it near an open flame or excessive heat. The flash point of solvent is 1380 F.

Page ii, chapter 5, section IX, page number column change "5-58" to "5-57".

Page 1-1, paragraph 1-2b is superseded as follows:

b. Reporting Errors and Recommending Improvements. You can help to improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA 2028 (Recommended Changes to Publications and Blank Forms) direct to: Commander, US Army Tank-Automotive Materiel Readiness Command, ATTN: DRSTAMBP, Warren, MI 48090. A reply will be furnished to , you.

Page 1-11. After paragraph 1-4b(6) add the following:

(7) Hydraulic circuit pressure check points. See figure 1-5.

Page 1-15. Figure 1-5 is added as follows:

*** This change supersedes C 1, 18 July 1974.**

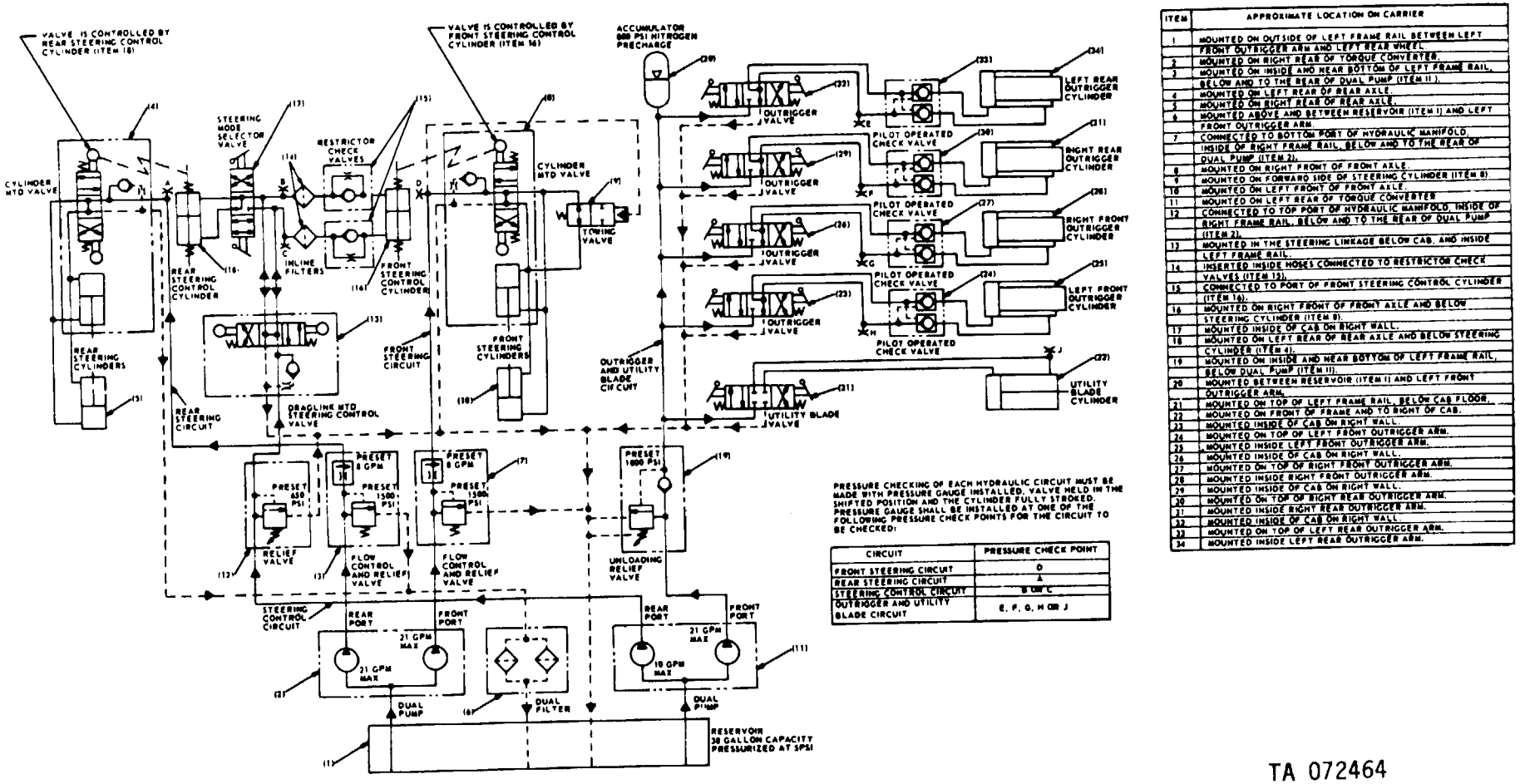



*Figure 1-5. Hydraulic circuit pressure points.*

Page 2-1, paragraph 2-1 is superseded as follows:

**2-1. Special Tools and Equipment**

For swing clutch and torque fuel adjustments, see Special Tools, table 4-1, TM 5-3810-232-12.

Page 2-5, table 2-1, add the following:

| Malfunction | Probable cause | Corrective action |
|---|---|---|
| 15. Deleted | | |
| 28. Outrigger will not operate. | a. Defective control valve. | a. Repair or replace control valve (para 5-26, 5-27). |
| | b. Defective hydraulic pump. | b. Repair or replace hydraulic pump (para 5-24, 5-25). |
| | c. Defective outrigger hydraulic cylinder. | c. Repair outrigger hydraulic cylinder (para 5-31). |
| 29. Steering is hard to operate or slow. | a. Defective hydraulic pump. | a. Repair hydraulic pump (para 5-24). |
| | b. Defective control valve. | b. Repair steering control valve (para 5-26, 5-27). |
| | c. Centering cylinder is defective. | c. Repair or replace centering cylinder (para 5-32). |
| | d. Defective relief valve. | d. Repair or replace relief valve (para 5-27). |
| | e. Control cylinder is defective. | e. Repair or replace control cylinder (para 5-32). |
| 30. Front axle will not steer. | a. Leakage past piston in control cylinder. | a. Replace steering control cylinder (para 5-32). |
| | b. Defective main cylinder. | b. Repair or replace main cylinder (para 5-32). |
| | c. Damaged spool in steering control valve. | c. Repair steering control valve (para 5-27). |
| | d. Damaged spool in tandem unit valve. | d. Repair or replace tandem unit valve (para 5-27). |
| | e. Defective hydraulic pump. | e. Repair or replace hydraulic pump (para 5-24). |
| | f. Sticking flow control valve. | f. Repair flow control valve (para 5-26). |
| | g. Relief valve pressure is low in control circult. | g. Repair or replace the relief valve (para 5-26). |
| 31. Steering is loose. | a. Pitman arm is loose. lash | a. Tighten pitman arm and adjust pitman shaft (para 5-14). |
| | b. Loose bushings in steering gear box. | b. Repair the steering gear (para 5-14). |
| | c. Cylinder mounting socket is worn. | c. Tighten or replace socket (para 5-32). |
| 32. Front axle steers only one way. | a. Damaged spool in steering control valve. | a. Repair or replace control valve (para 5-27). |
| | b. Damaged spool in tandem unit valve. | b. Repair or replace tandem unit valve (para 5-27). |
| | c. Defective orifice in check valve. | c. Repair or replace check valve (para 5-27). |
| 33. Steering gear will not operate in any direction. | a. Defective control cylinder. | a. Repair or replace control cylinder (para 5-32). |
| | b. Oil leaks at steering control valve. | b. Repair or replace steering control valve (para 5-26, 5-27). |
| | c. Tandem cylinder is defective. | c. Repair or replace tandem cylinder (para 5-32). |
| | d. Defective steering control valve. | d. Repair or replace control valve (para 5-27). |
| | e. Defective centering cylinder. | e. Repair or replace centering cylinder (para 5-32). |
| | f. Defective steering pump., | f. Repair or replace hydraulic pump (para 5-24). |
| 34. Rear axle will not steer. | a. Defective control cylinder. | a. Repair or replace control cylinder (para 5-32). |
| | b. Defective main cylinder. | b. Repair or replace main cylinder (para 5-32). |
| | c. Defective steering control valve. | c. Repair or replace steering control valve (para 5-27). |
| | d. Defective tandem control valve. | d. Repair or replace tandem unit valve (para 5-27). |
| | e. Defective hydraulic pump. | e. Repair or replace hydraulic pump (para 5-24). |
| | f Defective relief valve. | f. Repair or replace relief valve (para 5-26). |
| | g. Defective flow control valve. | g. Repair or replace flow control valve (para 5-26, 5-27). |

Page 3-12, paragraph 3-9a is superseded as follows:

a. Remove starter and solenoid as illustrated in figure 3-7.1.

Figure 3-7.1, Sheet 1 of 3: 2 of 3; and 3 of 3 are added as follows;

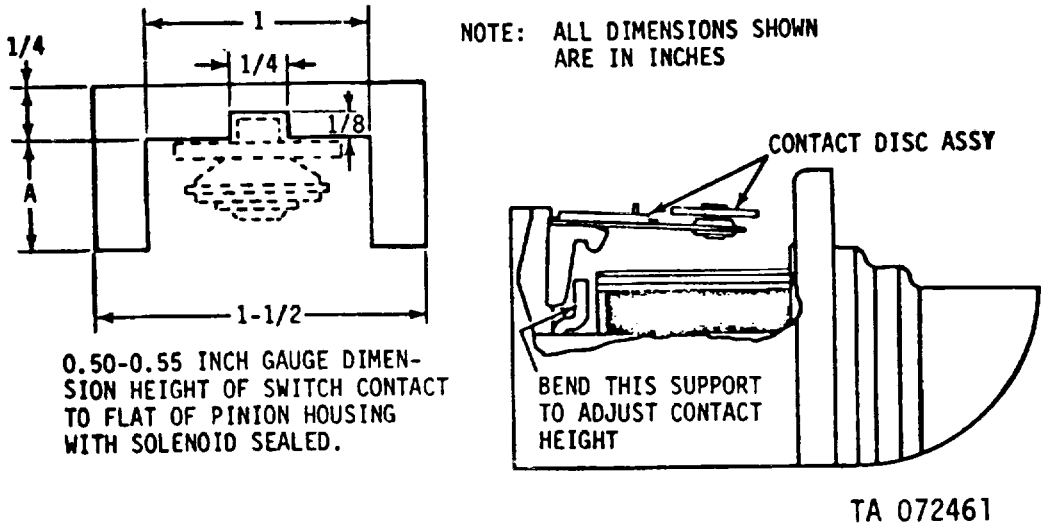



*Figure 3-7.1. Crane engine starter and solenoid removal and installation (Sheet 1 of 3).*

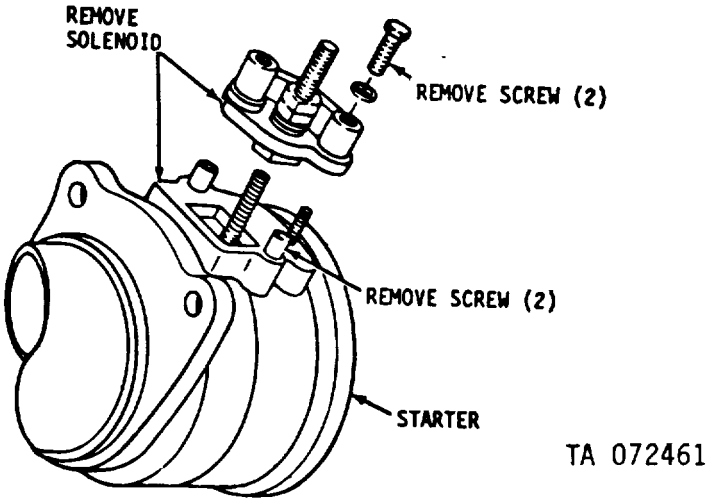



*Figure 3-7.1. Crane engine starter and solenoid, removal and installation (Sheet 2 of 3).*

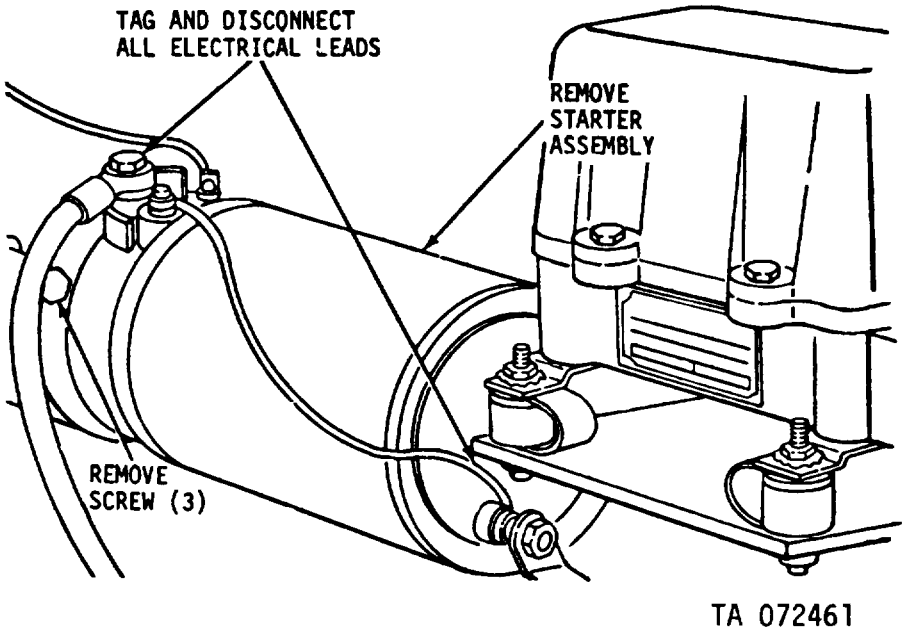



*Figure 3-7.1. Crane engine starter and solenoid, removal and installation (Sheet 3 of 3)*

Page 3-16, paragraph 3-11 b is superseded as follows:

*b. Adjustment and Installation*

(1) Place a gage, made of sheet metal and cut to dimensions shown in figure 3-7.1, over center of solenoid contact disc. Energize solenoid by applying battery to solenoid terminal and ground. Contact disc should bottom on gage. Adjust contact height by bending support as shown in figure 3-7.1.

(2) Install solenoid as illustrated in figure 3-7.1.

(3) Install starter as illustrated in figure 3-7.1.

Page 3-21, figure 3-10(2). Change callout numbers "128" through "133" to "127" through "132" respectively.

Page 3-46, figure 3-25(1). Change callout number "7" to "3".

Page 3-66, figure 3-44. Change callout numbers "8" through "23" to "7" through "22" respectively.

Page 4-20, figure 4-13.

Delete callout "5" and leader arrow.

Change callout "6" to "5".

Add callout "6" and leader arrow pointing to the gasket on mounting surface of housing.

Column (1) change "6 Wire" to "5 Wire".

Column (2).

Delete "4 Dowel".

Change "5 Gasket" to "6 Gasket, Housing".

Page 5-32, paragraph 5-14a(3)(b), line 1. Change "(fig. 4-14)" to "(fig. 5-14)"

Page 5-43, figure 5-21(1) legend. Change "68 Bushing" to "68 Bearing".

Page 5-50, paragraph 5-18d(26), line 4. Delete the third sentence.

Page 5-56, figure 5-27. Change callout "9" near callout 20 to "19".

Page 5- 75, following paragraph 5-27f(5) add the following:

g. Tilt Lock Valve.

(1) Removal. Remove the tilt lock valve (IM 5-3810-232-12).

(2) Disassembly. Disassemble the tilt lock valve assembly in numerical sequence as illustrated in figure 5-34.1.

(3) Cleaning, Inspection, and Repair.

(a) Clean all metal parts with cleaning solvent (Fed Spec PD-680) and dry thoroughly.

(b) Inspect all parts for cracks, breaks or scoring, corrosion, or other defects.

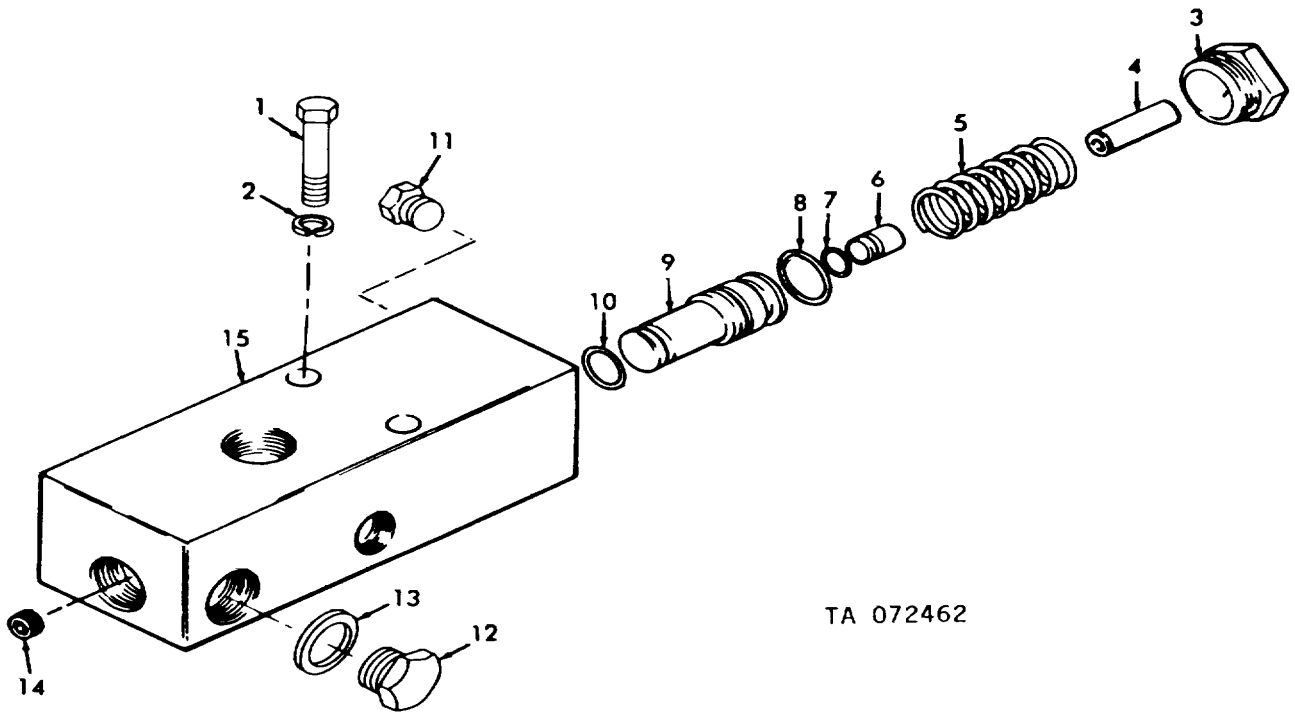
(c) Discard and replace all seals, gaskets, and 0rings.

(a) Repair by replacement of defective parts.

(4) Reassembly. Reassemble the tilt lock valve in the reverse of numerical sequence as illustrated.

(5) Installation. Install the tilt lock valve (TI 5-3810-232-12).

Figure 5-34.1 is added as follows:




1 Hex head capscrews
2 Lockwashers
3 Stop plug
4 Stroke stop
5 Helical spring
6 Power assist plunger
7 Performed packing
8 Plunger seal
9 Plunger
10 Plunger seal
11 Pipe plug
12 Pipe plug
13 Performed packing
14 Valve orifice
15 Valve housing

*Figure 5-34.1. Tilt lock valve, disassembly and reassembly*

Page 5-85, figure 5-41(1).

Add callout " 11" and leader arrow pointing to the plug located below item 6, hose assembly.

Add callout "12" and leader arrow pointing to the O ring located adjacent to the plug, item 11.

Add callout "21" and leader arrow pointing to the tilt-lock valve located in upper right hand cover, adjacent to items 11 and 12.

Page 5-90. Paragraphs 5-32a and b are superseded as follows:

a. Removal

'(1) Centering cylinder.

(a) Tag and disconnect two hydraulic hoses at the disassemble and reassemble.
centering cylinder.

(b) Remove cotter pin and slotted nut (15, fig. 5-43 (2)) securing the ball stud (18) to the tandem steering cylinder.

(c) Remove cotter pin and slotted nut (1, fig. 5-43

(1) securing the opposite end of the tandem steering cylinder and remove the centering cylinder.

(2) Tandem steering cylinder.

(a) Remove the centering cylinder (1) above.

(b) Remove bolt and nut securing the tandem steering cylinder to the spindle support and remove the tandem cylinder.

(3) Steering cylinder.

(a) Remove two hoses at the steering cylinder.

(b) Remove two cotter pins, slotted nuts, and bolts securing the steering cylinder to the differential housing and remove the steering cylinder.

b. Disassembly.

(1) Centering cylinder. The centering cylinder (fig.5-43 (1)) can be repaired, but the cylinder weldment (18) cannot be disassembled and must be replaced as a subassembly. The piston (34), which includes items (29) through (33) will not be disassembled or repaired. Disassemble the remaining components of the centering cylinder as illustrated in figure 5-43 (1).

(2) Tandem steering cylinder. Disassemble the tandem steering cylinder as illustrated in figure 5-43 (2).

(3) Steering cylinder. Disassemble the steering cylinder in numerical sequence as illustrated in figure 5-43
(3).

Figure 5-42.1 is added as follows:

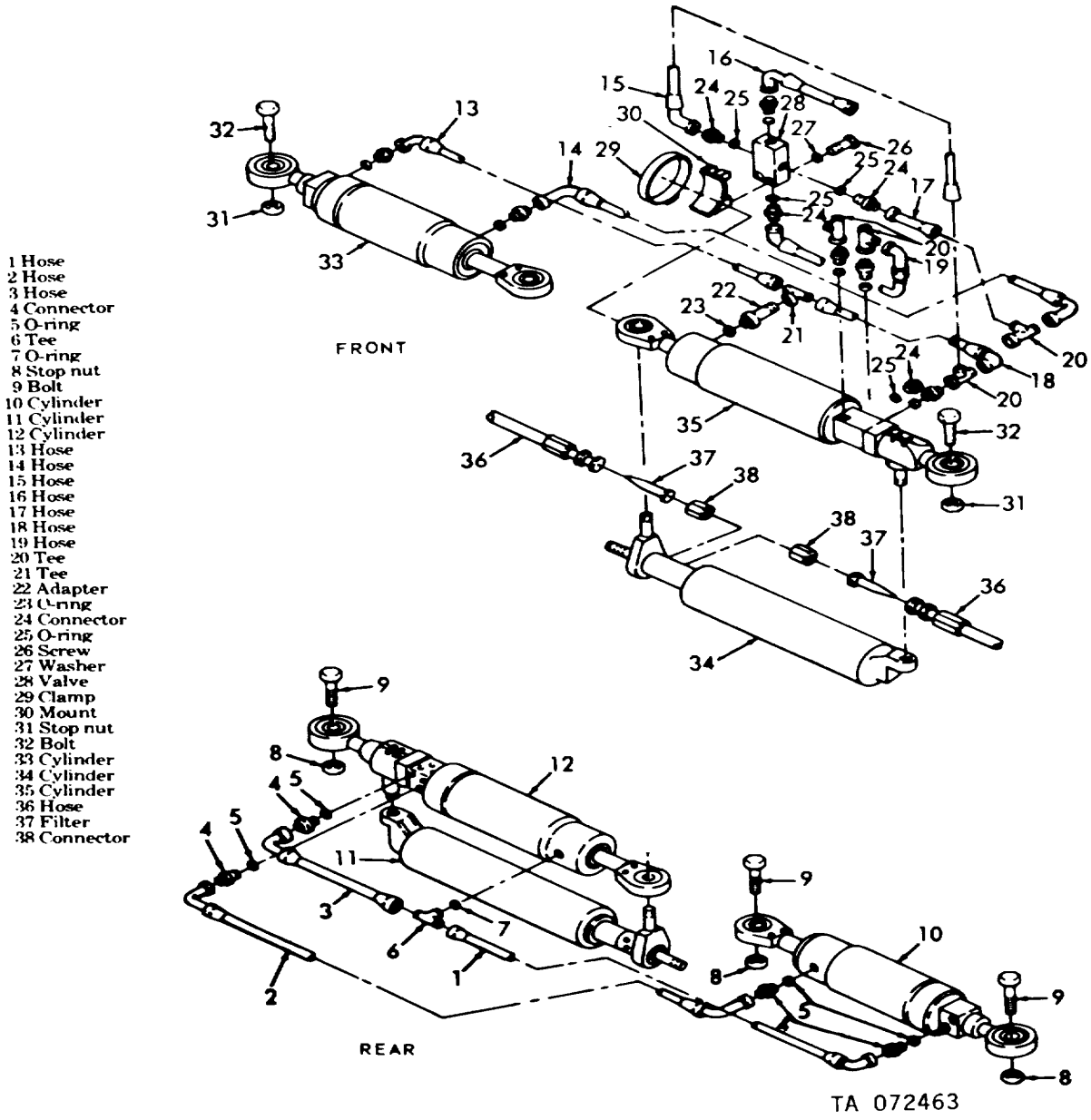



*Figure 5-42.1. Hydraulic steering cylinder and related parts removal and installation.*

Page 5-93. Paragraph 5-32e is superseded as follows:

e. Installation. Refer to figure 5-43 and install the centering, tandem, and steering cylinders in the reverse order of removal instructions.

Paragraph 5-33b delete "('M 5-3810-232-12)" and add, "as shown on figure 5-42.1".

Page 5-94, paragraph 5-33f, line 2. Delete "(TM 5-3810-232-12)" and add, "in reverse of the numerical sequence shown in figure 5-42.1".

Page 5-96, paragraph 5-43 b(12). Change "desired charge

pressure" to "800 PSI charge pressure".

Page 5-98, figure 5-46. Add "leader lines" from callout "42" to capscrew from callout "39" to lock-washer located at upper right of item 28.

Page 5-107, figure 5-53 legend. Add item "3 Pin".

Page 6-10, following paragraph 6-7b add the following:

**CAUTION**

Main cord angles shall not be repaired or straightened below depot level. Lacing members may be cold straightened at direct support level; cutting and welding of lacing and cord angles is permitted at depot level only.

Page A-1, add the following:

**A-6. Safety**

TB MED 251Noise and Conversation of Hearing

By Order of the Secretary of the Army:

E. C. MEYER
*General, United States Army*
*Chief of Staff*

Official:

J. C. PENNINGTON
*Major General, United States Army*
*The Adjutant General*

Distribution:

ACTIVE ARMY, USAR, ARNG: To be distributed in accordance with DA Form 12-25B, Direct and General Support Maintenance requirements for Crane Shovels, Wheel Mounted.

TECHNICAL MANUAL

No. 5-3810-232-34

HEADQUARTERS
DEPARTMENT OF THE ARMY
*WASHINGTON, D. C., 5 May 1971*

# DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

## CRANE, WHEEL MOUNTED: 20 TON AT 10 FOOT RADIUS; 2 ENGINES, DIESEL ENGINE DRIVEN, 4x4; AIR TRANSPORTABLE, PHASE III; W/BLADE, BULLDOZER, EARTH-MOVING; W/BLOCK, TACKLE, 20-TON; W/BOOM, CRANE, 30 FOOT (AMERICAN HOIST AND DERRICK MODEL 2830) FSN 3810-763-7728 (AMERICAN HOIST AND DERRICK MODEL 2835) FSN 3810-043-5354



*This manual supersedes TM 5-3810-232-35, 1 June 1966, Including all changes.

## LIST OF ILLUSTRATIONS

# CHAPTER 1

# INTRODUCTION

## Section I. GENERAL

### 1-1. Scope

a. This manual contains instructions for the use of direct and general support maintenance personnel maintaining the American Hoist and Derrick Model 2380 and Model 2385 Rough Terrain Crane as allocated by the Maintenance Allocation Chart contained in TM 5-3810-232-12. It provides information on the maintenance of the equipment which is beyond the scope of the tools, equipment, personnel, or supplies normally available to operational and organizational maintenance.

b. Numbers in parentheses on illustrations indicate quantity. Numbers preceding nomenclature callouts on illustrations indicate the preferred maintenance sequence.

### 1-2. Record and Report Forms

a. DA forms and procedures used for equipment maintenance will be only those prescribed by TM 38-750, The Army Maintenance Management System.

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 the Commanding General, U. S. Army Mobility Equipment Command, ATTN: AMSMEMPP, 4300 Goodfellow Boulevard, St. Louis, Mo. 63120.

## Section II. DESCRIPTION AND DATA

### 1-3. Description

A general description of the Model 2380 and Model 2385 Rough Terrain Crane and information pertaining to the identification plates are contained in TM 53810-232-12. A more detailed description of specific components and assemblies is contained in the applicable sections of this manual. Detailed descriptions of the components of the Model 2380 and Model 2385 Rough Terrain Crane 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 and general support and depot maintenance personnel. Additional data is in TM 5-3810-232-12. Wiring diagrams, figure 1-1 for Model 2380 and Model 2385 carrier, and figure 1-2 for crane, are also included.

b. Torque Data

(1) Nut and bolt torque data (carrier engine).

| Part | Torque |
|---|---|
| Main bearing capscrew | (See para 3-73) |
| Main bearing side bolts | (See para 3-73) |
| Connecting rod nuts | (See para 3-71) |
| Vibration damper and front pulley. | 200/205 foot-pounds |
| Crankshaft pipe plug | foot-pounds |
| Cylinder head capscrews | 230/240 foot-pounds |
| Injector hold-down capscrews | 30/35 foot-pounds |
| Valve cross-head nuts | 25/30 foot-pounds |
| Fuel fittings | 11/13 foot-pounds |
| Intake and exhaust manifold | 30/35 foot-pounds |
| Oil pan drain plug (1 inch) | 60/70 foot-pounds |
| Flywheel capscrews | 200/205 foot pounds |
| Flywheel adapter capscrews | 200/205 foot pounds |
| Flywheel housing capscrews (3/8 inch) | 28/35 foot-pounds |

(2) Nut and bolt torque data (crane engine).

| Part | Torque |
|---|---|
| Cylinder Head: | |
| 3/4-inch capscrews | 400-foot-pounds |
| 11/16-inch capscrews | 260 foot-pounds |
| Exhaust manifold: | |
| 7/16-inch studs (washers or lockplates under nuts) | 25 foot-pounds |
| 1/2-inch studs (washers or lockplates under nuts) | 30 foot-pounds |
| 1/2-inch studs | 45 foot-pounds |
| 3/8-inch studs | 25 foot-pounds |
| 3/8-inch capscrews | 22 foot-pounds |
| Main bearings capscrews | (See para 4-76) |
| Connecting rod capscrewa | (See para 4-73) |
| Flywheel capscrews | 100/110 foot-pounds |
| Injector: | |
| Hold-down standard | 10/12 foot-pounds |
| Nylock | 12/14 foot-rounds |
| Pressure Adjustment (at 140'F oil (temperature) | 60 inch-pou'rds |
| Pressure Adjustment (at 70*F oil temperature) | 48 inch-pounds |
| Adjusting screw nut | 70 foot-pounds |

Part Torque

Valve:
Adjusting screw nut ..... 70 foot-pounds
Fuel inlet and drain connections. .20/25 foot-pounds
Injector cup ..... 45 foot-pounds
Vibration damper capscrews ... 35/45 foot-pounds
Crankshaft flange ..... 130/140 foot-pounds
Cross-head adjusting screw nuts 25/30 foot-pounds
Tappet guide screws ..... 95/115 inch-pounds
Oil pan capscrew ..... 25/30 foot-pounds
Water header cover plate
capscrew .30/35 foot-pounds
Lubricating oil filter center
capscrews ..... 25/30 foot-pounds
Tappet guide plate capscrews . 18/20 foot-pounds
Gear housing capscrews ..... 30/35 foot-pounds
Vibration damper and crankshaft
pulley ..... 200/205 foot-pounds
Injector cup ..... 50/55 foot-pounds
Orifice plug ..... 6/8 inch-pounds

(3) Adjustment Data

(a) Valves (carrier engine)

(70'F oil temperature) ..... Exhaust 0.029 inches
Intake 0.016 inches
(140°F oil temperature) .....Exhaust 0.027 inches
Intake 0.014 inches

(b) Valves (crane engine).

(70'F oil temperature) .....Exhaust 0.027 inches
Intake 0.017 inches
(140'F oil temperature) .....Exhaust 0.025 inches
Intake 0.015 inches

(c) Alternator regulator adjustments.

Cutout relay air gap .....0.048 in.
Contact points .....0.035 in.
Voltagp regulator air gap .....0.084 in.
Cutout relay closing voltage ....26 volts
Voltage regulator opening
voltage ..... 29.2 volts
Current regulator maximum
amperage .....40 amperes

(4) Repair and replacement standards. Table 1-1 lists manufacturer's sizes, tolerances, desired clearances, and maximum allowable wear and clearances for the carrier and crane engines. Manufacturer's Maximum dimensions and Desired allowable tolerances clearance wear and in inches clearances

*Table 1-1. Repair and Replacement Standards.*

| Component | Manufacturer's dimensions and tolerance in inches | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| CRANE ENGINE: | | | | | |
| Cylinder block: | | | | | |
| Height from center of main bearing bore to top of block | 15.122 | 15.124 | | | 15.114 |
| Maximum amount removed in resurfacing | | | | | 0.010 |
| Liner counterbore depth | 0.309 | 30.3105 | | | 0.3105 |
| Maximum depth after repair | | | | | 0.4023 |
| Liner protrusion above block | 0.0045 | 0.00675 | | | 0.0045 |
| Main bearing cap fit in block | -0.002 | -0.004 | | | 0.001 |
| Main bearing bore | 4.124 | 4.125 | | | 4.1255 |
| Camshaft bushing I.D. | 1.8745 | 1.8765 | | | 1.878 |
| Cylinder liners I.D. | 4.125 | 4.126 | | | 4.130 |
| Camshaft end clearance | 0.007 | 0.011 | | | 0.015 |
| Camshaft thrust bushings I.D. | 1.750 | 1.761 | | | 1.753 |
| Cam thrust bushing Out of round at top one inch only | | | | | |
| Note. Liner may contact block if it does not force liner out-of-round | | | | | |
| Interference fit, liner and block0.0005-0.0045-0.005 | | | | | |
| Crankshaft: | | | | | |
| Main journals | 3.874 | 3.875 | | | 3.872 |
| Rod journals | 2.624 | 2.625 | | | 2.622 |
| Fillet radii | O ;41 | 0.164 | | | 0.141 |
| Main bearings | | | | | |
| Shell thickness 0.1216 | | 0.1231 | 0.1286 | | |
| Journal clearance | 0.0018 | 0.0048 | | | 0.0068 |
| End clearance | 0.004 | 0.015 | | | 0.022 |
| Connecting rod bearings | | | | | |
| Shell thickness 0.07100 | | 0.07225 | 0.07276 | | |
| Journal clearance | 0.0020 | 0.0045 | | | 0.008 |
| Connecting rod: | | | | | |
| Center to center | 9.498 | 9.500 | | | 9.498 |

*Table 1-1. Repair and Replacement Standards-Continued*

| Component | Manufacturer's dimensions and tolerance in inches | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| Crankpin bore | 2.7725 | 2.7730 | | | 2.7730 |
| Maximum out-of-round | | | | | 0.0015 |
| Clearance between rod and piston boss | 0.040 | 0.050 | | | |
| Bore misalignment (center to center) | 0.040 | 0.050 | | | |
| Bend | 0.000 | 0.004 | | | 0.004 ±0.001 |
| Twist | 0.000 | 0.010 | | | 0.010 ±0.001 |
| Side clearance on shaft | 0.008 | 0.012 | | | 0.016 |
| Piston: | | | | | |
| Piston skirt dia. at 70DF | | | | | |
| Part No. 112340 | 4.1195 | 4.1200 | | | 4.1165 |
| Part No. 112350 | 4.1195 | 4.1205 | | | 4.1165 |
| Part No. 117250 | 4.1185 | 4.1195 | | | 4.115 |
| Part No. 117380 | 4.118 | 4.119 | | | 4.115 |
| Piston pin bore (at 70°F) | 1.4988 | 1.4990 | | | 1.500 |
| Piston pin outside diameter | 1.4988 | 1.4990 | | | 1.4978 |
| Ring gap clearance (new liner) | 0.013 | 0.023 | | | |
| Rear cover: | | | | | |
| Cover plate to crankshaft clearance | .004 | 0.006 | | | |
| Bore to crankshaft runout | | 0.005 | | | |
| Camshaft: | | | | | |
| Journal diameter | | | | | |
| No. 1 | 1.747 | 1.748 | | | 1.746 |
| Nos. 2, 3, 4, 5, 6, 7 | 1.872 | 1.873 | | | 1.871 |
| Gear case cover: | | | | | |
| Fuel pump or compressor drive bushing 1.314 1.319 1.321 | | | | | |
| Counterbalancer: | | | | | |
| Weight shaft journals O.D | 1.9975 | 1.9985 | | | 1.9960 |
| Pushing I.D. (raised) | 2.0015 | 2.0045 | | | 2.0060 |
| Bushing I.D. (pan) | 1.2565 | 1.2580 | | | 1.2595 |
| Cylinder head: | | | | | |
| Height | 5.000 | 5.010 | | | |
| Minimum permissible height after refacing | | | | | 4.970 |
| Valve seat insert counter bore standard depth | 0.006/ 0.010 inch deeper than insert thick-ness | | | | |
| Standard inside diameter | 1.427 | 1.428 | | | |
| Valve seat insert: | | | | | |
| Valve seat angle | 30° | 30° | | | 30° |
| Insert outside diameter | 1.430 | 1.431 | | | |
| Thickness | 0.157 | 0.161 | | | |
| Over sizes | 0.010, 0.020, 0.030, 0.040 | | | | |
| Valve guide inside diameter | 0.3425 | 0.3432 | | | 0.345 |
| Intake and exhaust valve: | | | | | |
| Seat angle | 30° | 30° | | | 30° |
| Stem diameter | 0.340 | 0.341 | | 0.339 | |
| Crosshead guide bore (tubular stem) | 0.3760 | 0.3800 | | 0.3780 | |
| Crosshead stem diameter (solid stem) | 0.3708 | 0.3713 | | 0.3700 | |
| Crosshead guide inside diameter (tubular type) | 0.3755 | 0.3760 | | 0.3780 | |
| Crosshead guide outside diameter (solid type) | 0.3750 | 0.3755 | | 0.3740 | |
| Injector seat angle in sleeve | 60° | 60° | | 60° | |

*Table 1-1. Repair and Replacement Standards-Continued*

| Component | Manufacturer's dimensions and tolerance in inches | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| Injector sleeve, upper I.D | 1.3750 | 1.3800 | | | |
| Injection tip protrusion | 0.0400 | 0.0550 | | | 0.0650 |
| Rocker lever valve guide protrusion assembly | 1.240 | 1.260 | | | |
| Shaft | 1.1230 | 1.1235 | | | 1.1220 |
| Bronze bushings | 1.1245 | 1.1255 | | | 1.1265 |
| Steel bushings | 1.1245 | 1.1275 | | | 1.1285 |
| Valve tappets | | | | | |
| Roller outside diameter | 1.0610 | 1.0630 | | | 1.0590 |
| Roller inside diameter | 0.5030 | 0.5040 | | | 0.5050 |
| Roller pin outside diameter | 0.4995 | 0.5000 | | | 0.4985 |
| Tappet outside diameter | 1.1850 | 1.1860 | | | 1.1840 |
| Roller side clearance | 0.0080 | 0.0220 | | | 0.0270 |
| Injector tappets: | | | | | |
| Roller outside diameter | 1.1230 | 1.1250 | | | 1.1210 |
| Roller inside diameter | 0.5655 | 0.5665 | | | 0.5675 |
| Roller pin outside diameter | 0.5620 | 0.5625 | | | 0.5610 |
| Tappet outside diameter | 1.3100 | 1.3110 | | | 1.3090 |
| Roller side clearance | 0.0050 | 0.0170 | | | 0.0220 |
| Lubrication oil pump: | | | | | |
| Drive and idler shaft O.D | 0.6150 | 0.6155 | | | 0.6140 |
| Drive and idler shaft bushing I.D | 0.6165 | 0.6175 | | | 0.6186 |
| Idler gear bushings I.D | 0.9925 | 0.9935 | | | 0.9945 |
| Idler gear shaft O.D | 0.9900 | 0.9910 | | | 0.9890 |
| Idler and driven gear O.D | 1.8320 | 1.8330 | | | 1.8310 |
| Gear pockets I.D | 1.8400 | 1.8420 | | | 1.8430 |
| Gear pocket depth | 1.6230 | 1.6250 | | | 1.8430 |
| Double lubricating oil pump: | | | | | |
| Idler and drive shaft bushings I.D | 0.6165 | 0.6175 | | | 0.618 |
| Idler gear bushing I.D | 0.992F | 0.9935 | | | 0.9945 |
| Idler and drive shaft O.D | 0.6150 | 0.6155 | | | 0.6140 |
| Idler gear spindleshaft | 0.9900 | 0.9910 | | | 0.9890 |
| Gears outside diameter | 1.8320 | 1.8330 | | | 1.8310 |
| Bodies, gear pockets | 1.8400 | 1.8420 | | | 1.8430 |
| Water pump | | | | | |
| Cover face to impeller hub | 0.620 | 0.625 | | | |
| Exhaust back pressures | | | | | |
| Maximum permissible inches of mercury | | 1.5 | | | |
| Flywheel housing | | | | | |
| Bore run-out | 0.000 | 0.010 | | | 0.010 |
| Face run-out | 0.000 | 0.008 | | | 0.008 |
| Flywheel | | | | | |
| Static balance tolerance | | 2 in. oz | | | |
| Pilot bearing bore run-out | 0.000 | 0.005 | | | 0.005 |
| Drive ring pilot bore run-out | 0.000 | 0.005 | | | 0.005 |
| Clutch face run-out per inch diameter | 0.000 | 0.0005 | | | 0.0005 |
| CARRIER ENGINE: | | | | | |
| Cylinder Block: | | | | | |
| Height from center of main bearing bore to top of block | 13.1480 | 13.1540 | | | 13.1420 |
| Maximum amount removed in resurfacing | | | | | 0.006 |
| Liner counterbore | | | | | |
| Inside diameter | 6.4990 | 6.5010 | | | 6.5015 |
| Depth | 0.3500 | 0.3520 | | | |
| Depth after repair | | | | | 0.4130 |
| Packing ring bore I.D. | 5.990 | 6.0010 | | | |
| Water hole inside diameter (top of block) | | 7/16 | | | 1/2 |
| Camshaft bushing I.D | 2.4990 | 2.5005 | | | 2.5020 |
| Camshaft bushing bore I.D | 2.6245 | 2.6255 | | | |

*Table 1-1. Repair and Replacement Standards-Continued*

| Component | Manufacturer's dimensions and tolerance in inches | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| Main bearing bore I.D | 3.7520 | 3.7530 | | | 3.7535 |
| Main bearing cap pad width | 6.7485 | 6.7495 | | | 6.7610 |
| Main bearing cap width | 6.7535 | 6.7545 | | | 6.7525 |
| Tappet bore inside diameter | | | | | |
| Valve | 1.1000 | 1.1010 | | | 1.1025 |
| Injector | 1.4000 | 1.4010 | | | 1.4025 |
| Out-of-round | | | | | 0.0015 |
| Cylinder liner inside diameter at 70°F less protective coating | 5.4995 | 5.6010 | | | 5.6050 |
| Out-of-round packing ring area | | | | | .0015 |
| Out-of-round above piston ring travel | | | | | .003 |
| Cylinder liner outside diameter | | | | | |
| Packing ring lands | 5.9930 | 5.9970 | | | 5.9900 |
| Top flange (press fit area) | 6.5015 | 6.5035 | | | 6.5015 |
| Cylinder liner flange: | | | | | |
| Thickness | 0.3550 | 0.3560 | | | 0.3550 |
| Protrusion above block | 0.0040 | 0.0060 | | | 0.0040 |
| Cylinder liner to block packing ring bore clearance 0.0020 0.0080 | | | | | |
| Crankshaft | | | | | |
| Main journal O.D | 3.4990 | 3.5000 | | | 3.4965 |
| Rod journal O.D. 158370 | 3.1240 | 3.1260 | | | 3.1216 |
| Rear main (thrust) width | 1.9400 | 1.9420 | | | 1.9440 |
| Fillet radii | 0.140 | 0.160 | | | |
| Crankshaft adaptor O.D | 4.749 | 4.751 | | | 4.747 |
| Main bearing shell thickness | 0.12465 | 0.12526 | | | 0.1230 |
| Main bearing journal clearance | 0.0015 | 0.0045 | | | 0.0070 |
| Crankshaft end clearance | 0.005 | 0.015 | | | 0.0220 |
| Thrust bearing thickness | 0.1510 | 0.1530 | | | 0.1490 |
| Connecting Rod | | | | | |
| Connecting rod bearing shell | | | | | |
| Thickness-STD | 0.09425 | 0.09476 | | | 0.09295 |
| Journal clearance | 0.0015 | 0.0045 | | | 0.0070 |
| Length center to center | 8.1920 | 8.1940 | | | |
| Piston pin bushing bore inside diameter (in rod) | 1.9995 | 2.0005 | | | |
| Crankpin bore inside diameter | | | | | |
| Standard | 3.3160 | 3.3165 | | | |
| Maximum out-of-round | | | | | 0.0015 |
| Bore misalignment | | | | | |
| Bend | | | | | 0.0040 |
| Twist | | | | | 0.0100 |
| Rod bolts: | | | | | |
| Fit in rod | 0.0007 | 0.0003 | | | 0.0006 |
| Pilot outside diameter | 0.5640 | 0.5645 | | | |
| Minimum outside diameter | 0.4790 | 0.4830 | | | 0.4775 |
| Hole inside diameter in cap | 0.5638 | 0.6643 | | | 0.5645 |
| Assembled side clearance | | | | | |
| Rod to rod | 0.0080 | 0.0160 | | | 0.0180 |
| Rod to piston boss | 0.0800 | 0.0700 | | | |
| Piston pin bushing inside diameter | 1.7510 | 1.7516 | | | 1.7525 |
| Bolt pad corner radius standard | 0.2500 | 0.2700 | | | |
| Piston: | | | | | |
| Piston pin bore inside diameter (70°F) | 1.7485 | 1.7489 | | | 1.750 |
| Piston pin outside diameter | 1.7488 | 1.7490 | | | 1.7478 |
| Piston ring-to-groove clearance | | | | | |
| New ring with piston wall | 0.002 | | | | 0.006 |

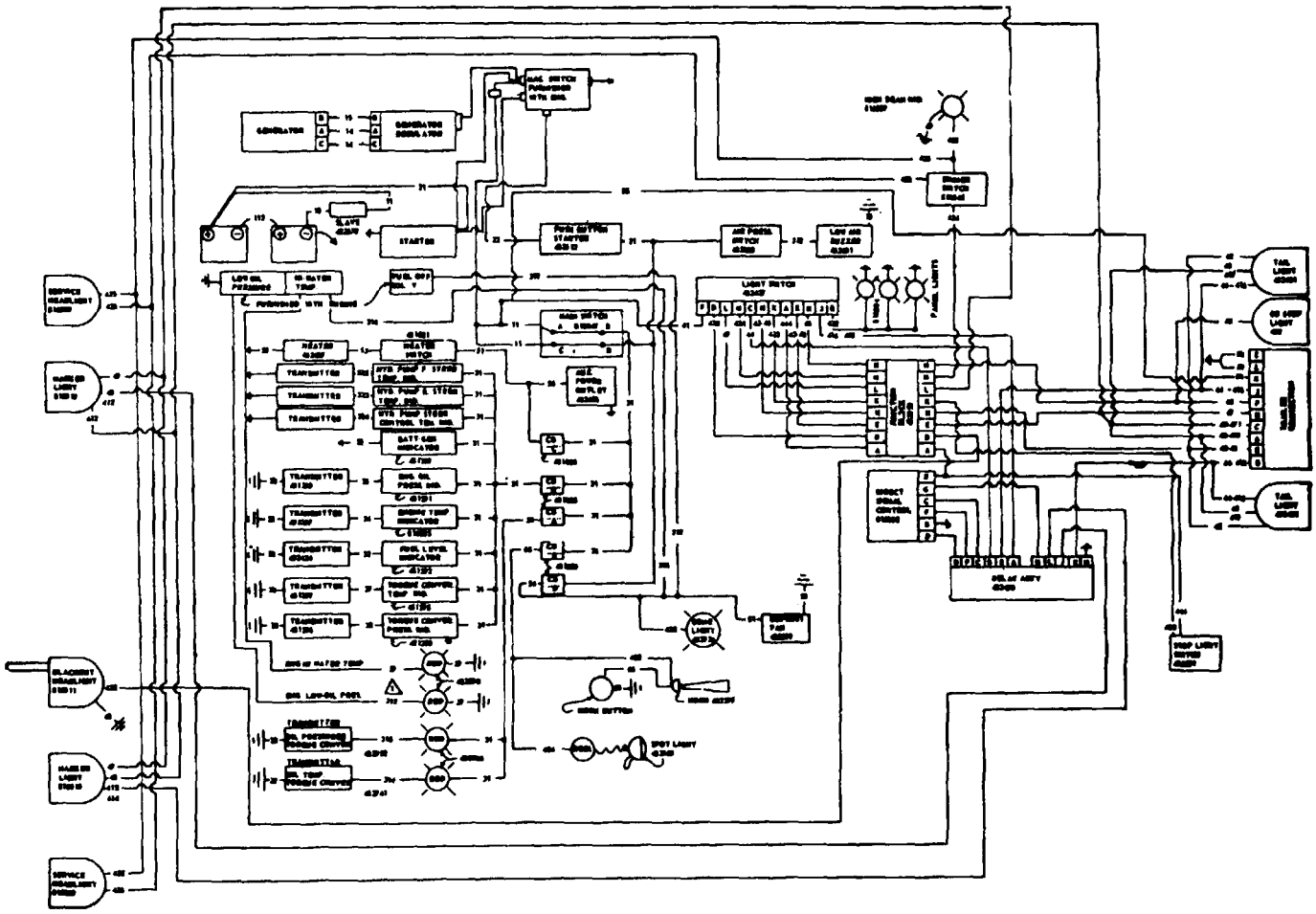
*Table 1-1. Repair and Replacement Standard - Continued*

| Component | Manufacturer's dimensions and tolerance in inches | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| Piston skirt outside diameter (at 70'F) | | | | | |
| Part No. 146750, 156220 and 168960 | 5.4870 | 5.4880 | | | 5.4830 |
| Part No. 155420 | 5.483 | 5.484 | | | 5.479 |
| Piston ring gap clearance (in new liners) | | | | | |
| Part No. 147670 | 0.0170 | 0.0270 | | | |
| Part No. 154020 | 0.0130 | 0.0230 | | | |
| Part No. 122560 | 0.0150 | 0.0270 | | | |
| Camshaft: | | | | | |
| Journal outside diameter | 2.4960 | 2.4970 | | | 2.4940 |
| Injector lobe total lift | 0.1680 | 0.1720 | | | 0.1670 |
| End clearance | 0.0070 | 0.0110 | | | 0.0150 |
| Gear Housing: | | | | | |
| Crankshaft to seal bore (max. runout) | 0.0040 | | | | |
| Gear lash (use to align housing) all gears | 0.0060 | 0.0090 | | | |
| Accessory drive cover bushing inside diameter | 1.2525 | 1.2545 | | | 1.2555 |
| Front cover: | | | | | |
| Crankshaft to seal bore (max. runout) | 0.0050 | | | | |
| Cylinder Head | | | | | |
| Cylinder head height | 4.4950 | 5.5050 | | | |
| Minititum permissible height after resurfacing | | | | | 4.4650 |
| Injector tip protrusion | 0.1000 | 0.1150 | | | 0.1250 |
| Injector sleeve-upper inside diameter | 1.140 | 1.150 | | | |
| Valve guide inside diameter | 0.4525 | 0.4532 | | | 0.4545 |
| Protrusion above head | 0.6950 | 0.7100 | | | |
| Crosshead guide outside diameter | 0.4332 | 0.4335 | | | 0.4322 |
| Protrusion above head | 2.0900 | 2.1100 | | | |
| Crosshead | | | | | |
| Inside diameter | 0.4340 | 0.4360 | | | 0.4400 |
| Valve insert | | | | | |
| Thickness-standard intake | 0.2590 | 0.2610 | | | |
| Exhaust | 0.2790 | 0.2810 | | | |
| Outside diameter-standard | 2.0025 | 2.0035 | | | |
| Swirl plate thickness | 0.0200 | 0.0210 | | | |
| Head counterbore inside diameter-standard | 1.9995 | 2.0005 | | | |
| Valve seat angle | 30° | | | | |
| Valve seat width | | | | | 0.1250 |
| Valve edge thickness | | | | | 0.0780 |
| Valve stem outside diameter | 0.4500 | 0.4512 | | | 0.4490 |
| Valve springs | | | | | |
| Part No. 128235 | | | | | |
| Free length 2.090 | | | | | |
| Load length: | | | | | |
| Valve open 1.317 | 161 lbs | 179 lbs | | | 1565 lbs |
| No. of coils | 6 1/3 | | | | |
| Part No. 146732 | | | | | |
| Free length | 2.090 | | | | |
| Load length: | | | | | |
| Valve open 1.237 | 80 lbs. | 90 lbs | | | 75 lbs. |
| No. of coils | 7 3/4 | | | | |
| Part No. 146731 | | | | | |
| Free length 2 | .350 | | | | |
| Load length: | | | | | |
| Valve open 1.287 | 124 lbs | 136 lbs | | | 120 lbs. |
| No. of coils | 6 1/2 | | | | |
| Rocker levers and shafts: | | | | | |
| Lever bushing-inside diameter | 1.1875 | 1.1905 | | | 1.1916 |

*Table 1-1. and Replacement Standards-Continued*

| Component | Manufacturer's dimensions and tolerance in inches | | Desired clearance | | Maximum allowable wear and clearance |
|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | |
| Shaft-outside diameter | 1.1855 | 1.1865 | | | 1.1845 |
| Adjusting screw ball end radius | | | | | |
| Injector | 0.4350 | 0.4370 | | | |
| Valve | 0.3725 | 0.3745 | | | |
| Tappets and push rods: | | | | | |
| Injector tappet | | | | | |
| Body outside diameter | 1.3980 | 1.3990 | | | 1.3965 |
| Guide spring outside diameter | 1.456 | | | | |
| Roller outside diameter | 1.1690 | 1.1710 | | | 1.1670 |
| Roller inside diameter | 0.6280 | 0.6290 | | | 0.6300 |
| Roller pin outside diameter | 0.6245 | 0.6250 | | | 0.6235 |
| Roller side clearance | 0.005 | 0.017 | | | 0.022 |
| Valve tappet: | | | | | |
| Body outside diameter | 1.0980 | 1.0990 | | | 1.09i6 |
| Guide spring outside-diameter | 1.148 | | | | |
| Roller outside diameter | 0.9290 | 0.9310 | | | 0.9270 |
| Roller inside diameter | 0.5030 | 0.5040 | | | 0.5060 |
| Roller pin outside diameter | 0.4995 | 0.6000 | | | 0.4985 |
| Roller side clearance | 0.004 | 0.014 | | | 0.019 |
| Injector push rod: | | | | | |
| Ball end radius | 0.3110 | 0.3125 | | | 0.3200 |
| Socket end radius | 0.2188 | 0.2203 | | | 2.2165 |
| Valve push rod: | | | | | |
| Ball end radius | 0.3110 | 0.3125 | | | 0.3150 |
| Socket end radius | 0.1875 | 0.1890 | | | 0.1860 |
| Injectors: | | | | | |
| Injector plunger spring data | | | | | |
| Free length | 2.4500 | 2.4900 | | | |
| Load when compressed to: | | | | | |
| 2.139 inches | 87.6 lbs | 95.6 lbs | | | |
| 1.975 inches | 133 lbs | 147 lbs | | | |
| Lubricating oil pumps: | | | | | |
| Bodies: | | | | | |
| Gear pocket inside diameter | 2.4070 | 2.4090 | | | 2.4105 |
| Gear pocket depth | 1.2490 | 1.2510 | | | 1.2525 |
| Gear outside diameter | 2.3990 | 2.4000 | | | 2.3970 |
| Gear length | 1.2490 | 1.2500 | | | 1.2470 |
| Bushing, idler gear, inside diameter | 0.8770 | 0.8775 | | | 0.8785 |
| Bushing, body and cover, inside diameter | 0.8770 | 0.8775 | | | 0.8785 |
| Drive shaft journal outside diameter | 0.8745 | 0.8750 | | | 0.8740 |
| Idler shaft journal outside diameter | 0.8755 | 0.8760 | | | 0.8750 |
| Drive gear inside diameter | 0.8730 | 0.8735 | | | 0.8738 |
| Water pump | | | | | |
| Impeller to body clearance | 0.0100 | 0.0200 | | | |
| Exhaust back pressure, inches of mercury | | | | | |
| Naturally aspirated engines | | 1.5 | | | |
| Flywheel and housing | | | | | |
| Housing bore run-out | | 0.010 | | | |
| Housing face run-out | | 0.008 | | | |
| Flywheel pilot bearing | | | | | |
| Bore run-out | | 0.005 | | | |
| Clutch face run-out | | 0.005 | | | |
| Flywheel static balance Tolerance | | 2 in. oz. | | | |

(5) *Schematic wiring diagram*. Figure 1-1 shows the schematic wiring for the carrier. Figure 1-2 shows the schematic wiring for the crane.



A. (Model 2380)

*Figure 1-1. (1). Carrier schematic wiring diagram.*

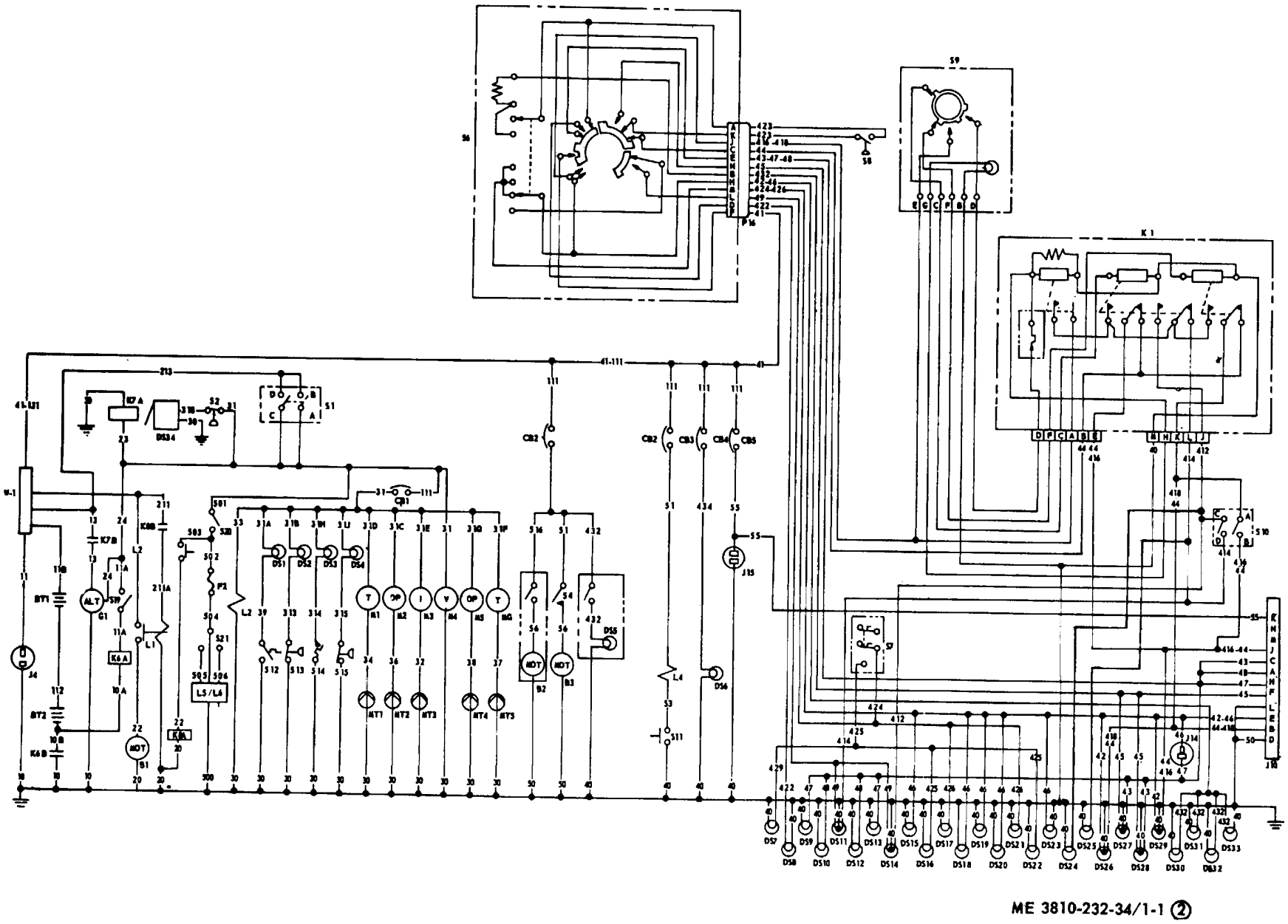



*Figure 1-1. (2). Continued*

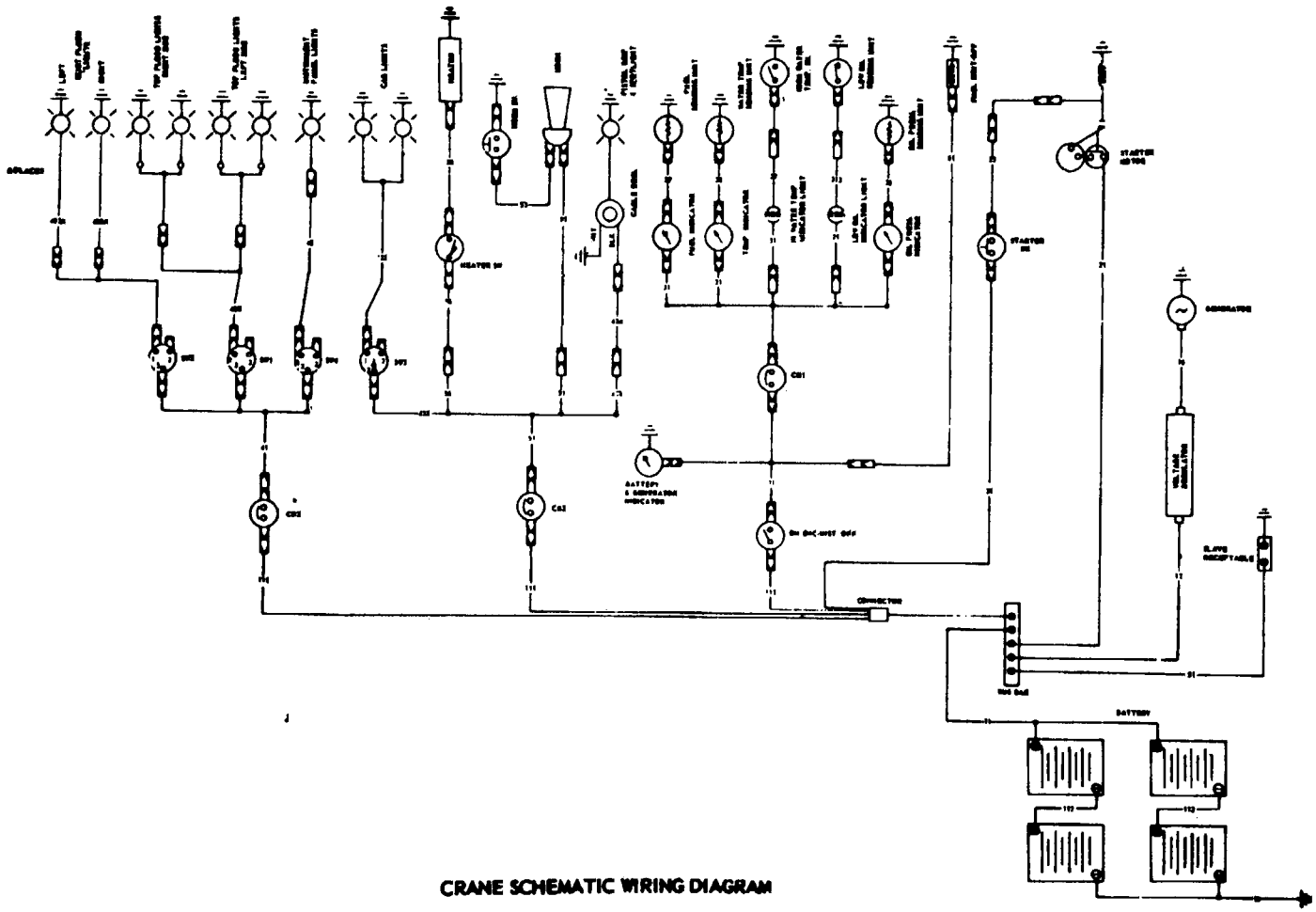



*Figure 1-2. Crane schematic wiring diagram.*

(6) *Hydraulic system diagram*. Figure 1-3 shows the hydraulic system for the carrier, Model 2880 and figure 1-4 for the carrier, Model 2385.

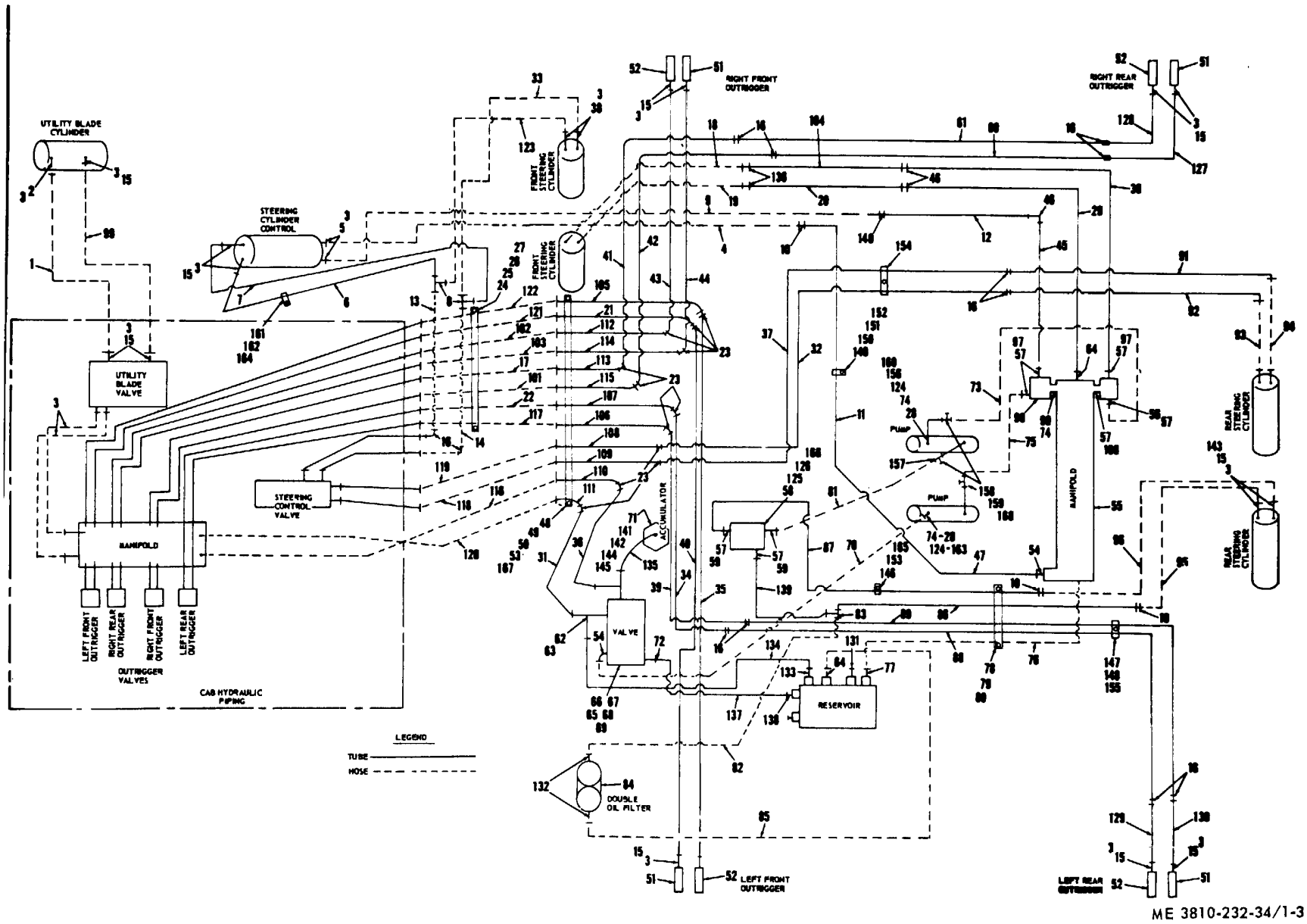
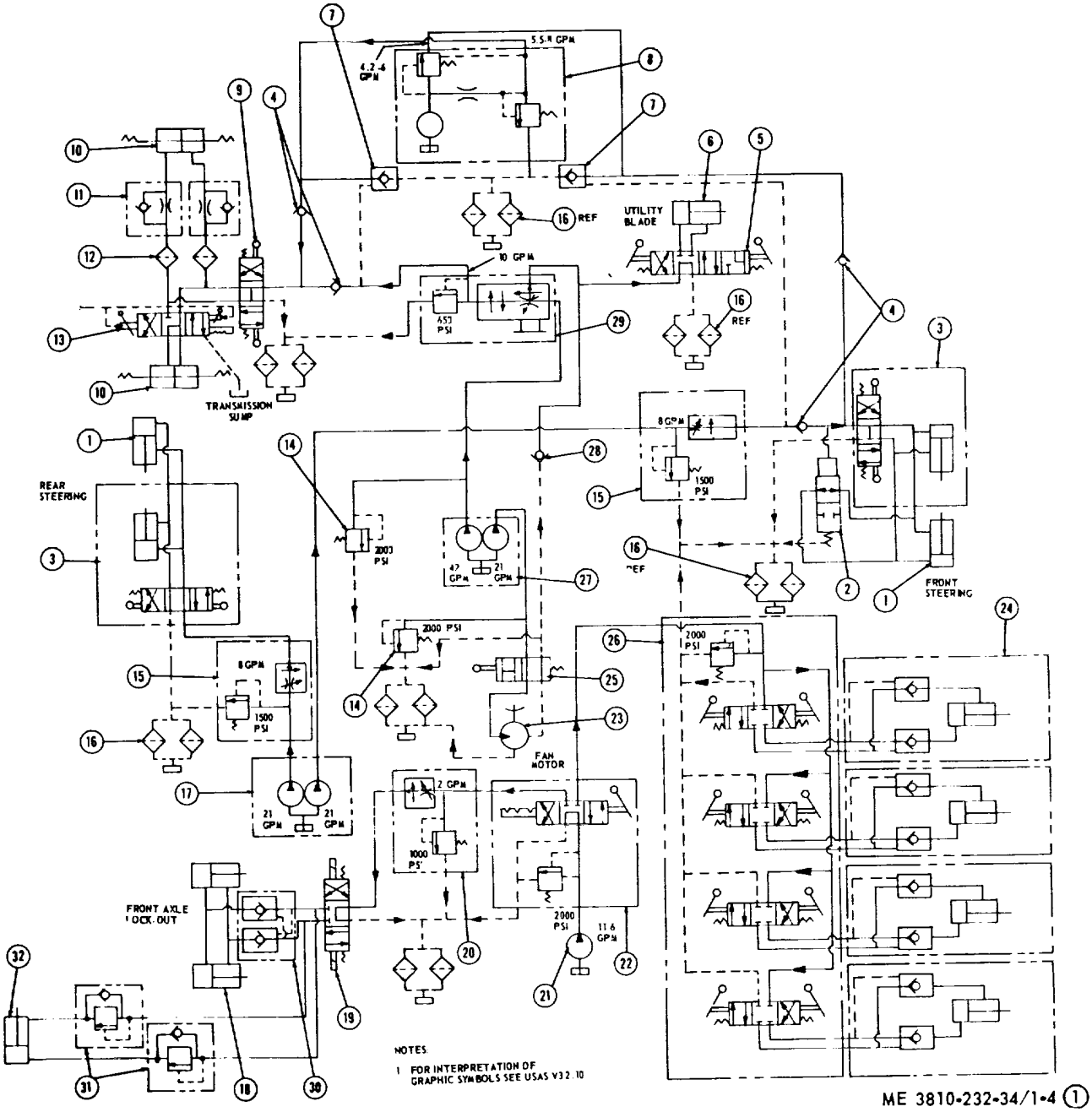



*Figure 1-3. Carrier hydraulic system assembly, schematic (Model 2380).*

1 Hose
2 Elbow
3 O-ring
4 Hose assembly
5 Adapter O-ring
6 Hose assembly
7 Hose assembly
8 Bulkhead tee
9 Hose assembly
10 Adapter
11 Tube assembly
12 Tube assembly
13 Hose assembly
14 Hose assembly
15 Connector
16 Connector
17 Hose assembly
18 Hose assembly
19 Hose assembly
20 Tube assembly
21 Tube assembly
22 Hose assembly
23 Elbow
24 Block, tube support
25 Block, tube support
26 Strap, tube support
27 Capscrew
28 Lockwasher
29 Tube assembly
30 Tube assembly
31 Tube assembly
32 Tube assembly
33 Hose assembly
34 Tube assembly
35 Tube assembly
36 Tube assembly
37 Tube assembly
38 Check valve
39 Tube assembly
40 Tube assembly
41 Tube assembly
42 Tube assembly
43 Tube assembly
44 Tube assembly
45 Tube assembly
46 Elbow
47 Tube assembly
48 Block, tube support
49 Block, tube support
50 Strap, tube support
51 Coupling body
52 Coupling adapter
53 Capscrew
54 Connector, male
55 Manifold assembly
56 Connector, male
57 O-ring
58 Valve assembly
59 Adapter, O-ring
60 Tube assembly
61 Tube assembly
62 Tee
63 Bushing, pipe
64 Elbow
65 Plate and bolt mounting
66 Unloading relief valve
67 Capscrew
68 Lockwasher
69 Nut
70 Hose assembly
71 Accumulator
72 Connector
73 Hose assembly
74 O-ring
75 Hose assembly
76 Hose assembly
77 Elbow
78 Block, tube support
79 Block, tube support
80 Strap, tube support
81 Hose assembly
82 Hose assembly
83 Union tee
84 Double oil filter assy.
85 Hose assembly
86 Tube assembly
87 Tube assembly
88 Tube assembly
89 Tube assembly
90 Connector
91 Tube assembly
92 Tube assembly
93 Hose assembly
94 Hose assembly
95 Hose assembly
96 Hose assembly
97 Elbow
98 Relief valve assy.
99 Hose assembly
100 Connector
101 Hose assembly
102 Hose assembly
103 Hose assembly
104 Tube assembly
105 Tube assembly
106 Tube assembly
107 Tube assembly
108 Tube assembly
109 Tube assembly
110 Tube assembly
111 Tube assembly
112 Tube assembly
113 Tube assembly
114 Tube assembly
115 Tube assembly
116 Hose assembly
117 Hose assembly
118 Hose assembly
119 Hose assembly
120 Hose assembly
121 Hose assembly
122 Hose assembly
123 Hose assembly
124 Capscrew
125 Capscrew
126 Lockwasher
127 Tube assembly
128 Tube assembly
129 Tube assembly
130 Tube assembly
131 Pipe plug
132 Connector male
133 Elbow, 90° male
134 Tube assembly
135 Tube assembly
136 Tube union
137 Tube assembly
138 Elbow, 90° male
139 Tube assembly
140 Union elbow
141 Capscrew
142 Lockwasher
143 Elbow, female swivel
144 Bracket
145 Bracket
146 Nut
147 Bracket
148 Bar
149 Clamp
150 Capscrew
151 Nut
152 Lockwasher
153 Bracket
154 Bracket
155 Capscrew
156 Adapter elbow
157 Tee
158 Bushing
159 Sending unit, temperature
160 Split flange
161 Clamp
162 Grommet
163 Washer plain
164 Capscrew
165 Capscrew
166 Nut
167 Capscrew
168 Tee




1 Cylinder, steering, front
2 Valve, control front axle
3 Cylinder, steering, rear
4 Check valve
5 Control valve, utility blade
6 Cylinder, utility blade
7 Check valve
8 Hydraulic pump, emergency steering
9 Control valve, steering
10 Cylinder, centering, front and rear axle
11 Check valve
12 Filter, strainer, steering line
13 Valve, hand and pilot operated
14 Relief valve
15 Flow control and relief valve
16 Oil filter, hydraulic
17 Dual hydraulic pump, front and rear steering
18 Lockout cylinder, front axle oscillate
19 Double solenoid valve
20 Flow control and relief valve
21 Hydraulic pump, outrigger and front axle oscillate lockout
22 Selector control valve
23 Hydraulic fan drive motor
24 Cylinder, outrigger
25 Control valve, fan drive
26 Directional control valve
27 Dual hydraulic pump, utility blade and fan drive motor
28 Check valve, right angle
29 Flow divider valve
30 Double check valve
31 Relief and check valve
32 Cylinder, lockout-trans gear range selector

*Figure 1-4. (1). Carrier hydraulic system assembly, schematic (Model 2385).*

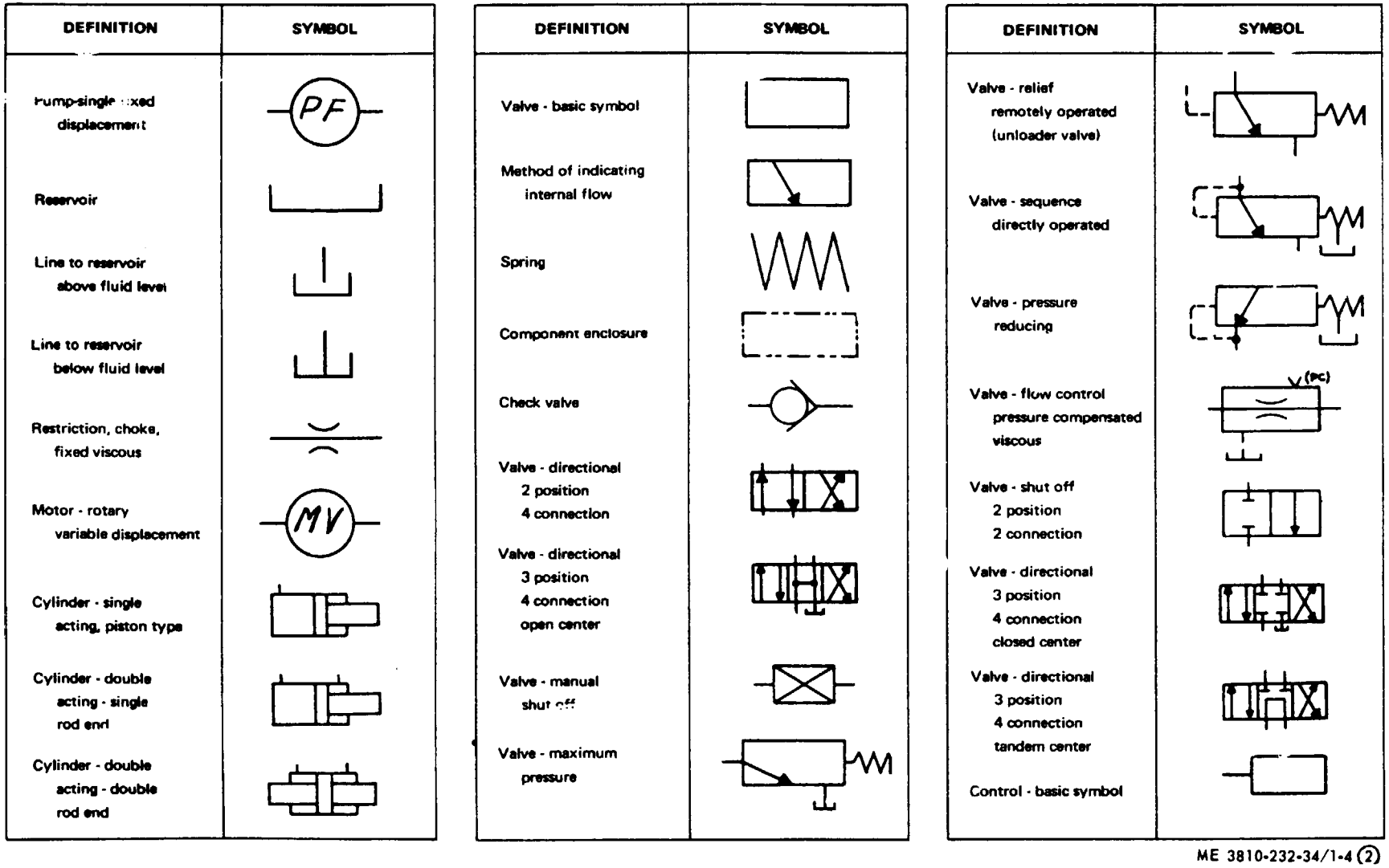



*Figure 1-4. (2). continued*

## 1-5. Differences in Models

The Rough Terrain Cranes, models 2380 and 2385, differ in the design of several components, such as the carrier engine fan drive assembly, differential, air cleaner, transmission control, gear housing and camshaft. The model 2380 carrier engine employs a battery charging generator whereas the model 2385 employs a battery charging alternator. There are minor dimensional differences between the models. There is also a difference in weight, model 2385 being the heavier of the two models. Specific physical differences between the models are described in the applicable sections of this manual.

## CHAPTER 2

## DIRECT AND GENERAL SUPPORT MAINTENANCE

## INSTRUCTIONS

### Section I. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT

**2-1. Special Tools and Equipment**
No special tools or equipment are required by direct and general support maintenance personnel for performing maintenance on the Model 2380 and Model 2385 Rough Terrain Crane.

**2-2. Direct and General Support Maintenance Repair Parts**
Direct and General Support Maintenance Repair Parts are listed and illustrated in TM 5-3810-232-35P.

**2-3. Specially Designed Tools and Equipment**
No specially designed tools and equipment are required.

### Section II. TROUBLESHOOTING

**2-4. General**
This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the Model 2380 and Model 2385 Rough Terrain Crane or any of its components. Malfunctions which may occur are listed in Tables 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 Chart.*

| Malfunction | Probable cause | Corrective action |
|---|---|---|
| 1. Engine Miss or Operate Erratically , | a. Valves not seating | a. Grind or replace valves (para 3-48, 4-42). |
| | b. Injector need adjustments | b. Adjust injectors (TM 5-3810-232-12). |
| | c. Low compression on one or more cylinders. | c. Restore compression by reconditioning valves or replacing piston rings (para 3-48, 4-42). |
| 2. Engine fail or is hard to start | a. Incorrect fuel pressure | a. Check and adjust fuel pressure. |
| | b. Plugged injector spray holes | b. Remove and clean or replace injector (TM 5-3810-232-12). |
| | c. Broken fuel pump drive shaft | c. Replace or repair fuel pump (para 3-17, 4-21). |
| | d. Scored gear pump worn gears | d. Replace or repair fuel pump (para 3-17, 4-21). |
| | e. Engine due for overhaul | e. Overhaul engine. |
| | f. Incorrect valve and injector timing | f. Retime valves and injector (TM 5-3810-232-12). |
| 3. Excessive Smoke | a. Restricted air intake | a. Inspect and correct. (para 3-39). |
| | b. Plugged injector spray holes | b. Remove, clean or replace injector (TM 5-3810-232-12). |
| | c. Gasket blow by or leakage | c. Inspect and correct. |
| | d. Broken or worn piston rings | d. Overhaul engine. |
| | e. Incorrect valve and injector timing | e. Retime valves and injectors (TM 5-3810-232-12). |
| | f. Worn or scored liners or pistons | f. Overhaul engine. |

*Table 2-1. Troubleshooting Chart - Continued*

| Malfunction | Probable cause | Corrective action |
|---|---|---|
| | g. Injectors need adjustment | g. Adjust injectors (TM 5-3810-232-12). |
| 4. Low Power or Loss or Power | a. Incorrect fuel pressure | a. Check and adjust pressure (TM 5-3810-232-12). |
| | b. Plugged injector spray holes | b. Remove, clean or replace injectors (TM 5-3810-232-2). |
| | c. Scored gear pump or worn gears | c. Repair fuel pump (para 3-18, 4-21). |
| | d. High speed governor-set to low | d. Adjust governor setting (TM 5-3810-232-12). |
| | e. Gasket blow-by or leakage | e. Inspect and correct. |
| | f. Valve leakage | f. Grind or replace valves (para 3-48, 4-42). |
| | g. Broken or worn piston rings | g. Overhaul engine. |
| | h. Incorrect valve and injector timing | h. Retime valves and injectors (TM 5-3810-232-12). |
| | i. Injectors need adjustment | i. Adjust injectors (TM 5-3810-232-12). |
| 5. Excessive fuel consumption | a. Incorrect fuel pressure | a. Check and adjust fuel pressure (TM 5-3810-232-12). |
| | b. Defective injector cup O-ring | b. Inspect and replace (para 3-46, 4-39). |
| 6. Low lubricating oil pressure | a. Oil suction line restriction | a. Inspect and correct |
| | b. Faulty oil pressure regulator | b. Check and replace (para 3-67). |
| | c. Incorrect bearing clearances | c. Inspect and correct (para 4-76). |
| | d. Engine due for overhaul. | d. Overhaul engine. |
| 7. Coolant temperature too high. | a. Worn water pump | a. Replace water pump (para 3-36, 4-35). |
| | b. Faulty thermostat | b. Replace thermostat (TM 5-3810-232-12). |
| | c. Radiator core plugged with dirt. | c. Clean or replace radiator (para 3-33, 4-29). |
| 8. Lube oil temperature too high | a. Worn water pump | a. Replace water pump (para 3-36, 4-35). |
| | b. Faulty thermostat | b. Replace thermostat (TM 5-3810-232-12). |
| | c. Clogged oil cooler | c. Inspect and correct (para 4-75). |
| 9. Main chain drive excessively noisy | a. Defective chain | a. Replace chain (TM 5-3810-232-12). |
| | b. Worn sprocket | b. Replace sprocket (para 6-16). |
| | e. Improper adjustment | c. Adjust main drive chain. (TM 5-3810-232-12). |
| | d. Improper or insufficient lubrication | d. Refer to LO and lubricate. |
| 10. Crane hoist gears noisy | a. Worn gear teeth | a. Replace gear (para 6-14). |
| | b. Worn or scored bearings | b. Replace bearings (para 6-14). |
| | c. Bent hoist shaft | c. Replace hoist shaft (para 6-14). |
| | d. Improper or insufficient lubrication | d. Refer to LO and lubricate. |
| 11. Crane Swing Gear Noisy or Pulsates in operation. | a. Worn gear teeth | a. Replace gear (para 6-20). |
| | b. Worn or scored bearing | b. Replace bearings (para 6-20). |
| | c. Bent swing shaft | c. Replace swing shaft (para 6-20). |
| | d. Improper or insufficient lubrication | d. Refer to LO and lubricate. |
| 12. Crane Boom or Hoist Operation Rough. | a. Bent drive shaft | a. Replace drive shaft (para 6-18). |
| | b. Inner boom gear binding | b. Replace gear bushing (para 6-15). |
| | c. Broken shaft bearings | c. Replace shaft bearings (para 6-14). |
| | d. Improper or insufficient lubrication | d. Refer to LO and lubricate. |
| 13. Revolving Frame Teeters or Will Not Swing adjustment | a. Worn rollers | a. Replace hook rollers (TM 5-3810-232-12). |
| | b. Swing clutches out of | b. Adjust swing clutch (TM 5-3810-232-12). |
| | c. Broken vertical swing shaft or related parts. | c. Replace broken swing shaft of or related parts as required. |

*Table 2-1. Troubleshooting Chart - Continued*

| Malfunction | Probable cause | Corrective action |
|---|---|---|
| | d. Defective ring or pinion gears | d. Replace gears (TM 5-3810-232-12). |
| 14. Continuous Humming Noise or Noisy Axle When Driving | a. Defective wheel bearings | a. Replace defective wheel bearing. Adjust as per para 5-18). |
| | b. Lack of lubrication or use of improper grade of lubricant in universal joints, wheel bearings | b. Check lubricant for correct amount and grade in lubrication order. |
| | c. Broken axle | c. Replace axle (para 5-18). |
| | d. Worn or broken differential or pinion gears | d. Replace gears (para 5-18). |
| | e. Worn or broken differential or pinion bearings | e. Replace bearings (para 5-18). |
| | f. Worn pinion gear or pinion gear bearings. | f. Replace pinion and ring gear/bearing as required. |
| 15. Carrier Has No Brake Action, Insufficient Action or Brake Apply Slowly | a. Improper brakeshoe adjustment | a. Adjust brakeshoes (TM 5-3810-232-12). |
| | b. Worn brake linings | b. Adjust for lining wear or replace brakeshoes or linings (para 5-20). |
| | c. Blocked, bent or broken tubing or hose (TM 5-3810-232-12). | c. Remove obstruction in line or replace faulty tubing |
| | d. Brake valve delivery pressure below normal 232-12). | d. If brake valve is defective, replace unit (TM 5-3810- |
| | e. No air pressure | e. Replace or repair air compressor (para 3-25). |
| 16. Brake Release Too Slowly With Pedal Released | a. Insufficient brakeshoe clearance | a. Adjust brakeshoes if clearance is insufficient (TM 5-3810-232-12). |
| | b. Weak or broken valve diaphragm return spring | b. Replace brake valve (TM 5-3810-232-12). |
| | c. Defective quick release valve | c. Replace quick release valve (TM 5-3810-232-12). |
| 17. Brakes Grab When Pedal is Depressed great | a. Brakeshoe clearance too | a. Adjust clearance (TM 5-3810-232-12). |
| | b. Grease or oil on linings | b. Clean linings or replace brakeshoes or linings (para 5-20). |
| | c. Drums out-of-round | c. Replace drums (para 5-18) |
| | d. Defective brake valve | d. Replace faulty unit (TM 5-3810-232-12). |
| | e. Brakes need relining | e. Replace brakeshoes (para 5-20). |
| | f. Brake chamber diaphragm leaks | f. Tighten all fittings. If caused by broken or faulty unit, replace brake chamber (TM 5-3810-232-12). |
| 18. Carrier Transmission Excessively Noisy in Operation | a. Insufficient or improper lubricant. | a. Fill to level with proper lubricant as specified in lubrication order. |
| | b. Unit out of line | b. Tighten all mountings securely. |
| | c. Loose transmission mounting bolts | c. Tighten or replace bolts (para 5-9, 5-10). |
| | d. Defective gears | d. Replace gears (para 5-10). |
| | e. Defective bearings | e. Replace bearings (para 5-10). |
| | f. Defective spline shaft- | f. Replace spline shaft (para 5-10). |
| 19. Fan drive hydraulic motor fails to start (Model 2385) | a. System leakage loose port connections or broken lines | a. Inspect and tighten port connections and lines. |
| | b. No fluid-inadequate fluid supply at inlet or in system | b. Check fluid level in reservoir. Replenish as necessary. |
| | c. System return line or drain line restricted | c. Check drain filter. Clean and/or replace filter element. |
| | d. System inlet line restricted Clean if necessary. | d. Check all strainers and filter for dirt and sludge. |

*Table 2-1. Troubleshooting Chart - Continued*

| Malfunction | Probable cause | Corrective action |
|---|---|---|
| | e. Fluid viscosity too heavy to pick up prime | e. Completely drain the system. Add new filtered fluid of proper viscosity. |
| | f. Air in system | f. Tighten any loose connections. Bleed air from highest point in system and replenish fluid. |
| | g. System relief valve stuck open | g. Disassemble and clean the valve with solvent. Use pressure gauge to adjust the relief valve |
| | h. Motor binding | h. Remove and disassemble the unit. Check for correct assembly of parts. Also check for dirt or metal chips. Clean the parts thoroughly and replace any damaged parts. |
| 20. Fan Drive Hydraulic Motor not Developing Sufficient Speed or Torque (Model 2385) | a. Insufficient pump speed. | a. Check pump drive speed. |
| | b. Insufficient fluid pressure | b. Check delivery of pump. Make certain sufficient hydraulic fluid is available to the pump. |
| | c. System overload relief valve set too low | c. Check pressure and reset relief valve. |
| | d. Motor requiring excessive torque | d. Remove motor and check torque requirements of driven shaft. |
| | e. Parts of motor cartridge scored due to excessive pressure or foreign matter in oil. | e. Remove motor for overhaul. |
| 21. Fan drive hydraulic motor turning in wrong direction (Model 2385) | a. Improper port connections or control valve in wrong direction | a. Reverse port connections or shift valve. |
| | b. Components in system not functioning as intended. | b. Check complete system for proper operation. |
| 22. Fan drive hydraulic motor noisy (Model 2385) | a. Air in system | a. Bleed air from highest point in system and replenish fluid. |
| | b. Motor internally damaged | b. Remove motor for overhaul. |
| | c. Noise from other system components telegraphing back through lines and emerging from motor | c. Check complete system for proper operation. |
| 23. External leakage from motor | Worn seals or cut "0" rings | Install new seals and "O" rings. |
| 24. Motor shaft continuing to rotate when control is in "Off" position | Control valve is not functioning properly | Check control valve for correct spool and leakage. |
| 25. (Model 2385) Hydraulic pump not delivering fluid | a. Driven in wrong direction of rotation | a. The drive direction must be reversed immediately to prevent seizure. |
| | b. Coupling or shaft sheared or disengaged | b. Disassemble the pump and check the shaft and cartridge for damage. Replace the necessary parts. Check the drive alignment. |
| | c. Fluid intake pipe in-reservoir restricted | c. Check all strainers and filters for dirt and sludge. Clean or replace as necessary. |
| | d. Fluid viscosity too heavy to pick up prime | d. Completely drain the system. Add new filtered fluid of the proper viscosity. |
| | e. Air leaks at the intake Pump not priming being drawn in. | e. Check the inlet connections to determine where air is Tighten any loose connections. Replace seals where necessary. See that the fluid in the reservoir is above the intake pipe opening. Check the minimum drive speed which may be too slow to prime the pump. |

*Table 2-1. Troubleshooting Chart - Continued*

| Malfunction | Probable cause | Corrective action |
|---|---|---|
| | f. Relief valve stuck open (Emergency steering hydraulic pump only) | f. As required, remove and disassemble the relief valve hydrostat. Wash the valve in clean solvent. Return the valve of its bore and check for any stickiness. A gritty feeling on the valve periphery can be polished with crocus cloth. Do not remove excess material, round off the edges of the bands or attempt to polish the bore. Wash all parts and reassemble the pump. |
| | g. Vane(s) stuck in the rotor slot(s) | g. Disassemble the pump. Check for dirt or metal. |
| 26. (Model 2385) Hydraulic pump insufficient pressure build up | System relief valve set too low | Use a pressure gauge to correctly adjust the relief valve. |
| 27. (Model 2385) Hydraulic Pump making noise | a. Pump intake partially blocked | a. Service the intake strainers. Check the fluid condition end, if necessary, drain and flush the system. Refill with clean fluid. |
| | b. Air leaks at the intake or shaft seal. (Oil in reservoir may be foamy) | b. Check the inlet connections and seal to determine where air is being drawn in. Tighten any loose connections and replace the seal if necessary. See that the fluid in the reservoir is above the intake pipe opening. |
| | c. (Model 2385) Hydraulic pump drive speed too slow or too fast | c. Operate the pump at the recommended drive speed. |
| | d. Coupling misalignment | d. Check if the shaft seal, bearing or other parts have been damaged. Replace any damaged parts. Realign the coupled shafts. |

## Section III. RADIO INTERFERENCE SUPPRESSION

### 2-5. General

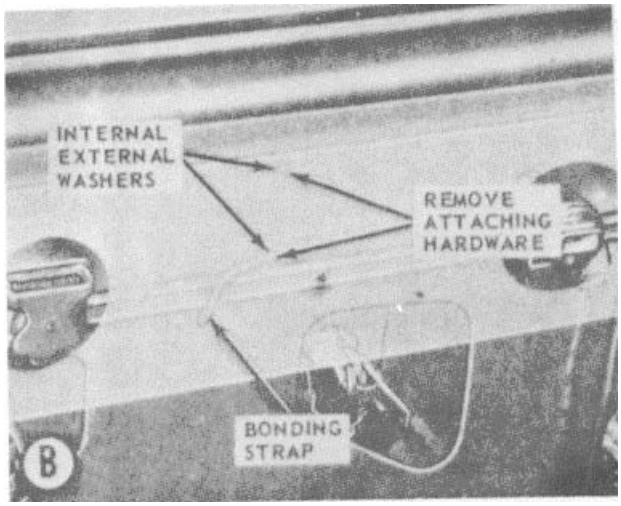
Refer to TM 11-483 for definitions, purposes, source and methods used to obtain radio suppression.

### 2-6. Replacement of Suppression Components

Refer to figure 2-1 and replace the radio interference suppression components.


A-Voltage regulator

*Figure 2-1. (1) Interference suppression components.*




B-Bonding strap
*Figure 2-1. (2) Continued*

## Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS

### 2-7. Crane Revolving Superstructure Assembly

*a. Removal.*

(1) Remove the crane boom assembly (TM 5-3810-232-12).

(2) Remove the front and rear roller assemblies (para 6-32).

(3) Refer to figure 6-20 and remove capscrew (3), looking clip (4), and plate (5) and pinion gear (6) from bottom end of vertical swing shaft.

(4) Use a suitable lifting device and remove the revolving superstructure from carrier assembly. During lifting, care must be taken to lift the superstructure with a straight upward motion in such a way as not to damage the vertical swing shaft (7).

*b. Installation.*

(1) Using a suitable lifting device place the superstructure on the carrier assembly. When lowering the superstructure on to the carrier, care must be taken to lower it with a straight downward motion in such a way as not to damage the vertical swing shaft (7).

(2) Install the pinion gear (6), and plate (5), locking clip (4), and capscrews on the bottom of the vertical swing shaft.

(3) Install the front and rear roller assemblies (para 6-34).

(4) Install the crane boom assembly (TM 5-3810-232-12).

(4) Install the crane boom assembly (TM 5-3810-232-12).

### 2-8. Crane Cab Assembly

*a. Removal.*

(1) Remove the crane boom attachment as necessary (TM 5-3810-232-12).

(2) Disconnect the control panel instruments and engine controls, (TM 5-3810-232-12).

(3) Remove the crane cab assembly from the crane base as instructed on figure 2-2.

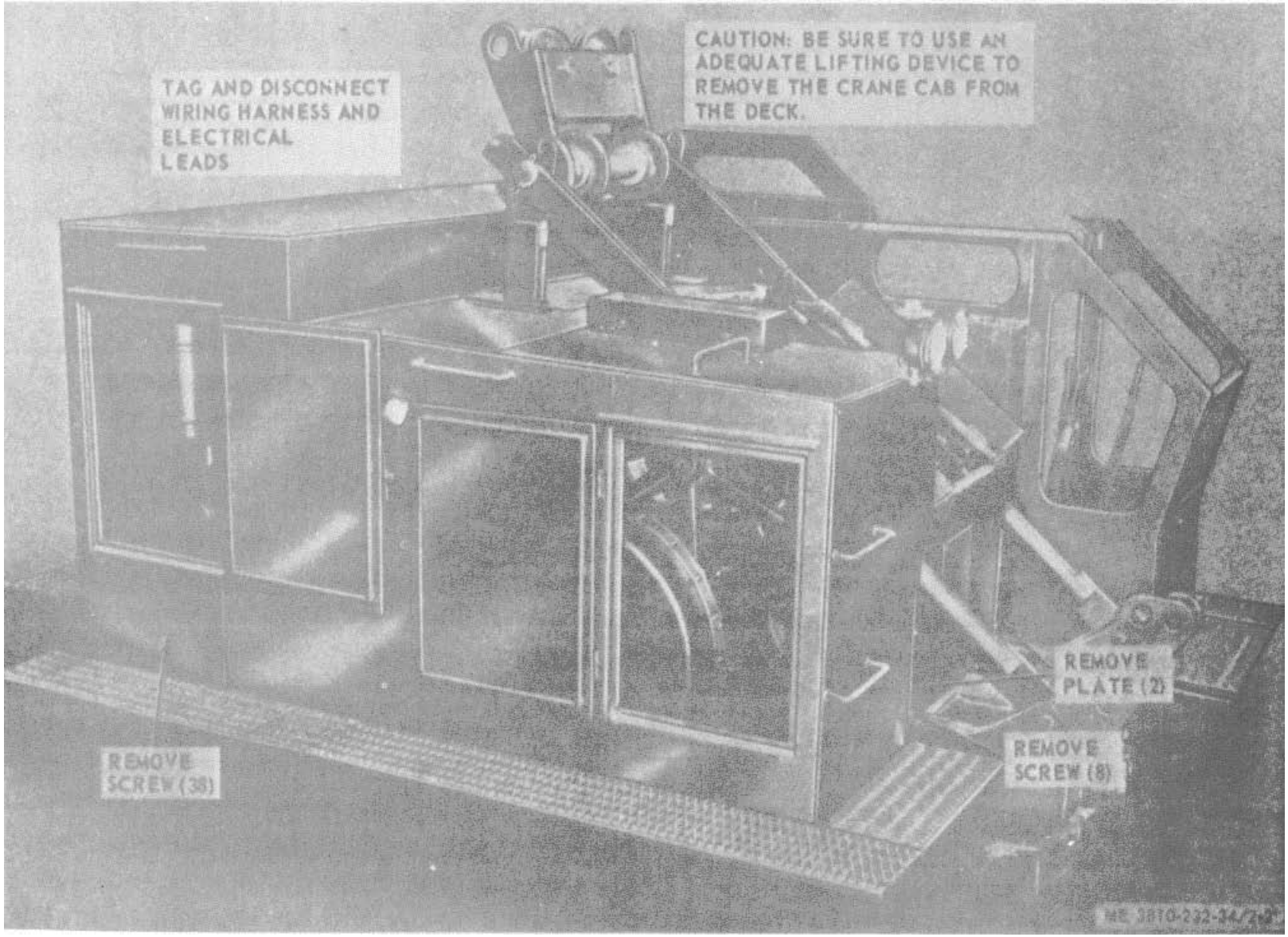



*Figure 2-2. Crane cab assembly, removal and installation.*

*b. Installation.*

(1) Install the crane cab assembly as illustrated on figure 2-2. Recaulk roof joints.

(2) Connect the control panel instruments and engine controls (TM 5-3810-232-12).

(3) Install the crane boom attachment as necessary (TM 5-3810-232-12).

**2-9. Crane Engine Assembly**

*a. Remove.*

(1) Remove the crane cab (para 2-8).

**NOTE**

**Rear portion of roof and right side only need be removed to remove engine assembly.**

(2) Drain the cooling system.

(3) Disconnect the battery cables.

(4) Disconnect the fuel line (TM 5-3810-232-12).

(5) Disconnect the cab heater (TM 5-3810-232-12).

(6) Disconnect the throttle linkage (TM 5-3810-232-12).

(7) Disconnect the master clutch linkage (TM 5-3810-232-12).

(8) Remove the main drive chain case cover and chain (TM 5-3810-232-12).

(9) Remove bolt, lockwasher, and retaining ring, then using a gear pulley pull the drive gear from the clutch shaft.

(10) Remove chain case plate, nuts, bolts and washers. Remove the inner and outer chain case plates.

(11) Remove the engine wiring harness (para 3-14).

(12) Remove the clutch assembly (para 6-2).

(13) Remove the crane engine assembly as instructed on figure 2-3.

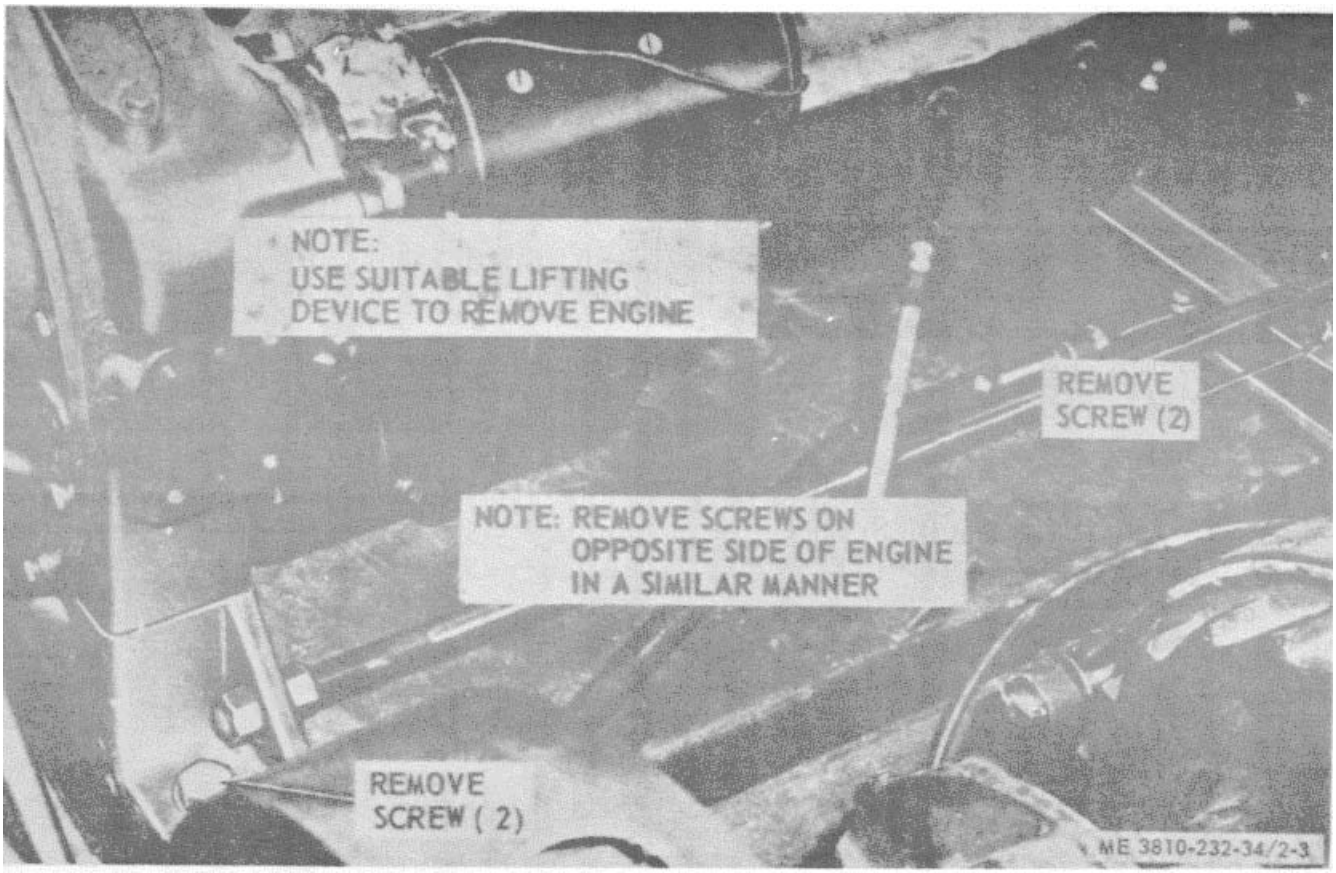



*Figure 2-3. Crane engine assembly, removal and installation.*

*b. Installation.*

(1) Install the crane engine assembly as illustrated on figure 2-3.

(2) Install the clutch assembly (para 6-2).

(3) Install the main drive chain case, chain, and drive gear (TM 5-3810-232-12).

(4) Install the engine wiring harness (TM 5-3810-232-12).

(5) Connect the throttle control linkage (TM 5-3810-232-12).

(6) Connect the master clutch linkage (TM 5-3810-232-12).

(7) Connect the cab heater (TM 5-3810-232-12).

(8) Connect the fuel line (TM 5-3810-232-12).

(9) Connect the battery cables.

(10) Fill the cooling system.
(11) Install the crane cab (para 2-8).

**2-10. Carrier Engine Assembly**

*a. Removal.*

(1) Drain the cooling system, and remove radiator hoses (TM 5-3810-232-12).

(2) Remove the deck plates over engine (TM 5-8810-282-12).

(38) Disconnect the battery cable (TM 5-3810282-12).

(4) Disconnect the fuel line (TM 5-3810-282-12).

(5) Disconnect the throttle linkage (TM 5-810-282-12).

(6) Disconnect the engine wiring.

(7) Remove the air cleaner, duct, and shroud (TM 53810-232-12).

(8) Remove the exhaust pipe and muffler (TM 5-3810-232-12).

(9) Disconnect the air compressor line (TM 5-3810-232-12).

(10) Disconnect the transmission control (para 5-6).

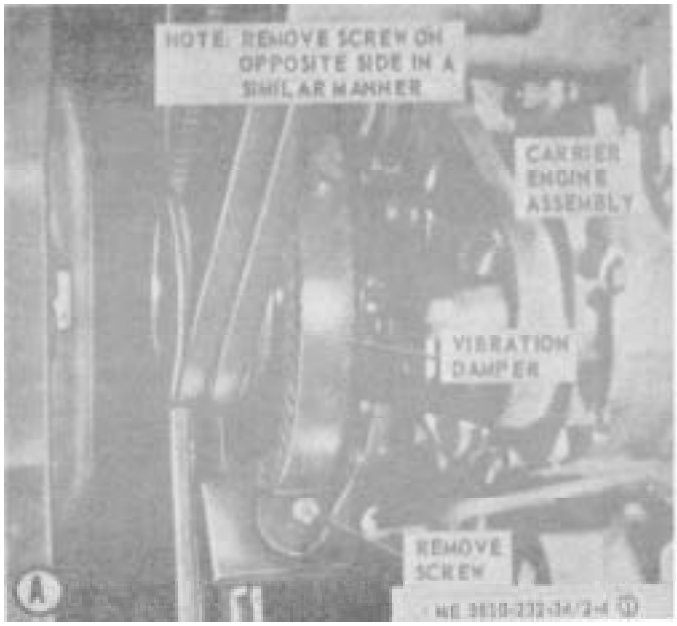
(11) Disconnect the universal joint from torque converter to transmission (para 5-4).

(12) Remove the carrier engine assembly as instructed on figure 2-4.

**NOTE**

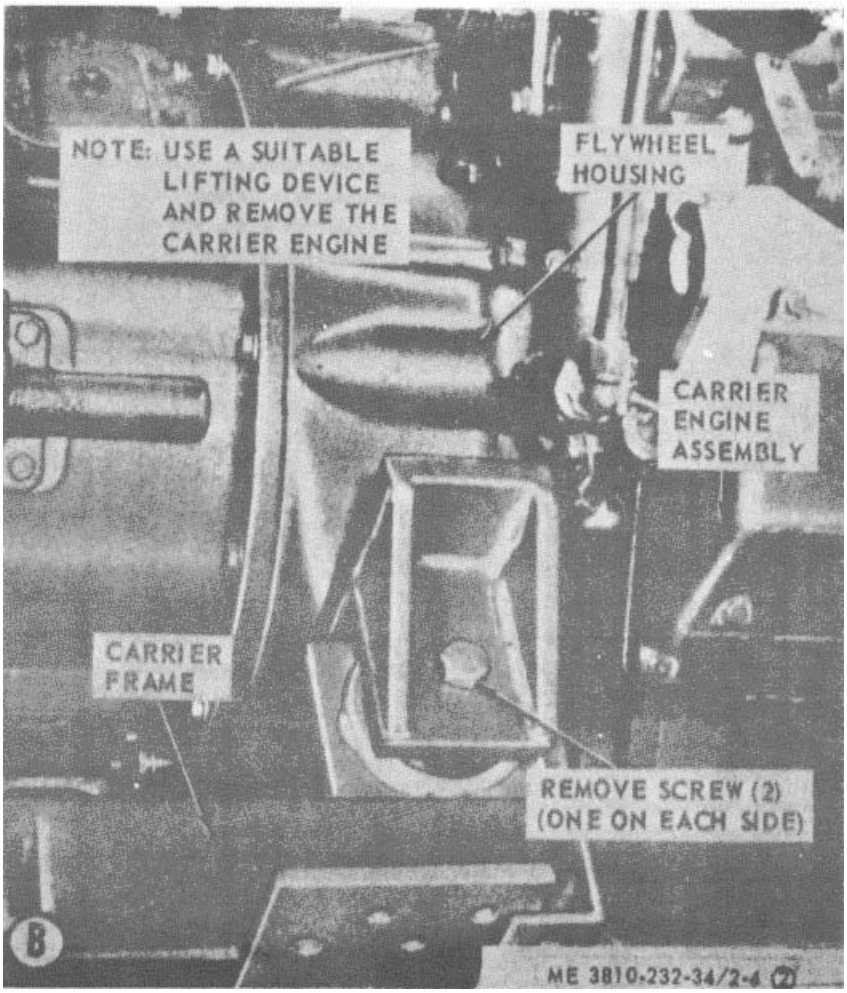
**Remove engine with torque converter attached.**

(13) Remove the torque converter (para 5-2).



A-Engine front mount, Installed view

*Figure 2-4. (1) Carrier engine assembly, removal and installation.*



B-Engine rear mount, installed view

*Figure 2-4. (2) Continued*

*b. Installation.*

(1) Install the torque converter assembly to the engine (para 5-2).

(2) Install the carrier engine assembly as illustrated on figure 2-4.

(3) Connect the universal joint between torque converter and transmission (para 5-4).

(4) Connect the transmission control (para 5-6).

(5) Connect the air compressor lines (TM 5-3810-232-12).

(6) Install the exhaust pipe and muffler (TM 5-3810-232-12).

(7) Install the air cleaner, duct and shroud (TM 5-3810-232-12).

(8) Connect the engine wiring.

(9) Connect the throttle linkage (TM 5-3810-232-12).

(10) Connect the fuel line.

(11) Connect the battery cables.

(12) Install the deck plates over engine TM 5-3810-232-12).

(13) Attach radiator hoses and fill the cooling system (TM 5-3810-232-12).

**2-11. Carrier Transmission Assembly**

*a. Removal.*

(1) Remove the propeller shafts (para 5-4).

(2) Disconnect the transmission control (para 5-6).

(3) Remove the transmission assembly as instructed on figure 5-5.

*b. Installation.*

(1) Install the transmission assembly as instructed on figure 5-5.

(2) Connect the transmission control (para 5-6).

(3) Install the propeller shafts (para 5-4).

**2-12. Carrier Differential and Drive Steer Axles**

*a. Removal.*

(1) Crib up carrier frame or provide suitable supports.

(2) Disconnect propeller shafts (para 5-4).

(3) Remove axle assembly as illustrated on figure 5-17.

*b. Installation.*

(1) Install the axle assembly as illustrated on figure 5-17.

(2) Connect the propeller shafts (para 5-4).

## CHAPTER 3

## CARRIER ENGINE REPAIR INSTRUCTIONS

### Section I. CARRIER ENGINE GENERATOR AND ALTERNATOR

**3-1. General**

The Model 2380 Crane uses a generator in the carrier engine electrical system and the Model 2385 uses an alternator.

*a. Generator (Model 2380).* The generator is a 24-volt type, V-belt driven from the engine crankshaft and supplies electrical energy to recharge the batteries to make up for cranking and other power supplies by the batteries while the generator is not in operation.

*b. Alternator (Model 2385).* The alternator is a 28 volt type, V-belt driven from the engine crankshaft and supplies electrical energy to recharge the batteries. The unit is rated at a maximum 60 amperes and has built-in silicon rectifiers and contains a built in regulator.

**3-2. Carrier Engine Generator (Model 2380)**

*a. Removal and disassembly.*

(1) *Removal.* Refer to TM 5-3810-232-12.

(2) *Disassembly.* Refer to figure 3-1 and disassemble the generator and mounting parts as illustrated.

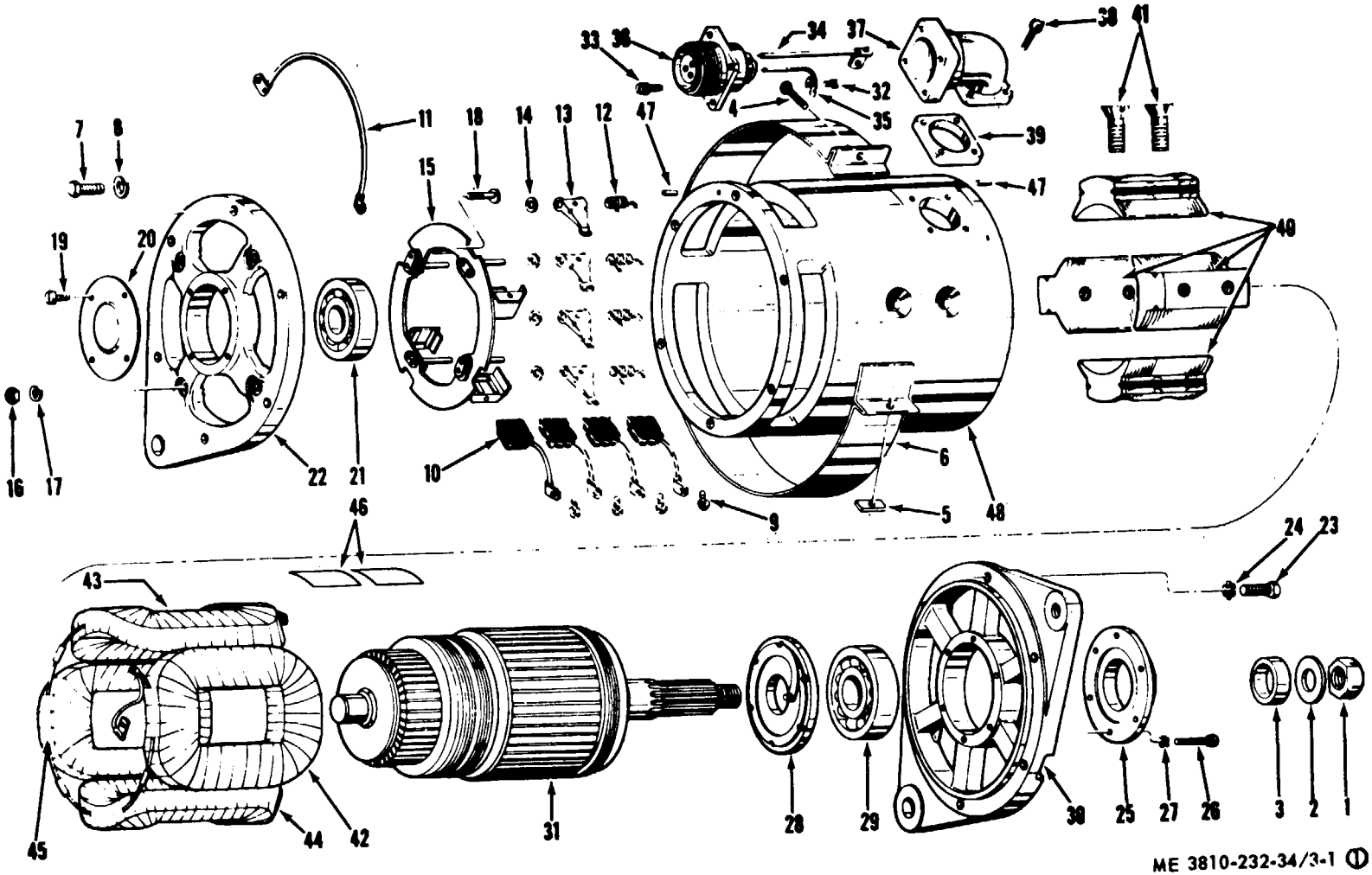



*Figure 3-1. (1) Carrier engine generator assembly, exploded view.*

| | | | | | |
|---|---|---|---|---|---|
| 1 | Nut | 17 | Washer | 33 | Screw and washer |
| 2 | Washer | 18 | Screw | 34 | Lead and clip |
| 3 | Collar | 19 | Screw | 35 | Lead and clip |
| 4 | Screw | 20 | Plate | 36 | Terminal |
| 5 | Nut | 21 | Bearing | 37 | Elbow |
| 6 | Cover | 22 | Frame | 38 | Screw and washer |
| 7 | Screw | 23 | Screw | 39 | Spacer |
| 8 | Washer | 24 | Washer | 40 | Shoe pole |
| 9 | Screw and washer | 25 | Plate | 41 | Screw |
| 10 | Brush | 26 | Screw | 42 | Coil |
| 11 | Lead assembly | 27 | Washer | 43 | Coil |
| 12 | Spring | 28 | Plate | 44 | Coil |
| 13 | Arm | 29 | Bearing | 45 | Coil |
| 14 | Washer | 30 | Frame | 46 | Insulator |
| 15 | Plate assembly | 31 | Armature | 47 | Pin |
| 16 | Nut | 32 | Screw | | |

1 Bracket
2 Link
3 Deleted
4 Screw
5 Bolt
6 Screw
7 Screw
8 Bolt
9 Washer
10 Washer
11 Nut
12 Washer
13 Washer
14 Screw
15 Deleted
16 Bracket
17 Belt
18 Fan
19 Pulley
20 Spacer
21 Washer

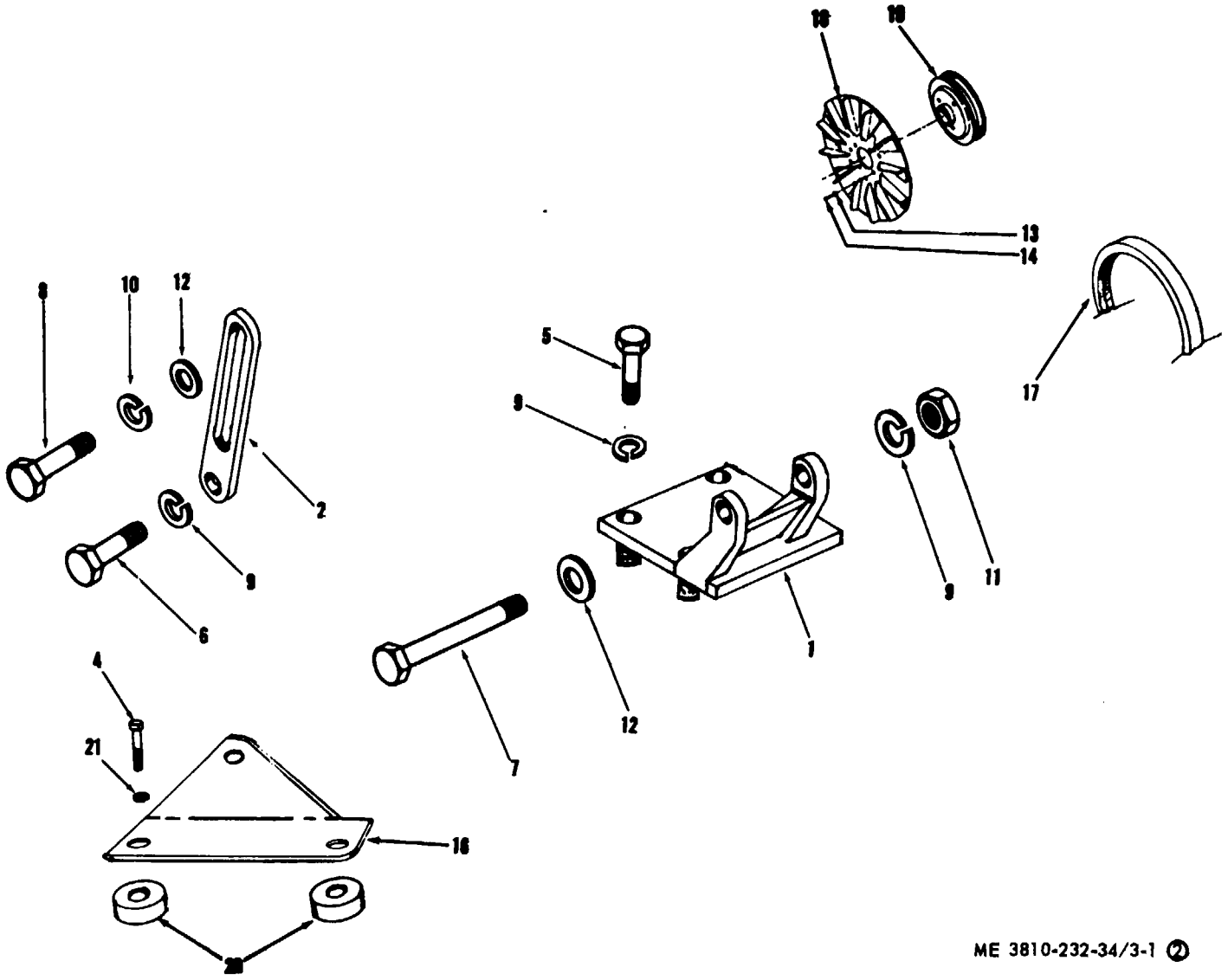



*Figure 3-1. (2) Continued*

*b. Cleaning, Inspection and Repair.*

(1) Clean all metal parts with an approved cleaning solvent and dry thoroughly.

(2) Remove all dirt, dust, and foreign matter from the frame and fields with compressed air.

(3) Inspect all parts for excessive wear or other damage. Repair or replace all defective parts.

(4) Refer to TM 5-764 for armature and field coil tests.

*c. Reassembly and Installation.*

(1) *Reassembly*. Refer to figure 3-1 and reassemble the generator and mounting parts as illustrated.

(2) *Installation*. Refer to TM 5-3810-232-12.

**3-3. Carrier Engine Alternator (Model 2385)**

*a. Removal and Disassembly.*

(1) *Removal*. Refer to TM 5-3810-232-12.

(2) *Disassembly*. Refer to figure 3-1 and disassemble the alternator as illustrated.

*b. Electrical Test of the Vehicle.*

(1) Remove the alternator terminal cover to expose the "G" plus and "G" minus terminals and check the voltage across these terminals. Turn battery disconnect switch on. Full battery voltage should be present. If no voltage is present across the "G" plus and 'G" minus terminals, an open circuit between the alternator and battery is indicated. This may be due to loose or broken wiring or possibly a defective circuitbreaker, master switch or ammeter. Turn on the main switch and check for battery voltage between ground and the alternator ignition terminal. Correct any defects before proceeding to the next test. Full battery voltage must be present at the alternator positive terminal as well as the alternator ignition terminal when the main switch is turned on.

(2) Reconnect the voltmeter across the "'G" plus and "G" minus alternator terminals. The engine should now be started and run at a speed which will maintain approximately 2,000 alternator RPM. Electrical accessories should now be turned on until the alternator output is approximately 10 amps. At this point, the voltage should be 28.0. If the voltage is above or below this reading it should be readjusted by removing the pipe plug from the top of the drive end housing and turning the voltage adjusting screw with a small screwdriver. Increase voltage by turning the screw counterclockwise and decrease voltage by turning screw clockwise. Be sure to replace the plug after adjustments have been made to keep out the dirt and moisture. When vehicles are operated in locations where extremely high temperatures are encountered, it may be necessary to reduce the voltage to prevent battery damage. Under these conditions voltage should be reduced to a point where batteries remain charged but do not overheat or use excessive amounts of water.

*c. Removal*. Refer to TM 5-3810-232-12.

*d. Disassembly and Testing.*

(1) Remove pulley nut (61, fig. 3-2) and guard washer (59) and remove pulley with a suitable puller.

**NOTE**

**When removing pulley nut, secure pulley in a vise or suitable clamp to prevent rotation of the shaft. Do not attempt to hold the rotor shaft by placing. screwdrivers or bars in the fan, as damage will result. When the pulley has been removed, the woodruff key and pulley spacer (58) may now be removed.**

(2) Remove the six socket head screws (60) which retain the drive end housing (52) and using a puller, remove the drive end housing and regulator assembly (47).

(3) The voltage regulator may be removed from the drive end housing by removing the four socket head screws.

**NOTE**

**The regulator also serves as a bearing retainer and must be removed when replacing the drive end bearing (48).**

(4) Press the bearing from the drive end housing.

**NOTE**

**When pressing the bearing out of the housing, force should be applied to the outer race to avoid the possibility of brinneling the bearing.**

(5) Remove the two round head screws and guard washers which secure the brush holder (39) and lift the brush holder out of the way. Remove the brushes (42) by pulling them out of the holder.

(6) Remove the socket head screw (1) and washer (2) which retain the fan (5) and pull the fan off of the rotor shaft. Remove the key (4) from the shaft.

(7) Remove the six socket head screws (8) which secure the anti drive end housing (9) and pull the housing and rotor assembly (13) out of the stator (12) and intermediate housing assembly (29).

(8) Pull the housing off of the rotor shaft, using a suitable puller.

**NOTE**

**In some cases, the bearing (10) may remain in the housing and in other cases may remain on the shaft.**

(9) Pull the bearing (10) from the rotor shaft or press it out of the housing, whichever is required.

(10) Press the seal out of the intermediate housing. Discard this seal when it has been removed. A new seal should always be used when reassembling the alternator.

(11) Further disassembly of the unit is not required unless the following tests indicate a defective component.

1. Screw
2. Washer
3. Sleeve seal
4. key
5. Fan and hub
6. Seal, lip
7. O-ring
8. Screw
9. Housing, anti D.E.
10. Bearing
11. O-ring
12. Stator end terminal
13. Rotor
14. Seal
15. Mount, rectifier
16. Mount, rectifier
17. Bushing
18. Insulator, mount
19. Washer, insulator
20. Washer, guard
21. Lockwasher
22. Screw
23. Rectifier and lead
24. Rectifier and lead
25. Stud
26. Nut, hex
27. Insulator, support
28. Screw
29. Housing, intermediate
30. Gasket
31. Capacitor and lead
32. Clamp
33. Screw
34. Cover
35. Lockwasher
36. Screw
37. Screw
38. Pin
39. Holder, brush
40. Washer, guard
41. Screw
42. Brush
43. Connector, socket
44. Screw
45. O-ring
46. Nut, hex
47. Regulator
48. Bearing
49. O-ring
50. Spacer
51. Screw
52. Housing, D.E.
53. Plug, pipe
54. Gasket
55. Plate, cover
56. Lockwasher
57. Screw
58. Spacer
59. Washer, guard
60. Screw
61. Nut, lock
62. Nut, hex
63. Panel, capacitor
64. Nut
64. Nut

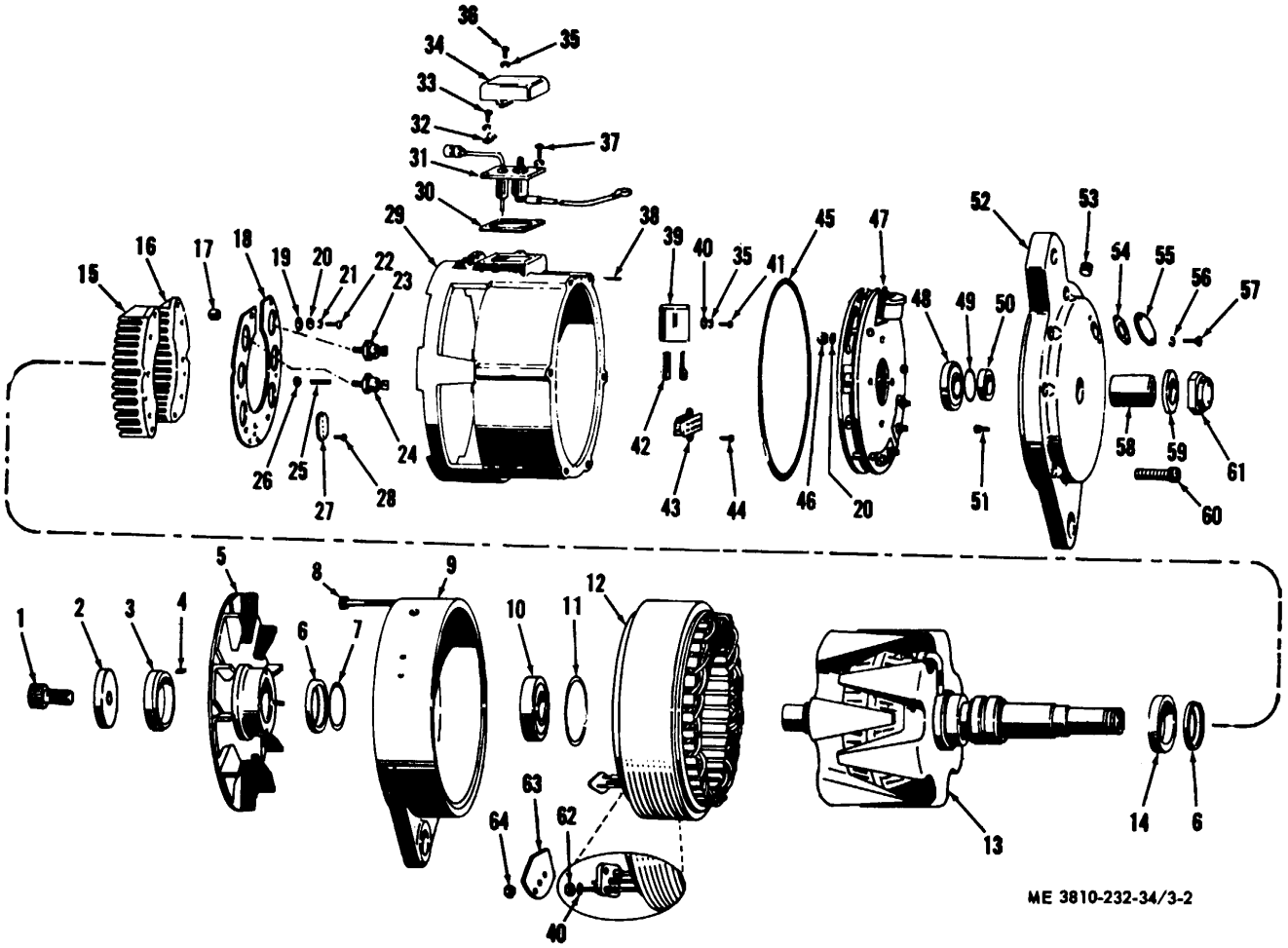



*Figure 3-2. Carrier engine alternator assembly, exploded view.*

*e. Electrical Tests, Alternator Disassembled.*

(1) *Stator disconnector*. Slide the three insulating sleeves away from the splices and unsolder the splices to disconnect the stator from the rectifiers (23 and 24).

(2) *Stator ground test*. Connect a test light from each stator lead to the stator core or frame of the alternator. If the bulb lights, the stator is grounded and must be replaced. (See stator replacement).

(3) *Stator continuity test*. Connect the test light between each phase of the stator. If the bulb fails to light, the stator is open and should be replaced. (See stator replacement).

(4) *Rectifier tests-positive heat sink*. The positive heat sink is insulated from the housing by means of a rubber insulator under its base and fiber washers and bushings around the retaining screws and stud. Carefully check for broken or missing insulators which could cause the positive heat sink to ground to the housing. The diodes may now be checked in the following manner. Connect the negative lead of an ohmmeter to test point two and touch the positive lead of the ohmmeter to diode terminals, 1, 2, and 3. A low resistance reading should be obtained. Reverse the ohmmeter leads connecting the positive lead to test point two and touch the negative lead to the diode terminals 1, 2, and 3. A high resistance reading should be obtained. If a low resistance reading is obtained, the diode is shorted and must be replaced. See figure 3-3.

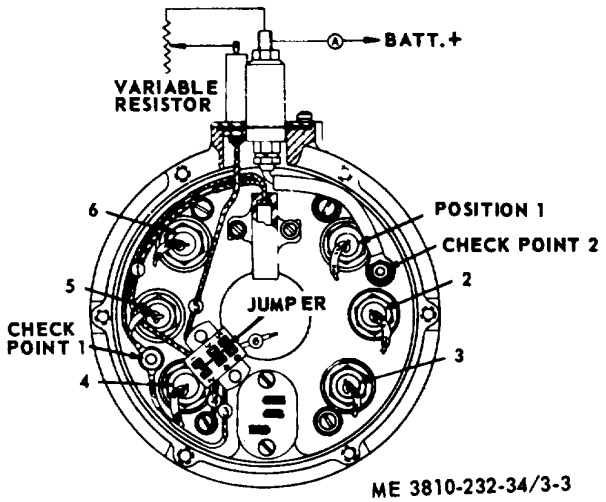



*Figure 3-3. Carrier engine rectifier testing-(Model 2385).*

(5) *Rectifier Tests-Negative Heat Sink*.

(*a*) The negative heat sink is grounded to the housing by means of its mounting screws 3-8 and stud. Be sure that these screws are clean and tight so that the negative heat sink makes good contact with the housing. The diodes may now. be checked in the following manner. Connect the negative lead of an ohmmeter to test point one and touch the positive lead to terminals 4, 5 and 6. A high resistance reading should be obtained. If a low resistance reading is obtained, the diode is shorted and must be replaced. See figure 3-3.

(*b*) Rotor tests are performed with an ohmmeter and consist of a resistance check and ground test. Rotor coil resistance should be 7.0 to 7.8 ohms and is measured by connecting the ohmmeter across the two slip rings. If the resistance is not within the above specifications, the rotor coil is defective. Check for grounds by connecting the ohmmeter between either slip ring and the shaft. No reading should be obtained. If a reading is obtained, the rotor coil is grounded. If the coil is defective or slip rings are badly worn it will be necessary to replace the complete rotor assembly.

*f. Voltage Regulator*. If preceeding test indicate that all components are working satisfactorily a defective regulator is indicated and a new one should be installed. Due to special testing equipment required repair of this regulator is not recommended.

*g. Diode Replacement*. If electrical tests indicate one or more defective diodes, the following procedure should be followed. Unsolder the lead from the defective diode and push the lead aside. With a sharp knife or ice pick, carefully remove the RTV rubber sealant from around the diode, and unscrew the diode using a suitable 11/16 socket wrench. After the diode has been removed, check the mounting surface of the heat sink for burrs or foreign matter which would prevent the new diode from seating properly. It is very important that the diode seat firmly against the heat sink to insure proper heat transfer as well as electrical contact.

**CAUTION**

**Diodes used in the negative (grounded) heat sink differ from those used in the positive (ungrounded) heat sink. If they are interchanged, serious damage will result. Consult figure 3-4 to insure proper diode identification and position. Insert the proper diode, tighten to 20-25 inch pounds torque and reconnect the lead. When resoldering, do not use excessive heat which could damage the diode. Reseal the diode against moisture.**

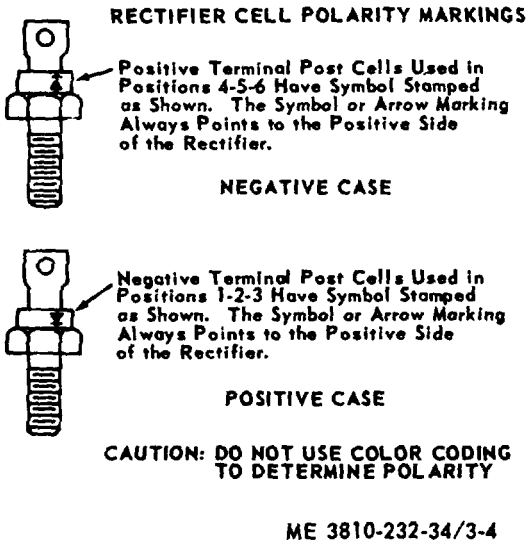



*Figure 3-4. Diode markings*

*h. Stator Replacement.*

(1) When tests indicate an open or grounded stator, or if it is mechanically damaged, the stator must be replaced. Unsolder the three stator leads from the splices and cut the three stator leads on both sides of the intermediate housing. These leads should be cut as close to the housing as possible. The defective stator may now be removed from the intermediate housing by tapping it carefully with a soft hammer. Remove the two screws which retain the insulator and carefully pry the insulator off of the three leads.

(2) Using a small drill or a punch and hammer remove epoxy which seals the three leads into the housing.This must be done very carefully to avoid damage to the housing. When all epoxy has been removed from the hole, insert the new stator so that the three leads protrude through the housing and reinstall the fibre insulator around the leads. Replace the two screws which secure the insulator. Reconnect the three leads to the splices and solder them securely. Be sure to slip the insulating sleeving over the splices when completed. Place the stator and intermediate housing on the bench with the stator facing upward and apply epoxy around the stator leads. Sufficient epoxy should be used to completely fill the recess in the housing around the leads. Allow the epoxy to harden thoroughly before reassembling the alternator.

*i. Reassembly.*

(1) Install new bearing on anti drive end of rotor and press housing onto bearings. If the bearings are to be replaced, special care must be used to avoid damage. When pressing a bearing onto the shaft, apply pressure to the inner face with a suitable tool. When pressing a bearing into a housing, press only on the outer race. This will avoid applying force through the bearing balls which will brinnell the bearing. When replacing seal, pack cavity 50 to 50% full of grease MIL-G-3545B spec.

(2) Install rotor and housing assembly into stator and intermediate housing. When installing the rotor, it is necessary to use a fabricated tool to avoid damage to the seal. Details of the tool are shown in figure 3-5. Fabricate from mild steel at DS, GS level.

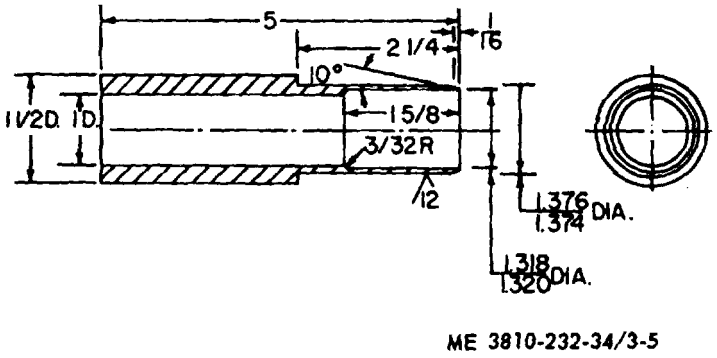



*Figure 3-5. Rotor installation tool.*

(3) Insert the tapered end of the tool into the intermediate housing seal from the drive end or brush holder site of the housing. Be sure that the surface of the tool which enters the seal is free from nicks and burrs which would damage the seal.

(4) Insert the rotor into the stator and intermediate housing assembly so that the slip rings enter the recess in the end of the tool.

Carefully slide the rotor into the stator and housing assembly. The tool will be forced back out of the seal as the rotor shaft enters. The

tool prevents the slip rings from catching on the edge of the seal and damaging the sealing lips.

(5) Install socket head bolts which retain anti drive end housing to the stator and intermediate housing.

(6) Install brushes in brush holder and install brush holder with the two screws that were originally removed.

(7) Install new bearings in drive end housing and install voltage regulator with four socket head screws.

(8) Install spacer or seals0 on rotor shaft in reverse order as removed.

(9) Press regulator and housing on rotor shaft.

**CAUTION**

**The six prong plug on the regulator must line up its male in the alternator. Use several long screws to properly pilot the housing while pressing it on. Be sure the rubber O-ring (45 fig. 3-2) is in place on the drive end housing.**

(10) Replace the six socket head screws which retain the drive end housing. Install key and fan using socket head screw and retaining washer. Install the pulley spacer, woodruff key, and pulley. Install the guard washer and pulley nut, torquing to 50 ft.-lbs. When possible use a new pulley nut as its self-locking ability is reduced lifter the nut has been removed.

*j. Bench Testing Complete Unit.* The unit may now be checked on a test clock and the voltage properly adjusted. Connect the alternator as shown in figure 3-6. With the alternator running at a speed of 2.000 RP, adjust the voltage by removing the pipe plug from the end housing and turning the adjusting screw with a small screwdriver. The screw should be turned clockwise to reduce voltage and counterclockwise to increase voltage. Voltage should be adjusted to 27.5 to 28.0. After the has been adjusted, apply a sixty ampere load. Alternator output should be 55 to 60 amps.

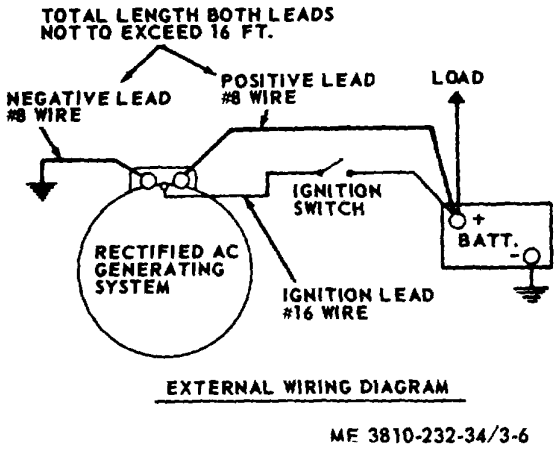



*Figure 3-6. Bench test wiring diagram (Model 2385).*

*k. Installation.* Refer to TM 5-3810-232-12.

## Section II. CARRIER ENGINE GENERATOR REGULATOR

### 3-4. General

The voltage regulator prevents line voltage from exceeding a predetermined valve and thus protects battery and other electrical units in system from high voltage.

### 3-5. Removal

*a.* Disconnect batteries before removing regulator.

*b.* Disconnect the electrical leads at the couplings of the voltage regulator. Tape the ends of the cables to avoid short circuiting.

*c.* Remove the four bolts and lockwashers that secure the voltage regulator and brackets to the carrier; remote the assembled voltage regulator and bracket.

### 3-6. Testing and Adjusting

*a.* Remove the four screws and lockwashers and the two seal cups that secure the cover the regulator base assembly; remove the cover.

NOTE

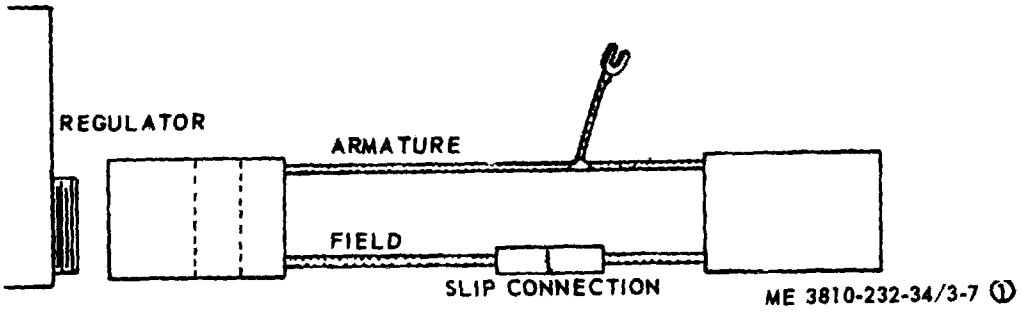
The generator regulator must be in operating position when being adjusted or tested. Power to the regulator must be shut off when making adjustments. All checks must be made with the regulator at operating temperature and connected to the same type of DC generator as is used on the engine.

Replace the cover after each adjustment, and operate the generator until the regulator returns to its normal operating temperature. In performing the regulator test, the DC generator should be turned at 3500 to 4000 RPM. In the event voltage and amperage continue to rise without control from the regulator, it is an indication that the voltage regulator is defective.

**CAUTION**

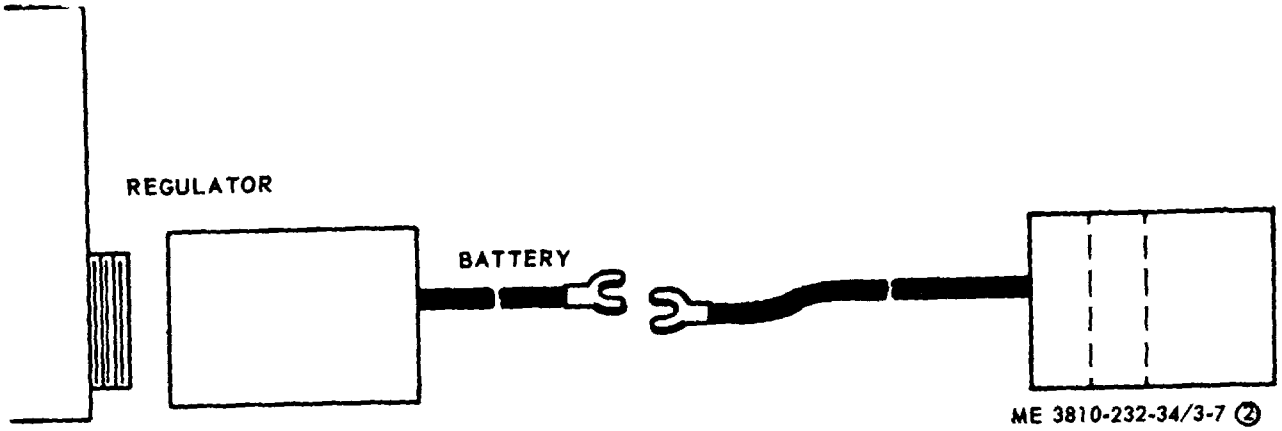
**Air gap and point gap opening are checked with the battery disconnected.**

b. Measure the air gap of the cutout relay between the armiture and the core with the contact points barely touching. The air gap should be .037 inch. If the points do not close, aline the lower contact bracket slightly or bend the spring fingers on the armature until the points meet and aline. Adjust the air gap by loosening two screws attaching the lower contact bracket. Raise or lower the contact bracket as required. Aline the contact points and tighten the screws. Measure the contact points and tighten the screws. Measure the contact point opening; it should be .037 inch. Adjust to obtain the correct contact point opening by bending the upper armature stop. To check the closing voltage, insert a wiring harness in the generator circuit as shown in figure 3-7A. Connect a voltmeter and a variable resistor in the circuit.




A- Cutout relay checking wiring harness.

*Figure 3-7. (1) Carrier engine generator regulator testing.*




B Voltage and current regulator checking wiring harness.

*Figure 3-7. (2)-Continued.*

**CAUTION**

**The cutout relay, contact points must never be closed by hand with the battery connected to the voltage regulator. This would cause high current to flow through the units and seriously damage them.**

Gradually increase the speed of the generator until the relay contacts close. Note the voltage; it should be between 25 and 27 volts. If the closing voltage is not within this rage, adjust by loosening the lock and eccentric screw at the base of the cutout relay frame. The eccentric screw increases or decreases the tension of the spiral spring. Increasing the spring tension increases the relay closing voltage; decreasing the spring tension decreases the closing voltage. When the proper adjustment is secured, tighten the lockscrew.

**CAUTION**

**The generator must be cycled before each check and adjustment. Cycle the generator speed until the cutout relay opens; then increase the speed slowly until the proper speed for checking is reached.**

c. Measure the air gap in the regulator.
Push the armature down until the points open; release until the points barely close. Measure the air gap at the point between the armature and the part of the core next to the residual pan. Do not measure the gap when the flat spring that supports the contact screw is raised up off the fiber mounting plate. The air gap should be .084 inch. Adjust by loosening the lock nut and turning the contact screw. This can be done most conveniently by inserting a flat gage in the gap, pressing down on the armature to hold it in place, and turning the contact setscrew until the contacts barely touch.
Check the voltage setting. Insert the special wiring harness shown in figure 3-2B leaving the connections open.

**CAUTION**

**Make sure the ends of the leads are insulated. from the ground at all times to avoid a short circuit. Connect a voltmeter between the connection from the regulator to ground. Cycle the generator as directed in (B) above. With the generator operating at 4,000 rpm and the regulator at operating temperature, note the voltage registered on the voltmeter; it should be between 27.5 and 29.5 volts. If the voltage is not within range. adjust by loosening the lock and eccentric screws of the base of the voltage regulator frame. The eccentric screw increases or decreases the tension of the spiral spring. Increasing the spring tension increases the closing voltage. Adjust to 28.2 volts. Cycle the generator after each change of adjustment.**

*d.* Measure the gap of the current regulator by the same method used to measure the air gap of the voltage regulator. The gap between the armature and that part of the core next to the residual pin should be .115 inch. Adjust the air gap by loosening the lock nut and turning the contact screw. Tighten the lock nut after proper setting is obtained. Check the current regulator setting by connecting an accurate ammeter to the leads of the special wiring harness (fig. 3-7B) in the battery circuit. Voltage regulator operation must be prevented during this check and can be done by partly discharging the batter by inserting a carbon pile load approximately the current regulator setting across the battery terminals during the current regulator setting test is made. When the generator output is increased to maximum, the current should be 38 to 42 amperes, but this must be measured before rising battery voltage causes the voltage regulator to operate. If the voltage is not within this range, adjust by loosening the lock and eccentric screw at the base of the current regulator frame. The eccentric screw increases or decreases the tension of the spiral spring. Increasing the spring tension increases the relay closing voltage; decreasing the spring tension decreases the closing voltage. When the proper setting is obtained, tighten the lockscrew. When the proper setting is obtained, tighten the lockscrew. After each change of adjustment, reduce the generator speed until the cutout relay opens; then return to speed and check the current indication on the ammeter.

### 3-7. Installation

*a.* Secure the voltage regulator to the carrier with four bolts and lockwashers.

*b.* Connect the electrical leads to the couplings of the voltage regulator.

## Section III. CARRIER ENGINE STARTING MOTOR

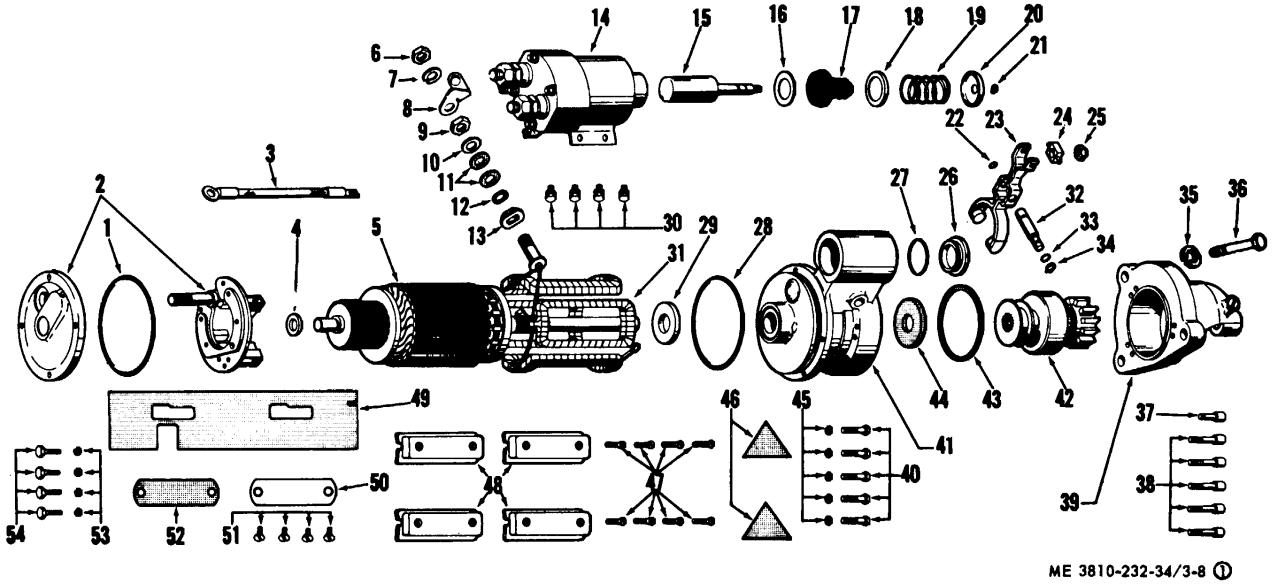
### 3-8. General

The starter is a 24-volt, 4-brush, gear drive type. The starter converts the electrical energy of the batteries into the mechanical energy necessary to crank the engine. The starter has an overrunning clutch which shifts the pinion of the state into mesh with the ring gear on the engine flywheel.

### 3-9. Removal and Disassembly

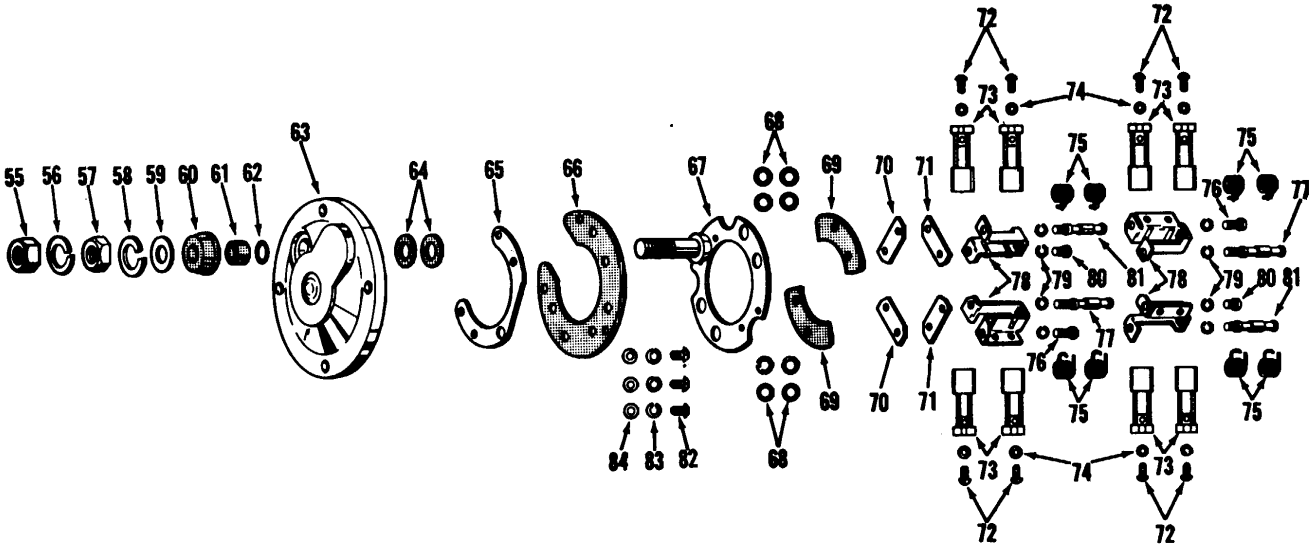
*a. Removal*. Refer to TM 5-3810-232-12.

*b. Disassembly*. Refer to figure 3-8 and disassemble the starting motor assembly.



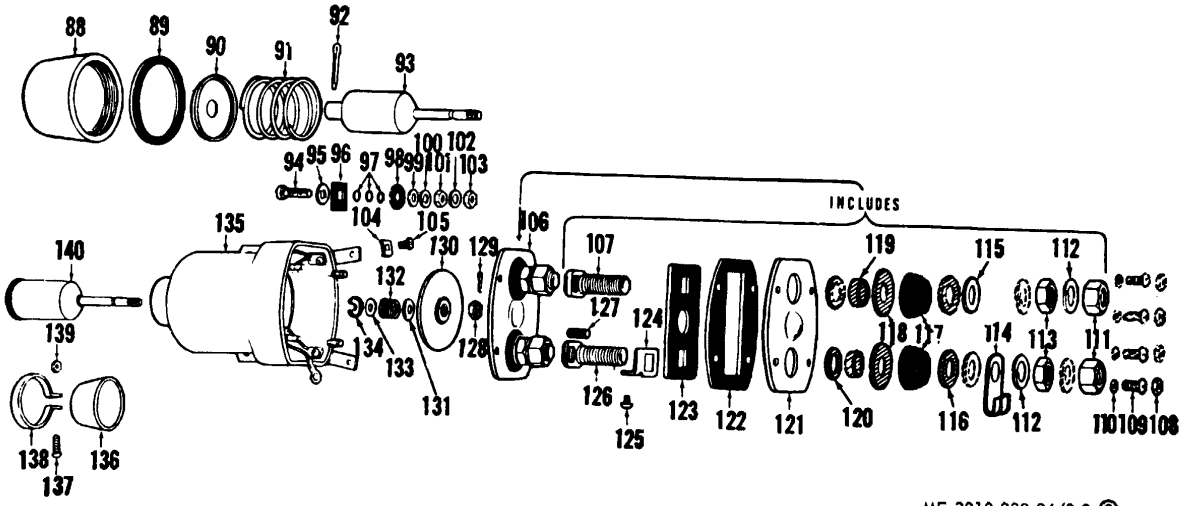

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | O-ring | 12 | Washer | 23 | Lever | 34 | Snap ring | 45 | Washer |
| 2 | Plate assembly | 13 | Bushing | 24 | Block | 35 | Washer | 46 | Insulation |
| 3 | Terminal and lead | 14 | Switch | 25 | Nut | 36 | Capscrew | 47 | Screw |
| 4 | Washer | 15 | Plunger assembly | 26 | Plug | 37 | Screw | 48 | Pole |
| 5 | Armature | 16 | Washer | 27 | O-ring | 38 | Screw | 49 | Insulation |
| 6 | Nut | 17 | Boot | 28 | O-ring | 39 | Housing | 50 | Insulation |
| 7 | Washer | 18 | Retainer | 29 | Washer | 40 | Screw | 51 | Screw |
| 8 | Connector | 19 | Spring | 30 | Screw and washer | 41 | Housing | 52 | Insulation |
| 9 | Nut | 20 | Retainer | 31 | Winding | 42 | Drive clutch assembly | 53 | Washer |
| 10 | Washer | 21 | Snap ring | 32 | Lever pin | 43 | Gasket | 54 | Screw |
| 11 | Washer | 22 | O-ring | 33 | O-ring | 44 | Washer | | |

*Figure 3-8. (1) Carrier engine starting motor, exploded view.*



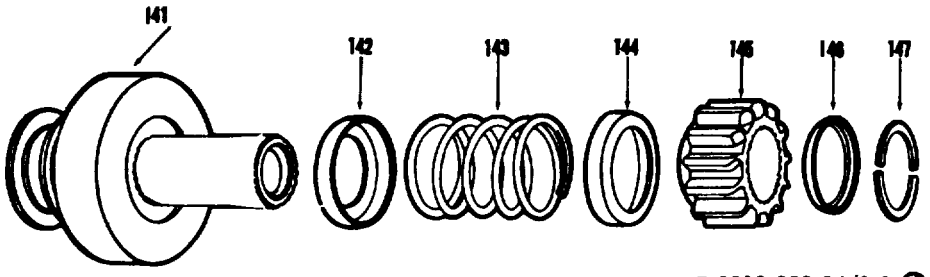

55 Nut
56 Washer
57 Nut
58 Washer
59 Washer
60 Stud
61 Bushing
62 O-ring
63 Frame
64 Washer
65 Plate
66 Plate
67 Plate and stub
68 Bushing
69 Plate
70 Plate
71 Plate
72 Screw
73 Brush
74 Washer
75 Spring
76 Screw
77 Holder screw
78 Holder
79 Washer
80 Screw
81 Holder screw
82 Screw
83 Washer
84 Washer

*Figure 3-8. (2)--Continued.*




| | | | | | |
|---|---|---|---|---|---|
| 85 | (Deleted) | 103 | Nut | 122 | Gasket |
| 86 | (Deleted) | 104 | Terminal | 123 | Insulator |
| 87 | (Deleted) | 105 | Screw | 124 | Support |
| 88 | Cover | 106 | Terminal and plate assembly | 125 | Screw |
| 89 | O-ring | 107 | Stud | 126 | Stud |
| 90 | Retainer | 108 | Nut and lockwasher | 127 | Screw |
| 91 | Spring | 109 | Screw | 128 | Nut |
| 92 | Cotter pin | 110 | Washer | 129 | Cotter pin |
| 93 | Plunger | 111 | Nut | 130 | Contack dics |
| 94 | Screw | 112 | Washer | 131 | Washer |
| 95 | Washer | 113 | Nut | 132 | Spring |
| 96 | Insulator | 114 | Terminal clip | 133 | Washer |
| 97 | Washer | 115 | Washer | 134 | Retainer |
| 98 | Insulator | 116 | Washer | 135 | Case and coil assembly |
| 99 | Washer | 117 | Stud | 136 | Boot |
| 100 | Washer | 118 | Washer | 137 | Screw |
| 101 | Nut | 119 | Bushing | 138 | Clamp |
| 102 | Washer | 120 | Washer | 139 | Nut |
| | | 121 | Plate | 140 | Plunger |

*Figure 3-8. (3)-Continued.*




141 Sleeve and bushing assembly
142 Cup
143 Spring
144 Cup
145 Pinion
146 Cup
147 Split washer

*Figure 3-8. (4) Continued.*

**3-10. Cleaning, Inspection and Repair**

*a.* Clean all metal parts with an approved cleaning solvent and dry thoroughly.

*b.* Remove all dust, dirt, and foreign matter from the frame and fields using compressed air.

*c.* Inspect all parts for excessive wear or other damage. Repair or replace all defective parts.

*d.* Refer to TM 5-764 for armature and field coil tests.

**3-11. Reassembly and Installation**

*a. Reassembly*. Refer to figure 3-8 and reassemble the starting motor assembly.

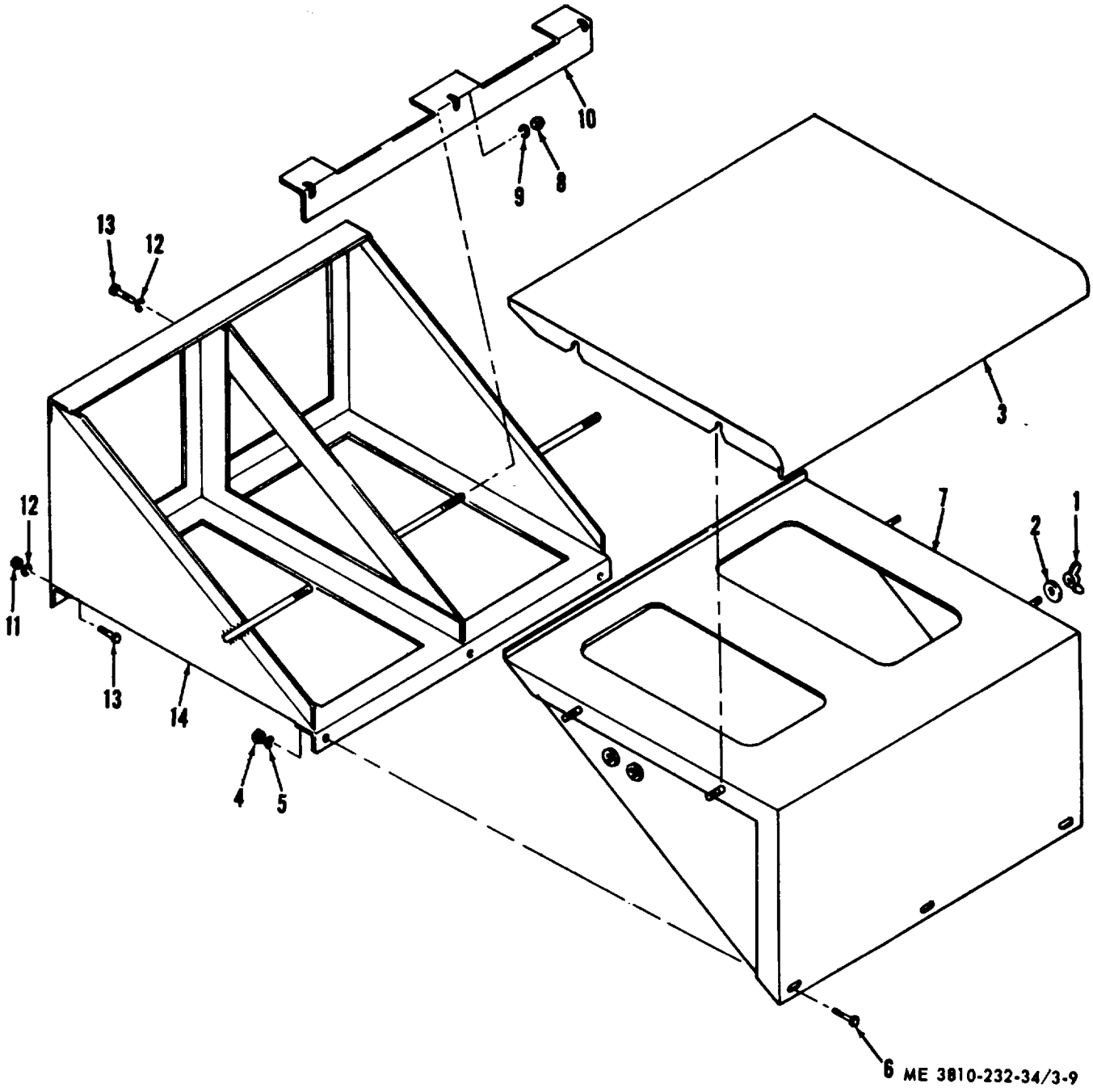
*b. Installation*. Refer to TM 5-3810-232-12.

## Section IV. CARRIER BATTERY BOX ASSEMBLY

**3-12. Removal and Disassembly**

*a. Removal*. Remove battery box assembly (TM 5-3810-232-12).

*b. Disassembly*. Disassemble the battery box (fig. 3-9.)




| | | | |
|---|---|---|---|
| 1 | Nut | 8 | Nut |
| 2 | Washer | 9 | Washer |
| 3 | Plate | 10 | Holddown |
| 4 | Nut | 11 | Nut |
| 5 | Washer | 12 | Washer |
| 6 | Screw | 13 | Screw |
| 7 | Cover | 14 | Box assembly |

*Figure 3-9. Battery box components, carrier.*

**3-13. Reassembly and Installation**

*a. Reassembly.* Reassemble the battery box assembly (fig. 3-9).

*b. Installation.* Install the battery box assembly (TM 5-3810-232-12).

## Section V. CARRIER ENGINE WIRING HARNESS CABLES

**3-14. Removal**

*a*. Tag and disconnect all electrical leads, connectors and clamps.

*b.* Remove wiring harness.

**3-15. Installation**

*a.* Install wiring harness.

*b.* Secure clamps, leads and connectors to the harness.

## Section VI. CARRIER ENGINE FUEL PUMP ASSEMBLY

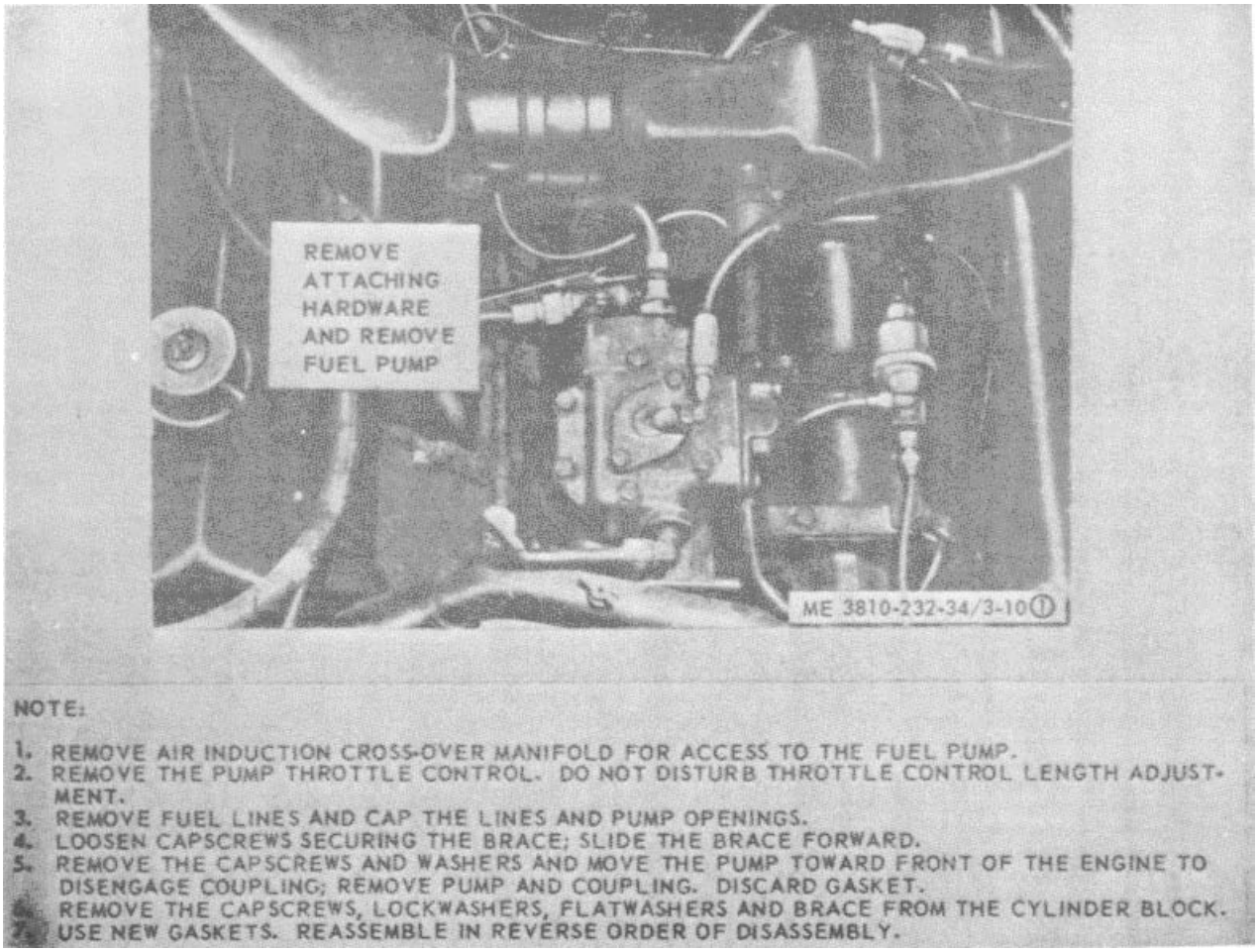
**3-16. General**

The fuel pump incorporates the governor assembly and is flange-mounted to the rear of the air compressor and is gear driven from the engine gear train. The fuel pump draws fuel from the supply tank and delivers it at correct pressure and amount to the injectors for each cylinder.

**3-17. Removal and Disassembly**

*a. Removal*. Remove fuel pump assembly as illustrated in figure 3-10.

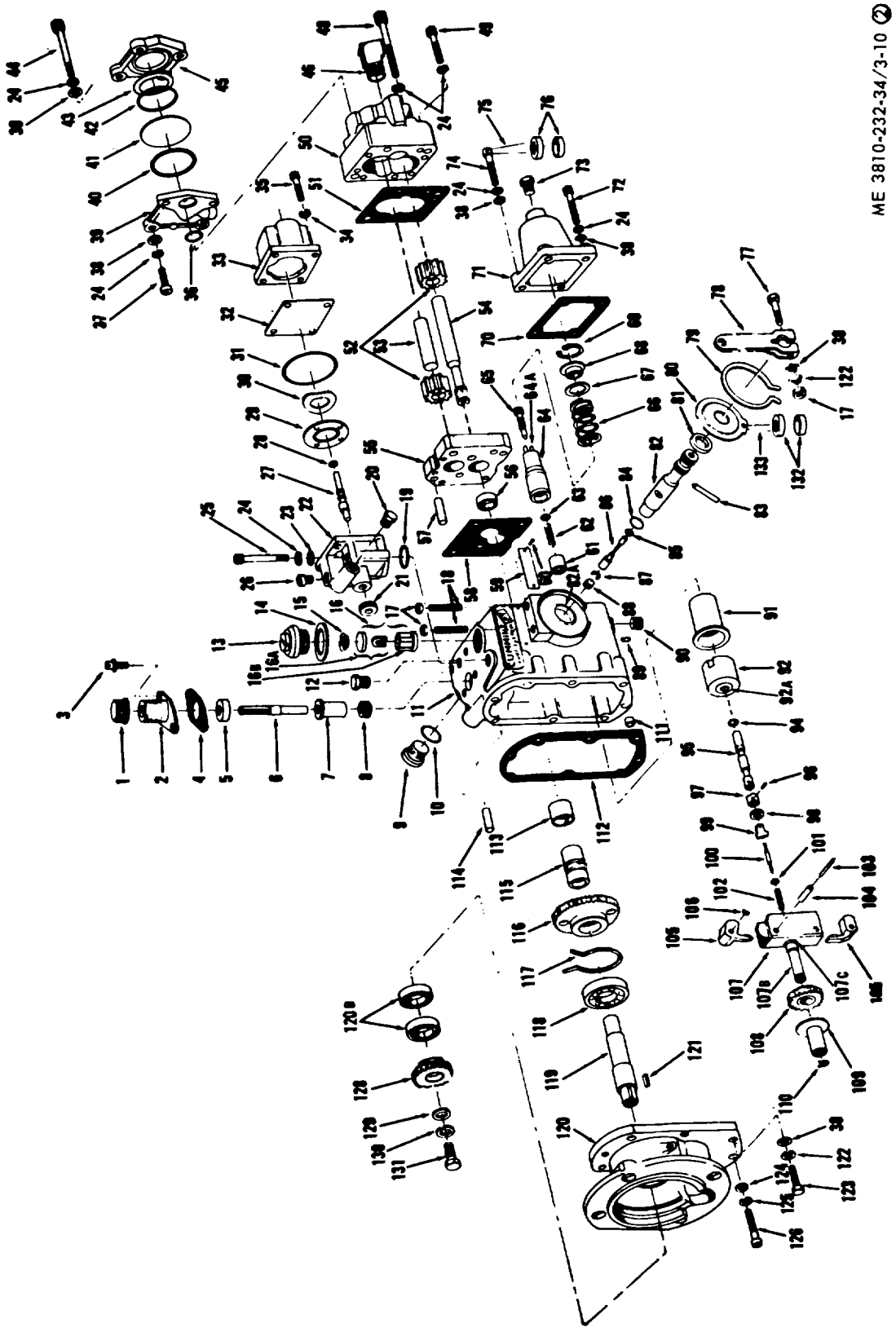
*b. Disassembly*. Refer to figure 3-10 and disassemble the fuel pump assembly.




A-Carrier engine fuel pump removal.

*Figure 3-10. (1) Carrier, engine fuel pump assembly.*

1 Cap
2 Housing
3 Capscrew
4 Gasket
5 Seal
6 Shaft
7 Gear
8 Bushing
9 Plug
10 O-ring
11 Housing assembly
12 Plug
13 Cap
14 Seal
15 Spring
16 Filter assembly
16A Retainer and magnet
16B Retainer and screen
17 Nut
18 Setscrew
19 O-ring
20 Plug
21 Knob
22 Housing
23 Washer
24 Lockwasher
25 Capscrew
26 Connection
27 Shaft
28 O-ring
29 Valve
30 Spring
31 O-ring
32 Shield
33 Coil assembly
34 Lockwasher
35 Capscrew
36 O-ring
37 Capscrew
38 Washer
39 Body
40 O-ring
41 Diaphragm
42 O-ring
43 Washer
44 Capscrew
45 Plate
46 Adapter
48 Capscrew
49 Capscrew
50 Housing and cover assembly
51 Gasket
52 Gear
53 Shaft
54 Shaft
55 Housing and cover assembly
56 Bearing
57 Dowel
58 Gasket
59 Plate
60 Screw
61 Bushing
62 Spring
63 Washer
64Guide and clip assembly
64A Clip
65 Screw
66 Spring
67 Shim
68 Retainer
69 Snap
70 Gasket
71 Cover
72 Capscrew
73 Plug
74 Capscrew
75 Wire
76 Seal
77 Capscrew
78 Lever
79 Snap ring
80 Cover
81 Spacer
82 Shaft
82A Sleeve
83 Pin
84 O-ring
85 Shim
86 Plunger
87 Washer
88 Bushing
89 Clip
90 Plug
91 Housing
92 Barrel
92A Sleeve
94 Shim
95 Plunger
96 Pin
97 Spacer
98 Washer
99 Driver
100 Plunger
101 Shim
102 Spring
10 Pin
104 Shaft
105 Weight
106 Washer
107 Carrier
107A Shaft
107B Wire
108 Gear
109 Bushing
110 Snap ring
111 Dowel
112 Gasket
113 Bushing
114 Dowel
115 Gear
116 Gear
117 Snap ring
118 Bearing
119 Shaft
120A Cover
120B Seal
121 Key
122 Washer
123 Capscrew
124 Washer
125 Washer
126 Capscrew
127 Coupling
128 Washer
129 Washer
130 Capscrew
131 Seal
132 Wire




B Carrier engine fuel pump assembly, exploded view.

*Figure 3-10. (2) Continued.*

**3-18. Cleaning, Inspection and Repair**

*a.* Clean all parts with an approved cleaning solvent and dry thoroughly.

*b.* Inspect pump shafts and gears for wear or scoring. Replace defective or damaged parts.

*c.* Inspect gear body and cover for scoring or excessive wear.

**NOTE**

**If shaft bore is scored 1/3 of circumference or more in cover or body replace.**

**3-19. Reassembly and Installation**

*a. Reassembly.* Refer to figure 3-10 and reassemble the fuel pump assembly.

**NOTE**

**Total gear backlash must be 0.001/0.004 inch. The drive shaft must protrude 2.370/2.412 inch from the body. End clearance should not exceed 0.0015 inch nor be less than 0.0009 inch. If pump binds or has excessive play, check error in assembly which must be corrected to prevent early pump failure.**

*b. Installation.* Install the fuel pump assembly as illustrated in figure 3-10.

*c. Governor Adjustment.* Adjust governor (TM 5-3810-232-12)

## Section VII. CARRIER FUEL TANK

**3-20. Removal**

Refer to TM 5-3810-232-12.

**3-21. Fuel Tank Cleaning, Inspection, and Repair**

*a.* Clean all parts with an approved cleaning solvent.

*b.* Inspect the fuel tank for cracks, breaks, or leaks. Clean tank with live steam and weld after all flumes are removed.

**WARNING**

**Steam clean fuel tank thoroughly before welding. Leave all openings uncovered during welding. Refer to TM 9-237 for safety precautions for welding containers that have held combustibles.**

*c.* Replace all gaskets.

**3-22. Installation**

Refer to TM 5-3810-232-12.

## Section VIII. CARRIER AIR COMPRESSOR ASSEMBLY

### 3-23. General

The air compressor is mounted in the vee of the engine block, and is gear driven. The air compressor provides compressed air for the air system.

### 3-24. Removal and Disassembly

*a. Removal.*

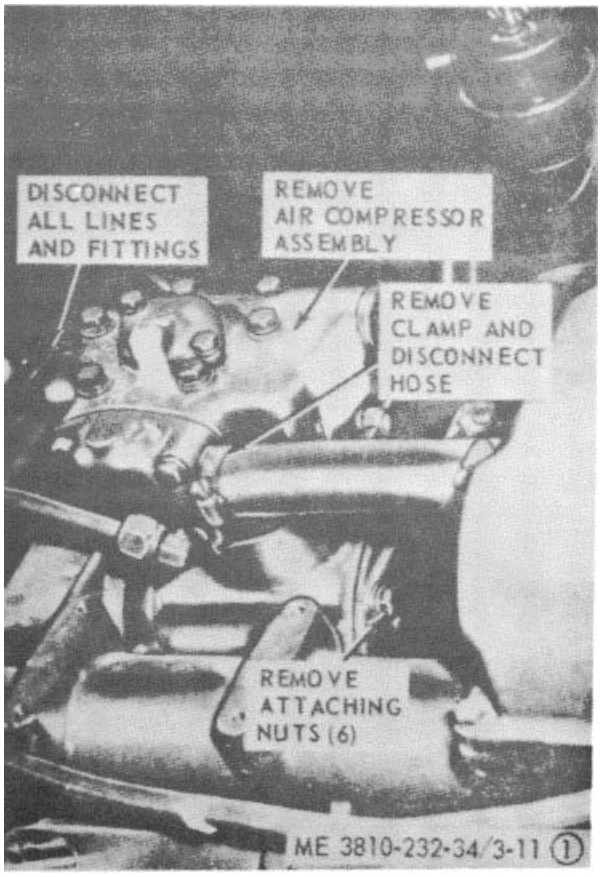
figure 3-11.

(1) Drain cooling system.

(2) Clean area around the air compressor and fuel pump before removing the air compressor.

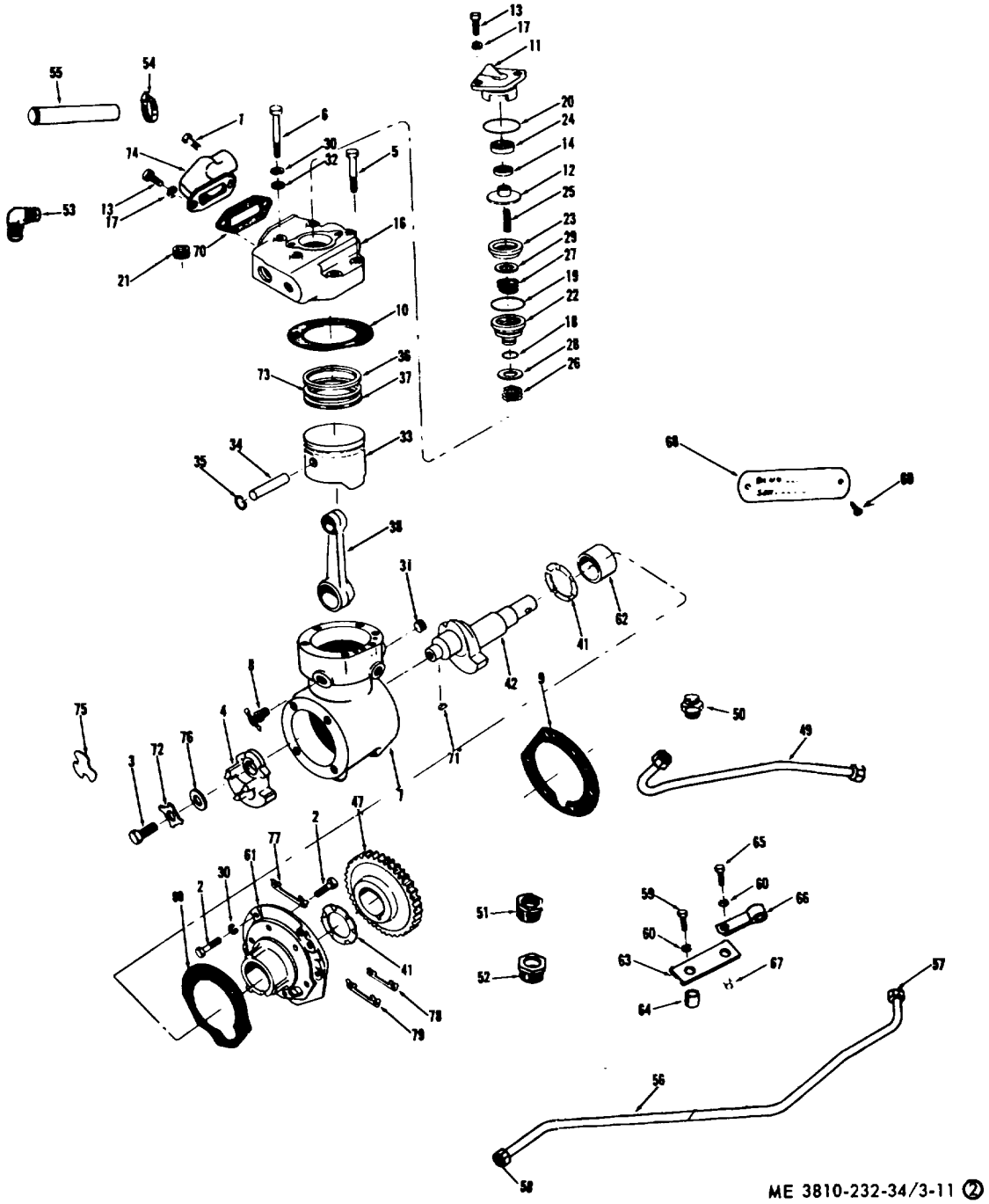
(3) Remove air compressor as shown in figure 3-11.

*b. Disassembly.* Refer to figure 3-11 and disassemble the air compressor assembly.




A. Air compressor assembly, removal and installation.

*Figure 3-11. (1) Air compressor assembly.*




| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Screw | 13 | Screw | 25 | Spring | 38 | Rod | 58 | Sleeve | 70 | Gasket |
| 2 | Screw | 14 | Guide | 26 | Spring | 41 | Bearing | 59 | Screw | 71 | Key |
| 3 | Screw | 15 | Head | 27 | Washer | 42 | Crankshaft | 60 | Washer | 72 | Plate |
| 4 | Weight | 16 | Washer | 28 | Washer | 47 | Gear | 61 | Support | 73 | Ring |
| 5 | Screw | 17 | Packing | 29 | Washer | 49 | Tube | 62 | Bushing | 74 | Connector |
| 6 | Screw | 18 | Packing | 30 | Plug | 50 | Body | 63 | Bracket | 75 | Plate |
| 7 | Crankcase | 19 | Packing | 31 | Washer | 51 | Bushing | 64 | Spacer | 76 | Washer |
| 8 | Cock | 20 | Plug | 32 | Piston | 52 | Bushing | 65 | Screw | 77 | Plate |
| 9 | Gasket | 21 | Seat | 34 | Pin | 54 | Clamp | 66 | Clamp | 78 | Plate |
| 10 | Gasket | 22 | Seat | 35 | Ring | 55 | Hose | 67 | Nut | 79 | Plate |
| 11 | Valve | 23 | Seal | 36 | Ring | 56 | Tube | 68 | Plate | 80 | Gasket |
| 12 | Cap | 24 | Spring | 37 | Ring | 57 | Nut | 69 | Screw | | |

B. Air compressor assembly exploded view.

*Figure 3-11. (2)-Continued*

**3-25. Cleaning, Inspection and Repair**

*a.* Clean all parts with an approved cleaning solvent and dry thoroughly.

*b.* Inspect all parts for excessive wear and damage.

*c.* Replace or repair damaged or defective parts.

**3-26. Reassembly and Installation**

*a. Reassembly*. Refer to figure 3-11 and reassemble the air compressor assembly.

*b. Installation*.

(1) Install air compressor as shown in fig. 3-11.

NOTE

Align timing marks on air compressor drive gear with marks on camshaft gear.

(2) Refill cooling system.

## Section IX. CARRIER ENGINE FAN CLUTCH AND DRIVE ASSEMBLY

**3-27. General**

Both crane Models the 2380 and the 2385 are equipped with a carrier engine fan.

*a. Model* 2380. The fan is separately mounted and clutch driven by a propeller shaft.

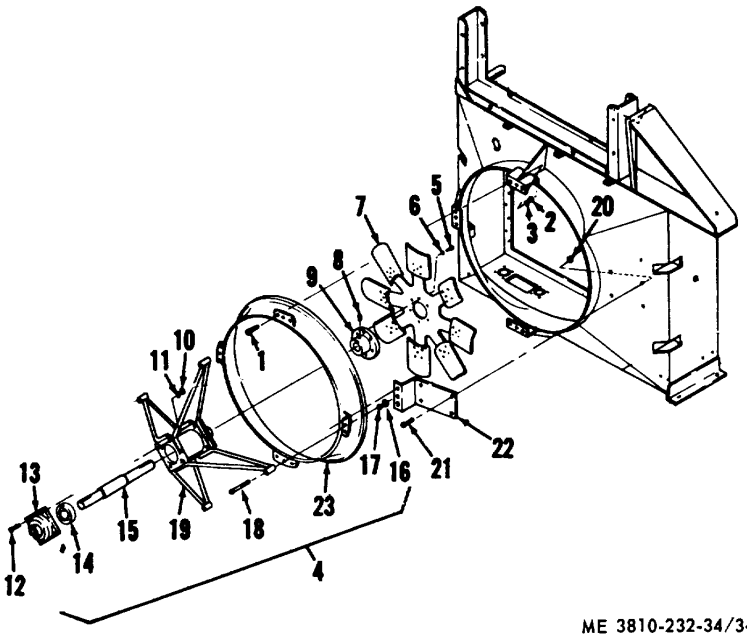
*b. Model* 2385. The fan is separately mounted and driven by a hydraulic motor. A thermostatic control operates the hydraulic fan drive motor.

**3-28. Carrier Engine Fan Clutch and Drive Assembly** (Model 2380)

*a. Removal and Disassembly.*

(1) Remove carrier engine cooling system (TM 5-3810-232-12).

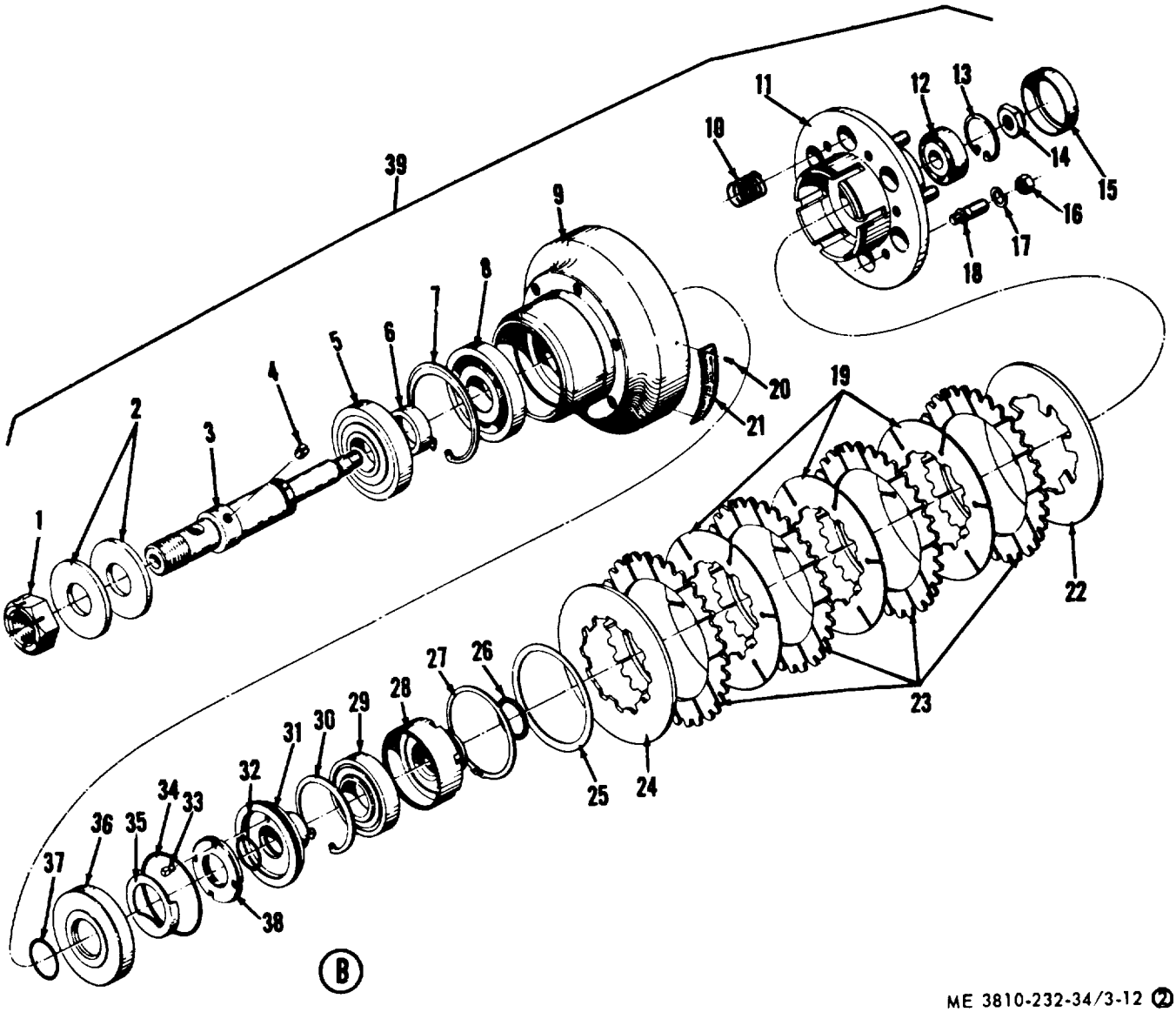
(2) Remove and disassemble fan clutch and drive assembly as instructed on figure 3-12.




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Capscrew | 7 | Fan blade | 13 | Bearing assembly | 19 | Mounting |
| 2 | Nut | 8 | Setscrew | 14 | Collar | 20 | Nut |
| 3 | Lockwasher | 9 | Fan hub | 15 | Shaft | 21 | Capscrew |
| 4 | Fan drive assembly | 10 | Nut | 16 | Flat washer | 22 | Bracket |
| 5 | Capscrew | 11 | Lockwasher | 17 | Lockwasher | 23 | Shroud |
| 6 | Lockwasher | 12 | Capscrew | 18 | Capscrew | | |

A—Fan drive assembly, disassembly and reassembly.

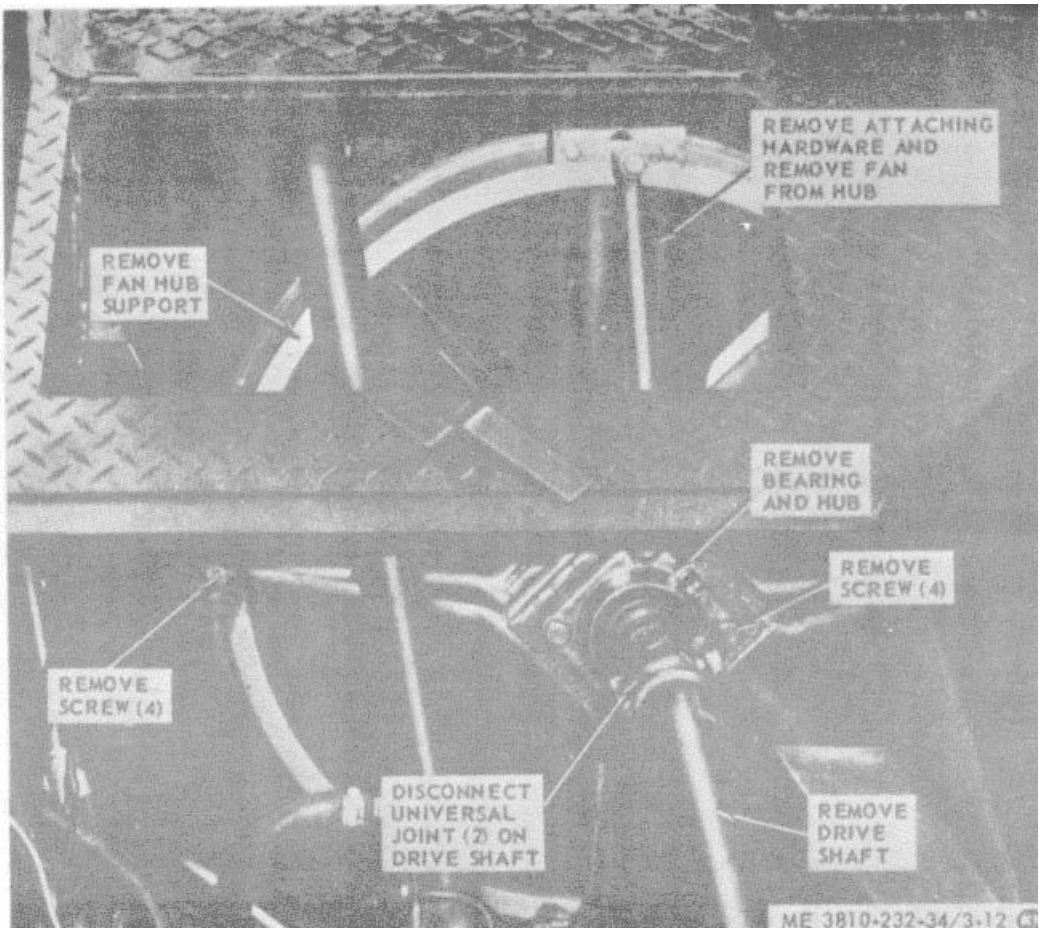
*Figure 3-12. (1) Fan clutch and drive assembly, removal, disassembly, reassembly and installation. Model 2380*




| | | | |
|---|---|---|---|
| 1 | Nut, marsden | 21 | Plate, name |
| 2 | Washer, clamp | 22 | Plate, pressure |
| 3 | Shaft assembly | 23 | Disc, friction |
| 4 | Plug, pipe | 24 | Plate, pressure |
| 5 | Bearing, ball | 25 | Shim |
| 6 | Spacer, bearing | 26 | Packing, preformed |
| 7 | Ring, retainer | 27 | Ring, retainer |
| 8 | Bearing, ball | 28 | Collar, pressure release |
| 9 | Hub, pulley | 29 | Bearing, ball |
| 10 | Spring | 30 | Ring, snap |
| 11 | Hub assembly | 31 | Piston assembly |
| 12 | Bearing, ball | 32 | Packing, preformed |
| 13 | Ring, retainer | 33 | Pin, lock |
| 14 | Nut, lock | 34 | Packing preformed |
| 15 | Cap, hub end | 35 | Washer, lock |
| 16 | Nut | 36 | Cylinder |
| 17 | Lockwasher | 37 | Packing, preformed |
| 18 | Stud, shoulder | 38 | Nut |
| 19 | Disc, friction | 39 | Fan hub assembly |
| 20 | Screw, drive | | |

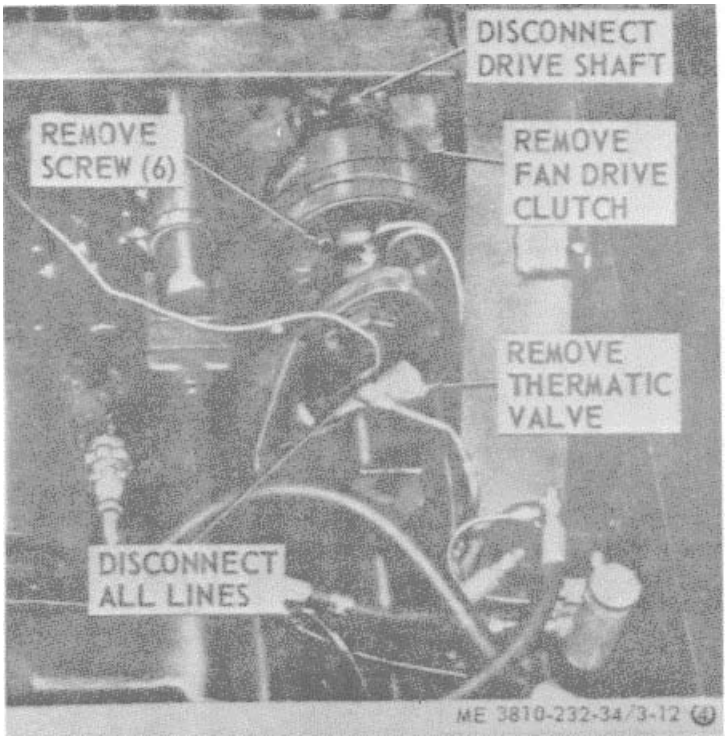
B--Clutch assembly, disassembly and reassembly.

*Figure 3-12. (2)-Continued.*




C-Fan drive assembly, removal and installation.

*Figure 3-12. (3)-Continued.*



D-Clutch assembly, removal and installation.

*Figure 3-12. (4)-Continued*

(3) Remove and disassemble fan drive clutch as shown in figure 3-12.

*b. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent.

(2) Inspect all parts for cracks, breaks and other damage. Repair or replace defective parts.

(3) Inspect fan for visible damage, deformation and vibration. Replace a defective fan.

*c. Reassembly and Installation.*

(1) Reassemble and install fan drive assembly as instructed on figure 3-12.

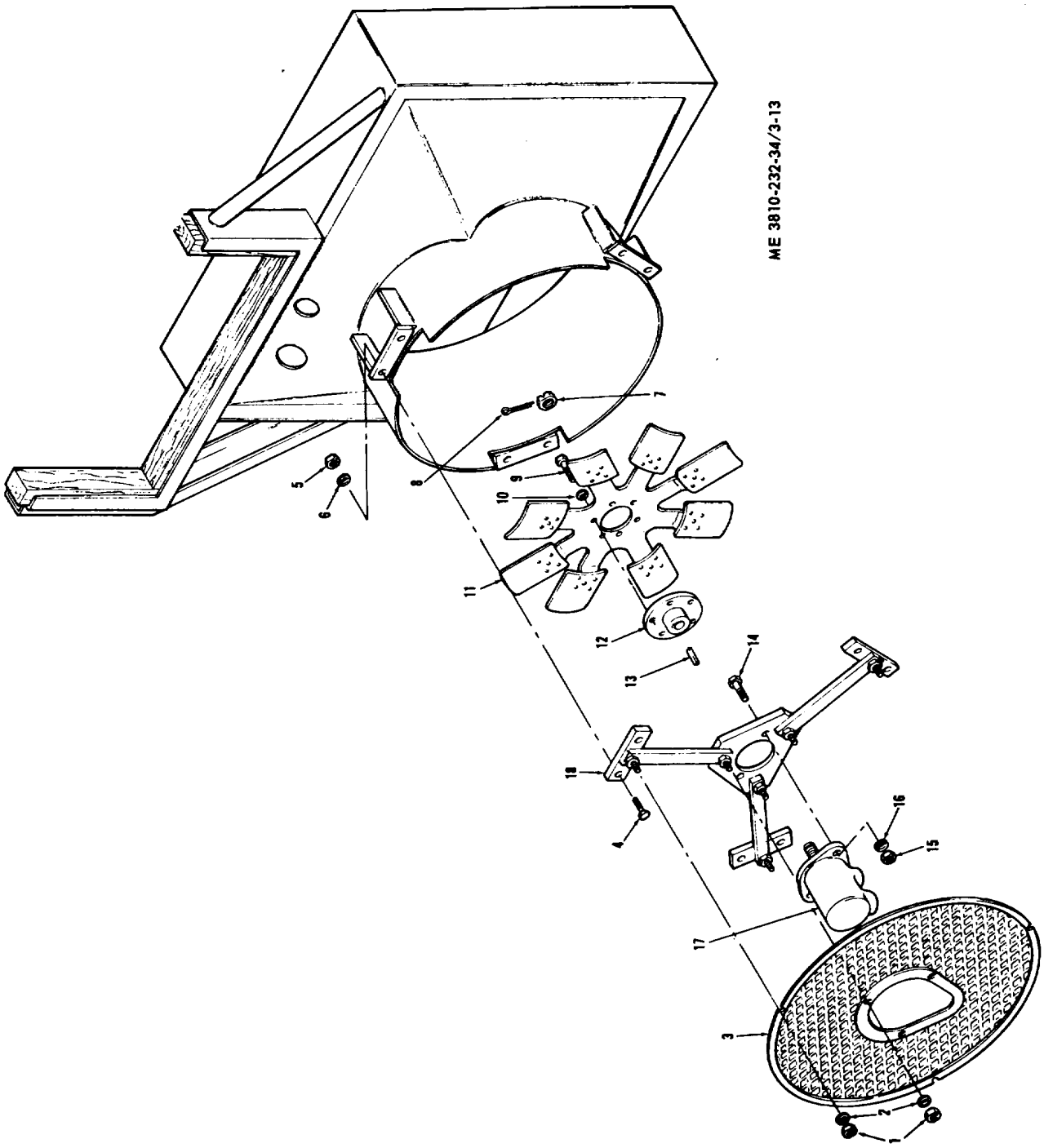
(2) Reassemble and install clutch assembly as shown on figure 3-12.

**3-29. Fan and Drive Assembly (Model 2385)**

*a. Removal and Disassembly.*

(1) Refer to figure 3-13 and remove the fan and drive assembly.

(2) Refer to figure 3-13 and disassemble the fan and drive assembly in numerical sequence as illustrated.




| | | | | | |
|---|---|---|---|---|---|
| 1 | Nut | 7 | Nut | 13 | Key |
| 2 | Lockwasher | 8 | Cotter pin | 14 | Capscrew |
| 3 | Guard | 9 | Capscrew | 15 | Nut |
| 4 | Capscrew | 10 | Lockwasher | 16 | Lockwasher |
| 5 | Nut | 11 | Blade | 17 | Hydraulic motor |
| 6 | Lockwasher | 12 | Hub | 18 | Bracket |

*Figure 3-13. Fan drive assembly (Model 2385).*

*b. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent.

(2) Inspect all parts for cracks, breaks and other damage. Repair or replace defective or damaged parts.

(3) Inspect fan for visible damage and deformation. Replace a defective fan.

*c. Reassembly and Installation.*

(1) Reassemble fan and drive assembly in reverse order of the numerical sequence illustrated on figure 3-13.

(2) Refer to figure 3-13 and install the fan and drive assembly.

**3-30. Hydraulic Motor, Fan Drive (Model 2385)**

*a. General*. The carrier engine fan is mounted on, and driven by a hydraulic motor that is thermostatically operated.

*b. Removal and Disassembly*.

(1) *Removal*. Refer to figure 3-14 and remove the fan drive hydraulic motor.

(2) *Disassembly*.

(*a) Cover end*. Clamp the motor in a vice with protective jaws, cover end up. Mark the cover (2, fig. 3-14), and body (13) for correct relationship for reassembly. Remove the four cover bolts (1) and lift off the cover. Remove the cartridge assembly (23) from the body. If the cartridge is not being replaced as an assembly, remove the two screws (30) and separate the pressure plates (24, 29) from the rotor (28), ring (25), vanes and springs (27).

**NOTE**

**Use a standard piston ring compressor of suitable size when disassembling and assembling the cartridge components. Carefully pull the rotor and vane assembly half way out of the ring and install the ring compressor (fig. 3-15). Compress the vanes into the rot(or and remove this assembly from the ring. Release the ring compressor and disassemble components. Remove the O-ring (20, 21) and backup rings (19, 22) from the pressure plates and body.**

*(b) Shaft end*. Remove shaft key (10). Carefully pull the hub adapter (5) from the body. Remove lock ring (6) next to the shaft bearing (8) from the body then tap the shaft (9) and bearing assembly out. If it is necessary to remove the small snap rings (7) and bearing from the shaft support the bearing inner race in an arbor press, remove snap ring and press bearing of the shaft. Remove washer (11) and then the seal (32) and wiper (31) from the body.

*c. Cleaning, Inspection and Repair.*

(1) Discard the shaft seal, wiper, 0-rings and back-up rings. Use a new seal kit for reassembly. Wash the metal parts in a clean mineral oil solvent, blow them dry with filtered compressed air and place on a clean surface for inspection.

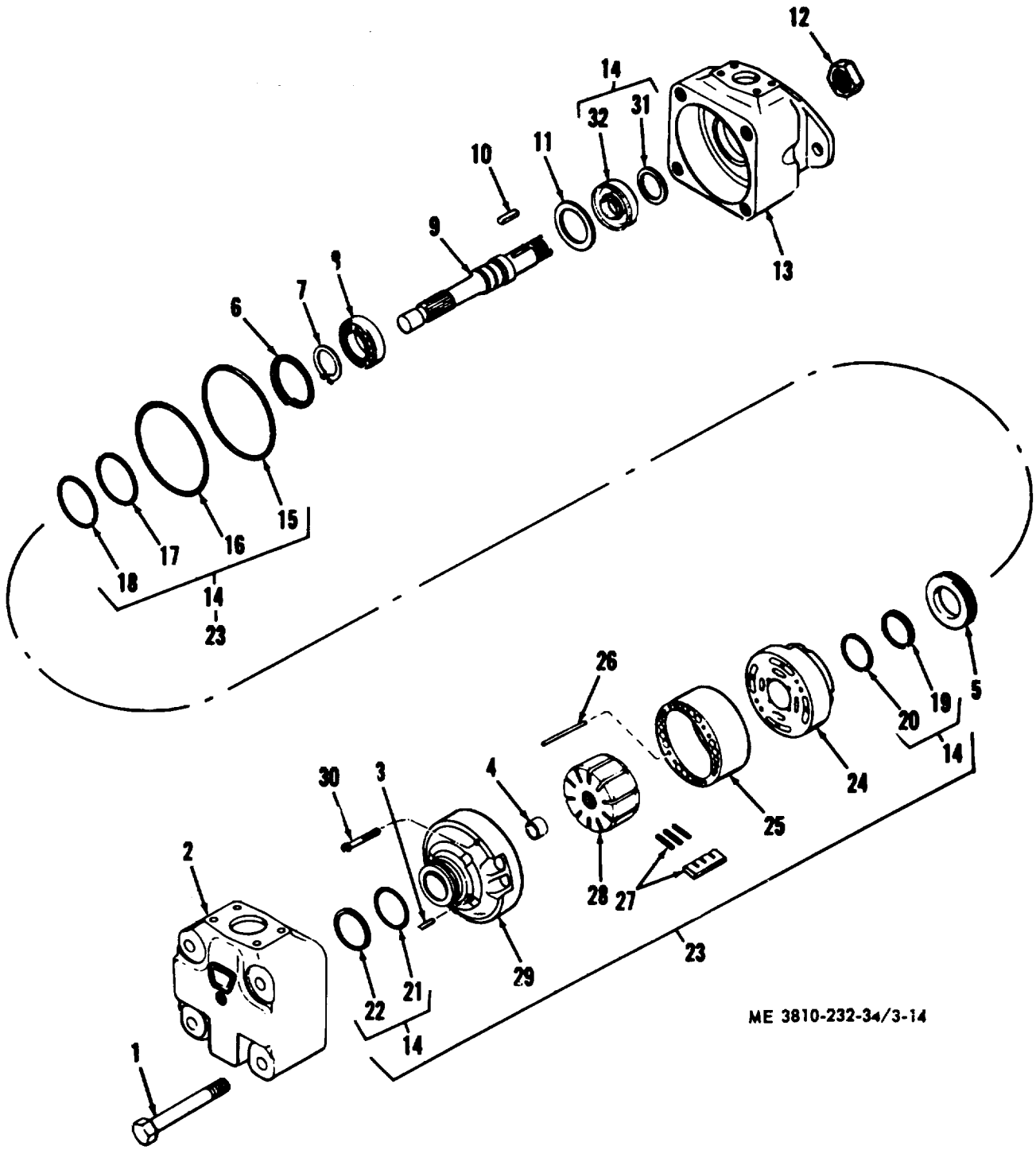
(2) If the cartridge parts are badly worn, a new cartridge kit should be used. Check the wearing surfaces of the cartridge pressure plates and ring for scoring and excessive wear. Remove light score marks by lapping. Replace any heavily scored or badly worn parts.

(3) Inspect the vanes for burrs, wear and excessive play in the rotor slots. Carefully dress down burrs with a medium India stone. Replace the rotor if the slots are worn. Replace vanes with a new vane and spring kit if the vane tips are rounded.

(4) Rotate the bearing on the shaft while applying pressure to check for wear, looseness, roughness and pitted or cracked races.

(5) Inspect the seal and bushing mating surfaces on the shaft for scoring or wear. Replace the shaft if marks cannot be removed by light polishing.

(6) Be sure that any paint or burrs raised on the body and cover mating surfaces are removed before assembly.




| | | | | | |
|---|---|---|---|---|---|
| 1 | Bolt | 12 | Nut | 23 | Cartridge kit |
| 2 | Cover | 13 | Body | 24 | Pressure plate |
| 3 | Pin | 14 | Seal kit | 25 | Ring |
| 4 | Bushing | 15 | O-ring | 26 | Pin |
| 5 | Hub adapter | 16 | O-ring | 27 | Van kit |
| 6 | Lock ring | 17 | Back-up ring | 28 | Rotor |
| 7 | Snap ring | 18 | O-ring | 29 | Pressure plate |
| 8 | Bearing | 19 | Back-up ring | 30 | Screw |
| 9 | Shaft | 20 | O-ring | 31 | Wiper |
| 10 | Key | 21 | O-ring | 32 | Seal |
| 11 | Washer | 22 | Back-up ring | | |

*Figure 3-14. Hydraulic motor, fan drive (Model 2385).*

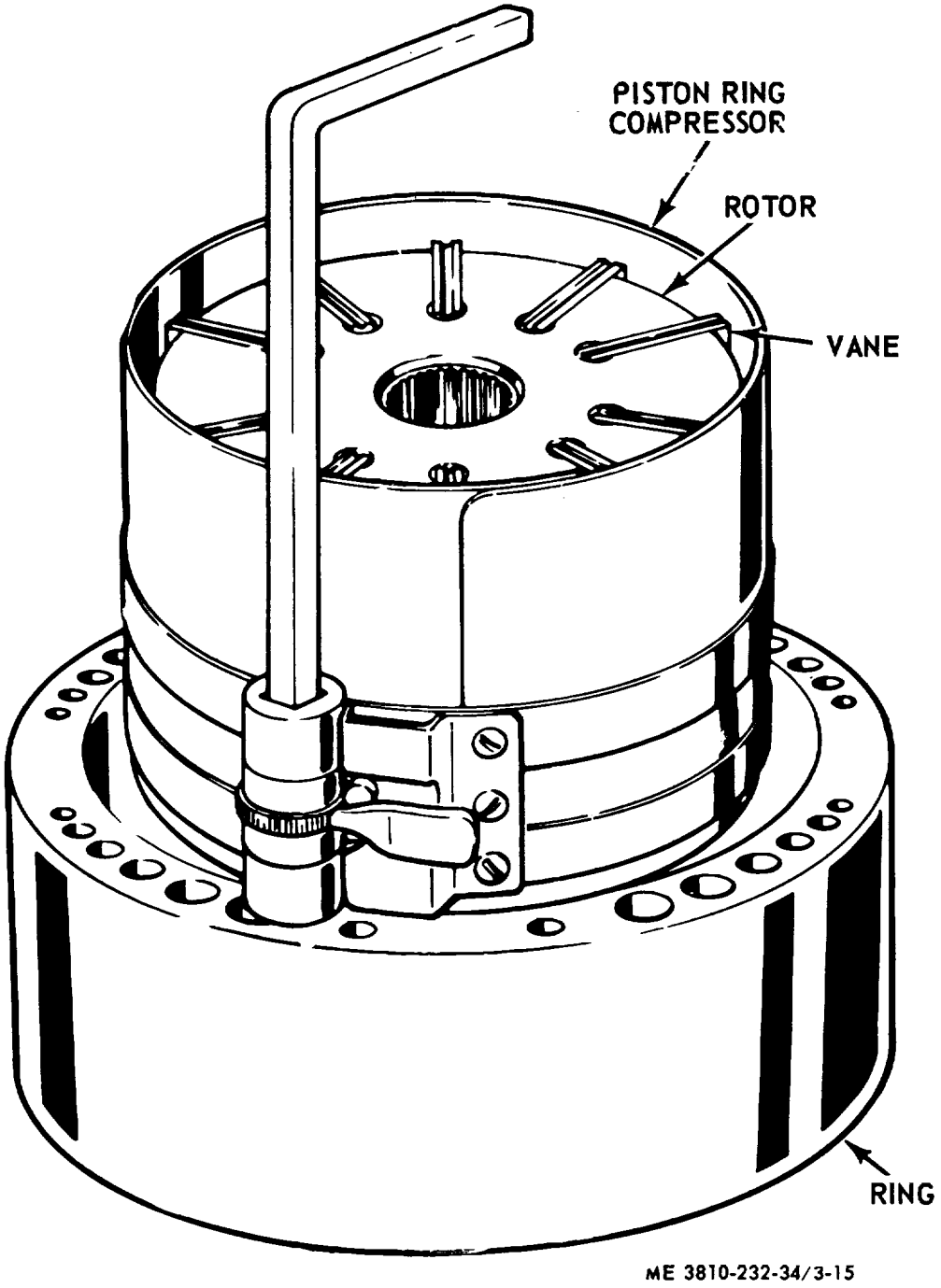



*Figure 3-15. Cartridge assembly removal (Model 2385).*

*d. Reassembly and Installation.*

(1) Reassembly.

**NOTE**

**Coat all parts with clean OE10 to facilitate reassembly and provide initial lubrication. Use small amounts of petroleum jelly to hold the O-rings in place during assembly Soak the shaft wiper in oil before assembly.**

*(a) Shaft seal assembly*. Install the shaft wiper (31, fig. 3-14) in the body (13). Grease the shaft seal (32) and press it into the body. The spring on the shaft seal must be toward the bearing (8). Place the washer (11) in the body against the shaft seal.

*(b) Shaft assembly*. Support the bearing inner race and press in the shaft (9). In-

stall the snap ring (7) on the shaft. Lightly tap the shaft and bearing assembly into the body with a plastic hammer. Install lock ring (6) in the body to secure the bearing and shaft. Thoroughly inspect to insure that lock ring is correctly installed.

(*c) Cartridge assembly*. With the rotor (28) lying on a clean, flat, surface, slide the vanes and springs (27) into the rotor slots. Lift the vanes slightly to insure the springs are positioned in spring recesses of the rotor. With a piston ring compressor of suitable size, compress the vanes in the slots so the vanes will clear the minor diameter of the ring. (fig. 3-15).

**CAUTION**

**Be certain the springs remain seated in the spring recesses of the rotor as vanes are compressed.**

(*d) Rotor and vane assembly*. Position the ring (25, fig. 3-14) on a flat surface and insert the rotor and vane assembly 1/4 way into the ring. Use a suitable size hard wood plug as a driver for positioning the rotor and vane assembly. Release the ring compressor carefully so the vanes do not snap out against the ring surface. With the hard wood plug, press the vanes and rotor flush with the ring.

(*e) Pressure plate assembly*. Install the pins (26) on the body end pressure plate (24). Place the rotor, ring, and vane assembly over the pins on the plate. Install the cover end pressure plate (29) against the rotor and ring. The porting in this plate will be 90° from the other plate. Carefully install the two capscrews (30) in the cartridge. Tighten the screws, being certain the peripheral edges of the ring and plates are flush. Tap with a plastic hammer if necessary to effect alignment.

(*f) Plate hubs*. Install O-rings (20, 21) first, then back-up rings (19, 22) on the pressure plate hubs. Grease with petroleum jelly.

Inspect this assembly to insure the O-ring is positioned in the concave side of the back-up ring.

*(g) Cartridge installation*. Clamp the body in a vise with protective jaws. Assemble the hub adapter (5) on the cartridge pressure plate (body end) (24). Install the O-ring (18) and then back-up ring (17) on the hub adapter. Grease with petroleum jelly. Install the cartridge (23) on the shaft, with the hub adapter toward the body. Tap cartridge into position.

Install the O-ring (15) in the body.

*(h) Cover assembly*. Install the O-ring (16) in the cover (2) greasing liberally. Carefully install the cover being sure that locating pin (3) engages the pin hole in the cover. To check engagement turn the cover 30 degrees in both directions and be certain the cartridge moves with it. Install the four cover bolts (1) and tighten to 65 to 70 foot-pounds torque.

(2) *Installation*. Refer to figure 3-14 and install the fan drive hydraulic motor.

## Section X. CARRIER RADIATOR ASSEMBLY

### 3-31. Carrier Radiator Assembly

The radiator assembly, which is used on both Models 2380 and 2385, is a 3 piece unit made up of top and bottom tanks attached to the core unit. Coolant is circulated from the coolant pump to the radiator where it is cooled, and then recirculated through the cooling system.

### 3-32. Removal and Disassembly

*a. Removal (Model 2380).*

(1) Drain the cooling system.

(2) Remove cover assembly and deck plates (TM 5-3810-232-12).

(3) Disconnect radiator hoses (TM 5-3810-232-12).

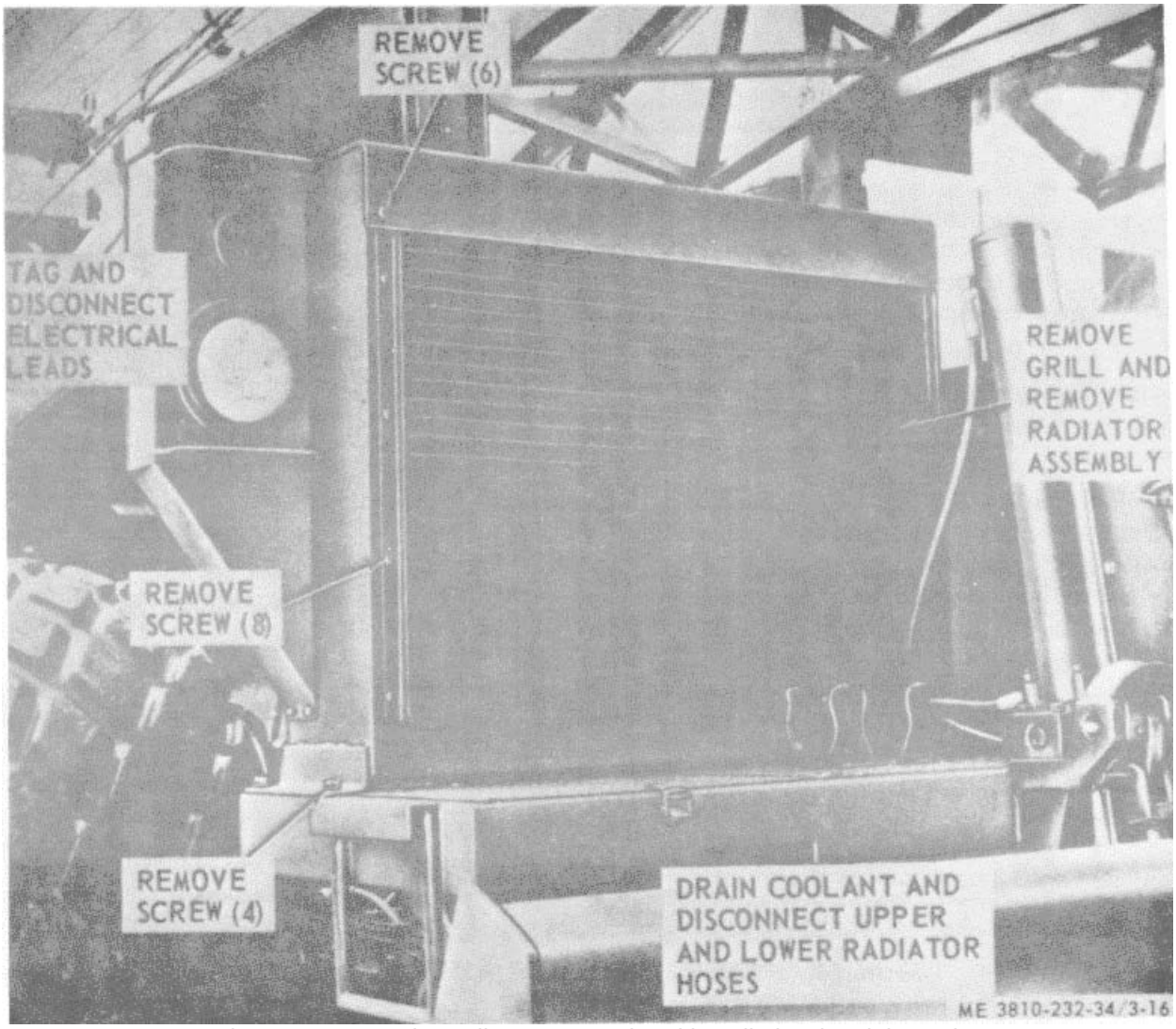



*Figure 3-16. Carrier radiator, removal and installation (model 2380).*

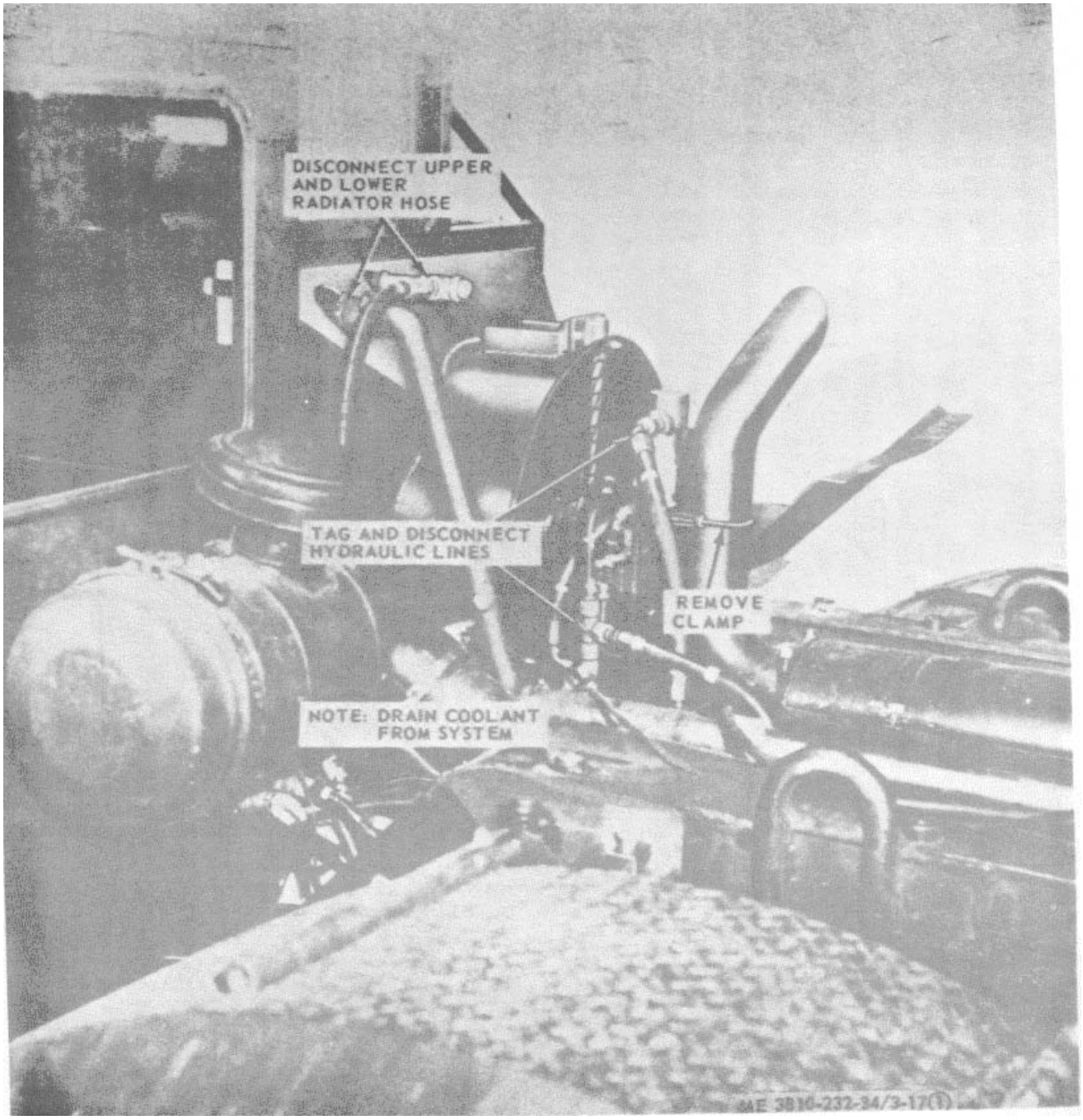



*Figure 3-17. (1) Carrier radiator, removal and installation (model 2385).*

*b. Removal (Model 2385).* Perform step 1, 2 and 3 in sub-paragraph a above and remove the radiator as illustrated on figure 3-17.

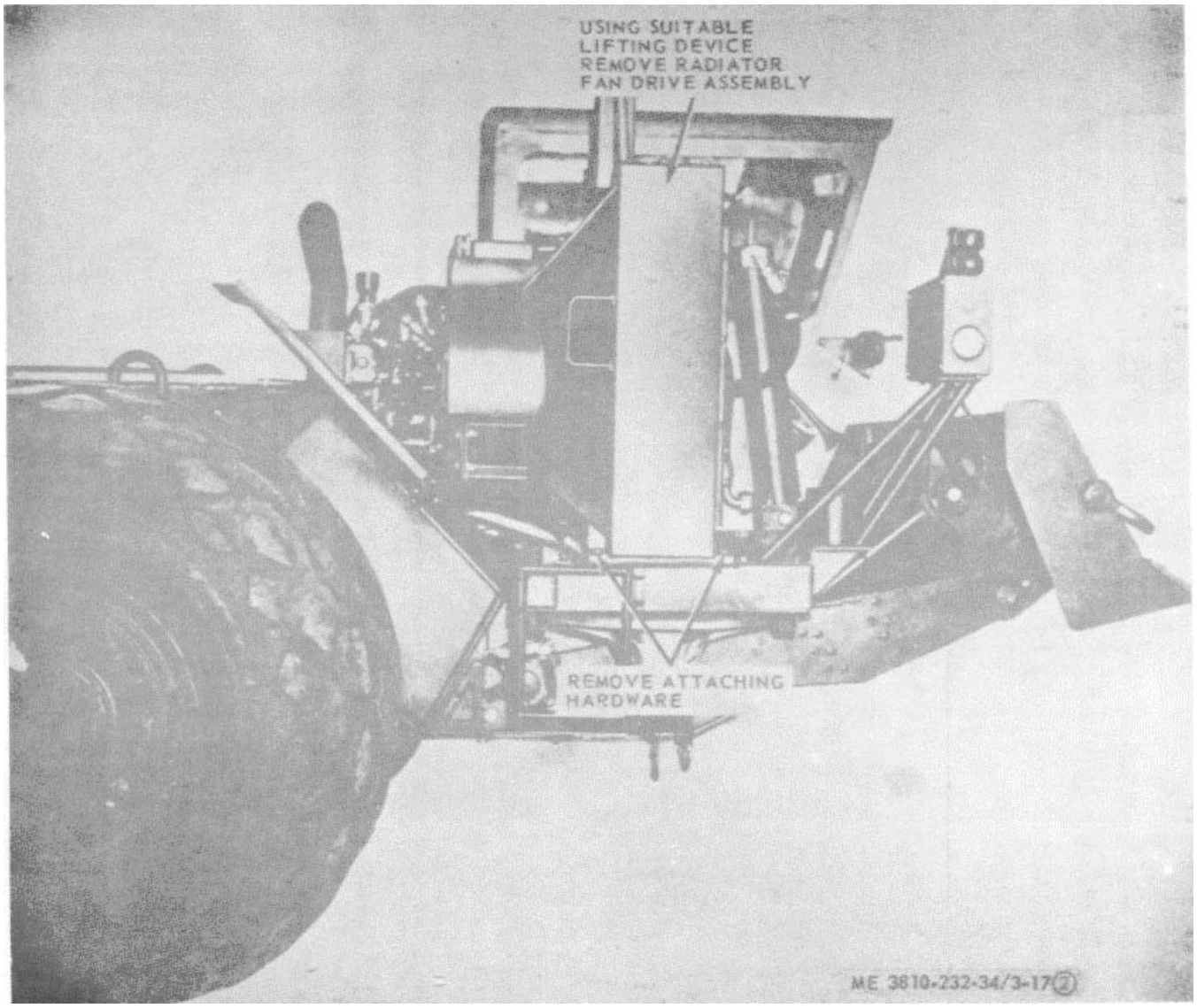
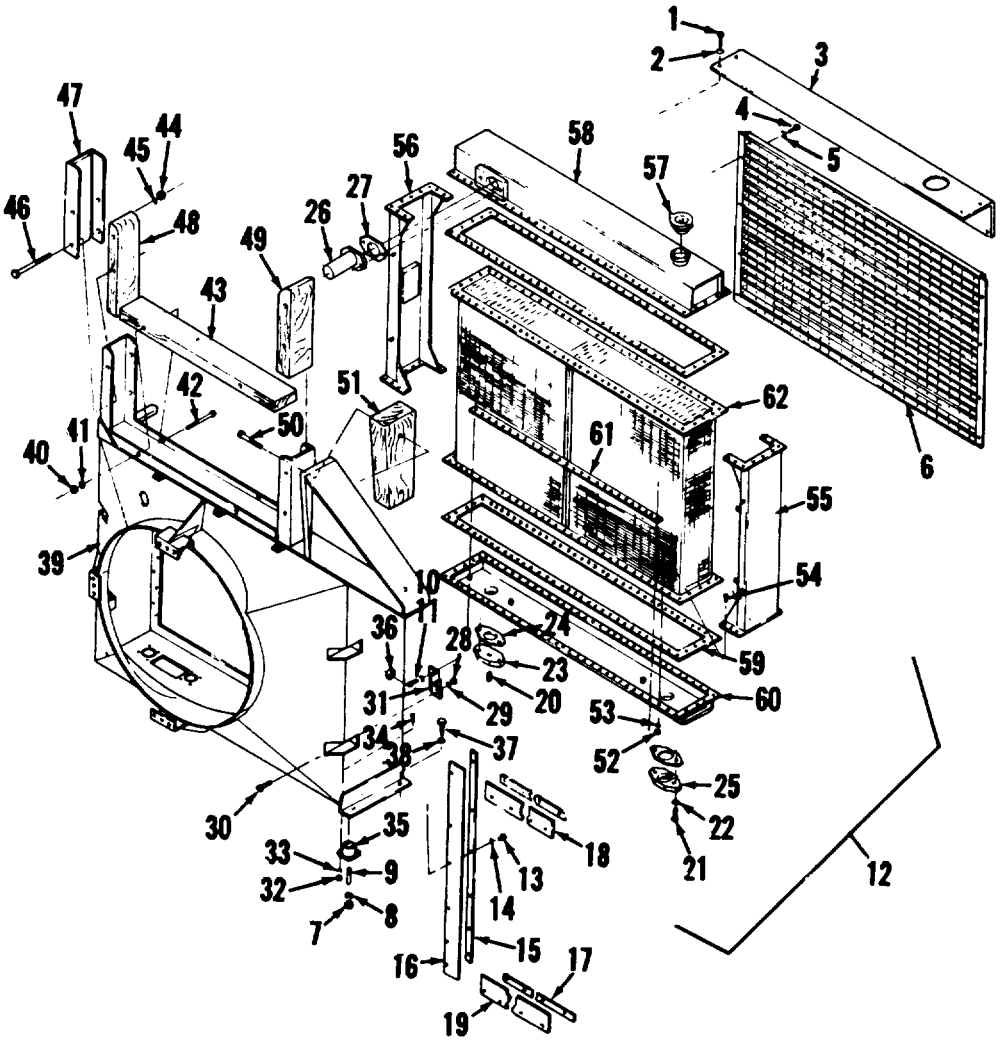



*Figure 3-17. (2) —Continues.*

*c. Disassembly*. Disassemble radiator in numerical sequence as shown on figure 3-18.



ME 3810-232-34/3-18

| | | | | | |
|---|---|---|---|---|---|
| 1 | Capscrew | 22 | Lockwasher | 43 | Block |
| 2 | Lockwasher | 23 | Mounting plate | 44 | Nut |
| 3 | Cover | 24 | Gasket | 45 | Lockwasher |
| 4 | Capscrew | 25 | Gasket | 46 | Capscrew |
| 5 | Lockwasher | 26 | Water inlet | 47 | Upright arm |
| 6 | Grille | 27 | Gasket | 48 | Block |
| 7 | Nut | 28 | Nut | 49 | Block |
| 8 | Lockwasher | 29 | Header gaskets | 50 | Capscrew |
| 9 | Capscrew | 30 | Capscrew | 51 | Block |
| 10 | Capscrew | 31 | Vibration dampener | 52 | Nut |
| 11 | Capscrew | 32 | Nut | 53 | Lockwasher |
| 12 | Radiator assembly | 33 | Lockwasher | 54 | Bolt |
| 13 | Machine screw | 34 | Machine screw | 55 | Channel R.H. |
| 14 | Lockwasher | 35 | Vibration dampener | 56 | Channel L.H. |
| 15 | Side clamp | 36 | Grommet | 57 | Filler cap |
| 16 | Side seal | 37 | Capscrew | 58 | Top tank |
| 17 | Bottom clamp | 38 | Lockwasher | 59 | Header gaskets |
| 18 | Top seal | 39 | Radiator shell | 60 | Bottom tank |
| 19 | Bottom seal | 40 | Nut | 61 | Clamping strip |
| 20 | Pipe plug | 41 | Lockwasher | 62 | Core and header |
| 21 | Capscrew | 42 | Capscrew | | |

*Figure 3-18. Carrier radiator assembly exploded view..*

**3-33. Cleaning, Inspection and Repair**

*a.* Remove sediment and scale from core by pressure flushing and, if necessary, boil with an approved cleaning solvent.

*b.* Inspect tanks for cracks, breaks or damaged seams. Repair or replace a defective tank.

c. Inspect for cracked, or broken fins in the core. Repair fins by soldering or replace a defective core.

*d.* Inspect general condition of hardware and replace tank gaskets with new ones.

**3-34. Reassembly and Installation**

*a. Reassembly.* Reassemble the radiator in reverse of the numerical sequence shown on figure 3-18.

*b. Installation (model 2380).*

(1) Install radiator as illustrated in figure 3-16.

(2) Install radiator hoses (TM 5-3810-232-12).

(3) Install dock plates and cover assembly (TM 5-3810-232-12).

(4) Refill cooling system.

*c. Installation (model 2385).* Install radiator as illustrated in figure 3-17 and perform steps 2, 3 and 4 of sub-paragraph b above.

## Section XI. CARRIER ENGINE WATER PUMP ASSEMBLY

**3-35. Removal and Disassembly**

a. Removal.

(1) Drain the cooling system.

(2) Remove generator drive belt (TM 53810-232-12).

(3) Loosen drive belt adjustment at the generator to full release position and slip the drive belt from its pulley. (TM 5-3810-232-12).

(4) Remove water pump as instructed on figure 3-19.

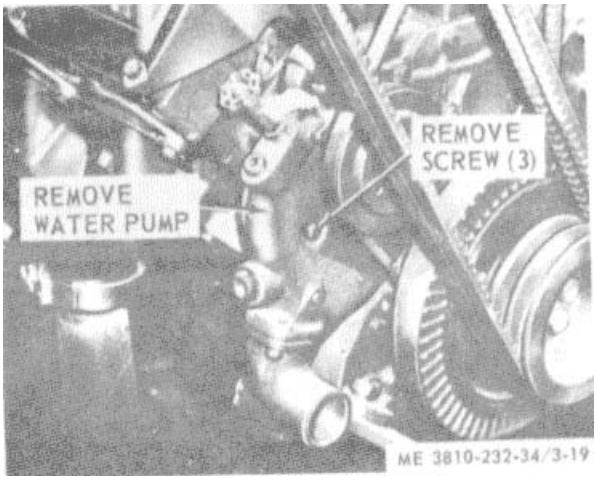
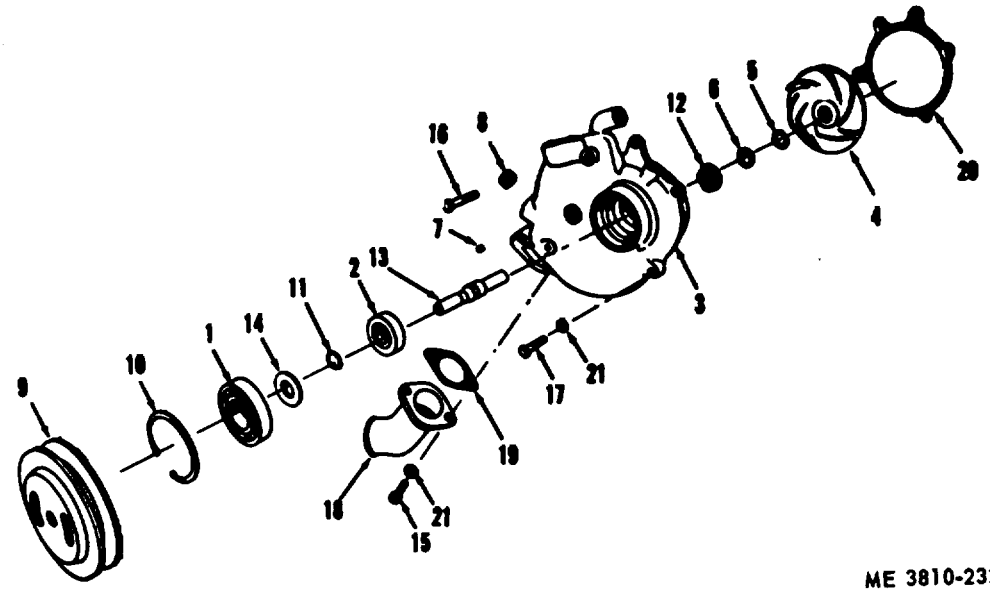



*Figure 3-19. Carrier engine water pump, removal and installation.*

*b. Disassembly.* Refer to figure 3-20 and disassemble the water pump assembly.




| | | | |
|---|---|---|---|
| 1 | Bearing | 12 | Seal |
| 2 | Bearing | 13 | Shaft |
| 3 | Body | 14 | Spacer |
| 4 | Impeller | 15 | Capscrew |
| 5 | Film | 16 | Capscrew |
| 6 | Seat | 17 | Capscrew |
| 7 | Plug | 18 | Connection |
| 8 | Plug | 19 | Gasket |
| 9 | Pulley | 20 | Gasket |
| 10 | Retainer | 21 | Lockwasher |
| 11 | Ring | | |

*Figure 3-20. Carrier engine water pump, exploded view. engine*

**3-36. Cleaning, Inspection and Repair**

*a.* Clean all parts with an approved cleaning solvent and dry thoroughly.

*b.* Inspect bearings, shaft and impeller for cracks, pitts, scoring or other damage. Replace defective parts as necessary.

*c.* Inspect pump body for cracks, breaks, or scoring on seal face. Replace if defective.

*d.* Measure impeller bore and shaft outside diameter. There must be a minimum of 0.0012 inch press fit between shaft impeller. Replace if necessary.

**3-37. Reassembly and Installation**

*a. Reassembly.* Refer to figure 3-20 and reassemble the water pump assembly.

*b. Installation.*

(1) Install water pump as instructed on figure 3-19.

(2) Install water pump lines and connections (TM 5-3810-232-12).

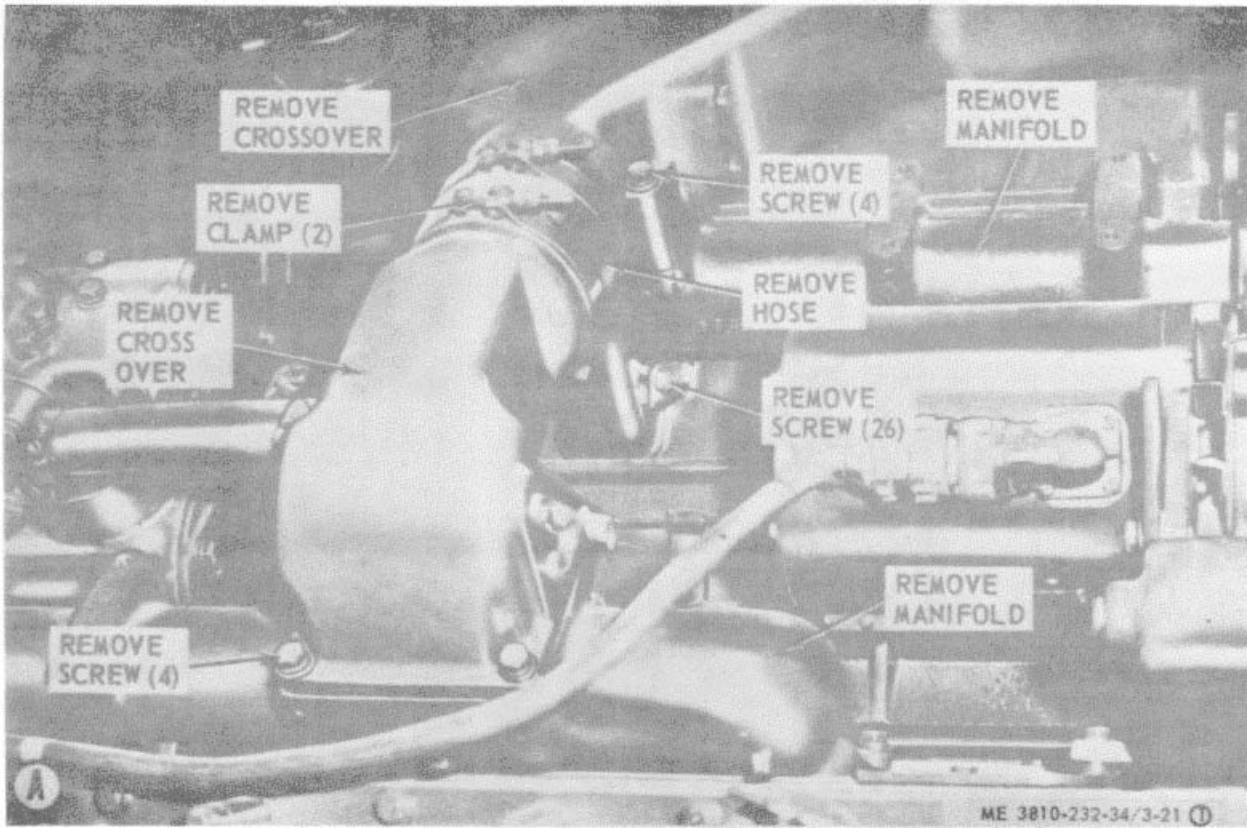
(3) Install drive belt and adjust tension.

(4) Refill cooling system.

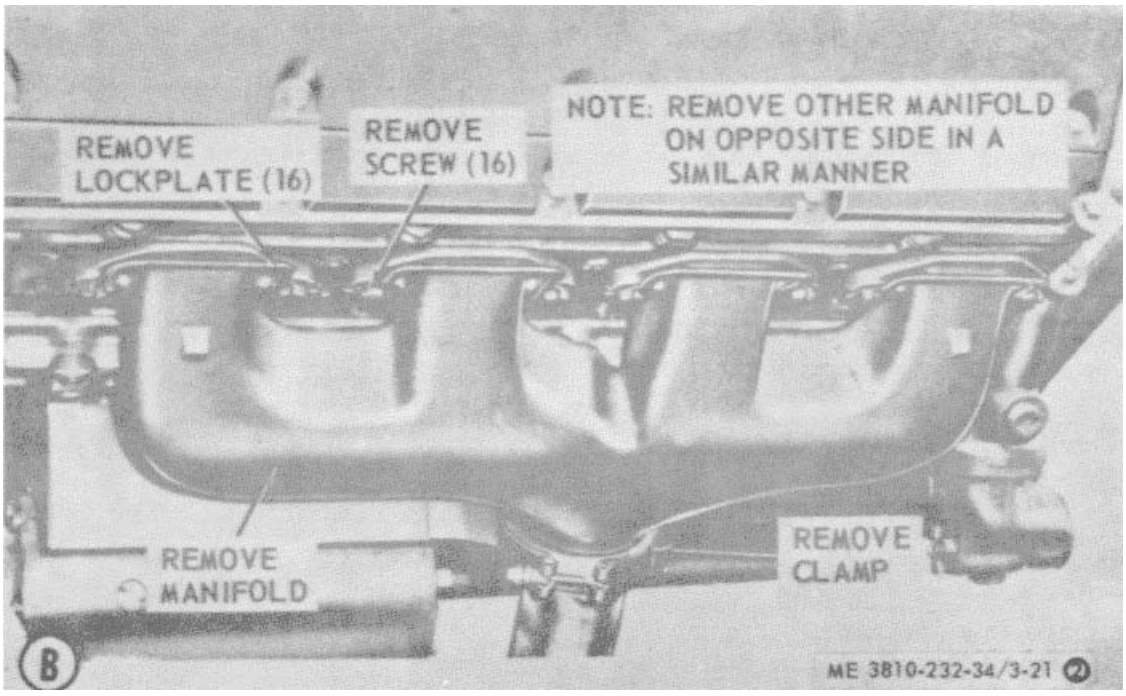
## Section XII. CARRIER ENGINE AIR INTAKE MANIFOLD AND EXHAUST MANIFOLD

**3-38. Removal**

*a.* Remove air connection, hose clamps, and mounting hardware as shown on figure 3-21.




*A—Air intake connections and air intake manifolds.*
*Figure 3-21. (1) Air Intake manifold and exhaust manifold, removal and installation.*




*B—Exhaust Manifold*
*Figure 3-21. (2) —Continued.*

*b.* Remove air intake manifolds as illustrated on figure 3-21.

*c.* Remove exhaust manifold as illustrated on figure 3-21.

**3-39. Cleaning, Inspection and Repair**

*a.* Clean all parts with an approved cleaning solvent and dry thoroughly.

*b.* Inspect for cracks, breaks and damaged or defective hardware.

*c.* Replace damaged or defective parts.

**3-40. Installation**

*a.* Install air intake manifolds as illustrated on figure 3-21. Torque capscrews alternately, starting in the middle, to 30 32 ft-lbs in increments of 10 ft-lbs.

*b.* Install air connections, hose clamps, and mounting hardware as shown in figure 3-21.

*c.* Install exhaust manifolds as illustrated on figure 3-21. Torque capscrews to 30 '35 ft.-lbs. in 15 ft.-lbs. increments.

## Section XIII. CARRIER ENGINE ROCKER COVERS AND PUSH ROD CAVITY COVERS

**3-41. Removal**

Remove rocker covers (TM 5-3810-232-12).

Remove push rod cavity covers as illustrated on figure 3-22.

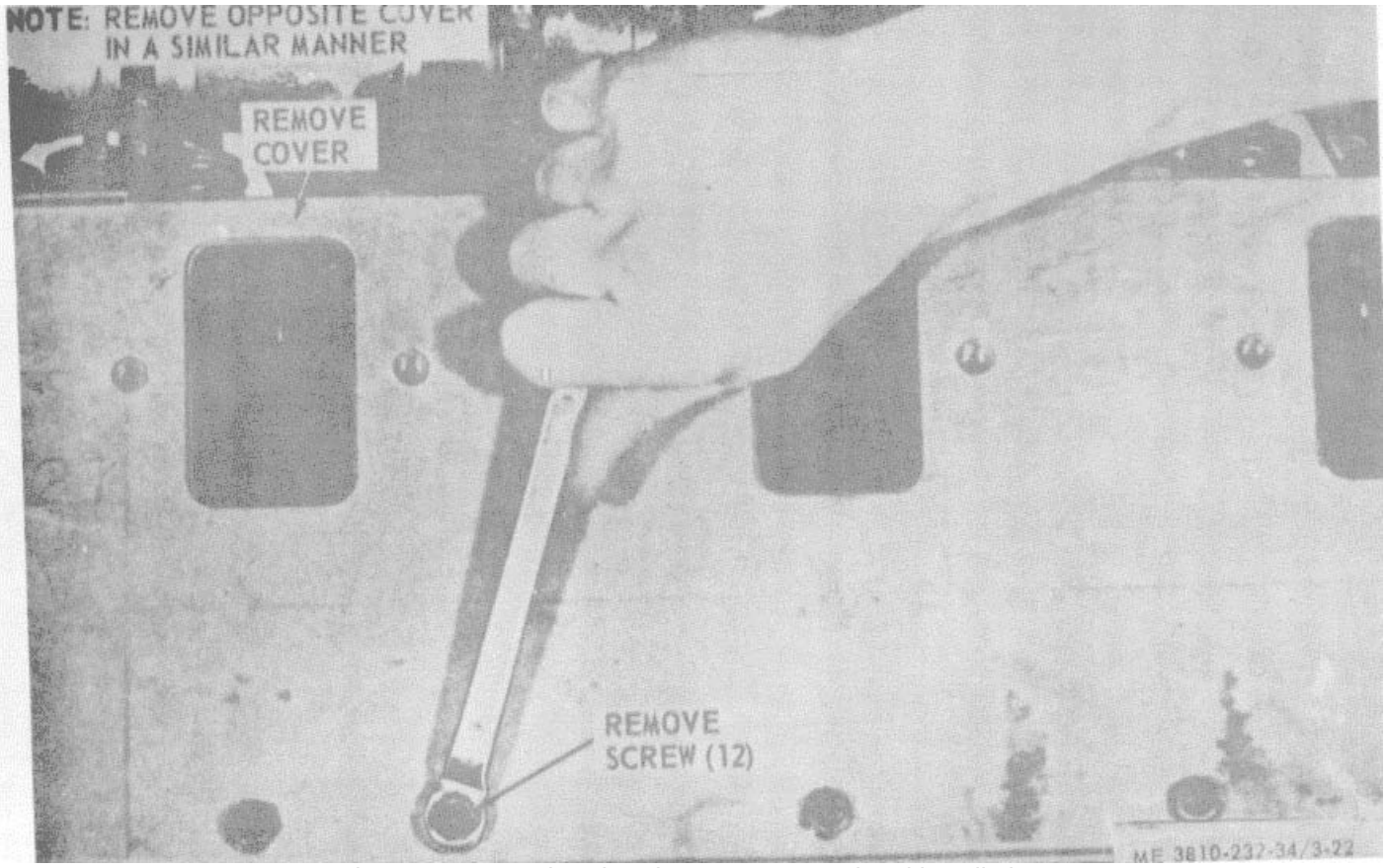



*Figure 3-22. Push rod cavity cover, removal and installation.*

**3-42. Cleaning, Inspection and Repair**

*a.* Clean all parts with an approved cleaning solvent and dry thoroughly.

*b.* Inspect for cracks, breaks, or other damage.

*c.* Repair or replace defective parts.

**3-43. Installation**

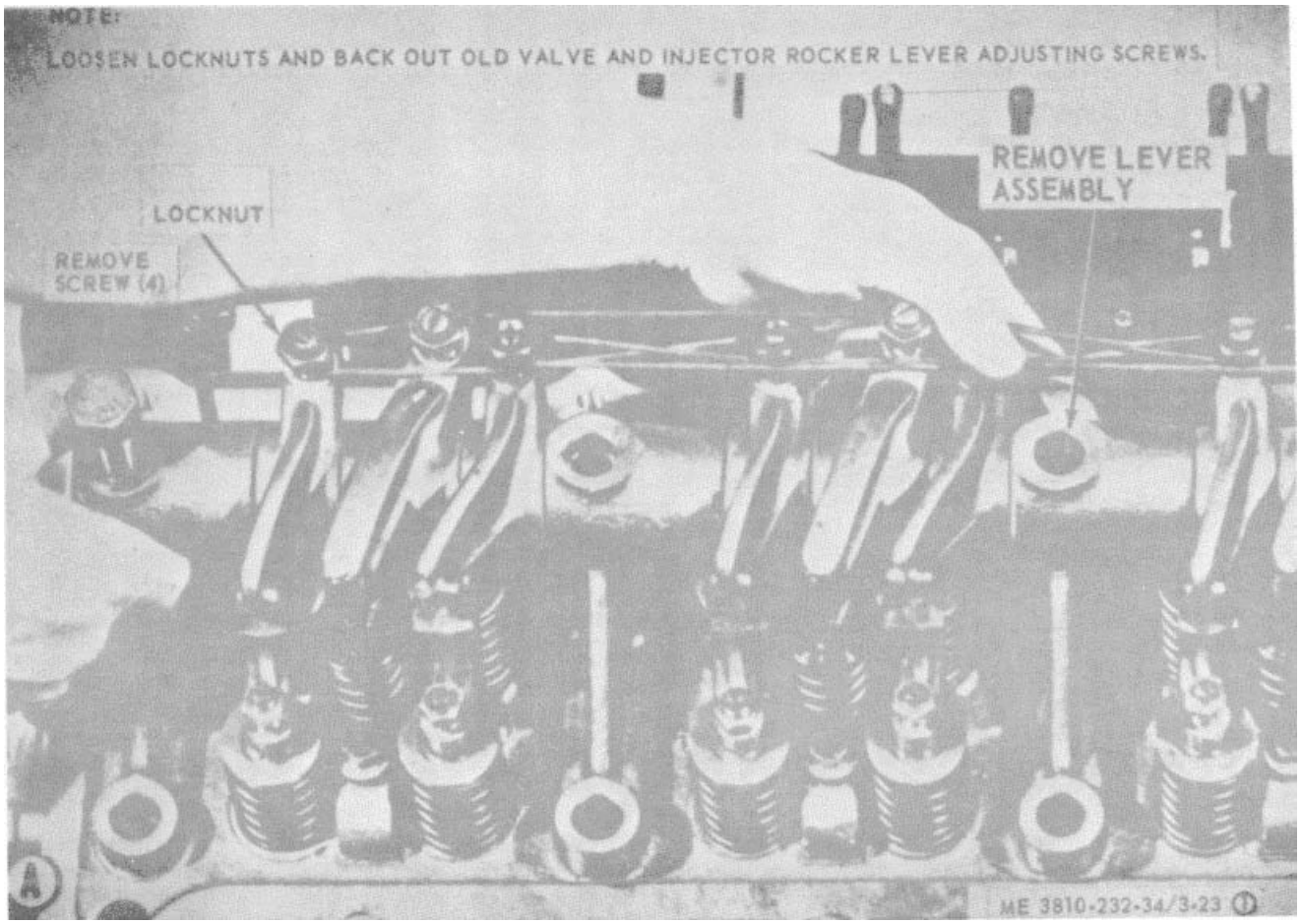
Install push rod cavity cover as illustrated on figure 3-22 and rocker covers (TM 5-3810-232-12).

## Section XIV. CARRIER ENGINE ROCKER LEVER AND INJECTORS

**3-44. Removal**

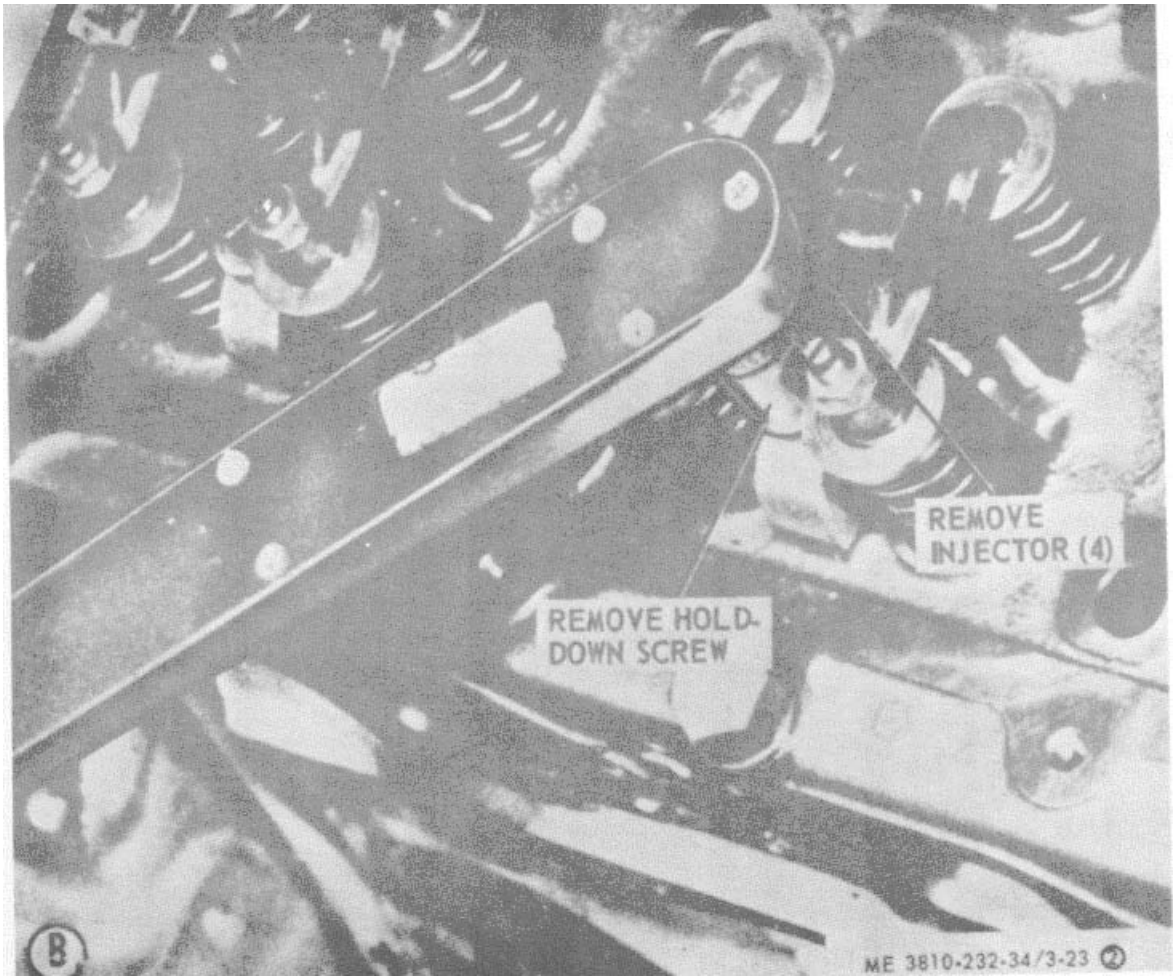
*a.* Remove rocker covers and push rod cavity covers (para 3-41).

*b.* Remove rocker lever assemblies as illustrated on figure 3-23.




*A—Rocker arm assembly.*

*Figure 3-23. (1) Rocker levers and injectors, removal and installation.*




*B-Fuel*
*Figure 3-23. (2) Continued.*

*c.* Remove injectors from cylinder heads as illustrated on figure 3-23.

**NOTE**
**Use a rolling head pry bar to remove the right and left front injectors.**

**3-45. Cleaning, Inspection and Repair**

*a.* Clean all parts with an approved cleaning solvent.

*b.* Inspect all parts for cracks, burrs, pitting, excessive wear and damaged threads. Replace defective parts as necessary. See table 1-1.

*c.* Inspect and see that all lubricating oil passages are open and unobstructed.

*d.* Inspect lever shaft for scoring, goring and wear. Replace if worn smaller than 1.1845 inches.

*e.* Inspect thread conditions on all screws and rocker levers. Replace defective or damaged parts.

**3-46. Installation**

*a.* Install injectors in cylinder heads as instructed on figure 3-23.

*b.* Install rocker lever assemblies as instructed on figure 3-23.

*c.* Adjust the fuel injector plungers (TM 53810-232-12).

*d.* Adjust the valve crossheads (TM 5-3810232-12).

*e.* Adjust valve clearance (TM 5-3810-232-12).

*f.* Install cylinder head covers and push the tube covers (para 3-43).

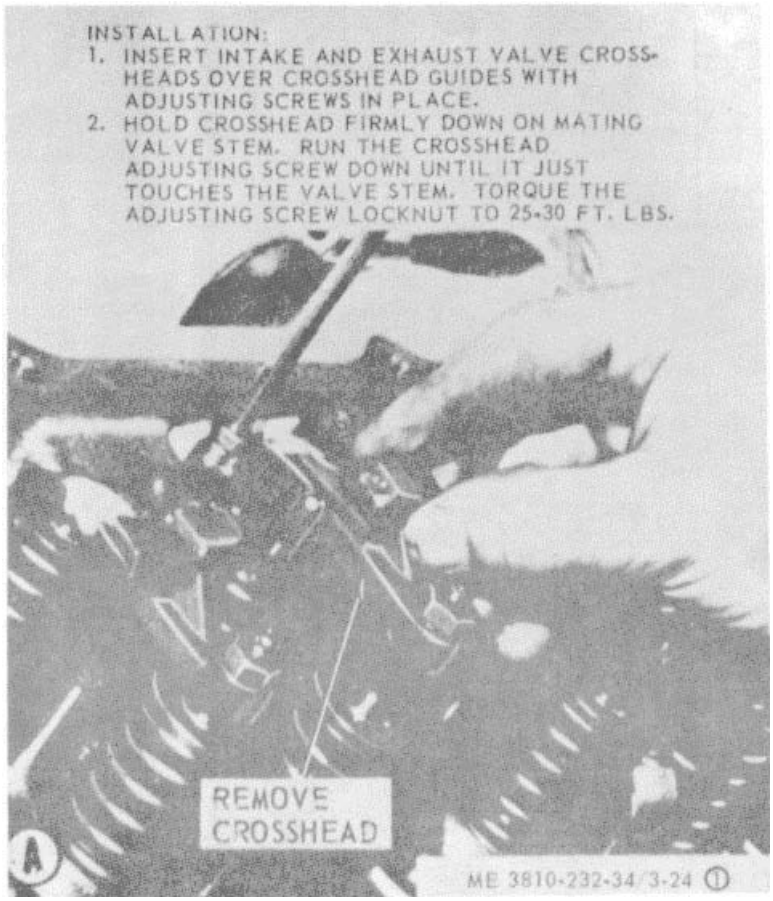
## Section XV. CARRIER ENGINE CYLINDER HEAD ASSEMBLIES

### 3-47. Removal and Disassembly

*a.* Remove intake and exhaust manifolds (para 3-38).

*b.* Remove rocker levers, and injectors (para 3-44).

*c.* Remove valve crossheads from guides, as illustrated on figure 3-24.




*A—Valve crosshead removal.*

*Figure 3-24. (1) Carrier engine cylinder head and valve crossheads, removal and installation.*

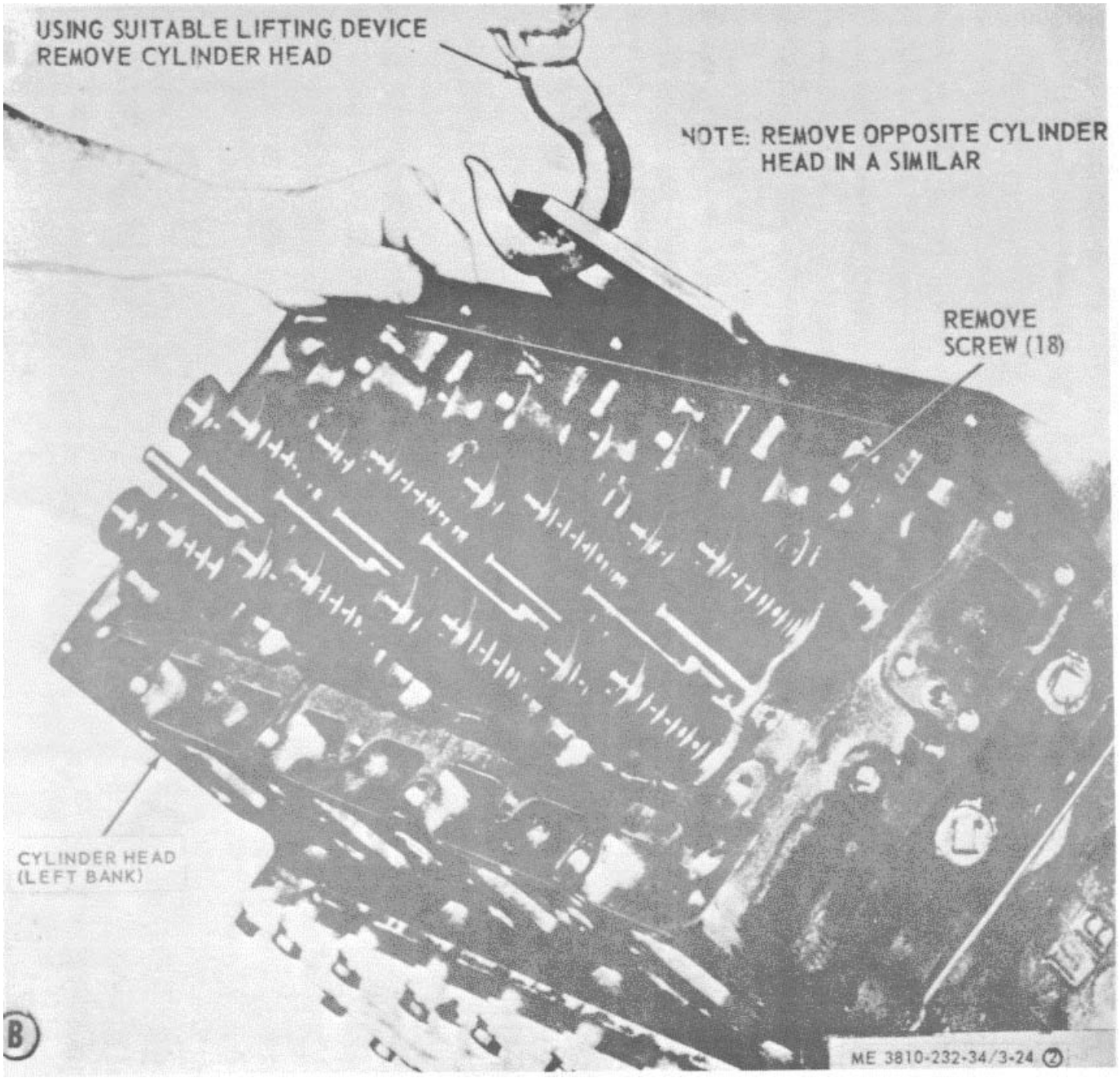
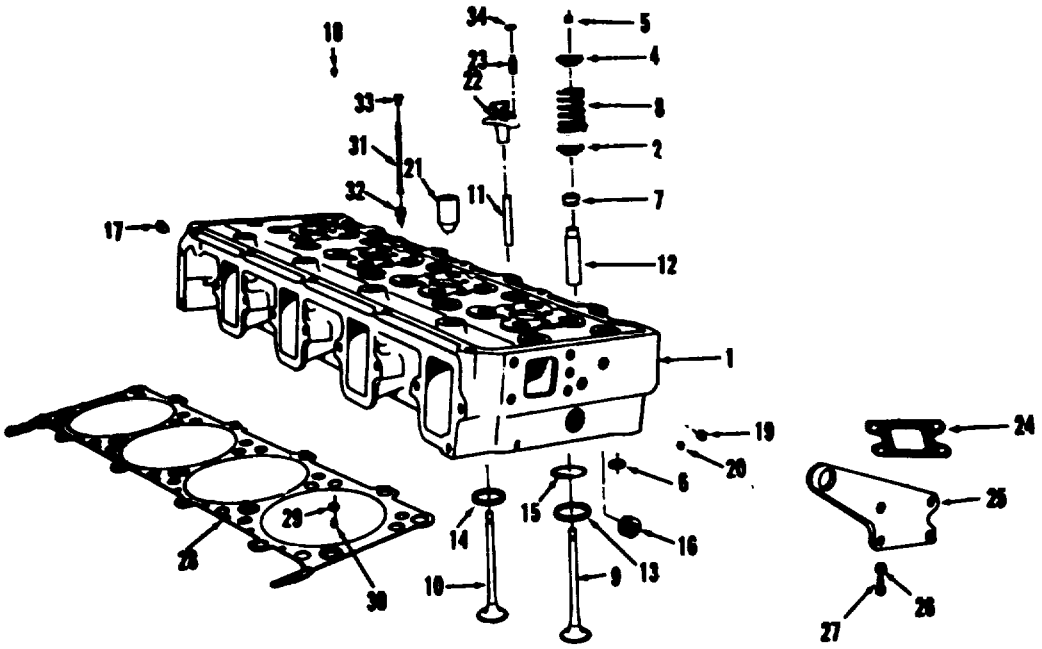



*Figure 3-24. (2) —Continued.*

*d.* Remove cylinder head assemblies as illustrated on figure 3-24

*e.* Refer to figure 3-25 and disassemble the cylinder head assembly.

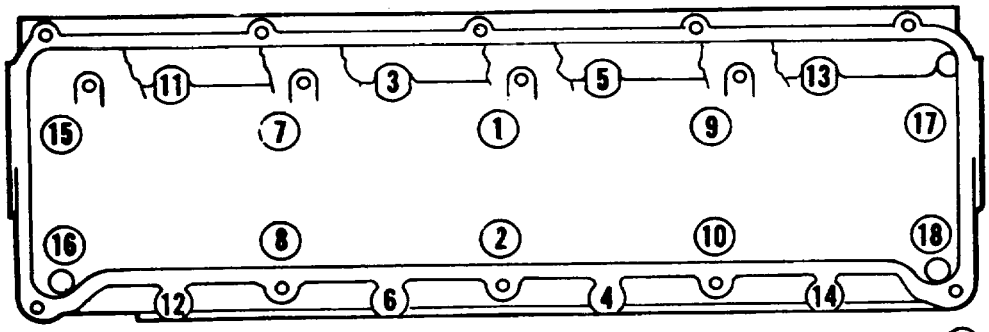


ME 3810-232-34/3-25 (1)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Head assembly | 6 | Seal | 12 | Guide | 17 | Plug | 23 | Screw | 29 | Grommet |
| 2 | Guide | 8 | Spring | 13 | Insert | 18 | Plug | 24 | Gasket | 30 | Retainer |
| 3 | Guide | 9 | Valve | 14 | Insert | 19 | Plug | 25 | Bracket | 31 | Tube |
| 4 | Cap | 10 | Valve | 15 | Plate | 20 | Plug | 26 | Washer lock | 32 | Connector |
| 5 | O-ring | 11 | Guide | 16 | Plug | 21 | Sleeve | 27 | Capscrew | 33 | Nut |
| | | | | | | 22 | Crosshead | 28 | Gasket | 34 | Nut |

A—Exploded view

*Figure 3-25. (1) Cylinder head assembly, disassembly and reassembly.*




ME 3810-232-34/3-25 (2)

*B—Cylinder head bolt tightening sequence*
*Figure 3-25. —Continued*

**3-48. Cleaning, Inspection and Repair**

a. Clean all parts with an approved cleaning ,solvent and dry thoroughly.

b. Test cylinder head for leaks. Check carefully around valve and injector seats for cracks.
Discard if cracked at seats.

c. Inspect cylinder head examining fuse plugs, valve seats, and injectors sleeves for signs of overheating, looseners, excessive wear or other damage. Replace parts as necessary.

**NOTE**

Cylinder heads are- equipped with fuse plugs containing a metal-alloy center that melts **.**' the engine is overheated. Examine fuse plugs for signs of overheating. If metal-alloy has melted, as other engine disassembly proceeds, check carefully for damage from overheating.

d. Inspect valves for cupped, pitted or worn condition. Replace or grind valves as necessary.

e. Inspect valve springs and valve guides for excessive wear and replace defective parts. See table 1-1.

f. Inspect cylinder head surface for scratches, etching or other damage. Resurface head or replace as necessary. Minimum permissible height after resurfacing is 4.4650 inches.

**3-49. Reassembly and Installation**

a. Reassembly. Refer to figure 3-25 and reassemble the cylinder head assembly.

b. Installation.

(1) Install cylinder head assemblies as illustrated on figure 3-24.

(2) Torque the cylinder head bolts in sequence as illustrated in figure 3-25B and in increments of 30 to 40 ft-lbs. Final torque all cylinder head bolts to 230,240 ft-lbs.

(3) Install valve crossheads on guides as illustrated on figure 3-24.

(4) Install rocker levers, and injectors (para 3-46).

(5) Install intake and exhaust manifolds (para 3-40).

## Section XVI. CARRIER ENGINE VIBRATION DAMPER

**3-50. Removal**

Remove vibration damper as illustrated on figure 3-26.

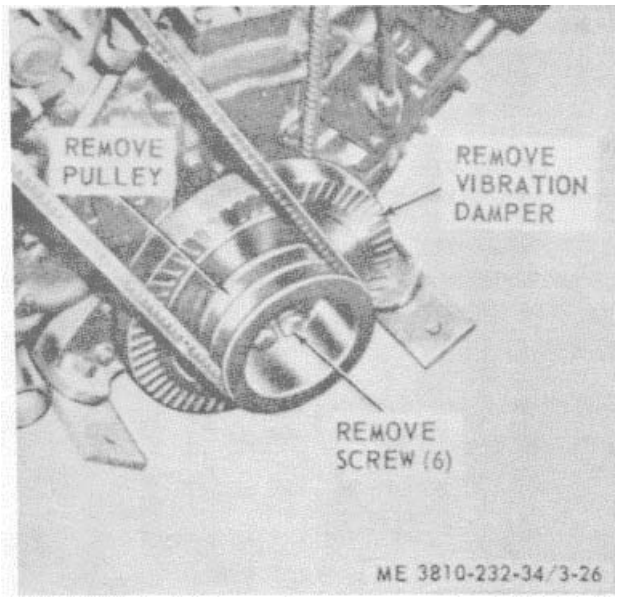



*Figure 3-26. Vibration damper, removal and installation.*

**3-51. Cleaning, Inspection and Repair**

a. Clean rubber damper exterior with a detergent.

**CAUTION**

**Use of solvent of degreasing compounds will cause deterioration of rubber in damper.**

b. Inspect rubber damper for cracks, dents,

c. Damper hub inertia member are stamped with an alinement mark to permit detection of relative movement between these two components (fig. 3-27).

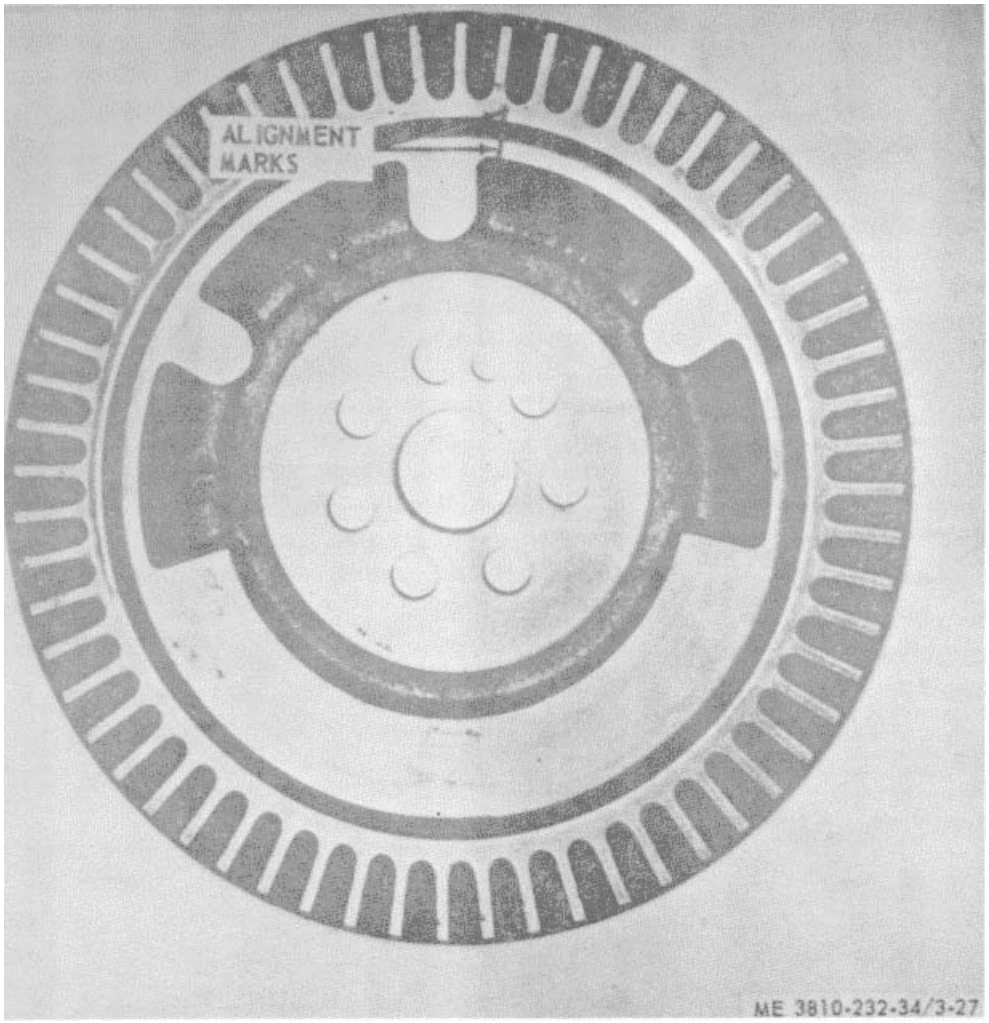



*Figure 3-27. Vibration damper- alinement marks.*

This -alinement must be checked to insure correct valve setting and damper effectiveness. If marks are out of alignment more than 1 16 inch discard damper.

**3-52. Installation**

a. Install vibration damper as illustrated on figure 3-26. Torque attaching capscrews alternately to 200 205 ft-lbs.

b. With a dial gage mounted to front cover, check vibration damper eccentricity and wobble at points A and B as shown on figure 3-28.

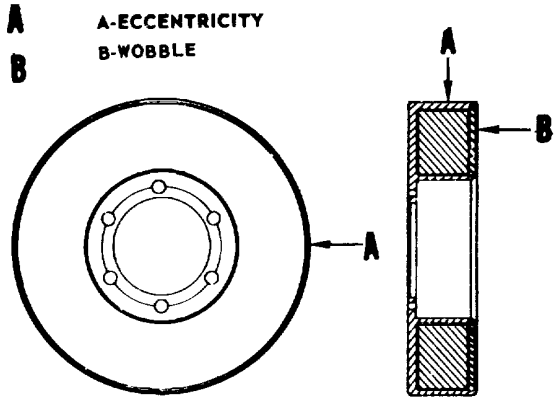



*Figure 3-28. Vibration damper eccentricity and wobble check.*

c. Eccentricity must not exceed 0.030 inch and wobble 0.030 at 4.85 inch radius. Crankshaft must be kept front or rear limit of thrust clearance while wobble is being checked.

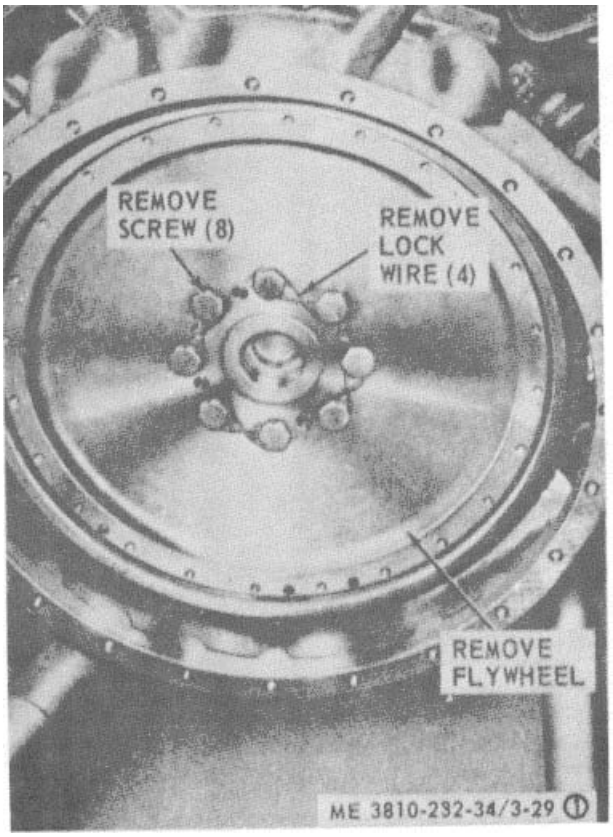
NOTE

## Section XVII. CARRIER ENGINE FLYWHEEL AND FLYWHEEL HOUSING

### 3-53. Removal

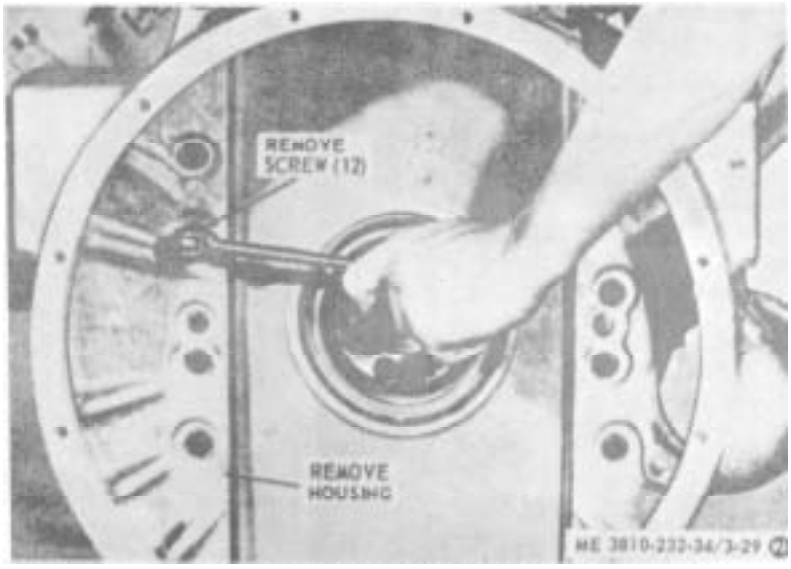
a. Remove the starter (TM 5-3810-232-12).

b. Remove flywheel assembly and flywheel housing as illustrated of figure 3-29.




A.--Flywheel removal.

*Figure 3-29. (1) Flywheel and flywheel housing, removal and installation.*



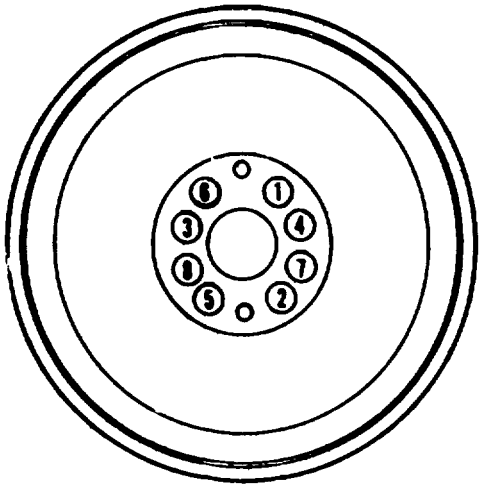

B-Flywheel housing removal
*Figure 3-29. (2) -Continued,*

**3-54. Installation**

a. Install flywheel housing and flywheel as illustrated on figure 3-29. (Refer to torque data, para 1-4).

**NOTE**

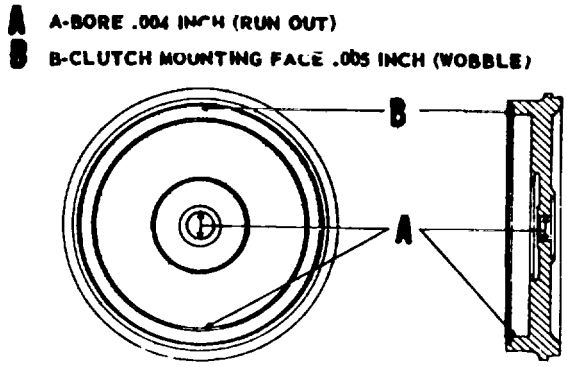
**When tightening flywheel capscrews, tighten in sequence shown on figure 3-30, and in increments of 50/60 ft.-lbs. Refer to figure 3-31 for torquing sequence of flywheel housing.**




ME 3810-232-34/3-30 (1)

A--Flywheel torquing sequence.

*Figure 3-30. (1) Flywheel torquing and checks data.*




B-Flywheel bores and clutch face check points
*Figure 3-30. (2) --Continued*

b. Use indicator and check flywheel bores and clutch face. Refer to figure 3-30B. for check points and limits.

**NOTE**

**Crankshaft must be kept to either front or rear limit of thrust clearance while checking face**

(1) If run-out exceeds limits, remove flywheel. Clean flywheel and crankshaft adapter mating surfaces.

(2) Reinstall flywheel and torque flywheels capscrews, retorquing in proper sequence.

(3) Recheck flywheel bores and clutch face.

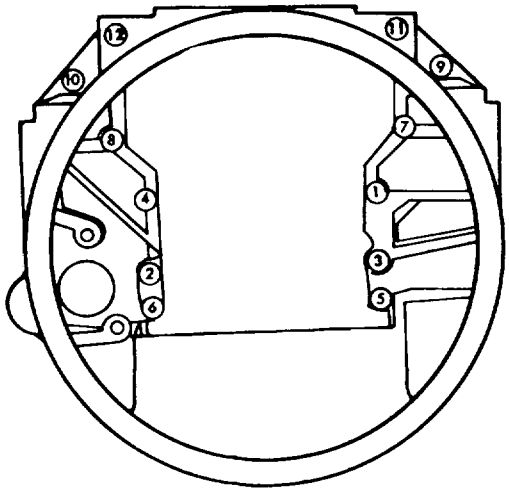



*Figure 3-31. Flywheel housing torquing sequence.*

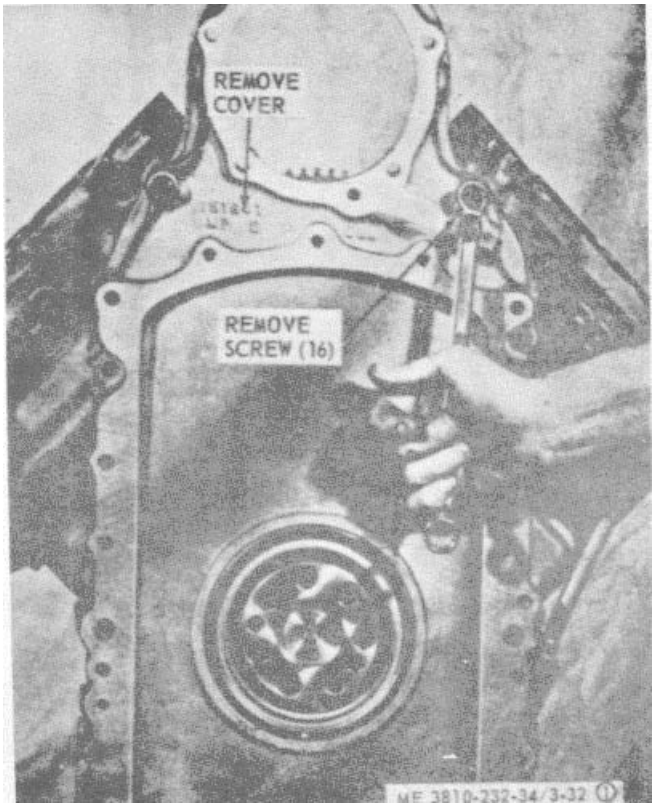
c. Install starter (TM 5-3810-232-12).

d. Install engine assembly (para 2-10).

## Section XVIII. CARRIER ENGINE GEAR HOUSING AND CAMSHAFT

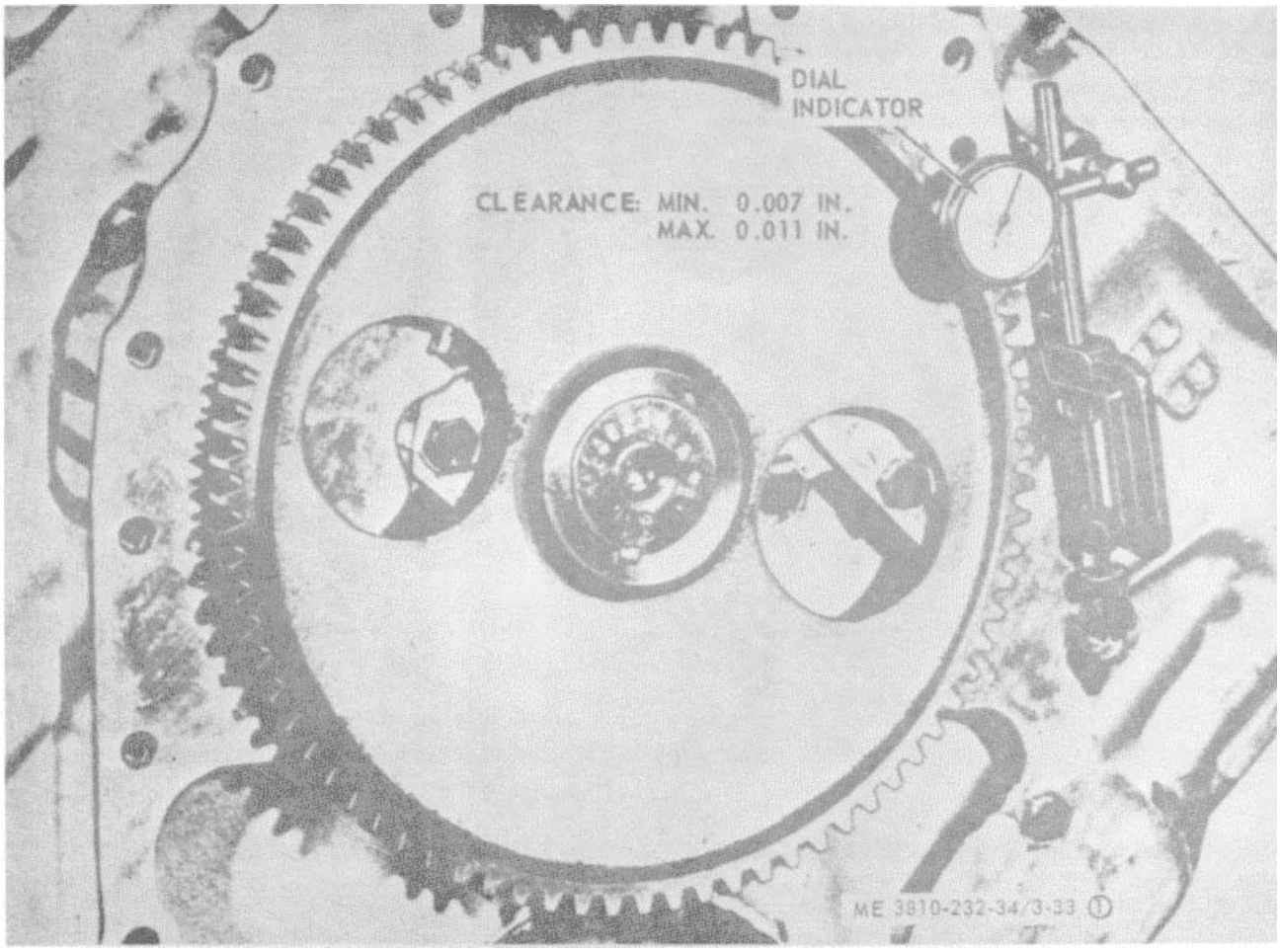
### 3-55. Removal

a. Remove gear cover as illustrated on figure 3-32.




A--Gear cover, removal

*Figure 3-32. (1) Gear cover and camshaft, removal and installation.*




B-- Camshaft, removal

*Figure 3-32. (2) - Continued*

b. Remove camshaft as illustrated on figure 3-32.

**3-56. Cleaning, Inspection and Repair**

a. Clean all parts with an approved cleaning solvent and dry thoroughly.

b. Inspect gear housing and thrust plates for cracks, breaks, or worn condition. Repair or replace a damaged or defective housing.

c. Inspect camshaft gear for cracked, worn or broken teeth. Replace a defective gear.

d. Inspect camshaft journals and lobes for scuffs, scoring, pitting or other damage. Measure camshaft bearing journals. Replace camshaft if journals are worn smaller than 2.494 inches. Perform magnetic inspection on camshaft. Replace a worn or defective camshaft.

**3-57. Installation**

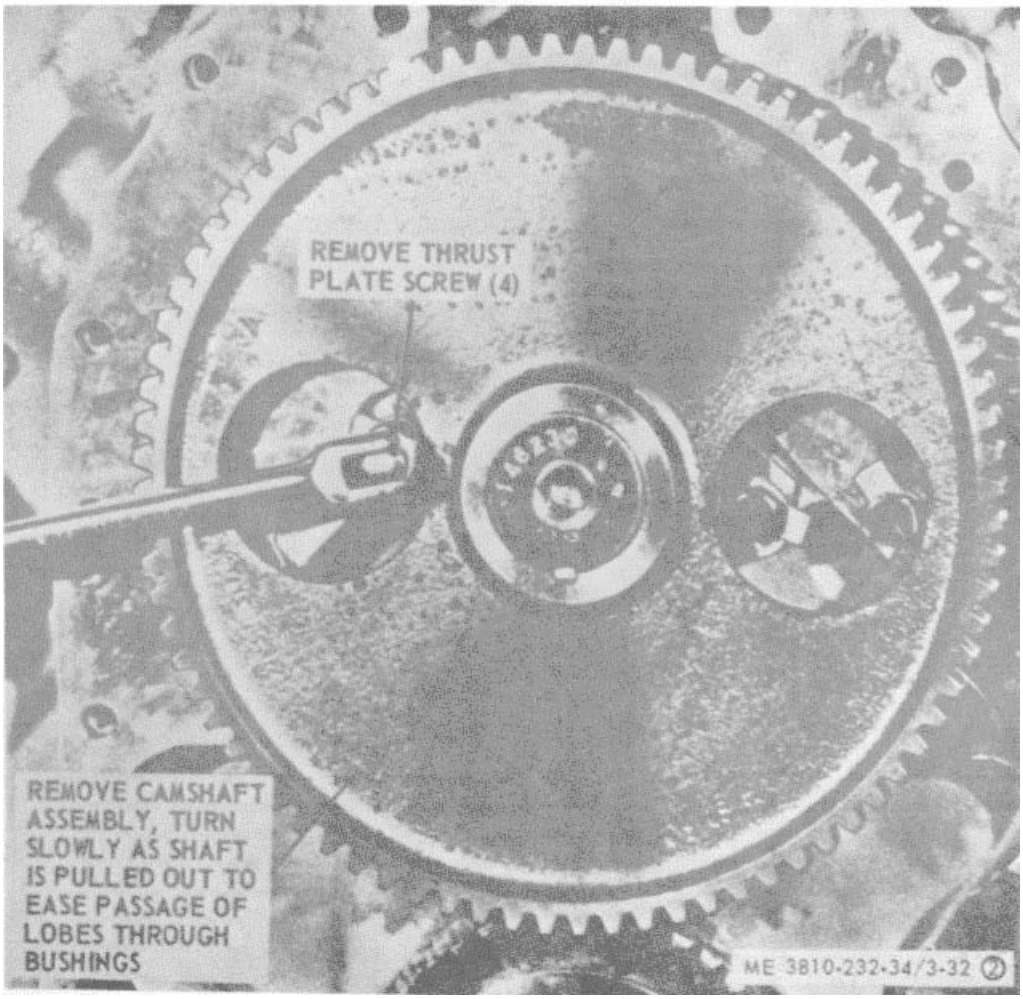
a. Install camshaft in block rotating as it enters to ease passage of lobes through bushings. Index timing mark on camshaft gear with mark on crankshaft gear.

b. Secure camshaft thrust plate to block as illustrated on figure 3-32.

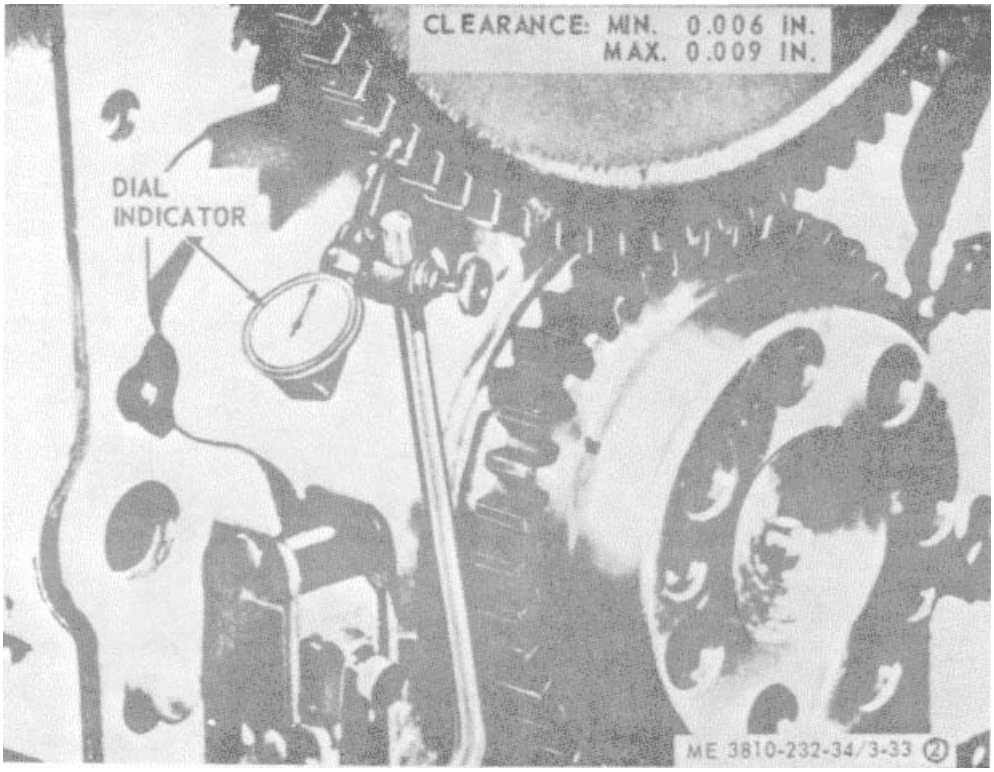
c. Attach dial indicator gauge with proper holder and check camshaft end clearance and gear backlash as shown on figure 3-33. Proper end clearance must be .007 to .011 inch and gear backlash 0.004 to 0.010. If end clearance is not within limits, remove camshaft and change thrust washer as shown in figure 3-32.

**NOTE**

**Block must be in upright position when checking camshaft end clearance and gear backlash.**




*A-Checking camshaft gear clearance.*
*Figure 3-33. (1) Checking camshaft gear, clearance..*




B--Checking gear backlash
*Figure 3-33. (20 Continued.*

d. Check the injection timing. Timing may be advanced or retarded by changing the camshaft key.

(1) Install the injector push tube in the injector tappet of No. 2 cylinder on the right bank and opposite the cylinder on the left bank.

(2) Install the timing fixture in the injector bore. The indicator extension must rest in the socket of the injector push rod.

(3) Tighten the timing fixture in place in the injector mounting capscrew hole.

(4) Bar the crankshaft in the direction of engine rotation to the top center firing position. At the point of maximum piston rise, "zero" dial indicator above piston.

(5) Bar the crankshaft to 60 degrees after top center. At this point, the 60 degree mark on the moving plunger should be in line with the groove on the retainer.

(6) Zero" the dial indicator above the push tube.

(7) Bar the crankshaft in the direction opposite the engine rotation to approximately 60 degrees before top center or until the 60 degree mark on the plunger in the injector bore is in line with the groove on the retainer. This is the same index mark indicated in step 5 above.

(8) Bar the crankshaft in the direction of the engine rotation until the dial indicator above the piston shows the piston has traveled to the location shown at the first check point under "piston travel" in table 3-1.

(9) Read the push rod travel on the dial indicator and check the reading against the limits shown on table 3-1.

(10) Check the push rod travel at each of the two remaining positions shown in table 3-1.
If the push rod travel is greater than the limits shown, the timing is slow. If the push rod travel is less than the limits shown, the timing is fast.

(11) If the timing check shows a timing change is desirable, select the next advance or retard key from the listing in table 3-2.

**NOTE**

**Always install the key with the arrow or color cod. toward the gear end of the camshaft.**

(12) Recheck the timing as outlined above if the camshaft key is changed.

**NOTE**

**Each 0.007 inch offset of the camkey is equal to approximately 0.0025 inch push rod indicator travel the 23 degree crank angle check.**

e. Install gear cover as illustrated on figure 3-32.

*Table 3-1. Camshaft Timing Specifications*

| Engine | Crank piston angle (degree) | Piston travel (inches) | Push rod travel Nominal | Fast | Slow |
|---|---|---|---|---|---|
| Rated above 200 RPM Naturally Aspirated | 23.0 BTC<br>04.5 BTC<br>6.0 BTC | 0.2032<br>0.0816<br>0.0143 | 0.0470<br>0.0230<br>0.0040 | 0.0440<br>0.0205<br>0.0025 | 0.0500<br>0.0255<br>0.0060 |

*Table 3-2. Camshaft Key Data*

| Key part No. | | Timing effect | Amount of offset |
|---|---|---|---|
| S-302 | (15434) | 0 Degree | 0.000 |
| 200711 | (15434) | 1/2 Degree | 0.007 |
| 200709 | (15434) | 1 Degree | 0.015 |
| 200708 | (15434) | 1 1/2 Degree | 0.023 |
| 200706 | (15434) | 2 Degree | 0.032 |

**NOTE**

**To retard the RH engine, reverse the direction of the arrow. To advance the LH engines, reverse the direction of the arrow.**

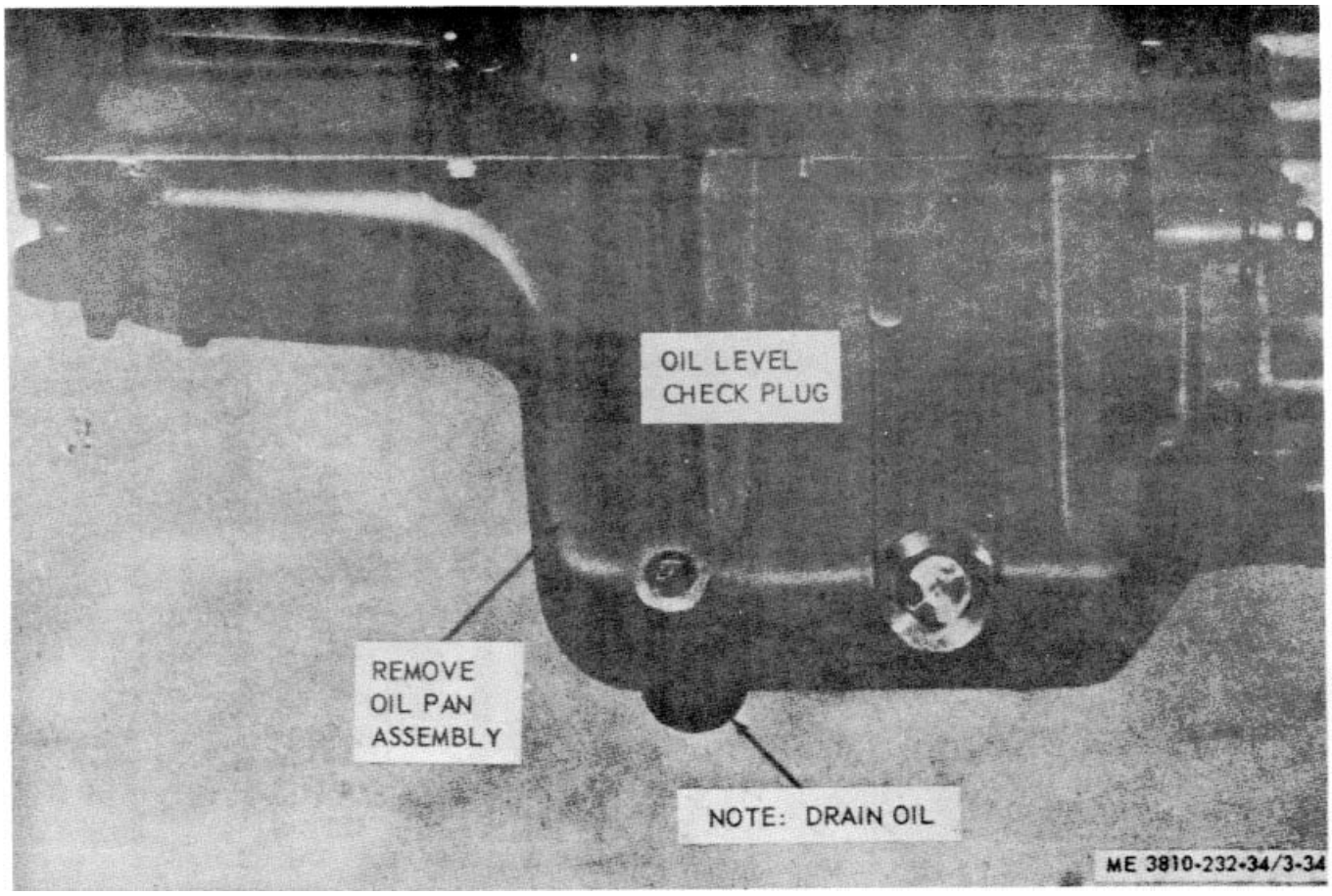
## Section XIX. CARRIER ENGINE OIL PAN ASSEMBLY

**3-58. Removal and Disassembly**

*a. Removal.*

(1) Drain oil. on figure 3-34.

(2) Remove oil pan assembly as illustrated.




REMOVAL:

REMOVE CAPSCREWS, LOCKWASHERS AND FLATWASHERS SECURING OIL PAN TO BLOCK AND FRONT COVER; LIFT OFF OIL PAN AND DISCARD GASKET.

INSTALLATION:

1. INSTALL NEW SINGLE-PIECE GASKET TO OIL PAN.

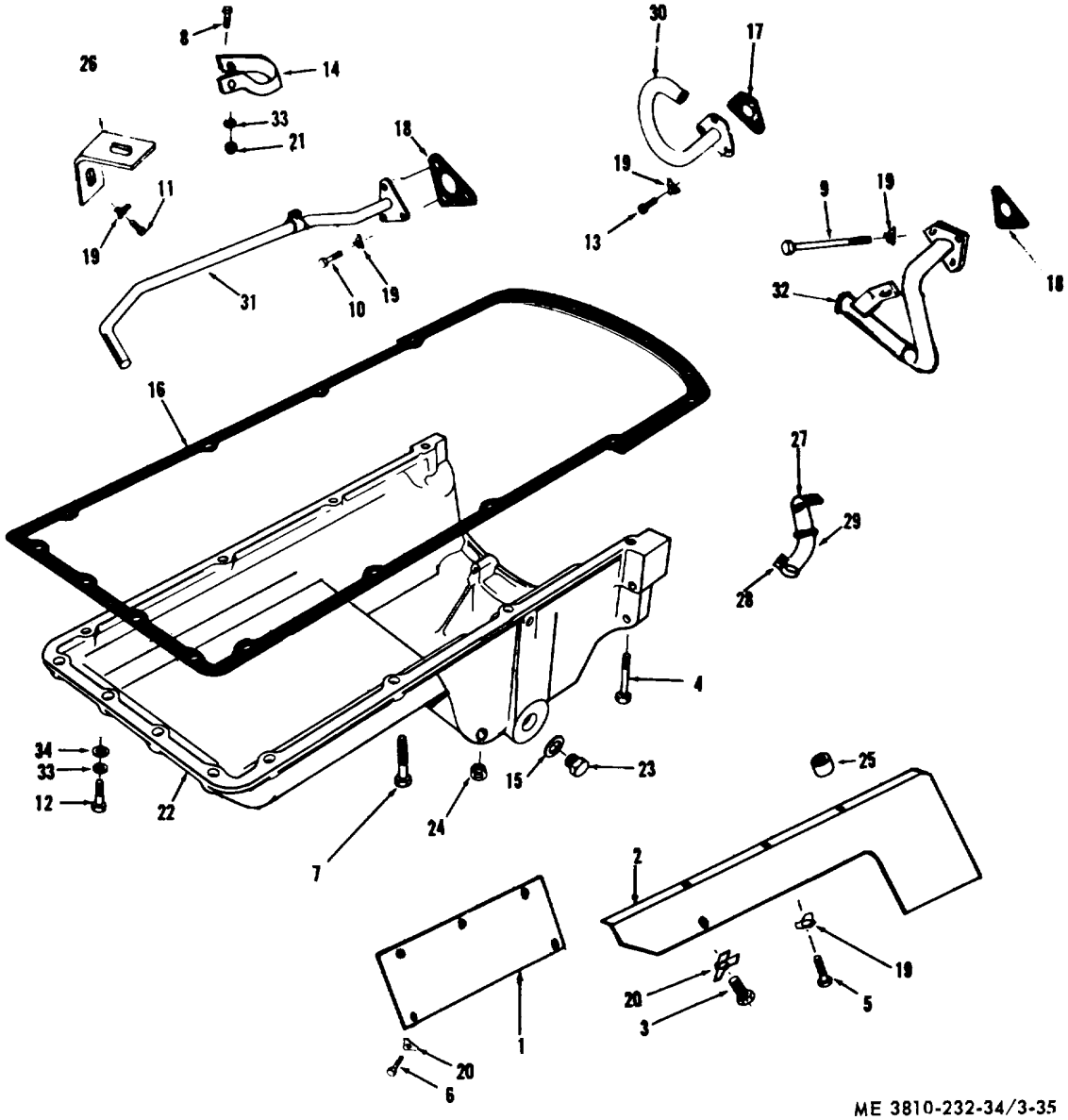
   NOTE: CARE MUST BE TAKEN TO ALIGN GASKET TO OIL PAN TO PREVENT LEAKAGE.
2. POSITION OIL PAN TO GASKET, BLOCK, AND GEAR HOUSING SPACER PLATE: MAKE SURE REAR EDGE OF PAN IS ALIGNED WITH REAR EDGE OF BLOCK.
3. INSTALL SEVERAL PAN-TO-BLOCK CAPSCREWS AND SNUG TIGHTEN TO HOLD PAN IN PLACE.
4. INSTALL CAPSCREWS THROUGH GEAR HOUSING AND SPACER PLATE INTO REAR OF PAN. SNUG-TIGHTEN ONLY.
5. TIGHTEN GEAR HOUSING-TO-PAN AND PAN-TO-BLOCK CAPSCREWS ALTERNATELY AND EVENLY TO "PULL" PAN INTO CORNER FORMED BY BLOCK AND GEAR HOUSING SPACER.

*Figure 3-34. Carrier engine oil pan assembly, removal installation*

**NOTE**

**Two bolts through oil pan and cylinder block flange at flywheel end of engine are dowel fit. Remove nuts and drive out dowel bolts with soft hammer.**

*b. Disassembly*.. Refer to figure 3-35 and disassemble oil pan assembly.




| | | | |
|---|---|---|---|
| 1 | Baffle | 18 | Gasket |
| 2 | Baffle | 19 | Lockplate |
| 3 | Capscrew | 20 | Lockplate |
| 4 | Capscrew | 21 | Nut |
| 5 | Capscrew | 22 | Pan |
| 6 | Capscrew | 23 | Plug |
| 7 | Capscrew | 24 | Plug pipe |
| 8 | Capscrew | 25 | Spacer |
| 9 | Capscrew | 26 | Support |
| 10 | Capscrew | 27 | Tube |
| 11 | Capscrew | 28 | Support |
| 12 | Capscrew | 29 | Tube |
| 13 | Capscrew | 30 | Tube & flange |
| 14 | Clamp | 31 | Tube |
| 15 | Gasket | 32 | Tube |
| 16 | Gasket | 33 | Washer |
| 17 | Gasket | 34 | Washer |

*Figure 3-35. Carrier engine oil pan assembly, exploded view.*

**3-59. Cleaning, Inspection and Repair**

a. Clean all parts with an approved cleaning solvent and dry thoroughly.

b. Inspect oil pan for cracks, breaks, and general condition. Repair or replace a defective oil pan.

c. Inspect capscrews and drain plugs for damaged threads. Replace damaged or defective parts.

**3-60. Reassembly and Installation**

*a. Reassembly*. Refer to figure 3-35 and reassemble oil pan assembly.

*b. Installation*.

(1) Install oil pan assembly as illustrated on figure 3-34.

(2) Refill with engine oil (refer to lubrication order).

**NOTE**

**Torque oil pan capscrews to 26-30 ft-lbs.**

## Section XX. CARRIER ENGINE LUBRICATING OIL PUMP

**3-61. Removal and Disassembly**

*a. Removal.*

(1) Remove oil pan assembly (para 3-58)

(2) Remove oil pump as illustrated on figure 3-36.

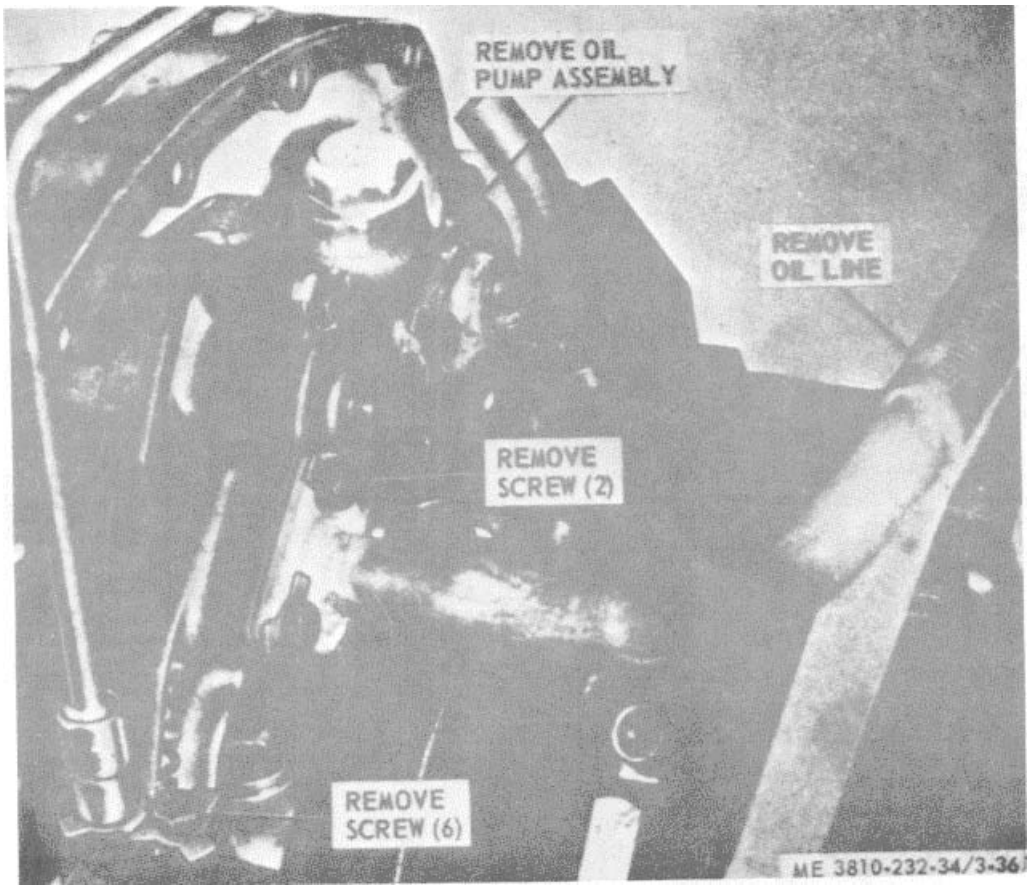
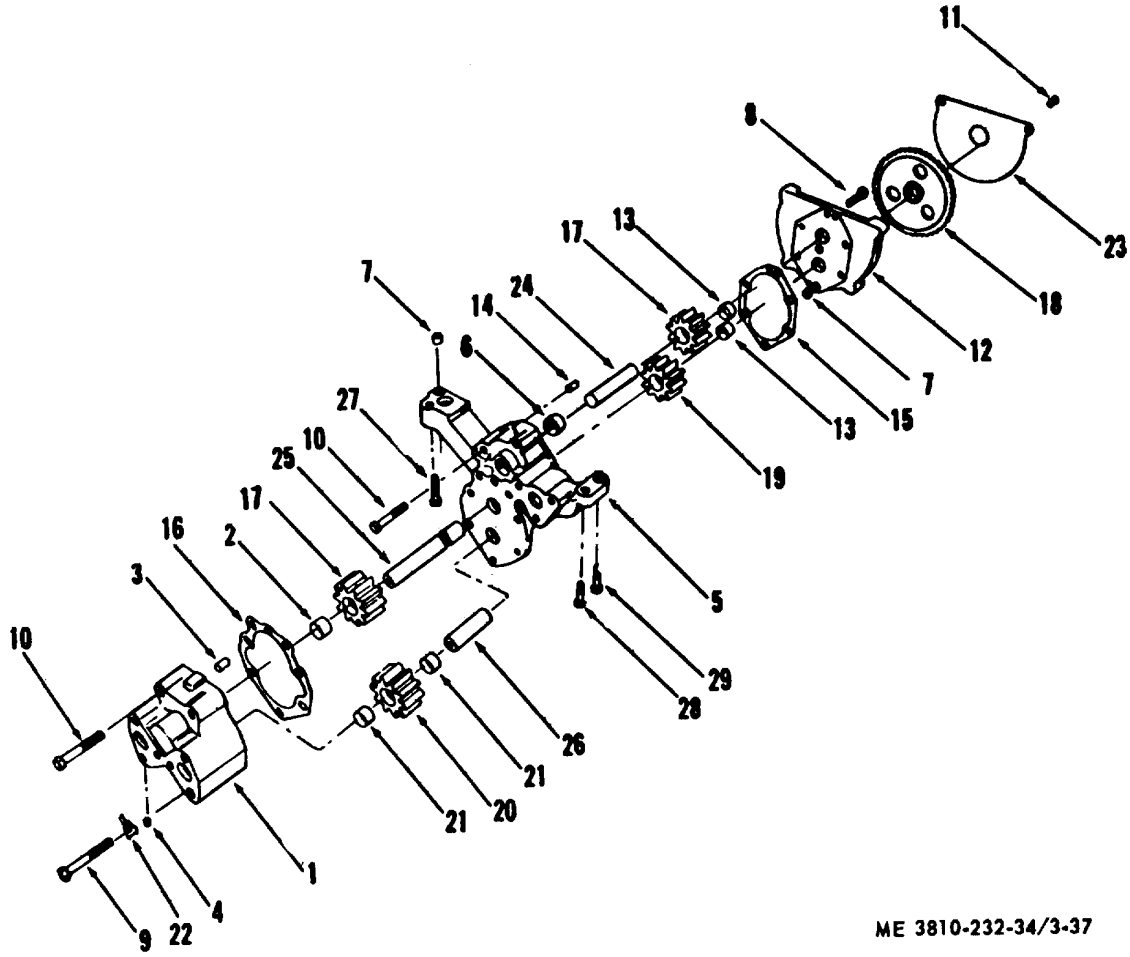



*Figure 3-36. Carrier engine lubrication oil pump, removal and installation.*

*b. Disassembly*. Refer to figure 3-37 and disassemble engine oil pump.




1 Housing
2 Bushing
3 Dowel
4 Plug
5 Housing
6 Bushing
7 Dowel
8 Capscrew
9 Capscrew
10 Capscrew
11 Capscrew
12 Cover
13 Bushing
14 Dowel
15 Gasket
16 Gasket
17 Gear
18 Gear
19 Gear
20 Gear
21 Bushing
22 Lockplate
23 Plate
24 Shaft
25 Shaft
26 Shaft
27 Capscrew
28 Capscrew
29 Capscrew

*Figure 3-37. Carrier engine lubricating oil pump assembly, exploded view.*

**NOTE**

**Pull gear from shafts and idle shaft from scavenger body only if inspection warrants.**

**3-62. Cleaning, Inspection and Repair**

a. Clean all parts in an approved cleaning solvent and dry thoroughly.

b. Inspect pump gears for cracked, scored, worn or chipped teeth and measure outside diameter of gears. Replace gear if worn smaller than 2.397 or if damaged.

c. Inspect drive shaft and idler shafts for scoring and wear. Drive shafts worn smaller than 0.874 inch outside diameter and idler shafts worn smaller than 0.875 inch must be replaced.

d. Inspect all bushings for distortion or wear. Replace if defective or worn larger than 0.8785 inch inside diameter.

e. Inspect gear pockets finished surfaces for scratches or scoring and wear. Replace if finished surfaces are damaged or pocket inside di-

ameter is worn larger than 2.4105 inches, or if depth is worn deeper than 1.252 inches.

**3-63. Reassembly and Installation**

*a. Reassembly.*

(1) Refer to figure 3-37 and reassemble the engine lubricating oil pump.

(2) If idler shaft was removed press new shaft into scavenger body until shaft protrudes 1.935,'1.965 inch from bottom surface of pocket.

(3) Press pump drive gear (with drilled oil hole) on main shaft until shaft protrudes 0.0590,'0602 inch through gear.

(4) Press scavenger pump driver gear on main shaft and maintain 0.002/0.004 inch clearance between gear and body.

(5) Press lubricating oil pump driver gear on drive shaft until drive end of shaft protrudes through gear 1.455. 1.485 inches.

(6) With convex (numbered) side of pump drive gear up, press gear onto shaft until protrudes 0.185,0.215 inch through drive gear.

(7) When pump has been completely torqued (para 1-4), check for end clearance of 0.0035/0.0075 of pump drive shaft using a dial indicator.

*b. Installation.*

(1) Install oil pump assembly as illustrated on figure 3-36.

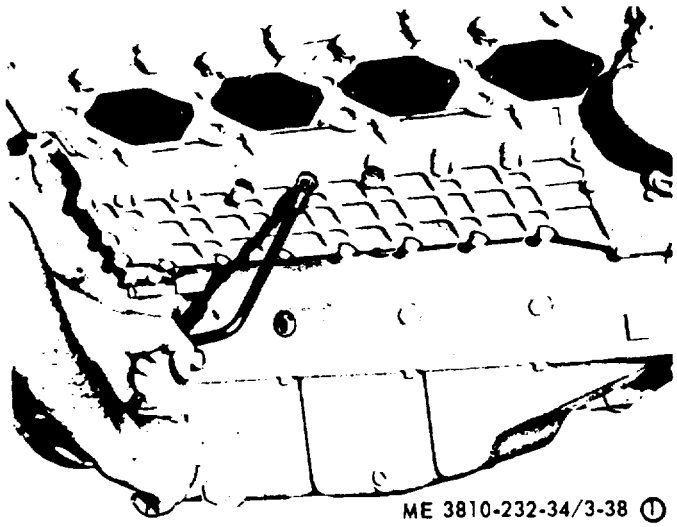
(2) Install oil pan assembly (para 3-61).

## Section XXI. CARRIER ENGINE OIL COOLER

**3-64. Removal and Disassembly**

*a. Removal*. Remove the oil cooler as illustrated in figure 3-38.

*b. Disassembly*. Disassemble the oil cooler as illustrated in figure 3-38.

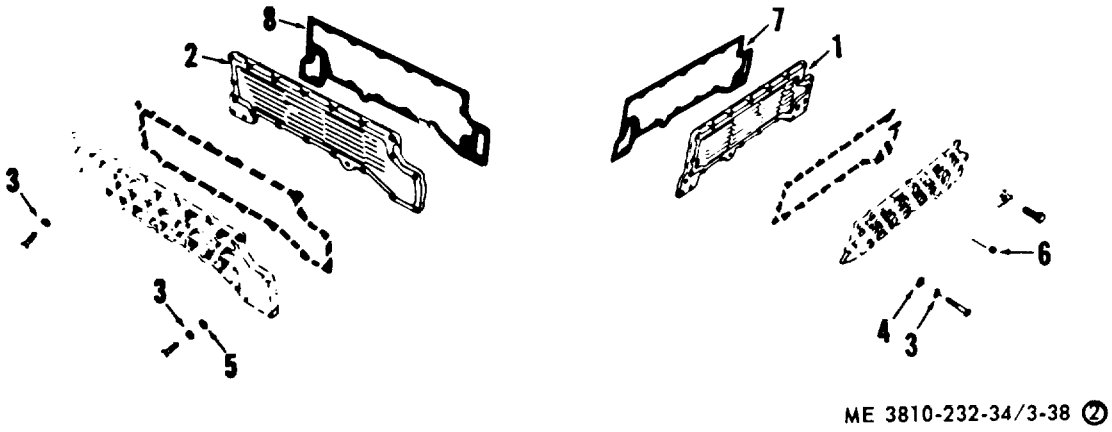



NOTE:

1. REMOVE CAPSCREWS, LOCKWASHERS AND FLATWASHERS OR LOCKPLATES SECURING COVERS AND ELEMENTS TO CYLINDER BLOCK.
2. REMOVE COVER AND ELEMENT FROM CYLINDER BLOCK.
3. SEPARATE COVERS AND ELEMENTS.
4. DISCARD ALL GASKETS AND LOCKPLATES.

A-carrier oil cooler removal and installation

*Figure 3-38. (1) Carrier engine oil cooler.*




| | | | |
|---|---|---|---|
| 1 Element | 3 Washer | 5 Washer | 7 Gasket |
| 2 Element | 4 Washer | 6 Plug | 8 Gasket |

B—Carrier engine oil cooler, disassembly and assembly.

Figure 3-38. (2) -Continued..

**3-65. Cleaning, Inspection and Repair**

a Clean all parts with an approved cleaning solvent and dry thoroughly.

b Inspect cooler housing and connectors for cracks, breaks or worn condition. Repair or replace a damaged or defective part.

**3-66. Reassembly and Installation**

Refer to figure 3-38 and proceed as follows:

a Position the cooler element with a new gasket to the side of the cylinder block.

b Hold it in place by installing the flatwashers, lockwashers and capscrews in the two holes that go through the element only.

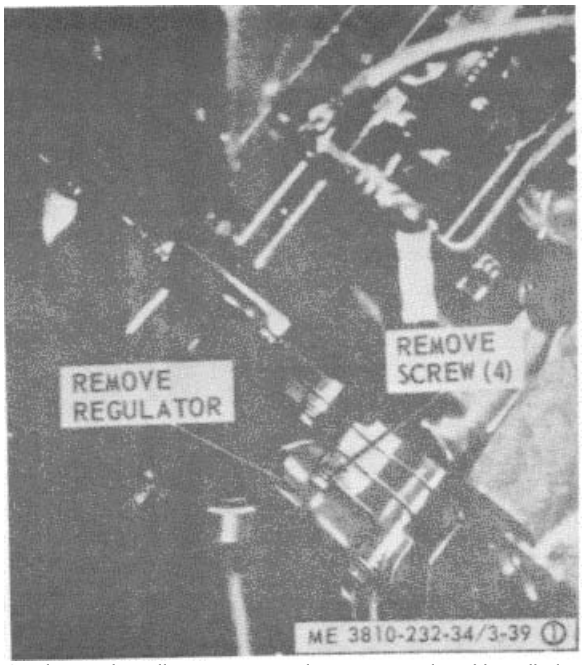
c Position the cooler cover with a new gasket to the element.

d Secure the cover with flatwashers, lockwashers and capscrews. Torque the capscrews alternately to 30 35 ft-lbs.

## Section XXII. CARRIER ENGINE OIL PRESSURE REGULATOR

3-67. Removal and Disassembly

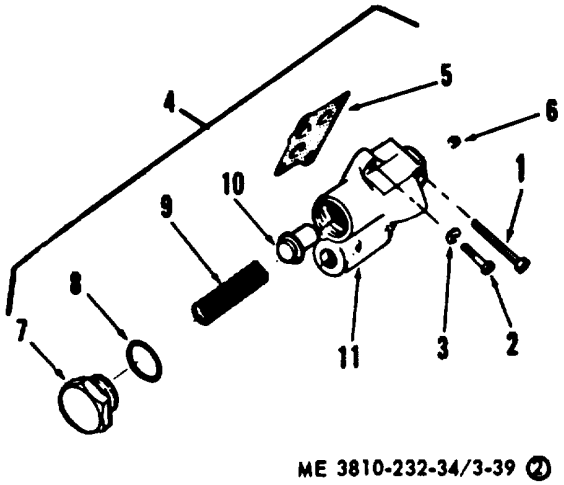
a Remove pressure regulator as illustrated on figure 3-39.




Carrier engine oil pressure regulator, removal and installation

Figure 3-39. Carrier engine pressure regulator

b. Disassembly. Disassemble pressure regulator in numerical sequence shown on figure 3-39.




B-Carrier engine oil pressure regulator. exploded view
Figure 3-39. -Continued.

1 Capscrew
2 Capscrew
3 Lockwasher
4 Regulator assembly
5 Gasket
6 Plug
7 Cup
8 Gasket
9 Spring
1 Plunger
1 Housing

**3-68. Cleaning, Inspection and Repair**

a Clean all parts with an approved cleaning solvent and dry thoroughly.

b Inspect plunger and housing bore for wear and sign of seizure. Replace defective parts as necessary.

**3-69. Reassembly and Installation**

a Reassembly. Reassemble pressure regulator in reverse of numerical sequence shown on figure 3-39.

b Installation. Install pressure regulator as illustrated figure 3-39on

## Section XXIII. CARRIER ENGINE CONNECTING ROD AND PISTON ASSEMBLIES

**3-70. Removal and Disassembly**

a. Remove cylinder head assemblies (para 3-47).
b. Remove oil pan (para 3-58).
c. Scrape all carbon from top of cylinder liners.
d. Refer to figure 3-40 and remove connecting rod bolt nuts and knock bolts from cap and rod. Remove caps and mark to assure replacement on rod from which removed.

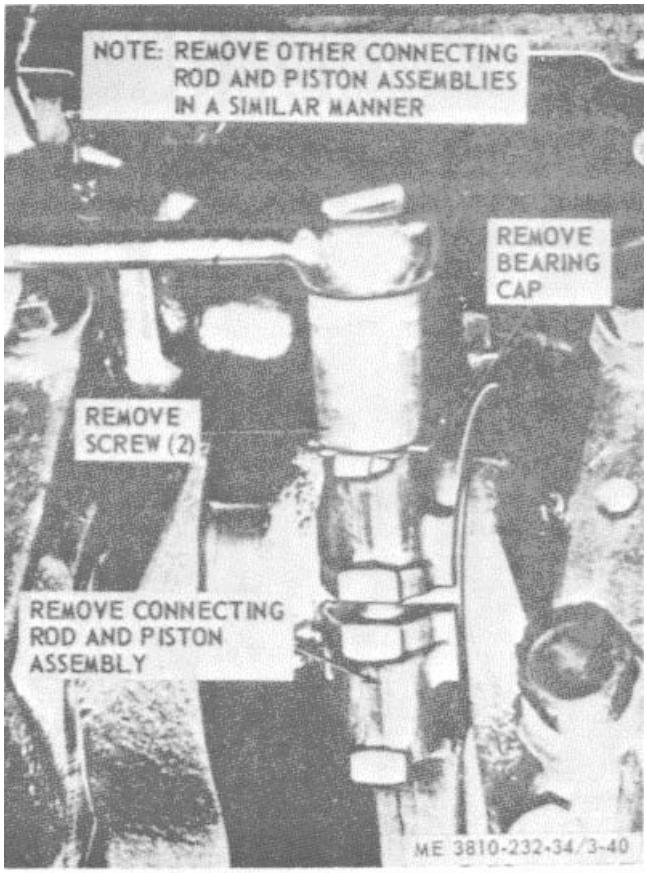



Figure 3-40. Carrier engine connecting rod and piston assemblies, removal and installation.

**CAUTION**

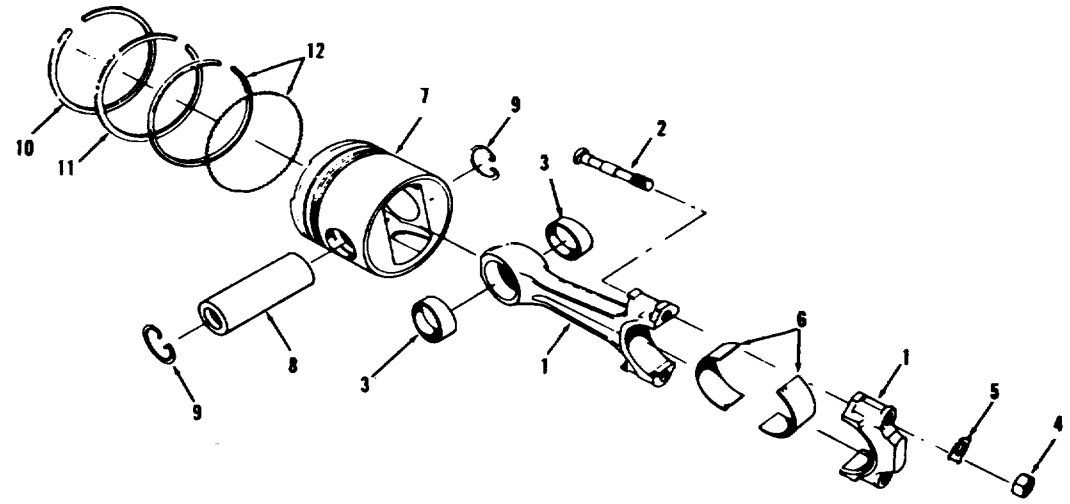
Failure to remove bolts may permit bolt head to catch on bottom of cylinder liner before all rings clear liner and cause piston to lock in liner.

e Use a wooden stick and push piston and connecting rod assembly out top of cylinder liner.

f. Reassemble connecting rod bolts, caps and nuts as they are removed. Bearing caps are not interchangeable.

g Tape bearing halves together and identify by cylinder number as they are removed.

h. Refer to figure 3-41 and remove piston snap rings from pistons.




| | | | | | |
|---|---|---|---|---|---|
| 1 | Rod | 5 | Lockplate | 9 | Ring |
| 2 | Bolt | 6 | Bearing | 10 | Ring |
| 3 | Bushing | 7 | Piston | 11 | Ring |
| 4 | Nut | 8 | Pin | 12 | Ring |

*Figure 3-41. Carrier engine connecting rod, and piston assemblies, exploded view.*

i Heat aluminum pistons in hot water to expand pin bores. Push pin from piston by thumb pressure.

**CAUTION**

Driving pins from piston will distort bore and. necessitate discarding piston.

**3-71. Cleaning and Inspection**

a Clean all parts with an approved cleaning solvent and dry thoroughly.

b Check connecting rods, caps and bolts by magnetic inspection for cracks. If cracks are detected replace rod and cap as an assembly.

c Check connecting rod piston pin bushing diameter to see that it is within tolerance limits (table 1-1).

d Check connecting rod alignment. (Refer to table 1-1 for tolerance and wear limits).

e Inspect connecting rod bolts and bolt holes to see that bolt heads rest squarely on milled surfaces of rod. Discard all bolts and nuts that have distorted threads.

f Check the piston for piston ring groove clearance. Hold new ring flush with piston land and insert 0.006 inch feeler gage. If gage enters groove, wear is excessive and piston mtust be replaced.

g Check piston ring gap by inserting each compression ring in mating cylinder liner seating it squarely with a piston head in an unworn surface of liner.

h Measure ring gap with feeler gage. (Refer to table 1-1 for allowable tolerances).

i If necessary file ends of the rings to obtain minimum ring gap.

**CAUTION**
**Never file chrome plated piston rings.**

j Check piston skirt diameter with micrometers at right angles to piston Din bore. (Refer to Table 1-1 for allowable wear limits and tolerances).

k Check piston pin bore and piston pin outside diameter. (Refer to Table 1-1 for allowable tolerances).

l Replace all damaged or defective parts as necessary. Always replace connecting rod bearings as matched sets.

### 3-72. Reassembly and Installation

a Refer to figure 3-41 and assemble connecting rod and piston assemblies as shown.

b Install connecting rod and piston assemblies being sure to lubricate piston and rings with clean lubricating oil, before installation.

c Install piston and rod assembly in cylinder positioned so numbered side of rod is toward outside of block.

**CAUTION**
**Pistons are marked to indicate which side is to be assembled to the "out" exhaust side.**

d Install rod cap over blots so that numbered side of cap is matched with numbered side of rod. Lubricate bolt and nut threads.

**NOTE**
**Always coat both units of connecting rod bearing shells with an approved lubricant before installing.**

e Install lockplate and nuts on bolts and tighten nuts as outlined below:

(1) Tighten both nuts to 55-60 ft-lbs.
(2) Tighten both nuts to 105-115 ft-lbs.
(3) Loosen both nuts completely to remove all tension.
(4) Tighten both nuts 30-32 ft-lbs.
(5) Tighten both nuts to 60-65 ft-lbs.
(6) Advance the nuts 60° in 30° increments

f Install next piston and rod assembly opposite the one just installed. Secure rod to same crankshaft journal. Install remaining assemblies in similar manner.

g Check tightened connecting rods to see that they are free to move sideways on crank journal. Check with hand pressure first; tap lightly with soft hammer only if necessary.

h Push rods apart; check for 0.008/0.016 inch clearance between rods with feeler gauge as shown in figure 3-42.

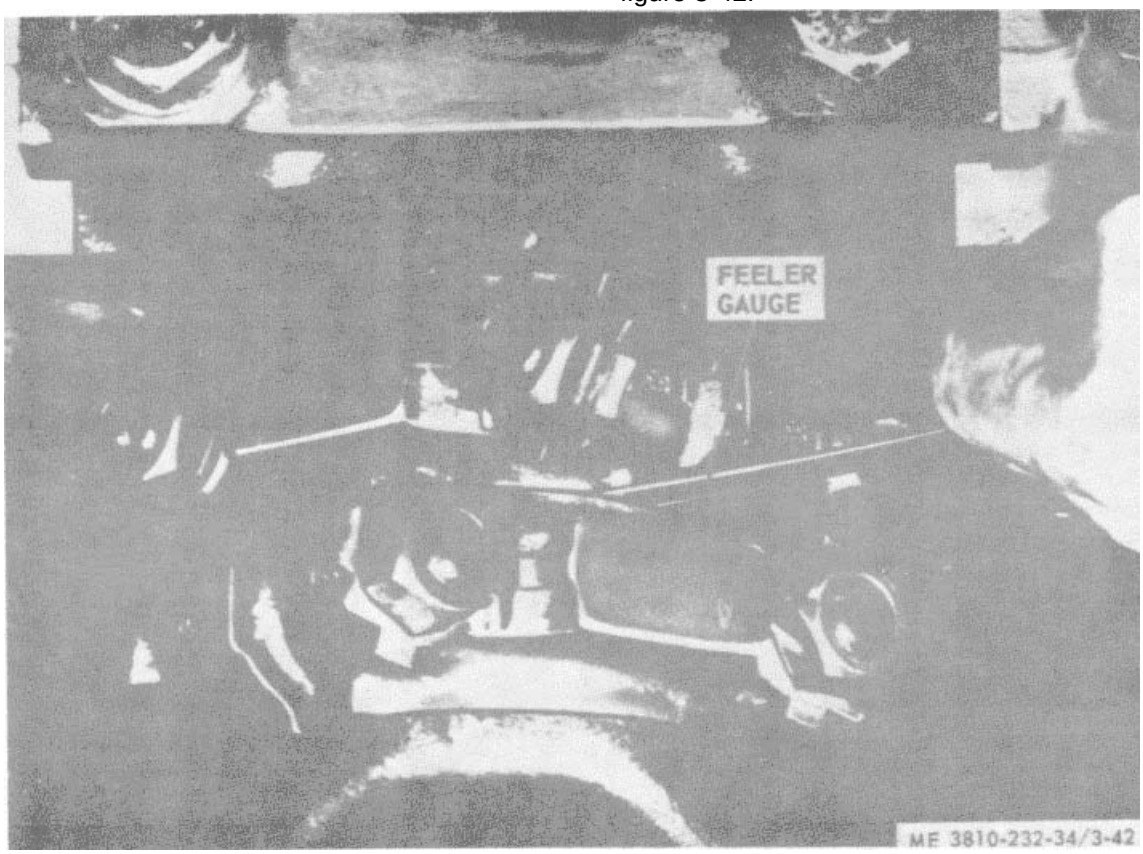



*Figure 3-42. Checking rod side clearance.*

i Bend tangs on lock plates to secure nuts.
j Install oil pan (para 3-60).
k Install cylinder head assemblies (para 3-49).

**3-73. Removal and Disassembly**

a. Remove engine assembly (para 3-10).

b. Remove connecting rod and piston assemblies (para 3-69).

c. Remove flywheel and housing (para 3-53).

d. Remove gear housing and camshaft (para 3-55).

e. Refer to figure 3-43 and 3-44 and remove crankshaft and main bearings. Tape bearing shell inserts together and mark with number corresponding to main bearing cap.

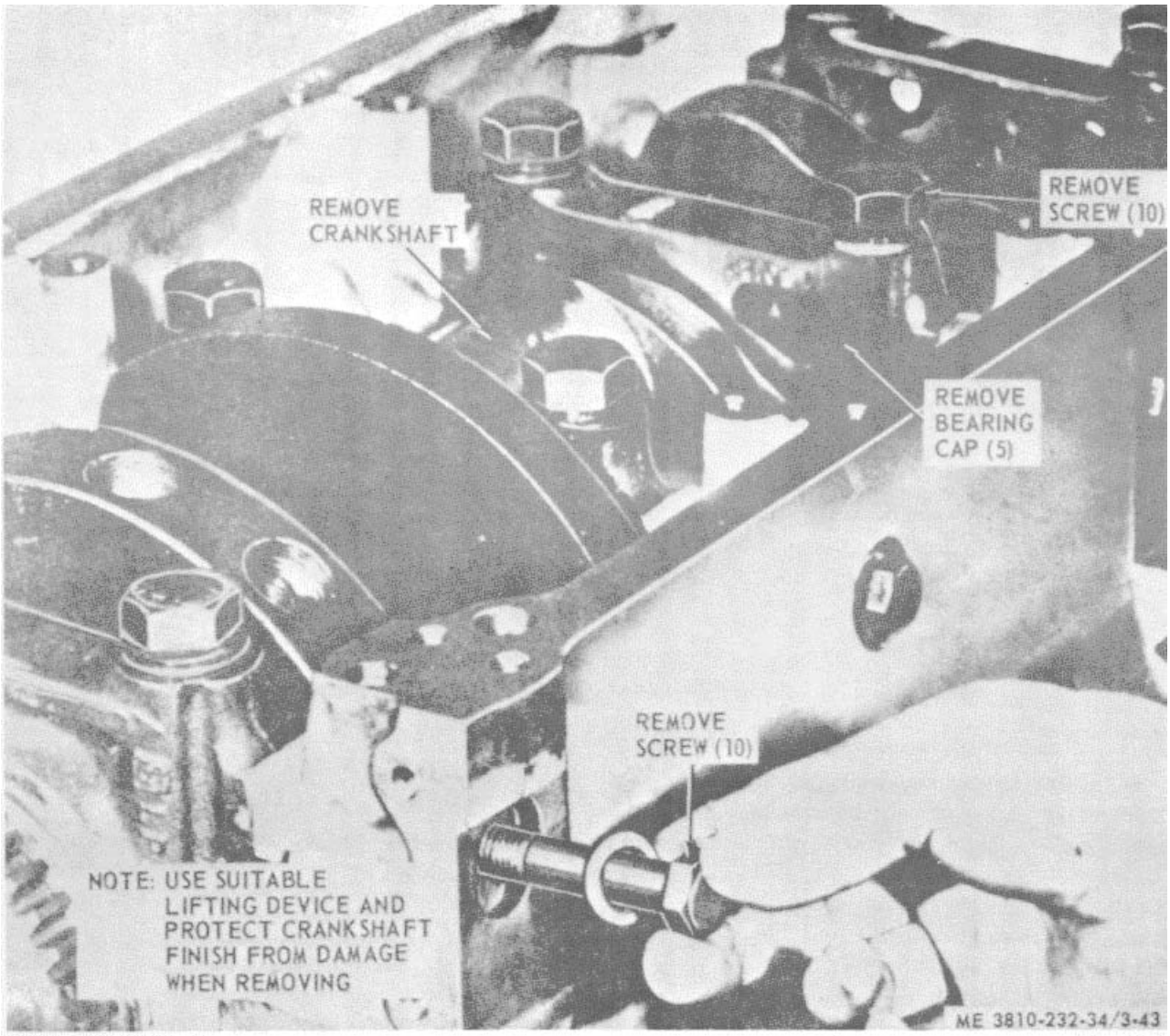
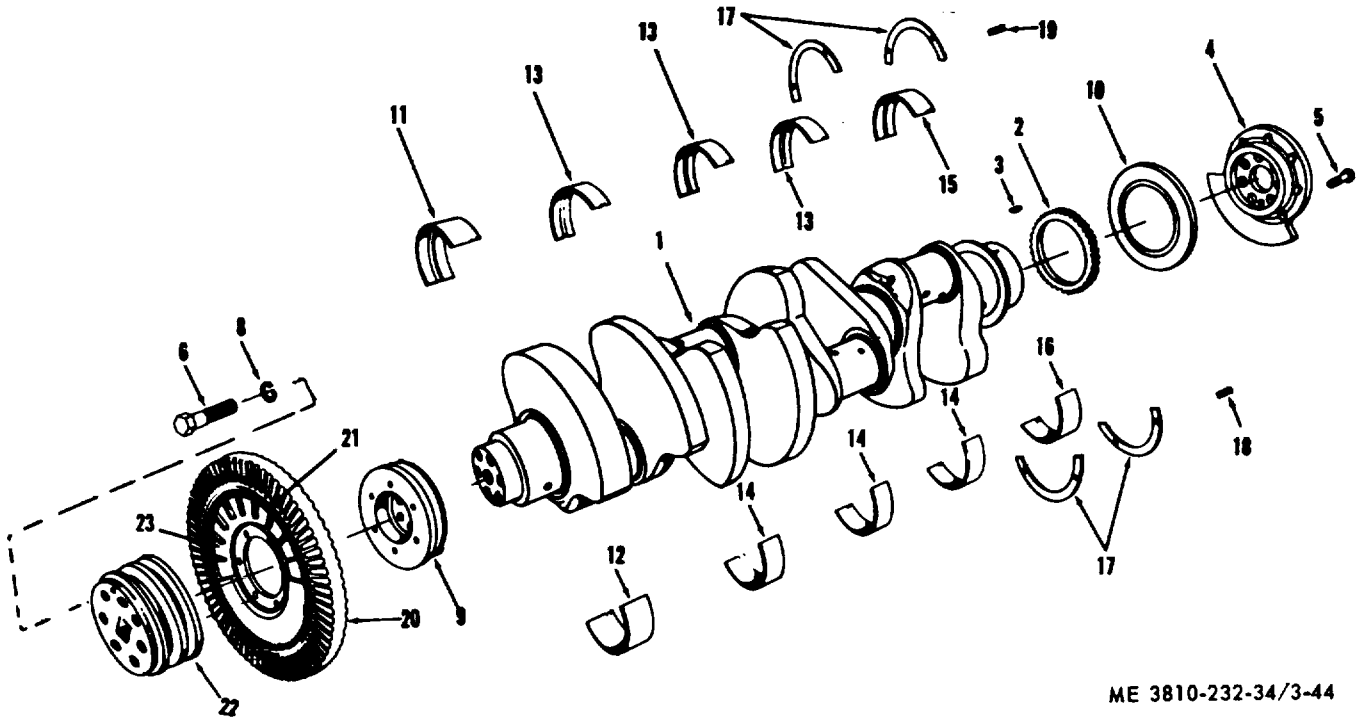



*Figure 3-43. Carrier engine crankshaft and main bearing, removal and installation.*




| | | | |
|---|---|---|---|
| 1 | Crankshaft | 12 | Bearing |
| 2 | Gear | 13 | Bearing |
| 3 | Key | 14 | Bearing |
| 4 | Adapter | 15 | Bearing |
| 5 | Bolt | 16 | Ring |
| 6 | Screw | 17 | Pin |
| 7 | Washer | 18 | Pin |
| 8 | Pulley | 19 | Damper |
| 9 | Slinger | 20 | Elastic |
| 10 | Bearing | 21 | Pulley |
| 11 | Bearing | 22 | Hub |

*Figure 3-44. Carrier engine crankshaft and main bearing, exploded view*

**3-74. Reassembly and Installation**

a Refer to figures 3-43 and 3-44 and install crankshaft and main bearings. Coat main bearing shells thoroughly with an approved high pressure grease. Install all pipe plugs and torque to 5 ft-lbs. Stake plugs by making a 1,/'64 inch indentation at outside diameter of threads with center punch.

b Install main bearing caps so that numbers stamped on cap correspond with numbers stamped on block. Main bearing caps are not interchangeable.

c Lubricate threads of capscrews, lockplates, and shoulders of capscrews head with clean lubrication oil. Threads and lockplates must be completely covered with an oil film and must not be damaged in any manner.

d Start each capscrew and set caps in position by alternately tightening capscrews.

**CAUTION**

**Driving main bearing caps into position can dislodge lower bearing half.**

e Tighten main bearing capscrews as outlined below:

(1) Tighten both capscrews on each cap alternately to 150-160 ft-lbs.

(2) Tighten both capscrews on each cap alternately to 340-350 ft-lbs.

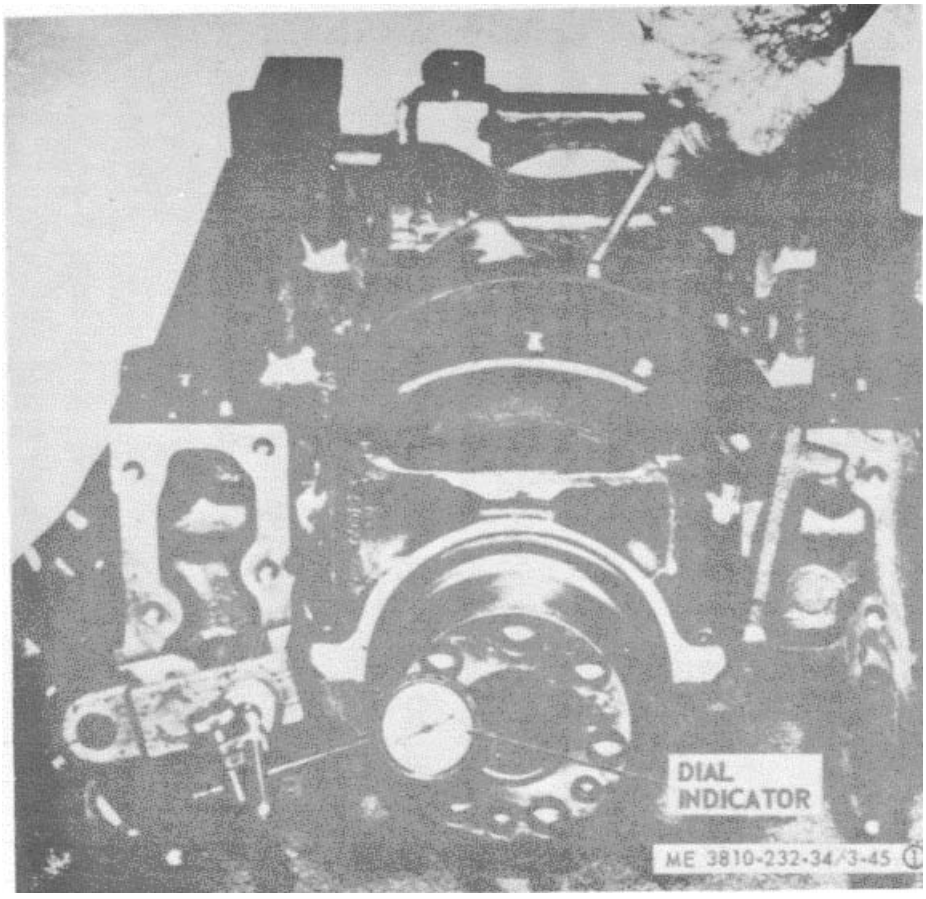
(3) Loosen both capscrews to removal all tension.

(4) Tighten both capscrews on each cap alternately to 85-90 ft-lbs.

(5) Tighten both capscrews on each cap alternately to 170-180 ft-lbs.

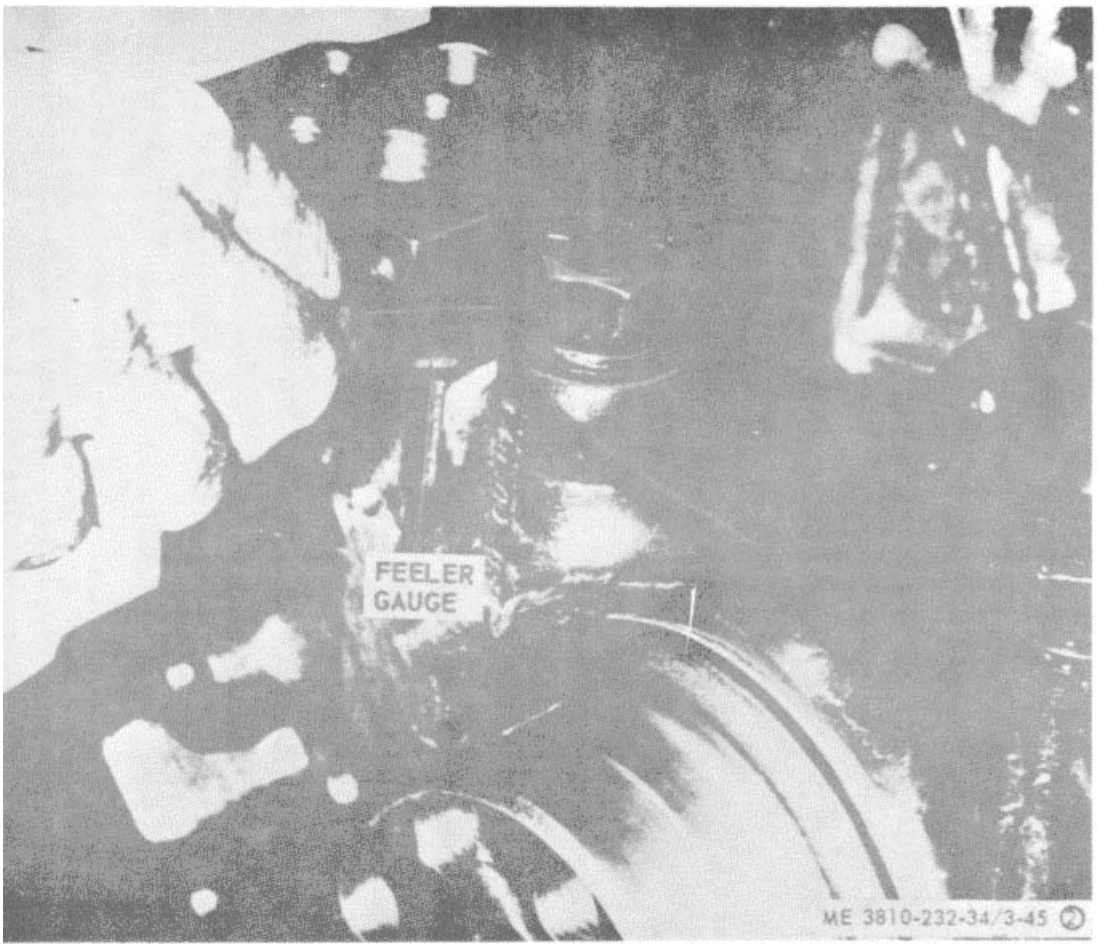
(6) Scribe each cap in line with corner hex of each capscrew, then advance all capscrews 60° in 30° increments.

f Check crankshaft end clearance (fig. 3-45) by barring crankshaft toward front and rear Total gauge reading should be 0.005 0.015 inch. '__




A-Checking crankshaft and clearance.

*Figure 3-45. (1) Carrier engine crankshaft and main bearing clearances.*




B-Checking main bearing cap to block clearance

*Figure 3-45. (2) --Continued.*

g Check clearance between main bearing cap and block at side bolt contact area on each side of cap as shown on figure 3-45. Clearance must be 0.015,10.0035 inch.

h Lubricate threads and install main bearing cap side bolts and washers.

i Tighten side bolts to 70-75 ft-lbs in 35-40 ft-lbs increments using a sequence on figure 3-46.

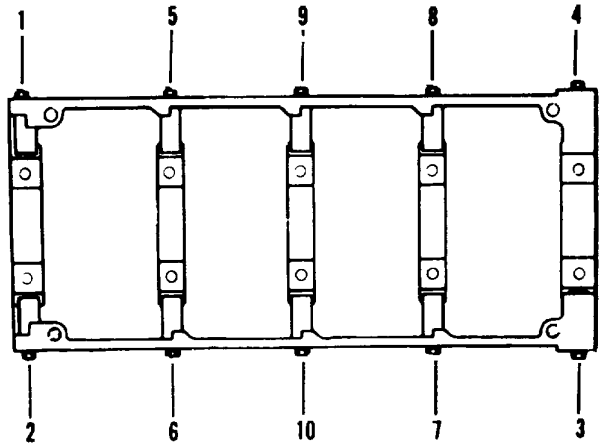



*Figure 3-46. Carrier engine main bearing side bolt tightening sequence.*

j Bend tangs on all lockplates to secure bolts.
k Install gear housing and camshaft (para 3-57).
l Install flywheel and housing (para 3-54).
m Install connecting rod and piston assemblies (para 3-71).
n Install engine assembly (para 2-10).

# CHAPTER 4

# CRANE ENGINE REPAIR INSTRUCTIONS

## Section I. CRANE ENGINE GENERATOR

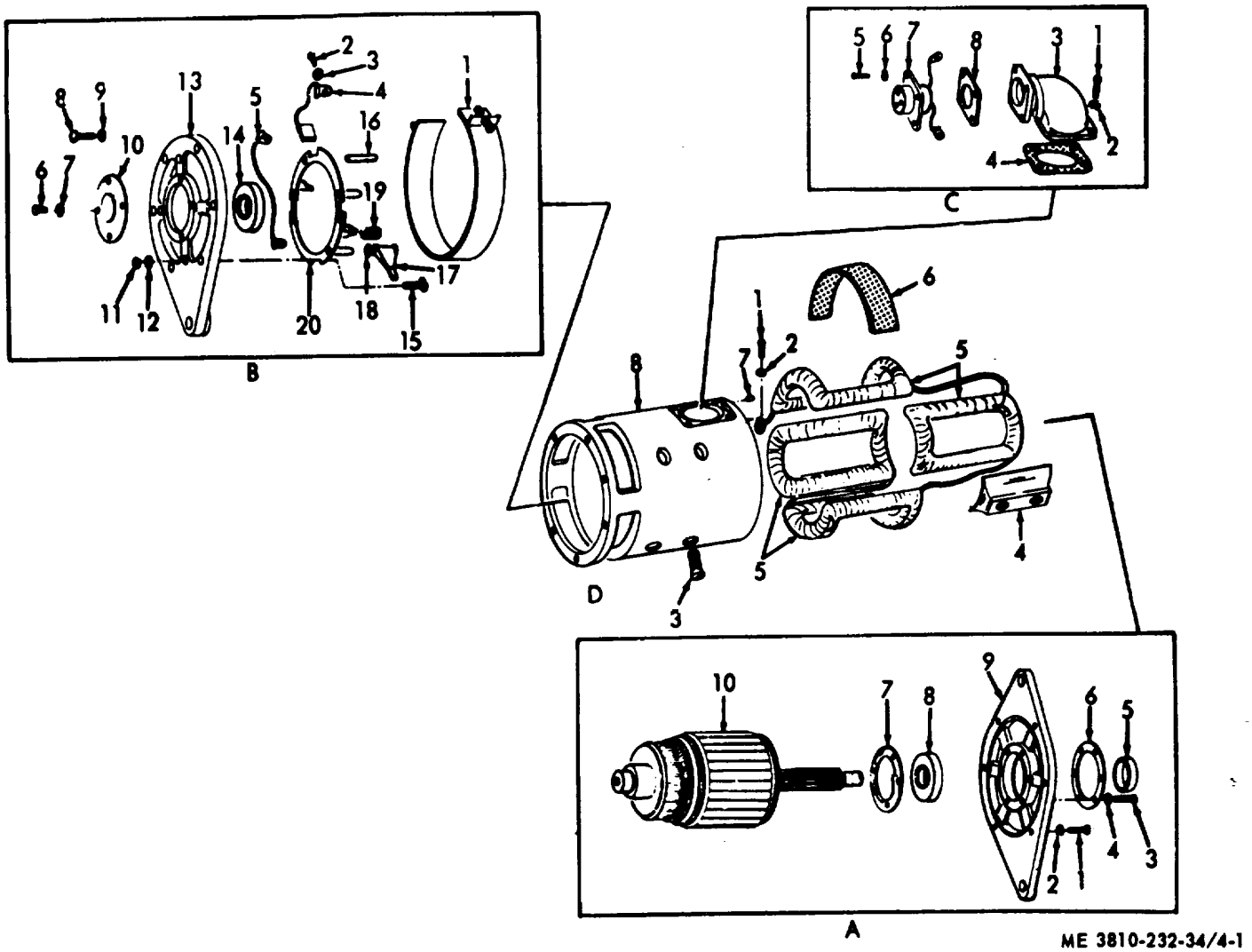
### 4-1. General

The generator is a 24-volt type, V-belt driven from the engine crankshaft and supplies electrical energy to recharge the batteries to make up for cranking and other power supplied by the batteries while the generator is not in operation.

### 4-2. Removal and Disassembly

a Removal. Refer to TM -3810-232-12.

b Disassembly. Disassemble the generator in the numerical sequence as illustrated on figure 4-1.




1 Screw, cap
2 Washer, lock
3 Screw
4 Washer, lock
5 Collar
6 Retaining plate, external
7 Retaining plate, internal
8 Bearing, sealed
9 Drive end frame

A—Armature and drive end frame

1 Screw
2 Washer, lock
3 Elbow
4 Gasket
5 Screw
6 Washer, lock
7 Terminal receptacle
8 Spacer block

C—Outlet receptacle

1 Cover band assembly
2 Screw
3 Washer, lock
4 Brush
5 Lead assembly
6 Screw
7 Washer, lock
8 Screw, cap
9 End cover plate
11 Nut
12 Washer, lock
13 Commutator end plate
14 Bearing, sealed
15 Screw, special
16 Dowel pin
17 Brush arm
18 Spacer washer
20 Brush plate assembly

B—Commutator end frame and brushes

1 Screw
2 Washer, lock
3 Pole shoe screw
4 Pole shoe
5 Field coil
6 Insulation band
7 Dowel pin
8 Field coil frame

D—Field coils, field coil frame, and pole shoes

*Figure 4-1. Crane engine generator assembly, exploded view.*

**4-3. Cleaning, inspection and Repair**

a Clean all metal parts with an approved cleaning solvent and dry thoroughly.

b Remove all dust, dirt and foreign matter from the frame and fields with compressed air.

c Inspect all parts for excessive wear or damage. Repair or replace defective parts.

**4-4.Reassembly and Installation**

a Reassernbly. Reassemble the generator in reverse of the numerical sequence as illustrated on figure 4-1.

b Installation. Refer to TM 5-3810-232-12.

## Section II. CRANE GENERATOR REGULATOR

**4-5. Removal**

Remove the crane engine generator regulator as described in paragraph 3-5.

**4-6. Adjustment**

Adjust regulator as described in paragraph 3-6.

**4-7. Installation**

Install the regulator as described in paragraph 3-7.

## Section III. CRANE ENGINE STARTING MOTOR

**4-8. General**

The starter is a 24-volt, 4-brush, gear drive type. The starter converts the electrical energy of the batteries into the mechanical energy necessary to crank the engine.

**4-9. Removal and Disassembly**

a Removal. Refer to TM 5-3810-232-12.

b Disassernmbly. Refer to figure 4-2 and disassemble the starting motor assembly.

NOTE

Do not disassemble the relay solenoid as this is a replace item only.

1 Cover
2 Washer, felt
3 Bearing
4 Head assembly, C.E.
5 Lead assembly
6 Insulation
7 Collar
8 Snap ring
9 Sleeve
10 Spring
11 Thrust, washer
12 Washer
13 Screw, 10-32 x 13/16
14 Lockwasher, 3/8
15 Nut, 10-32
16 Lockwasher, #10
17 Washer #10
18 Cover, switch
19 Stud, 3/8-16
20 Gasket
21 Spring
22 Contact disc
23 Housing
24 Bearing
25 Clutch
26 Bushing
27 Snap ring
28 Thrust washer, D.E.
29 Bearing
30 Armature
31 Screw, 10-32 x 1
32 Frame
33 Field coil
34 Pole shoe
35 Screw
36 Brush plate
37 Screw, 8-32 x 3/8
38 Brush set
39 Screw, 8-32 x 5/16
40 Insulator bushing
41 Insulator washer
42 Lockwasher, 3/8
43 Nut, 3/8-16
44 Screw, 10-32 x 5/8

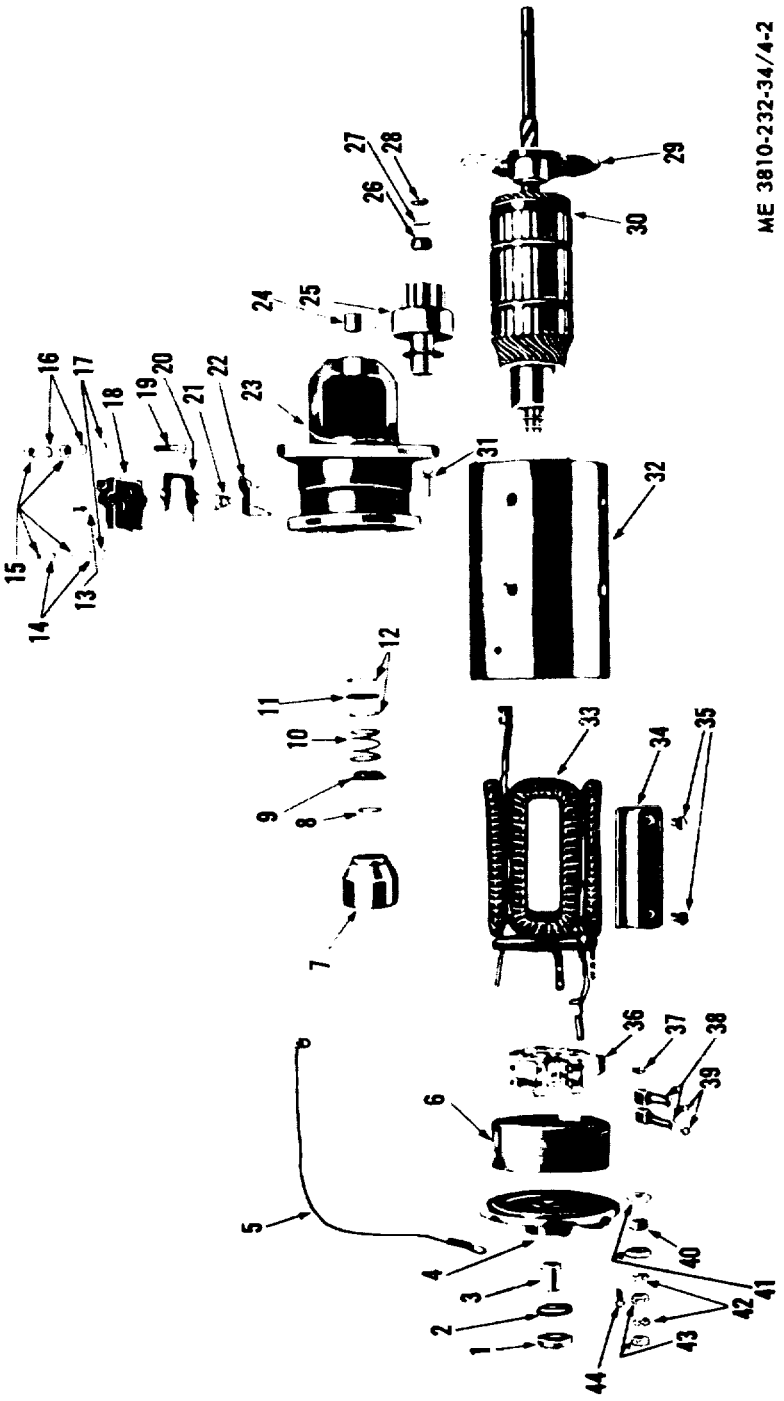



*Figure 4-2. Crane engine starting motor assembly, exploded view.*

**4-10. Cleaning, Inspection and Repair**

a Clean all metal parts with an approved cleaning solvent and dry thoroughly.

b Remove all dust, dirt, and foreign matter from the frame and fields using compressed air.

c Inspect all parts for excessive wear or other damage. Repair or replace all defective parts.

d Refer to TM 5-764 for armature and field coil tests.

**4-11. Reassembly and Installation**

a Reassembly. Refer to figure 4-2 and reassemble the starting motor assembly.

b Installation. Refer to TM 5-3810-232-12.

## Section IV. CRANE BATTERY CASE ASSEMBLY

**4-12. Removal**

Remove the battery case. (TM 5-3810-232-12).

**4-13. Cleaning, Inspection and Repair**

a Clean all parts with an approved cleaning solvent and dry thoroughly.

b Inspect all parts for defects or damage. Repair all defective parts.

**4-14. Installation**

Install the battery case. (TM 5-3810-232-12).

## Section V. CRANE WIRING HARNESS

**4-15. General**

The wiring harness covered in this section include all wiring harness assemblies used in the crane assembly. Wire size and length of wire are given in TM 5-3810-232-35P.

**4-16. Removal**

a Tag and disconnect all electrical leads.

b Tag and disconnect all electrical connectors.

c Disconnect all clamps and straps, noting location.

d. Remove wiring harness.

**4-17. Repair**

Repair defective wires in wiring harness.

**4-18. Installation**

a Note tags and connect all electrical leads and connectors.

b Connect all clamps and straps.

## Section VI. CRANE ENGINE FUELPUMP AND GOVERNOR ASSEMBLY

**4-19. General**

The fuel pump assembly incorporates the governor assembly and is flange mounted to the engine gear case and is driven from the engine gear train. The fuel pump draws fuel from the supply tank and delivers it at correct pressure and amount to the injectors for each cylinder.

**4-20. Removal and Disassembly**

a Removal. Remove the fuel pump as illustrated in figure 4-3.

b Disassembly. Refer to figure 4-4 and d the fuel pump assembly.

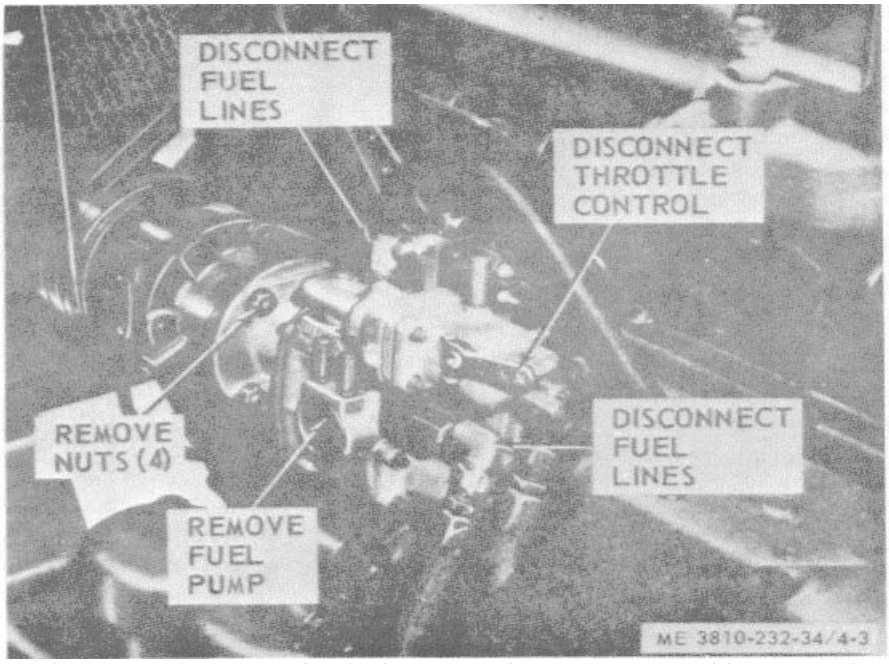



*Figure 4-3. Crane engine fuel pump and governor assembly -removal.*

Key to fig 4-4

1 Cap
2 Housing
3 Capscrew
4 Gasket
5 Seal
6 Shaft
7 Bushing
8 Gear
9 Plug
10 Seal
11 Housing
12 Seal
13 Capscrew
14 Screen
15 Clip
16 Washer
17 Nut
IS Screw
19 Cap
20 Seal
21 Screen
22 Spring
23 Seal
24 Lockwasher
25 Cap
26 Shaft
27 Wile
28 Weight
29 Barrel
30 Bracket
31 Capscrew
32 Clip
33 Lockwasher
34 Nut
35 Seal
36 Capscrew
37 Washer
38 Plate
39 Seal
40 Diaphragm
41 Seal
42 Capscrew
43 Plate
44 Carrier
45 Capscrew
46 Capscrew
47 Housing
48 Gasket
49 Guide
50 Gear
51 Shaft
52 Shaft
53 Cover
54 Bushing
55 Dowel
56 Gasket
57 Plate
58 Screw
59 Plunger
60 Spring
61 Washer
62 Guide & clip display
63 Screw
64 Spring
65 Shim
6)6 Retainer
67 Ring
68 Gasket
69 Cover
70 Capscrew
71 Plug
72 Capscrew
73 Wire
74 Seal
75 Adapter
76 Clip
77 Ring
78 Cover
79 Spacer
80 Shaft
81 Pin
82 Seal
83 Barrel
84 Sleeve
85 Sleeve
86 Pipe
87 Plug
88 Housing
89 Barrel assy
90 Spring
91 Shim
92 Plunger
93 Pin
94 Spacer
95 Washer
96 Driver
97 Plunger
98 Shim
99 Spring
100 Pin
101 Shaft
102 Weight
103 Clip
104 Carrier assy
105 Gear
106 Bushing
107 Ring
108 Dowel
109 Gasket
110 Bushing
111 Dowel
112 Gear
113 Gear
114 Ring
115 Bearing
116 Shaft
117 Lockwasher
118 Key
119 Cover
120 Capscrew
121 Washer
122 Lockwasher
123 Capscrew
124 Ring
125 Plug
126 Adapter
127 Elbow
128 Seal
129 Coupling
130 Washer
131 1Lockwasher
132 Capscrew
133 Nut
134 Washer
135 Nut
136 Screw
137 Capscrew
138 Washer
139 Lockwasher
140 Bushing
141 Stop
142 Screw set
143 Seal
144 Shaft
145 Pin
146 Lever
147 Screw
148 Block
149 Washer
150 Capscrew
151 Lockwasher
152 Nut
153 Cover
154 Gasket
155 Plate
156 Seal
157 Shim
158 Plunger
159 Shim
160 Spring
161 Ring
162 Shim
163 Housing
164 Retainer
165 Spring
166 Plunger
167 Ring
1;8 Plunger
169 Housing
170 Ring
171 Ring
172 Coupling
173 Gasket
174 Nut
175 Ring
176 Screw
177 Washer
178 Washer
179 Plate


*Figure 4-4. Crane engine fuel pump and governor assembly, exploded view.*

**4-21. Cleaning, Inspection and Repair**

a Clean all parts with an approved cleaning solvent and dry thoroughly.

b. Inspect pump shaft and gears for wear or scoring. Replace defective or damaged parts. See table 1-1 for allowable wear limits.

c. Inspect gear body and cover for scoring or excessive wear. See table 1-1 for allowable wear limits.

**NOTE**

**If shaft bore is scored 1/3 of circumference or more in cover or body, replace. If scored less than 11/ clean up and reuse part in current bearings less gear pumps.**

**4-22. Reassembly and Installation**

a. Reassembly. Refer to figure 4-3 and reassemble the fuel pump and governor assembly.

NOTE

Total gear backlash must be 0.001/0.004 inch. The drive shaft must protrude 2.370/2.412 inch from the body. Each clearance should not exceed 0.015 inch nor be less than 0.009 inch. If pump binds or has excessive play, check error in assembly which must be corrected to prevent early pump failure.

b. Installation. Refer to figure 4-3 and install the fuel pump and governor assembly.

c. Governor Adjustment. Adjust governor (TM 5-3810-232-12).

## Section VII. CRANE FUEL TANK ASSEMBLY

**4-23. Removal**

Remove the fuel tank (TM 5-810-232-12).

**4-24. Repair**

Repair or weld any cracks, breaks or leaks.

**WARNING**

**Weld only after all fumes are removed. Steam the interior of the tank with live steam for at least 8 hours before welding.** Refer to TM 9-237 for safety precautions for welding containers that have held combustibles.

**4-25. Gaskets**

Replace all gaskets in the fuel tank with new gaskets.

**4-26. Installation**

Install fuel tank. Refer to TM 5-3810-232-12.

## Section VIII. CRANE RADIOTOR ASSEMBLY

**4-27. General**

The radiator assembly is a one piece core unit mounted on the front engine support. Coolant is circulated from the coolant pump to the radiator where it is cooled, and then recalculated through the coolant passages.

**4-28. Removal**

a. Remove radiator hoses (TM 53810-232-12).

b. Remove radiator (TM 5-3810-232-12).

**4-29. Cleaning, Inspection and Repair**

a. Flush the inside of the radiator with an approved cleaning solvent. Avoid high pressure so as not to damage the radiator core.

b. Clean the radiator core with compressed air or water under pressure from the fan side of the core. Clean the overflow line with compressed air.

c. Plug all openings in the radiator and insert air hose in the radiator outlet pipe and caulk around the base.

d. Immerse the radiator in water and apply 12 to 15 psi air pressure. Watch for signs of air bubbles

e. Remove the radiator from the water and disconnect air hose. Repair or replace a damaged or defective radiator.

**4-30. Installation**

a. Install radiator (TM 5-3810-232-12).

b. Install radiator hoses (TM 5-3810-232-12)

## Section IX. CRANE ENGINE FAN ASSEMBLY

**4-31. Removal**

Remove the fan assembly (TM 5-3810-232-12).

**4-32. Repair**

Replace a damaged fan. Only minor blade damage is considered repairable.

**4-33. Installation**

Install the fan assembly (TM 5-3810-232-12).

## Section X. CRANE ENGINE WATER PUMP ASSEMBLY

**4-34. Removal and Disassembly**

a. .Removal

(1) Drain cooling system.

(2) Remove water pump drive belt (TM SM810-282-12).

(8) Remove water pump as instructed on figure 4-5).

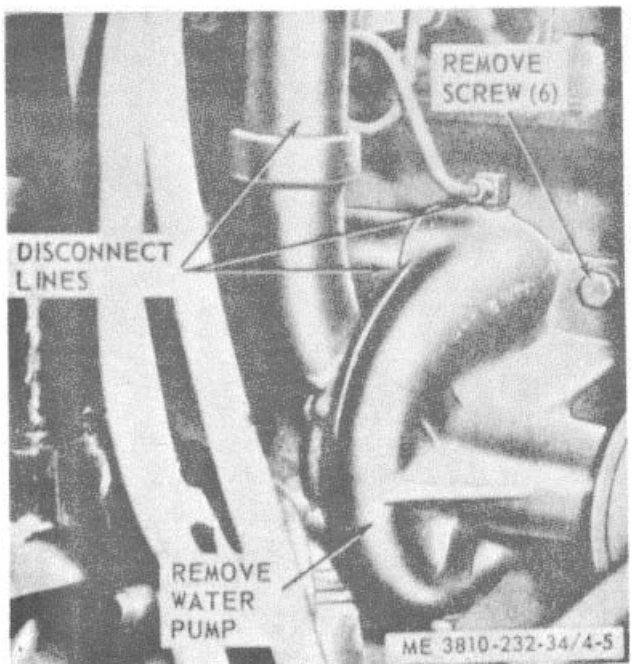
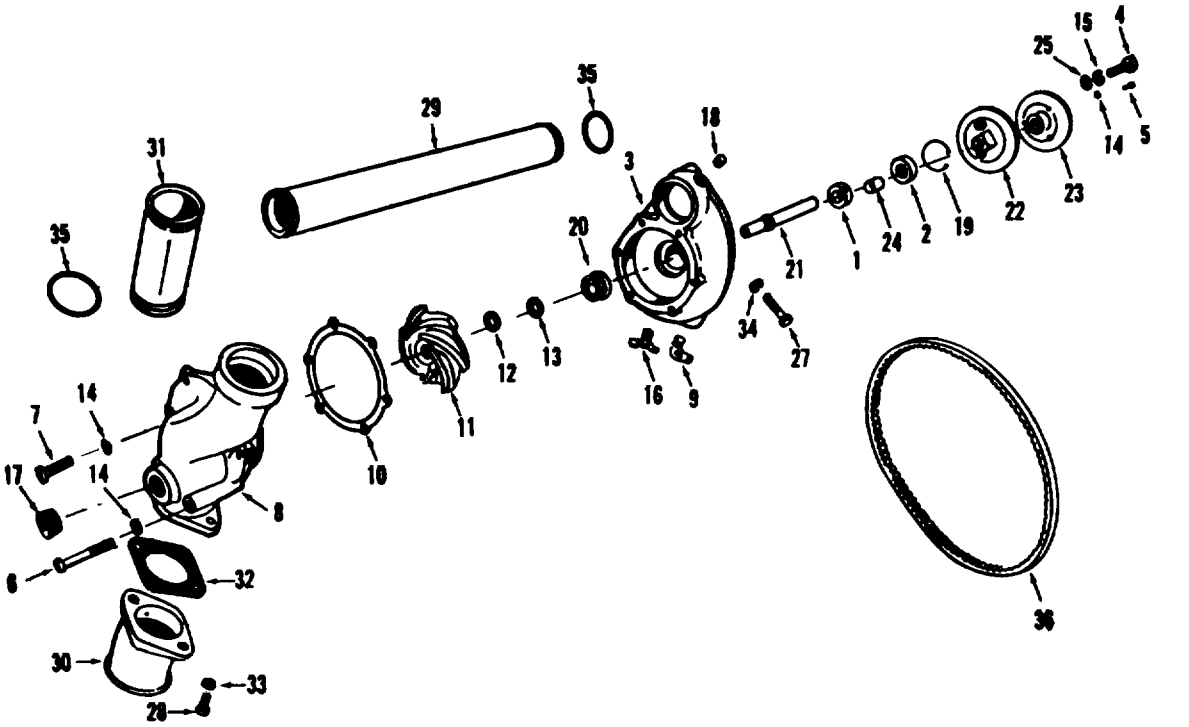



*Figure 4-5. Grave water pump, removal and installation*

b. Disassembly. Refer to figure 4-6 and dis- assemble the water pump assembly.




| | | | | | |
|---|---|---|---|---|---|
| 1 | Bearing | 13 | Seat | 25 | Washer |
| 2 | Bearing | 14 | Lockwasher | 26 | (Deleted) |
| 3 | Body | 15 | Lockwasher | 27 | Capscrew |
| 4 | Capscrew | 16 | Petcock | 28 | Capscrew |
| 5 | Capscrew | 17 | Plug | 29 | Connection |
| 6 | Capscrew | 18 | Plug | 30 | Connection |
| 7 | Capscrew | 19 | Ring | 31 | Coupling |
| 8 | Cover | 20 | Seal | 32 | Gasket |
| 9 | Elbow | 21 | Shaft | 33 | Lockwasher |
| 10 | Gasket | 22 | Sheave | 34 | Lockwasher |
| 11 | Impeller | 23 | Sheave | 35 | O-ring |
| 12 | Film | 24 | Spacer | 36 | Belt |

*Figure 4-6. Crane engine water pump, assembly, exploded view.*

**4-35. Cleaning, Inspection and Repair**

a. Clean all parts with an approved cleaning solvent and dry thoroughly.

b. Inspect shaft, impeller, and pulley sheaves for cracks, breaks, or other damaged, Repair or replace damaged or defective parts.

c. Inspect shaft outside diameter in impeller area. Shaft must be 0.0015 inches larger than impeller bore diameter. If interference fit between shaft and impeller is less than 0.001 inch, discard impeller.

d. Inspect ball bearings for rough or binding operation, excessive looseness and worn or damaged races. Replace defective bearing.

**4-36. Reassembly and Installation**

a. Reassembly. Refer to figure 4-6 and reassemble the water pump assembly.

NOTE

When pressing the impeller on the shaft, ceramic face or impeller hub, must be 0.620/0.625 inch below cover face of housing. Press impeller straight on pump shaft to prevent cracking ceramic seat.

b. Installation.

(1) Install water pump as instructed on figure 4-5.

(2) Install water pump drive belt (TM 5-3810-232-12).

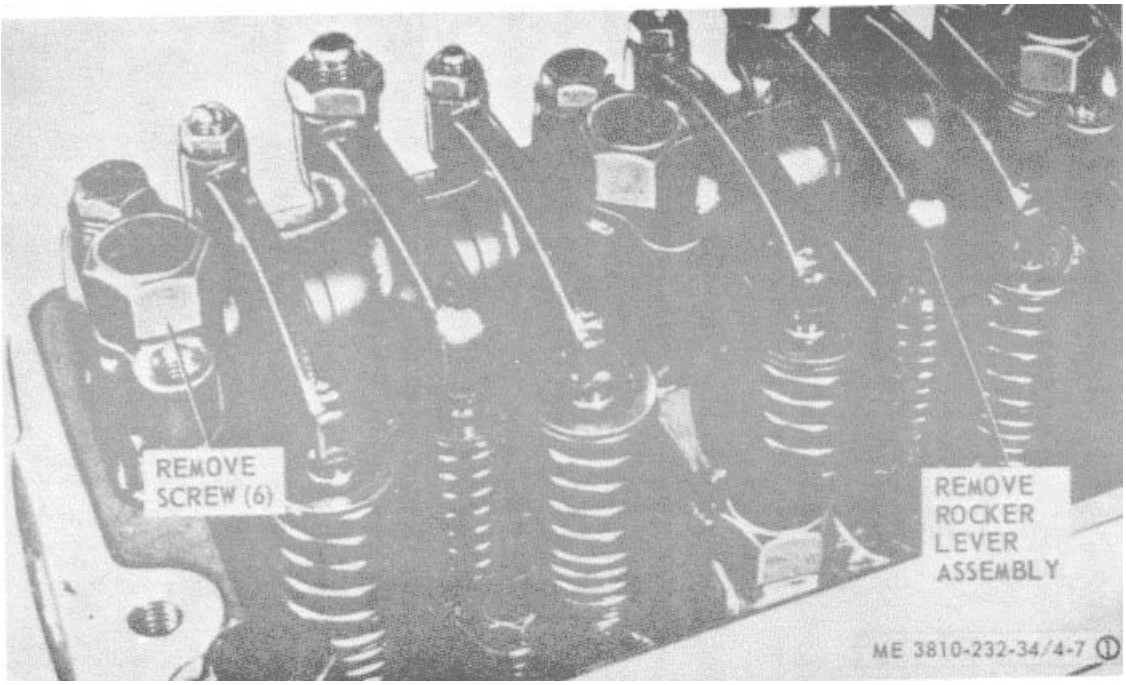
(3) Refill cooling system.

## Section XI. CRANE ENGINE ROCKER LEVERS, PUSH RODS, CROSSHEAD AND INJECTORS

**4-37. Removal**

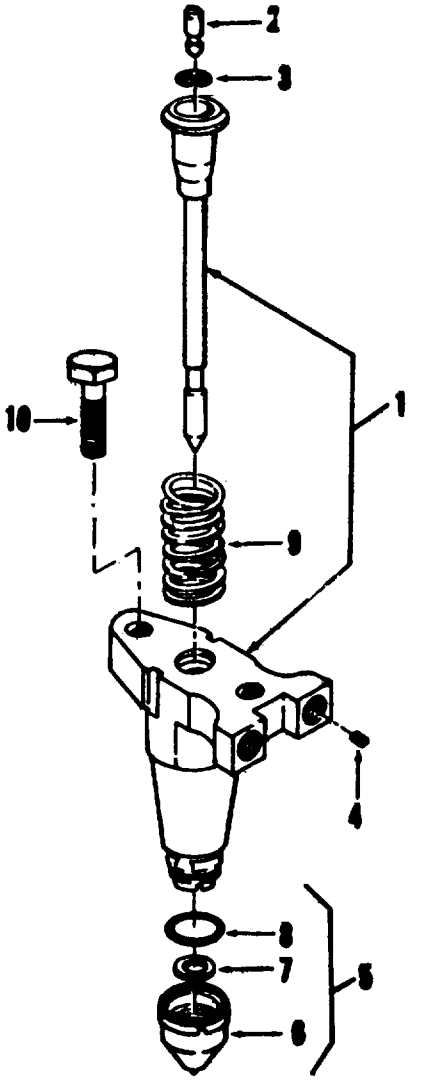
a. Remove rocker lever cover (TM 5-3810-232-12).

b. Remove rocker lever assembly, push rods, crossheads, and injectors as illustrated on figure 4-7




*A-Rocker lever removal*

*Figure 4-7. at Rocker lever, push rods, injectors, ,removal and installation.*

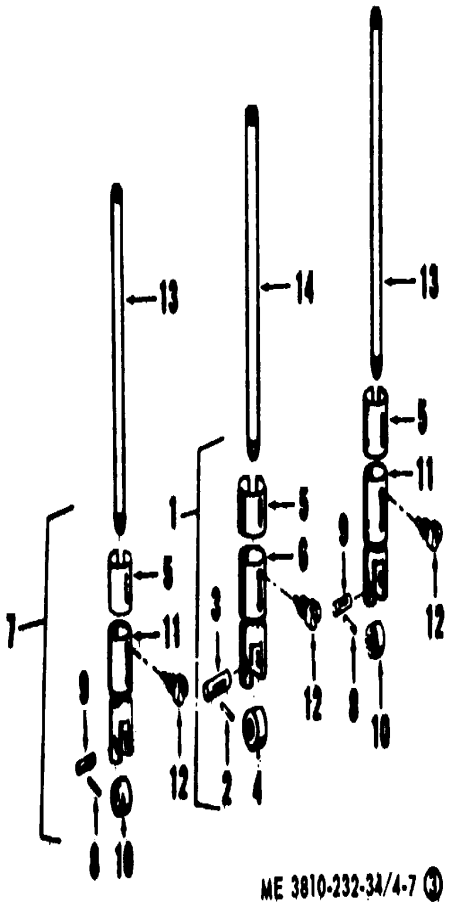



ME 3810-232-34/4-7 (2)

1 Body and plunger ay.
2 Link, plunger
3 Ring, retainer
4 Plug, orifice
5 Cup assembly
6 Cup (NSS)
7 Gasket
8 O-ring
9 Spring
10 Capscrew

B—Injector assembly

*Figure 4-7. (2)-Continued.*

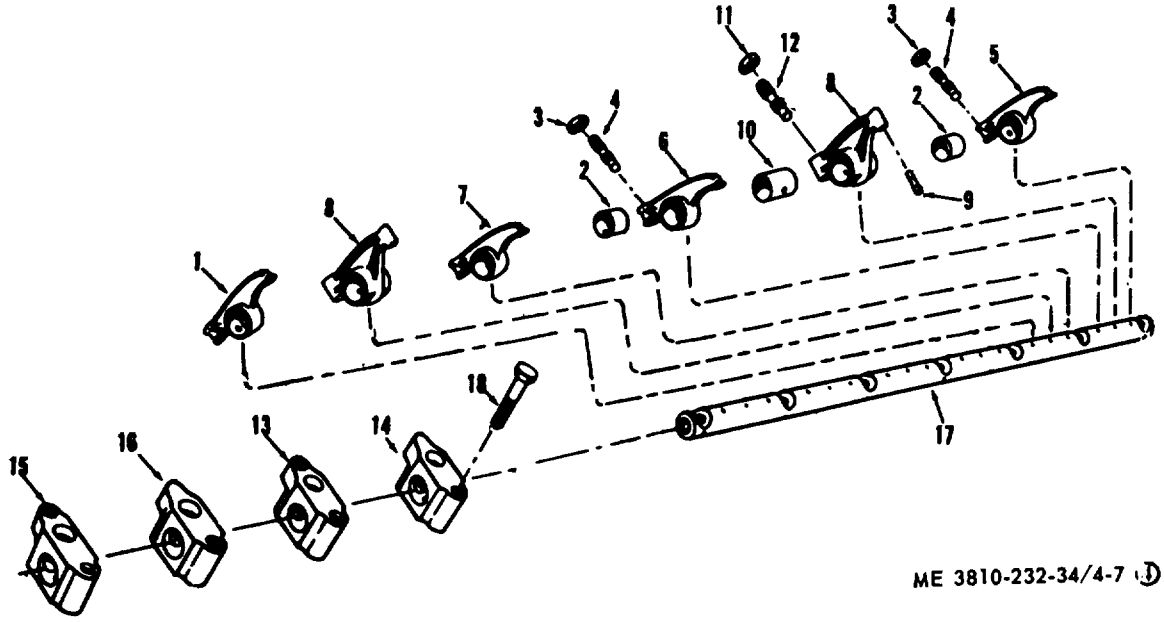



ME 3810-232-34/4-7 (3)

1 Tappet assy. (injector)
2 Lockwire
3 Pin roller
4 Roller, tappet
5 Sleeve, guide
6 Tappet (NSS)
7 Tappet, assy. (valve)
8 Lockwire
9 Pin roller
10 Roller, tappet
11 Tappet (NSS)
12 Guide, tappet
13 Rod, intake and exhaust
14 Rod, injector

C—Push rods and tappets

*Figure 4-7. {3)--Continued.*




1 Lever
2 Bushing
3 Nut
4 Screw
5 Lever
6 Lever
7 Lever
8 Lever
9 Socket
10 Bushing
11 Nut
12 Screw
13 Bearing
14 Bearing
15 Bearing
16 Bearing
17 Shaft
18 Capscrew

D—Rocker levers

*Figure 4-7. (4)—Continued.*

**4-38. Cleaning, Inspection and Repair**

a. Clean all parts with approved cleaning solvent and dry thoroughly.

b. Inspect all parts for cracks, burrs, pitting and excessive wear and damaged threads. Replace defective parts as necessary.

c. Inspect and see that all lubricating oil passages are clear.

d. Inspect ball ends of adjusting screws with a 1/4 inch radius gage. Replace screws worn flat or with damaged threads.

e. Inspect rocker lever shaft for wear and scoring. Replace a defective shaft or one worn smaller than 1.122 inches.

**4-39. Installation**

a. Install injectors, crossheads, push rods, and rocker lever assembly as illustrated on figure 4-7.

b. Adjust fuel injector plungers, crosshead and valve clearance (TM 5-3810-232-12).

c. Install rocker lever cover (TM 5-3810-232-12).

## Section XII. CRANE ENGINE CYLINDER HEAD

**4-40. General**

The cylinder head assembly consists of intake and exhaust valves, valve guides and crosshead guides.

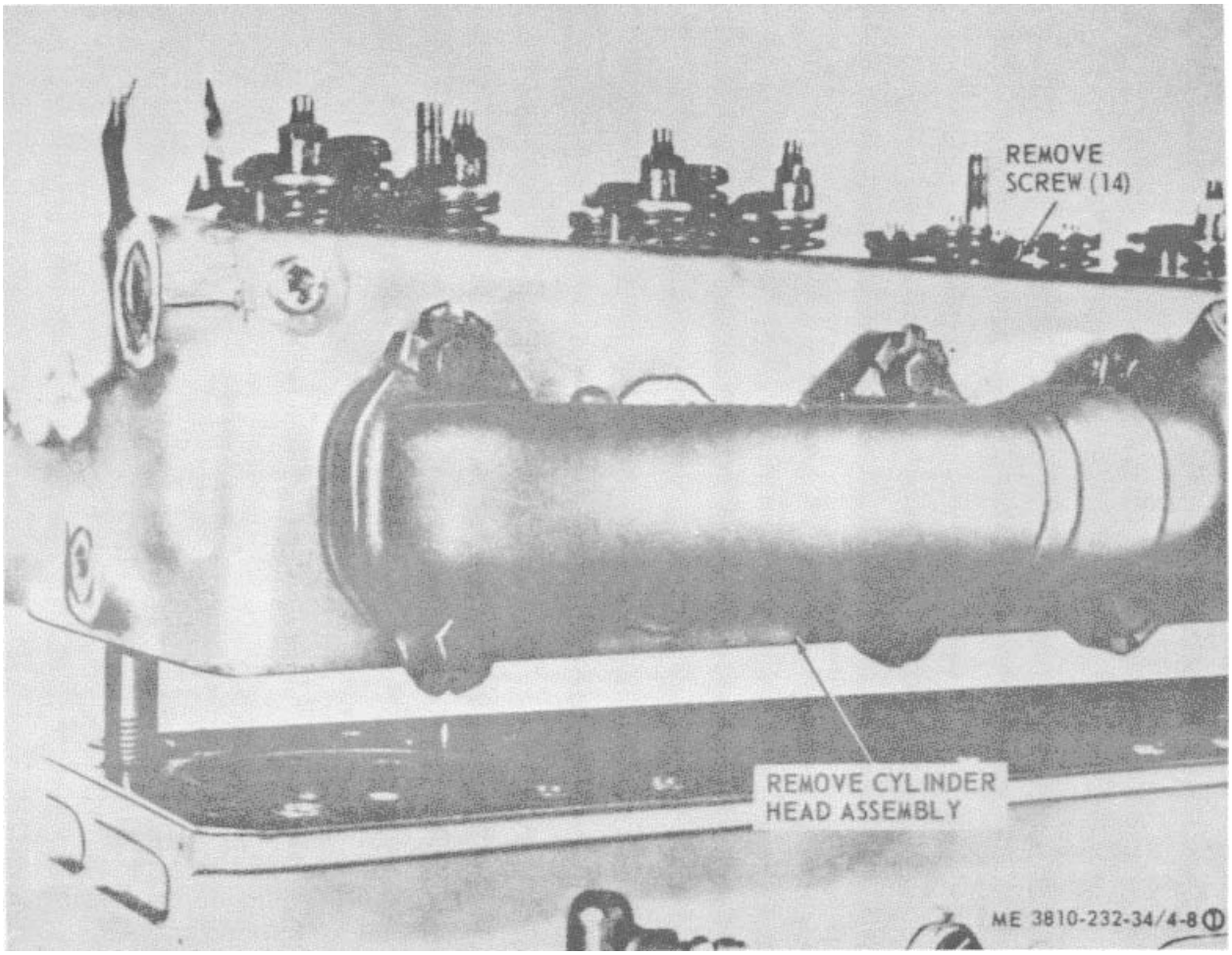
**4-41. Removal and Disassembly**

a. Remove intake and exhaust manifolds (TM 5-3810-232-12).

b. Disconnect fuel and drain lines (TM 5-3810-232-12).

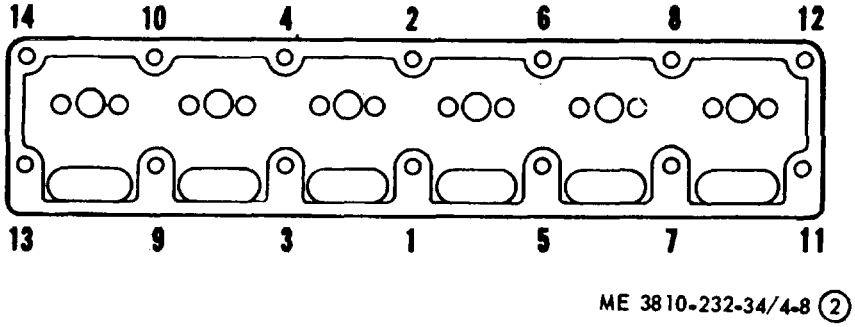
c. Remove rocker lever assembly (para 4-37).

d. Remove cylinder head as illustrated on figure 4-8.



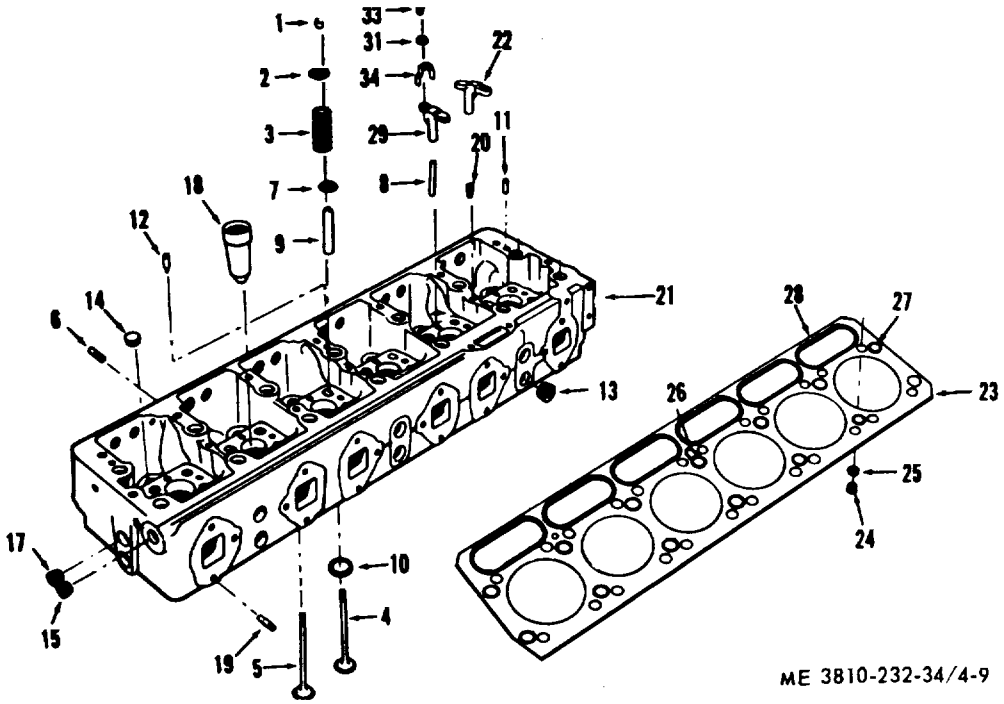

**A-Removal Instructions**

*Figure 4-8. (1) Crane engine head assembly, removal and installation.*




**B—Cylinder head cap screw tightening sequence**

*Figure 4-8. (2)-Continued.*




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Valve, keeper | 10 | Insert | 19 | Stud | 28 | Ring |
| 2 | Retainer | 11 | Pin | 20 | Ventilator | 29 | Valve |
| 3 | Spring | 12 | Pin | 21 | Cylinder head | 30 | Deleted |
| 4 | Valve | 13 | Plug | 22 | Valve | 31 | Nut |
| 5 | Valve | 14 | Plug | 23 | Gasket | 32 | Deleted |
| 6 | Dowel | 15 | Plug | 24 | Ferrule | 33 | Screw |
| 7 | Guide | 16 | (Deleted) | 25 | Grommet | 34 | Retainer |
| 8 | Guide | 17 | Plug | 26 | Grommet | | |
| 9 | Guide | 18 | Sleeve | 27 | Grommet | | |

*Figure 4-9. Crane engine cylinder head assembly, exploded view.*

**4-42. Cleaning, Inspection and Repair**

a. Clean all parts with an approved cleaning solvent and dry thoroughly.

b. Test the cylinder head for leaks. Check carefully around the valve and injector seats for cracks. Discard any part cracked at the seats.

c. Inspect cylinder head examining fuse plugs, valve seats, and injectors sleeves for signs of overheating, looseness, excessive wear or other damage. Replace part as necessary.

**NOTE**

**Cylinder heads are equipped with fuse plugs containing a metal-alloy center that melts if the engine is overheated. Examine fuse plugs for signs of overheating. If metal-alloy has melted, as other engine disassembly proceeds, check carefully for damage from overheating.**

d. Inspect valves for cupped, pitted or worn condition. Replace or grind valves as necessary.

e. Inspect valve springs and valve guides for excessive wear and replace defective parts.

f. Inspect cylinder head surface for scratches, etching or other damage. Resurface head or replace as necessary. Minimum permissable height after resurfacing is 4.970 inches.

**4-43. Reassembly**

Refer to figure 4-9 and reassemble the cylinder head assembly.

**4-44. Installation**

a. Install cylinder head assembly as shown on figure 4-8.

b. Torque the cylinder head capscrews in sequence as illustrated in figure 4-8B.

(1) Tighten all capscrews to 25 ft-lbs.

(2) Continue to tighten capscrews in 100 ft-lbs. increments to 300 ft-lbs.

(3) Then tighten capscre,ws in 50, ft-lbs. increments to 390,'400 ft-lbs.

c. Install the valve cross heads on the guides.

d. Install rocker lever assembly and injectors (para 4-39).

e. Connect fuel and drain lines (TM 5-3810-232-12).

f. Install intake and exhaust manifolds (TM 5-3810-2)

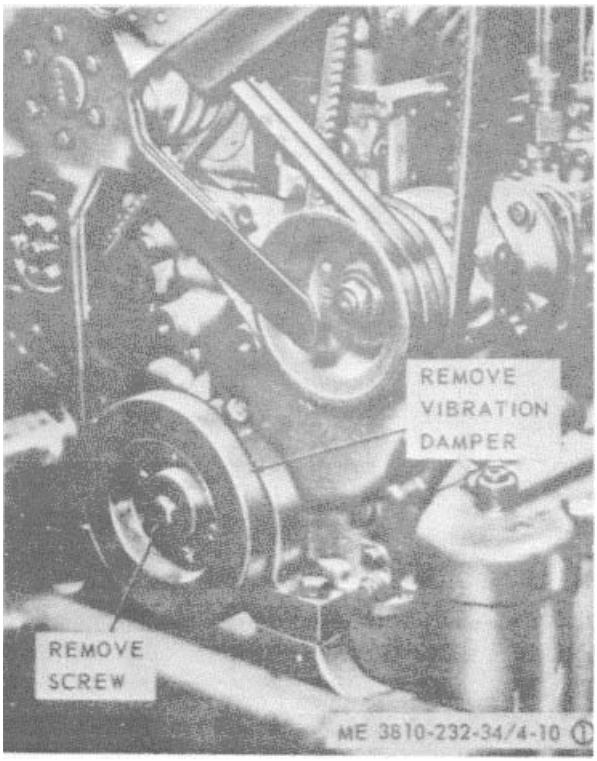
## Section XIII. CRANE ENGINE VIBRATION DAMPER

4-

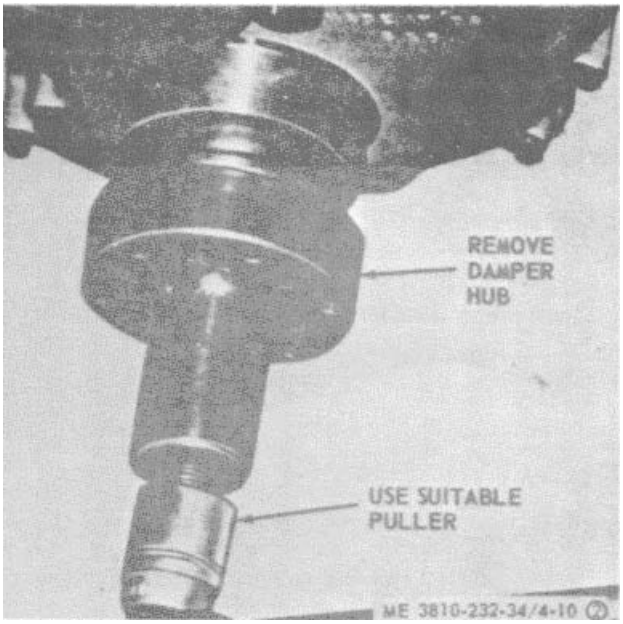
### 4-45. Removal

a Remove radiator (TM 5-3810-232-12).

b Remove vibration damper and adapter hub as illustrated in figure 4-10.




**A-Vibration damper removal**




**B--Adapter hub removal**

*Figure 4-10. (1) Vibration damper, removal and installation.*

*Figure 4-10.(2)—Continued*

### 4-46. Cleaning, Inspection and Repair

a Clean damper exterior with a cloth dampened with an approved cleaning solvent.

b Inspect damper for dents and cracks. Shake damper from front to rear. Movement of loose pieces will be felt or heard if fluid has been lost. Replace a damaged or defective damper.

C. Inspect adapter hub for cracks, breaks or ,. other damage. Repair or replace a defective hub.

**4-47. Installation**

a Install damper as illustrated on figure 4-10.

b With a dial gage check vibration damper eccentricity and wobble at points A and B E shown on figure 4-11.

c 'Eccentricity of damper must not exceed 0.010 inch and wobble 0.010 inch @ 4 inch radius. The adapter hub eccentricity must not exceed 0.004 inch and wobble 0.003 inch @ 2 3/4 inch radius.

NOTE

Keep crankshaft thrust clearance to front or rear limit while checking wobble.

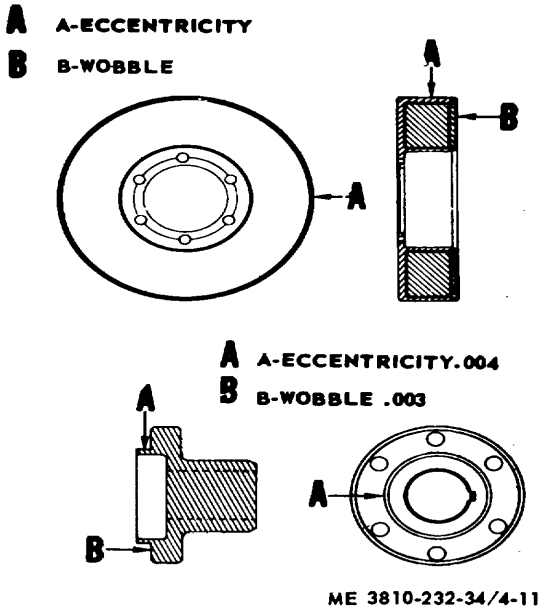



*Figure 4-11. Vibration damper and adapter hub eccentricity and wobble check.*

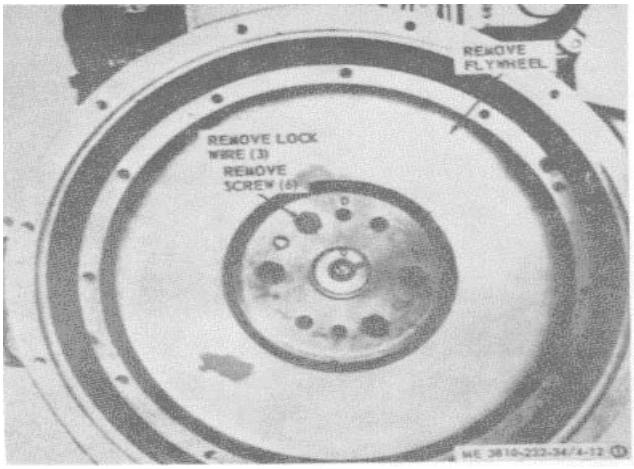
## Section XIV. CRANE ENGINE FLYWHEEL AND FLYWHEEL HOUSING

**4-48. Removal**

a Remove engine (para 2-9).

b. Remove the starter (TM 5-3810-232-12).

c. Remove the flywheel and flywheel housing as illustrated on figure 4-12.




**A-Flywheel removal**

*Figure 4-12. (1) Flywheel and flywheel housing, removal and installation.*

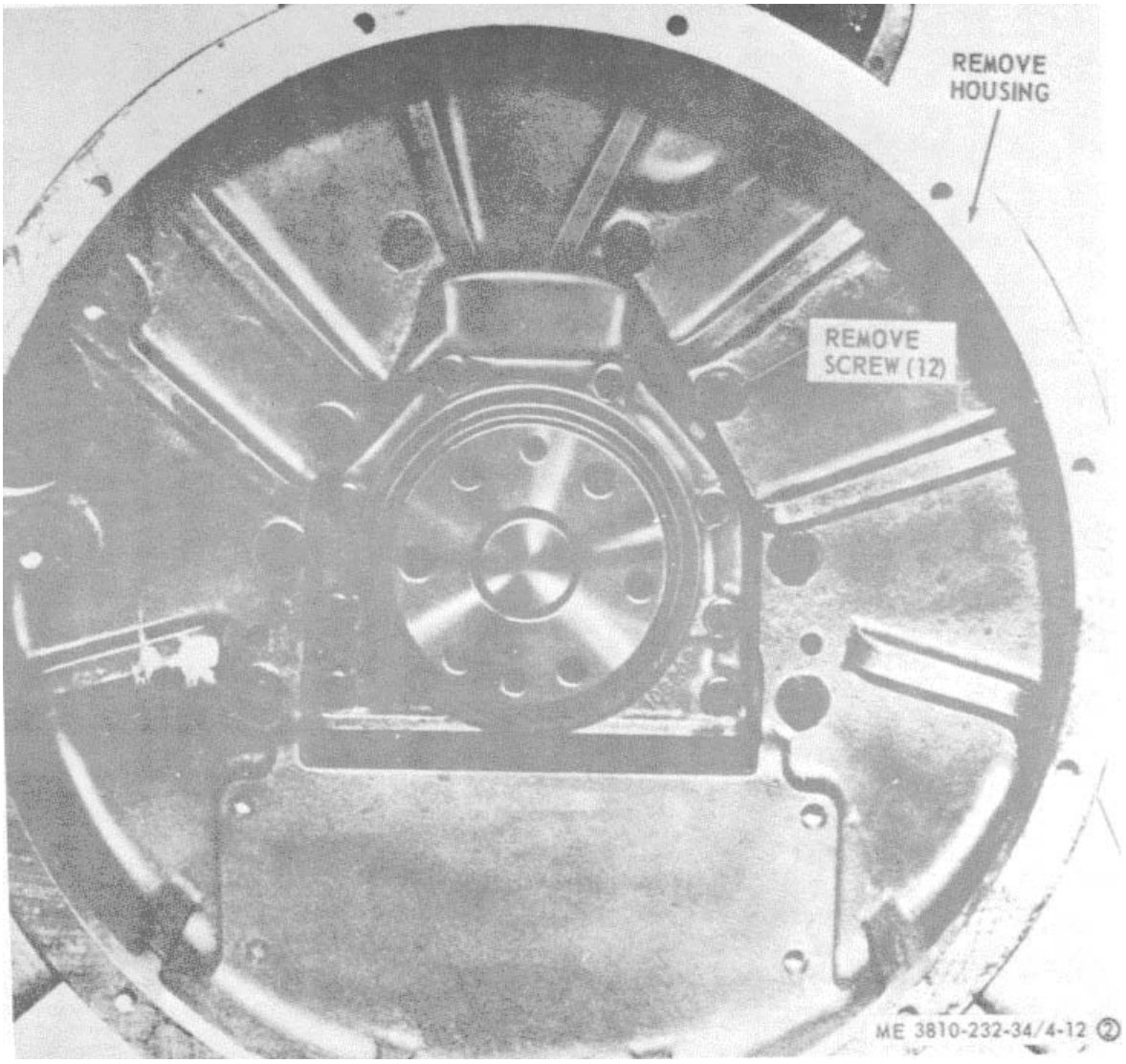
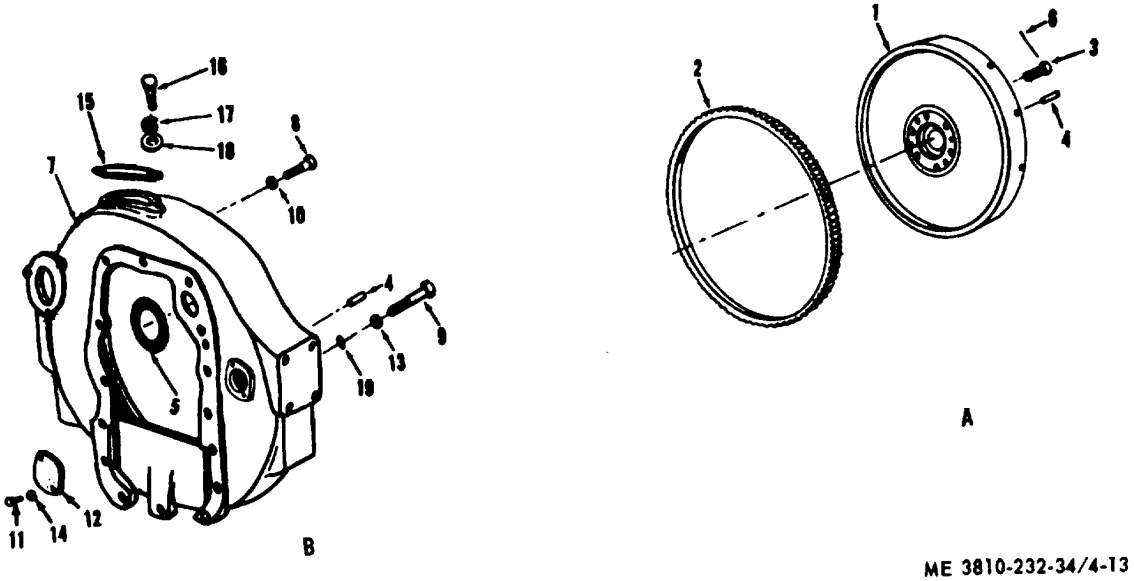



*Figure 4-12. (2) -Continued.*

**449. Cleaning, Inspection and Repair**

*a.* Clean all parts with an approved cleaning solvent and dry thoroughly.

*b.* Inspect ring gear for broken or cracked teeth. If replacement is necessary, drive gear (fig. 4-13) from flywheel with blunt chisel. Install new ring gear by heating to expand it and press on flywheel




| | | | |
|---|---|---|---|
| 1 Flywheel | 4 Dowel | 10 Lockwasher | 14 Lockwasher |
| 2 Gear | 5 Gasket | 11 Screw | 15 Shield |
| 3 Capscrew | 7 Housing | 12 Cover | 16 Capscrew |
| 4 Dowel | 8 Capscrew | 13 Lockwasher | 17 Lockwasher |
| 6 Wire | 9 Capscrew | 14 Lockwasher | 18 Washer |
| A—Flywheel assembly | | B—Flywheel housing assembly | 19 Washer |

*Figure 4-13. Flywheel, ring gear, and flywheel housing, exploded view*

**CAUTION**

**Overheating to temperature above 600° will soften gear.**

c. Inspect flywheel housing for cracks or distortion, and stripped or crossed threads. Repair or replace as necessary.

**4-50. Installation**

a. Install flywheel housing and flywheels as illustrated on figure 4-12.

(1) Torque the flywheel housing capscrews alternately and evenly to 80/100 ft-lbs.

(2) Torque the flywheel capscrews alter-ME 3810-232-34/4-14 alternately and evenly to 50/60 ft-lbs. Using the same sequence, then torque to 100/110 ft-lbs. Figure 4-14.

b. Use indicator and check flywheel and clutch face. Refer to figure 4-14 for limits.

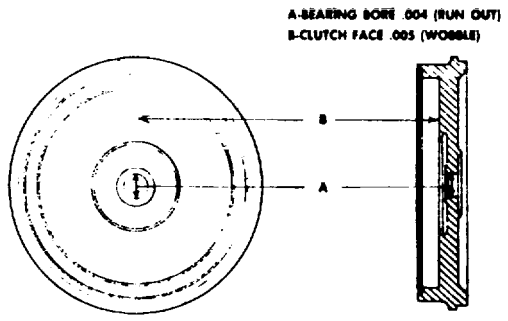



*Figure 4-14. Flywheel bearing bore and clutch face limits*

c. Install starter assembly (TM 5-3810-232-12).

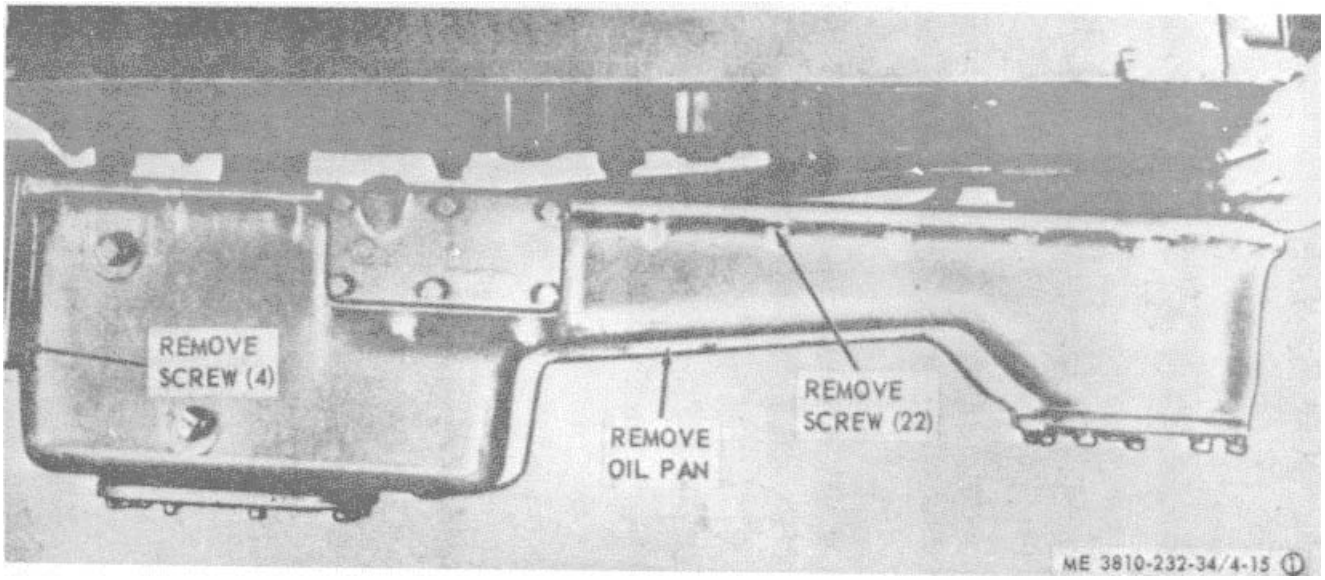
d. Install engine (para 2-9).

## Section XV. CRANE ENGINE OIL PAN ASSEMBLY

**4-51. Removal and Disassembly**

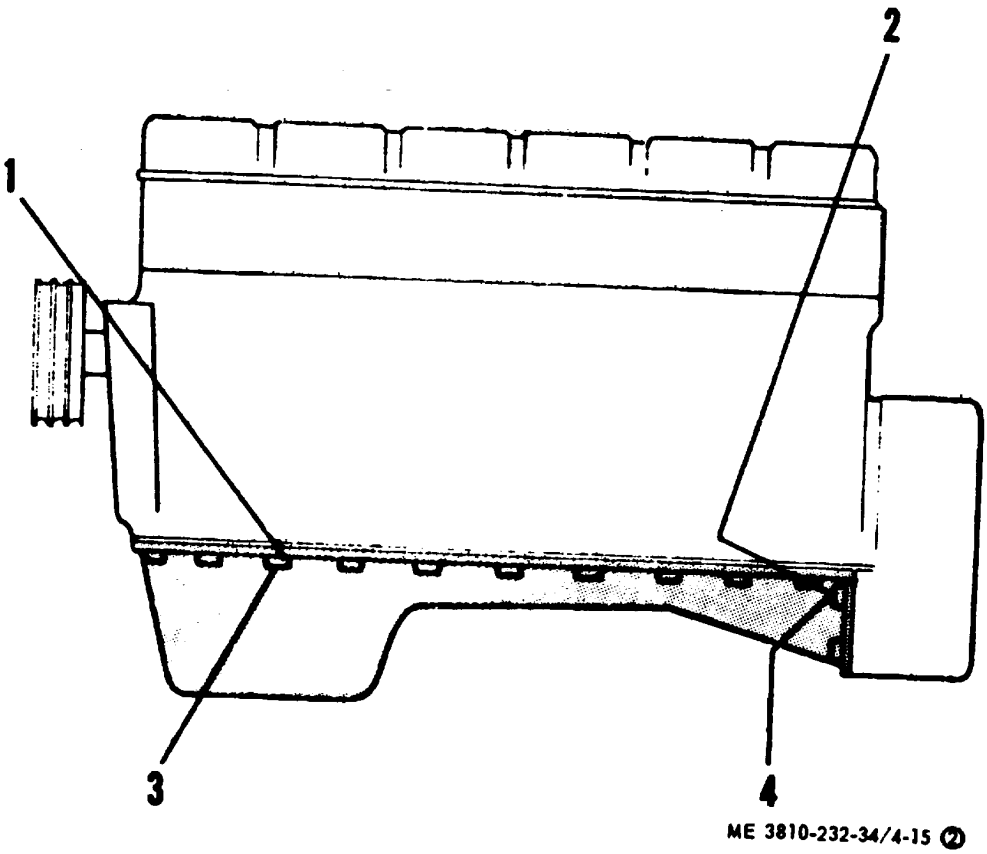
*a.* Drain nil. figure 4-15.

*b.* Remove oil pan assembly as illustrated on figure 4-15




A-1 pan removal

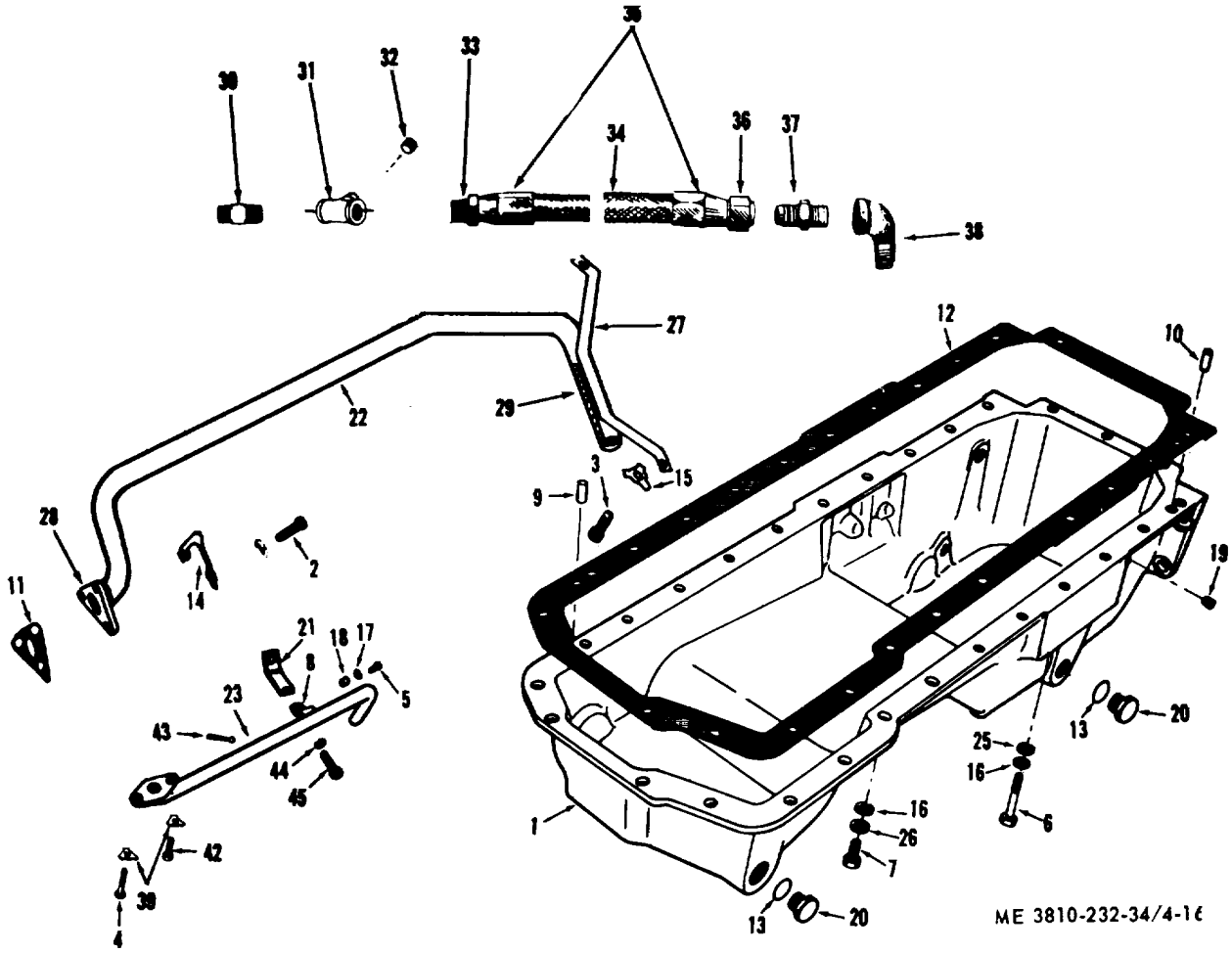
*Figure 4-15.* (1) *Crane engine oil pan assembly, removal and installation*




B-Screw tightening sequence

*Figure 4-16. (2) --Continued.*

*c.* Refer to figure 4-16 and disassemble the oil pan assembly.




| | | | | | |
|---|---|---|---|---|---|
| 1 | Pan | 16 | Lockwasher | 31 | Tee |
| 2 | Capscrew | 17 | Lockwasher | 32 | Plug |
| 3 | Capscrew | 18 | Nut | 33 | Nipple |
| 4 | Capscrew | 19 | Plug | 34 | Hose |
| 5 | Capscrew | 20 | Plug | 35 | Socket |
| 6 | Capscrew | 21 | Strap | 36 | Swivel |
| 7 | Capscrew | 22 | Tube | 37 | Adapter |
| 8 | Clamp | 23 | Tube | 38 | Elbow |
| 9 | Stud | 24 | Washer | 39 | Lockplate |
| 10 | Stud | 25 | Washer | 40 | (Deleted) |
| 11 | Gasket | 26 | Washer | 41 | (Deleted) |
| 12 | Gasket | 27 | Bracket | 42 | Capscrew |
| 13 | Gasket | 28 | Flange | 43 | Pin |
| 14 | Lockplate | 29 | Screen | 44 | Washer |
| 15 | Lockplate | 30 | Nipple | 45 | Capscrew |

*Figure 4-16. Crane engine oil pan assembly, exploded View.*

**452. Cleaning, Inspection and Repair**

*a.* Clean all parts with an approved cleaning solvent and dry thoroughly.

*b.* Inspect oil pan for cracks, breaks, and other damage. Repair or replace a defective oil pan.

*c.* Inspect capscrews and drain plug for damaged threads. Replace or repair defective parts.

**4-53. Reassembly and Installation**

*a. Reassembly.* Refer to figure 4-16 and reassemble the oil pan assembly.

*b. Installation*

(1) Position the oil pan over the studs and hand tighten the oil pan capscrews, lockwashers and flatwashers as illustrated in figure 4-15.

(2) Install and tighten the middle buttress-to-flywheel housing capscrews (2 and 4, fig 4-15A) and two center capscrews (1 and 2, fig. 4-15B).

(3) Remove the buttress capscrews installed in step (2) above. (Removal is necessary to provide socket clearance to corner pan-to-block capscrews).

(4) Tighten the two rear corner pan-to-block capscrews, then tighten the remainder of all oil pan capscrews.

(5) Refill with engine oil. Refer to lubrication chart.

## Section XVI. CRANE ENGINE LUBRICATING OIL PUMP

**4-54. Removal and Disassembly**

*a. Removal.*

(1) Remove oil pan assembly (para 4-51).

(2) Remove oil pump illustrated on figure 4-17.

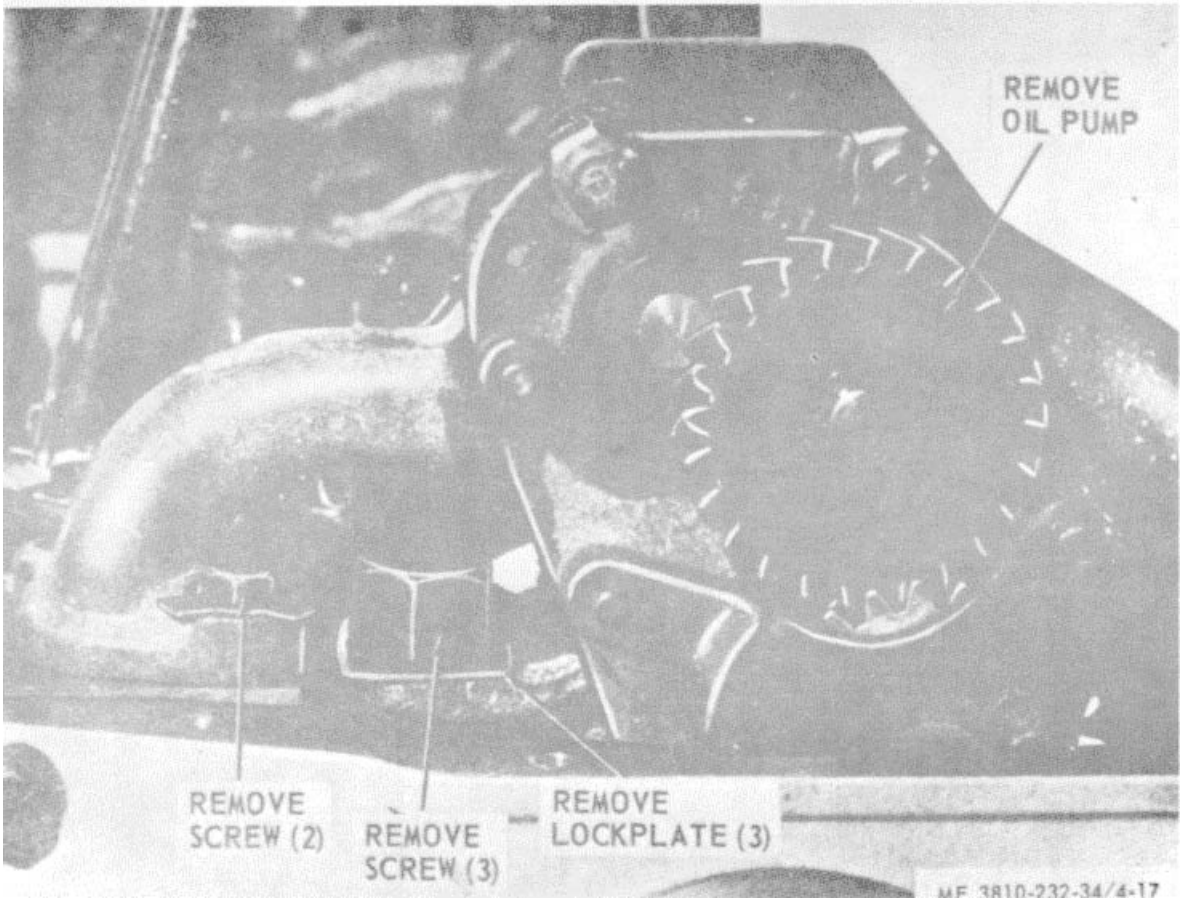
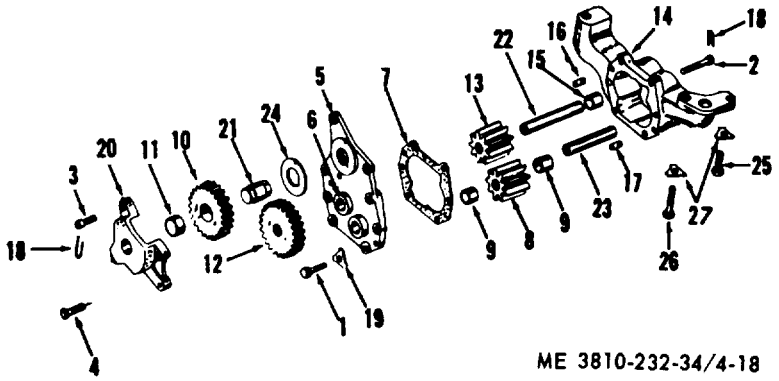



*Figure 4-17. Crane engine oil pump assembly, removal and installation*

*b. Disassembly.* Refer to figure 4-18 and .
disassemble the lubricating oil Dump assembly




| | | | | | |
|---|---|---|---|---|---|
| 1 | Capscrew | 10 | Gear | 19 | Lockplate |
| 2 | Capscrew | 11 | Bushing | 20 | Retainer |
| 3 | Capscrew | 12 | Gear | 21 | Shaft |
| 4 | Capscrew | 13 | Gear | 22 | Shaft |
| 5 | Cover | 14 | Housing | 23 | Shaft |
| 6 | Bushing | 15 | Bushing | 24 | Washer |
| 7 | Gasket | 16 | Dowel | 25 | Capscrew |
| 8 | Gear | 17 | Dowel | 26 | Capscrew |
| 9 | Bushing | 18 | Lockwire | 27 | Lockplate |

*Figure 4-18. Crane engine lubricating oil pump assembly, exploded view.*

**4-55. Cleaning, Inspection and Repair**

*a.* Clean all parts with an approved cleaning solvent and dry thoroughly.

*b.* Inspect pump gears for cracked, scored, worn or chipped teeth. Replace a defective gear.

*c.* Inspect bushings and shaft for scoring, distortion or wear. Replace defective parts.

*d.* Inspect gear pockets finished surfaces for scratches, or , scoring and wear. Replace pump bodies if wear indicates.

**NOTE**

**See table 1-1 for allowable wear tolerances of components named in this paragraph.**

**4-56. Reassembly and Installation**

*a. Reassembly.*

(1) Refer to figure 4-18 and reassemble the lubricating oil pump assembly.

(2) When assembling place driven gear over shaft with marked end to oil inlet side of body.

(3) Assemble driven gear and shaft to cover, leaving 0.002 inch clearance between gear and cover.

*b. Installation.*

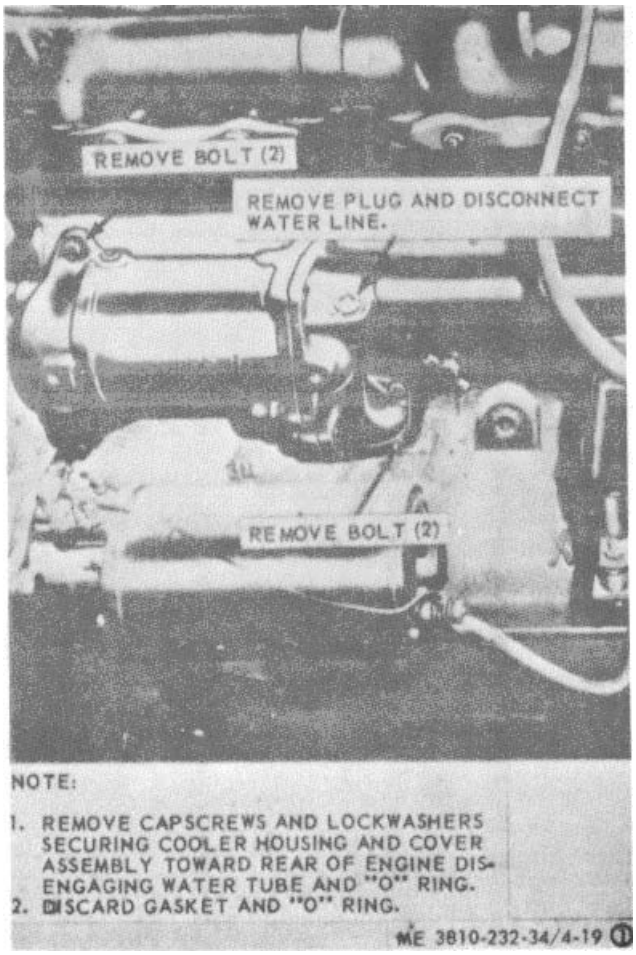
(1) Install oil pump assembly as illustrated on the figure 4-18.

(2) Install oil pan assembly (para 4-53).

## Section XVII. CRANE ENGINE OIL COOLER

### 4-57. Removal

Remove cooler assembly and gaskets from engine block (fig 4-19).




A-Crane oil cooler, removal and installation.

*Figure 4-19. (1) Crane engine oil cooler.*

### 4-58. Disassembly

*a.* Remove cooler cover (3, fig. 4-19) and gasket (5).

*b.* Remove exposed top O-ring packing (9) under brass retainer (11).

CAUTION

Do not scratch or mar sealing surface on element.

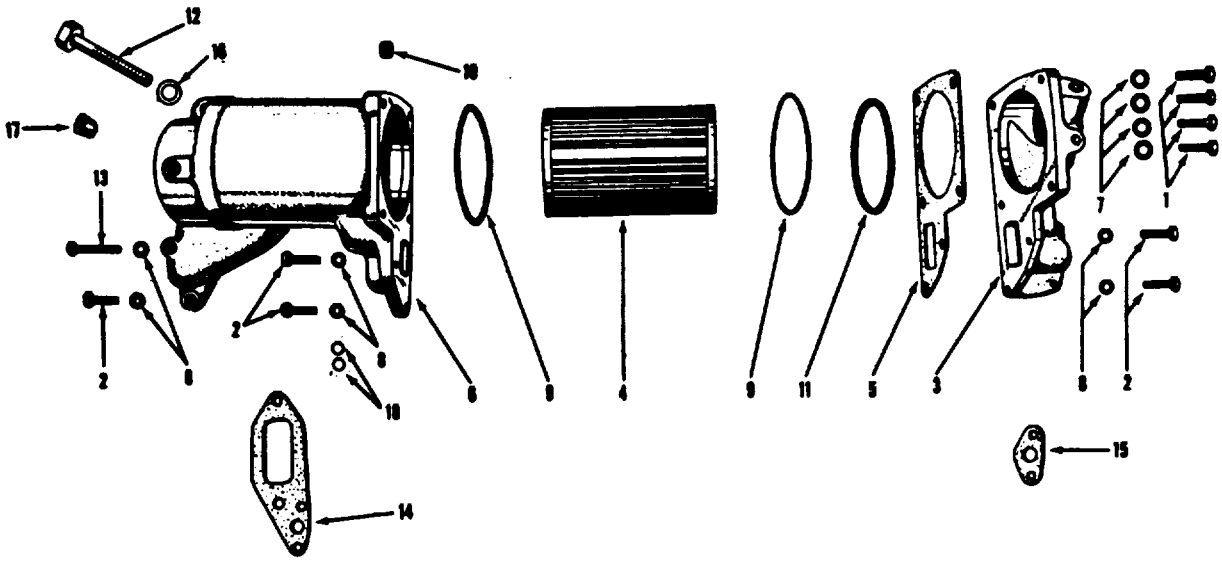
*c.* To remove the element (4) from the housing (6) insert two 7/32 in. dia. rods 8 in. Long into the outside row of tubes opposite each other.

NOTE

The rods should not drag bottom of housing.

*d.* Place a flat bar between rods and rotate element in housing to unseat lower O-ring packing (9).

*e.* Grasp rods and while rotating elements lift gradually to free O-ring packing. When up about 3/8 in., lift element from housing.




| | | |
|---|---|---|
| 1. Screw | 7. Washer | 13. Screw |
| 2. Bolt | 8. Washer | 14. Gasket |
| 3. Cover | 9. Packing | 15. Gasket |
| 4. Filter | 10. Plug | 16. Washer |
| 5. Gasket | 11. Retainer | 17. Plug |
| 6. Housing | 12. Bolt | 18. Washer |

B--Crane engine oil cooler, disassembly and reassembly.

*Figure 4-19. (2) -Continued.*

**4-59 Repair**

a. Repair defective or damaged parts.

b. Repair damaged tubes by inserting smaller O. D. tube inside damaged tube. Cut and flair ends, then solder securely. If more than 5%o of tubes are defective, discard element.

**4-60 Reassembly**

a. Lubricate O-ring packing (9) and place in groove at bottom of housing (6).

b. Push element (4) into housing (6) aligning index marks on element and housing.

c. Press second O-ring packing (9) around top of element with a wooden block to assure equal pressure around ring circumference.

d. Place new retainer ring (11) over O-ring packing.

e. Assemble new gasket (5) and front cover (3) to housing.

**4-61. Installation**

a. Place oil cooler assembly and new gasket in position on engine block. Align bolt holes (fig. 4-19).

b. Secure the cooler housing and cover assembly to block with bolts and washers.

c. Connect external oil and water lines to cooler.

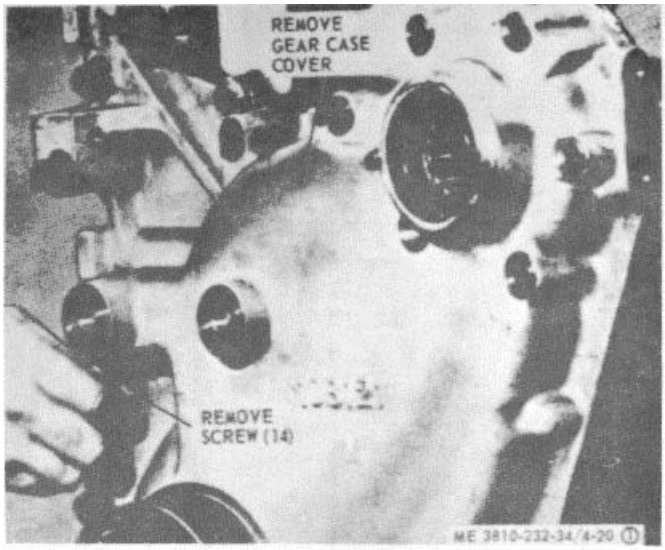
## Section XVIII. CRANE ENGINE GEAR CASE COVER AND CAMSHAFT

**4-62. Removal**

a. Remove engine assembly (para 2-9). d. Remove gear case cover and camshaft as

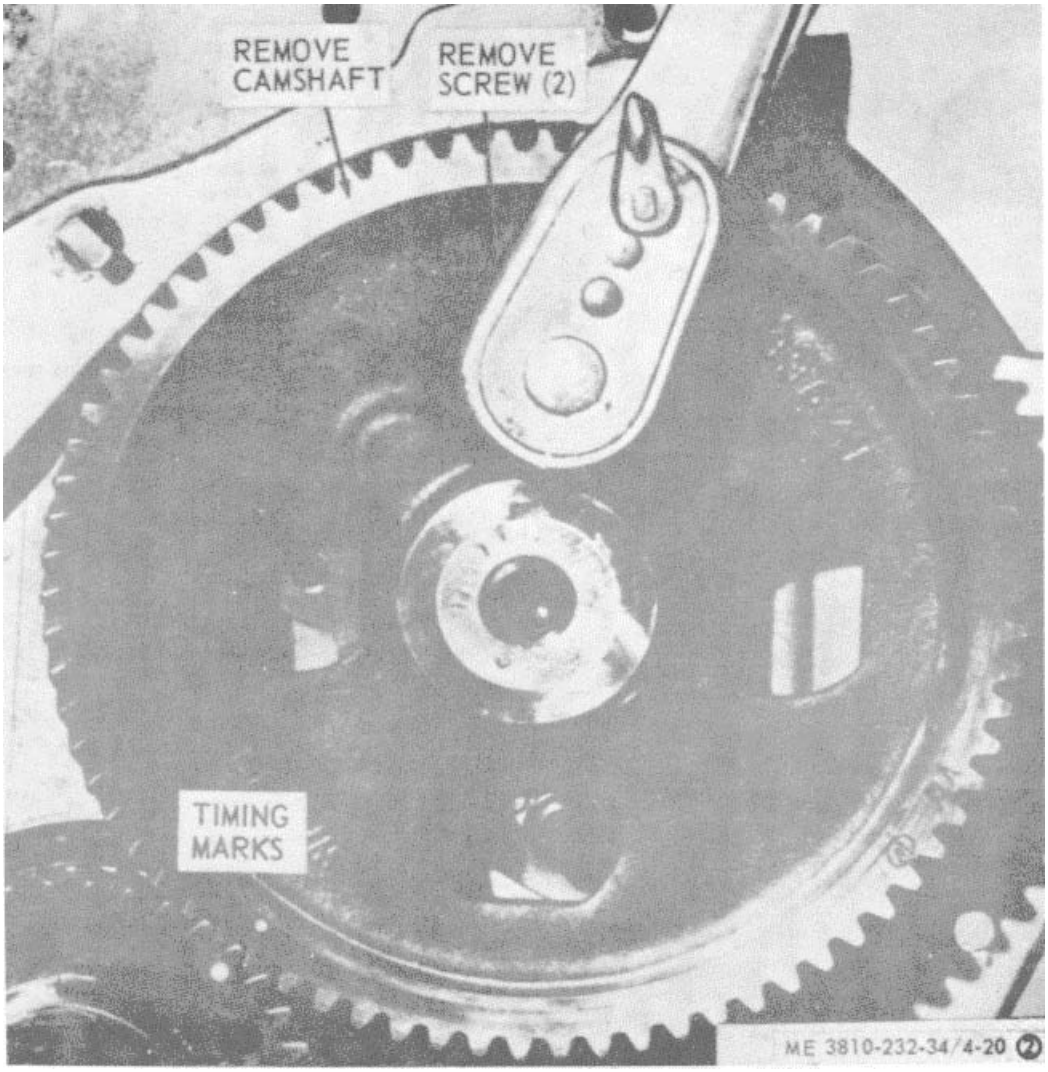
b. Remove water pump (para 4-34). illustrated on figure 4-20.

c. Remove cylinder head (para 4-41).




A-Gear case cover removal.

*Figure 4-20. (1) Crane engine gear cover and camkshaft, removal and installation.*




B--Camshft removal

*Figure 4-20. (2) -Continued*

**4-63. Cleaning, Inspection and Repair**

*a.* Clean all parts with an approved cleaning solvent and dry thoroughly.

*b.* Inspect camshaft gear for cracked, broken, or worn teeth. Replace defective gear.

*c.* Inspect camshaft journals and lobes for scuffs, scoring, pitting, or other damage. Check by magnetic inspection for possible cracks. Replace a worn or defective camshaft. See table 1-1 for allowable wear tolerance.

*d.* Inspect gear case cover for cracks, breaks or other damage. Repair or replace a defective cover.

**4-64. Installation**

*a.* Install camshaft in block rotating as it enters to ease passage through bushings. Index timing mark on camshaft gear with mark on crankshaft gear (fig. 4-20).

*b.* Align camshaft bearing retainer mounting holes with those in block. Torque mounting capscrews alternately to 30-35 ft-lbs.

*c.* Attach dial indicator gauge to gear ease mounting plate and check camshaft and clearance and gear backlash. Proper end clearance is 0.007 0.011 inch and normal gear backlash is 0.004 0.007 inch. If end clearance exceeds 0.015
inch, replace bearing retainer. Replace camshaft gear if backlash exceeds 0.020 inch.

*d.* Check injector timing. Timing may be advanced or retarded by changing camshaft key.

(1) Insert an injector push tube into an injector tappet of any cylinder desired.

(2) Install timing tool in injector sleeve of same cylinder by engaging short rod in injector push tube socket.

(3) Secure timing tool in place with retainers.

(4) Bar crankshaft in direction of engine rotation to top dead center.

(5) Install dial indicator above piston within 0.10 inch of fully compressed position. Set indicator dial at "O".

(6) Continue to bar crankshaft in direction of engine rotation until rod reaches 90' mark on left side of tool. (7) Install indicator above push tube to within 0.010 inch of the fully compressed position. Set indicator dial at "O".

**NOTE**

Each of the two dials used must have total travel of at least 0.250 inch.

(8) Bar crankshaft in opposite direction of engine rotation to 450 before top dead center.

**NOTE**

**The rod over piston will travel up to TDC and then down to 450 mark on the left side of the tool rod retainer.**

(9) Bar engine in direction of rotation until indicator above piston shows piston has traveled to location shown at first check point under "Piston Travel" in table 4-1.

(10) Read push rod travel on dial indicator and check reading against limits shown in table 4-1.

(11) Check push rod travel at each of the two remaining positions shown in Table 3-1.

(*a*) If push rod travel is greater than limits shown, timing is slow.

(*b*) If push rod travel is less than limits shown, timing is fast.

(12) If timing check shows a timing change is desirable, select next advance or retard key from listing in table 4-2.

(13) If camshaft key is changed, recheck timing.

*e.* Install gear case cover as shown on figure 4-20.

*f.* Install cylinder head (para 4-44).

*g.* Install water pump (para 4-36).

*h.* Install engine assembly (para 2-9).

## Section XIX. CRANE ENGINE GEAR CASE MOUNTING PLATE

**4-65. Removal**

a. Remove gear case cover and camshaft (para 4-62).

*Table 4-1. Camshaft Timing Specifications*

| Crank angle (degree) | Piston travel (in.) | Push rod travel (In.) | | |
|---|---|---|---|---|
| | | Nominal | Fast | Slow |
| 19 BTC | 0.1711 | 0.0295 | 0.0265 | 0.0315 |
| 12 BTC | 0.0689 | 0.0162 | 0.0137 | 0.0172 |
| 5 BTC | 0.0120 | 0.0555 | 0.0037 | 0.0067 |

*Table 4-2. Camshaft Key Data*

| Key : No. | Timing Change | | Amount of offset | Assembly Instructions |
|---|---|---|---|---|
| | Effect | Degrees | | |
| 124696 | Advance | 1 | 0.0121/0.0141 | Arrow toward rear of engine |
| 120602 | Advance | 1 1 / 2 | 0.0187/0.0207 | Arrow toward rear of engine |
| 120602 | Retard | 1 1 / 2 | 0.0187/0.0207 | Arrow toward front of engine |
| 103275 | Retard | 2 1 / 2 | 0.0318/0.0338 | Arrow toward front of engine |

*b.* Remove gear case mounting plate as shown on figure 4-21.

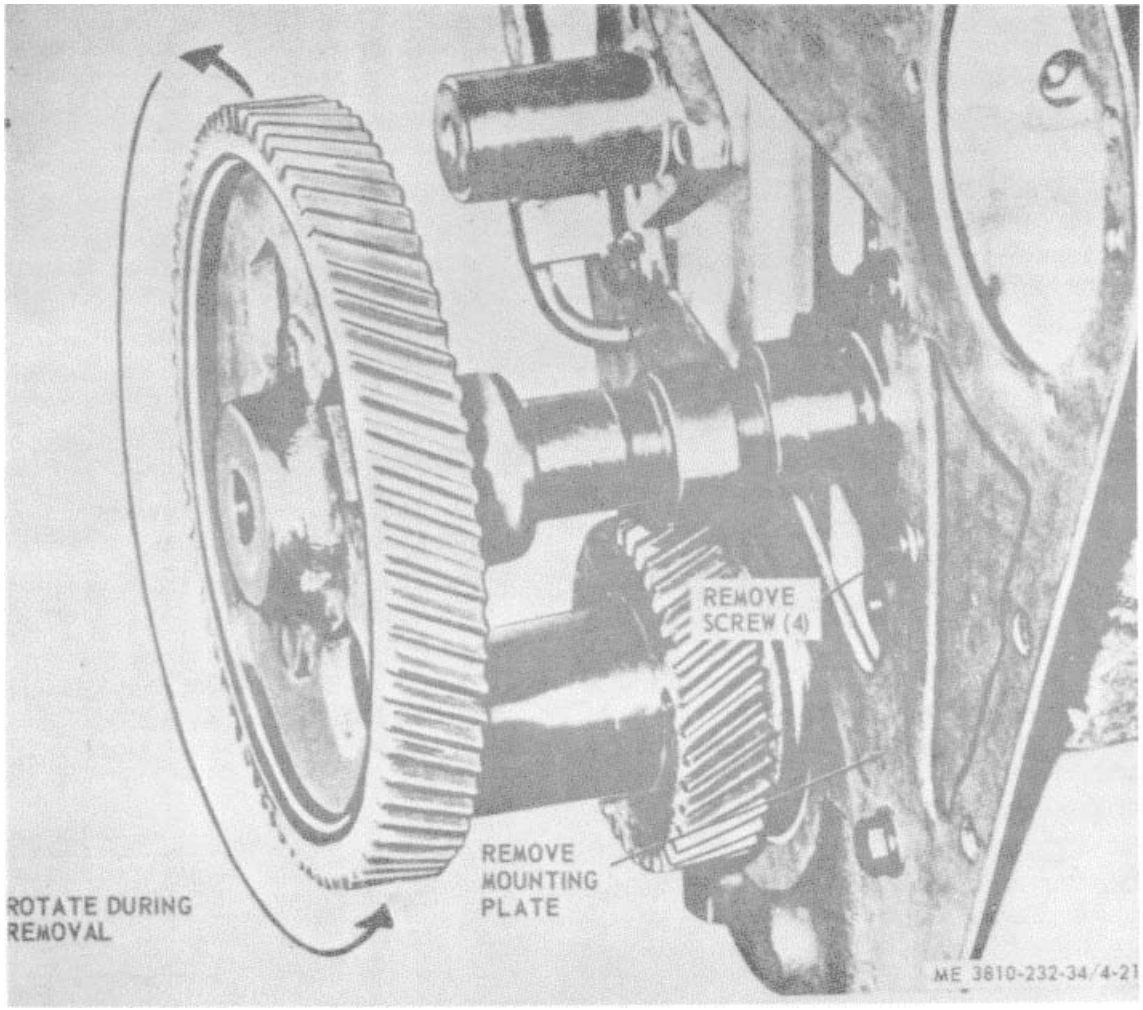



*Figure 4-21. Crane engine gear case mounting plate, removal and installation.*

**4-66. Cleaning and Inspection**

*a.* Clean with an approved cleaning solvent and dry thoroughly.

*b.* Inspect plate for cracks, breaks, and other damage. Replace a defective plate.

**4-67. Installation**

a. Install gear case mounting plate as shown on figure 4-21. Torque mounting capscrews to 30, /35 ft-lbs.

b. Install gear case cover and camshaft (para 4-64).

## Section XX. CRANE ENGINE REAR COVER AND SEAL

**4-68. Removal**

a. Remove flywheel and flywheel housing (para 4-48).

b. Remove gear cover and seal as illustrated on figure 4-22.

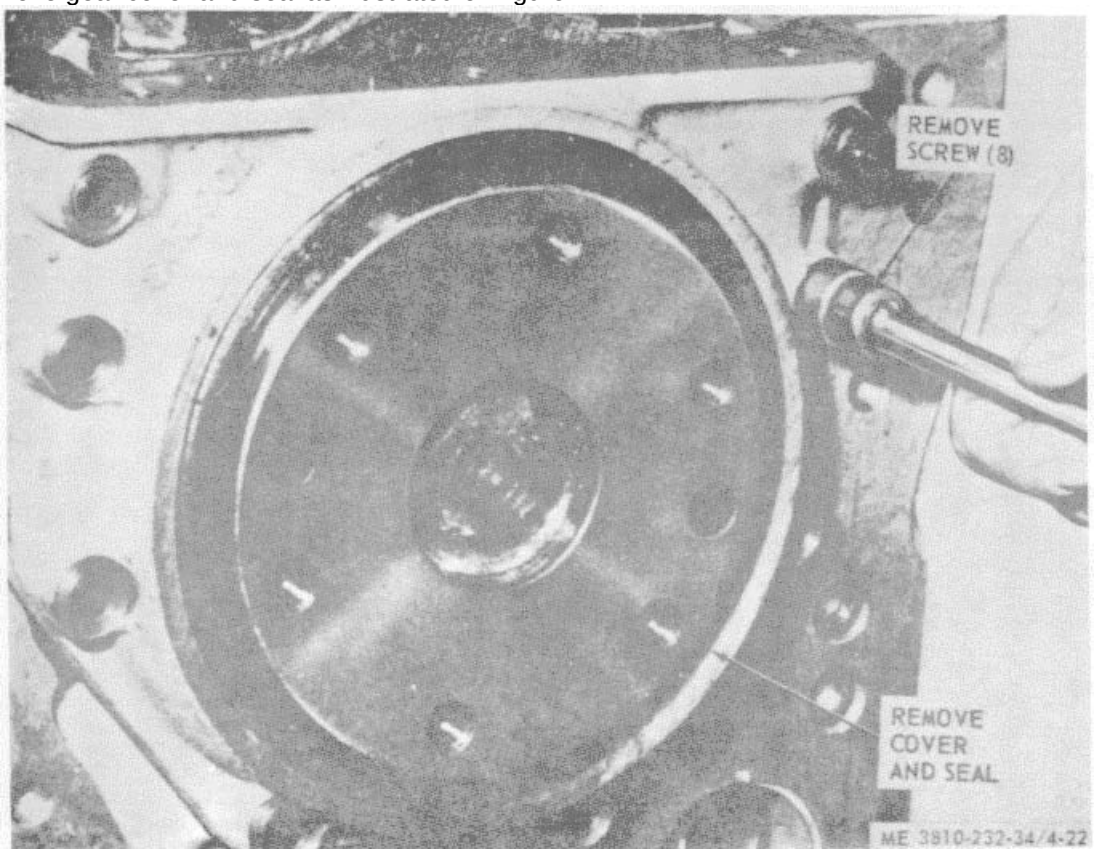



*Figure 4-22. Crane engine rear cover and seal, removal and installation.*

**4-69. Cleaning and Inspection**

a. Clean with an approved cleaning solvent and dry thoroughly.

b. Inspect cover for cracks, breaks or other damage. Replace a defective cover. Always replace seal assembly.

**4-70. Installation**

a. Install the rear cover and seal, see figure 4-22.

(1) Press the seal "open" side down into the cover until the rear of the seal is flush with the rear of the cover. and seal, removal and installation.

(2) Hand tighten the mounting capscrews.

(3) Shift the cover until the oil pan surface of the cover is flush with the oil pan surface of the cylinder block.

(4) Check the rear cover alignment. Mount the dial indicator on the crankshaft with the point of the indicator on the machine surface of the rear cover trunnion. Rotate the crankshaft and check the alignment. Maintain runout within 0.005 inch.

(5) Tighten the mounting capscrews to 20/25 ft-lbs.

b. Install flywheel and flywheel housing (para 4-50).

## Section XXI. CRANE ENGINE CONNECTING ROD AND PISTON ASSEMBLIES

**4-71. Removal and Disassembly**

a. Remove cylinder head (para 4-41).

b. Remove oil pump assembly (para 4-54).

c. Scrape all carbon from top of cylinder liner bore.

d. Refer to figure 4-23 and remove connecting rod bolt nuts. Remove cap and bearing shells.


*Figure 4-23. Crane engine connecting rod and piston assembly, removal end installation.*

e. Push piston and connecting rod from cylinder liner with a wooden stick.

f. Reassemble connecting rods, caps, bolts and nuts as they are taken out. These parts are not interchangeable; number each assembly for identification.

g. Tape bearing halves together and identify by cylinder number as removed.

h. Refer to figure 4-24 and remove piston pin snap rings and remove piston pins.

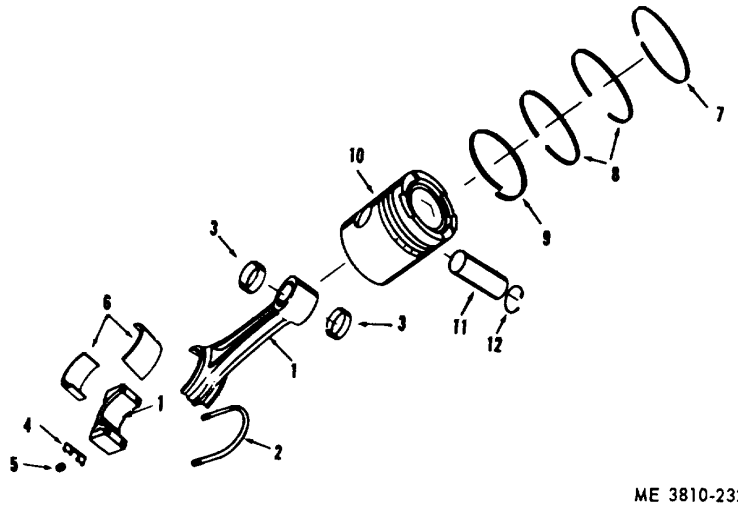



*Figure 4-24. Crane engine connecting rod and piston assembly, exploded view.*

| | | | |
|---|---|---|---|
| 1 Connecting rod | 4 Lockplate | 7 Ring | 10 Piston |
| 2 Bolt | 5 Nut | 8 Ring | 11 Pin |
| 3 Bushing | 6 Bearing | 9 Ring | 12 Ring |

**NOTE**

**Heat aluminum pistons in hot water before removal of piston pins. This will permit pin to be pushed out easily without distorting piston.**

**4-72. Cleaning, Inspection and Repair**

*a.* Clean all parts with an approved cleaning solvent and dry thoroughly.

*b.* Check connecting rods, caps, and U-bolts by magnetic inspection, for cracks. If cracks are detected, replace rod and cap as an assembly.

*c.* Check connecting rod piston pin bushing diameter to see that it is within tolerance limits (table 1-1).

*d.* Check connecting rod alignment. (Refer to table 1-1 for tolerance and wear limits). Replace a defective unit.

*e.* Check the pistons for piston ring groove clearance. Hold new ring flush with piston land and insert 0.006 inch feeler gage. If gage enters groove, wear is excessive and piston must be replaced.

*f.* Check piston ring gap by inserting each compression ring in mating cylinder liner, seating it squarely with a piston head in an unworn surface of liner.

*g.* Measure ring gap with feeler gage. (Refer to table 1-1 or allowable tolerances).

*h.* If necessary file ends of the rings to obtain the minimum ring gap.

**CAUTION**

**Never file chrome plated piston rings.**

*i.* Check piston skirt diameter with micrometers at right angles to piston pin bore. (Refer to table 1-1 for allowable wear limits and tolerances).

*j.* Check piston pin bore and piston outside diameter. (Refer to table 1-1 for allowance tolerances).

*k.* Replace all damaged or defective parts as necessary. Always replace connecting rod bearings at matched sets.

**4-73. Reassembly and Installation**

*a.* Refer to figure 4-24 and assemble connecting rod and piston assemblies as shown.

**NOTE**

**Heat the pistons in hot water before installing the piston pins to provide easy pin installation and prevent piston distortion.**

*b.* Check the side clearance of the connecting rod (the piston pin end) to the piston boss with a feeler guage. Clearance will be 0.040/0.050 inch.

*c.* Lubricate piston and rings with clean lubrication oil and install chrome compression ring in top piston groove. All rings must be installed with the word "Top" toward the top of the piston. Stagger ring gaps so they are not in line with each other or with piston pin.

*d.* Install connecting rod and piston assembly matching cylinder and numbers stamped on connecting rod. Locate number on connecting rod toward camshaft side of engine. Install connecting rod bearing cap so numbered side of cap is matched with numbered side of rod. Lubricate U-bolts, nuts, and lock plates and assemble.

*e.* Tighten front U-bolt nuts, then rear U-bolts nuts to 15.'20 foot pounds. Then tighten each nut to 30 foot pounds in same sequence.

*f.* Loosen all nuts completely to remove tension, then repeat step (d) above.

*g.* Advance each nut one-half hex (30'-). Finish tightening by advancing additional half hex (300).

*h.* Check torque in clockwise direction. If less than 38 foot-pounds is required to break nut loose after tightening sequence is completed, remove U-bolts and replace with new U-bolts.

*i.* Check side clearance between connecting rod and crankshaft on both sides of connecting rod by tapping rod from side to side with rubber mallet and inserting feeler gage as shown in figure 4-25. Clearance must not be less than 0.008 inch.

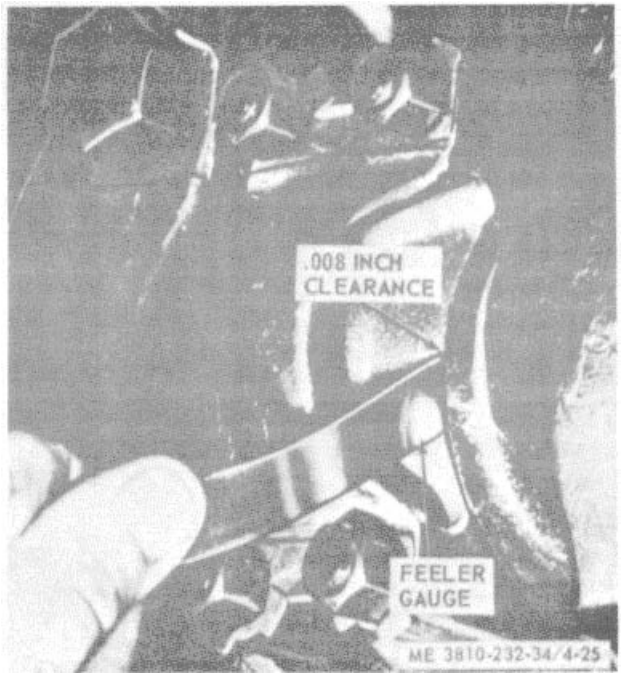



*Figure 4-25. Checking rod to crankshaft clearance.*

*j.* Lock nuts in position with lockplates. After each piston and rod assembly is installed, bar engine over to see if piston is binding in liner.

*k.* Install oil pump assembly (para 4-56).
*l.* Install cylinder head (para 4-44).

## Section XXII. CRANE ENGINE CRANKSHAFT AND BEARINGS

### 4-74. Removal and Disassembly

*a.* Remove connecting rod and piston assemblies (para 4-71).

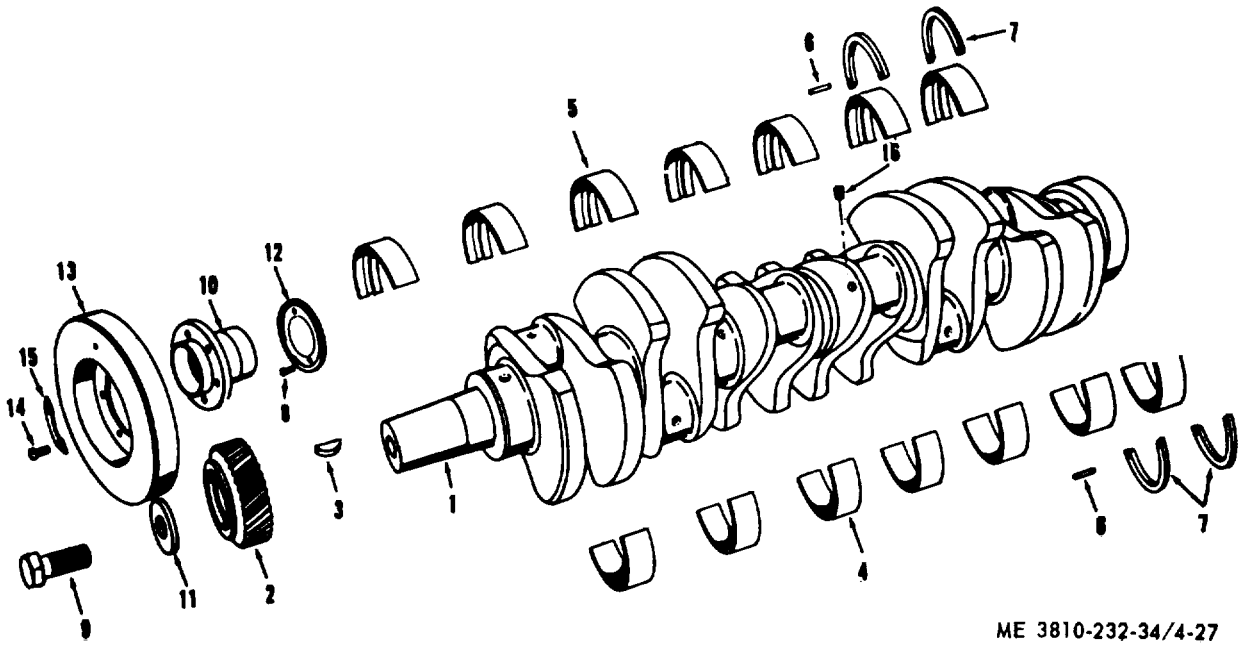
*b.* Remove the gear case cover (para 4-62).

*c.* Remove the rear cover and seal (para 4-68).

*d.* Remove the flywheel and flywheel housing (para 4-48).

*e.* Refer to figure 4-26 and 4-27 and remove and disassemble crankshaft and main bearings.


*Figure 4-26. Crane engine crankshaft and main bearings, removal and installation.*




| | | | |
|---|---|---|---|
| 1 | Crankshaft | 9 | Capscrew |
| 2 | Gear | 10 | Hub |
| 3 | Key | 11 | Retainer |
| 4 | Bearing | 12 | Slinger |
| 5 | Bearing | 13 | Damper |
| 6 | Pin | 14 | Capscrew |
| 7 | Ring | 15 | Lockplate |
| 8 | Capscrew | 16 | Plug |

*Figure 4-27. Crane engine crankshaft and main bearings, exploded view.*

*f.* Tape upper and lower main bearing shells together and identify by cylinder number.

**4-75. Cleaning, Inspection and Repair**

*a.* Clean all parts with an approved cleaning solvent and dry thoroughly.

*b.* Inspect crankshaft gear. If chipped, cracked or broken, replace.

*c.* Inspect crankshaft journals and if worn more than 0.002 inches below low limit or are out-of-round in excess of 0.0015 inches, regrind crankshaft (table 1-1).

*d.* Remove all pipe plugs and clean all drilled oil passages with a rod and rag.

*e.* Perform a magnetic inspection on crankshaft for cracks, breaks, or signs of fatigue.

*f.* Inspect bearing shells for chipped, flaked, or scored condition and wear exceeding 0.002 inch. Replace defective or worn bearing shells.

*g.* Regrind or replace a worn or defective crankshaft as necessary. (Refer to table 1-1 for allowable wear tolerances).

**CAUTION**

**To regrind the crankshaft the operation must be performed by a shop equipped with adequate equipment and fully trained personnel.**

**4-76. Reassembly and Installation**

*a.* Refer to figures 4-26 and 4-27 and reassemble and install crankshaft and main bearings. Coat main bearing shells thoroughly with an approved high pressure grease.

*b.* Lay the upper main bearing shells in the block bores, engaging the locking tangs with the recesses in the block bores. Index the drilled oil passage holes in the block and shells.

*c.* Place the crankshaft carefully in place.

*d.* 'Roll the upper thrust rings into position with the grooved sides facing the crankshaft flanges e. Install the lower bearing shells.

*f.* Position the lower thrust rings over the dowels on No. 7 main bearing cap.

*g.* Lubricate the threads of the capscrews and lockplates with clean lubricating oil.

*h.* Install the caps with the numbers (corresponding to the upper main bearings) toward the camshaft side of the engine.

*i.* Install capscrews by tightening alternately and slowly to seat the caps in position.

**NOTE**

**Driving the main bearing caps into position may jar lower main bearing shells out of position.**

*j.* Tighten the main bearing capscrews alternately to 65/75 ft-lbs. to set shells, caps and lockplates, then advance to 140/150 ft.-lbs.

*k.* Loosen completely to remove all tension. Retighten to 45/50 foot-pounds.

*l.* Scribe capscrew heads to coincide with permanent mark on cap or scribe each cap in line with hex corner. Advance each bolt 600 (one hex) from position described in step (e) above. This will align scribed mark (or next corner) with mark on main bearing cap. Tighten each side of bearing a little at a time and as evenly as possible until operating position is reached.

*m.* Check crankshaft end clearance (fig. 4-28) by barring crankshaft toward front and rear. Total gauge reading should be 0.004/0.015 inch. If end clearance exceeds 0.022 inch, new thrust rings and/or crankshaft must be installed.

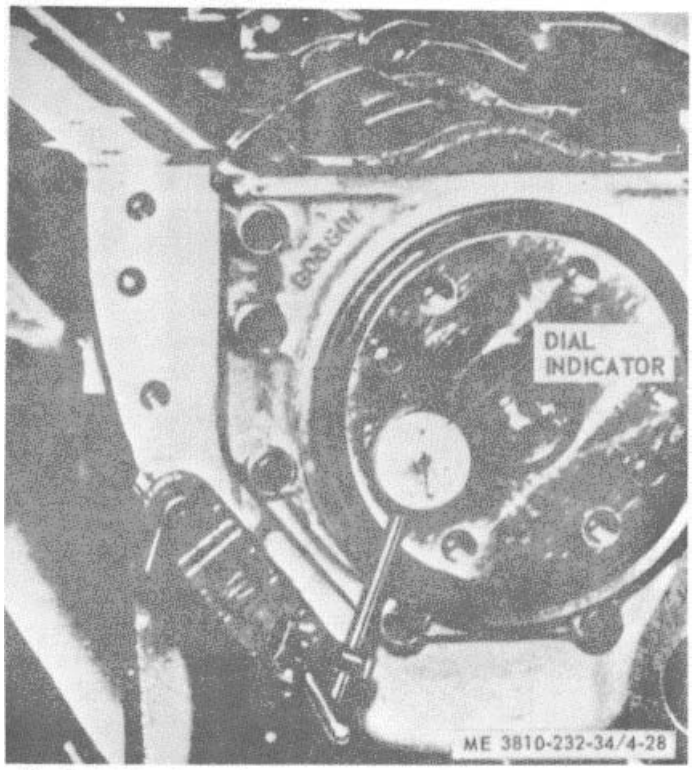



*Figure 4-28. Checking crankshaft and clearance.*

*n.* Bend tab on all lockplates to secure bolts.

*o.* Install connecting rod and piston assemblies (para 4-73).

# CHAPTER 5

# CARRIER REPAIR INSTRUCTIONS

## Section I. CARRIER TORQUE CONVERTER ASSEMBLY

### 5-1. General

The torque converter shaft carries engine rotation to the carrier transmission. In the transmission air-actuated clutches engage gears of the inner and outer trains to obtain the gear ratio selected by the shift lever in the carrier cab. From the transmission the rotation is transferred by the drive shafts to the front and rear drive axles. Here the rotation goes through a differential and then to a planetary in each drive wheel. If the speed of the torque converter output shaft approaches 1800 rpm, the converter automatically locks in whatever gear the transmission is in, thus assuring maximum efficiency from the converter. When converter speed drops and torque multiplication is again needed or whenever the transmission is shifted, the lockup automatically disengages.

### 5-2. Torque Converter Assembly

*a. Removal.*

(1) Remove engine (para 2-11).

(2) Remove torque converter assembly as instructed on figure 5-1.

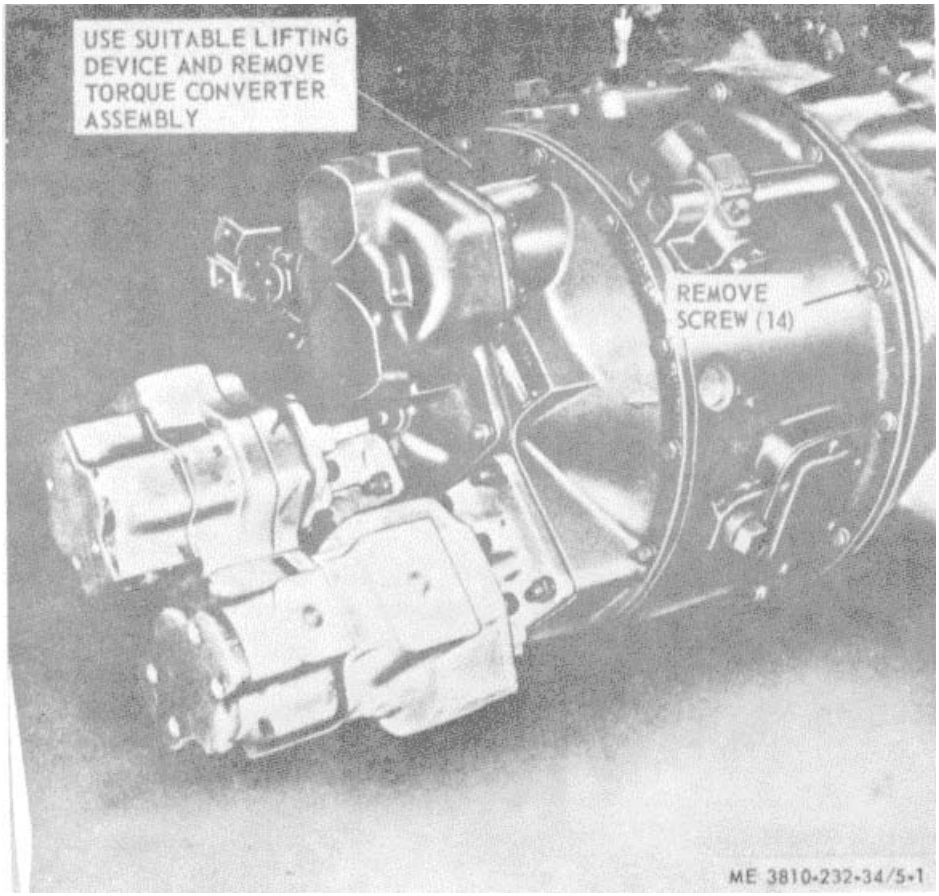



*Figure 5-1. Torque converter assembly, removal and installation.*

**CAUTION**

**Cleanliness is of extreme importance and an absolute must in the repair and overhaul of this unit. Before attempting any repairs, the exterior of the unit must be thoroughly cleaned to prevent the possibility of dirt and foreign matter entering the mechanism.**

*b. Disassembly*.

(1) Remove pump stud nuts (102, fig. 5-2), washer (103), stud (104), pump assembly (101), gasket (100), and drive sleeve (99).

(2) Remove impeller cover bearing cap screws (147). Install two bolts in threaded holes in bearing cap (122). Turn the bolts evenly and remove bearing cap and O-ring (123). Remove bearing retainer plate snap ring (146).

(3) Remove impeller-to-impeller cover screws (89) and washer (88). Using a puller, remove bearing retainer (145), bearing (125), ring (124) and turbine (137) from turbine shaft (44). Remove screw (136) and plate (135) from turbine (137).

**CAUTION**

**Secure impeller cover (144) with a chain to prevent assembly from dropping.**

(4) Block impeller cover on the outer diameter and drive turbine hub (134) from impeller bearing (86).

(5) Straighten tangs on lock plate (132) and remove screw (133), lock plate and plate (131) from cover.

(6) Remove snap ring (130), backing plate (140), inner and outer lock-up discs (128, 129), disc (141), lock up piston (142), lock up piston inner and outer sealing rings (127, 143), and O-ring (126).

(7) Remove stud (70), lockwasher (71) and nut (72) and remove turbine shaft bearing cap (33), O-rings (34, 36, 37), lube tube (35), ring (67) and shim (68). Remove lock and adapter screws (39), from adapter (66). Install

two bolts in threaded holes in adapter. Turn bolts evenly and remove adapter.

(8) Lock output gears (19) with a soft bar and remove output flange nut (13). Remove washer (11), O-ring (14), and flange (10). Remove rear housing cover screws (77), lockwashers (78) and pin (79). Remove rear cover (41). Remove bearing cup (40) and bring (42) from rear cover. Remove screw (73), lockwasher (74), cover (75) and gasket (76) from rear cover.

(9) Remove studs (7), lockwashers (8) and nuts (9). Remove the output shaft bearing cap (16), oil seal (15) shims (17). Using a split puller remove output shaft (18) and rear bearing cone (4). Remove bearing cup (5) and bring (6). Remove output gear (19), front bearing spacer (3), front bearing cone (20), bearing cup (2), snap ring (21), oil baffle (1) and oil tube (22) from rear cover.

(10) Remove turbine shaft (44), ring (47), bearing cones (45, 65) and gear (43) from converter housing (24). Remove three oil baffle retainer screws (112) and washers (111, 110) from housing. Remove the snap ring (118). Remove reaction member (84), spacer (85), bearing (86), snap rings (51, 116), roll pin (117), gear (52), sleeve (55), ball (49) and ring (53) from sleeve (54). If snap ring is tight, threaded holes are provided to pull same from sleeve.

(11) Remove plugs (23, 26, 27, 59), cover (57, 61) and the downstream pressure regulating valve assembly (25) from the converter housing (24). Disassemble the downstream pressure regulating valve as shown in part B of figure 5-2.

(12) Remove impeller and baffle assembly (114, 92) from impeller hub (115). Remove screws (121) and washers (120) and remove flywheel ring gear bag assembly from impeller (114). Remove O-ring (148) from flywheel ring gear bag assembly. Remove spacer (85), bearing (86), 0-ring (87) and snap ring (116) from impeller hub (116). Remove roll pin (117) from spacer (85). Remove bring (113), screw (91) and plate (90) from impeller (114). Remove oil seal (93) from oil baffle (92). Remove pump driven gear snap ring (83), gear (82) and bearing (81). Remove snap rings (108, 109), bearing (94), and washers (95, 96). Using a soft bar tap pump shaft assemblies (80) from converter housing.

(13) Remove screws (50) from sleeve (54). Remove sleeve (54). If inner turbine shaft bearing cup (46) is to be replaced, remove using suitable puller.

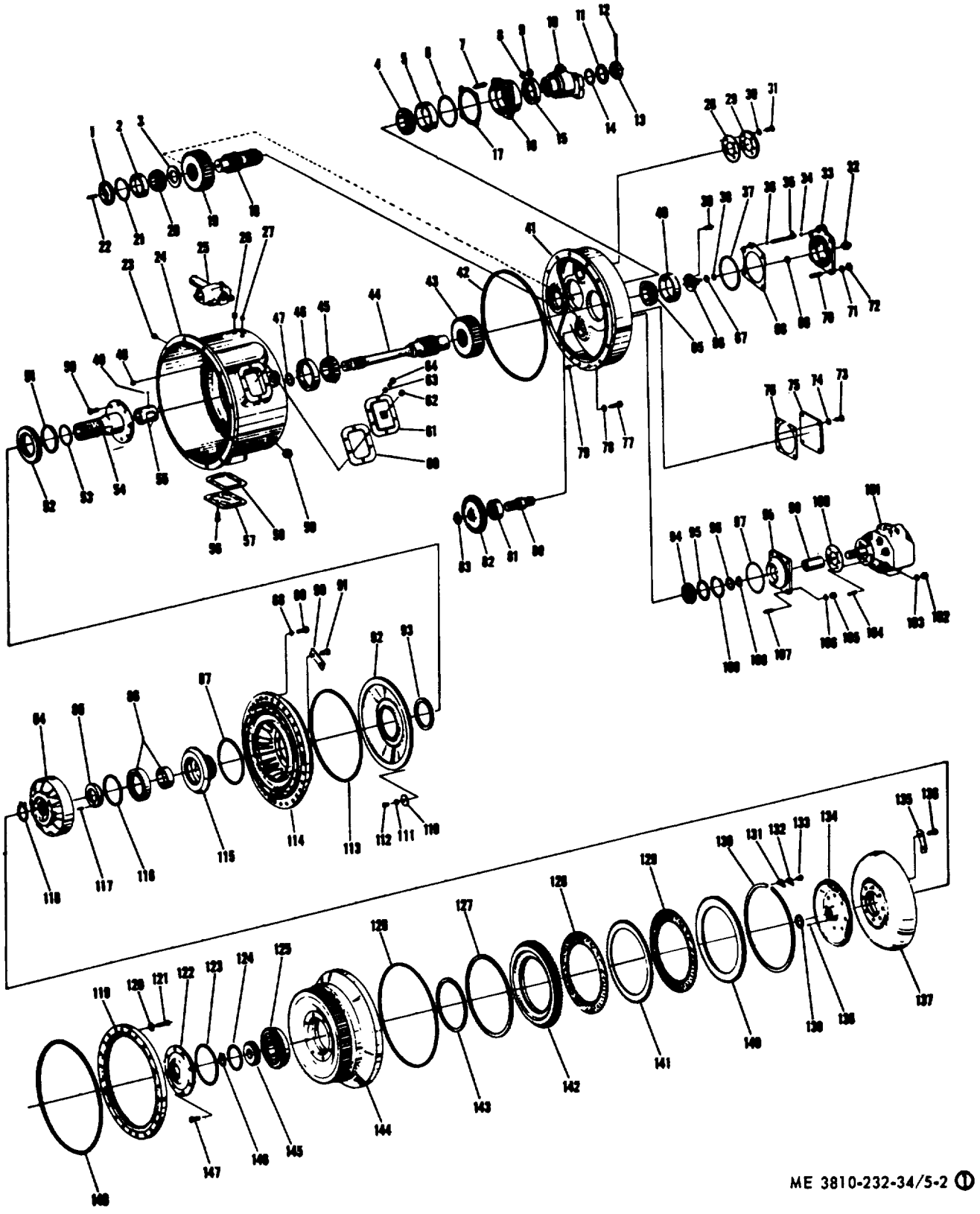
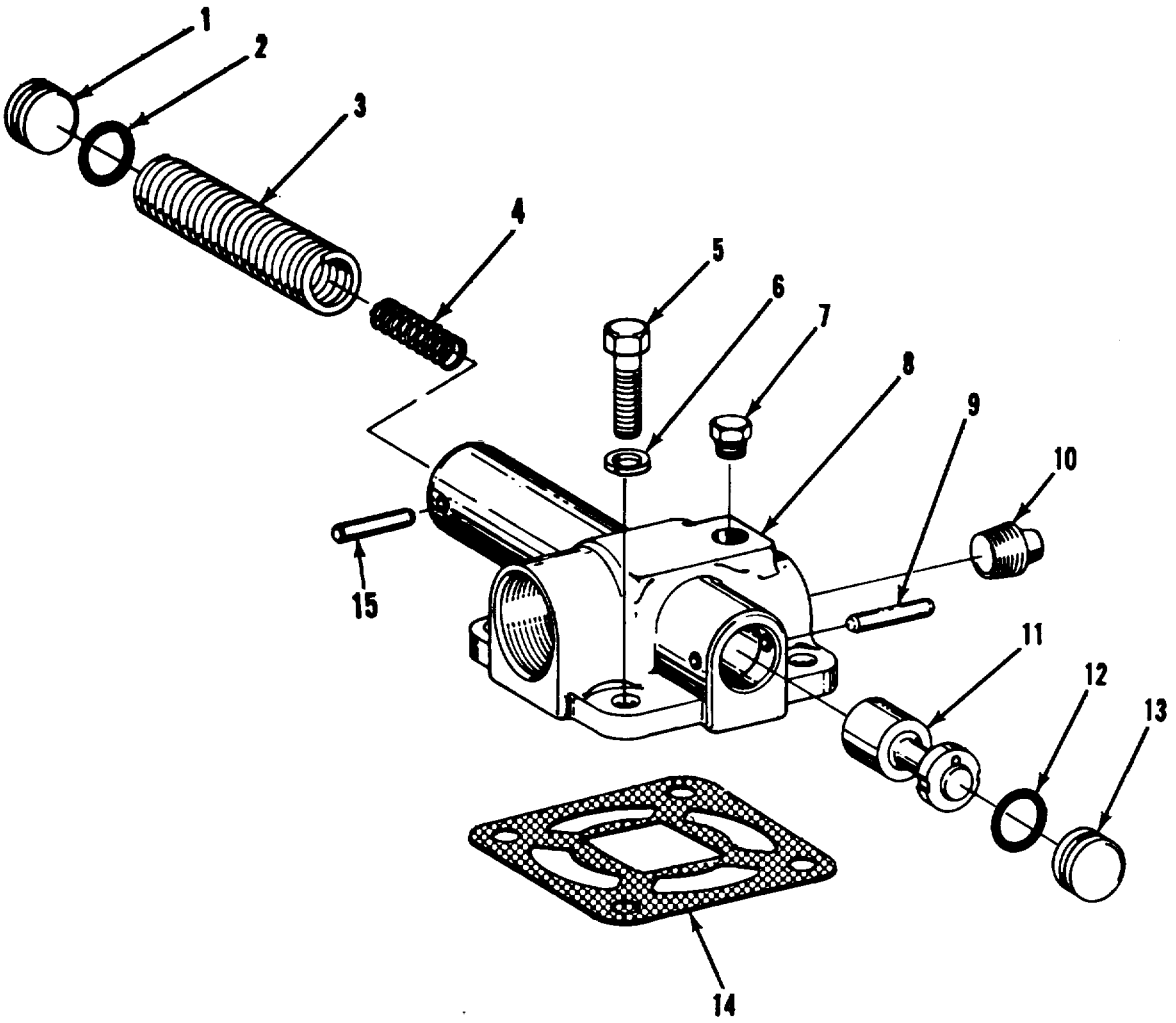



*Figure 5-2. Torque converter assembly, exploded view.*

| | |
|---|---|
| 1 | Oil baffle |
| 2 | Bearing Cup |
| 3 | Bearing spacer |
| 4 | Bearing cone |
| 5 | Bearing cup |
| 6 | O-ring (1/8x4-5/8x4-7/8) |
| 7 | Stud |
| 8 | Lockwasher (1/2x.509x.879) |
| 9 | Nut (1/2-20x6/16) |
| 10 | Flange |
| 11 | Washer |
| 12 | Pin (3/16x2) |
| 13 | Nut |
| 14 | O-ring (1/16x2-1/8x2-1/2) |
| 15 | Oil seal |
| 16 | Bearing cap |
| 17 | Shim |
| 17A | Shim |
| 17B | Shim |
| 18 | Shaft |
| 19 | Gear (34T) |
| 20 | Bearing cone |
| 21 | Snap ring |
| 22 | Oil tube |
| 23 | Plug |
| 24 | Housing |
| 25 | Pressure regulating valve assembly |
| 26 | Pipe plug (1/4) |
| 27 | Pipe plug (1/4) |
| 28 | (Deleted) |
| 29 | Deleted) |
| 30 | (Deleted) |
| 31 | (Deleted) |
| 32 | (Deleted) |
| 33 | Bearing cap |
| 34 | O-ring (3/x32/9x16) |
| 35 | Lube tube |
| 36 | O-ring (8/x8/8x9/16) |
| 37 | O-ring (1/8x4-4/4) |
| 38 | Not used |
| 39 | Screw (3/8/-24x3/4) |
| 40 | Bearing cup |
| 41 | Cover |
| 42 | O-ring |
| 43 | Gear (38T) |
| 44 | Shaft |
| 45 | Bearing cone |
| 46 | Bearing cup |
| 47 | Piston ring |
| 48 | Pie plug-(1/4) |
| 49 | Ball (1/4) |
| 50 | Screw (1/2x18x1/4)) |
| 51 | Snap ring |
| 52 | Gear(8) |
| 53 | Piston ring |
| 54 | Sleeve |
| 55 | Sleeve |
| 56 | Lockwasher |
| 57 | Cover |
| 58 | Gasket |
| 59 | Plug (1/4) |
| 60 | Gasket |
| 61 | Cover |
| 62 | Plug (3/8) |
| 63 | Lockwasher |
| 64 | Caper |
| 65 | Bearing cone |
| 66 | Adaptor |
| 67 | Piston ring |
| 68 | Shim |
| 68A | Shim |
| 68B | Shim |
| 69 | (Deleted) |
| 70 | Stud |
| 71 | Lockwasher (1/2x.509x.879 |
| 72 | Nut (1/2-20x5/16) |
| 73 | Screw (1/2x13x3/4) |
| 74 | Lockwasher (1/2x.509x.879) |
| 75 | Cover |
| 76 | Gasket |
| 77 | Screw |
| 78 | Lockwasher |
| 79 | Pin |
| 80 | Shaft |
| 81 | Bearing |
| 82 | Gear |
| 88 | Snap ring |
| 84 | Reaction member |
| 86 | Spacer |
| 88 | Lockwasher |
| 87 | O-ring |
| 88 | Lockwasher |
| 89 | Screw |
| 90 | Plate |
| 91 | Screw |
| 92 | Oil baffle |
| 93 | Oil seal |
| 94 | Bearing |
| 95 | Washer-outer |
| 96 | Washer-inner |
| 97 | (Deleted) |
| 98 | (Deleted) |
| 99 | Sleeve |
| 100 | Pump gasket |
| 101 | Pump |
| 102 | Nut |
| 103 | Lockwasher |
| 104 | Stud |
| 106 | (Deleted) |
| 106 | (Deleted) |
| 107 | (Deleted) |
| 108 | Snap ring |
| 109 | Snap ring |
| 110 | Washer |
| 111 | Lockwasher |
| 112 | Screw |
| 113 | 0-ring |
| 114 | Impeller |
| 115 | Hub |
| 116 | Snap ring |
| 117 | Roll pin |
| 118 | Snap ring |
| 119 | Flywheel ring gear bag assy |
| 120 | Washer |
| 121 | Screw |
| 122 | Bearing cap |
| 123 | O-ring |
| 124 | Piston ring |
| 125 | Bearing |
| 126 | O-ring |
| 127 | Piston ring-outer |
| 128 | Lock-up inner disc |
| 129 | Lock-up inner disc |
| 130 | Snap ring |
| 131 | Plate |
| 132 | Plate |
| 133 | Screw |
| 134 | Hub |
| 135 | Plate |
| 136 | Turbine |
| 137 | Turbine |
| 138 | Pin |
| 139 | Ring |
| 140 | Plate |
| 141 | Disc |
| 142 | Piston |
| 143 | Piston |
| 144 | Cover |
| 145 | Retainer |
| 146 | Snap ring |
| 147 | Cap screw |
| 148 | O-ring |

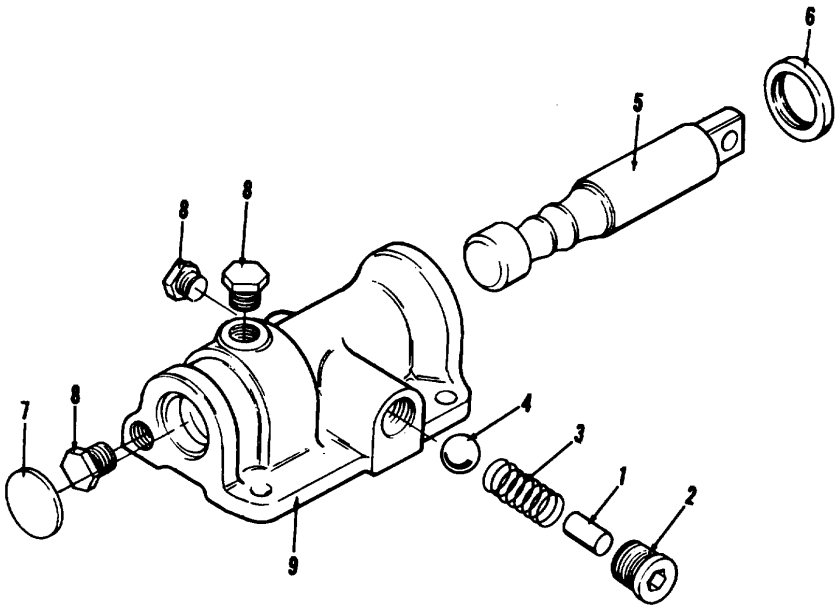



ME 3810-232-34/5-2 ②

| | | | |
|---|---|---|---|
| 1 | Piston stop | 9 | Roll pin |
| 2 | O-ring | 10 | Pipe plug |
| 3 | Spring | 11 | Piston |
| 4 | Spring | 12 | O-ring |
| 5 | Screw | 13 | Piston stop |
| 6 | Lockwasher | 14 | Gasket |
| 7 | Pipe plug | 15 | Roll pin |
| 8 | Valve | | |

B—Downstream pressure regulating valve

*Figure 5-2. (2) —Continued.*




1 Detent pin
2 Detent plug
3 Detent spring
4 Detent ball
5 Lock-up valve spool
6 Valve spool oil seal
7 Valve housing welch plug
8 Pipe plug
9 Lock-up valve housing

C—Lock-up Valve

*Figure 5-2. (3) —Continued.*

*c. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent anl dry thoroughly.

(2) Inspect bearings, cages and cups for wear, chipping or nicks. Replace defective or damaged bearings, both cone and cup as a set.

(3) Inspect gears and shafts with magnetic inspection. Inspect all gears for wear, pitting, chipping, nicks, cracks, or scoring. Replace defective gears.

(4) Inspect shafts and quills to make certain they are not sprung, bent, or splines twisted. Replace defective shafts.

(5) Inspect housing, covers, and bearing caps and see that mating surfaces, bearing bores, etc., are free from nicks or burrs. Check all parts carefully for evidence of cracks or conditions which would cause subsequent oil leaks or failures. Repair or replace defective parts.

(6) Replace all spring loaded oil seals, O-rings, metal sealing rings, gaskets, and snap rings.

*d. Reassembly* (fig. 5-2).

(1) Install sleeve (54). Install support self locking screws (50) and tighten 70 to 86 ft-lbs torque. With pump driven gear (82) in position, install pump shaft (80) and bearing assembly (81) through rear of case and into pump driven gear. Install pump bearing retainer washer (95) and ring (109). Install pump driven gear to snap ring (83). Repeat procedure for all pump shafts and gears.

(2) Apply a thin coat of No. 2 Permatex to outer diameter of oil seal (93) and press into bore of oil baffle (92). Lip of seat must be upward.

**NOTE**

**Before installing oil baffle remove impeller hub bolts and install new impeller to hub O-ring (87). Install oil baffle on impeller and hub assembly. Use caution as not to damage oil seal. Install pump drive gear (52) and snap ring (51). Install oil baffle O-ring (118). Lubricate O-ring with type "A" automatic transmission fluid. Install stator support sealing ring (58).**

(3) Install impeller and oil baffle assembly over stator support and into converter housing. Use caution not to damage oil baffle O-ring. Install impeller hub bearing (86). Press roll pin

(117) in reaction member (84). Press spacer (85) on roll pin. Install reaction member on stator support and secure with snap ring (118).

(4) Install oil baffle washer (110) and lockwasher (111) on baffle screws (112). Install bolts and washers in converter housing. Tighten evenly and securely. Using a soft bar install turbine shaft inner bearing cup (46).

(5) Install turbine shaft inner bearing cone (45) and gear (43) and outer bearing cone (65) on shaft (44). Install piston ring (47). Block converter housing on pilot end and install turbine shaft assembly in converting housing. Position output shaft inner bearing cone (20) bearing spacer (3) and gear (19) in cover (41). Press bearing cone (4) on gear (19). Turn shaft in output gear and cover over and position gear (19) in output gear and spacer. Press output shaft into inner bearing.

(6) Apply a thin coat of Permatex No. 2 on the outer diameter of the output shaft oil seal (15). Press oil seal in bearing cap (16) with lip of seal down. Install new O-ring (6) on output shaft bearing cap. Install bearing cap on output shaft.

(7) Install stud nuts (9) and tighten securely. This is to insure proper seating of taper bearings. Loosen stud nuts. Tighten stud nuts evenly finger tight, this will prevent bearing cap from moving while selecting shims (17). Check gap between bearing cap and rear cover with shims used as a feeler gauge. Remove sufficient shims to produce a .002" tight condition. Example: Gap is .010" final shim pack thickness to .008". Install shim pack (17) bearing cap (16) stud lockwasher (8) and stud nuts (9). Tighten nuts to 47 to 55 ft-lbs. torque.

(8) Install converter housing to rear cover O-ring (42). Install rear cover and output shaft on converter housing. Install rear cover screws (77) and lockwasher (78). Tighten bolts to 35 to 45 ft-lbs. torque. Using a soft bar, lock converter output gears. Install output flange (10) flange O-ring (14) washer (11) and nut (13). Tighten flange nut 250 to 300 ft-lbs torque.

(9) Install turbine shaft outer bearing cup (40) in bearing cap (33). Install bearing cap on turbine shaft. Install stud nuts (72) and tighten securely. This is to insure proper seating of taper bearings. Loosen stud nuts. Tighten stud nuts evenly finger tight, this will prevent bearing cap from moving while selecting shims (68). Check gap between cap and rear cover with shims used as a feeler gauge. Add sufficient shims to produce a .002" loose condition. Example: Gap is .010"; final shim thickness to be .012". Remove $4 bearing cap. Install adapter (66) or turbine shaft. Install screws (39) nad tighten 20 to 25 ft-lbs. torque. Lockwire to prevent loosening.

(10) Install O-ring (36) on lube tube (35). Using bearing cap as a guide for lube tube flange, install O-ring (37) in position install bearing cap. Install lockwashers (71) and nuts (72). Tighten nuts 47 to 55 ft-lbs. torque.

(11) Install inner piston ring (143), outer piston ring (127), and lock-up piston (142) in impeller cover (144).

(12) Install one bronze inner disc (128) against lock-up piston. Install one steel outer disc (129). Install bronze inner disc against steel outer disc. Install lock-up backing plate (140) with flat side of plate against the last bronze disc. Install backing plate snap ring (130) with split in ring at lock plate position. Install plate (131), plate (132) and screw (133). Tighten bolt to 10 ft-lbs. torque. Bend tangs of bolt lock over the head of the bolt.

(13) Install turbine and lock-up hub (134) in impeller cover (144). Turn turbine slowly to allow lock-up hub to engage in inner lock-up discs. Do not force this operation. When turbine is in full position in lock-up discs, turn assembly over and block turbine to prevent it from dropping out of position. Install impeller cover to turbine hub pin (138). Position impeller to impeller cover 0-ring (126). Install turbine and lock-up cover on turbine shaft.

(14) Align holes in impeller with holes in impeller cover. Install screw (89) and lockwashers (88). Tighten bolts evenly and securely. Install bearing retainer cover (145) on turbine shaft. Install bearing plate snap ring (146). Install piston ring (124). Position new O-ring on impeller cover bearing cap (122). Install bearing cap on impeller cover. Install self-locking bearing cap screws (147) in bearing cap and tighten 45 to 60 ft-lbs. torque.

(15) Install pump drive-sleeve (99) and pump (101) on converter housing rear cover. Install lockwashers (103) and stud nuts (102). Tighten securely.

*e. Installation.*

(1) Install torque converter assembly as instructed in figure 5-1.

(2) Install engine (para 2-11).

*f. Service Machine After Torque Converter Overhaul.*

(1) The torque converter, transmission and its allied hydraulic system are important links in the drive line between the engine and the wheels. The proper operation of either unit

depends greatly on the condition and operation of the other, therefore, whenever repair or overhaul of one unit is performed, the balance of the system must be considered before the job can be considered completed.

(2) After the overhauled or repaired torque converter has been installed in the machine, the transmission, oil cooler, filter and connecting hydraulic system must be thoroughly cleaned. This can be accomplished in several manners and a degree of judgment must be exercised as to the method employed.

(3) The following are considered the minimum steps to be taken: (a) Drain the entire system thoroughly.

*(b)* Disconnect and clean all hydraulic lines. Where feasible hydraulic lines should be removed from machine for cleaning.

*(c)* Replace oil filter elements, cleaning out filter cases thoroughly.

*(d)* The oil cooler must be thoroughly cleaned. The cooler should be "back flushed" with oil and compressed air until all foreign material has been removed. Flushing in direction of normal oil flow will not adequately clean the cooler. If necessary radiator and cooler assembly should be removed from machine for cleaning, using oil, compressed air and steam cleaner for that purpose. DO NOT use flushing compounds for cleaning purposes.

*(e)* Remove transmission sump pan and screen. Clean thoroughly. Use new gasket when reassembling.

*(f)* Remove clutch covers and clutch assemblies. Clean disassembled clutch components thoroughly, check for wear.

*(g)* Remove transmission control cover and check it for foreign material. Check inside of transmission case, gears, shafts and bearings for presence of foreign materials. If presence of considerable foreign material is noted inside of case and clutch components, it will be necessary that transmission be disassembled and cleaned thoroughly. DO NOT attempt to clean by use of flushing compounds.

*(h)* Reassemble all components and using oil specified in the Lubrication Order, fill torque converter and transmission through filler opening until fluid comes up to FULL mark on transmission dipstick. Reinstall fill plug and dipstick and run engine two minutes at 500-600 rpm to prime torque converter, and hydraulic lines. Recheck level of fluid in transmission with engine running at idle (500-600 rpm) and add quantity necessary to bring level up to FULL mark on dipstick. Recheck with hot oil (180° to 2000).

*(i)* Recheck all drain plugs, lines, connections, etc., for leaks and tighten where necessary.

## Section II. CARRIER PROPELLER SHAFTS

### 5-3. General

The carrier is equipped with four propeller shafts. Each propeller shaft is equipped with two universal joints and one slip joint. Each has two flanged yokes for connecting to driving, and driven components. The propeller shafts are of tubular-type construction.

### 5-4. Propeller Shafts

*a. Removal.*

(1) Remove the torque converter to transmission propeller shaft in the numerical sequence as instructed on figure 5-3.

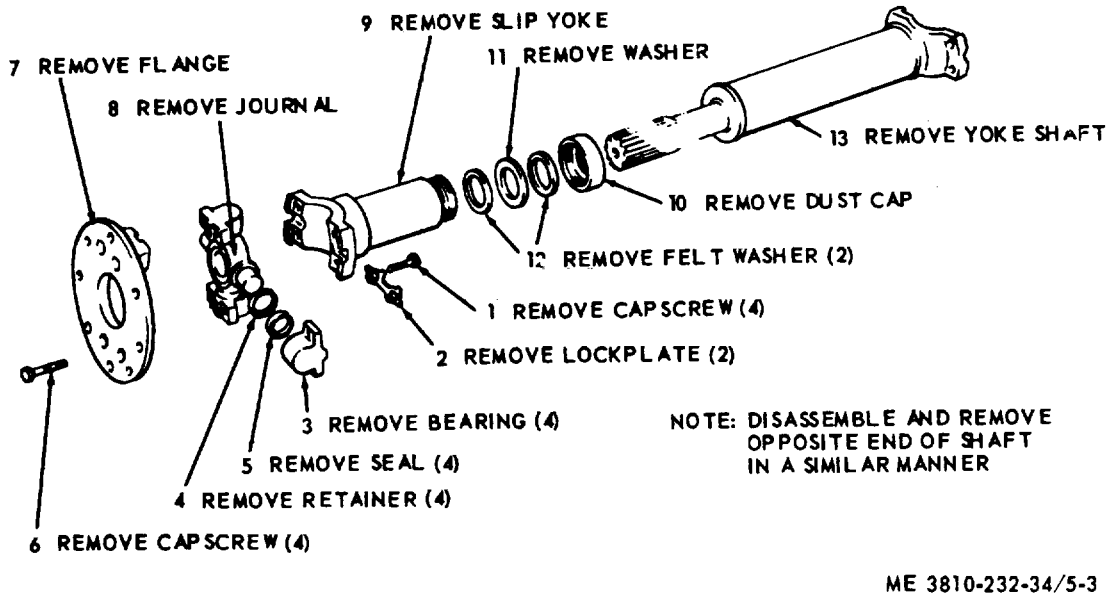



*Figure 5-3. Propeller shaft and universal joint, removal disassembly, exploded view.*

(2) Remove the rear axle, the front axle and the fan drive, propeller shafts in a similar manner.

*b. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent.

(2) Inspect the spider bearings for excessive wear and other damage. Replace spider bearings as necessary.

*c. Installation.*

(1) Install the torque converter transmission propeller shaft in the reverse of the numerical sequence as illustrated on figure 5-3.

(2) Install the front axle, the rear axle, and the fan drive, propeller shafts in a similar manner.

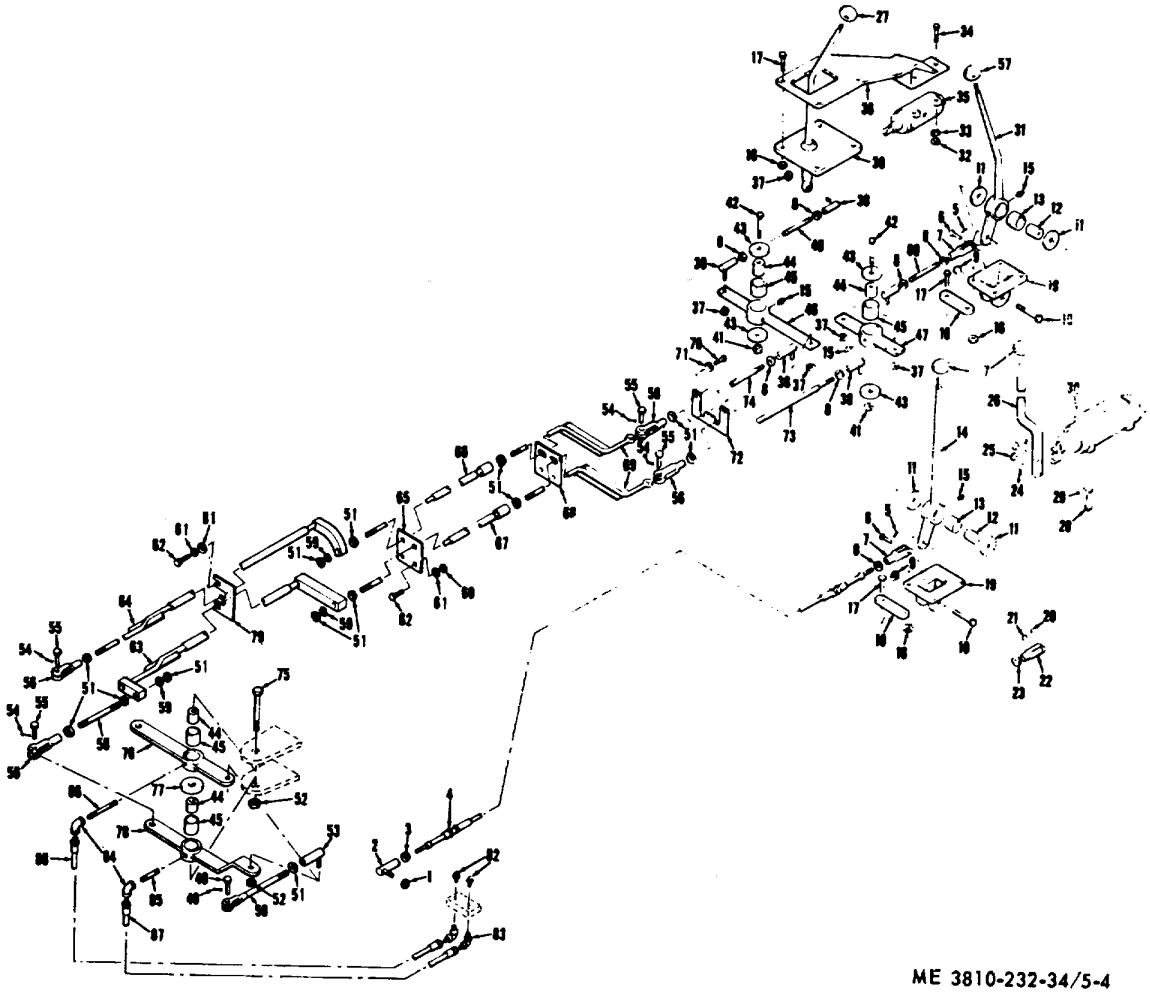
## Section III. CARRIER TRANSMISSION CONTROL

### 5-5. General

The carrier transmission controls, which consist of four control levers, the control linkage, the lock-up valve and the actuator valve, provides the control mechanism with which the carrier transmission is made to operate. The four control levers are the front axle declutch control, the transmission directional control lever, the transmission gear range selector and the utility blade control lever.

### 5-6. Removal and Disassembly

Remove and disassemble the transmission control as illustrated on figure 5-4.




1 Nut, self locking
2 Ball joint
3 Nut
4 Control cable
5 Cotter pin
6 Clevis pin
7 Clevis
8 Nut
9 Nut, self-locking
10 Capscrew
11 Spacer
12 Bushing
13 Bushing
14 Lever
15 Lube fitting
16 Nut, self locking
17 Capscrew
18 Plate
19 Lever support
20 Cotter pin
21 Clevis pin
22 Clevis
23 Nut
24 Cotter pin
25 Clevis pin
26 Arm bar
27 Knob
28 Capscrew
29 Lockwasher
30 Valve
31 Lever
32 Nut
33 Lockwasher
34 Capscrew
35 Converter lock-up valve
36 Mounting bracket
37 Nut, self locking
38 Ball joint
39 Shift lever
40 Rod bar
41 Nut, self locking
42 Capscrew
43 Spacer
44 Bushing
45 Sleeve
46 Bell crank
47 Bell crank
48 Clevis pin
49 Cotter pin
50 Rod weldment
51 Nut
52 Nut, self locking
53 Ball joint
54 Cotter pin
55 Clevis pin
56 Clevis
57 Knob
58 Rod bar
59 Lockwasher
60 Nut
61 Lockwasher
62 Capscrew
63 Control rod
64 Control rod
65 Guide
66 Control rod
67 Control rod
68 Guide
69 Control rod
70 Capscrew
71 Lockwasher
72 Bracket plate
73 Rod bar
74 Rod bar
75 Capscrew
76 Bell crank
77 Spacer plate
78 Bell crank
79 Guide
80 Rod
81 Flatwasher
82 Lube fitting
83 Elbow
84 Elbow
85 Pipe
86 Pipe
87 Pipe
88 Pipe

*Figure 5-4. Transmission controls, removal, disassembly, reassembly, and installation.*

**5-7. Cleaning, Inspection and Repair**

*a.* Clean all parts with an approved cleaning solvent.

*b.* Inspect all parts for excessive wear, bends, breaks and other damage. Replace or repair all defective parts as necessary.

**5-8. Reassembly and Installation**

Reassemble and install the control rod assembly as illustrated on figure 5-4.

## Section IV. CARRIER TRANSMISSION ASSEMBLY

**5-9. General**

*a.* The transmission and torque converter function together and operate through a common hydraulic system. To obtain maximum serviceability, they have been designed and built as separate units.

*b.* With the engine running, the converter charging pump draws oil from the transmission sump and directs it through oil filters to the regulating valve located in the transmission control cover. From the regulating valve it is then directed through the control on the transmission to the converter and to the transmission clutches.

*c.* The pressure regulating valve located in the transmission control conver remains closed until required pressure is delivered to the transmission for actuating the direction and speed clutches. A safety valve is built in the transmission control cover and will open to bypass oil only if an excessive pressure is built up due to blocked passage.

*d. Transmission Control Lever.*

(1) Model 2380. On the model, with the engine running and the directional control lever in the netural position, oil pressure from the converter pump is blocked at the control valve, and the transmission is in netural. Movement of the forward and reverse spool will direct oil, under pressure, to either the forward or reverse direction clutch as desired, and the opposite one is open to relieve pressure.

(2) Model 2385. The transmission shift and range control on the model 2385 differs from the model 2380 in several ways. Shift (forward and reverse) and range (speed) control is accomplished hydraulically, rather than mechanically, as on the model 2380. The transmission is controlled by separate valve assemblies. Connected by hydraulic hoses. The transmission control valve assembly, mounted on the transmission, directs oil to the speed and directional clutches in response to the selection made on the shift selector control valve assembly mounted in the operator's cab. In addition to making shift and range changes as mentioned, the valve assembly mounted on the transmission also includes the torque converter pressure regulator valve. Oil, under pressure, is tapped from the clutch port in the transmission control valve assembly to supply the shift selector control valve assembly located in the operator's cab. A small accumulator and check valve are incorporated in the shift selector control valve housing. The accumulator assures a pressurized oil supply to the selector valve. Pressure range is 180 to 220 psi. The shift selector tower is equipped with a hydraulic shift locknut device that is actuated when the axle oscillate lock-out is engaged. The shift selector must be in neutral before the axle oscillate device will activate. Also, the axle oscillate lock-out must be returned to release the shift selector lock.

*e.* The transmission gear train consists of six shafts:

(1) Input shaft
(2) Reverse shaft
(3) Idler shaft
(4) First and third shaft
(5) Second and fourth shaft
(6) Output shaft

*f.* The axle de-clutching unit consists of a split output shaft with a sliding splined sleeve to engage or disengage the axle. This is accomplished by shifting a lever in the operator's compartment.

**5-10. Transmission Assembly**

*a. Removal.*

(1) Remove propeller shafts (para 5-4).

(2) Remove transmission assemblies as instructed on figure 5-5.

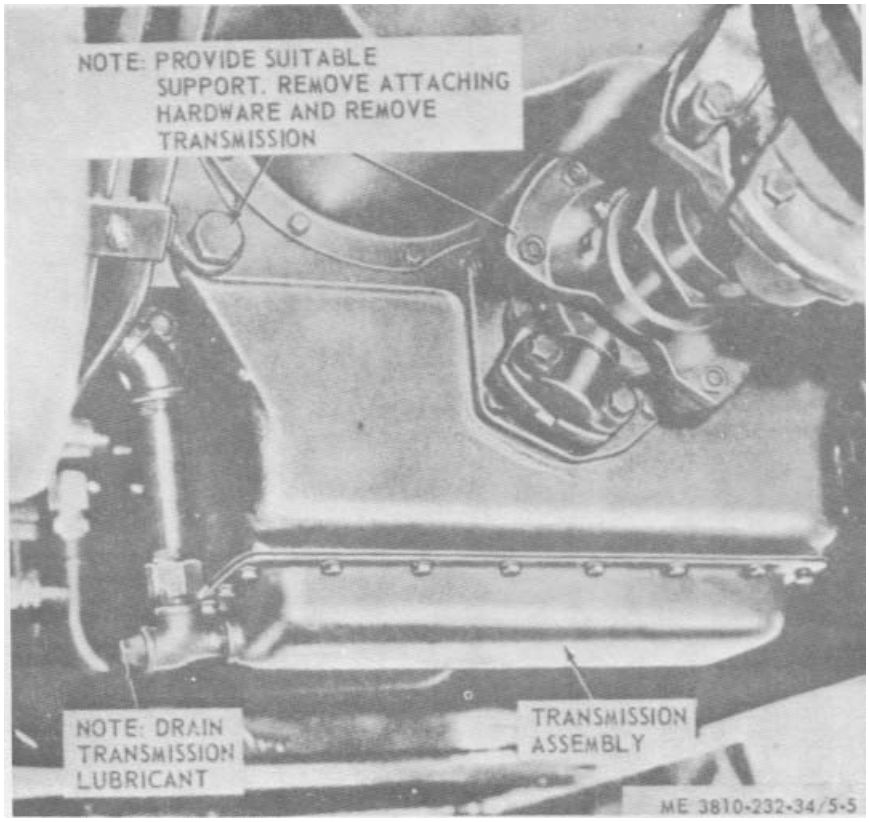



*Figure 5-5. Transmission assembly, removal and installation.*

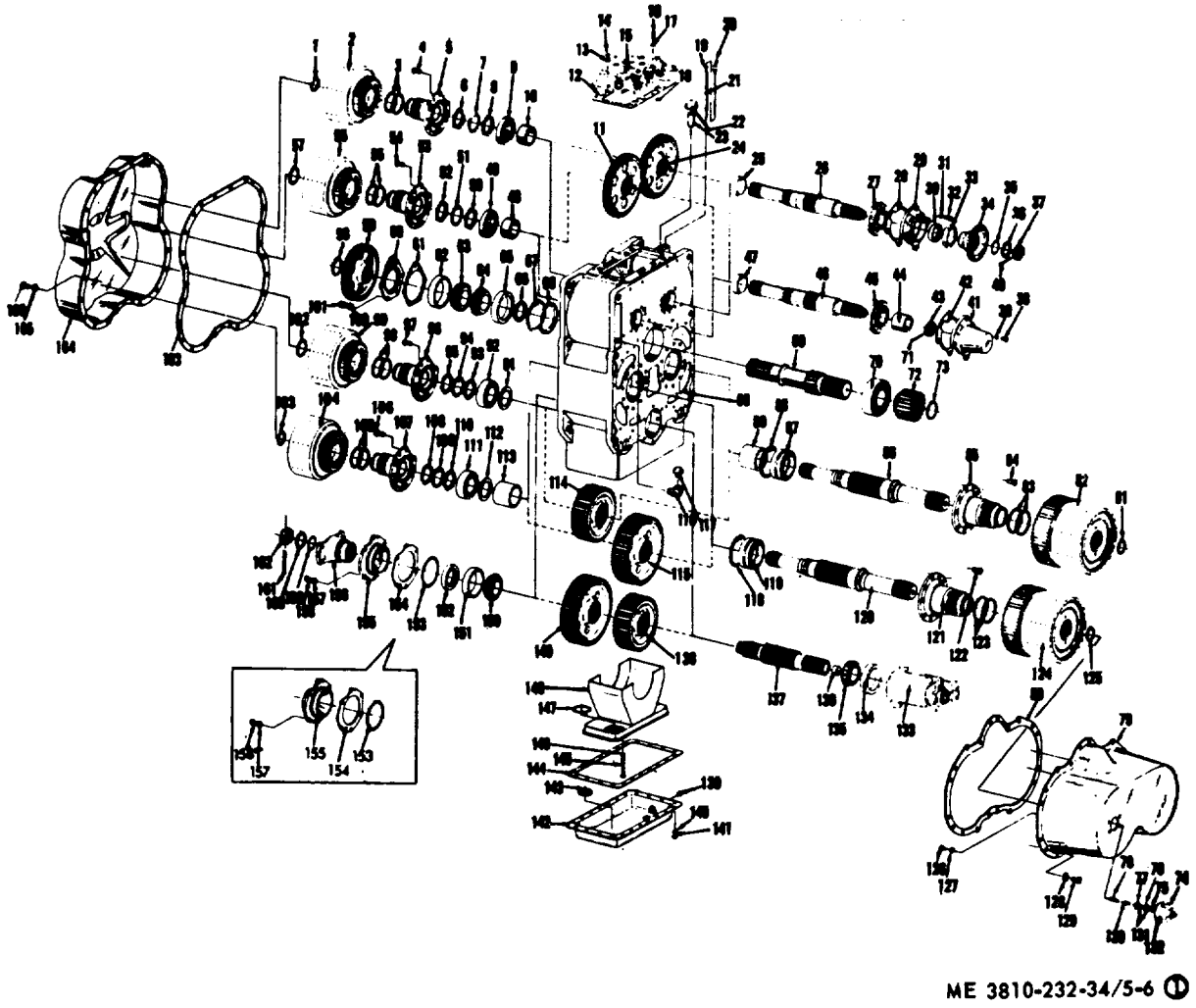
**CAUTION**

**Cleanliness is of extreme importance and an absolute must in the repair and overhaul of this unit. Before attempting any repairs, the exterior of the unit must be thoroughly cleaned to prevent the possibility of foreign matter and dirt entering the mechanism.**

*b. Disassembly.*

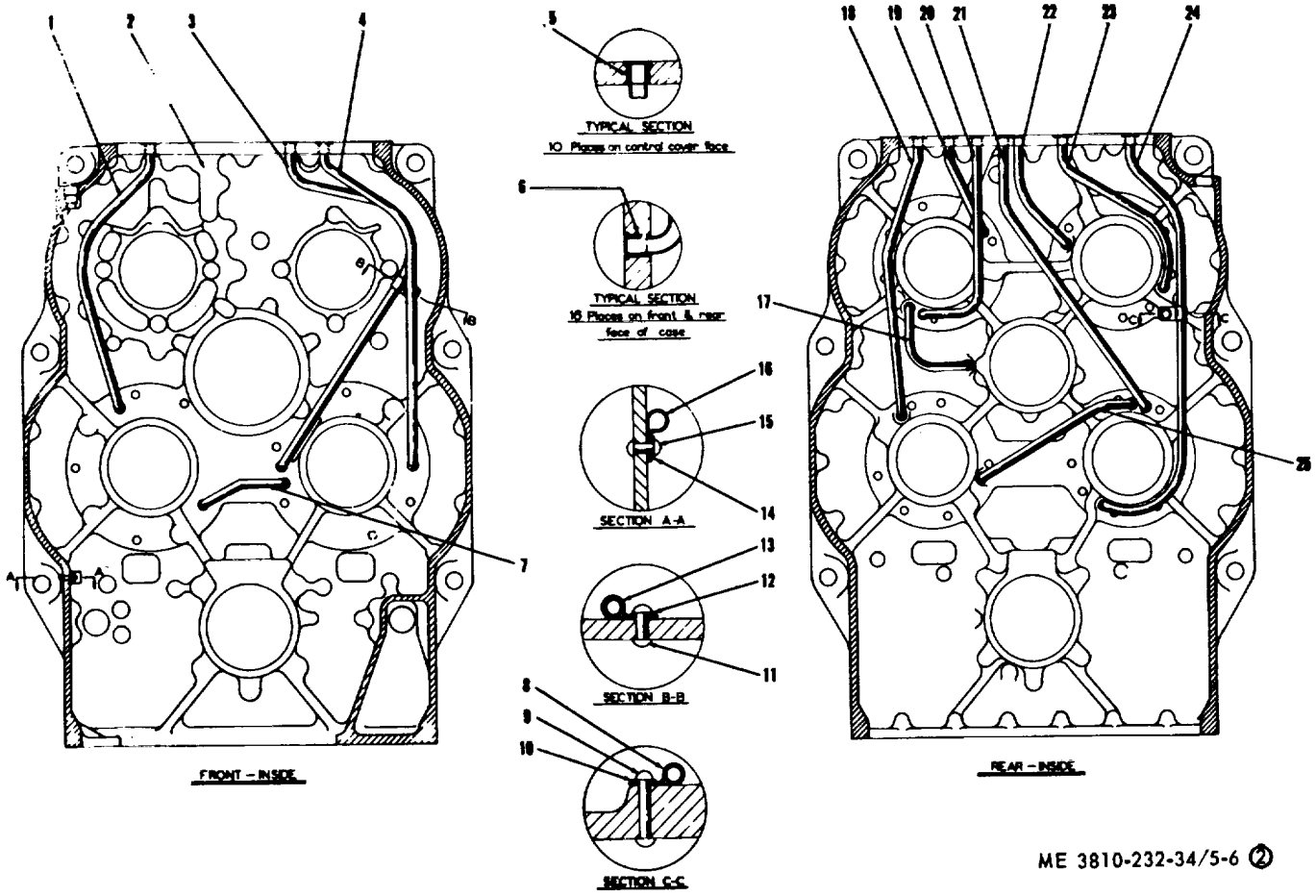
(1) Drain the unit

(2) Remove sump pan bolts (141, fig. 5-6), sump pan (142) and magnets (143). Remove sump screen bolts (145) and sump screen (148).




*A—Transmission assembly, exploded view.*
*Figure 5-6. (1) Transmission assembly.*

| | |
|---|---|
| 1 | Snapring |
| 2 | Input clutch |
| 3 | Piston ring |
| 4 | Cap screw |
| 5 | Clutch support |
| 6 | Bearing lock nut |
| 7 | Nut lock |
| 8 | Bearing lock nut |
| 9 | Rear bearing |
| 10 | Bearing spacer |
| 11 | Reverse shaft gear |
| 12 | Gasket |
| 13 | Lockwasher |
| 14 | Cap screw |
| 14A | Cap screw |
| 15 | Control valve assembly |
| 16 | Cap screw |
| 17 | Lockwasher |
| 18 | O-ring |
| 19 | Seal washer |
| 20 | Cap |
| 21 | (Deleted) |
| 22 | Filler plug |
| 23 | (Deleted) |
| 24 | Input shaft gear |
| 25 | Spacer |
| 26 | Input shaft |
| 27 | Bearing |
| 28 | Gasket |
| 29 | Bearing cap |
| 30 | Oil seal |
| 31 | Lockwasher |
| 32 | Cap screw |
| 33 | Defector |
| 34 | Input flange assembly |
| 35 | O-ring |
| 36 | Washer |
| 37 | Nut |
| 38 | Capscrew |
| 39 | Lockwasher |
| 40 | Pin |
| 41 | Bearing Cap |
| 42 | Gasket |
| 43 | Nut |
| 44 | Spacer |
| 45 | Bearing |
| 46 | Shaft |
| 47 | Spacer |
| 48 | Spacer |
| 49 | Bearing |
| 50 | Nut |
| 51 | Nut lock |
| 52 | Nut |
| 53 | Clutch support assembly |
| 54 | Cap screw |
| 55 | Piston ring |
| 56 | Reverse clutch |
| 57 | Snap ring |
| 58 | Snap ring |
| 59 | Gear |
| 60 | Bearing cap |
| 61 | Shim |
| 61A | Shim |
| 61B | Shim |
| 62 | Bearing cup |
| 63 | Bearing cone |
| 64 | Bearing cone |
| 65 | Bearing cup |
| 66 | Bearing spacer |
| 67 | Bearing snap ring |
| 68 | Oil baffle |
| 69 | Idler shaft |
| 70 | Front bearing |
| 71 | Cotter |
| 72 | Gear |
| 73 | Snap ring |
| 74 | Speedometer drive housing |
| 75 | (Deleted) |
| 76 | Bearing |
| 77 | Snap ring |
| 78 | Spring |
| 79 | Clutch cover |
| 80 | Gasket |
| 81 | Snap ring |
| 82 | Speed clutch |
| 83 | Piston ring |
| 84 | Cap screw |
| 85 | Clutch support assy |
| 86 | Shaft |
| 87 | Tapered bearing assy |
| 88 | Snap ring |
| 89 | Spacer |
| 90 | Transmission case assy |
| 91 | Spacer |
| 92 | Bearing |
| 93 | Lock nut |
| 94 | Nut lock |
| 95 | Lock nut |
| 96 | Clutch support assy |
| 97 | Cap screw |
| 98 | Piston ring |
| 99 | Speed clutch |
| 100 | Lockwasher |
| 101 | Cap screw |
| 102 | Snap ring |
| 103 | Snap ring |
| 104 | Speed clutch |
| 105 | Piston ring |
| 106 | Cap screw |
| 107 | Clutch support assy |
| 108 | Locknut |
| 109 | Nut lock |
| 110 | Lock nut |
| 111 | Roller bearing |
| 112 | Spacer |
| 118 | Spacer |
| 114 | Gear (43T) |
| 115 | Gear (60T) |
| 116 | Air breather |
| 117 | Air breather |
| 118 | Snap ring |
| 119 | Tapered bearing assy |
| 120 | Shaft |
| 121 | Clutch support |
| 122 | Cap screw |
| 123 | Piston ring |
| 124 | Speed clutch |
| 125 | Snap ring |
| 126 | (Deleted) |
| 127 | Lockwasher |
| 128 | Lockwasher |
| 129 | Screw |
| 130 | Drive Shaft |
| 131 | Snap ring |
| 132 | Gasket |
| 133 | Mechanical disconnect |
| 134 | Bearing cup |
| 135 | Bearing cone |
| 136 | Bushing |
| 137 | Output shaft assembly |
| 138 | Gear (43T) |
| 139 | Drain plug |
| 140 | Screw & lockwasher |
| 141 | (Deleted) |
| 142 | Oil pump assembly |
| 143 | Magnet |
| 144 | Gasket |
| 145 | Cap screw |
| 146 | Cap screw lockwasher |
| 147 | Gasket |
| 148 | Oil pump frame assembly |
| 149 | Gear (60T) |
| 150 | Bearing cone |
| 151 | Bearing cup |
| 162 | Oil seal |
| 153 | O-ring |
| 154 | Shim |
| 154A | Shim |
| 154B | Shim |
| 165 | Bearing cap assembly |
| 156 | Output flange assembly |
| 157 | Screw lockwasher |
| 158 | Cap screw |
| 159 | 0-ring |
| 160 | Washer |
| 161 | Cotter |
| 162 | Nut |
| 163 | Gasket |
| 164 | Clutch cover |
| 165 | Lockwasher |
| 166 | Screw |




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Clutch pressure tube | 7 | Lube tube | 13 | Tube clip | 19 | Pressure tube |
| 2 | Transmission case | 8 | Tube clip | 14 | Washer | 20 | Lube tube |
| 3 | Lube tube | 9 | Rivet | 15 | Rivet | 21 | Lube tube |
| 4 | Pressure lube | 10 | Washer | 16 | Dipstick tube clip | 22 | Input lube tube |
| 5 | Tube sleeve | 11 | Rivet | 17 | Reverse lube tube | 23 | Input clutch pressure tube |
| 6 | Tube sleeve | 12 | Washer | 18 | Pressure tube | 24 | Pressure tube |
| | | | | | | 25 | Lube tube |

B—Transmission case assembly

*Figure 5-6. (2) —Continued.*

(3) Remove forward, reverse, 3d and 4th clutch cover bolts (166). and remove clutch cover (164).

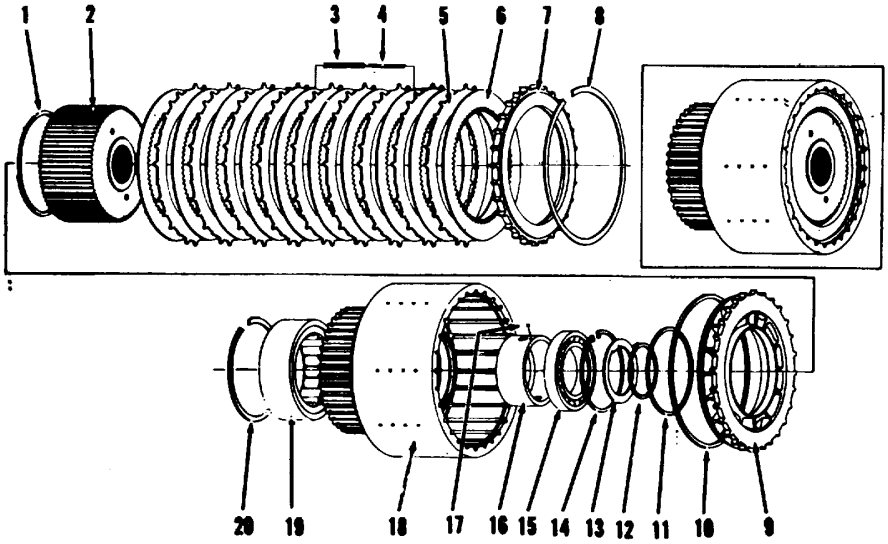
(4) Lock transmission gears with a soft bar and remove output flange nut (162), O-ring (159), washer (160) and flange (156).

**NOTE**

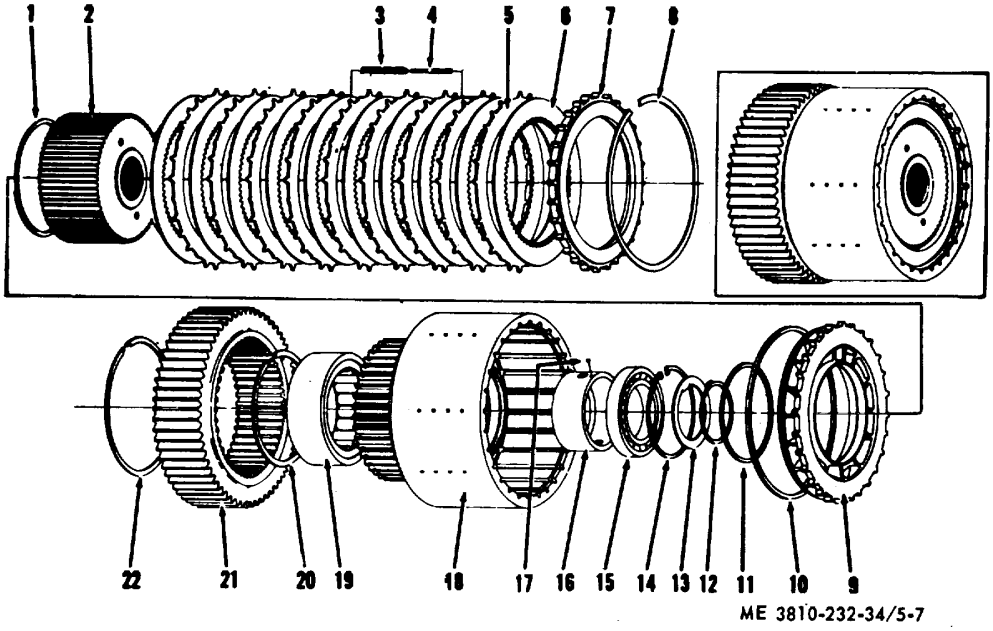
**All clutches are disassembled and assembled in a similar manner. However, the number of inner and outer clutch discs may differ between the first and second clutches and the forward, reverse, ad and 4th clutches. The clutch being disassembled is the 4th speed clutch.**

(5) Depress end plate (7, fig. 5-7) and remove retainer ring (8), and end plate.

**INPUT, REVERSE, 3rd & 4th CLUTCH GROUP**




**1st & 2nd CLUTCH GROUP**




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Baffle | 7 | Endplate | 12 | Snap ring | 17 | Ball |
| 2 | Disc hub assembly | 8 | Snap ring | 13 | Washer | 18 | Clutch drum assembly |
| 3 | Spring | 9 | Piston | 14 | Snap ring | 19 | Bearing |
| 4 | Pin | 10 | Piston ring | 15 | Bearing | 20 | Snap ring |
| 5 | Outer disc | 11 | Piston ring | 16 | Piston ring | 21 | Gear (53T) |
| 6 | Inner disc | | | | | 22 | Snap ring |

*Figure 5-7. Clutch assemblies, exploded view*

(6) Remove clutch disc hub retainer ring (103, fig. 5-6). Remove clutch disc hub (2, fig. 5-7). Remove disc springs (3), spring pins (4), and inner and outer clutch disc (5), (6). Remove clutch piston (9) and piston outer sealing ring (10). Remove clutch drum snap ring (12) and washer (13). Remove piston ring (16) ball (17) and clutch drum assembly (18).

**NOTE**

**If clutch drum hub gear, support bearings, or piston ring outer race, are to be replaced use (7) and (8); if replacement is not necessary disregard and continue on with (9).**

(7) Remove clutch drum snap ring (22) (1st and 2d clutch only), and remove clutch drum hub gear (21) (1st and 2d clutch only).

(8) Remove drum support roller bearing snap ring (20), and remove drum support ball bearing snap ring (14). Press or drive roller and ball bearing from clutch drum. Press piston ring outer race (16) from clutch drum.

**CAUTION**

**Do not lose lock ball (17).**

(9) Remove output shaft bearing screws (158, fig. 5-6), and remove output shaft bearing cap (155). Remove idler gear snap ring (58) and remove idler gear (59).

(10) Remove clutch support capscrews (4, 54, 97, 106) and remove clutch supports (5, 53, 96, 107).

(11) Remove idler shaft bearing cap bolts (101) and remove idler shaft bearing cap (60) and shims (61).

(12) Straighten tangs on bearing nut locks (7, 51, 94, 109). Lock transmission gears with a soft bar and remove the outer lock nuts (6, 52, 95, 108), nut locks (7, 51, 94, 109) and inner lock nuts (8, 50, 93, 110).

(13) Remove cap screws and mechanical disconnect (133). Remove idler gear snap ring (73) and idler gear (72).

(14) Using a suitable pusher tool, remove the reverse shaft (46) pushing from the lock nut side. Remove gears (11) and spacers (47) from inside case.

(15) Using a suitable pusher tool, remove the input shaft (26) pushing from the lock nut side. Remove gears (24) and spacers (25) from inside case. Press output shaft (137) from case (90). Output shaft may be removed from either side.

(16) Using a suitable pusher tool, remove the 2d and 4th shaft (120) pushing from the lock nut side. Remove gears and spacers from inside case. Using a suitable pusher tool, remove the 1st and 3d shaft (86) pushing from the lock nut side. Remove gears and spacers from inside case. Remove idler shaft (69) by pushing shaft out until double cone bearing and outer bearing race are exposed on opposite side. Using a suitable puller remove bearing cones and cups (62, 63, 64, 65), from idler shaft (69) and front bearing (70) from case.

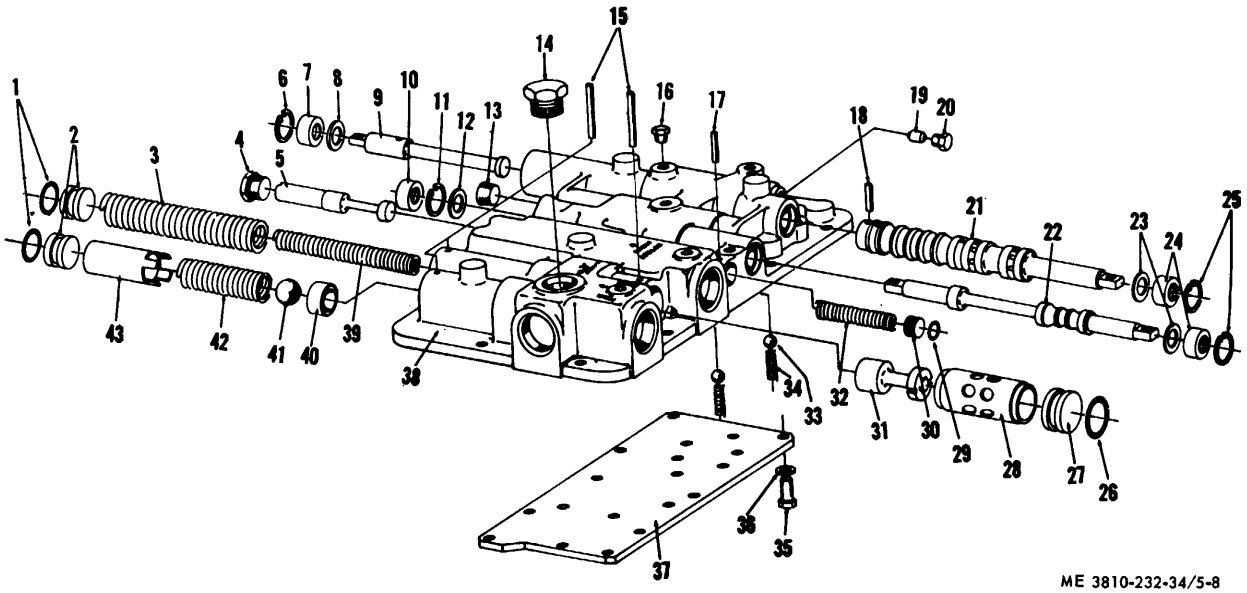
*c. Disassembly.*

(1) *Control cover.*

*(a)* Remove bolts (35, fig. 5-8) from cover plate (37). Remove cover plate. Remove speed selector valve assembly snap ring (6). Tap lightly on opposite end of speed selector valve (9, 18, 21). Valve and valve oil seal (7) will come out together.

**CAUTION**

**Do not lose detent springs (34).**




| | | | | | |
|---|---|---|---|---|---|
| 1 | O-ring | 15 | Roll pin | 29 | O-ring |
| 2 | Valve stop | 16 | Pipe plug | 30 | Spool |
| 3 | Spring outer | 17 | Roll pin | 31 | Valve Spool |
| 4 | Plug | 18 | Roll pin | 32 | Spring |
| 5 | Spool | 19 | Shuttle valve | 33 | Ball |
| 6 | Snap ring | 20 | Shuttle valve plug | 34 | Spring |
| 7 | Oil seal | 21 | Outer selector valve | 35 | Screw |
| 8 | Washer | 22 | Selector valve | 36 | Lockwasher |
| 9 | Inner selector valve | 23 | Washer | 37 | Cover plate |
| 10 | Oil seal | 24 | Oil seal | 38 | Cover |
| 11 | Snap ring | 25 | Snap ring | 39 | Spring inner |
| 12 | Washer | 26 | O-ring | 40 | Seat |
| 13 | Pipe plug | 27 | Valve stop | 41 | Ball |
| 14 | Pipe plug | 28 | Sleeve | 42 | Spring |
| | | | | 43 | Spacer |

*Figure 5-8. Control cover assembly, exploded view (Model 2380).*

(b) Remove forward and reverse selector valve snap ring (25). Tap lightly on opposite end of forward and reverse selector valve. Valve and valve oil seal (24) will come out together. Remove shut-off valve plug (4) and O-ring. Remove shut-off valve (5) and shut-off valve spring (32).

**CAUTION**

**When removing roll pins, it is recommended a press be used to depress valve stop (2), valve (28, 29), and spool springs (3, 42).**

*(c)* Depress regulating valve spring stop (2) and spring (3). Remove roll pin (15). Release press slowly. Springs will push spring stop (2) from control housing (38). Remove spring stop and inner and outer spring (39, 3). Remove roll pin on opposite end. Remove result ing valve stop (27) and valve (28, 31) from control housing. Depress safety valve spring sop, valve spring and safety ball valve (41).

(2) *Disassembly* of transmission control valve assembly.

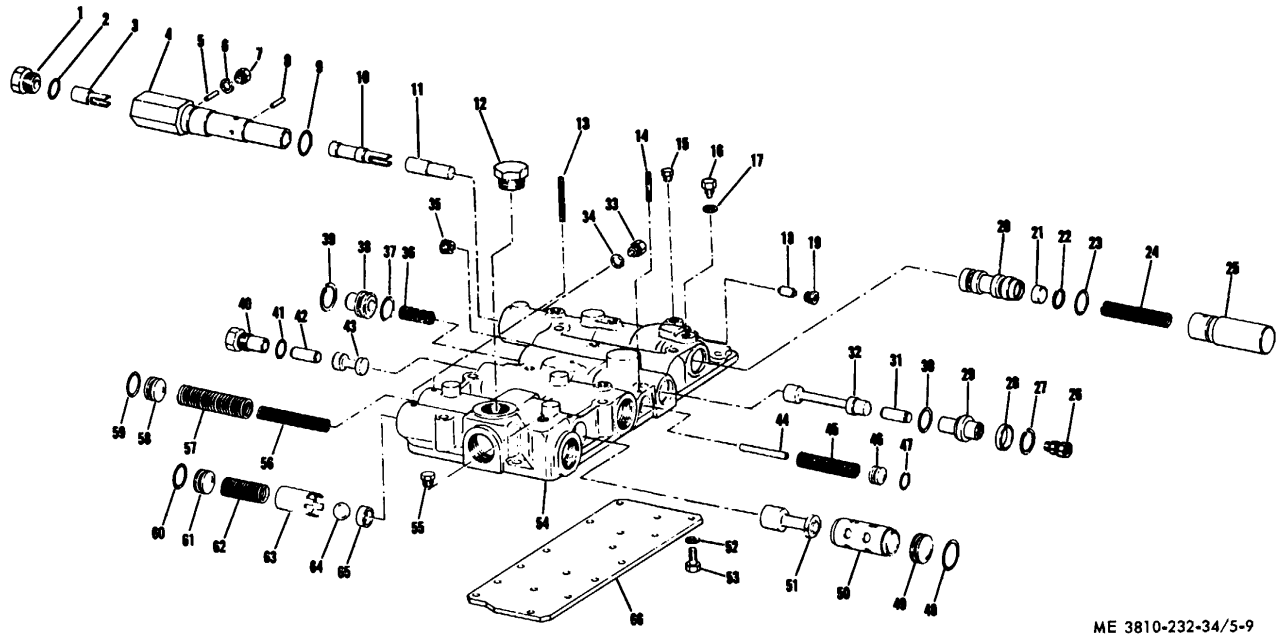
*(a)* Remove shift cylinder and end plug housing retaining plug (1, fig. 5-9). Remove shift cylinder (4), end plug (19), and selector valve spring (24). Remove selector valve (20). Compress lightly forward and reverse piston guide (29) ad remove retainer ring (27). Remove piston guide and piston (31).

*(b)* From opposite end remove spring stop retainer ring (39), spring stop (38), valve spring (36) and forward and reverse valve (v). Remove neutral valve guide plug (40), piston (42), neutral valve (43) valve spring (45), and stop pin (44). From opposite end remove snap ring (47) and spring stop (46).

**CAUTION**

**It is recommended when removing the roll pins (13, 14) from the pressure regulating (50, 51) and regulating valve (63, 64) a press be used, to depress valve stop and spring.**

*(c)* Depress pressure regulating valve (58) and spring (6, 57). Using. a m remove roll pin (18). Release press slowly springs will push spring stop (58) from housing. Remove inner and outer spring (56, 57). Remove roll pin on opposite end. Remove valve stop (49), valve (51), and valve sleeve (50). Depress safety valve stop (61) and spring (62). Remove roll pin (14). Remove stop (61), spacer (63), spring (62), and regulating valve ball (64). Remove screws (63) and washers (52) from oil circuit plate (66). Use caution so as not to scratch or mar control housing surface or oil circuit plate.




1 Shift cylinder hang plug
2 O-ring
3 3rd speed valve
4 Shift cylinder housing
5 Valve stop pin
6 Washer
7 Plug
8 Valve stop pin
9 O-ring
10 2nd speed valve
11 1st speed valve
12 Plug
13 Stop roll pin
14 Stop roll pin
15 Pipe plug
16 Lock plug
17 Washer
18 Valve
19 Plug
20 Selector valve
21 Valve plug
22 Snap ring
23 O-ring
24 Valve spring
25 Plug housing
26 Adaptor union
27 Snap ring
28 Spacer
29 Fwd. Rev. piston guide
30 O-ring
31 Fwd. Rev. piston
32 Fwd. Rev. valve
33 Plug
34 Washer
35 Pipe plug
36 Valve spring
37 O-ring
38 Fwd. Rev. spring cap
39 Spring cap washer
40 Neutral piston guide plug
41 O-ring
42 Neutral valve piston
43 Neutral valve spool
44 Pin
45 Neutral valve spring
46 Neutral valve stop
47 O-ring
48 O-ring
49 Valve spring stop
50 Valve spool sleeve
51 Regulating valve spool
52 Lockwasher
53 Screw
54 Control cover
55 Pipe plug
56 Spool spring inner
57 Spool spring outer
58 Valve spool stop
59 O-ring
60 O-ring
61 Spring stop
62 Regulating valve spring
63 Regulating valve spacer
64 Regulating valve ball
65 Regulating valve seat
66 Oil circuit plate

*Figure 5-9. Control cover valve assembly (Model 2385).*

*d. Cleaning, Inspection, and Repair.*

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all bearing roller, cages and cups for wear, chipping or nicks. Replace a defective bearing.

**NOTE**

**Do not replace a bearing one or cup without replacing the mating cup or cone also.**

(3) Perform a magnetic inspection of all gears and shafts. Inspect gear teeth for wear, pitting, chipping, nicks, cracks or scoring. Replace defective parts.

(4) Inspect shafts for wear and spring for bent condition and twisted splines. Replace a defective shaft

(5) Inspect housing, covers, and bearing caps to see that mating surfaces, bearing bores, etc., are free from nicks or burrs. Inspect for cracks or breaks. Repair or replace defective parts

*e. Reassembly of Transmission* (fig 5-6). Instruction given below on reassembly of components of transmission are given in the sequence that must be followed rebuilding. Principle of operations cited and views shown are similar and parallel on all shafts. The various drive shafts are assembled in the following order:

Step 1. Idler shaft
Step 2. First and third shaft
Step 3. Second and fourth shaft
Step 4. Output shaft
Step 5. Reverse shaft
Step 6. Input shaft

(1) *Reassembly of idler shaft.*

(a) If transmission case was changed, install idler bearing cup locating ring. Install oil baffle (68) in idler bearing bore. This must be done from inside the case and flange of the oil baffle must be 1/8" from the bearing cup locating ring. Install idler shaft inner cone bearing cup (62) in transmission came.

*(b)* Press roller bearing (70) on idler shaft (69). Install bearing and shaft in case, opposite side of inner bearing cup. On taper bearing end of shaft install bearing spacer (66).

**CAUTION**

**This spacer has a taper on the outer edge This taper must go toward taper bearing. If install wrong, the larger idler gear sap ring will not seat in ring groove.**

*(c)* Install inner taper bearing cone (63) on shaft with large diameter of taper outward. Install taper bearing cone (64) on shaft with large diameter inward. Install outer taper bearing cup (65) on idler shaft. Drive outer taper bearing cup against outer taper bearing.

*(d)* Install idler shaft bearing cap (60) and shims (61). Install bearing cap screws (101) torque screws 47 to 65 ft-lbs. Adjust idler shaft taper bearing by adding or omitting shims. Check adjustment with dial indicator. Adjust taper bearings 0.0 to 0.008 and play.

(2) Reassembly of 1st and 3d shaft.

*(a)* Press lot and 3d double taper bearing assembly (87) on 1st and, 3d shaft (86).

**CAUTION**

**These bearings are in matched sets and under no circumstances can any of the four (4) parts be changed or mixed up with another bearing.**

*(b)* Position 1st and 3d gear (114) in transmission case. Install long gear spacer (88) on shaft and against taper bearing assembly. Insert shaft into bore of case and through 1st and 3d gear. Push shaft assembly in case until taper bearing shoulders against locating ring in bore of case. Do not remove shaft pusher.

*(c)* On opposite end of shaft install short spacer (91) against 1st and 3d gear. Install roller bearing (92). Drive bearing in place.

**NOTE**

**Bearing must be driven in tight. Check long spacer on shaft. When spacer can not be turned by hand, stack up between the front and rear bearing is tight. DO NOT attempt to draw bearing up tight with bearing lock nuts. Remove shaft pusher. This was left on only to hold shaft while installing roller bearing.**

(3) Reassembly of 2d and 4th shaft.

*(a)* Press 2d and 4th double taper bearing assembly (119) on 2d and 4th shaft (120).

**CAUTION**

**These bearings are in matched sets and under no circumstances can any of the four (4) parts be changed or mixed with another bearing.**

*(b)* Position 2d and 4th gear (115) in transmission case with long offset of gear hub toward front case (input side). Insert shaft into bore of case and through 1st and 3d gear. Push shaft assembly in case until taper bearing shoulders against locating in bore of case. Do not remove shaft pusher.

*(c)* On opposite end of shaft, install long spacer (118) on shaft and against 2d and 4th gear. Install short spacer (112) on shaft against

long pacer. Install roller bearing (111) and drive in place.

**NOTE**

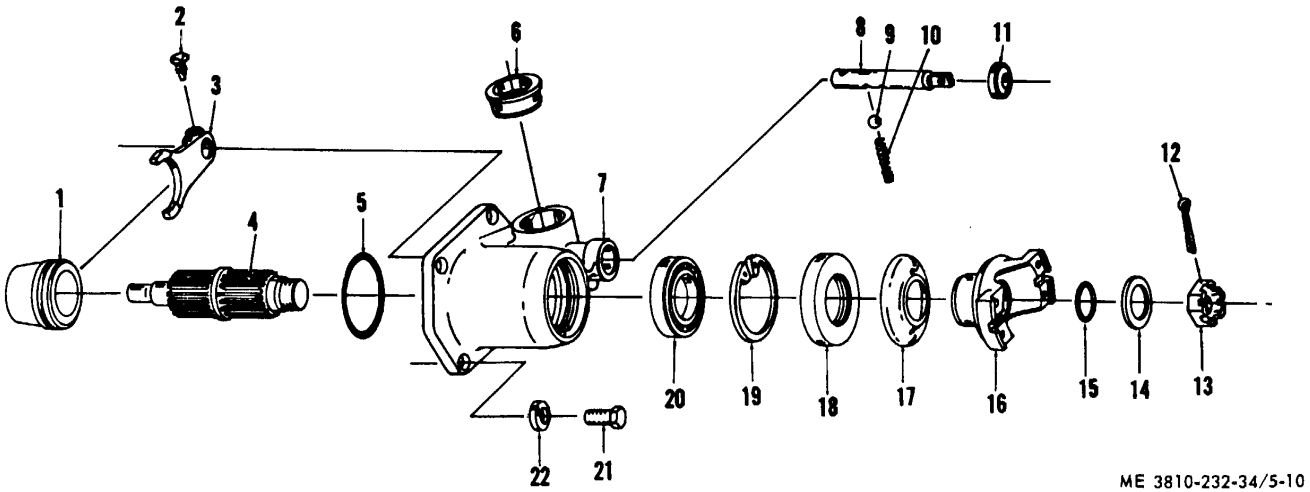
**Bearing must be driven in tight. Check Check long spacer on shaft. When spacer cannot be turned by hand, stack up between the front and rear bearing is tight. DO NOT attempt to draw bearing up tight with bearing lock nits. Remove shaft pusher. This was left on only to hold shaft while installing roller bearing.**

*(d)* Install 1st and 2d clutch supports (85, 121). Align holes in clutch supports with holes in transmission case and install self locking screws (84), (122). Tighten screws 70 to 85 ft lbs. torque.

(4) *Reassembly of the output shaft.*

*(a)* Press taper bearing cone (10) (large diameter of taper inward over threaded end of output gear (137) against shoulder on shaft. Position small output shaft (138) in transmission case to the Input aide (front) with longer offset of gear hub to the front. Position large output gear (149) in transmission case to the rear with longer offset of gear hub to the rear. Insert output shaft through the rear bore of case and through large and small output gears. Block output haft and install front taper bearing cone (135) (large diameter of taper inward) on output s-ht until bearing shoulders against small output gear. Install bearing cups (134, 151) over front and rear bearing

*(b)* Install new O-ring (5, fig. 5-10) on disconnect housing (7). lubricate O-ring with type "A" automatic transmission fluid. Install disconnect assembly on output shaft. Secure disconnect assememby to transmission case with screws (21) and lockwashers (22). Tighten 46 to 5 lbs. torque.




| | | | |
|---|---|---|---|
| 1 | Hub | 12 | Pin |
| 2 | Lockscrew | 13 | Nut |
| 3 | Fork | 14 | Washer |
| 4 | Shaft | 15 | O-ring |
| 5 | O-ring | 16 | Disconnect assembly |
| 6 | Plug | 17 | Deflector |
| 7 | Housing | 18 | Oil seal |
| 8 | Rail19 | 19 | Snap ring |
| 9 | Ball 20 | 20 | Bearing |
| 10 | Spring | 21 | Cap screw |
| 11 | Oil seal | 22 | Lockwasher |

*Figure 5-10. Mechanical disconnect assembly, exploded view.*

*(c)* Install flange nut (162, fig. 5-6) end of output shaft. Use an inch-lb. torque on the flange nut. Determine the amount of torque required to turn output shaft and gear train. Install bearing cap, O-ring (153) and shims (154) to transmission case. Install bearing cap screws (158) and lockwashers (157). Tighten 47 to 55 ft-lbs. torque.

*(c)* With an inch-pound torque wrench turn output shaft and gear train. Add or move bearing cup shims to adjust preload. When bearings are properly adjusted, it will take 6 to 8 inch-pounds more to turn gear train than it did before bearing cap was installed.

*(5) Reassembly of Input and Reverse Shaft.*

*(a)* Press roller bearing (27) on threaded end of input shaft (26). Install short spacer (25) on shaft opposite threaded end. Position input gear (24) in case with longer offset of gear to the rear. Install input shaft and bearing into front case bore and through input gear. Push bearing and shaft in case bore until bearing snap ring shoulders against transmission case. Do not remove shaft pusher. Install larger spacer (10) on shaft against input gear. Drive rear roller bearing in place.

**NOTE**

**Bearing must be driven in tight. Check gear spacer on shaft. When spacer cannot be turned by hand, stack up between input gear spear and rear roller bearing is tight. DO NOT attempt to draw bearings up tight with bearing lock nuts. Remove shaft pusher.**

*(b)* Apply a thin coat of Permatex No. 2 on the outer diameter of the input shaft oil seal (30). Press seal, lip of seal inward, into input shaft bearing cap (29). Install bearing cap and seal assembly on input shaft. Install bearing cap screws (32) and lockwashers (31). Torque screws 47 to 55 ft-lbs. torque. Install companion flange (34) and flange O-ring (35), washer (36) and flange nut (37). Tighten nut to 150 to 175 ft-lbs. torque.

*(c)* Assemble the reverse shaft the same as the input shaft. Install reverse shaft bearing spacer (44) and nut (43). Lock gears with a soft bar and tighten reverse nut to 175 ft-lbs. torque. Install nut cotter (71). Place gasket (42) and bearing cap (41) on reverse shaft. Install bolts (38) and lockwashers (39). Tighten 47 to 55 ft-lbs. torque. Lock gears using a soft bar, and install bearing inner lock nut (8, 50, 93, 110) (all four shafts). Tighten lock nut 175 to 200 ft-lbs. torque. Install nut locks (7, 51, 94, 109) and outer lock nuts (6, 52, 95, 108).Tighten outer lock nuts 175 to 200 ft-lbs. torque. Bend a portion of the nut lock over one flat of the inner lock nut. Bend a portion of the nut lock over one flat of the outer lock nut.

*(d)* Install clutch supports (5, 53, 96, 107). Align holes in clutch supports with holes in transmission case and install self locking screws (4, 54, 97, 106). Tighten bolts 70-85 ft-lbs. torque. Install new clutch support piston rings (3, 55, 98, 105, 83, 123). Lock rings in position. Lubricate piston rings with Type "A" automatic transmission fluid.

*(e)* Install large idler gear (59) on idler shaft (69) with longer offset of gear hub inward. Install idler gear snap ring (58). Install flange nut O-ring (15, fig. 5-10), nut washer (14) and flange nut (13). Lock gears with a soft bar and tighten flange nut 250 to 300 ft-lbs. torque. Install pin (12). Install small idler gear (72, fig. 5-6) on idler shaft with longer offset of gear inward.

(6) Reassembly of clutches.

**NOTE**

**All clutches reassembled in a similar manner. However, the 1st and 2nd speed clutches have a clutch drum gear and retainer ring. Also, the quantity of inner and outer clutch discs will differ. Clutch being assembled in the following steps is the 1st speed.**

*(a)* Insert lock ball (17, fig. 5-7) in clutch piston ring outer race (16). Press outer race and ball in clutch drum (18). Outer race must be pressed from flush to 1/64" below shoulder in clutch drum. Press support ball bearing (15) in clutch drum and secure with bearing snap ring (14). From rear end of clutch drum, press support roller bearing (19) in drum. Secure with snap ring (20). Press clutch drum hub gear inward. Secure clutch drum hub gear with snap ring (22).

**NOTE**

**Clutch drum hub gear is used only on the 1st and 2nd clutch.**

(*b*) Install clutch drum assembly on clutch support. Install clutch drum hub bearing washer (13) and washer snap ring (12). Install clutch piston inner sealing ring (11). Lubricate piston ring with type "A" automatic transmission fluid. Install clutch piston outer ring (10). Lubricate piston ring with type "A" automatic transmission fluid. Slide clutch piston (9) into position in clutch drum. Install clutch disc hub (2) in clutch drum. Install disc hub snap ring (81, fig. 5-6).

**CAUTION**
**Do not damage clutch support piston rings.**

**CAUTION**
**Do not damage inner and outer piston rings.**

*(c)* Install one bronze disc (6, fig. 5-7) on disc hub and against the clutch piston. Install one steel disc (5) in clutch drum. Insert all release springs (3) and guide pins (4) in clutch drum. Install clutch disc and plate (7). Compress clutch disc end plate and install end plate 5smp ring (8). Use the same procedure to assemble all clutches. Install input, reverse, 3d and 4th clutch as explained above.

**NOTE**
**The steel disc has teeth missing on the outer diameter. This is to allow passage for the clutch release springs. Insert two or more release springs (3) in drum and against the teeth of the clutch piston. Install next bronzed disc. Alternate clutch discs, steel against bronze, and always align the teeth on the preceeding steel disc. If assembly is correct, each release spring is against a tooth on the clutch piston and you start with a bronze disc.**

*(d)* Install companion flange (156, fig. 5-6) flange O-ring (159), washer (160) and nut (162). Tighten flange nut 250 to 300 ft-lbs. torque and install cotterpins (161).

*(e)* Install new gaskets (80, 163) on clutch covers (79, 164). Align holes in clutch covers and holes in transmission case. Install bolts and lockwashers. Tighten 20 to 25 ft-lbs. torque. Install new gasket (147) on sump screen opening.

Install sump screen (148) in case and secure with crewr (145) and lockwasher (146). Tighten 20 to 25 ft-lb. torque. Install magnet (143) in sump pan. Install new gasket (144) over welded washers in sump pan. Install sump pan bolts and tighten 20 to 25-ft lbs. torque.

*f. Reassembly.*

(1) Control cover model 2380 fig. 5-8.

**NOTE**
**Lubricate all valves, springs, O-rings, sleeve and oil seals with a light coat of OE10 engine oil.**

*(a)* Install safety valve ball (41) and springs (42) in cover (38). With new O-ring in position install spring stop (2) 'on spring. Install spring stop roll pin (15).

*(b)* Install regulating valve spool (31) in valve cover. Install new Oring (26) on valve stop (27). Install valve stop in cover and retain with roll pin (15). At opposite end of regulating valve install inner (39) and outer (3) valve spring. Install new O-ring on spring stop. Install spring stop on springs. Depress spring top and spring. Install spring stop roll pins.

*(c)* Install spring (32). Install spool (5) in housing. Depress spool and spring with valve plug (4). Tighten plug securely.

*(d)* Install forward reverse selector valve (22) in housing. Install selector valve stop washer (23) and oil seal (24) on selector valve. Apply a light coat of Permatex No. 2 on the outer diameter of a new selector valve oil seal. Install oil seal in housing. Install oil seal snap ring (25).

*(e)* Install speed selector valves and pin (9, 18, 21) in housing. Install selector valve stop washer (8) and oil seal (7) on selector valve. Apply a light coat of Permatex No. 2 on the outer diameter of a new selector valve oil seal. Install oil seal in housing. Install oil seal snap ring (6).

*(f)* Install balls (33) and springs (34) in drilled ports in control cover. Install control cover plate (37). Secure with bolts (35) and external shake proof washers (36). Tighten 10 to 15 ft-lbs. torque.

*(g)* Using new control valve to case O-ring (18, fig. 5-6) gaskets (12). Install control cover assembly on transmission case, secure with screws (16) and lockwashers (17). Tighten 20 to 25 ft.-lbs. torque.

(2) Control valve Model 2385 (fig. 5-9).

**NOTE**
**Lubricate all valves, springs, O-rings, spools, sleeves, and seals with a light coat of OE10.**

*(a)* Install oil circuit plate (66). Install screws (53) and washers (52) and tighten securely. Install regulating valve ball (64), spacer (63), and spring (62) in cover (54). Install new 0-ring (60) on spring stop (61). Depress spring stop and spring. Use caution so as not to damage O-ring. Install roll pin (14). Install pressure regulating valve sleeve (50) and valve (51). Install new 0-ring (48) on valve stop (49). Install valve stop in housing and retain with roll pin.

*(b)* At opposite end of regulating valve, install inner and outer valve spring (56, 57). Install new O-ring (59) on spring stop (58). Install spring stop on springs. Depress spring stop and spring. Install spring stop roll pin. (13). Install new O-ring (47) on neutral valve spring stop (46). Install spring stop in housing and retain with Toll pin. At opposite end install neutral valve spring (45), stop pin (44), neutral valve (43), valve piston (42) and piston guide plug (40). Install new O-ring (37) on forward and re-

verse valve spring stop (38). Install forward stop reverse (32), valve spring (36), and spring stop in housing. Secure with retainer ring.

(c) From the opposite end, install forward and reverse piston (31). Install new O-ring (30) on piston guide (29). Install piston guide (29). Install piston guide in housing and secure with retainer ring (27). Install selector valve (20) in housing. Install 3rd speed valve (3) in housing with slot in valve lined up with stop pin (8). Install stop pin (5) and pin retainer plug (7). Install cylinder housing plug (1). Install 2nd speed valve (10) in shift cylinder (4) with slot in valve lined up with stop pin in cylinder housing. Install 1st speed valve (11) in housing with slot in valve lined up with stop pin. Install stop pin (8). Install new O-ring (9, 2) on shift cylinder assembly and end cap (11). Install selector valve spring (24) in housing and secure with lock plugs (16). Using new control valve to case O-rings and new gasket install control cover valve assembly on transmission case. Secure with screws and lockwasher. Tighten 20-25 ftlb. torque.

*g. Installation.*

(1) Install transmission assembly as instructed on figure 5-5.

(2) Install propeller shafts (para 5-10).

*h. Service Machine after Transmission Overhaul.*

(1) The transmission, torque converter and its allied hydraulic system are important links in the drive line between the engine and wheels. The proper operation of either unit depends greatly on the condition and operation of the other, therefore, whenever repair or overhaul of one unit is performed, the balance of the system must be considered before the job can be considered completed.

(2) After the overhauled or repaired transmission has been installed in the machine, the torque converter, oil cooler, filter and connecting hydraulic system must be thoroughly cleaned. This can be accomplished in several manners and a degree of judgment must be exercised as to the method employed.

(3) The following are considered the minimum steps to be taken:

*(a)* Drain the entire system thoroughly.

*(b)* Disconnect and clean all hydraulic lines. Where feasible hydraulic lines should be removed from machine for cleaning.

*(c)* Replace oil filter elements, cleaning out filter cases thoroughly.

*(d)* The oil cooler must be thoroughly cleaned. The cooler should be "back flushed" with oil and compressed air until all foreign material has been removed. Flushing in direction of normal oil flow will not adequately clean the cooler. If necessary, radiator should be removed from machine for cleaning, using oil, compressed air and steam cleaner for that purpose. DO NOT use flushing compounds for cleaning purposes.

*(e)* Remove bottom drain cover and plug from torque converter and inspect interior of converter housing, gears, etc. (para 5-2). If presence of considerable foreign material is noted, it will be necessary that converter be removed, disassembled and cleaned thoroughly.

*(f)* Reassemble all components and 0 E 10 engine oil, fill torque converter and transmission through filler opening until fluid comes up to FULL mark on transmission dip-stick. Reinstall fill plug and dip-stick and run engine two minutes at 500-600 rpm to prime torque converter and hydraulic lines. Recheck level of fluid in transmission with engine running at idle (500600 rpm) and add quantity necessary to bring level up to FULL mark on dip-stick. Recheck with hot oil (180° to 2000).

*(g)* Recheck all drain plugs, connections, etc., for leaks and tighten where necessary.

## Section V. CARRIER STEERING ASSEMBLY

### 5-11. General

The carrier is equipped with a mechanical steering system with hydraulic power assist. Front wheel steering is operated by the steering wheel. The rear wheels are steered hydraulically by a double-acing cylinder, engaged by a lever in the cab. Hydraulic pressure for steering is provided by the hydraulic system pump.

### 5-12. Carrier Steering Column

a. Removal.

(1) Remove steering wheel (TM 5-3810232-12).

(2) Remove steering column at illustrated on figure 5-11.

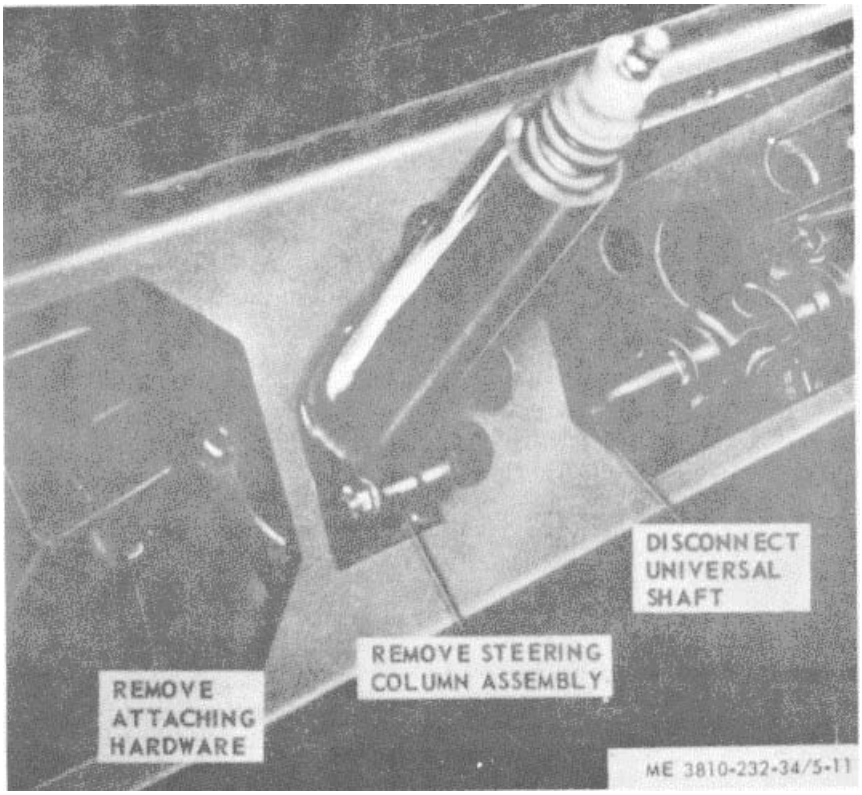
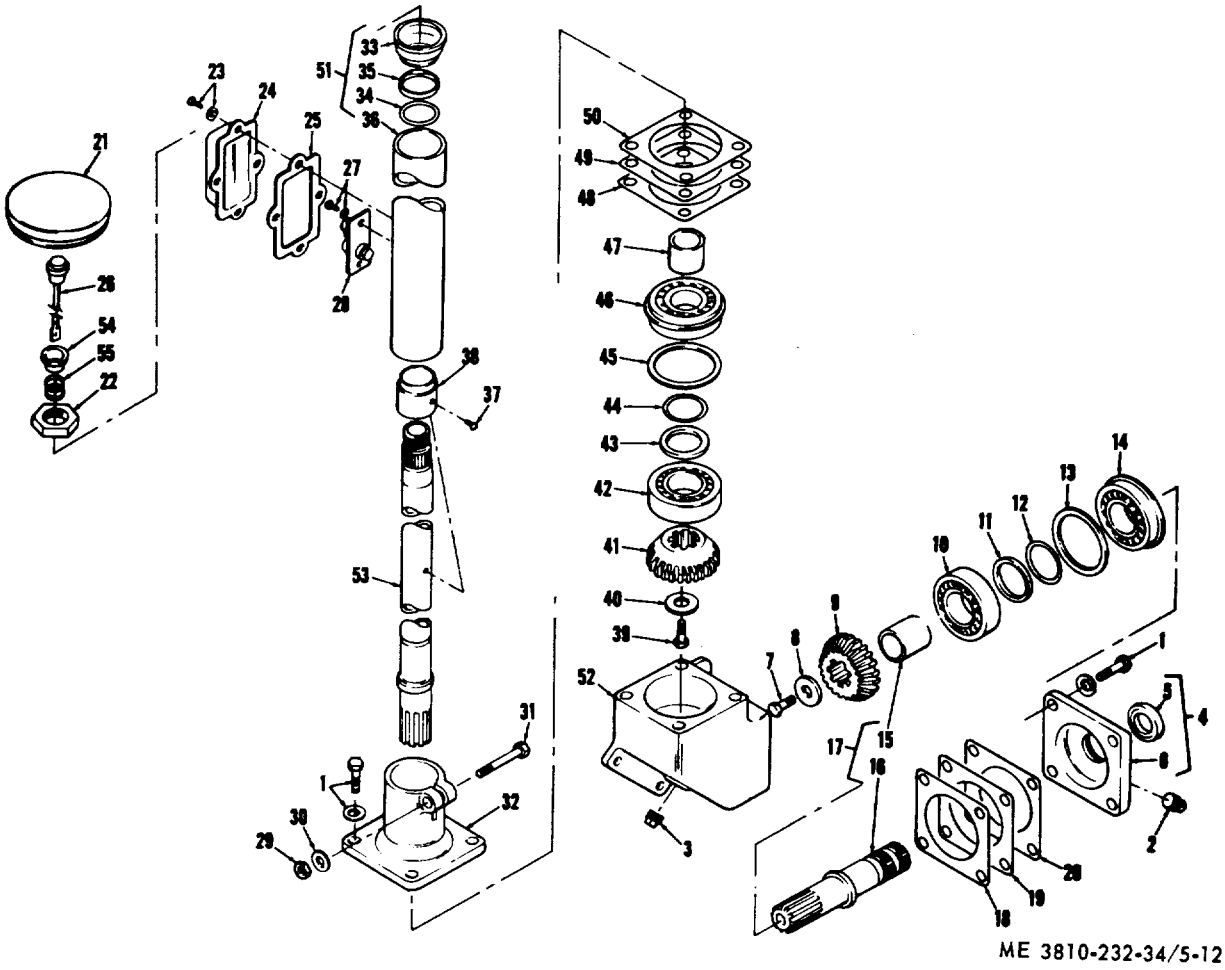



*Figure 5-11. Carrier steering column and gear box assembly, removal and installation.*

*b. Disassembly.* Refer to figure 5-12 and disassemble the steering column as illustrated.




1 Bolt and washer
2 Pipe plug
3 Pipe plug
4 Cover and seal assy.
5 Oil seal
6 Cover
7 Lock screw
8 Washer
9 Bevel gear
10 Bearing
11 Spacer
12 Shim
13 Spacer
14 Bearing
15 Collar
16 Shaft
17 Shaft and collar assy.
18 Shim (0.002")
19 Shim (0.003")
20 Shim (0.010")
21 Horn button unit
22 Wheel nut
23 Screw
24 Cover assembly
25 Cover seal
26 Cable assembly
27 Screw and lockwasher
28 Contact brush
29 Nut
30 Plain washer
31 Screw
32 Upper cover
33 Bearing
34 Bearing spring seat
35 Bearing spring
36 Tube
37 Screw
38 Contact ring assembly
39 Lockscrew
40 Washer
41 Bevel gear
42 Bearing
43 Spacer
44 Shim
45 Spacer
46 Bearing
47 Collar
48 Shim (0.002")
49 Shim (0.003")
50 Shim (0.010")
51 JT tube assembly
52 Housing
53 Shaft and tube assembly
54 Spring
55 Contact cup

*Figure 5-12. Carrier steering column and gear box assembly, exploded view.*

*c. Cleaning, Inspection and Repair.*

(1) Clean all metal parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for cracks, breaks, or other damage. Replace damaged or defective parts as necessary.

*d. Reassembly*. Refer to figure 5-12 and reassemble the steering column as illustrated.

*e. Installation*

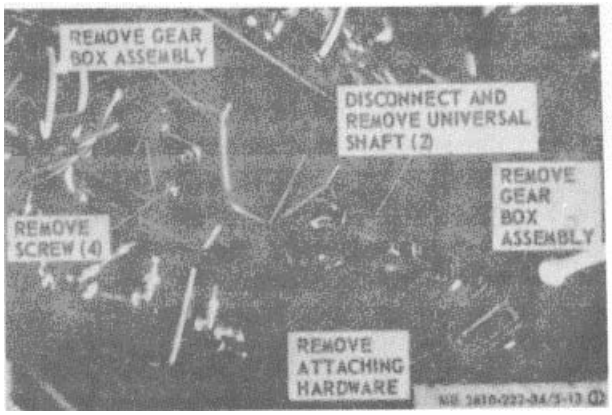
(1) Install steering column as illustrated on figure 5-11.

(2) Install steering wheel (TM 5-3810232-12).

**5-13. Carrier Steering Gear Boxes**

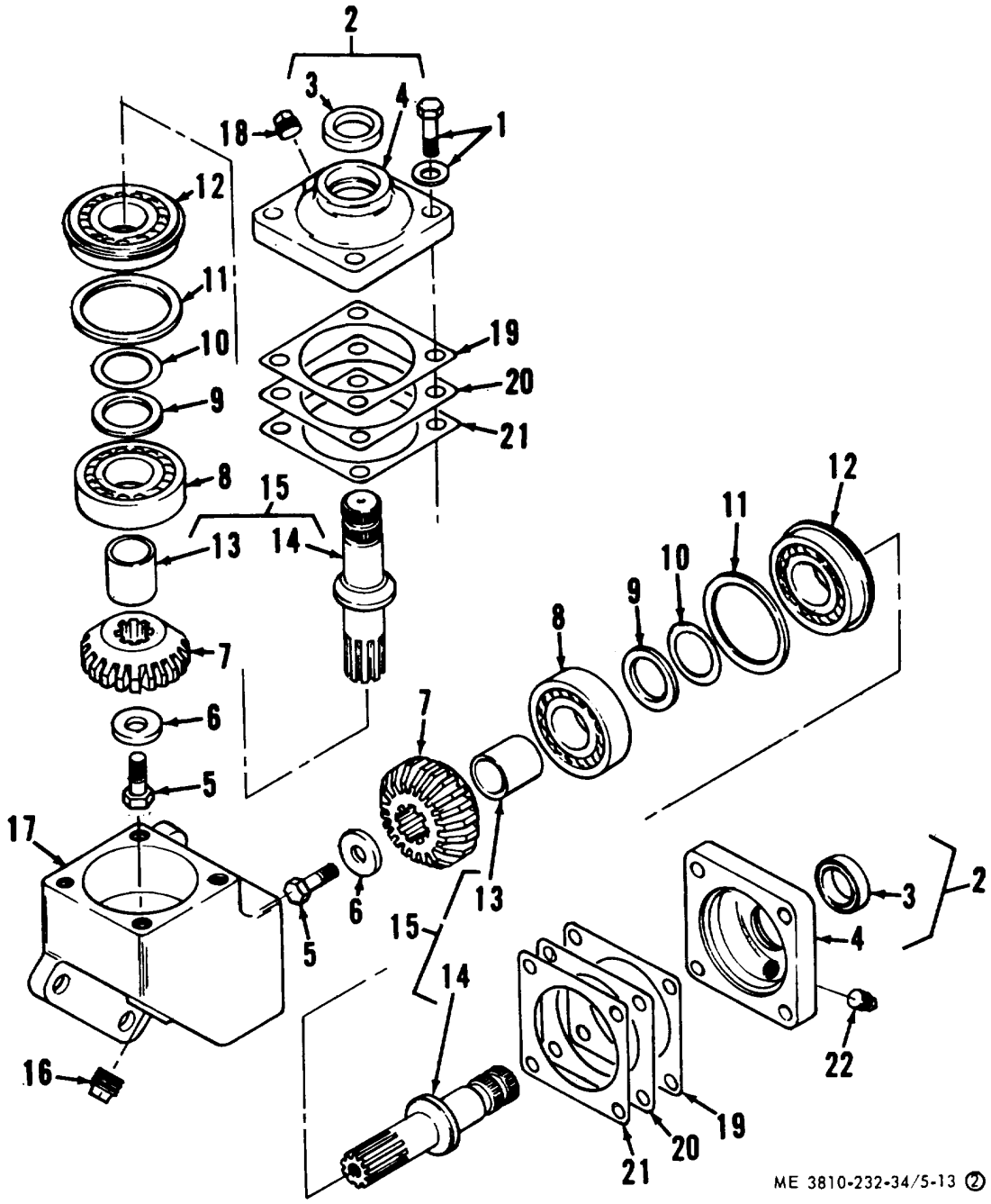
*a. Removal*. Refer to figure 5-13 and remove the steering gear boxes.

*b. Disassembly*. Refer to figure 5-13 and disassemble the steering gear boxes as illustrated.




A-Carrier steering gear box, removal and installation

*Figure 5-13. (1) Carrier steering gear box.*




| | | | | | |
|---|---|---|---|---|---|
| 1 | Bolt and washer | 8 | Bearing | 15 | Shaft and collar assembly |
| 2 | Cover and seal assy. | 9 | Spacer | 16 | Pipe plug |
| 3 | Oil seal | 10 | Shim | 17 | Housing |
| 4 | Cover | 11 | Spacer | 18 | Vent plug |
| 5 | Lockscrew | 12 | Bearing | 19 | Shim (0.010") |
| 6 | Washer | 13 | Collar | 20 | Shim (0.003") |
| 7 | Bevel gear | 14 | Shaft | 21 | Shim (0.001") |
| | | | | 22 | Pipe plug |

B—Carrier steering gear box, exploded view.

*Figure 5-13. (2) -Continued*

*c. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for cracks, breaks and other damage. Repair or replace defective parts.

*d. Reassembly.* Refer to figure 5-13 and reassemble the steering gear boxes as illustrated.

*e. Installation.* Refer to figure 5-13 and install the steering gear box.

**5-14. Carrier Steering Gear and Valve Assembly**

*a. Steering Gear Adjustments.*

(1) General. The steering gear assembly is designed to provide adjustment to compensate for normal wear at worn bearings, pitman shaft, and mating parts. The starting gear box discussed here is mounted on the frame.

(2) Steering gear box removal.

*(a)* Disconnect drag link from pitman arm. Note relative position of linkage and pitman arm so parts may be reassembled in the same relative position

*(b)* Adjust worn bearings as follows: Proper adjustment of worn bearings is obtained by adding or removing shims between steering gear housing and top cover or end cover (fig. 5-14). Shims are available in thickness of 0.002", 0.005", and 0.030". Refill gear housing with lubricant (refer to lubrication order).

*(c)* Assemble steering gear box in accordance with figure 5-14. With the lock nut loose (fig. 5-15) turn the lash adjuster a few turns counterclockwise to relieve the load from the worm bearing and to provide clearance between the sector gear (16, fig. 5-14) and the worn ball nut (28). Turn the worm shaft (27) by hand, in one direction until it stops, then back off one full turn. Using a 12 point socket wrench and an inch pound torque wrench, check the torque required to move the shaft and keep it moving. Correct torque is 5 to 9 inch pounds. If torque is not within tolerance, add or remove shims as required.

(3) Pitman shaft lash adjustment,

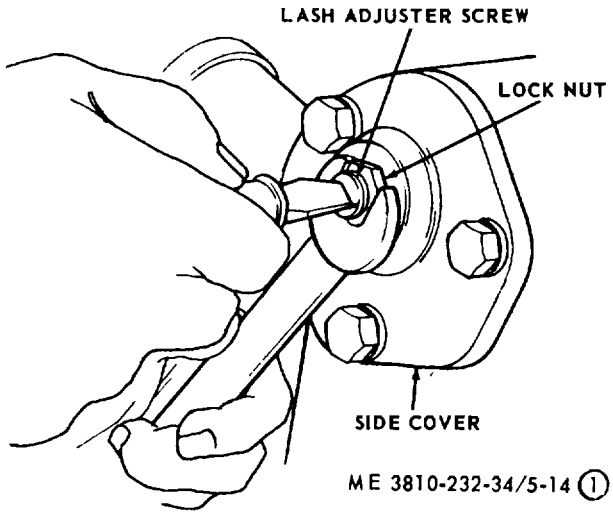
*(a)* Center the steering gear by turning the input shaft from extreme left positions, counting the exact number of turns and factions thereof. Turn the input shaft back exactly halfway to center position. Mark the input shaft and the housing so as to establish a center position reference point.

*(b)* Loosen lash adjuster lock nut (fig. 4-14) and turn the adjuster screw clockwise to remove all backlash between gear teeth. Tighten 5-32 adjuster screw lock nut 25 to 35 ft-lbs. torque. Using a 12 point socket and an inch pound torque wrench check the inch pounds required to pull the input shaft through the center position. Acceptable torque is 11 to 15 inch pounds.

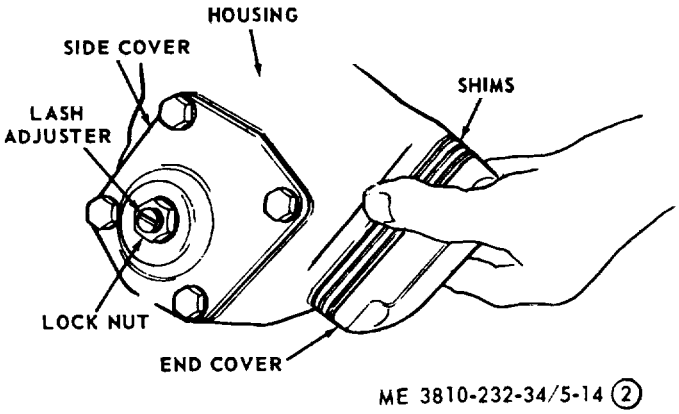
*(c*) If input shaft pull is not within specified limits, loosen lock nut and turn lash in order to bring torque pull of the input shaft within limits. Always recheck pull valve after lock nut has been tightened.

*(d)* Loosen lock nut on back-up adjuster (fig. 5-14), turn adjuster in until it bottoms, then back off 1/8 to 1/4 turn and tighten lock nut.

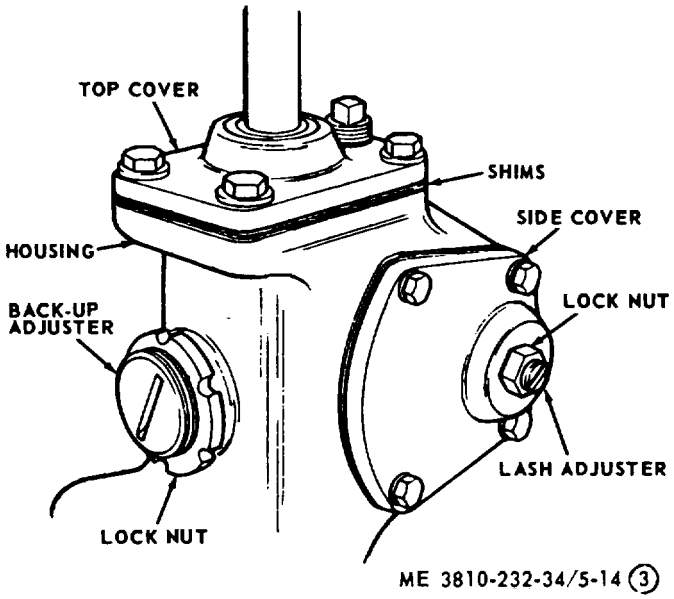
*(e)* After all adjustments have been made install the steering box in the vehicle frame. Install the pitman arm on the sector shaft aligning with the reference marks established at time of disassembly.




*A-Sector gear lash adjustment (Model 2385)*
*Figure 5-14. (1) Steering gear and valve adjustment (Model 2385).*




*B-Installing and cover shims (Model 2385)*
*Figure 5-14. --Continued.*




*C-Steering gear and adjustment points (Models 2385)*
*Figure 5-14. ( 3) Continued.*

*b. Removal*. Remove steering gear and valve assembly as illustrated on figure 5-15.

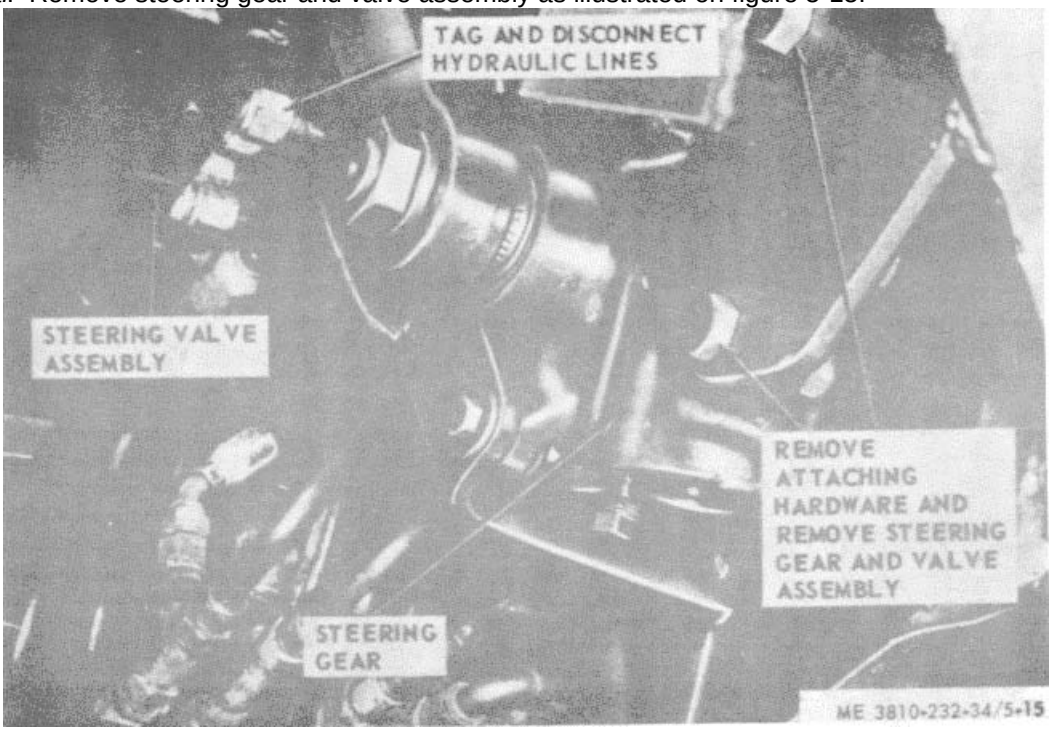
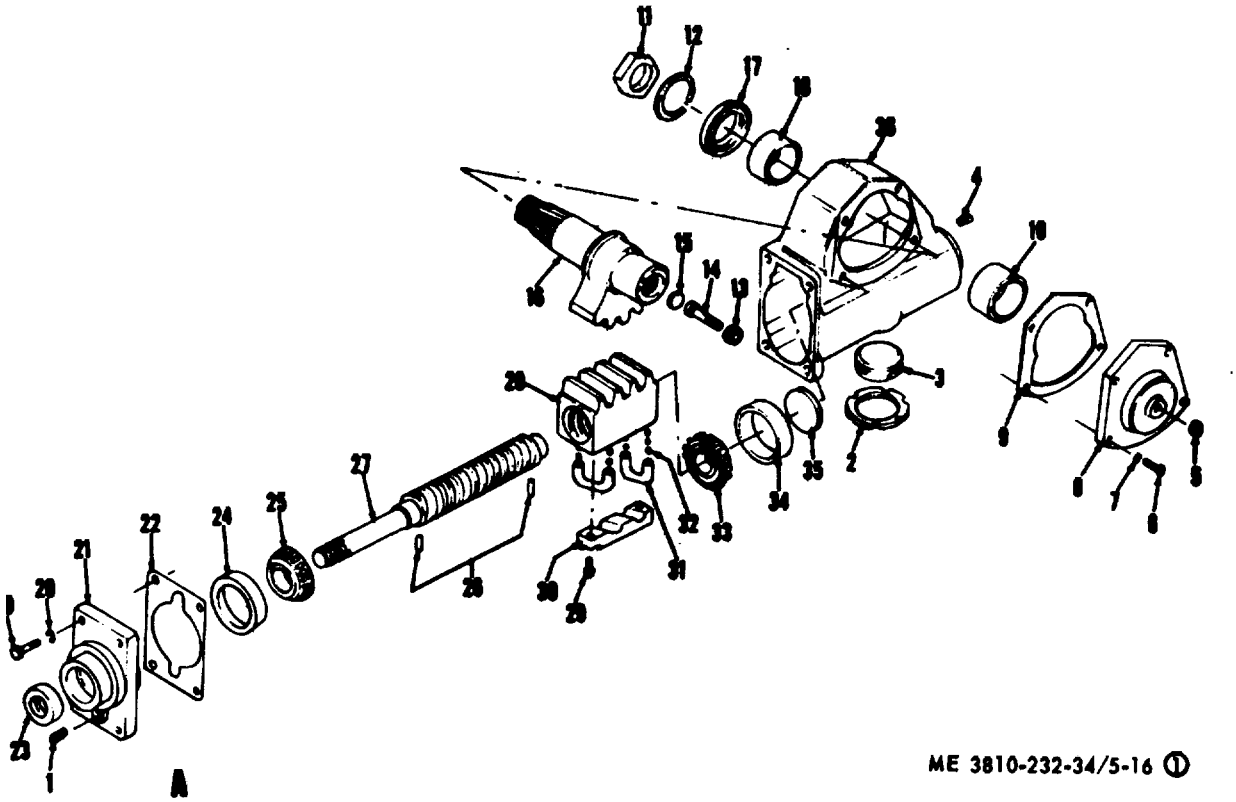



*Figure 5-15. Steering gear and valve assembly, removal and installation.*

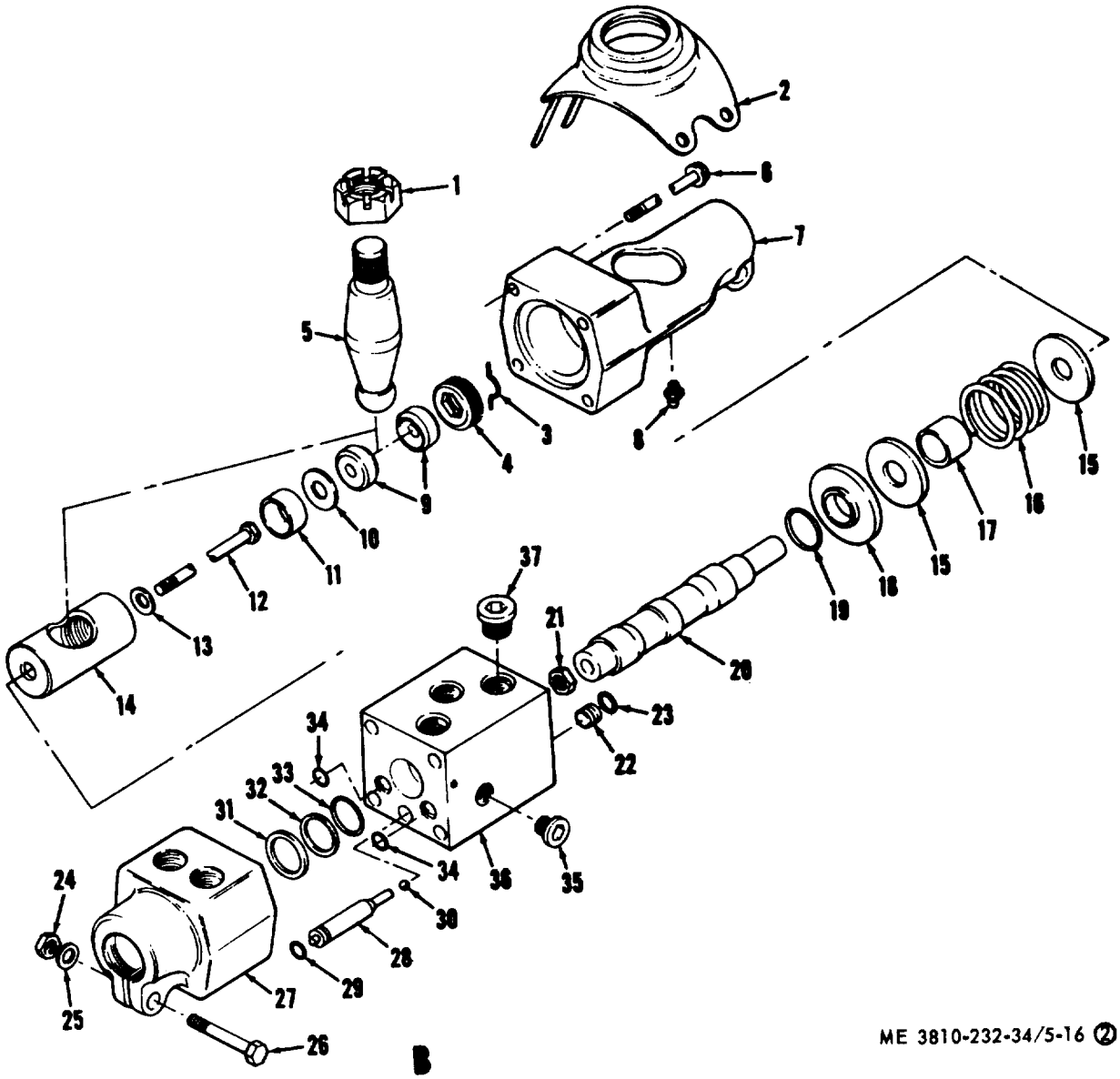
*c. Disassembly*. Disassemble steering gear and valve assembly in numerical sequence a shown on figure 5-16.




| | | | |
|---|---|---|---|
| 1 | Plug | 19 | Bolt |
| 2 | Nut | 20 | Washer |
| 3 | Adjuster, back-up | 21 | Cover |
| 4 | Plug | 22 | Shim |
| 5 | Nut | 23 | Seal |
| 6 | Bolt | 24 | Cup |
| 7 | Washer | 25 | Bearing |
| 8 | Cover, side | 26 | Stop, ball nut |
| 9 | Gasket | 27 | Worn |
| 10 | Bearing | 28 | Nut |
| 11 | Nut | 29 | Bolt and washer assembly |
| 12 | Washer | 30 | Clamp |
| 13 | Retainer | 31 | Guide |
| 14 | Adjuster | 32 | Ball |
| 15 | Washer | 33 | Cone |
| 16 | Gear | 34 | Cup |
| 17 | Seal | 35 | Plug |
| 18 | Bearing | 36 | Housing |

A— Steering gear

*Figure 5-16. (1) Steering gear and valve assembly, exploded view..*




| | | | | | |
|---|---|---|---|---|---|
| 1 | Nut | 13 | Washer | 25 | Lockwasher |
| 2 | Dust cover | 14 | Sleeve | 26 | Bolt |
| 3 | Lockwire | 15 | Centering spring washer | 27 | End cap |
| 4 | Adjusting plug | 16 | Centering spring | 28 | Check ball plug |
| 5 | Ball stud | 17 | Spacer | 29 | O-ring |
| 6 | Bolt | 18 | O-ring retainer | 30 | Ball |
| 7 | Housing | 19 | O-ring | 31 | Spacer |
| 8 | Grease fitting | 20 | Valve spool | 32 | O-ring retainer |
| 9 | Ball stud seat | 21 | Nut | 33 | O-ring |
| 10 | Washer | 22 | Plug | 34 | O-ring |
| 11 | Spacer | 23 | O-ring | 35 | Plug |
| 12 | Spool bolt | 24 | Nut | 36 | Valve body |
| | | | | 37 | Plug |

B— Steering valve

*Figure 5-16. (2)--Continued.*

*d. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for excessive wear. Replace or repair defective parts.

*e. Reassembly.* Reassembly steering gear and valve assembly in reverse of numerical sequence shown on figure 5-16.

## Section VI. WHEEL ASSEMBLY

### 5-15. General

The carrier is equipped with four 26.5 x 25 (26 ply) tubeless tires. All rims and tires on the carrier are interchangeable and can be mounted on either axle.

### 5-16. Rim and Tire

*a. Removal*. Remove rim and tire assembly as instructed on figure 5-17.

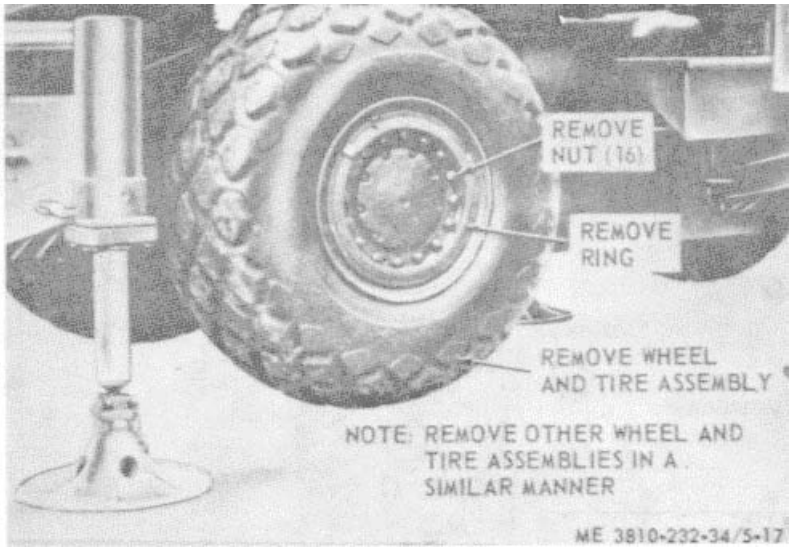


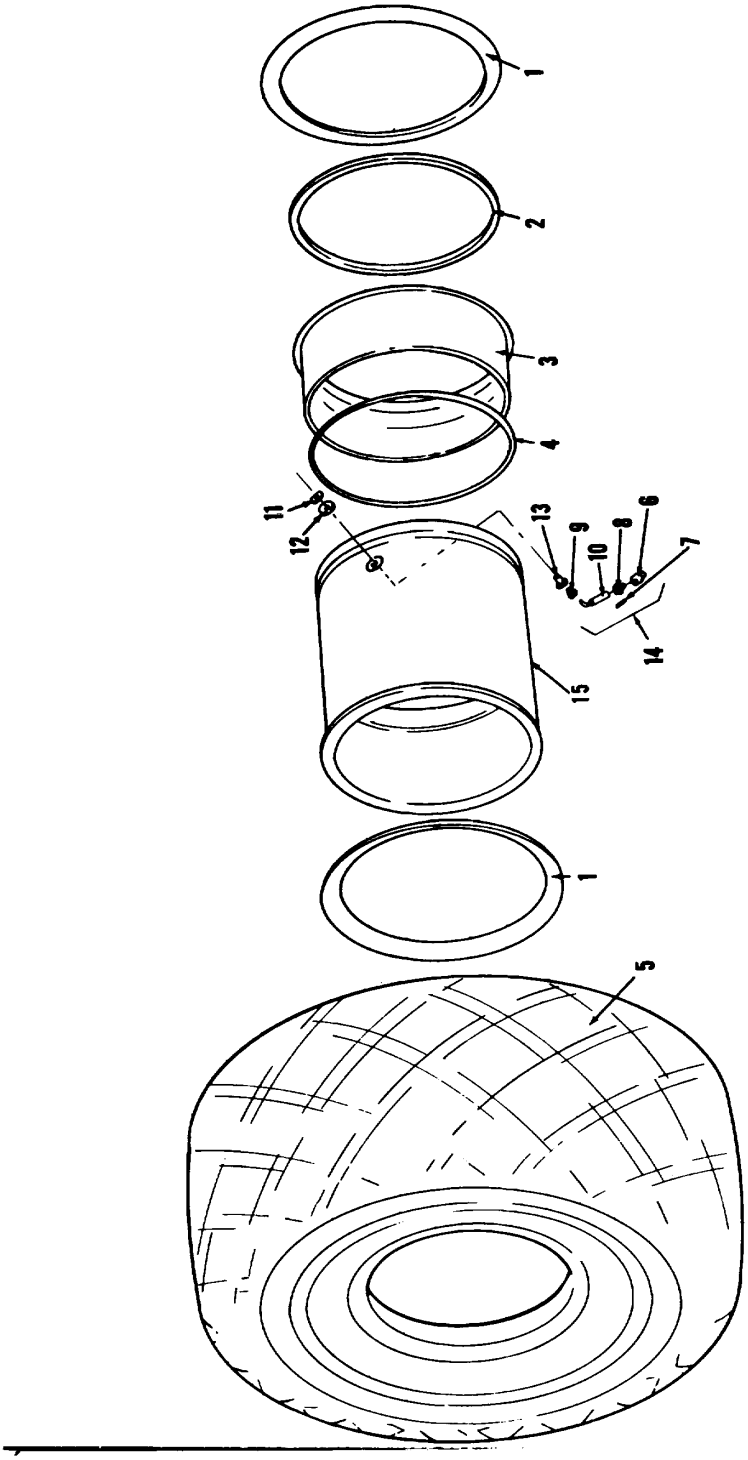

*Figure 5-17. Carrier wheel rim and tire assembly, ,removal and installation.*

*b. Tire Care and Maintenance*. Refer to TM 9-1870-1.

*c. Cleaning, Inspection and Repair*.

(1) Clean rim assembly (fig. 5-18) with an approved cleaning solvent.

(2) Inspect rim assembly for cracks, breaks, or other damage. Repair or replace defective parts.




ME 3810-232-34/5-18

1 Ring, side
2 Ring, lock
3 Bead seat band
4 O-ring
5 Tire, tubeless
6 Valve cap
7 Valve core
8 Adaptor
9 Nut
10 Valve
11 Stud
12 Gormmet, rubber
13 Nut, lock
14 Valve stem

*Figure 5-18. Carrier wheel rim and tire assembly, exploded view.*

## Section VII. CARRIER

### 5-17. General

Both front and rear axles of the carrier are the combination drive and steer type. The power is delivered through the differential to the axle shafts and out through the constant velocity universal joints to the wheels. The front axle can be engaged to operate as a driving unit or disengaged to rotate freely by operating the control lever in the operator's cab. Maintenance procedures are identical for both front and rear axles on Model 2380. The Model 2385 Rough Terrain Crane is equipped with a "no spin" differential unit in the rear axle assembly. The clutch members (49, fig. 5-19) of the "no spin" differential are held out of engagement while over-running by the automatic positioning of rotatable "holdout" cam ring (50) mounted on each driven clutch member (49). The spider (52) has one long tooth or key on its inside diameter which engages a slot of predetermined width, in the center cam (53). This slot limits the travel of the center cam to either side of the clutch teeth of driven clutch member (49) as required to permit the unlocking and locking action of the differential assembly in either direction. The rotatable "hold-out" cam ring (50) is mounted over the outer diameter of the fixed cam ring of each driven clutch member (49). The gap between the ends of the "hold-out" ring (50) meshes with the long tooth or key of the spider (52) as the driven clutch members and other components are brought together to complete the differential assembly (32).

1 Capscrew
2 Lockwire
3 Washer
4 Flange
5 Capscrew
6 Lockwasher
7 Retainer
8 Shim
9 Oil seal
10 Bearing cup
11 Bolt
12 Lockwasher
13 Case cover
14 Gasket
15 Cotter pin
16 Capscrew
17 Bearing cone
18 Drop gear
19 Input shaft
20 Bearing cone
21 Bearing cup
22 Thrust screw
23 Nut
24 Dowel
25 Washer
26 Capscrew
27 Bolt
28 Bolt
29 Nut
80 Case half
31 Ring gear
2 No-spin unit
83 Nut
34 Case half
35 Bearing
36 Drive pinion
37 Capscrew
38 Lockwasher
39 Nut lock
40 Adjusting nut
41 Bearing cup
42 Bearing cone
43 Nut
44 Lockwasher
45 Carrier
46 Side gear
47 Spring
48 Retainer
49 Cam and clutch
50 Holdout ring
51 Snap ring
52 Spider
53 Center cam
54 Bearing cone
55 Bearing cup
56 Spacer and shim
57 S him
58 Bearing cage
59 Screw
60 Bearing cup
61 Bearing cone
62 Drop gear
63 Shaft washer
64 Shaft nut
65 Capscrew

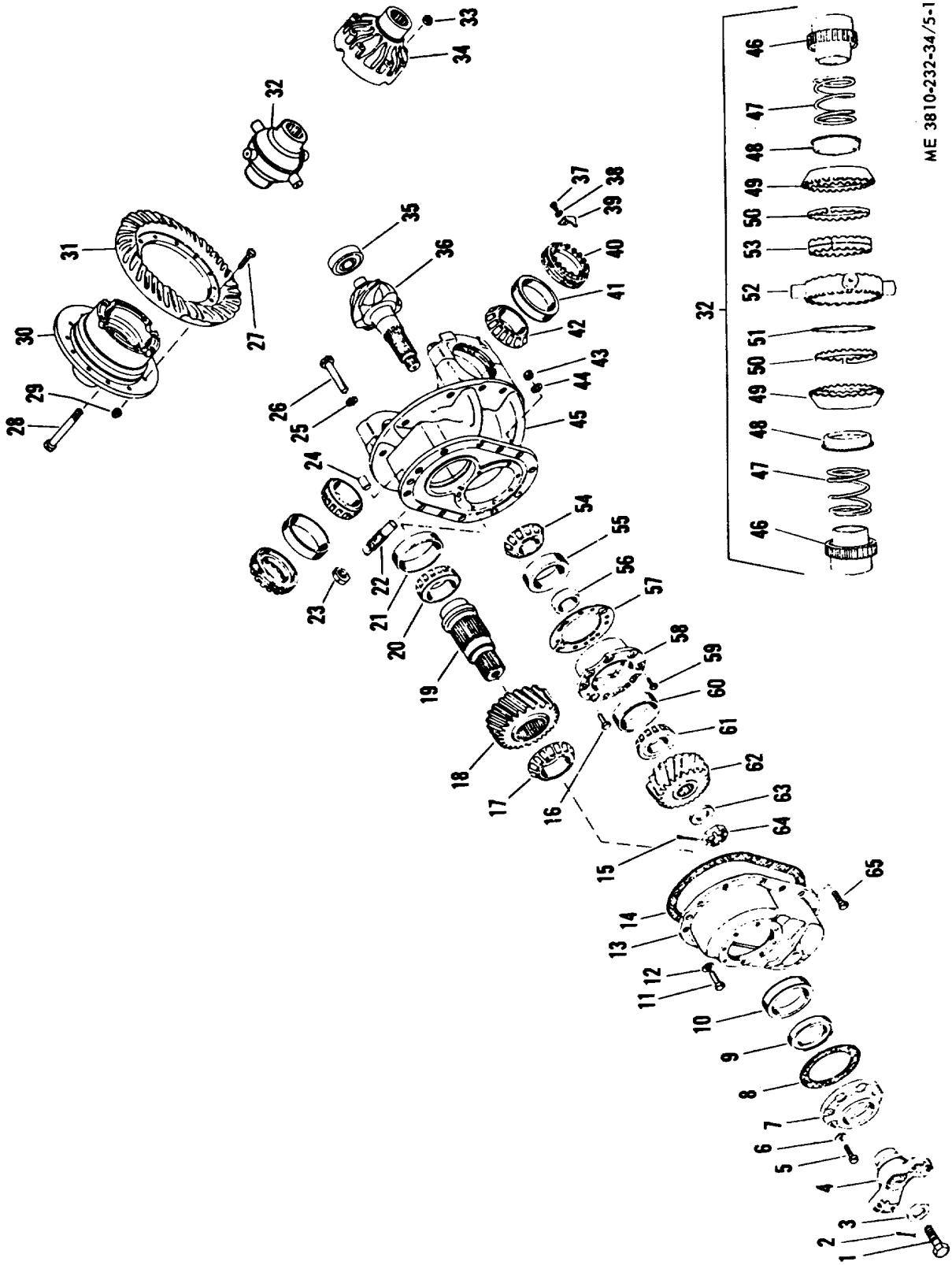



*Figure 5-19. Differential assembly, exploded view, Model 2386.*

**5-18. Drive Steer Axle Assemblies (Front and Rear)**

*a. Removal.*

(1) Remove wheel rim and tire assemblies (para 5-16).
(2) Remove axle assembly as illustrated on figure 5-20.

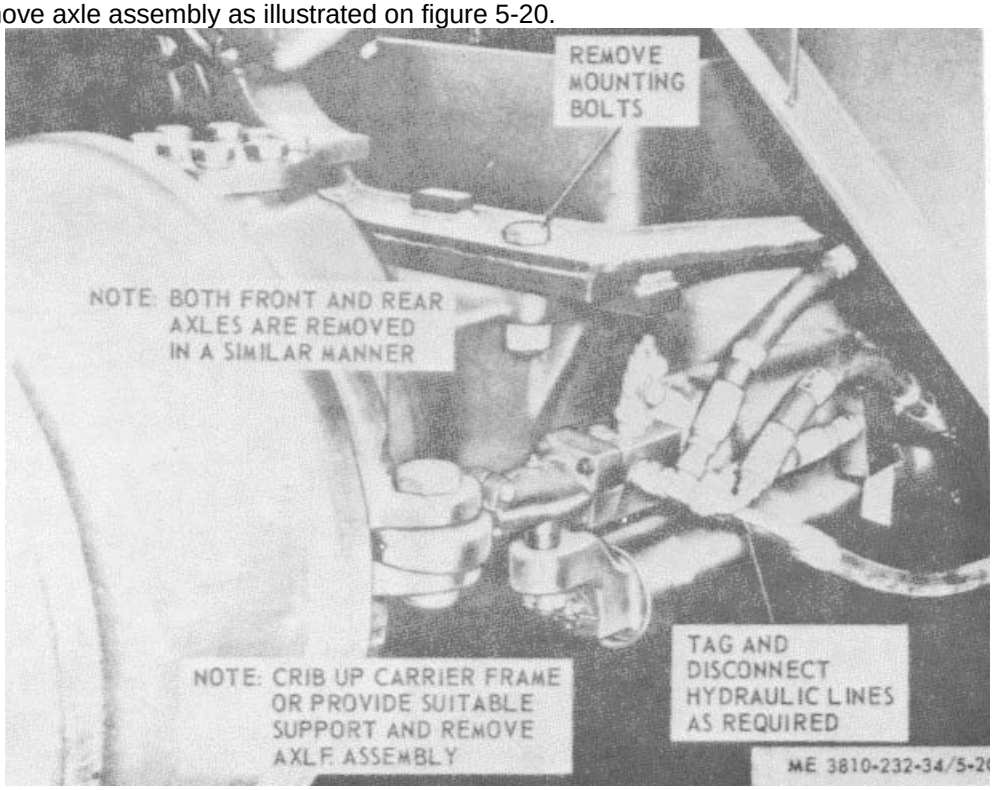
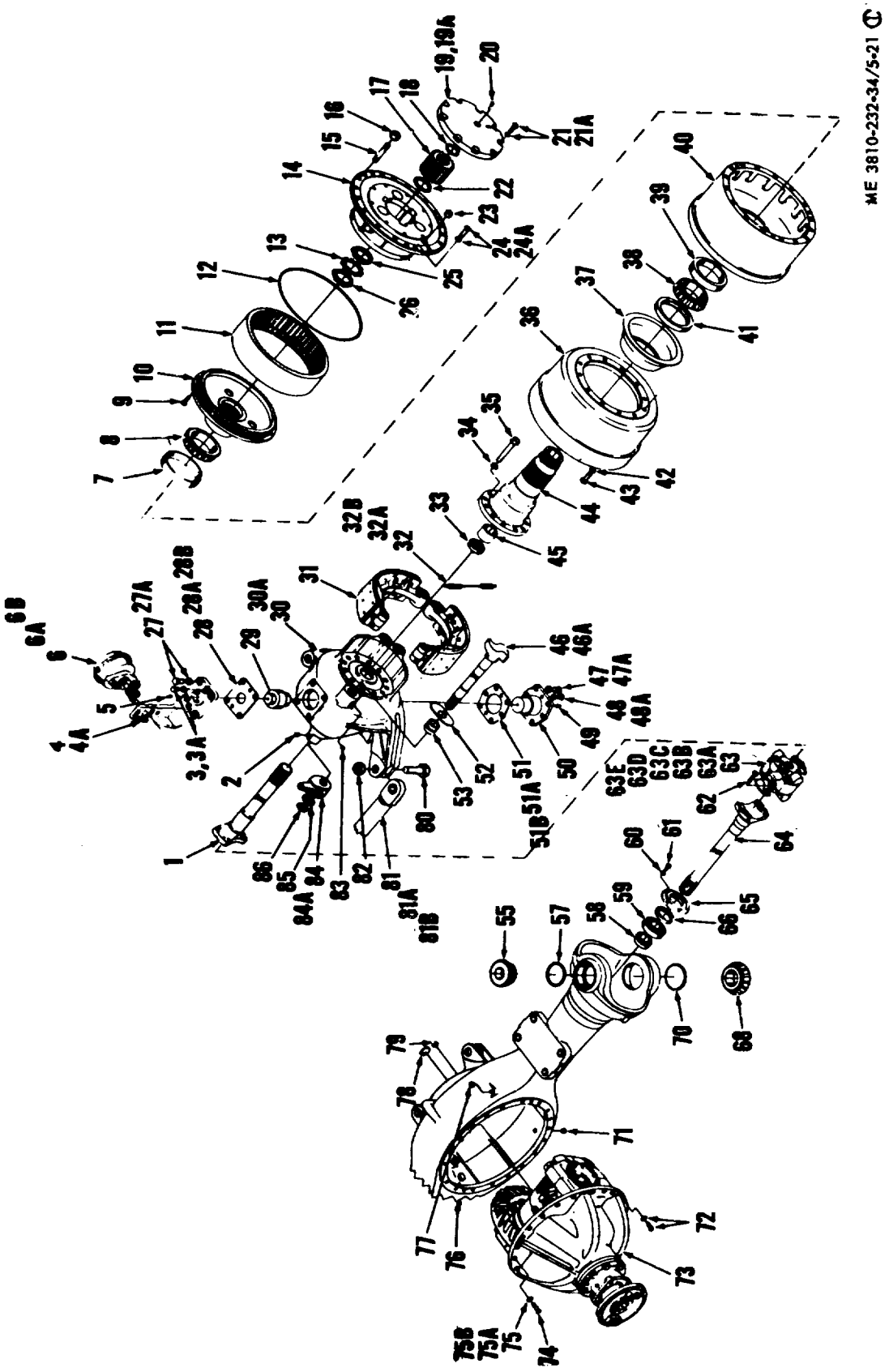



*Figure 5-20. Drive steer axle assemblies, removal and installation.*

*b. Disassembly.*

(1) Drain all lubricant from differential and planetaries.

(2) Remove thrust cap (19, fig. 5-20) from planetary carrier.

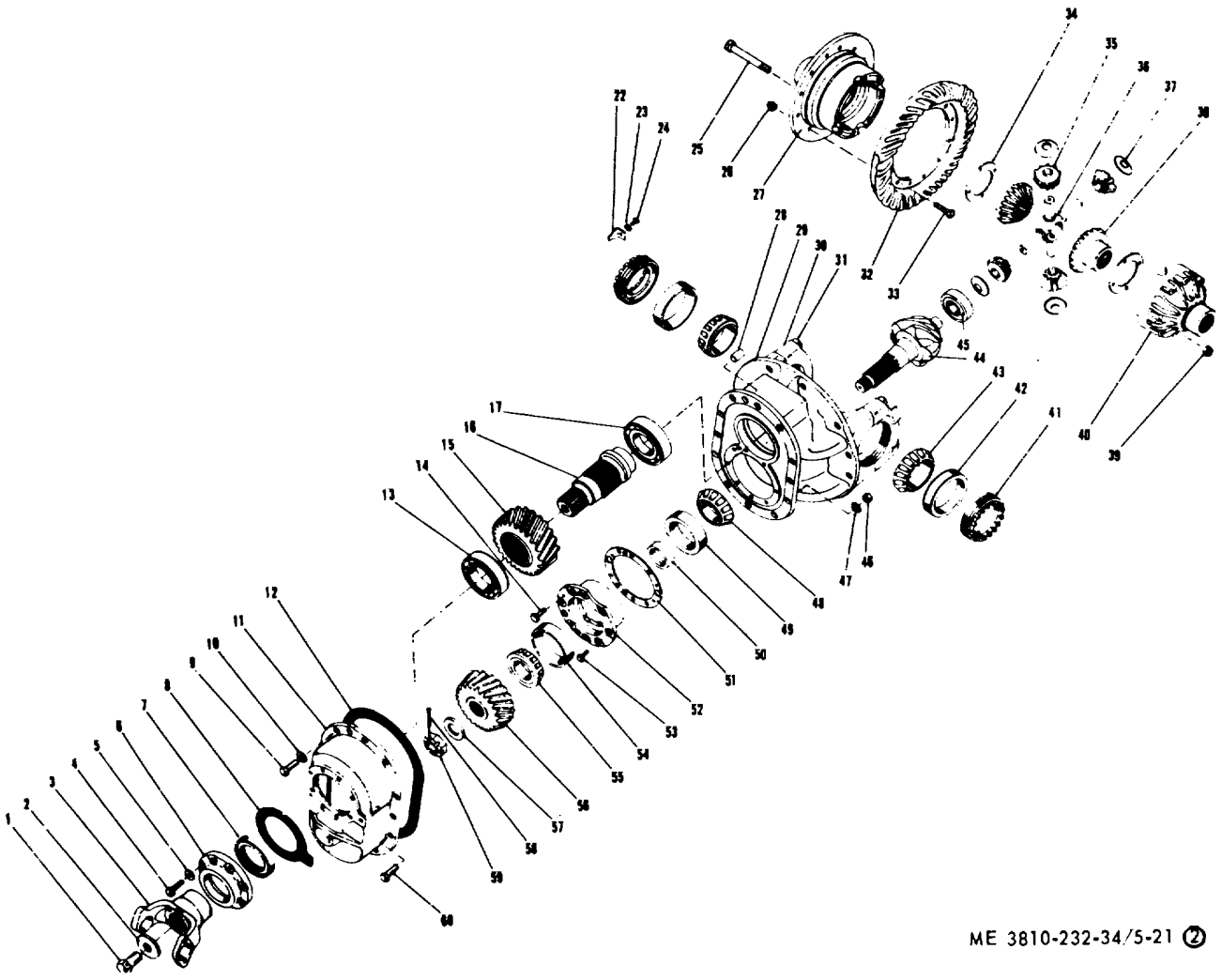



*A-Front and rear axle assembly.*

*Figure 5-21. (1) Carrier drive steer axle and differential assemblies, (front and rear) exploded view.*

Key to Figure 5-21 (1).

| | |
|---|---|
| 1 | Wheel shaft |
| 2 | Plug |
| 3 | Bolt |
| 3A | Lockwasher |
| 4 | Bracket LH. |
| 4A | Bracket R.H. |
| 5 | Plug |
| 6 | Air chamber |
| 6A | Nut |
| 6B | Lockwasher |
| 7 | Cup |
| 8 | Cone |
| 9 | Bolt |
| 10 | Hub |
| 11 | Gear |
| 12 | O-ring |
| 13 | Nut lock |
| 14 | Planet carrier |
| 15 | Wheel stud |
| 16 | Nut |
| 17 | Gear |
| 18 | Ring |
| 19 | Cap |
| 19A | Ring |
| 20 | Valve |
| 21 | Bolt |
| 21A | Lockwasher |
| 22 | Washer |
| 23 | Plug |
| 24 | Bolt |
| 24A | Lockwasher |
| 25 | Nut |
| 26 | Nut |
| 27 | Screw |
| 27A | Lockwasher |
| 28 | Shim |
| 28A | Shim |
| 28B | Shim |
| 29 | Trunnion |
| 30 | Spindle support assy. L.H. |
| SOA | Spindle support assy. R.H. |
| 31 | Brake shoe assembly |
| 32 | Spring |
| 32A | Shim |
| 82B | Cotter |
| 34 | Washer |
| 35 | Bolt |
| 36 | Drum |
| 37 | Oil catcher |
| 38 | Con |
| 39 | Cup |
| 40 | Hub & cup assembly |
| 41 | Oil seal |
| 42 | Washer |
| 43 | Bolt |
| 44 | Spindle assembly |
| 45 | Bushing |
| 46 | Cam shaft R.H. |
| 46A | Cam shaft L.H. |
| 47 | Bolt |
| 47A | Lockwasher |
| 48 | Bolt |
| 48A | Lockwasher |
| 49 | Plug |
| 50 | Trunnion |
| 51 | Shim |
| 51A | Shim |
| 5lB | Shim |
| 52 | Washer |
| 53 | Bushing |
| 55 | Bearing |
| 57 | Retainer |
| 68 | Collar |
| 69 | Bearing |
| 60 | Lockwasher |
| 61 | Bolt |
| 62 | Bolt |
| 63 | U-point assy |
| 68A | Plate |
| 63B | Bolt |
| 63C | Bearing |
| 63D | Seal |
| 63E | Fitting |
| 64 | Shaft |
| 65 | Retainer |
| 66 | Seal |
| 68 | Bushing |
| 70 | Retainer |
| 71 | Plug |
| 72 | Stud |
| 78 | Differential & carrier assembly |
| 74 | Stud |
| 75 | Washer |
| 75A | Stud nut |
| 75B | Dowel |
| 76 | Housing |
| 77 | Breather |
| 78 | Retainer |
| 79 | Plug |
| 81 | Tie rod assy |
| 81A | Bushing |
| 81B | Dowel |
| 82 | Nut |
| 83 | Plug |
| 84 | Adjuster L.H. |
| 84A | Adjuster R.H. |
| 85 | Retainer |
| 86 | Ring |



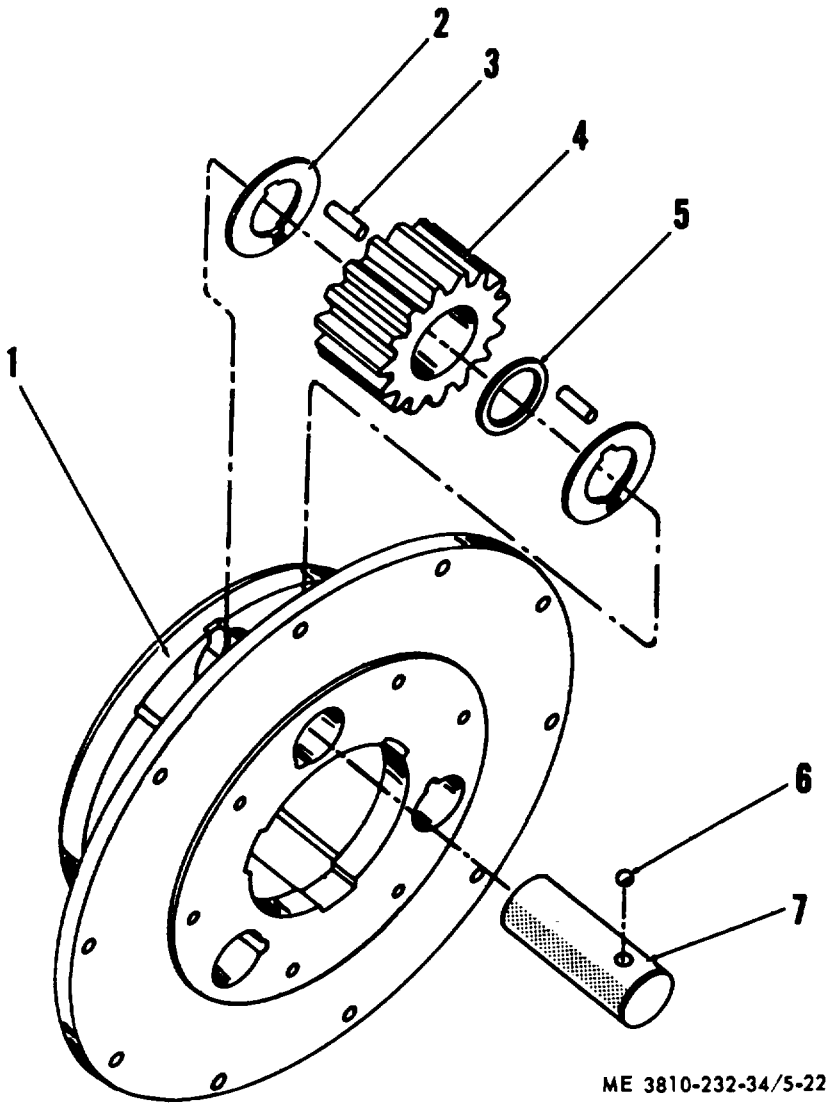
ME 3810-232-34/5-21 ②

1 Capscrew
2 Washer
3 Flange (8c)
3A Shield
4 Capscrew
5 Lockwasher
6 Retainer
7 Oil seal
8 Shim
8A Shim
8B Shim
9 Capscrew
10 Lockwasher
11 Cover
12 Gasket
13 Cone
13A Bearing
14 Capscrew
15 Gear
16 Shaft
17 Cone
17A Cup
22 Lock
23 Lockwasher
24 Capscew
25 Bolt
26 Nut
27 Case
28 Dowel
29 Carrier
30 Carrier
31 Capscrew
32 Gear
33 Bolt
34 Washer
35 Pinion
36 Spider
37 Washer
38 Gear
39 Nut
40 Case
41 Nut
42 Cup
43 Cone
44 Pinion R.H.
45 Bearing
46 Carrier
47 Carrier
48 Cone
49 Cup
50 Shim kit
51 Shim
51A Shim
51B Shim
52 Cage
53 Screw
54 Cup
55 Cone
56 Gear
57 Washer
58 Cotter
59 Nut
60 Bolt

B—Differential assembly

*Figure 5-21. (2) Continued*

(3) Disassemble axle planetary assembly as shown on figure 5-22.




1 Spider
2 Washer
3 Roll
4 Pinion
5 Spacer
6 Ball
7 Shaft

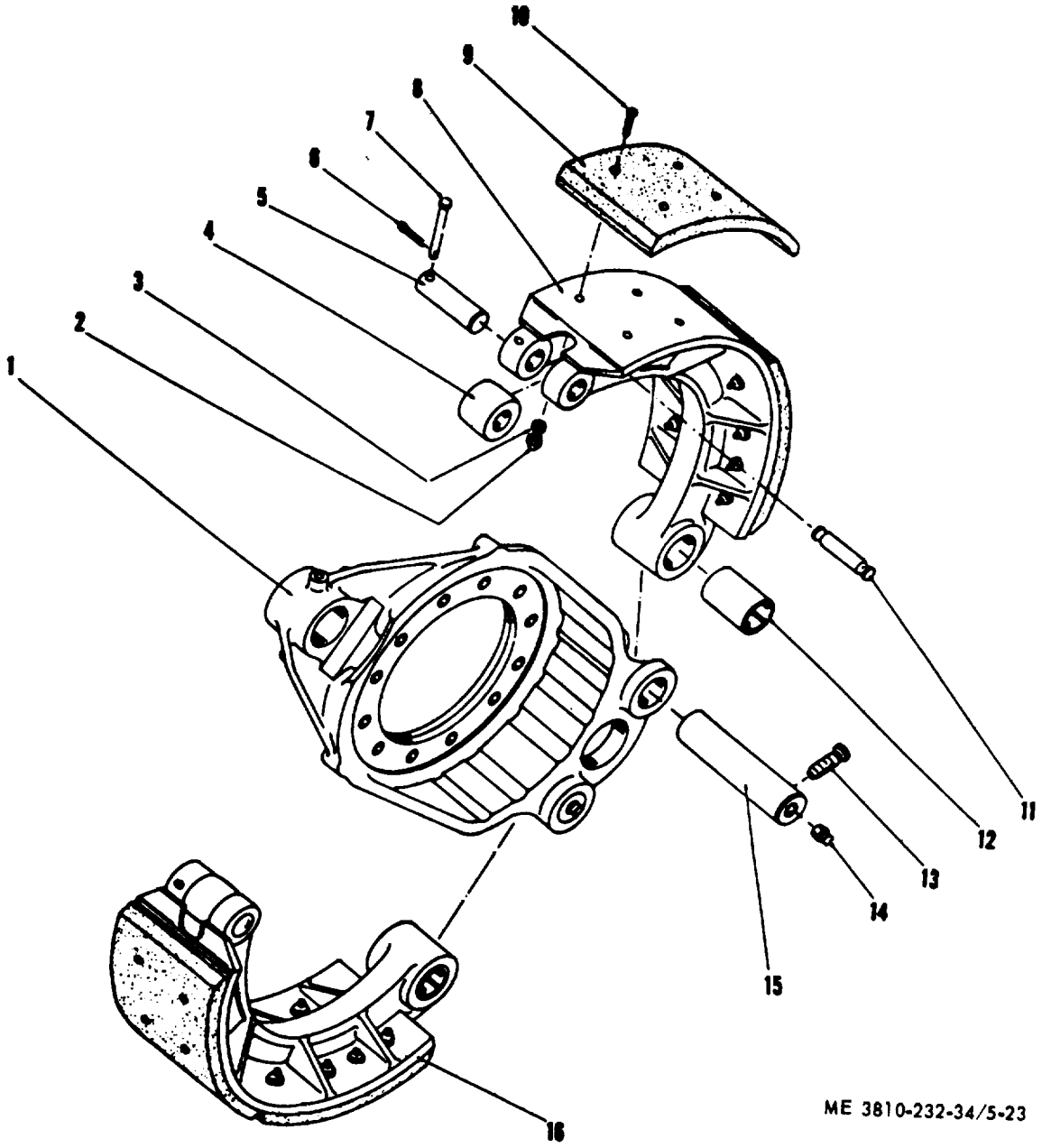
*Figure 5-22. Axle planetary carrier assembly, exploded view*

(4) Remove locknut (25, fig. 5-21) nut lock (13) and adjusting nut (26). Support wheel hub and drum assembly in a level position. Using a suitable puller, remove internal gear and hub assembly (10, 11). Remove wheel hub (A0) and drum assembly (36).

**NOTE**

**Hexagon socket wrench furnished with each end item is used for removal and installation of lock-nut (25, fig. 5-21) and adjusting nut (26. fig. 5-21).**

(5) Remove brake release spring (82). Remove plug (14, fig. 5-23) and anchor pin (15). Remove brake shoes (8, 16).




1 Integral parts of spindle socket
2 Nut
3 Lockwasher
4 Roller
5 Pin
6 Cotterpin
7 Pin
8 Shoe
9 Lining
10 Bolt
11 Pin
12 Bushing
13 Screw
14 Plug
15 Pin
16 Brake shoe and lining assy.

*Figure 5-23. Broke shoe assembly, exploded view*

(6) Remove camshaft retainer ring (86, fig. 5-21) and retainer (85). Remove adapter (84). Remove camshaft (46), thrustwasher (52), bushing (53), from axle. Remove spindle bolts (35) from brake spider, which is part of spindle support (30), remove brake spider.

(7) Remove oil catcher (37) spindle attaching bolts (35) and remove spindle end (44).

(8) Remove lower trunnion (50) and shims (51). Remove upper trunnion (29) shims (28) and air chamber bracket (4). Spindle support (30) may now be removed.

(9) Disconnect wheel shaft (1) from universal joint (63). Disconnect universal joint from axle shaft (64).

(10)Remove axle shaft bearing retainer bolts (61). Remove axle shaft (64) and bearing assembly (65, 66, 59, 58) from axle housing.

(11)Remove differential assembly (73). Remove input yoke capscrew (1, fig. 5-21B) and washer (2). Pull flange (3) from shaft (16). Remove input shaft retainer (6) and oil seal assembly (7). Remove input shaft from differential cover. Inner bearing cone (17) will remain in cover.

(12)Remove pinion nut (59) and pinion drop gear (56) from pinion (44).

(13)Remove pinion shaft (44) and bearing cage assembly (52) from cover. Use caution not to damage shims (51) located between bearing cage and differential housing.

**NOTE**

**Jack screw holes are provided in bearing cage to facilitate disassembly.**

(14)Remove differential bearing capscrew (24) and lock (22). Remove differential carrier (30).

**NOTE**

**Each carrier must be marked; as they must be reassembled on the same side as they are removed.**

(15)The ring gear and related parts are not removed in the same manner on both Models 2380 and 2385. Use the following instructions and refer to fig. 5-21 (B) for Model 2380 and to fig. 5-19 for Model 2385.

(a) Model 2380. On Model 2380, refer to fig. 5-21 (B), and remove ring gear (32) and differential case assembly (27, 40) from the carrier housing. Differential bearing (43) may be removed, should either the bearing or differential case need replacing. Differential plain case half (40) and flange half (27) must be marked so they can be reassembled at the same place they were removed. Remove differential case bolts (25) and nuts (39).

(b) Model 2385. On Model 2385, refer to fig. 5-19 and remove the ring gear (31) and differential case assembly (30 and 34) which includes the no-spin unit (32). The original retaining bolt and washers is available, can be
used to hold the no-spin assembled while the case is disassembled. Otherwise, hold the case firmly as the last case bolt is removed because the nospin is assembled under spring pressure and must not be allowed to fly apart. Remove the assembly (32) from the case and release the retainer bolt. Hold the assembly firmly to absorb the sudden release from spring pressure. If removal of the center cam (53) is desired, expand the snap ring (51) outward into the spider (52) with
small screw drivers or tapered wedges. The center cam can then be pressed through the spider.

(16)Lift plain case (40) from flange case (27). Lift side gear (38) and thrust washer (34) from flange. Lift spider (36) differential pinions (35) thrust washers (37) inner side gear and thrust washer from flange.

(17)Remove ring gear bolt (33) and remove ring gear (32) from flange

*c. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for cracks, breaks, excessive wear and other damage. Replace all gaskets, oil seals, O-rings and external lockwashers.

(3) Perform magnetic inspection on axle shafts, wheel shafts, input shaft, pinions, etc. Repair or replace damaged or defective parts as necessary.

(4) On the rear axle of Model 2385 only, check the splines on the side gears and clutch members of the no-spin units (32, fig. 5-19). Remove any burrs or small chipped edges with a stone or electric burr grinder. If large sections of the spline are broken away, replace the part. Check the side gear hubs for fractures. Check for fractures or chipping on the holdout ring and rounded edges on the lugs. A badly worn or chipped holdout ring can cause chipping of clutch teeth. Inspect the clutch teeth on the spider and driven clutches. If excessively chipped or rounded, these parts must be replaced. If a part is replaced due to chipped teeth, always replace the mating part as it may have invisible fractures.

*d. Reassembly.*

(1) Install the ring gear and related parts. Use the following instructions for Models 2380 and 2385 as noted and refer to figure 5-21B for Model 2380 and to figure 5-19 for Model 2385.

(a) Model 2380. Install the ring gear (32, fig. 21B) on flange half (27) and secure with bolts (33). Place side gear thrust washer (34) and side gear in flange half of the differential. Assemble pinions (35) and thrust washers
(37) on spider (36) and place in position in flange half case. Tighten to specified torque.

(See torque chart). Place side gear (38) and thrust washers in position on pinions

(b) Model 2385 On the rear axle lightly lubricate all parts of the no-spin differential unit as it is being assembled. Assemble the no-spin unit (32, fig 5-19) being careful to position the spring retainers (48) so that the spring (47) seats inside the cupped section A bolt and washer can be used to hold the no-spin unit assembled, provided the washers are small enough to pass through the differential case ends (30) and (34) after the case bolts are tightened. If a retainer bolt is not available, it is quite easy to assemble by hand pressure, holding in position until a case bolt is started. Secure the differential case assembly to the ring gear (31) with bolts (27) and nuts (29)

(2) Place case (40) in position on case (27) Install differential case bolts (25) and self locking nuts (39) Tighten to specified torque. (See torque chart).

**NOTE**

**Make certain matching marks of both halves are in alignment.**

(3) Press bearing cones (43) and install differential and bearing assembly in differential carrier (29). Place adjusting nuts (41) in position. Install differential carrier caps (30) but do not tighten. Press input shaft (16) in rear input shaft bearing cone (17). Install shaft and bearing in carrier.

**NOTE**

**Make certain carrier caps are reassembled on the same side they were removed.**

(4) Press center bearing cone (48) onto pinion shaft (44) with rollers upward; then slide shim kit (50) into place, making certain the inside chamber is toward the cone. This spacer as provided in the original assembly is ground to proper length to obtain the specified bearing preload of 13 to 23 inch-pounds rolling pinion bearing resistance. Should a new pinion bearing cage or pinion bearings be used in reassembly, a service spacer and skim kit must be used.

**NOTE**

**In the event that the bearing cage does not require replacement, the spacer furnished as original equipment may be reinstalled.**

(5) Press pinion bearing cups (49) into bearing cage (52) then set cage and cup assembly in place over shaft and press outer cone (55) onto pinion shaft and into position in cup (54). Maintain full pressure on the cone and check for proper bearing preload. To increase preload, shims (51) may be removed; to decrease preload, shims may be added.

(6) Press pinion and bearing assembly into carrier until outer pinion bearing cup cage is approximately 1, ’4" from face of carrier. During this operation, be certain the oil return holes are in line.

(7) Split shims (51) are provided for adjustment of pinion tooth contact. Approximately 0.016 shim pack is the basic amount for starting the adjustment, and shims may be added or removed as required to move pinion inward or outward. The shims are installed between bearing cup cage and face of carrier. The pinion assembly may now be drawn into position in carrier by tightening screws (14, 53) evenly.

(8) Adjust backlash .008 to .011 as follows:

(a) If backlash is too great, back off adjusting nut (41) on plain half case (40) and tighten opposite side until all lash is removed. Tighten nut on plain half case solidly to seat bearings. Back off nuts on flange side, one notch at a time and follow with opposite nut until correct backlash is obtained.

(b) If backlash is under minimum specification, back off nut on flange half and tighten nut on opposite side. Operation should be done in one notch steps until correct backlash is obtained.

(c) Tighten carrier cap (30) and recheck backlash, if backlash has changed, repeat above procedure to correct.

**NOTE**

**Carrier cap bolts should be tightened to specified torque (See torque chart).**

(9) Install differential bearing adjusting nut locks (22) and secure with screw (24) and lockwasher (23). Tighten to specified torque. (para 1-4). Lockwire to prevent loosening.

(10) Install pinion drop gear (56) on pinion shaft, (long hub outward). Place washer (57) on shaft and install pinion nut (59). Tighten to specified torque. (para 1-4). Install cotter key (58).

(11) Thrust screw adjustment (Model 2385).

(a) Turn thrust screw (3, fig. 5-24).

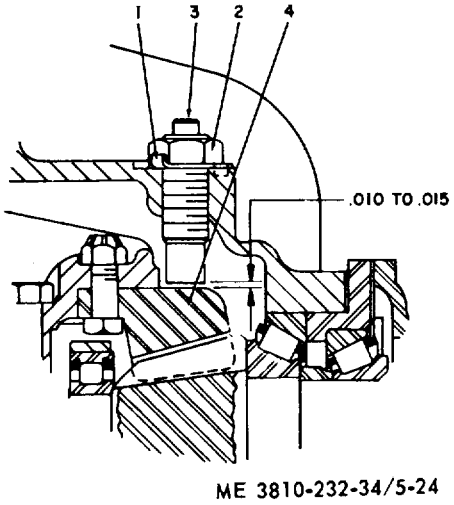
(b) Install a dial indicator on end of thrust screw.

(c) Turn thrust screw away from ring gear until a 0.012 reading is taken on the dial indicator. The specification is’ 0.010 to 0.015 distance from end of thrust screw to side of ring gear. 0.012 was used as an in-between reading.

(*d*) Hold thrust screw and tighten lock nut (2).

**NOTE**

**The dial indicator reading must not move during this operation. Bend one tank of lock nut lock (1) over flat side of housing and one tank over flat side of the lock nut.**




1 Lock
2 Lock nut
3 Screw
4 Ring gear

*Figure 5-24. Thrust screw adjustment (Model 2385).*

(12) Install drop gear (15, fig. 218) on input shaft (16). Install drop gear cover (11) on carrier housing (29). Tighten bolts to specified torque, (para 1-4). Install front input shaft bearing (13).

**NOTE**

**Drop gear is counterbored to prevent spline interference. This counterbore must face rear input bearing.**

(13) Press new oil seal (17) in input shaft retainer (6) and using new gasket, assemble cap to drop gear cover. Tighten to specified torque.

(para 1-4) Install input shield (3). Coat entire end of input shaft with No. 2 Permatex and install retaining washer (2) and screw (1). Tighten to specified torque. (para 1-4). Lockwire to prevent loosening.

(14) If differential (73, fig. 5-21) was removed, coat axle housing (76) with Permatex No. 2 and install differential in axle housing; secure with taper dowels, studs (72, 74) and lockwasher. (75). Tighten to specified torque. (para 1-4)

(15) If trunnion bearing grease retainer (57) is to be replaced, coat outer diameter with permatex to assure a water tight fit, install trunnion bearing (55), install retainer with lip of seal out-lower retainer with lip of seal downupper retainer with lip seal up. This is to prevent water from entering trunnion bearings.

(16) Install axle shaft oil seal (66) into bearing retainer (65) lip of seal up. (Grease lips of seal with an approved grease). Place oil seal and retainer over axle shaft (64) oil seal away from the axle shaft flange. Press axle shaft bearing (59) on shaft. Heat bearing collar (58) until it is blue or about 600°. Place on axle shaft with square shoulder of collar next to the bearing.

Using new gasket and permatex, install axle shaft, oil seal and bearing into axle housing, aligning splines of axle shaft into side gear of differential. Secure oil seal retainer to axle housing with bolts (61) and washers. Tighten to specified torque. (para 1-4).

(17) Install universal joint (63) to axle shaft flange with bolts (62), and tighten to specified torque. (para 1-4). Install wheel shaft (1) to universal joint with bolts (62) and tighten to specified torque. (para 1-4).

(18) Place spindle support (30) over trunnion bores. Cam shaft bores up. Install top trunnion and air chamber bracket (4) through top of spindle support and into trunnion bearing. It is recommended if any of the bearings of the trunnion parts were replaced, use about 0.015" shims under trunnion flange. Secure flange with cap screws and washers (27); tighten to specified torque. para 1-4). Install bottom trunnion (50) with about 0.015" shims. Secure flange with bolts and washers (47); tighten to specified torque. (para 1-4).

(19) Install spindle (44) on spindle support (30) with drilled hole in spindle to bottom of spindle support. Install oil catcher (37) on spindle.

(20) Install brake assembly (31) on spindle with cam shaft hole in brake spider aligned with cam shaft hole in spindle support. Install bolts (35) and washers (34). Tighten to specified torque. (para 1-4). Install brake return spring (32).

(21) Place thrust washer (52) and bushing (53) on cam shaft (46). Enter cam shaft through bore in brake spider which is part of spindle support (30). Install cam shaft retainer (85). Install slack adjuster (84) on cam shaft and secure with retainer ring (86). Connect air chamber (6) to slack adjuster with pin and cotter. Adjust cams so the rollers on the brake shoes are in a neutral position by pushing in and turning the hex head adjusting nut on slack adjuster.

(22) If hub (40) and drum (36) were disassembled-align holes in brake drum with holes in wheel hub; install bolts (43) and washers

(42). Tighten to specified torque. (para 1-4). Lockwire in pairs to prevent loosening. Place inner cone bearing (38) in inner cup (39) of wheel hub. Install oil seal (41) over bearing with lip of seal toward bearing.

**NOTE**

**Leave oil seal stand out 1/16" from flush position in wheel hub. Install brake drum, wheel hub, inner bearing and oil seal on spindle end.**

**CAUTION**

**Do not damage oil seal**

(23) If internal gear (11) and hub (10) were disassembled-align holes in gear and hub and secure with bolts (9) tighten to specified torque (para 1-4). Lockwire in pairs to prevent loosening. Press cone bearing (8) on gear hub. Place spline end of gear hub over spindle, aligning on gear hub with splines on spindle.Using a soft hammer tap gear and hub assembly on spindle.

(24) Install wheel bearing adjusting nut (26). While tightening nut rotate wheel hub, and rap with a rubber or rawhide mallet until a definite drag is felt. Insert a screw driver through the holes in the internal gear hub and check outer wheel hub bearing roller cage. If hub bearings have enough preload, roller bearing cage will not move. Install adjusting nut lock (13) and locknut (25). Tighten securely and bend one tag of lock over flat of adjusting nut and one tag over flat of lock nut.

(25) Use Permatex No. 2 on planet carrier (14). Assemble planet carrier to wheel hub. Install bolts (24) and washers; tighten to specified torque. (para 1-4). Install sun gear (17) and retainer ring (18) in planet carrier. Use Permatex No. 2 on thrust cap (19) and install cap to planet carrier. Tighten bolts to specific torque (para 1-4).

(26) Assemble tie rod assembly (81) to spindle support with tie rod bolts (80) and nuts (82). Bow in the tie rod should be away from the housing for clearance when turning. The tie rod should be adjusted so the distance between the front of the brake drums and the rear of the drums is the same when measured across the axle.

(27) Refill differential planetaries with lubricant. (Refer to lubrication order).

*e. Installation.*

(1) Install axle assembly as illustrated on figure 5-20.

(2) Install wheel rim and time assemblies (para 5-22).

(3) Adjust brakes (TM 5-3810-232-12).

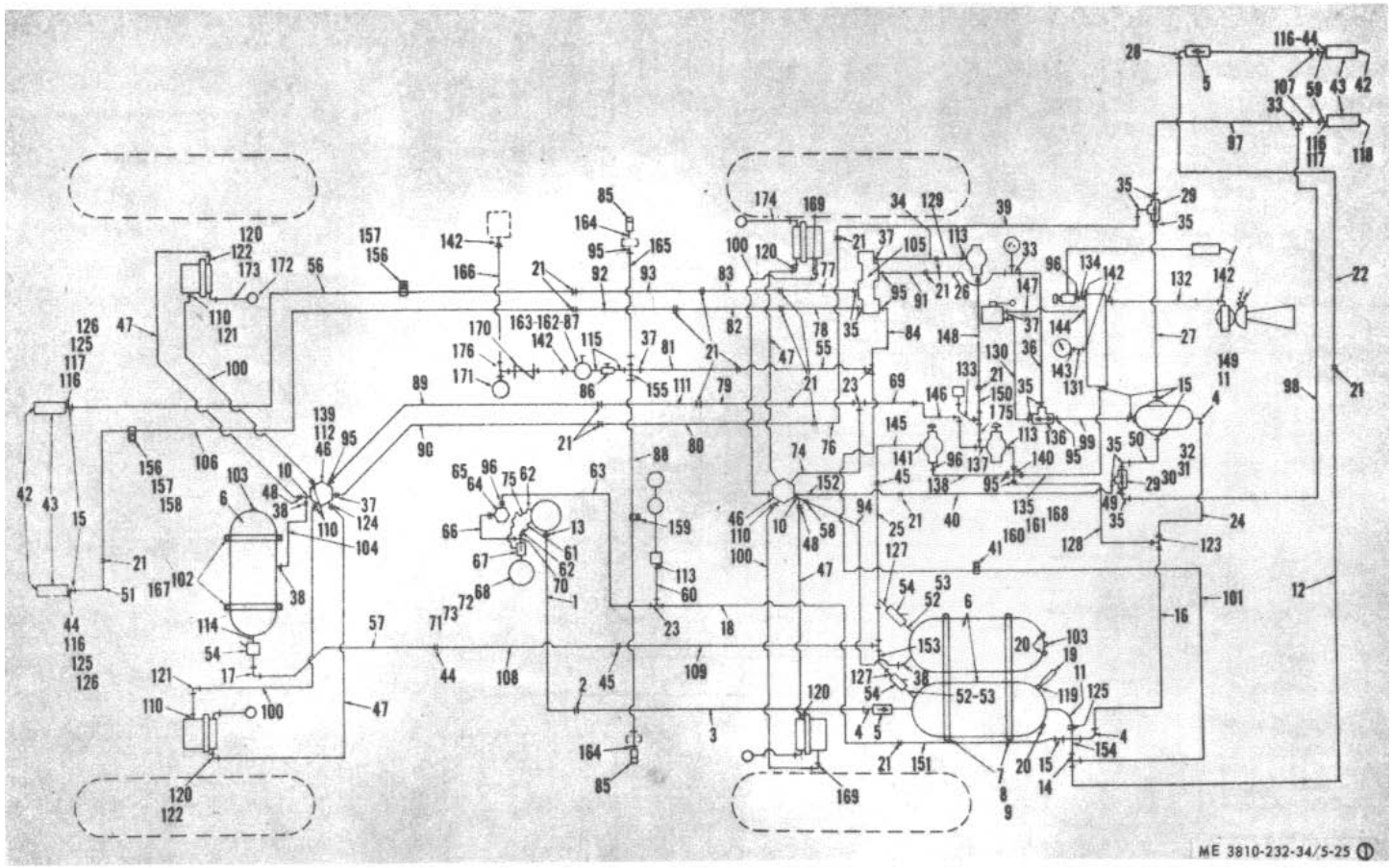
(4) Adjust steering and wheel alignment (TM 5-3810-232-12)

## Section VIII. CARRIER AIR BRAKE SYSTEM

**5-19. General**

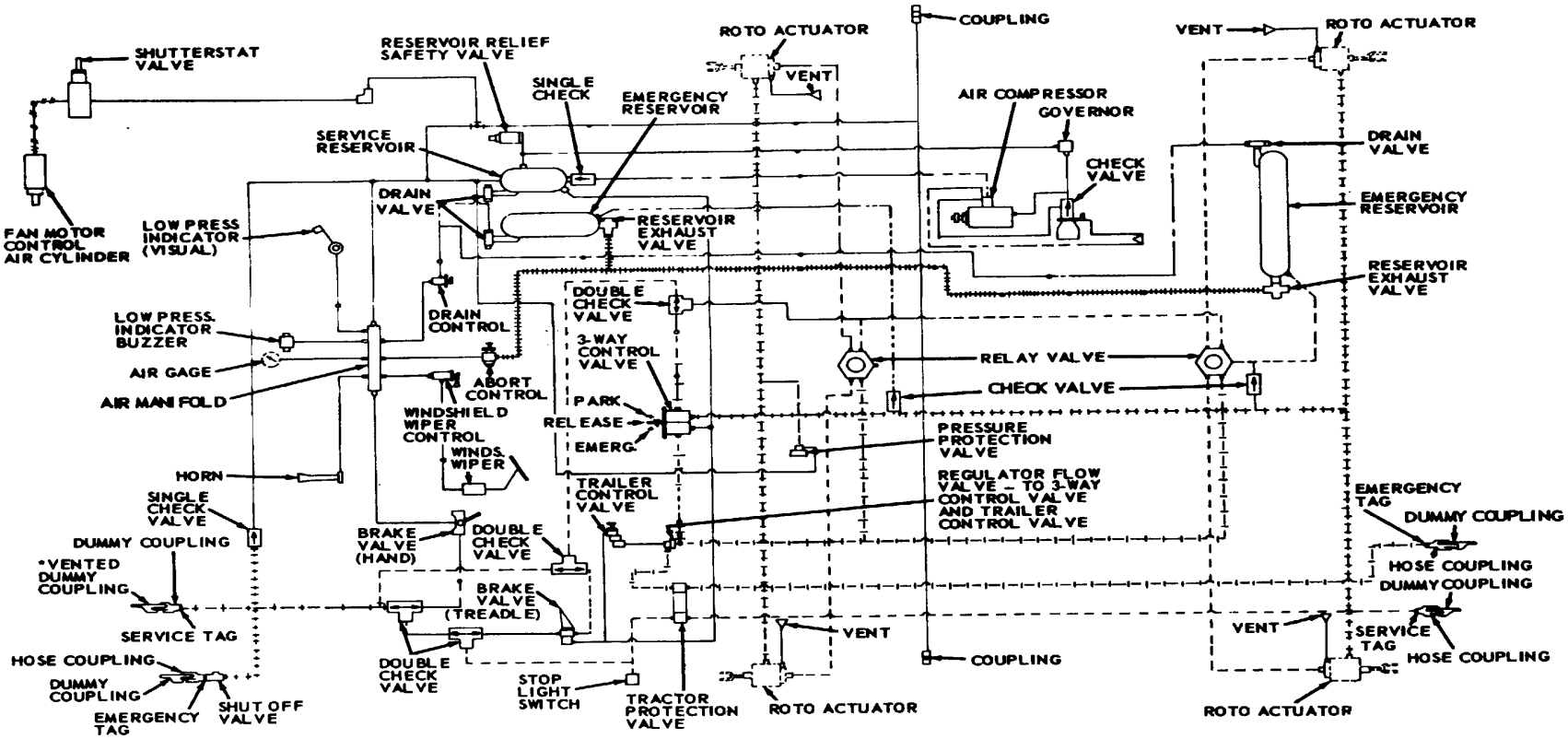
The carrier is equipped with service brakes on each wheel controlled by the air brake system. In this air brake system the brakes are set by the power of compressed air. The air system consists of the air compressor, valves, reservoir, brake chambers connecting hoses. tubes and fittings (fig. 5-25).

1 Tube assembly
2 Tube union
8 Tube assembly
4 Elbow, 900 male
5 Single check valve
6 Air reservoir
7 Strap
8 Lockwasher
9 Nut
10 Tee
11 Elbow, street
12 Tube assembly
13 Connector, male
14 Tee
15 Connector
16 Tube assembly
17 Elbow, 90° male
18 Tube assembly
19 Safety valve
20 Plug, pipe
21 Tube union
22 Tube assembly
23 Tee, union
24 Tube assembly
25 Tube assembly
26 Tube assembly
27 Tube assembly
28 Elbow, 900 male
29 Double check valve
30 Capscrew
31 Lockwasher
32 Nut
33 Tee
34 Tube assembly
35 Elbow, 900 male
36 Tube assembly
37 Connector
38 Elbow, 450 male
39 Tube assembly
40 Tube assembly
41 Clamp
42 Dummy coupling
43 Hose coupling
44 Tag (emergency)
46 Union
46 Relay valve
47 Hose assembly
48 Connector
49 Elbow. 90° street
50 Tube assembly
51 Tube assembly
52 Pipe nipple
53 Coupling
54 Drain valve
55 Tube assembly
56 Tube assembly
57 Tube assembly
58 Connector
59 Elbow, 450 street
60 Tube assembly
61 Hose assembly
62 Elbow, 900 male
63 Tube assembly
64 Governor
65 Capscrew
66 Tube assembly
67 Check valve
68 Alcohol evaporator
69 Tube assembly
70 Tee
71 Capscrew
72 Lockwasher
78 Nut
74 Tube assembly
75 Hose assembly
76 Tube assembly
77 Tube assembly
78 Tube assembly
79 Tube assembly
80 Tube assembly
81 Tube assembly
82 Tube assembly
83 Tube assembly
84 Tube assembly
85 Coupling body
86 Shut-off cock
87 Pressure regulator
88 Tube assembly
89 Tube assembly
90 Tube assembly
91 Tube assembly
92 Tube assembly
93 Tube assembly
94 Tube assembly
95 Connector
96 Connector
97 Tube assembly
98 Tube assembly
99 Tube assembly
100 Hose assembly
101 Tube assembly
102 Tank bracket
103 Pipe plug
104 Tube assembly
105 Tractor protection valve
106 Tube assembly
107 Clamping stud
108 Tube assembly
109 Tube assembly
110 Connector
111 Tube assembly
112 Capscrew
113 Elbow, 90° male
114 Elbow, 90° street
115 Pipe nipple
116 Plate
117 Connection tag (service)
118 Dummy coupling
119 Reducing bushing
120 Elbow, 90° male
121 Hose assembly
122 Hoe assembly
123 Toe
124 Connector male
12 Pipe nipple
126 Locknut
127 Tee
128 Tube assembly
129 Tube assembly
180 Tube assembly
131 Tube assembly
182 Tube assembly
183 Tube assembly
134 Tube assembly
135 Tube assembly
186 Tube assembly
137 Tee
138 Tube assembly
139 Plug, pipe
140 Cross, pipe
141 Elbow, tube
142 Elbow, tube
143 Connector, tube
144 Elbow tube
145 Tube assembly
146 Tube assembly
147 Tube assembly
148 Tube assembly
149 Pipe plug
150 Tube assembly
151 Tube assembly
152 Tube assembly
153 Tube assembly
154 Cross, pipe
155 Cross, pipe
156 Capscrew
157 Bracket
158 Plate
159 Capscrew
160 Nut
161 Lockwasher
162 Capscrew
163 Washer, plain
164 Pipe nipple
165 Tube assembly
166 Tube assembly
167 Capscrew
168 Screw, self-tapping
169 Elbow, 456 male
170 Valve, check
171 Gauge, air pressure
172 Breather
173 Hose assembly
174 Hose assembly
175 Tube assembly
176 Tee, street




A-Mode2380

*Figure 5-25. (1) Carrier air system assembly, schematic.*




B—Model 2385

*Figure 5-25. (2)-Continued.*

**5-20. Brake Shoes**

*a. Removal and Disassembly*. Remove brake shoes as described in paragraph 5-18. Disassembly, 1 through 6.

*b. Cleaning, Inspection and Repair*.

(1) Clean all parts, except brake lining, with an approved cleaning solvent and dry thoroughly.

(2) Inspect brake lining for excessive wear and glazing. Remove glazing by brushing with a wire brush. Replace defective or worn linings.

**When installing new brake lining, tighten lining bolt nuts to 190 inch/lbs. torque.**

(3) Inspect brake shoes for cracks, breaks and excessive pinhole wear. Replace damaged or defective breakshoes.

*c. Reassembly and Installation*. Reassemble and install brake shoes as described in paragraph 6-18, reassembly, 19 through 24.

*d. Adjustment*. Adjust brakes (TM 5-3810232-12).

**5-21. Air Reservoir Tanks**

*a. Removal*. Remove air reservoir tanks as instructed on figure 5-26.

**NOTE**

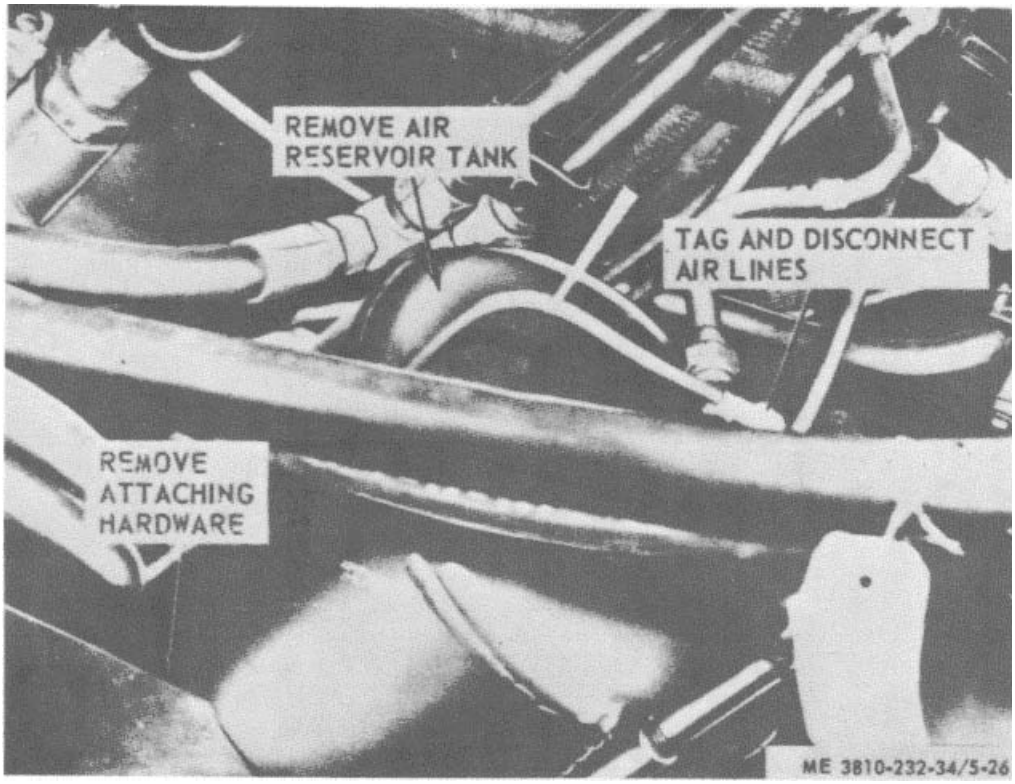



*Figure 5-26. Air reservoir tank, removal and installation.*

*b. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect tanks for cracks, dents or other damage. Repair or replace a defective tank.

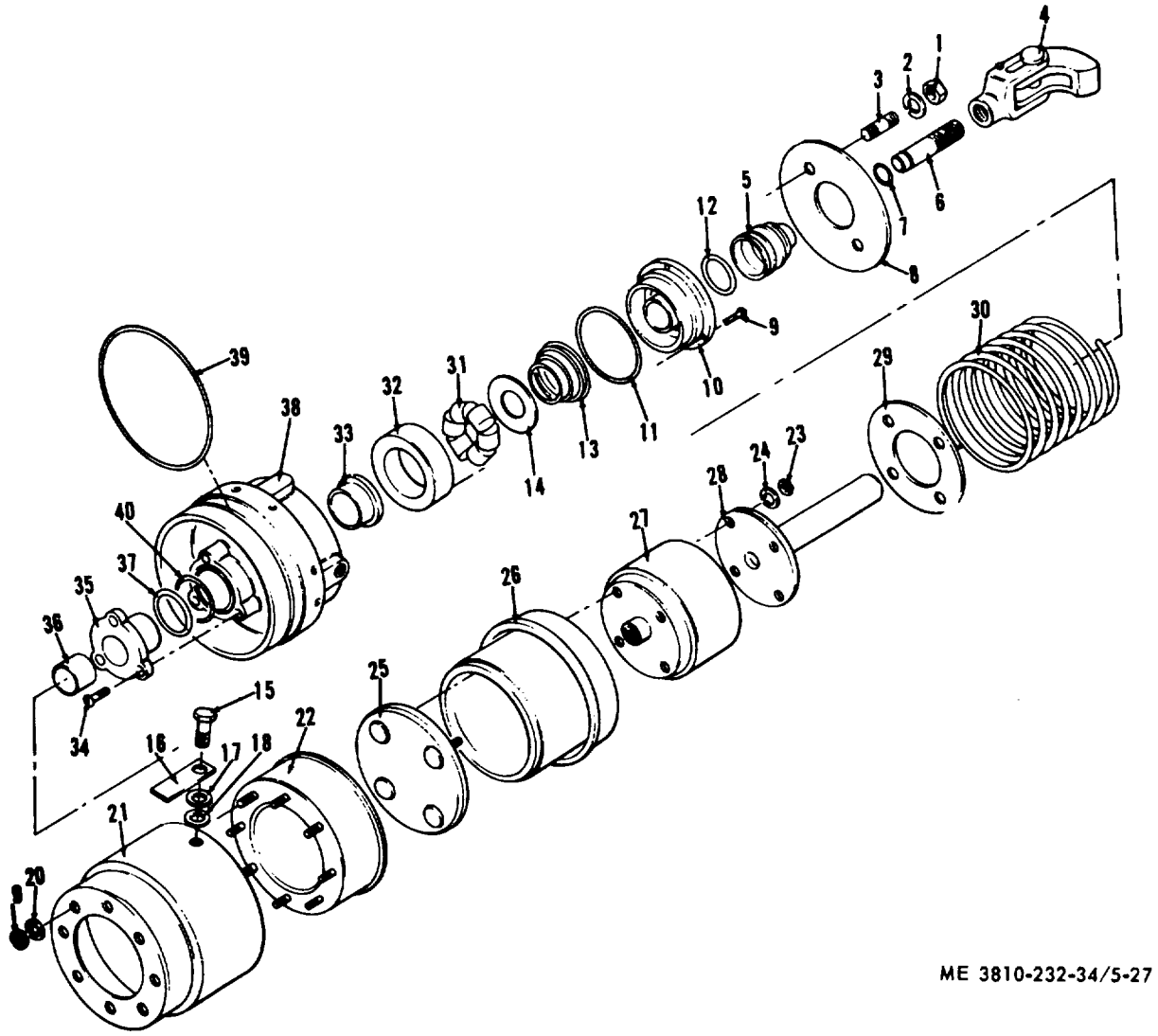
(3) Inspect all fittings and mounting hardware for stripped or damaged threads. Replace as necessary.

*c. Installation*. Install the air reservoir tanks as illustrated on figure 5-26.

**5-22. Carrier Brake Chambers**

*a. Removal*. Remove brake chambers (TM 5-3810-232-12).

**b. Disassembly**. Disassemble the brake chamber in numerical sequence as illustrated on figure 5-27.




| | | | |
|---|---|---|---|
| 1 | Nut | 21 | Housing |
| 2 | Lockwasher | 22 | Outer clamp |
| 3 | Stud | 23 | Nut |
| 4 | Yoke assembly | 24 | Lockwasher |
| 5 | Boot | 25 | Inner clamp |
| 6 | Push rod | 26 | Diaphragm |
| 7 | Retaining rod | 27 | Guide |
| 8 | Splash guard | 28 | Shaft |
| 9 | Screw | 29 | Spring seat |
| 10 | Cap assembly | 30 | Spring |
| 11 | Cap-O-ring | 31 | Rollers |
| 12 | Shaft O-ring | 32 | Collar |
| 13 | Roller spring | 33 | Piston |
| 14 | Washer | 34 | Screw |
| 15 | Capscrew | 35 | Cover |
| 16 | Warning plate | 36 | Bearing |
| 17 | Washer | 37 | Piston O-ring |
| 18 | Washer | 38 | Body |
| 19 | Nut | 39 | Housing O-ring |
| 20 | Lockwasher | 40 | Cover O-ring |

*Figure 5-27. Brake chamber assembly, exploded view.*

*c. Cleaning, Inspection and Repair.*

(1) Clean all metal parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for cracks, breaks, excessive wear or other damage. Repair or replace defective parts as necessary.

*d. Reassembly*. Reassemble the brake chamber in the reverse of the numerical sequence illustrated on figure 5-27.

## Section IX. CARRIES

### 5-23. General

The carrier hydraulic system consists of a pump, fluid reservoir, relief valves, control valves, cylinders, filters and necessary connecting tubes and fittings. Hydraulic pressure is used to operate utility blades, outriggers and steering power assist. The hydraulic working pressure on the outrigger system is 1850 psi plus or minus 25 psi. The hydraulic working pressure on the steering cylinder is 1500 psi. The steering control valve working pressure is 650 psi.

### 5-24. Hydraulic Pump Assemblies (2380)

*a. General*. There are four hydraulic pumps in the hydraulic system; the configuration is two dual pumps which are mounted on and driven HYDRAULIC SYSTEM by the torque converted. Two pumps (1 pump in dual configuration) are 21 GPM capacity and supply pressure for the front and rear wheel steer cylinders. The other dual pump consists of one 10 GPM and one 21 GPM pump. The 21 GPM pump operates the outrigger and the utility blade, the 10 GPM pump supplies pressure for the steering control system. Both dual pumps are similar in construction and maintenance procedures.

*b. Removal*. Remove hydraulic pump assemblies (TM 5-3810-232-12).

*c. Disassembly*. Disassemble hydraulic pump in numerical sequence as illustrated on figure 5-28 or 5-29.

1 Capscrew
2 Body assembly
3 Plug
4 Drive shaft assembly
5 Drive shaft assembly
6 O-ring
7 Backup washer
8 Mask-off ring
9 Wave spring
10 Thrust plate cover
11 Thrust plate cover
12 Gear (1OT-6P)
13 Drive shaft
14 Gear (10OT-6P)
15 Drive shaft
16 Thrust plate, body
17 Thrust plate, body
18 Bearing
19 Body
20 Cover gasket
21 Cover spring
22 Bearing
23 Pipe plug
24 Capscrew
25 Washer
26 Setscrew
27 Cover assembly
28 Cover gasket
29 Cover spring
30 Bearing
31 Retaining ring
32 O-ring
33 Seal retainer
34 Seal
35 Retainer
36 Retainer
37 O-ring
38 Backup washer
39 Mask-off ring
40 Wave spring
41 Thrust plate
42 Thrust plate
43 Drive shaft assy
44 Drive shaft
45 Key
46 Drive shaft
47 Center section assy
48 Bearing
49 Center section
50 O-ring
51 Name plate

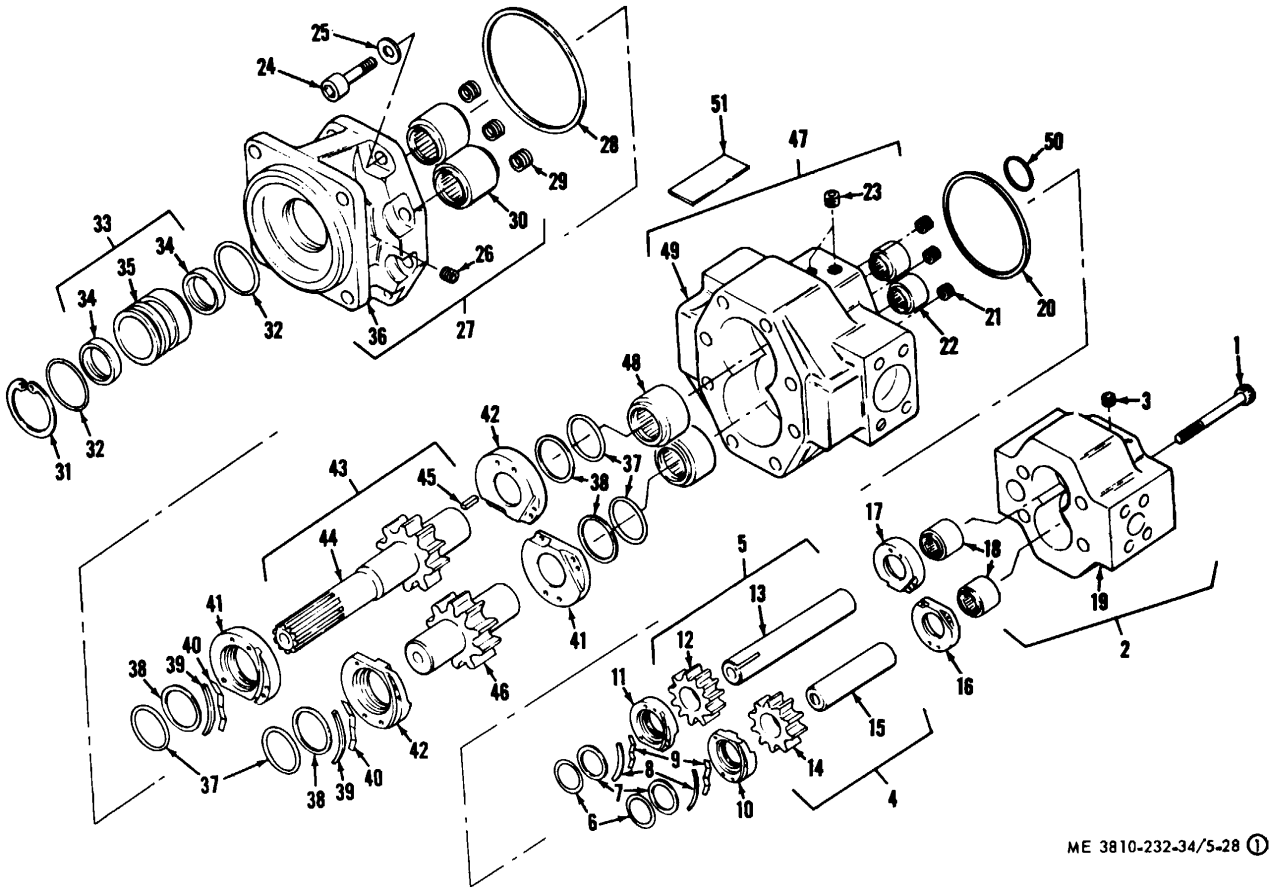
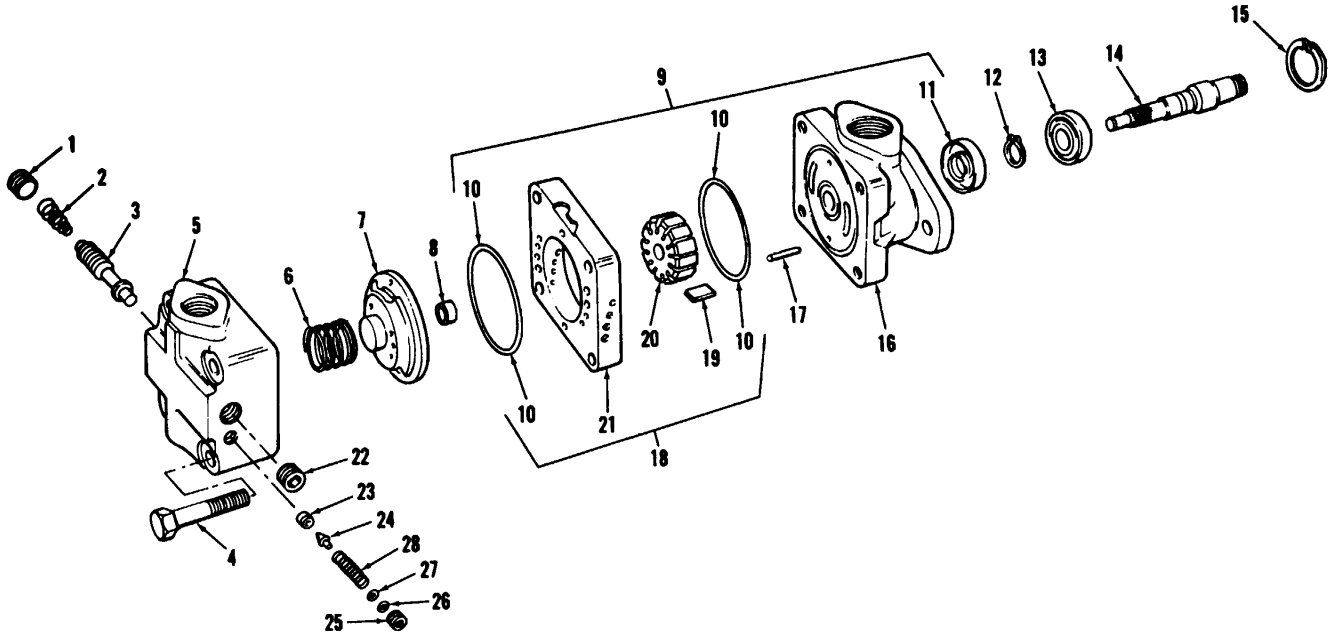



*Figure 5-28. (1) Steering system pump assembly, exploded view.*

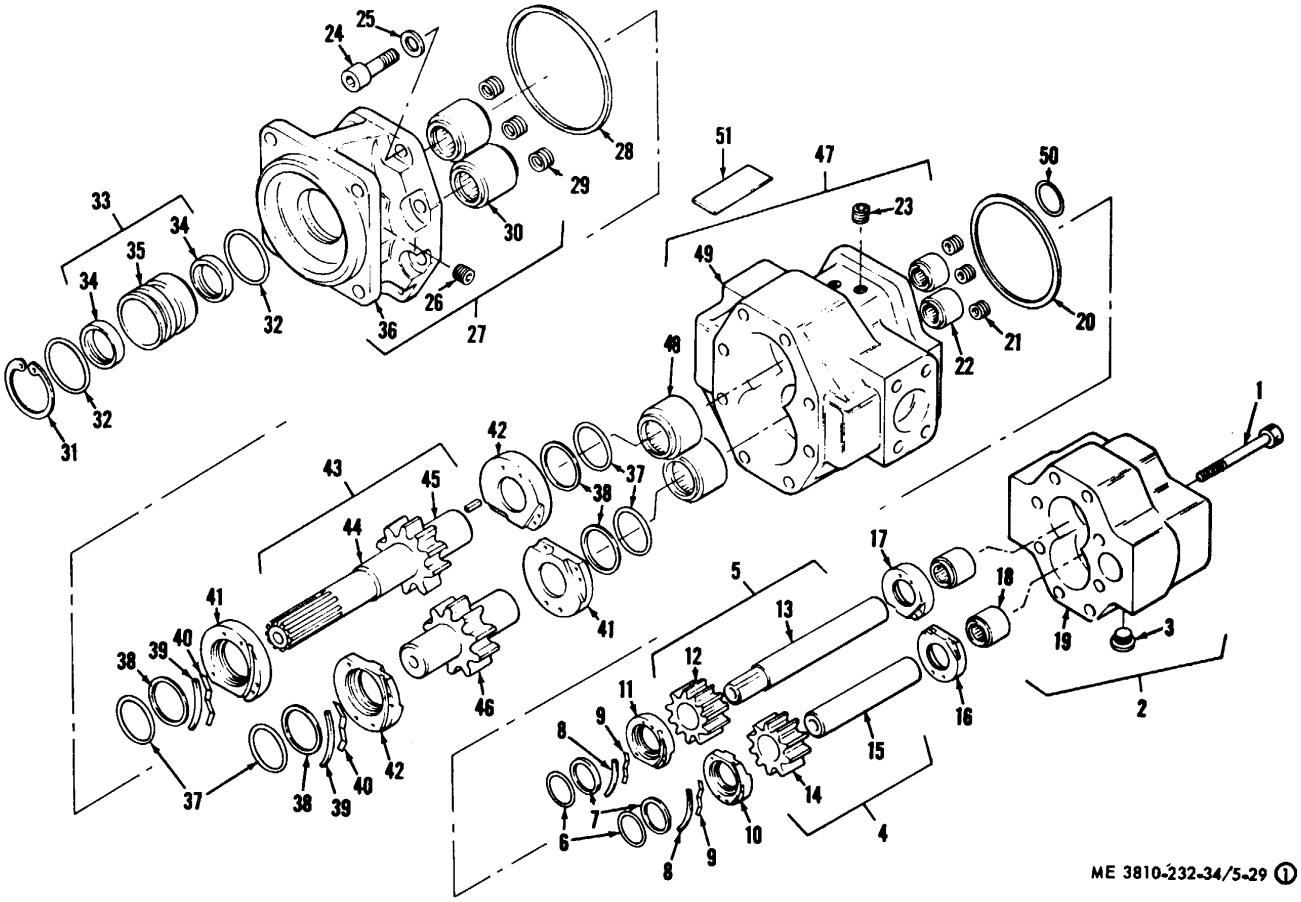



ME 3810-232-34/5-28 (2)

| | | |
|---|---|---|
| 1 Plug | 10 O-ring | 19 Vane kit |
| 2 Spring | 11 Seal | 20 Rotor |
| 3 Piston | 12 Snap ring | 21 Ring |
| 4 Screw | 13 Bearing | 22 Plug |
| 5 Cover | 14 Shaft | 23 Seat |
| 6 Spring | 15 Snap ring | 24 Poppet |
| 7 Pressure plate assembly | 16 Body | 25 Plug |
| 8 Bushing | 17 Pin | 26 Shim |
| 9 Seal kit | 18 Cartridge kit | 27 Shim |
| | | 28 Spring |

B—Model 2385

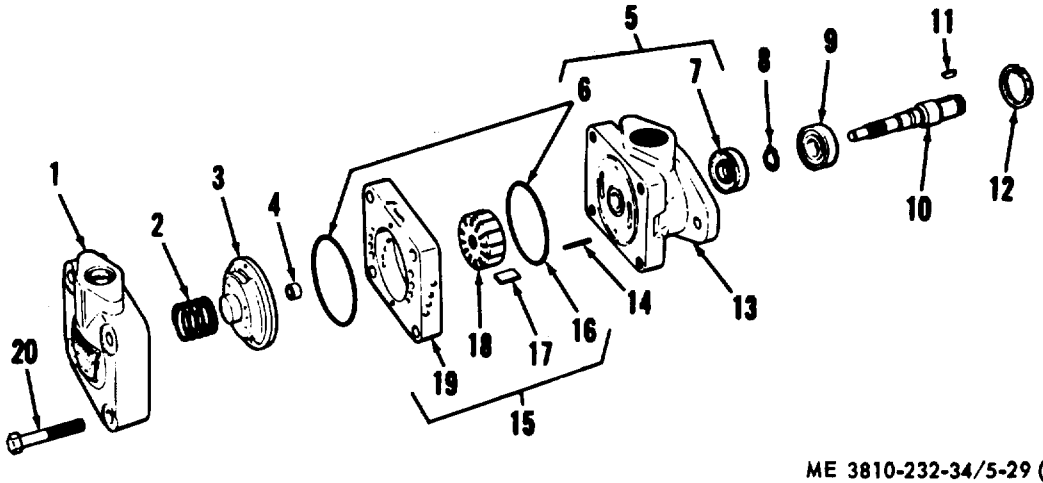
*Figure 5-28. (2)--Continued*




A—(Model 2380) Outrigger and utility blade system pump.

*Figure 5-29. (1) Hydraulic pumps, exploded view.*

1 Capscrew
2 Body assembly
3 Plug
4 Drive shaft assy
5 Drive shaft assy
6 O-ring
7 Backup washer
8 Mask-off ring
9 Wave spring
10 Thrust plate, cover
11 Thrust plate, cover
12 Gear (10T-6P)
13 Drive shaft
14 Gear (10T-6P)
15 Drive shaft
16 Thrust plate, body
17 Thrust plate, body
18 Bearing
19 Body
20 Cover gasket
21 Spring
22 Bearing
23 Pipe plug
24 Capscrew
25 Washer
26 Setscrew
27 Cover assembly
28 Cover gasket
29 Cover spring
30 Bearing
31 Retaining ring
32 O-ring
33 Seal retainer
34 Seal
35 Retainer
36 Cover
37 O-ring
38 Backup washer
39 Mask-off ring
40 Wave spring
41 Thrust plate
42 Thrust plate
43 Drive shaft assembly
44 Drive shaft
45 Key
46 Drive shaft
47 Center section assembly
48 Bearing
49 Center section
50 O-ring
51 Name plate

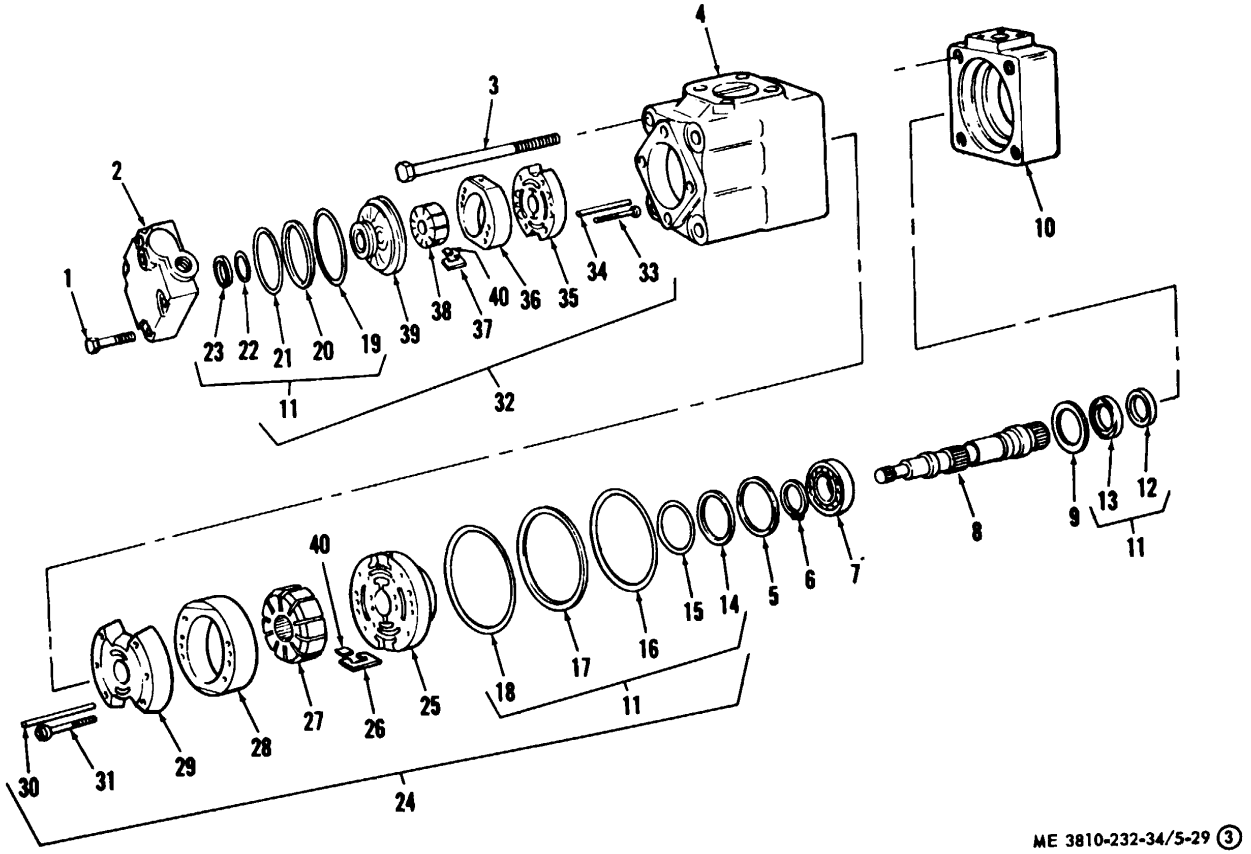



ME 3810-232-34/5-29 (2)

1 Cover
2 Spring
3 Pressure plate assembly
4 Bushing
5 Seal-kit
6 O-ring
7 Seal
8 Snap ring
9 Bearing
10 Shaft
11 Key
12 Snap ring
13 Body
14 Pin
15 Cartridge kit
16 O-ring
17 Vane kit
18 Rotor
19 Ring
20 Screw

B—(Model 2385) Outriggers and front axle oscillate lock-out pump.

*Figure 5-29. (2)-Continued*




C-(Model 2385) Dual hydraulic pump, and fan utility blade and fan drive, and steering system, front and rear.

*Figure 5-29. (3)-Continued*

1 Bolt
2 Cover
3 Bolt
4 Housing
5 Lock ring
6 Snap ring
7 Bearing
8 Shaft
9 Washer
10 Body
11 Seal kit
12 Wiper
13 Seal
14 Back-up ring
15 O-ring
16 O-ring
17 Back-up ring
18 O-ring
19 O-ring
20 Back-up ring
21 0-ring
22 O-ring
23 Back-up ring
24 Cartridge kit
25 Pressure plate
26 Vane kit
27 Rotor
28 Ring
29 Wear plate
30 Pin
31 Screw
32 Cartridge kit
33 Screw
34 Pin
35 Wear plate
36 Ring
37 Vane kit
38 Rotor
39 Pressure plate
40 Intra vane (insert)

*d. Cleaning, Inspection and Repair.*

(1) Clean all metal parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect pump body, center section and covers for cracks, or damaged mating surfaces. Inspect thrust plates for excessive wear, scoring, or other damage. Repair or replace defective parts.

(3) Inspect pump gears and shafts for scoring, excessive wear, chipped or cracked teeth or other damage. Repair or replace defective parts.

(4) Inspect bearings for pitting, scoring, or excessive wear. Replace defective bearings.

(5) Replace all seals, gaskets, O-rings and damaged or defective hardware.

*e. Reassembly*. Reassemble hydraulic pumps in reverse of numerical sequence illustrated on figures 5-28 and 5-29.

**5-25. Hydraulic Pump Assemblies (Model 2385)**

*a. General*. There are four hydraulic pump assemblies in the hydraulic system (fig. 1-3B). There are two dual pumps and one single pump mounted on and driven by the torque converter. The single pump mounted on the converter is a gear type and is used to charge the converter and transmission and is not considered a part of the hydraulic system being discussed here. One dual pump with a capacity of 21 GPM per pump supplies hydraulic for the steering cylinders. One side of the dual pump supplies hydraulic pressure for front wheel steer cylinders, the other side supplies pressure for the rear steer cylinders. The second dual pump mounted on the torque convertor has different capacities. One side of this dual pump rated at 38 GPM supplies hydraulic pressure for the utility blade and the steering control system; the other side, rated at 21 GPM supplies hydraulic pressure to the fan motor.

**NOTE**

**Pressure to the steering control system is reduced to 650 PSI. A single hydraulic pump mounted on and driven by the transmission is a "back up pump" used to supply emergency hydraulic power to the steering system in case of engine failure. A single 11.6 GPM pump mounted on the rear of the carrier engine supplies pressure to the outriggers and to the front axle oscillate lockout system.**

*b. Removal*. Remove hydraulic pump assemblies (TM 5-3810-232-12).

*c. Disassembly.*

(1) *Emergency steering pump.*

(a) Mark the cover (5 fig. 5-28B) the ring (21) and the body (16) before disassembly. Note the direction of arrow cast into the ring. The arrow indicates the direction of arrow cast into the ring. The arrow indicates the direction of pump rotation.

Insert a screwdriver in the control valve bore (b) Clamp pump in a vise with protective jaws, cover end up. Remove the four cover screws (4) and lift off the cover (5). Remove the cartridge (18) from the body (16). Separate the pressure plate (7) from ring (21) and body (16). Carefully pull the rotor (20) and vanes (19) out of the ring and disassemble the components. Note the contour of the rotor vanes in order to avoid error in reassembly. The contour faces out. Remove the O-ring (10) from the pressure plate and body.

(c) Remove snap ring (15) next to shaft bearing (13) from the body, then tap the shaft (14) and bearing and bearing assembly out. If it is necessary to remove the small snap ring (12) and bearing from the shaft, support the bearing inner race in a arbor press, remove snap ring and press bearing off the shaft. Remove shaft seal and wiper assembly (11) from the body.

(d) Remove the pipe plugs (1 and 22).

in the end opposite the spring and push the spring (2) and piston (3) out.

**CAUTION**
**Be careful not to score the valve bore.**

(2) *Outrigger and front axle oscillate lockout pump.*

(*a*) Mark the cover (1, fig. 5-29B), and ring (19) and body (13) before disassembly. Note the direction of arrow cast into the ring. The arrow indicates the direction of pump rotation.

(*b)* Clamp the pump in a vise with protective jaws, cover end up. Remove the four cover screws (20) and lift off the cover (1). Remove the cartridge (15)from the body (13). Separate the pressure plate (3)from ring (19) and body (13). Carefully pull the rotor (18) and vanes (17) out of the ring and disassemble the components. Note the contour of the rotor vanes in order to avoid error in reassembly. The contour faces out. Remove the O-rings (6) from the pressure plate and body.

(c) Remove snap ring (12) next to the shaft bearing (9) from the body, then tap the shaft (10) and bearing assembly out. If it is necessary to remove the small snap ring (8) and bearing from the shaft, support the bearing inner race in an arbor press, remove snap ring and press bearing of the shaft. Remove shaft seal and wiper assembly (5) from the body.

(3) *Dual hydraulic pumps, utility blade and fan drive pump and steering system pump*.

NOTE

The dual pumps are identical in construction and maintenance procedures are the same for both. Mark the pump body (10, figure 5-29c), inlet housing (4) and cover (2) for correct re-assembly. Note the direction of the arrow cast into the ring (36). The arrow indicates the direction of pump rotation.

(*a*) Clamp the pump body in a vise with protective jaws. Remove the four cover bolts (1) and lift the cover off the pump. Remove the cover O-ring (21), pull and or pry out the cover end cartridge assembly (32). Remove the four bolts (3) attaching inlet housing to the body. Lift off the inlet housing and the body O-ring (16). Turn the shaft to free the large cartridge (24) from the body. Remove the lock ring (5) and pull the shaft (8) and bearing (7). Drive the shaft seal (13) and wiper (12) out from the shaft end of the body. It is necessary to remove the shaft bearing, remove the snap ring (6) and press the shaft out of the bearing, supporting the bearing inner race.

(*b*) Remove the O-rings (15, 16, 18, 19, 21, 22) and backup rings (14, 17, 20, 23) from the pressure plates (25, 39). Remove the fillister head screws (31, 33) and lift off the wear plates (29, 35). Note the position of the rings (28, 36), rotors (27, 38) and vanes (26, 37) intra vanes (40) locating pins (30, 34) and pressure plates (25, 39).

*d. Cleaning, Inspection and Repair.*

(1) Discard the shaft seal and O-rings. Use new parts for reassembly. Clean the metal parts in a clean mineral oil solvent, blow them dry with filtered compressed air and place on a clean surface for inspection.

(2) Check the wearing surfaces of the cartridge parts for scoring and excessive wear. Remove light score marks by lapping. Replace a heavily scored or badly worn parts.

NOTE

If cartridge parts are badly worn, it is advisable that new parts be used.

(3) Inspect the vanes for burrs, wear and excessive play in the rotor slots. Carefully dress down burrs with a medium India stone. Replace the rotor if the slots are worn. Replace vanes with a new vane kit if vane tips are scored.

(4) Rotate the bearing on the shaft while applying pressure to check for wear, looseness, roughness and pitted or cracked races.

(5) Inspect the seal and bushing mating surfaces on the shaft for scoring or wear. Replace the shaft if marks cannot be removed by light polishing.

(6) Be sure that any paint or burrs raised on the body and cover mating surfaces are removed before assembly.

*e. Reassembly.*

(1) *Emergency steering pump*.

NOTE

Coat all parts with clean OE10 to facilitate reassembly and provide initial lubrications. Use small amounts of petroleum jelly to hold O-rings in place during assembly. Soak shaft seal and wiper assembly (11, fig 5-28B) in oil before assembly.

(a) Install piston (3, fig. 5-28B) and spring (2) and replace pipe plugs (1 and 22). If a sealing compound is used, exercise care that none gets into the valve bore.

(b) Install shaft seal and wiper assembly in the body (16) and press it into the body. The spring on the shaft seal must be toward the bearing. Place the washer .in the body against the shaft seal.

(c) Support the bearing inner race and

press in the shaft (14). Install snap ring (12) on the shaft. Lightly tap the shaft and bearing assembly into the body with a plastic hammer. Install snap ring (12) in the body to secure the bearing and shaft. Thoroughly inspect to insure that snap ring is correctly installed.

(d) Place the rotor (20) on the pressure plate (7) and insert vanes (19) in the rotor slots. The radius edges of the vanes must be toward the ring. Install the location pins (17) in the pressure plate and place the ring (21) over them with the ring arrow pointing in the correct direction of rotation. Stick pressure plate spring (6) in cover (5) with petroleum jelly. Install the cover and screws (4). Tighten screws to 75 to 85 foot-pounds torque.

*(2) Outrigger and front axle oscillate lock out pump.*

(a) Install the shaft seal and wiper assembly in the body (16) and press it into the body. The spring on the shaft seal must be toward the bearing. Place the washer in the body against the shaft seal.

(b) Support the bearing inner race and press in the shaft (14). Install snap ring (12) on the shaft.. Lightly tap the shaft and bearing assembly into the body with a plastic hammer.

Install snap ring (12) in the body to secure the bearing and shaft. Thoroughly inspect to insure that the snap ring is correctly installed.

(c) Place the rotor (20) on the pressure plate (7) and insert vanes (19) in the rotor slots. The radius edges of the vanes must be toward the ring. Install the locating pins (17) in the pressure plate and place the ring (21) over them with the ring arrow pointing in the correct direction of rotation. Stick pressure plate spring (6) in cover (5) with petroleum jelly. Install the cover and screws (4). Tighten screws to 75 to 85 foot-pounds torque.

(3) Dual hydraulic pumps utility blades and fan drive pump and steering system pump.

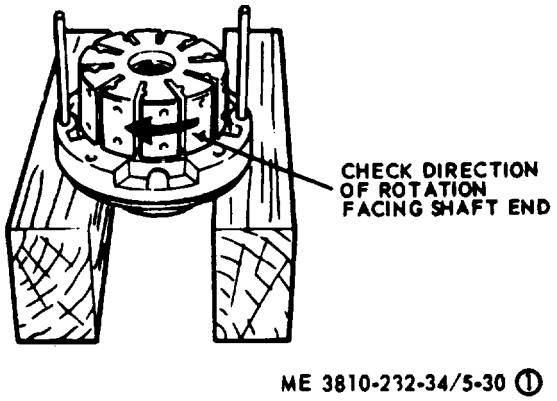
**NOTE**

**The direction of rotation is as viewed from the shaft end; right hand rotations is clockwise; left hand counterclockwise.**

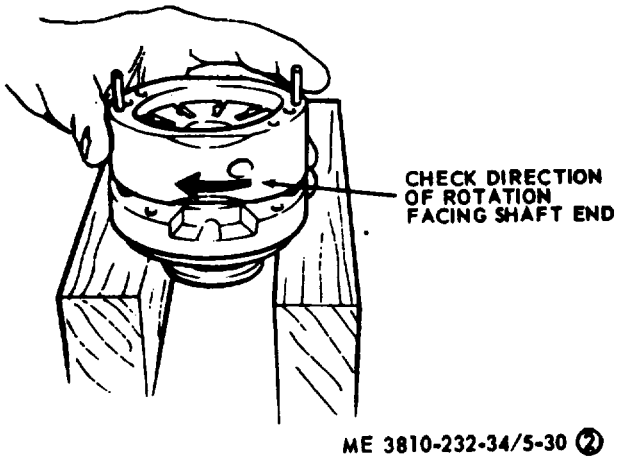
(a) Place the pressure plate (39, fig. 5-29C) on blocks as shown in figure 5-30A and the rotor (38) on the plate with the arrow pointed in the correct direction of rotation. Install locating pins (34). Position the rings (36) over the pins and rotor, again observing the rotation arrow figure 5-30B. Place the intra vanes (inserts) (40) in the vanes (37) and install both in the rotor slots. Be sure the sharp edges are toward the direction of rotation fig. 5-30C and that both vanes and inserts move freely in the slots. Install wear plate (35) and screws (33). Reassemble other cartridge in a similar manner.

(b) Soak a new shaft wiper (12) in OE10 and install wiper and seal (13). Be certain the seal 0. D. is below the chamfer in the body. Clamp the body (10) in vise or place it on blocks and place the bearing washer (9) against the seal. Cover the end of the shaft with a "bullet" lubricated with grease or petroleum jelly to protect the seal. Press the shaft (8) into the bearing in an arbor press, supporting the bearing inner race. Remove the "bullet". Install the small snap ring (6). Tap the shaft and bearing gently into the body (10) and install lock ring (5). Install O-ring (15) and backup ring (14) on the cartridge pressure plate hub (25). Lay the body O-ring (16) in place and install back-up ring (17) and O-ring (18) on the cartridge. Carefully install the cartridge in the body so one of the chamfers or flats on the ring will align with the inlet port when the inlet housing is installed. Place the inlet housing over the cartridge so the locating pins (30) are properly engaged and the inlet is in the correct position with respect to the body outlet. Install the four bolts (3) and torque tighten to 70 to 75 foot-pounds for the utility blade system and fan drive pump, and 90-95 foot-pounds for steering pump, front and rear. Install the cover end cartridge (32) being certain the pins (34) engage the housing. Place the large back-up ring (20) and then the O-ring (19) on the pressure plate (39). Install the small O-ring (22) and back-up ring (23) on the pressure plate hub. Put the cover O-ring (21) in place in its groove. Install cover (20) and bolts (1). Tighten screws to 45 to 50 foot-pounds torque.

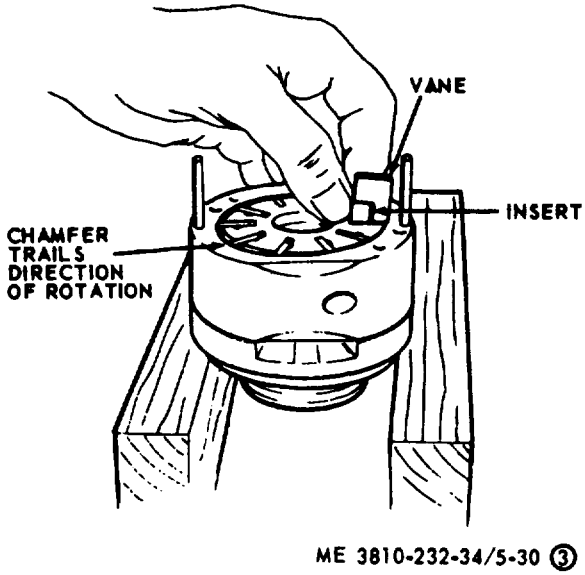
f. Installation. Install hydraulic pump assemblies (TM 53810-232-12)




A--Installing rotor (Model 2385).
*Figure 5-30. (1) Dual hydraulic Pump, reassembly (Model 2856).*




B-Installing ring (Model 2385).
*Figure 5-30. (2) --Continued.*




C-Installing vane and inserts (Model 2385)
*Figure 5-30. (3) --Continued.*

**5-26. Hydraulic Control Valves (Model 2380)**

*a. Outrigger Control Valve (2380).*

(1) *Removal*. Remove the outrigger control valve (TM 5-3810-232-12).

(2) *Disassembly*. Disassemble control valve in numerical sequence as shown in figure 5-31.

*(3) Cleaning, inspection and repair.*

(a) Clean all metal parts with an approved cleaning solvent and dry thoroughly.

(b) Inspect all parts for cracks, breaks, and other damage. Inspect spool and body for scoring, scratches, or burrs. Repair or replace defective parts as, necessary. Replace all O-rings and seals.

(4) *Reassembly*. Reassemble outrigger valve in reverse of numerical sequence shown on figure 5-1.

(5) *Installation*. Install outrigger valve (TM 5-3810-232-12).

*b. Utility Blade Control Valve.*

(1) *Removal*. Remove utility blade control valve (TM 5-3810-232-12).

(2) *Disassembly*. Disassemble control valve in numerical sequence as illustrated on figure 5-31.

*(3) Cleaning, inspection and repair.*

(a) Clean all metal parts with an approved cleaning solvent and dry thoroughly.

(b) Inspect all parts for cracks, breaks, corrosion or other damage. Inspect spool and body for scoring, pitting or other defects. Repair or replace defective parts. Replace all 0-rings and seals.

(4) *Reassembly*. Reassemble the utility blade control valve as shown on figure 5-31.

(5) *Installation*. Install the utility blade control valve (TM 5-3810-232-12).

| | | | |
|---|---|---|---|
| 1 | Nut | 16 | Spool |
| 2 | Bushing | 17 | O-ring |
| 3 | Bolt | 18 | Washer |
| 4 | Link | 19 | Plug |
| 5 | Plug | 20 | End cap |
| 6 | Plug | 21 | Bearing |
| 7 | Bolt | 22 | Spacer |
| 8 | End cap | 23 | Spacer |
| 9 | Nut | 24 | O-ring retainer |
| 10 | Washer | 25 | O-ring |
| 11 | Centering washer | 26 | O-ring |
| 12 | Stroke stop | 27 | Plug |
| 13 | Centering spring | 28 | O-ring |
| 14 | O-ring retainer | 29 | O-ring |
| 15 | Spool bolt | 30 | Valve body |

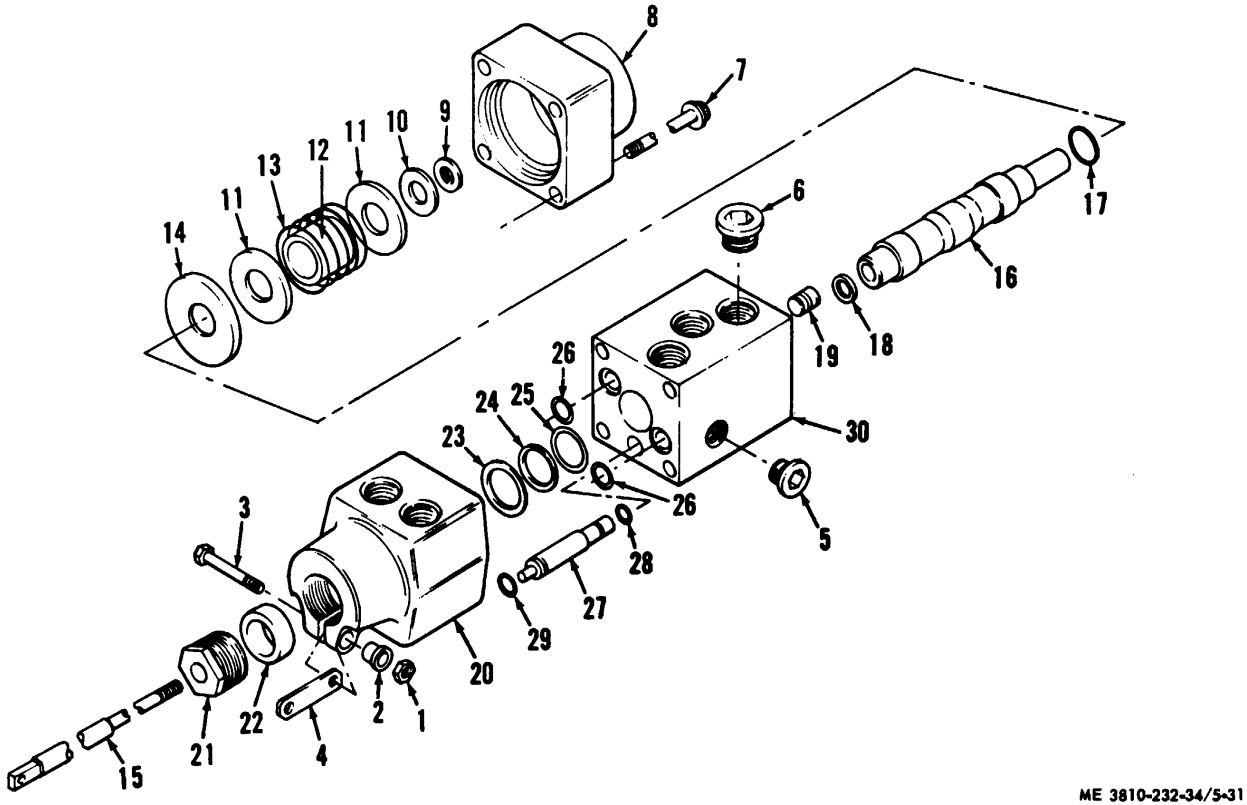



*Figure 5-31. Outrigger and utility blade control valves*

**5-27. Hydraulic Control Valves (Model 2385)**

a. *General*. There are five hydraulic, spool type, control valves. The transmission gear range selector control, the steering selector control, the 4 bank, directional control for the outriggers, the utility blade control, and the fan drive control.

b. Transmission Gear Range Selector Tower Hydraulic Control Valve.

(1) *Removal*. Remove transmission gear. range selector tower hydraulic control valve (TM 5-3810-232-12) (2) Disassenbly. Disassemble transmission gear range selector tower hydraulic control valve as illustrated in figure 5-32.

(2) *Disassembly*. Disassemble transmission gear range tower hydraulic control valve illustrated in figure 5-32.

*(3) Cleaning, inspection and repair.*

(a) Clean all metal parts with an approved cleaning solvent and dry thoroughly.

(b) Inspect all parts for cracks, scoring, corrosion, or other defects.

(c) Replace all gaskets, O-rings, and damaged or defective parts.

(4) *Reassembly*. Reassemble transmission gear range selector tower hydraulic control valve as illustrated in figure 5-32.

(5) *Installation*. Install transmission gear range selector tower hydraulic control valve (TM 5-3810-232-12).

1 Knob
2 Bolt
3 Lockwasher
4 Flat washer
5 Stop plate
6 Screw
7 Lockwasher
9 Pipe plug
10 Housing
11 Stop pin
12 Roll pin
13 Inner spring
14 Outer spring
15 Piston
16 Valve stop
17 Snap ring
18 O-ring
19 Spool
20 Plug
21 Link
22 Spring
24 Fitting
25 Link
27 Plug
28 Roll pin
30 Pin
32 Spring
31 Plug
33 Ball
35 Plug
36 Spring
37 Ball
38 Pin assembly
39 Bearing
40 Snap ring
41 Gasket
42 Cap
43 Oil seal
44 Bracket
45 Lock screw
46 Roll pin
47 Roll pin
48 Lever

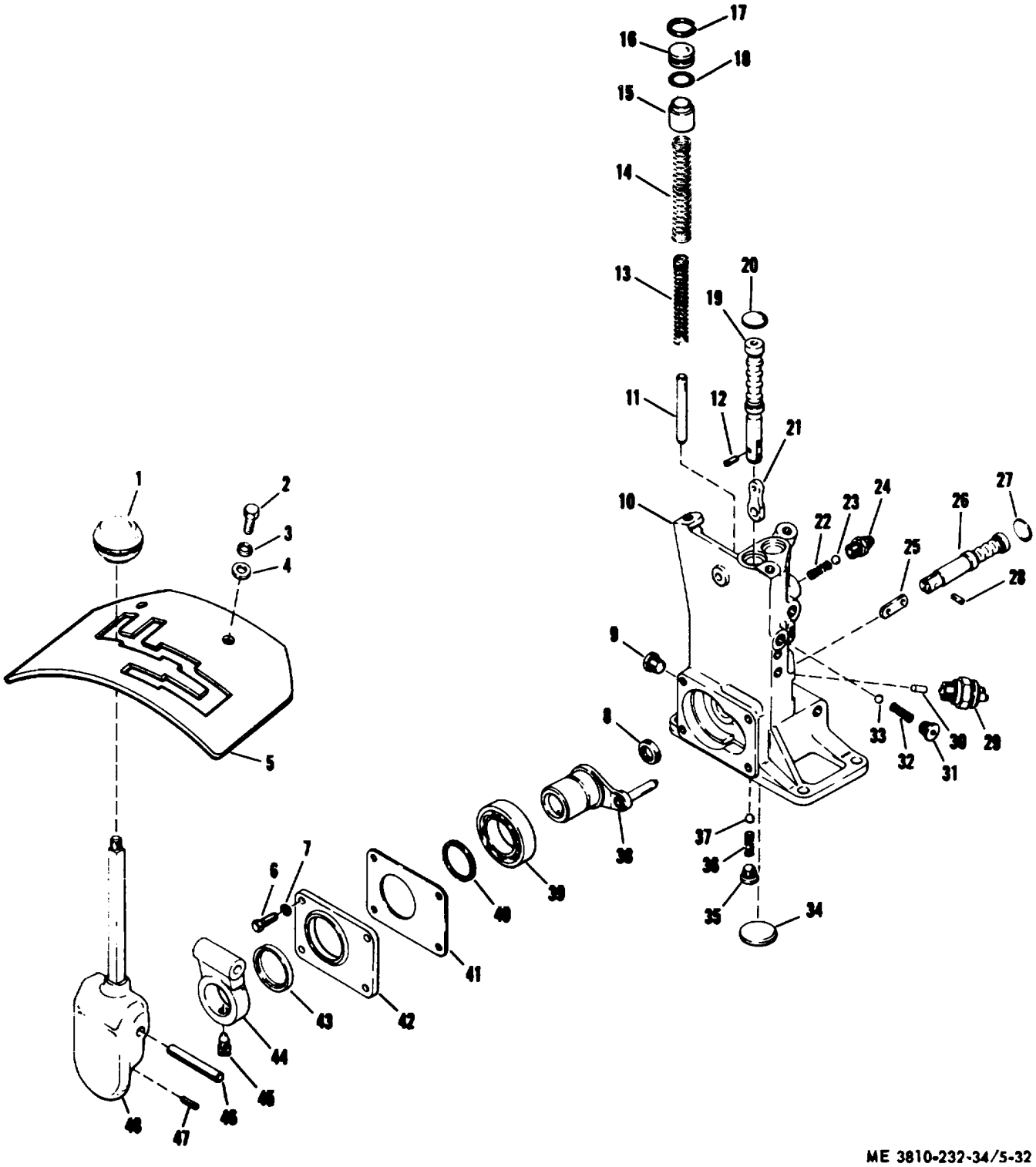



*Figure 5-32. Transmission gear range selector tower hydraulic control valve (Model 2385).*

*c. Steering Selector Control Valve.*

(1) *Removal*. Remove the steering selector control valve (TM 5-3810-232-12).

(2) *Disassembly*. Disassemble selector control valve in numerical sequence as illustrated in 5-33.

*(3) Cleaning, inspection and repair.*

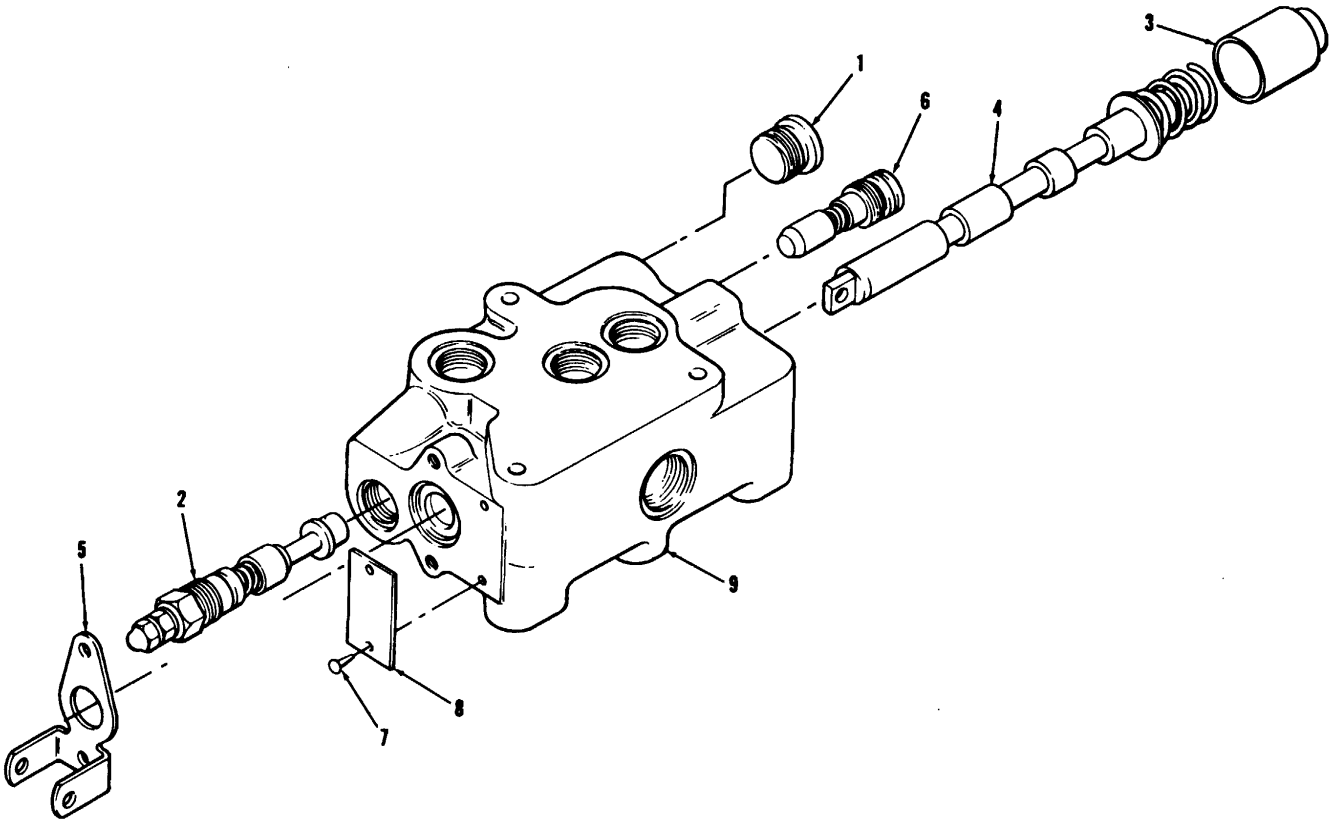
(a) Clean all metal parts with an approved cleaning solvent and dry thoroughly.

(b) Inspect all parts for cracks, scoring, corrosion, or other defects.

(c) Replace all gaskets, O-rings and damaged or defective parts.

(4) *Reassembly*. Reassemble selector control valve in reverse of the numerical sequence illustrated in figure 5-33.

(5) *Installation*. Install steering selector control valve (TM 5-3810-232-12).




1 Plug
2 Relief valve assembly
3 Spool cap
4 Spool assembly
6 Spool seal assembly
6 Check valve assembly
7 Drive screw
8 Nameplate
9 Body

*Figure 5-33. Steering selector control valve (Model 2385).*

*d. Outrigger Control Valves.*

(1) *Removal*. Remove the outrigger control valve (TM 5-3810-232-12).

(2) *Disassembly*. Disassemble control valves in numerical sequence as illustrated in figure 5-34.

(3) *Cleaning, inspection and repair.*

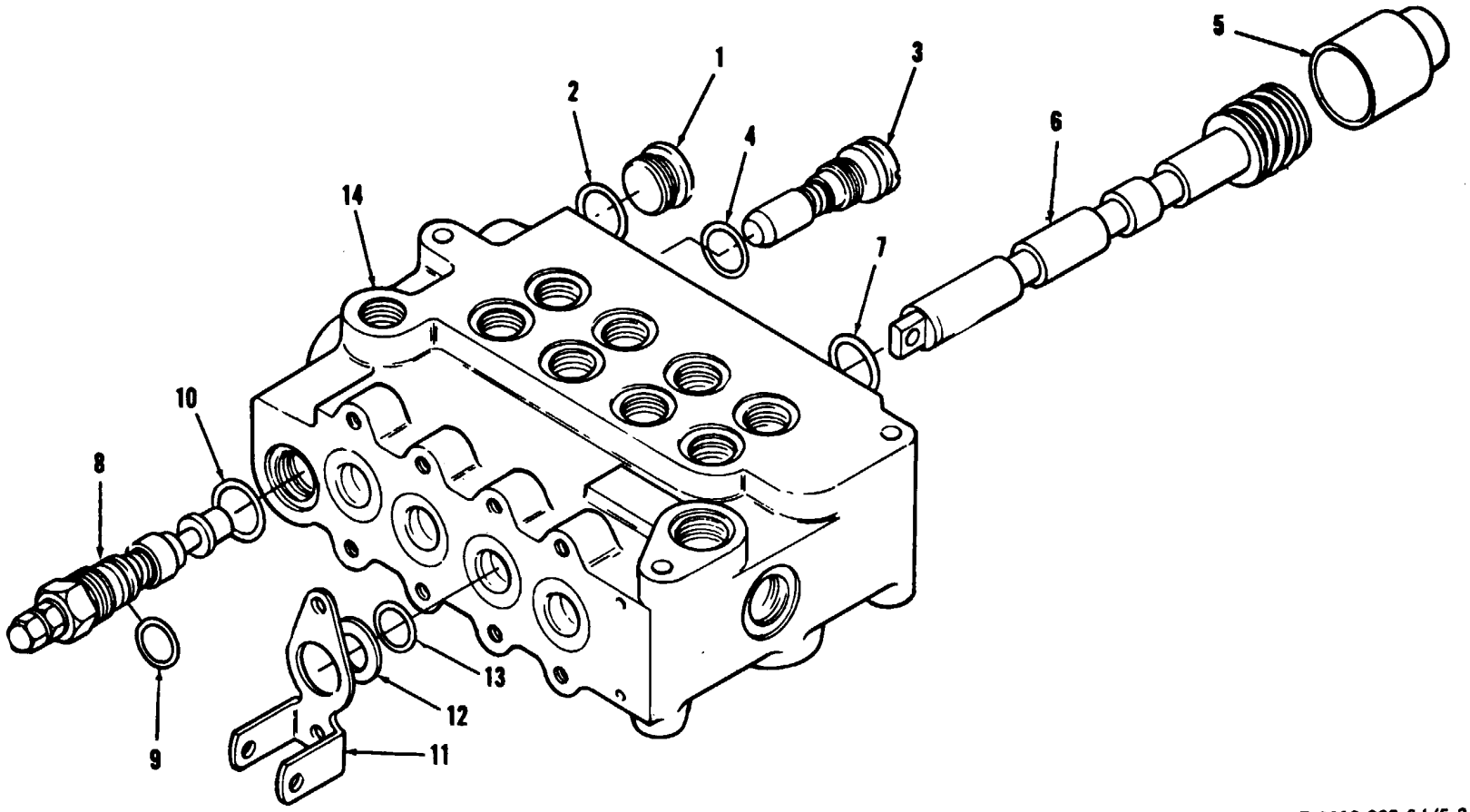
(a) Clean all metal parts with an approved cleaning solvent and dry thoroughly.

(b) Inspect all parts for cracks, scoring, corrosion, or other defects.

(c) Replace all gaskets, -ring, and damaged or defective parts.

(4) *Reassembly*. Reassemble control valves in reverse of the numerical sequence illustrated in figure 5-34.

(5) *Installation*. Install outrigger control valves (TM 5-3810-232 12)




| | | | |
|---|---|---|---|
| I | Plug | 8 | Relief valve assembly |
| 2 | O-ring | 9 | O-ring |
| 3 | Check valve assembly | 10 | O-ring |
| 4 | O-ring | 11 | Spool seal assembly |
| 5 | S)pool cap | 12 | Seal |
| 6 | Spool assembly | 13 | O-ring |
| 7 | O-ring | 14 | Body |

*Figure 5-34. Outrigger control valves (Model 2385).*

*e Utility Blade Control Valve.*

(1) *Removal*. Remove utility blade control valve (TM 5-3810-232-12).

(2) *Disassembly*. Refer to figure 5-35 and disassemble as follows.

(a) Remove retaining rings (28), "E" rings (2), and remove fulcrum rod (3), link (30), and lever (29).

(b) Remove screws (8), cap (9), and remove screw (11), guide (12), retainer (13), and retainer (4) Then push spool (14) from body (14). Remove O-rings (5 and 15).

(c) Remove plug (21) and remove spring (23) and valve (31). Remove plug (20), backup ring (19), O-ring (18), and remove spring (17) and poppet (16).

(d) Remove nuts (27) from studs (26) and separate valve body halves (1) and (14). Remove O-rings (6) and (7).

(3) Cleaning, inspection and repair.

(a) Clean all metal parts with an approved cleaning solvent and dry thoroughly.

(b) Inspect all parts for cracks, scoring, corrosion, and other defects.

(c) Replace all O-rings and damaged or defective parts.

**NOTE**

**Body and spool (14) must be replaced as a unit.**

(4) Reassembly. Refer to figure 5-35 and reassemble valve as follows.

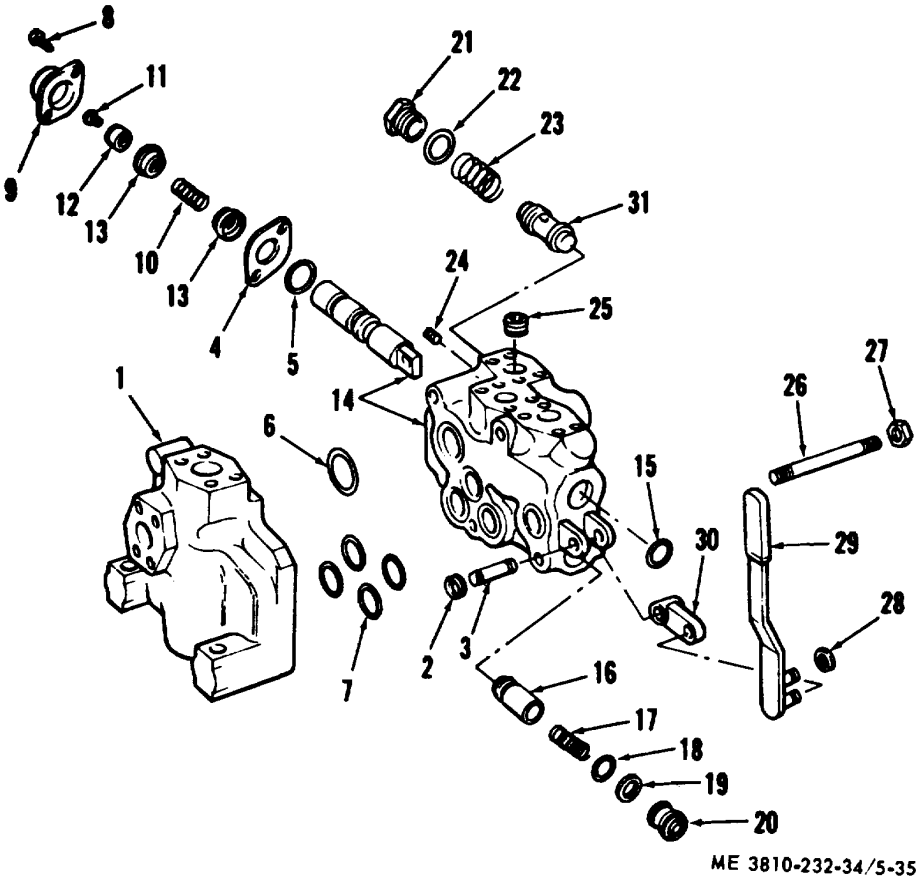
(a) Coat all metal parts with clean OE10 to provide initial lubrication and ease of assembly. Use petroleum jelly on O-ring and back-up rings to hold them in place when assembling.

(b) Install O-ring (6) and (7) in body halves (1) and (14). Assemble body halves, install studs (26) and tighten nuts (27) to 55 to 60 foot-pounds torque.

(c) Install poppet (16), spring (17), O-ring (18), back-up ring (19) in body (14) and secure with plug (20). Install valve (31), and spring (23) in body and install O-ring (22) and plug (21).

(d) Install O-ring (15) in body and O-ring (5) on spool (14) and insert spool in body taking care not to damage O-rings. Place retainer (4) in position and install retainer (13), spring (10), guide (12) and screw (11). Secure these components with cap (9) and screw (8).

(5) Installation. Install utility blade control valve (TM 5-3810-232-12).




| | | | |
|---|---|---|---|
| I | Body | 17 | Spring |
| 2 | E-ring | 18 | O-ring |
| 3 | Fulcrum rod | 19 | Back-up ring |
| 4 | Retainer | 20 | Plug |
| 5 | O-ring | 21 | Plug |
| 6 | O-ring | 22 | O-ring |
| 7 | O-ring | 23 | Spring |
| 8 | Screw | 24 | Plug |
| 9 | Cap | 25 | Plug |
| 10 | Spring | 26 | Stud |
| 11 | Screw | 27 | Nut |
| 12 | Guide | 28 | Retaining ring |
| 13 | Retainer | 29 | Lever |
| 14 | Body and spool | 30 | Link |
| 15 | O-ring | 31 | Valve |
| 16 | Poppet | | |

*Figure 5-35. Utility blade control valve (Model 2385).*

*f. Fan Drive Control Valve.*

(1) *Removal.* Remove the fan drive control valve (TM 5-3810-232-12).

(2) *Disassembly.* Disassemble the fan drive control valve in the numerical sequence illustrated on figure 5-36.

*(3) Cleaning, inspection, and repair.*

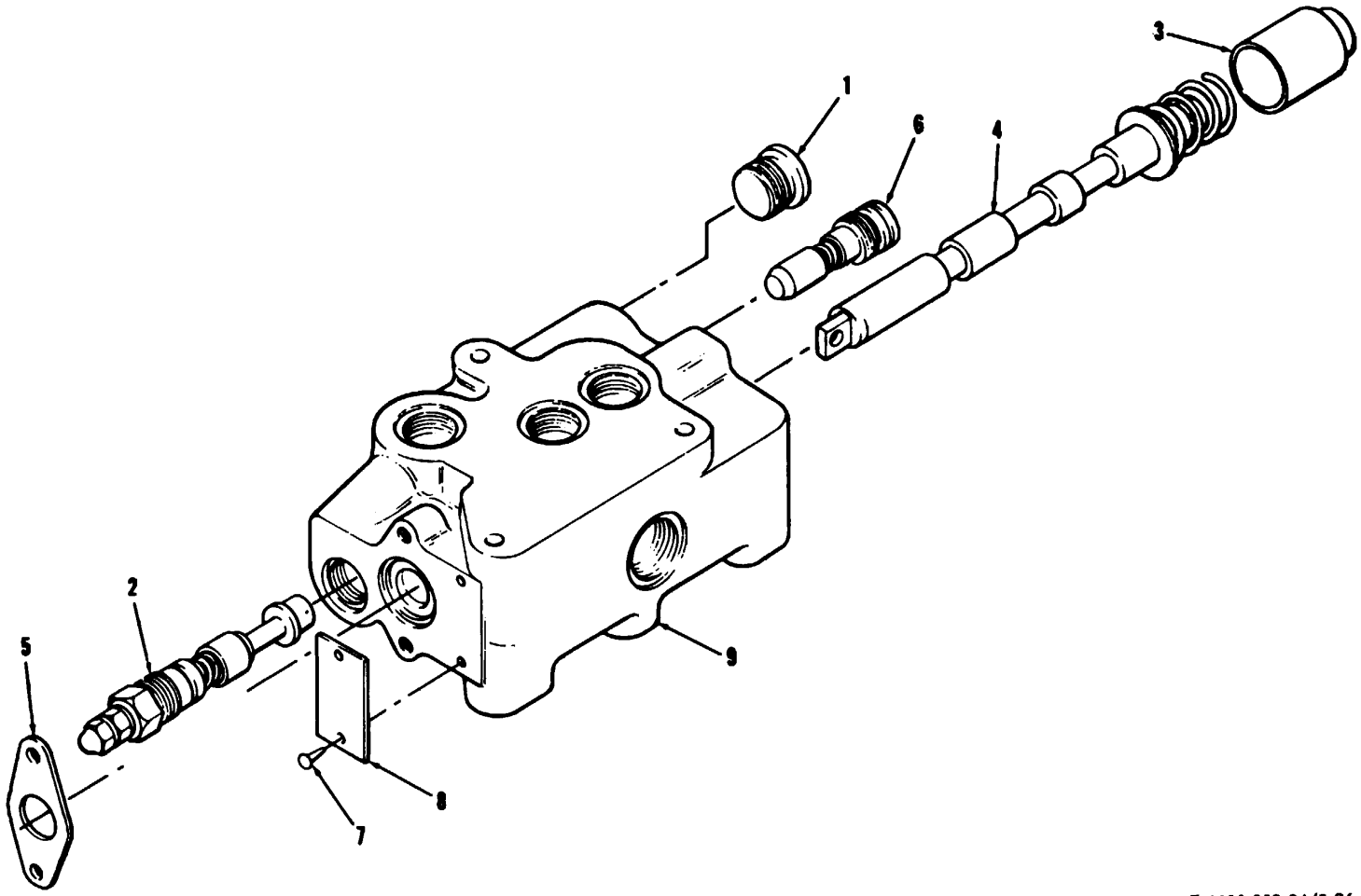
(a) Clean all metal parts with an approved cleaning solvent and dry thoroughly.

(b) Inspect all parts for cracks, scoring, corrosion, or other defects.

(c) Replace all gaskets, -rings and damaged or defective parts.

(4) *Reassembly.* Reassemble fan drive control valve in the reverse of the numerical sequence in figure 5-36.

(5) *Installation.* Install fan drive control valve (TM 53810-232-12).



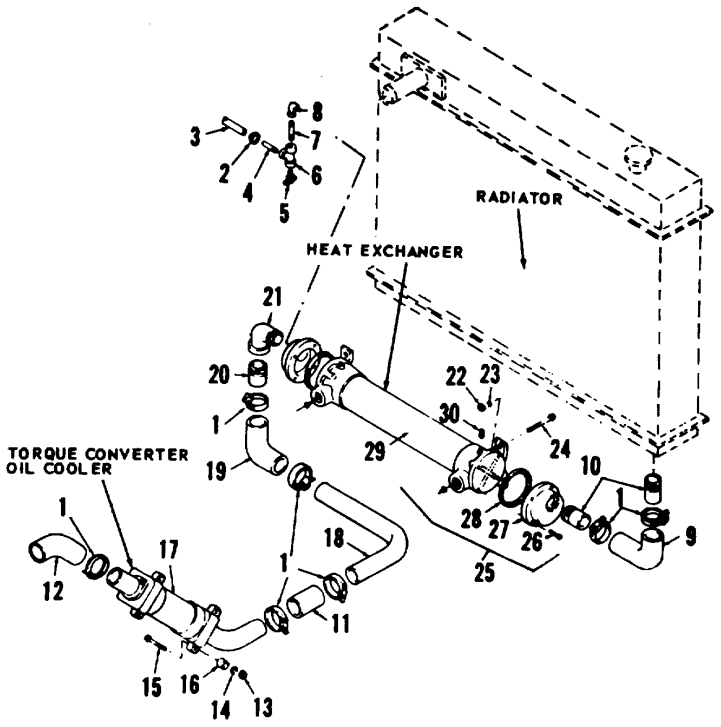

| | | | | | |
|---|---|---|---|---|---|
| 1 | Plug | 4 | Spool assembly | 7 | Drive screw |
| 2 | Relief valve assembly | 5 | Spool seal assembly | 8 | Nameplate |
| 3 | Spool cap | 6 | Check valve assembly | 9 | Body |

*Figure 5-36. Fan drive control valve (Model 2385).*

**5-28. Heat Exchanger Assembly**

a. *Removal*. Remove heat exchanger (TM 5-3810-232-12).

b. *Disassembly*. Refer to figure 5-37 and disassemble the heat exchanger as illustrated.




| | | | |
|---|---|---|---|
| 1 | Clamp hose | 16 | Spacer |
| 2 | Clamp, hose | 17 | Cooler, oil |
| 3 | Hose | 18 | Tube |
| 4 | Adapter | 19 | Hose, 90° |
| 5 | Seat, internal | 20 | Adapter |
| 6 | Tee, pipe | 21 | Elbow, 90° |
| 7 | Nipple, pipe | 22 | Nut |
| 8 | Elbow, 90° | 23 | Washer, lock |
| 9 | Hose, 90' | 24 | Screw, cap |
| 10 | Adapter | 25 | Exchanger, heat |
| 11 | Hose | 26 | Screw, cap |
| 12 | Hose 45' | 27 | Bonnet |
| 13 | Nut | 28 | Gasket |
| 14 | Washer, lock | 29 | Core assembly |
| 15 | Screw, cap | 30 | Plug, pipe |

*Figure 5-37. Heat exchange assembly, exploded view.*

*c. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect shell and tubes for cracks, breaks, and other damage. Repair or replace defective parts as necessary.

d. *Reassembly*. Refer to figure 5-37 and reassemble the heat exchanger as illustrated.

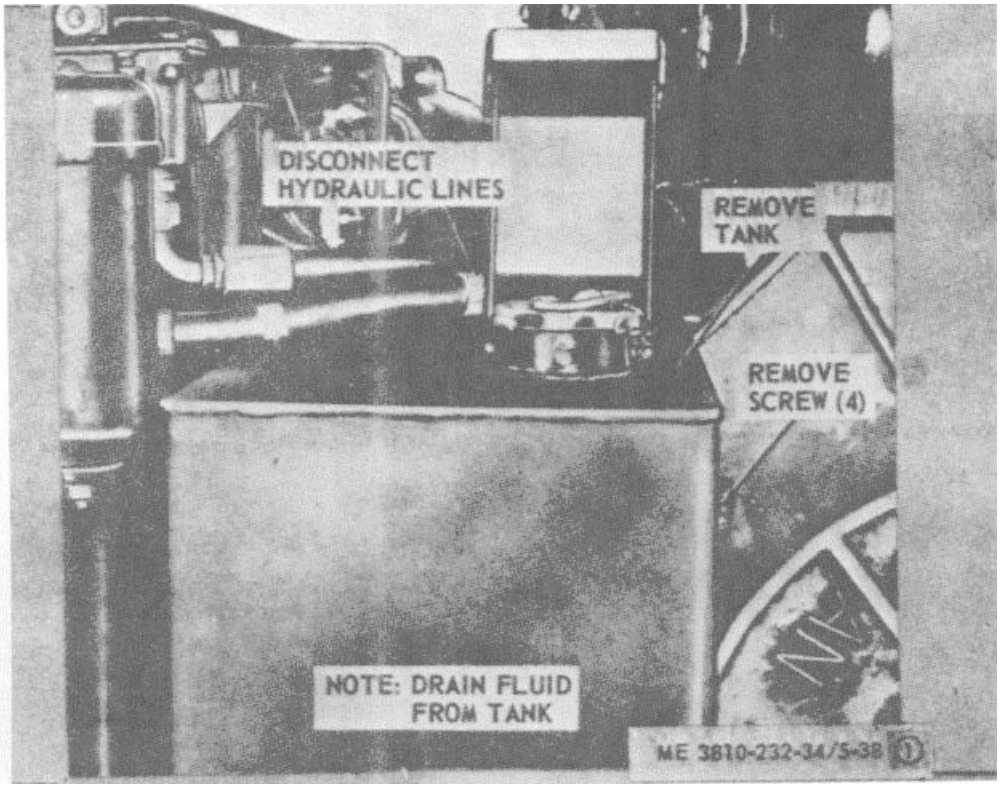
e. *Installation*. Install heat exchanger (TM 5-3810-232-12).

**5-29. Hydraulic Reservoir Tank**

*a. Removal.*

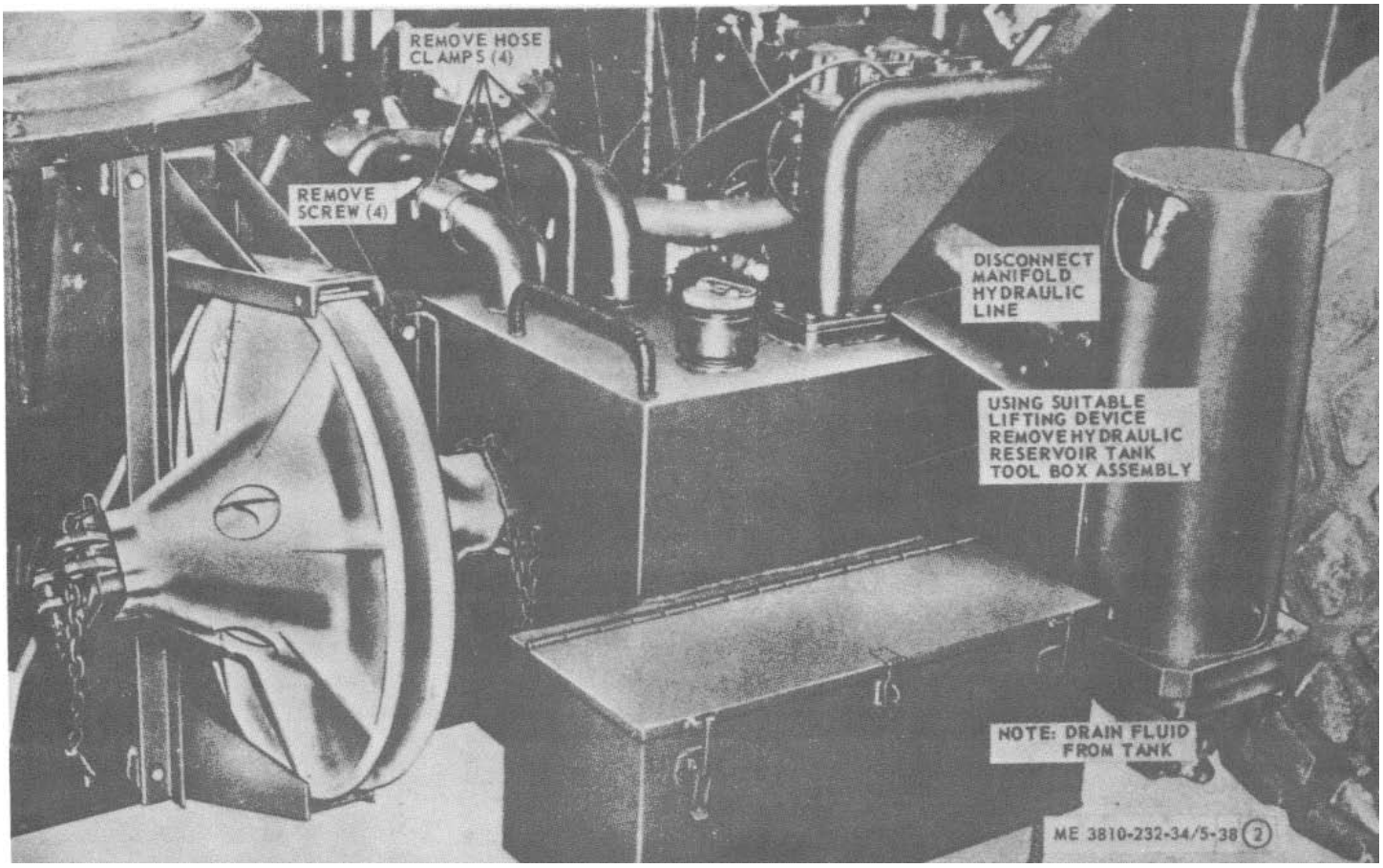
(1) Model 2380. Remove the hydraulic reservoir tank as illustrated on figure 5-38A.

(2) Model 2385. Remove the hydraulic reservoir tank as illustrated on figure 5-38B.




A-Model 2330

*Figure 5-38. (1) Carrier hydraulic reservoir tank removal and installation.*




B--Model 2385
*Figure 5-38. (2) -Continued*

*b. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect filler assembly and strainer for damage. Replace parts as necessary.

(3) Inspect tank for cracks, breaks, or other damage. Repair or replace defective tank.

*c. Installation.*

(1) *Model 2380*. Install the hydraulic reservoir tank as illustrated on figure 5-38A.

(2) *Model 2385.* Install the hydraulic reservoir tank as illustrated on figure 5-38B.

**5-30. Utility Blade Hydraulic Cylinder**

a. *Removal*. Remove hydraulic cylinder (TM 5-3810-232-12).

*b. Disassembly.*

(1) *Model 2380*. Disassemble utility blade hydraulic cylinder in numerical sequence as shown on figure 5-39A.

(2) *Model 2385.* Disassemble utility blade hydraulic cylinder in numerical sequence as shown on figure 5-39B.

*c. Cleaning, Inspection and Repair.*

(1) Clean all metal parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect rod, pistons, and cylinder for cracks, scoring or excessive wear. Repair or replace defective parts.

(3) Inspect packing and 0-rings. Replace as necessary.

*d. Reassembly.*

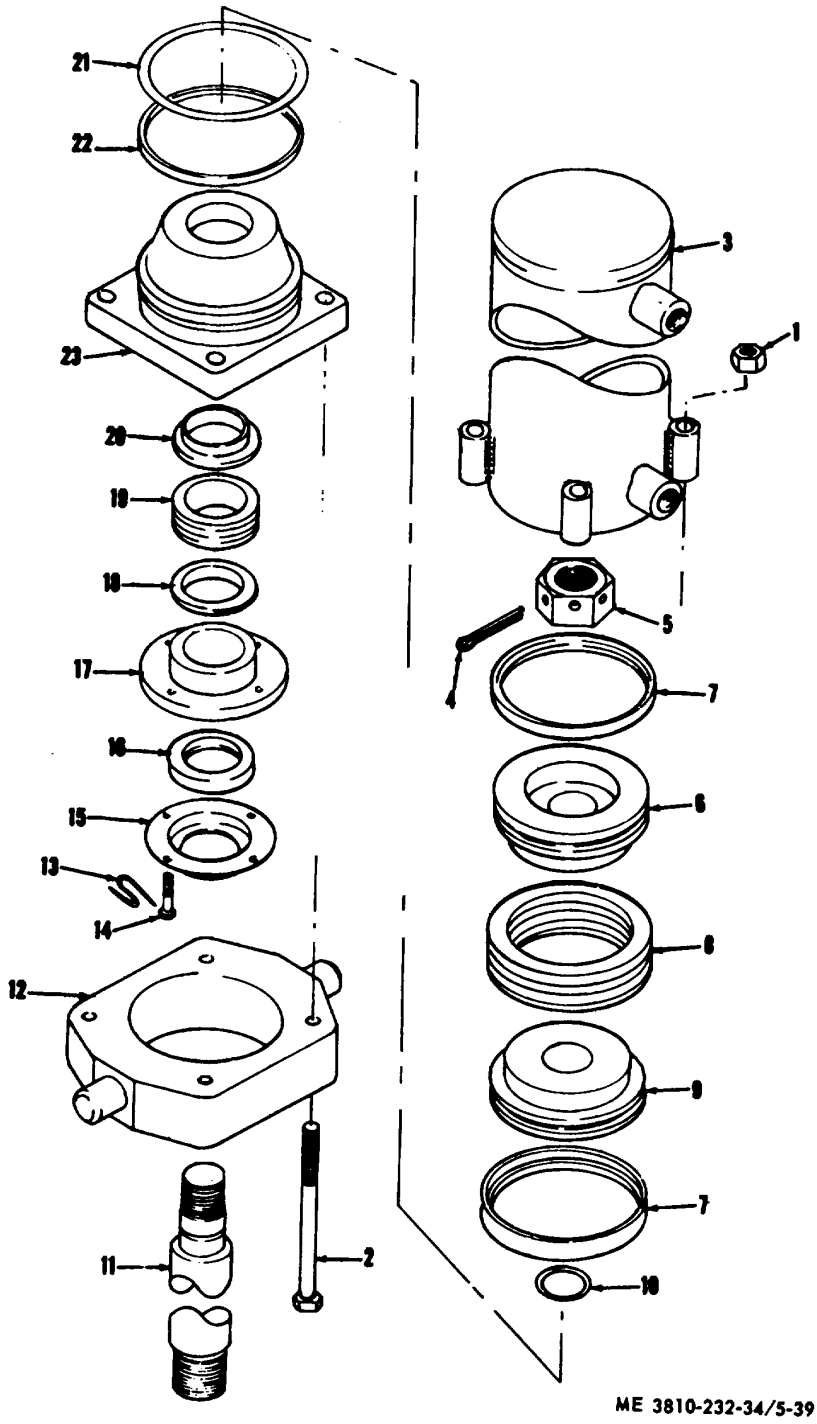
(1) Model 2380. Reassemble utility blade hydraulic cylinder in reverse of numerical sequence shown on figure 5-39A.

(2) Model 2385. Reassemble utility blade hydraulic cylinder as shown on figure 5-39B.

**NOTE**

**When reassembling the utility blade hydraulic cylinder tighten piston attaching nut (4) to 600 to 700 foot-pounds torque and tighten threaded end cap (2) to 10 or 12-foot-pounds torque.**

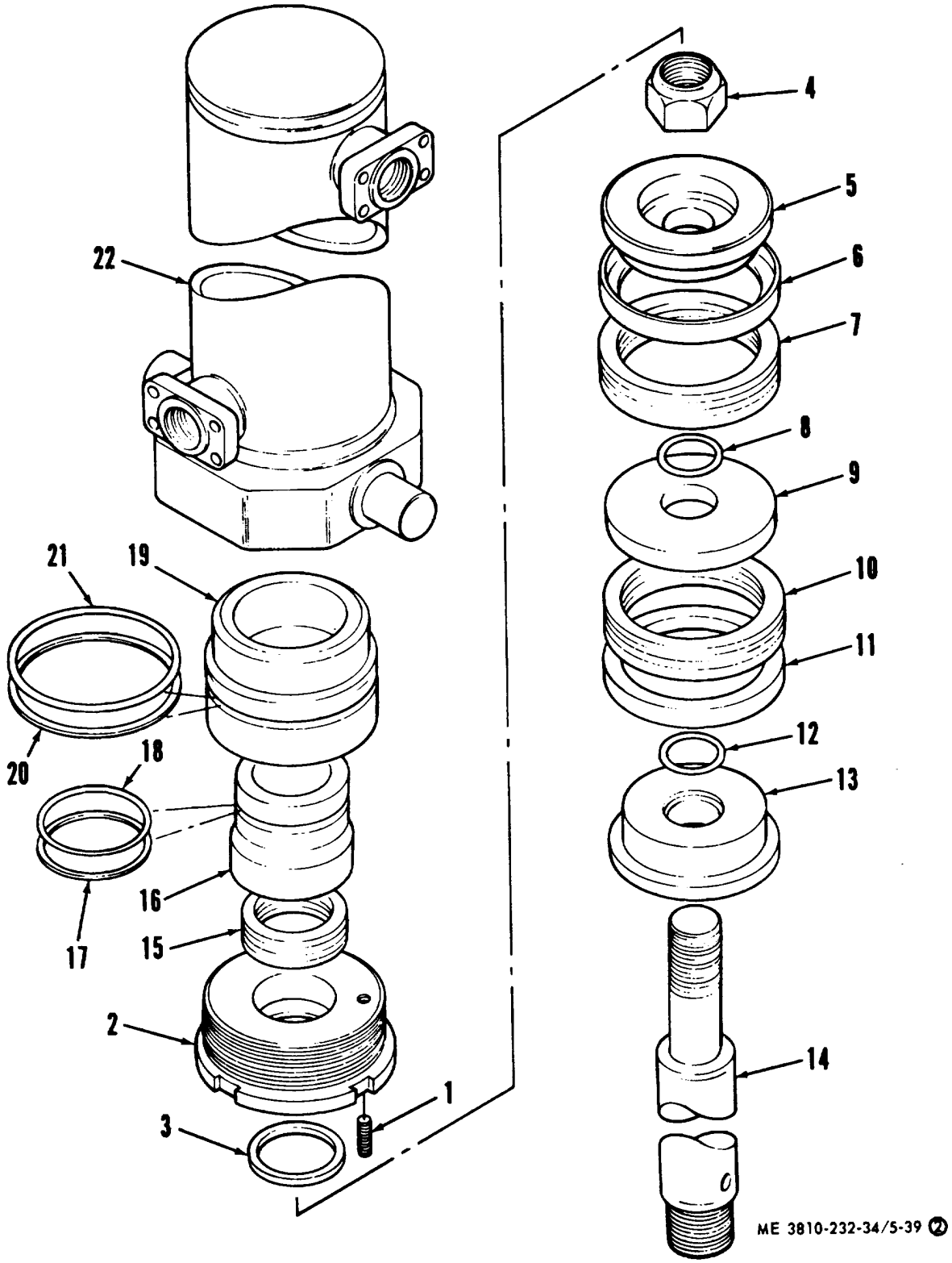
e. *Installation*. Install utility blade hydraulic cylinder (TM 5-3810-232-12).




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Nut | 7 | Piston wear ring | 13 | Lockwire | 19 | Chevron packing assy |
| 2 | Bolt | 8 | Chevron packing assy | 14 | Bolt | 20 | Adapter, chevron male |
| 3 | Cylinder tube assembly | 9 | Piston | 15 | Seal retainer | 21 | O-ring |
| 4 | Pin | 10 | O-ring | 16 | Seal | 22 | Back-up ring |
| S | Nut, piston rod | 11 | Piston, rod | 17 | Packing gland | 23 | Cylinder cap |
| 6 | Piston | 12 | Cylinder trunnion assy | 18 | Adapter, chevron female | | |

A-Model 2380

*Figure 5-39. (1) [Utility blade hydraulic cylinder assembly, exploded view..*




B--Model 2385
*Figure 5-39. (2)--Continued*

*Key to Figure 5-39 (2)*

| | |
|---|---|
| 1 | Setscrew |
| 2 | Threaded end cap |
| 3 | Wiper ring |
| 4 | Nut |
| 5 | Piston half |
| 6 | Nylon rider |
| 7 | Packing assembly |
| 8 | O-ring |
| 9 | Piston half |
| 10 | Packing assembly |
| 11 | Nylon rider |
| 12 | O-ring |
| 13 | Piston half |
| 14 | Rod |
| 15 | Packing assembly |
| 16 | Bushing |
| 17 | Parbak ring |
| 18 | O-ring |
| 19 | Retainer |
| 20 | Parbak ring |
| 21 | O-ring |
| 22 | Shell assembly |

5-31. Outrigger Hydraulic Cylinders

a. Removal. Remove outrigger hydraulic cylinders as shown on figure 5-40.

b. Disassembly.

(1) Model 2380. Disassemble the hydraulic cylinder in numerical sequence as shown on figure 5-41.

(2) Model 2385. Disassemble the hydraulic cylinder in numerical sequence as shown on figure 5-42.

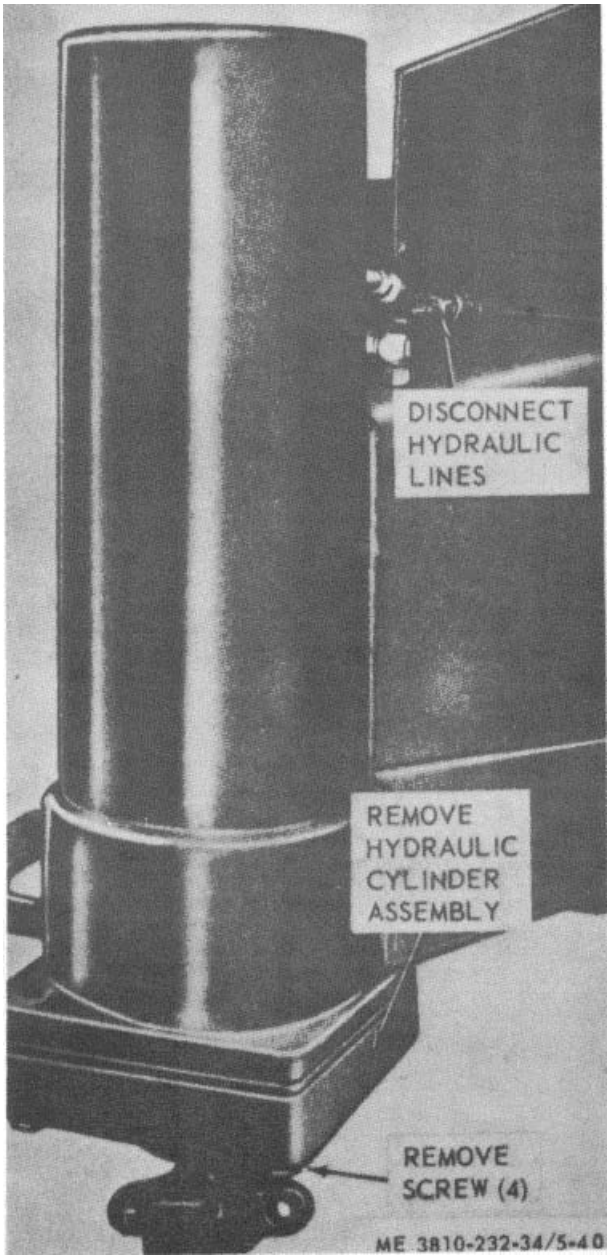
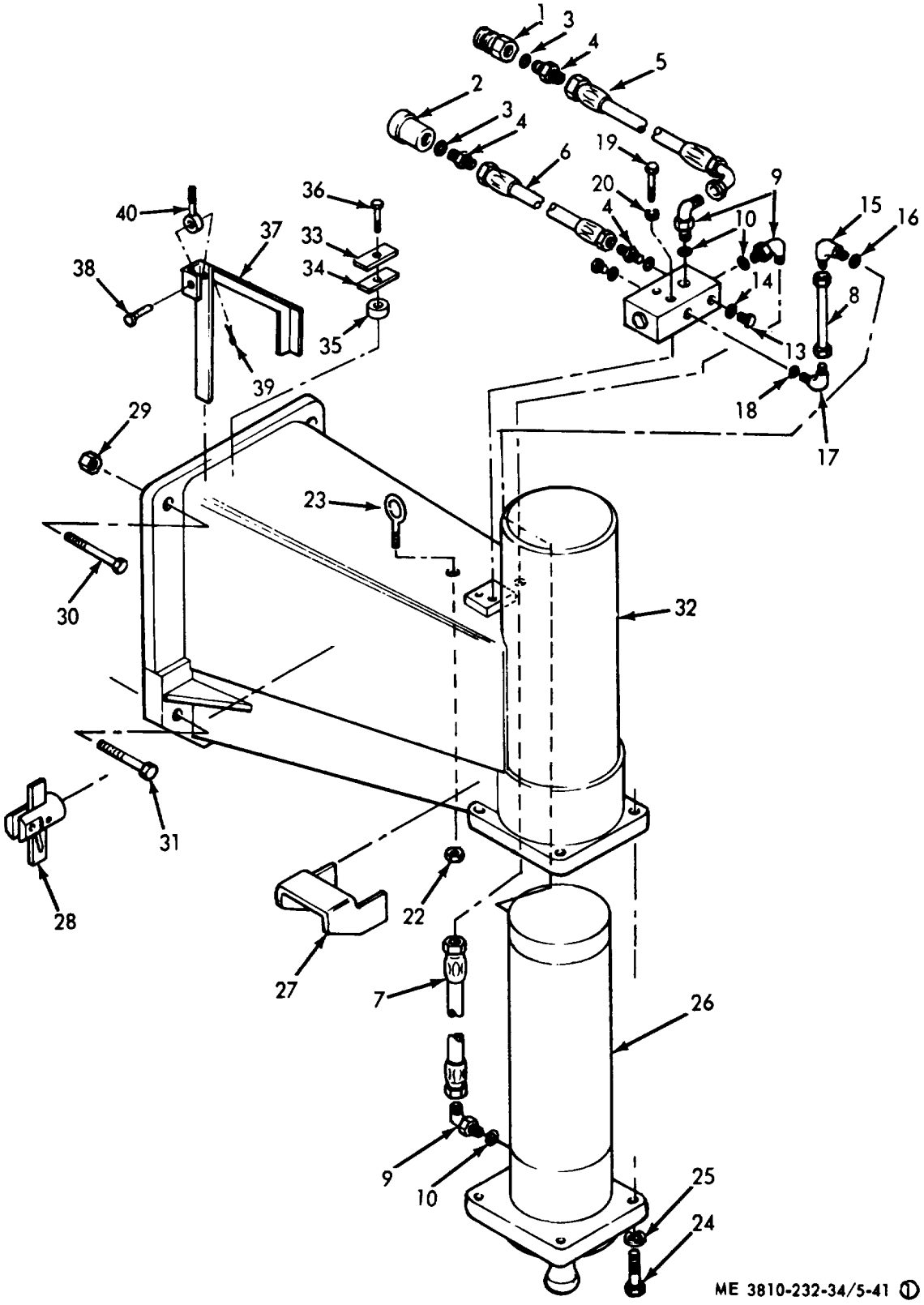



*Figure 5-40. Outrigger hydraulic cylinder, removal and installation.*

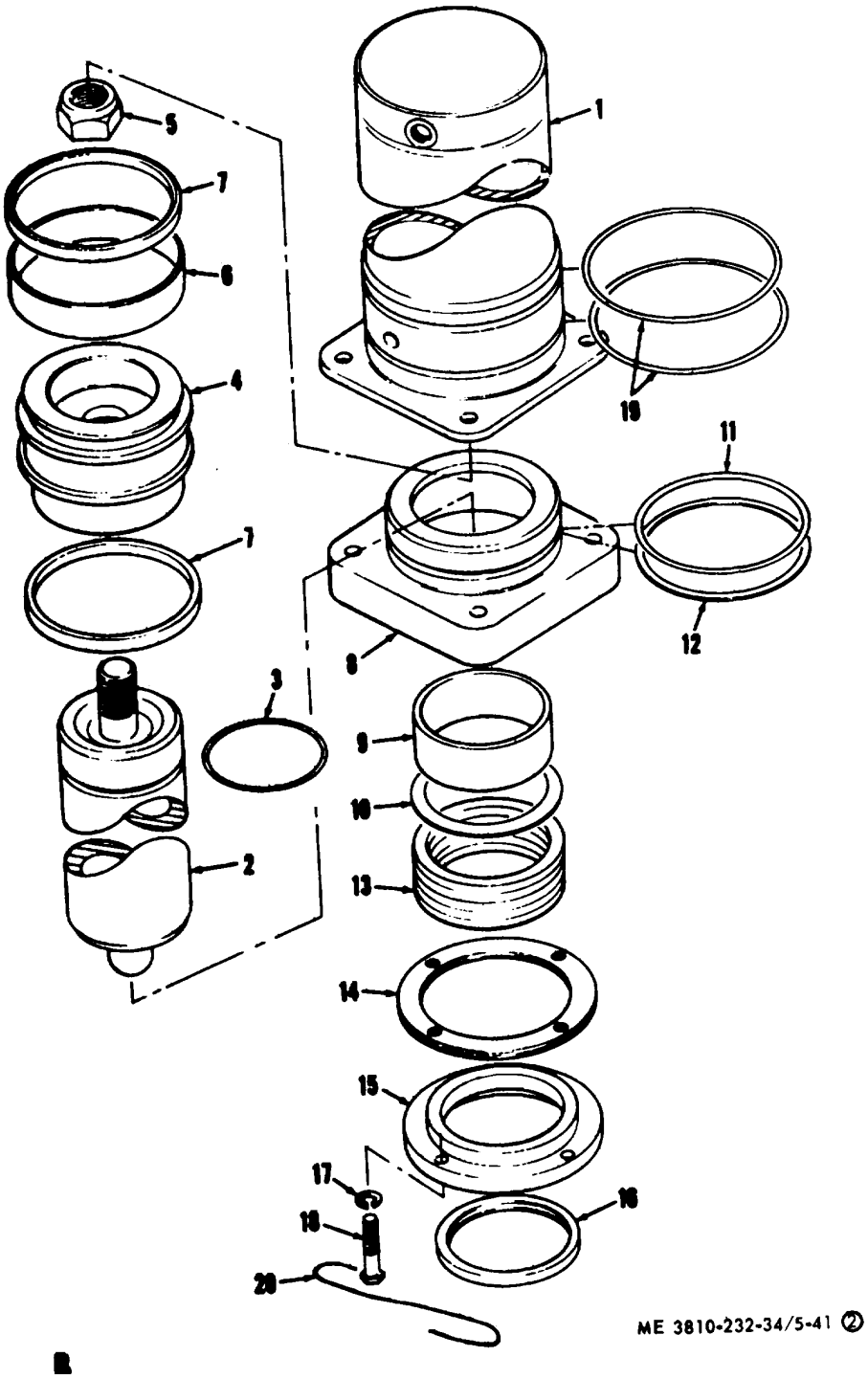
Key to Figure 5-41 (1)

| | |
|---|---|
| 1 | Adapter, coupling |
| 2 | Body, coupling |
| 3 | O-ring |
| 4 | Connector |
| 6 | Hose assembly |
| 6 | Hose assembly |
| 7 | Hose assembly |
| 8 | Tube assembly |
| 9 | Elbow. adjustable |
| 10 | O-ring |
| 11 | Plug |
| 12 | O-ring |
| 1S | Plug |
| 14 | O-ring |
| 15 | Elbow |
| 16 | O-ring |
| 17 | Elbow |
| 18 | O-ring |
| 19 | Capscrew |
| 20 | Lockwasher |
| 21 | Tilt-lock valve |
| 22 | Nut, plain |
| 23 | Eye-bolt, turnbuckle |
| 24 | Capscrew |
| 25 | Lockwasher |
| 26 | Cylinder |
| 27 | Step |
| 28 | Float pad lock ay |
| 29 | Nut, self-locking |
| 30 | Capscrew |
| 31 | Capscrew |
| 32 | Outrigger arm ay |
| 33 | Bar |
| 34 | Bar |
| 35 | Ferrule |
| 36 | Screw, cap |
| 37 | Bracket |
| 38 | Pin, clevis |
| 39 | Pin, cotter |
| 40 | Eye, clevis |




A--Outrigger assembly, exploded view.

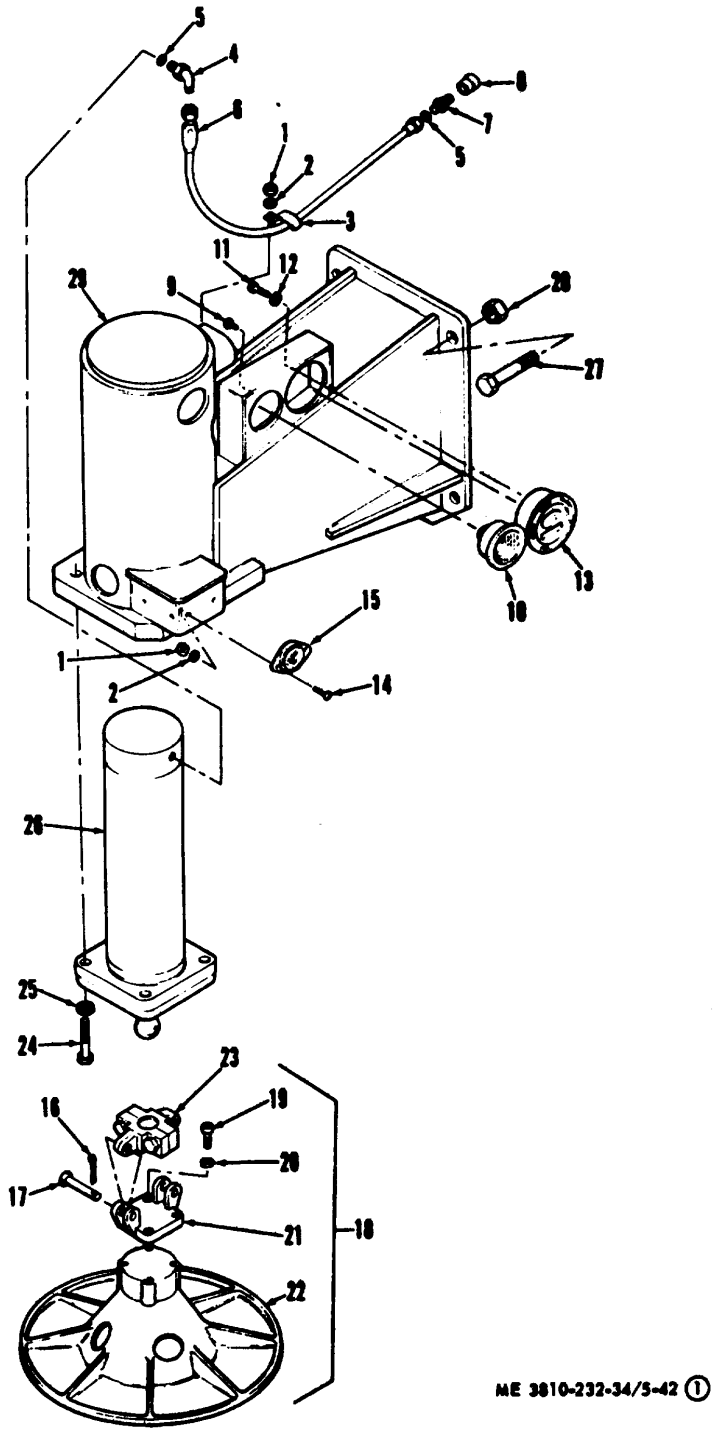
*Figure 5-41. (1) Outrigger assembly components (model 2380).*




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Cylinder | 6 | Bearings | 11 | O-ring | 16 | Seal |
| 2 | Rod, piston | 7 | O-ring | 12 | Back-up ring | 17 | Lockwasher |
| 3 | O-ring | 8 | Cap, cylinder | 13 | Packing | 18 | Screw |
| 4 | Piston | 9 | Bearing | 14 | Shim | 19 | O-ring |
| 5 | Stop nut | 10 | Washer | 15 | Gland | 20 | Lock wire |

B-Outrigger hydraulic cylinder. exploded view

*Figure 5-41. (2) .--Continued..*




A-Outrigger assembly, exploded view.

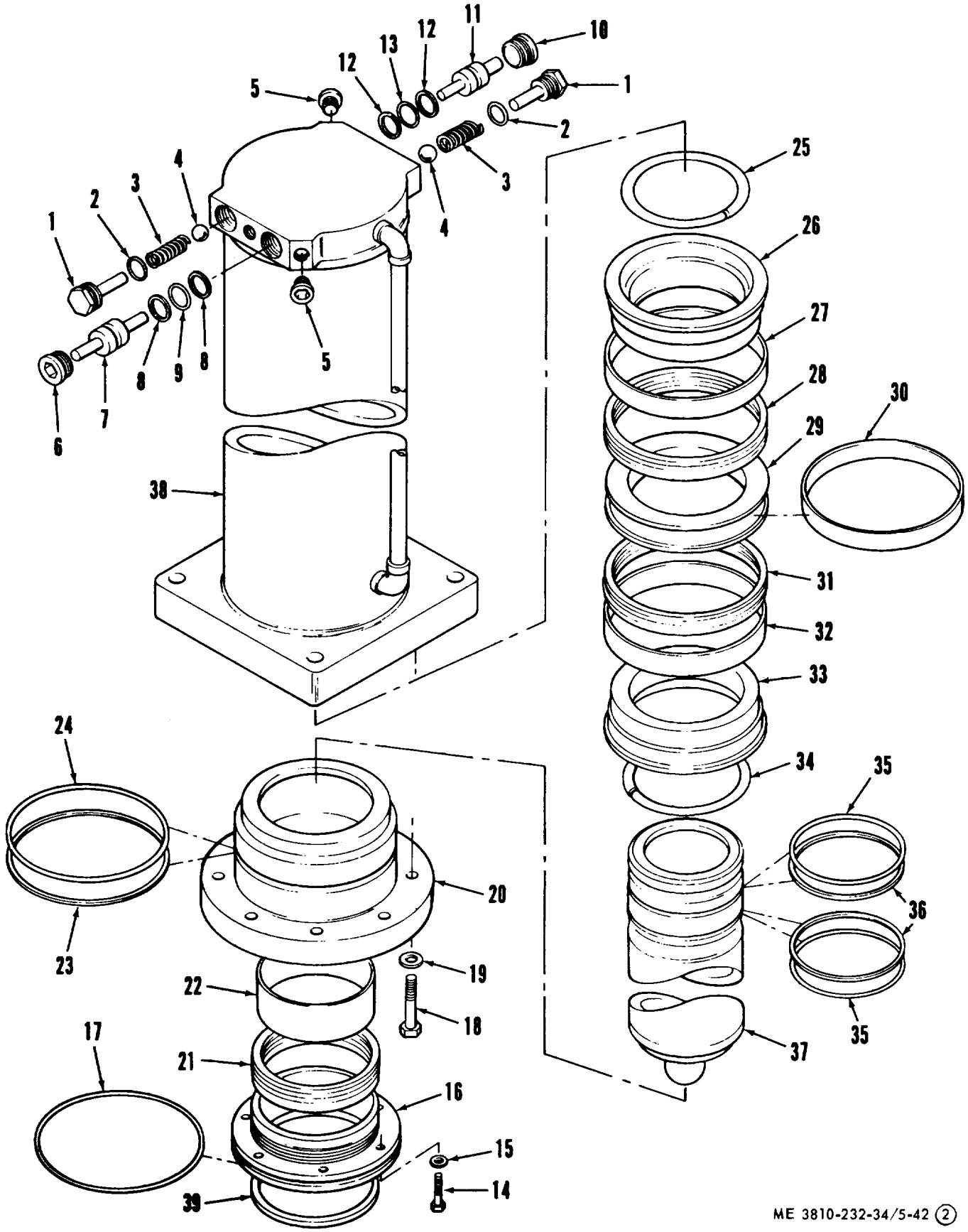
*Figure 5-42. (1) Outrigger assembly components (Model 2385).*

Key to Figure 5-42 (1)

1 Nut
2 Lockwasher
3 Clamp
4 Elbow
5 O-ring
6 Hose
7 Coupling
8 Coupler
9 Screw
10 Light assembly
11 Screw
12 Lockwasher
13 Blackout light assembly
14 Screw
15 Reflector
16 Pin
17 Pin
18 Float pad assembly
19 Screw
20 Lockwasher
21 Face plate
22 Float pad
23 Ball socket assembly
24 Screw
25 Lockwasher
26 Cylinder
27 Screw
28 Nut
29 Outrigger arm

Key to Figure 5-42 (2)

1 Space plug
2 O-ring
3 Spring
4 Ball
5 Plug
6 Plug
7 Plunger
8 Parbak ring
9 O-ring
10 Plug
11 Plunger
12 Parbak ring
13 O-ring
14 Capscrew
15 Lockwasher
16 Packing nut
17 O-ring
18 Capscrew
19 Lockwasher
20 Retainer
21 Packing assembly
22 Bushing
23 Parbak ring
24 O-ring
25 Retaining ring half
26 Piston half
27 Bushing
28 Packing assembly
29 Split piston
30 Bushing
31 Packing assembly
32 Bushing
33 Piston half
34 Retaining ring half
35 O-ring
36 Parbak ring
37 Plunger assembly
38 Shell assembly
39 Wiper ring




B--Outrigger hydraulic cylinder. exploded view.

*Figure 5-42. (2) -Continued.*

*c. Cleaning, Inspection and Repair.*

(1) Clean all metal parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect rod, pistons and cylinder for cracks, scoring and excessive wear. Repair or replace defective parts.

(3) Inspect packing, O-rings, and seals. Replace as necessary.

*d. Reassembly.*

(1) Model 2380. Reassemble the outrigger cylinders in reverse of the numerical sequence shown on figure 5-41.

(2) Model 2385. Reassemble the outrigger cylinders in reverse of the numerical sequence shown of figure 5-42A.

**NOTE**

**When reassembling tighten capscrew (18, fig. 5-42B) to 50-60 foot-pounds torque.**

e. *Adjustment*. To adjust packing assembly model 2385.

(1) Remove capscrew (14) figure 5-42B.

(2) Tighten packing nut (16) the required amount to align capscrew hole in packing nut (16) with the tapped holes in retainer (20). These holes are radially in line at 45° intervals. When packing nut is tight against packing (21) advancing capscrew one position (45°) will increase packing compression 0.011 inch.

(3) Install locking capscrew and tighten securely.

*f. Installation*. Install outrigger cylinders (TM 5-3810-232-12).

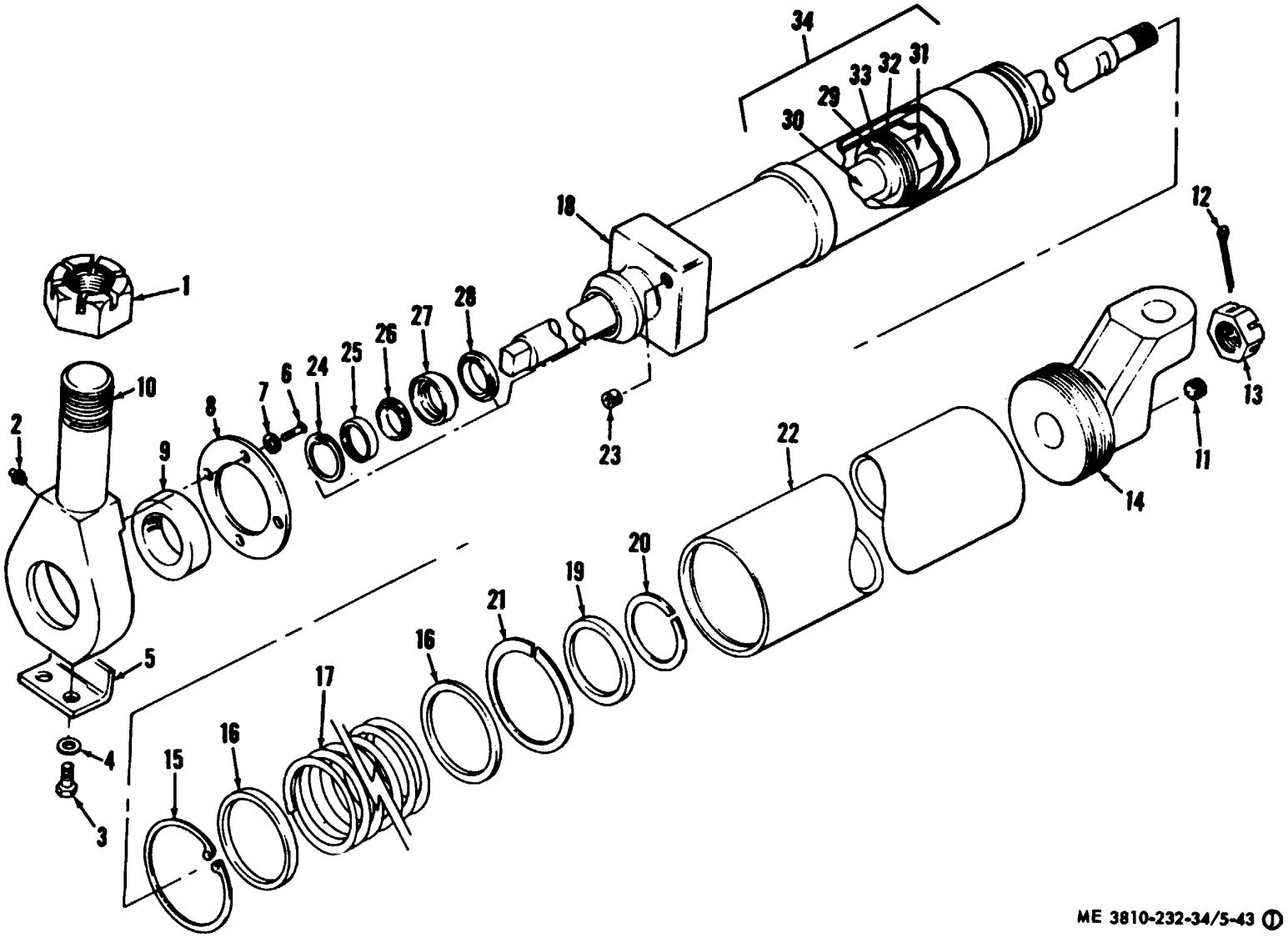
**5-32. Axle Hydraulic Steering Cylinders**

*a. Removal*. -Remove axle steering cylinders (TM 5-3810-232-12).

*(b) Disassembly.* Disassemble the axle steering cylinders in the numerical sequence shown on figure 5-43.

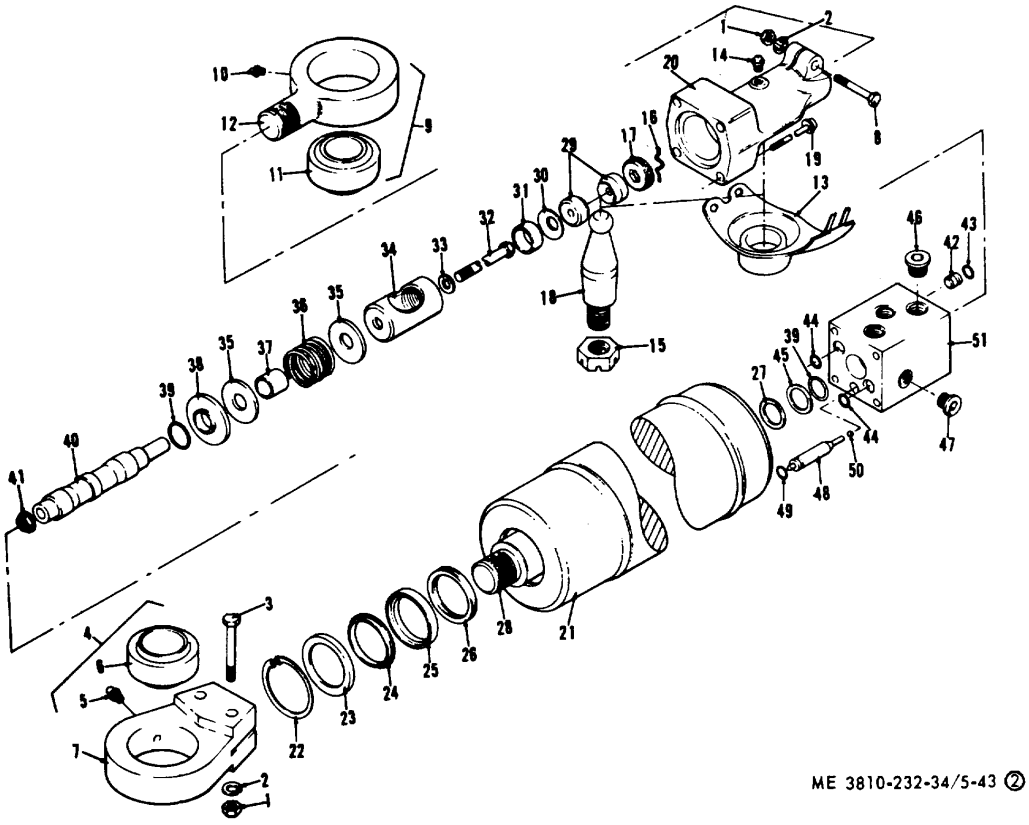
Key to Figure 5-43 (1)

| | |
|---|---|
| 1 | Nut |
| 2 | Grease fitting |
| 3 | Bolt |
| 4 | Lockwasher |
| 5 | Stop plate |
| 6 | Flat head screw |
| 7 | Lockwasher |
| 8 | Bearing retainer |
| 9 | Bearing |
| 10 | Bearing housing |
| 11 | Pipe plug |
| 12 | Cotter pin |
| 13 | Nut |
| 14 | Mounting |
| 15 | Retaining ring |
| 16 | Washer |
| 17 | Spring |
| 18 | Cylinder weldment |
| 19 | Stop ring |
| 20 | Snap |
| 21 | Snap ring |
| 22 | Tube |
| 23 | Plug |
| 24 | Snap ring |
| 25 | Scraper |
| 26 | Wiper |
| 27 | Seal retainer |
| 28 | Seal |
| 29 | Roll pin |
| 30 | Piston rod |
| 31 | Rod |
| 32 | Piston ring |
| 33 | Piston |
| 34 | Piston |




A-Centering cylinder

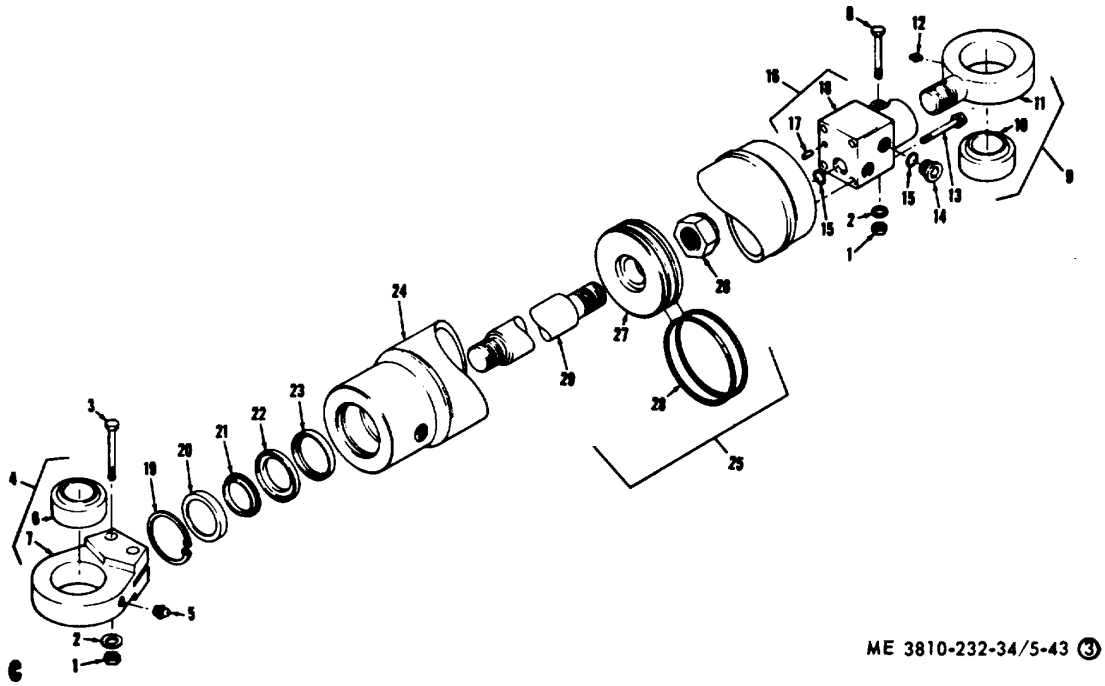
*Figure 5-43. (1) Axle hydraulic assemblies, exploded view.*




| | | | |
|---|---|---|---|
| 1 | Nut | 27 | Spacer |
| 2 | Lockwasher | 28 | Piston and rod assy |
| 3 | Bolt | 29 | Ball stud seat |
| 4 | Rod end assembly | 30 | Washer |
| 5 | Grease fitting | 31 | Spacer |
| 6 | Grease fitting | 32 | Spool bolt |
| 7 | Bearing housing | 33 | Washer |
| 8 | Bolt | 34 | Washer |
| 9 | Bearing assembly | 35 | Washer |
| 10 | Grease fitting | 36 | Centering spring |
| 11 | Bearing | 37 | Stop |
| 12 | Housing | 38 | O-ring retainer |
| 13 | Boot | 39 | O-ring |
| 14 | Grease fitting | 40 | Valve spool |
| 15 | Nut | 41 | Nut |
| 16 | Lockwire | 42 | Plug |
| 17 | Adjusting plug | 43 | -ring |
| 18 | Ball stud | 44 | O-ring |
| 19 | Bolt | 45 | O-ring retainer |
| 20 | Housing | 46 | Plug |
| 21 | Cylinder weldment | 47 | Plug |
| 22 | Snap ring | 48 | Checkball plug |
| 23 | Scraper | 49 | O-ring |
| 24 | Wiper | 50 | Ball |
| 25 | Seal retainer | 51 | Valve body |
| 26 | Seal | | |

B-Tandem unit steering cylinder

*Figure 5-43. (2)--Continued.*




| | | | |
|---|---|---|---|
| 1 | Nut | 16 | End cap assembly |
| 2 | Lockwasher | 17 | Roll pin |
| 3 | Bolt | 18 | End cap |
| 4 | Bearing assembly | 19 | Snap ring |
| 5 | Grease fitting | 20 | Scraper |
| 6 | Bearing | 21 | Wiper |
| 7 | Bearing housing | 22 | Seal retainer |
| 8 | Bolt | 23 | Sea; |
| 9 | Bearing assembly | 24 | Cylinder weldment |
| 10 | Bearing | 25 | Piston and rod assy |
| 11 | Bearing housing | 26 | Nut |
| 12 | Grease fitting | 27 | Piston |
| 13 | Bolt | 28 | Piston ring |
| 14 | Plug | 29 | Piston rod |
| 15 | O-ring | | |

C -Steering cylinder
*Figure 5-43. (3) - Continued.*

*c. Cleaning, Inspection and Repair.*

(1) Clean all metal parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect rod, pistons and cylinder for cracks, scoring, or excessive wear. Repair or replace defective parts.

(3) Inspect packing, O-rings, and seals. Replace as necessary.

d. *Reassembly*. Reassemble axle steering cylinders in reverse of the numerical sequence shown on figure 5-43.

e. *Installation*. Install axle steering cylinders (TM 5-3810-232-12).

**5-33. Front Axle Oscillate Lockout Hydraulic Cylinders (Model 2385)**

a. *General*. The front axle oscillate lockout hydraulic cylinder, when actuated, extend locking devices between the main frame and the front axle housing preventing oscillation or tilting when lifting light loads without the outriggers. The engagement of both locks can only be achieved when the main frame and the axle housing are relatively parallel (within 5/8 in.).

**NOTE**

**The transmission shift control must be in neutral to operate the oscillate lockout. As pressure is built up in the axle oscillate lockout system (900 psi) a double-acting cylinder mounted on the transmission shift tower is actuated, locking out the transmission control. In the event an electrical failure occurs, which cannot be corrected by a fuse replacement, the system can be retracted and the transmission shift lever re-leased manually by depressing the recessed release buttons on the two-way valve located behind the operator's seat (TM 5-3810-232-12).**

b. *Removal*. Remove front axle oscillate cylinders (TM 5-3810-232-12).

c. *Disassembly*. Disassemble the axle oscillate lockout cylinder in the numerical sequence shown in figure 5-44.

*d. Cleaning, Inspection and Repair.*

(1) Clean all metal with an approved cleaning solvent and dry thoroughly.

(2) Inspect rod, pistons and cylinder for cracks, scoring, or excessive wear. Repair or replace defective parts.

(3) Inspect packing, O-rings and seals. Replace as necessary.

*e. Reassembly*. Reassemble the axle oscillate lockout cylinder in reverse of the numerical sequence shown on figure 5-44.

*f. Installation*. Install front axle oscillate lockout cylinder (TM 5-3810-232-12).

Key to Figure 5-44.

| | |
|---|---|
| 1 | Setscrew |
| 2 | Threaded washer |
| 3 | Wiper |
| 4 | Nut |
| 5 | Piston half |
| 6 | O-ring |
| 7 | Nylon rider |
| 8 | Packing assembly |
| 9 | Washer |
| 10 | Packing assembly |
| 11 | Nylon rider |
| 12 | O-ring |
| 18 | Piston half |
| 14 | Rod |
| 15 | Packing assembly |
| 16 | Bushing |
| 17 | Parbak ring |
| 18 | O-ring |
| 19 | Retainer |
| 20 | Parbak ring |
| 21 | O-ring |
| 22 | Shell assembly |

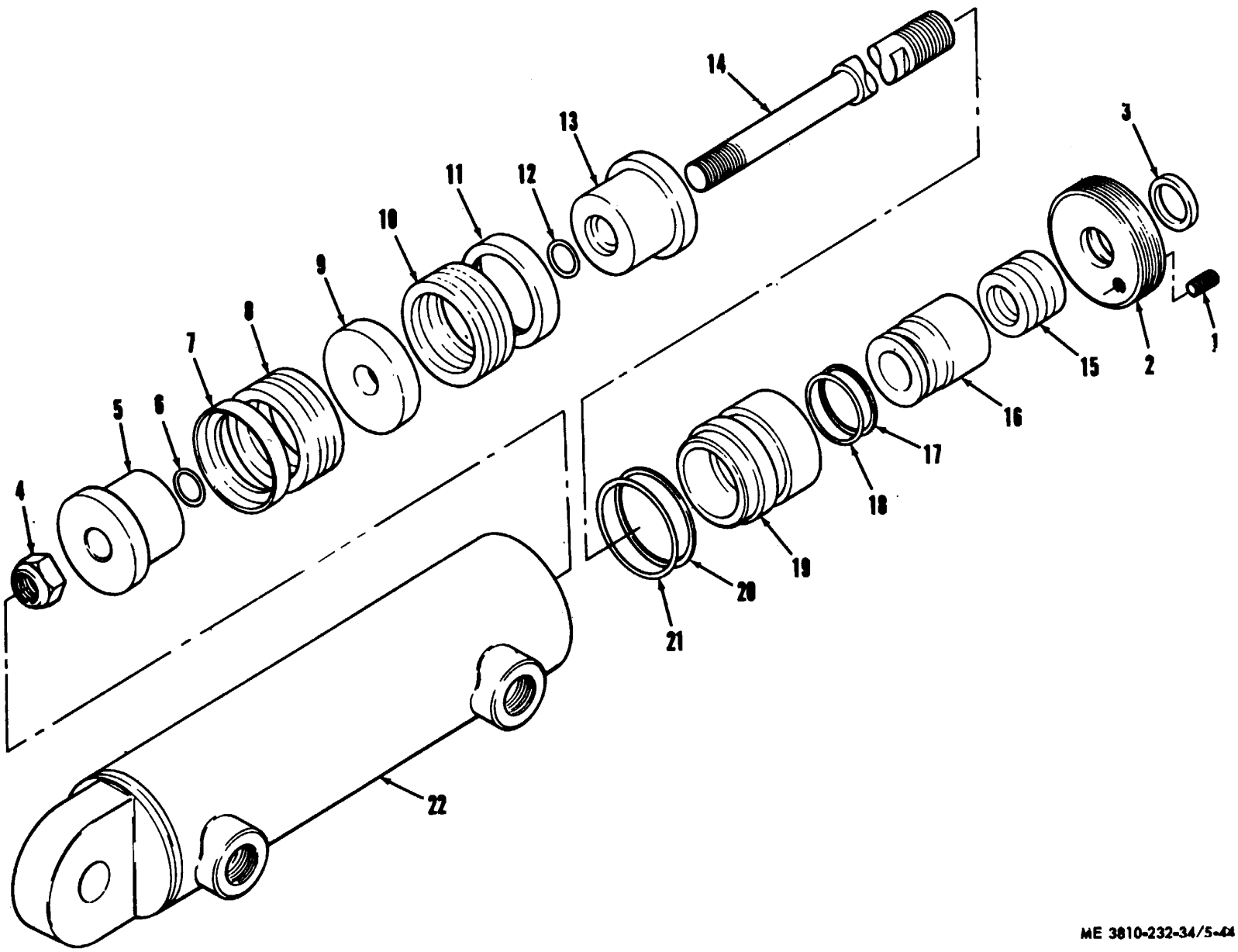



*Figure 5-44. Front axle oscillate lockout hydraulic cylinders.*

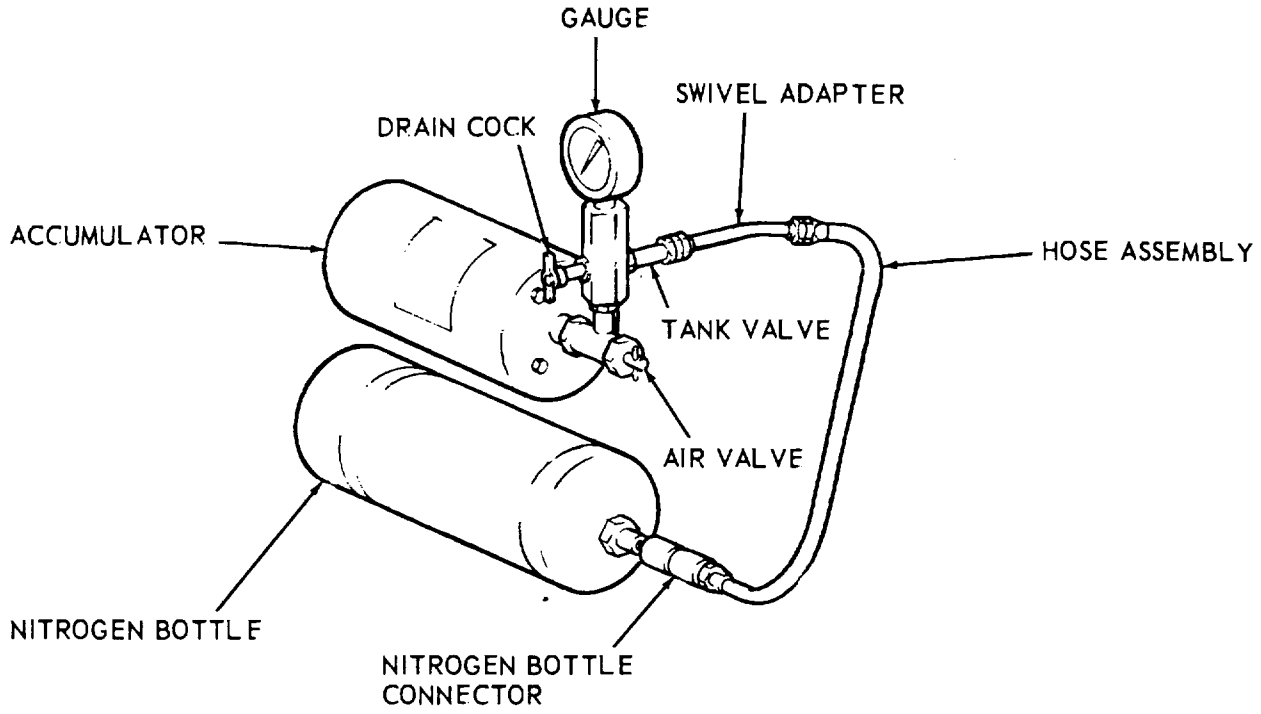



*Figure 5-44A. Accumulator Charging Assembly.*

**5-34. Accumulator**

*a. Removal.* Remove the accumulator (TM 5-3810-232-12).

*b. Pre-Operation Service.*

(1) With engine of carrier shut off, move one of the outrigger cylinders down, then back up, until the outrigger ceases to move.

(2) Select proper adapter for nitrogen bottle and attach to bottle and hose assembly, figure 5-44A.

(3) Remove protective device (any guards and dust caps) from charging valve on accumulator.

(4) Close drain cock at gauge. (See diagram for proper part names).

(5) Turn "T" handle on air valve to extreme counter-clockwise position (pin all way out).

(6) Attach air valve to accumulator and tighten.

(7) Attach hose swivel adapter to tank valve.

(8) Turn in "T" handle on air valve (clockwise). Gauge reads accumulator pressure. If gauge reads less than 800 psi, continue with charging procedure.

(9) Turn handle on air valve out (counter-clockwise).

(10) Crack open drain cock at gauge.

(11) VERY SLOWLY crack valve on nitrogen bottle.

(12) When accumulator reaches desired charge pressure (read on gauge), close valve on nitrogen bottle.

(13) If accumulator is overcharged, turn in handle on air valve (clockwise). Bleed off excess pressure by opening drain cock slightly.

(14) Disconnect charging assembly and replace dust caps and guards.

## Section X. CARRIER CAB AND COMPONENTS

**5-35. General**

The carrier cab is a one-man, sheet metal and glass enclosed structure. All carrier operating controls and instruments are mounted in the cab.

**5-36. Carrier Cab**

*a. Removal.*

(1) Disconnect steering assembly (para 5-12, 5-13).

(2) Tag and disconnect all hydraulic lines at connections that will allow removal of cab assembly (para 5-23).

(3) Tag and disconnect all electrical leads to allow removal of cab assembly.

(4) Tag and disconnect all air lines to allow removal of cab assembly (para 5-22).

(5) Disconnect all controls necessary to allow removal of cab assembly.

(6) Remove cab assembly as instructed on figure 5-45.


*Figure 5-45. Carrier cab assembly, removal and installation.*

*b. Cleaning, Inspection and Repair.*

(1) Clean with an approved cleaning solvent and dry thoroughly.

(2) Inspect for cracks, breaks and other damage. Repair cracks and breaks by welding if necessary.

(3) Replace a badly damaged or defective cab.

*c. Installation*

(1) Install cab assembly as instructed on figure 5-45.

(2) Connect all air lines (para 5-19).

(3) Connect all electrical lead

(4) Connect all hydraulic leads (para 5-28).

(5) Connect steering assembly (para 6-15, 5-16).

**5-37. Carrier Operator's Seat**

*a. Removal.* Remove carrier operator's seat (TM 5-810-22-12).

*b. Disassembly.* Disassemble the operator's seat as shown on figure 5-46.

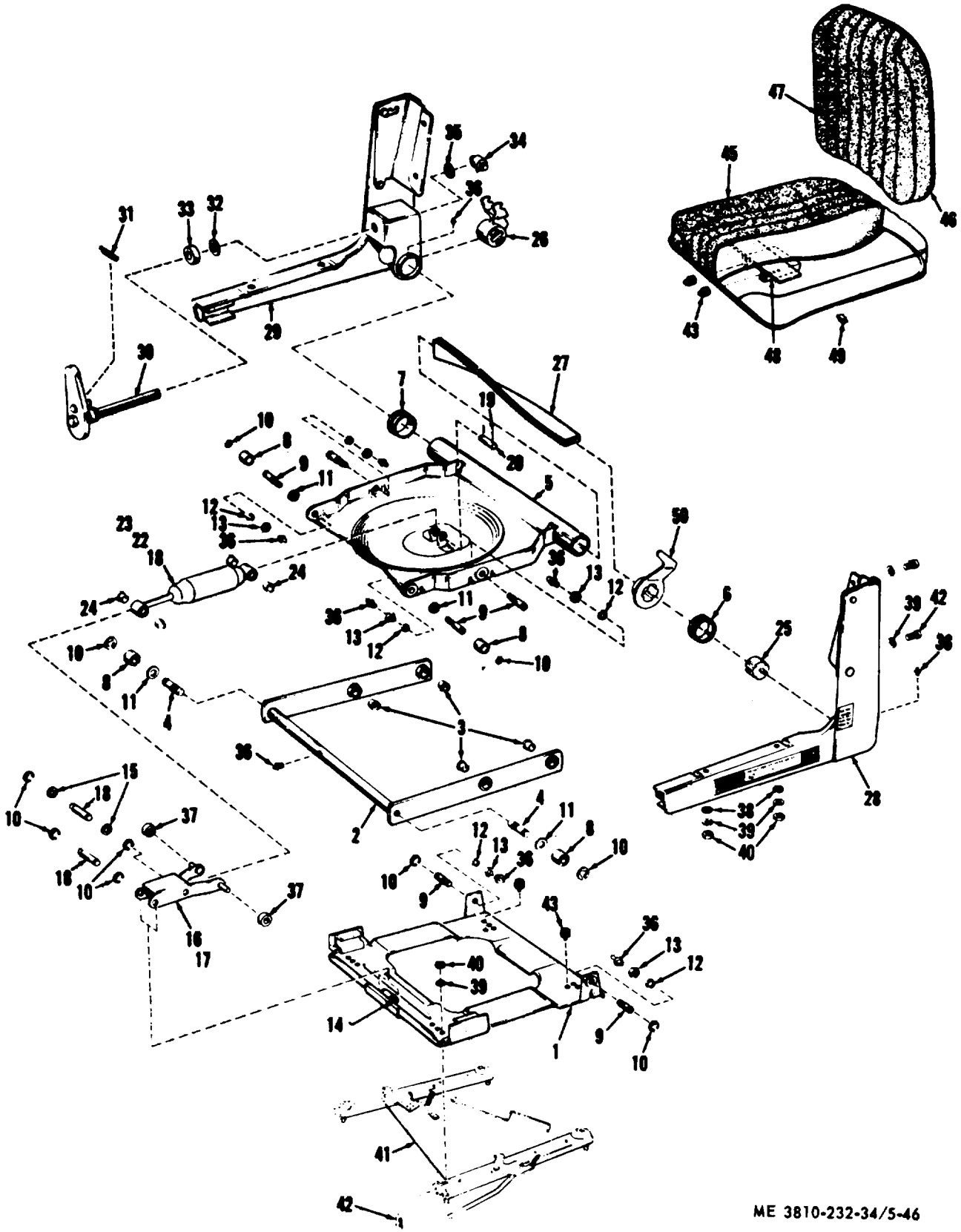



*Figure 5-46. Carrier operator's assembly, exploded view.*

Key to Figure 5-46..

1. Base assembly
2. Outer lever assembly
3. Bearing, flanged
4. Pin, drive
5. Center lever assembly
6. Bering, housing L.H.
7. Bearing housing R.H.
8. Roller & bearing assy.
9. Stud
10. Snap ring
11. Washer, plain
12. Lockwasher (38/8)
13. Nut, hex (3/8-16)
14. Bearing, flanged
15. Washer, plain
16. Kit, shock lever assy.
17. Shock lever assy.
18. Hinge shaft, shock
19. Hinge shaft, shock rear
20. Roll pin
22. Shock absorber assy.
23. Bearing kit, shock absorber
24. Bearing, flanged
25. Retainer. T-bar
26. Yoke
27. Torison bar set (2)
28. Side panel ma. L.H.
29. Side panel assy. R.H.
30. Adjuster screw & lover my.
31. Spring, tension
32. Washer plain
33. Thrust ball bearing
34. Adjuster pin
35. Washer, plain
36. Lube fittings
37. Roller, nylon
38. Washer, plain (5/16)
39. Lockwasher (5/16)
40. Nut, hex 5/16-18)
41. Adjuster kit
42. Capscrew (5/16-18x5/8)
43. Bumper
45. Cover assembly
46. Back cushion assembly
47. Cover assembly
48. Universal riser kit
49. Fastener clip cushion
50. Ride level indicator

*c. Cleaning, Inspection and Repair.*

(1) Clean all metal parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for cracks, breaks or other damage. Repair or replace defective parts.

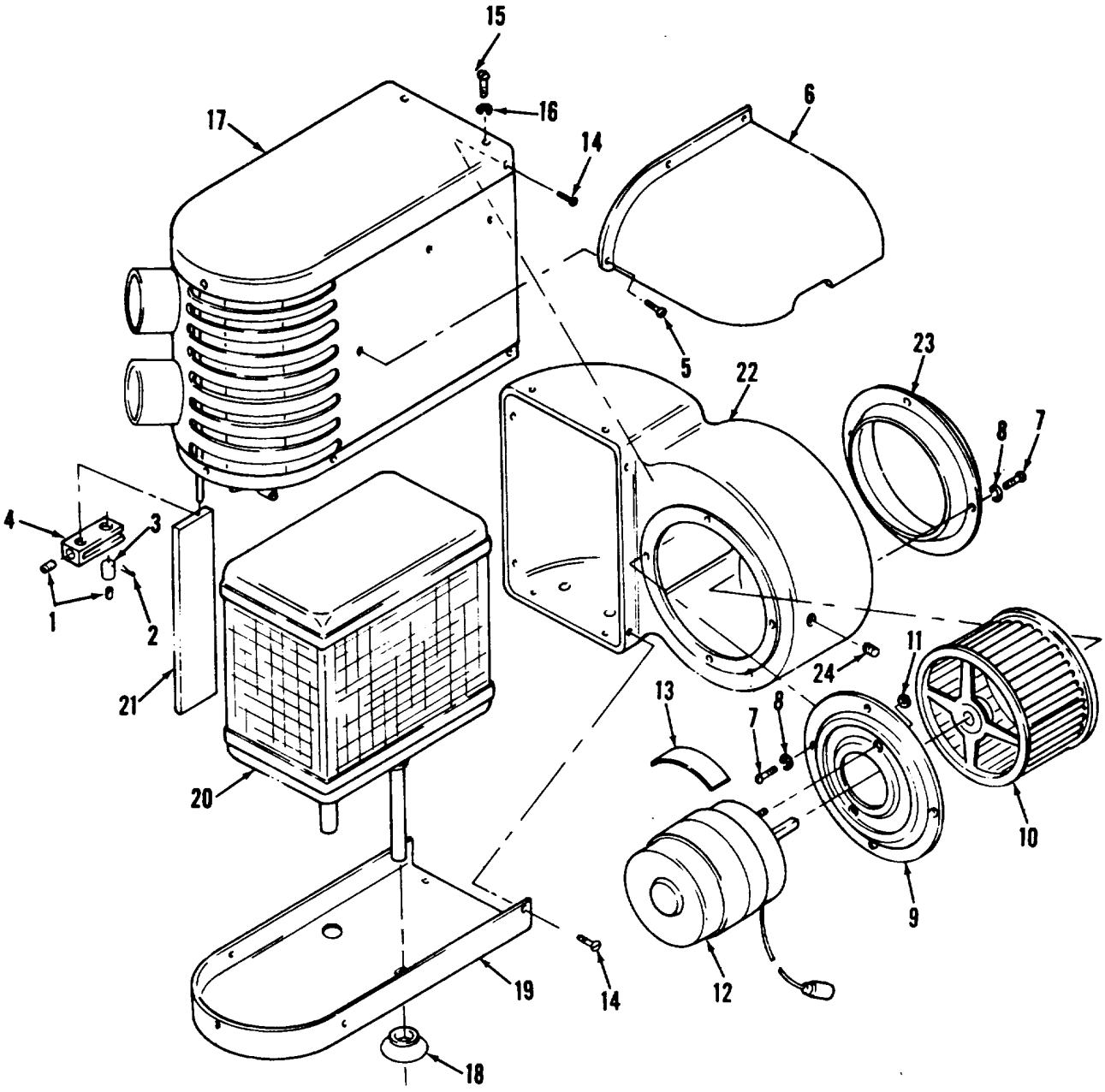
*d. Reassembly*. Reassembly operator's seat in reverie of the numerical sequence shown on figure 5-46.

*e. Installation.* Install carrier operator's seat (TM 5-8102-2-12).

**5-38. Carrier Cab Heater.**

*a. Removal.* Remove cab heater (TM 5-3810-232-12).

*b. Disassembly.* Disassembly cab heater as shown in figure 5-47.




| | | | |
|---|---|---|---|
| 1 | Screw, set | 13 | Plate, name |
| 2 | Pin | 14 | Screw |
| 3 | Pin, wire lock | 15 | Screw, machine |
| 4 | Lever | 16 | Washer, lock |
| 5 | Screws | 17 | Jacket assembly |
| 6 | Cover, motor | 18 | Grommets |
| 7 | Screws, machine | 19 | Cover back |
| 8 | Washer, lock | 20 | Core & tanks assembly |
| 9 | Flange, motor | 21 | Spacer |
| 10 | Impeller | 22 | Blower housing & duct |
| 11 | Nut, lock | 23 | Flange, intake |
| 12 | Motor | 24 | Plug, pipe |

*Figure 5-47. Carrier cab heater assembly, exploded view.*

*c. Cleaning, Inspection and Repair.*

(1) Clean all metal parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect heater core for cracks, breaks, corrosion or signs of leakage. Repair or replace defective heater core.

(3) Inspect blower motor and fan for general conditions. Repair or replace defective parts as necessary.

(4) Inspect housing and hardware for cracks, breaks, and other damage. Repair or replace defective parts necessary.

*d. Reassembly.* Reassemble heater in reverse of numerical sequence shown on figure 5-47.

*e. Installation.* Install heater assembly (TM 5-3810-232-12).

**5-39. Windshield Wiper Motor**

*a. Removal.* Remove wiper motor (TM 53810-232-12).

*b. Disassembly.* Refer to figure 5-48 and disassemble wiper motor as illustrated.

Key to Figure 5-48.

1. Motor assembly
2. Fitting, nut
3. Fitting, body
4. Silencer, exhaust
5. Cover
6. Washer, felt
7. Cylinder
8. Plate & bushing assy.
9. Screw
10. Washer, steel
11. Washer, leather
12. Nut
13. Driver
14. Washer, lock
15. Nut, cap
16. Blade, wiper
17. Arm, wiper
18. Valve, control
19. Shaft and gear assembly
20. Piston assembly
21. Stop, valve
22. Valve, head
23. Gasket
24. Screw
25. Plate, end

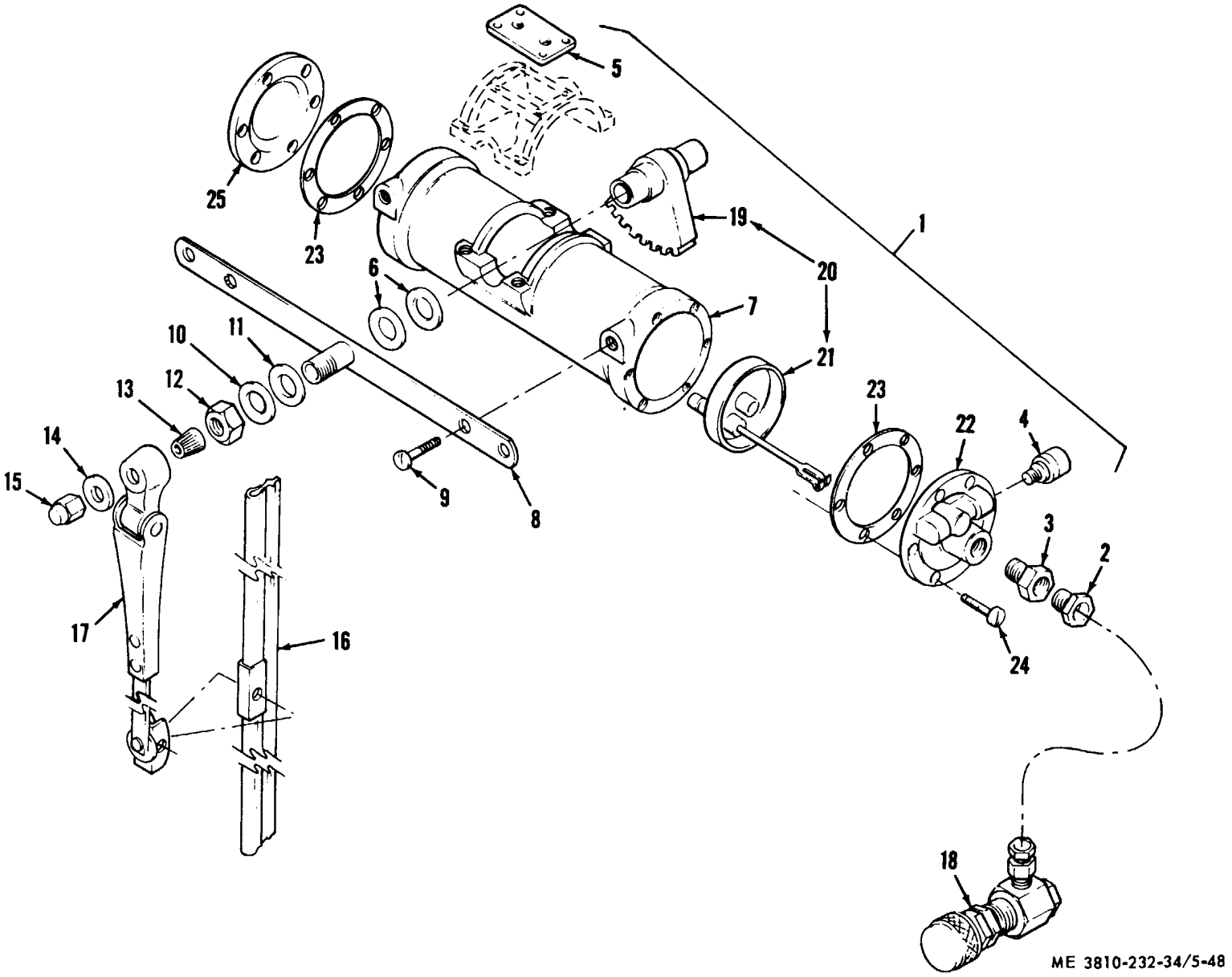



*Figure 5-48. Wiper motor assembly, exploded view.*

*c. Cleaning, Inspection and Repair.*

(1) Clean all metal parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for cracks, breaks, and proper operation.

(3) Replace damaged or defective windshield wiper motor.

*d. Reassembly.* Refer to figure 5-48 and reassemble the wiper motor as illustrated.

*e. Installation.* Install wiper motor (TM 53810-232-12).

## Section XI. UTILITY BLADE AND PUSH BEAM

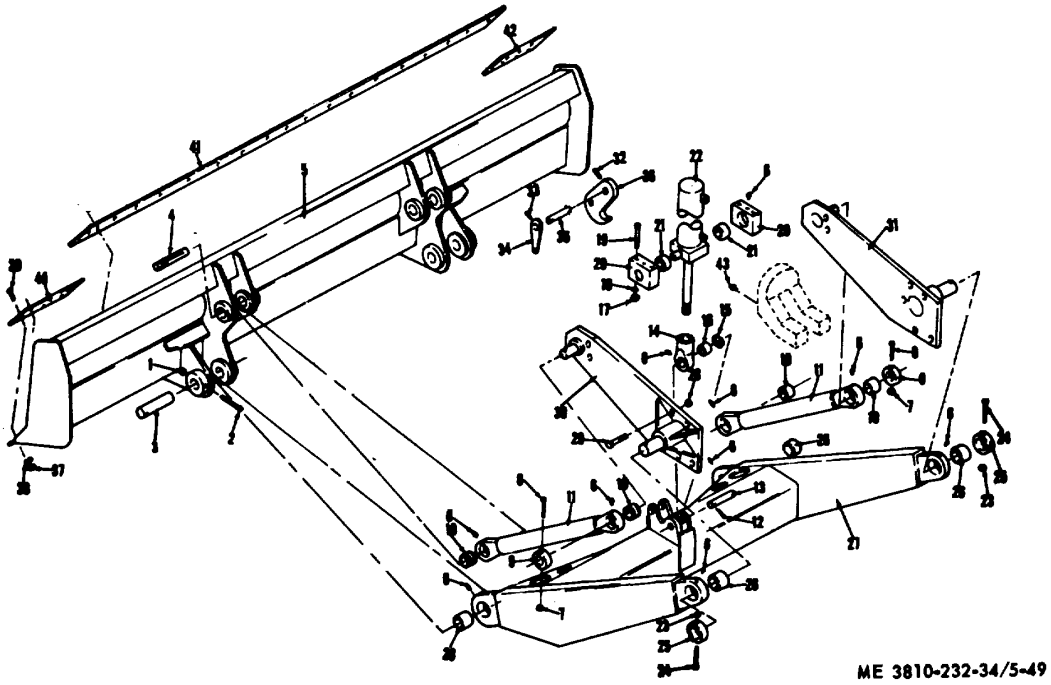
### 5-40. General

The utility blade is mounted on the push beams attached to the carrier frame. The blade is raised and lowered hydraulically from the operator's cab.

### 5-41. Utility Blade

*a. Removal.* Remove utility blade assembly (TM 53810-232-12).

*b. Disassembly.* Disassemble utility blade in numerical sequence as shown on figure 5-49.




1 Nut, self-locking
2 Screw, cap
8 Pin
4 Pin
5 Bowl
6 Fitting, lube
7 Nut, self-locking
8 Screw, cap
9 Collar
10 Bushing
11 Upper arm
12 Pin
13 Pin
14 Eye, lifting
15 Ring, retaining
16 Double seal bushing assy.
17 Nut
18 Washer, lock
19 Screw, cap
20 Block bearing, cylinder
21 Double sealed bushing assy.
22 Cylinder assembly
23 Nut, self-locking
24 Screw, cap
25 Collar, casting
26 Bushing
27 Push beam
28 Nut, self-locking
29 Screw, cap
30 Arm mounting plate R.H.
31 Arm mounting plate L.H.
32 Pin, spring
33 Pin, spring
34 Lever arm
35 Shaft
36 Hook
37 Nut
38 Washer, lock
39 Bolt, plow
40 End bit dozer L.H.
41 Dozer cutting edge
42 End bit dozer R.H.
43 Lube fittings

*Figure 5-49. Utility blade assembly, exploded view.*

*c. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent.

(2) Inspect all parts for cracks, breaks, and other damage. Repair by welding or replace defective parts.

*d. Reassembly.* Reassemble utility blade in reverse of numerical sequence shown on figure 5-49.

*e. Installation.* Install utility blade assembly (TM 56-810-232-12).

**5-42. Push Beams**

*a. Removal.* Remove push beams as instructed on figure 5-50.

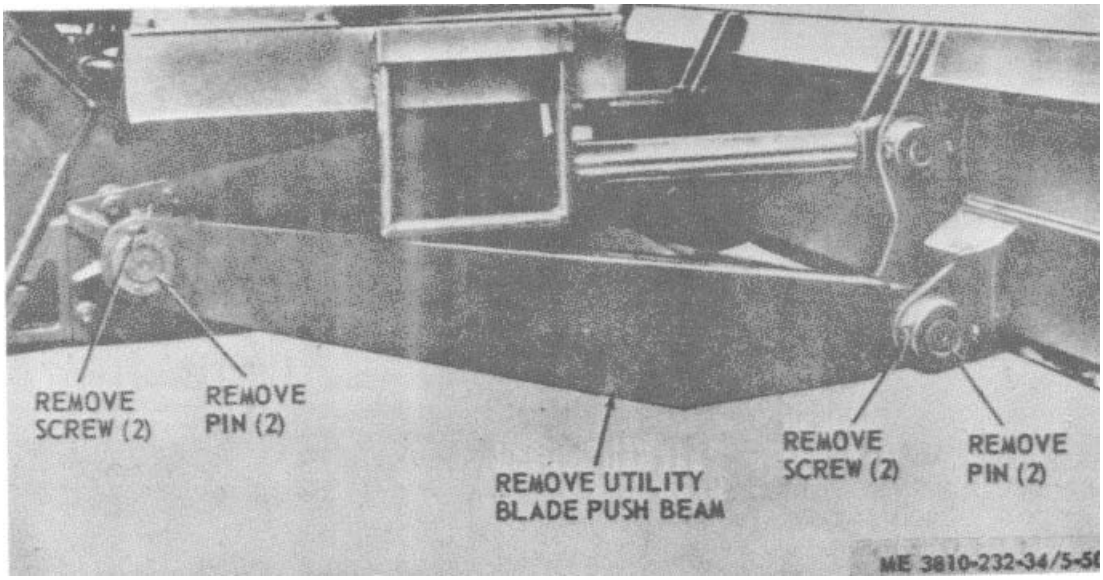



*Figure 5-50. Utility blade push beam, removal and installation.*

*b. Disassembly.* Disassemble push beams as shown on figure 5-49.

*c. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent.

(2) Inspect all parts for cracks, breaks, and signs of structural damage. Repair by welding, or replace defective parts as necessary.

*d. Reassembly.* Reassemble push beams as shown on figure 5-49.

*e. Installation.* Install push beams as instructed on figure 5-50.

## Section XII. ROTATING FRAME RING GEAR

**5-43. General**

A dual flanged center, hub-type ring gear, is bolted to the carrier frame and serves as the swing or tracking gear in which the crane assembly rotating gear and rollers operate.

**5-44. Rotating Frame Ring Gear**

*a. Removal.*

(1) Remove the crane boom assembly (TM 5-3810-232-12).

(2) Remove the crane rotating frame base assembly (para 6-31).

(3) Remove the rotating frame ring gear as instructed on figure 5-51.

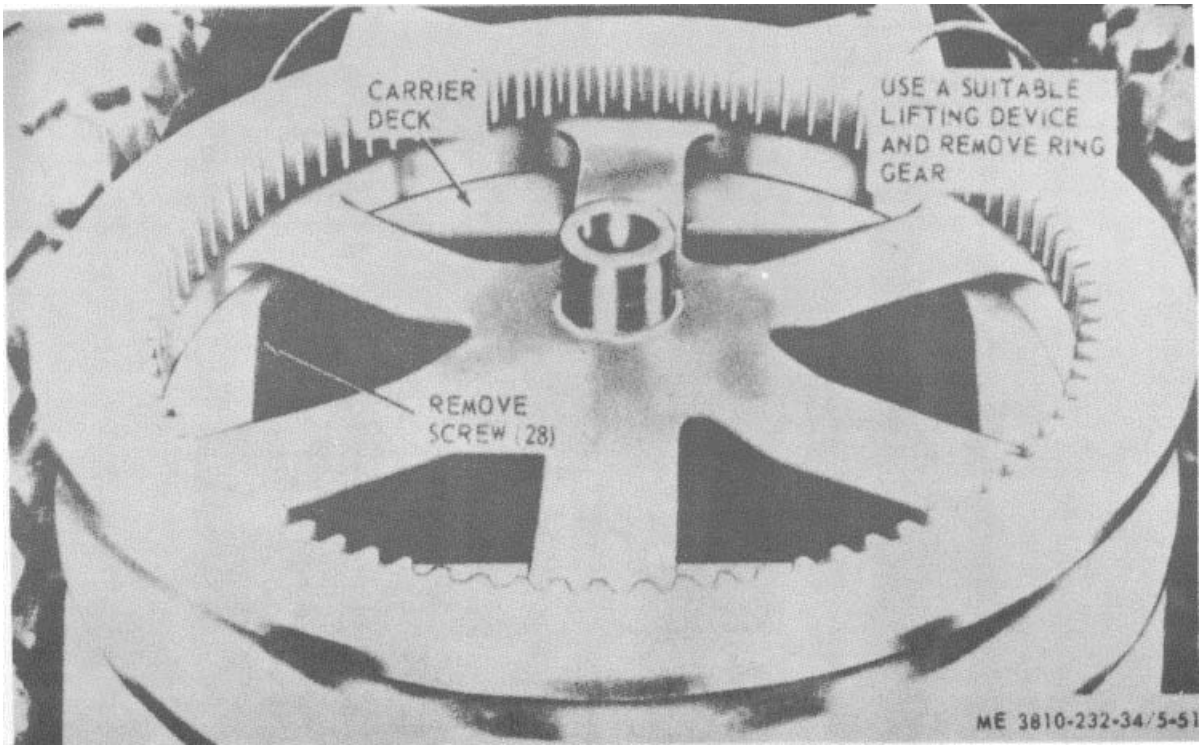



*Figure 5-51. Rotating frame ring gear, removal and installation*

*b. Inspection Repair.*

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect ail parts for excessive wear and damage. Replace or repair a defective ring gear.

*c. Installation.*

(1) Install the rotating frame ring gear assembly as illustrated on figure 5-51.

(2) Install the cone rotating frame base assembly (para 6-31).

(3) Install the crane boom assembly (TM 53810-282-12).

## Section XIII. OUTRIGGER ASSEMBLIES

### 5-45. Removal

Remove the outrigger assembly from the frame as illustrated in figure 5-52.

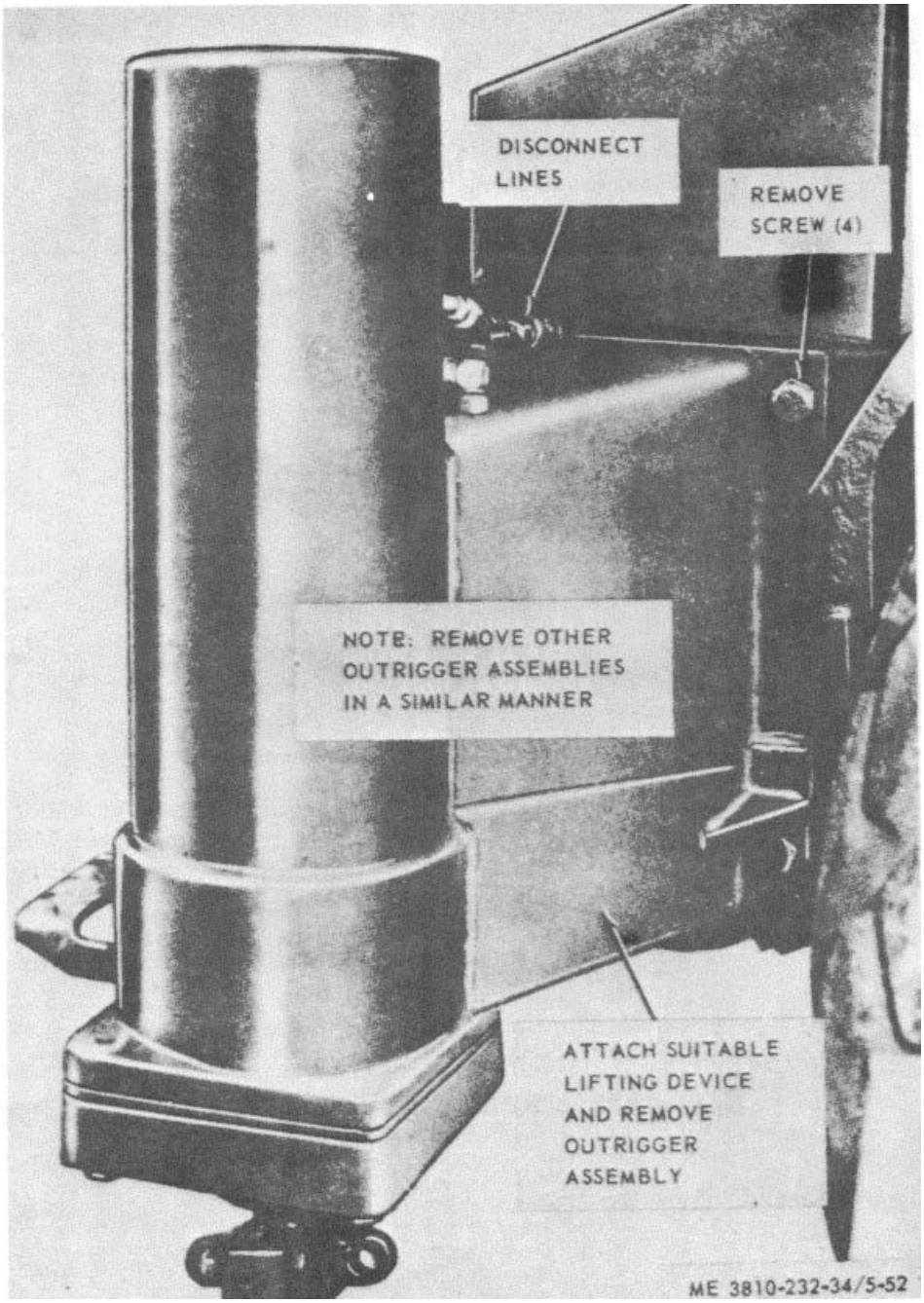



*Figure 5-52. Outrigger assembly.*

**5-46. Disassembly.**
Disassemble the outrigger assembly as illustrated in figure 5-41.

**5-47. Cleaning, Inspection and Repair**

a. Clean all parts with an approved cleaning solvent.

b. Inspect all parts for defective conditions.

c. Repair or replace damaged parts as necessary.

**5-48. Reassembly and Installation**

a. Reassemble the outrigger assembly as illustrated in figure 5-41.

b. Install the outrigger assembly as illustrated in figure 5-51.

## Section XIV. CARRIER MAIN FRAME ASSEMBLY

### 5-49. General

The carrier frame is an all weld-steel structure with crossmembers, supporting brackets welded integrally with the frame. The carrier frame supports and carries the crane and all components.

### 5-50. Removal

a. Remove the outrigger assembly from the frame as instructed on figure 5-52.

b. Remove the crane cab assembly (para 2-8).

c. Remove the carrier engine assembly (para 2-10).

d. Remove the rotating frame ring gear (para 5-46).

e. Remove the utility blade (para 5-45).

### 5-51. Disassembly

Disassemble the frame assembly as illustrated in figure 5-53.

1. Pin
2. Nut
4. Candle
5. Fitting
6. Bushing
7. Nut
8. Screw
9. Nut
10. Washer
11. Screw
12. Support
13. Nut
14. Washer
15. Screw
16. Spring
17. Nut
18. Washer
19. Screw
20. Support
21. Support
22. Nut
23. Washer
24. Screw
25. Bracket
26. Screw
27. Washer
28. Bracket
29. Screw
30. Washer
31. Bridge
32. Spacer
33. Deleted
34. Shim
35. Washer
36. Tail Light assy
37. Main frame assy
38. Support
39. Nut
40. Pan
41. Bracket
42. Screw
43. Screw
44. Washer
45. Nut
46. Washer
47. Ring Gear
48. Screw
49. Washer
50. Outrigger float
51. Air horn
52. Guard
53. Pin
54. Clevis
55. Plate
56. Plate
57. Plate
58. Plate
59. Plate
60. Pin
61. Screw
62. Washer
63. Nut
64. Screw
65. Plate
66. Screw
67. Screw
68. Washer
69. Plate
70. Plate
71. Screw
72. Plate
73. Plate
74. Screw
75. Plate
76. Plate
77. Plate

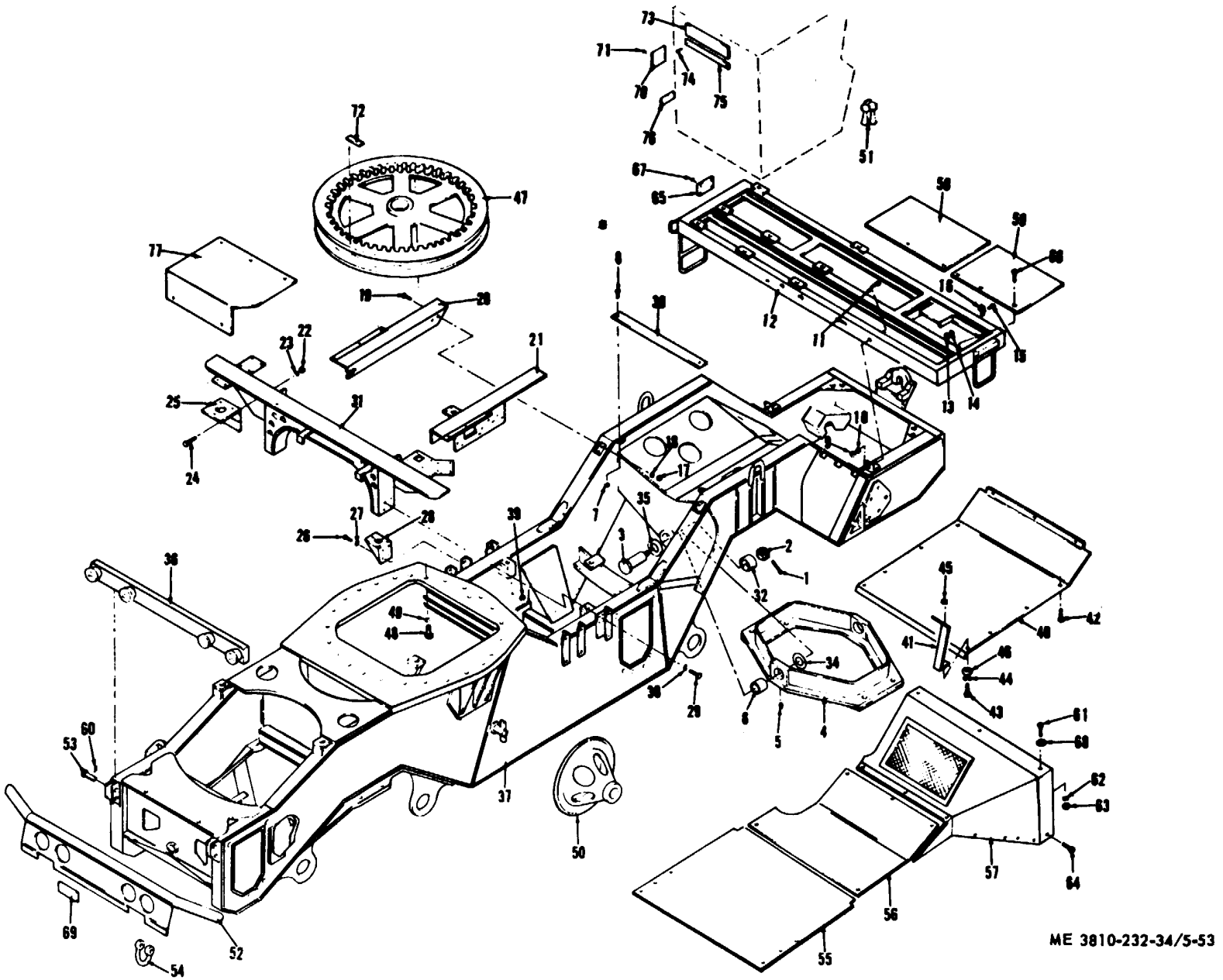



*Figure 5-53. Carrier main frame assembly.*

**5-52. Cleaning, Inspection and Repair**

*a. Cleaning.* Clean with an approved solvent.

*b. Inspection.* Inspect for cracked, broken or damaged parts.

*c. Repair.* Repair or replace a defective part. Repair parts by welding when necessary.

**5-53. Reassembly**

Reassemble the main frame assembly as illustrated in figure 5-53.

**5-54. Installation**

a. Install the crane cab assembly (para 2-9).

b. Install the carrier engine Amenably (para 2-11).

c. Install the outrigger assembly to the frame as illustrated in figure 5-50.

d. Install the rotating frame gear (para 5-43).

## CHAPTER 6

## CRANE ASSEMBLY REPAIR INSTRUCTIONS

## Section I. CRANE ENGINE CLUTCH ASSEMBLY

### 6-1. General

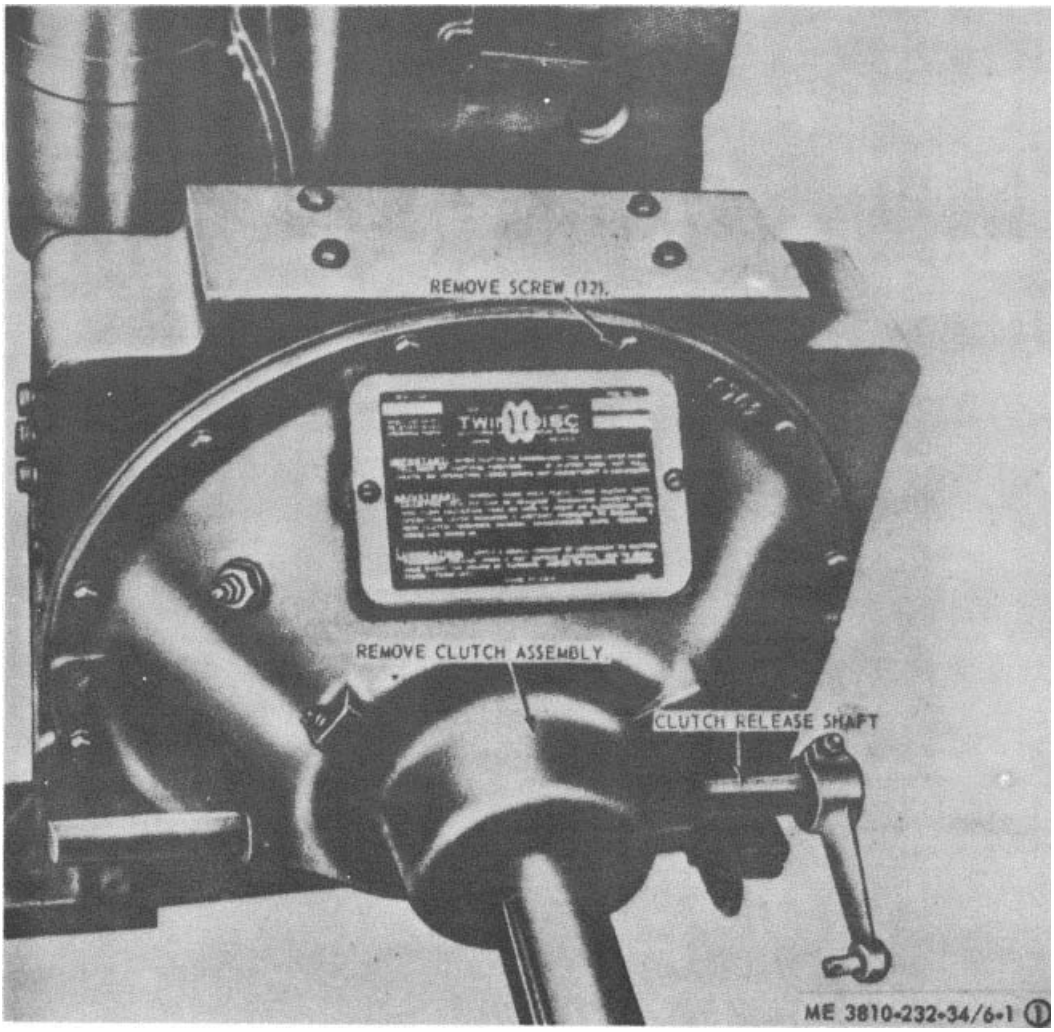
The crane engine is equipped with a friction-type clutch assembly that is enclosed within its own housing and is bolted to the engine flywheel housing. Engagement and disengagement of the clutch is by lever. The friction plate is engaged by splines into a driving ring bolted to the flywheel.

### 6-2. Crane Engine Clutch Assembly

*a. Removal.*

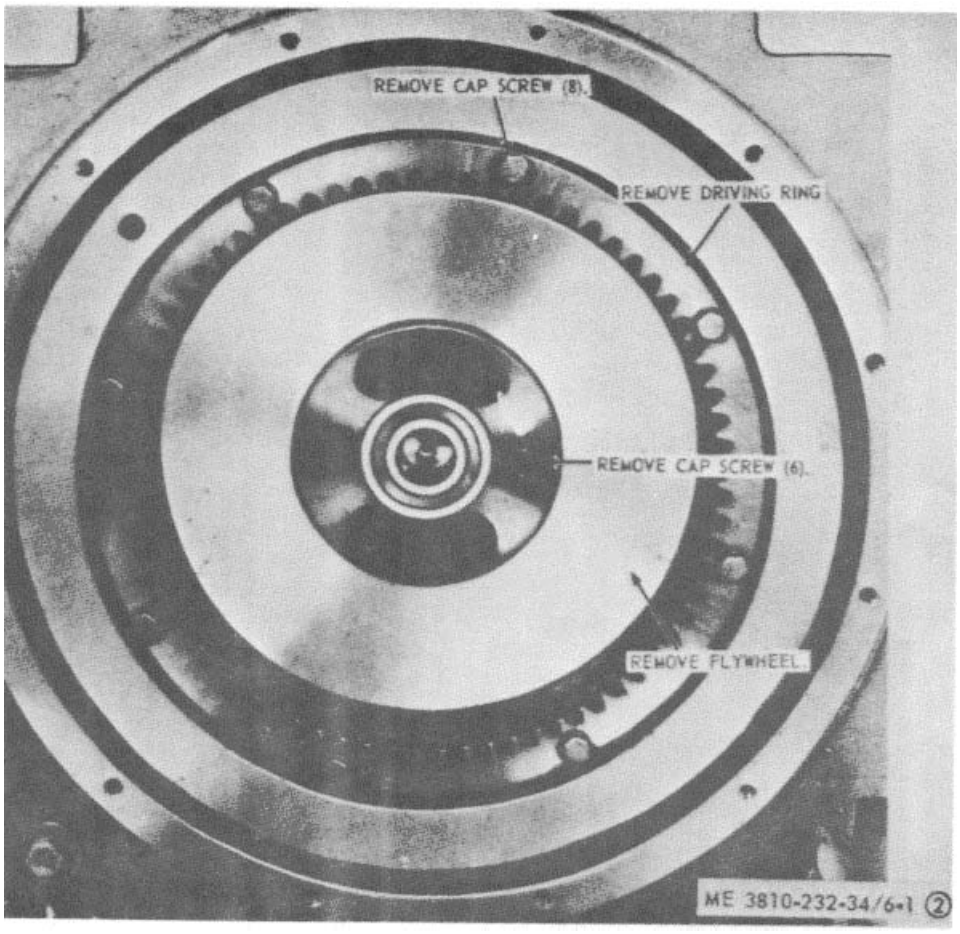
(1) Remove the primary drive chain guard and drive chain (TM 5-3810-232-12).

(2) Remove the engine clutch assembly and the master clutch control assembly as instructed on figure 6-1.

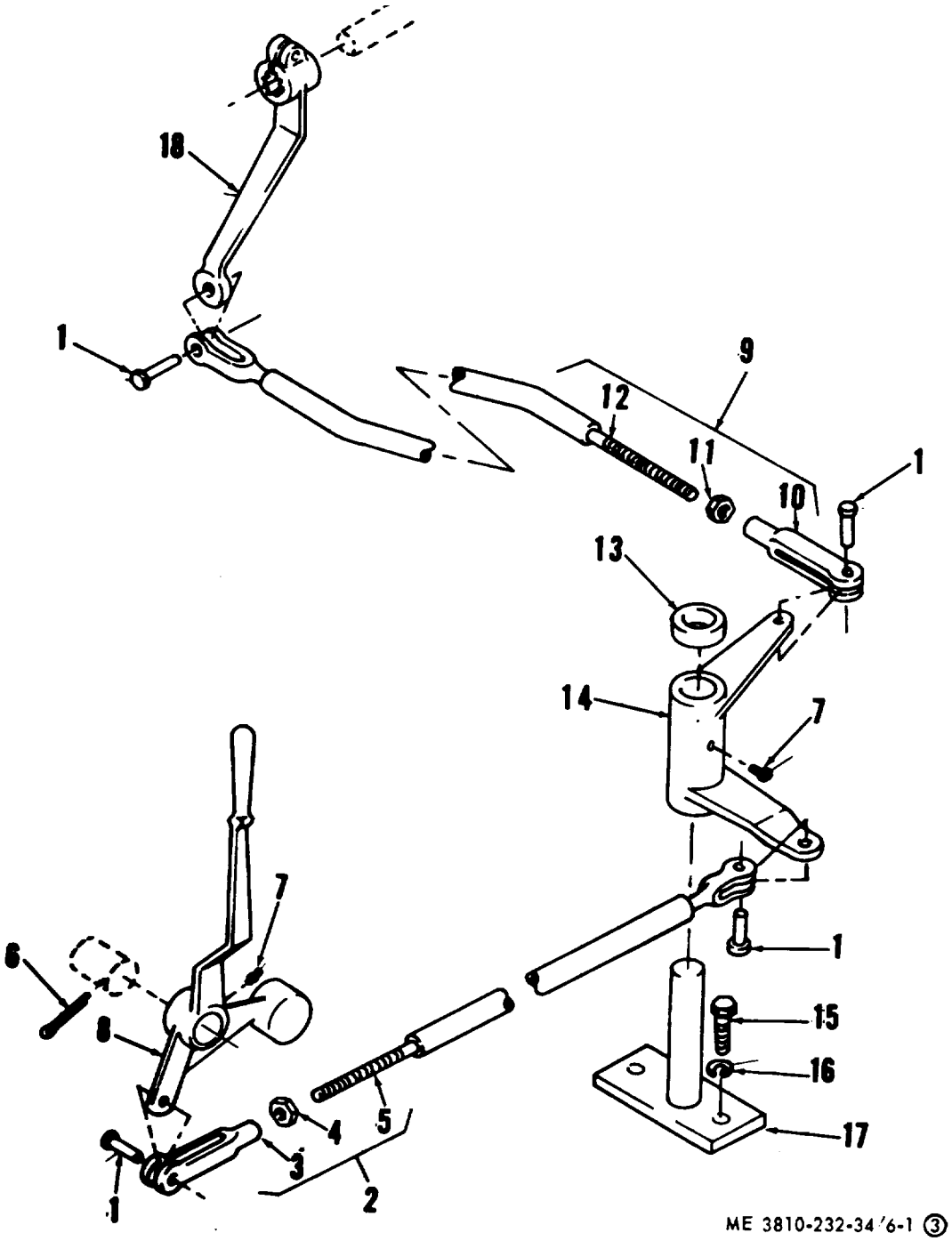



A-Clutch housing

*Figure 6-1. (1) Crane engine clutch assembly, removal and installation.*




B-Ring gear flywheel
*Figure 6-1. (2)-Continued.*




1. Pin
2. Connector assy
3. Clevis
4. Nut
5. Clevis
6. Pin
7. Fitting
8. Lever
9. Connector any
10. Clevis
11. Nut
12. Clevis
13. Collar
14. Bellcrank
15. Screw
16. Washer
17. Support
18. Crank

C-Master clutch control
*Figure 6-1. (3)-Continued*

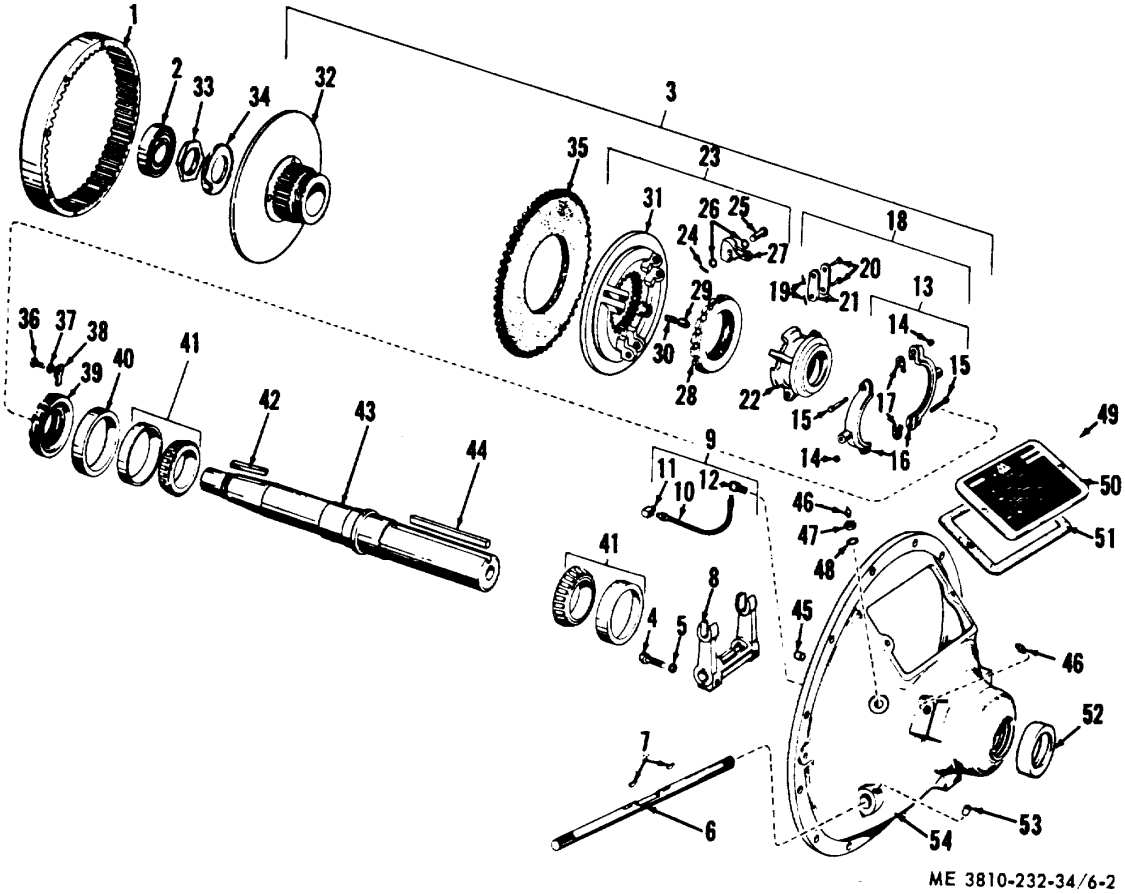
*b. Disassembly.*

(1) Refer to figure 6-2 and using a suitable bearing puller to remove the pilot bearing (2) from the clutch shaft (43).

(2) Straighten the bent portion of hub nut lockwasher (34). Remove nut (33) and lockwasher (34) from the shaft; discard the lockwasher.

(3) Pull the plates (31, 32) and gear (p5) from the clutch shaft; make sure key (42) comes off with the clutch assembly so that it does not interfere with the adjusting yoke and the sliding sleeve assembly (19 thru 22), which will also come off the shaft with the clutch assembly.

(4) Continue disassembly of the remaining clutch assembly in accordance with figure 6-2.




| | | | | | |
|---|---|---|---|---|---|
| 1 | Driving ring | 19 | Roll pin | 37 | Lockwasher |
| 2 | Pilot bearing | 20 | Link pin | 38 | Bearing retainer lock |
| 3 | Clutch assembly | 21 | Lever link | 39 | Bearing retainer |
| 4 | Capscrew | 22 | Sliding sleeve | 40 | Spacer |
| 5 | Lockwasher | 23 | Floating plate assembly | 41 | Bearing assembly |
| 6 | Operating shaft | 24 | Roll pin | 42 | Hub key |
| 7 | Keys | 25 | Lever pin | 43 | Shaft |
| 8 | Throwout yoke | 26 | Spring washer | 44 | Shaft key |
| 9 | Hose assembly | 27 | Lever | 45 | Bearing assembly |
| 10 | Flexible hose | 28 | Adjusting ring | 46 | Fitting |
| 11 | Fitting | 29 | Lock pin | 47 | Jam nut |
| 12 | Fitting | 30 | Lock pin spring | 48 | Washer |
| 13 | Collar assembly | 31 | Fo[ating plate | 49 | Screw |
| 14 | Hex nut | 32 | Hub and back plate | 50 | Plate |
| 15 | Capscrew | 33 | Nut | 51 | Gasket |
| 16 | Sleeve collar | 34 | Lockwasher | 52 | Fitting |
| 17 | Shim | 35 | Gear | 53 | Fitting |
| 18 | Sliding sleeve assembly | 36 | Capscrew | 54 | Housing |

*Figure 6-2. Crane engine clutch and power take-off assembly, exploded view.*

*c. Cleaning, Inspection, and Repair.*

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect the drive plate segments for wear; inspect hub and back plate (32) and the floating plate (31) for heat checking and distortion due to excessive heat. Replace or repair all defective parts.

*d. Reassembly.*

(1) Refer to figure 6-2 and sub paragraph b. above and reassemble the engine clutch assembly.

(2) Check end play of bearing to shaft for proper clearance of 0.004 to 0.007 inch.

*e. Installation.*

(1) Install the engine clutch assembly and the master clutch control assembly as instructed on figure 6-1.

(2) Install the primary drive chain and chain guard (TM 5-3810-232-12).

(3) Adjust clutch (TM 5-3810-232-12).

## Section II. CRANE HYDRAULIC MASTER CYLINDER ASSEMBLIES AND CLUTCH CYLINDER ASSEMBLIES

### 6-3. General

The master cylinder piston is connected to the operator's control lever through linkage. The piston forces fluid under pressure through the lines into the clutch cylinder moving the piston outward thus actuating the clutch. When the master cylinder control lever is released the clutch release springs return the displaced fluid to the master cylinder. An accumulator actually serving as a pressure limiter is Tee connected into the master cylinder to the clutch cylinder hydraulic line.

### 6-4. Crane Hydraulic Master Cylinder Assembly

*a. Removal.*

(1) Drain the master cylinder.

(2) Remove the master cylinder assembly as illustrated on figure 6-3.

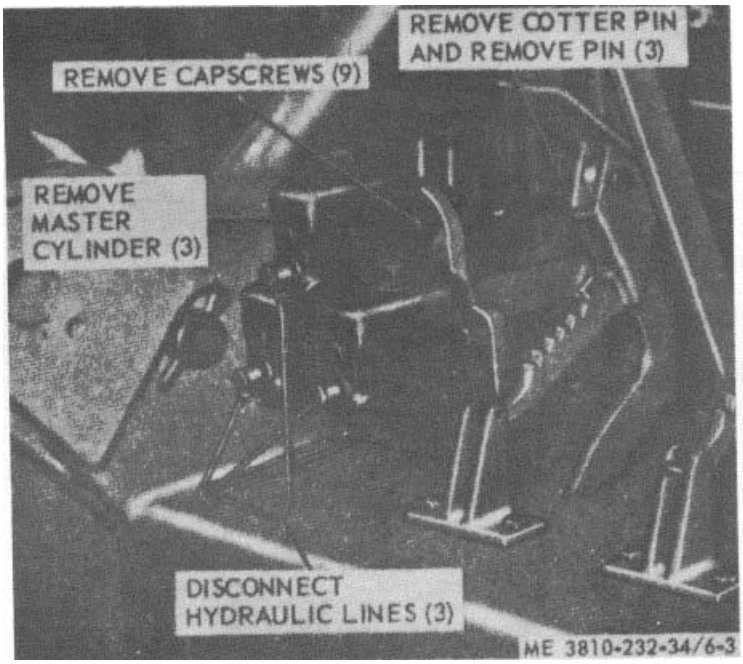
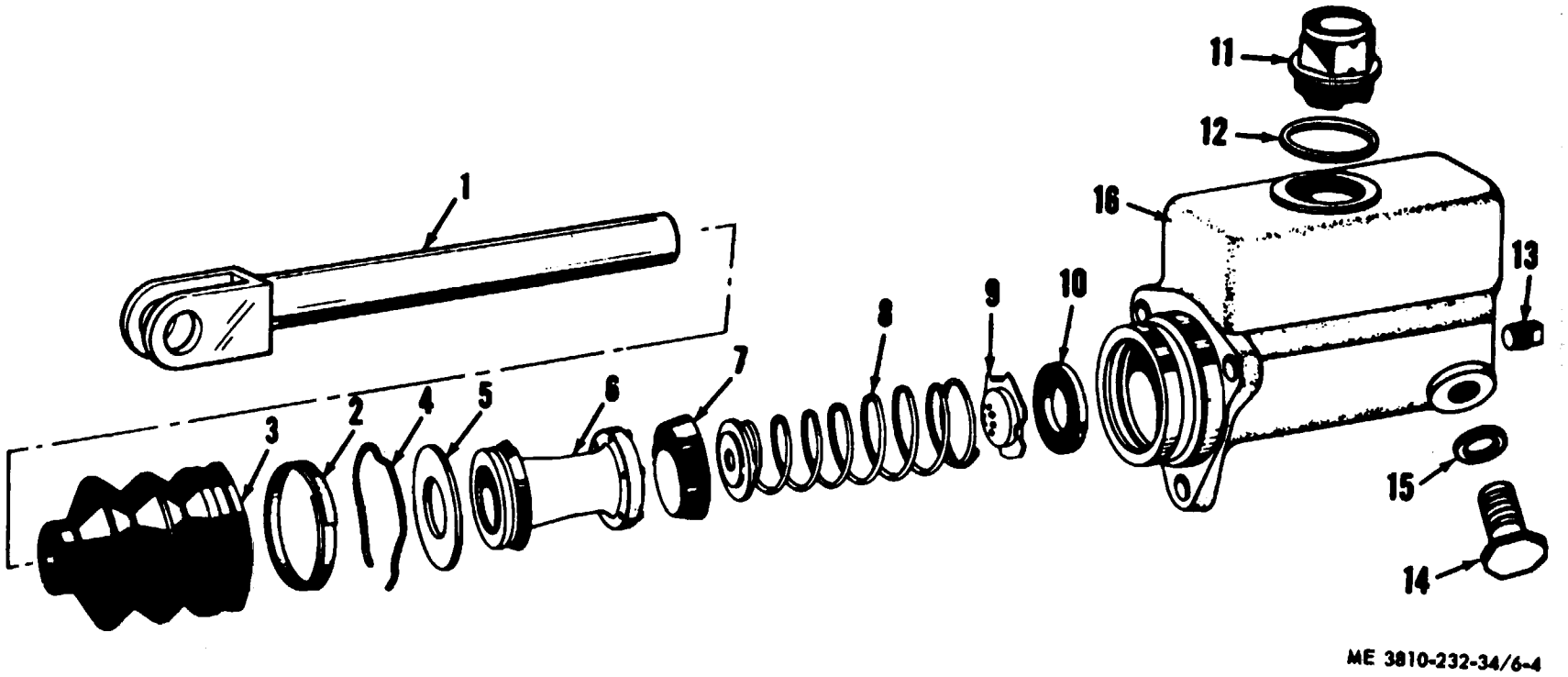



*Figure 6-3. Crane hydraulic master cylinder, removal and installation.*

*b. Disassembly*. Disassembly the master cylinder assembly in numerical sequence as illustrated in figure 6-4.




1. Push rod
2. Boot strap
3. Boot
4. Lockwire
5. Piston stop
6. Piston assembly
7. Primary cup
8. Return spring
9. Check valve
10. Check valve seat
11. Filler cap
12. Filler cap gasket
13. Pipe plug
14. Plug
15. Plug gasket
16. Cylinder casting

*Figure 6-4. Crane hydraulic master cylinder assembly, exploded view.*

*c. Cleaning, Inspection, and Repair.*

(1) Clean all parts with an approved cleaning solvent and dry thoroughly. Cleanliness is of extreme importance when repairing hydraulic components.

(2) Inspect the housing cylinder bore for rusting or pitting. If rusting and pitting cannot be corrected by light honing, discard the cylinder and replace the assembly. Inspect the primary cup (7, fig. 6-4) for scratches. If scratched or broken, replace with a new repair kit.

*d. Reassembly.* Reassemble the master cylinder assembly in the reverse of the numerical sequence as illustrated on figure 6-4.

*e. Installation.*

(1) Install the master cylinder assembly as illustrated on figure 6-3.

(2) Fill and bleed hydraulic system (TM 5-3810-232-12).

**6-5. Crane Clutch Hydraulic Cylinder Assembly**

*a. Removal.*

(1) Drain the crane clutch hydraulic cylinder assembly.

(2) Remove the crane hydraulic cylinder assembly as illustrated on figure 6-5.

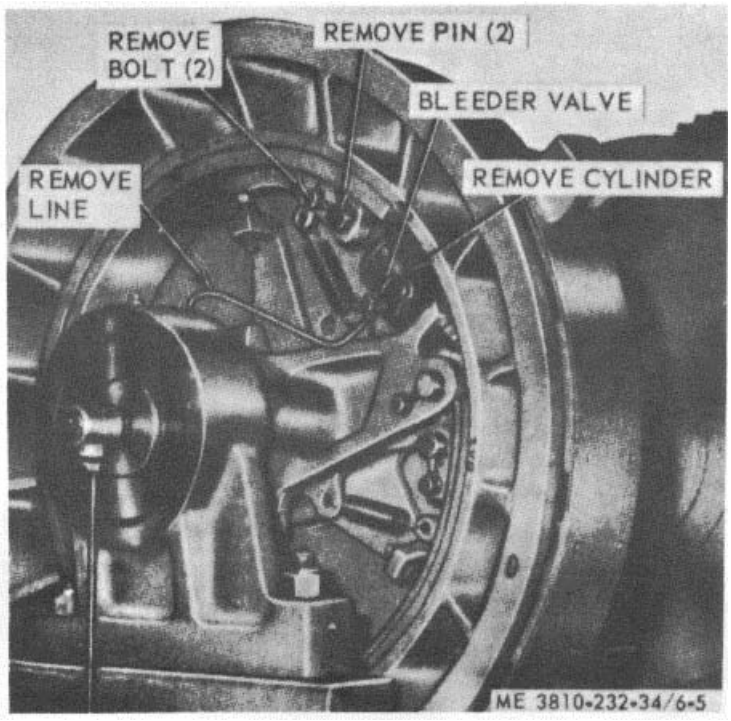
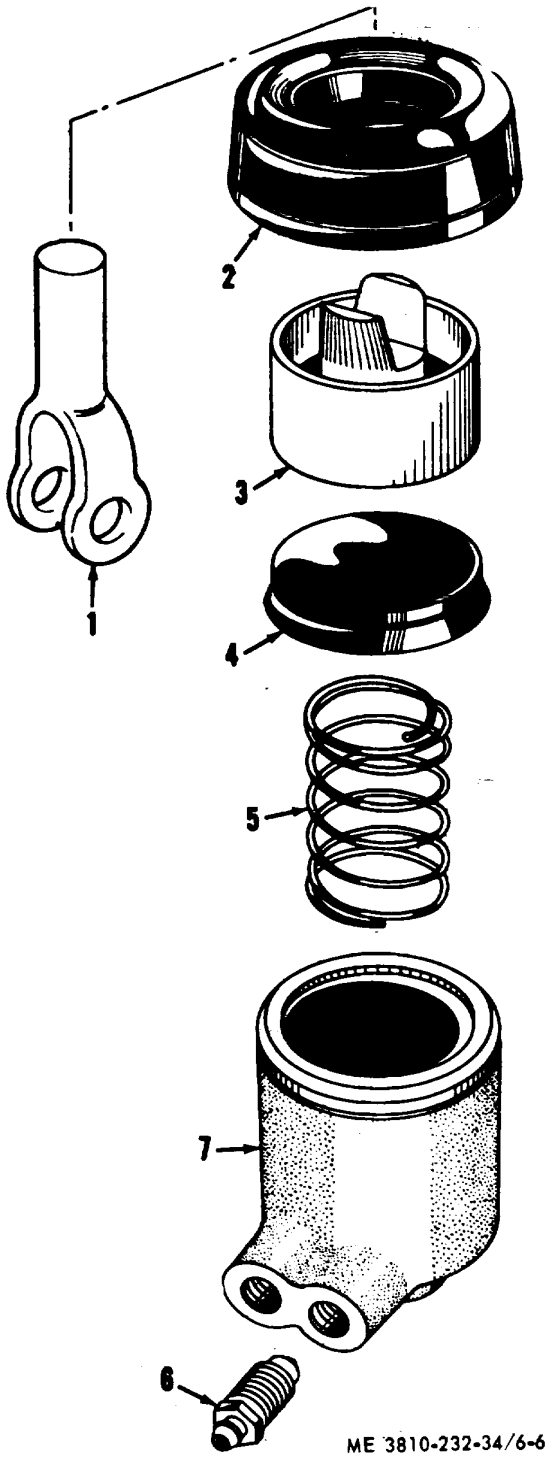



*Figure 6-5. Crane clutch hydraulic cylinder, removal and installation.*

*b. Disassembly.* Disassemble the crane clutch hydraulic cylinder assembly in numerical sequence as illustrated on figure 6-6.




1. Push rod
2. Boot
3 Piston
4 Cup
5 Spring
6 Breeder screw
7 Cylinder casting

*Figure 6-6. Clutch cylinder assembly, exploded view.*

*c. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent and dry thoroughly. Cleanliness is of extreme importance when repairing hydraulic components.

(2) Clean all parts with an approved cleaning solvent and dry thoroughly. Replace or repair all defective parts.

*d. Reassembly.* Reassemble the crane clutch hydraulic cylinder assembly in the reverse of the numerical sequence as illustrated on figure 6-6.

*e. Installation.*

(1) Install the crane clutch hydraulic cylinder assembly as illustrated on figure 6-5.

(2) Fill and bleed hydraulic system (TM 5.3810-232-12).

**6-6. Hydraulic Tubes, Fitting and Accumulator**

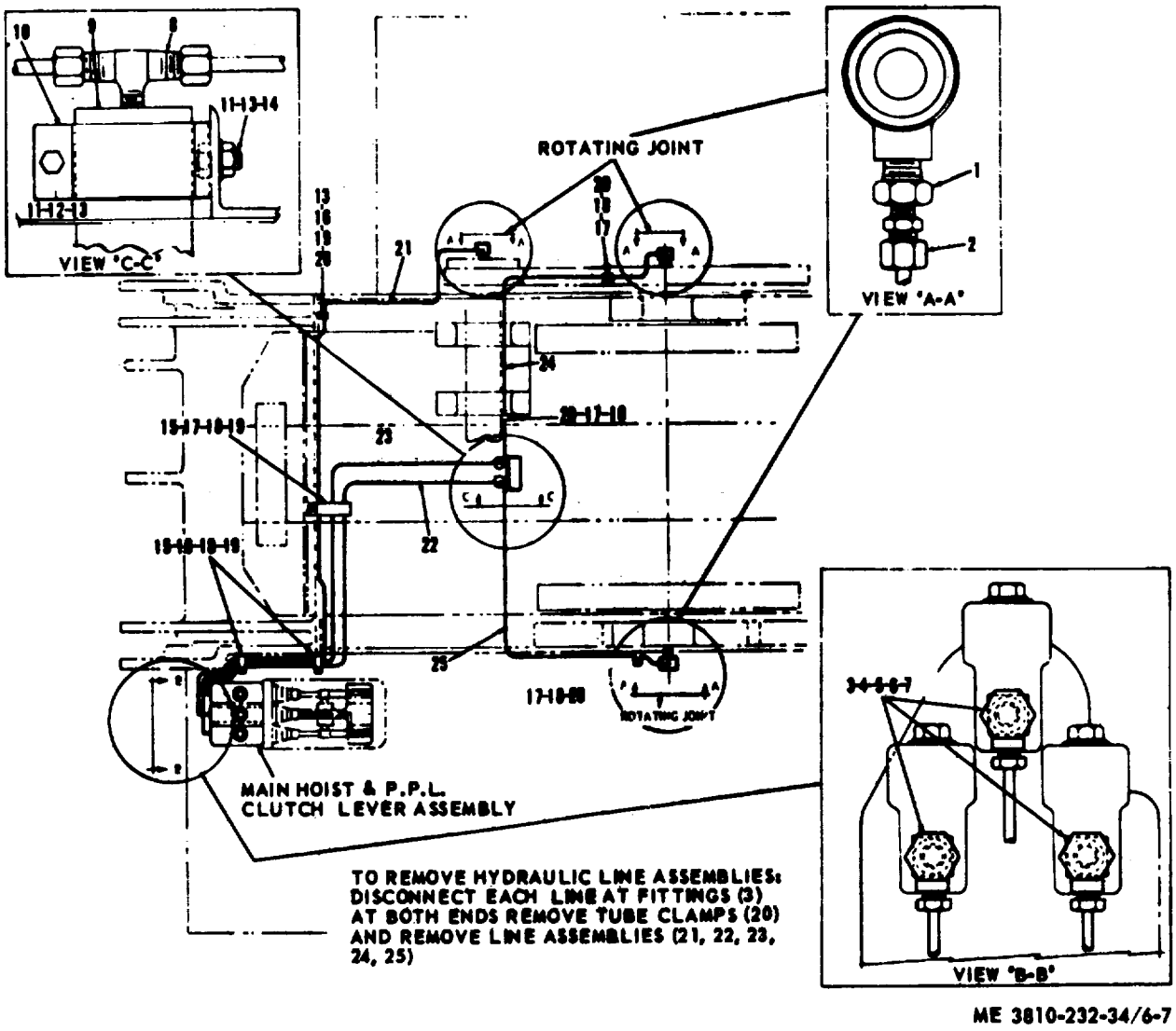
*a. Removal.*

(1) Drain hydraulic system.

(2) Remove crane hydraulic tubes, fittings and accumulator as illustrated in figure 6-7.

**NOTE**

**Do not attempt to disassemble the accumulator (9, fig. 6-7). This is a nonrepairable item.**




1. Bushing
2. Union
3. Connector bolt
4. Connector
5. Copper washer
6. Copper washer
7. Tube nut
8. Accumulator
10. Hanger
11. Nut
12. Capscrew
13. Washer
14. Capscrew
15. Tubeclamp
16. Screw
17. Screw
18. Washer
19. Screw
20. Tube clamp
21. Tube
22. Tube
23. Tube
24. Tube
25. Tube

*Figure 6-7. Crane hydraulic system tube, fitting and accumulator, removal and installation.*

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for cracks, breaks, obstructions.

(3) Replace all defective parts.

*c. Installation.*

(1) Install hydraulic system tubes, fitting, and accumulator as illustrated In figure 6-7.

(2) Fill and bleed hydraulic system TM 8810-282-12.

(3) The accumulators are the spring-loaded type and calibrated 500 to 500 PSI. To tat the accumulator connect a suitable pressure gage at a convenient location in the master cylinder to the clutch cylinder line. Be sure that no air is in the system; bleed as required. Apply pressure to the system with the operator's control lever. In the event pressure is significantly below 500 PSI on the gage replace the accumulator.

## Section III. CRANE BOOM ASSEMBLY

### 6-7. Removal and Disassembly

*a. Removal.* Remove the crane boom assembly TM 5-3810-232-12.

*b. Disassembly.* Disassemble the crane boom as illustrated in figure 6-8.

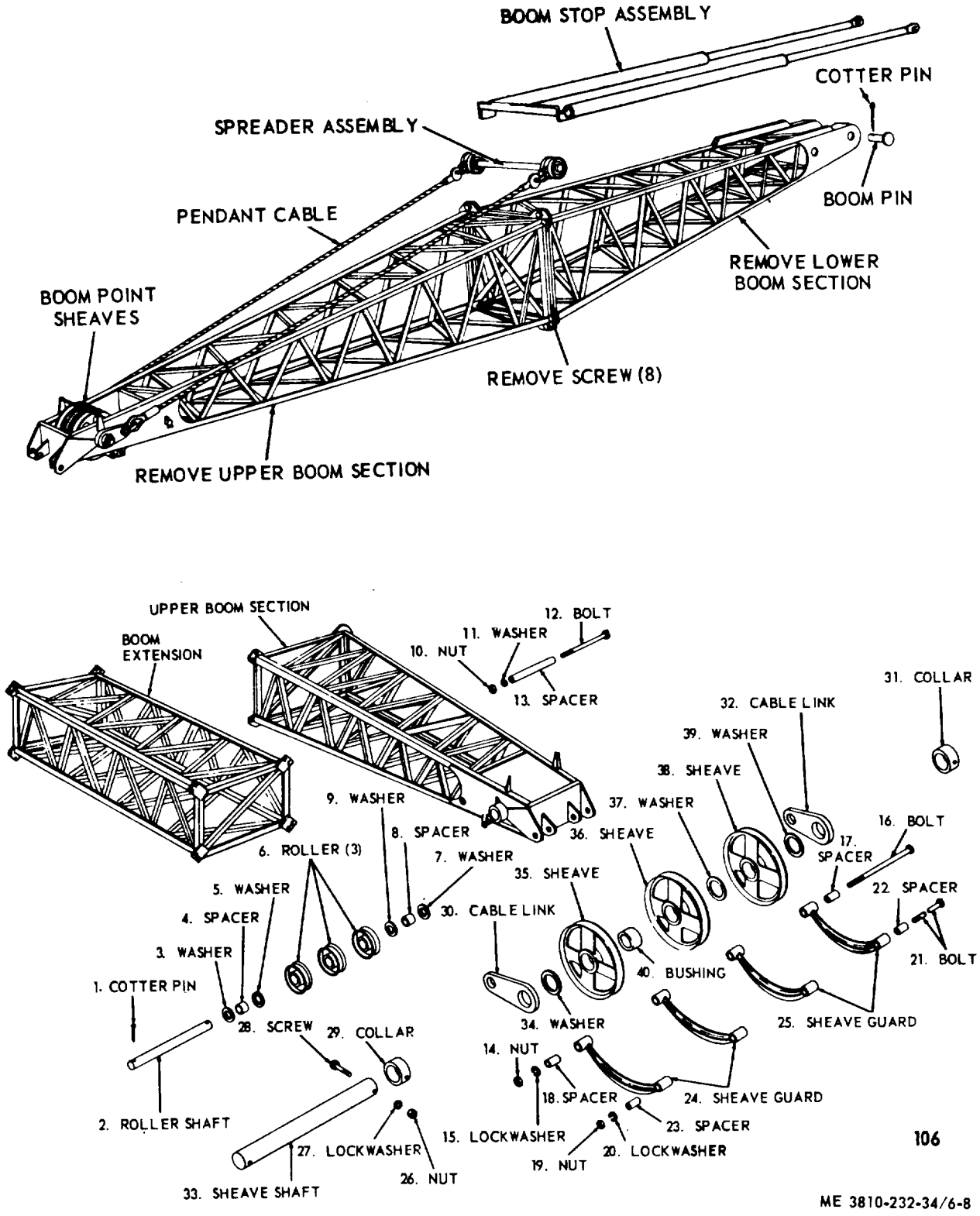



*Figure 6-8. Crane boom disassembly and reassembly.*

**6-8. Inspection and Repair**

a. Inspect the crane boom for broken welds, bends, and other damage. Repair or replace the crane boom as necessary.

b. Inspect the boom point sheaves, roller guards and other parts for breaks, excessive wear, and other damage. Replace or repair all defective parts.

**6-9. Reassembly and Installation**

a. Reassembly. Reassemble the crane boom as illustrated in figure 6-8.

b. Installation. Install the crane boom assembly TM 5-3810-232-12.

## Section IV. CRANE CAB ASSEMBLY

**6-10. Removal and Disassembly**

*a. Removal.* Refer to paragraph 2-8 and remove the cab assembly.

*b. Disassembly.* Disassemble the cab assembly as illustrated in figure 6-9.

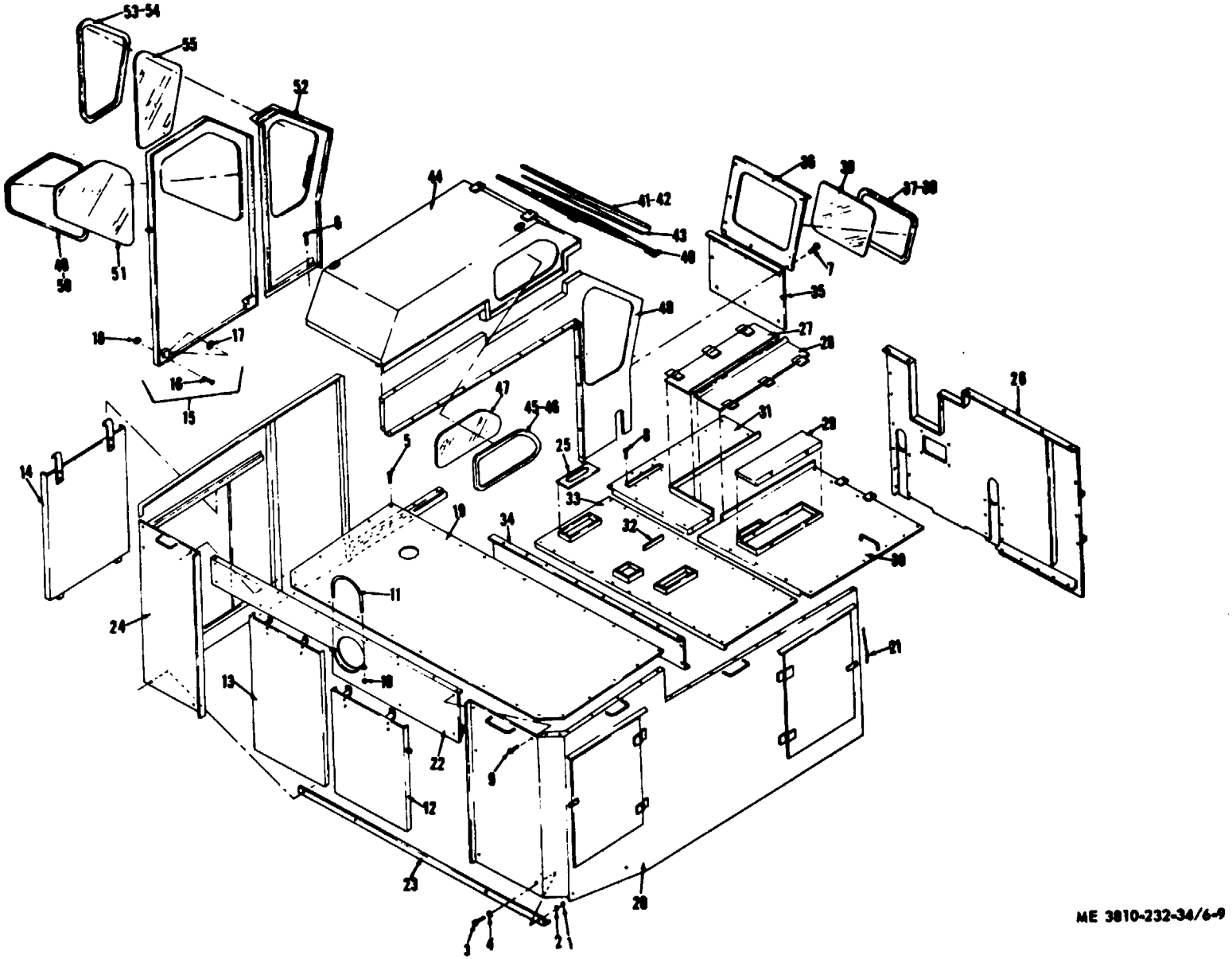



*Figure 6-9. Cab components, crane.*

Key to Figure 6-9

| | | | | | |
|---|---|---|---|---|---|
| 1 | Nut | 20 | Panel | 39 | Glass |
| 2 | Washer | 21 | Door pin | 40 | Frame |
| 3 | Screw | 22 | Panel | 41 | Weather strip |
| 4 | Washer | 23 | Guide | 42 | Filler strip |
| 5 | Screw | 24 | Panel | 43 | Glass |
| 6 | Screw | 25 | Plate | 44 | Top |
| 7 | Screw | 26 | Panel | 45 | Weather strip |
| 8 | Screw | 27 | Door | 46 | Filler strip |
| 9 | Screw | 28 | Door | 47 | Glass |
| 10 | Nut | 29 | Cover | 48 | Panel |
| 11 | Clamp | 30 | Panel | 49 | Weather strip |
| 12 | Door | 31 | Panel | 50 | Filler strip |
| 18 | Door | 32 | Panel | 51 | Glass |
| 14 | Door | 33 | Panel | 62 | Panel |
| 15 | Door | 34 | Panel | 53 | Weather strip |
| 16 | Screw | 35 | Panel | 54 | Filler strip |
| 17 | Washer | 36 | Panel | 55 | Glass |
| 18 | Nut | 37 | Weather strip | | |
| 19 | Panel | 38 | Filler strip | | |

**6-11. Inspection and Repair**

Inspect for cracks, breaks, and other damage. Repair cracks and breaks by welding if possible.

**6-12. Reassembly and Installation**

*a. Reassembly.* Reassemble the cab assembly illustrated in figure 6-9.

*b. Installation.* Refer to paragraph 2-8 and install the cab assembly.

## Section V. CRANE HOIST DRUM SHAFT

**6-13. General**

The crane hoist drum shaft is mounted uppermost on the revolving frame between the countershaft and the horizontal reversing shaft and is gear driven from the horizontal reversing shaft. It is secured to the frame by two bearing assemblies which are bolted to the frame. The cable drums are held stationary by the brakes until the individual clutch assembly is engaged, which in turn rotates the clutch and brake drum. The hoist drum shaft assembly can be removed as a unit without disturbing the counter-shaft or horizontal reversing shaft.

**6-14. Crane Hoist Drum Shaft Assembly**

*a. Removal.*

(1) Remove the main drive gear guards (TM 53810-232-12).

(2) Remove the brake band assemblies (TM &3810-232-12).

(3) Disconnect hoses to rotating joints (TM 5-3810-232-12).

(4) Remove the hoist drum shaft assembly as instructed in figure 6-10.

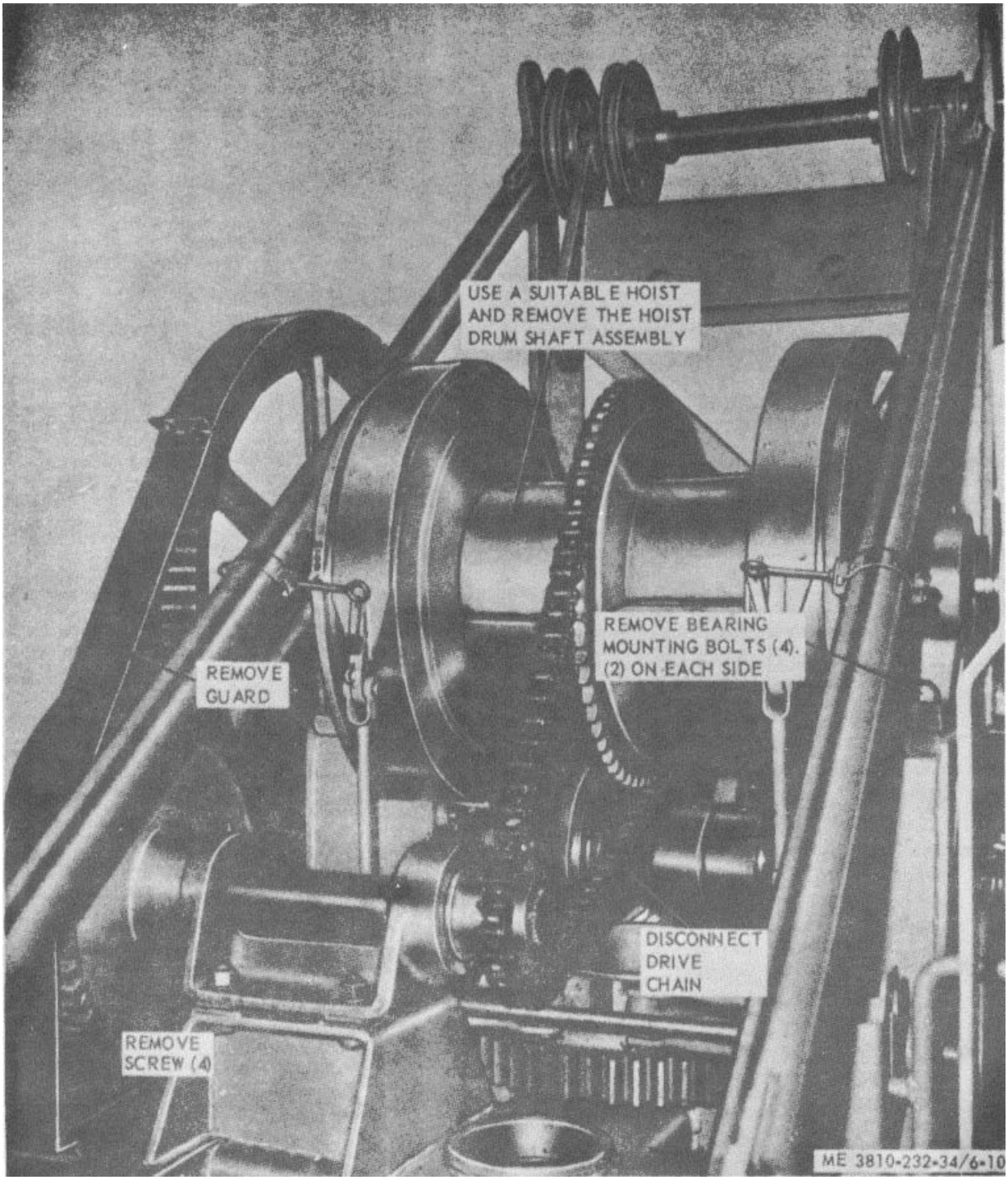
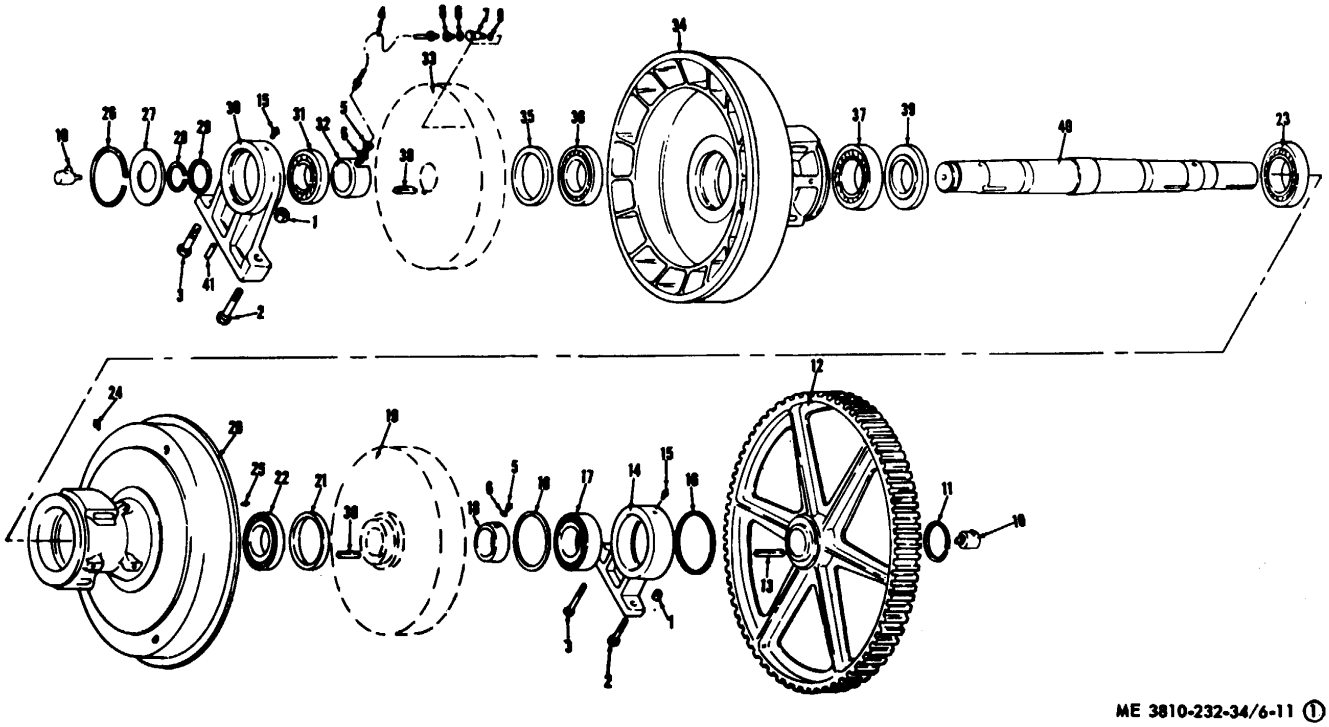



*Figure 6-10. Crane hoist drum shaft assembly, removal and installation.*

*b. Disassembly.* Disassemble the hoist drum shaft assembly in numerical sequence as illustrated on figure 6-11.

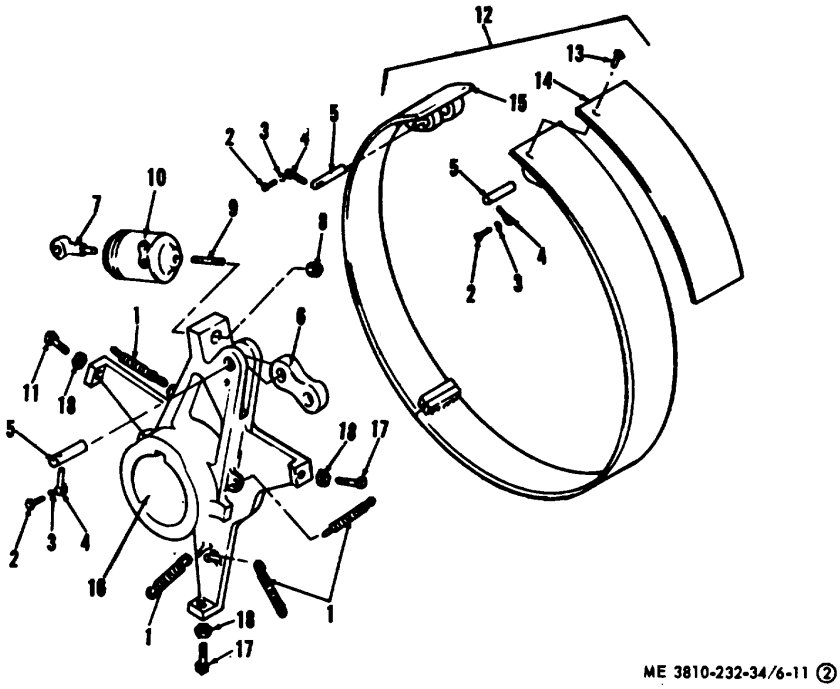


ME 3810-232-34/6-11 (1)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Elastic stop nut | 11 | Ring, retaining | 21 | Seal, oil | 31 | Bearing, ball |
| 2 | Screw, cap | 12 | Gear, drum shaft | 22 | Bearing, ball | 32 | Spacer |
| 3 | Screw, cap | 13 | Key | 23 | Bearing, ball | 33 | Clutch assembly l.h. |
| 4 | Tub assembly | 14 | Pillow block r.h. | 24 | Fitting, relief | 34 | Drum |
| 5 | Connector | 15 | Fitting, lube | 25 | Fitting lube | 35 | Seal, oil |
| 6 | Gasket, copper | 16 | Ring, retaining | 26 | Ring, retaining | 36 | Bearing, ball |
| 7 | Connector, bolt | 17 | Bearing, ball | 27 | Retaining ring | 37 | Bearing, ball |
| 8 | Connector | 18 | Spacer | 28 | Ring, retaining | 88 | Key |
| 9 | Gasket, copper | 19 | Clutch assembly r.h. | 29 | Ring, retaining | 89 | Center ring |
| 10 | Joint, rotating | 20 | Drum | 30 | Pillow block l.h. | 40 | Shaft |
| | | | | | | 41 | Dowel pin |

A-Hoist drum shaft assembly

*Figure 6-11. (1) Crane hoist drum shaft assembly, exploded view.*




| | | | |
|---|---|---|---|
| 1 | Spring | 10 | Cylinder, slave |
| 2 | Screwcap | 11 | Screw, set |
| 3 | Washer lock | 12 | Clutch band assembly |
| 4 | Lock pin | 18 | Rivet, semi-tubular |
| 6 | Pin | 14 | Lining kit, clutch |
| 6 | Link, dead end | 16 | Band |
| 7 | Push rod | 16 | Spider, hoist clutch r.h. |
| 8 | Nut, self-locking | 17 | Screw, set |
| 9 | Stud | 18 | Nut |

B-Clutch band, main and auxiliary hoist.

*Figure 6-11. (2) -Continued.*

*c. Cleaning, Inspection, and Repair.*

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for excessive wear or damage. Replace or repair worn or damaged parts.

*d. Reassembly.* Reassemble the crane hoist drum shaft assembly in the reverse of the numerical sequence as illustrated on figure 6-11.

*e. Installation.*

(1) Install the hoist drum shaft assembly as illustrated on figure 6-10.

(2) Install the brake band assemblies (TM 5-810-282-12).

(3) Install the main drive gear guard (TM 5-3810-282-12).

## Section VI. CRANE COUNTERSHAFT ASSEMBLY

### 6-15. General

The countershaft assembly is located below the hoist drum shaft assembly and is secured by two bearings which are bolted to the same part of the revolving frame as the hoist drum shaft. The countershaft is the means for transmitting power from the crane engine to other shaft assemblies.

### 6-16. Crane Countershaft Assembly

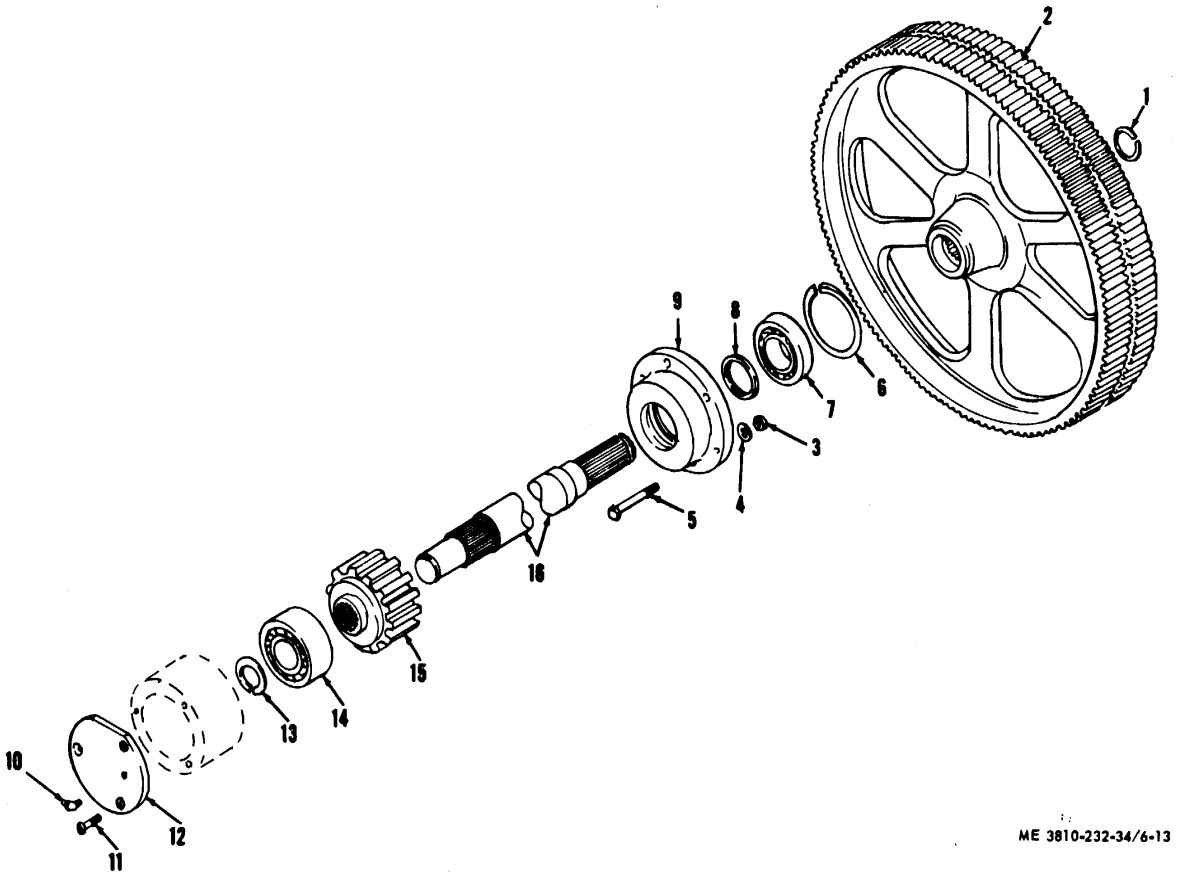
*a. Removal.*

(1) Remove the main drive chain guard and drive chain (TM 53810-232-12).

(2) Remove the retainer ring and sprocket, then remove the remaining countershaft assembly as instructed on figure 6-12.


*Figure 6-12. Crane countershaft assembly, removal and installation.*

*b. Disassembly*. Disassemble the countershaft in numerical sequence as illustrated on figure 6-13.




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Ring, retaining | 5 | Screw, cap | 9 | Bearing insert | 13 | Ring, retaining |
| 2 | Sprocket | 6 | Ring, retaining | 10 | Fitting lube | 14 | Bearing |
| 3 | Nut, self-locking | 7 | Bearing | 11 | Screw cap | 15 | Pinion spur |
| 4 | Washer, plain | 8 | Oil seal | 12 | End plate | 16 | Shaft |

*Figure 6-13. Crane countershaft assembly, exploded view.*

*c. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for excessive wear or damage. Replace or repair all defective parts.

*d. Reassembly.* Reassemble the countershaft in the reverse of the numerical sequence as illustrated on figure 6-13.

*e. Installation.* Install the countershaft as illustrated in figure 6-13

.

## Section VII. CRANE INDEPENDENT BOOM HOIST SHAFT ASSEMBLY

### 6-17. General

The independent boom hoist shaft assembly consists of the boom hoist clutch, clutch drum, brakedrum, boom hoist drive chain sprocket, and the boom hoist gear. The shaft mounts to the revolving frame with two bearing unit.

### 6-18. Crane Independent Boom Hoist Shaft Assembly

*a. Removal.*

(1) Remove the main drive chain and chain guard (TM 5-3810-232-12).

(2) Remove the boom hoist drive chain guard and drive chain (TM 5-3810-232-12).

(3) Remove the shifting levers from the shifter collar, at the boom hoist clutch (TM 53810-232-12).

(4) Remove the boom hoist assembly as instructed on figure 6-14.

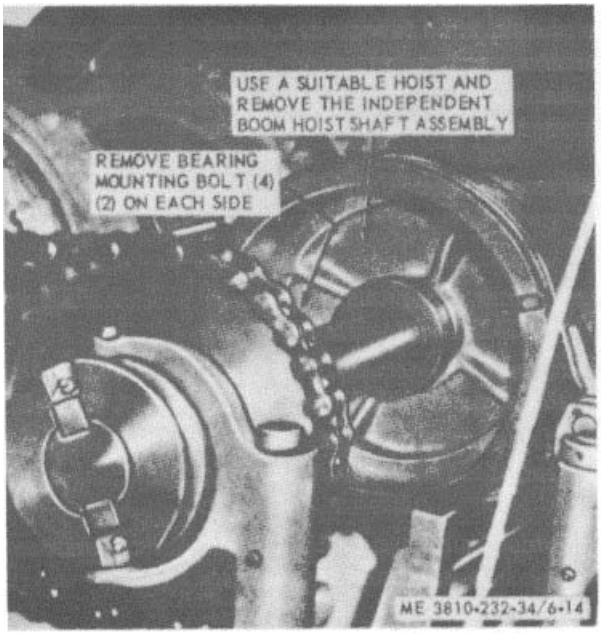
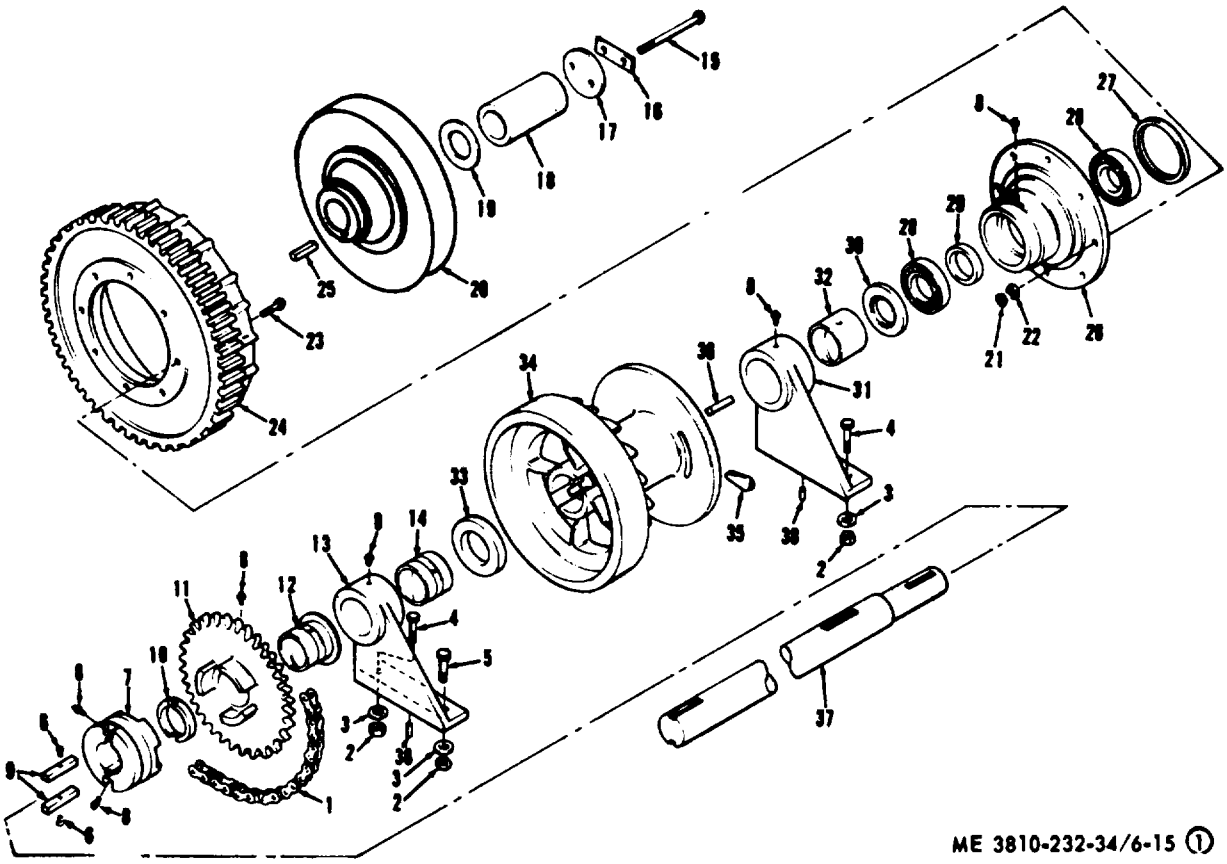



*Figure 6-14. Crane independent boom hoist shaft assembly removal and installation.*

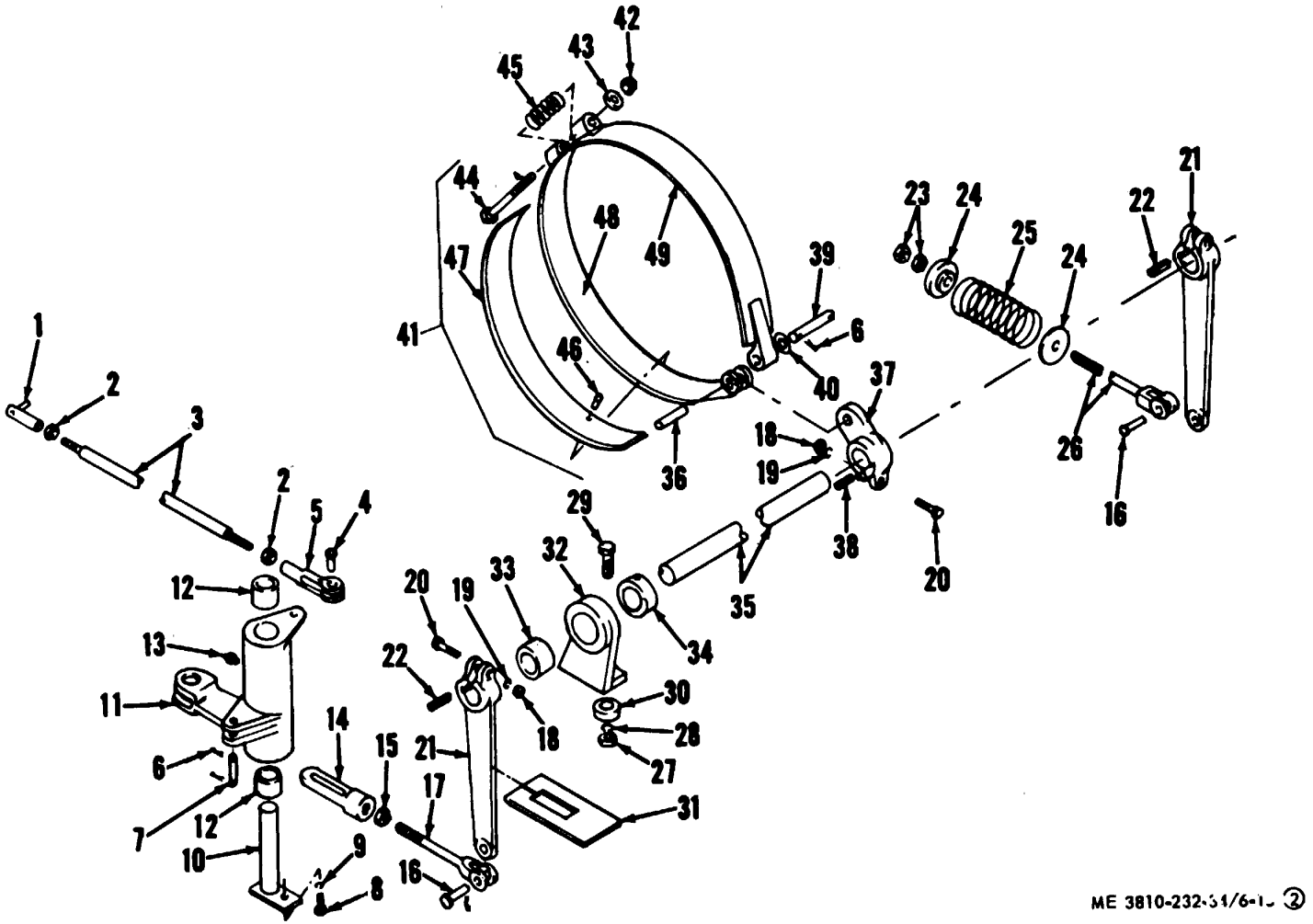
*b. Disassembly*. Disassemble the independent boom hoist shaft assembly in numerical sequence as illustrated in figure 6-15.




| | | | | | |
|---|---|---|---|---|---|
| 1 | Chain, roller | 14 | Bushing | 27 | Oil seal |
| 2 | Nut, self-locklng | 15 | Screw cap | 28 | Bearing ball |
| 3 | Washer, flat | 16 | Clip | 29 | Spacer |
| 4 | Screw, cap | 17 | End cap | 30 | Spacer |
| 5 | Bolt special | 18 | Sleeve | 31 | Pillow block |
| 6 | Screw, cap | 19 | Spacer | 32 | Bushing |
| 7 | Clutch, jaw | 20 | Clutch assembly r.h. | 33 | Collar, plain |
| 8 | Fitting. lube | 21 | Nut | 34 | Drum |
| 9 | Key | 22 | Washer, lock | 35 | Wedge |
| 10 | Retaining ring | 23 | Screw, cap | 36 | Key |
| 11 | Sprocket | 24 | Gear clutch flange | 37 | Shaft |
| 12 | Bushing | 25 | Key | 38 | Dowel pin |
| 13 | Pillow. block | 26 | Bearing housing | | |

A-Boom hoist shaft assembly

*Figure 6-15. (1 )Crane independent boom assembly, exploded view.*




B-Boom hoist brake assembly, explode view.

*Figure 6-15. (2) -Continued*

Key to Figure 6-15. (2)

1 Ball joint superior
2 Nut
3 Connecting rod
4 Yoke pin assembly
5 Clevis, rod end
6 Pin cotter
7 Pin
8 Screw, cap
9 Washer, lock
10 Shaft
11 Bell crank
12 Bushing
13 Fitting lube
14 Shifter, yoke end
15 Nut
16 Yoke pin assembly
17 Brake release rod
18 Nut
19 Washer, lock
20 Screw, cap
21 Brake lever
22 Key
23 Nut
24 Spring seat
25 Spring
26 Brake spring rod
27 Nut
28 Washer, lock
29 Screw, cap
30 Washer, plain
31 Cover
32 Bearing bracket
33 Bushing
34 Collar, hallowell
35 Shaft
38 Pin
37 Brake lever
38 Key
39 Pin
40 Washer, plain
41 Brake band assembly
42 Nut
43 Washer, plain
44 Bolt, machine
45 Spring
46 Rivet
47 Lining, strip
48 Band, half
49 Band, half

*c. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for excessive wear or damage. Replace or repair all defective parts.

*d.* Reassemble the boom hoist shaft assembly in the reverse of the numerical sequence as illustrated on figure 6-15.

*e. Installation.*

(1) Install the boom hoist shaft as instructed on figure 6-14.

(2) Install the shifting levers on the shifter collar of the boom hoist clutch (TM 53810-23212).

(3) Install the boom hoist drive chain and guard (TM 5-3810-232-12).

(4) Install the main drive chain and guard (TM 5-3810-232-12).

## Section VIII. HORIZONTAL REVERSING SHAFT ASSEMBLY

### 6-19. General

The horizontal reversing shaft assembly is attached to the revolving frame below and to the rear of the hoist drum shaft assembly. This shaft has two beveled swing gears which drive the vertical reversing shaft assembly in either direction.

### 6-20. Crane Horizontal Reversing

**a. Removal.**

(1) Remove the hoist drum shaft (para 6-14).

(2) Remove the countershaft assembly (para 6-16).

(3) Remove shifter lever shaft and remove shifter levers free of shifter collars on horizontal reversing shaft clutches (TM 5-3810-232-12).

(4) Remove horizontal reversing shaft assembly as instructed on figure 6-16.

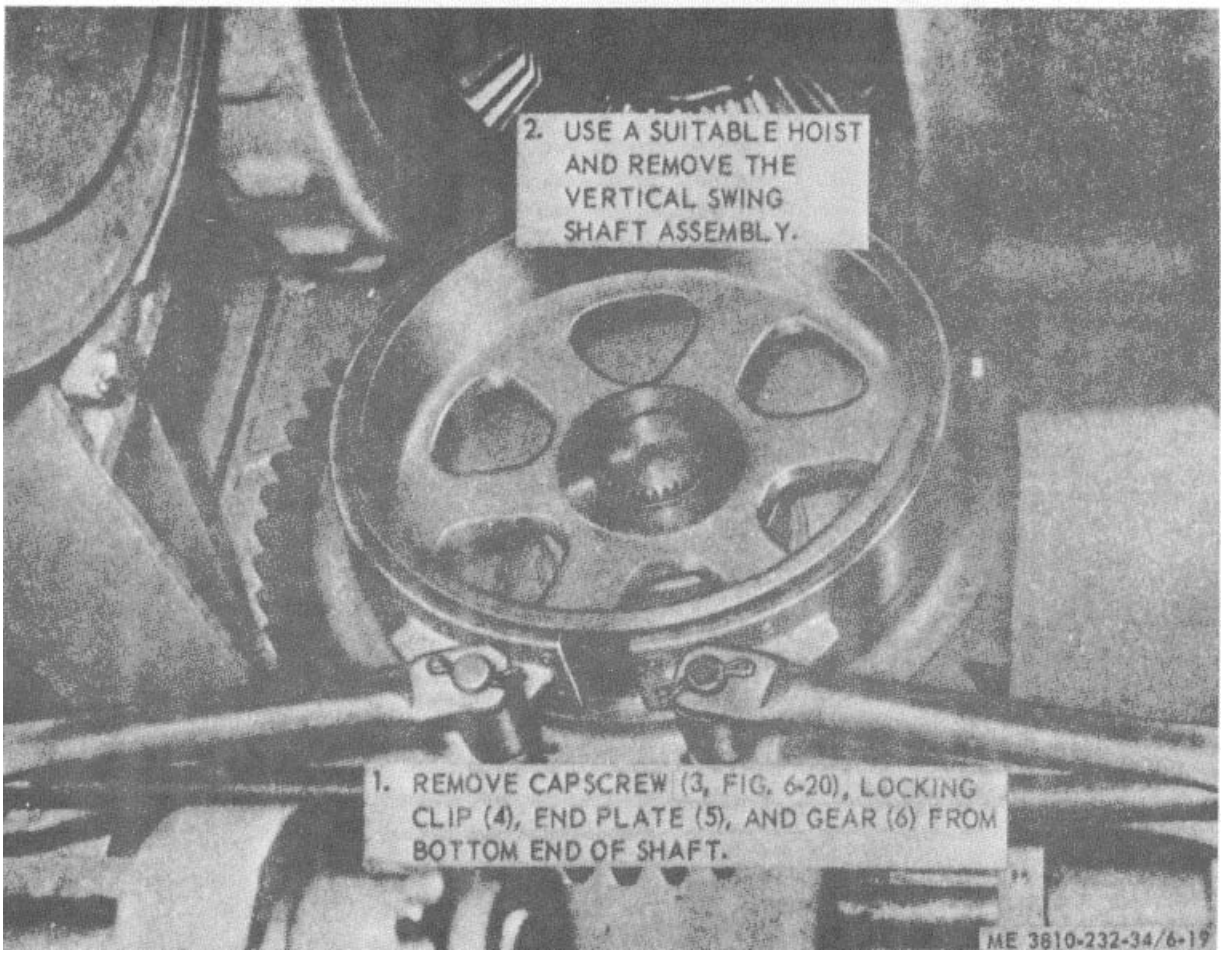
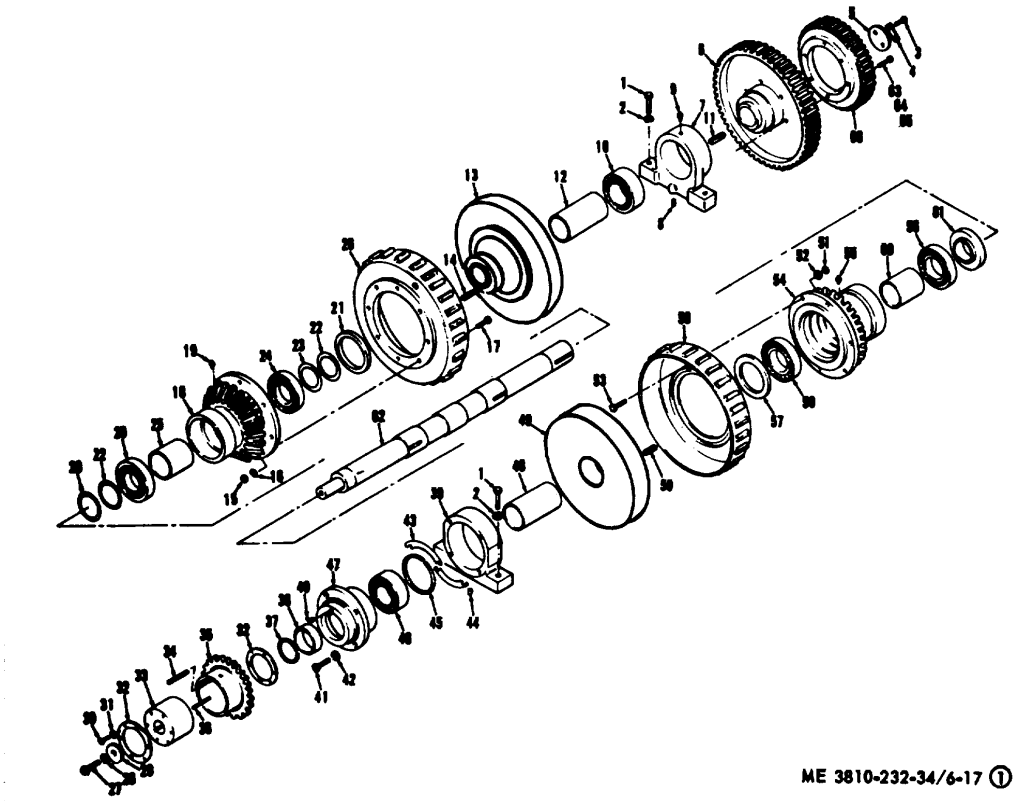



*Figure 6-16. Crane horizontal reversing shaft assembly, removal and installation.*

*b. Disassembly*. Disassemble the horizontal reversing shaft assembly in numerical sequence as illustrated on figure 6-17.

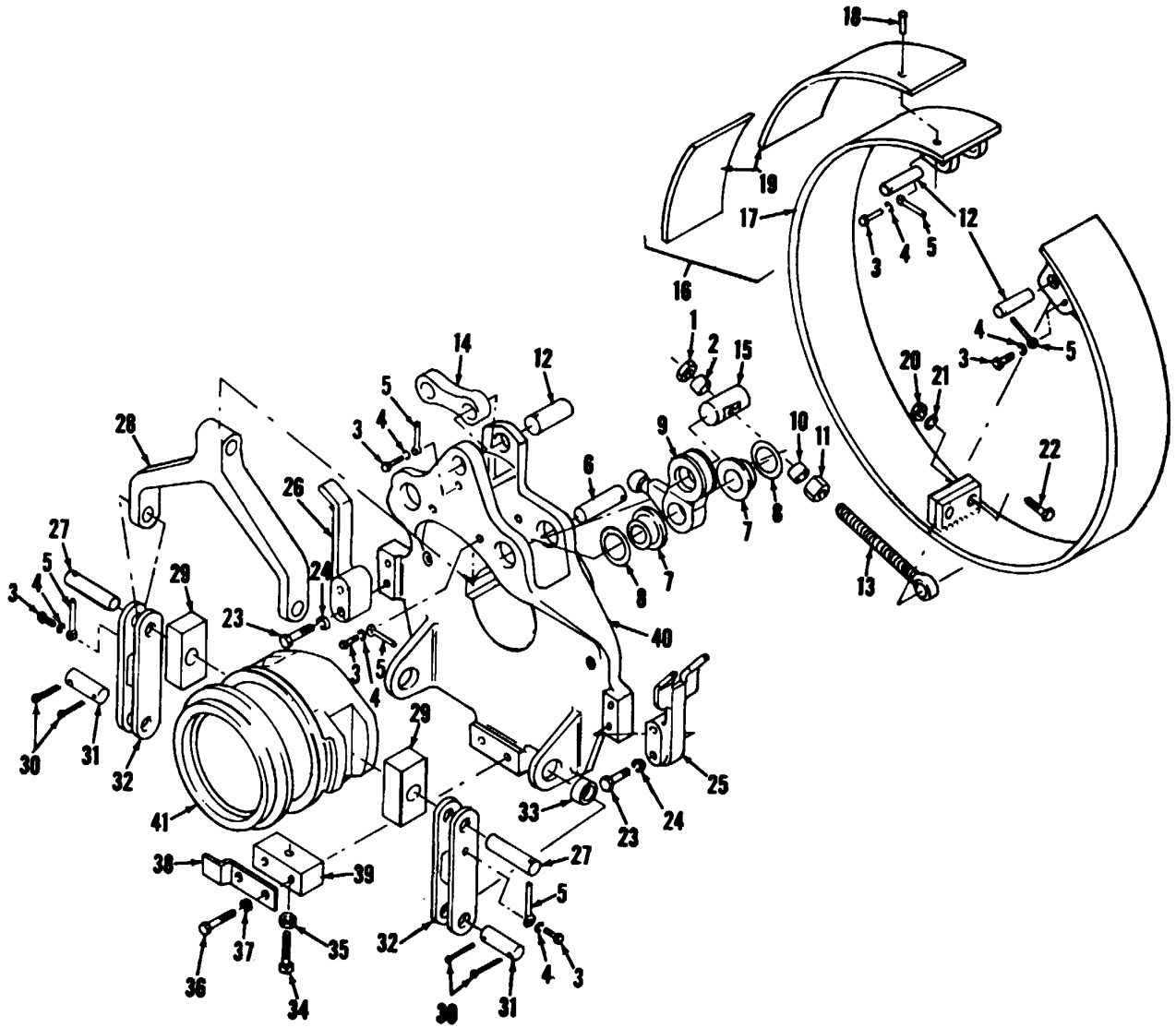


ME 3810-232-34/6-17 ①

| | | | | | |
|---|---|---|---|---|---|
| I | Screw, cap | 23 | Shim | 45 | Ring, retaining |
| 2 | Washer, lock | 24 | Bearing | 46 | Bearing |
| 3 | Screw, cap | 25 | Spacer | 47 | Retainer, bearing |
| 4 | Locking clip | 26 | Clutch | 48 | Spacer, tubing |
| 5 | End plate | 27 | Washer, lock | 49 | Clutch assembly |
| 6 | Gear | 28 | Screw, cap | 50 | Key |
| 7 | Pillow block r.h. | 29 | End cap | 51 | Nut |
| 8 | Pin, dowel | 30 | Screw, cap | 52 | Washer, lock |
| 9 | Fitting, lube | 31 | Washer, lock | 53 | Screw, cap |
| 10 | Bearing | 32 | Retainer ring | 64 | Bevel gear |
| 11 | Key | 33 | Clutch spear type | 55 | Fitting, lube |
| 12 | Spacer, tubing | 34 | Key | 56 | Bearing |
| 13 | Clutch assembly | 35 | Formsprag clutch housing | 57 | Seal, oil |
| 14 | Key | 36 | Bearing | 58 | Clutch, flange |
| 15 | Nut | 37 | Ring retaining | 59 | Bearing |
| 16 | Washer, lock | 38 | Spacer | 60 | Spacer |
| 17 | Screw, cap | 39 | Pillow block l.h. | 61 | Center ring |
| 18 | Bevel gear | 40 | Fitting, lube | 62 | Shaft |
| 19 | Fitting, lube | 41 | Screw, cap | 63 | Nut |
| 20 | Bearing | 42 | Washer, lock | 64 | Washer, lock |
| 21 | Seal, oil | 43 | Shim | 65 | Screw, cap |
| 22 | Shim | 44 | Pin, dowel | 66 | Gear |

A--Shaft Assembly.

*Figure 6-17. Crane Horizontal reversing shaft, assembly, exploded view.*




B--Horizontal reversing clutch assembly, right hand. exploded view

*Figure 6-17. (2) --Continued.*

Key to Figure 6-17. (2)

1 Nut self-locking
2 Spacer
3 Screw cap
4 Washer, lock
5 Pin, lock
6 Pin
7 Bushing
8 Shim
9 Lever, live
10 Spacer
11 Nut
12 Pin
13 Screw, adjusting
14 Link, dead
15 Pin, pivot
16 Band assembly
17 Band
18 Rivets
19 Lining kit
20 Nut
21 Lockwasher
22 Screw, cap
23 Screw, cap
24 Washer. lock
25 Bar, adjustment
26 Bar, adjustment
27 Pin
28 Yoke, toggle
29 Link, dead
30 Pin, cotter
31 Pin
32 Link, toggle
33 Bushing
34 Screw set
35 Nut
36 Screw, cap
37 Washer, lock
38 Bar clutch keeper
39 Block, adjustment
40 Spider
41 Collar

*c. Cleaning, Inspection, and Repair.*

(1) Clean all parts in an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for excessive wear or damage. Replace or repair all defective parts.

d. Reassembly. Reassemble the swing shaft assembly in the reserve of the numerical sequence as illustrated on figure 6-17.

*e. Installation.*

(1) Install the swing shaft as instructed on figure 6-16.

(2) Install shifter levers on shifter collars or horizontal reversing shaft clutches (TM 5 3810-232-12).

(3) Install countershaft assembly (para 6-16).

(4) Install the hoist drum shaft (para 6-14)

## Section IX. CRANE VERTICAL REVERSING SHAFT ASSEMBLY

### 6-21. General

The crane vertical reversing shaft assembly is driven by the swing shaft assembly through beveled gears. A machined gear on the vertical reversing shaft meshes with a gear on the swing shaft and another meshes with a gear on the vertical swing shaft.

### 6-22. Crane Vertical Reversing Shaft Assembly

*a. Removal.*

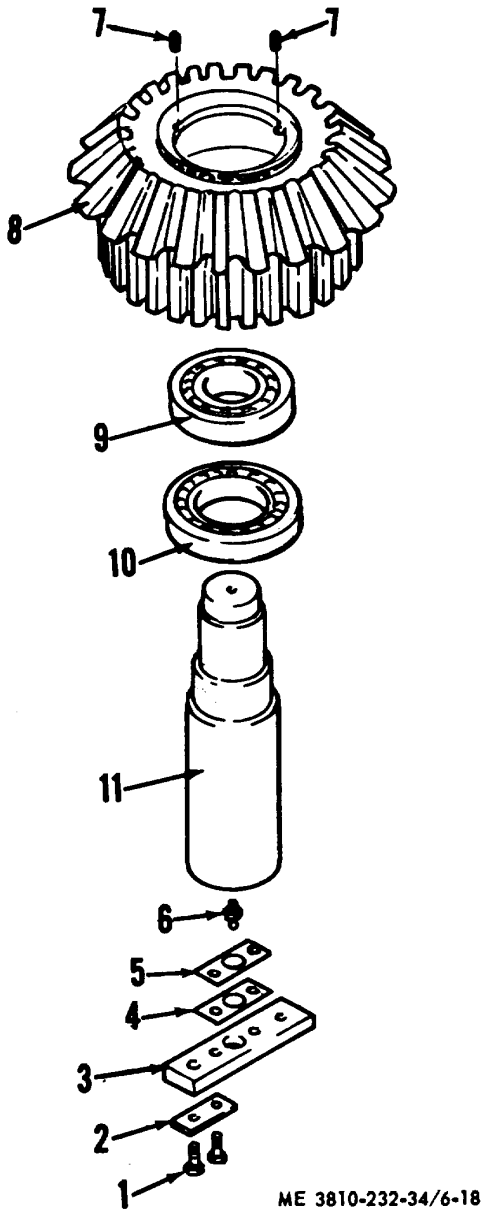
(1) Remove the swing shaft assembly (para 6-20).

(2) Remove the vertical reversing shaft assembly.

(a) Remove four screws (1, fig. 6-18), two lock plates (2), end plate (3) and shims (5, 6).

*(b)* Using a suitable hoist remove the gear (8) and shaft (11) separately.

*b. Disassembly*. Disassemble the vertical reversing shaft assembly in numerical sequence as shown on figure 6-18.




1 Screw cap
2 Plate, lock
3 Plate, end
4 Shim
5 Shim
6 Fitting lube
7 Plug, pipe
8 Gear
9 Bearing
10 Bearing
11 Shaft

*Figure 6-18. Crane vertical reversing shaft assembly, removal, disassembly, reassembly and installation.*

*c. Cleaning, Inspection and Repair.*

(1) Clean all parts in an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for excessive wear or damage. Replace or repair defective parts.

*d. Reassembly*. Reassemble the vertical reversing shaft in reverse of the numerical sequence shown on figure 6-18.

*e. Installation*.

(1) Install the vertical reversing shaft assembly.

*a)* Using a suitable hoist install the shaft (11), bearing (9 and 10) and gear (8).

*(b)* Install lock plates (2), and plate (3), shims (5 and 6) and screws (1).

(2) Install the swing shaft assembly (para 6-20).

## Section X. CRANE VERTICAL SWING SHAFT ASSEMBLY

### 6-23. General

The crane vertical swing shaft assembly is driven by vertical reversing shaft through a set of gears. A machined gear on the bottom end of the vertical swing shaft meshes with the turn table gear on the carrier and provides a means of rotating the crane revolving frame to the desired position.

### 6-24. Crane Vertical Swing Shaft Assembly

*a. Removal.*

(1) Remove the vertical reversing shaft assembly (para 6-22).

(2) Remove the vertical swing shaft assembly as instructed on figure 6-19.

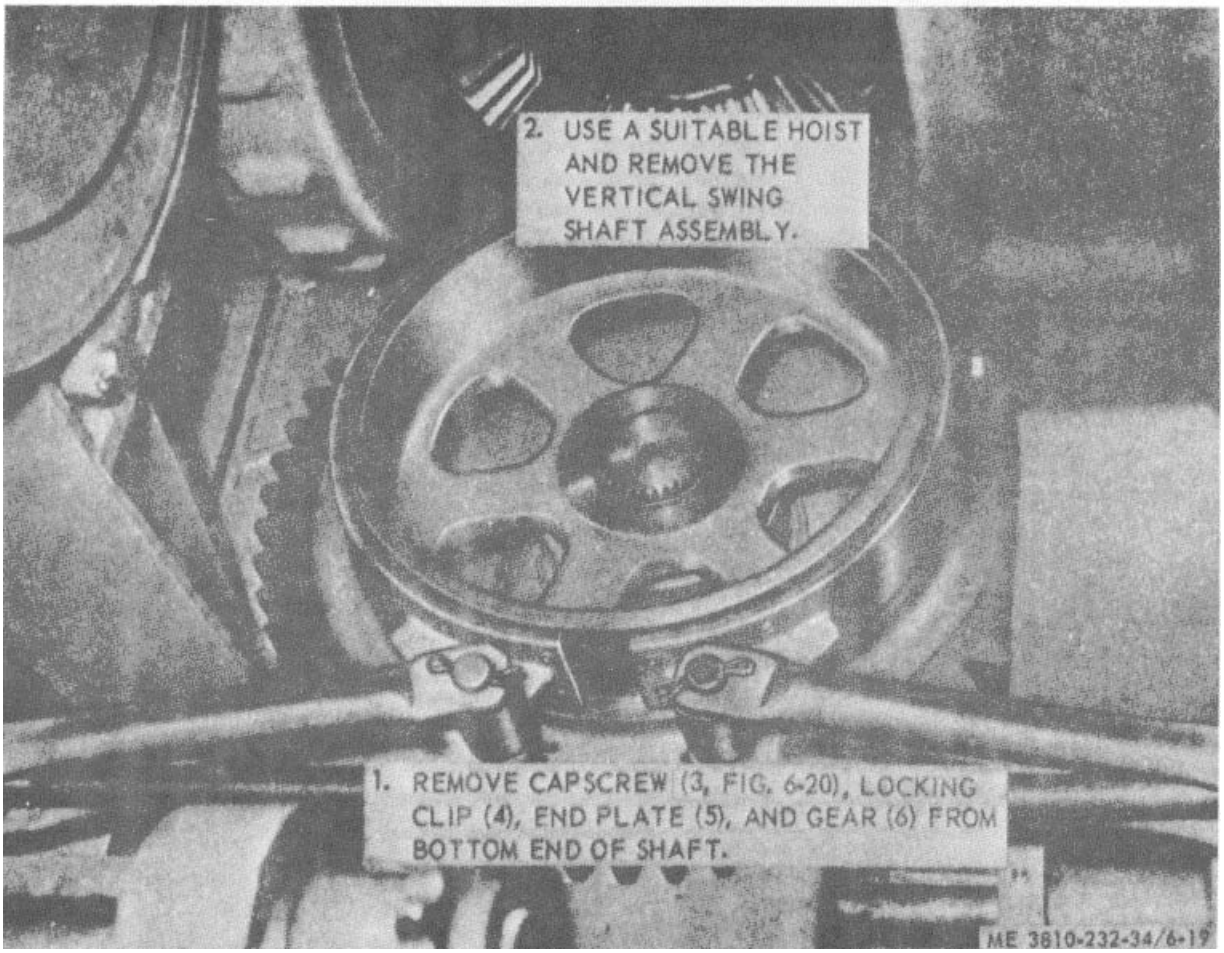
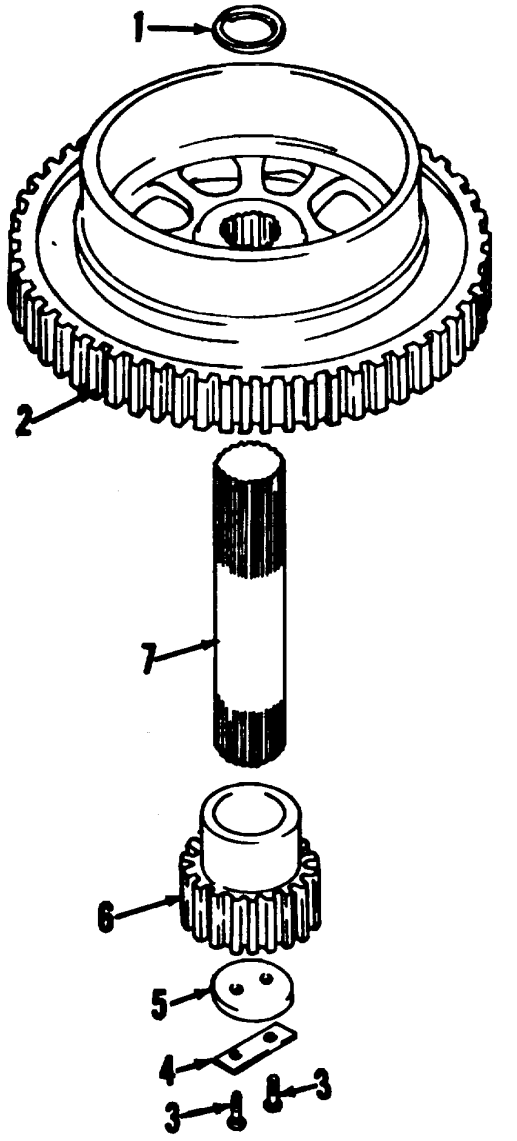



*Figure 6-19. Crane vertical sawing shaft assembly, removal and installation.*

*b. Disassembly.* Disassemble the vertical swing shaft assembly in numerical sequence as shown on figure 6-20.




ME 3810-232-34/6-20

1 Ring, retaining
2 Gear & brake drum
3 Screw, cap
4 Locking clip
5 End plate
6 Gear pinion
7 Shaft, vertical swing

*Figure 6-20. Crane vertical swing shaft assembly, exploded view.*

*c. Cleaning, Inspection, and Repair.*

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for excessive wear or damage. Replace or repair all defective parts.

*d. Reassembly.* Reassemble the vertical swing shaft assembly in reverse of the numerical sequence shown on figure 6-20.

*e. Installation.*

(1) Install the vertical swing shaft assembly as instructed on figure 6-19.

(2) Install the vertical reversing shaft assembly (para 6-22).

## Section XI. CRANE AUXILLIARY SHAFT ASSEMBLY

## (POWER LOAD LOWERING)

### 6-25. General

The crane auxiliary shaft assembly is used for power load lowering to power-down a load under power at a speed controlled by the engine throttle setting. The auxiliary shaft assembly is gear driven and mounts to the revolving frame with two bearings.

### 6-26. Crane Auxiliary Shaft Assembly

*a. Removal.*

(1) Remove the hoist drum shaft (para 6-14).

(2) Remove the auxiliary shaft assembly as instructed on figure 6-21.

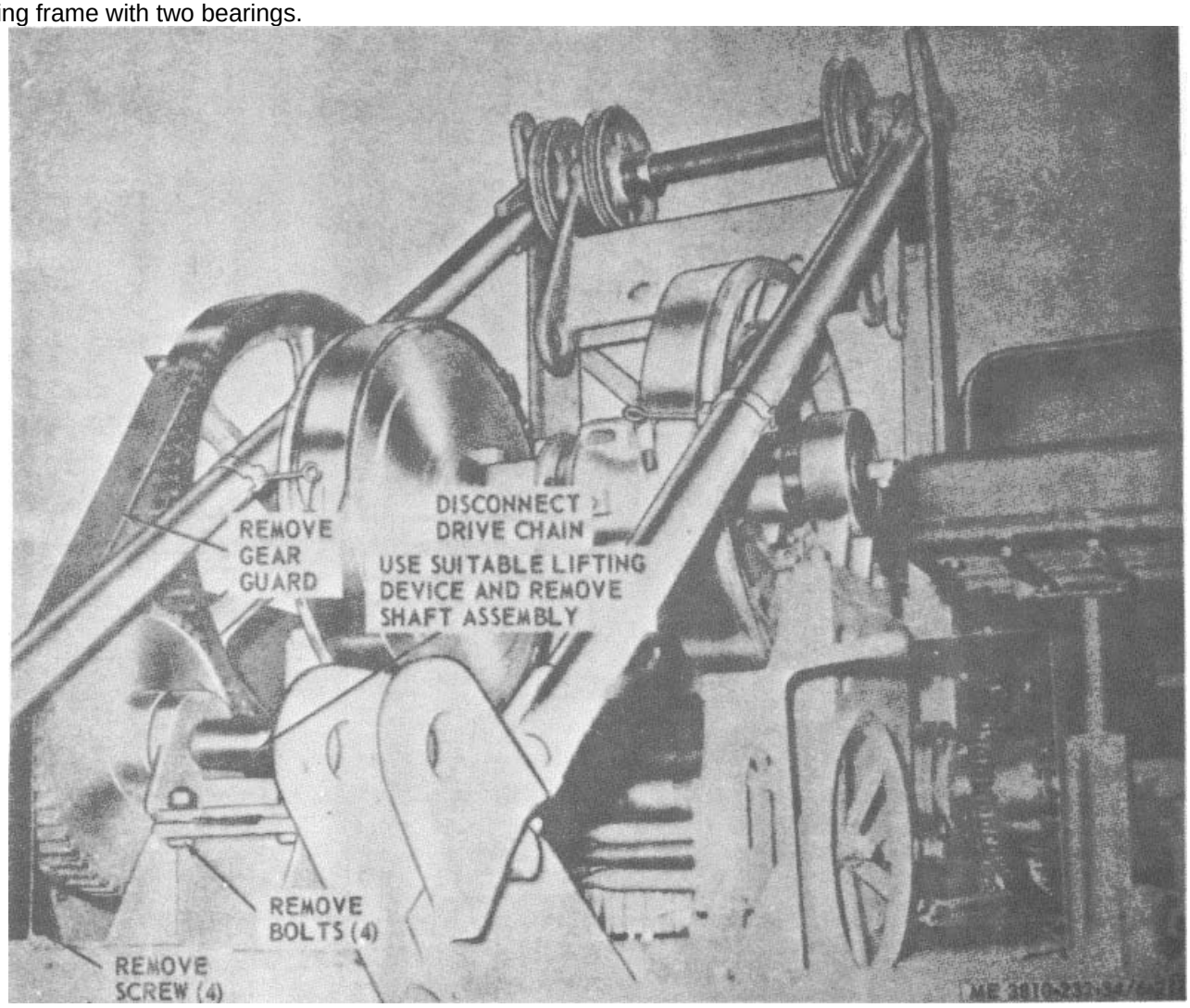
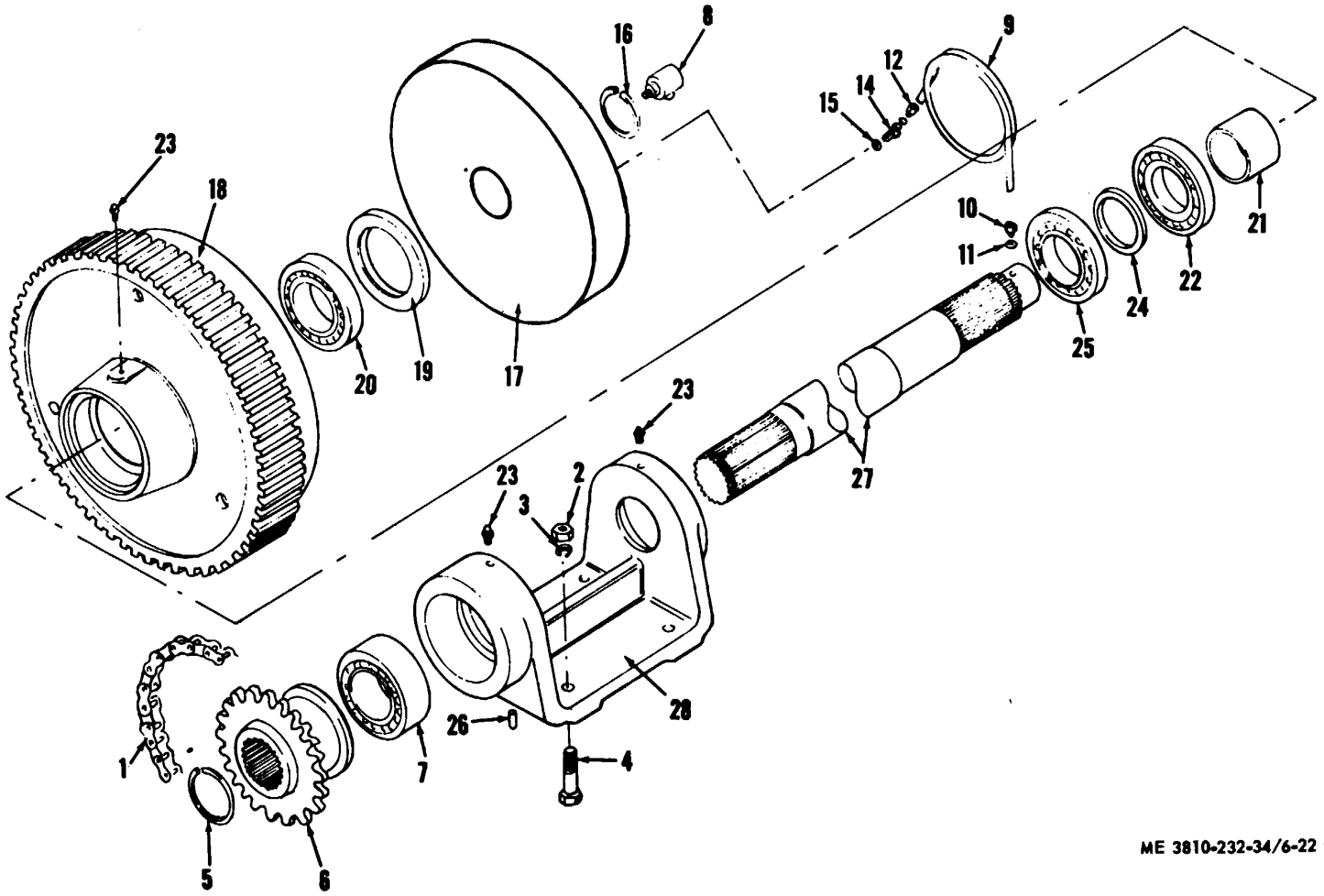



*Figure 6-21. Crane auxiliary shaft assembly removal and installation.*

*b. Disassembly*. Disassemble the auxiliary shaft assembly in the numerical sequence shown on figure 6-22.

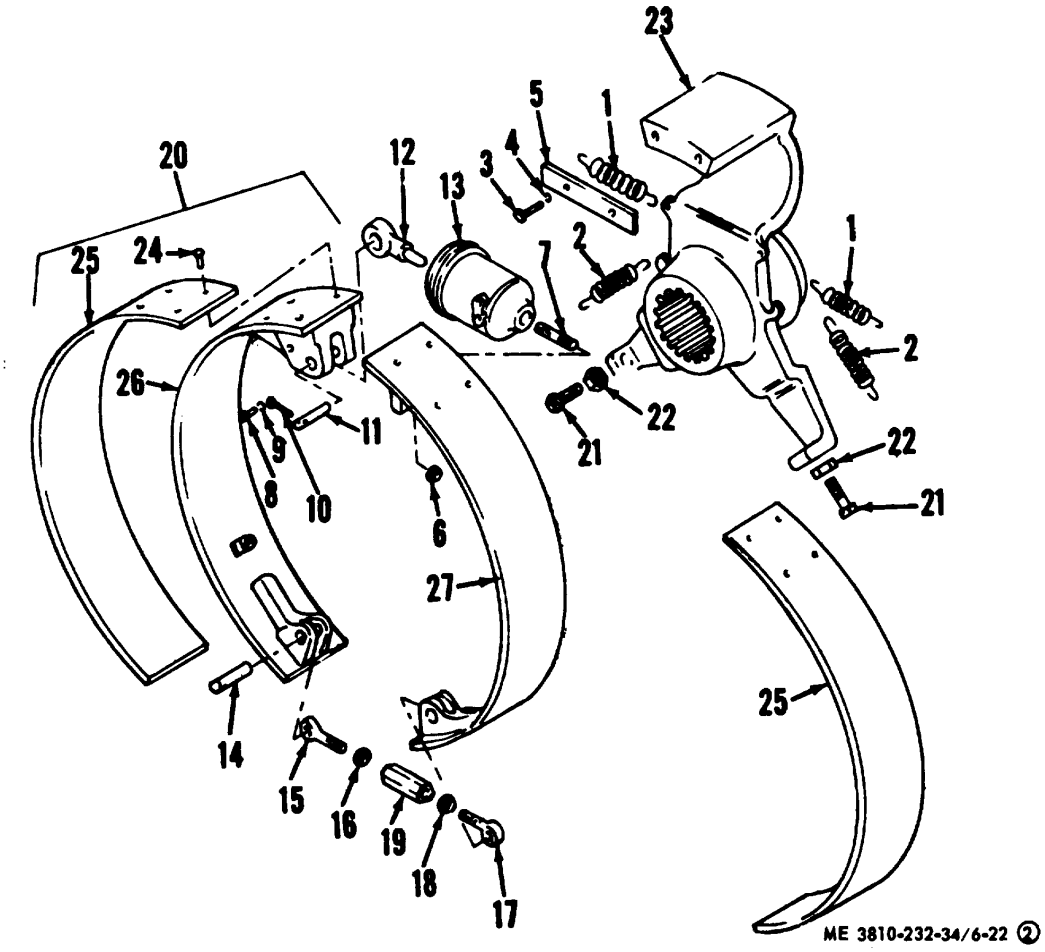



A-Auxiliary shaft assembly

*Figure 6-22. (1) Crane Auxiliary shaft assembly, exploded view.*

Key to Figure 6-2. (1)

1 Chain roller
2 Nut
3 Washer, lock
4 Screw, cap
5 Ring, retaining
6 Sprocket
7 Bearing, ball
8 Joint, rotating
9 Tubing assembly
10 Connector
11 Gasket, copper
12 Connector
13 Gasket, copper
14 Connector, bolt
15 Gasket ,copper
16 Ring, retaining
17 Clutch assembly
18 Gear & clutch flange
19 Seal, oil
20 Bearing, ball
21 Spacer
22 Bearing, ball
23 Fitting, lube
24 Spacer
26 Bearing, ball
27 Shaft
28 Housing




1 Spring
2 Spring
3 Screw, cap
4 Washer, lock
5 Bar
6 Nut, self-locking
7 Stud, slave cylinder
8 Washer, lock
9 Screw, cap
10 Pin, lock
11 Pin
12 Rod, push
13 Cylinder slave
14 Yoke pin assembly
16 Bolt, eye l..
16 Nut
17 Bolt eye, r.h.
18 Nut
19 Bar, hex
20 Clutch band assembly
21 Screw, cap
22 Nut
23 Spider
24 Rivet, semi-tubular
25 Lining, woven
26 Band l.h.
27 Band r.h.

B-Clutch band, power lowering.
*Figure 6-22. (2) -Continued.*

*c. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent and dry thoroughly.

(2) Inspect all parts for excessive wear and damage. Replace or repair damaged or defective parts.

*d. Reassembly*. Reassemble the crane auxiliary shaft assembly in reverse of the numerical sequence shown on figure 6-22.

*e. Installation*.

(1) Install the crane auxiliary shaft as instructed on figure 6-21.

(2) Install the hoist drum shaft assembly and crane cab assembly (para 6-14).

## Section XII. CRANE GANTRY FRAME

### 6-27. General

The crane gantry frame is a supporting device used to support the boom. It is mounted on the crane frame by means of pins and is constructed of heavy steel.

### 6-28. Crane Gantry Frame Removal

*a.* Remove the crane gantry sheave block (TM 5-3810-232-12).

*b.* Remove the crane cab assembly (para 2-8).

*c.* Remove the crane gantry frame from the revolving frame as instructed on figure 6-23.

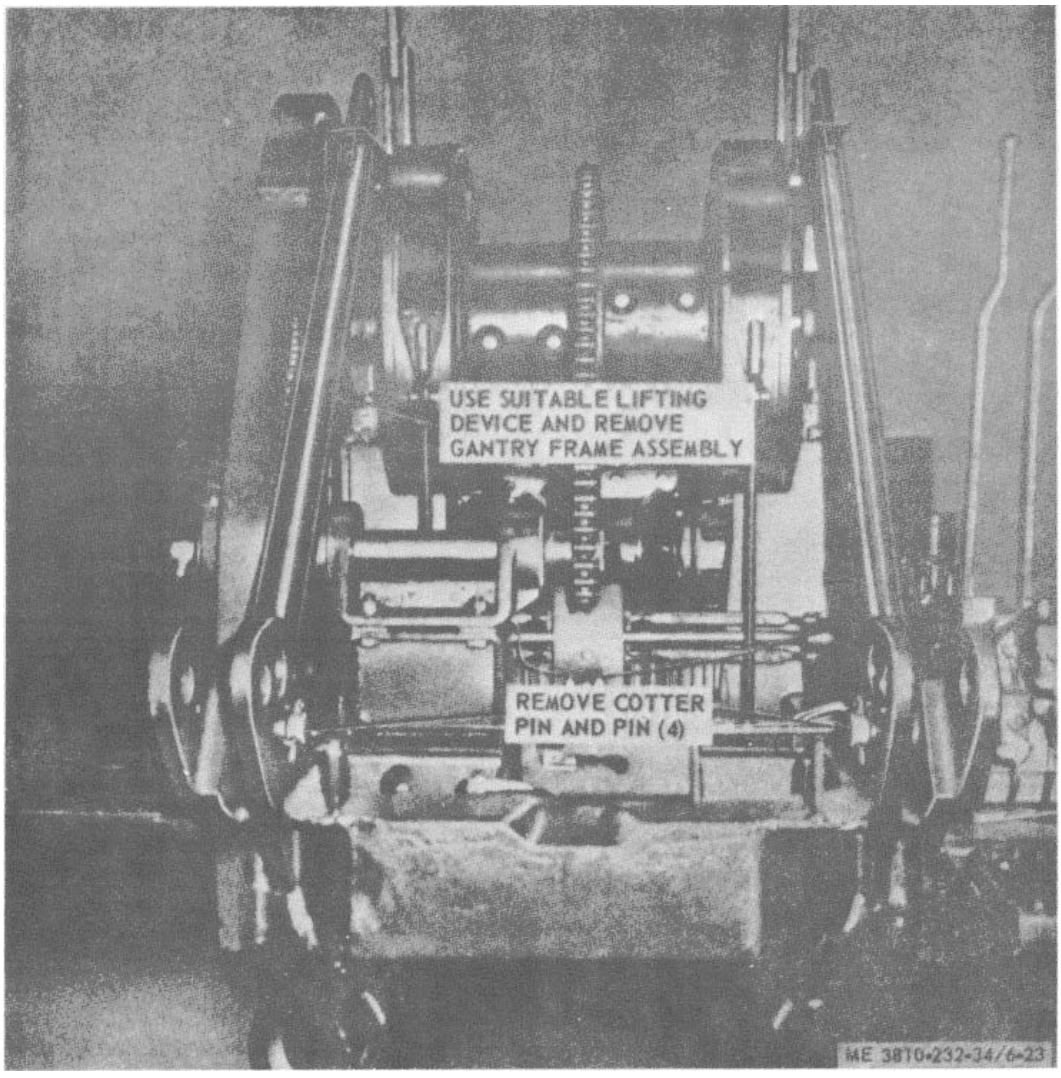



*Figure 6-23. Crane gantry, frame, removal and installation.*

**6-29. Crane Gantry Frame Cleaning, Inspection**

*a. Cleaning*. Clean the crane gantry frame with an approved cleaning solvent.

*b. Inspection and Repair.* Inspect the crane gantry frame and pins for cracks, breaks, bends, and excessive wear. Replace or repair defective crane gantry frame or pins as necessary. Replace cotter pins.

**6-30. Crane Gantry Frame Installation**

*a.* Install the crane gantry frame on the revolving frame as illustrated on figure 6-23.

*b.* Install the crane cab assembly (para 2-8).

*c.* Install the crane gantry sheave block (TM 5-3810-232-12)

## Section XIII. CRANE ROTATING FRAME BASE ASSEMBLY

**6-31. General**

The crane rotating main frame base supports the entire crane assembly that includes the deck machinery, operator's cab, engine and crane boom. It is made up of structural steel weldments. Rotation is by means of rollers attached to the main frame base, operating around a ring gear and center pin mounted on the carrier.

**6-32. Crane Rotating Frame Base Assembly Removal** *a.* Remove the crane boom assembly (TM 53810-232-12).

*b.* Place adequate cribbing between carrier frame and underside of main frame and remove front and rear roller assemblies as shown in fig. 6-24.

c. Remove the crane cab assembly (para 2-8).

*d.* Remove the operator's controls (TM 53810-232-12).

*e.* Disconnect and remove all lines and wiring.

*f.* Remove the crane engine (para 2-9)

*g.* Remove the rear gantry legs (para 6-28).

*h.* Remove the fuel tank (TM 5-3810-232-12).

*i.* Remove the lights (TM 5-3810-232-12).

*j.* Remove the hoist shaft assembly (para 6-14).

*k.* Remove the independent boom hoist shaft assembly (para 6-18).

*l.* Remove the vertical swing shaft assembly (para 6-26).

*m.* Remove the auxiliary shaft assembly (para 6-26)

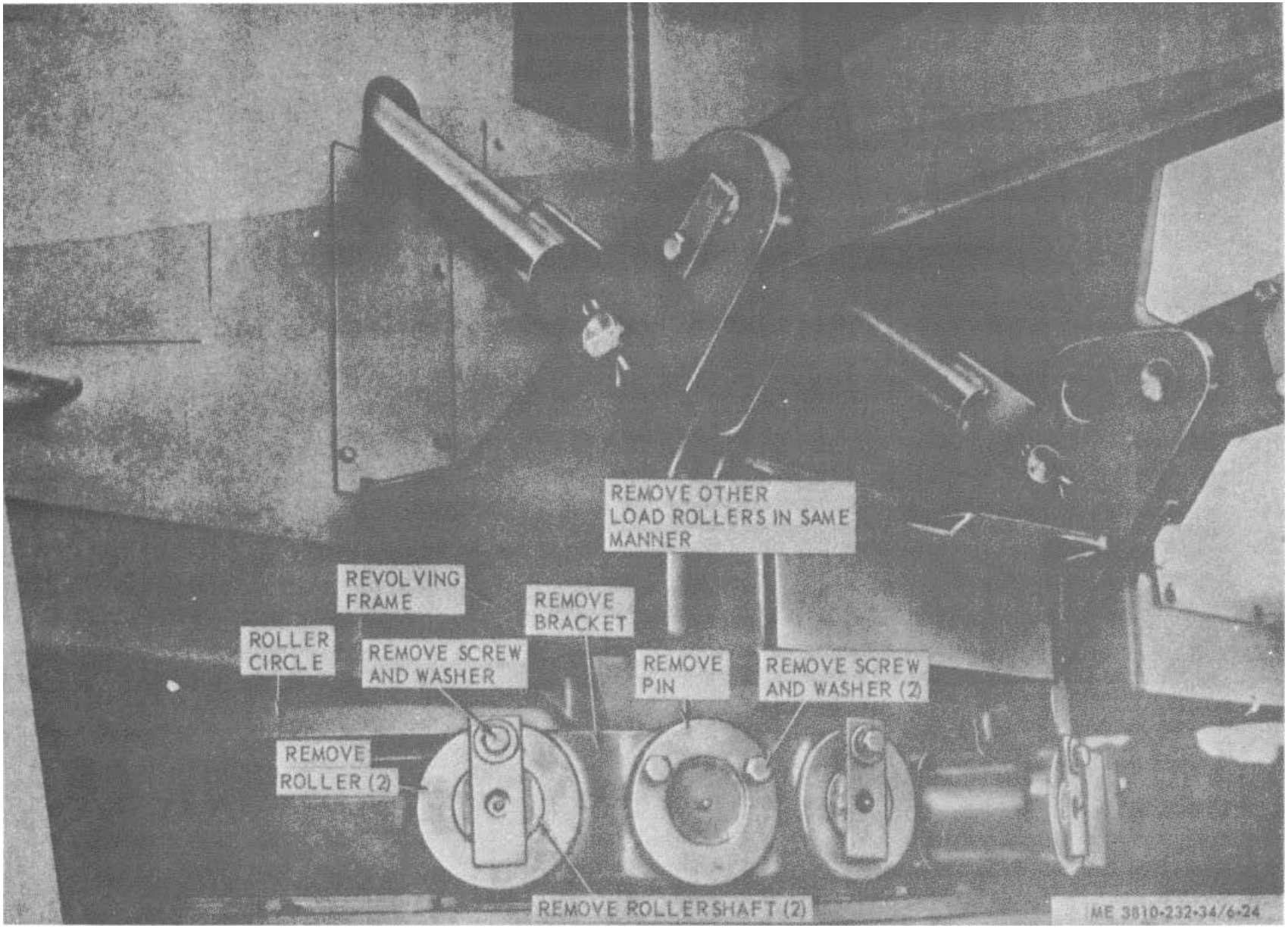



*Figure 6-24. Load rollers. Removal and installation.*

**6-33. Crane Rotating Frame Base Assembly Cleaning, Inspection, and Repair**

*a. Cleaning.* Clean the rotating frame base with live steam.

*b. Inspection and Repair.* Inspect the crane rotating frame base for excessive wear or damage. Replace or repair a damaged or defective rotation frame base assembly.

**6-34. Crane Rotating Frame Base Assembly Installation**

*a.* Install the auxiliary shaft assembly (para 6-26).

*b.* Install the vertical swing shaft assembly (para 6-24).

*c.* Install the independent boom hoist shaft assembly (para 6-18).

*d.* Install the hoist drum shaft assembly (para 6-14).

e. Install lights (TM 5.3810-232-12).

*f.* Install fuel tank (TM 5-3810-232-12).

*g.* Install the rear gantry legs (para 6-30).

*h.* Install the crane engine (para 2-9).

*i.* Install and connect all lines and wiring.

*J.* Install the operator's controls (TM 5-3810282-12).

*k.* Install the crane cab assembly (para 2-8).

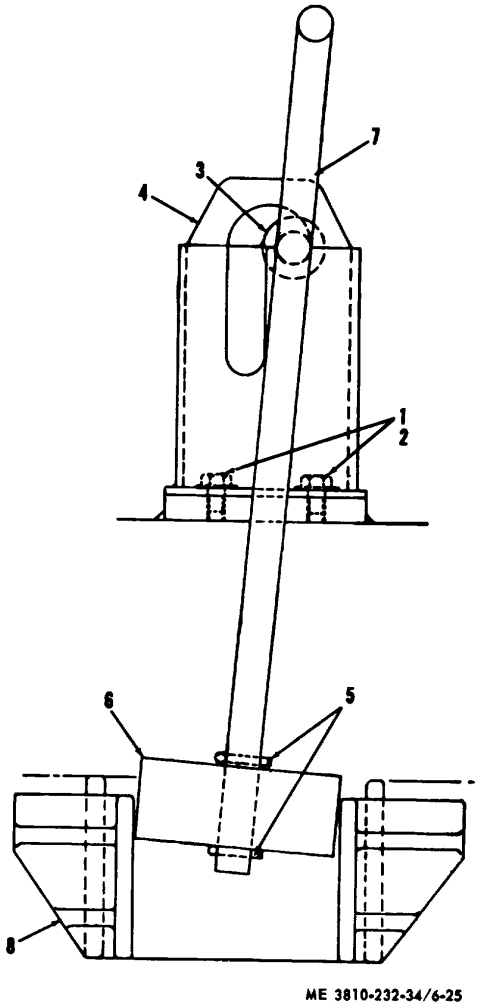
*l.* Install the front and rear roller assembly as illustrated in figure 6-24 and remove cribbing.

*m.* Install the crane boom assembly (TM 53810-232-12).

**6-35. Crane Cab Lock Assembly**

*a.* General. The crane rotating frame base assembled is locked In place by the crane cab lock assembly which is controlled from the operators cab.

*b.* Removal. Remove cab lock assembly as instructed on figure 6-25




1 Capscrew, hex hd.
2 Washer, lock
3 Pin, cotter
4 Bracket
5 Collar
6 Gear
7 Rod
8 Cab lock guide

*Figure 6-25. Crane cab lock assembly.*

*c. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent.

(2) Inspect all parts for breaks, bends, excessive wear and other damage. Repair or replace parts as necessary

*d. Installation*. Install cab lock assembly as shown in figure 6-25.

**6-36. House Lock Assembly (Model 2385)**

*a. General*. In addition to the crane cab lock an additional positive type lock is provided to lock the crane rotating base assembly in place for over the road travel. The house lock is controlled from the operator's cab.

*b. Removal*. Remove the house lock assembly as illustrated in figure 6-26,

1 Cotter pin
2 Pin
8 Link
4 Capscrew
6 Nut
6 Lockwasher
7 Lever
B Pin
9 Lever
11 Collar
12 Fitting
18 Shaft
14 Bracket
15 Lock pin
16 Bracket

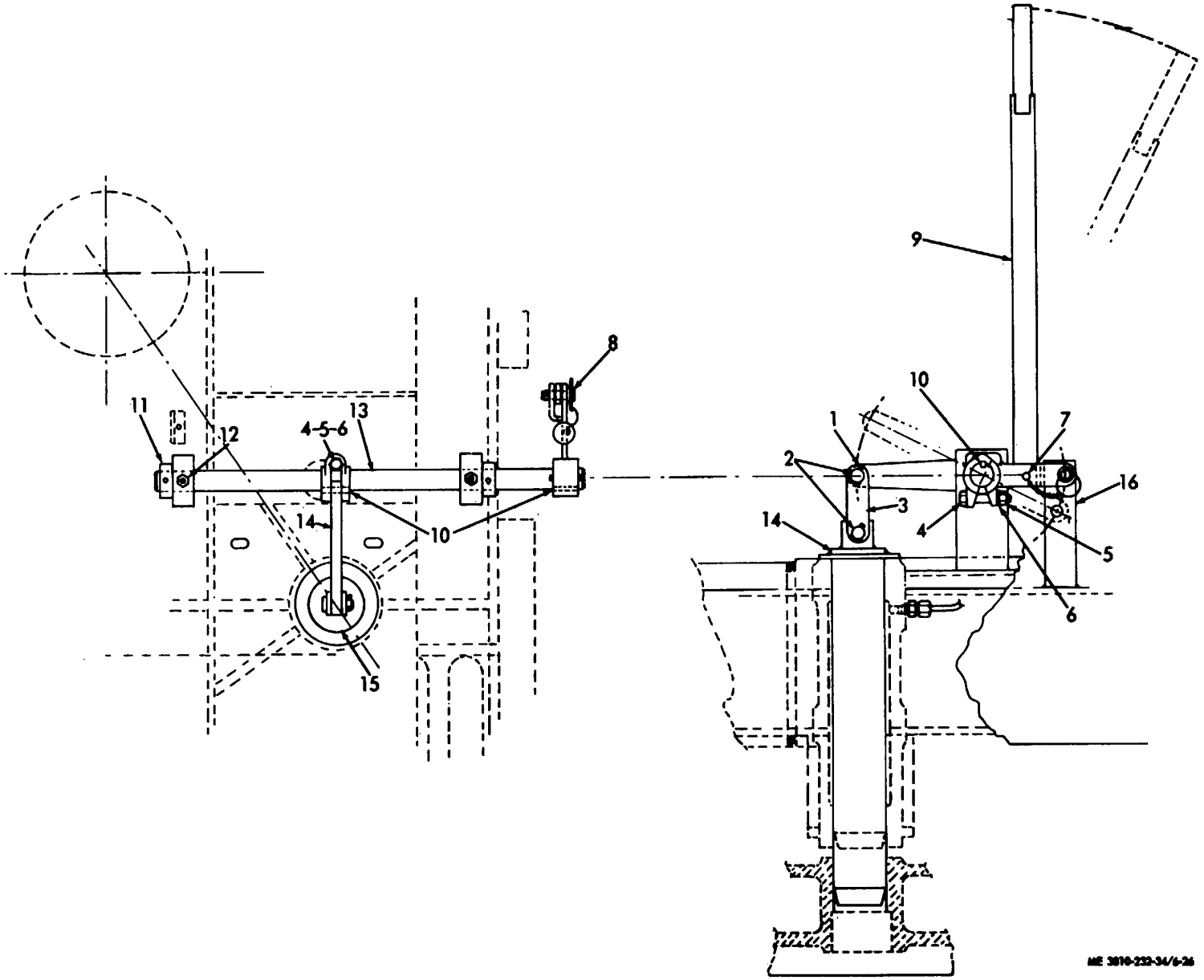



*Figure 6-26. House lock assembly (Model 2385)*

*c. Cleaning, Inspection and Repair.*

(1) Clean all parts with an approved cleaning solvent.

(2) Inspect all parts for breaks, bends, excessive wear, and other damage. Repair or replace parts as necessary.

*d. Installation.* Install house lock assembly as illustrated in figure 6-26.

## APPENDIX A.
## REFERENCES

**A-1. Fire Protection**

| | |
|---|---|
| TB 5400-200-10 | Hand Portable Fire Extinguishers Approved for Army Users |

**A-2. Lubrication**

| | |
|---|---|
| LO 5-3810-283-12 | Lubrication Order: Crane, Wheel Mtd. |
| C9100IL | Petroleum, Petroleum-Base Products and Related Material |

**A-3. Painting**

| | |
|---|---|
| TM 9-213 | Painting Instructions for Field Use |

**A-4. Radio Interference Suppression**

| | |
|---|---|
| TM 11-483 | Radio Interference Suppression |

**A-5 Maintenance**

| | |
|---|---|
| TM 5-3810-232-12 | Operator and Organizational Maintenance Manual |
| TM 9-207 | Operation and Maintenance of Army Materiel in Extreme Cold Weather (0° to --65°F) |
| TM 9-6140-200-15 | Operation and Organizational, Field and Depot Maintenance: Storage Batteries, Lead-Acid Type |
| TM 38-750 | Army Equipment Record Procedures |
| TM 5-8810-939-b5P | Direct and General Support and Depot Maintenance Repair Parts and Special Tool Lists |
| TM 5-764 | Electric Motor and Generator Repair |
| TM 9-237 | Welding Theory and Application |

**INDEX**

**By Order of the Secretary of the Army:**

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

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

Distribution:
To be distributed in accordance with DA Form 1/2-25, Sec II (qty rqr Block #367), Direct/General Support requirements for Crane-Shovels, Wheel Mounted.

* U.S. GOVERNMENT PRINTING OFFICE : 1993 0 - 342-421 (63335)

TEAR ALONG PERFORATED LINE

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS


**SOMETHING WRONG WITH THIS PUBLICATION?**

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

| PUBLICATION NUMBER | PUBLICATION DATE | PUBLICATION TITLE |
|---|---|---|
| | | |

BE EXACT. . .PIN-POINT WHERE IT IS

| PAGE NO. | PARA-GRAPH | FIGURE NO. | TABLE NO. |
|---|---|---|---|
| | | | |

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

| PRINTED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER | SIGN HERE: |
|---|---|
| | |

DA FORM 1 JUL 79 2028-2 PREVIOUS EDITIONS ARE OBSOLETE.

P.S.—IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

**PIN: 025241-00**