This copy is a reprint which includes current pages from Changes 1 and 2.

TM 10-3930-243-34

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

TRUCK, LIFT, FORK, DIESEL ENGINE PNEUMATIC TIRED WHEELS, ROUGH TERRAIN, 10,000 LB CAPACITY, 24 INCH LOAD CENTER

PETTIBONE-MULLIKEN MODEL RTL10

ARMY MODEL MHE 199, FSN 3930-903-0899

PETTIBONE-MULLIKEN MODEL RTL10-1

ARMY MODEL MHE 215, FSN 3930-465-5869

HEADQUARTERS, DEPARTMENT OF THE ARMY

JUNE 1971

WARNING PAGE

Before starting the engine, make sure all operating levers are in the neutral or off position.

Always provide a metal-to-metal contact between dispenser or container and fuel tank when refueling. Never fill the tank near an open flame.

Before welding the fuel or hydraulic tanks be sure the tanks are properly steam cleaned or filled with water for at least 30 minutes before welding repairs are made.

Always assume a safe position when inflating a tire to avoid possibility of injury, should the tire fall or the locking ring be forced from the rim.

Do not work around the fork while it is in the raised position unless it is properly blocked.

Make certain slings and hoists are securely fastened to equipment and that the lifting area is clear of personnel and obstructions when loading or unloading the truck.

Make sure that cribbing is properly placed and of sufficient strength to hold the equipment when working on the truck.

Shut off the engine before performing any cleaning, adjusting or lubrication of the truck.

Do not attempt to break any hydraulic lines or remove components from the brake, steering or main hydraulic systems until all pressure is relieved. Relieve pressure by operating hydraulic system (with engine shut down) until system will no longer function.

Before doing any maintenance on the electrical system, disconnect the battery cables.

Do not allow the spray of the fuel injectors to be directed upon any part of the body. The high pressure of the fuel being forced from the injectors have sufficient power to penetrate the skin.

Fasten your seat belt during operations.

Do not carry passengers.

Operate in proper speed range. Select an operating speed that is safe for the particular job.

Be sure that overhead clearance is sufficient to clear the load.

Lower fork when transporting a load. Greatest stability is achieved when the load is carried close to the ground.

Keep operating controls and decks clean. Keep hands and operating controls free from grease, water and mud to insure positive movement of the controls. Keep decks free of oil and grease to minimize the danger of slipping.

Do not exceed rated capacity. The rated capacity of the truck is 10,000 pounds.

Never leave the machine unattended with engine running. Lower the fork to the ground, place the directional shift lever in neutral, set the parking brake, and shut down the engine before leaving the operator's seat.

Do not allow smoking or open flame near the truck when servicing the batteries, fuel tank or cooling system.

TM 10-3930-243-34
C 2

CHANGE
NO. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington D.C., *29 January 1990*

Direct Support and General Support Maintenance Manual

TRUCK, LIFT, FORK; DIESEL ENGINE, PNEUMATIC TIRED WHEELS, ROUGH TERRAIN; 10,000 LB CAPACITY, 24-INCH LOAD CENTER (PETTIBONE-MULLIKEN MODEL RTL10) ARMY MODEL MHE 199 NSN 3930-00-903-0899

(PETTIBONE-MULLIKEN MODEL RTL10, WITH ROLL-OVER PROTECTIVE STRUCTURE) ARMY MODEL MHE 199 NSN 3930-01-052-8997

(PETTIBONE-MULLIKEN MODEL RTL10-1) ARMY MODEL MHE 215 NSN 3930-00-465-5869

(PETTIBONE-MULLIKEN MODEL RTL10-1, WITH ROLL-OVER PROTECTIVE STRUCTURE) ARMY MODEL MHE 215 NSN 3930-01-053-4824

TM 10-3930-243-34, 3 June 1971, is changed as follows:

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

Page ii, List of Illustrations. Delete the entries for figure numbers 3-6, 3-7, and 3-37.

Page iv, List of Illustrations.

After figure number 3-98, add "3-98.1, Transmission unit valve removal and installation, page 3-141".

Delete the entries for figure numbers 3-113, 3-117, and 3-118.

Page v, List of Illustrations.

After figure number 3-139, add "3-139.1, Hydraulic reservoir, removal and installation, page 3-195",

Delete the entries for figure numbers 3-141 and 3-149.

After figure number 3-158, add "3-158.1, Fenders, removal and installation, page 3-227".

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.

Paragraph 1-2.1 is added after paragraph 1-2.

1-2.1. Reporting Errors and Recommending Improvements

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

Page 2-1, paragraph 2-3. Change "TM 10-3930-243-35P" to "TM 10-3930-243-34P".

Page 3-5. Paragraph 3-4 is rescinded.

Page 3-6. Figure 3-6 is rescinded.

Page 3-7. Figure 3-7 is rescinded

Page 3-8. Paragraph *3-5b* (1) is superseded as follows:

(1) Remove the inlet housing (see TM 10-3930-243-12).

Page 3-29, paragraph 3-11. Subparagraphs a, *b,* and c are rescinded.

Page 3-49. Paragraph 3-16 is rescinded.

Page 3-50. Figure 3-37 is rescinded.

Page 3-108, paragraph 3-36e (3). Change " (TM 10-3930-243-34)" to "(TM 10-3930-243-12)".

Page 3-140.

Paragraph 3-38f(1) is superseded as follows:

(1) *Main pressure check.* Refer to TM 10-3930-243-12.

Paragraph *3-38f(3)* is superseded as follows:

(3) *Lubrication oil pressure.* Refer to TM 10-3930-243-12.

Paragraph 3-38g is superseded as follows:

g. Linkage Adjustment. Refer to TM 10-3930-243-12.

Page 3-141. Paragraph 3-39.1 is added after paragraph 3-39.

3-39.1. Transmission Cut-Off Valve (Inching)

a. Removal.

(1) Remove the driver's access ladder (TM 10-3930-243-12).

(2) Refer to figure 3-98.1 and remove the transmission cut-off valve.

b. Installation.

(1) Refer to figure 3-98.1 and install the transmission cut-off valve.

(2) Install the driver's access ladder (TM 10-3930-243-12).

Page 3-164.

Paragraph 3-53b is superseded as follows:

b. Removal. Refer to TM 10-3930-243-12.

Paragraph 3-53f is superseded as follows:

f. Installation. Refer to TM 10-3930-243-12.

Figure 3-113 is rescinded.

Page 3-166. Paragraph 3-55 is rescinded.

Page 3-167. Figure 3-117 is rescinded.

Page 3-168.

Paragraph *3-57b* is superseded as follows:

b. Removal. Refer *to* TM 10-3930-243-12.

Paragraph 3-57g is superseded as follows:

g. *Installation.* Refer to TM 10-3930-243-12.

Figure 3-118 is rescinded.

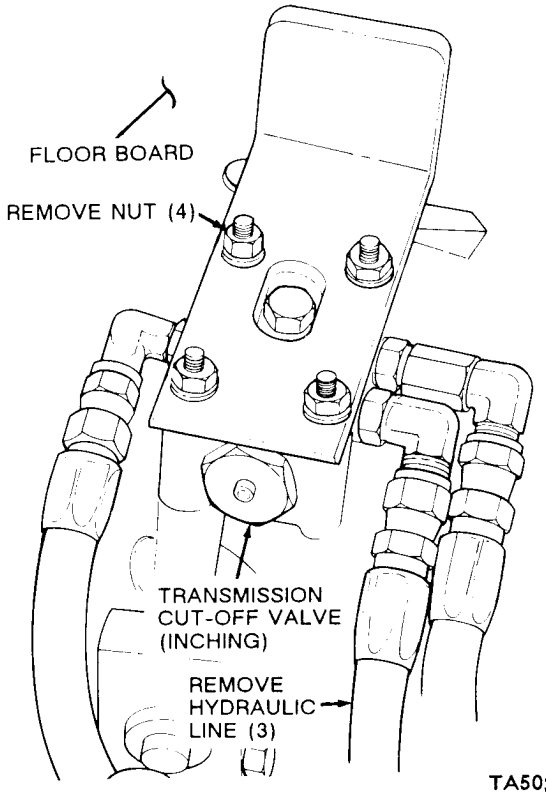


Figure 3-98.1. Transmission cut-off valve, removal and installation.

Page 3-195.

Paragraph *3-69b* is superseded as follows:

b. Removal. Refer to figure 3-139.1 and remove the hydraulic oil reservoir.

CAUTION

When removing any hydraulic hoses and lines, cap all openings to prevent foreign material from entering system, causing serious damage to the system.

Paragraph 3-69g is superseded as follows:

g. Installation. Refer to figure 3-139.1 and install the hydraulic oil reservoir.

Page 3-197.

Paragraph 3-7 *1b* is superseded as follows:

b. Removal. Refer to TM 10-3930-243-12.

Paragraph 3-71h is superseded as follows:

h. Installation. Refer to TM 10-3930-243-12.

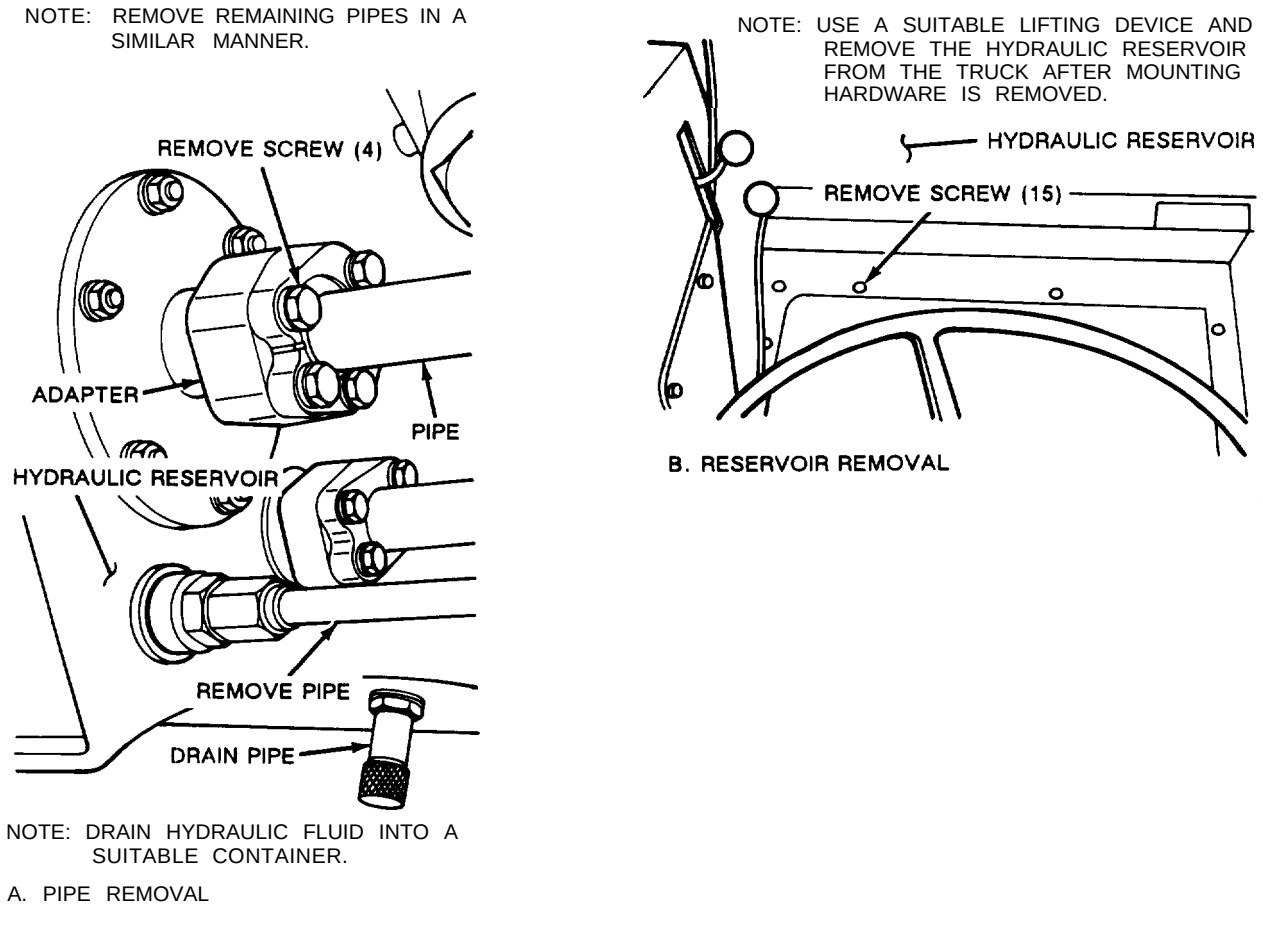


Figure 3-139.1. Hydraulic reservoir, removal and installation.

Page 3-198. Figure 3-141 is rescinded.

Page 3-213.

Paragraph 3-75b is superseded as follows:

b. Removal. Refer to TM 10-3930-243-12.

Paragraph 3-75h is superseded as follows:

h. Installation. Refer to TM 10-3930-243-12, Figure 3-149 is rescinded.

Page 3-227. Paragraph 3-82.1 is added after paragraph 3-82,

3-82.1. Fenders

a. Removal. Refer to figure 3-158.1 and remove the fenders.

b. Inspection.

(1) Inspect fenders for cracks or damage.

(2) Inspect mounting hardware for damage or stripped threads. Replace defective mounting hardware.

(3) Repair cracks or breaks by welding.

c. Installation. Refer to figure 3-158.1 and install the fenders.

Page A-1.

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

Paragraph A-3.

Change "TM 38-750" to "DA Pam 738-750".

Change "TM 10-3930-243-35P" to "TM 10-3930-243-34P".

Page I-1.

Delete the entry for "Air inlet housing".

Before *Flywheel,* add "Fenders, paragraph 3-82.1, page 3-227".

Delete the entry for "Forms and records".

Delete the entry for "Fuel pump".

Delete the entry for "Hydraulic brake reservoir".

After *Maintenance hydraulic pump,* add "Maintenance forms, records, and reports, paragraph 1-2, page 1-1".

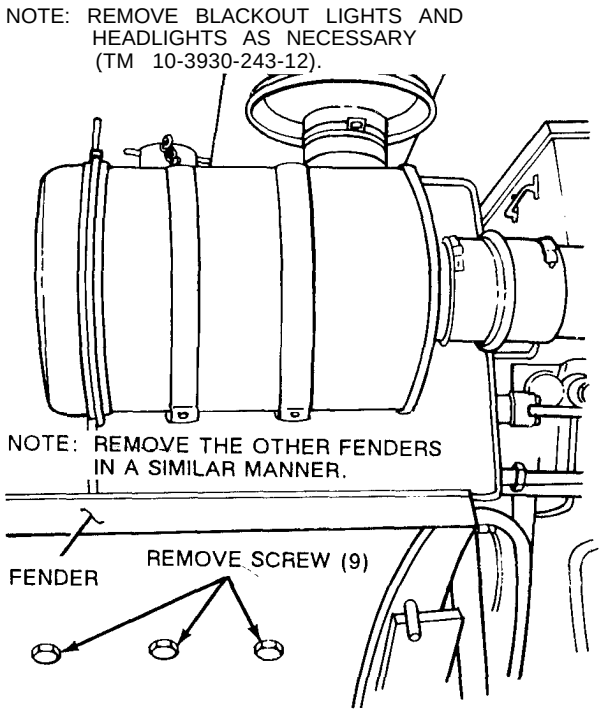


Figure 3-158.1. Fenders, removal and installation.

After *Rear propeller shaft,* add Reporting errors and recommending improvements, paragraph 1-2.1, page 1-1".

Page I-2.

After *Transmission control valve,* add "Transmission cut-off valve, paragraph 3-39.1, page 3-141".

By Order of the Secretary of the Army:

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

Official:

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

Distribution:

To be distributed in accordance with DA Form 12-25F (Block No. 2244), Direct Support and General Support maintenance requirements for Fork Lift, 10,000 LB Capacity, Rough Terrain, Pneumatic Tire, Diesel (Model MHE-199, 215).

By Order of the Secretary of the Army:

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

Official:

ROBERT M. JOYCE
Brigadier General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-25A, Direct and General Support maintenance requirements for Truck, Fork Lift, Rough Terrain.

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON DC, *1 December 1981*

Direct Support and General Support Maintenance Manual
TRUCK, LIFT, FORK, DIESEL ENGINE, PNEUMATIC TIRED WHEES, ROUGH TERRAIN, 10,000 LB CAPACITY, 24 INCH LOAD CENTER
PETTIBONE-MULLIKEN MODEL RTL10
ARMY MODEL MHE 199, NSN 3930-00-903-0899
PETTIBONE-MULLIKEN MODEL RTL10-1
ARMY MODEL MHE 215, NSN 3930-00-465-5869

TM 10-3930-243-34, 3 June 1971, is changed as follows:

Page 1-1, paragraph 1-2*b* 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 Command, ATTN: DRSTA-MBP, Warren, MI 48090. A reply will be furnished to you.

Page 1-6, Figure 1-2.1 is added as follows.

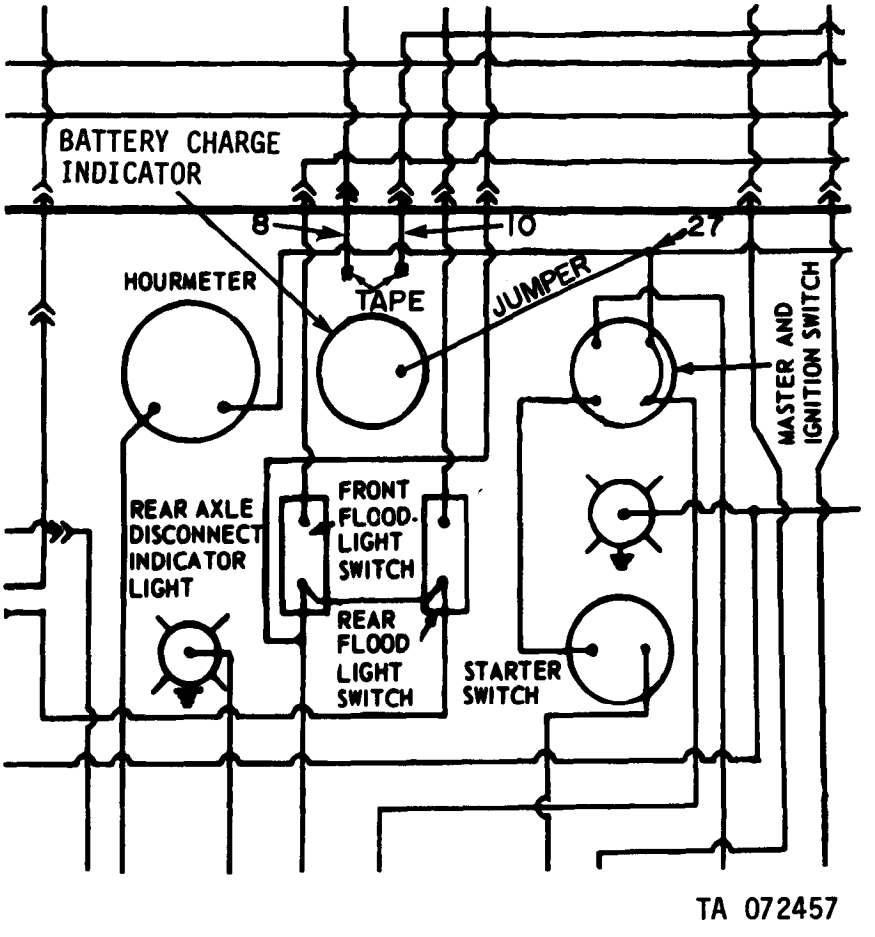


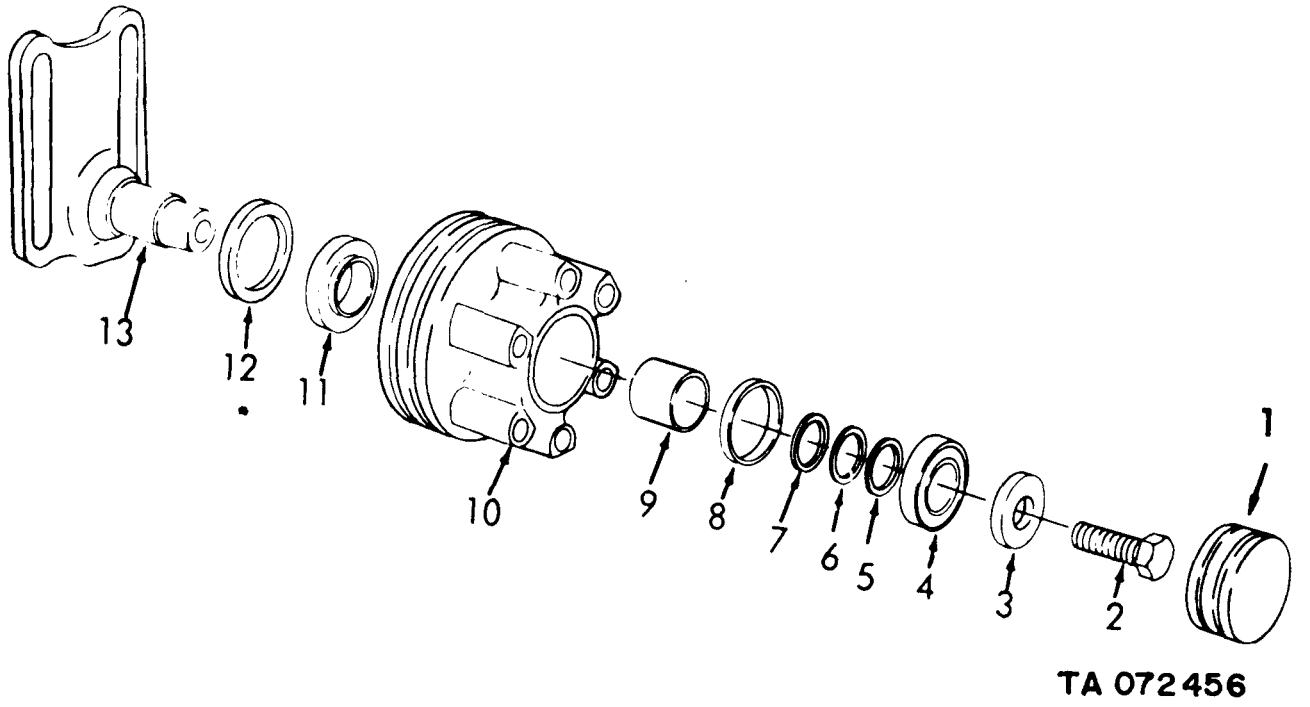
Figure 1-2.1. Portion of wiring diagram with battery charge indicator installed.

Page 2-2, paragraph 2-4, item 14, Truck Will Not Move.

Probable Cause column. Add "*d.* Torque converter lost charge".

Corrective Action column. Add "... Charge top of converter with OE 10 oil".

Page 3-22. Figure 3-15.1 is added as follows.



1	Cap	8	Grease retainer
2	Retainer bolt	9	Bearing spacer
3	Retainer flat washer	10	Fan hub (Pulley)
4	Front bearing	11	Rear bearing
5	Shim .015	12	Grease seal
6	Shim .020	13	Fan hub shaft
7	Shim .025		

Figure 3-15.1. Fan hub assembly.

Page 3-22. Paragraph 3-8.1 is added as follows.

3.8.1. Fan Hub (Pulley) Assembly

a. General. Original fan hub (pulley) assemblies have sealed bearings and may require disassembly before major overhaul for lubrication of dry bearings and replacement of excessively worn bearings or damaged grease seals. Replacement fan hub assemblies may contain a grease fitting and relief valve to aid lubrication.

b. Removal and Disassembly. Refer to figure 3-15.1 and remove and disassemble as follows:

(1) Remove fan hub cap (1).

(2) Remove hub retaining bolt (2), special washer (3), and shims (5, 6, and 7).

(3) Withdraw hub and bearing assembly (9, 10, 11, and 12) from shaft (13). If necessary, tap end of shaft with a soft hammer to loosen hub assembly.

c. Inspection.

WARNING

Drycleaning solvent SD-2, used to clean parts, is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 138°F.

(1) Wash fan hub parts thoroughly with solvent, drycleaning Type II (P-D-680), dry with compressed air, and inspect for wear or damage.

(2) Replace bearings (4 and 11) if rough or worn.

(3) Replace grease seal (12) and fan hub cap (1).

(4) Remove any rust or rough spots in the grooves of fan pulley (10). If grooves are damaged or worn, replace pulley.

d. Reassembly. Refer to figure 3-15.1 and reassemble as follows:

(1) Apply grease (MIL-G-81322), NSN 9150-00-944-8953) to rollers of both bearings (4 and 11) before installing them in Fan Hub (Pulley)(10).

(2) Install rear bearing (11) with protruding face of inner race facing outward from hub (10).

(3) Install *new* seal (12) with felt side flush with bearing spacer (9).

(4) Place hub (10) over shaft (13) and install bearing spacer (9).

(5) Pack cavity approximately 1/4 full with grease and install grease baffle (8).

(6) Place shims (7, 6, and 5) against bearing spacer (9); then install front bearing (4) with protruding face of inner race outward from hub (10).

(7) Secure hub (10) with retaining washer (3) and bolt (2). Tighten 1/2 inch-20 bolt to 83-93 lb-ft torque *while rotating pulley.*

(8) Check end play in assembly with shaft (13) in horizontal position. End play must be within .001 inch to .006 inch. If necessary, remove bolt, washer, and front bearing and select proper number and thickness of shims to obtain required thickness. Then, reassemble Fan Hub and check end play.

(9) Fill *new* fan hub cap (1) 3/4 full of grease and install it in end of fan hub (pulley) (10).

Page 3-23, paragraph 3-9. After subparagraph *h* add the following Note.

NOTE

The schematic wiring diagrams, figures 1-2 and 1-3 show wiring of an ammeter in the battery charging circuit. The originally installed vibrator type voltage regulator has been deleted from the supply system and replaced with a transistor type voltage regulator. Changing from the vibrator type regulator to the transistor type regulator requires replacing the ammeter with a Battery Charge Indicator because the ammeter isn't compatible with the transistor type voltage regulator. The Battery Charge Indicator is compatible with either type voltage regulator.

To install the Battery Charge Indicator, refer to figure 1-2.1 portion of wiring diagram with Battery Charge Indicator installed and proceed as follows:

(a) Disconnect and tape the ends of wires No. 8 and No. 10 that are attached to the ammeter.

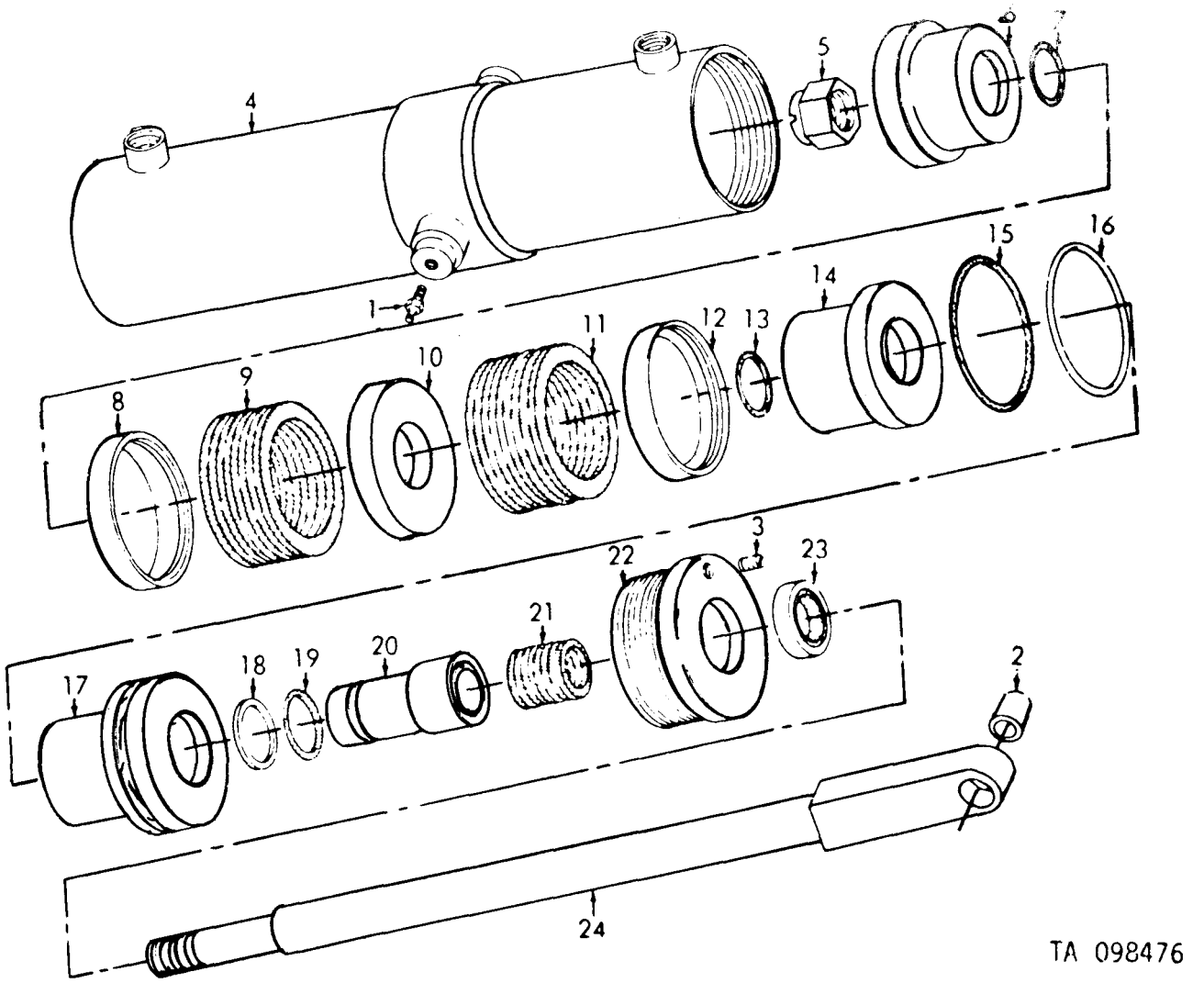
(b) Remove ammeter and replace with Battery Charge Indicator.

(c) Connect a jumper from wire No. 27 (attached to ignition switch) to the Battery Charge Indicator. The Indicator is grounded and will complete the circuit".

Page 3-178, paragraph 3-61. Subparagraph *a* is superseded as follows:

a. General. The accumulator is provided to reduce the shock effects to the steering lock system. The accumulator is charged with nitrogen and hydraulic oil under high pressure. It is located behind the operator's access ladder panel. The steering lock system accumulator is mounted next to the brake system accumulator and is identical in construction, removal and disassembly.

Page 3-207. Figure 3-146 is superseded as follows.



MODEL RTL10

1	Fitting	13	Packing
2	Bearing	14	Piston
3	Setscrew	15	O-ring
4	Shell assembly	16	Ring
5	Nut	17	Retainer
6	Piston	18	Ring
7	Packing	19	O-ring
8	Rider	20	Bearing
9	Packing assembly	21	Packing
10	Washer	22	Nut
11	Packing assembly	23	Wiper
12	Rider	24	Rod

Figure 3-146. Hydraulic left cylinder, disassembly and reassembly (sheet 1 of 2).

All changes, additions, or deletions of stock numbers, manufacturers' codes, and part numbers with this change should be appropriately reflected in the index.

By Order of the Secretary of the Army:

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

Official:

ROBERT M. JOYCE
Brigadier General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-25A, Direct and General Support maintenance requirements for Truck, Fork Lift, Rough Terrain.

TECHNICAL MANUAL
No. 10-3930-243-34

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *3 June 1971*

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

TRUCK, LIFT, FORK, DIESEL ENGINE

PNEUMATIC TIRED WHEELS, ROUGH

TERRAIN, 10,000 LB CAPACITY,

24 INCH LOAD CENTER

PETTIBONE-MULLIKEN MODEL RTL10

ARMY MODEL MHE 199, FSN 3930-903-0899

PETTIBONE-MULLIKEN MODEL RTL10-1

ARMY MODEL MHE 215, FSN 3930-465-5869

***This manual supersedes TM 10-3930-243-35, 27 September 1966, including all changes.**

List of Illustrations

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

These instructions are published for the use of direct support and general support personnel maintaining the Pettibone-Mulliken Model RTL10 and Model RTL10-1 forklift trucks. They provide information for the maintenance of the equipment which is beyond the scope of the tools, equipment, personnel, or supplies normally available to using organizations.

1-2. Forms and Records

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

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

Section II. DESCRIPTION AND DATA

1-3. Description

A general description *of* the forklift truck, the location and description of the identification and instruction plates, and information on the difference in models are contained in TM 10-3930-243-12. Paragraphs throughout the manual will indicate difference between the two models by applicable model numbers. The repair and maintenance instructions for direct support and general support maintenance personnel are described in the appropratie sections of this manual.

1-4. Tabulated Data

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

b. General

Manufacturer . . . . . Pettibone-Mulliken Corp.
Models . . . . . RTL10 and RTL10-1
Length . . . .203 in.
Width. . . . . 106 in.
Height . . . . . 133 in,
Shipping weight ... . ..,... 34,500 lbs.
cube. . . . . 1505-0 ft.
Load center . . . . . 24 in.
Drawbar pull . . . .l9,000 lbs.
Maximum fording depth . . . . 5 ft. to crest of wave
Capacity . . . . 10,000 lbs.

c. Engine.

Manufacturer . . . . . Detroit Diesel Engine Div., General Motors Corp.
Mode 5063-5200
Beads 53
Type V
Cylinders 6
Cycle 2
Bore. .. . .3.875 in.
Stroke ..... 4.5 in.
Compression ratio (nominal) 17 to 1
Displacement . . . . 318.6 cu. in.
Firing order 1L-3R-3L-2R-2L-1R
Rotation . . . . . Clockwise
Idle speed. ... . 500 to 600 rpm
Governed speed (no load) . ..3010 rpm
Oil pressure..... 40 to 60 psi at 2800 rpm
Minimum oil pressure . . . . . 30 psi

d. Generator.

Manufacturer, ... Delco-Remy (Model RTL10)
Part No, ...1117495
Rating . . . .24 V, DC
Manufacturer . .. . Prestolite (Model RTL10-1)
Part No... ... ... GHA4808UT
Rating . . . .24 V, DC

e. Generator Regulator.

Manufacturer, ... Delco-Remy
Part No. 1118656
Rating . . . . . 24 V, DC, 25amp
Ground „ „. . . . . Negative

f. Starter.

Manufacturer . . . . . Delco-Remy
Part No 1113847
Rating . . . .24 V, DC

g. *Transmission with Torque Converter.*

Manufacturer . . . . . Allison Div., General Motors Corp.
Model . . . . CRT 3531-1

Type . . . . . .Torque converter and planetary gear
Converter model TC350
Speeds . . . .3 forward and 3 reverse
Output shafts . . . . . 2 wheel drive or 4 wheel drive
Oil pressures, full throttle converter outlet:
Stall . . . .25 psi min.
No load . . . .65 psi max.
Main, stall . . . . . 150-160 psi (approx.)
Lubrication . . . . . 15-30 psi
Oil temperature:
Normal .. . .180-210°F.
Maximum . . . . . 250° F.

h. Brake Hydraulic Pump.

Manufacturer . . . . . Borg-Warner
Part No. PD2-2-55-ERS-2-L01
Rating, each section . . . . 6 gpm at 2800 rpm and 1800 psi
Rotation (viewed from drive end). . . . . ..CCW

i. Steering Hydraulic Pump.

Manufacturer . . . . . Borg-Warner
Part No. MHD3-23EH5-1R01
Rating .. . .30 gpm at 2800 rpm and 1800 psi
Rotation (viewed from drive end) . . . .CW

j. Main Hydraulic Pump.

Manufacturer Borg-Warner
Part No. MHD3-3-28-12-EZ5-1R01
Rating at 2800 rpm and 1600 psi
Large section . . . .35 gpm
Small section . . . .15 gpm
Rotation (viewed from drive end) . . . .CW

k. Hydraulic Cylinders (Model RTL10).

(1) Extension cylinder.

Manufacturer . . . Cascade Mfg. Co.
Part No 4C621455A
Inside diameter . 4½ in.
Stroke . . . .445/8 in.

(2) *Lift cylinder.*

Manufacturer . . . . . Cascade Mfg. Co.
Part No. 4C621442A
Inside diameter 6 in.
Stroke .....32 3/4 in.

(3) Lock cylinder, crab steering.

Manufacturer ..... Cascade Mfg. Co.
Part No. 4C900092
Inside diameter:
Large . . . . . 3.280-3.282 in.
Small ... . 2.780-2.782 in.

(4) Lock cylinder, 2 wheel steering.

Manufacturer . . . . . Cascade Mfg. Co.
Part No 4C900118
Inside diameter:
Large . . . . . 333/4 in.
Small ... . 3¼ in.

(5) *Lock cylinder, 4 wheel steering.*

Manufacturer . . .. Cascade Mfg. Co.
Part No 4C900057
Inside diameter:
Large .. . .3.280-3.282 in.
Small . . . . . 2.780 -2.782 in.

(6) *Oscillation cylinder, front.*

Manufacturer . . . . . ., Cascade Mfg. co.
Part No 4C621508AC621508A
Inside diameter .. .. 4 ¾ in.
Stroke . . . .7 3/16 in.

(7) *Oscillation cylinder, rear.*

Manufacturer . . . . . Cascade Mfg. co.
Part No..... 4C621519B
Inside diameter . . 4 ¾ in.
Stroke . . . .10 9/16 in.

(8) *Side Shift cylinder.*

Manufacturer .. Cascade Mfg. Co.
Part No 4C621467A
Inside diameter .. 4 ¼ in.
Stroke . . . . . 34 ½ in.

(9) *Slave cylinder.*

Manufacturer .. . . . Cascade Mfg. co.
Part No 4C621386U
Inside diameter 6 ½ in.
Stroke . . . .245 /8 in.

(10) *Steering cylinder.*

Manufacturer . Cascade Mfg. co.
Part No. 4C621479A
Inside diameter .. .. 3 in.
Stroke ....6 7/8 in.

(11) *Tilt cylinder.*

Manufacturer Cascade Mfg. Co.
Part No. . . . . 6 ½ in.
Stroke. ... ...33 in. ..33 in.

(12) *Fan disconnect cylinder (Model RTL10).*

Manufacturer Cascade Mfg. Co.
Part No 2C900031
Inside diameter 1.5-1.505 in.
Stroke . . . . . 2 . . . .2 in.

l. Hydraulic cylinders (Model RTL10-1).

(1) *Lift cylinder.*

Manufacturer . . PM Corp.
Part No. F10801
Stroke . . . . . 323/ 4 in.
Diameter, ...6 in.

(2) *Extension cylinder.*

Manufacturer . . PM Corp.
Part No F10802
Stroke . . . .445/ 8 in.
Diameter, ...4 ½ in.

(3) *Tilt cylinder.*

Manufacturer ., ... PM Corp.
Part No. F10804
Stroke . . . .33 in.
Diameter . . . .6 ½ in.

(4) *Slave cylinder.*

Manufacturer ..... PM Corp.
Part No. F10803
Stroke ..... 24⅝ inch
Diameter ..... 6½ inch

(5) *Side shift cylinder.*

Manufacturer . . . . . PM Corp.
Part No. F10805
Stroke . . . .34 ½ inch
Diameter . . . . . 4 17/64 inch

(6) *Oscillation cylinder, front.*

Manufacturer . . . . . .PM Corp.
Part No. F10800
Stroke . . . .7 3/16 inch
Diameter . . . . . 4 49/64 inch

(7) *Steering cylinders.*

(a) Steering cylinder.

Manufacturer . . . . PM Corp.
Part No. F10806
Stroke . . . .6 13/16 inch
Diameter . . . .3 inch

(6) *Two wheel lock cylinders.*

Manufacturer . . . . . PM Corp.
Part No. A2-3561
Stroke . . . .8 3/8 inch
Diameter . . . .3 3/4 inch

(c) Four wheel lock cylinders.

Manufacturer . . . . . PM Corp.
Part No. A6-3561
Stroke . . . .25 3/8 in.
Diameter. . . . . ..3 19/64 inch

m. Brake Treadle Valve.

Manufacturer . . . . . Bendix Corp.
Part No. 610795

n. Steering Value.

Manufacturer . . . . . Char-Lynn Co.
Model YU2-11

o. Tire Specifications.

Size . . . . . 20.5 x 25
Ply rating 16
Tread design . . . . . Directional
Pressure :
Front . . . . . 50 psi
Rear . . . . . 45 psi

p. Brakes.

Manufacturer . . . . . B. F. Goodrich
Type . . . . . Expander tube
Part No. 2-1019

q. Automatic Brake Adjuster.

Manufacturer . . . . . B. F. Goodrich
Type . . . . In-line
Part No. 107-193

r. Capacities.

Engine crankcase . . . . . 20 qt.
Transmission . . . . . 7.5 gal.
Fuel tank . . . . . 110 gal.
Cooling system . . . .30 qt.
Hydraulic reservoir, main . . 152 qt.
Brake reservoir . . . . . 30 qt. (Model RTL10)
Wheel hub (planetary drive) . . ..4 qt. each
Differential . . . . . 10 qt. each

s. Nut and Bolt Torque Date. Torque valves expressed in foot pounds for clean dry threads (unless otherwise specified).

(1) *Engine.*

Air box cover bolts:
¼ in. thick clamp 8-10
¼ in. thick clamp 10-15
Air inlet housing bolts 16-20
Blower cam retainer to coupling bolts 8-10
Blower drive to flywheel housing bolts 20-25
Blower front end plate bolts 20-25
Blower timing gear to rotor shaft bolts 25-30
Blower thrust washer retaining bolt 54-59
Blower to block bolts 55-60
Can follower guide bolts 12-15
Camshaft nuts 300-325
Camshaft gear nut retainer bolts 35-39
Connecting rod nuts 50-5
Camshaft end bolt 200.220
Cylinder block rear end plate:
sin. 30-35
½ in..... 71-75
Cylinder head bolts . . . .170-180 (lubricated)
Exhuast manifold nuts 30-35
Flywheel bolts 130-140
Flywheel housing bolts 25-30
Fuel connector 20-28
Fuel line nuts 12-15
Fuel pump drive gear bolt 71-75
Governor drive plate bolts 8-10
Governor to blower front end plate bolts . . . 20-25
Governor to flywheel housing bolts 10-12
Idler gear hub and spacer bolts:
5/ 16 x 18 19-23
3/8 x 16 40-45
Injector clamp bolt 25-30
Injector control shaft bracket bolts 10-12
Injector filter cap 65-75
Injector nut 55-65
Main bearing bolts . . . .120-130 (lubricated)
Main bearing cap stabilizer to block bolts . . 70-75
Rocker arm shaft bracket bolts 50-55
Water pump cover screws 6-7

(2) Standard engine (unless previously listed).

Size	*Torque*	*Size*	*Torque*
1 / 4-20	7-9	9/ 16-12	90-100
1 / 4-28	8-10	9/ 16-18	107-117
5/ 16-18	13-17	5/8-11	137-147
5/ 16-24	15-19	5/8-11	168-178
3/8-16	30-35	3/4-10	240-250
3/ 8-24	35-39	3/4-16	290-300
7/ 16-14	46-50	7/ 8-9	410-420
7/16	57-61	7/8-14	475485
1/2-13	71-75	1-8	580-590
1 / 2-20	83-93	1-14	685-695

(3) *Transmission:*

Transfer idler gear spindle retainer bolt 42-45
Transfer gear cover bolts 26-32
Oil screen cover bolt 8-10
Front output shaft bearing retainer bolts 26-32

Front output shaft flange bolts ,.,,,.,,.....41-49
Forward planetary carrier bearing retainer bolts 26-32
Transfer gear housing to transmission housing bolts 42-50
Converter housing to transmission housing bolts 42-50
Converter pump cover bolts 33-40
Converter pump mounting bolts 26-32
Pressure regulator valve plugs 90-100
Parking brake flange and drum bolts 41-49
Brake backing plate bolts 117-140

(4) Axle.

Differential bearing adjuster lock screw:
9/16-12 . . . .' '15-125
5/8-11 1160-175
Differential bearing cap to carrier bolts:
5/8-11 150-170
11/16-11 210-250
13/16-11 350-425
Differential carrier to axle housing bolts 175
Differential case (axle) bolts:
7/16-14(grade5) 445-55
7/16-14(grade 7) 55-65
½-13 90-105
9/16-12 135-155

(5) *Ring gear to differential case.*

7/16-20 50-60
½-20 90-100
5/8-18 190-200

(6) *Drive pinion nut.*

1-20 225-350
1-1/8-18 325-450
1-¼-12 400-600
1-½-18 500-700
1-¾-12. 600-800

(7) Drive pinion bearing cage to carrier bolts.

7/16-12 (grade 5),.., ...115-125
9/16-12 (grade 7) 135-155
5/8-ll (grade 5) 160-175
%-ll (grade 7) 170-190

(8) Inspection cover to axle housing screws.

7/16-14 (grade 3) 35-50
7/16-14 (grade 5) ., ...45-55
7/16 -20 Stud-nut 70-85

(9) Companion flange (yoke). 600

(10) Ball joint assembly to housing bolts.

¾ 330
7/8 500

(11) *Ball housing bolts.* 250

(12) *Wheel spindle to ball housing bolts* 160-180

(13) *Brake drum to wheel hub bolts.* 175

(14) *Wheel bearing nut.* 600

(15) *Automatic brake adjuster.*

Piston assembly screws... . . . . 15 in. lb.
Housing bolts . . . . . 206-226 in. lb.

(16) *Hydraulic control valves*

Seal retainer screws.....15-20
Plunger cap 30
Plunger cover screws. 15-20

(17) *Hydraulic cylinder rod nut.*

Extension, lift and oscillation 500-600
Side shift ., ... 600-700
Slave 900-1000
Steering 200-250
Tilt 400-550

(18) *Steering control unit.*

Check seat . . . . . 150 in. lb.
Mounting plate screws . . . .250 in. lb.
End cap-screws . . . . . 150 in. lb.
Unit to column screws . . . .280 in. lb.

(19) *Miscellaneous.*

Hydraulic pump cover bolts..... 28-32
Brake frame bolts, ... 38-42
Transmission cut off valve plugs 25

t. Adjustment Data.

(1) *Engine.*

Valve clearance:
Cold setting 0.026
Hot setting 0.023-0.025
Injector timing dimension . .....1.460 in.
Govern or low speed spring cap to high speed spring plunger gap .... 0.0015 in.
Belt deflection . . . . ¾ in.

(2) *Electrical.*

Generator regulator voltage . . . .21.5 -29.5 V
Initial setting . . . . . 28.2 *V*
Voltage and current regulator air gap .....0.084 in.
Cutout relay air gap . . . .0.048 in.
Cutout relay point opening . . . . . 0.035 in.
Cutout relay closing voltage . . . .25-27 V
Initial setting . . . .26 V
Current regulator setting . . . .23-27 amp
Initial setting . . . .2.5 amp

(3) *Differential.*

Drive gear backlash . . . .0.006-0.016 in.
Differential (pinion bearing) preload ..... 15-35 in. lb.

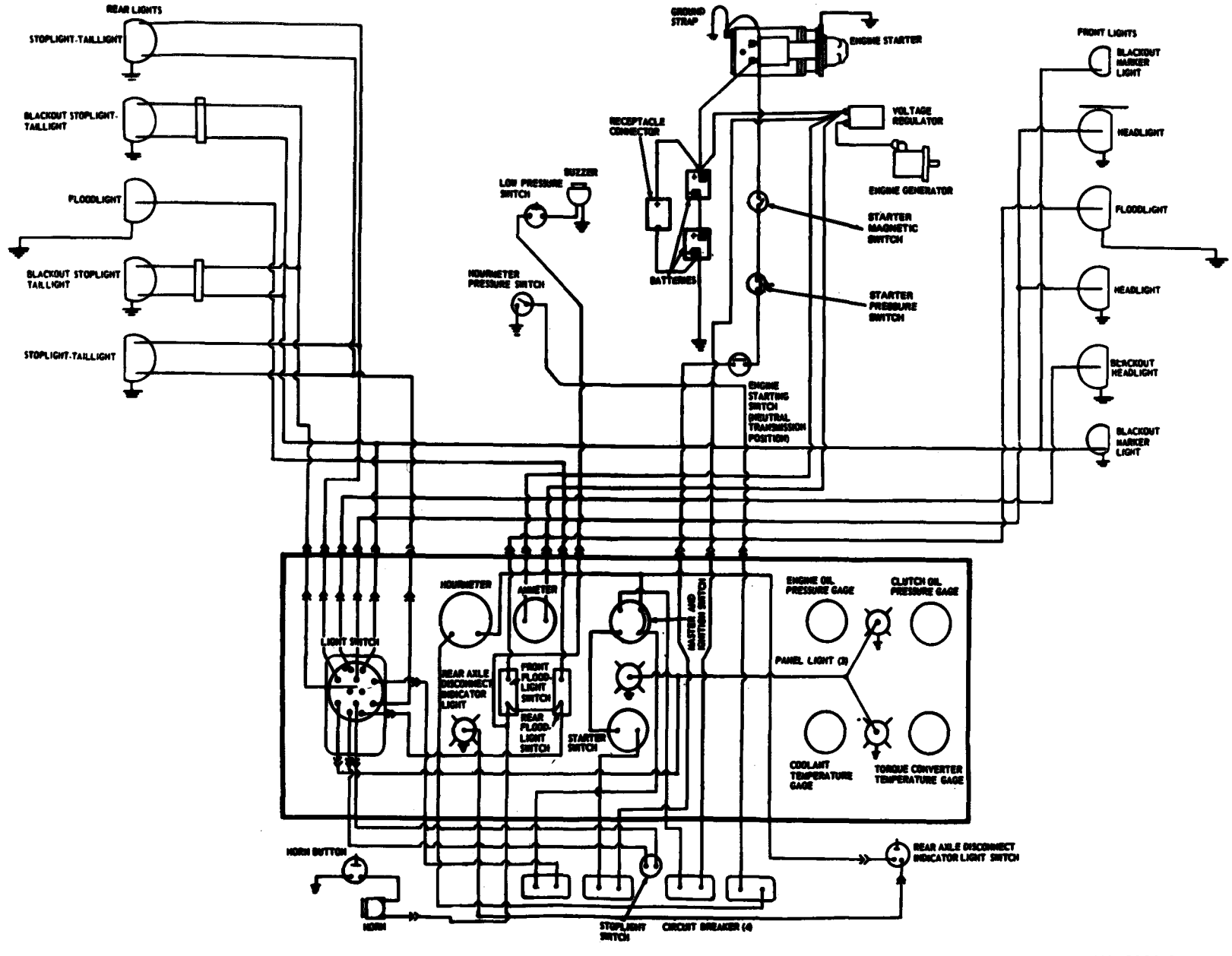
(4) *Brake control (treadle) valve.*

Brakeline pressure . . . .350-400 psi
Low limit [accumulator) pressure .....550-650 psi
High limit (accumulator) pressure .....1300 psi
Hydraulic control valve relief pressure (all) .....2000 psi

u. Engine Repair and Replacement Standards. Table 1-1 lists the manufacturer's sizes, tolerances, clearances, and maximum allowable wear and clearance.

v. Schematic Wiring Diagram. Refer to figures 1-1 and 1-2 for the schematic wiring diagram.

Figure 1-1. Schematic wiring diagram Model RTL10.
(Located in back of manual).



ME 3930-243-34/1-2

Figure 1-2. Schematic wiring diagram Model RTL10-1.

w. Hydraulic Piping Diagram. Refer to figures 1-3 and 1-4 for the hydraulic piping diagram.

Figure 1-3. Hydraulic piping diagram (Model RTL10)
(Located in back of manual).

Figure 1-4. Hydraulic piping diagram (Model RTL10-1)
(Located in back of manual).

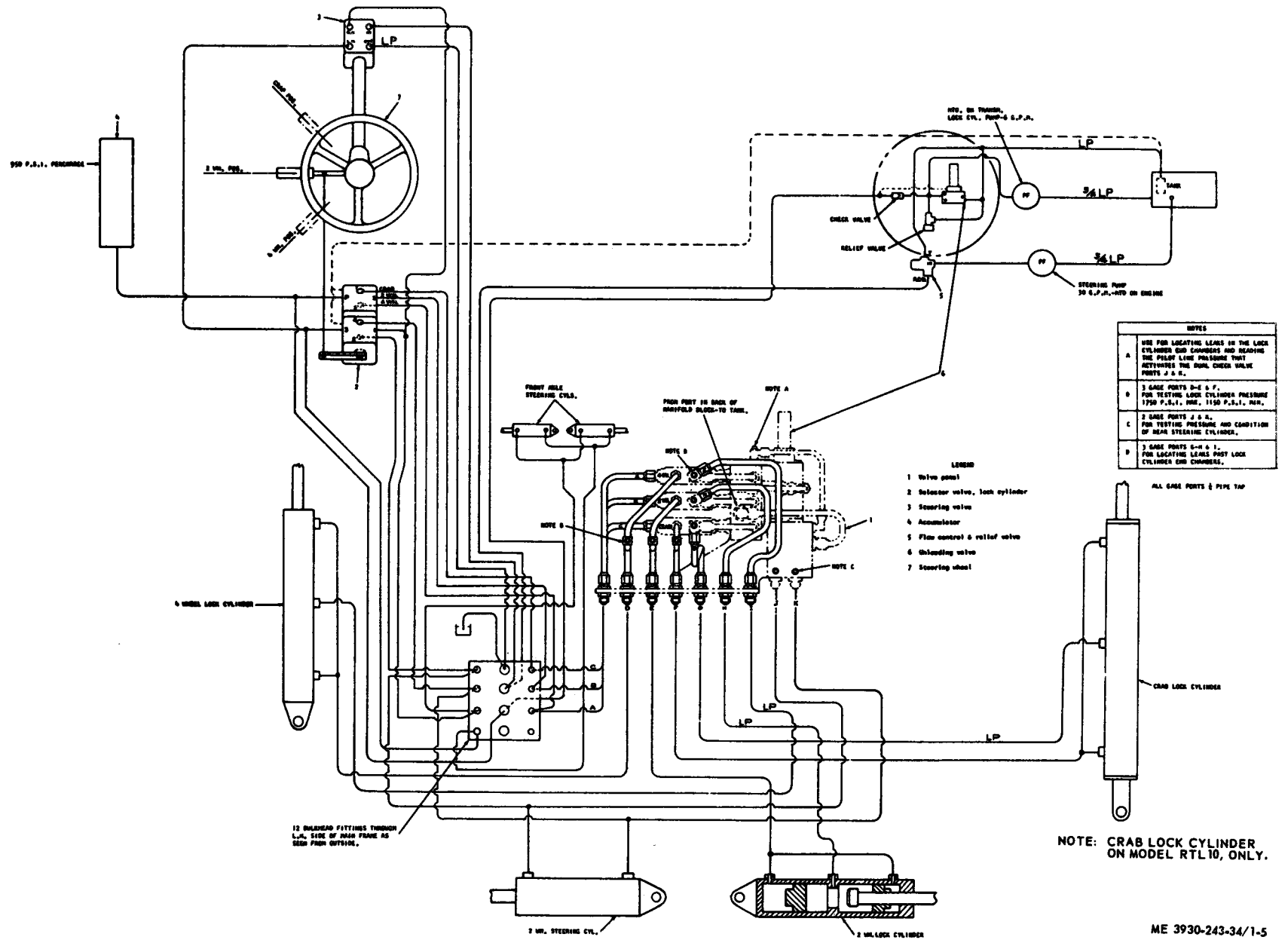


Figure 1-5. Hydraulic steering system diagram.

x. Transmission Repair and Replacement Standards. Table 1-2 lists the manufacturer's sizes, tolerances, clearances, and maximum allowable wear and clearance.

Table 1-1. Repair and Replacement Standards

Component points of measurement	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
Cylinder Block					
Cylinder bores	Minimum	Maximum	Minimum	Maximum	
Top	4.5195	4.5215			4.5235
Center	4.4865	4.4880			4.4900
Bottom	4.3565	4.3575			4.3595
Out-of-round		0.0015			
Taper		0.0015			
Top surface transverse flatness					0.003
Top surface longitudinal flatness					0.006
Depth of counterbores (top surface)					
Cylinder head seal strip groove	0.097	0.107			
Oil holes	0.092	0.098			
Water holes	0.109	0.1150			
Main bearing bore (vertical axis)	3.751	3.752			
Cylinder liner counterbore					
Diameter	4.820	4.835			
Depth	0.300	0.302			
Cylinder Liner					
Upper seal ring surface (od)	4.485	4.486			
Lower seal ring surface (od)	4.355	4.356			
Inside diameter	3.8752	3.8767			
Out-of-round		0.002			0.003
Taper		0.001			0.002
Depth of flange below block	0.0465	0.0500			0.0500
Cylinder Head					
Cam follower bore	1.0626	1.0636			
Valve seat insert counterbore					
Diameter	1.159	1.160			
Depth	0.300	0.312			
Longitudinal warpage					0.005
Transverse warpage					0.004
Minimum height					4.376
Rocker Arms and Shafts					
Rocker arm shaft dia.	0.8735	0.8740			
Injector rocker arm bushing ID	0.8750	0.8760			
Valve rocker arm bore	0.8753	0.8763			
Injector rocker arm bushing to shaft clearance	0.0010	0.0025			0.004
Valve rocker arm bore to shaft clearance	0.0013	0.0028			0.004
Cam Followers					
Diameter	1.060	1.061			
Follower to head clearance	0.0016	0.0036			0.006
Width of roller slot	0.5635	0.5685			
Roller pin hole diameter	0.4362	0.4370			
Cam Follower Rollers and Pins					
Roller OD	0.902	0.907			
Roller bushing ID	0.4390	0.4395			
Roller pin OD	0.4374	0.4377			
Pin to bushing clearance	0.0013	0.0021			0.010 horiz.
Side clearance roller in follower	0.015	0.023			
Valves					
Stem diameter	0.2480	0.2488			
Stem to guide clearance	0.0017	0.0035			0.005
Valve head relation to cylinder head	flush	0.024			0.039
Valve Guides					
Inside diameter	0.2505	0.2515			
Distance below top of head	0.010	0.040			
Valve Seat Inserts					
Outside diameter	1.1605	1.1615			
Seat width	3/64	5/64			
Valve seat runout		0.002			

Table 1-1. Repair and Replacement Standards — Continued

Component points of measurement	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
Crankshaft	**Minimum**	**Maximum**	**Minimum**	**Maximum**	
Main bearing journal dia.	3.499				
Connecting rod journal dia.	2.749	2.750			
Journal out-of-round		0.00025			0.002
Journal taper		0.0005			0.002
Thrust washer thickness	0.1205	0.1220			
Crankshaft End Clearance	0.004	0.011			0.018
Main Bearing Thickness	0.1240	0.1245			0.1230
Main Bearing Clearance	0.0025	0.0057			0.007
Connecting Rod					
Lower bore diameter	3.0015	3.0025			
Upper bore diameter	1.6000	1.6010			
Piston pin bushing ID	1.3760	1.3765			
Connecting Rod Bearing Thickrtem	0.1247	0.1252			0.1230
Connecting Rod Bearing Clearance	0.0016	0.0046			0.0060
Connecting Rod Side Clearance	0.008	0.016			
Piston Pin					
Diameter	1.3746	1.3750			
Clearance pin to piston bushing	0.0025	0.0034			0.010
Clearance pin to rod bushing	0.0010	0.0019			0.010
Piston					
Diameter (at skirt)	3.8693	3.8715			
Piston to liner clearance	0.0037	0.0075			0.010
Out-or-round taper		0.0005			
Piston pin bushing ID	1.3775	1.3780			
Ring Gap (Compression)	0.020	0.046			
Ring Gap (Oil)	0.010	0.025			
Ring to Groove Clearance					
No. 1 (top)	0.007	0.010			0.014
No. 2	0.007	0.010			0.014
No. 3 and 4	0.005	0.008			0.013
Oil ring	0.0015	0.0055			0.008
Camshaft					
Journal diameter	2.1820	2.1825			
Runout at center bearing (when mounted on end bearings)		0.002			
Thrust washer thickness	0.028	0.210			
End thrust	0.008	0.015			0.019
Camshaft Bearing ID	2.187	2.188			
Camshaft Bearing Clearance	0.0045	0.0060			0.008
Gear Backlash	0.003	0.005			0.007
Blower Drive Gear Shaft End Play	0.004	0.006			
Blower Drive Gear Thrust					
Washer Thickness	0.093	0.103			
Idler Gear					
Bearing ID	2.186	2.187			
Hub OD	2.1825	2.1835			
Clearance, bearing to hub	0.0025	0.0045			0.007
Thrust washer thickness	0.118	0.120			
End play	0.006	0.013			0.017
Blower					
Gear backlash	0.0005	0.0025			0.0035
Thrust plate to thrust washer clearance	0.001	0.003			
Rotor lobe to housing clearance (outlet side)	0.004				
Rotor lobe to housing clearanee (inlet side)	0.010				
Lobe clearance (closest position)	0.010				
Front end plate to rotor clearance	0.008				
Rear end plate to rotor clearance	0.012				
External Splined Clutch Plate					
Thickness	0.107	0.123			0.097
Cone					0.030
Internal Splined Clutch Plate					
Thickness	0.150	0.156			0.130
Cone					0.012
Groove depth					0.005

Table 1-1. Repair and Replacement Standards-Continued

Component points of measurement	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
Reverse Planetary and Clutch					
Clutch anchor (front) facewear					0.020
Total (clutch wear) permissible					0.307
Forward Planetary and Clutch					
Bushing clearance					0.010
Clutch anchor (rear) face wear					0.020
Total clutch wear permissible					0.162
Intermediate Range Clutch and Transmission Main Shaft					
Bushing to shaft clearance					0.010
High range carrier (front) face wear					0.010
Piston face					0.010
Total clutch wear permissible					0.080
High Range Planetary and Clutch					
Clutch anchor (front) face wear					0.020
Total clutch wear permissible					0.062
Low Range Planetary and Clutch					
Clutch anchor (rear) face wear					0.020
Total clutch wear permissible					0.134

CHAPTER 2

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT

2-1. Tools and Equipment

Tools, equipment, and repair parts issued, with or authorized for the forklift are listed in the basic issue items list, TM 10-3930-243-12.

2-2. Special Tools and Equipment

No special tools or equipment are required for direct support and general support maintenance of the forklift.

2-3. Maintenance Repair Parts

Repair parts and equipment are listed and illustrated in the repair parts and special tools list covering direct support and general support maintenance for this equipment in TM 10-3930-243-35P.

Section II. TROUBLESHOOTING

2-4. General

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the forklift truck and its components. Malfunctions which may occur are listed in table 2-1. Each malfunction stated is followed by a list of probable causes of the trouble. The corrective action recommended is described opposite the probable cause.

Table 2-1. Troubleshooting

Malfunction	Probable Cause	Corrective Action
1. Engine Hard to Start or Fails to start.	*a.* Batteries low.	*a.* Charge or replace (TM 10-3930-243-12).
	b. Fuel injector defective.	*b.* Replace injector (para 3-14).
	c. Cylinder head gasket defective.	*c.* Replace gasket (para 3-19).
	d. Valves defective	*d.* Repair or replace valve (para 3-19).
	e. Push rods bent.	*e.* Replace push rods (para 3-19).
	f. Blower defective.	*f.* Repair or replace blower (para 3-5).
	g. Engine speed governor defective.	*g.* Replace or repair governor (para 3-7).
	h. Piston rings worn or broken.	*h.* Replace rings (para 3-26).
	i. Flywheel gear defective.	*i.* Replace gear (para 3-21).
	j. Camshaft gear defective.	*j.* Replace gear (para 3-21).
2. Engine Lacks Power.	*a.* Valves defective.	*a.* Replace valves (para 3-19).
	b. Piston or piston rings defective.	*b.* Replace piston or rings (para 3-26).
	c. Rocker arms and / or push rods defective,	*c.* Replace rocker arm or push rod (para 3-19).
3. Engine Misses or Runs Erratically.	*a.* Fuel injector defective.	*a.* Replace or repair injector (para 3-14).
	b. Valves defective.	*b.* Replace or repair valve (para 3-20).
	c. Piston rings defective.	*c.* Replace ,ti,~, ...para 3-26).
4. Engine Overheats.	*a.* Radiator defective.	*a.* Replace or repair radiator (para 3-36).
	b. Cylinder head cracked.	*b.* Replace head (para 3-19).

Table 2-1. Troubleshooting-Continued

Malfunction	Probable Cause	Corrective Action
	c. Valves defective.	*c.* Replace or repair valves (para 3-20).
	d. Water pump defective.	*d.* Repair or replace pump (para 3-8).
5. Engine Exhaust Smokey.	*a.* Fuel injector defective.	*a.* Replace or repair injector (para 3-13).
	b. Piston rings defective.	*b.* Replace rings (para 3-26).
	c. Piston cracked or broken.	*c.* Replace piston (para 3-26).
6. Engine Stops Suddenly.	*a.* Piston or connecting rod broken.	*a.* Replace piston or connecting rod (para 3-26).
	b. Camshaft or camshaft gear defective.	*b.* Replace camshaft or camshaft gear (para 3-30).
	c. Crankshaft defective.	*c.* Replace crankshaft (para 3-33).
7. Engine Noisy.	*a.* Flywheel loose or defective.	*a.* Tighten or replace flywheel (para 3-21).
	b. Connecting rod bearings defective.	*b.* Replace bearings (para 3-26).
	c. Main bearings defective.	*c.* Replace bearings (para 3-32).
	d. Piston pins loose or broken.	*d.* Replace pins (para 3-26).
8. Engine Has Low or No Oil Pressure.	*a.* Oil pump defective.	*a.* Replace pump (para 3-25).
	b. Main bearings defective.	*b.* Replace bearings (para 3-32).
	c. Connecting rod bearings defective.	*c.* Replace bearings (para 3-26).
	d. Sending units defective.	*d.* Replace units.
9. Starter Fails to Crank Engine.	*a.* Starter armature defective.	*a.* Replace armature (para 3-9).
	b. Flywheel ring gear defective.	*b.* Replace flywheel ring gear (para 3-21).
	c. Batteries low.	c. Charge or replace (TM 10-3930-243-12).
10. Engine Oil Consumption High.	*a.* Piston rings defective.	*a.* Replace ring (para 3-26).
	b. Piston defective.	*b.* Replace piston (para 3-26).
	c. C ylinder sleeves defective.	c. Replace sleeves (para 3-26).
	d. Valve guides worn.	*d.* Replace guides (para 3-19).
	e. Check for leaks.	*e.* Repair leaks.
11. Engine Generator Ammeter Shows Low or No Charging Rate When Batteries Are Low.	*a.* Generator brush holders defective.	*a.* Replace brush holders (para 3-9).
	b. Regulator faulty.	*b.* Adjust or replace.
12. Engine Generator Ammeter Shows Charge When Batteries Are Fully Charged.	Engine generator field winding. grounded	Replace generator (para 3-9).
13. Generator Overheats.	*a.* Armature shorted or grounded.	*a.* Replace armature (para 3-9).
	b. Bearing defective.	*b.* Replace bearings (para 3-9).
14. Truck Will Not Move.	*a.* Torque convertor defective.	*a.* Replace or repair torque convertor (para 3-38).
	b. Transmission defective.	*b.* Replace or repair transmission (para 3-38).
	c. Differential defective.	*c.* Replace or repair differential (para 3-46).
15. Forks Will Not Lift.	*a.* Hydraulic pump defective.	*a.* Repair pump (para 3-71).
	b. Lift cylinder defective.	*b.* Repair cylinder (para 3-73).
	c. Control valve defective.	*c.* Replace valve (para 3-72).
16. Forks Will Not Tilt.	*a.* Tilt cylinder defective.	*a.* Repair cylinder (para 3-73).
	b. Control valve defective.	*b.* Replace valve (para 3-72).
	c. Hydraulic pump defective.	*c.* Repair pump (para 3-71).
17. Excessive Looseness in Steering.	*a.* Steering cylinder defective.	*a.* Repair cylinder (para 3-64).
	b. Steering valve defective.	*b.* Repair valve (para 3-59).

Table 2-1. Troubleshooting-Continued

Malfunction	Probable Cause	Corrective Action
18. Truck Steers Hard.	a. Hydraulic pump defective. *b.* Steering cylinder defective. c. Steering valve defective.	*a.* Repair pump (para 3-57). *b.* Repair cylinder (para 3-64). c. Repair valve (para 3-59).
19. Fork Does Not Shift to Side.	*a.* Sideshift cylinders defective. *b.* Hydraulic pump defective. *c.* Control valve defective.	*a.* Repair cylinders (para 3-78). *b.* Repair pump (para 3-71). c. Replace valve (para 3-72).
20. Truck Does Not Stop When Brakes Are Applied.	*a.* Brake shoes defective. *b.* Hydraulic brake cylinder defective. *c.* Air in brake, lines. *d.* Accumulator not charged.	*a.* Replace shoes (para 3-50). *b.* Replace cylinder (para 3-50). *c.* Bleed brake system (TM 10-3930-243-12). *d.* Charge, repair or replace (para 3-54).

Section III. GENERAL MAINTENANCE

2-5 General

Refer to TM 10-3930-243-12 for analysis of operation and for organizational maintenance instructions.

2-6. Wiring Harness

The electrical circuits in the forklift are completed by individual wire leads or by leads laced or enclosed to form a wiring harness. When testing, repairing, or replacing the individual wires or harness refer to the wiring diagrams (figs. 1-1 and 1-2).

2-7. Cleaning and Inspection

a. Cleaning. Dirt can cause malfunctions. All parts must be clean to permit effective inspection. At assembly, it is very important that no dirt or foreign matter enters the transmission or engine. Even minute particles can cause the malfunction of close-fitting parts such as valves.

(1) *Cleaning parts.*

(a) All metallic parts except bearings should be cleaned thoroughly with volatile mineral spirits, or by the steam cleaning method. Do not use caustic soda solution for steam cleaning.

(b) Parts should be dried with compressed air. Steam-cleaned parts should be oiled immediately after drying.

(c) Clean oil passages by working a piece of wire back and forth, through the passages and flushing them with spirits. Dry the passages with compressed air.

(d) Examine parts, especially oil passages, after cleaning, to make certain they are entirely clean. Reclean them if necessary.

(2) *Cleaning bearings.* Bearings that have been in service should be thoroughly washed in volatile mineral spirits.

NOTE

Never dry bearings with compressed air. Do not spin bearings while they are not lubricated.

b. Inspection.

(1) Inspecting cast parts, machined surfaces.

(a) Inspect bores for wear, grooves, scratches and dirt. Remove scratches and burrs with crocus cloth. Remove foreign matter. Replace parts that are deeply grooved or scratched.

(b) Inspect mounting faces for burrs, scratches, nicks, and foreign matter. Remove such defects with crocus cloth or a soft stone. If scratches are deep, replace the defective part.

(c) Inspect all machined surfaces for damage that could cause oil leakage or other malfunction of the part. Rework or replace the defective parts.

(2) *Inspecting bushings, thrust washers.*

(a) Inspect bushings for roundness, scores, burrs, sharp edges, and evidence of overheating. Remove scores with crocus cloth. Remove burrs and sharp edges with a scraper or knife blade. If the bushing is out-of-round, deeply scored, or excessively worn, replace it, using the proper size replacement.

NOTE

If it is necessary to cut out a defective bushing, be careful not to damage the bore into which the bushing fits.

(b) Inspect thrust washers for distortion, scores, burrs, and wear. Replace the thrust washer, if it is defective or worn. It is much less expensive to replace such parts than to replace converter elements or transmission gearing, which can fail due to defective bearings, bushings, or thrust washers.

(3) *Inspecting gears.*

(a) Inspect gears for scuffed, nicked, burred or broken teeth. If the defect cannot be removed with a soft stone, replace the gear.

(b) Inspect gear teeth for wear that may have destroyed the original tooth shape. If this condition is found, replace the gear.

(c) Inspect the thrust faces of. gears for scores, scratches and burrs. Remove defects with a soft stone. If scores and scratches cannot be removed with a soft stone, replace the gear.

Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND AUXILIARIE

2-8. General

This section provides instructions for removal and installation of the major components of the forklift truck. The major components in this section consist of the engine, torque convertor, transmission and transfer assembly, the mast column assembly, and the axle assembly. Refer to the appropriate paragraphs in this section for each assembly.

2-9. Engine

a. Removal.

(1) Remove the top panel, universal joint, fan pulley, radiator hoses, air intake duct, voltage regulator base, hoses, and lines (TM 10-3930-243-12).

(2) Refer to figure 2-1 and remove the engine.

b. Installation.

(1) Refer to figure 2-1 and install the engine.

(2) Install the lines, cables, hoses, voltage regulator base, air intake duct, radiator hoses, fan pulley, universal joint, and top panel (TM 10-3930-243-12).

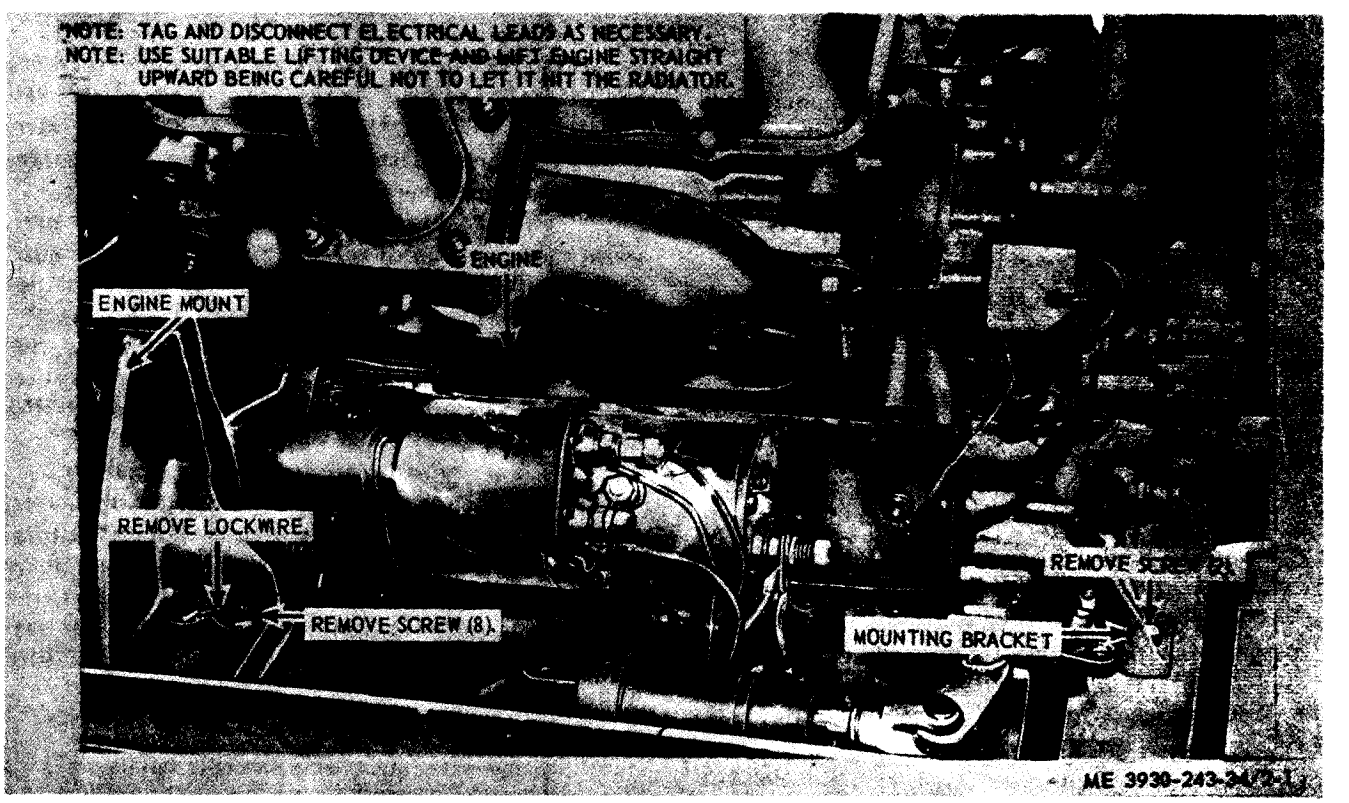


Figure 2-1. Engine, removal and installation.

2-10. Torque Converter, Transmission and Transfer Assembly

a. Removal.

(1) Remove the universal joints, top panel, hydraulic valves, linkage, lines and hoses (TM 10-3930-243-12).

(2) Remove the mast assembly (para 2-11).

(3) Refer to figure 2-2 and remove the torque convertor, transmission and transfer assembly.

b. Installation.

(1) Refer to figure 2-2 and install the torque convertor, transmission and transfer assembly.

(2) Install the mast assembly (para 2-11).

(3) Install the hydraulic valves, lines, hoses, linkage, universal joints and top panel (TM 10-3930-243-12).

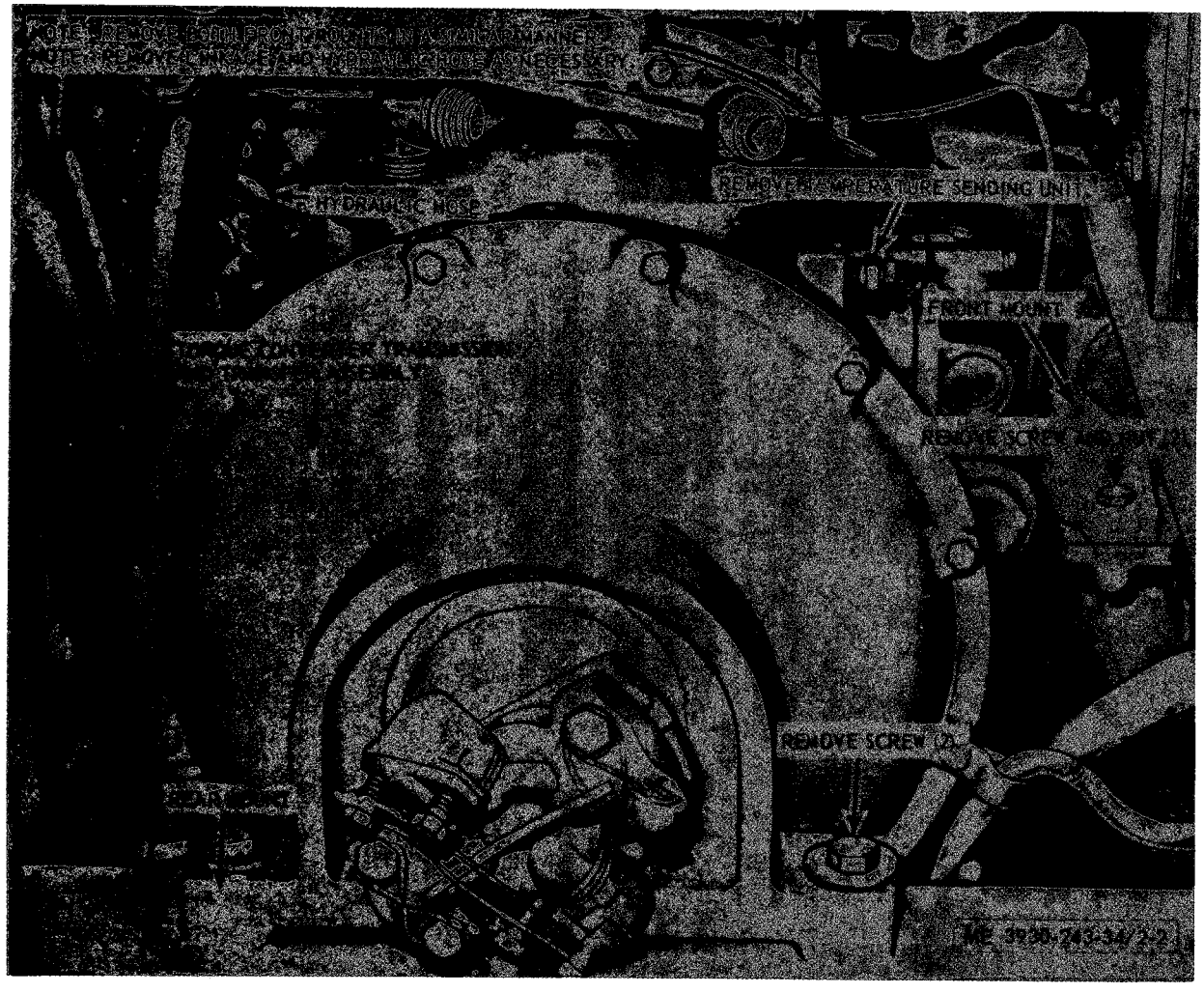


Figure 2-2. Torque convertor, transmission and transfer assembly, removal and installation.

2-11. Mast Column Assembly

a. Removal.

(1) Remove the overhead guard, top panel, tilt cylinder and fuel tank (TM 10-3930-243-12).

(2) Remove the lift cylinders (para 3-73).

(3) Refer to figure 2-3 and remove the mast column assembly.

b. Installation.

(1) Refer to figure 2-3 and install the mast column assembly.

(2) Install the lift cylinders (para 3-73).

(3) Install the fuel tank, tilt cylinder, top panel and overhead guard (TM 10-3930-243-12).

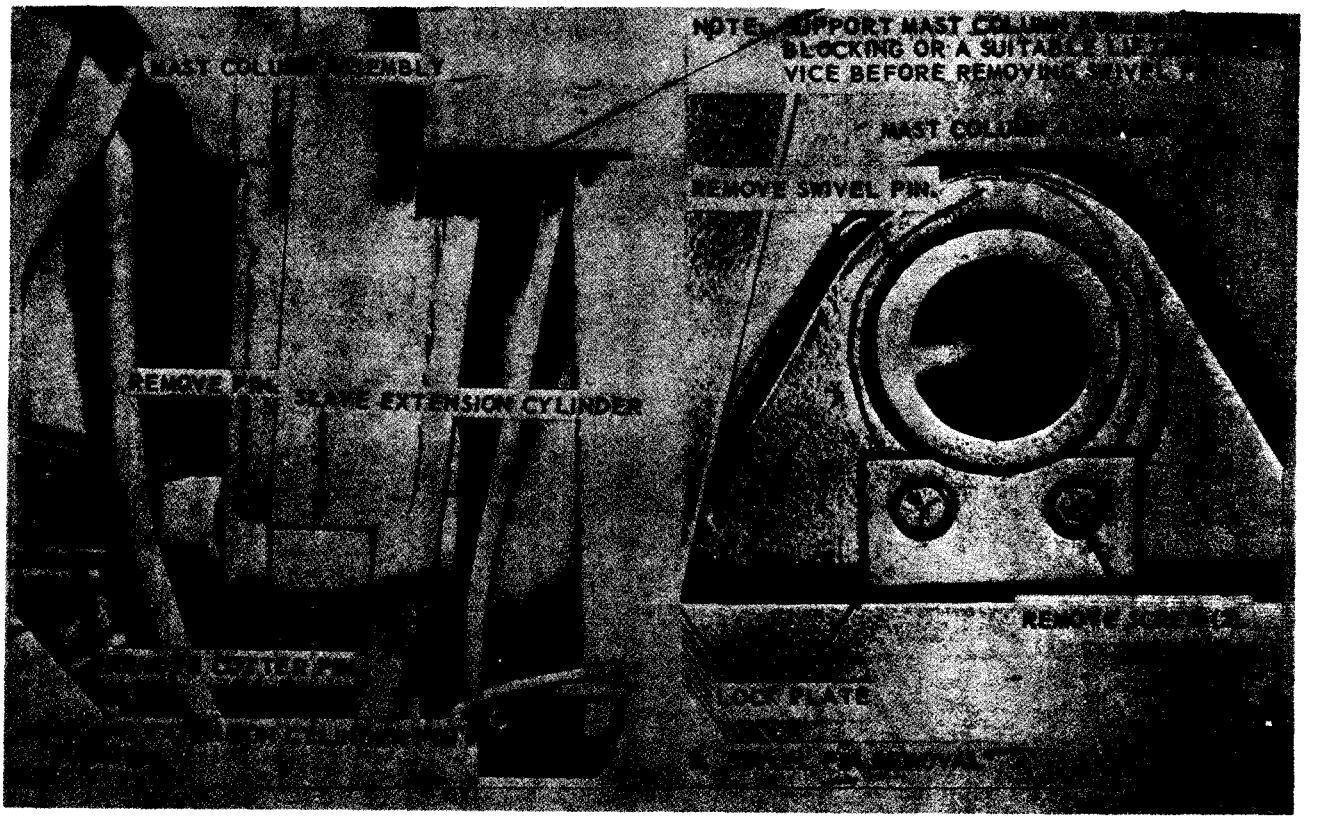


Figure 2-3. Mast column assembly, removal and installation.

2-12. Axle Assembly

a. Removal.

(1) Disconnect brake hoses, steering cylinder hoses, universal joint, and disconnect the oscillating cylinders and crabbing cylinders (TM 10-3930-243-12).

(2) Remove the mast column assembly (para 2-11).

(3) Refer to figure 2-4 and remove the axle assembly.

b. *Installation.*

(1) Refer to figure 2-4 and install the axle assembly.

(2) Install the mast column assembly (para 2-11).

(3) Connect the oscillating and crabbing cylinders, connect the universal joint, steering cylinder hose and brake hose (TM 10-3930-243-12).

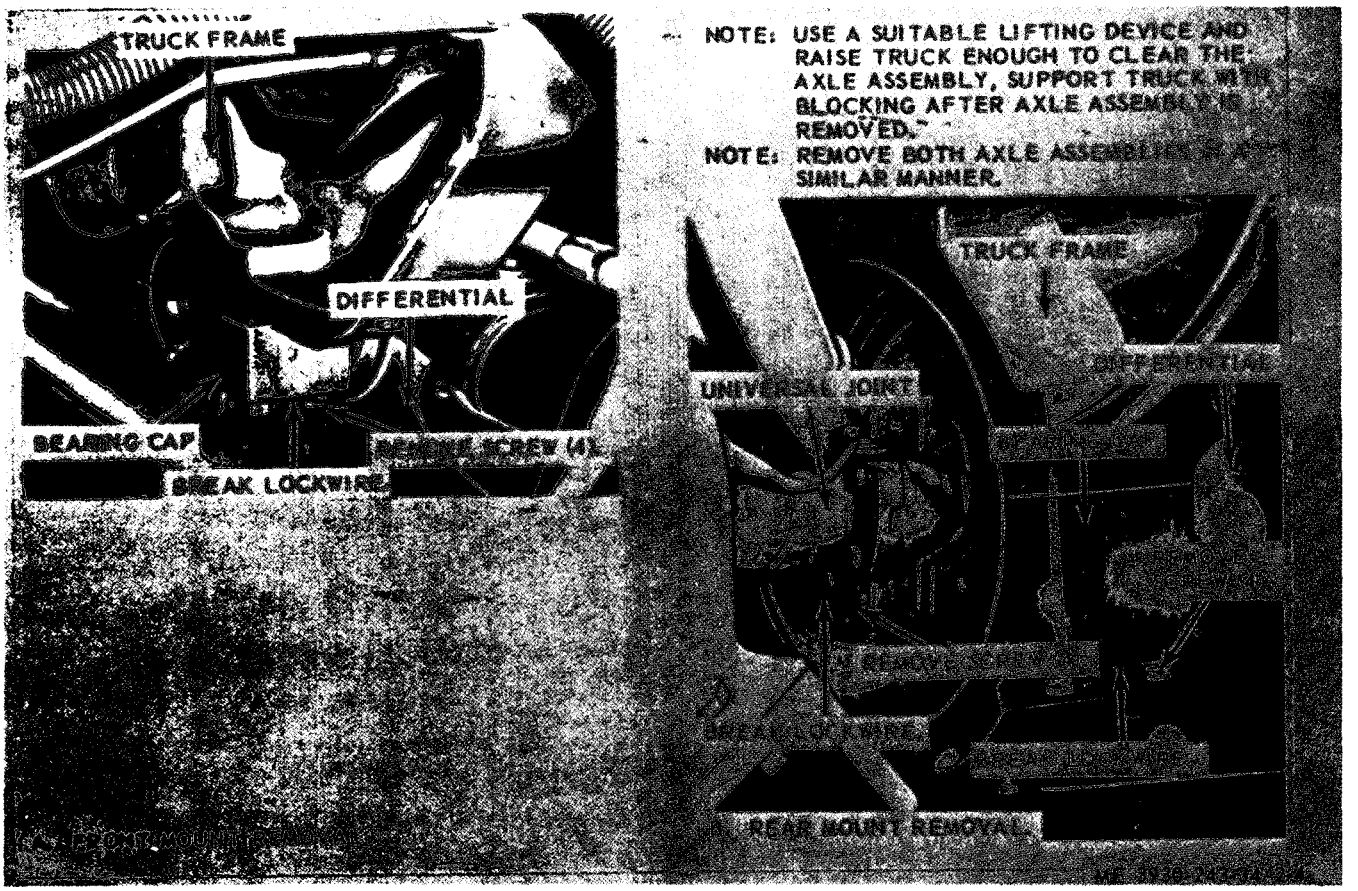


Figure 2-4. Axle assembly, removal and installation.

CHAPTER 3

REPAIR OF FORKLIFT

Section I. ENGINE ACCESSORIES

3-1. General

This section contains information on the maintenance of those items considered to be engine accessories. These items consist of the oil pump, oil cooler, air inlet housing, blower assembly, limiting speed mechanical governor, water pump, engine generator and starter.

3-2. Oil Pump and Crankshaft Pulley

a. General. The rotor type oil pump is bolted to inside of the lower engine front cover and driven directly by the crankshaft. Oil is directed to the lower engine front cover and then to a mail oil gallery in the cylinder block, under pressure, to the main bearings, balance shaft, and crankshaft bearings. The crankshaft pulley is used to drive the engine generator and the radiator fan.

b. Removal.

(1) Remove the engine (para 2-9).

(2) Remove the oil pan (fig. 3-1).

(3) Refer to figure 3-2 and remove the oil pump and crank shaft pulley.

c. Disassembly. Refer to figure 3-3 and disassemble the oil pump in numerical sequence.

NOTE

Clean pump thoroughly to remove all traces of dirt, sand, or foreign matter which might damage the pump. Discard all gaskets and replace with new one upon reassembly.

d. Inspection.

(1) The greatest amount of wear in the oil pump occurs on the lobes of the inner (10, fig. 3-3) and outer (11) rotor of each lobe. Clearance should not be less than 0.004 inch nor more than 0.011 inch.

(2) Using a micrometer depth gage, measure distance from face of pump body (7) to sides of inner (10) and outer (11). Clearance should not be less than 0.001 inch nor more than 0.0035 inch.

NOTE

Rotors are obtainable only in matched sets.

e. Reassembly. Reassembly is the reverse order of disassembly. Refer to figure 3-3 and reassemble the oil pump.

f. Installation.

(1) Refer to figure 3-2 and install the oil pump and crankshaft pulley.

(2) Install the oil pan (fig. 3-1).

(3) Install the engine (para 2-9).

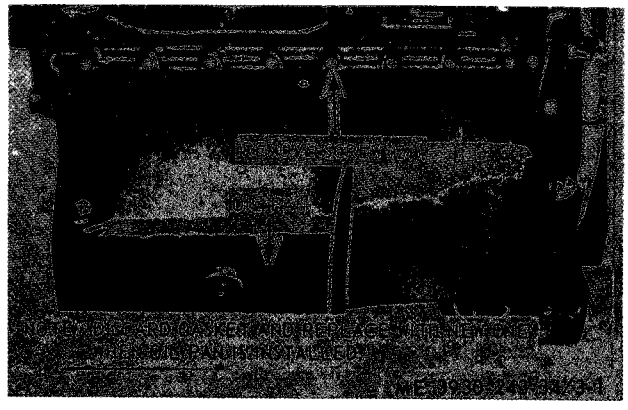


Figure 3-1. Oil pan, removal and installation.

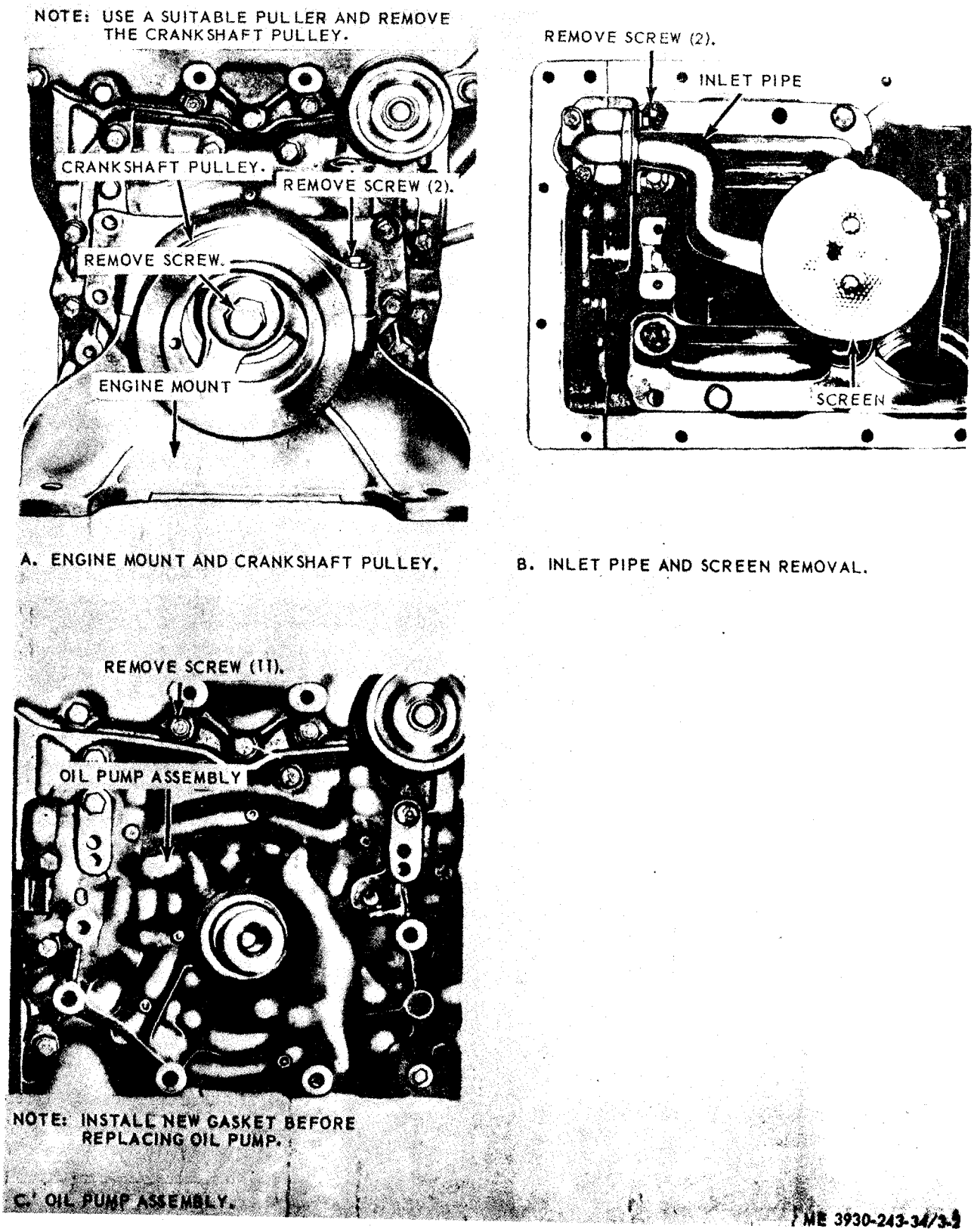
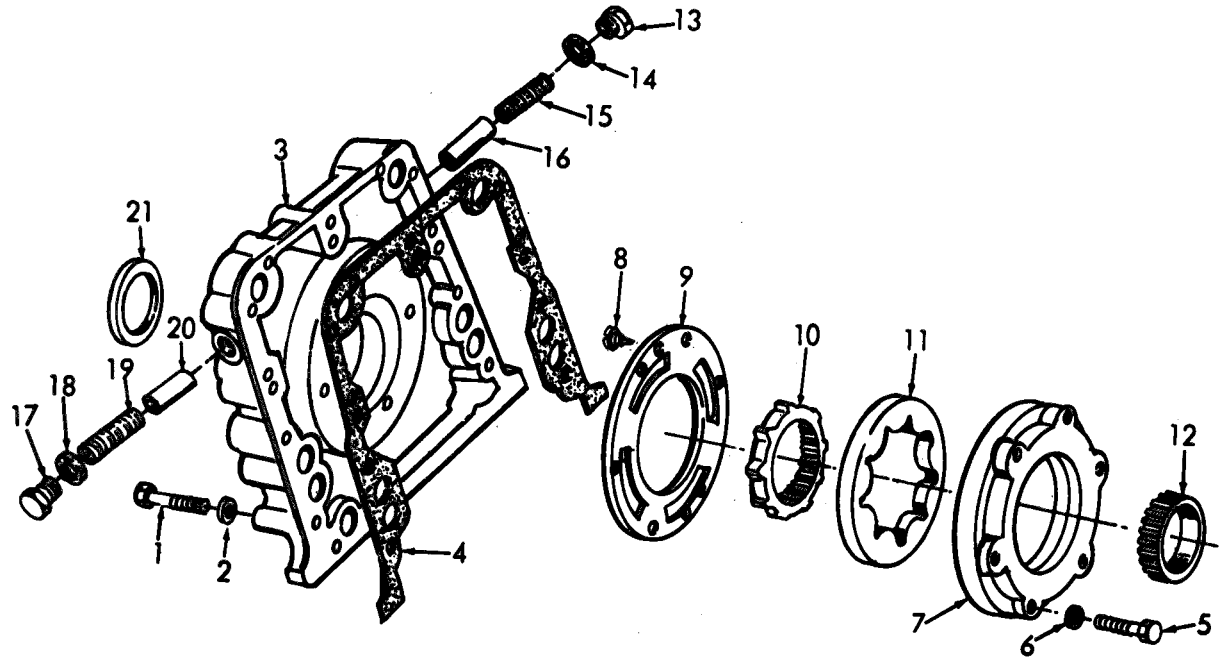


Figure 3-2. Oilpump and crankshaft pulley, removal and installation.



ME 3930-243-34/3-3

1 Bolt
2 Washer
3 Cover
4 Gasket
5 Bolt
6 Washer
7 Pump body
8 Screw
9 Cover plate
10 Inner rotor
11 Outer rotor
12 Drive gear
13 Plug
14 Gasket
15 Spring
16 Oil cooler bypass valve
17 Plug
18 Gasket
19 Spring
20 Oil pressure regulator valve
21 Oil seal

Figure 3-3. Oil pump, disassembly and reassembly.

3-3. Oil Cooler

a. General. The oil cooler is attached directly to the cylinder block. Cooling water circulated through the oil cooler completely surrounds the oil cooler core. Therefore, whenever an oil cooler is assembled, special care must be taken to have the proper gaskets in place and the retaining bolts tight to assure good sealing.

b. Removal.

(1) Drain cooling system by opening drain cock at bottom of oil cooler housing.

(2) Remove any accessories or other equipment necessary to provide access to the oil cooler.

(31 Refer to figure 3-4 and remove the oil cooler.

c. Disassembly. Refer to figure 3-5 and disassemble oil cooler.

d. Inspection.

(1) Inspect housing for cracks, breaks and other damage.

(2) Inspect all mounting hardware for damage.

(3) Inspect core for damage. Clean oil passage with compressed air. Replace damage or defective parts.

e. Reassembly. Refer to figure 3-5 and reassemble oil cooler.

f. Pressure Test.

(1) Make a suitable plate and attach to flange side of cooler core. Use a gasket made from rubber to assure tight seal. Drill and tap the plate to permit an air hose fitting to be. attached to inlet side of core .

(2) Apply approximately 75 psi air pressure and submerge cooler core and plate assembly in container of water. Any leaks will be indicated by air bubbles in. the water. If leaks are indicated, replace the core.

g. Installation.

(1) Refer to figure 3-4 and install oil cooler.

(2) Replace any accessories or other equipment removed.

(3) Refill cooling system to proper level (TM 10-3930-243-12).

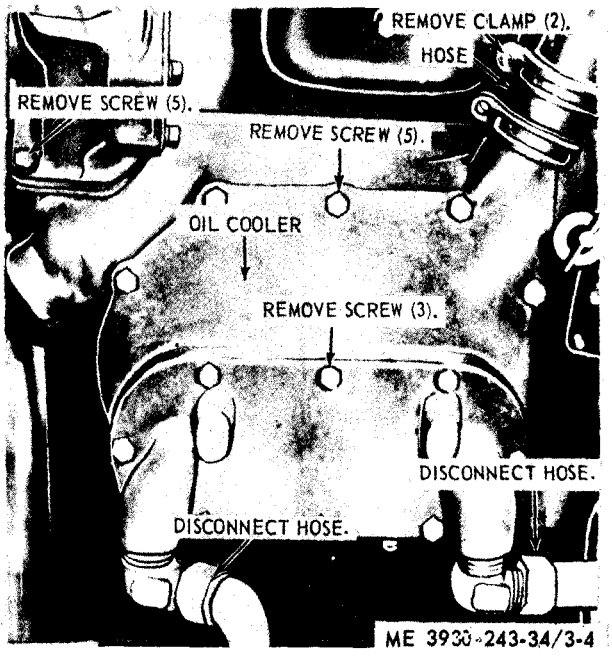
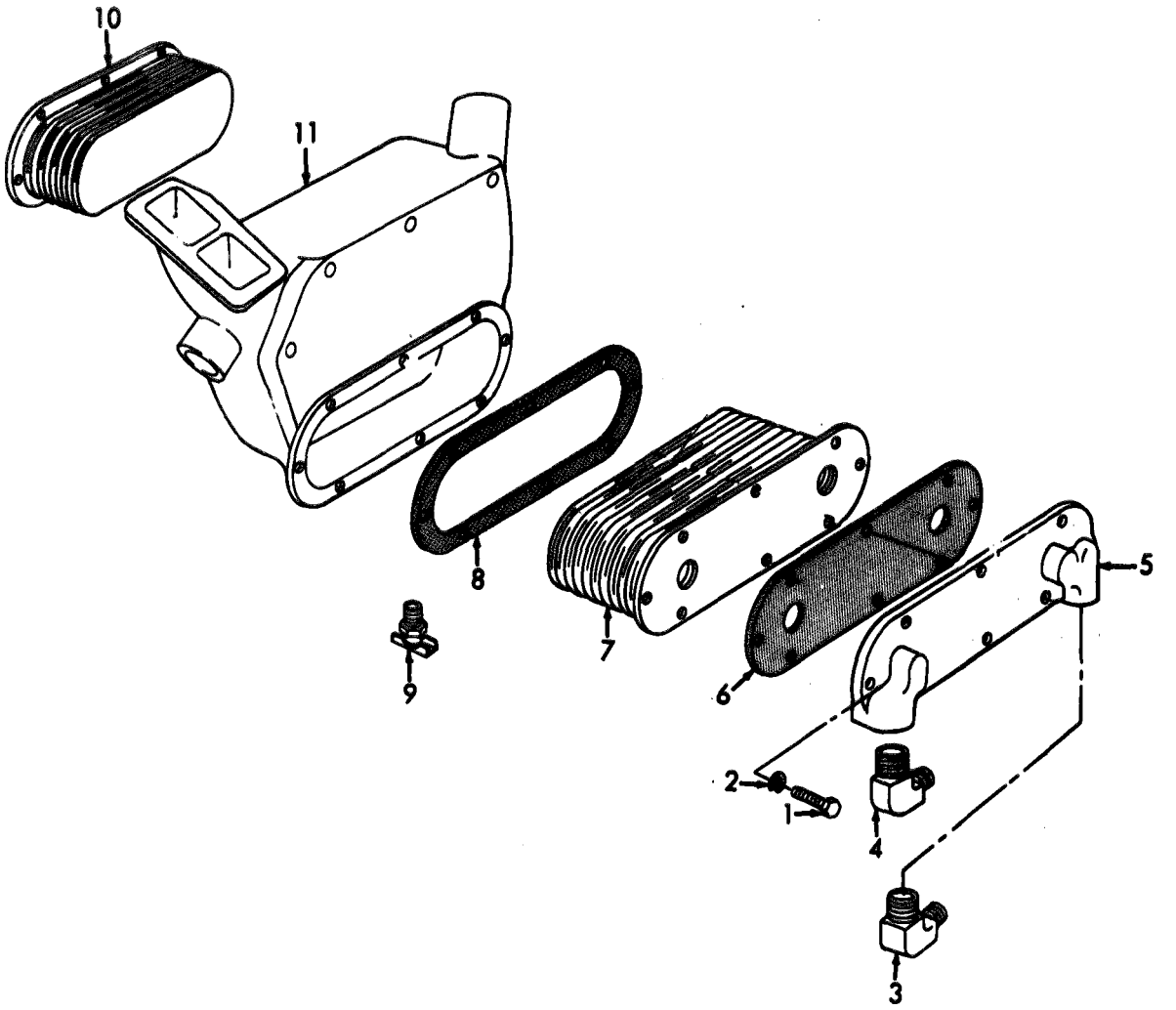


Figure 3-4. oil cooler, removal and installation.



ME 3930-243-34/3-5

1 Screw
2 Washer, lock
3 Elbow
4 Elbow
5 Cover
6 Gasket
7 Core assembly
8 Gasket
9 Drain cock
10 Core assembly
11 Housing

Figure 3-5. Oil cooler, disassembly and reassembly.

3-4. Air Inlet Housing

a. General. The air inlet housing is mounted to the top of the blower. It contains an air shutdown valve that shuts off the air supply, and stops the engine, whenever abnormal operating conditions requires an emergency shut down.

b. Removal. Remove air intake tube and refer to figure 3-6 and remove air inlet housing.

c. Disassembly. Refer to figure 3-7 and dissemble the air inlet housing.

d. Inspection.

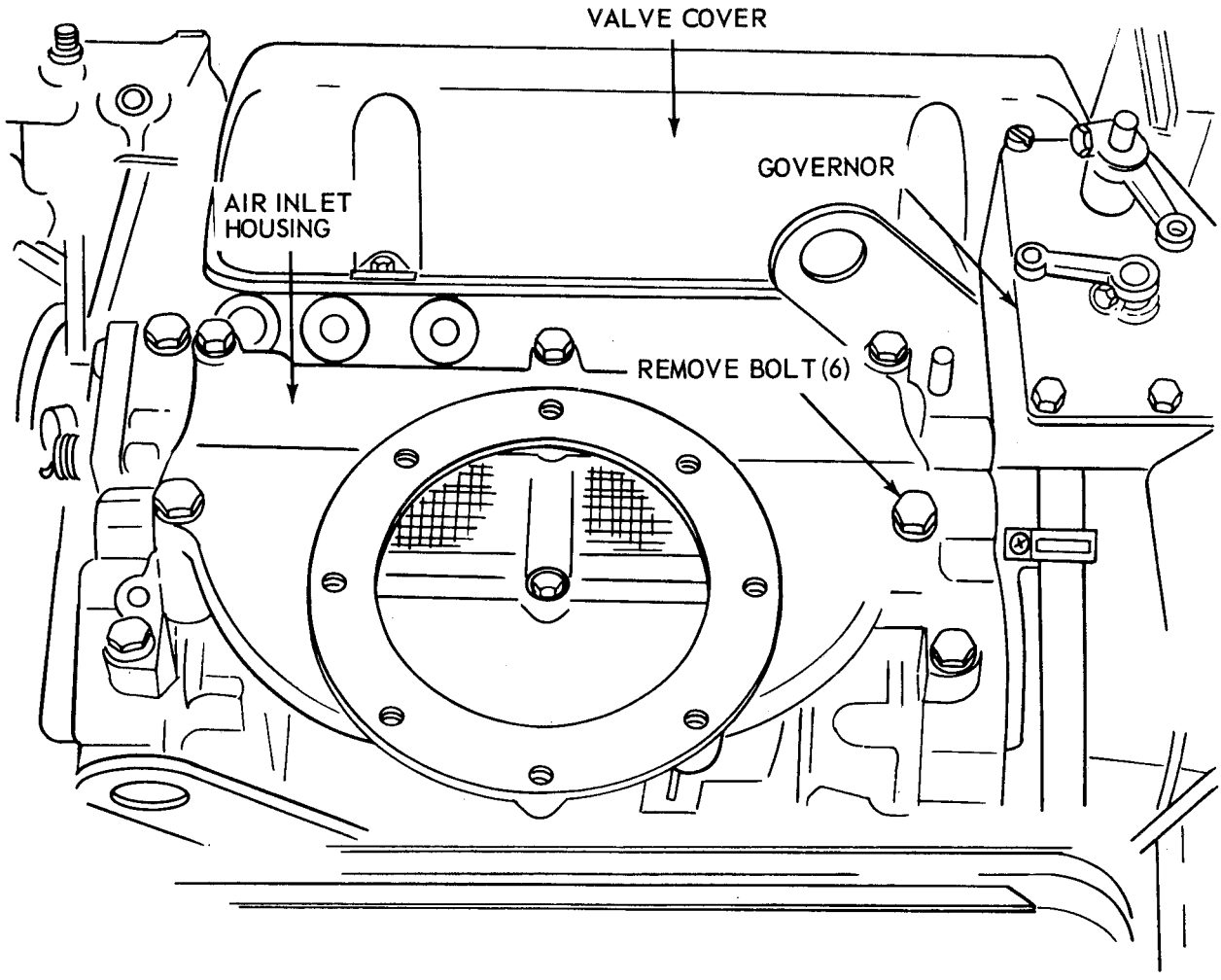
(1) Inspect the spring (15, fig. 3-7) for bends and breaks.

(2) Inspect screen (14) for tears.

(3) Inspect valves (13) for bends and cracks. Replace a defective part.

e. Reassembly. Refer to figure 3-7 and reassemble the air inlet housing.

f. Installation. Refer to figure 3-6 and install the air inlet housing.

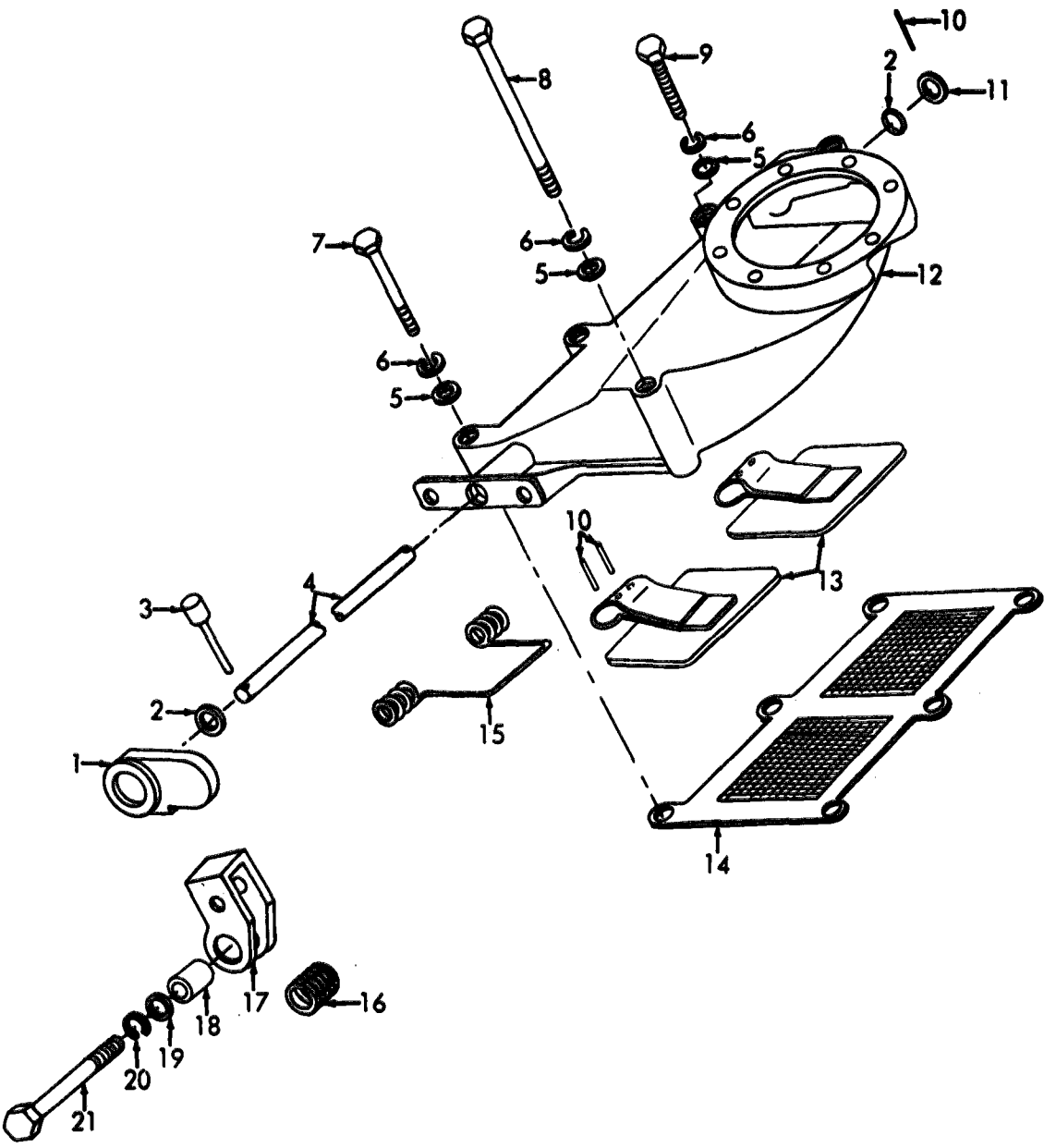


ME 3930-243-34/3-6

Figure 3-6. Air inlet housing blower assembly, removal and installation.

KEY to figure 3-7:

1 Cam
2 Packing
3 Handle ay.
4 Shaft
5 Washer
6 Washer
7 Screw
8 Screw
9 Bolt
10 Pin
11 Washer
12 Housing
13 Valve
14 Screen
15 Spring
16 Spring
17 Latch
18 Spacer
19 Washer
20 Washer
21 Screw



ME 3930-243-34/3-7

Figure 3-1. Air inlet housing, disassembly and reassembly.

3-5. Engine Blower Assembly

a. General. The blower assembly supplies fresh air required for combustion and scavenging. The revolving motion of the rotor provides a continuous and uniform displacement of air.

b. Removal.

NOTE

The blower and governor are bolted together and must be removed as an assembly (fig. 3-8).

(1) Remove the air inlet housing (fig. 3-6).

(2) Disconnect the linkage from the governor control levers.

(3) Remove the screws and lock washers which attach the governor cover to the governor housing. Remove the cover and gasket from the housing.

(4) Remove two bolts and lock washers which hold the spring housing (3, fig. 3-14) to the governor housing. Remove spring housing and gasket.

(5) Remove spring assembly from the governor.

(6) Loosen the hose clamps and slide the hoses back on the fuel rod covers.

(7) Remove the rocker arm cover from each cylinder head.

(8) Disconnect the lower fuel rod from each injector control tube lever and also from each upper fuel rod.

(9) Remove the threaded pins connecting the fuel rods to the control link lever. Remove the upper fuel rods.

(10) Remove the blower drive cover plate. Remove the snap ring and withdraw the blower drive shaft from the housing (fig. 3-9).

(11) Remove the two bolts and copper washers holding the blower drive support assembly. Then, withdraw the assembly until the splined end of the drive shaft is free from the drive plate. Turn the drive assembly slightly so the serrated end of the governor weight shaft will pass around the governor operating fork. Remove the blower drive support from the engine.

c. Disassembly. Refer to figure 3-10 and disassemble the blower assembly as follows:

(1) Wedge a clean cloth between the blower rotors to prevent their turning and remove four bolts (6) that hold the blower drive cam retainer (7) and blower drive spring support (9) to rotor gear.

(2) Use two pullers to remove both blower gears from the rotor shaft at the same time. Mark the left-hand rotor gear to facilitate identification at reassembly.

d. Inspection.

(1) Inspect rotors and housing for burrs or scratches. If burrs or scratches exist, dress the parts down with an oil stone.

(2) Inspect rotors for scoring.

(3) Check for oil leaks,

(4) Check for loose or worn shaft bearings, Refer to table 1-1 for replacement standards.

NOTE

Loose rotor shafts or worn rotor shaft bearings will result in contact between rotor lobes, rotor and end plates or rotor and housing. Excessive backlash between blower timing gears usually results in rotor lobes rubbing together throughout their entire length.

e. Reassembly. Refer to figure 3-10 and reassemble the blower assembly as follows:

(1) Lubricate the oil seals (27) with clean engine oil and place a seal in each front end plate (26) counterbore.

(2) Place the front end plate on two wood blocks. Install the rotors, gear end up, on the end plate.

(3) Install two oil seals (34) in the rear end plate (33) as outlined in step 1.

(4) Place the rear end plate over the rotor shafts. Be sure that seals are properly positioned on rotors. Secure end plates to blower housing with bolts (l).

NOTE

To prevent inadequate lubrication or low oil pressure, care must be exercised in assembly of front and rear blower end plates to blower housing. The rear end plate does not have tapped holes for the thrust washer plate bolts and is the only cover that has the vertical oil passage drilled through into the pocket on left side of end plate for supplying lubrication to the blower drive gear bearing.

(5) Attach two thrust washers (24) to front end of the blower with thrust washer retaining bolts (23). Refer to paragraph 1-4 *r* for proper torque.

(6) Attach three spacers (25) and thrust plate (22) to the front end of blower with three thrust plate bolts (21). Tighten the bolts to 7-9 foot-pounds torque . Check the clearance between thrust plate and thrust washer. Refer to table 1-1.

(7) Position the rotors so that the missing serrations on the gear end of rotor shafts are 90º apart. This is accomplished by placing the rotors with missing serration in the upper rotor facing to the left, and missing serration in the lower rotor facing the bottom. Install shims (19) and spacers (20) in counterbore in the rear face of rotor gears. Place the gears on ends of the shafts with missing serrations in alignment with missing serrations on the shafts.

(8) Tap gears lightly with a soft hammer to seat gears on the shaft. Rotate gears until the punch marks on the fate of the gears match. If punch marks do not match, reposition gears.

(9) Wedge a clean cloth between blower rotors. Use the blower rotor gear retaining bolts and plain washers to press gears on the rotor shafts. Turn

bolts uniformly until gears are tight against the shoulders of shaft. Remove gear bolts, plain Washers and cloth.

(10) Place the pilot in the counterbore of gears and start the twelve point bolt in the right-hand rotor shaft and start the hex head bolt in the left-hand rotor shaft. Tighten the bolts to 25-30 ft-lb torque.

(11) Check the backlash between blower gears (table 1-1).

(12) After the blower rotors and gears have been installed, the blower rotors must be timed. Rotors, when properly positioned run with a slight clearance between the rotor lobes and with a slight clearance between the lobes and the walls of the housing. The clearance between rotors may be established by moving one of the helical gears out or in on the shaft relative to the other gear. Moving gears "out" or "in" on the rotors is accomplished by adding or removing shims between gear hub and rotor spacers.

(13) Measurements should be taken from both the inlet and outlet sides of blower by inserting feeler gage between housing (29) and rotors (32). Measurements should be taken across the entire length of each rotor lobe. Refer to table 1-1 for proper clearance.

f. Installation. Installation is the reverse procedure of removal. Replace all gaskets.

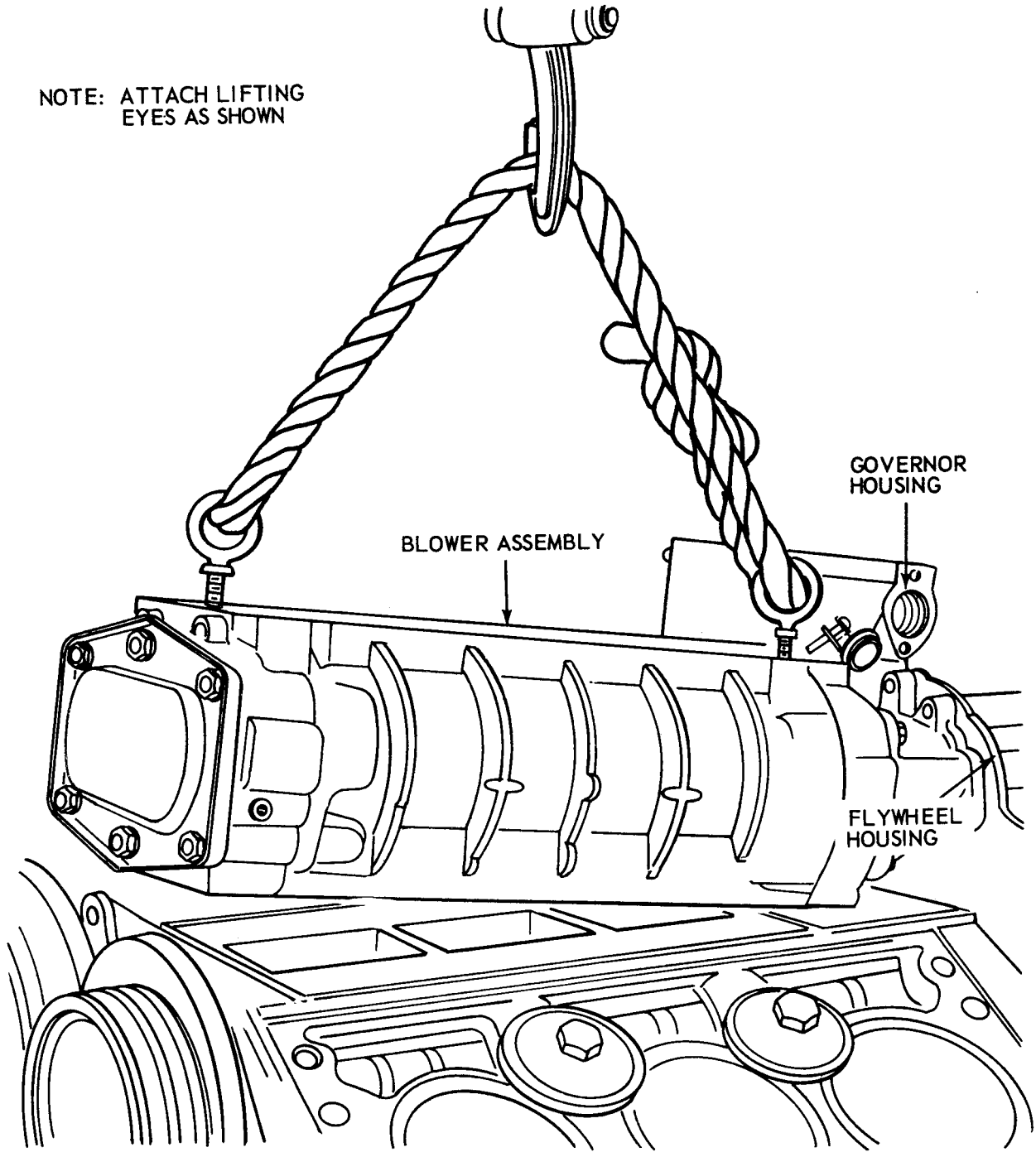


Figure 3-8. Engine blower assembly and governor housing, removal and installation.

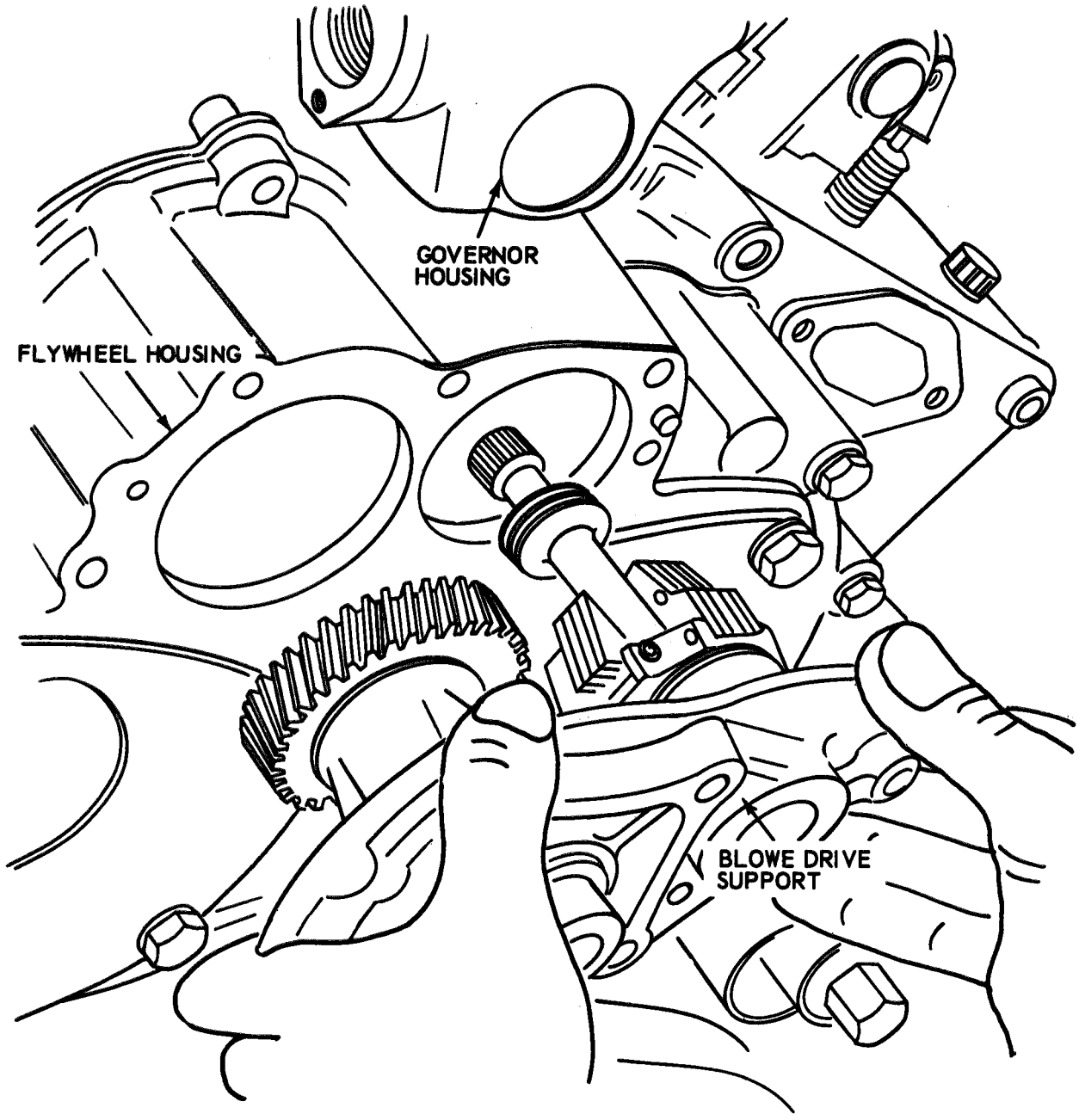
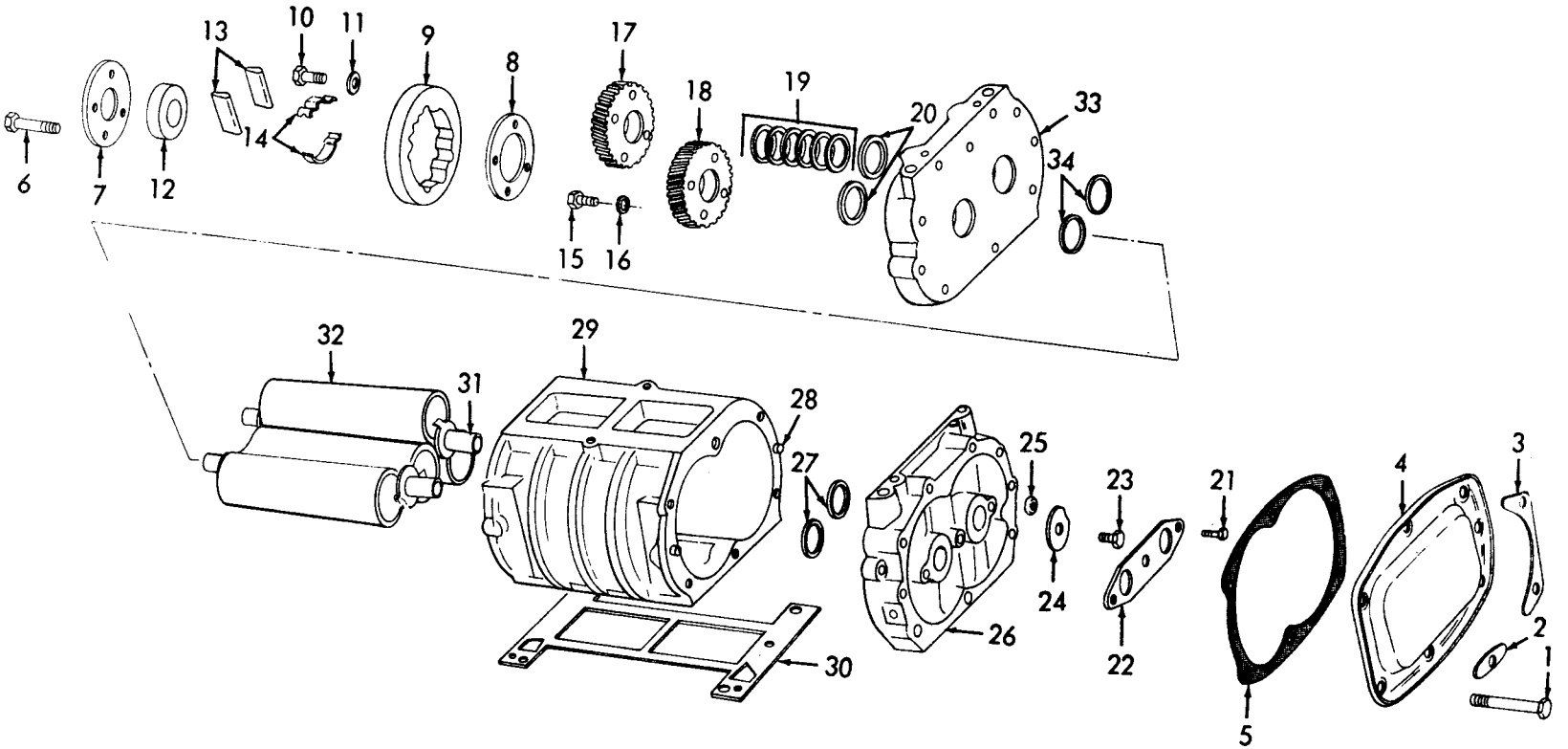


Figure 3-9. Blower drive support, removal and installation.



ME 3930-243-34/3-10

Figure 3-10. Blower assembly, disassembly and reassembly.

KEY to figure 3-10:

1 Bolt
2 Washer
3 Reinforcement plate
4 Cover
5 Gasket
6 Bolt
7 Retainer
8 Spacer
9 Drive spring support
10 Bolt
11 Washer
12 Drive cam
13 Drive springs
14 Drive spring seat
15 Bolt
16 Blower drive cam pilot
17 Blower rotor gear (R / H)
18 Blower rotor gear (L / H)
19 Rotor shims
20 Spacers
21 Bolt
22 Thrust plate
23 Bolt
24 Thrust washer
25 Spacer
26 Front end plate
27 Oil seals
28 Dowel
29 Blower housing
30 Gasket
31 Rotor shaft
32 Rotor
33 Rear end plate
34 Oil seals

3-6. Blower Drive Support

a. Genera/. The blower drive support is mounted to the flywheel housing. The blower drive support supports the blower drive shaft governor weights and shaft.

b. Removal. Refer to figure 3-9 and remove the blower drive support.

c. Disassembly. Refer to figure 3-11 and disassemble the blower drive support as follows:

(1) Remove snap ring and thrust washer from blower drive gear shaft. Slide the shaft and gear from the blower drive support.

(2) Press the drive gear from shaft and remove the key.

(3) Tap the governor weight shaft bearing from blower drive support. If the bearing is a tight fit, drive plug from the support and, using a spacer against outer race of bearing, press or tap bearing from the support.

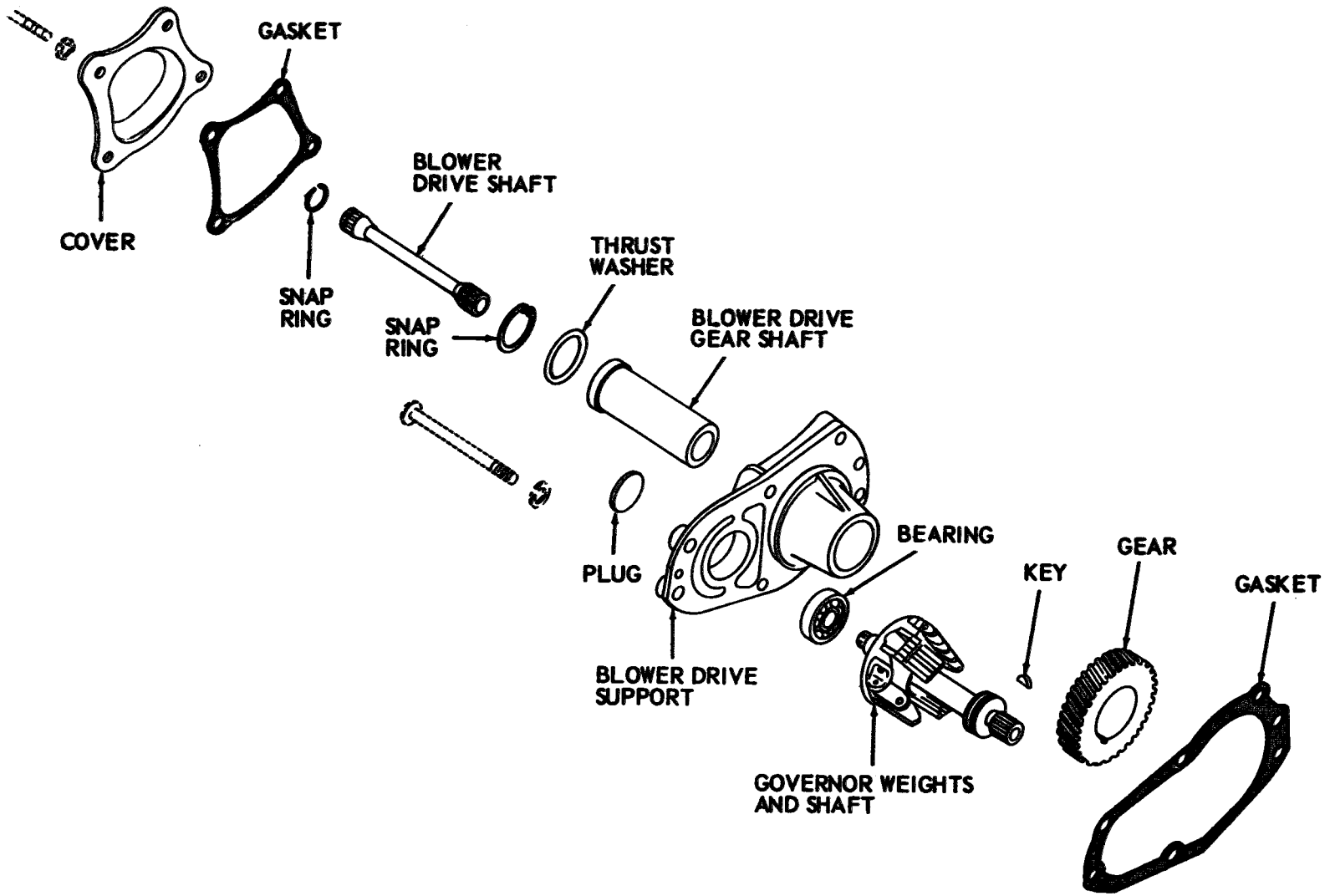
d. Inspection.

(1) Inspect bearing for corrosion and pitting.

(2) Inspect the serrations on the governor weight shaft.

(3) Inspect the blower drive shaft, drive support and gear for wear or damage. Replace a defective or worn part. Refer to table 1-1 for wear and replacement standards.

e. Reassembly. Refer to figure 3-11 and reassemble blower drive support.



ME 3930-243-35/3-11

Figure 3-11. Blower drive support, disassembly and reassembly.

3-7. Limiting Speed Mechanical Governor

a. General. The limiting speed mechanical governor is mounted between the flywheel housing and the engine blower assembly. One end of the governor weight shaft is splined to a drive plate attached to the driven blower timing gear to provide a means of driving the governor. The other end of the shaft is supported by a bearing in the blower drive support. The governor controls the engine idle speed and limits the maximum operating speed of the engine. The governor consists of four basic subassemblies: a cover and lever assembly; governor housing; spring housing; and a weight and shaft assembly.

b. Removal. Since the governor is mounted between the blower and the flywheel housing (fig. 3-12) the blower and blower drive support assemblies must also be removed.

(1) Remove the blower drive support (para 3-6).

(2) Remove the engine blower assembly (para 3-5).

(3) Remove the governor weight shaft (fig. 3-11) and carrier from the blower drive support, using pry bars if necessary.

(4) Remove the six attaching bolts and lock washers and detach the governor housing from the blower rear end plate. Remove the gasket.

c. Disassembly. Refer to figure 3-13 and disassemble the limiting speed governor in numerical sequence as follows:

(1) Disassemble governor cover (1 thru 22, fig. 3-13).

(2) Remove two bolts (1, fig. 3-14) and washer (2) and remove the spring housing (3) from governor housing (61, fig. 3-13).

(3) Remove the spring retainer lock nut (5, fig. 3-14) and remove spring (7) and the spring retainer (13).

(4) Remove the low speed spring cap (6), spring (7) and spring seat (8) from spring plunger (12).

(5) Depress the high speed spring (11) by hand and remove the idle speed adjusting screw lock nut (9). The spring retainer (13) and high speed spring (and shims) may be removed. Remove the idle speed adjust screw (10) from the spring plunger (12).

(6) Disassemble the governor housing (23 thru 51, fig. 3-13).

(7) Disassemble the governor weights (52 thru 60) (para 3-6).

d. Inspection.

(1) Inspect all bearings for corrosion and pitting.

(2) Inspect the riser thrust bearing (52, fig. 3-13).

(3) Inspect the control lever link (37) needle bearing (30) and control link lever pin (44) for wear. If a new control link lever pin is required remove the old pin and press the new pin in the governor housing; the new pin must project 1.055 inch to 1.060 inch above the boss in the housing.

(4) Inspect the weight carrier, weights and pins for excessive wear.

(5) Inspect the governor springs, spring seat, spring cap, plunger, spring retainer, adjusting screws for excessive wear.

(6) Inspect the serrations on the governor weight shaft and drive plate on the blower timing gear for wear. Replace worn or damaged parts.

e. Reassembly. Refer to figure 3-13 and reassemble the governor assembly. Reassembly is the reverse order of disassembly.

CAUTION

Do not use impact tools to install needle bearings and do not break housing.

NOTE

The low speed weights are identified by the long cam arm, on the opposite side of the weight carrier. The high speed weights are identified by the short cam arm.

NOTE

The minimum clearance between the blower drive gear and governor weights must not be less than 0.100 inch.

f. Installation. Installation is the reverse procedure of removal. Refer to paragraph 3-7 *b.*

g. Adjust Governor Gap. With the engine at normal operating temperature, set the governor gap as follows:

(1) With engine stopped, remove the two bolts and with draw the governor high speed spring retaining housing (3, fig. 3-14).

(2) Back out the buffer screw (43, fig. 3-13) extends 9/16 to 5/8 inch from the surface of the governor housing.

CAUTION

Do not back the buffer screw out beyond the limits given or the control link lever may disengage the differential lever.

(3) Start the engine and loosen idle speed adjusting screw lock nut (9, fig. 3-14). Adjust the idle speed screw (10) to obtain the desired engine idle speed.

(4) Stop the engine and remove the governor cover and the engine valve rocker covers. Discard the gaskets.

(5) Start and run engine, between 800 and 1,000 rpm, by manual operation of the differential level (26, fig. 3-13).

CAUTION

Do not overspeed the engine.

(6) Check the gap between the low speed spring cap (6, fig. 3-14) and the high speed spring plunger (12) with a 0.0015 inch feeler gage. If gap setting is incorrect, reset the gap adjusting screw (32, fig. 3-13).

(7) Hold the gap adjusting screw and tighten the lock nut (33).

(8) Recheck the gap and readjust if necessary.

h. Adjust Maximum No-Load Engine Speed.

(1) Loosen the retainer lock nut (5, fig. 3-14) and back off the high speed spring retainer (13) several turns. Start the engine and increase speed slowly. If speed exceeds required no-load speed before the speed control lever reaches end of its travel, back off the spring retainer a few additional turns.

(2) With engine at operating temperature and no-load on engine, place speed control lever in maximum speed position. Turn the high speed spring retainer (13) in until engine is operating at recommended no-load speed. The maximum no load speed varies with the full load operating speed.

Example. **If the full load speed is to be 2600 rpm, then the no-load speed settings should be 2800 rpm to ensure governor will move the injector racks into the full-fuel position at the desired full load speed.**

(3) Hold the spring retainer (13) and tighten the retainer lock nut (5).

i. Adjust Buffer Screw.

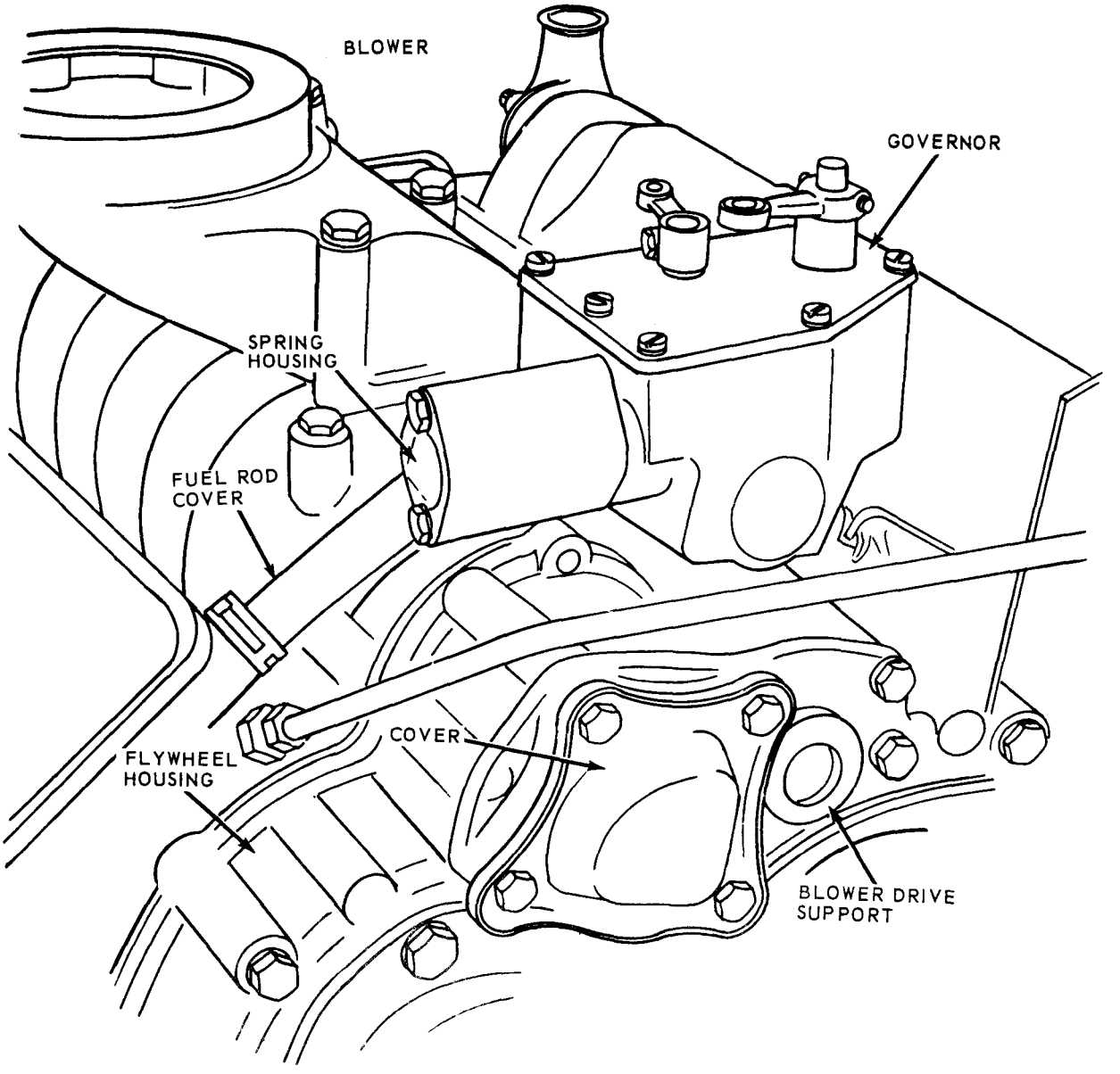
(1) With engine running at normal operating temperature, turn the buffer screw (43, fig. 3-13) in so it contacts the differential lever (26) as lightly as possible and still eliminates the engine roll.

NOTE

Do not increase engine idle speed more than 15 rpm with buffer screw.

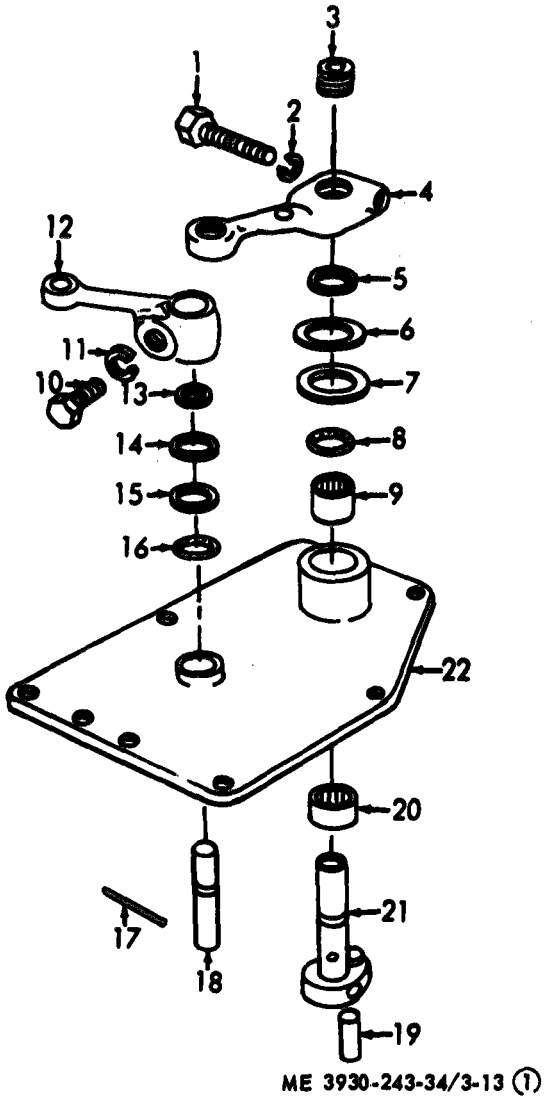
(2) Recheck the maximum no-load speed. If it has increased more than 25 rpm, back off buffer screw until the increase is less than 25 rpm.

(3) Hold the buffer screw (43) and tighten the lock nut (42).



ME 3930-243-34/3-12

Figure 3-12. Governor assembly, removal and installation



1 Screw	12 Stop lever
2 Lockwasher	13 Ring
3 Plug	14 Washer
4 Speed control lever	15 Washer
5 Ring	16 Seal
6 Washer	17 Pin
7 Washer	18 Stop lever shaft
8 Seal	19 Pin
9 Bearing	20 Bearing
10 Screw	21 Throttle shaft
11 Lockwasher	22 Cover

Figure 3-13. Limiting speed governor, disassembly end reassembly (sheet 1 of 2).

KEY to figure 3-13 (sheet 2 of 2):

23 Retainer	33 Nut	43 Buffer screw	53 Pin
24 Washer	34 Screw	44 Conntrol link lever pin	54 Rfng
25 Pin	35 Washer	45 Pin	55 Pin
26 Differential lever	36 Operating shaft lever	46 Pin	56 Weight
27 Retainer	37 Control link lever	47 Operating fork	57 Weight
28 Washer	38 Bearing	48 Pin	58 Carrier
29 Link pin	39 Washer	49 Plug	59 Riser
30 Bearing	40 Bearing	50 Plug	60 Shaft
31 Pin	41 Operating shaft	51 Bearing	61 Housing
32 Gap adjusting screw	42 Nut	52 Bearing	

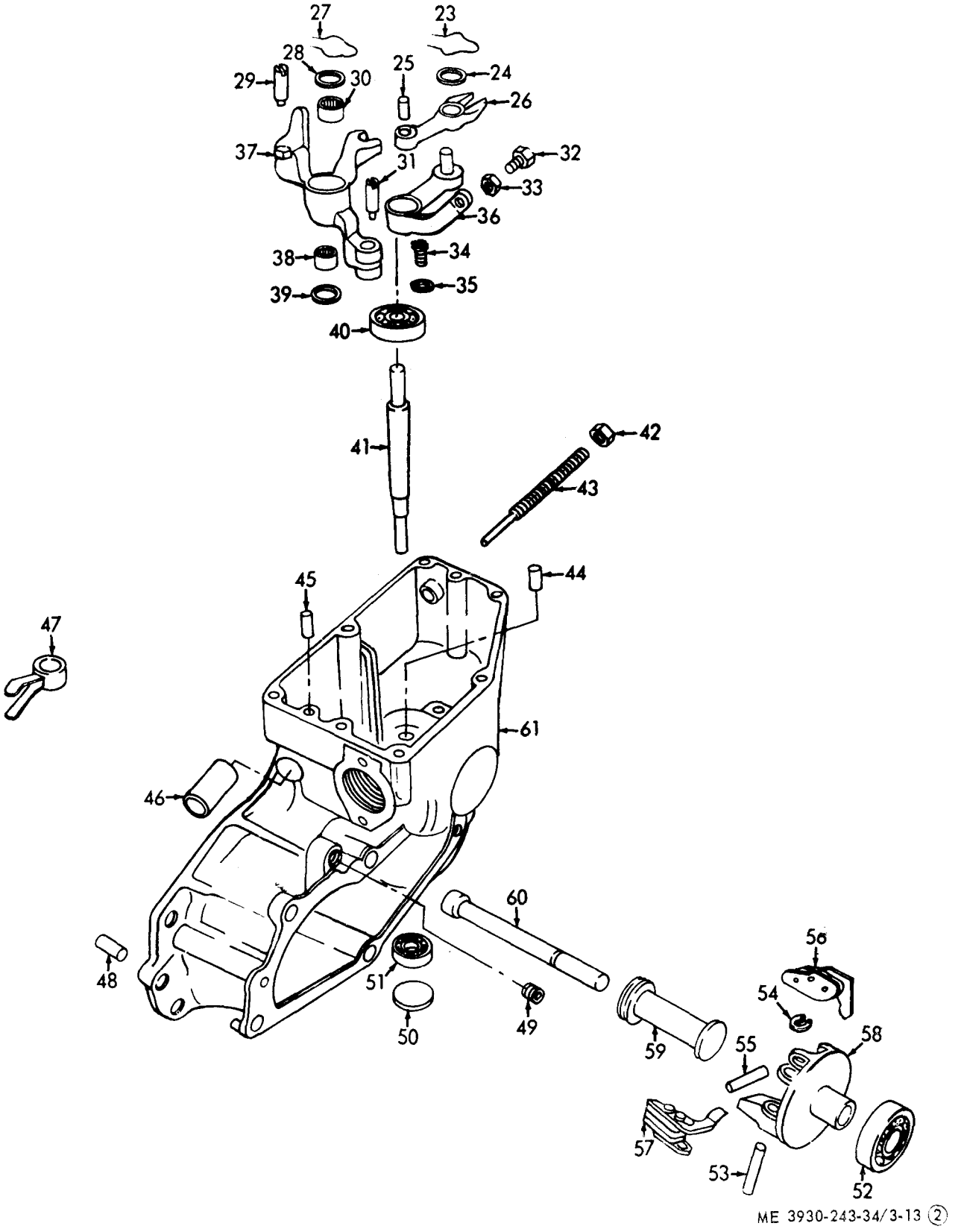
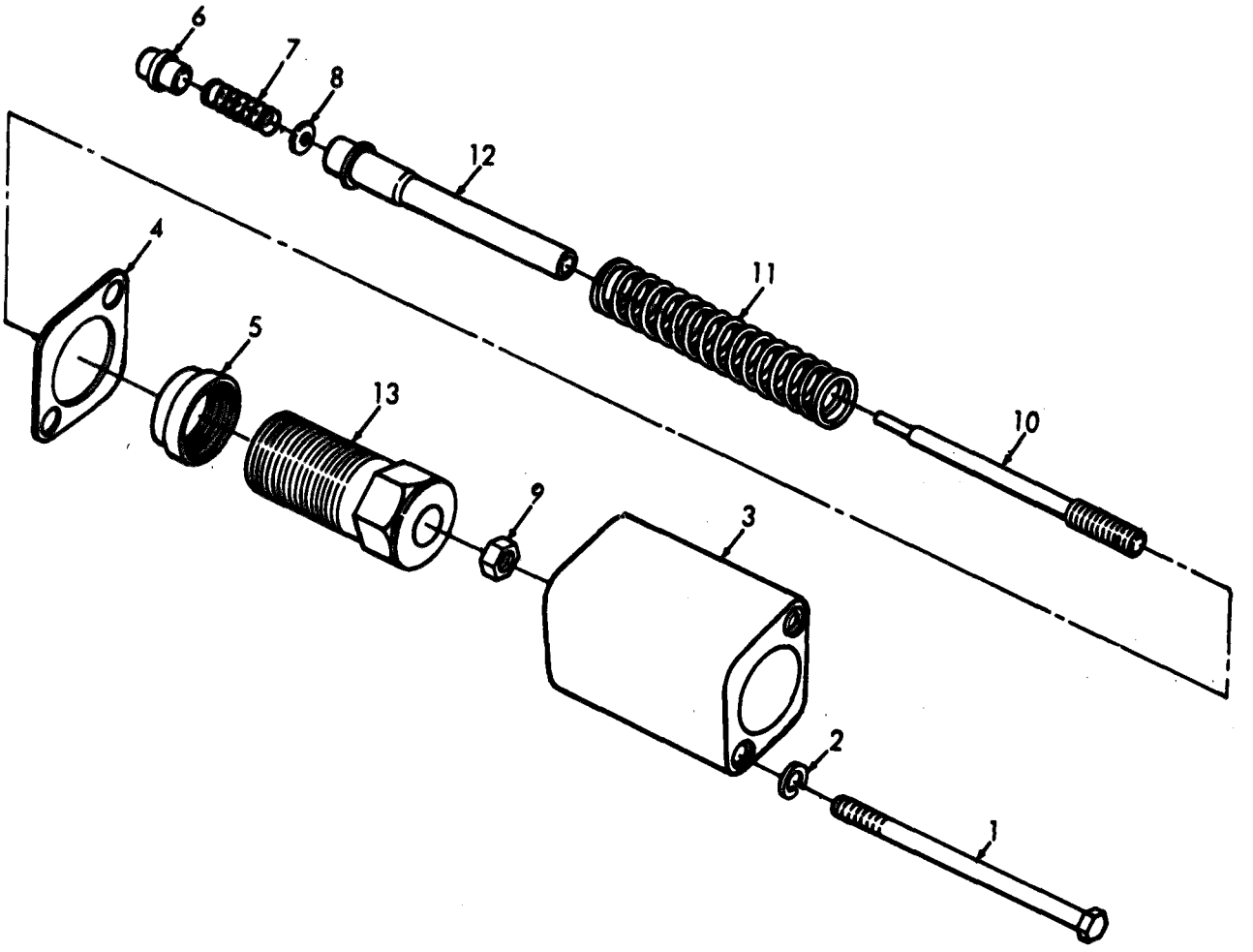


Figure 3-13. Limiting speed governor, disassembly and reassembly (sheet 2 of 2).



ME 3930-243-34/3-14

1 Bolt
2 Washer
3 Housing
4 Gasket
5 Retainer, look nut
6 Spring cap
7 Low speed spring
8 Spring seat
9 Lock nut
10 Idle speed adjusting screw
11 High speed spring
12 Plunger
13 Spring retainer

Figure 3-14. Governor spring assembly, disassembly and reassembly.

. **Water Pump**

a. *General.* A centrifugal-type water pump is mounted on top of the engine oil cooler housing. It circulates the coolant thru the oil cooler cylinder block, cylinder heads and radiator.

b. Removal. Remove the water pump TM 10-,930-243-12).

c. Disassembly.

(1) Note position of pulley on the shaft so that pulley can be reinstalled in the same position when pump is assembled. Use a puller and remove water pump pulley.

(2) Remove pump cover (2, fig. 3-15) and gasket (3).

(3) Press the shaft and bearing assembly (8), seal (5) and impeller (4) out of the pump body (12) as an assembly by applying pressure on bearing outer race (7).

CAUTION

The bearing will be damaged if the pump is disassembled by pressing on the end of the pump shaft.

(4) Press the end of the shaft out of the impeller (4) and remove and discard the seal (5).

d. Inspection.

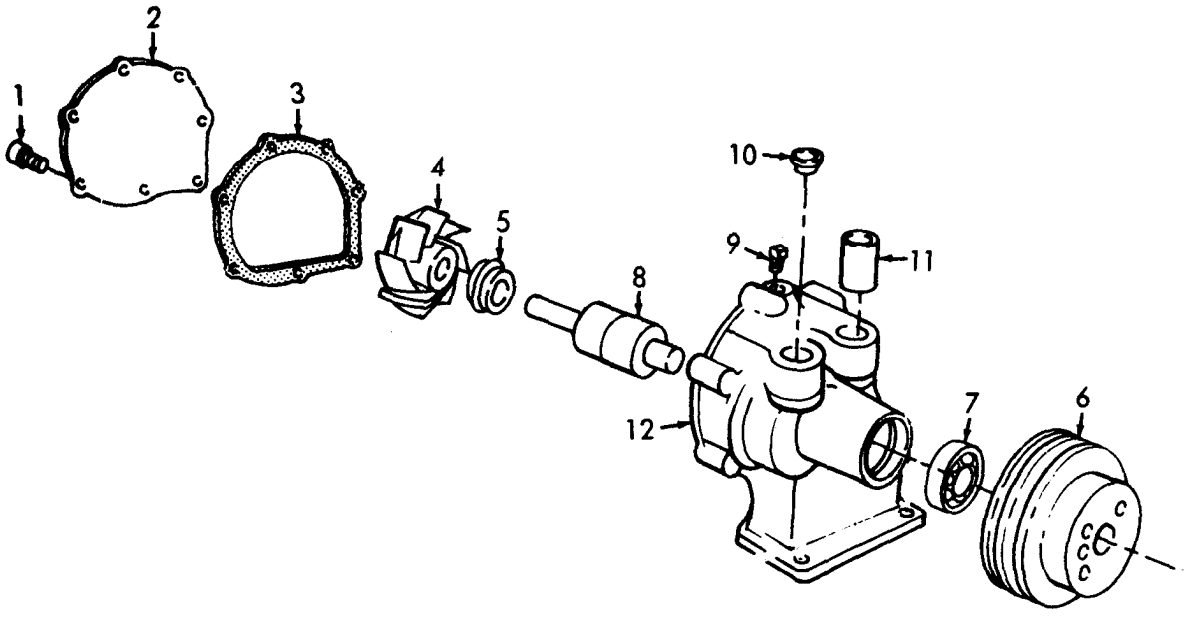
(1) Inspect the impeller for damage or excessive wear on impeller face which contacts the seal.

(2) Revolve the shaft bearings slowly by hand; if rough or tight spots are detected, the bearing and shaft must be replaced.

e. Reassembly.

(1) Refer to figure 3-15 and reassemble the water pump in reverse order of disassembly.

(2) Run the pump dry at 1200 rpm for 30 seconds to assure seating of the seal.



ME 3930-243-34/3-15

1 Screw
2 Cover
3 Gasket
4 Impeller
5 Seal
6 Pulley
7 Bearing
8 Shaft
9 Plug
10 Plug
11 Nipple
12 Body

Figure 3-15. Water pump, disassembly and reassembly.

f. Installation. Install the water pump (TM 10-3930-243-12).

3-9. Engine Generator

a. General. The forklift is equipped with a 24 V, DC generator. The battery charging generator is introduced into the electrical system to provide a source of electrical current for maintaining the storage battery in a charged condition and to supply sufficient current to carry any other electrical load requirements up to the rated capacity of the generator.

b. Removal. Remove the engine generator (TM 10-3930-243-12).

c. Disassembly. Refer to figure 3-16 and disassemble the engine generator.

d. Inspection.

(1) Inspect insulation, leads and windings.

(2) Inspect commutator bars for roughness and pitting.

(3) Inspect all bearings for excessive wear.

(4) Inspect brushes for wear. Replace a missing or defective part.

e. Reassembly. **Refer to figure 3-16 and reassemble the engine generator.**

f. Bench Testing, Field Draw. **Install a suitable adapter plug in the connector. Connect a voltmeter between the field terminal and generator frame. Connect an ammeter, field rheostat, battery switch, and a fully-charged 24 volt battery in series with each other and connect the group, the field terminal, and generator frame. Close the battery switch and adjust the field rheostat for a reading of 24 volts on the voltmeter. Ammeter reading should be between 0.9 and 1.07 amperes. If current does not fall within this range, inspect the field frame terminals, terminal insulation, internal connections,**

g. Installation. **Install the engine generator (TM 10-3930-243-12).**

h. On-Equipment Testing. **Refer to TM 10-3930-243-12 for on-equipment testing procedure.**

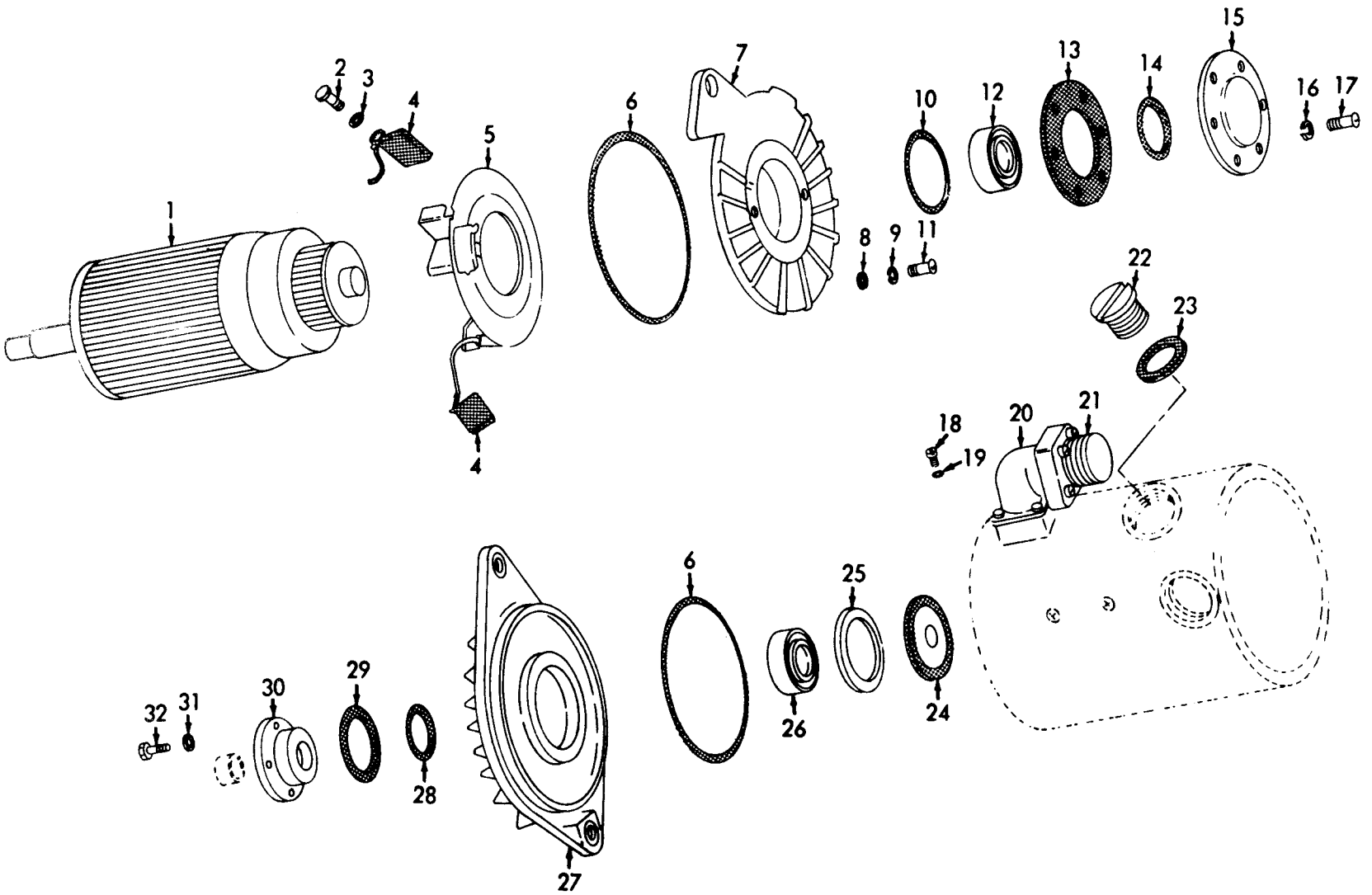
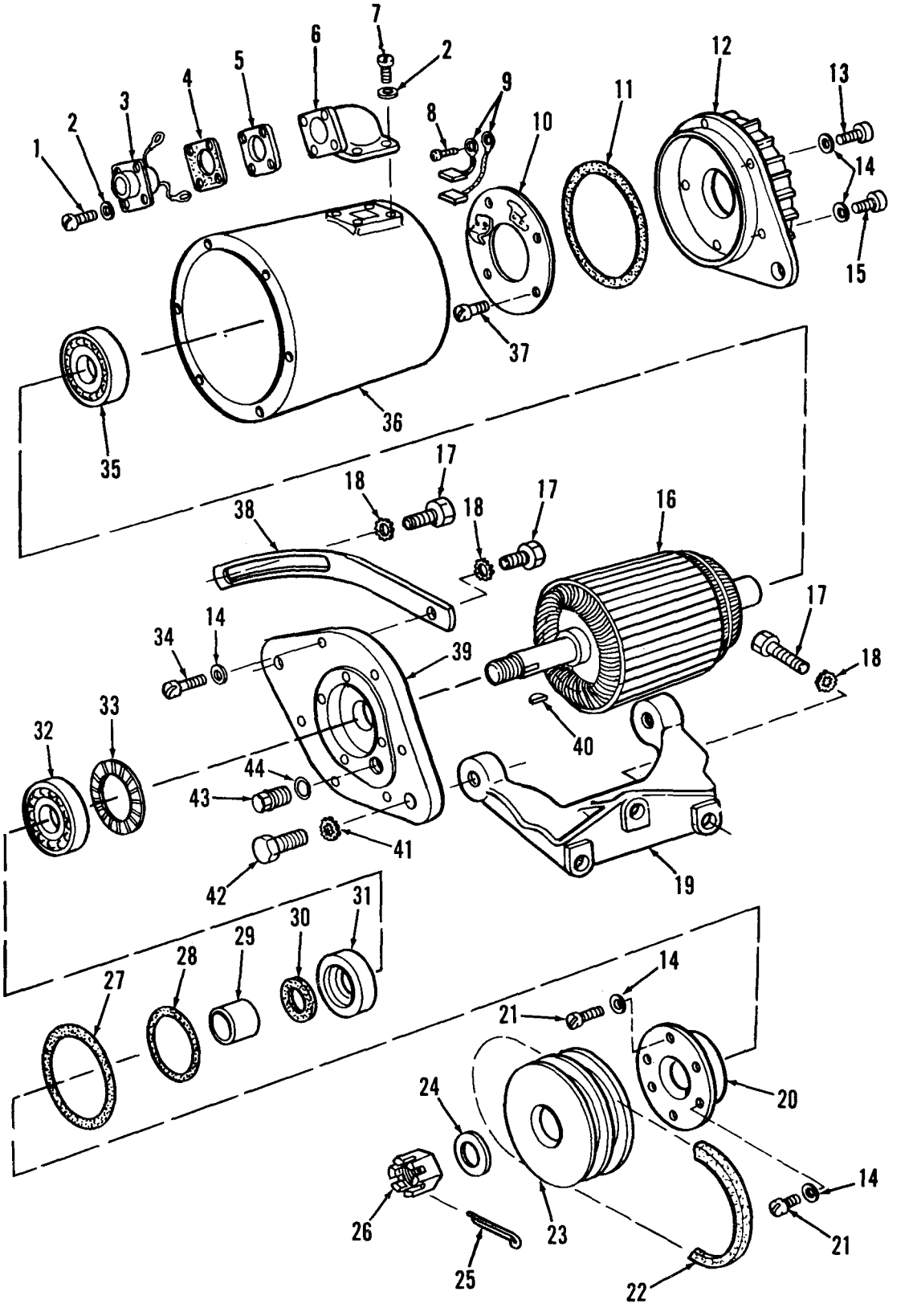


Figure 3-16. Engine generator, disassembly and reassembly (sheet 1 of 2).

KEY to figure 3-16 (sheet 1 of 2):

1 Armature
2 Screw
3 Washer
4 Brush
5 Brush
6 Seal
7 Frame
8 Washer
9 Washer
10 Seal
11 Screw
12 Bearing
13 Gasket
14 Spacer
15 Plate
16 Washer
17 Screw
18 Screw
19 Washer
20 Elbow
21 Receptacle
22 Plug
23 Gasket
24 Brush
25 Plate
26 Bearing
27 Frame
28 Seal
29 Collar
30 End plate
31 Washer
32 Screw



Model RTL10-1.

ME 3930-243-34/3-16 ②

Figure 3-16.

KEY to figure 3-16 (sheet 2 of 2) :

1 Screw
2 Washer
3 Receptacle
4 Gasket
5 Spacer
6 Elbow
7 Screw
8 Screw
9 Brush set
10 Plate
11 Packing
12 Head
13 Screw
14 Washer
15 Screw
16 Armature
17 Screw
18 Washer
19 Bracket
20 Retainer
21 Screw
22 Belt set
23 Pulley
24 Washer
25 Pin
26 Nut
27 Packing
28 Packing
29 Spacer
30 Washer
31 Seal
32 Bearing
33 Washer
34 Screw
35 Bearing
36 Frame
37 Screw
38 Strap
39 Head
40 Key
41 Washer
42 Screw
43 Plug
44 Packing

3-10. Starting Motor

a. General. The starter is mounted to the flywheel housing. It is 24 volt DC. The starter components are totally enclosed to protect them from road dirt, icing conditions and road splash.

b. Removal. Remove the starter (TM 10-3930-243-12).

c. Disassembly. Refer to figure 3-17 and disassemble the starting motor in numerical sequence.

d. Inspection.

(1) Inspect field coils, armature and insulating parts for any damage.

(2) Inspect bushing for excessive wear.

(3) Inspect brushes for excessive wear. Replace a defective or worn part.

e. Reassembly. Refer to figure 3-17 and reassemble the starting motor. Reassembly is the reverse procedure of disassembly.

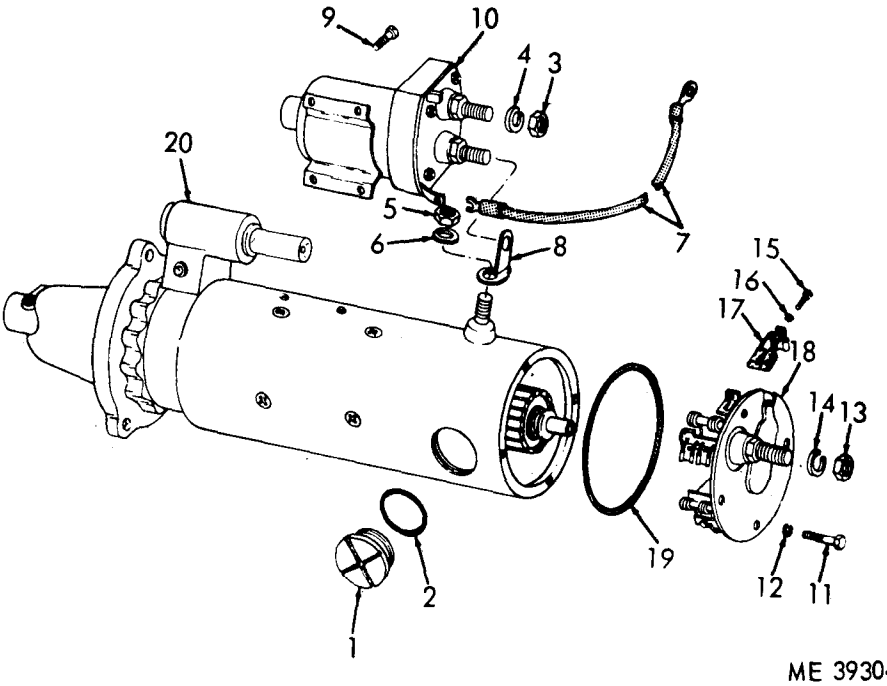
f. Bench Testing.

(1) *No load test.* Connect a 24 volt battery in series with a load rheostat and an ammeter shunt of a capacity greater than 50 amperes and connect this group to the starter terminal and the starter housing. Connect an ammeter to the shunt and a direct current voltmeter to the starter terminal and the starter housing. With voltage adjusted to 22.5 volts, the current should be 80 amperes maximum at 3,600 rpm. If current and speed are both low, inspect for high resistance in the internal connections. If current is high and speed is low, inspect the bearings and armature for binding and incorrect alignment.

(2) *Stall torque test.* With the starter connected as in (1) above, fasten a torque arm and a spring scale to the armature at the drive end. Adjust the rheostat to give 3.52 volts. The correct readings are 500 amperes and a stall torque of 20 foot-pounds minimum. The stall torque is the product of the spring scale reading in pounds multiplied by the torque arm in feet. If the current and torque are both low, inspect for high resistance in the internal connections and for improper brush contact. High current and low torque may be caused by a defective armature or field coil.

g. Installation. Install the starting motor (TM 10-3930-243-12).

h. On-Equipment Testing. Refer to TM 10-3930-243-12 for on-equipment testing procedures.

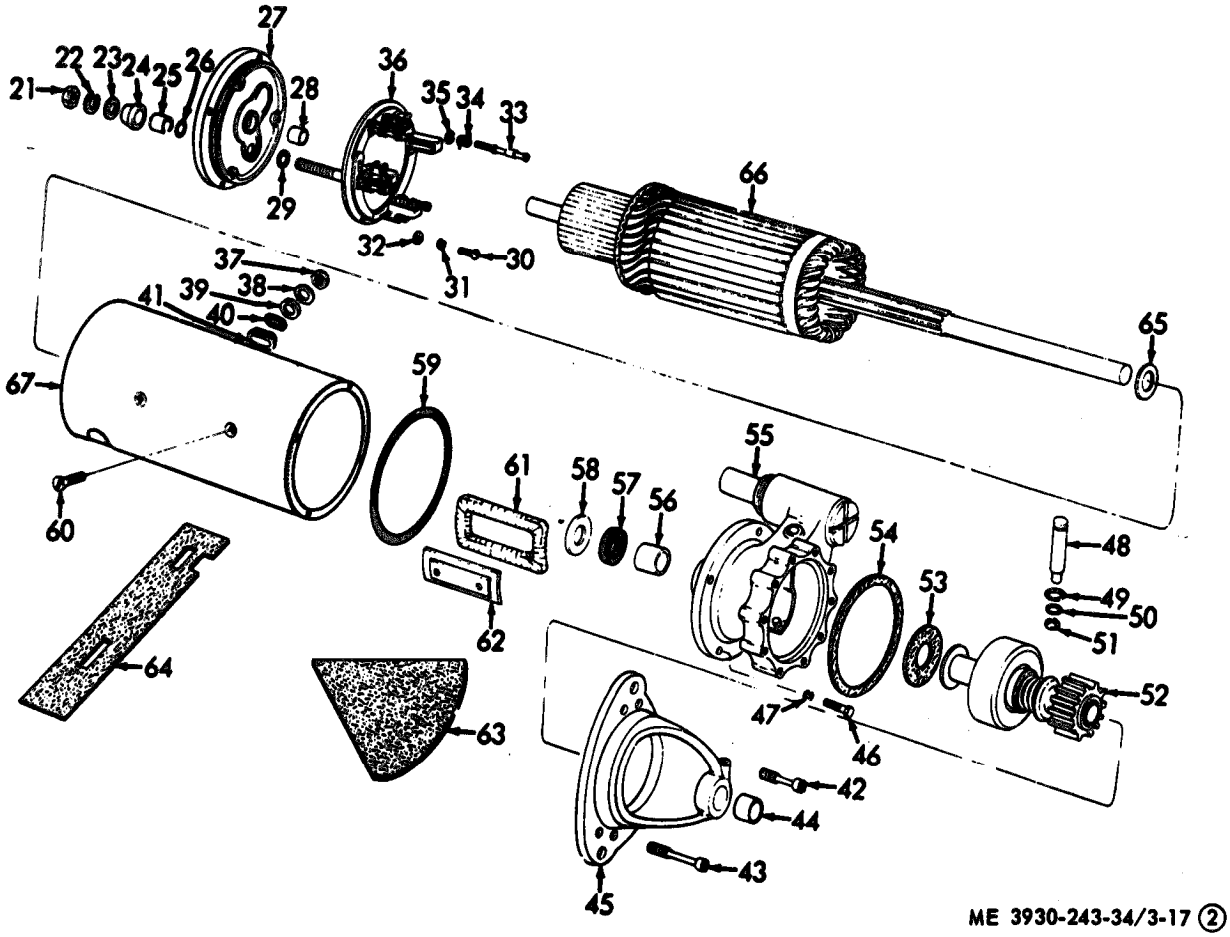


ME 3930-243-34/3-17 ①

1 Plug
2 Gasket
3 Nut
4 Lockwasher
5 Nut
6 Lockwasher
7 Lead
8 Connector
9 Screw
10 Solenoid
11 Screw
12 Lockwasher
13 Nut
14 Lockwasher
15 Screw
16 Lockwasher
17 Brush
18 End bell
19 Packing
20 Starter assembly

(1) Starter and brushes

Figure 3-17. Starting motor, disassembly and reassembly (sheet 1 of 2).



21 Nut	37 Nut	53 Washer
22 Lockwasher	38 Washer	54 Gasket
23 Washer	39 Washer	55 Line housing
24 Insulator	40 Gasket	56 Bearing
25 Insulator	41 Insulator	57 Packing
26 Packing	42 Screw	58 Washer
27 End frame	43 Screw	59 Packing
28 Bearing	44 Bushing	60 Screw
29 Washer	45 Drive housing	61 Field winding
30 Screw	46 Screw	62 Pole shoe
31 Washer	47 Washer	63 Insulator
32 Washer	48 Shaft	64 Insulator
33 Screw	49 Packing	65 Washer
34 Spring	50 Packing	66 Armature
35 Washer	51 Ring	67 Armature housing
36 Holder assembly	52 Drive	

(2) Starter assembly

Figure 3-17. starting motor, disassembly and reassembly (sheet 2 of 2).

3-11. Wiring Harness

a. General. Most wires in the forklift truck, whether run individually, or in a harness, are marked or numbered. The vast majority of the electrical leads have crimp-on connectors at each end; quick disconnect connections are on most of the controls, panel instruments, switches, and lights.

b. Inspection. Inspect the insulation for cracks or frayed material. Pay particular attention to the wires passing through holes in the frame or over rough edges. If inspection reveals a cut or broken wire, and the break in the wire is exposed, the wire must be repaired *(d* below). If the break in the wire is in the wiring harness or in an inaccessible area, replace the wire *(e* below).

c. Testing. Test the wire for continuity by disconnecting one end from the component to which it is attached, as this will make an open circuit. Touch the test probes of a multimeter to

each end of the wire. If the meter shows no indication, the wire is defective and should be repaired or replaced *(d* or *e* below).

d. Repair. Shave the insulation on the wire to expose one-half inch of bare wire at both ends of the break. Twist the bare wire together and solder the connection. Cover the repaired break with electrical tape and friction tape. Do not leave any bare wire exposed. If a terminal lug breaks from a wire, replace it with an exact duplicate.

e. Replacement. Replace a wire by disconnecting it from the component or components to which it is attached and remove the wire. Install a new wire and connect it to the component or components. If a broken wire is part of a harness, disconnect the wire at each end and tape the loose ends with electrical tape. Install a new wire and attach it to the outside of the wiring harness.

f. Removal.

(1) Disconnect wires from the instrument panel.

(2) Disconnect wires from headlights, marker lights, blackout lights, and taillights.

(3) Disconnect wires from overhead guard spotlight, warning buzzer, horn and horn connection at steering column.

(4) Uncouple connectors in front of the operator's panel.

(5) Disconnect wires from overspeed governor and oil pressure sending unit.

(6) Disconnect wires from starting motor, generator, and voltage regulator.

(7) Remove the necessary clamps and mounting hardware that secures the wiring harness.

g. Installation.

(1) Install wires on the starting motor, generator, and voltage regulator.

(2) Install the wires on the overspeed governor and oil pressure sending unit (TM 10-3930-243-12).

(3) Install the connectors in front of the operator's panel.

(4) Install wires on overhead guard spotlight, warning buzzer horn, and horn connections at steering column.

(5) Install wires at headlights, marker lights, blackout lights, and taillights.

(6) Install wires at instrument panel.

(7) Install the necessary clamps and mounting hardware that secures the wiring harness.

Section II. FUEL SYSTEM

3-12. General

The diesel engine fuel system consists of the fuel injectors, fuel pump and fuel tank. A restrictor fitting is located in the left cylinder head to maintain pressure in the fuel system. Three rocker arms are provided for each cylinder; the two outer arms operate the exhaust valves and the center arm operates the fuel injector.

3-13. Fuel Injector Control Lever and Tube Assembly

a. General. Each injector control rack is actuated by a lever on the injector control tube which, in turn, is connected to the governor by means of a fuel rod. The levers can be adjusted independently on the control tube, thus permitting a uniform setting of all injector racks.

b. Removal.

(1) Remove the engine hood and rocker arm cover (TM 10-3930-243-12).

(2) Refer to figure 3-18 and remove the fuel injector control lever and tube assembly.

c. Disassembly. Refer to figure 3-19 and disassemble the fuel injector control lever and tube assembly.

d. Inspection.

(1) Inspect the control lever (12, fig. 3-19) for cracks, bends and excessive wear.

(2) Inspect tube assembly (10) for dents and breaks.

(3) Inspect spring (4) for breaks or bends.

(4) Inspect all hardware for damage. Replace a defective part.

e. Reassembly. Refer to figure 3-19 and reassemble the injector control lever and tube assembly.

f. Installation. Refer to figure 3-18 and install fuel injector control lever and tube assembly.

g. Control Lever Adjustment.

NOTE

The letter R or L indicates the injector location in the right or left cylinder bank, viewed from the rear of engine. Cylinders are numbered starting at the front of the engine on each cylinder bank. Adjust number 3L injector rack control lever first to establish a guide for adjusting the remaining levers.

(1) Disconnect the linkage attached to the governor speed control lever (4, fig. 3-13).

(2) Turn the idle speed adjusting screw (10, fig. 3-14) until about ½ inch of the screw projects from the lock nut (9).

NOTE

This adjustment lowers the tension of the low speed spring so it can be depressed, while closing the low speed gap, without bending the fuel rods.

(3) Back out the buffer screw (43, fig. 3-13).

(4) Disconnect the clevis pin from the fuel rod and the right cylinder bank injector control tube lever (6, fig. 3-19).

(5) Loosen all inner and outer injector rack control lever adjusting screws (13) on both injector control tubes (10). Be sure all injector rack control levers (12) are free on the injector control tubes.

(6) Move the speed control lever (4, fig. 3-13) to maximum speed position with light finger pressure. Turn the inner adjusting screw (fig. 3-18) on the number 3L injector rack control lever down until a slight movement of the control tube lever is observed. This will place the number 3L injector in the full-fuel position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Alternately tighten both the inner and outer adjusting screws.

(7) To ensure the control lever is properly adjusted, hold the speed control lever in the maximum speed position and press down on the injector rack with a screwdriver or finger tip, causing rack to rotate. The setting is sufficiently tight if rack returns to its original position. If rack does not return to its original position, it is too loose. To correct this condition, back off outer adjusting screw slightly and tighten the inner adjusting screw. The setting is too tight if, when moving the speed control lever from idle to maximum speed position, the injector rack becomes tight before the speed control lever reaches its end of its travel (stop under the governor cover). This will result in a step-up in effort required to move the speed control lever to its maximum speed position and a deflection in the fuel rod (fuel rod deflection can be seen at the bend). If rack is too tight, back off inner adjusting screw slightly and tighten out adjusting screw.

(8) Remove the clevis pin from the fuel control rod and the left bank injector control tube lever

(9) Insert the clevis pin in the fuel rod and the right cylinder bank injector control tube lever and position the number 3R injector rack control lever as previously outlined in step 6 for the number 3L injector rack control lever,

(10) Insert clevis pin in fuel control rod and the left cylinder bank injector control tube lever. Repeat the check on 3L and 3R injector rack control levers as outlined in Step 7.

(11) Manually hold number 3L injector rack in the full-fuel position, with lever on the injector control tube, and turn the inner adjusting screw of the number 2L injector rack control lever down until the injector rack of the number 2L injector has moved into the full-fuel position. Turn the outer adjusting screw down until it bottoms lightly on the injector control tube. Alternately tighten both the inner and outer adjusting screws.

(12) Recheck the number 3L injector rack to be sure it has remained snug on the ball end of the rack control lever while positioning the number 2L injector rack. If the rack of the number 3L injector has become loose, back off the inner adjusting screw slightly on the number 2L injector rack control lever and tighten the outer adjusting screw. When the settings are correct, the rack of both injectors must be snug on the ball end of their respective rack control levers.

(13) Position the number 1L injector rack control lever as outlined in Steps 11 and 12.

(14) Position number 2R and 1R injector rack as outlined above for the left cylinder bank.

(15) Turn the idle speed adjusting screw (10, fig. 3-14) in until it projects 3/16 inch from the lock nut (9) to permit starting of the engine.

(16) Use new gaskets and replace the valve rocker cover and engine hood (TM 10-3930-243-12).

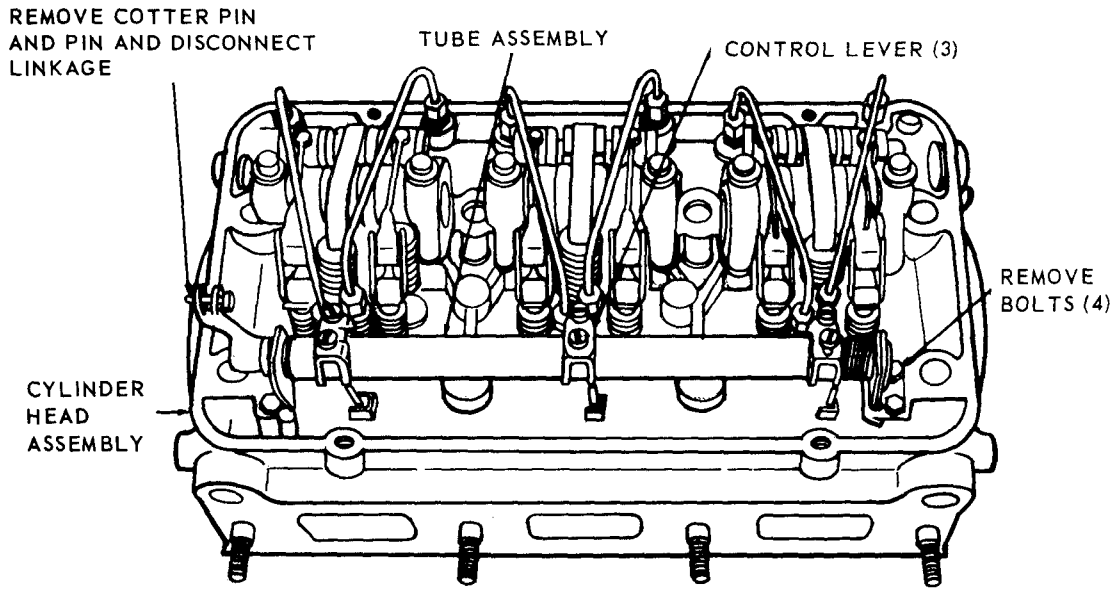
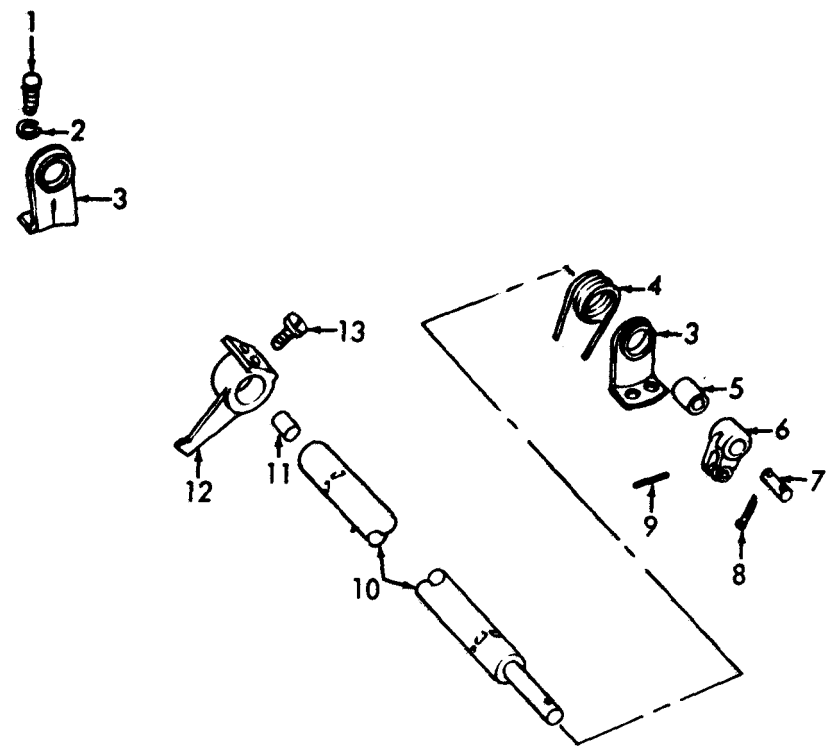


Figure 3-18. Fuel injector control lever and tube assembly, removal and installation.



1 Screw
2 Lock washer
3 Bracket
4 Spring
5 Spacer
6 Fuel rod lever
7 Clevis pin
8 Cotter pin
9 Cotter pin
10 Tube assembly
11 Pin
12 Control lever assembly
13 Adjusting screw

Figure 3-19. Fuel injector control lever and tube assembly, disassembly and reassembly.

3-14. Fuel Injector (Crown Valve)

a. General.

(1) The fuel injector performs four functions.

(a) Creates high fuel pressure required for efficient injection.

(b) Meters and injects fuel to exact amount required to handle load.

(c) Atomizes fuel for mixing with air in the combustion chamber.

(d) Permits continuous fuel flow.

(2) Each fuel injector has a circular disc pressed into a recess at the front side of the injector body for identification purposes. The identification tag indicates the nominal output of the injector in cubic millimeters.

(3) Each injector control rack is actuated by a lever on the injector control tube which, in turn, is connected to the governor by means of a fuel rod. The levers can be adjusted independently on the control tube, thus permitting a uniform setting of all injector racks (para 3-13 g).

b. Removal. Refer to figure 3-20 and remove fuel injectors and fuel lines.

NOTE

Install clean shipping caps on the injector fuel inlet and outlet and on the fuel connectors. Cover the injector hole in the cylinder head to keep out foreign material.

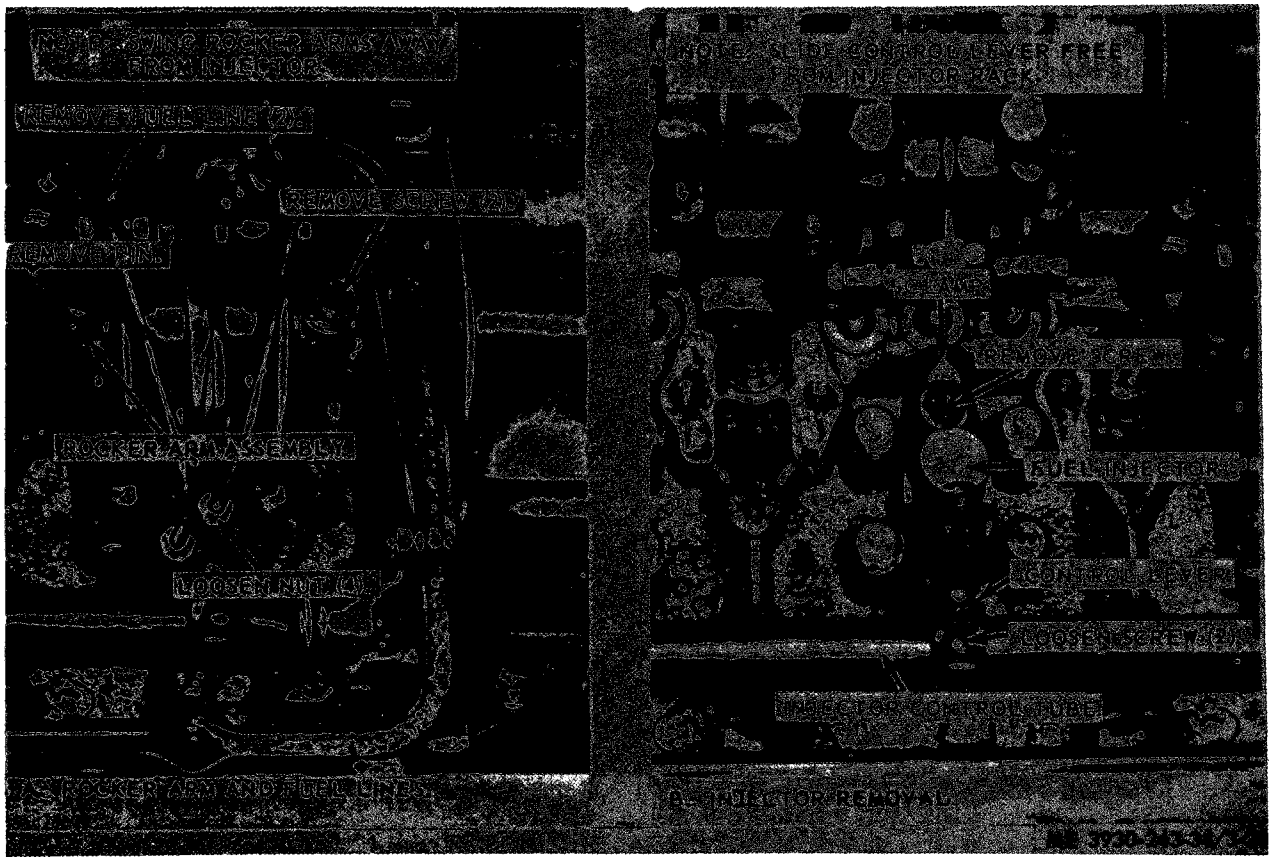


Figure 3-20. Fuel injector, removal and installation.

c. Fuel Injector Testing.

(1) *Injector rack and plunger movement.* Check to see if the plunger works freely in its bushing by placing injector against a bench and depressing follower to the bottom of its stroke while moving the rack back and forth. Failure to produce a free rack indicates internal parts of injector are dirty or damaged (fig. 3-21). With injector mounted in test stand (fig. 3-22) pump and maintain a pressure of 1600 to 2000 psi. Inspect for leaks. Relieve test pressure slowly to prevent damage to test gage.

WARNING

The injector must always be held in such a way as to prevent any fuel from penetrating a person's skin. Fuel which enters the blood stream could cause serious infection or death.

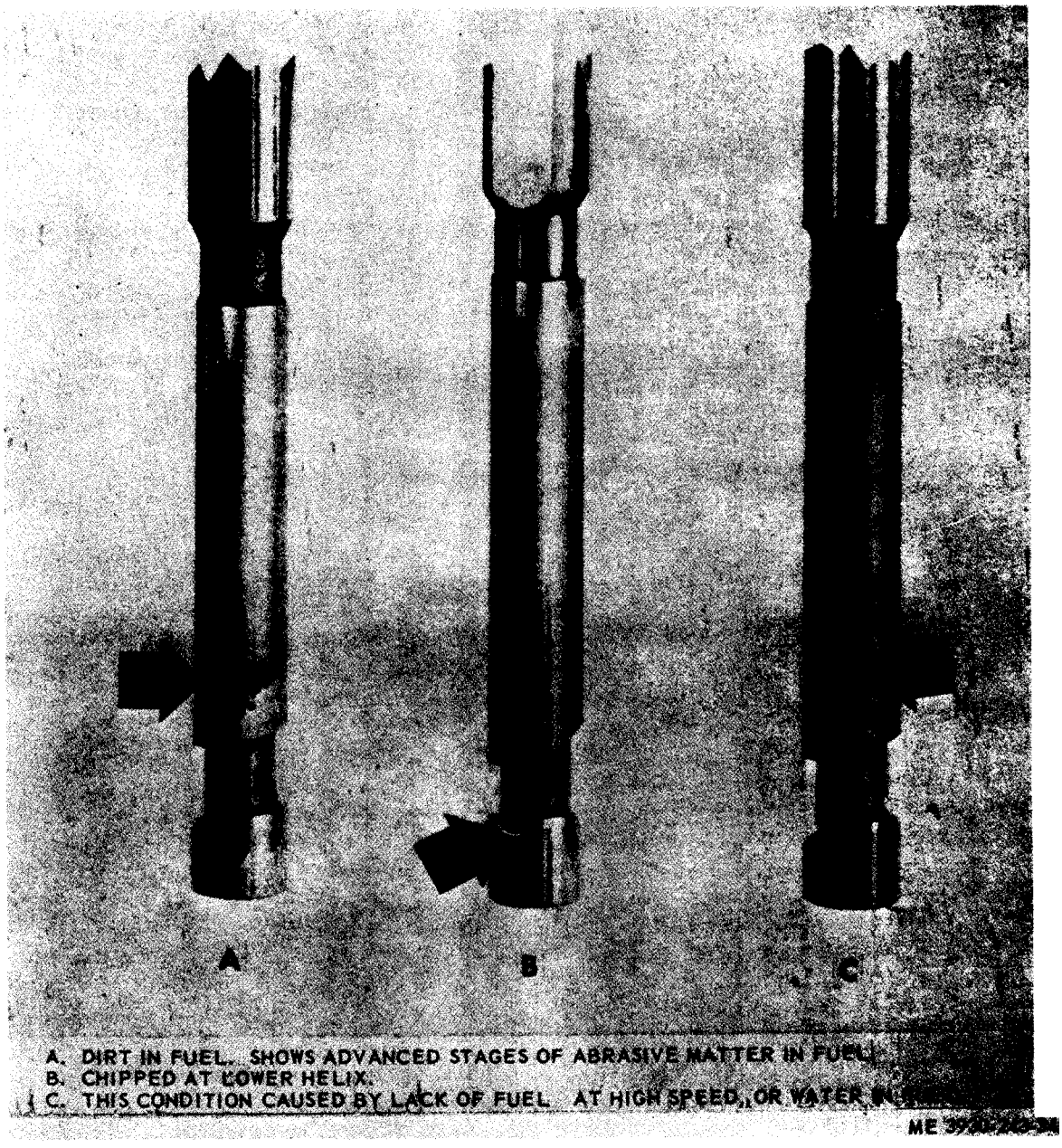


Figure 3-21. Defective fuel injector plungers.

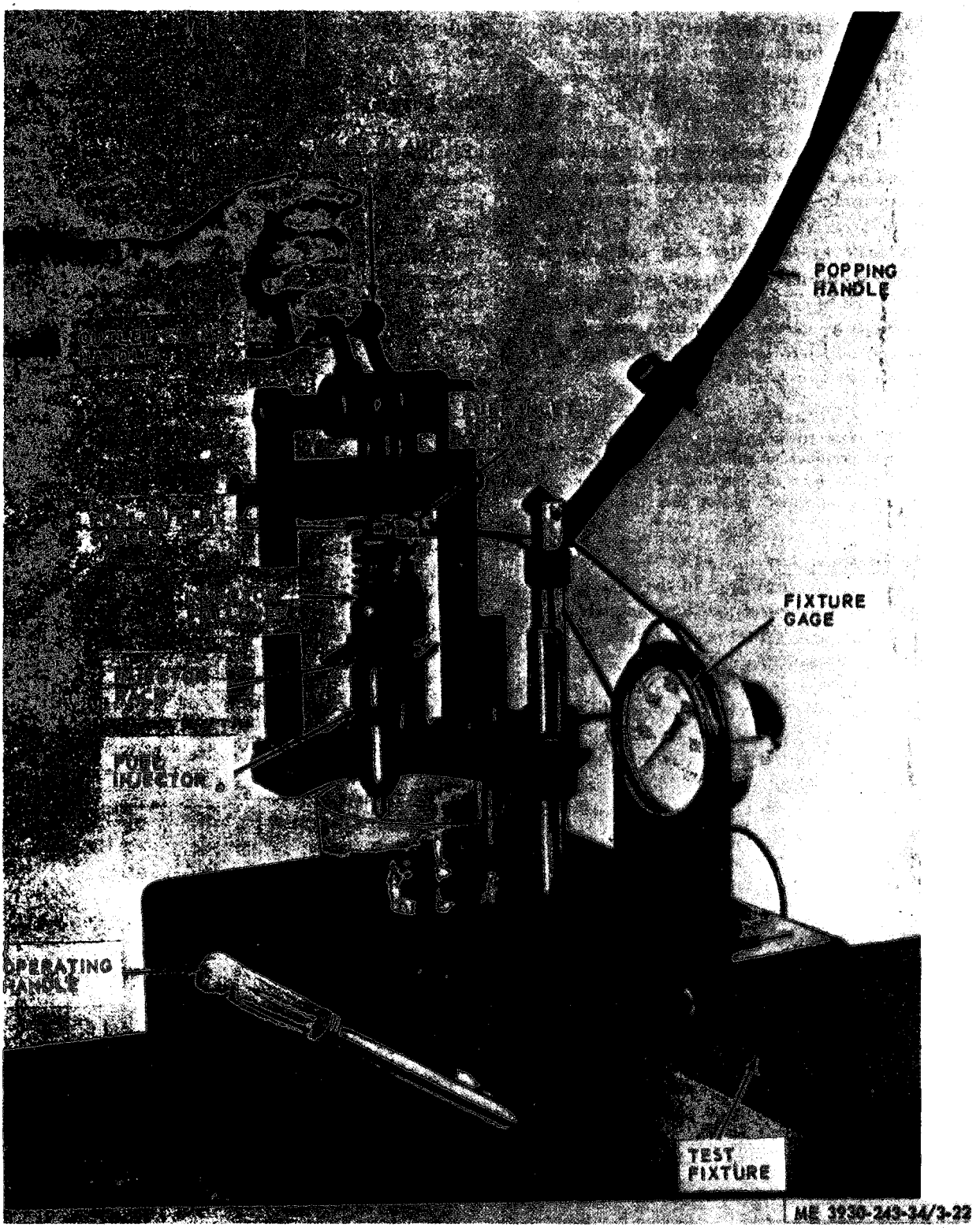


Figure 3-22. Fuel injector in testing and popping fixture, installation.

(2) ***Injector holding pressure test.***

(A) **Bring the pressure up, on tester, to a point just below the injector valve opening pressure.**

(b) Close **the fuel shut-off valve and note pressure drop. Time for pressure drop from 450 psi to 250 psi should not be less than 40 seconds.**

(c) **If injector pressure drops from 450 to 250 psi in less than 40 seconds, check the injector as follows:**

1. **Thoroughly dry injector with compressed air.**

2. Open the tester fuel valve and operate the pump handle to maintain test pressure.

3. Check for leak at the injector rack opening. A leak indicates a poor bushing-to-body fit.

4. A leak around the spray tip or seal ring usually is caused by a loose injector nut, a damaged seal ring, or a brinelled surface on the injector nut or spray tip.

5. A leak at the filter cap indicates a loose filter cap or a damaged filter cap gasket.

6. A "dribble" at the spray tip orifices indicates a leaking valve assembly due to a damaged surface or dirt. Leakage at the tip will cause preignition in the engine.

NOTE

A drop or two of fuel at the spray tip is only an indication of fuel trapped in the spray tip at the beginning of the test and is not detrimental as long as the pressure drop specified is not less than 40 seconds.

(3) *Spray pattern test.*

(a) With injector mounted in the tester and the injector rack in *Full Fuel* position, operate the pump handle to maintain a fuel pressure just below the valve opening pressure.

(b) Operate the injector several times with the pump handle and observe the spray pattern emitted from the spray tip orifices. Fuel should be discharged from each orifice and spray should produce a uniform pattern.

(c) If spray does not produce a uniform pattern, clean orifices in the spray tip (fig. 3-29).

(4) *High pressure test.*

(a) With the injector rack in the *Full Fuel* position and the injector tester handle locked in position by means of handle lock (fig. 3-23), operate pump handle to build up and maintain the pressure.

(b) Use the adjusting screw in the injector tester handle to depress the injector plunger just far enough to close both ports in the injector housing. The point at which both ports are closed may be easily ascertained by the fact that the injector spray will decrease appreciably and a rise in pressure will occur.

(c) At this time the condition of the plunger and bushing may be established. If there is excessive clearance between the plunger and bushing, pressure beyond the normal valve opening pressure cannot be obtained. Replacement of the plunger and bushing assembly is then required.

(d) Pump up the injector tester and maintain a pressure of 1600 to 2000 psi by actuating the pump handle. Inspect for leaks at the injector filter cap gaskets, body plugs, injector nut seal ring area.

NOTE

It is normal for some fuel leakage at the rack hole due to high pressure fuel being applied to a normally low pressure area in the injector assembly.

CAUTION

Do not permit pressure in the injector tester to equal or exceed the capacity of the pressure gage.

(5) *Visual inspection of plunger.* An injector which passes all the previous tests should have the plunger checked visually, under a magnifying glass, for excessive wear or a possible chip on the bottom helix. There is a small area on the bottom helix and lower portion of the upper helix, if chipped, that will not be indicated in any of the test. Remove the plunger from the injector as follows:

(a) Support injector, right side up, in holding fixture.

(b) Compress the follower spring. Using a screwdriver, raise the spring above the stop pin and withdraw the pin (fig. 3-24). Allow the spring to rise gradually.

(c) Remove the injector from the holding fixture. Turn injector upside down, to prevent the entry of dirt, and catch spring and plunger as they fall out.

(d) Inspect the plunger, and if chipped at lower helix (fig. 3-21), replace the plunger and bushing assembly.

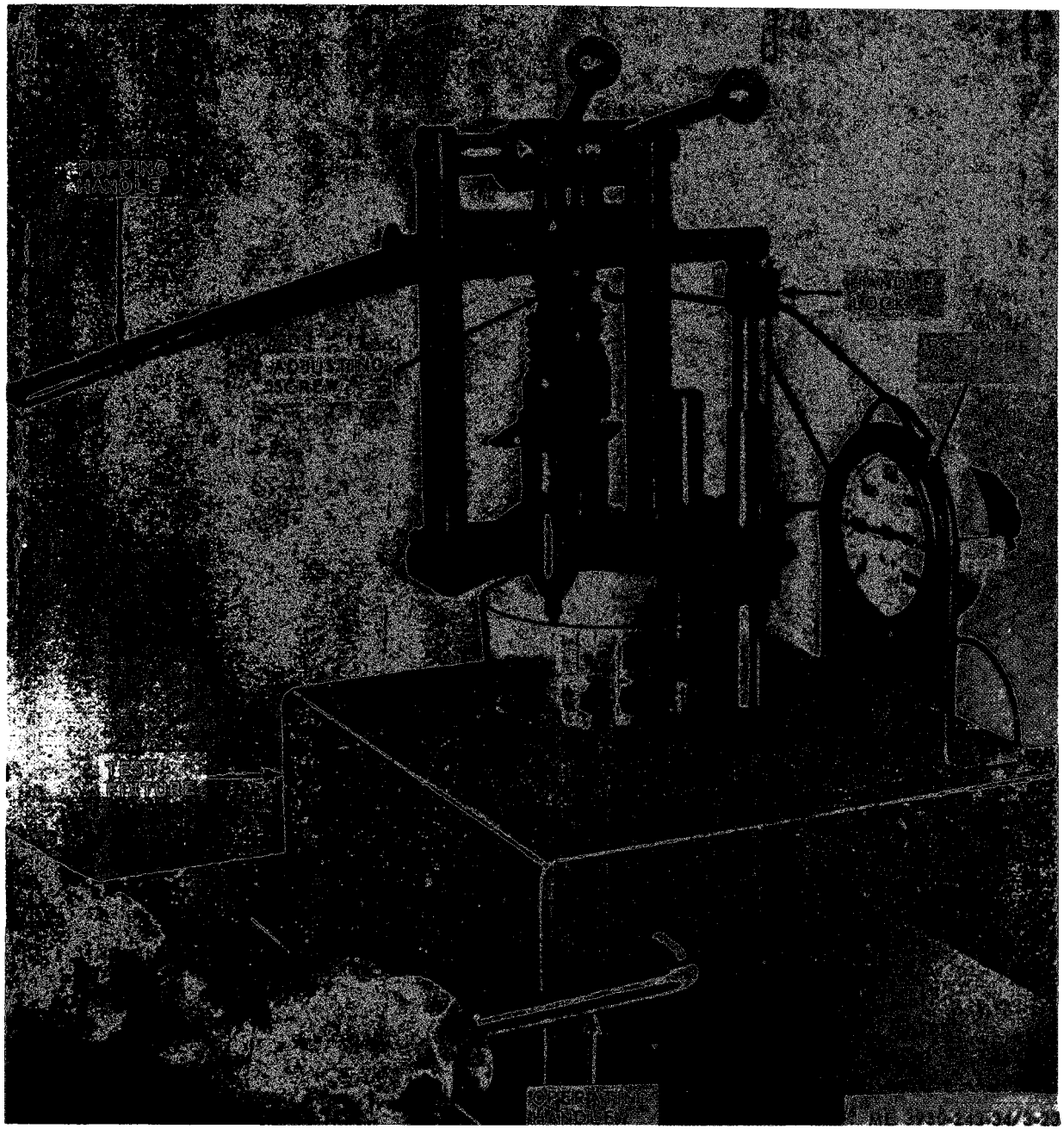


Figure 3-23. Fuel injector high pressure test.

d. Disassembly. Refer to figures 3-25, 3-26 and 3-27 and disassemble the fuel injector in numerical sequence.

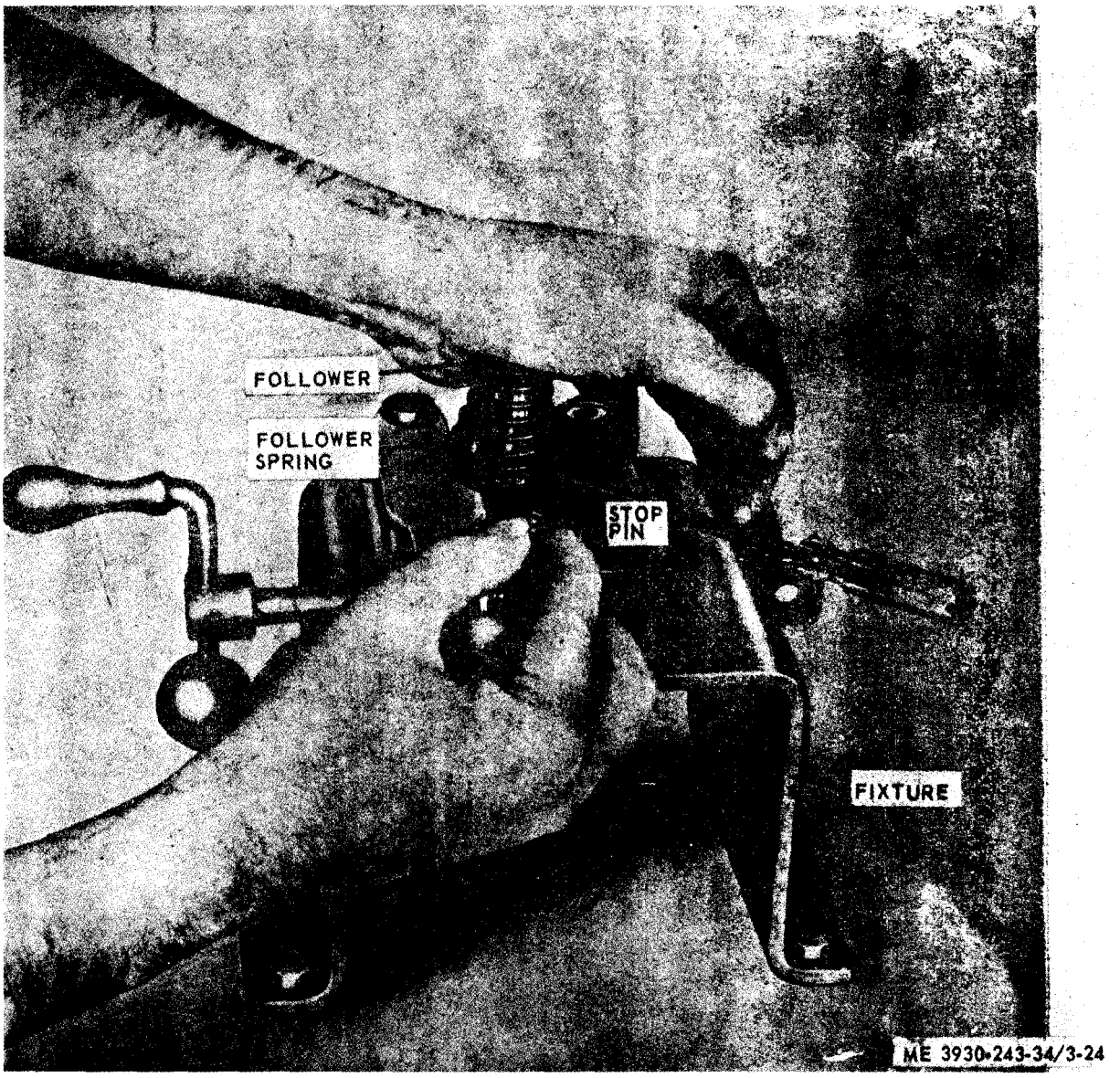


Figure 3-24. Fuel injector follower stop pin removal.

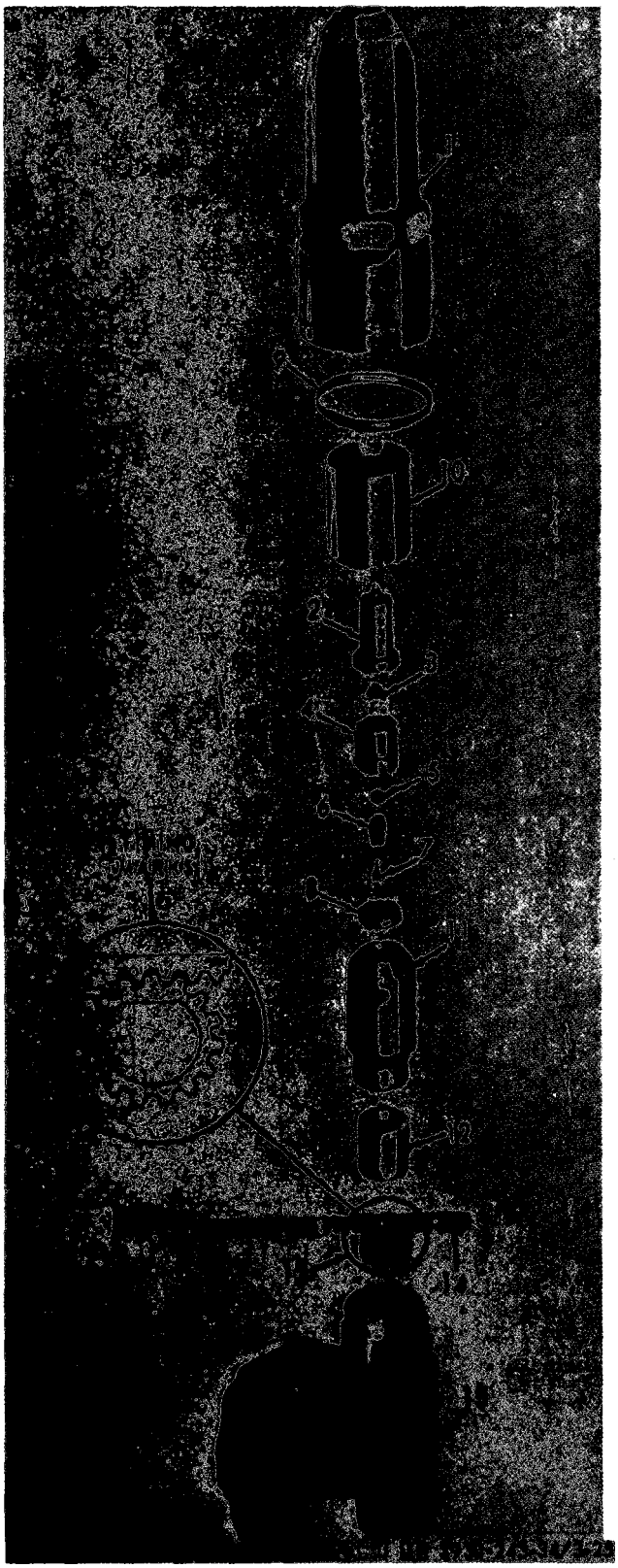
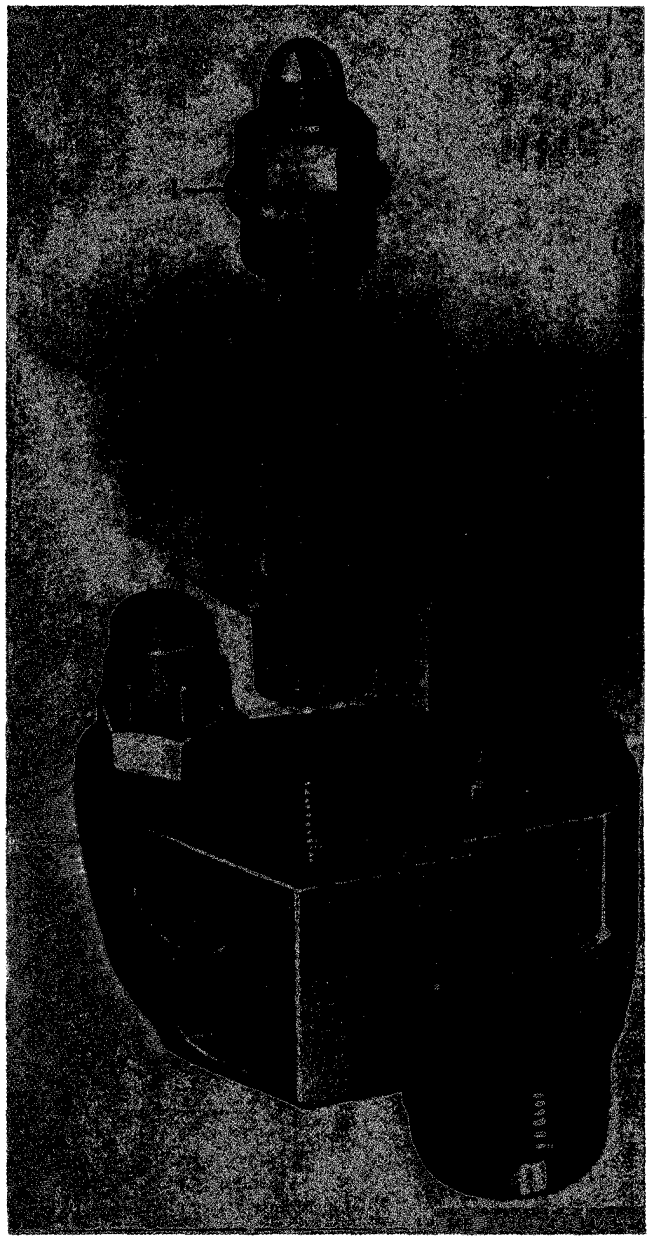


Figure 3-25. Injector rack, gear, spray tip and valve assembly components, removal and installation.

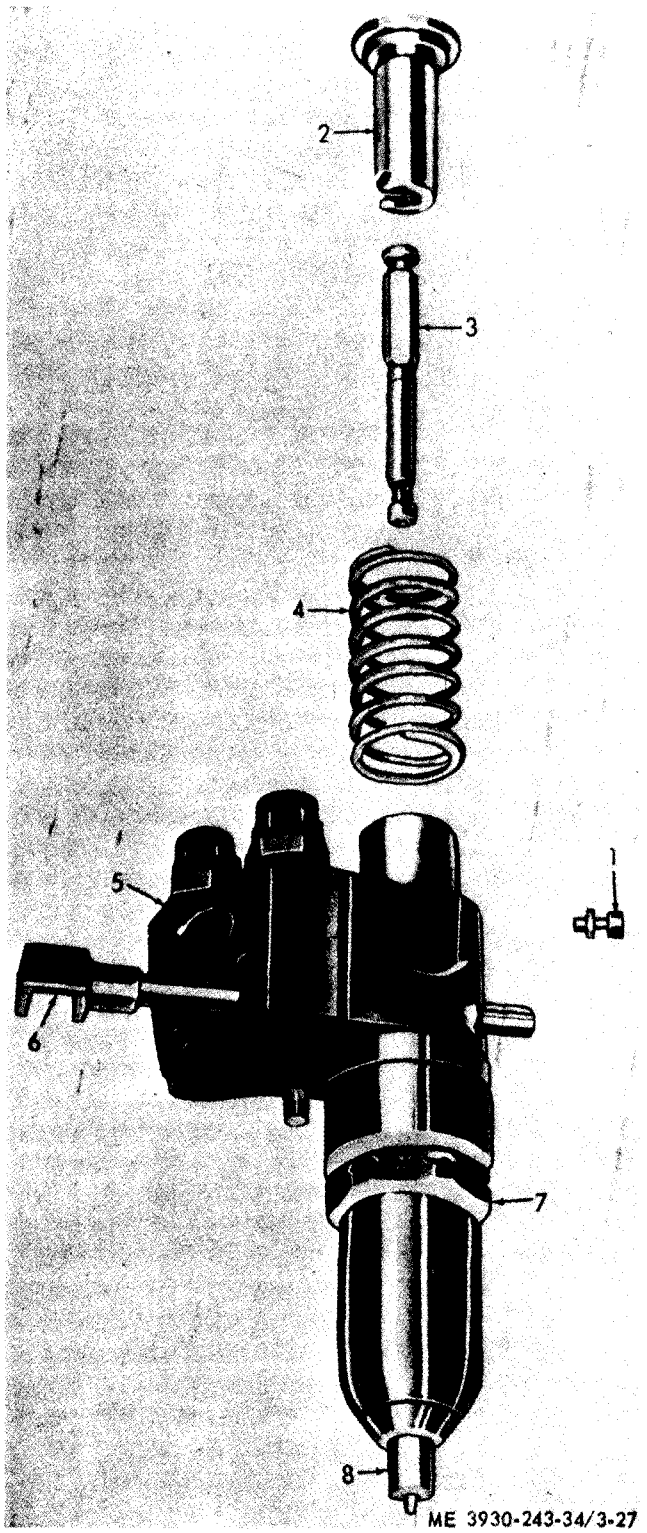


1 Filter cap
2 Cap gasket
3 Filter spring
4 Filter
5 Body

Figure 3-26. Fuel injector filter, removal and installation.

KEY to figure 3-25:

1 Nut
2 Spray tip
3 Check valve
4 Check valve gage
5 Valve atop
6 Valve spring
7 Injector valve
8 Valve seat
9 Seal ring
10 Spill deflector
11 Bushing
12 Gear retainer
13 Rack gear
14 Control rack
15 Injector body



1 Stop pin
2 Follower
3 Plunger
4 Follower spring
5 Body
6 Control rack
7 Nut
8 Spray tip

Figure 3-27. Injector follower, spring and plunger, removal and installation.

e. Cleaning and Inspection. Since most injector difficulties are the result of dirt particles, it is essential that a clean area be provided on which to place injector parts after cleaning and inspection.

(1) Clean out all passages, drilled holes and slots in the injector.

(2) Clean the spray tip with reamer (fig. 3-28). Turn reamer in a clockwise direction to remove carbon deposits.

(3) Clean the spray tip orifices with pin vise tool using the proper size spray tip cleaning wire (fig. 3-29). Use 0.0055 inch diameter wire to clean holes.

(4) Clean and brush all passages in injector body. Carefully insert reamer into the injector nut and ream injector spray tip seat (fig. 3-30). Turn reamer in a clockwise direction to remove carbon deposits.

(5) Inspect the teeth on the control rack and control rack gear for wear and damage. Inspect both ends of spill deflector for sharp edges or burrs. Remove burrs with a medium stone.

(6) Inspect follower spring for defects and proper tension. The spring has a free length of approximately 1.504 inches. Replace spring when load of less than 70 pounds will compress it to 1.028 inch.

(7) Check seal ring area in the injector body and surface which contacts the injector bushing for damage. If necessary lap this area.

(8) Inspect the injector plunger for scoring, erosion chipping or wear. Check for sharp edges on portion of plunger which rides in the gear. Remove any sharp edges with a 500 grit stone and clean. Slip the plunger into the bushing and check for free movement. Replace worn, chipped, or scored plungers and bushings as an assembly since they are mated parts.

(9) Excessive spray tip seating surface of injector nut for nicks, burrs, or brinelling.

(10) Inspect the sealing surfaces of injector parts as indicated by arrows (fig. 3-31). Inspect all surfaces with a magnifying glass, for even the slightest imperfection will prevent injector from operating properly. Check for burrs, nicks, erosion, cracks, chipping, and excessive wear. Inspect spray tips for enlarged orifices.

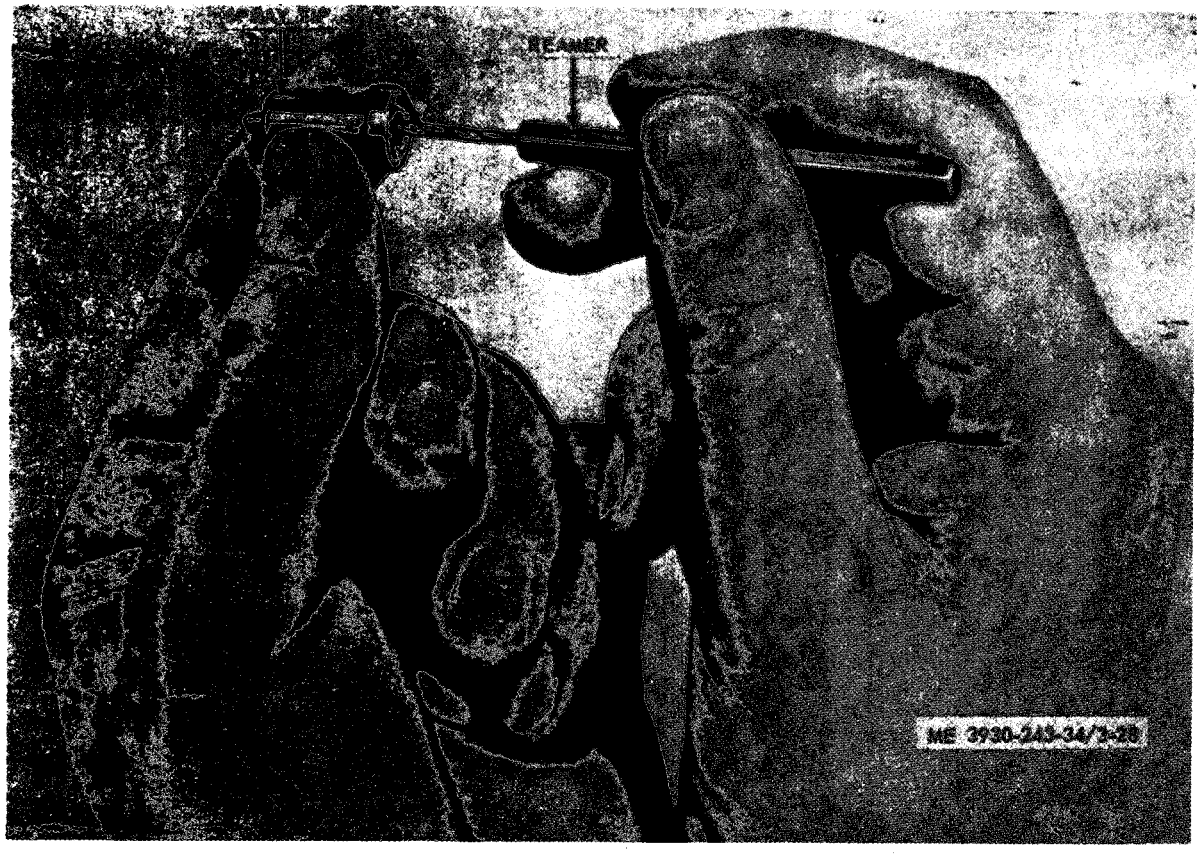


Figure 3-28. Reaming fuel injector spray tip.

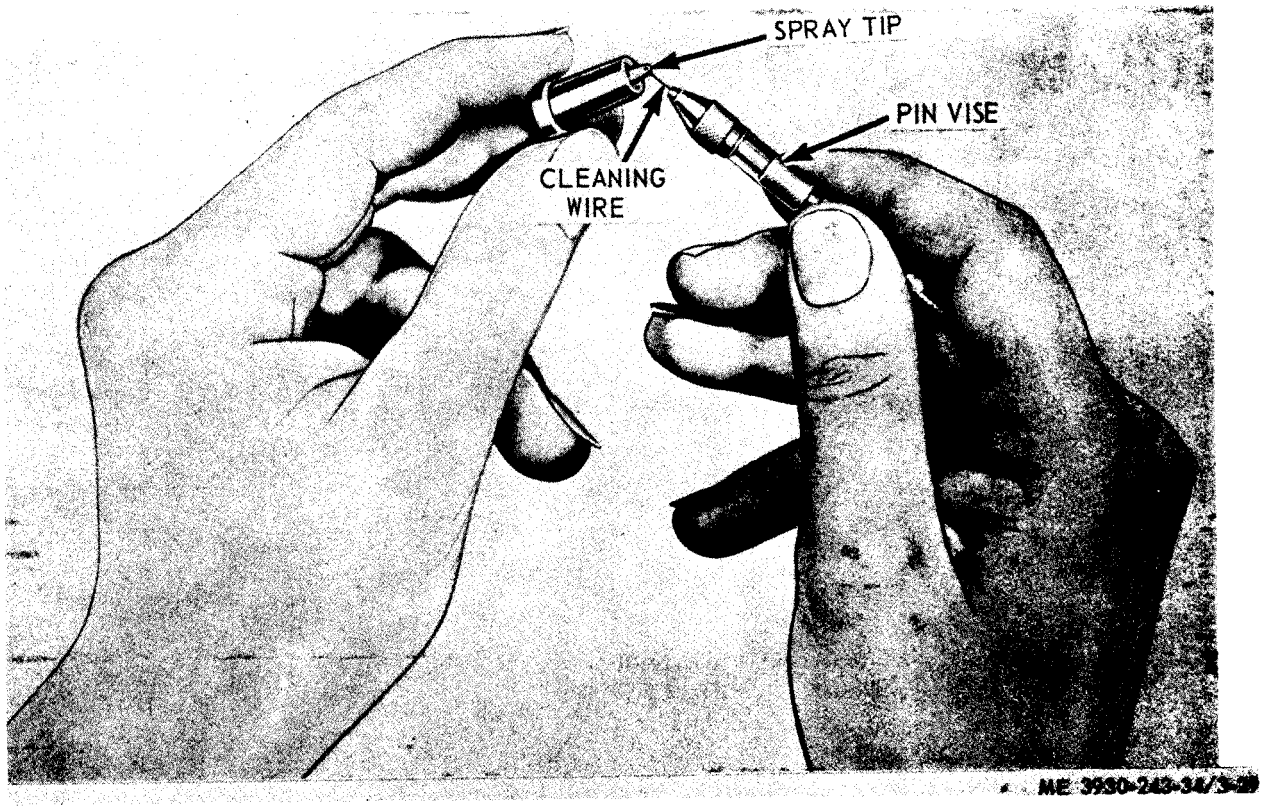


Figure 3-29. Cleaning fuel tip orifices.

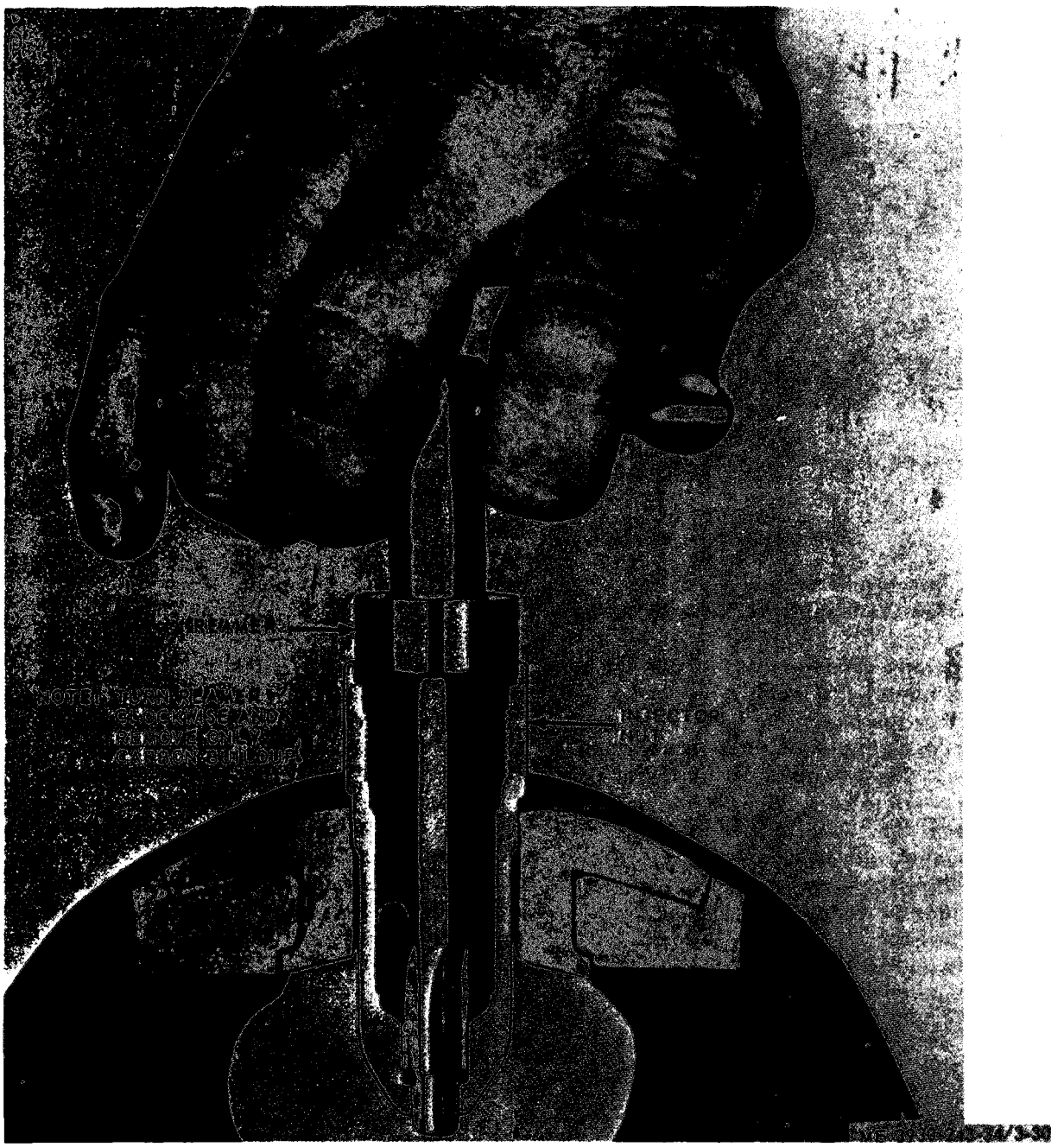


Figure 3-30. Cleaning fuel injector nut spray tip seat.

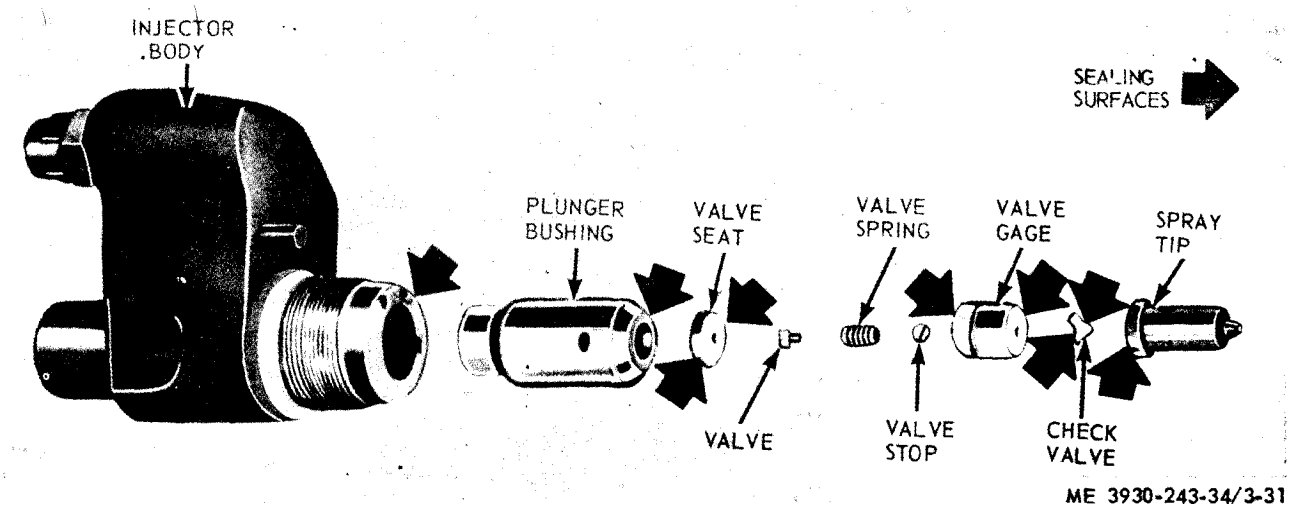


Figure 3-31. Fuel injector sealing surfaces which may require lapping.

f. Lap Injector Parts.

(1) Clean the lapping blocks with compressed air.

(2) Spread a good quality, 600 grit dry lapping powder on one of the lapping blocks.

(3) Place the part to be lapped flat on block, using a figure eight motion, move it back and forth across block. Do not press on part, but use just enough pressure to keep the part flat on the block. When part is flat, wash in solvent (P-D-680) and dry thoroughly with compressed air.

(4) Place the dry part on a second block; apply lapping powder and repeat action.

(5) Place the dry part on a third block, Do not use lapping powder on this block. Keep the part flat and move across block several times, using the figure eight motion. Lapping the dry part in this manner gives it the "mirror" finish required for perfect sealing.

g. Reassemble. Refer to figures 3-25, 3-26, and 3-27 and reassemble the fuel injector. Reassembly is the reverse procedure of disassembly.

h. Spray Tip Concentricity Check.

(1) Place injector in the concentricity gage and set dial gage indicator to zero (fig. 3-32).

(2) Rotate injector 360° and note total run-out as indicated on dial.

(3) If total run-out exceeds 0.008 inch, remove injector from gage. Loosen injector nut, center the spray tip, and tighten nut to 55 to 65 foot pounds torque. Recheck the spray tip for concentricity.

Figure 3-32. Checking fuel injector spray tip concentricity.

i. Illustration. Before installing an injector in an engine, remove carbon deposits from the beveled seat of injector tube in cylinder head. This will assure correct alignment of injector and prevent any undue stress from being exerted against spray tip. Use injector tube bevel reamer to clean carbon from injector tube. Exercise care to remove only carbon so that proper clearance between injector body and cylinder head be maintained. Pack the flutes of reamer with grease to retain the carbon removed from the tube. Install fuel injector as follows:

(1) Refer to figure 3-20 and install the fuel injector and fuel line. Insert the injector into the injector tube with the dowel in the injector body registering with the locating hole in the cylinder head.

NOTE

Check the injector control rack for free movement. Excess torque can cause the control rack to stick or bind.

(2) Move rocker arm assembly into position and tighten the rocker arm bracket bolts to 50 to 55 foot pounds torque.

CAUTION

There is a possibility of damaging exhaust valves if the exhaust valve bridges are not resting on the ends of exhaust valves when tightening the rocker shaft bracket bolts. Note position of exhaust valve bridges before, during and after tightening the rocker shaft bolts.

CAUTION

Do not bend the fuel pipes and do not exceed specified torque. Excessive torque will twist or fracture flared end of fuel lines and result in leaks. Lubrication oil diluted by fuel oil can cause serious damage to the engine bearings.

j. Fuel Injector Timing.

(1) Place the speed control lever in the idle speed position. If a stop lever is provided, secure it in the no-fuel position.

(2) Rotate the crankshaft, manually or with starting motor, until the exhaust valves are fully depressed on the cylinder to be timed.

CAUTION

If a wrench is used on the crankshaft bolt at the front of the engine, do not turn the crankshaft in a left-hand direction of rotation or the bolt will loosen.

(3) Place the small end of injector timing gage in the hole provided in the top of injector body, with the flat of the gage toward the injector follower.

(4) Loosen the push rod lock nut.

(5) Turn the push rod and adjust the injector rocker arm until the extended part of the gage will just pass over the top of the injector follower.

(6) Hold the push rod and tighten the lock nut. Check the adjustment and readjust, if necessary.

(7) Time the remaining injectors as outlined above.

3-15. Rocker Arms and Push Rods

a. General. Three rocker arms are provided for each cylinder; the two outer arms operate the exhaust valves and the center arm operates the fuel injector. The rocker arms are operated by the camshaft through cam followers and short push rods extending through the cylinder head.

b. Removal.

(1) Remove the rocker arm cover (TM 10-3930-243-12).

(2) Refer to figure 3-33 and remove rocker arms and push rod.

c. Disassembly. Refer to figure 3-34 and disassemble the rocker arm and push rod assembly in numerical sequence.

d. Inspection.

(1) Inspect the rounded end of push rod for wear.

(2) Inspect the springs for cracks and breaks.

(3) Inspect the cam follower holes in the cylinder head to ensure they are clean, smooth, and free of score marks. Dress out any score marks with crocus cloth.

(4) Inspect the cam follower roller for freedom of movement on its pin, flat spots and scuff marks.

(5) Inspect cam follower and cam follower guides (fig. 3-35) (cylinder head removed).

(6) Check the cam follower-to-cylinder head clearance. The clearance must not exceed 0.006 inch with new parts.

(7) Check the total side clearance between the roller and follower; this clearance must not be less than 0.015 inch or more than 0.023 inch.

(8) Check the clearance between the roller bushing and pin (fig. 3-36). If the diameter clearance exceeds 0.010 inch, replace the cam follower assembly or install a new cam roller and pin.

e. Reassembly. Refer to figure 3-34 and reassemble the rocker arm, and push rod assembly. Assembly is the reverse procedure of disassembly.

f. Installation. Refer to figure 3-33 and install the rocker arm and push rods. Refer to TM 10-3930-243-12 and adjust the push rods and rocker arms.

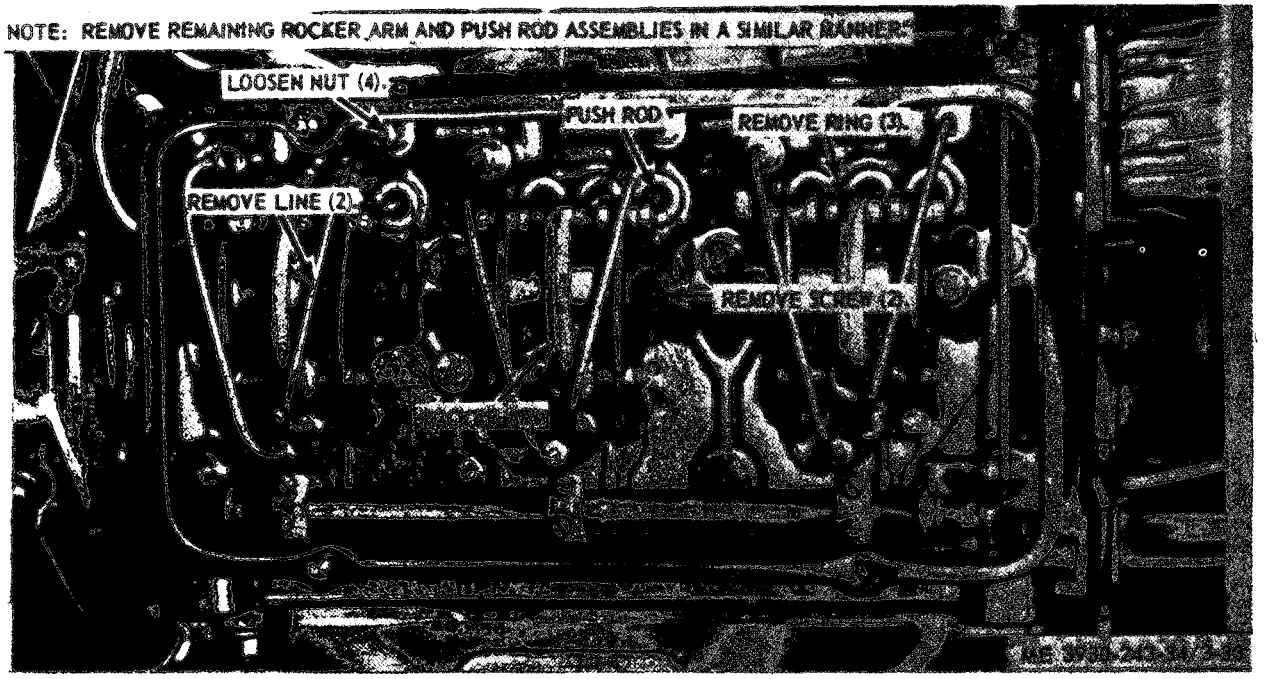
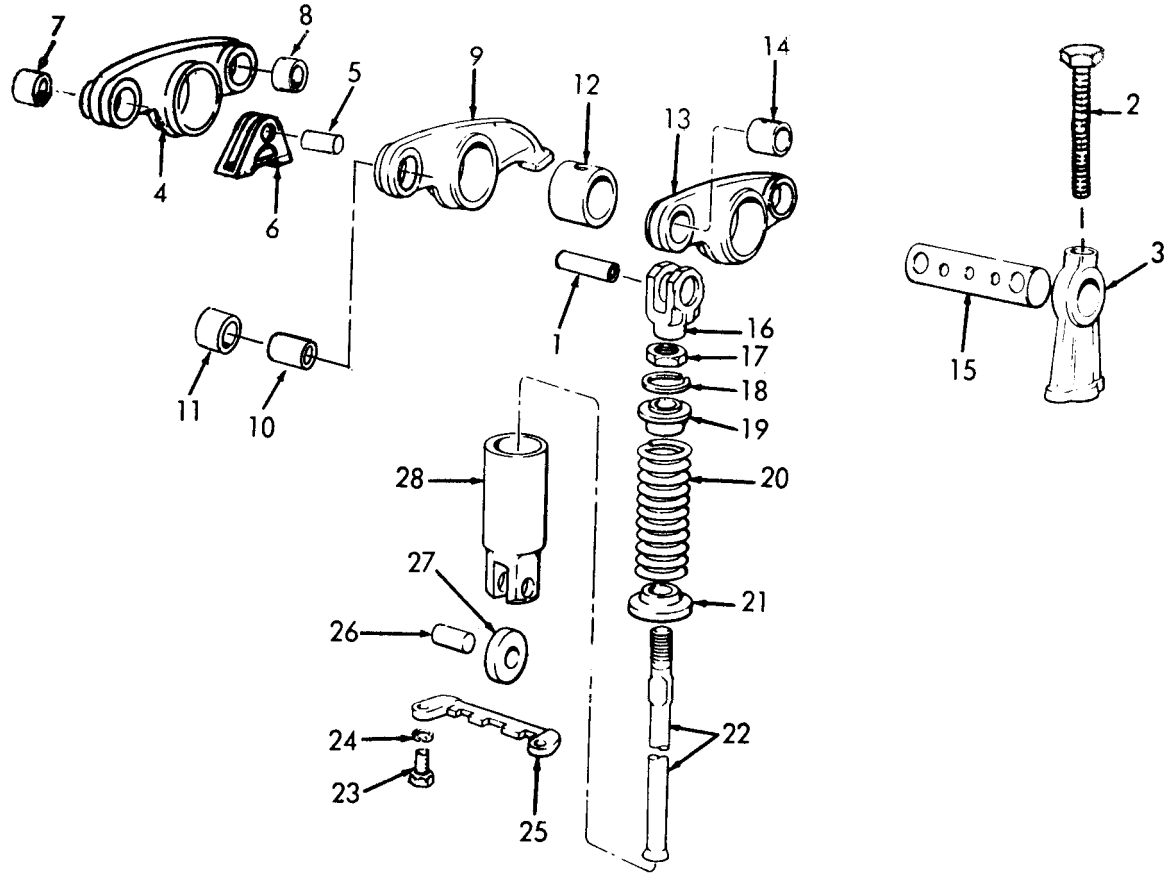


Figure 3-33. Rocker arm and push rods, removal and installation.



ME 3930-243-34/3-34

1 Pin
2 Bolt
3 Bracket
4 Rocker
5 Pin
6 Bridge
7 Bushing
8 Bushing
9 Rocker
10 Bushing
11 Bushing
12 Bushing
13 Rocker
14 Bushing
15 Shaft
16 Clevis
17 Nut
18 Retainer
19 Seat
20 Spring
21 Seat
22 Rod
23 Screw
24 Lockwasher
25 Guide
26 Pin
27 Roller
28 Follower

Figure 3-34. Rocker arm and push rod, disassembly and reassembly.

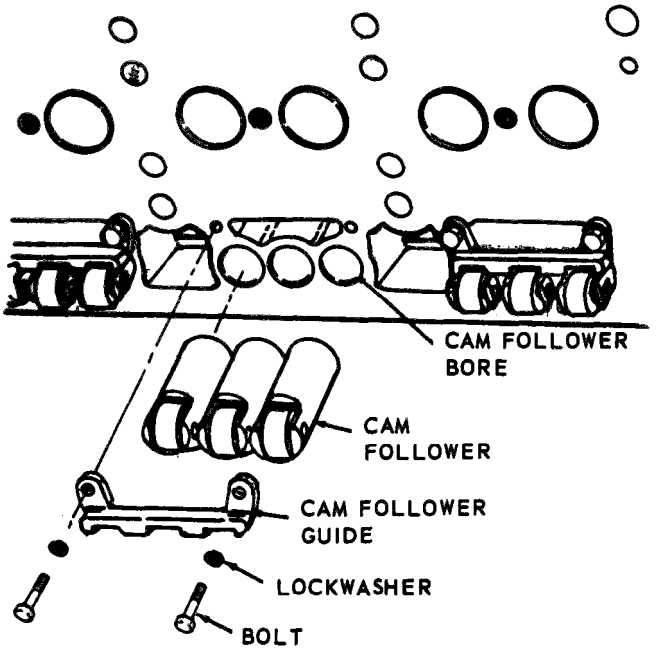


Figure 3-35. Cam follower and guide location.

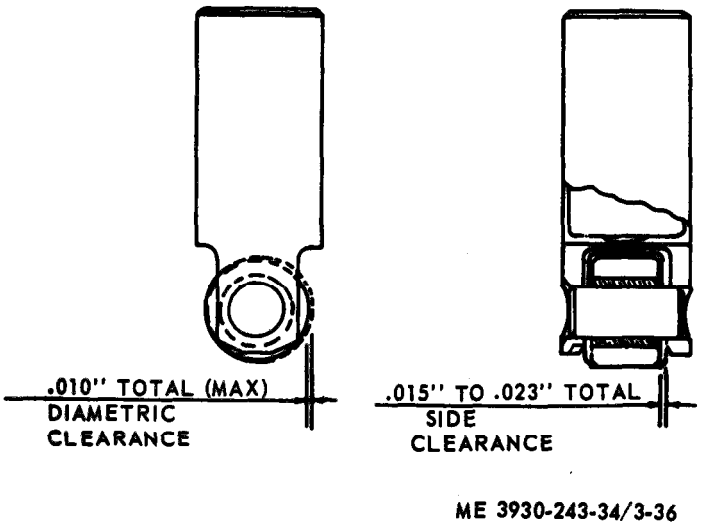


Figure 3-36. Cam roller wear and clearance diagram.

3-16. Fuel Pump

a. General. The fuel pump circulates, or transfers, fuel from the fuel supply tank to fuel injectors. The pump circulates excess supply of fuel through the injectors and the unused portion returns to the fuel tank by means of a fuel return manifold and fuel return line. The fuel pump is mounted on the flywheel housing.

b. Fuel Operational Check. If engine operation indicates an insufficient supply of fuel to the injectors and the fuel level is not low in the supply tank, check fuel flow between restricted fitting in the fuel return passage in the cylinder head and the fuel supply tank as follows:

(1) Disconnect the flexible fuel return tube from fitting at the fuel tank and hold open end of pipe in a convenient receptacle.

(2) Start and run the engine at 2500 rpm and measure the fuel flow return for one minute. Approximately 0.6 gallon of fuel should flow from the return tube per minute.

(3) Be sure all pipe connections between the fuel supply and the pipes are tight so that no air will be drawn into the fuel system. Immerse the end of the fuel tube in the fuel container. Air bubbles rising to the surface of the liquid will indicate a leak on the suction side of the pump.

(4) If the fuel flow is insufficient for satisfactory engine performance, change the element in the fuel strainer and replace the fuel filter element.

c. Checking Fuel Pump On Equipment. If the fuel pump fails to function satisfactorily, check for a broken pump shaft, or dirt in the relief valve before removing the pump from the engine as follows:

(1) Insert the end of a wire through one of the pump body drain holes. Crank the engine momentarily and see if the wire vibrates. Vibration will be felt if the pump shaft is rotating.

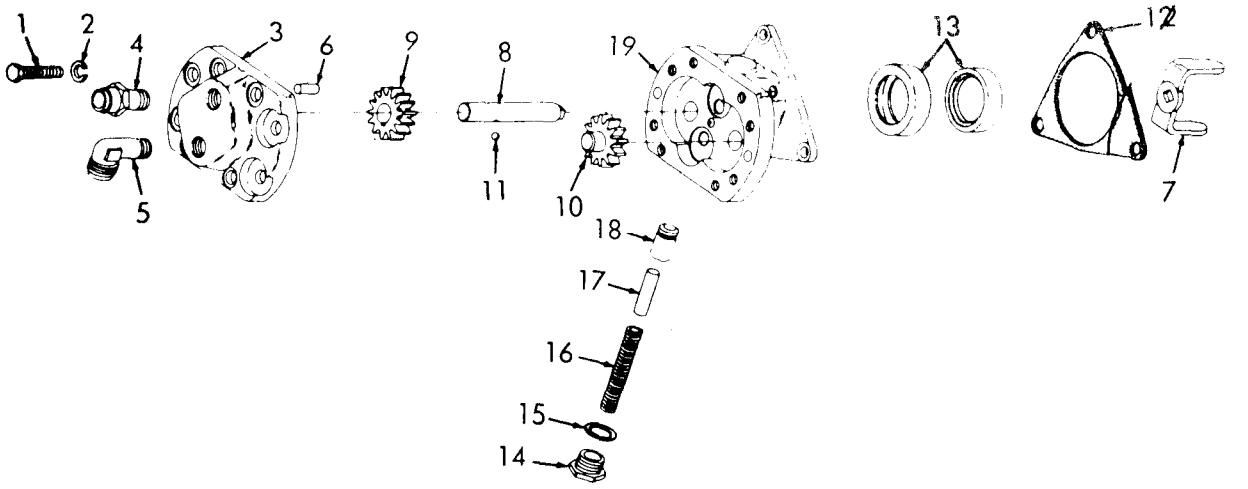
(2) Without removing the pump from engine, unscrew the valve plug (14, fig. 3-37). Remove the spring (16), pin (17) and valve (18). Wash the parts and blow out the valve cavity with compressed air. Reinstall valve parts.

d. Removal.

(1) Remove fuel pump (TM 10-3930-243-12).

(2) Cap all fuel lines.

e. Disassembly. Refer to figure 3-37 and disassemble the fuel pump assembly in numerical sequence.



ME 3930-243-34/3-37

1 Screw
2 Lockwasher
3 Pump cover
4 Adapter
5 Elbow
6 Dowel pin
7 Coupling drive fork
8 Drive shaft
9 Drive gear
10 Driven gear and shaft
11 Gear retaining ball
12 Gasket
13 Oil seals
14 Valve plug
15 Gasket
16 Spring
17 Pin
18 Relief valve
19 Pump body

Figure 3-37. *Fuel pump, disassembly and reassembly.*

f. Inspection.

(1) Remove and discard the oil seals. Inspect the pump drive shaft (8, fig. 3-37) for nicks and scratches. Remove scratches with crocus cloth.

(2) Inspect the gear teeth (9 and 10) for scoring or chipping.

(3) Inspect the mating faces of the housing (19) and cover (3) for tight fit.

(4) Inspect the relief valve (18) for score marks and proper fitting into seat of pump housing.

g. Reassembly. Refer to figure 3-37 and reassemble the fuel pump assembly. Reassembly is the reverse procedure of disassembly.

NOTE

After assembly rotate the pump shaft by hand to make certain that the parts rotate freely. When the shaft does not rotate freely, attempt to free it by tapping a corner of the pump.

h. Installation.

(1) Remove caps from fuel lines.

(2) Install fuel pump (TM 10-3930-243-12).

3-17. Fuel Tank

a. General. The fuel tank is located on the right side of the forklift opposite the driver's seat. The fuel tank is made from a heavy guage metal and access steps are made on the fuel tank.

b. Removal. Remove the fuel tank (TM 10-3930-243-12).

c. Testing. Install pipe plugs in all openings of the tank except one. In the remaining opening, install a source of air pressure. Submerge the tank in water and apply approximately 15 psi of air. If air bubbles appear, they denote a leak. Repair, or replace the fuel tank if damaged beyond repair. After repair, retest the fuel tank.

WARNING

Before attempting to weld or braze the fuel tank, steam clean the tank for a minimum of eight (8) hours. Remove fuel cap and open the discharge and return lines during the welding process. Failure to observe this warning may result in serious injury or death.

d. Installation. Install the fuel tank (TM 10-3930-243-12).

Section III. CYLINDER HEAD, VALVES, FLYWHEEL, AND FLYWHEEL HOUSING

3-18. General

This section contains maintenance information on those items that are Considered components of the engine. These items consist of various parts which make up the basic engine.

3-19. Cylinder Head and Valves

a. General. The cylinder head is a one piece casting. It may be removed as an assembly containing cam followers, cam follower guides, rocker arms, exhaust valves and injectors. The head is securely held to the top of the cylinder block with bolts.

b. Removal.

(1) Disconnect the exhaust piping at the exhaust manifold (TM 10-3930-243-12).

(2) Drain the cooling system (TM 10-3930-243-12).

(3) Disconnect fuel lines at cylinder head.

(4) Remove the thermostat housing and thermostat as an assembly (TM 10-3930-243-12).

(5) Remove the valve rocker cover (TM 10-3930-243-12).

(6) Disconnect and remove the fuel rod between the governor and the injector control tube lever (fig. 3-38).

(7) Remove the exhaust manifold (TM 10-3930-243-121).

(8) Remove the injector control tube and bracket as an assembly (para 3-13).

(9) If cylinder head is to be stripped for reconditioning of valves and valve seats or for a complete cylinder overhaul, the fuel lines and injectors should be removed at this time (para 3-14).

(10) Remove cylinder head bolts and lift the cylinder head off the cylinder block.

CAUTION

When resting the cylinder head assembly on a bench, protect the cam follower and the injector spray tip by resting the valve side of the head on wooden blocks at least 2 inches thick.

(11) Remove the cylinder head compression gaskets, oil seals, and water seals and discard.

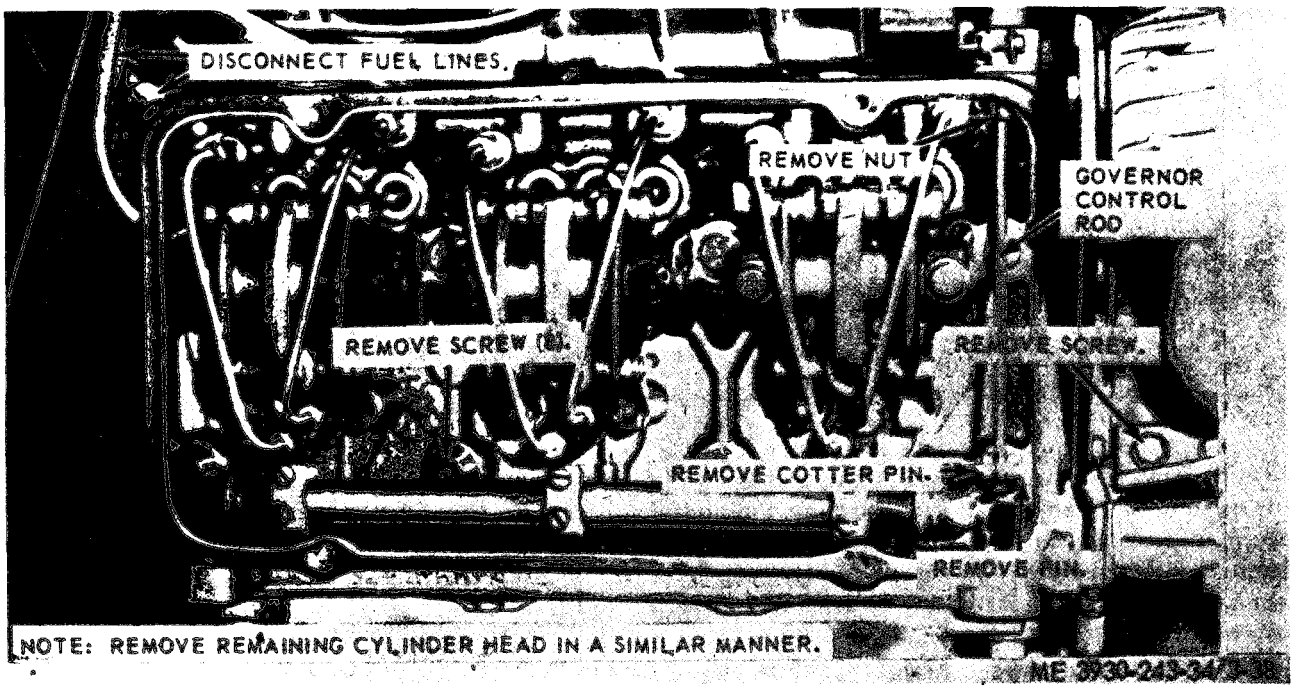


Figure 3-38. Cylinder head and valve assembly, removal and installation.

c. Disassembly. If cylinder head was removed for inspection and possible repair or replacement, refer to figure 3-39 and remove the following parts:

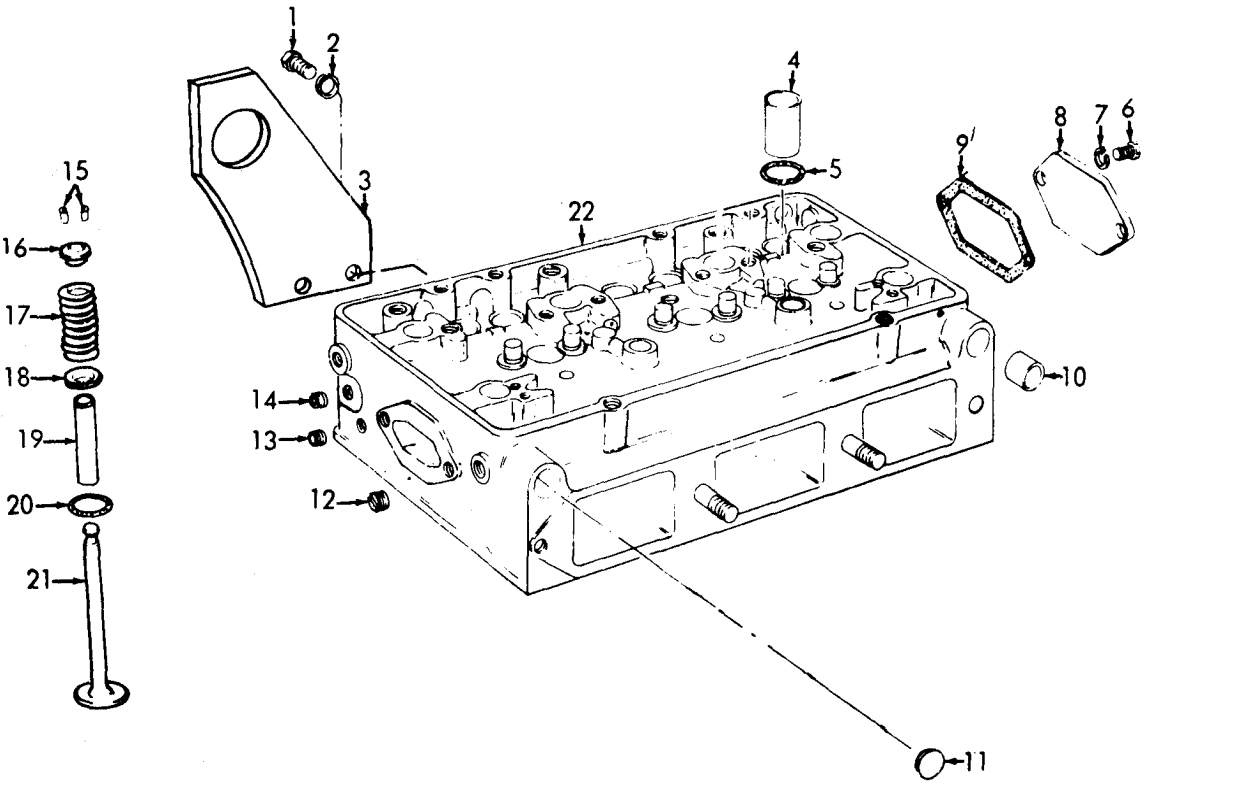
(1) Remove fuel injectors (para 3-14), if not previously removed.

(2) Remove the fuel connectors.

(3) Remove the cam follower guides and cam followers (para 3-15).

(4) Remove the rocker arms, rocker arm shafts, brackets, push rods, push rod springs, spring seats and spring seat retainer.

(5) Remove the exhaust valve (21, fig. 3-39) and valve spring (17).



1 Bolt	12 Plug
2 Lockwasher	13 Plug
3 Bracket	14 Plug
4 Tube	15 Lock
5 Seal	16 Seat
6 Screw	17 Spring
7 Washer	18 Seat
8 Cover	19 Guide
9 Gasket	20 Seat
10 Plug	21 Valve
11 Plug	22 Cylinder head

Figure 3-39. Cylinder head and valve assembly, disassembly and reassembly.

d. Inspection.

(1) After the cylinder head has been stripped of all component parts it should be thoroughly strained clean. Remove all rust proofing compound from a service cylinder head. A simple method of removing the rust proofing compound is to immerse the head in P-D-680 solvent, oleum, or fuel oil and clean with a soft bristle brush.

(2) Over a prolonged period of operation, the cylinder head may assume a contour to match that of the cylinder block, which is normal. However, if the cylinder head is allowed to become overheated because of coolant loss, the resultant high temperature cause stresses to occur in the casting which will affect the flatness of the head. Therefore, the bottom (fire deck) of the cylinder head should be checked for flatness as follows:

(a) Using an accurate straightedge and feeler gage, check for transverse warpage at each end and between all cylinders.

(b) Check longitudinal warpage in six places. Maximum allowable warpage is given below.

Maximum Longitudinal Warpage	*Maximum Transverse Warpage*
0.005 inch	0.004 inch

The maximum allowable warpage limits should be used as a guide in determining the advisability of reinstalling the head on the engine or refacing it, The number of times a cylinder head may be refaced will, of course, depend upon the amount of stock removed from the head during previous reworking operations. When refacing a cylinder

head, the amount of stocked removed should be stamped on the face of the fire deck near the outer edge of the head, in an area not used as a sealing surface. Not over 0.002 inch of metal should be removed from the fire deck of any cylinder head. The distance from the top deck to the bottom (fire deck) of the cylinder head must not be less than 4.376 inch as shown in figure 3-40. After a cylinder head has been refaced, and new injector tubes have been installed, the cylinder head should be pressured checked. The top surface of the cylinder block will not warp to the extent that machining will become necessary, therefore, no warpage limits or machining limits are required.

(3) Inspect cylinder head for leaks using the following procedure:

(a) Seal off the waterholes in the head, using steel plates and suitable rubber gaskets held in place by bolts.

(b) Install dummy or scrap injectors to insure seating of the injector hole tubes. The dummy injectors may be made up with old injector nuts and bodies, the injector spray tip is not necessary. Tighten the injector clamp bolt to 25-30 foot-pounds torque.

(c) Apply 80-100 psi air pressure to water jacket by drilling and tapping into one of the waterhole cover plates for an air hose connection. Immerse the head in a tank of water previously heated to 180º-200ºF. for 20 minutes to thoroughly heat the cylinder head.

(d) Observe the water in the tank for bubbles indicating cracks or leaks.

(e) Replace any leaking injector hole tubes. If inspection reveals cracks in the cylinder head, it should be replaced.

(4) Inspect cam follower bores in cylinder head for scoring or wear. Light score marks may be cleaned up with crocus cloth wet with fuel oil. If bores are excessively scored or worn so that cam follower-to-head clearance exceeds 0.006 inch, replace the cylinder head.

(5) Inspect the valve seat inserts for cracks or burning. Also, check the valve guides for scoring,

(6) Inspect water nozzles for tightness. Water nozzles are used only in the passages between cylinders. To install or replace cylinder head water nozzles:

(a) Be sure water inlet ports in bottom of head are clean and free of scale. Water holes may be cleaned up with a 5/8 inch diameter drill. Break the edges of the holes slightly.

(b) Check for press fit of nozzles in cylinder head. If water holes in head have been enlarged by corrosion, use wooden plug or other suitable tool to expand nozzle, so that they will remain tight after installation.

(c) Press nozzles into place with outlet holes positioned toward longitudinal centerline of cylinder head. The angle between outlet holes in the nozzle is 90º. Nozzles should be from flush to 1/32 inch below bottom surface of cylinder head, otherwise interference with proper seating of the head on the cylinder may be encountered.

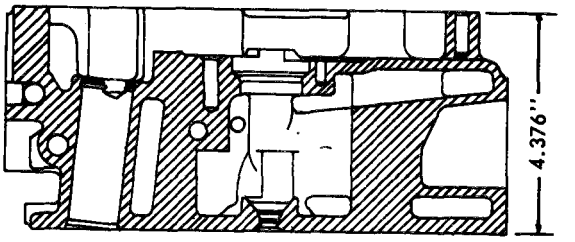


Figure 3-40. Minimum distance between top and bottom faces of cylinder head.

e. Assemble Cylinder Head. New service cylinder heads, for replacement purposes, are equipped with valve guides, valve seat inserts, exhaust manifold studs, water nozzles, injector hole tubes and necessary plugs.

CAUTION

When installing the plugs in the fuel manifolds apply a small amount of sealant to thread of plugs only. Work sealant into threads and wipe off excess with a clean, lint-free cloth so that sealant will not be washed into the fuel system and result in serious damage to the injectors. If the old cylinder head is to be reused, the parts listed below should be installed in the old head prior to assembling the head on the cylinder block.

(1) Install exhaust valves and springs.

(2) Install push rod assemblies, cam followers, cam follower guides, rocker arm shaft and rocker arms.

(3) Place new washers on fuel connectors; then install fuel connectors and tighten to 20-28 foot-pounds torque.

(4) Install fuel injectors at this time or after installing cylinder head.

f. Preinstallation Inspection. The following inspections should be made just prior to installing the cylinder head on the engine. These inspections should be made whether the head was removed from the engine for servicing only the head assembly, or to facilitate other repairs to the engine.

(1) Check the cylinder liner flange height with relationship to the cylinder block.

(2) Check to be sure the top of the pistons are clean and free of foreign material.

(3) Check to see that each push rod is threaded into its clevis until the end of the push rod projects through the clevis. This is important since serious engine damage will be prevented when the crankshaft is rotated during tune-up.

(4) To avoid damage to the water and oil seals, check to be sure that the groove and the counterbores in the top of the cylinder block are clean and smooth.

g. Install Cylinder Head.

(1) Install new cylinder head compression gaskets and seals as outlined below:

(a) Install a new compression gasket on each cylinder liner.

(b) Place new seal rings in the counterbores of the water and oil holes in the cylinder block.

(c) Install a new oil seal in the milled groove near the outer edge of the area covered by the cylinder head.

NOTE

Water seals, oil seals, and compression gaskets should never be reused.

(2) To install the cylinder head without disturbing the gaskets and seals, special guide studs must be used. Install the cylinder head guide studs, in the end cylinder block bolt boles. Wipe the bottom of the cylinder head clean; then, lower the head on the block.

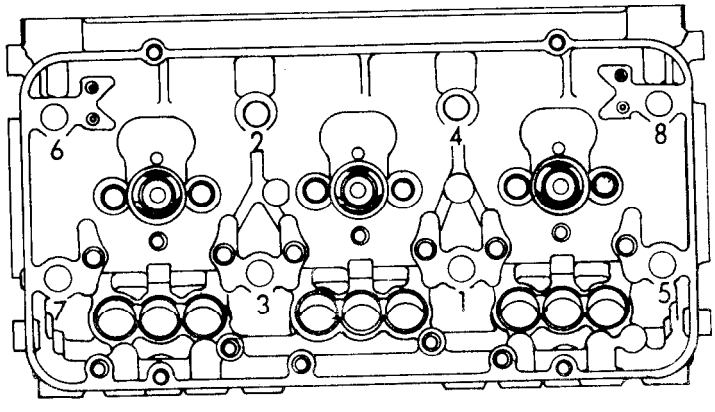
(3) The cylinder head must be gradually and uniformly drawn down on the gaskets and seals to ensure a good seal between the cylinder head and block. Therefore, it is vitally important that the cylinder head be installed with the utmost care. Install cylinder head bolts; then, beginning on the camshaft side of the head, take up the tension in the cam follower springs by tightening the bolts lightly. Finally tighten the bolts to 170-180 foot-pounds torque with a torque wrench about one-half turn at a time, in the sequence shown in figure 3-41.

(4) If the injectors were not previously installed, refer to paragraph 3-14 and install injectors at this time.

(5) Set injector control tube assembly in place on cylinder head and tighten hold-down bolts, finger tight only. When positioning injector control tube be sure that ball end of injector control rack levers engage the slots in the injector control racks. With one end of the control tube return spring hooked around one injector rack control lever and the other end hooked around the control bracket, tighten bracket bolts with a 7/16 inch universal socket wrench to 10-12 foot-pounds torque. After tightening bolts, revolve tube and see if the return spring pulls the injector racks OUT (NO-FUEL POSITION) after they have been moved all the way IN (FULL FUEL POSITION). Since the injector control tube is mounted in self-aligning bearings, tapping the tube lightly with a soft hammer will remove any bend that exists. The injector rack must return to the no fuel position freely by aid of the return spring only. Do not bend the return spring to bring about this condition.

(6) Install fuel rod (fig. 3-38).

(7) Install exhaust manifold, thermostat housing and thermostat (TM 10-3930-243-12).



ME 3930-243-34/3-41

Figure 3-41. Cylinder head bolt, tightening sequence.

3-20. Exhaust Valves, Spring, Guide and Seat

a. General. The exhaust valves, springs, guide and seat are mounted to the cylinder head. It is possible, if the occasion requires, to remove or replace the exhaust valve springs without removing the cylinder head. The springs, however, are normally removed when the cylinder head is removed from the engine block. Both methods are covered below.

b. Removal of Exhaust Valve Spring and Valve.

(1) An exhaust valve spring may be removed without removing the cylinder head as follows:

(a) Remove rocker arm cover (TM 10-3930-243-12).

(b) Bar engine over to bring valve and injector rocker arms in line horizontally.

(c) Disconnect and remove fuel lines from the injectors and fuel connectors (para 3-13).

(d) Remove two bolts holding the rocker arm shaft brackets to the cylinder head and remove the bracket and shaft (para 3-14).

(e) Remove the cylinder block air box cover so that the piston travel may be observed, then turn the crankshaft until the piston is at top of the stroke.

(f) Thread the valve spring compressor adaptor into a rocker shaft bolt hole in the cylinder head. Apply pressure to the end of the valve spring compressor handle to compress the valve spring (fig. 3-42). Remove the two-piece tapered spring locks (fig. 3-43).

(g) Release tool and remove the valve spring cap, valve spring and valve seat.

(2) To remove the exhaust valve spring with the cylinder head, removed from the engine, use the following procedure:

(a) Support the cylinder head on wood blocks 2 inches above the work bench to keep the cam followers clear of the bench.

(b) Remove the fuel lines from the injector and fuel connectors (para 3-13).

(c) Remove the two bolts holding the rocker arm shaft bracket to the cylinder head and remove the bracket from the-shaft (para 3-13).

(d) Remove the fuel injectors (para 3-14).

(e) Remove the exhaust valve spring from the cylinder head as previously outlined above. In addition, use a block of wood under the cylinder head to support the exhaust valve.

(f) Remove the cam followers and push rod assemblies (para 3-15).

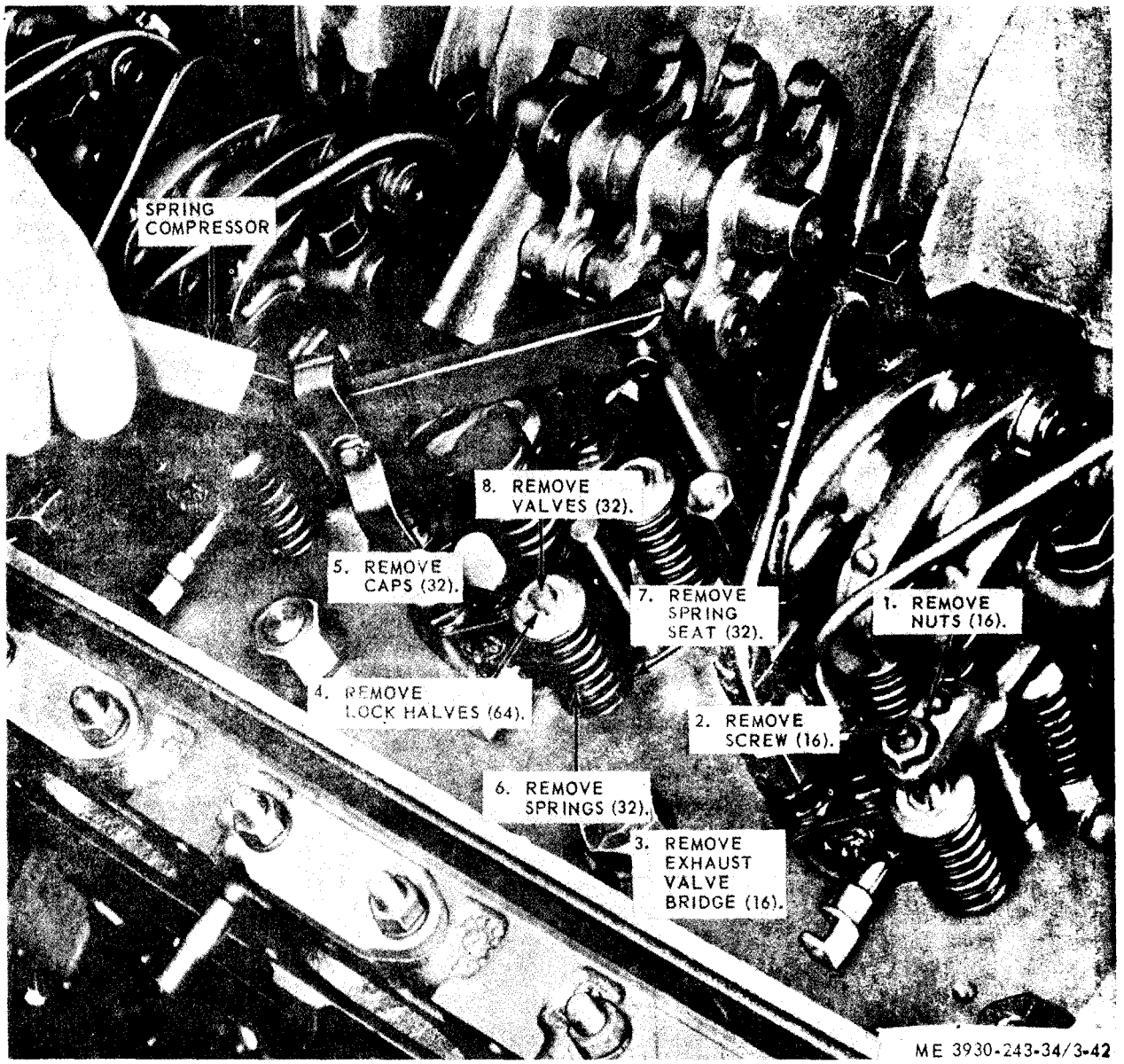
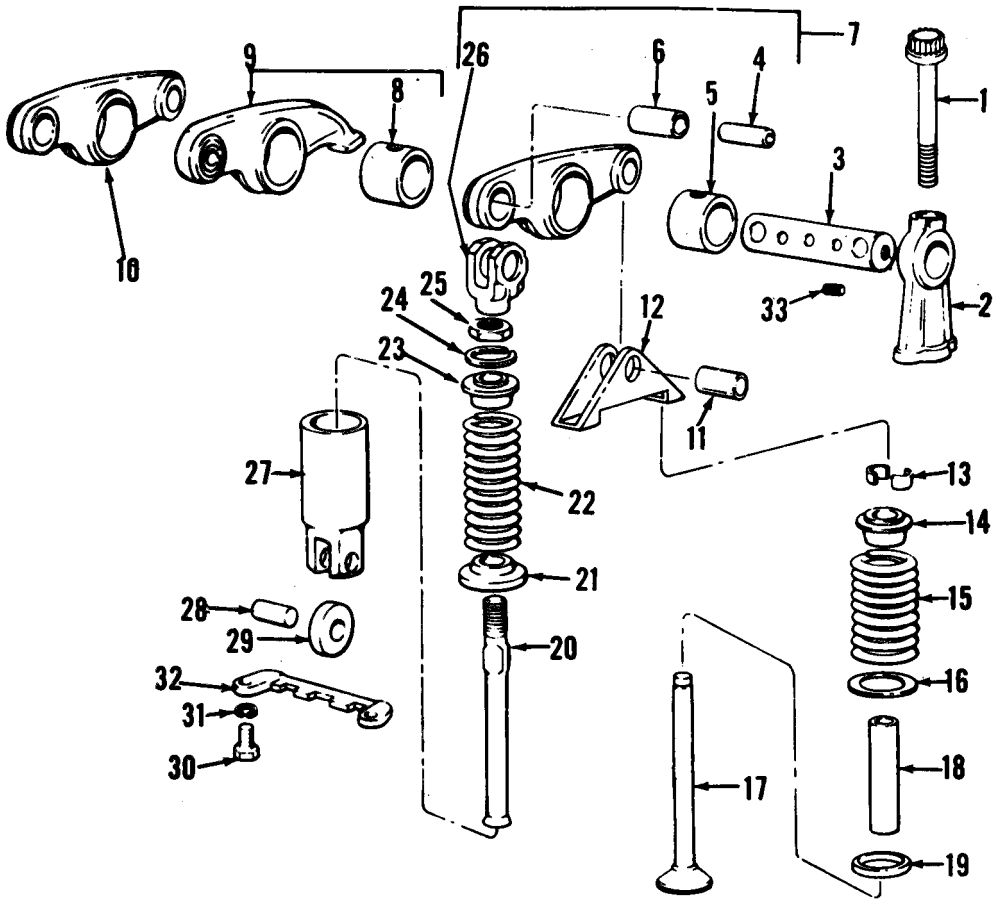


Figure 3-42. Removing exhaust valve spring.



1	Bolt	18	Guide
2	Bracket	19	Seat
3	Shaft	20	Rod
4	Pin	21	Seat
5	Bushing	22	Spring
6	Bushing	23	Seat
7	Arm assembly	24	Retainer
8	Bushing	25	Nut
9	Arm assembly	26	Clevis
10	Arm assembly	27	Follower
11	Pin	28	Roller
12	Bridge	29	Roller
13	Lock	30	Screw
14	Cap	31	Washer
15	Spring	32	Guide
16	Seat	33	Plug
17	Valve		

Figure 3-43. Valves and injector operating mechanism.

c. Inspect Exhaust Valve Spring.

(1) Inspect spring for pitted or fractured coils.

(2) Check the exhaust valve spring to insure a load of less than 25 pounds will compress the spring to 1.93 inch.

d. Remove Exhaust Valve.

(1) With the cylinder head removed from the engine, remove the valve springs as outlined above.

(2) Turn cylinder head over and withdraw the exhaust valves.

e. Inspect Exhaust Valves.

(1) Clean the exhaust valve with fuel oil.

(2) Check the valve stem for scratches or scuff marks.

(3) Inspect the valve face. It should be smooth, unpitted and free from ridges or cracks. Carbon on the face of the valve indicates a faulty seat and a resultant leak (or blow-by).

(4) Inspect the valve head. It should be square with the valve stem and should not be warped.

(5) Reface the valve or install a new valve. Refer to table 1-1.

f. Inspect Exhaust Valve Guide.

(1) After cleaning, inspect the valve guide for fractures, scoring or excessive wear.

(2) Check the valve-to-guide clearance. Worm valve guides may eventually result in improper valve seat contact. If the clearance exceeds 0.005 inch, replace the valve guides.

g. Remove Exhaust Valve Guide.

(1) Support the cylinder head, bottom side up, on wooden blocks at least three inches thick.

(2) Drive the valve guide out of the cylinder head.

h. Install Exhaust Valve Guide.

(1) Insert the threaded end of the valve guide into the installing tool.

(2) Locate the valve guide squarely in the cylinder head and tap gently to start it into place.

(3) Drive the guide in until the tool contacts the bottom of the counterbore. Refer to table 1-1.

CAUTION

Do not use the valve guide as a means of turning the cylinder over or in handling the cylinder head.

i. Inspect Exhaust Seat Insert.

(1) Inspect the valve seat inserts for excessive wear, pitting or cracking.

(2) Inspect the valve seat insert for improper seat angle. The proper angle for the seating face of both the valve and the insert is 30°

j. Remove Exhaust Valve Seat Insert. The valve seat inserts are pressed into the cylinder head and, therefore, must be removed as outlined in the following procedure to avoid damage to the cylinder head.

(1) Place the cylinder head on its side on the work bench.

(2) Place the collet of tool inside the valve seat insert so the bottom of the collet is flush with the bottom of the insert.

(3) Hold the collet handle and turn the T handle to expand the collet cone until the insert is held securely by the tool.

(4) Insert the drive bar of the tool through the valve guide.

(5) Tap the drive bar once or twice to move the insert about 1/16 inch away from its seat in the cylinder head.

(6) Loosen the collet cone and move the tool into the insert slightly so the narrow flange at the bottom of the collet is below the valve seat insert.

(7) Tighten the collet cone and continue to drive the insert out of the cylinder head.

k. Install Exhaust Valve Seat Insert.

(1) Clean the valve seat insert counterbores in the head with trichlorethylene (O-T-236) or other good solvent. Wash the valve seat inserts with the same solvent. Dry with compressed air.

(2) Inspect the counterbores for cleanliness, concentricity, flatness and cracks. The counterbores have a diameter of 1.159 inch to 1.160 inch and a depth of 0.300 inch to 0.312 inch.

(3) Immerse the cylinder head for at least 30 minutes in water heated to 180° F. to 200° F.

(4) Rest the cylinder head, bottom side up, on the work bench and locate the insert squarely in the counterbore, seating face up. Install the insert in the cylinder head while the head is still hot and the insert is at room temperature, otherwise installation may be difficult and the parts may be damaged.

(5) Drive the insert in place with the installing tool until it seats solidly in the cylinder head.

(6) Grind the valve insert and check it for concentricity in relation to the valve guide.

l. Recondition Exhaust Valve and Valve Seat Insert. An exhaust valve which is to be reused may be refaced, if necessary. To provide sufficient valve strength and spring tension, the edge of the valve head must not be less than 1/32 inch thick. Before either a new or used valve is installed, examine the valve seat insert in the cylinder head for proper valve seating. The proper angle for the seating face of both the valve and valve seat insert is 30°. The angle of the valve insert must be exactly the same as the angle of the valve face to provide proper seating of the valve. When a new valve seat insert is installed, or an old insert is reconditioned, the work must be with a grinding machine. Grind the inserts as follows:

(1) First apply the 30° grinding wheel on the valve seat insert.

(2) Use the 60° grinding wheel to open the throat of the insert.

(3) Grip the top surface of the insert with the 15° wheel to narrow the width of the seat to the

specified 3/64 inch to 5/64 inch (fig. 3-44). The 30° face of the insert may be adjusted, relative to the center of the valve face, with the 15° to 0° grinding wheels.

CAUTION

For best results, do not permit the grinding wheel to contact the cylinder head when grinding the inserts.

The position of the exhaust valve (when the valve is in the closed position), to maintain the proper piston-to-wall clearance is shown in figure 3-44. Grinding will reduce the thickness of the valve seat insert and cause the valve to recede into the cylinder head. If, after several grinding operations, the valve recedes beyond the limits shown in figure 3-44, replace the valve seat insert.

(4) After the grinding has been completed, clean the valve seat insert thoroughly with fuel oil and dry it with compressed air. Set the dial indicator in position as shown in figure 3-45 and rotate it to determine the concentricity of each valve seat insert relative to the valve guide. Total runout must not exceed 0.002 inch. If a runout of more than 0.002 inch is indicated, check for a bent valve guide before regrinding the insert.

(5) When a valve seat insert runout within the desired limits is obtained, determine the position of the contact area between the valve and the valve seat insert as follows:

(a) Apply a light coat of valve grinding compound paste to the valve seat insert.

(b) Lower the stem of the valve in the valve guide and bounce, but do not rotate, the valve on the insert. This procedure will indicate the area of contact on the valve face. The most desireable area of contact is at the center of the valve face.

(6) After the valve seat inserts have been ground and checked, thoroughly clean the cylinder head before installing the valves.

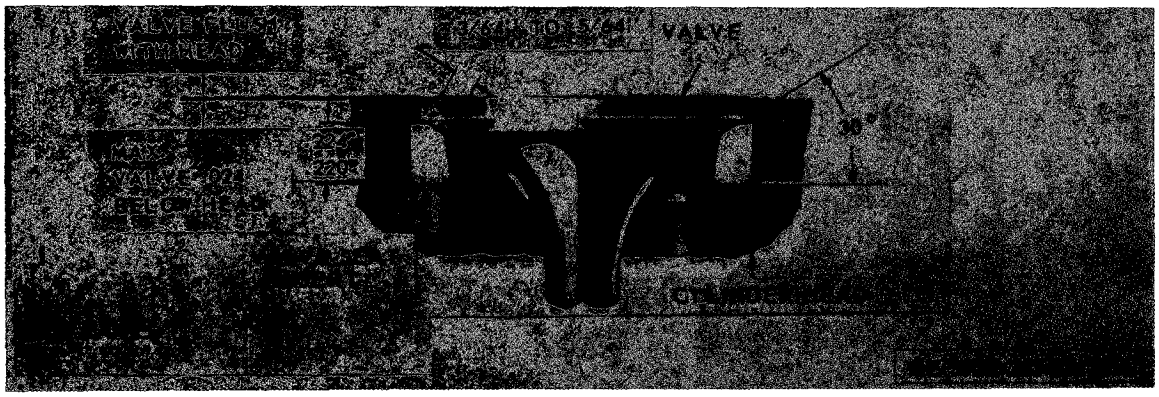


Figure 3-44. Relationship between exhaust valve, insert and cylinder head.

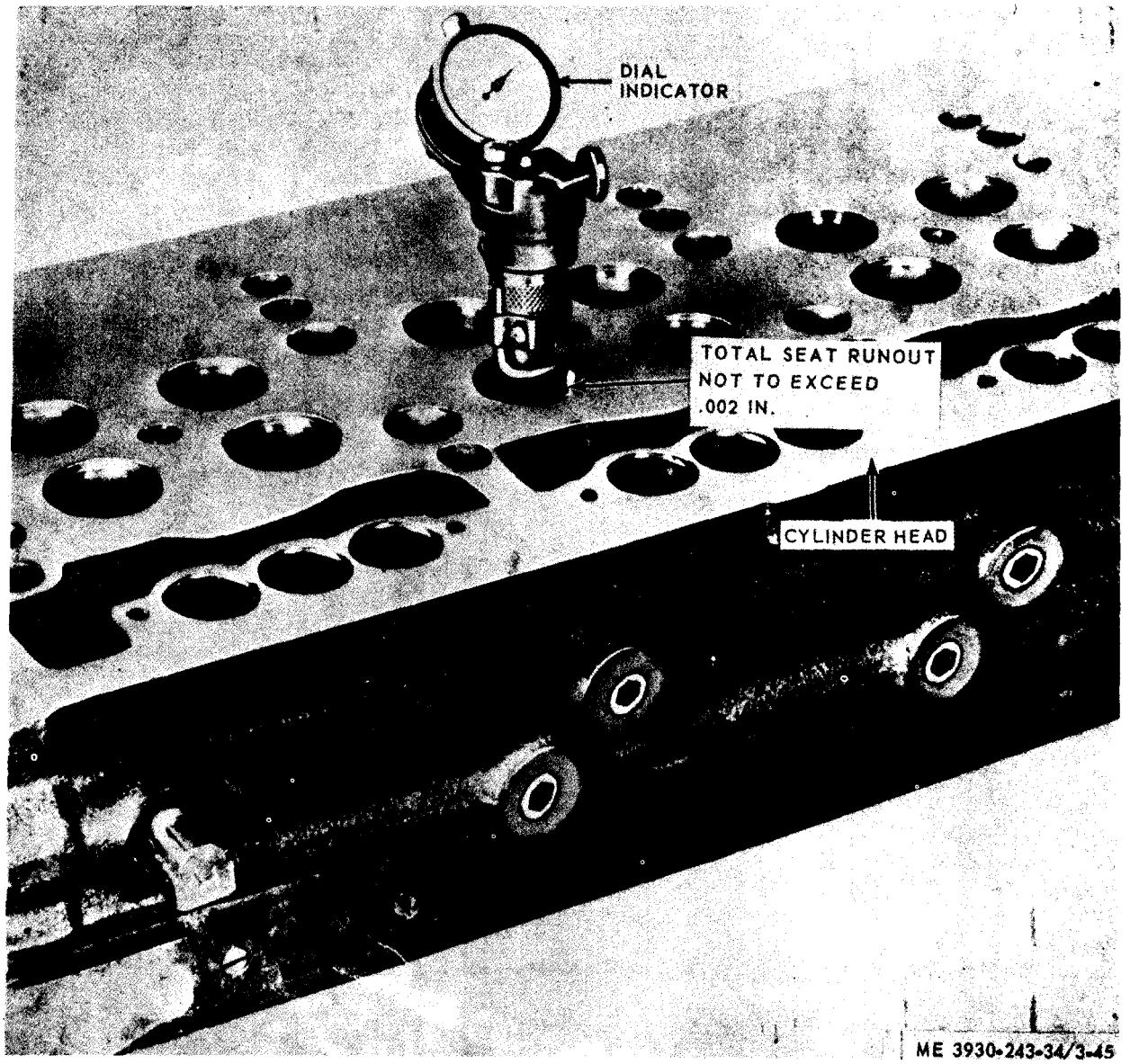


Figure 3-45. Checking relative concentricity of exhaust valve seat insert with relation to valve guide.

m. Install Exhaust Valves and Springs. With the cylinder head cleaned, the valve guides checked or replaced, the valves and valve seat inserts ground, install the exhaust valves and springs as follows:

(1) Apply a light coat of engine oil on the valve stems and install the valves in the cylinder head. If reconditioned valves are used, install them in the same relative location from which they were removed.

NOTE

The distance from the top of the cylinder head to the bottom of the valve spring seat counterbore is 1-11/64 inch. The valve spring lock groove in exhaust valves is 0.310 inch from the end of the valve.

(2) Hold the valves in place with a strip of masking tape and turn the cylinder head right side up on the work bench. Place a board under the head to support the valves and to provide clearance between the cam followers and the bench.

(3) Install the valve guide oil seals, if used, on the valve guides.

(4) Install the valve springs and valve spring caps.

(5) Thread the valve spring compressor into one of the rocker shaft bolt holes in the cylinder head.

(6) Apply pressure to the free end of the tool to compress the valve spring and install the two piece

tapered valve lock. Exercise care to avoid scoring the valve stem with the valve cap when compressing the spring.

NOTE

If valve guide oil seals are used, compress the valve spring only enough to permit installation of the valve locks. Compressing the spring too far may result in damage to the valve guide oil seal.

(7) Release the tool and install the valve locks on the remaining exhaust valves in the same manner.

(8) Check the position of the exhaust valve (fig. 3-44).

(9) Install the injectors, rocker arms, shafts, brackets, and any other parts that were previously removed from the cylinder head.

(10) Install the cylinder head (para 3-19).

(11) Perform a complete engine tune-up.

(12) Start the engine and check for leaks in the fuel, water and lubrication system. Install the rocker arm cover (TM 10-3930-243-12).

3-21. Flywheel

e. General. The flywheel is attached securely to the rear end of the crankshaft with six bolts in any one of six positions. A starter ring gear is shrunk onto the rim of the flywheel.

b. Removal of Flywheel.

(1) Remove the engine (para 2-6).

(2) Remove the shaft and flywheel cover (A, fig. 3-46).

(3) Remove the coupler (B).

(4) Remove the flywheel (C).

CAUTION

When removing or installing the attaching bolts, hold the flywheel firmly against the crankshaft by hand to prevent it from slipping off the end of the crankshaft. The flywheel is NOT dowelled to the crankshaft.

c. Inspection.

(1) Inspect flywheel for cracks, scoring or overheating of the clutch contact face. If the flywheel clutch surface is scored, it may be refaced. However, not more than 0.020 inch of metal should be removed from the flywheel and all radii should be maintained. If the contact face of the clutch wear plate shows signs of overheating or excessive scoring, replace the wear plate.

(2) Although the flywheel seldom wears to the point of requiring replacement, the flywheel ring gear may become worn due to normal usage or damaged by improper use of the starting motor to the extent that it must be replaced. Inspect the teeth on the ring gear.

d. Remove Ring Gear From Flywheel.

(1) Note whether the teeth on the ring gear are chamfered. The replacement gear must be installed so the chamfer on the teeth faces the same direction as on the gear that is to be removed.

(2) Support the flywheel, crankshaft side down, on a solid flat surface or hardwood block, which is slightly smaller than the inside diameter of the ring gear.

(3) With a suitable drift and hammer, drive the ring gear off of the flywheel. Work around the circumference of the ring gear to avoid bending the gear on the flywheel.

e. Install Ring Gear on Flywheel.

(1) Support the flywheel, ring gear side up, on a solid flat surface.

(2) Reset the ring gear on a flat metal surface and heat the ring gear uniformly with an acetylene torch, keeping the torch moving around the gear to avoid hot-spots.

CAUTION

Do not, under any circumstances, heat the gear over 400°F., excessive heating may destroy the original heat treatment. If available, use a heat indicating crayon to insure against overheating of the ring gear.

(3) Use a pair of tongs to place the gear on the flywheel with the chamfer, if any, facing the same direction as on the gear just removed.

(4) Tap the gear into place against the shoulder on the flywheel. If the gear cannot be tapped into place readily, remove it and apply additional heat, heeding the above caution about overheating.

f. Installation of Flywheel.

(1) If a pilot bearing is used in the bore of the flywheel and was removed, install the bearings. Install a new seal ring if one was previously used.

(2) Mount the flywheel, using lifting tool and chain hoist, into position against the rear end of the crankshaft.

(3) While holding the flywheel in place by hand, remove the flywheel lifting tool and install the flywheel attaching bolts and scuff plates. Tighten the bolts to 130-140 foot-pounds torque.

(4) Mount a dial indicator on the flywheel housing or clutch housing and check the runout of the flywheel at the clutch contact face. Maximum allowable runout is 0.001 inch total indicator reading per inch of radius (the radius is measured from the center of the flywheel to the outer edge of the clutch contact face of the flywheel).

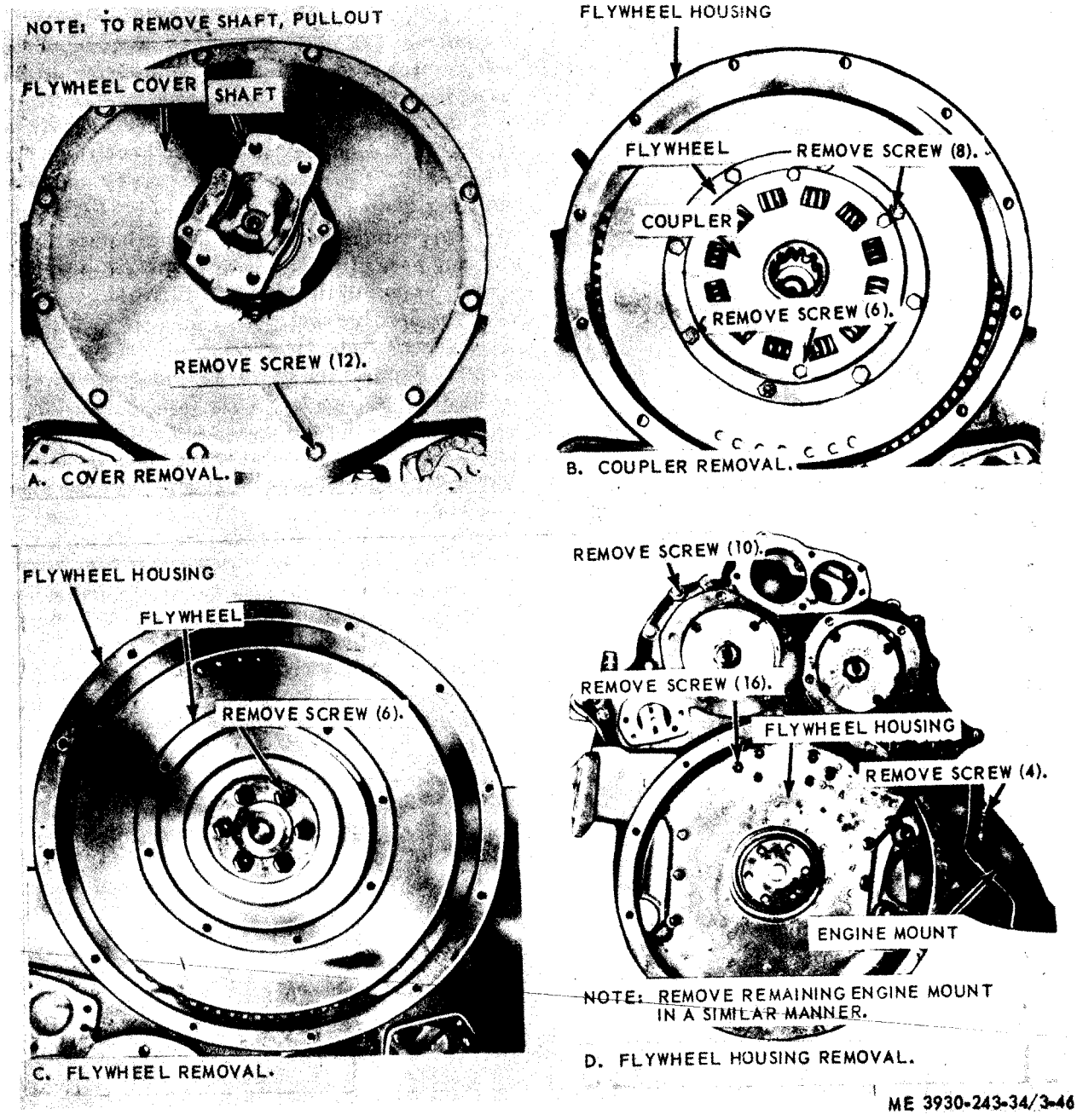


Figure 3-46. Flywheel and flywheel housing, removal and installation.

3-22. Flywheel Housing

a. General. A combination flywheel housing and gear train cover is attached to the rear cylinder block end plate and houses the flywheel and gear train.

b. Removal.

(1) Remove the engine (para 2-6).

(2) Remove the starter (TM 10-3930-243-12) from the flywheel housing or the clutch housing.

(3) Remove the flywheel (para 2-21).

(4) Remove the oil pan (para 3-2).

(5) Remove the clutch housing.

(6) Remove the fuel pump (TM 10-3930-243-12).

(7) Remove the engine driven hydraulic pump (para 3-23).

(8) Remove the blower drive cover, blower drive shaft retainer ring, and the blower drive shaft (para 3-5).

(9) Remove the blower drive support (para 3-5).

(10) Refer to figure 3-46 (D) and remove the flywheel housing bolts.

NOTE

When removing the flywheel housing bolts, note the location of the various size bolts, lock washers, flat washers, and copper washers so they may be reinstalled in their proper location.

(11) To guide the flywheel housing until the oil seal clears the end of the crankshaft, thread two pilot studs into the cylinder block.

(12) Thread eyebolts into the tapped holes in the pad (if provided) on the top or sides of the flywheel housing, and attach a chain hoist with a suitable sling to the eyebolts. Strike the front face of the housing alternately on each side of the engine with a soft hammer to loosen and work it off the dowel pins.

(13) Remove all traces of the old gaskets from the cylinder block rear end plate and the flywheel housing,

c. Inspection.

(1) Inspect the flywheel housing for cracks or any other damage. Replace the housing if it is damaged.

(2) Inspect the crankshaft rear oil for damage or deterioration.

d. Installation.

(1) Lubricate the gear train teeth with clean engine oil.

(2) Affix new flywheel housing gaskets to the rear face of the cylinder block rear end plate.

(3) If the flywheel housing has an integral cast hub, install a flywheel housing-to-end plate shim (0.015 inch thick). Use grease to affix the shim to the cylinder block rear end plate.

(4) Apply a light coat of high temperature cup grease to the lip of the crankshaft rear oil seal.

(5) Thread two pilot studs into the cylinder block to guide the housing into place.

(6) With the flywheel housing suitably supported, position it over the crankshaft and up against the cylinder block rear end plate and gaskets.

NOTE

While sliding the housing into position, manually hold the oil seal expander tool up against the rear end of the crankshaft.

(7) Install all of the flywheel housing bolts, lock washers, flat washers, and copper washers in their proper location, finger tight. only.

(8) Refer to figure 3-47 and draw the flywheel housing bolts up snug in the sequence shown.

(9) Refer to figure 3-48 for the final bolt tightening sequence. Tighten the 5/16 inch-18 bolts (number 13 and 14) to 19-23 foot-pounds torque. Tighten the 3/8 inch-16 bolts (numbers 9 thru 12) to 40-45 foot-pounds torque and tighten the remaining 3/8 inch-16 and 3/8 inch-24 bolts to 25-30 foot-pounds torque.

(10) Install the blower and governor drive support assembly (para 3-5).

(11) Using a dial indicator, check flywheel housing concentricity and bolting flange face as follows:

(a) Thread the dial indicator post tightly into one of the tapped holes in the flywheel. Assemble the dial indicators on the base post.

(b) Position the dial indicators straight and square with the flywheel housing and make sure each indicator has adequate travel in each direction.

NOTE

If the flywheel extends beyond the flywheel housing bell, the housing bore and face must be checked separately.

(c) Pry and hold the crankshaft in one direction to ensure end play is in one direction only.

(d) Adjust each dial indicator to read zero at the twelve o'clock position. Rotate the crankshaft one full revolution, taking readings at 45° intervals. Stop and remove the wrench or cranking bar before recording each reading to ensure accuracy. The maximum total indicator reading must not exceed 0.013 inch for either the bore or face.

(e) If the run-out exceeds the maximum limits, remove the flywheel housing; and check for dirt or foreign material (such as old gasket material) between the flywheel housing and the end plate, and between the end plate and the cylinder block. Reinstall the flywheel housing and tighten the attaching bolts in the proper sequence to the specified torque. Recheck the run-out. If necessary, replace the flywheel housing.

(12) Install the clutch housing, if used. Tighten the attaching bolts to specified torque.

(13) Install the fuel pump,

(14) Install the flywheel.

(15) Affix a new gasket to the oil pan, and install the oil pan.

(16) Install all accessories previously removed from the engine. Install engine.

(17) Install the transmission.

(18) Fill the crankcase with lubricating oil (LO 10-3930-243-12).

(19) Refill the cooling system (TM 10-3930-243-12).

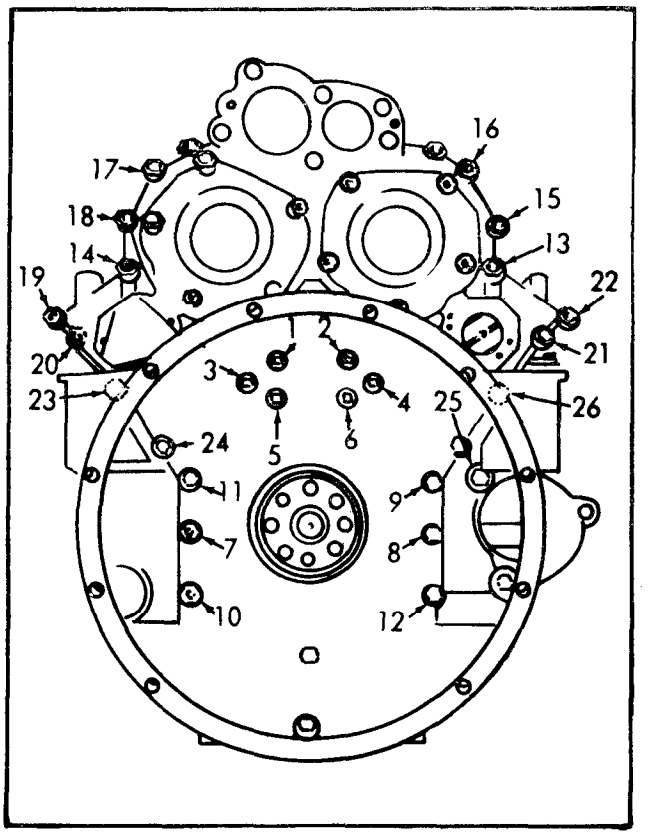


Figure 3-47. Flywheel housing bolt, tightening sequence (operation 1).

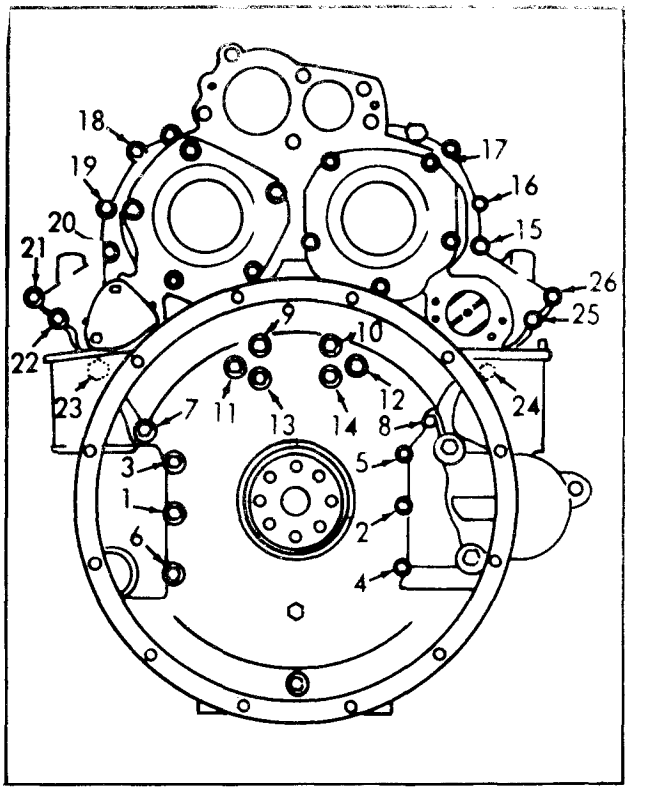


Figure 3-48. Flywheel housing bolt, tightening sequence (operation 2).

Section IV. OIL PAN, OIL PUMP SCREEN, INLET PIPE, CONNECTING ROD, PISTON AND OIL PRESSURE REGULATOR

3-23. General

The oil pan houses the lower engine components and also contains lubricating oil for the engine. The oil pump screen is secured to the main bearing cap with two bolts and lockwashers. The inlet pipe is secured to the oil pump. The pistons are secured to the connecting rods with a wrist pin and connecting rods and bearings are mounted around the crankshaft. The pressure regulator valve maintains a stabilized lubricating oil pressure regardless of oil temperature.

3-24. Oil Pan

a. General. The oil pan is secured to the bottom side of the engine block by 22 bolts and washers. A drain plug is located in the bottom of the oil pan for draining engine oil, at oil change intervals or for oil pan removal. A one-piece oil pan gasket is used.

b. Removal.

(1) Remove the drain plug and drain the engine oil.

(2) Refer to figure 3-1 and remove the oil pan.

c. Inspection.

(1) Inspect the oil pan for cracks, excessive dents or other damage.

(2) Inspect attaching hardware for damage.

(3) Remove all gasket material from gasket area and inspect for damage or bends.

d. Installation.

(1) Affix a new gasket to the oil pan.

(2) Refer to figure 3-1 and install the oil pan.

(3) Refer to the current lubrication order and service the engine lubrication system.

3-25. Oil Pump Screen and Inlet Pipe

a. General. As the rotors revolve, a vacuum is

formed on the inlet side of the pump and oil is drawn from the crankcase through the oil pump screen and inlet pipe into the rotor compartment of the oil pump.

b. Removal.

(1) Drain the engine oil and remove the oil pan (para 3-24).

(2) Refer to figure 3-2B and remove the inlet pipe and oil pump screen.

c. Disassembly. Refer to figure 3-49 and disassemble the oil pump screen and inlet pipe.

d. Inspection.

(1) Inspect the inlet pipe and screen for evidence of clogging.

(2) Inspect inlet pipe for deep dents and cracks.

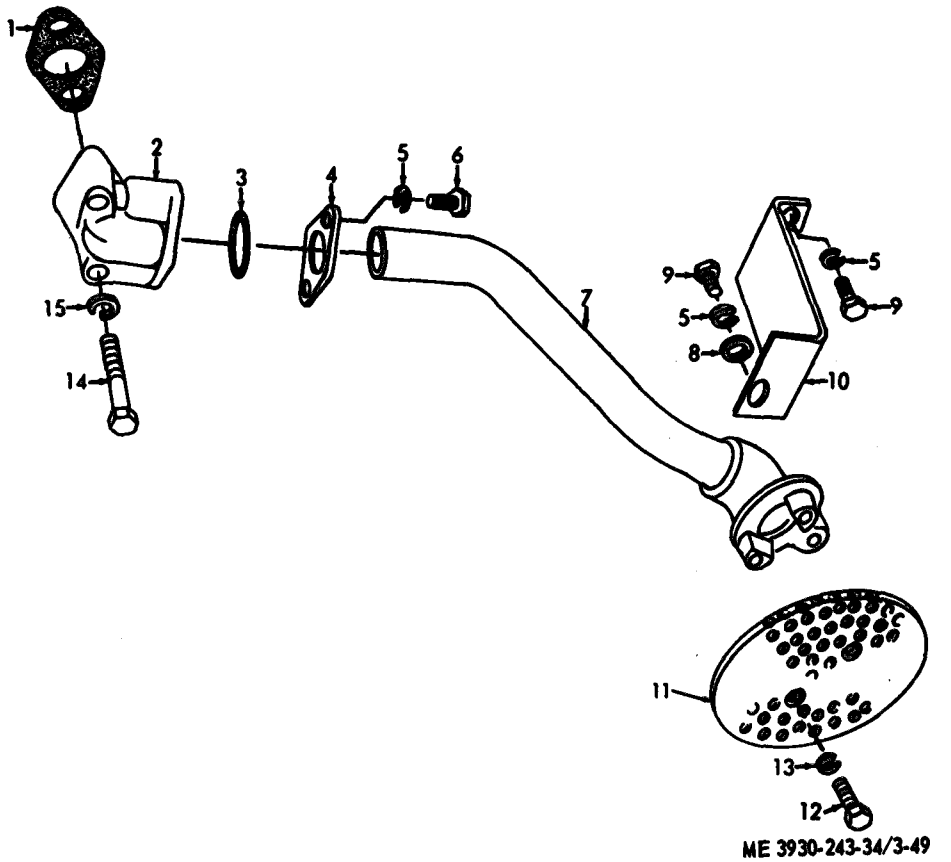
(3) Inspect mounting hardware and screen assembly for damage.

e. Installation.

(1) Install inlet pipe and oil pump screen (fig. 3-2 B).

(2) Install oil pan (para 3-24).

(3) Refer to current lubrication order and service the engine lubrication system.



1 Gasket
2 Elbow
3 Ring
4 Flange
5 Washer
6 Bolt
7 Tube assembly
8 Washer
9 Bolt
10 Support
11 Screen
12 Screw
13 Washer
14 Bolt
15 Washer

Figure 3-49. Oil pump screen and inlet pipe, disassembly and reassembly.

3-26. Piston, Rings, Connecting Rod, and Cylinder Liner

a. General. The top of the piston forms the combustion chamber bowl and is designed to compress the air into close proximity to the fuel spray. Each piston is fitted with six piston rings. Four compression rings are placed above the piston pin and two, three piece oil-control rings are placed below the pin to scrape off excess oil thrown onto the cylinder liner. The connecting rod connects the

piston to the crankshaft. The rod is drilled to provide lubrication to the piston pin at the upper end and is equipped with an oil spray nozzle for cooling the underside of the piston head. The angle of the ports in the cylinder liners creates a uniform swirling motion to the intake air as it enters the cylinder. This motion persists throughout the compression stroke and facilitate scavenging and combustion.

b. Removal.

(1) Drain oil and remove engine oil (para 3-24).

(2) Remove the cylinder head (para 3-19).

(3) Remove the carbon from the upper inner surface of the cylinder liner.

(4) If there is a ridge in the cylinder liner at the top of the piston ring travel, remove the ridge with a ridge cutter.

NOTE

Move the piston to the bottom of its travel and place a cloth on top of the piston to collect the cuttings.

(5) After the ridge is removed, turn the crankshaft until the piston is at the top of its stroke and carefully remove the cloth with the cuttings.

(6) After the ridge is removed, turn the crankshaft until the piston is at the top of its stroke and carefully remove the cloth with the cuttings.

(7) Remove the bearing cap and lower bearing shell from the lower end of the connecting rod; then push the piston and rod assembly out through the top of the cylinder block. The piston and rod cannot be removed from the bottom of the block.

(8) Reassemble the bearing cap and bearing shell.

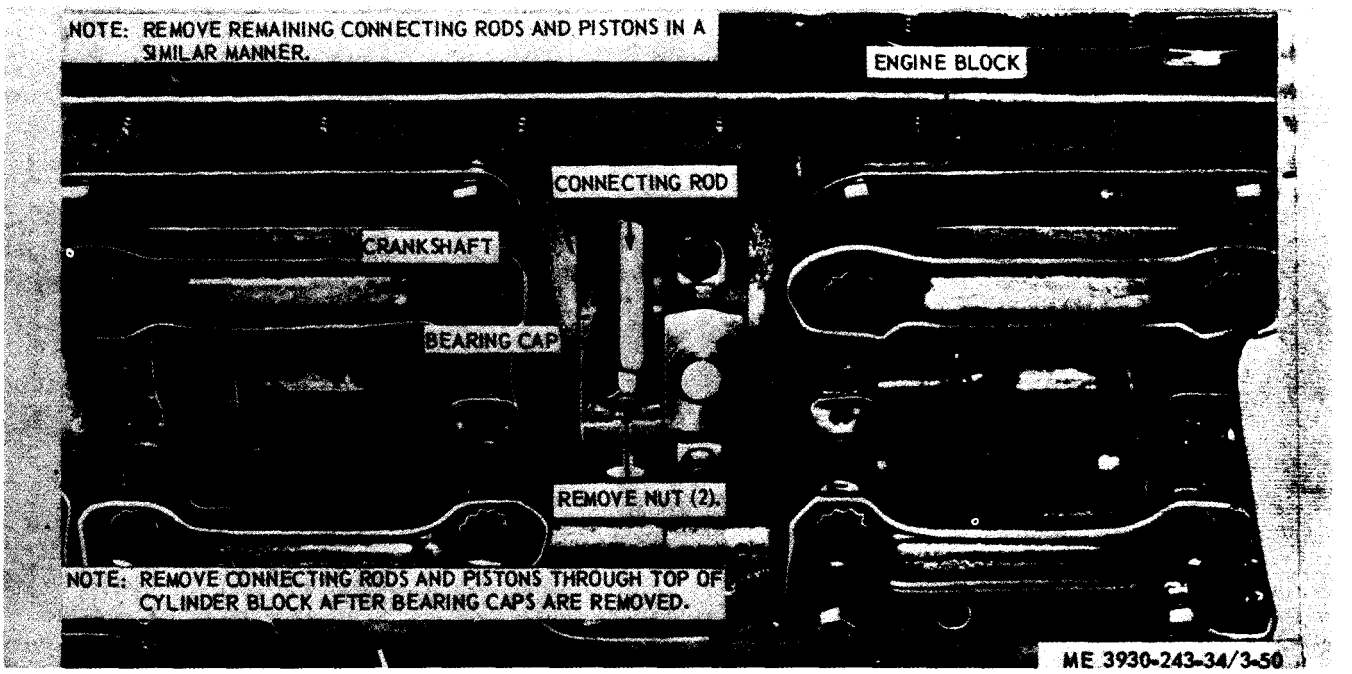


Figure 3-50. Piston and connecting rod assembly, removal and installation.

c. Disassembly.

(1) Refer to figure 3-51 and disassemble piston and connecting rod assembly in numerical sequence.

KEY to figure 3-51:

1 Nut
2 Cap
3 Lower shell
4 Upper shell
5 Bolt
6 Top compression ring
7 Compression ring, grooves 2, 3 and 4
8 Upper half oil control ring
9 Oil control ring expander
10 Lower half oil control ring
11 Oil control ring expander
12 Upper half oil control ring
13 Lower half oil control ring
14 Piston pin retainer
15 Piston pin
16 Piston
17 Piston pin bushing
18 Connecting rod bushing
19 Connecting rod
20 Cylinder sleeve

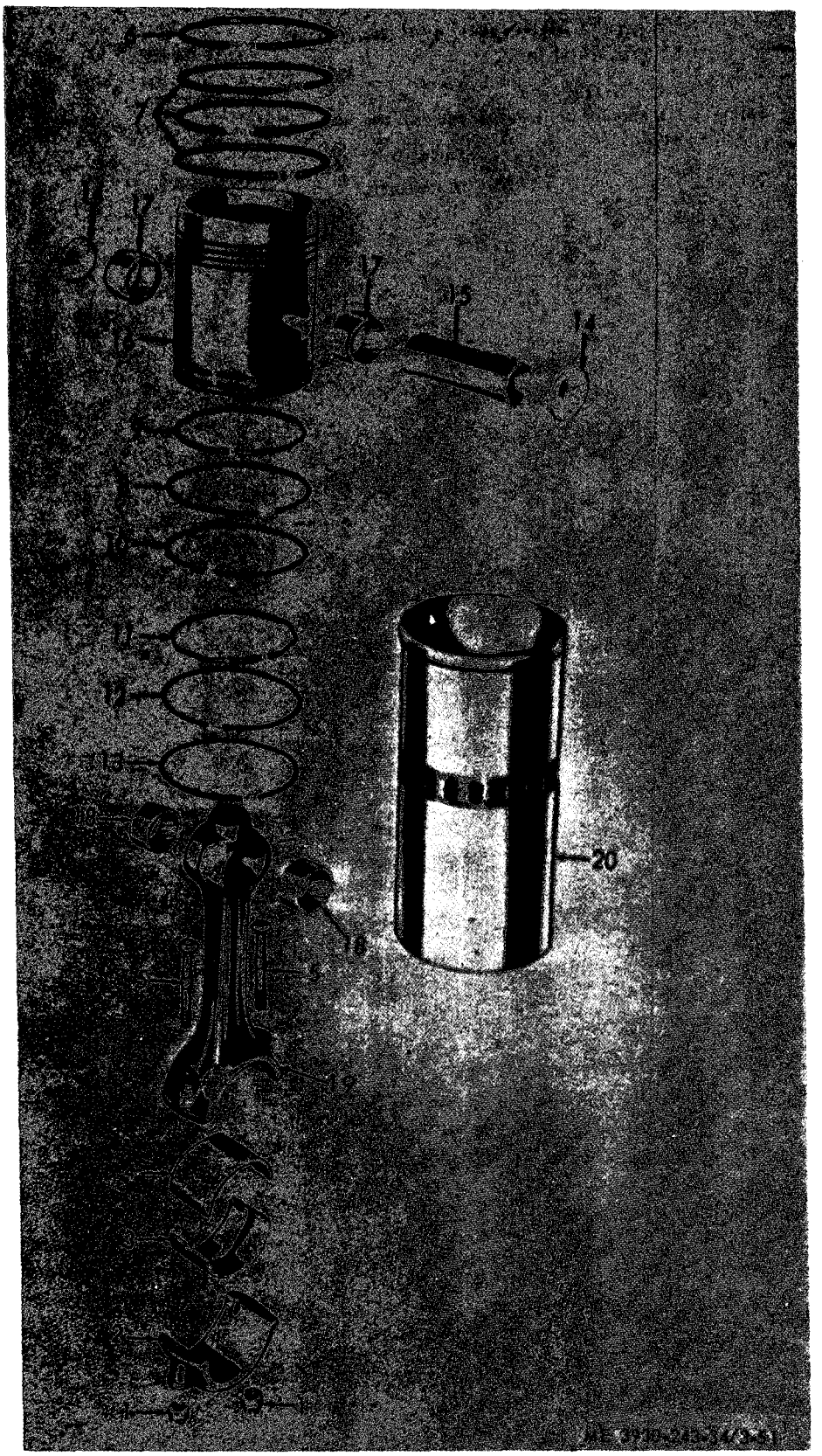


Figure 3-51. Piston and connecting rod, disassembly and reassembly.

(2) Refer to figure 3-52 for removal and installation of piston pin bushings.

NOTE

The bushing joint should be located toward the bottom of the piston.

(3) Refer to figure 3-53 for installation of piston pin retainer.

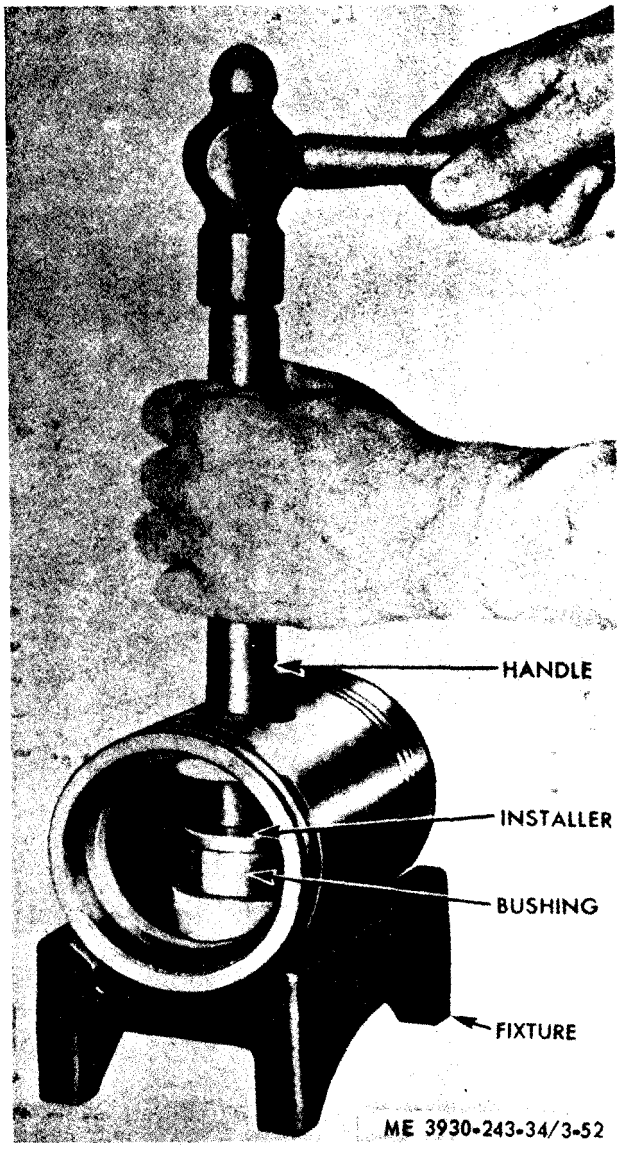


Figure 3-52. Piston pin bushing, removal and installation.

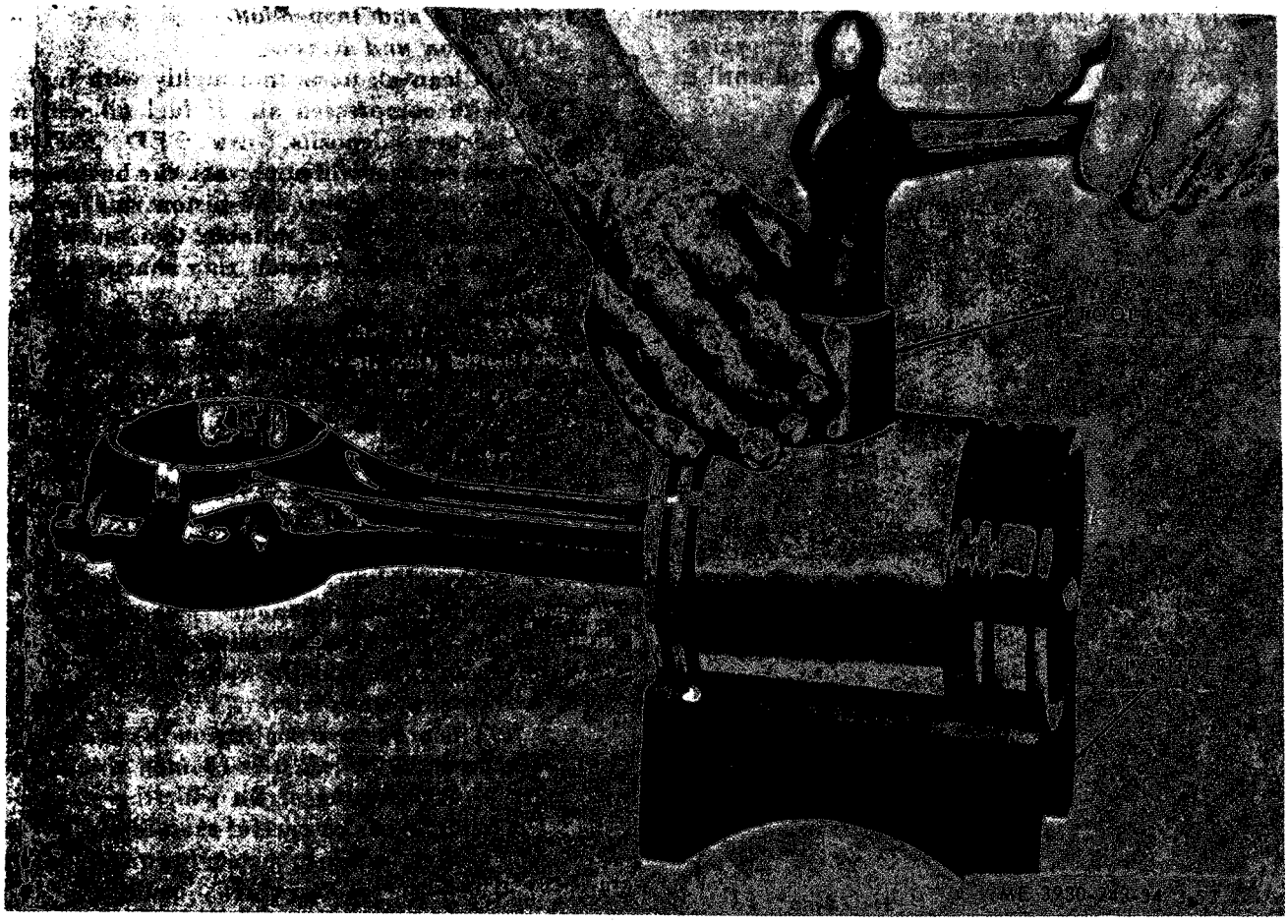


Figure 3-53. Piston pin retainer, installation.

(4) Refer to figure 3-54 for removal and installation of connecting rod bushings.

NOTE

If necessary, spray nozzles must be replaced before new connecting rod bushings are installed.

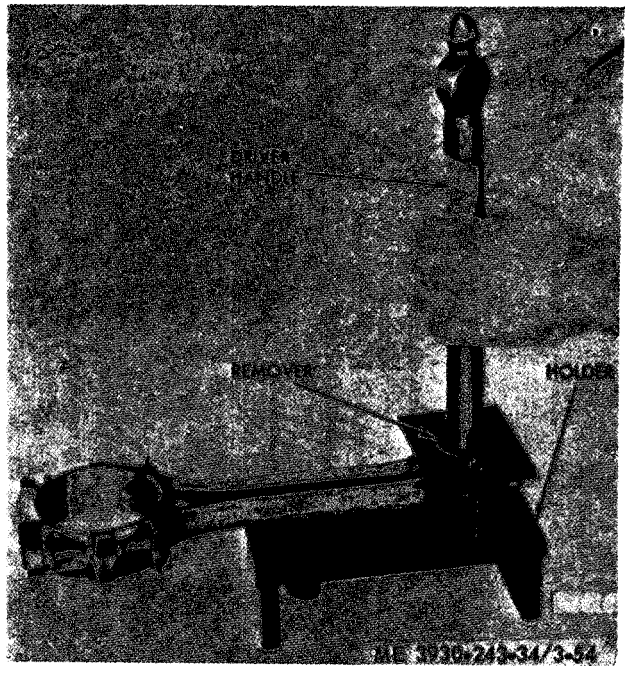


Figure 3-54. Connecting rod bushings, removal and installation.

(5) Refer to figures 3-55 and 3-56 for removal and installation of connecting rod spray nozzles. Press new spray nozzle into connecting rod until it bottoms in counterbore.

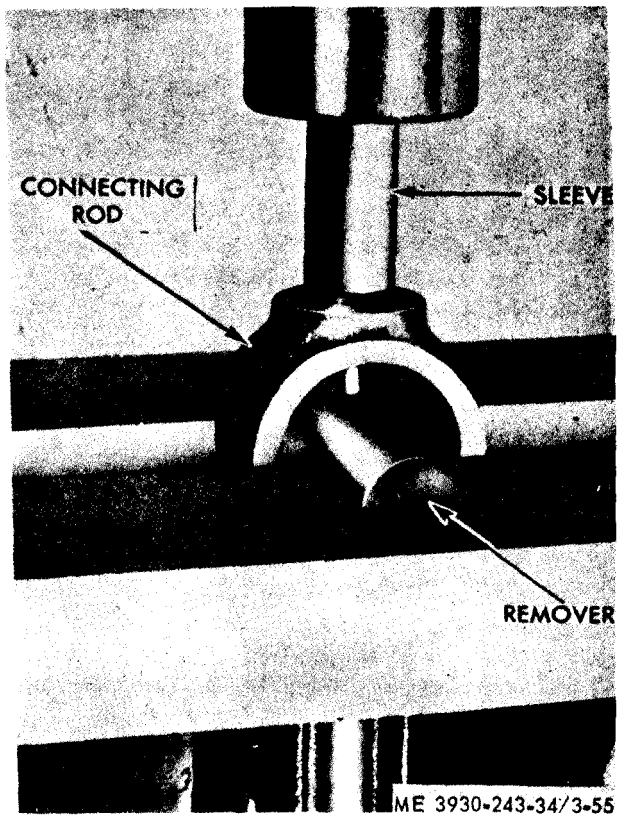


Figure 3-55. Connecting rod spray nozzle removal.

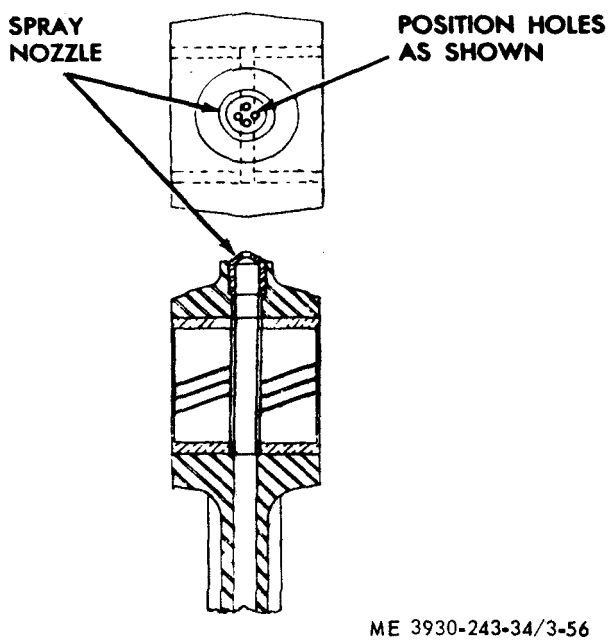


Figure 3-56. Location of spray nozzle in connecting rod.

d. Cleaning and Inspection.

(1) *Piston and Rings.*

(a) Clean all parts thoroughly with fuel oil and dry with compressed air. If fuel oil will not remove carbon deposits, use FED P-D-680 cleaning solvent that will not attack the bushings or tin plating on the piston. The piston ring grooves may be cleaned with a suitable tool, such as a broken half of a compression ring sharpened to a bevel edge.

(b) The cooling surfaces on the inside of the piston should also be cleaned. Oil return holes in the piston skirt must be thoroughly cleaned. Care must be exercised so that holes are not enlarged during the cleaning process. Excessively worn or scored pistons, rings and cylinder liners indicate abnormal maintenance or operating conditions which should be corrected as quickly as possible. Proper types of lubricating oil filters and air cleaners and their maintenance will reduce to a minimum the amount of abrasive dust and foreign material introduced into the cylinder and will, in turn, reduce the rate of wear.

(c) The protective coating on the skirt of the piston is from 0.0007 to 0.0015 inch thick. The presence of this coating of tin will, therefore, indicate very little wear. A careful examination of the piston should be made for scoring, burning, worn or damaged ring grooves and cracks inside the piston across the struts. A badly scored piston should not be reused, whereas a piston only slightly scored may be cleaned up and reused. Refer to figure 3-57 for comparison of pistons.

Figure 3-57. Comparison of used pistons.

(d) Examine the inside of the piston closely for cracks across the struts and discard piston if such cracks are present.

(e) Inspect the top of the piston crown for burned spots or other indications of overheating such as carbon formation on the underside of the piston.

(f) Inspect the piston rings for free fit in the grooves and side clearance.

(g) Inspect and measure the inside diameter of the piston pin bushings in each piston, and, if worn excessively, replace the bushings or piston assemblies. Also inspect and measure the piston pin. The standard inside diameter of bushings in a piston is 1.3775-1.3780 inches and the standard outside diameter of the piston pin is 1.3746 inch-1.3750; thus, the standard clearance between the piston pin and bushing, in a piston is 0.0025-0.0034 inch with a maximum allowable wear limit of 0.010 inch. Ream new piston bushings as illustrated in figure 3-58.

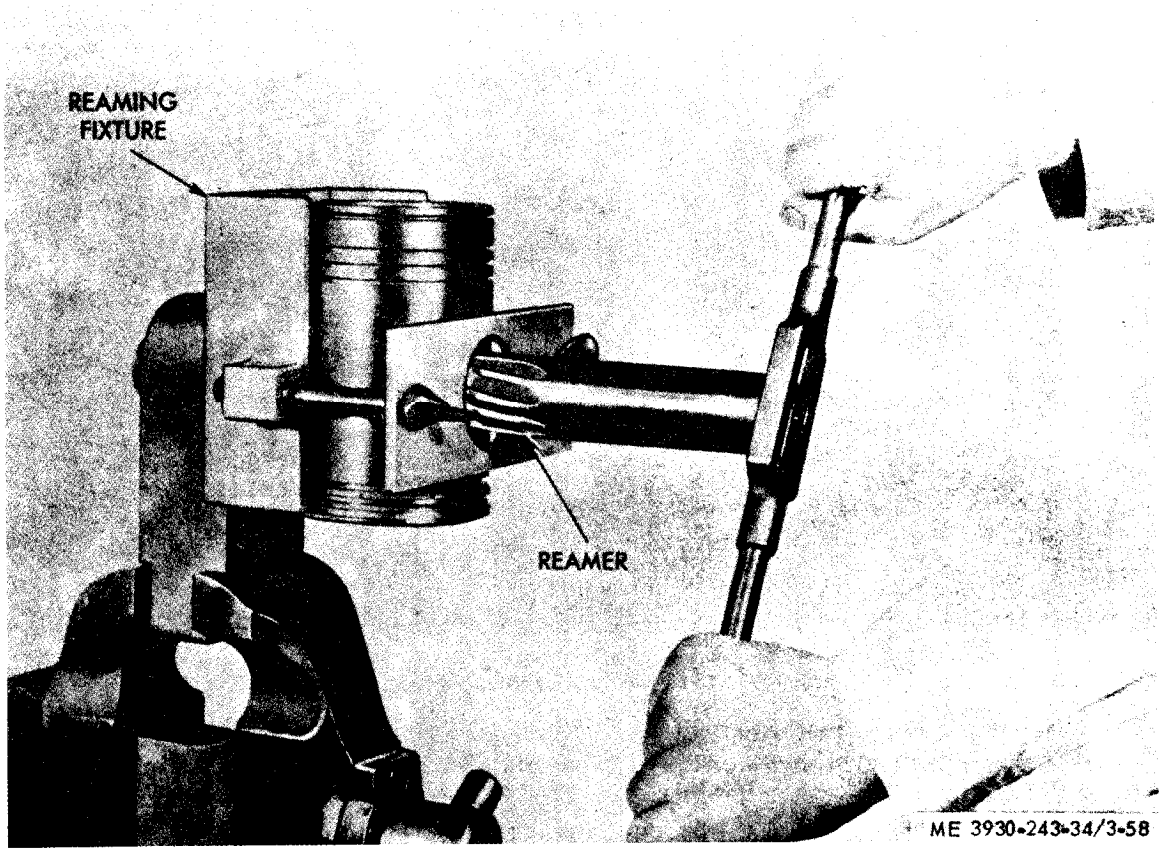


Figure 3-58. Reaming bushing in piston.

(h) The piston taper must not exceed 0.0005 inch from 7/16 inch below the bottom compression ring to the lower end of piston skirt. The diameter of a new standard piston below the compression ring grooves to bottom of piston skirt is 3.8693 to 3.8715 inch.

(i) Check the piston-to-liner clearance while the piston is held upside down in the liner. The liner should be in place in the cylinder block. This clearance should always be checked when installing either new or used pistons and liners. The clearance of a piston in a liner may be checked with liner in cylinder block, by inserting a ½ inch wide feeler ribbon about 15 inches long between the piston and liner (fig. 3-59), then withdraw feeler ribbon, measuring the force required with a spring scale. This force should not exceed six pounds. When this force is approximately 6 pounds, the actual clearance between the piston and the liner is 0.001 inch greater than the thickness of the feeler ribbon used. Feeler ribbon used for checking this clearance must be perfectly flat and free from nicks and scratches.

NOTE

If any bind between the piston and liner is detected, remove the piston and liner and inspect them for burs. If either part is marred, the parts must be cleaned up, using a fine hone on the liner and fine file on the piston before proceeding.

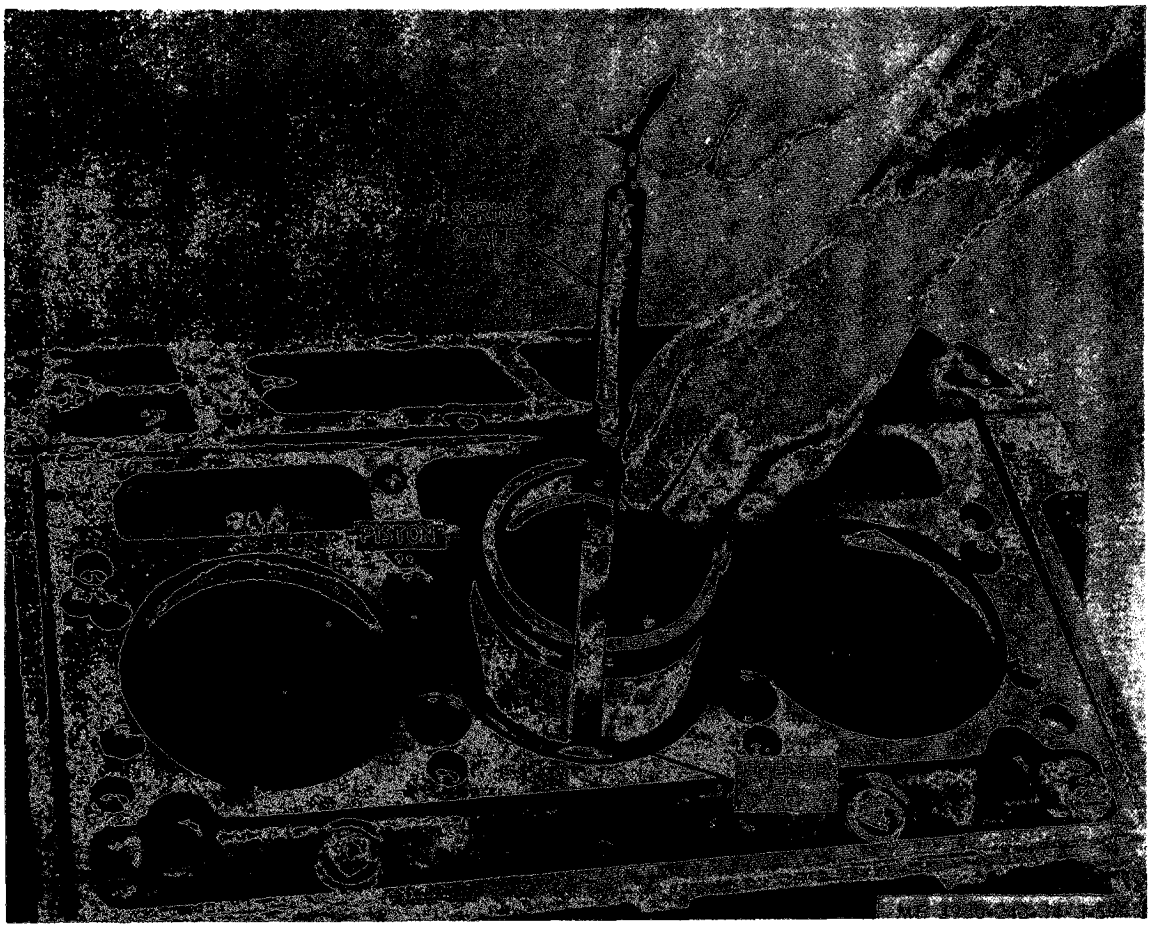


Figure 3-59. Measuring piston-to-liner clearance.

NOTE

New piston rings should always be used whenever a piston is removed for inspection or replacement.

(j) When fitting piston rings, the gap between the ends of the rings should be measured before installing the rings on the piston (fig. 3-60).

NOTE

The ring gap for the third compression ring and the lower compression ring is from 0.020 to 0.036 inch and the gap for the oil control ring is from 0.010 to 0.025 inch.

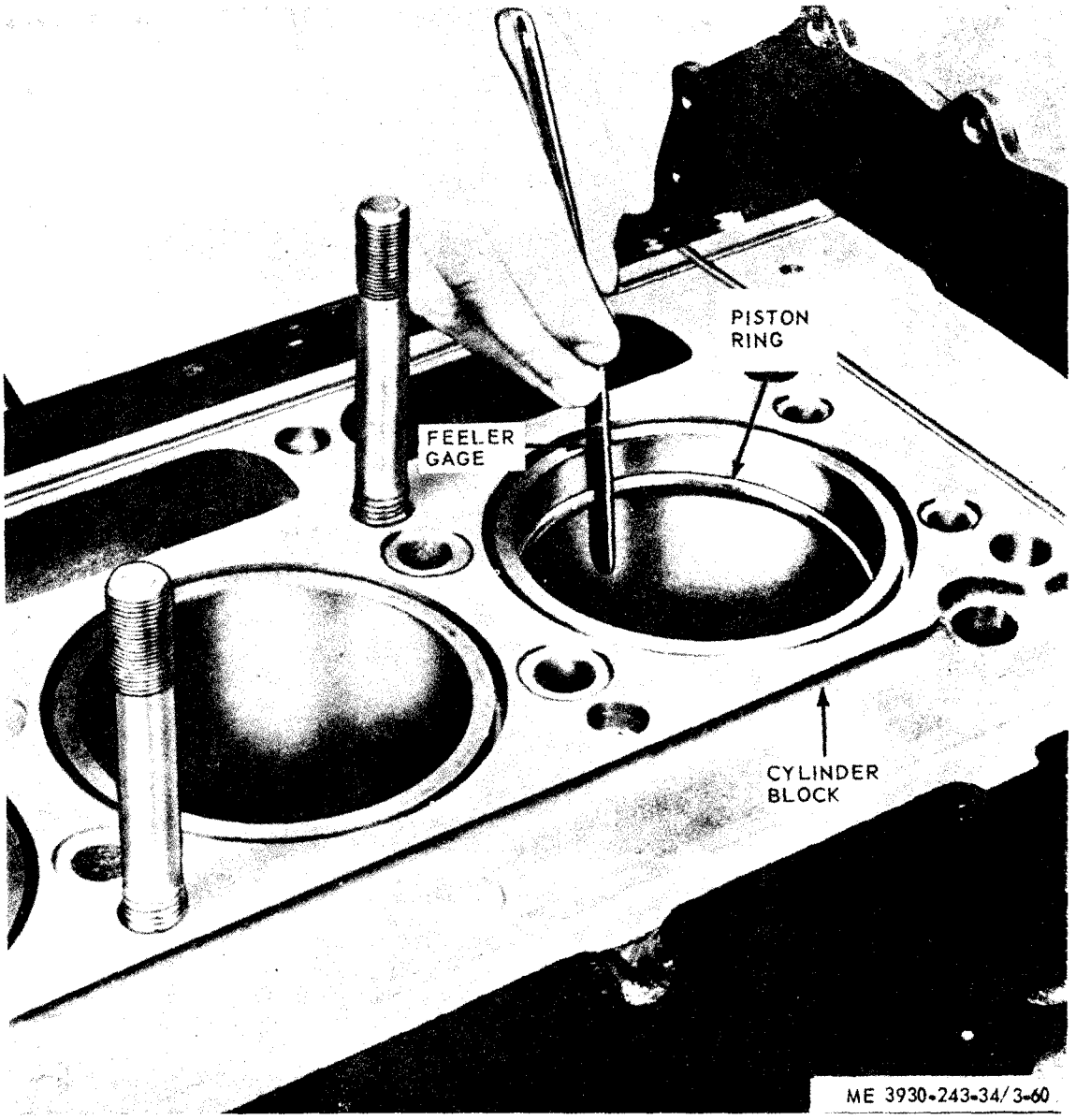


Figure 3-60. Measuring piston ring gap with feeler gage.

(k) Check the ring clearances in the piston grooves (fig. 3-61). Nominal ring groove width, which may vary±0.001 inch, and ring clearances in grooves should be as follows:

Upper compression (fire) ring (straight face)	-0.007 in. -0.010 in.
Upper compression (fire) ring (tapered face)	-0.003 in. -0.006 in.
Second compression ring	-0.007 in. -0.010 in.
Third compression ring	-0.005 in. -0.008 in.
Lower compression ring	-0.005 in. -0.008 in.
Upper oil control ring	-0.0015 in. -0.0055 in.
Lower oil control ring	-0.0015 in. -0.0055 in.

(2) *Wear limits.* For allowable wear limits refer to table 1-1.

(3) *Connecting rod, piston pins, and bearings.*
(a) Check rod for straightness. Hydrostatic

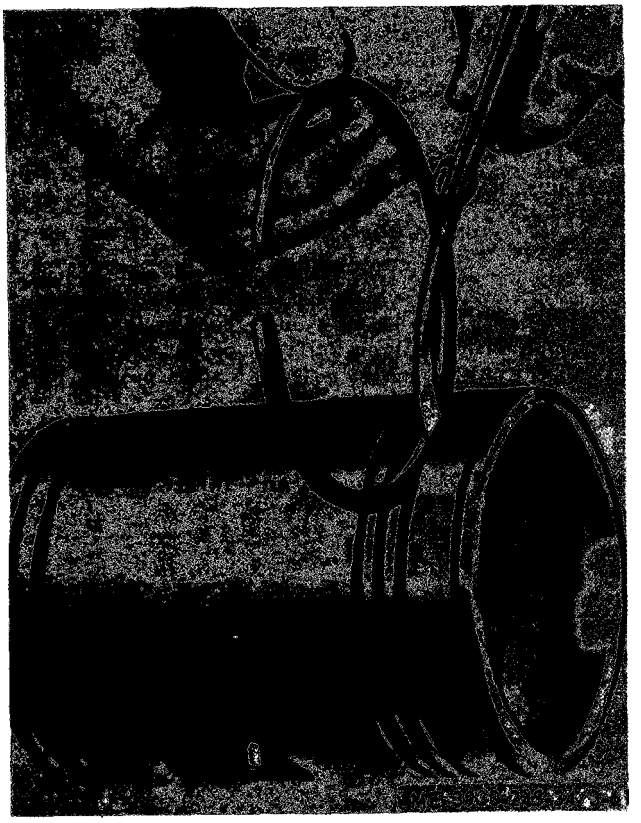


Figure 3-61. Measuring piston ring side clearance.

lock caused by fuel or water leakage to the piston crown may result in a bent and possible broken connecting rod.

(b) Check the connecting rods for cracks.

(c) Inspect and open holes in spray nozzle at upper end of connecting rod, if necessary. Blow dry, compressed air through drilled oil passage in rod nozzle to be sure all passages are open.

(d) Check rod bushings for signs of scoring or other damage.

(e) Measure the outside diameter of piston pin to determine wear. The standard diameter of new piston pins is 1.3746 to 1.3750 inches.

(f) The standard inside diameter of a new bushing in a connecting rod is 1.3760 to 1.3765 inches. The specified clearance between the piston pin and bushing in upper end of connecting rod is 0.0010 to 0.0019 inch with new parts, and the allowable wear limit 0.010 inch. The piston pin and/or rod bushings must be replaced if the above limits are not obtained.

(g) Visual inspection, as well as the dimensional measurements will be made to determine whether used bearings are satisfactory for further service or must be replaced. Ream new piston bushings as illustrated in figure 3-62.

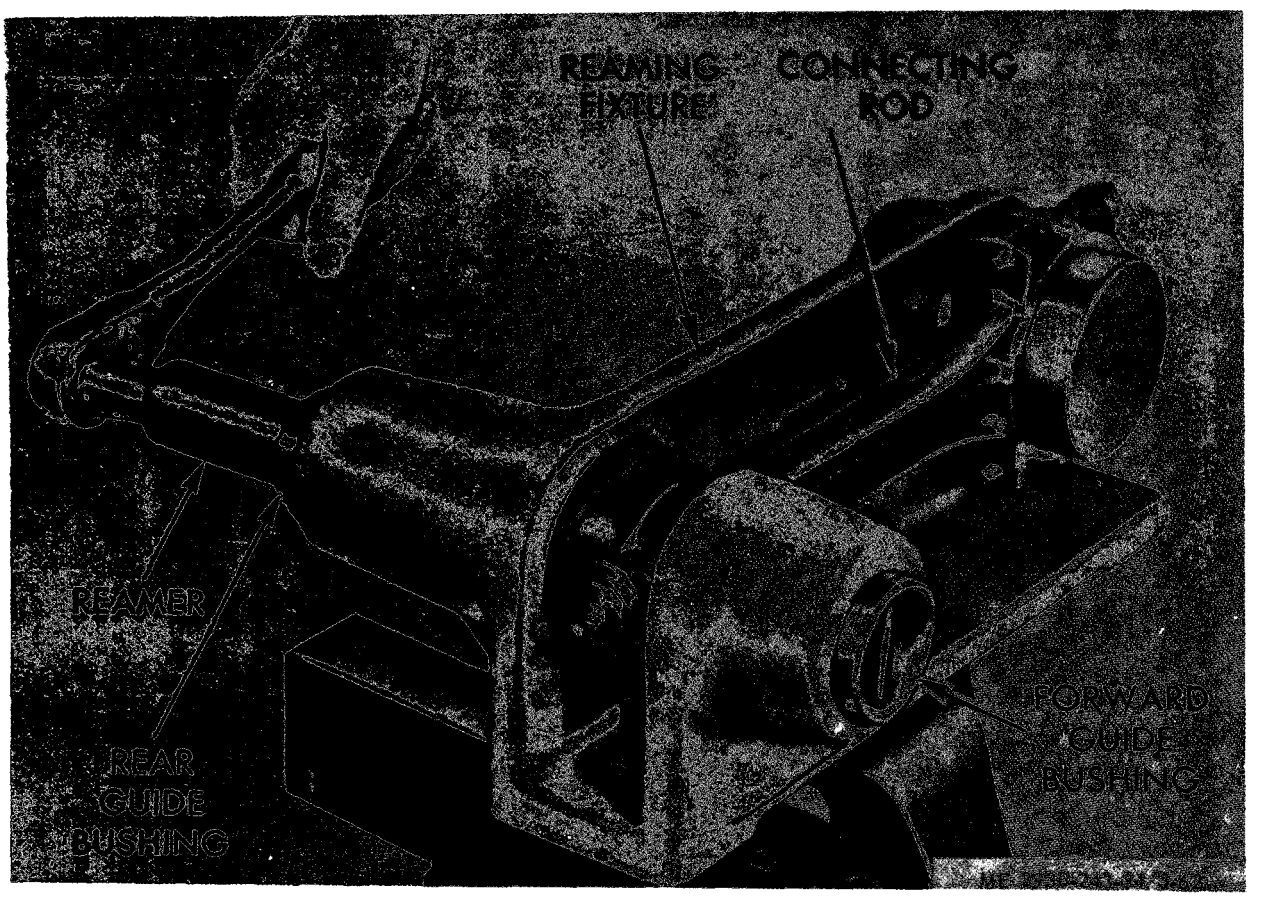


Figure 3-62. Reaming connecting rod bushings.

(h) Inspect the back of the bearing shells for bright spots which indicate they have been moving in their supports. If such spots are present, discard the bearing shells. Also inspect connecting rod bearing bores for burs and foreign particles.

(i) Measure the thickness of the bearing shells and check the clearance between each connecting rod crank throw and the corresponding bearing shells. Connecting rod cap nuts must be tightened to 40-45 foot-pounds torque with the bearing shells in place when measuring the inside diameter. Use a micrometer and a ball attachment. for measuring the shell thickness. If the standard size bearing shells are less than 0.123 inch in thickness and have more than 0.006 inch clearance between any crank thrown and its bearings, all shells, both upper and lower, must be discarded and new ones installed.

NOTE

One connecting rod shell alone should not be replaced. If one bearing shell requires replacement, both upper and lower shells should be installed.

(4) *Cylinder liner.*

NOTE

To avoid damage to the top land of piston, do not at any time try to loosen cylinder liner by inserting a long bolt or rod through the port openings in cylinder liner and turning the crankshaft, thus pushing the liner up with the piston.

(a) Refer to figure 3-63 and 3-64 for removal of cylinder liner and insert.

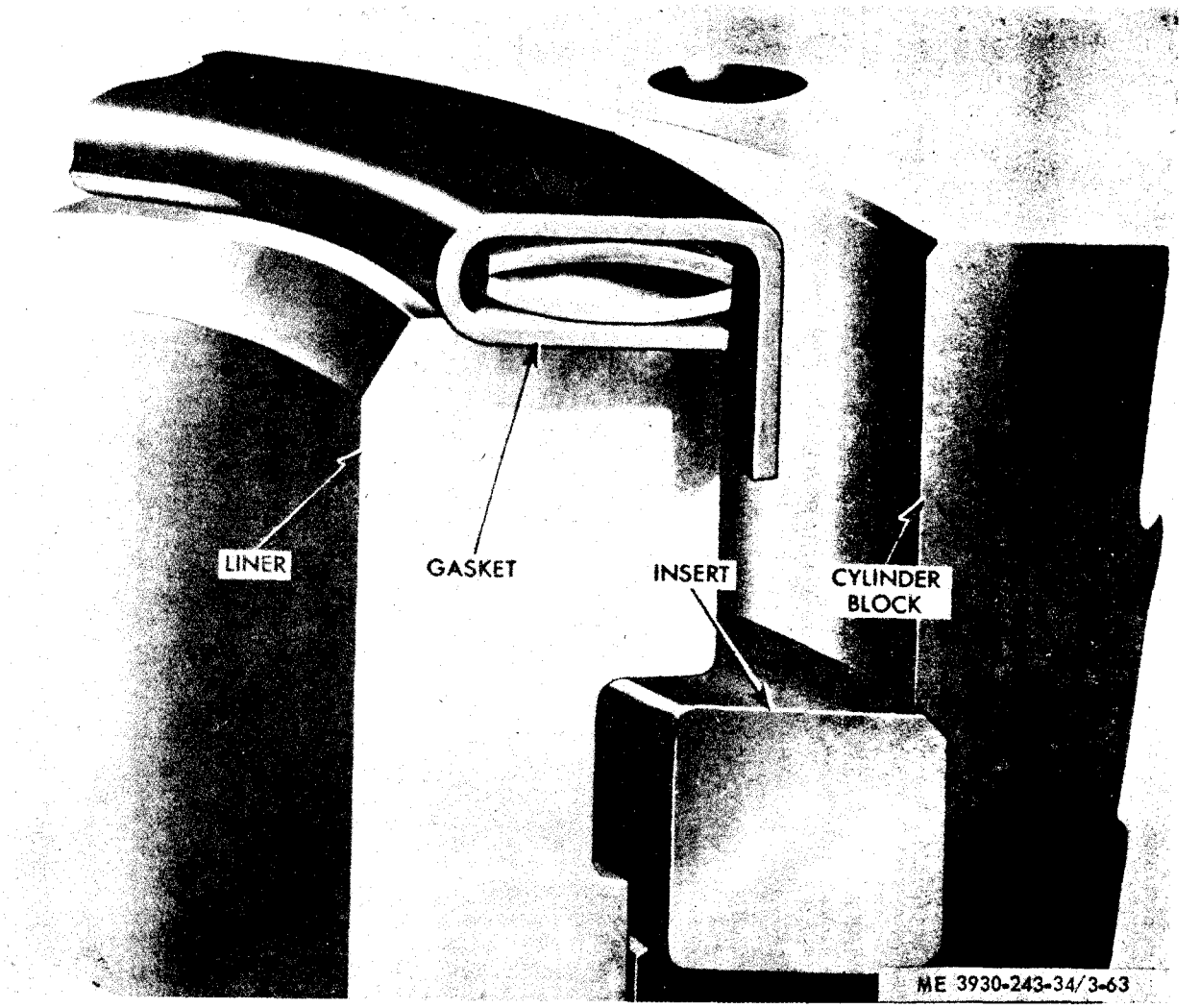


Figure 3-63. Cylinder liner mounted in block.

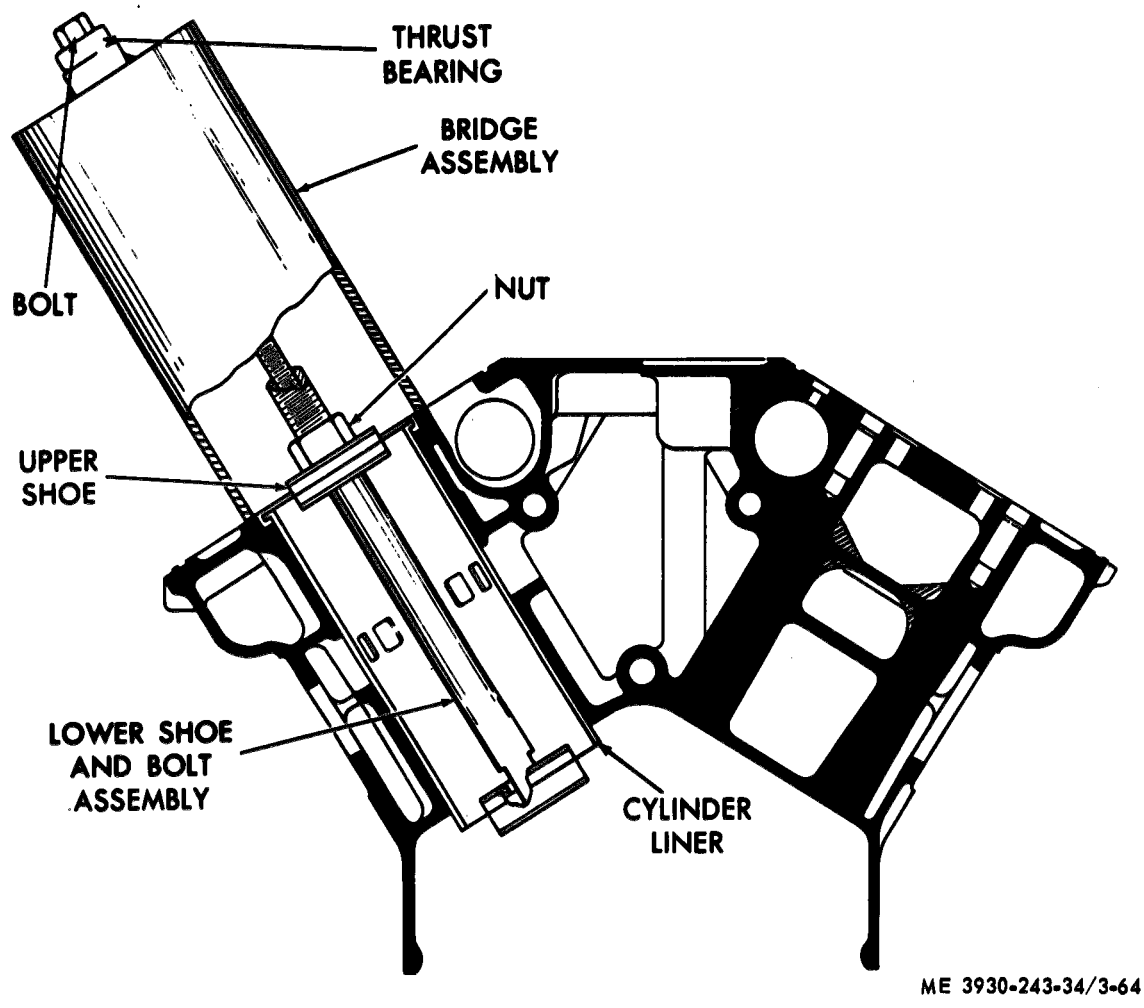


Figure 3-64. Cylinder liner removal.

(b) When the cylinder liner is removed from the engine, it should be cleaned, and checked for:

1. Out-of-round
2. Taper
3. Cracks
4. Scoring
5. Flange irregularities
6. Erosion

(c) A cracked or excessively scored cylinder liner must be discarded. A slightly scored cylinder liner may be cleaned up and reused.

(d) Install the cylinder liner in the block and measure the inside diameter of the liner at the various points shown in figure 3-65. If the taper exceeds 0.002 inch or the out-of-round exceeds 0.003 inch, replace the liner. To check the dimensions, use a dial bore gage which has a dial indicator calibrated in 0.0001 inch increments (fig. 3-66).

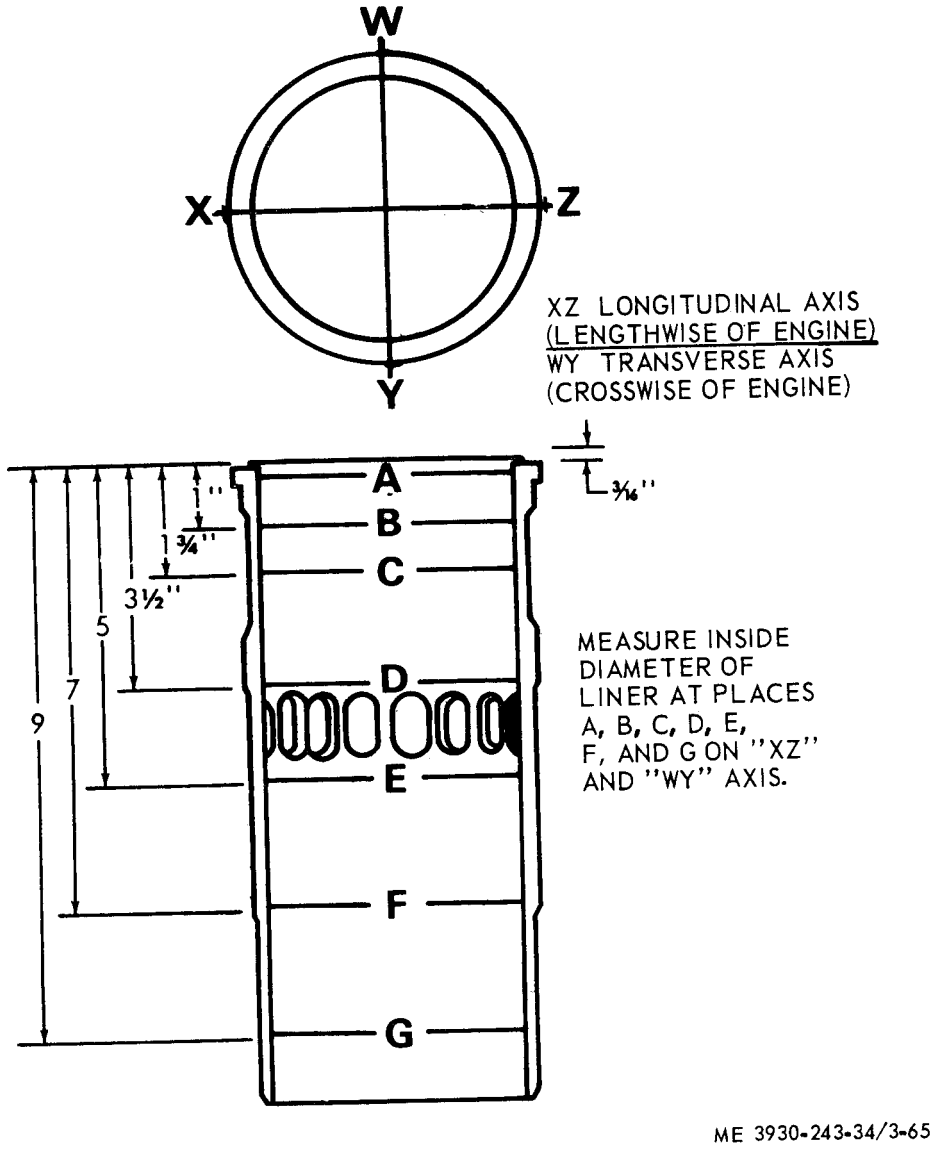


Figure 3-65. Cylinder liner measurement diagram.

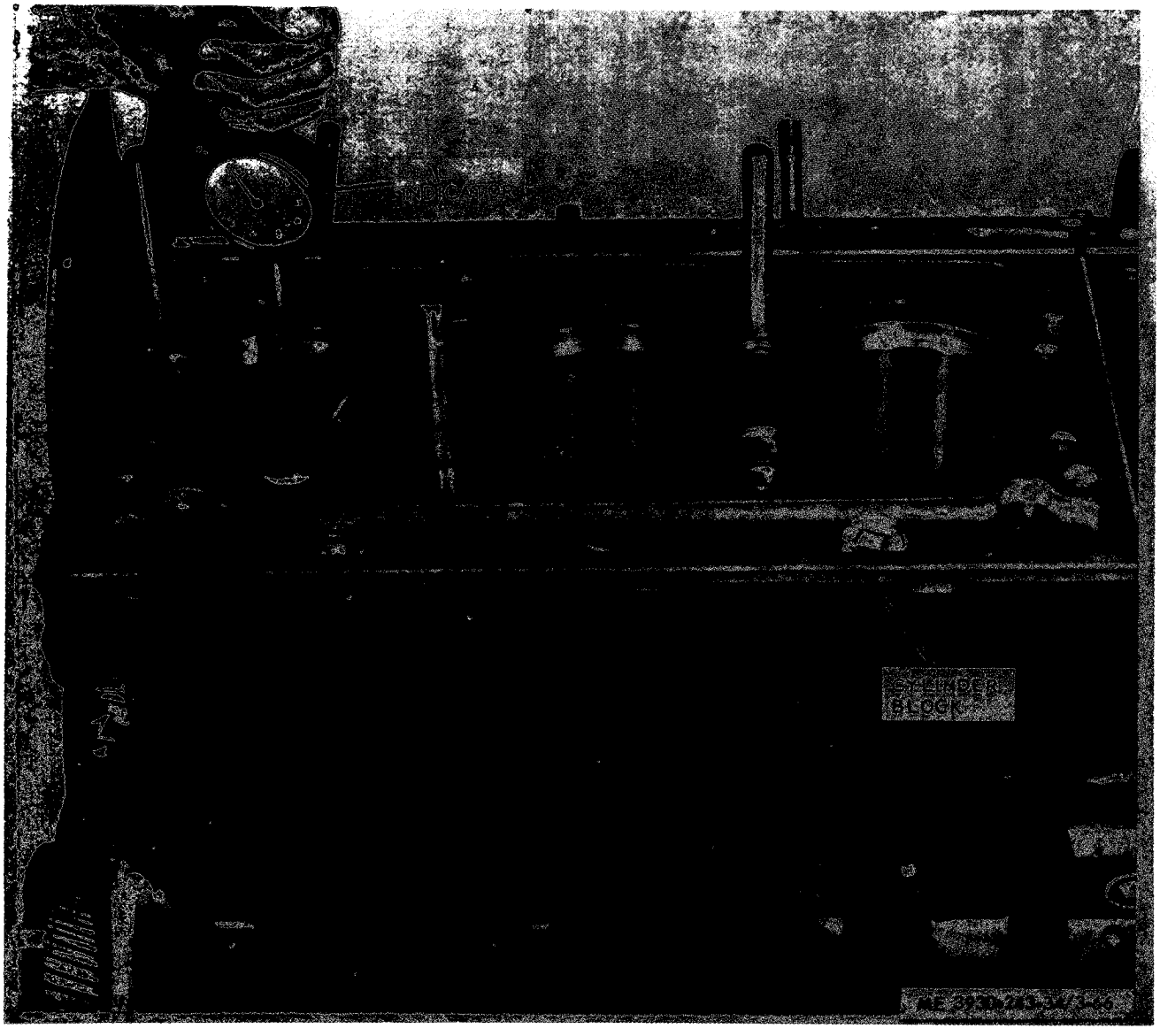


Figure 3-66. Checking bore of cylinder liner.

(e) Fitting cylinder liner to bore in block:

1. Clean inside and outside of cylinder liner. Also, clean block bore and counterbore to insure proper seating. Then, slide the liner into block until flange on liner rests on bottom of counter bore in the block.

CAUTION

Do not drop or slam liner against the bottom of counterbore in the block.

2. Tap the liner lightly with a soft hammer to make certain the liner flange seats on bottom of counterbore.

3. Clamp the liner in place with a holddown clamp and measure distance from top of the liner flange to top of the block. The top of the liner flange should be 0.0465 to 0.050 inch below top of the block; and there must not be over 0.0015 inch difference between any two adjacent liners when measured along the cylinder longitudinal centerline. If above limits are not met, install liner in another bore and recheck, or use a new liner (fig. 3-67).

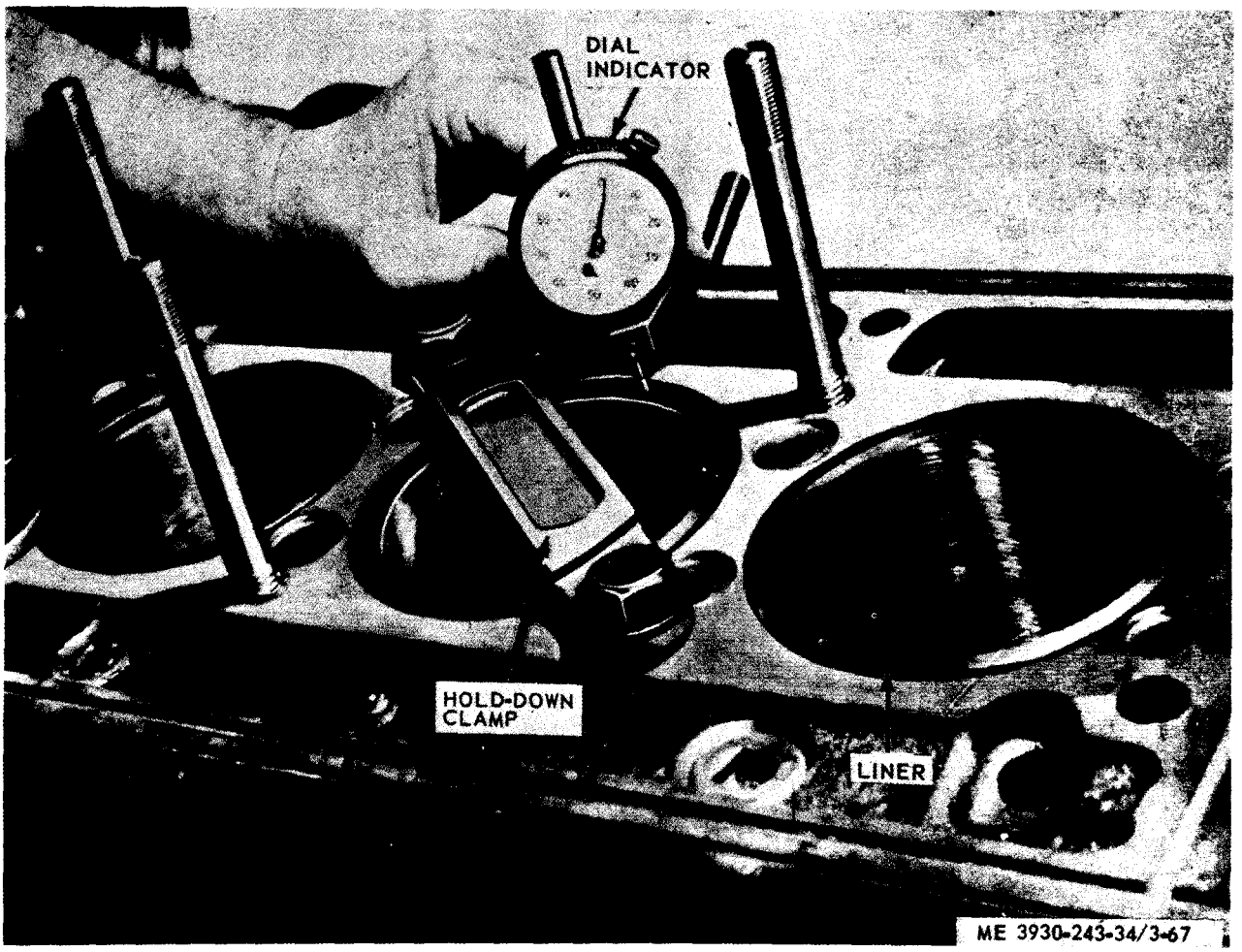


Figure 3-67. Checking distance of line flange below top face of cylinder block.

4. Match mark the liner and block with chalk or paint the serial number side of engine to insure the liner is reinstalled in same position in the same bore.

5. Remove holddown clamp and litter.

e. Reassembly.

(1) With the piston assembled to the connecting rod and the piston rings in place, apply clean engine oil to the piston, rings, and the inside of the piston ring compressor.

(2) Place ring compressor on a woodblock with taper end up.

(3) Stagger the piston ring gaps properly on the piston. Insure that oil control ring expanders are not overlapped.

(4) Start the piston straight into the ring compressor and push the piston down until it contacts the wood block (operation 1, fig. 3-68).

(5) Note position of the matched mark on the liner and place the liner on a block of wood.

(6) Place the ring compressor and the piston and rod assembly on the liner, so that the numbers on the rod and cap are aligned with the match mark on the liner (operation 2, fig. 3-68).

NOTE

The numbers, or number and letter on the side of the rod and cap identify the rod with the cap and indicate the cylinder in which they are to be used. If new rods are used, etch or stamp the same identification, in the same location as on the connecting rod replaced.

(7) Push the piston and rod assembly down into the liner until the piston is out of the compressor.

CAUTION

Do not force the piston into the liner. The expanders apply considerable force on the oil ring; therefore, extra care must be taken during the "loading" operation to prevent ring breakage.

(8) Remove the connecting rod cap and the ring compressor.

(9) Push the piston down into the liner until the compression ring passes the liner parts.

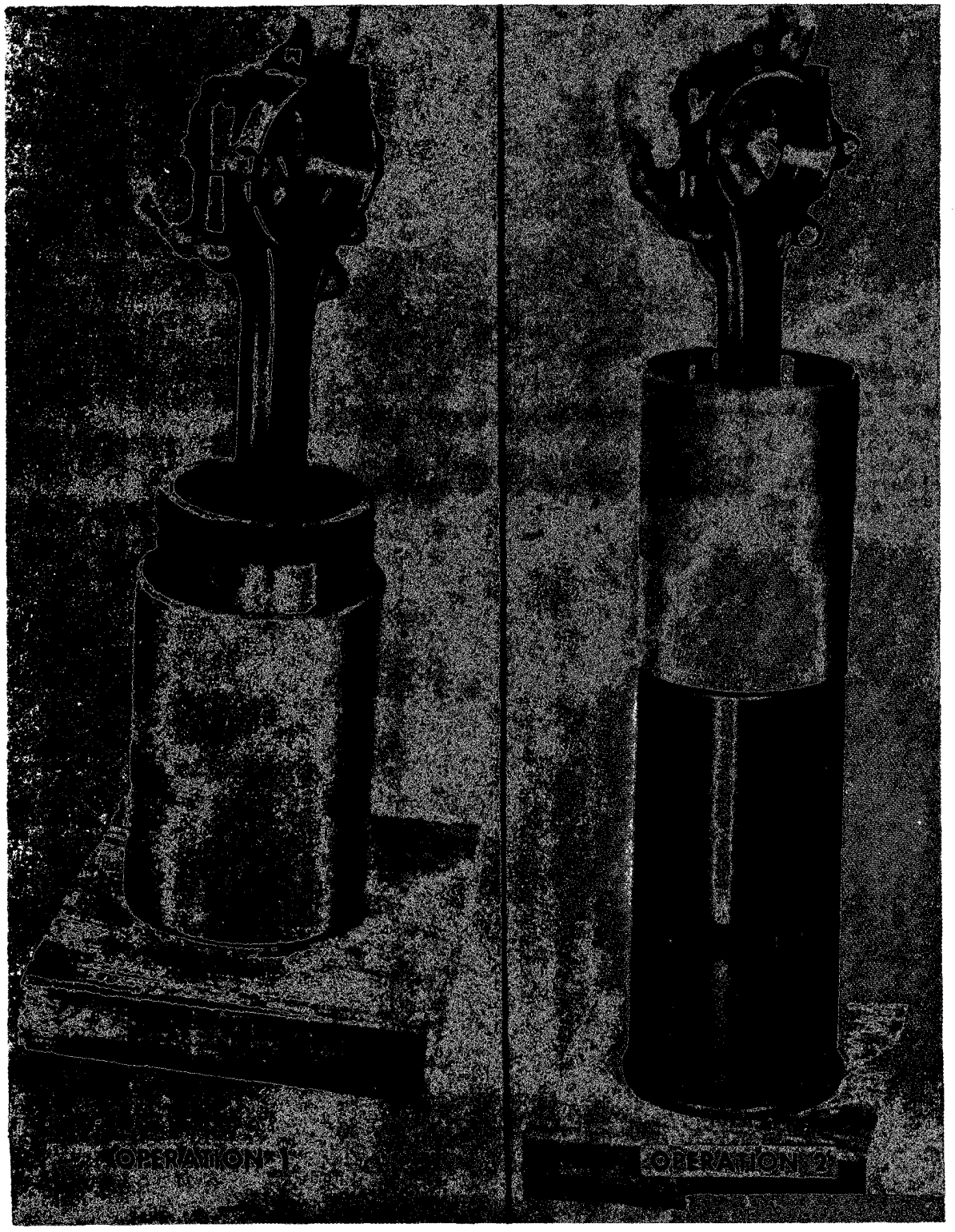


Figure 3-68. Installing piston and connecting rod assembly in ring compressor and cylinder liner.

f. Installation. After the piston and connecting rod assembly have been installed in the liner, the entire assembly may be installed in the engine as follows:

(1) Make sure the seal ring groove in the cylinder block is clean, then install the seal ring,

NOTE

The Current cylinder block has an additional seal ring groove approximately 1/8" below the top groove. This groove will permit further use of the cylinder block where erosion or corrosion of the upper seal ring groove has occurred. The lower seal ring groove in the current cylinder block has been eliminated. Reinstallation of the seal ring in the former block is not required.

(2) Apply vegetable type shortening or permanent type antifreeze solution to the seal ring.

(3) If any pistons and liners are already in place, use holddown clamps to keep the liners in place when the crankshaft is rotated.

(4) Rotate the crankshaft until the connecting rod journal of the particular cylinder being worked on is at the bottom of its travel, wipe the journal clean and lubricate it with clean engine oil.

(5) Install the upper bearing shell (the one with a short groove at each parting line) in the connecting rod. Lubricate the shell with clean engine oil.

(6) Hold the piston, rod and liner in line with the block bore (fig. 3-69) so that the identification number of the rod is facing the serial number side of the block. Also align the match marks on the lincr and block, Slide the entire assembly into the block bore and seal ring, being careful not to damage the seal ring.

(7) Pull or push the piston and connecting rod down until the upper bearing seats firmly on the crankshaft journal; use care so the hearing shell will not be dislodged from the rod.

(8) Place the lower bearing shell (the one with the continuous oil groove) in the connecting rod cap with the tang on the groove in the notch in the cap. Lubricate the bearing shell with clean engine oil.

(9) Install the bearing cap and shell on the connecting rod with the number on the cap and rod adjacent to each other. Tighten the connecting rod nuts (3/8-24 bolts) to 45-50 lbs. ft. (lubricated) or 50-55 lbs. ft. plain.

(10) Check the connecting rod side clearance. The clearance should be 0.006” to 0.012” new parts.

(11) Remove holddown clamps. Install new compression gaskets, water and oil seals and install the cylinder head,

(12) Install oil pan (para 3-24), and refer to current LO and fill crankcase with engine oil.

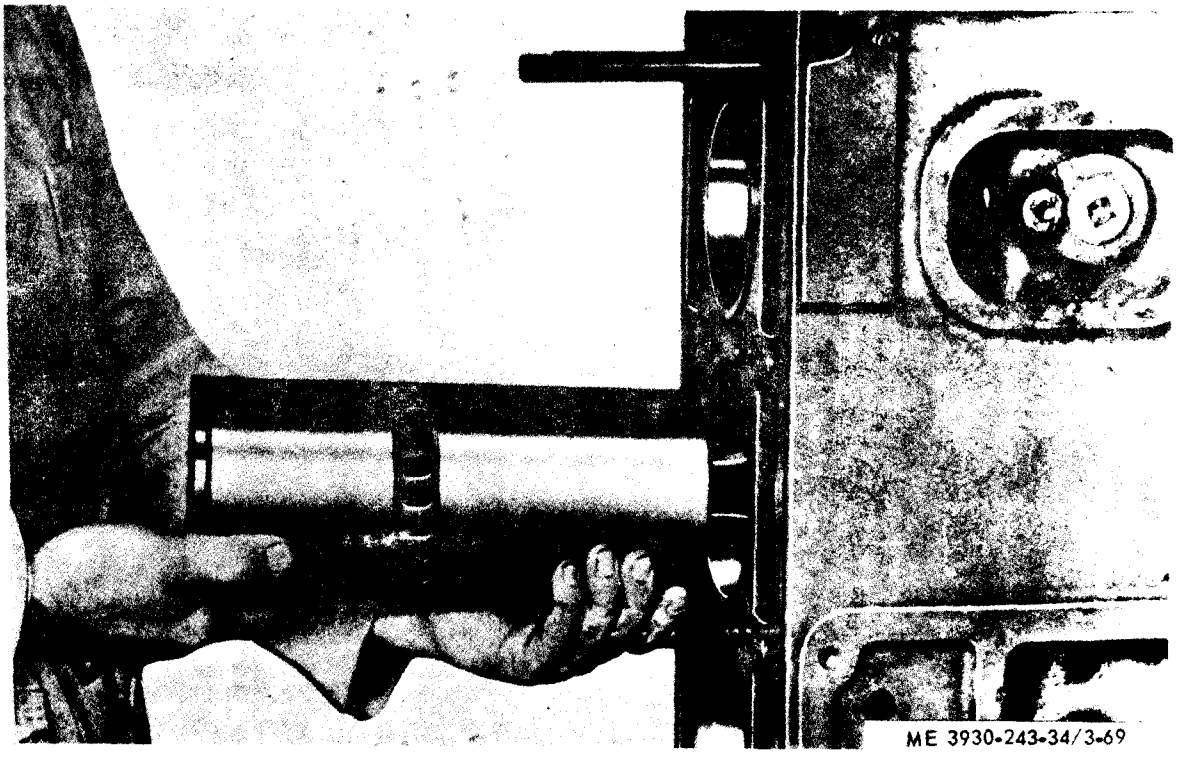


Figure 3-69. Installing piston, connecting rod and liner assembly in cylinder block.

3-27. Oil Pressure Regulator

a. General. The regulator assembly consists of a hollow piston type valve, a spring gasket and plug. The valve is located in an oil gallery within the lower front cover and is held tight against a counterbore valve seat by the compressed

spring and plug. Under normal conditions, the pressure regulator valve should require very little alteration. If sludge should accumulate in the lubricating system, the valve may not work freely, thereby remaining open or failing to open at the normal operating pressure. The valve opening pressure is 52 psi.

b. Removal.

(1) Remove the plug and washer from the engine lower front cover (fig. 3-70).

(2) Withdraw the spring and the valve from the cover.

c. Inspection. Inspect the valve spring and check valve for freedom of movement within the engine cover valve bore.

d. Installation.

(1) Apply clean engine oil, to the outer surface of the valve and slide the valve into the opening in the engine lower front cover (closed end first).

(2) Install a new copper gasket on the plug.

(3) While compressing the spring, start the plug in the cover. Tighten the plug.

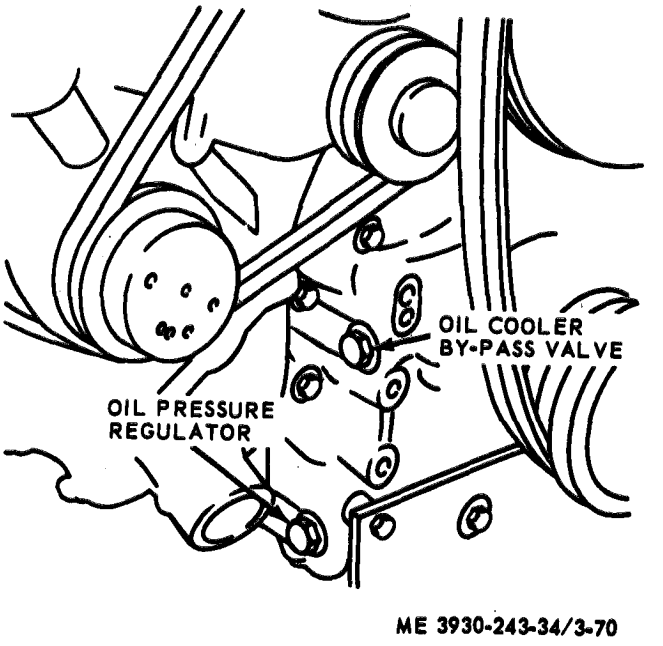


Figure 3-70. Oil pressure regulator, removal and installation.

Section V. CAMSHAFT, CRANKSHAFT AND BEARINGS

3-28. General

The camshaft has lobes that operate the push rods and directly operate the valves and fuel injectors. Crankshaft thrust is taken through two piece washers on each side of the rear main bearing. All main and connecting rod bearing journal surfaces and oil seal surfaces are induction hardened. Crankshaft wear is usually associated with bearing troubles. Therefore, whenever main or connecting rod bearings are inspected, the crankshaft should also be inspected. The camshaft is located just below the top of the cylinder block. The shafts are supported by bearings (bushing type) that are pressed into bores in the cylinder block. The camshaft is supported by end, intermediate, and center bearings. Lubrication is supplied under pressure to the end bearings by way of passages in the cylinder block which lead from the main oil gallery. From the end bearings, oil passes through the hollow camshaft to the intermediate and center bearings.

3-29. Engine Front Cover (Upper)

a. General. The engine upper front cover is attached to the cylinder block with attaching bolts. The camshaft oil seals are pressed into the cover.

b. Removal.

(1) Remove various parts and assemblies from engine upper front cover as outlined in their respective paragraph of this manual.

(2) Refer to figure 3-71 and remove front cover.

c. Disassembly. After front cover is removed, press oil seal from front cover.

d. Cleaning and Inspection.

(1) Clean the front cover.

(2) Inspect cover for cracks or damage.

(3) Inspect oil seals for wear or damage, replace if necessary.

e. Install Oil Seals.

(1) Support inner face of cover on woodblocks.

(2) If outside diameter of oil seal is not precoated with sealant, coat the bore in cover with nonhardening sealant.

(3) Position oil seal in cover with lip of seal pointing toward inner face of cover.

CAUTION

Keep lip of the oil seal clean and free of scratches.

(4) Press oil seal into cover until seal is flush with bottom of counterbore.

(5) Install second oil seal in same manner.

(6) Remove excess sealant from cover and seals.

f. Installation.

(1) Affix a new gasket to cover.

(2) Install cover on engine. Tighten bolts to 35 foot-pounds torque.

(3) Apply grease to the outside diameter of oil seal spacers; then, slide them on the shaft.

(4) Install a woodruff key in each shaft.

(5) Install pulleys on the shaft.

(6) Install and tighten pulley retaining nuts to 300-325 foot pounds torque.

(7) Install various parts and assemblies previously removed as outlined in their respective paragraphs of the manual.

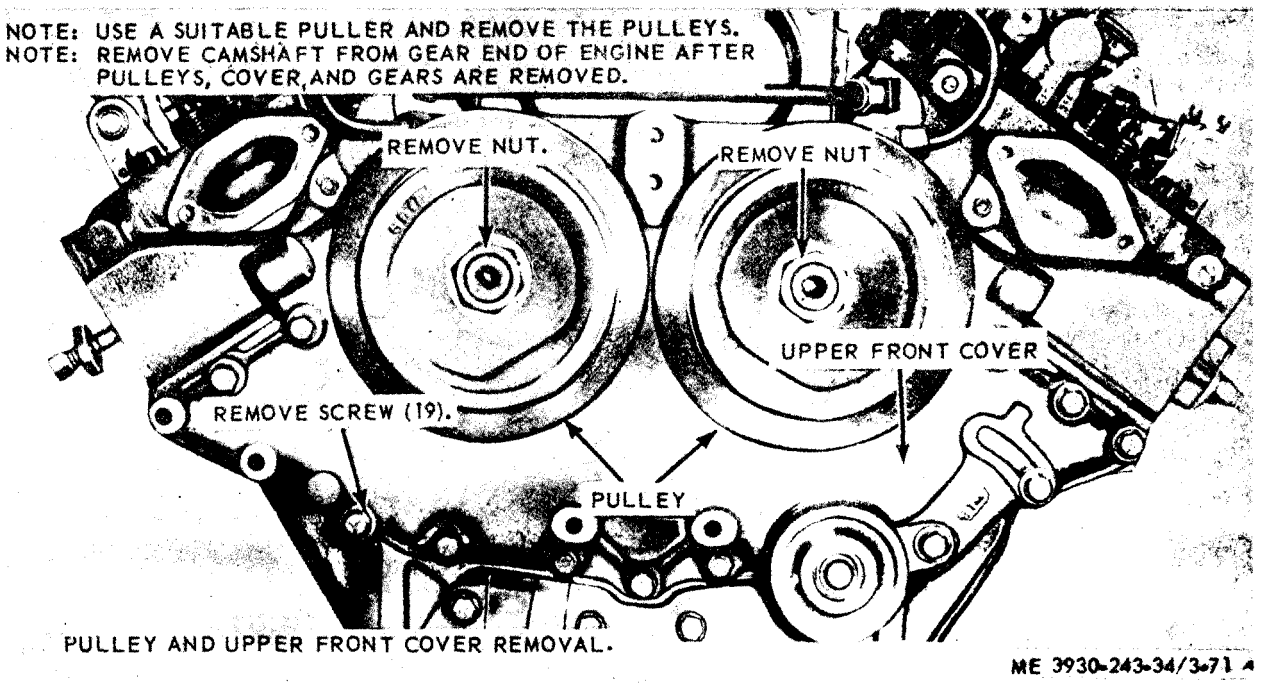


Figure 3-71. Engine front cover (upper), removal and installation.

3-30. Camshaft and Bearings

a. General. The camshaft and bearings are located just below the top of the cylinder block. The camshaft is described in paragraph 3-28.

b. Removal of Camshaft.

NOTE

Whenever an engine is being completely reconditioned or the bearings, thrust washers, or the gears on the shafts need replacing, the shafts should be removed from the engine in the following manner:

(1) Drain the engine cooling system.

(2) Remove the engine (para 2-9), and attaching parts necessary to mount engine on overhaul stand.

(3) Mount the engine on an overhaul stand. Be sure the engine is securely mounted on the stand before releasing the lifting sling.

(4) Remove the cylinder head (para 3-19).

(5) Remove the flywheel and the flywheel housing (para 3-21 and 3-22).

(6) Remove the bolts which secure the gear nut retainer plates (fig. 3-72) to the gears; then remove the retainer plates.

(7) Wedge a clean rag between the gears as shown in figure 3-73; then, remove the nuts from each end of both shafts with a socket wrench.

(8) Remove camshaft pulley from the front end of the shafts (fig. 3-74).

(9) Remove the upper engine front cover (para 3-29).

(10) Remove the oil slinger from the front end of both shafts.

(11) Remove the two thrust washer retaining bolts securing the camshaft or balance shaft thrust washer to the cylinder block, by inserting a socket wrench through a hole in the web of the gear (fig. 3-75).

(12) Withdraw the shaft, thrust washer, and gear, as an assembly, from the rear end of the cylinder block (fig. 3-76).

Figure 3-72. Camshaft gear retainer plate, removal and installation.

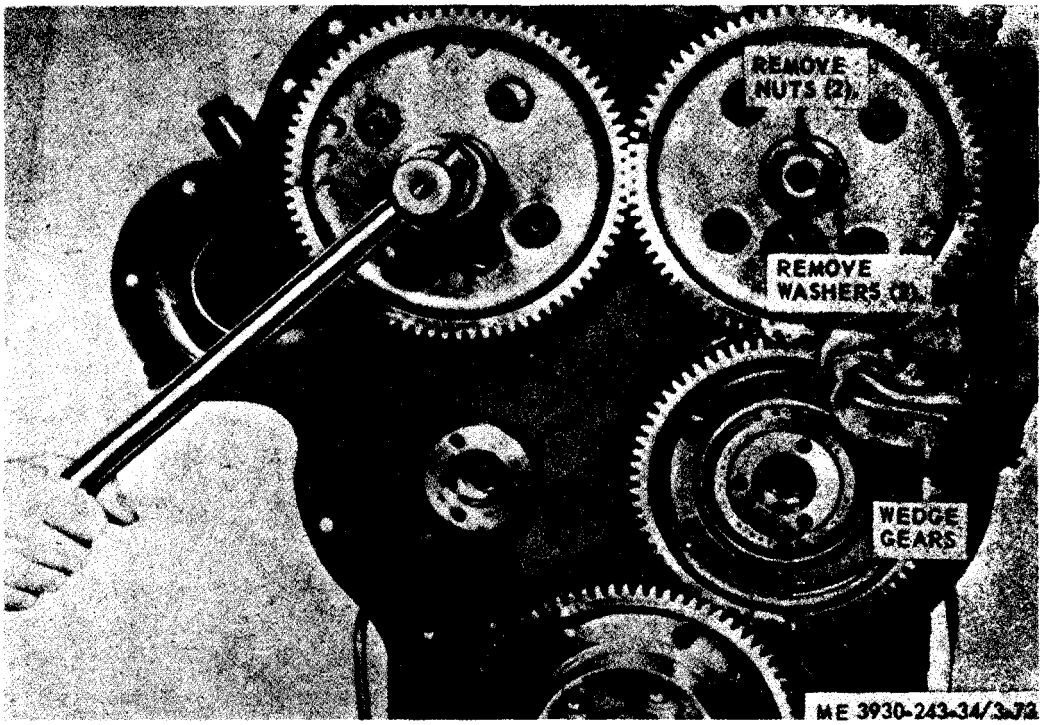


Figure 3-73. Removing or installing nut on camshaft.

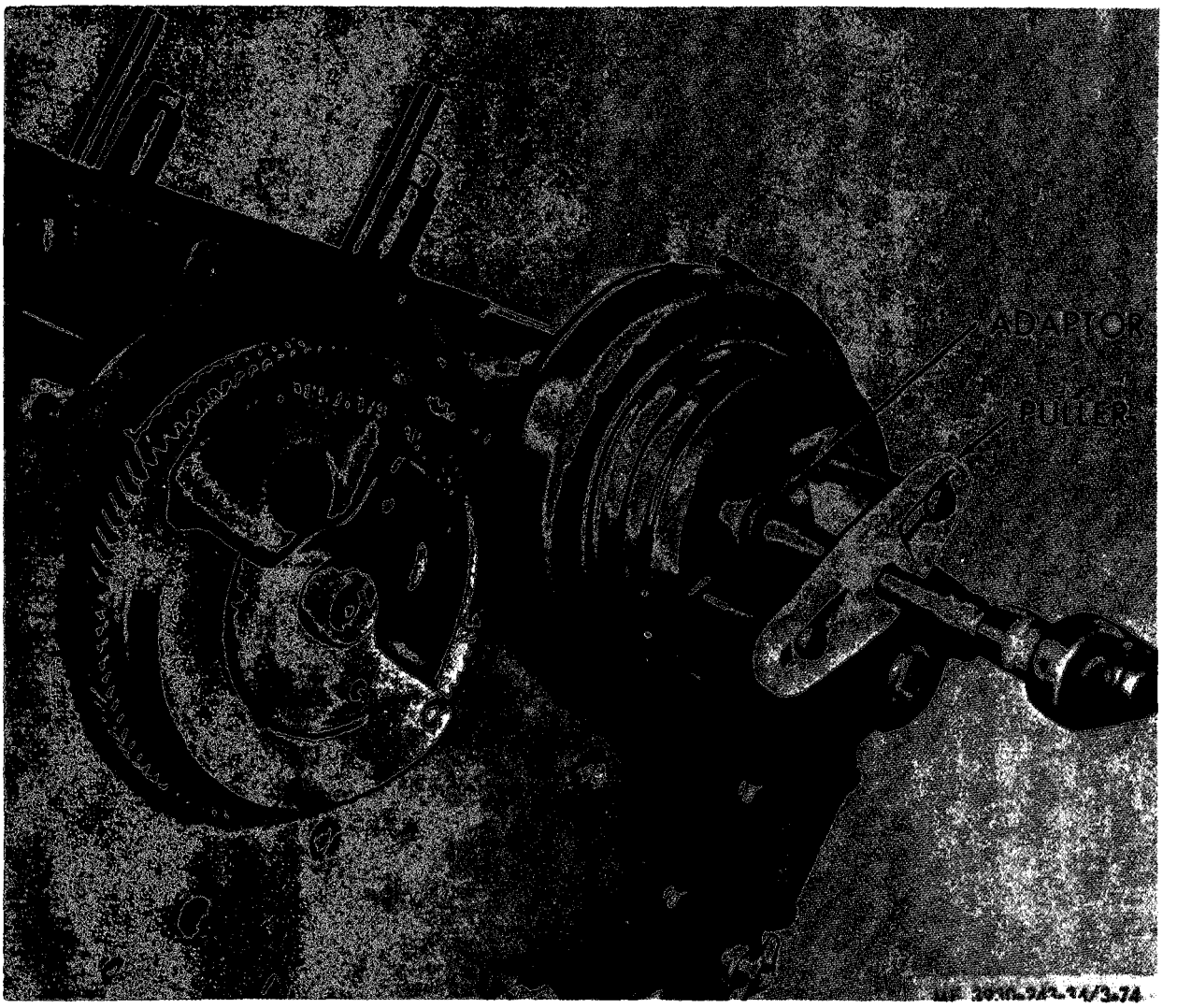


Figure 3-74. Camshaft pulley removal.

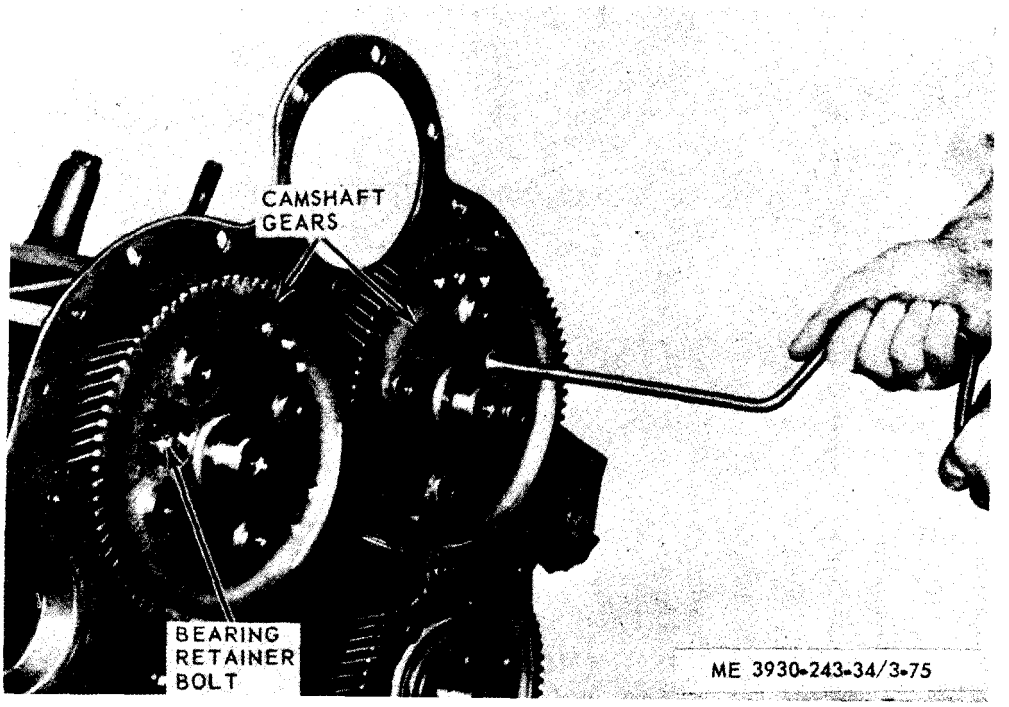


Figure 3-75. Thrust washer retaining bolts, removal and installation.

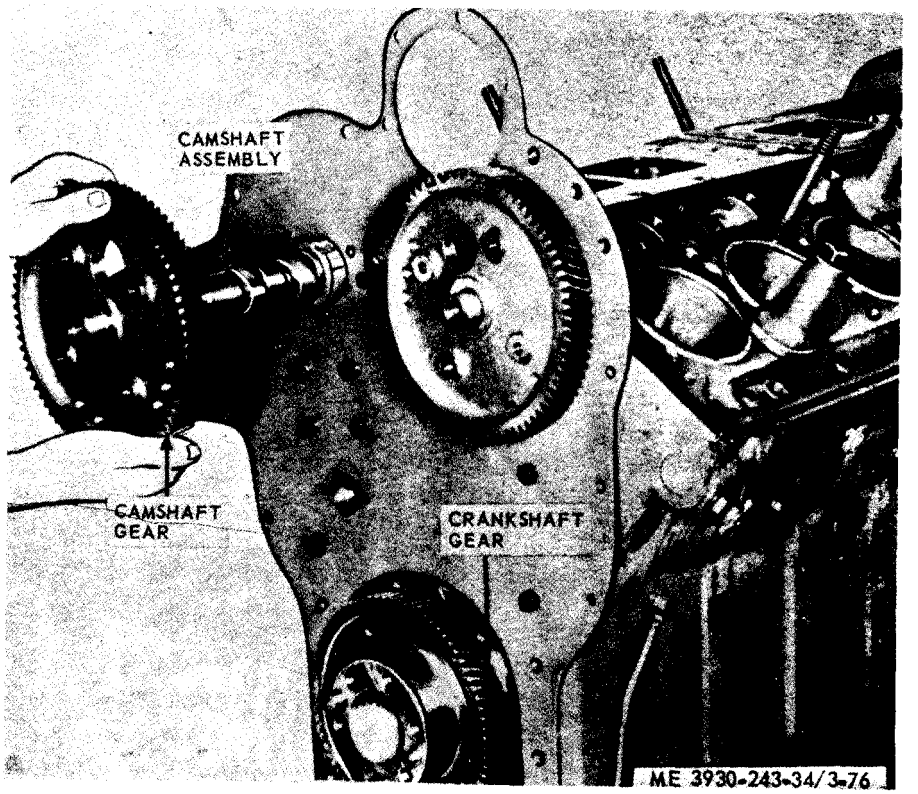


Figure 3-76. Camshaft assembly, removal and installation.

c. Disassemble Camshaft.

(1) Refer to figure 3-77 and remove the gear from the shaft.

(2) Refer to figure 3-78 and disassemble the camshaft in numerical sequence.

(3) To permit cleaning out any foreign material that may be lodged at the ends of the oil passage, remove the end plugs from the camshaft as follows:

(a) Clamp the camshaft in a vise equipped with soft jaws. Use care to prevent damage to the cam lobes and machined surfaces of the shaft.

(b) Make an indentation in the center of one of the end plugs with a 31-64 inch carboloy tip drill.

(c) To aid in breaking through the hardened surface of the plug, punch a hole as deeply as possible with a center punch.

(d) Then, use a 1/4 inch carboloy tip drill to drill a hole through the center of the plug.

(e) Redrill the end plug with a 5/16 inch carboloy tip drill.

(f) Thread the hole in the plug with a 3/8 inch-16 tap.

(g) Remove the end plug from the camshaft.

(h). Insert a 3/8 inch steel rod in the camshaft oil gallery and drive the remaining plug out. If a steel rod is not available perform steps *(a)* through *(g)* above to remove the remaining plug.

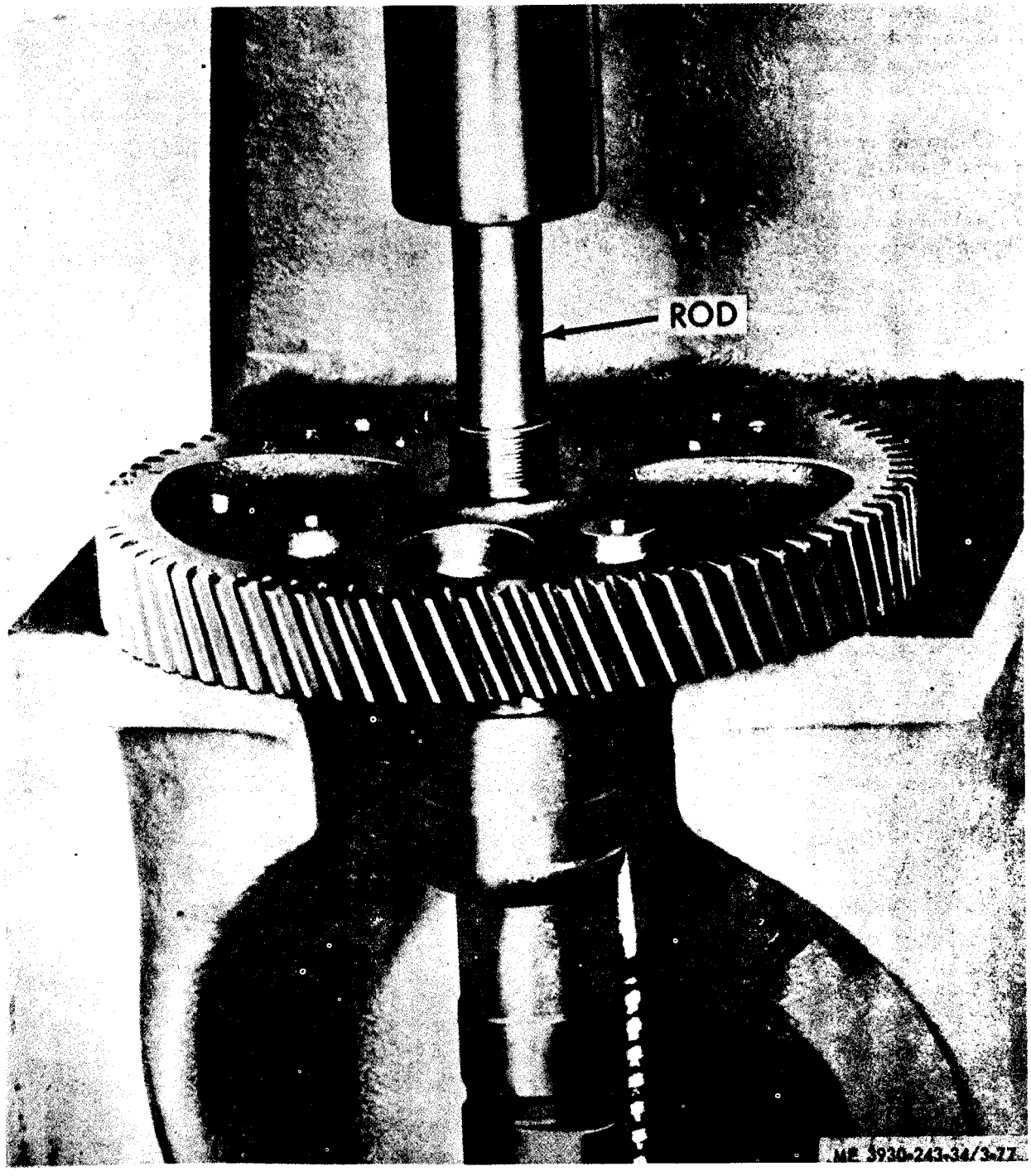


Figure 3-77. Camshaft gear removal.

d. Cleaning, Inspection and Repair.

(1) Clean all parts. Be sure the oil holes in the camshaft(s) are clean. Sludge accumulations, which might restrict the oil flow, must be removed.

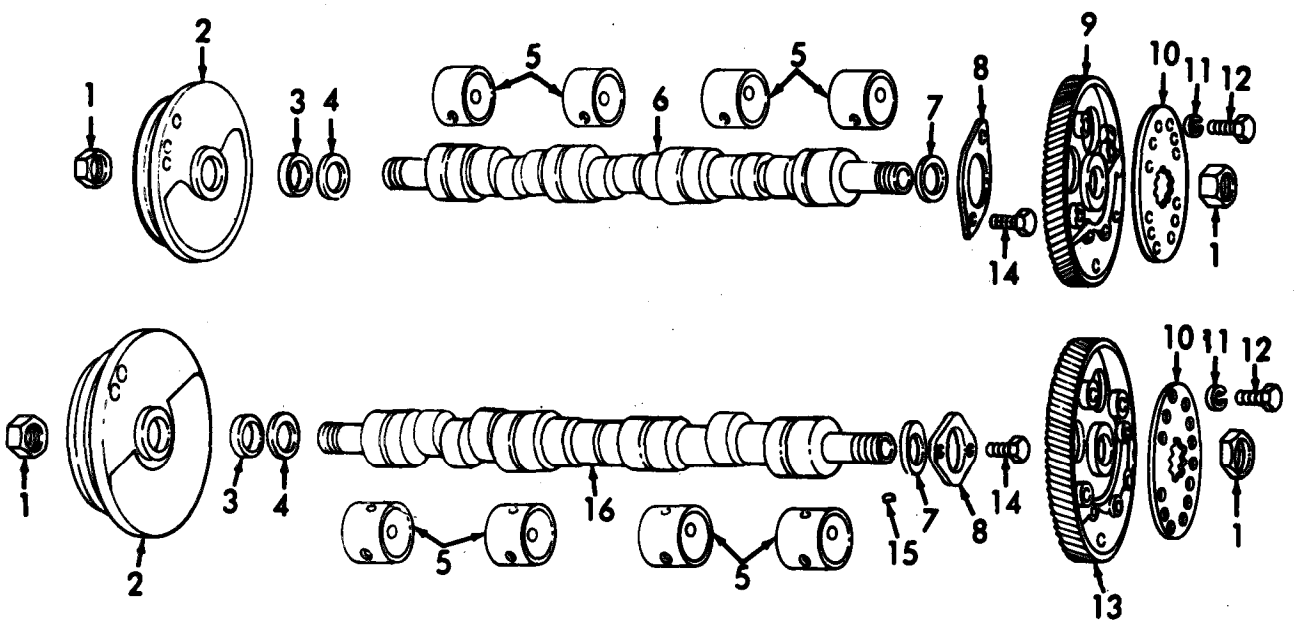
(2) Inspect the cams and journals, and, if they are badly scored or worn, replace the camshaft.

(3) If cams are scored, the cam followers should also be inspected (para 3-14).

(4) Examine both faces of the thrust washers. If either face is scored or if the thrust washers are worn excessively, replace the washers. New thrust washers are 0.208 to 0.210 inch thick.

(5) Also, examine surfaces which the thrust washers contact; if these surfaces are scratched but not severely scored, they may be smoothed down with an oil stone. However, if score marks are too deep to be removed, or if parts are badly worn, new parts must be used.

(6) The clearance between new shafts and new bearings is from 0.0045 to 0.006 inch or a maximum of 0.008 inch with worn parts. Excessive clearance between the shafts and the bearings will cause low oil pressure and excessive backlash between the gears.



1 Nut
2 Pulley
3 Spacer
4 Deflector
5 Bearing set
6 Camshaft
7 Washer
8 Washer
9 Gear
10 Retainer
11 Washer
12 Cap screw
13 Gear
14 Bolt
15 Woodruff key
16 Camshaft

Figure 3-78. Camshaft, disassembly and reassembly.

e. Remove Bearings.

NOTE

End bearings must be removed prior to removing the intermediate bearings.

CAUTION

When removing bearings be sure to note the position of the bearings in the bore with respect to the notch in the bearings. Replacement bearings must be installed in same position.

(1) Remove all accessories and assemblies with their attaching parts as is necessary.

(2) Press the end bearing out of the cylinder block. The nearest intermediate bearings can now be removed in the same manner.

(3) To facilitate assembly, the camshaft and balance shaft bearings are color coded as follows:

Bearing Position	*Color*	*Inside Diameter*	*Outside Diameter*
End	Black	Standard	Standard
Intermediate	Red	Standard	Standard

f. Sequence for Installing Bearings.

CAUTION

All replacement bearings must be installed with the notch located at the same position in the original bearings. The front intermediate and front bearings are installed by pressing the bearings from the front to the rear of the block.

g. Reassembly.

(1) Refer to figure 3-79 and install the camshaft gear onto the camshaft.

(2) Refer to figure 3-78 and reassemble camshaft. Reassembly is the reverse order of disassembly.

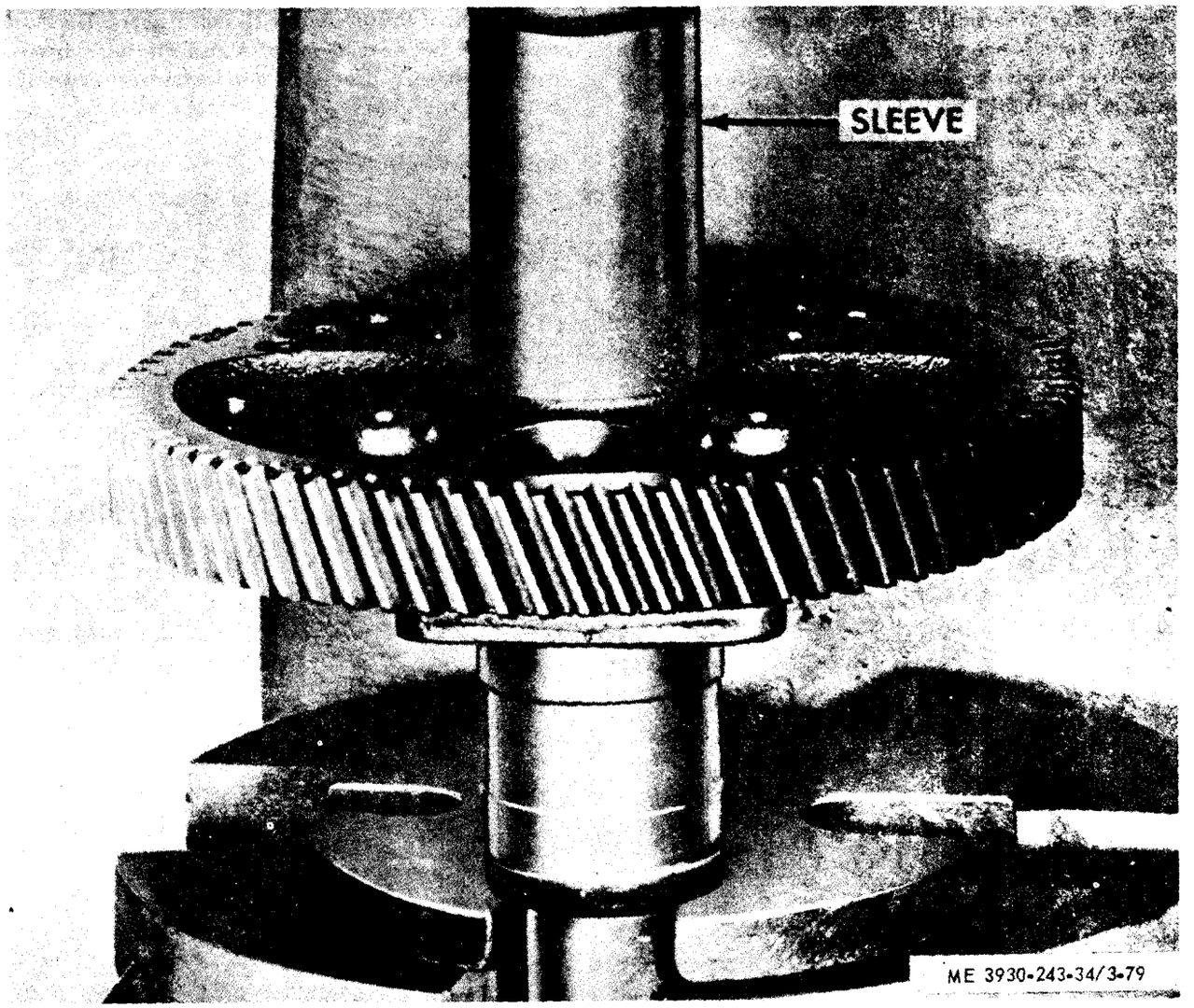


Figure 3-79. Camshaft gear installation

h. Installation.

(1) Lubricate bearings and shafts with engine oil and slide the shaft assemblies into the cylinder block being careful not to damage the bearings or the cams and journals. Make sure that the appropriate timing marks on the gears are aligned. "Gear Train and Engine Timing" is covered in paragraph 3-34.

(2) Slide an oil slinger on the front end of both shafts.

(3) Install the upper engine front cover (para 3-29).

(4) Secure the thrust washers in place and tighten the bolts to 30-35 foot-pounds torque (fig. 3-75).

(5) Install the front balance weights.

(6) Attach the gear nut retainer plates to the gears with bolts and lockwashers and tighten the bolts to 35-39 foot-pounds torque.

(7) Check the clearance between the thrust

washer and the gear on both shafts. The clearance should be 0.008 to 0.015 inch, or a maximum of 0.019 inch with used parts.

(8) Check the backlash between the mating gears. The backlash should be 0.003 to 0.005 inch and should not exceed 0.007 inch between used gears.

(9) Install the flywheel housing (para 3-22).

(10) Install the cylinder head (para 3-19).

(11) Install the engine (para 2-9).

3-31. Idler Gear Assembly

a. General. The engine idle gear and bearing assembly, located at the flywheel end of engine, meshes with camshaft and crankshaft gears, and rotates on a stationary hub. The hub is secured directly to cylinder block by a bolt which passes through hub, and three bolts which pass through the flywheel housing, hub and end plate.

b. Removal.

(1) Remove flywheel housing (para 3-22).

(2) Refer to figure 3-80 and remove idler gear assembly.

c. *Disassembly.* Refer to figure 3-81 and disassemble the idler gear assembly.

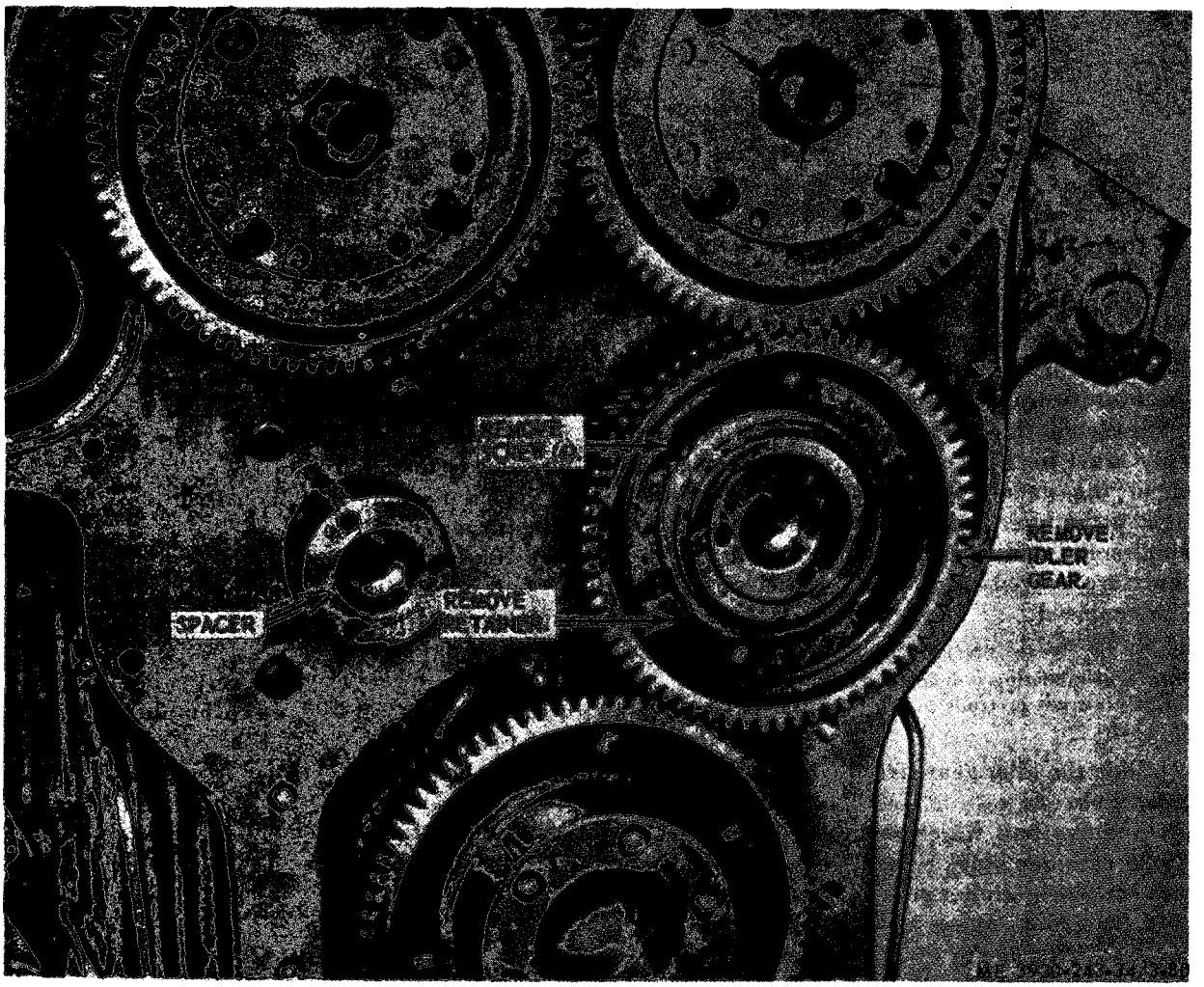


Figure 3-80. Idler gear, removal and installation.

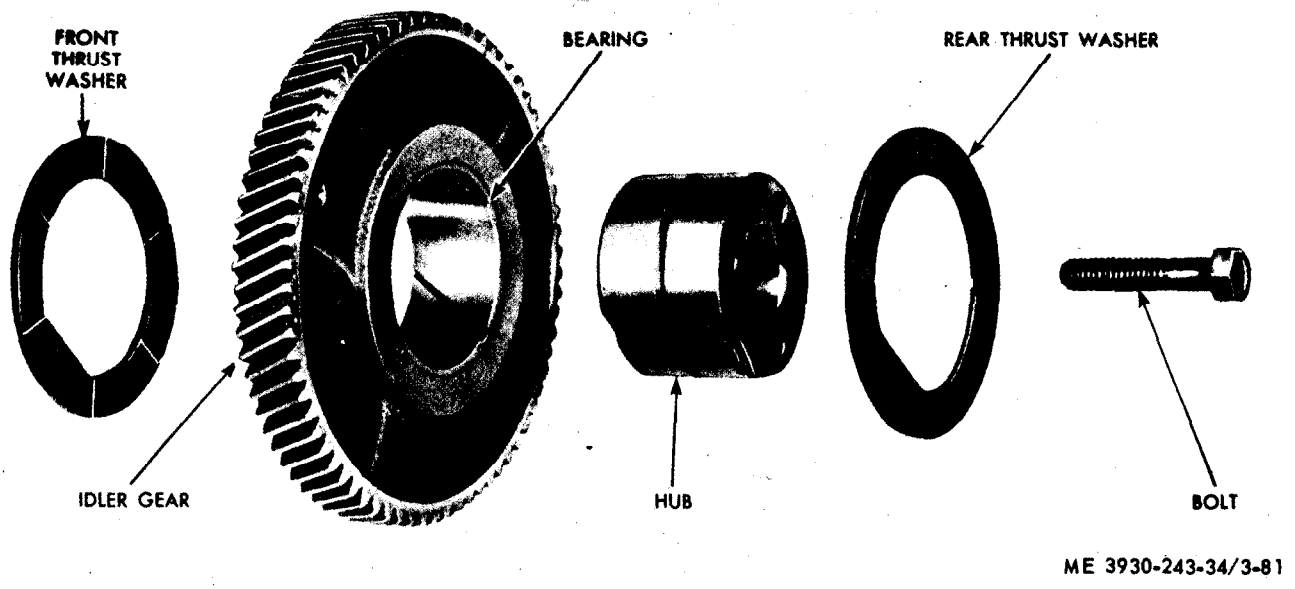


Figure 3-81. Idler gear assembly, disassembly and reassembly.

d. Cleaning, Inspection, and Repair.

(1) Clean the idler gear and bearing assembly, hub and thrust washers thoroughly. Examine gear teeth and bearing for scoring, pitting, and wear. If gear teeth are worn or bearing is scored, pitted or worn excessively, the gear and bearing and bearing assembly must be replaced, or a new bearing installed in the gear. Also, examine the outside diameter of the idler gear hub and thrust washers for being scored and worn. If the thrust washers or gear hub are scored and worn excessively, they must be replaced.

NOTE

When a new bearing is being installed in the idler gear, it must not protrude beyond the gear face on either side.

(2) Slide the idler gear straight back off of the idler gear hub.

(3) Remove bolt which secures the idler gear hub to the cylinder block. Then, remove the idler gear hub and the rear idler gear thrust washer as an assembly from the engine.

e. Installation.

(1) Place the inner thrust washer over the forward end of the idler gear hub with the flat in the inner diameter of the thrust washer over the flat on the end of the gear hub, and the oil grooves in the thrust washer facing the idler gear.

(2) Place the small protruding end of the idler gear hub through the end plate and into the counterbore in the cylinder block.

(3) Insert two 3/8 inch-16 bolts through the idler gear hub and thread them into the cylinder block, as shown in figure 3-82 to be sure the bolt holes will be in alignment when the flywheel housing is installed.

(4) Insert the 3/8 inch-16 by 1¾ inch special bolt through the center of the idler gear hub and thread it into the cylinder block. Tighten bolt to 30-35 foot pounds torque. Then, remove the two 3/8 inch-16 bolts previously installed for alignment of the gear hub.

(5) Lubricate the idler gear hub and idler gear bearings liberally with clean engine oil.

(6) Position the crankshaft gear and camshaft gear or balance shaft gear so that their match marks will align with those on the idler gear.

(7) With these match marks in alignment, install the idler gear, as shown in figure 3-83.

(8) Apply a thin film of cup grease to the inner face (face with oil grooves) of the outer idler gear thrust washer. Then, place the thrust washer over the end of the idler gear hub with the oil grooves in side of thrust washer facing the idler gear. and the flat in the inner diameter of thrust washer over the flat on the end of the idler gear hub.

(9) Install idler gear hole spacer.

(10) Install the flywheel housing (para 3-22).

Figure 3-82. Installing idler gear hub.

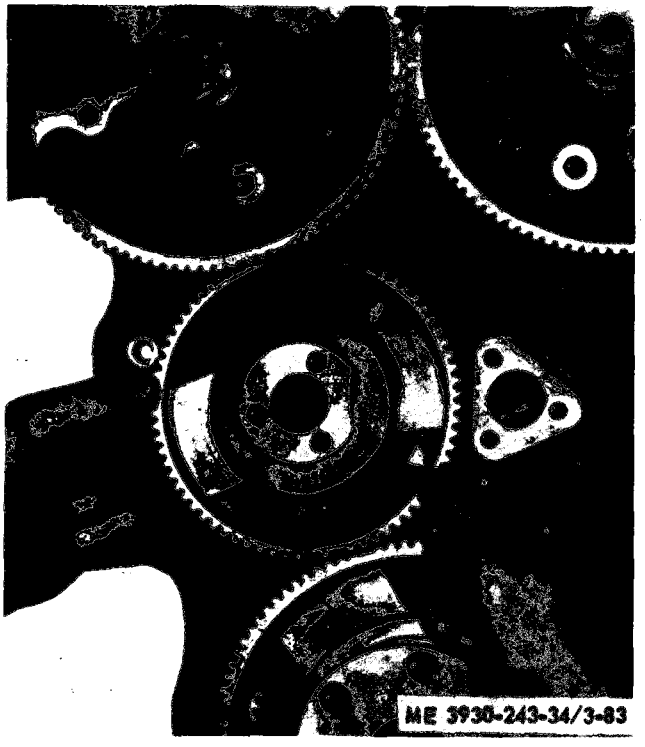


Figure 3-83. Installing idler gear.

3-32. Crankshaft Main Bearing

a. General. The main bearing shells are of precision type and are readily replaceable without machining. They are used at each journal and consist of an upper shell seated in cylinder Mock main bearing support and a lower shell seated in main bearing cap. The bearings are numbered 1, 2, 3, etc., indicating their respective position, and when removed must always be reinstalled in their original position. Lower main bearing shells have no grooves; therefore, the upper and lower bearing shells must not be interchanged. An oil hole in the groove of each upper shell midway between the parting liner registers with a vertical oil passage in the cylinder block. Lubricating oil, under pressure passes from the cylinder block by way of the bearing shell to the drilled passages in the crankshaft then to the connecting rods. Rear main bearing thrust washers absorb the crankshaft thrust at each side of the rear main bearing. Each washer is made of two halves; the lower halves are doweled to the bearing cap, the upper halves are not doweled.

b. Removal (crankshaft in place).

(1) Remove the engine (para 2-9).

(2) Remove the oil pan to expose the main bearing caps (para 3-24).

(3) Remove the oil pump inlet pipe and screen assembly (para 3-25).

(4) Remove all except the rear main bearing, dress down the head of a 1/4" x 3/4" bolt to a thickness of 1/16". (The thickness of the dressed down bolt head, must be less than the thickness of the bearing shell.) Insert the bolt into the crankshaft journal oil hole and revolve the crankshaft so that the bolt head contacts the bearing shell opposite the bearing locating tang and roll the bearing out of the block.

NOTE

Remove one main bearing cap at a time, inspect as outlined under INSPECTION in this section, and complete replacement of shell and reinstallation of cap before another cap is removed.

(5) Two-piece thrust washers are used on each side of the rear main bearing (fig. 3-84). The lower half of these washers will be removed when removing the rear main bearing cap; upper half can be removed by pushing on end of washer with a small rod, thus forcing washer around and out on opposite side of bearing.

(6) Remove rear main bearing upper shell by driving on the edge of the bearing shell with a small curved rod (fig. 3-85), at the same time revolving the crankshaft, thus rolling the shell from its position.

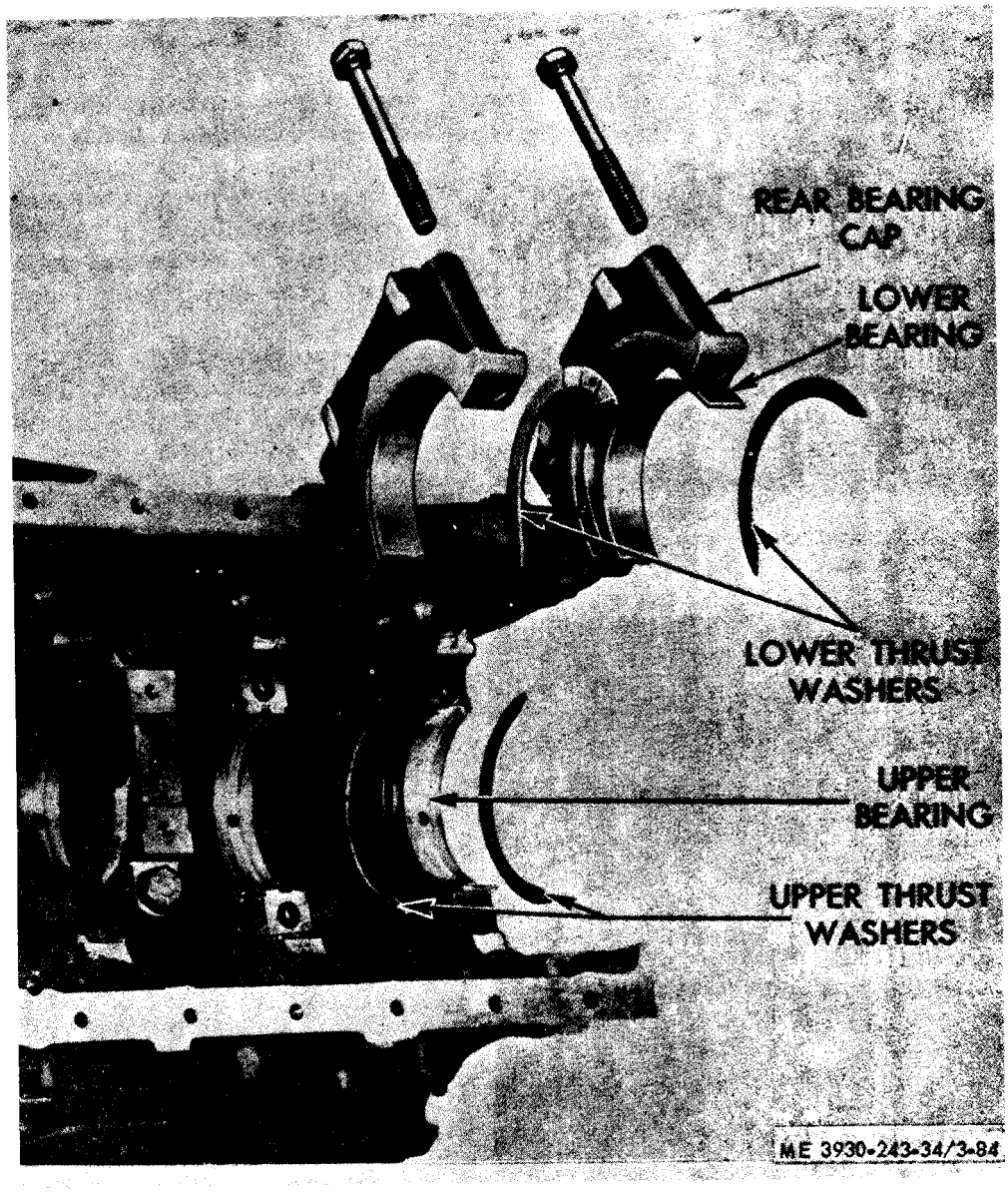


Figure 3-84. Upper and lower main bearing shells, bearing caps, and rear main bearing thrust washers.

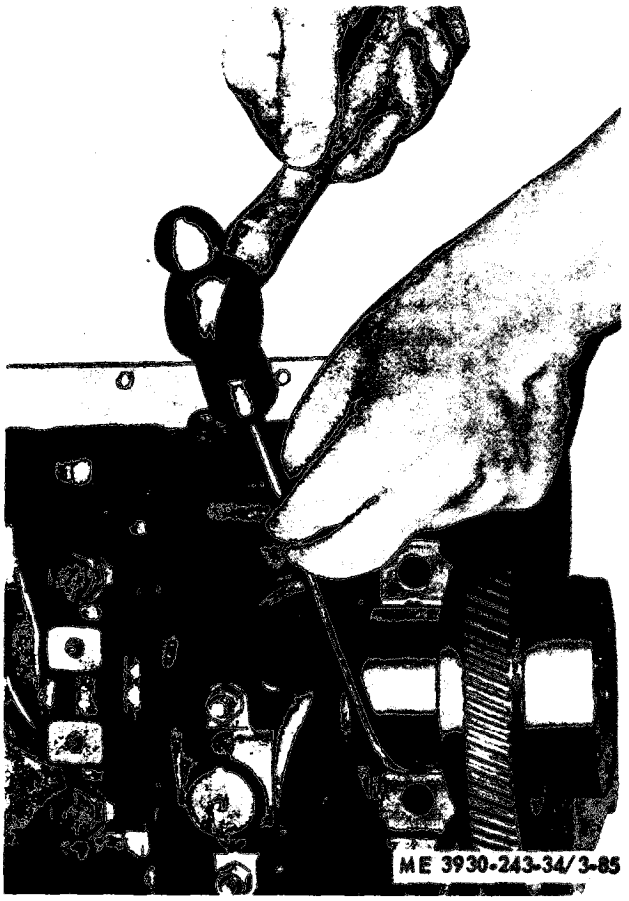


Figure 3-85. *Removing rear main bearing upper* shell *(crankshaft in place).*

c. Inspection.

(1) After removal, clean the bearing shells and inspect them for scoring, pitting, flaking, chipping, cracking, loss of babbitt or signs of overheating. If any of these defects are present, the bearings must be discarded. However, the babbitt plated bearings may develop minute cracks or small isolated cavities on the bearing surface during engine operation. These are characteristics of and are not detrimental to this type of bearing. The bearings should not be replaced for these minor surface imperfections since functioning of the bearings is in no way impaired and they will give many additional hours of trouble-free operation. The lower bearing shells, which carry the load, will normally show signs of distress before the upper shells do.

(2) Inspect the back of the bearing shells for bright spots which indicate they have been moving in the caps or cylinder block. If such spots are present, discard the bearing shells.

(3) The thickness of the bearing shells should be measured at point C, 90° from parting line.

NOTE

Minimum thickness of a worn standard main bearing shell is 0.123 inch and, if any of the shells are thinner than this dimension, all shells must be discarded and replaced with new shells. A new bearing shell has a thickness of 0.1245 to 0.1250 inch.

(4) In addition to this thickness measurement, the clearance between main bearings and crankshaft journals should be checked. This clearance may be determined with the crankshaft in place by means of a soft plastic measuring strip which is squeezed between journal and bearing, or with the crankshaft removed by measuring the outside diameter of the crankshaft main bearing journals and the inside diameter of the main bearing shells when installed in place with the proper torque of 120-130 foot-pounds on the main bearing cap bolts. If the clearance between any crankshaft main bearing journal and its bearing shells exceeds 0.006 inch, all bearings shells must be discarded and replaced with new shells. This clearance is 0.0013 to 0.0042 inch.

(5) When main bearing replacement is necessary, it is very important that the crankshaft journals be thoroughly inspected before new replacement bearings are installed. Very often, after prolonged engine operation, a ridge is formed on the circumference of the crankshaft journals in line with the journal oil holes. This ridge must not exceed 0.0002 inch and, if it is not moved before new bearings are installed, then during engine operation, localized high unit pressures in the center area of the bearing shell will cause pitting of the bearing surface. Also, damaged bearings may cause bending fatigue and resultant cracks in the crankshaft.

CAUTION

One main bearing shell alone should not be replaced. If one bearing shell requires replacement, a new upper and lower shell should be installed.

d. Installation (crankshaft in place).

NOTE

Make sure all parts are clean. Apply clean engine oil to all crankshaft journals and install main bearing shells by reversing the sequence of operations given for removal.

CAUTION

Main bearing shells should not be replaced separately. If bearing shell requires replacement, a new upper and lower shell should be installed. If a new crankshaft is used all new bearing shells should be installed.

(1) When installing the upper main bearing shells with crankshaft in place, start the end of the shell having no tang around the crankshaft journal,

so that when shell is in place the tang will fit into the groove in the shell support.

(2) Assemble crankshaft thrust washer before installing rear main bearing cap. Clean both halves of thrust washer carefully, removing any burs from the seats-the slightest particle of dirt may decrease clearance between washers and crankshaft beyond limits. Slide upper halves of thrust washers into place in their grooves, as shown in figure 3-86; then assemble lower halves over dowel pins in bearing cap.

NOTE

Main bearing caps are bored in position and marked 1, 2, 3, 4, and 5. They must be replaced in their original positions with marked side of caps facing the same side of cylinder block that carries the engine serial number.

(3) With the lower main bearing shells installed in bearing caps, install caps in their original position and draw bolts up snug. Then tap caps lightly with a soft hammer to seat them properly, and draw bearing cap bolts uniformly tight, starting with center cap and working alternately towards both ends of block, to 120-130 foot-pounds torque.

NOTE

If the bearings have been installed properly. the crankshaft will turn freely with all main bearing caps bolted tight.

(4) Check crankshaft end play at thrust washers (fig. 3-87). This clearance should be from 0.004 to 0.011 inch. Insufficient clearance will usually denote misalignment of the rear main bearing. In such case, loosen and retighten the rear main bearing cap. If lack of clearance is still present, dirt on a bur on inner face of one or more of the thrust washers may be the cause, or washer may be bent.

NOTE

If end play has increased to the point where clearance is in excess of 0.004 to 0.011 inch, *new* washers should be installed.

(5) Install lubricating oil pump inlet pipe assembly (para 3-25).

(6) Install oil pan with new gasket (para 3-24).

(7) Install the engine (para 2-9).

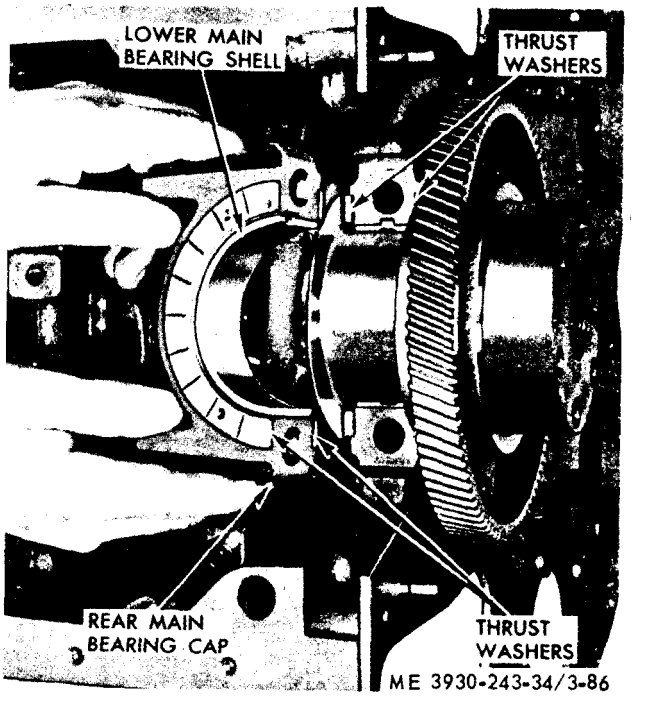


Figure 3-86. Rear main bearing thrust washer and mounting.

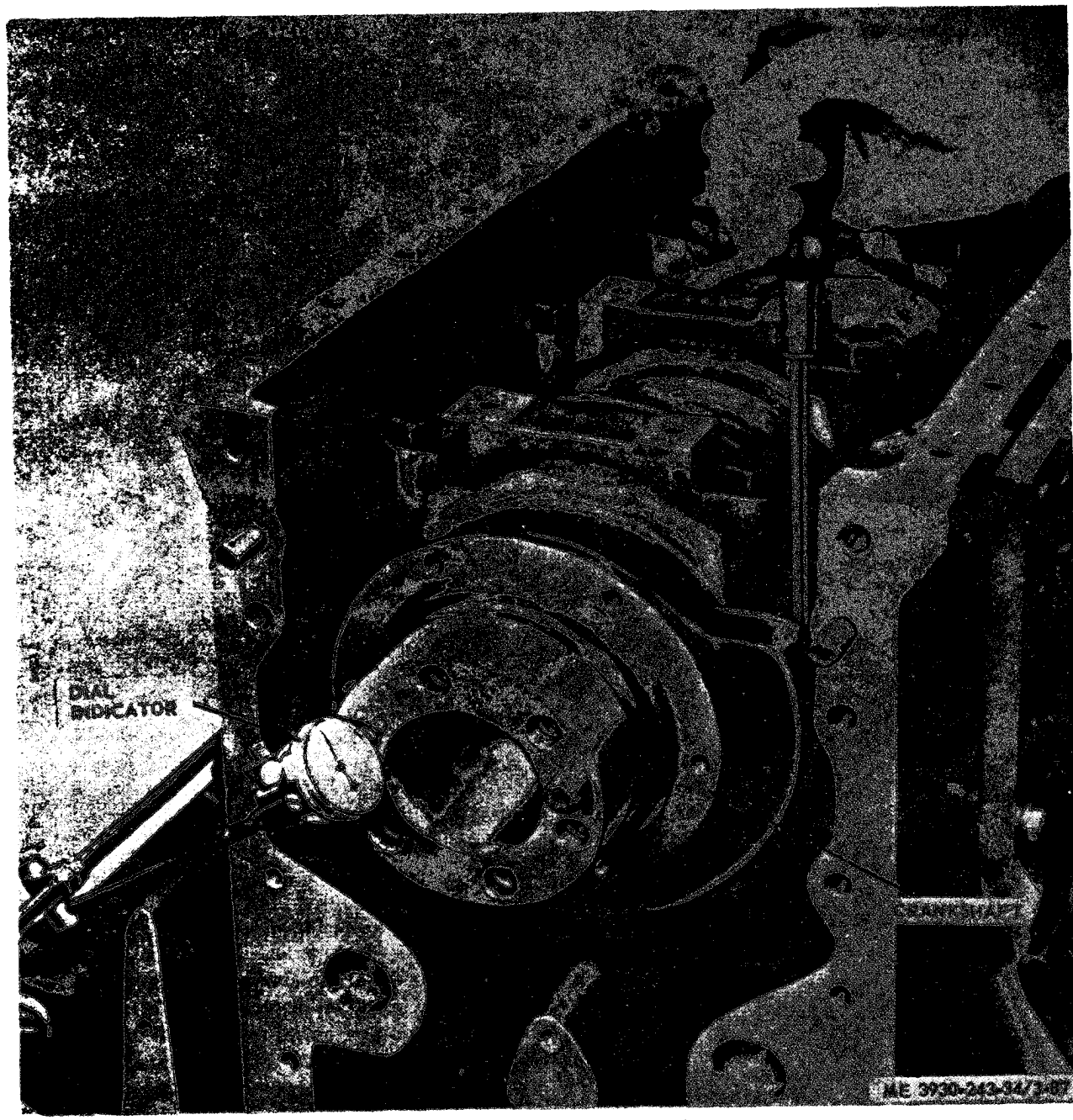


Figure 3-87. Checking crankshaft end play.

3-33. Crankshaft

a. *General. The* crankshaft is secured to the engine block by means of main bearings. The crankshaft has four journals on which connecting rods are mounted with enough clearance so that they will move freely over surface of crankshaft.

b. Removal.

(1) Remove engine (para 2-9).

(2) Remove oil-pan (para 3-24).

(3) Remove oil screen and inlet pipe (para 3-24).

(4) Remove flywheel housing (para 3-22).

(5) Remove front cover and oil pump (para 3-2).

(6) Remove rocker arm cover (TM 10-3930-242-12), then remove fuel oil pipes from injectors and fuel connectors. Install dust caps on injectors and fuel injectors.

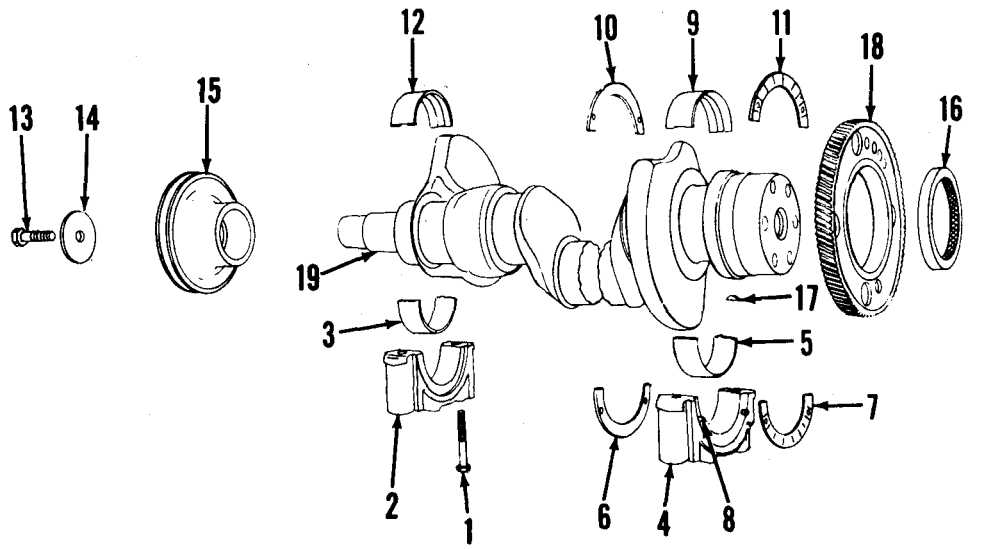
(7) Loosen all rocker arm shaft support-bracket bolts to prevent valves from opening when crankshaft is rotated.

(8) Remove the connecting rod bearing caps (para 3-26).

(9) Remove the main bearing caps (para 3-32).

(10) Remove thrust washers from each side of the main bearing (para 3-32).

(11) Refer to figure 3-88 and remove and disassemble the crankshaft in numerical sequence.



ME 3930-243-34/3-88

1 Screw
2 Cap
3 Shell
4 Cap
5 Shell
6 Washer
7 Washer
8 Pin
9 Shell
10 Washer
11 Washer
12 Shell
13 Screw
14 Washer
15 Pulley
16 Seal
17 Key
18 Gear
19 Crankshaft assy.

Figure 3-88. Crankshaft, disassembly and reassembly.

c. Cleaning, Inspection and Repair.

(1) Remove crankshaft plugs and clean out all oil passages thoroughly,

(2) Support crankshaft on its front and rear journals in a V-block or in a lathe and check runout on intermediate main bearing journals, using a dial indicator. When runout on adjacent journals is in opposite direction, the sum must not exceed 0.003 inch total indicator reading. When runout on adjacent journals is in the same direction, the difference must not exceed 0.003 inch total indicator reading. When high spots of runout on adjacent journals are at right angles to each other, the sum must not exceed 0.004 inch total indicator reading, or 0.002 inch on each journal. If runout limit is greater than given above, crankshaft must be replaced.

(3) Measure all main and connecting rod bearing journals. Journals should be measured at several places on the circumference in order to determine the smallest diameter, in case the journals have worn out-of-round. Taper on the journals of a used shaft should not exceed 0.003 inch, and out-of-round should not exceed 0.003 inch. The maximum taper on a new shaft is 0.0005 inch and maximum out-of-round is 0.0025 inch.

(4) Used crankshafts will sometimes show a certain amount of ridging caused by the groove in the upper main bearing shell (fig. 3-89). If this ridge is not removed before new bearing shells are installed, localized high unit pressures on the bearings will result during engine operation. A ridge exceeding 0.0002 inch or more must be removed. If ridges are greater than 0.001 inch, crankshaft may have to be replaced.

(5) Check surfaces of crankshaft for evidence of cracks as follows: Several methods of determining presence of minute cracks not readily visible to the eye are:

(a) Magnetic Particle Method.

(b) Fluorescent Magnetic Particle Method.

(c) Fluorescent Penetrant Method.

(6) Most of the indications revealed by the above inspection methods are normal and harmless and only in a small percentage of cases is reliability of the part impaired when indications are found. Since inspection reveals harmless indication with the same intensity as the harmful ones, detection is but one step in the procedure. INTERPRETATION OF the indications is the most important step.

(7) There are two types of loads imposed on a crankshaft in service; a bending force and a twisting force. The design of the shaft is such that the forces produce practically no stress over most of the surface. Certain small areas, designated as critical areas, however, sustain most of the load. See figure 3-90. Crankshaft failures are usually at the fillet at 45° to the axis of the shaft (fig. 3-91). Cracks of this nature should result in the replacement of the crankshaft.

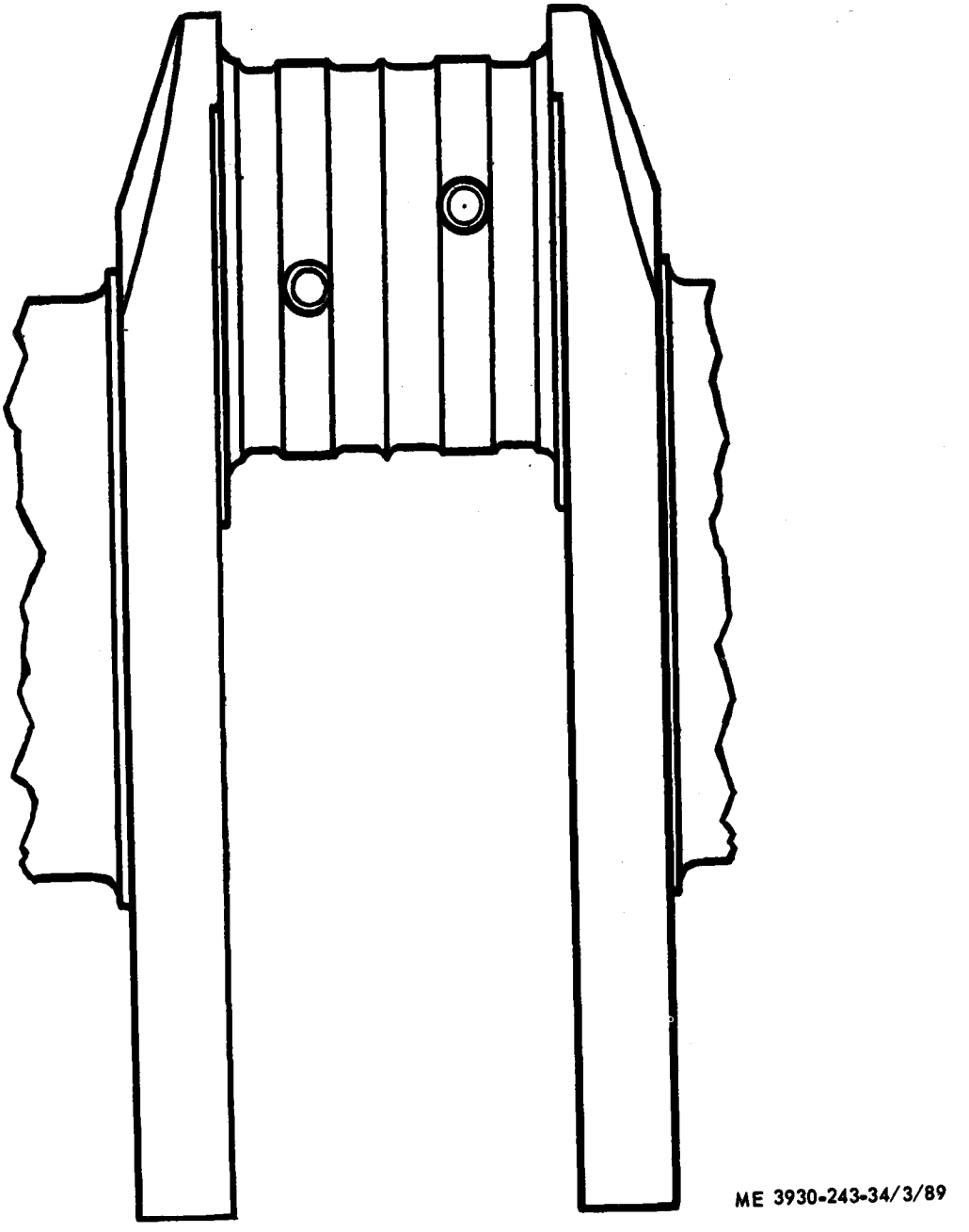


Figure 3-89. Ridging of crankshaft.

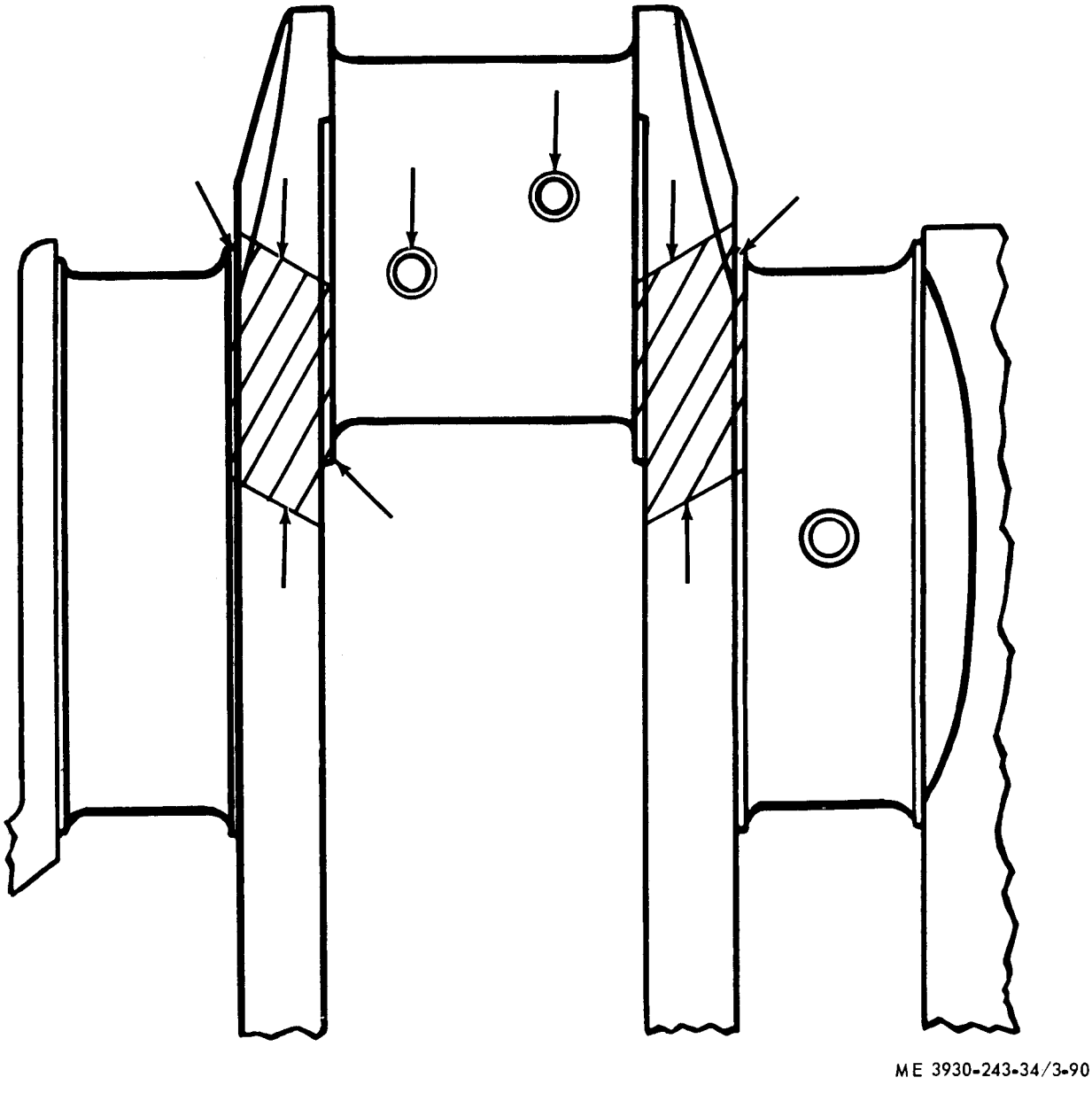


Figure 3-90. Critical crankshaft loading zones.

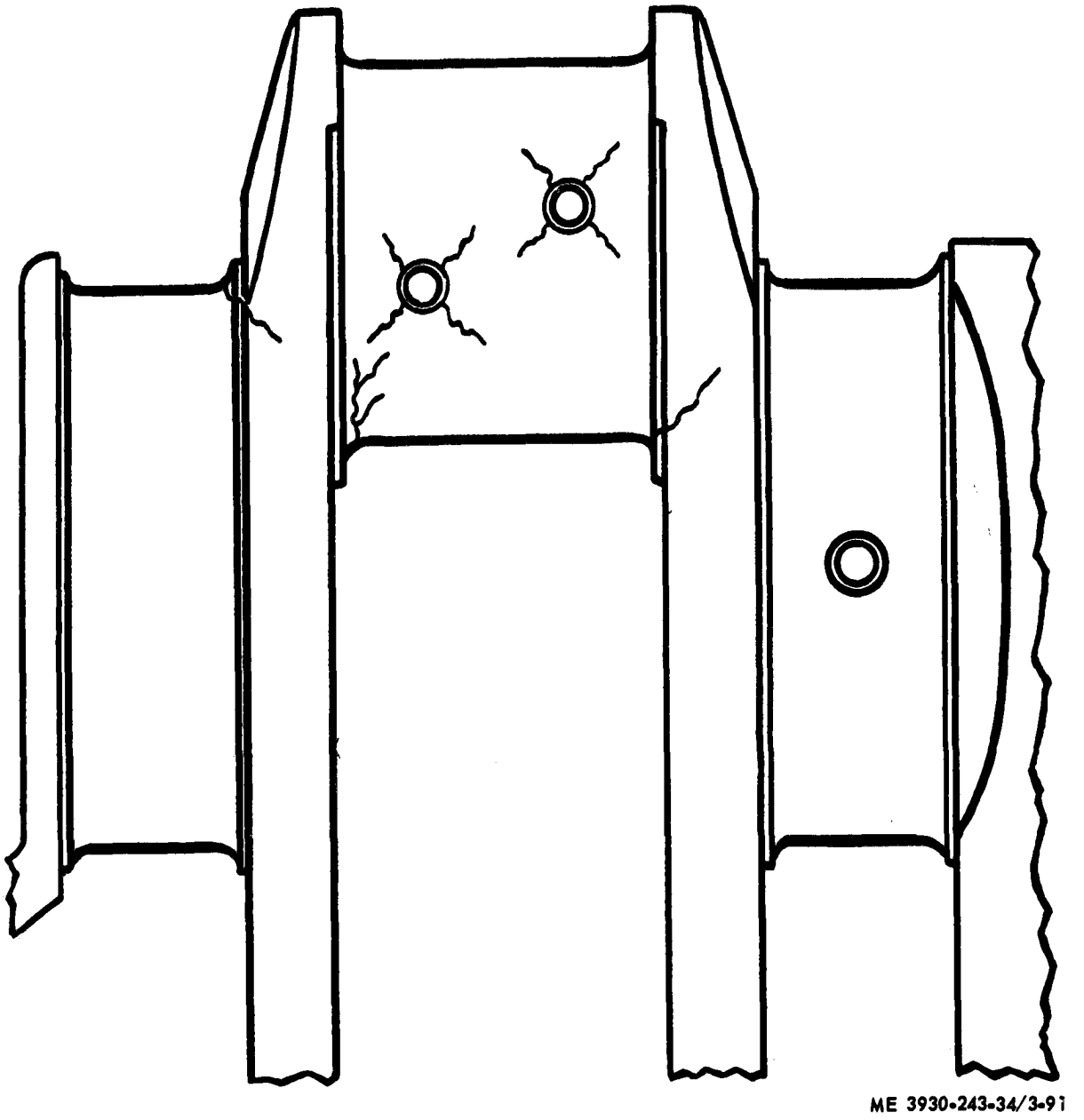


Figure 3-91. Crankshaft fatigue cracks.

(8) Check thrust surfaces for evidence of excessive wear or roughness. In many instances only slight grinding or "dressing up" of the thrust surfaces is necesaary. In such cases, use of new standard thrust washers will probably hold the end thrust clearance within the specified limits of 0.004 to 0.011 inch for new parts or a maximum of 0.018 inch with a used crankshaft. otherwise, it may be necessary to use 0.005 inch oversize rear thrust washers.

(9) Inspect keyways for evidence of cracks or worn condition, and replace shaft if necessary.

(10) Carefully inspect crankshaft in area of front and rear oil seal contact surface for evidence of rough or grooved condition. Any imperfections of oil seal contact this point.

Slight ridges
variation may be removed with crocus cloth, wet with fuel oil. The crankshaft should be rotated at intervals to remove ridges from the complete circumference of the shaft without disturbing the concentricity y. Ridges which approach 0.0005 inch or greater should first be cleaned up with 120 grit emery cloth, followed by use of 240 grit emery cloth for finishing. Crocus cloth, wet with fuel oil, should then be used for final polishing. If excessive wear or grooving is present, and cannot be cleaned up satisfactorily, the oil seal may be pressed in the flywheel housing and front cover approximately 1/8 inch from its original position.

(11) Check lube oil pump drive gear and crankshaft timing gear for worn or chipped teeth and replace if necessary.

(12) If the crankshaft is worn so that the connecting rod or main bearing maximum journal-to-bearing shell clearance (with new shells) exceeds 0.0044 inch and 0.0046 inch, or the maximum journals taper or out-of-round is greater than 0.003 inch, the crankshaft must be replaced. Measurements of the crankshaft should be accurate to the nearest 0.002 inch.

d. Installation.

(1) Install upper grooved bearing shells in the cylinder block.

(2) Apply clean engine oil to all crankshaft journals and set crankshaft in place.

(3) Install the upper halves of the rear main bearing thrust washers on each side of the bearing, and the doweled lower halves on each side of the rear main bearing cap.

(4) With the lower main bearing shells installed in bearing caps, tap the caps lightly with a soft hammer to seat them properly and draw the bearing cap bolts uniformly tight starting with center cap and working alternately toward both ends of the block, to 120-130 lbs.ft. torque. Tighten the bolts to the high side of the torque specification but do not exceed the limit.

NOTE

If bearings have been installed properly, the crankshaft will turn freely with all main bearing cap bolts drawn to specified torque.

(5) Check crankshaft end play at thrust washers. The crankshaft clearance with new thrust washers should be from 0.004 to 0.011 inch. Insufficient clearance will usually denote misalignment of the rear main bearing. In such case, loosen the bearing cap, then retighten as described above. If lack of clearance is still present, either dirt or a burr on the inner face of one or more of the thrust washers may be the cause.

(6) Refer to figure 3-88 and reassemble and install the crankshaft. Installation is the reverse procedure of removal.

3-34. Gear Train and Engine Timing.

a. General. The gear train consists of a crankshaft gear, and idler gear, a camshaft gear and a balance shaft gear. The crankshaft gear, camshift gear, and balance shaft gears are pressed on and keyed to their respective shafts and each gear is secured by a retaining nut and lock plate. The idler gear rotates on a stationary hub.

b. Engine Timing.

(1) The correct relationship between the crankshaft and camshaft must be maintained to properly control fuel injection and the opening and closing of the exhaust valves.

(2) The crankshaft timing gear can be mounted in only one position due to its being keyed to the crankshaft. The camshaft gear can also be mounted in only one position as result of the location of the keyway relative to the cams. Therefore, when the engine is properly timed, the markings on the various gears will match as shown in figure 3-92.

NOTE

An engine which is "out of time'" may result in preignition uneven running, and a loss of power.

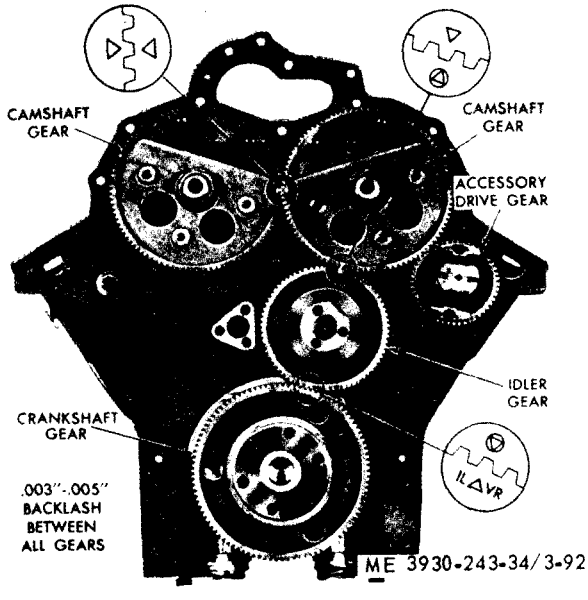


Figure 3-92. Gear train and timing marks.

(3) When an engine is suspected of being out of time, due to an improperly assembled gear train, a quick check can be made without having to remove the flywheel and flywheel housing by following the procedure outlined below,

c. Checking Engine Timing. Access to the crankshaft pulley, to mark the top-dead-center position of the selected piston and to the front end of the crankshaft or flywheel for barring the engine over is necessary in performing the timing check. Then, proceed as follows:

(1) Remove the cylinder head rocker arm cover (TM 10-3930-242-12).

(2) Select any cylinder for the timing check—it is suggested that a cylinder adjacent to one of the cylinder head cover studs be chosen since the stud may be used for mounting a dial indicator.

(3) Remove the fuel jumper lines (at the cylinder selected) and install shipping caps on injector fuel fittings to prevent the entry of dirt. Make sure that the valve and injector rocker arms are in the "up" position. then remove the rocker shaft bracket bolts and swing the rocker arm

assemblies back out of the way. Remove the injector assembly.

(4) Carefully place (do not drop) a welding rod or drill rod approximately 12 inches long through the injector hole and on top of the piston. With the throttle in the NO FUEL position, bar the crankshaft slowly in the direction of rotation of the engine, and stop barring when the rod reaches the end of its upward travel. Remove the rod and bar the crankshaft opposite the direction of rotation between 1/16 and 1/8 of a turn.

(5) Select a dial indicator having 0.001 inch graduations and with a spindle movement of at least 1 inch. Use suitable mounting attachments for the indicator so that it can be mounted over the injector hole in the cylinder head. Provide an extension for the spindle of the indicator. The extension must be long enough to contact the piston as it is approaching its upper position.

(6) Mount the indicator over the injector hole and tighten mountings sufficiently to hold the indicator rigid.

NOTE

The mounting leg may be threaded into the rocker rover retaining screw hole on the injector rack side of the cylinder head. Make sure that the spindle extension is free in the injector hole, does not bind, and is free to travel its full 1 inch movement.

(7) Provide a suitable pointer and attach it to the lower engine front cover. Pointer should extend over the crankshaft pulley.

(8) Turn the crankshaft in the direction of rotation slowly until the hand on the dial indicator just stops moving.

(9) Turn the crankshaft in the direction of rotation until the indicator hand just starts to move. Reset dial to 0. Continue barring slowly until indicator reading is 0.010-then stop turning.

(10) Scribe a line on the crankshaft pulley in line with the end of the pointer.

(11) Turn the crankshaft opposite the direction of rotation slowly until the hand on the dial indicator just stops moving.

(12) Turn the crankshaft opposite the direction of rotation until the indicator hand just starts to move. Reset dial to O. Continue barring slowly until indicator reading is 0.010-then stop turning.

(13) Scribe a second line on the crankshaft pulley in the same manner as in step 10.

(14) Scribe a third line halfway between the first two lines. This is positive top-dead-center. Remove the indicator from the engine.

NOTE

Make sure that the crankshaft pulley retaining bolt is not loosened during the turning operation. The bolt may be tightened to a torque of 200-220 foot-pounds if it becomes loose.

(15) Remove dial indicator and welding rod or drill rod from injector tube.

(16) Install injector assembly and tighten the injector clamp bolt to 25-30 foot-pounds torque. Swing the injector and valve rocker arm back into position and install rocker arm brackets and tighten bolts to 50-55 foot-pounds torque. Adjust the exhaust valve clearance and time the injector. Turn engine over until the exhaust valves in the selected cylinder are completely open.

(17) Install the dial indicator once again so that the spindle of the indicator rests on top of the injector follower. Set indicator dial to "0". Bar the crankshaft slowly in the direction of rotation, and stop when TDC mark on the crankshaft pulley lines up with the pointer.

(18) When checking the engine timing, note the reading on the indicator and compare it with the dimensions listed below for the camshaft being used.

(a) If the indicator reading is 0.204 to 0.207 inch, the engine is in time.

(b) If the indicator reading is 0.177 to 0.180 inch, the timing is one tooth retarded.

(c) If the indicator reading is 0.234 to 0.237 inch. the timing is one tooth advanced.

(19) After completing the timing check, remove the dial indicator; remove shipping caps from injector fuel fittings, and install the injector fuel pipes, making sure that they are tightened to prevent any fuel leaks. Remove the pointer attached to the front of the engine.

(20) Install the cylinder head rocker arm cover (TM 10-3930-242-12).

Section VI. CYLINDER BLOCK AND RADIATOR

3-35. Cylinder Block and End Plate

a. General. The cylinder block is a one-piece casting, serving as the main structural part of the engine. A flat steel plate is bolted to the rear end of the cylinder block to provide a means of attaching the flywheel housing, camshaft and crankshaft cover. The block has drilled passages for carrying lubricating oil to all moving parts, and fuel to the injectors, thus eliminating oil tubing and connections throughout the block. The model number and serial number are stamped on right-hand side of cylinder block on the upper rear corner. The radiator is bolted to the front of the engine base and is used for cooling the engine.

b. Removal.

(1) Remove the engine (para 2-9).

(2) Remove the cylinder head (para 3-19).

(3) Remove the blower (para 3-5) and blower drive support (para 3-6).

(4) Remove the crankshaft (para 3-33).

(5) Remove the camshaft balancer shaft and bearings (para 3-30).

(6) Remove piston and rod (para 3-26).

(7) Remove the idler gear (para 3-31).

c. Disassembly. Refer to figure 3-93 and disassemble the cylinder block and end plates in numerical sequence.

d. Cleaning, Inspection, and Repair.

(1) *Clean cylinder block.* First remove all plugs and scrape all old gaskets from the cylinder block as follows:

(a) Thoroughly clean the cylinder block using live steam. During the cleaning, special attention should be paid to the oil galleries, air box floor, and air box drain openings. Jets machined in camshaft and balance shaft bushing block bores permit oil to be sprayed on the cam followers and should be checked to make sure they are not plugged. Use a 0.020 inch wire to clean the jets.

(b) Dry cylinder block with compressed air.

(2) *Pressure test cylinder block.*

(a) Make sure the seal ring grooves in cylinder liner bore of block are clean. Then, install seal rings in the grooves.

(b) Apply light coating of vegetable type shortening or permanent type antifreeze solution to the inner diameter surface of seal ring in contact with cylinder liner.

(c) Carefully slide liner into the cylinder block bore, and through seal rings being careful not to roll or damage seal rings. Do not force. Hold the liners in position with suitable metal plates bolted to the top of the cylinder block. Tighten retaining plate bolts sufficiently to hold liners in place.

(d) Seal off the water inlet and outlet holes airtight. This can be done by using plates and suitable rubber gaskets held in place by bolts.

(e) Immerse the cylinder block for 20 minutes in tank of water heated to 180°-200°F.

(f) Using a suitable fitting at one of the water inlet or outlet openings, apply 15 pounds per square inch air pressure to water jacket and observe water in the tank for bubbles indicating cracks or leaks.

(g) Following the pressure test, blow out passages with dry compressed air.

(3) *Inspect cylinder block.* After cleaning and pressure testing, the cylinder block should be inspected as follows:

(a) Check the main bearing bores. Check bore inside diameter with main bearing caps secured in place with bolts tightened to 120-130 foot-pounds torque. Caps are numbered to correspond with their respective positions in the block. The number of the front and rear main bearing caps is stamped on the face of the oil pan mounting flange of the cylinder block, adjacent to their permanent location in the engine as established at the time of manufacture. The number 1 cylinder and main bearing cap are always located at the end opposite the flywheel end of the cylinder block, regardless of engine rotation. The standard bearing bore diameter is 3.251 to 3.353 inches.

(b) Check cylinder liner counterbores for squareness, proper depth, and diameter. Counterbores should be from 4.825 to 4.835 inches in diameter. Counterbored surfaces must be smooth and square with the cylinder bore within 0.001 inch total indicator reading. The liner counterbore depth should be from 0.300 to 0.302 inch and must not vary in depth more than 0.001 around the entire circumference.

(c) After inspection, if the cylinder block is not going to be assembled for a temporary period of time, spray the machined surfaces with engine oil. If the cylinder block is not going to be assembled for an extended period of time, spray or dip the block in a polar type rust preventive compound. Castings that are free of grease and oil will rust immediately when exposed to atmosphere.

(4) *Inspection of end plates.*

(a) When the end plate is removed, it is essential that all of the old gasket material be removed from both surfaces of the end plate and cleaned.

(b) Check surfaces of the end plate for nicks, dents, scratches, or score marks; also check end plate for flatness. Plug type nuts in the end plate should also be checked for cracks and damaged threads. If nicks or scratches on the sealing surfaces of the end plate are too deep to be cleaned up, or the plug type nuts are damaged, the end plate or plug nuts should be replaced.

e. Reassembly. Refer to figure 3-93 and reassemble the cylinder block and end plates. Reassembly is the reverse order of disassembly.

f. Installation.

(1) Install the crankshaft (para 3-33).

(2) Install the piston and connecting rods (para 3-26).

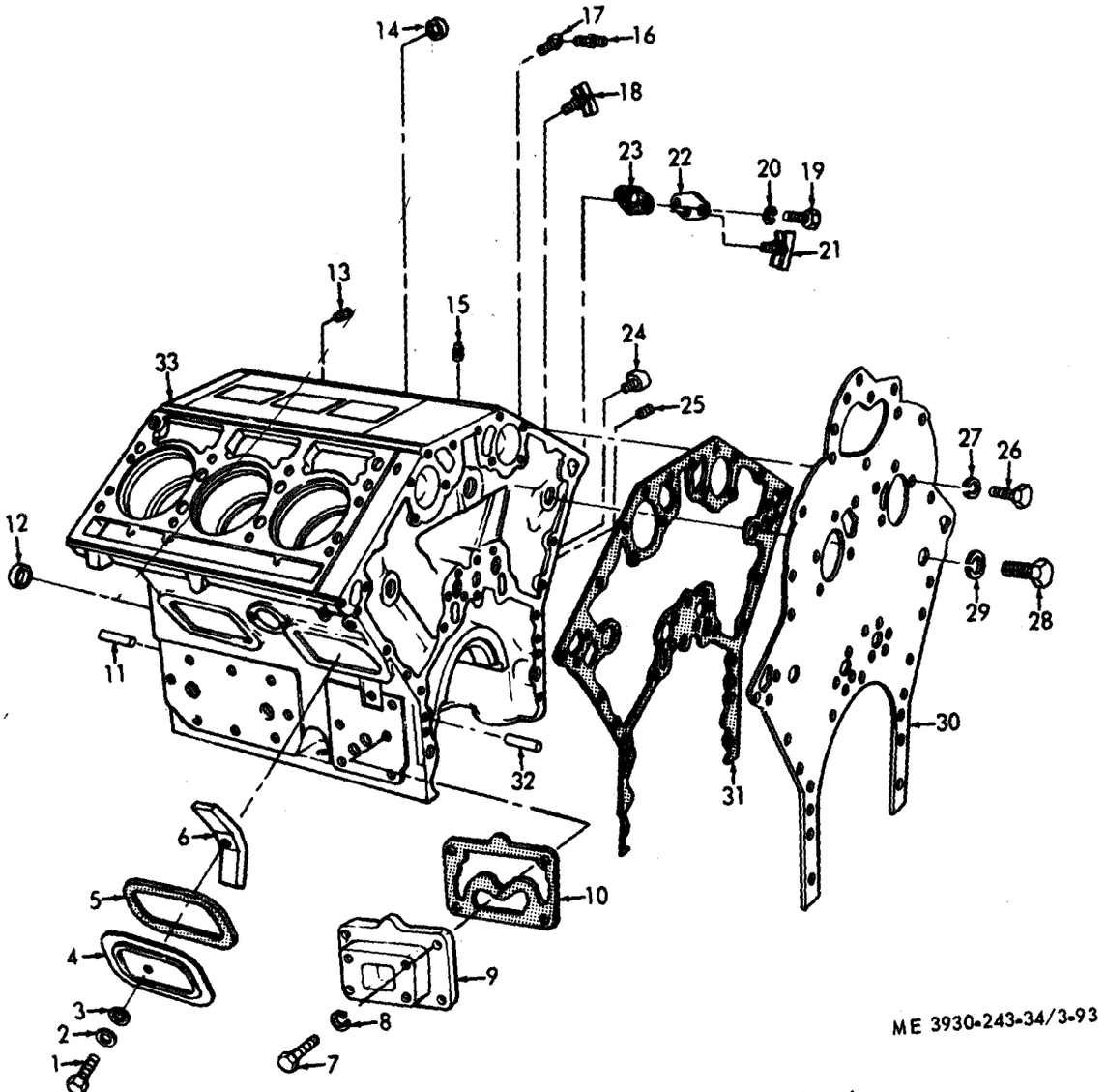
(3) Install the camshaft, balancer shaft and bearings (para 3-30).

(4) Install the idler gear (para 3-31).

(5) Install the cylinder head (para 3-19).

(6) Install the blower drive (para 3-6).

(7) Install the engine (para 2-9).



1 Screw
2 Washer
3 Gasket
4 Cover
5 Gasket
6 Bracket
7 Screw
8 Washer
9 Adapter
10 Gasket
11 Pin
12 Spacer
13 Plug
14 Spacer
15 Plug
16 Fitting
17 Elbow
18 Draincock
19. Screw
20 Washer
21 Draincock
22 Plate
23 Gasket
24 Fitting
25 Plug
26 Screw
27 Washer
28 Screw
29 Washer
30 End plate
31 Gasket
32 Pin
33 Block

Figure 3-93. Engine block, disassembly and reassembly.

3-36. Radiator Assembly

n. General. The radiator assembly is bolted to the front of the engine base (rear end of forklift). To increase cooling efficiency of radiator, a fan shroud is placed around the fan.

b. Removal.

(1) Remove the top cover (TM 10-3930-243-12).

(2) Drain cooling system (TM 10-3930-243-12).

(3) Refer to figure 3-94 and remove the radiator assembly.

c. Inspection.

(1) Inspect external condition of radiator.

(2) Inspect mounting hardware for rust and breaks.

(3) Inspect radiator core and inside of radiator for scale deposits. Steam cleaning is a preferred method of cleaning radiator.

(4) Examine each part for cracks or other damage. Replace or repair a faulty radiator.

NOTE

When repainting the radiator core, use a thin coat of dull black paint. Ordinary oil paints do not transmit heat as well.

d. Testing.

(1) If a leak in the radiator cannot be located, plug the inlet, filler and overflow pipes.

(2) Insert an air hose into outlet pipe and plug opening.

(3) Immerse the radiator in a vat of water and apply air pressure at 5-10 psi.

CAUTION

Do not exceed 10 pounds per square inch, as it may damage radiator core.

e. Installation.

(1) Refer to figure 3-94 and install the radiator.

(2) Refill the cooling system to proper level (TM 10-3930-243-12}.

(3) install top cover (TM 10-3930-243-34).

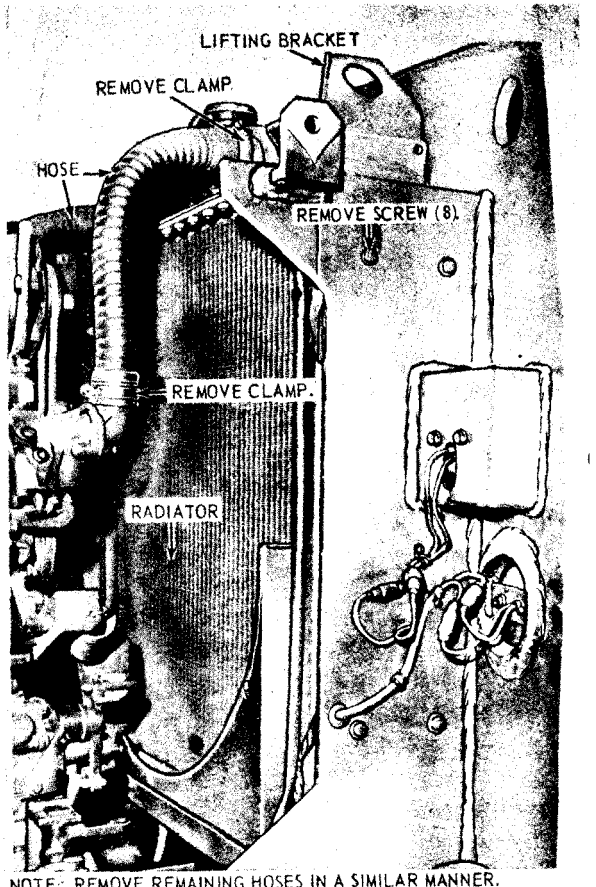


Figure 3-94. Radiator, removal and installation.

Section VII. TRANSMISSION

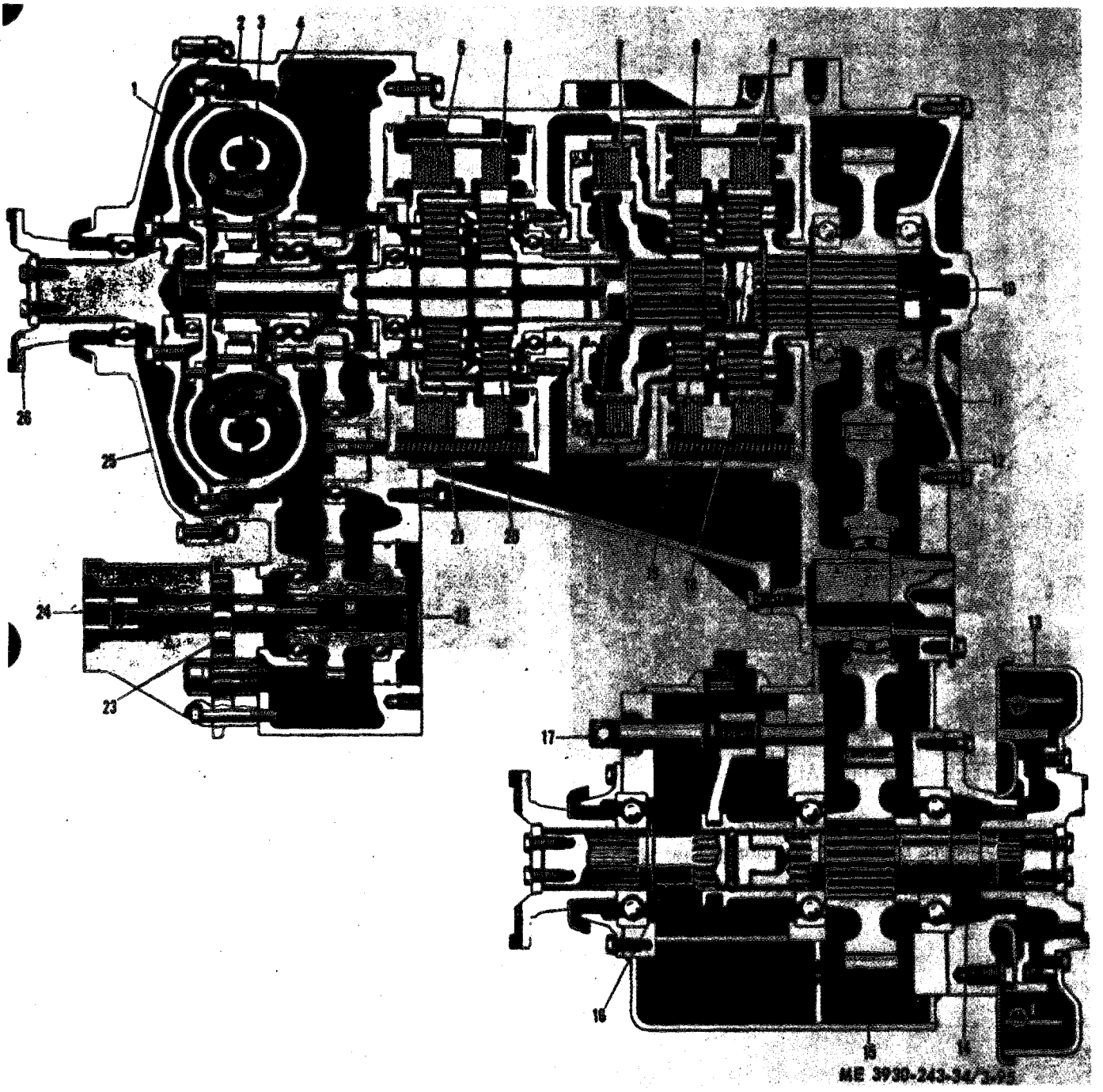
3-37. General

This section contains information on the maintenance of transmission assembly. This includes the transmission, torque converter, control valves and main pressure regulator valve. The transmission has three speeds and a transfer case and is the fullpowershift type, consisting of a torque converter coupled to planetary gearing controlled by hydraulic clutches. The gearing and clutches give forward and reverse operation in every range.

3-38. Torque Converter and Transmission

a. General. The torque converter and transmission assembly is removed as an assembly. The torque converter is a single-stage polyphase, 3-element unit consisting of a converter pump, stator and turbine. The torque converter elements are vaned, aluminum castings. The pump element is driven by the engine. The turbine element drives the planetary gearing. The stator is the reaction member which multiplies torque between the engine and transmission gearing. A single integral hydraulic system lubricates, cools, and controls the transmission. A pump, which supplies pressure at any time the engine is running, draws oil from the sump. Control valves regulate pressure and direct oil to various components. Oil pressure applies the clutches. Oil is the power-transmitting medium in

the torque converter. The oil is continually circulated, filtered and cooled during transmission operation. Refer to figure 3-95 for cross section view

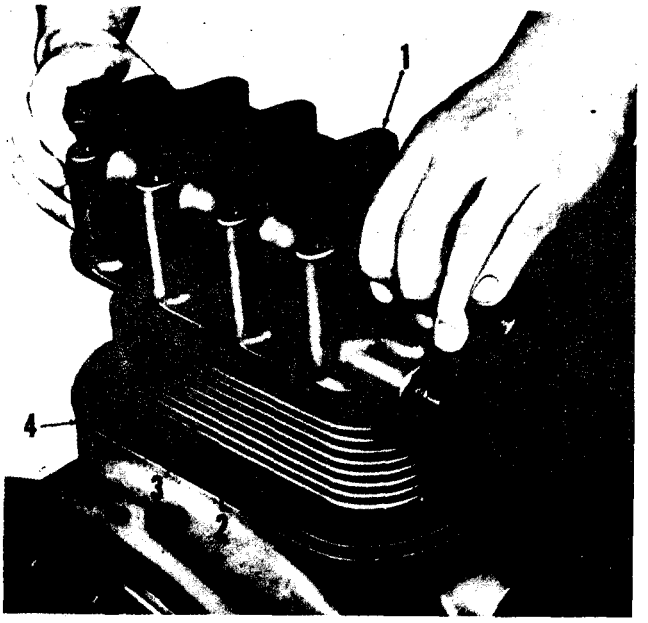


1 Converter pump cover
2 Converter turbine
3 Stator
4 Converter pump
5 Reverse clutch
6 Forward clutch
7 Intermediate-range clutch
8 High-range clutch
9 Low-range clutch
10 Transmission main shaft
11 Transfer drive gear
12 Transfer idler gear
13 Parking brake
14 Rear-output shaft
15 Transfer driven gear
16 Front-output shaft
17 Front-output disconnect
18 Low-range planetary
19 High-range planetary
20 Forward planetary
21 Reverse planetary
22 Implement pump drive
23 Input pump assembly
24 Steer pump adapter
25 Transmission front cover
26 Input flange

Figure 3-95. Transmission, cross-section view.

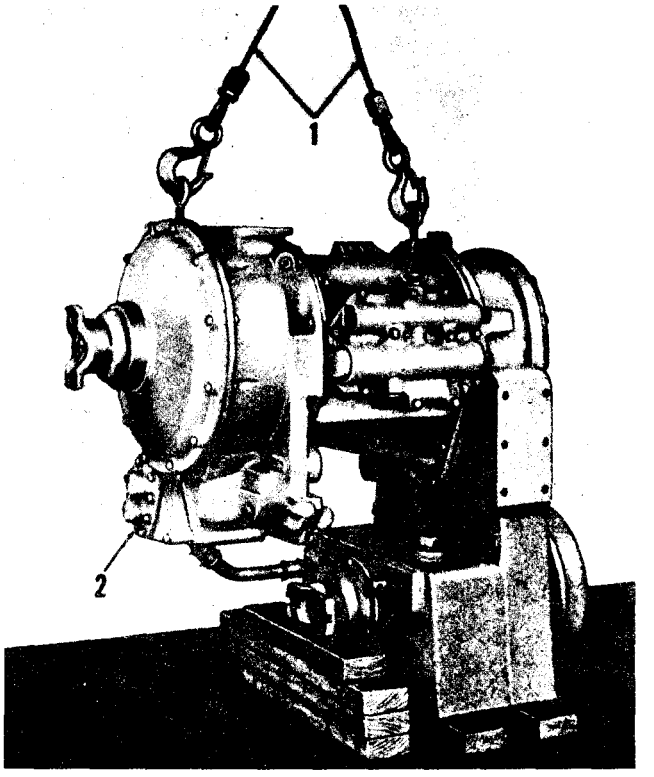
b. Removal. Remove the torque converter and transmission assembly (para 2-10).

c. Disassembly. The transmission should be cleaned externally and as much oil as possible drained from the assembly. Refer to figure 3-96 and disassemble the transmission as indicated in each step.



STEP 1 (OPTIONAL)

Remove twelve bolts which retain the oil cooler cover 1. Remove the cover, and gasket 2. Remove oil cooler core 3 and gasket 4.



STEP 2

Attach lifting sling 1 to the transmission and lower it onto the work table, leveling with wooden blocks. Remove six bolts and lock washers from input-driven charging oil pump 2. Remove the pump, pump coupling and gasket.

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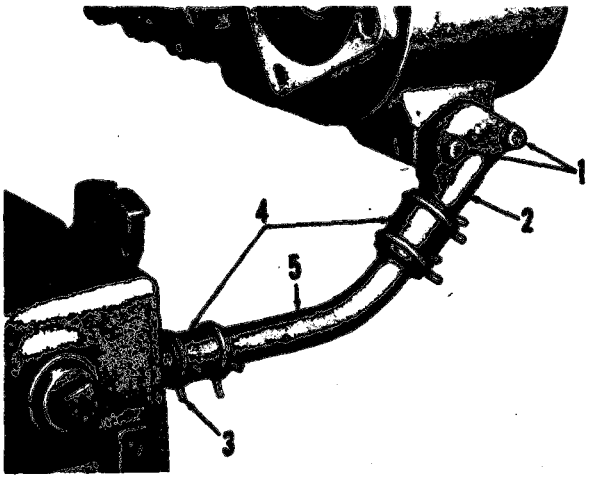
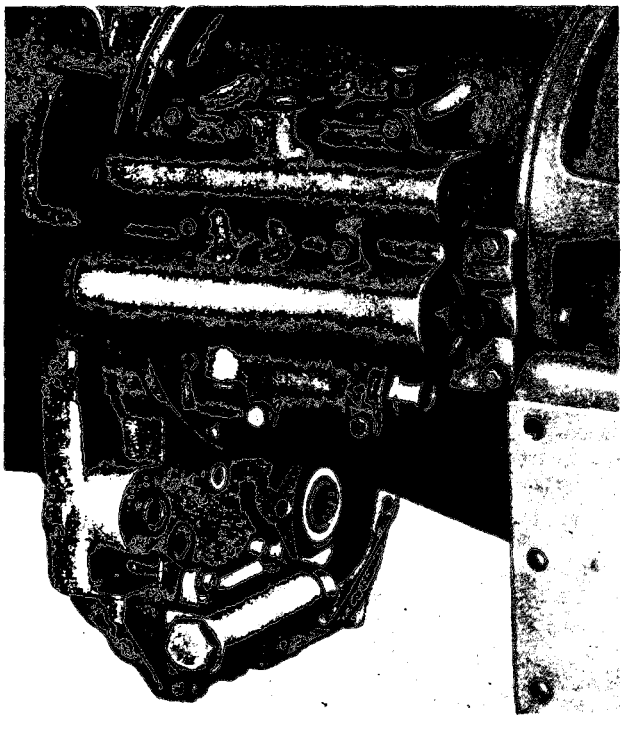
Figure 3-96. Transmission disassembly (sheet 1 of 15).



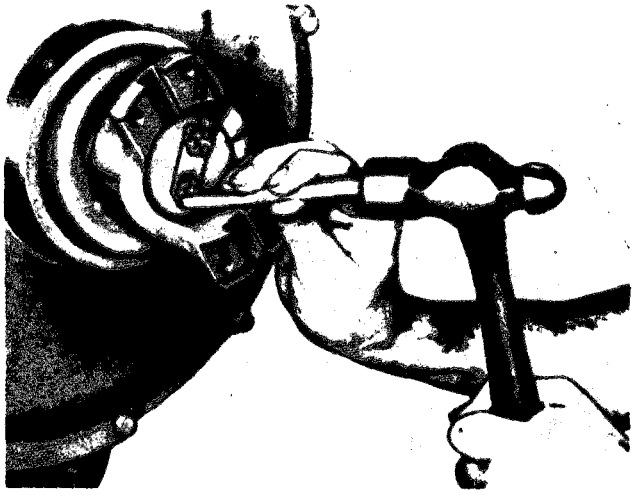
STEP 3

Remove two bolts and lock washers 1 from converter housing drain tube flange 2. Remove, as a unit, flange 2, hoses 4 and tube 5.



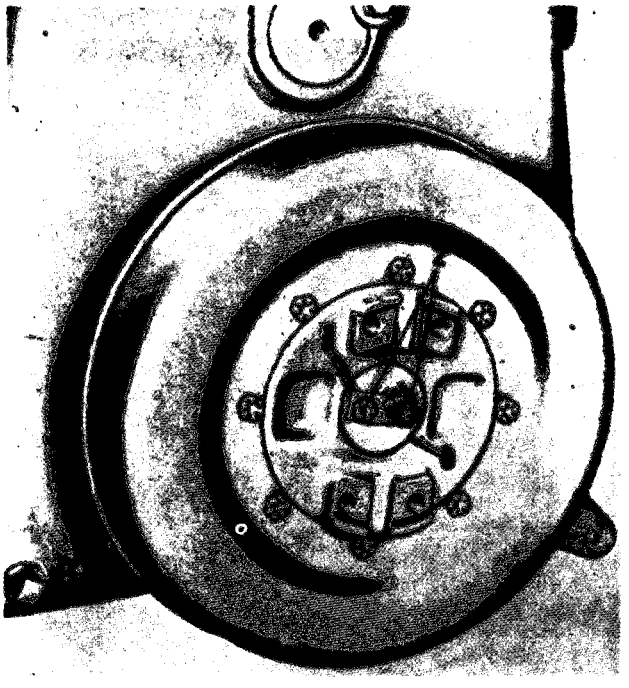
STEP 4

Remove eleven bolts and lock washers 1 from the selector valve body. Remove the valve assembly and gasket. Remove five bolts and lock washers 2 from the main-pressure regulator valve body. Remove the valve assembly and gasket.



STEP 5

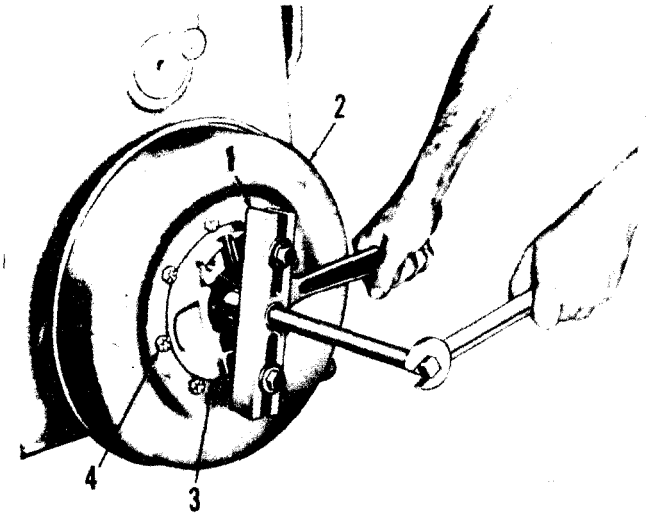
Flatten the corners of lock strip 1 and remove two self-locking bolts 2, flange retainer washer 3 and input flange 4. Note: Shims are used under some flange retainer washers. Tie these to the washer and identify the washer location.



STEP 6

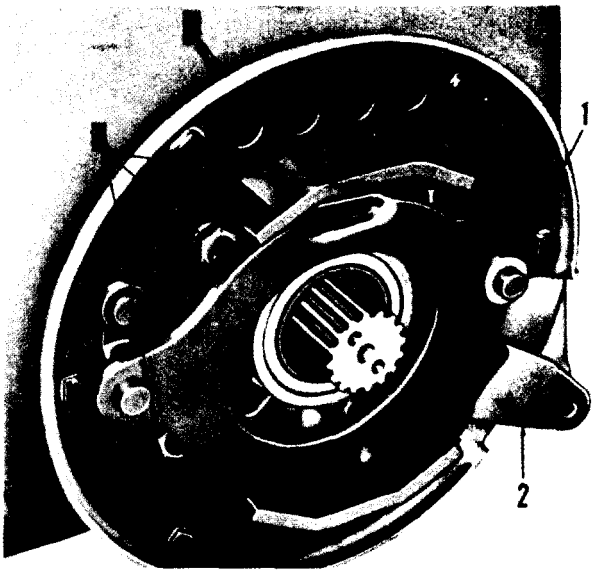
Flatten the corners of lock strip 1 and remove two self-locking bolts 2, the lock strip, and flange retainer washer 3. ME 3930-243-34/3-96 (2)

Figure 3-96. Transmission disassembly (sheet 2 of 15).



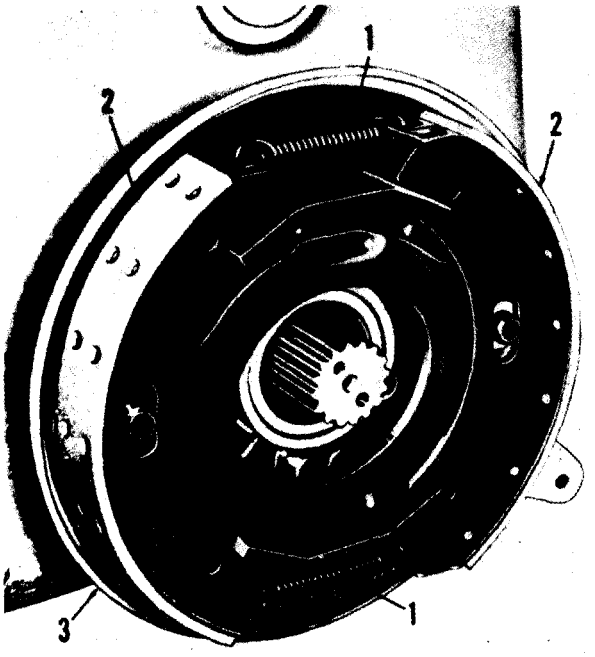
STEP 7

Using puller 1, remove as a unit, parking brake drum 2 and rear-output flange 3. Only if necessary for parts replacement, remove eight self-locking bolts 4 and remove the flange from the drum.



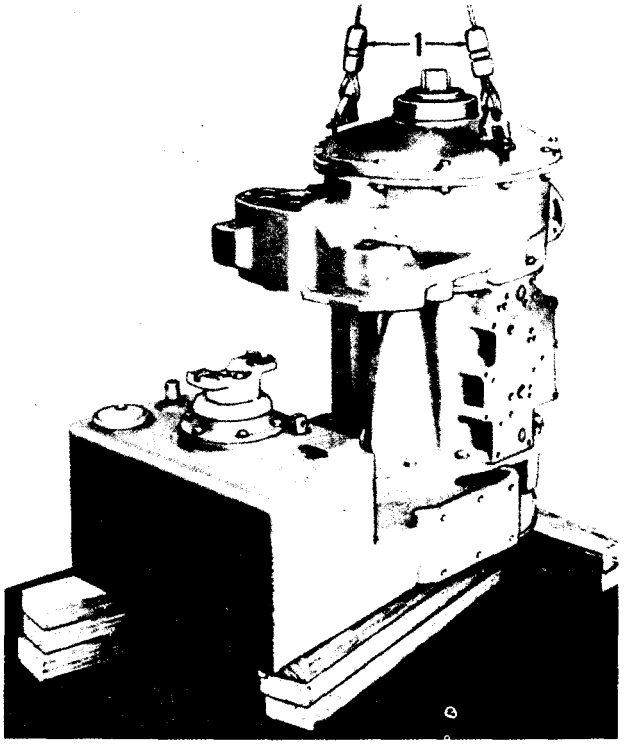
STEP 9

Remove brake roller 1 and brake apply lever 2. Remove three bolts and lock washers 3 and remove brake back plate 4.



STEP 8

Remove brake return springs 1 and brake shoe assembly 2 from brake back plate 3.



STEP 10

Attach lifting sling 1 to the front of the transmission and position the transmission to rest on its rear surface. Block the transmission sufficiently high to clear the output shaft.

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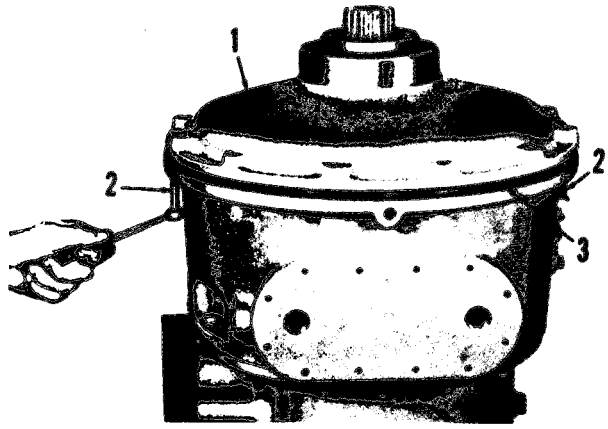
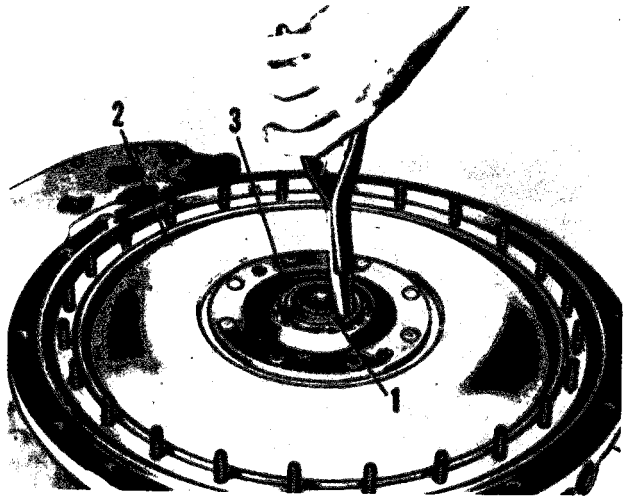
Figure 3-96. Transmission disassembly (sheet 3 of 15).



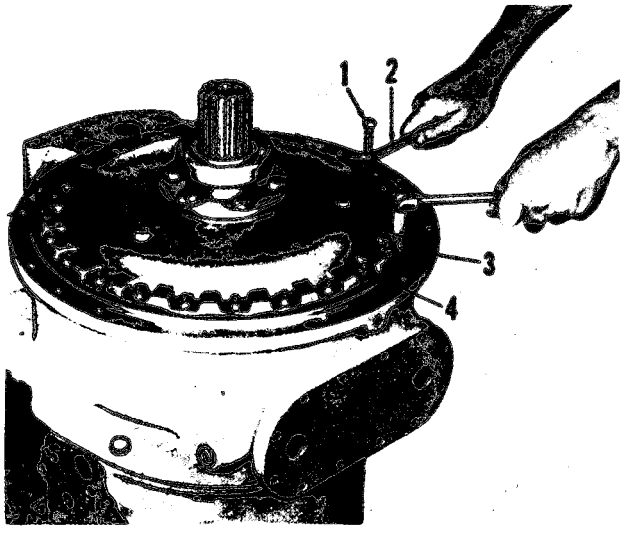
STEP 11

Remove 12 nuts, bolts and lock washers from transmission front cover 1. Using jackscrews 2, loosen and remove the cover and gasket 3.



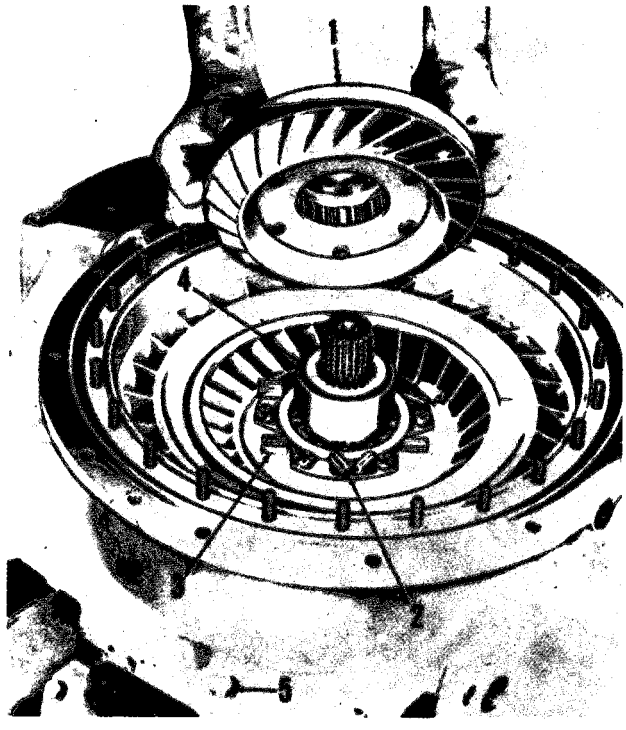
STEP 13

Using snap ring pliers, remove snap ring 1 from the converter shaft. Remove as a unit, turbine 2 and bearing 3. If necessary, use wire lifting hooks under the outer circumference of the turbine.



STEP 12

Using jackscrew 1 and wrench 2 to prevent converter pump cover 3 from rotating, remove 24 self-locking nuts 4. Remove the cover assembly.



STEP 14

Remove stator assembly 1, ten freewheel rollers 2 and ten freewheel roller springs 3. Remove freewheel roller race 4. Remove 13 bolts and lock washers 5 from the converter housing. Caution: Some of the rollers and springs may drop out when the stator is lifted.

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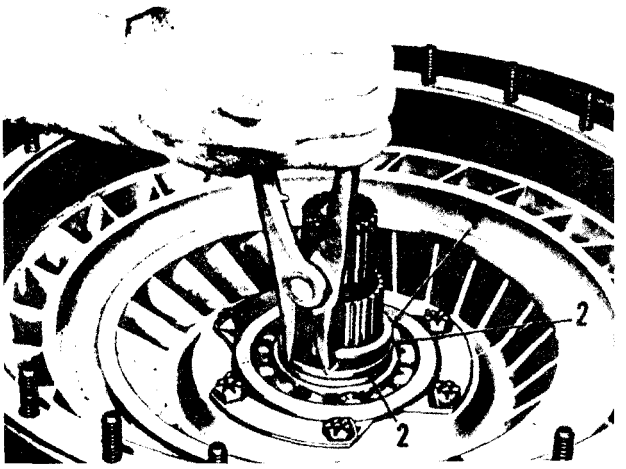
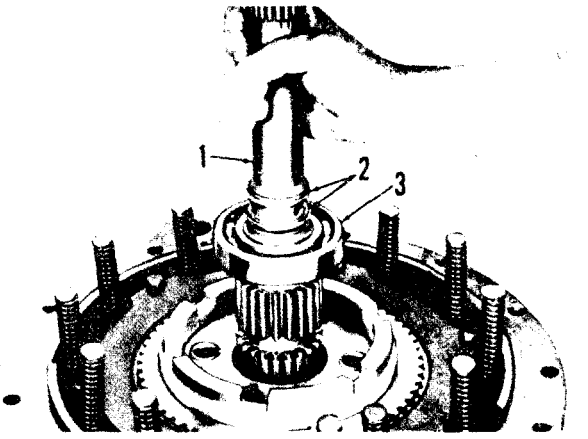
Figure 3-96. Transmission disassembly (sheet 4 of 15).



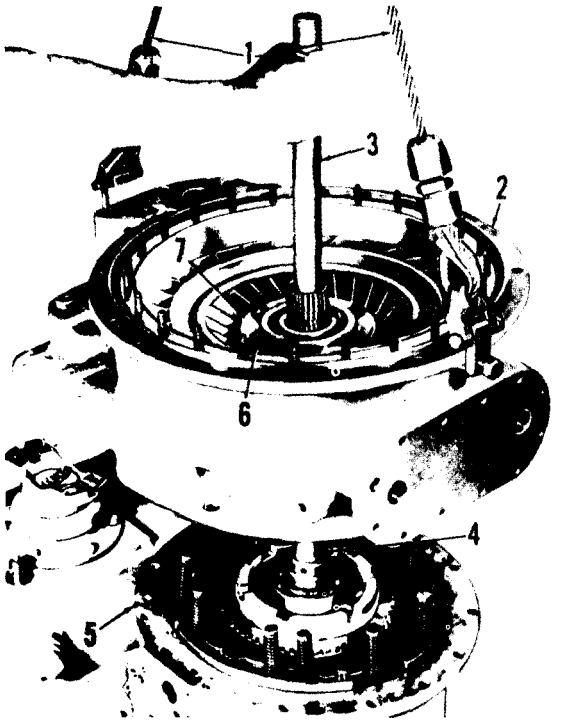
STEP 15

Using snap ring pliers, remove snap ring 1 from the converter ground sleeve. Remove two internal-splined spacers 2.



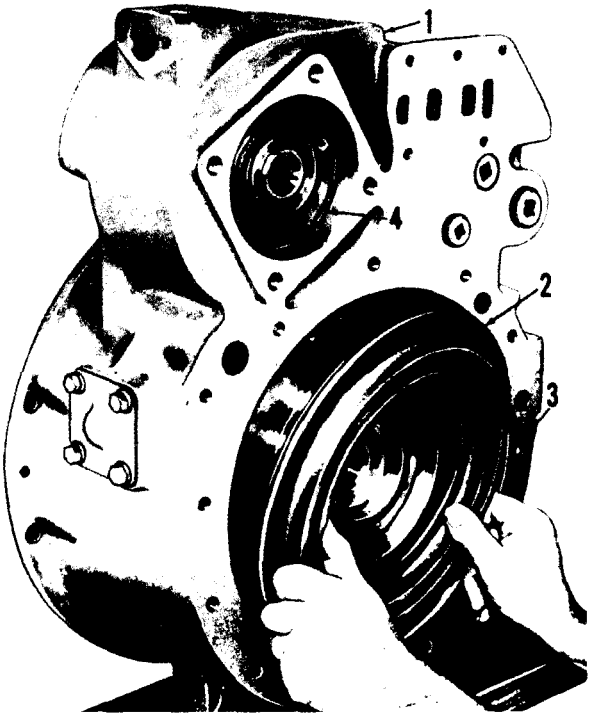
STEP 17

Remove turbine shaft assembly 1. Remove two hook-type seal rings 2. If necessary for parts replacement, remove bearing 3 by pressing toward the small end of the shaft.



STEP 16

Attach lifting sling 1 to converter housing 2 and raise the converter housing assembly. Use drift 3 to prevent turbine shaft 4 from rising. Remove gasket 5. Remove six self-locking bolts 6, two lock strips and three bearing retainers 7.

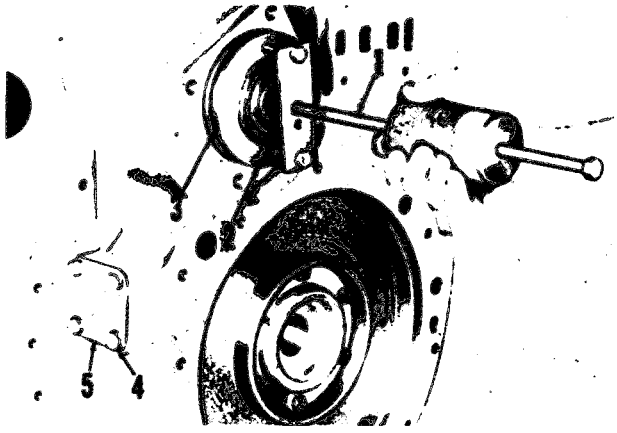


STEP 18

Position converter housing assembly 1 on the oil cooler pad and remove reverse-range piston assembly 2. (Use compressed air in piston apply hole 3 to loosen the piston.) Remove snap ring 4.

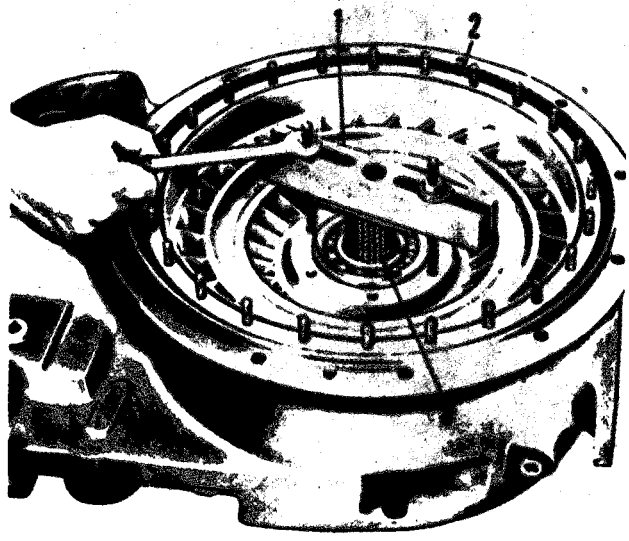
ME 3930-243-34/3-96 (5)

Figure 3-96. Transmission disassembly (sheet 5 of 15).



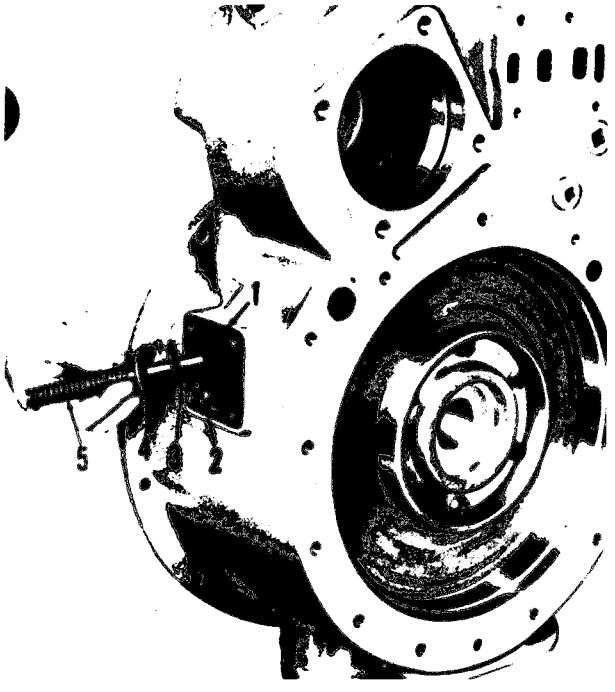
STEP 19

Using slide hammer remover 1; remove as a unit the implement pump gear bearing retainer, bearings and gear 2. Remove seal 3. Remove four bolts and lock washers 4. Remove lubrication regulator valve cover 5.



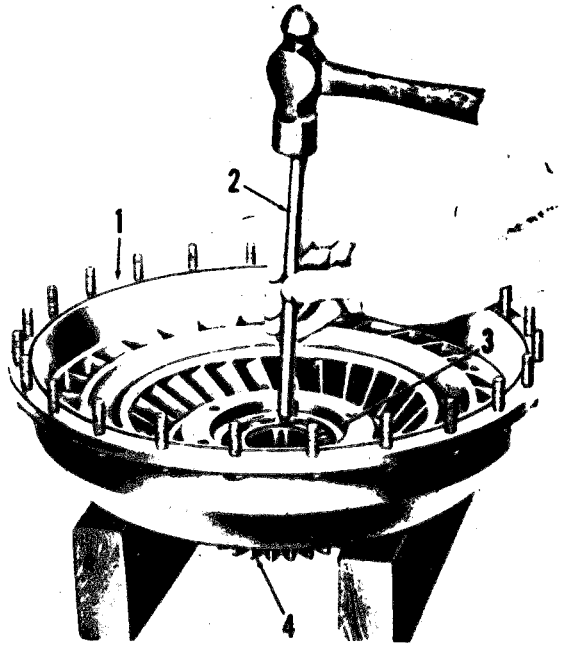
STEP 21

Position converter housing on its rear surface. Using puller 1, remove converter pump and bearing assembly 2 from ground sleeve 3.



STEP 20

Remove gasket 1, pin 2, washer 3, lubrication regulator valve 4 and valve spring 5.

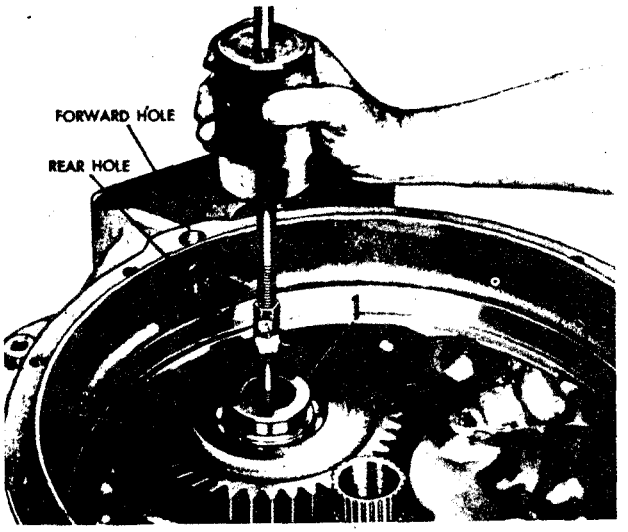


STEP 22

Position converter pump assembly 1 on wooden blocks. Using a soft drift 2, drive bearing 3 and pump drive gear 4 from converter pump 1.

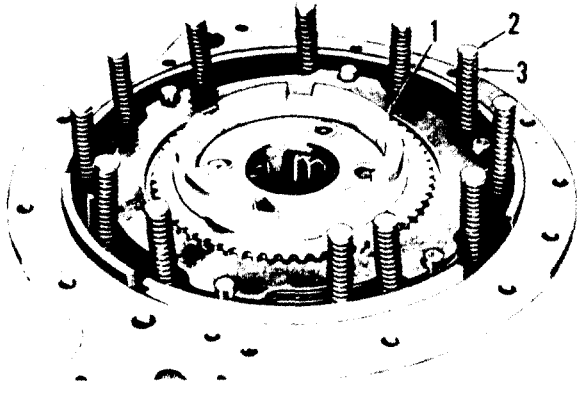
ME 3930-243-34/3-96 (6)

Figure 3-96. Transmission disassembly (sheet 6 of 15).



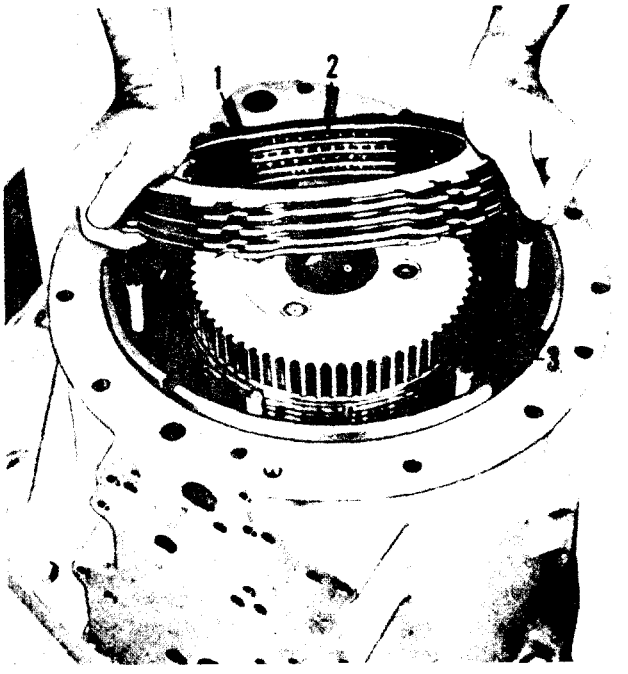
STEP 23

Remove the spindle retainer bolt from implement pump idler gear spindle 1. Install slide hammer 2 and remove the spindle. Remove implement pump idler gear and bearing 3. Do not remove the bearing from the gear unless replacement is necessary.



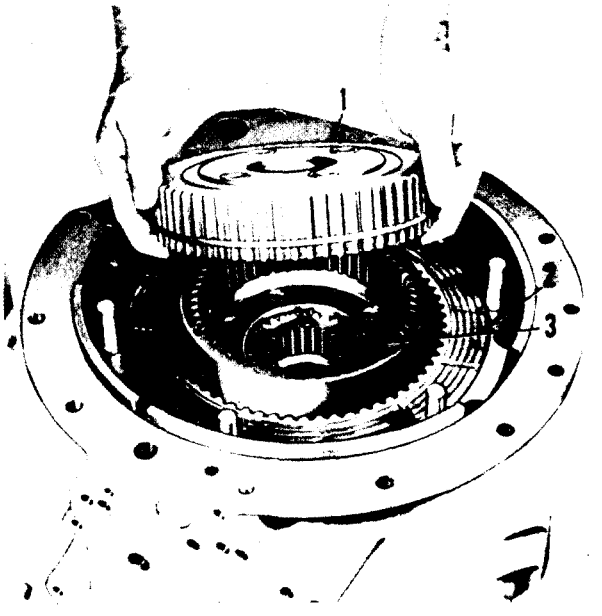
STEP 24

Remove thrust washer 1, twelve piston return spring guides 2 and springs 3.



STEP 25

Remove five external-tanged 1 and four internal-splined 2 reverse clutch plates. Note clutch plate positioning ring 3.

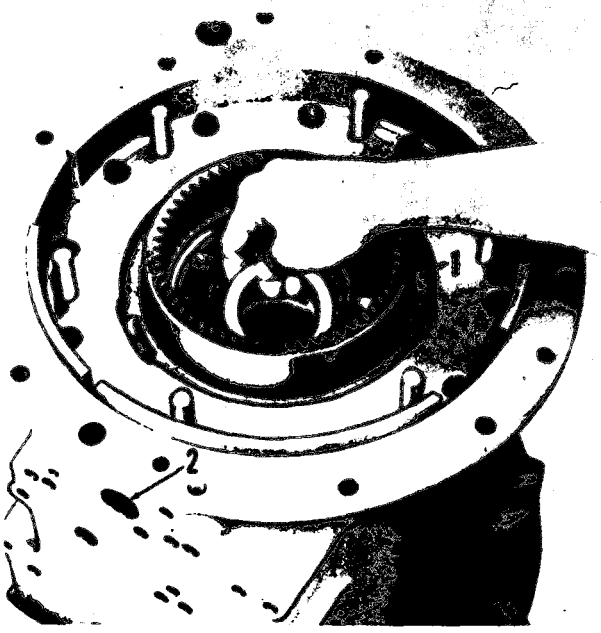


STEP 26

Remove reverse planetary carrier assembly 1 and remaining clutch plate 2. Remove forward sun gear 3.

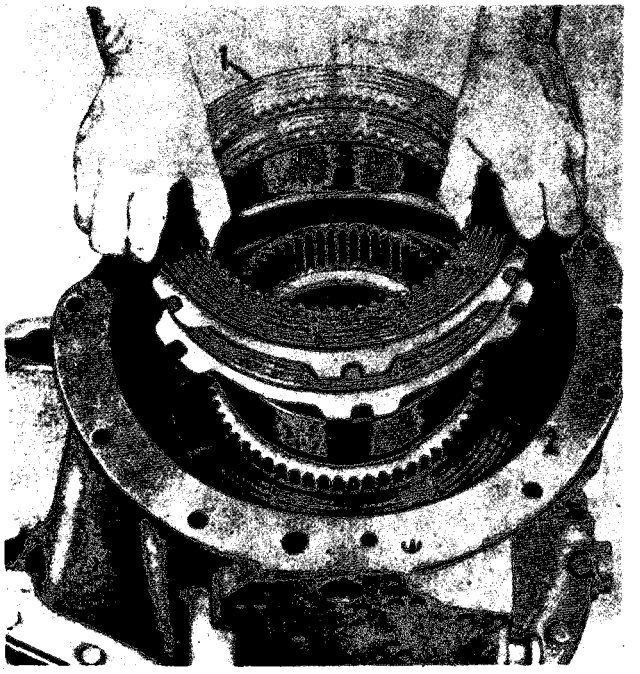
ME 3930-243-34/3-96 (7)

Figure 3-96. Transmission disassembly (sheet 7 of 15)



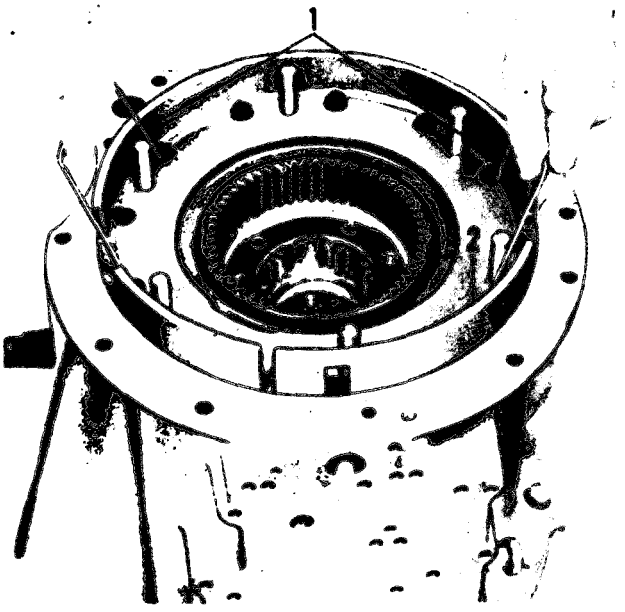
STEP 27

Remove forward sun gear thrust washer 1. Remove clutch anchor pin 2 from the transmission housing.



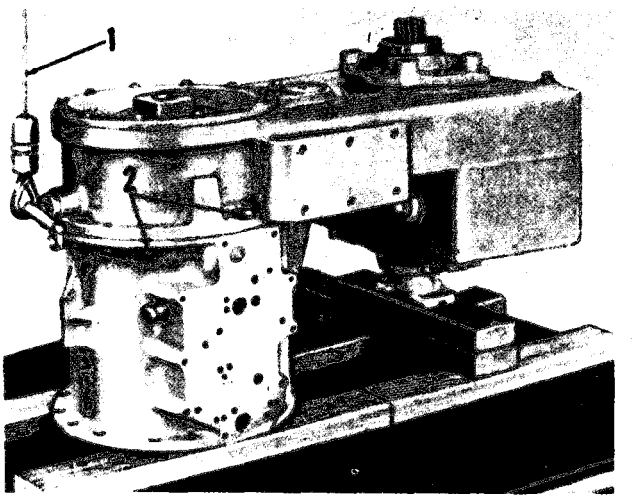
STEP 29

Remove two internal-splined 1 and two external-tanged 2 forward clutch plates.



STEP 28

Using wire lifting hooks 1, remove forward and reverse clutch anchor 2.

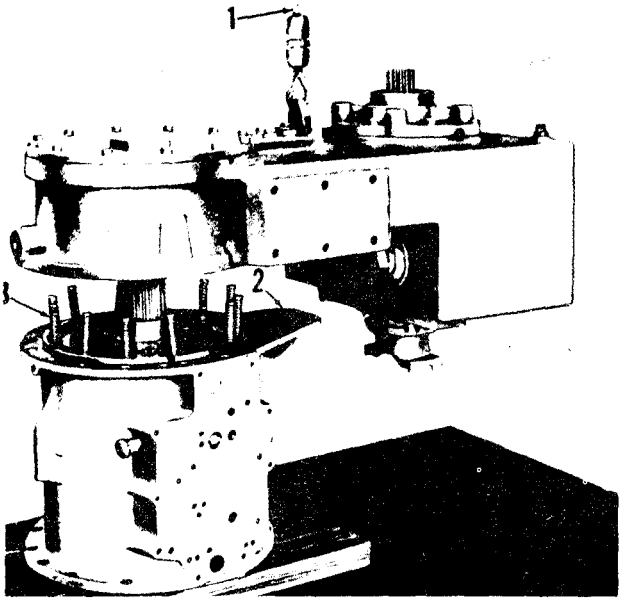


STEP 30

Attach lifting sling 1 to the rear lifting hole in the transmission housing and position the transmission on the work table with the rear end up. Block under flange to level. Remove eighteen bolts and lock washers 2.

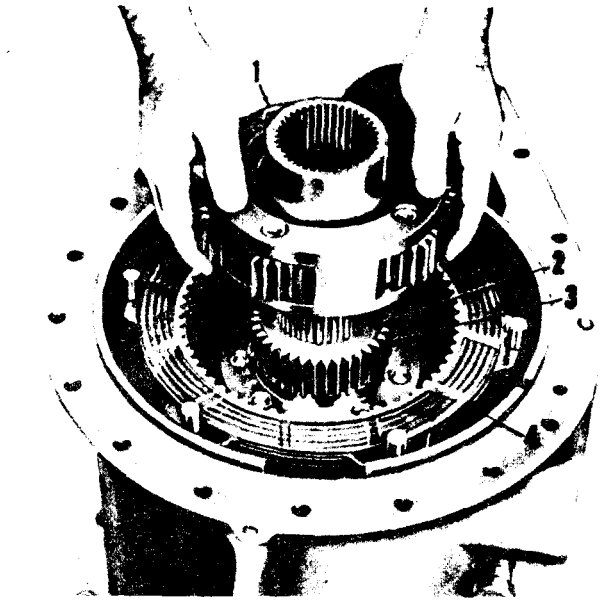
ME 3930-243-34/3-96 (8)

Figure 3-96. Transmission disassembly (sheet 8 of 15).



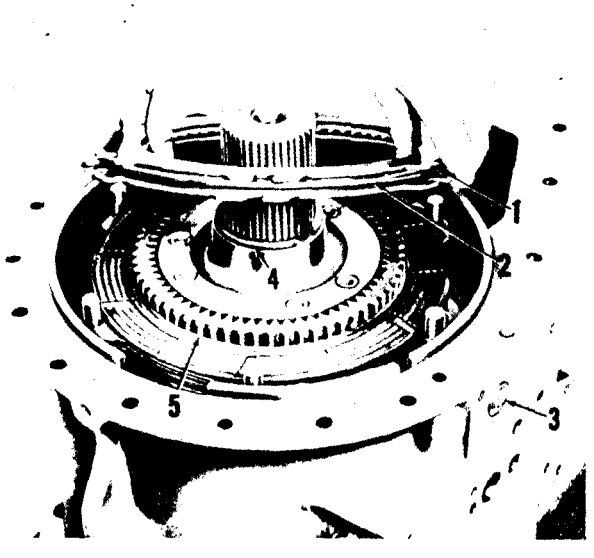
STEP 31

Attach lifting sling 1 to the center of the transfer gear housing and raise the transfer gear housing assembly. Remove gasket 2. Remove twelve low-range springs and spring guides 3.



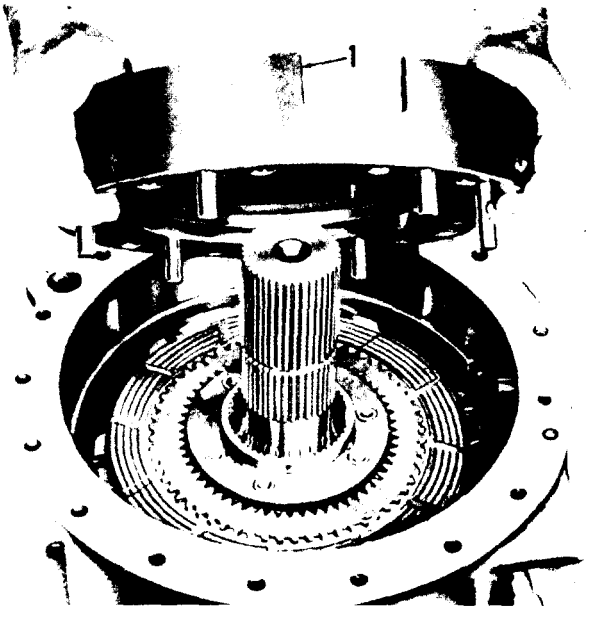
STEP 33

Remove low-range planetary carrier assembly 1, thrust washer 2 and low-range sun gear 3. Remove the remaining low-range clutch plates 4 (three external-tanged and four internal-splined).



STEP 32

Remove two external-tanged 1 and one internal-splined 2 low-range clutch plates. Remove clutch anchor pin 3. Remove snap ring 4. Remove low-range ring gear 5.

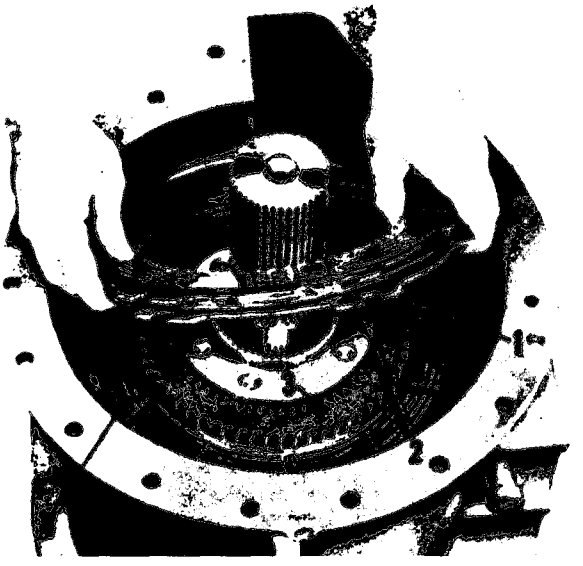


STEP 34

Remove high- and low-range clutch anchor assembly 1.

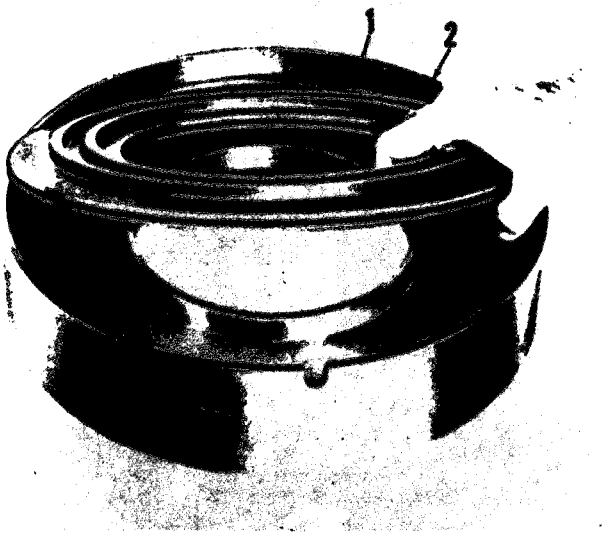
ME 3930-243-34/3-96 (9)

Figure 3-96. Transmission disassembly (sheet 9 of 15).



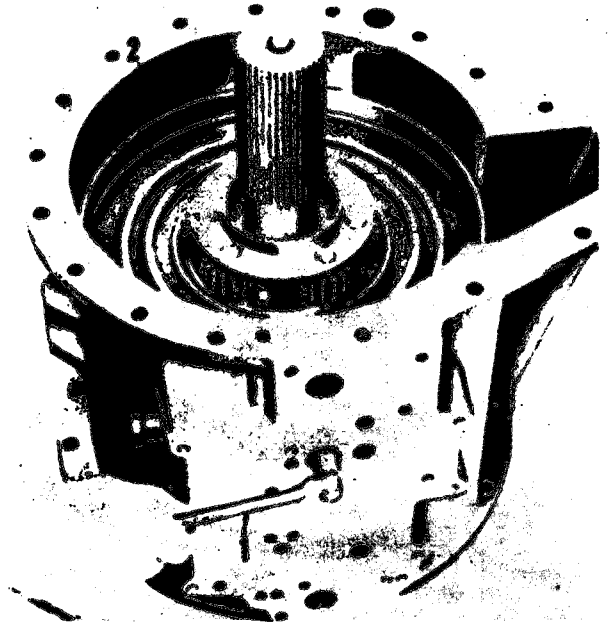
STEP 35

Remove two external-tanged 1 and two internal-splined 2 high-range clutch plates. Remove high-range ring gear 3. Remove remaining clutch plates 4 (one internal-splined and one external-tanged).



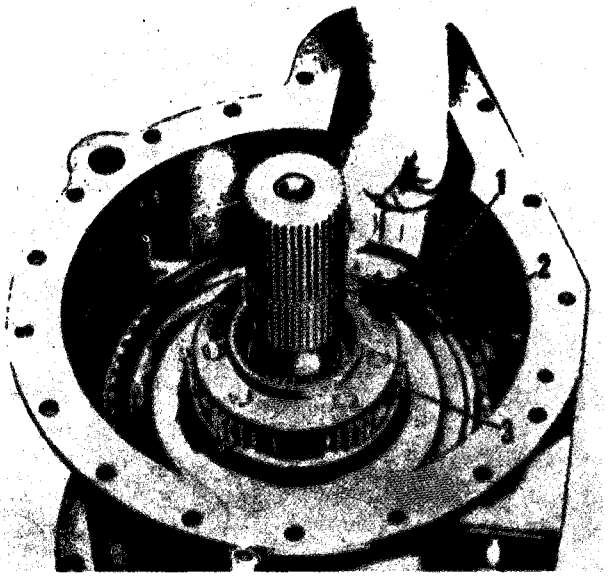
STEP 37

Remove high-range piston 1 from piston housing 2.



STEP 36

Using wrench 1, remove the high-range piston housing retainer bolt. Remove high-range piston and housing assembly 2.

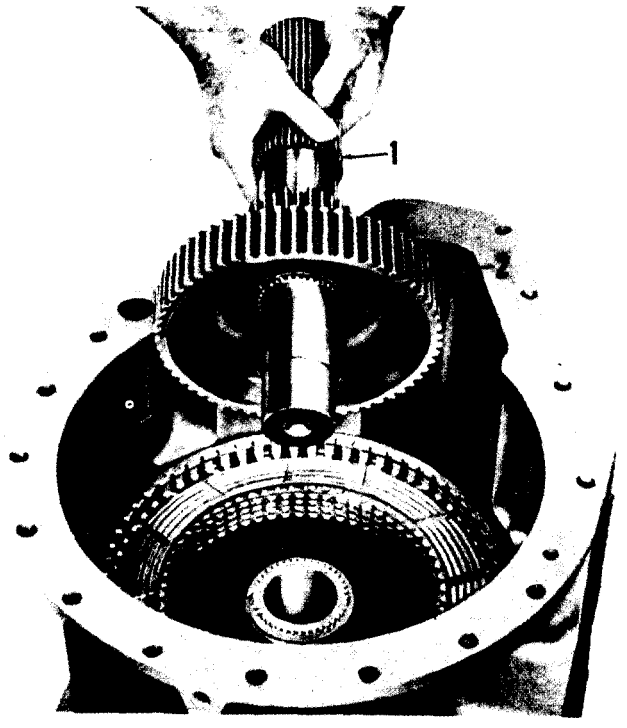


STEP 38

Remove internal-snap ring 1 from intermediate-range clutch drum 2. Remove high-range planetary carrier assembly 3.

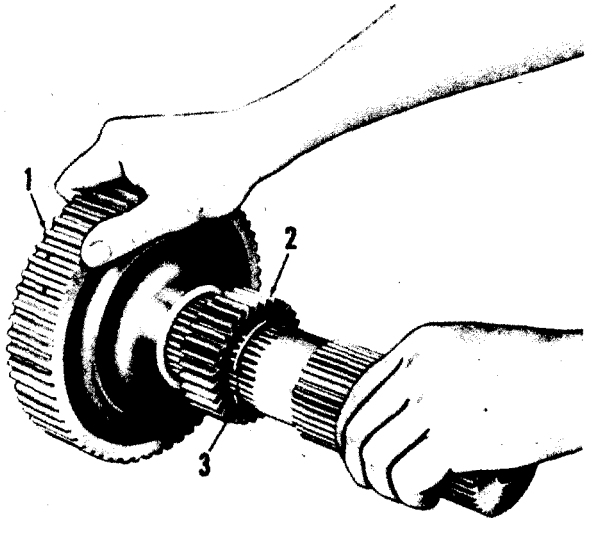
ME 3930-243-34/3-96 (10)

Figure 3-96. Transmission disassembly (sheet 10 of 15).



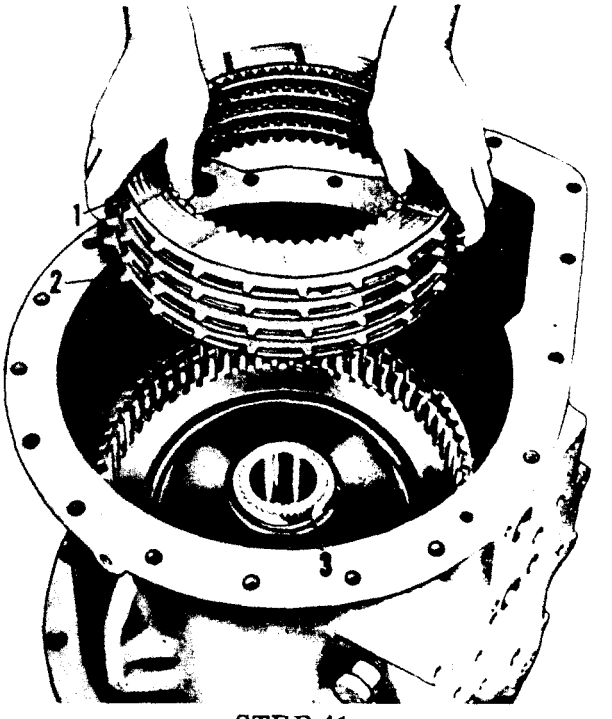
STEP 39

Remove transmission main shaft and attached parts 1. Remove snap ring 2 from the shaft.



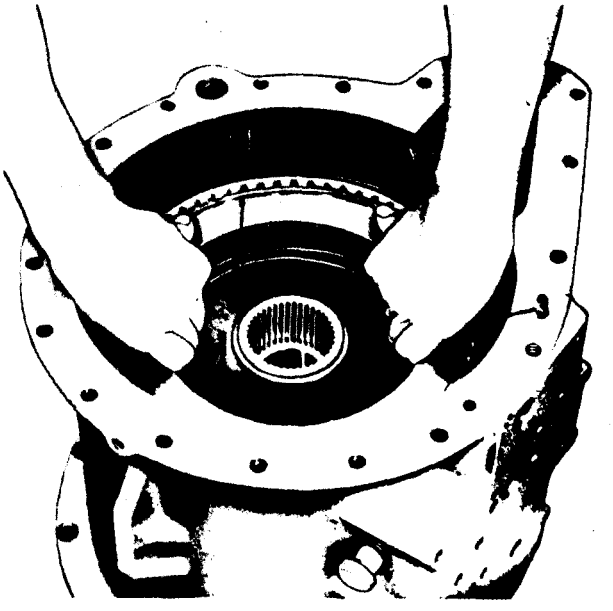
STEP 40

Remove intermediate-range clutch hub 1 and high-range sun gear 2. Remove snap ring 3 from the transmission main shaft.



STEP 41

Remove five internal-splined 1 and four external-tanged 2 intermediate-range clutch plates. Remove snap ring 3 from the forward carrier shaft.

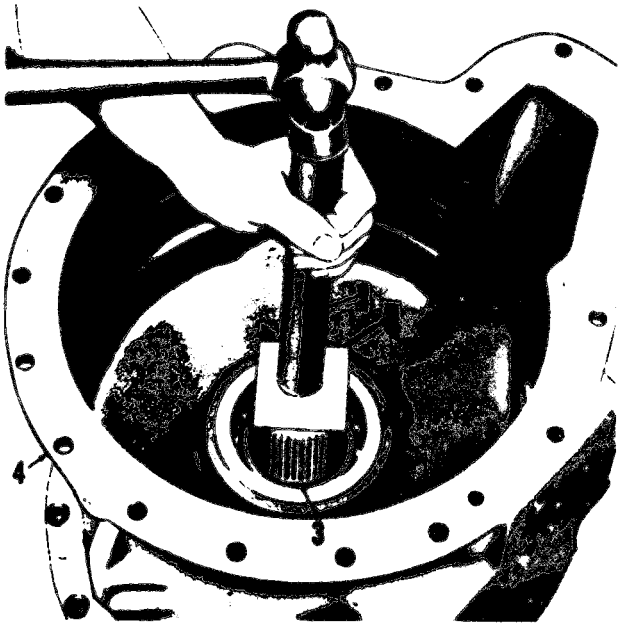


STEP 42

Install external-tanged clutch plate 1 and snap ring 2 into intermediate-range clutch drum 3. Grasp plate 1 and remove drum assembly 3.

ME 3930-243-34/3-96 (11)

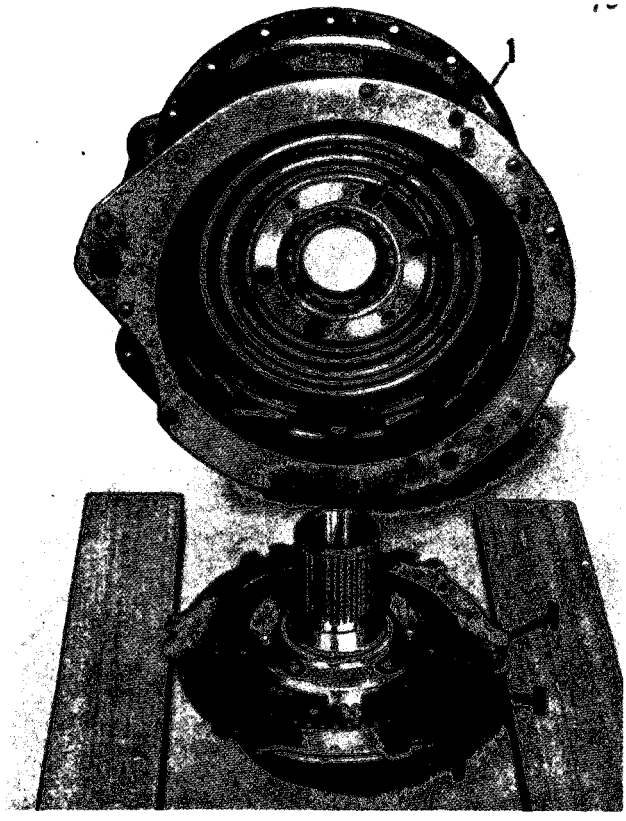
Figure 3-96. Transmission disassembly (sheet 11 of 15).



STEP 43

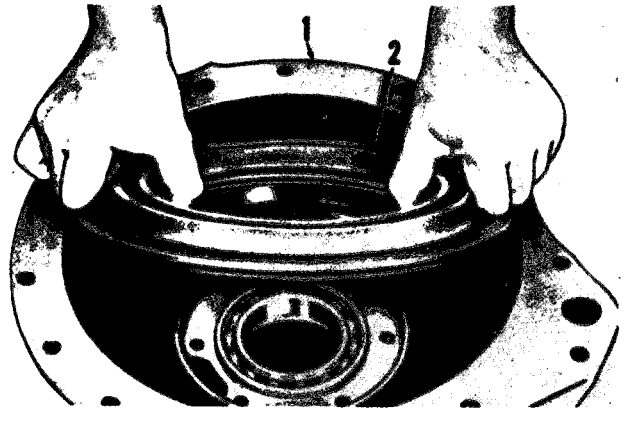
Using drift 1 and soft metal block 2, tap on forward carrier shaft 3.

Caution: Make sure transmission housing 4 is blocked sufficiently high to allow the forward-range carrier to drop out. Provide a wooden block, or other soft surface, beneath the carrier to prevent damage due to dropping.



STEP 44

Position transmission housing 1 on its side and remove four self-locking bolts 2 and two bearing retainers 3. Remove one external-tanged 4 and one internal-splined 5 forward clutch plates. Remove forward ring gear 6.

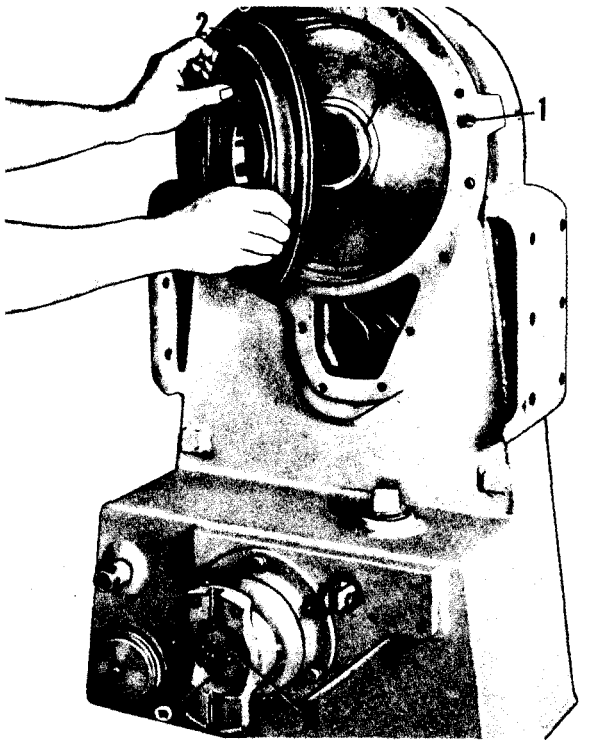


STEP 45

Position transmission housing 1 on the work table with the piston up and remove forward piston 2.

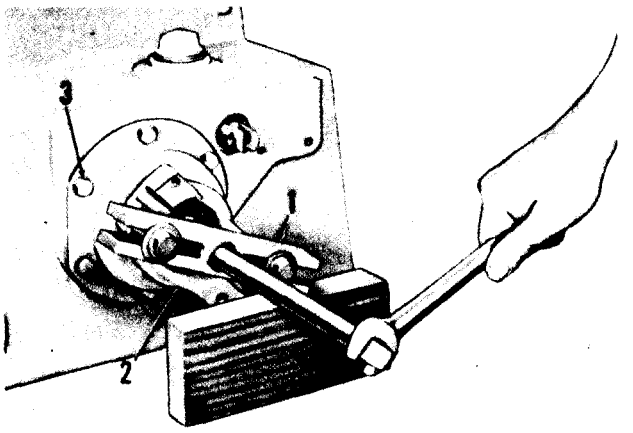
ME 3930-243-34/3-96 (12)

Figure 3-96. Transmission disassembly (sheet 12 of 15).



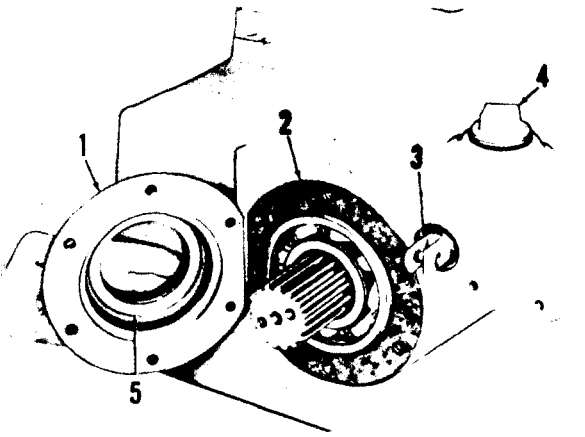
STEP 46

Using compressed air in piston apply hole 1, remove low-range piston 2. Remove hook-type seal 3. Flatten the corners of lock strip 4 and remove the two flange retainer washer bolts, lock strip and flange retainer washer 5.



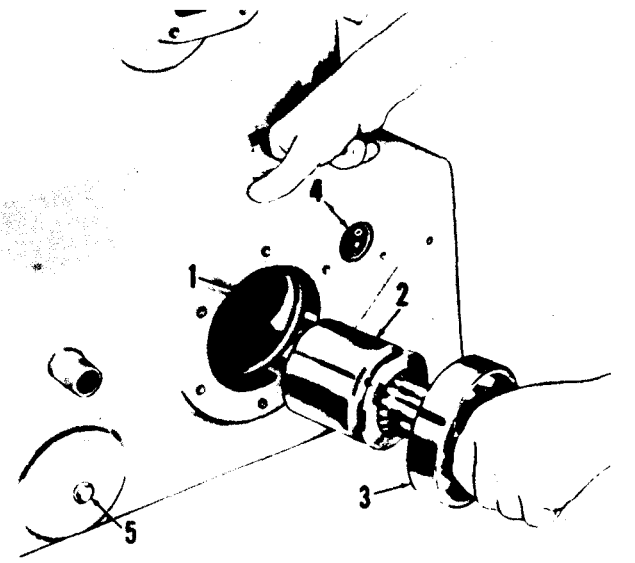
STEP 47

Using puller 1, remove front-output flange 2. Remove six bolts and lock washers 3 from bearing retainer.



STEP 48

Remove bearing retainer assembly 1 and gasket 2. Unthread shifter shaft 3 out of the shifter fork and remove it from the housing. Remove pipe plug 4. Press seal 5 toward the inside of retainer 1 to remove it.

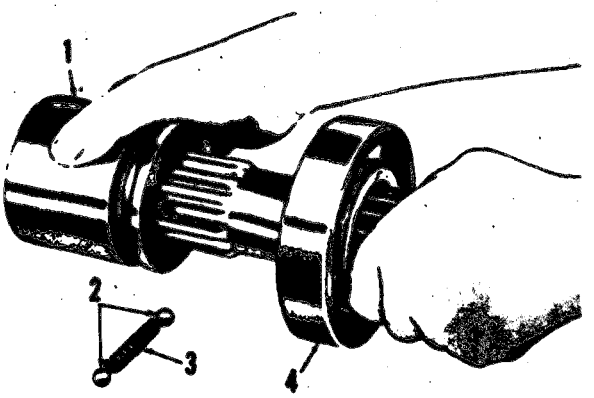


STEP 49

Using one hand to hold shifter fork 1 in an upward position, grasp the front-output shaft with the other hand and remove, as a unit, the shaft, coupling 2 and bearing 3. Remove shifter shaft seal 4. Remove bolt and washer 5.

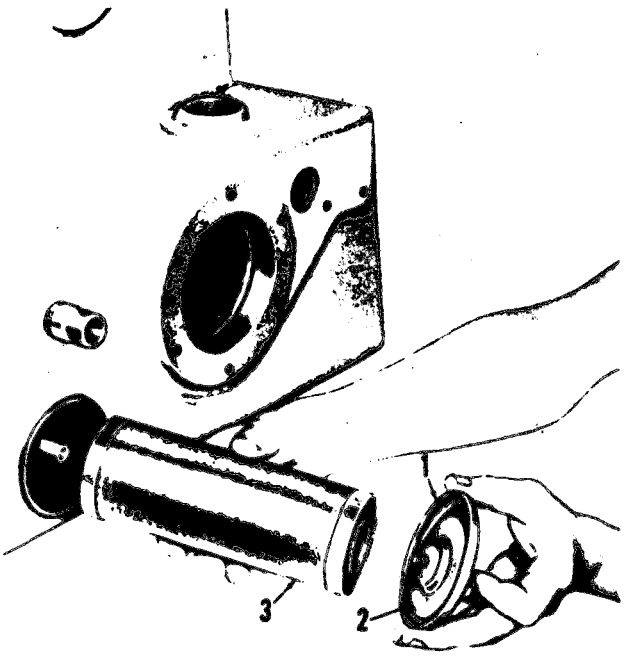
ME 3930-243-34/3-96 (13)

Figure 3-96. Transmission disassembly (sheet 13 of 15).



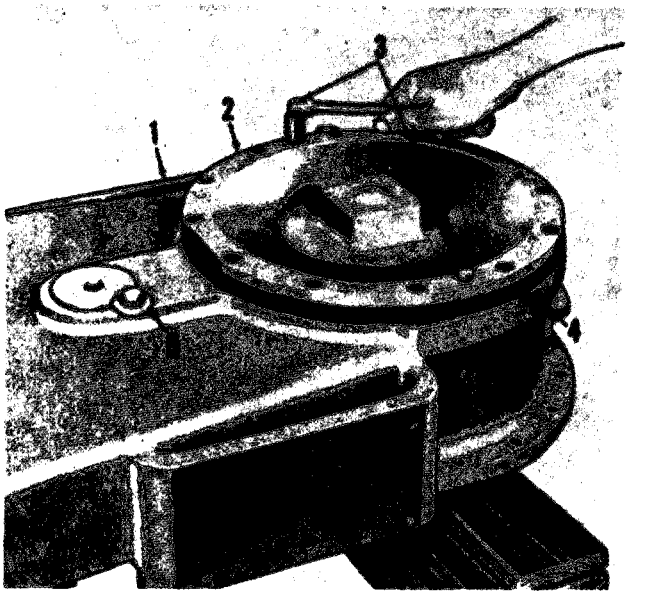
STEP 50

Remove front-output-disconnect coupling 1 from the front-output shaft. Remove two detent balls 2 and spring 3. If necessary, remove bearing 4 from the shaft.



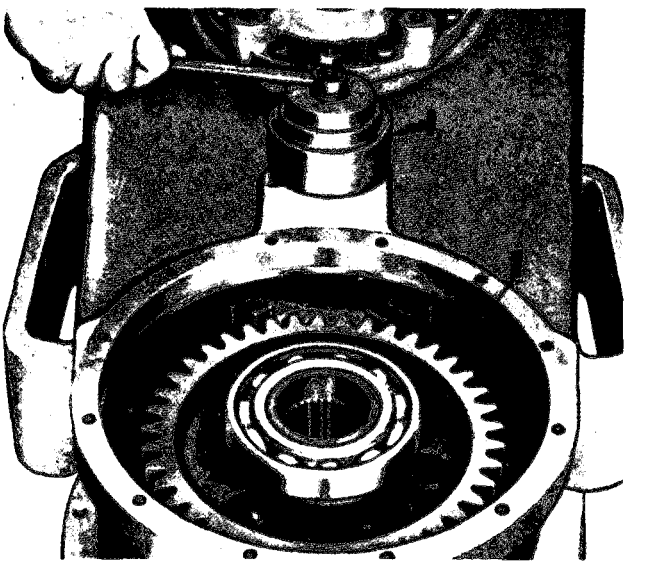
STEP 51

Remove oil screen cover and gasket 1. Remove retainer 2 and oil screen assembly 3.



STEP 52

Position transfer gear housing assembly 1 on its front surface and level it with blocks. Remove twelve bolts and lock washers from transfer drive gear cover 2. Use jackscrews 3 to loosen the cover. Remove the cover and gasket 4. Remove bolt, lock washer and transfer idler gear spindle retainer washer 5.

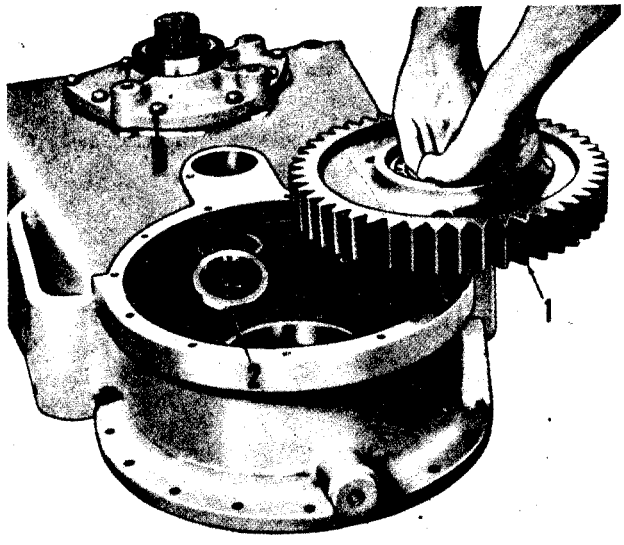


STEP 53

Using tool 1, remove the transfer idler gear spindle from the housing. Remove transfer drive gear and bearing assembly 2.

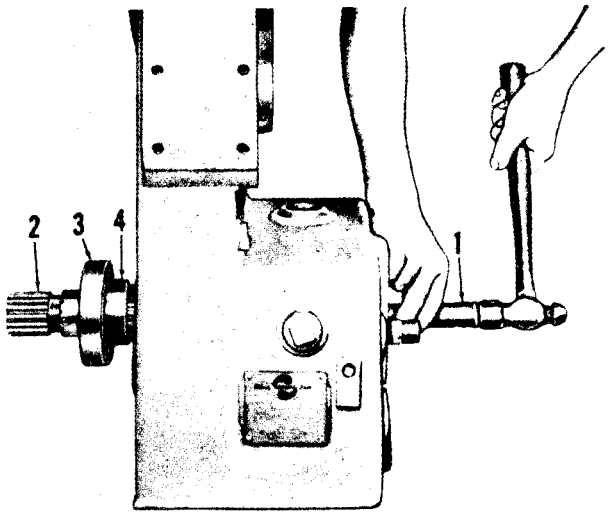
ME 3930-243-34/3-96 (14)

Figure 3-96. Transmission disassembly (sheet 14 of 15).



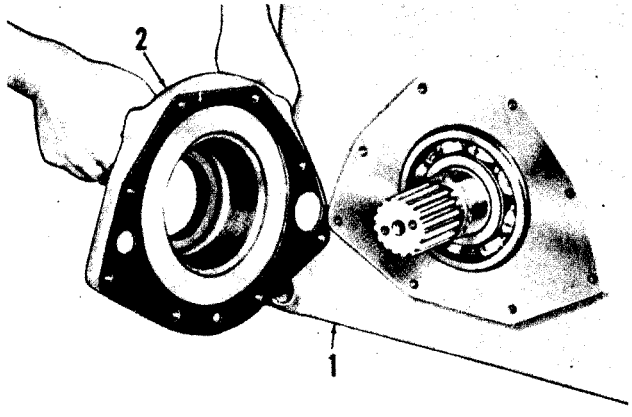
STEP 54

Remove transfer idler gear and bearing assembly 1. Remove transfer idler gear spacer 2. Remove eight bolts and lock washers 3 from the rear bearing retainer.



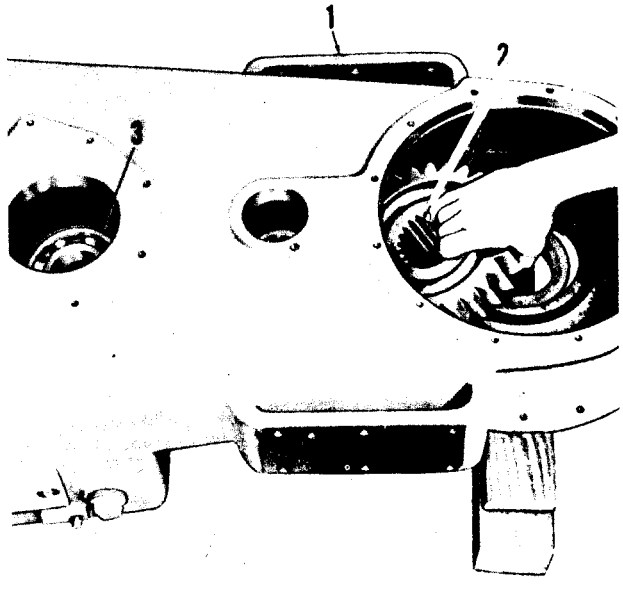
STEP 56

Using a hammer and soft drift 1, tap on rear output shaft 2 and remove the shaft, bearing 3 and spacer 4. Note: Use a drift of approximately 1 1/4-inch diameter so that drift will not enter the pilot bearing bore of the rear-output shaft. Leave the drift in place to support the driven gear until its removal.



STEP 55

Position transfer gear housing assembly 1 upright on the work table and remove rear-output-bearing retainer assembly and gasket 2.



STEP 57

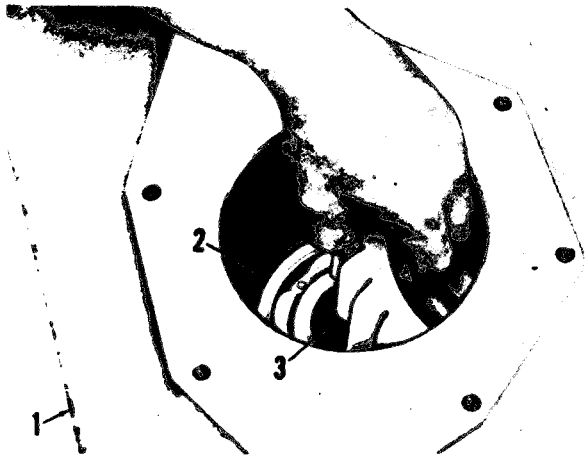
Position transfer gear housing 1 on its front surface and remove the drift and transfer driven gear 2. Remove bearing 3 from the housing.

ME 3930-243-34/3-96 (15)

Figure 3-96. Transmission disassembly (sheet 15 of 15).

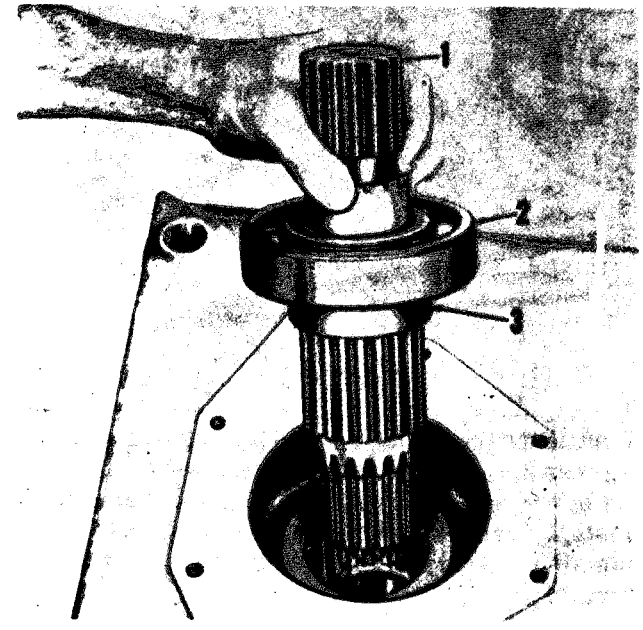
d. Cleaning and Inspection. Refer to paragraph 2-7 for cleaning and inspection instructions.

e. Reassembly. Refer to figure 3-97 and reassemble the transmission as indicated in each step. See figure 3-98 for transmission torque values.



STEP 1

Position transfer gear housing 1 on work table with the front surface down and install bearing 2. Install transfer driven gear 3 into the housing with the long hub toward the front of the housing. Aline the bores of the gear and bearing.

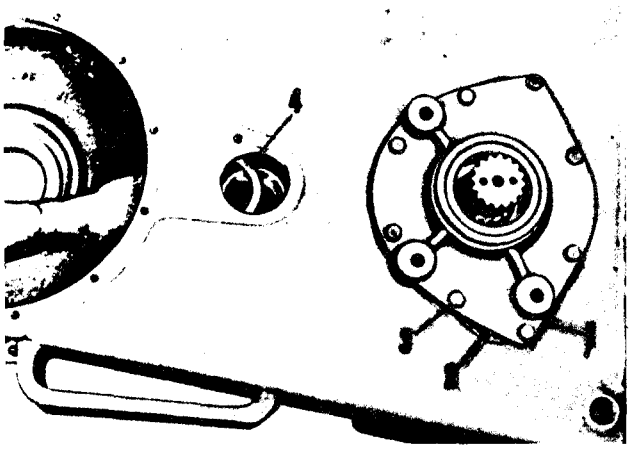


STEP 2

Install rear-output shaft 1, bearing 2 and spacer 3, as a unit, into the rear of the transfer gear housing. Aline the shaft splines with the gear splines.

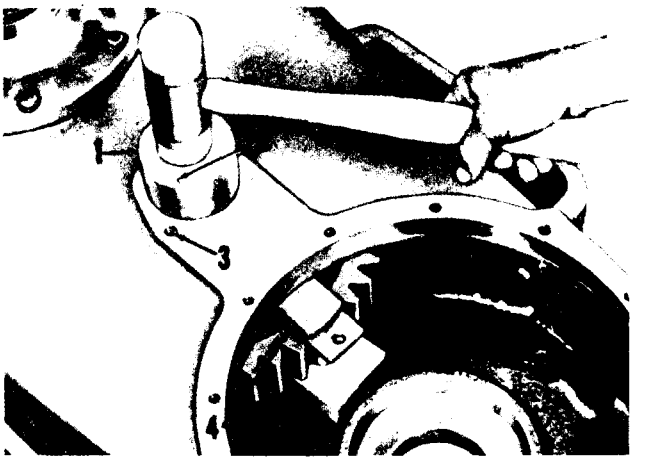
ME 3930-243-34/3-97 ①

Figure 3-97. Transmission reassembly (sheet 1 of 15).



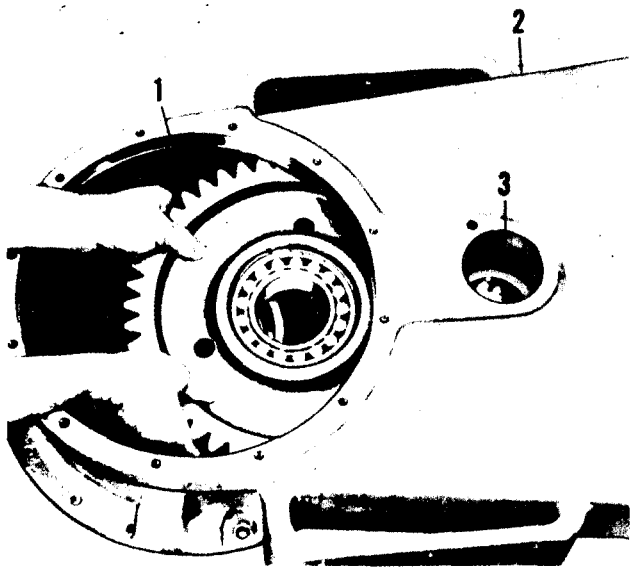
STEP 3

Install rear-output bearing retainer 1 and gasket 2. Secure the retainer with eight (six on some models) bolts and lock washers 3. Install transfer idler gear spacer 4 into the housing. Aline it with the spindle bore in the housing.



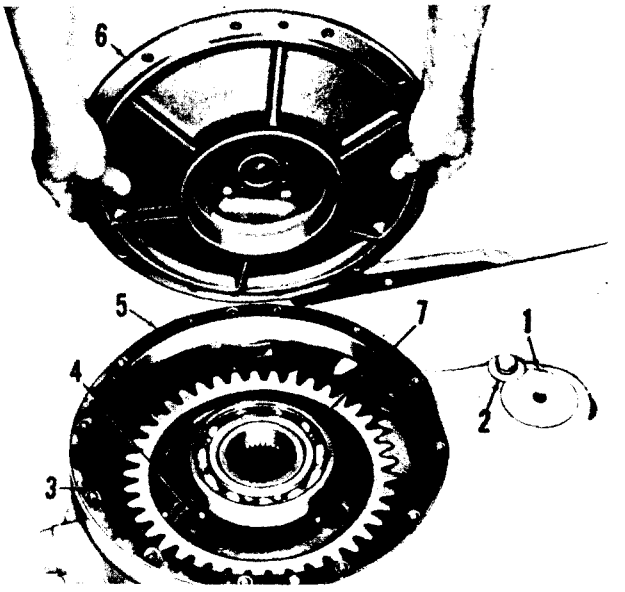
STEP 5

Install transfer idler gear spindle 1 into its bore, alining recess 2 in the spindle with bolt hole 3 in the housing. Use a soft hammer to seat the spindle. If necessary, use blocks 4 between the transfer idler gear and the housing to prevent the housing from springing when driving spindle into place. Remove blocks 4.



STEP 4

Install transfer idler gear assembly 1 into housing 2. Aline the gear and spacer 3 with the spindle bore in housing 2. Chill the transfer idler gear spindle in dry ice for an hour or longer (several hours, if convenient).

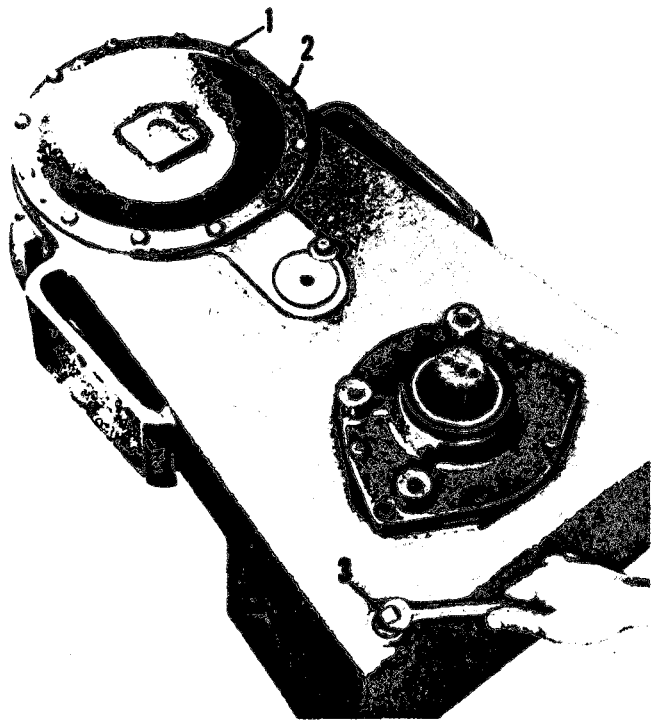


STEP 6

Secure spindle 1 with retainer, bolt and lock washer 2. Install transfer drive gear assembly 3. Tap bearing 4 to seat it in its bore. Install gasket 5 and transfer gear cover 6, alining the bolt holes. Tap cover 6 to seat it on bearing 7.

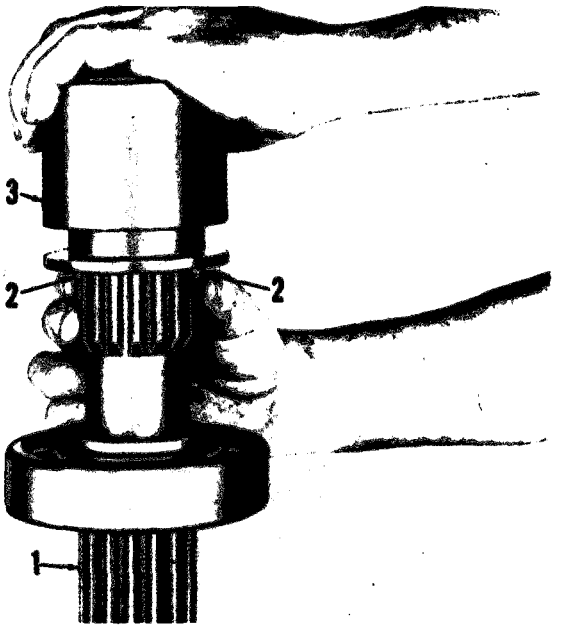
ME 3930-243-34/3-97 (2)

Figure 3-97. Transmission reassembly (sheet 2 of 15).



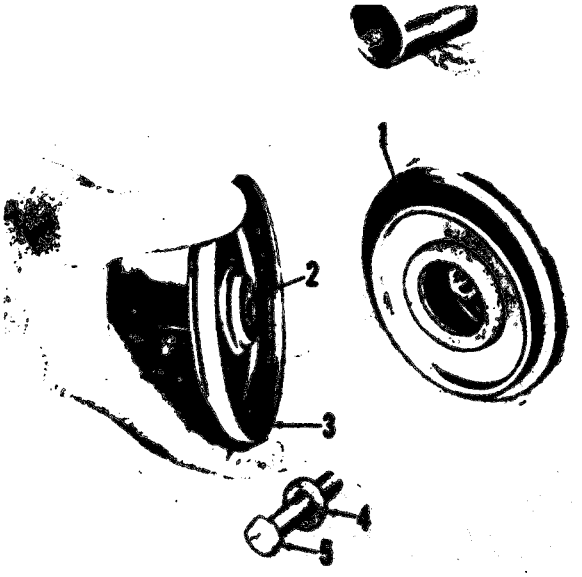
STEP 7

Secure transfer gear cover 1 with twelve bolts and lock washers 2. Install oil drain plug 3.



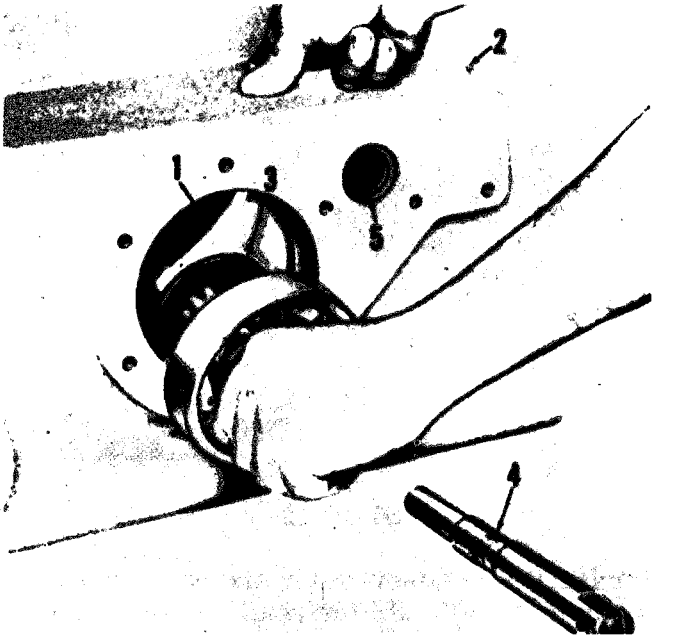
STEP 9

Holding front-output shaft 1 with one hand, install detent spring and two balls 2 into the shaft. Holding the balls to compress the spring, install coupling 3 onto the shaft with the groove toward the bearing. Engage the coupling at the first detent position.



STEP 8

Position transfer gear housing assembly upright and install oil screen assembly 1, retainer 2 and cover and gasket 3. Install bolt 5 (8 to 10 pound feet torque) and washer 4. Make sure washer 4 is in good condition to prevent oil or air leakage.



STEP 10

Install shifter fork 1 into housing 2. Install front-output shaft and coupling 3, engaging fork 1 in the coupling groove. Continuing to hold fork 1 in position, install shifter shaft 4 into its bore 5 and thread it into fork 1.

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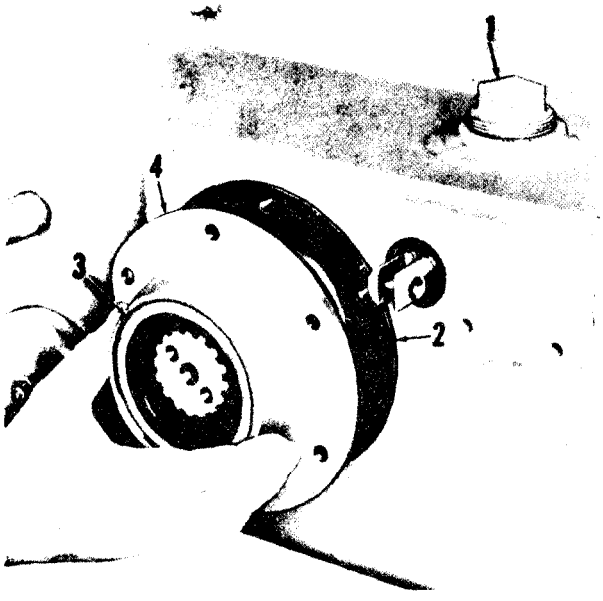
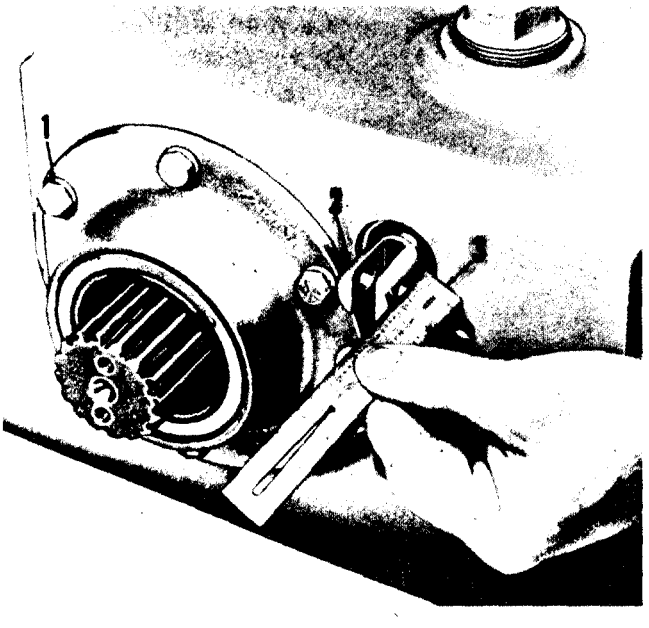
Figure 3-97. Transmission reassembly (sheet 3 of 15).



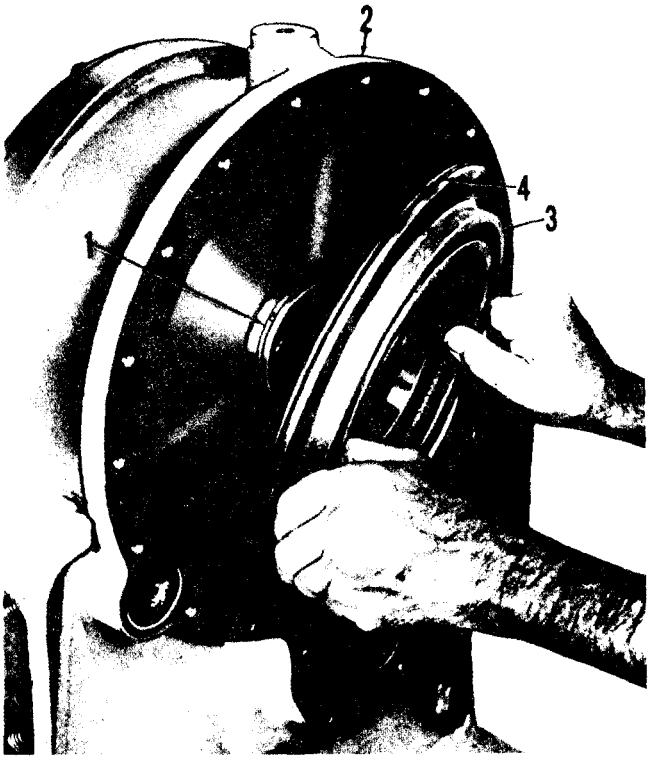
STEP 11

Install pipe plug 1 and gasket 2. Install seal 3 into the front of bearing retainer 4. Install the retainer.



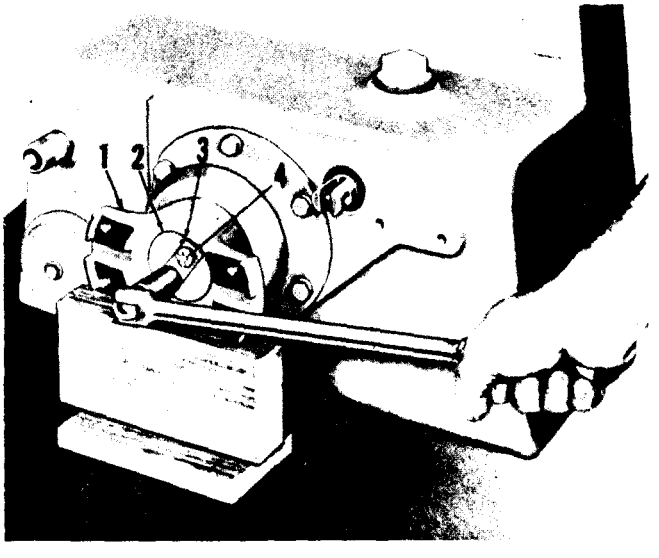
STEP 12

Secure the retainer with six bolts and lock washers 1. With shifter shaft 2 pushed all the way in, check the shaft adjustment by placing scale 3 against the face of the transfer gear housing and measuring to the center of the linkage hole in shaft 2. Rotate shaft 2 until the measurement is 0.610 to 0.650 (approximately 5/8) inch.



STEP 13

Install hook-type seal ring 1 into groove on transfer gear housing 2. Install the assembled piston 3, with seal ring 4 into the housing.



STEP 14

Install front-output flange 1 onto the front-output shaft. Secure flange 1 with flange retainer washer 2, lock strip 3 and two self-locking bolts 4. Bend the corners of the lock strip against the bolt heads. Refer to sect. IV, para 8b for tight-fit flange installation.

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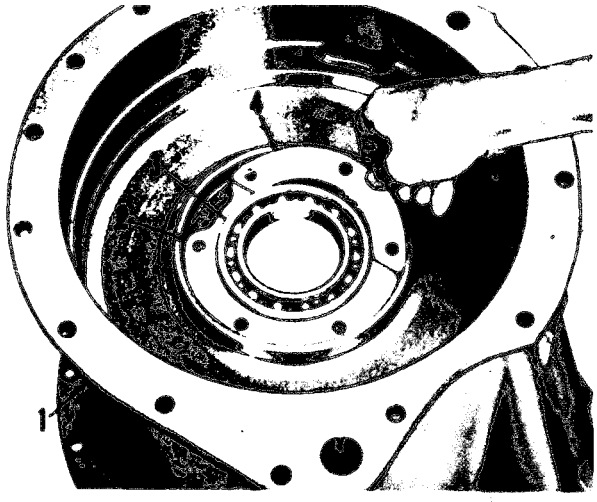
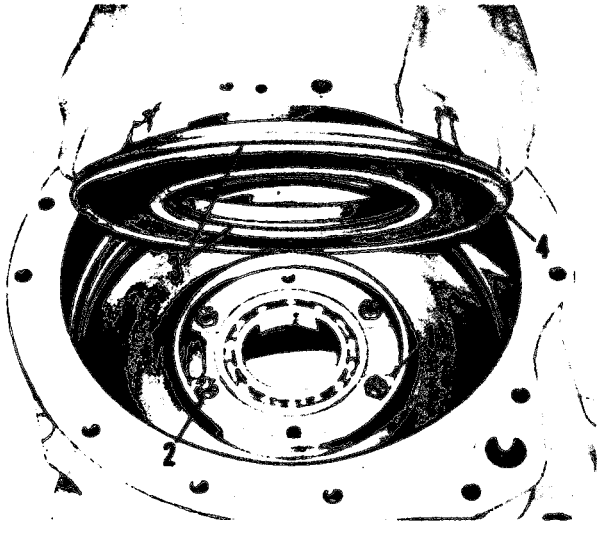
Figure 3-97. Transmission reassembly (sheet 4 of 15).



STEP 15

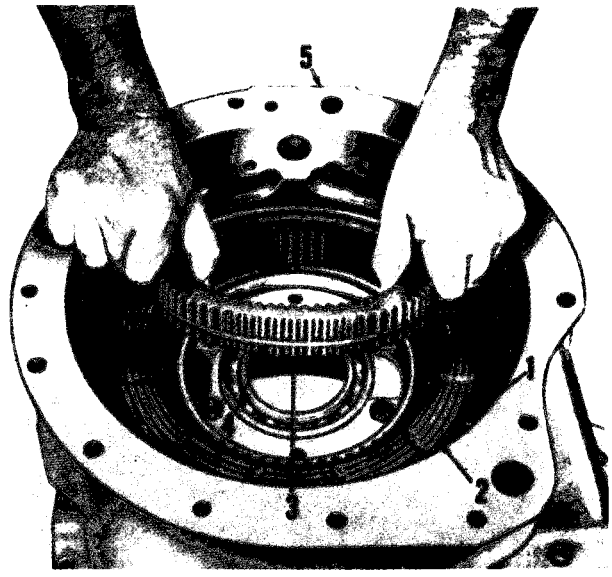
Position transmission housing 1, front end up, on wooden blocks. If hub 2 and bearing 3 were removed, press hub 2 and bearing 3 toward the rear of housing 1 alining the bolt holes. Install two bearing retainers 4.

Note: Check retainers 4 for bending or damage incurred during removal of forward carrier assembly.



STEP 16

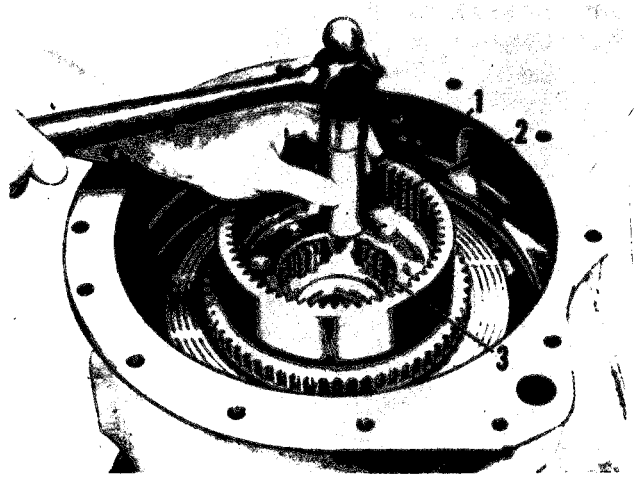
Secure both retainers 1 with four self-locking bolts 2 in the holes shown. Oil piston seal rings 3 and install the forward piston 4.



STEP 17

Install one external-tanged 1 and one internal-splined 2 forward clutch plates. Install forward ring gear 3 with positioning ring 4 toward the rear of housing 5.

Note: Pre-soak clutch plates 2 in type C-1 transmission oil before installation.



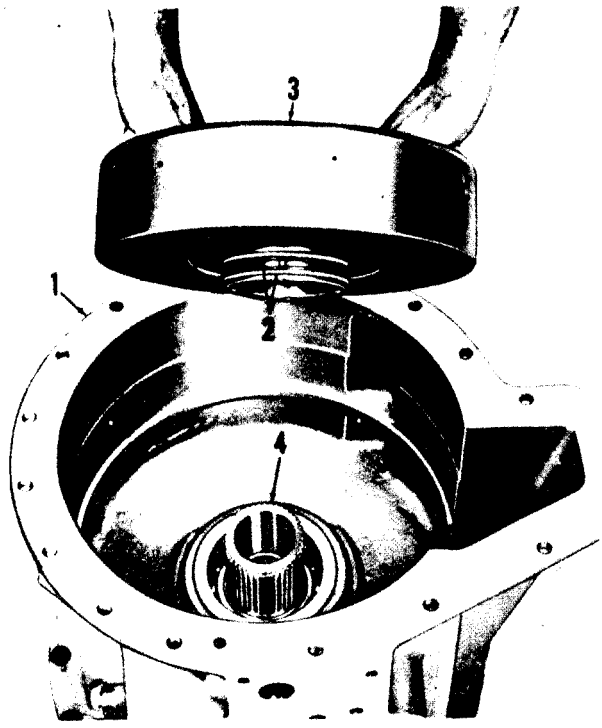
STEP 18

Install forward carrier assembly 1 alining the pinions with the internal splines of the forward ring gear. Using soft drift 2 on carrier web 3, seat carrier 1 in its bearing.

Note: Support the inner race of the carrier bearing to prevent damaging the bearing and retainers.

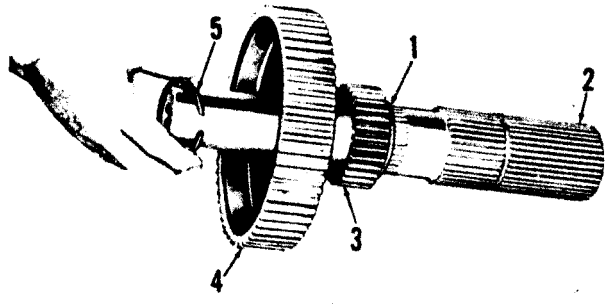
ME 3930-243-34/3-97 (5)

Figure 3-97. Transmission reassembly (sheet 5 of 15).



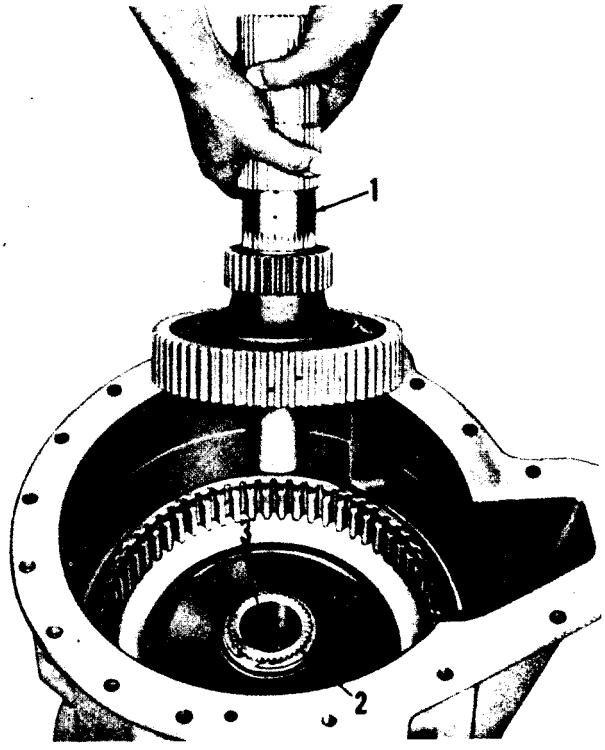
STEP 19

Turn transmission housing 1 over to rest on its front surface. Grease hook-type seal rings 2. Install intermediate-range clutch drum 3 onto forward carrier hub 4. Secure the drum with a snap ring.



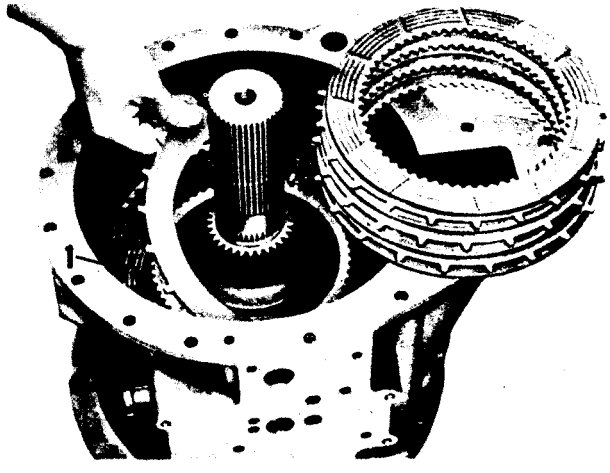
STEP 20

Install snap ring 1 on transmission main shaft 2. Install high-range sun gear 3 and intermediate-range clutch hub 4. Secure the hub with snap ring 5.



STEP 21

Install transmission main shaft and attached parts 1 into forward carrier hub 2. Be careful not to damage bushing 3.



STEP 22

Beginning with an internal-splined plate 1, alternately install five internal-splined 1 and four external-tanged 2 intermediate-range clutch plates.

Note: Pre-soak clutch plates 1 in type C-1 transmission oil before installation.

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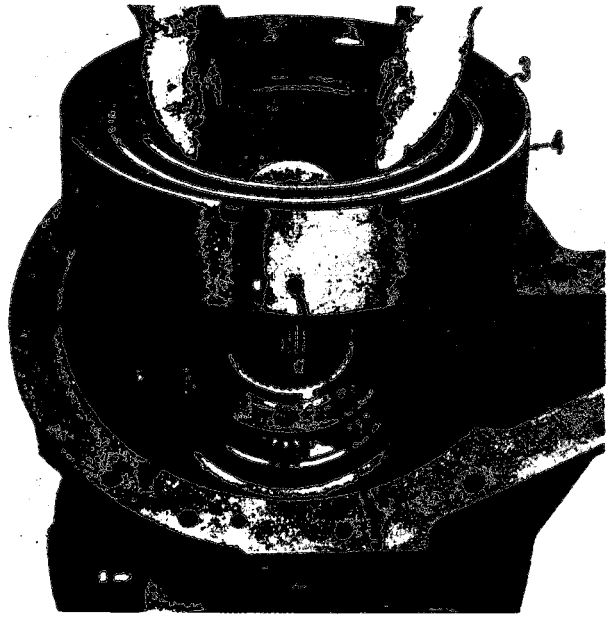
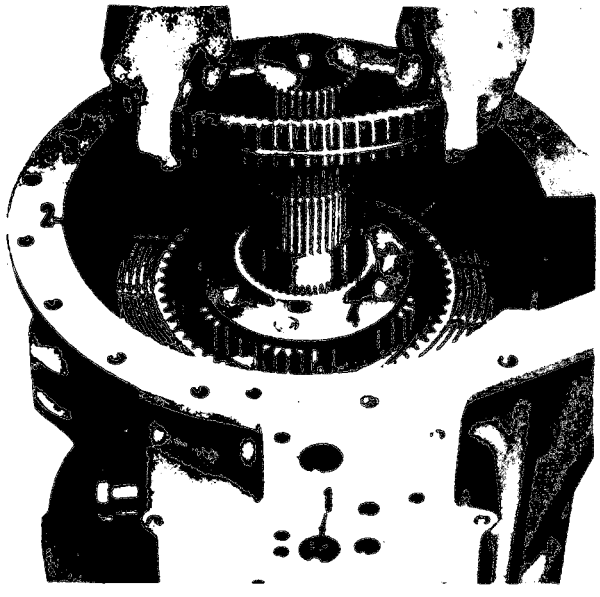
Figure 3-97. Transmission reassembly (sheet 6 of 15).



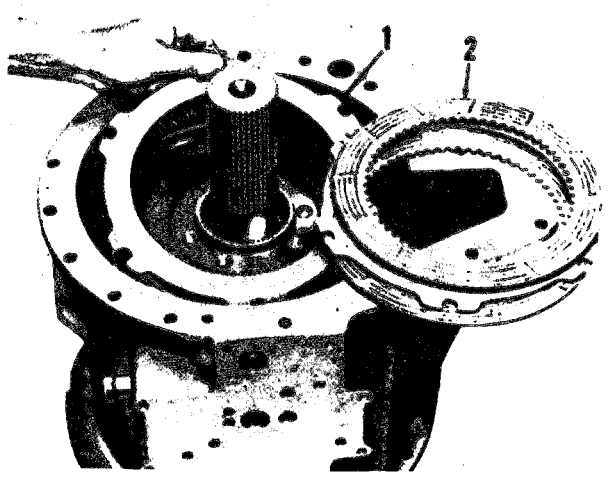
STEP 23

Install high-range carrier assembly 1 and secure it with internal-snap ring 2. Install high-range piston 3 (with seal rings assembled) into piston housing 4. Aline threaded hole 5 with the bolt hole in the housing. Install housing 4.



STEP 24

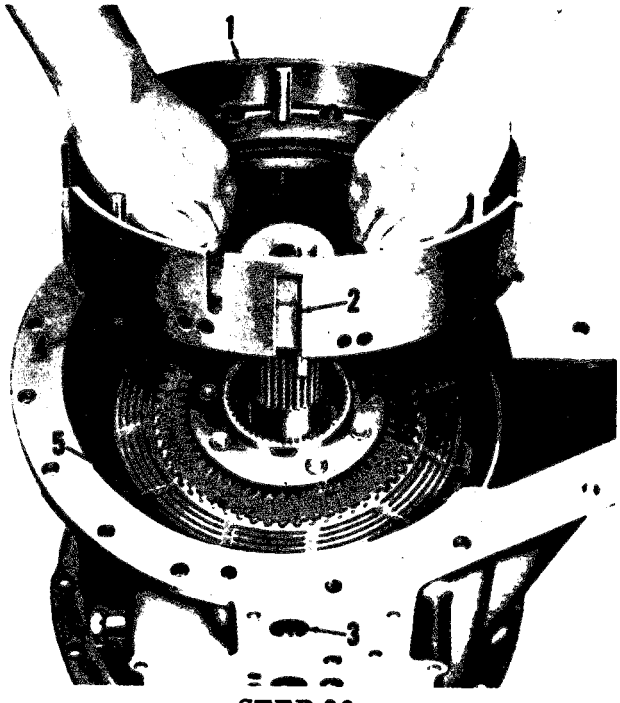
Install high-range piston housing retainer bolt 1. Install one external-tanged 2 and one internal-splined 3 high-range clutch plates. Install high-range ring gear 4 with the short ends of the external splines down.



STEP 25

Beginning with an external-tanged plate 1, alternately install two external-tanged and two internal-splined 2 high-range clutch plates. Aline the tangs of plates 1.

Note: Pre-soak clutch plates 2 in type C-1 transmission oil before installation.



STEP 26

Install high- and low-range clutch anchor 1, alining slot 2 with hole 3. Make sure pins 4 engage the slots in tangs 5.

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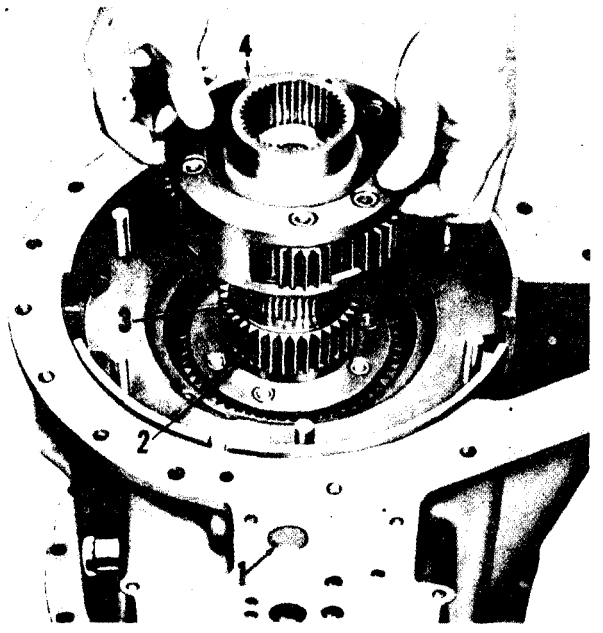
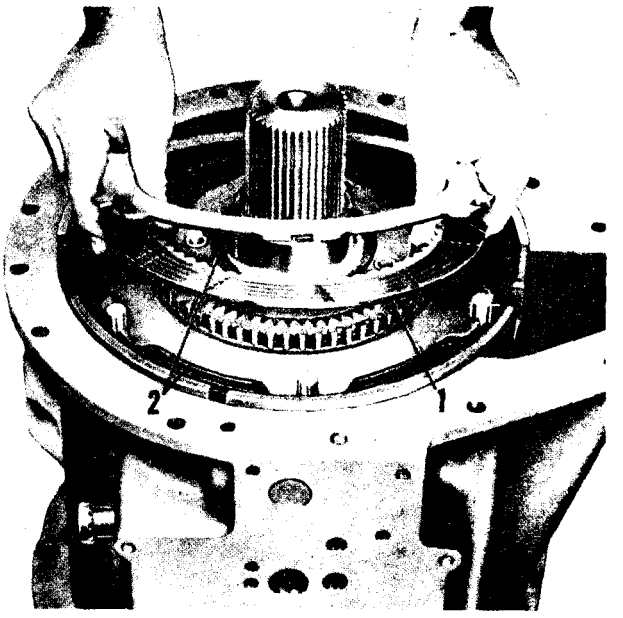
Figure 3-97. Transmission reassembly (sheet 7 of 15).



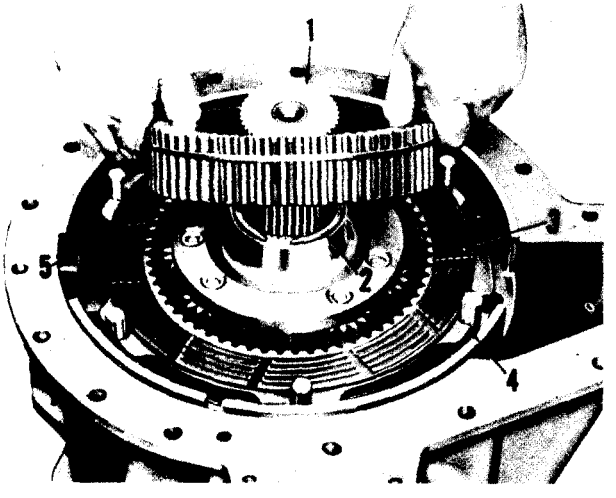
STEP 27

Install clutch anchor pin 1. Install low-range sun gear 2, thrust washer 3 and low-range planetary carrier assembly 4, alining the carrier pinions with sun gear 2.



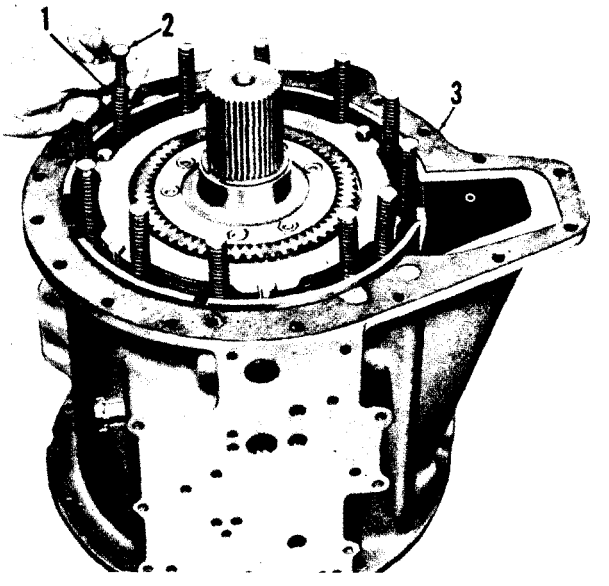
STEP 29

Install the remaining internal-splined 1 and two external-tanged 2 low-range clutch plates.



STEP 28

Grasp shaft 1 and pull upward to install snap ring 2. Beginning with an internal-splined plate, alternately install four internal-splined 3 and three external-tanged 4 low-range clutch plates. Install low-range ring gear 5 with the short ends of external splines up.

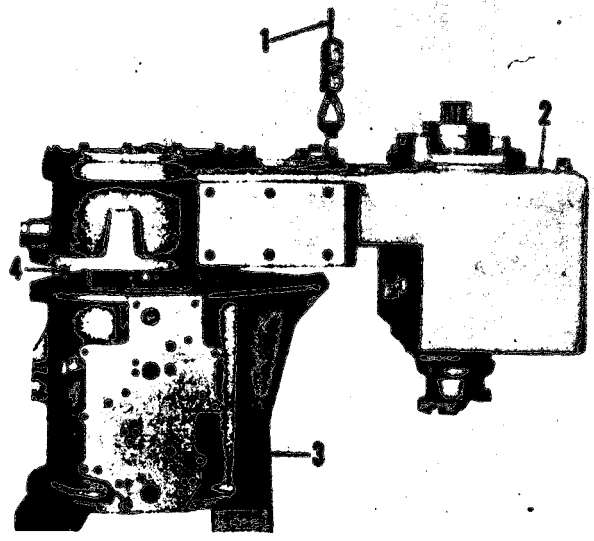


STEP 30

Install twelve clutch return springs 1 and guide pins 2 into their recesses in the high- and low-range clutch anchor. Install gasket 3. All springs 1 should be of equal height. If they are not, an external-tanged plate is out of position.

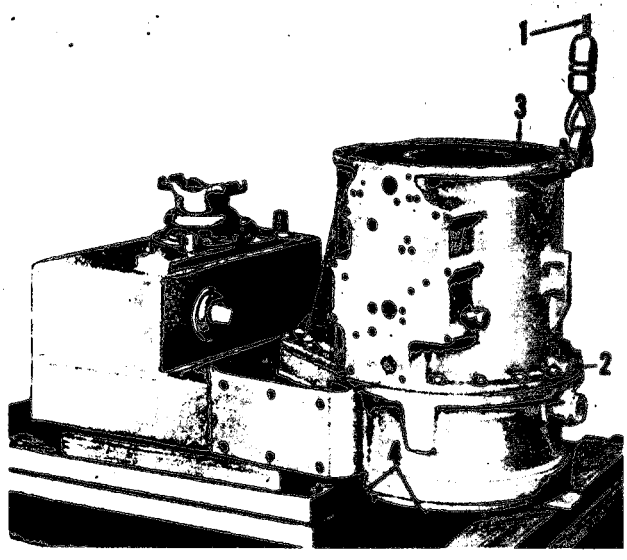
ME 3930-243-34/3-97 (8)

Figure 3-97. Transmission reassembly (sheet 8 of 15).



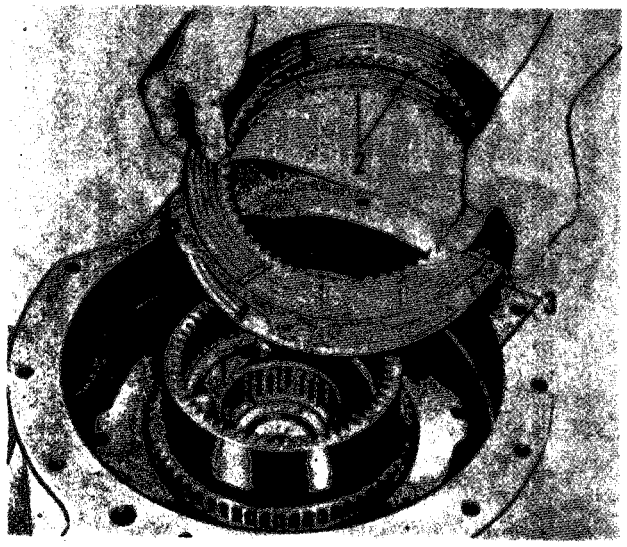
STEP 31

Attach lifting sling 1 to center of transfer gear housing 2 and lower it onto transmission housing 3, making sure springs 4 remain straight and that the bolt holes are alined. Install 18 bolts and lock washers at the split line. Place wood blocks under housing 2 to prevent the assembly tipping when the hoist is removed.



STEP 32

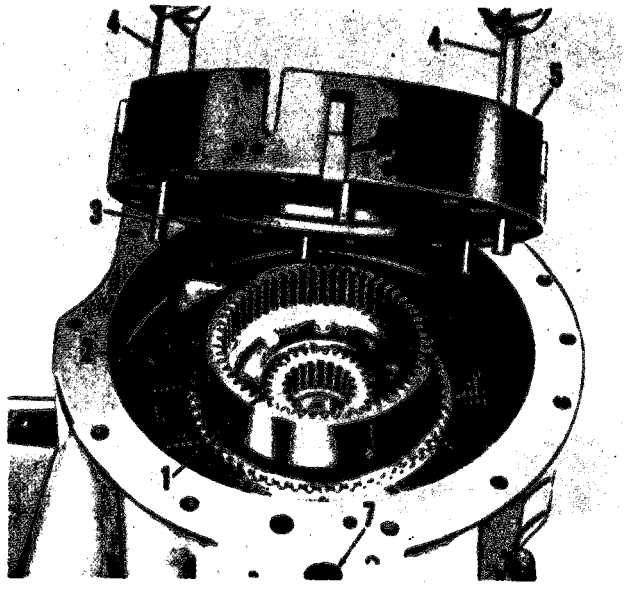
First, attach lifting sling 1 to rear lifting hole 2, raise the transmission to a vertical position and block it. Next, attach lifting sling 1 to front split line 3 and lower the transmission to rest on its rear surface. Use wooden blocks 4 to level the transmission.



STEP 33

Install thrust washer 1 inside the forward carrier. Beginning with an external-tanged clutch plate, alternately install two internal-splined 2 and two external-tanged 3, forward clutch plates.

Note: Pre-soak clutch plates 2 in type C-1 transmission oil before installation.

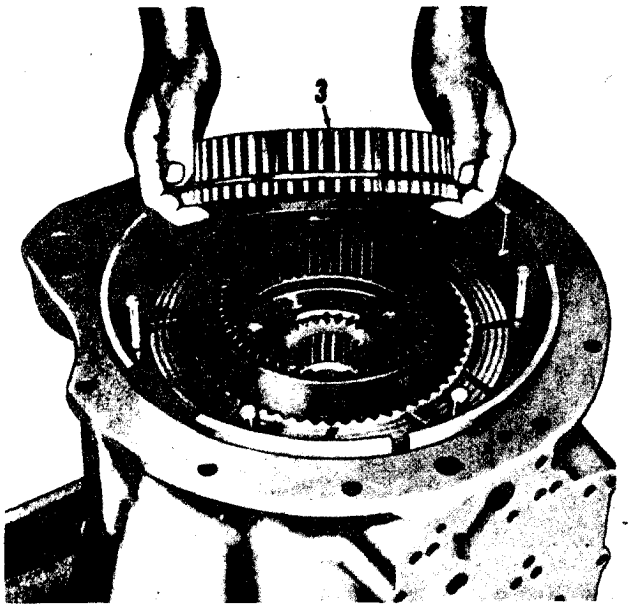


STEP 34

Install forward sun gear 1, flat side up. Aline clutch plate tangs 2 with anchor pins 3. Using wire lifting hooks 4, install the forward and reverse clutch anchor 5, alining pin slot 6 with hole 7.

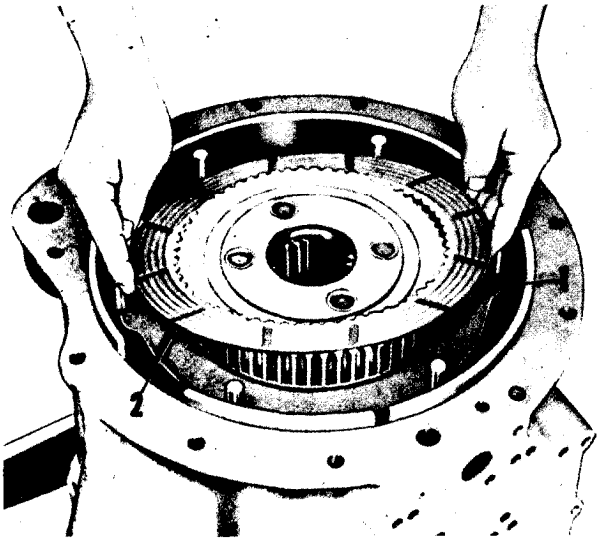
ME 3930-243-34/3-97 (9)

Figure 3-97. Transmission reassembly (sheet 9 of 15).



STEP 35

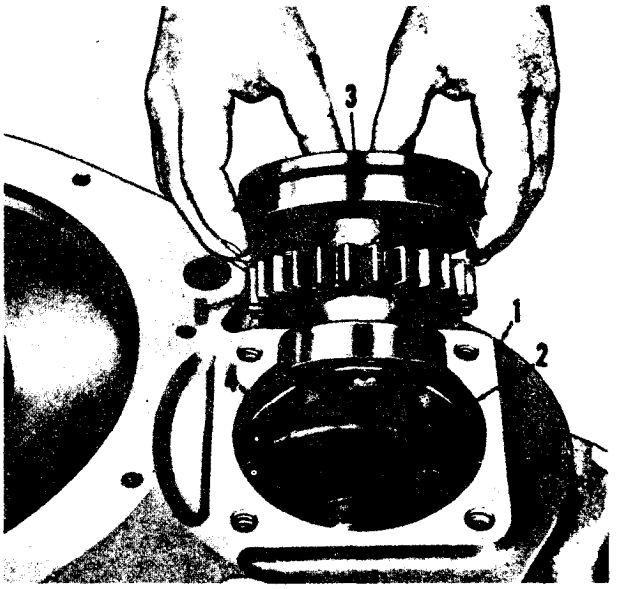
Install clutch anchor pin 1. Install one internal-splined, reverse clutch plate 2. Install reverse carrier assembly 3 with the short ends of external splines down.



STEP 36

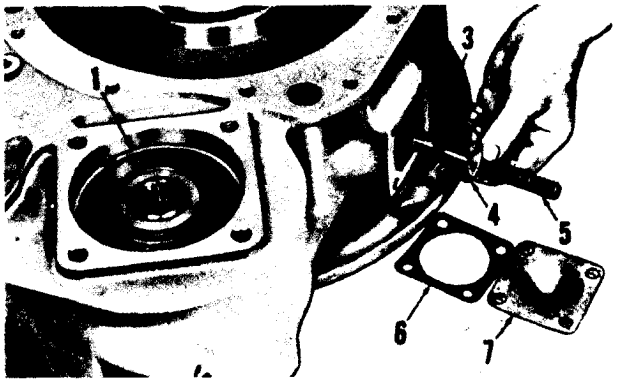
Beginning with an external-tanged plate, alternately install five external-tanged 1 and four internal-splined 2, reverse clutch plates.

Note: Pre-soak clutch plates 2 in type C-1 transmission oil before installation.



STEP 37

Position converter housing assembly 1 to rest on its front surface. Grease bore 2 so that seal ring 3 will not be damaged by snap ring groove 4. Fill the groove completely, with hard cup grease. Install seal ring 3. Install, as a unit, implement pump gear, bearing and bearing retainer 5. Tap on the unit to seat the bearing.

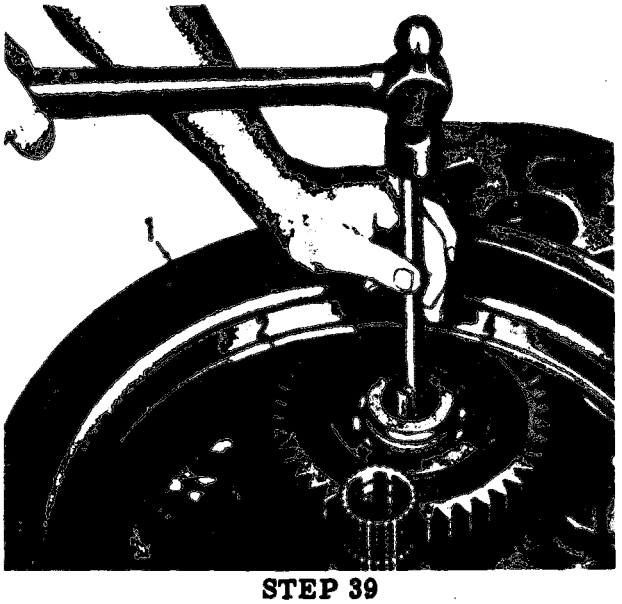


STEP 38

Install snap ring 1. Install, as a unit, pin 2, washer 3, lube valve 4, and spring 5. Install gasket 6 and cover 7. Secure the cover with four bolts and lock washers.

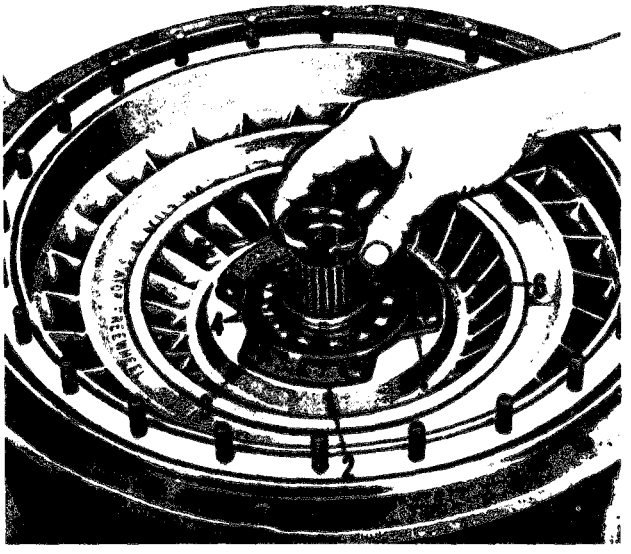
ME 3930-243-34/3-97 (10)

Figure 3-97. Transmission reassembly (sheet 10 of 15).



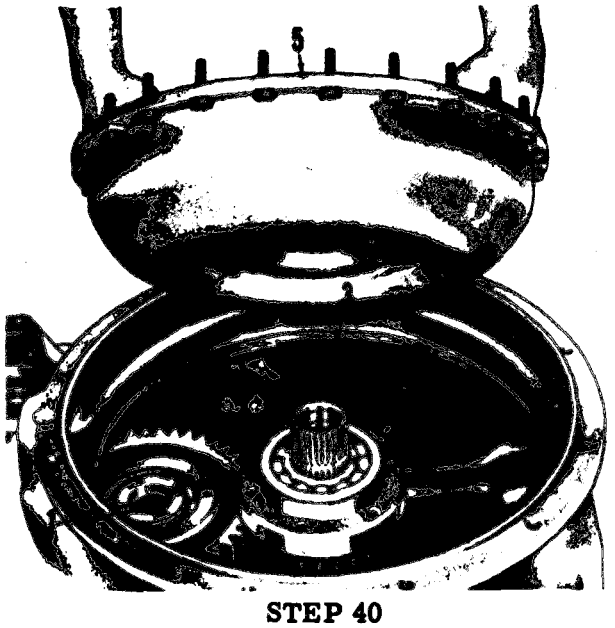
STEP 39

Position converter housing 1 to rest on its rear surface and install idler gear and bearing 2 with the hub side down. Using guide bolt 3, install idler gear spindle 4. Tap on spindle 4 to seat it in its bore. Remove guide bolt 3.



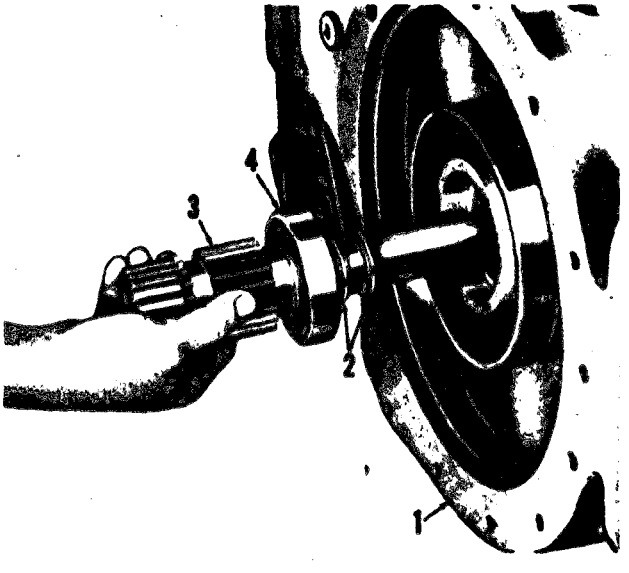
STEP 41

Install three bearing retainers 1, three lock strips 2 and six self-locking bolts 3. Bend the corners of the lock strips against the bolt heads. Install two internal-splined spacers 4 and snap ring 5 on ground sleeve 6.



STEP 40

Install idler gear spindle retainer bolt 1. Install pump drive gear and bearing assembly 2 onto converter ground sleeve 3. Install gasket 4, using oil-soluble grease to retain it. Install converter pump assembly 5, alining the bolt holes.

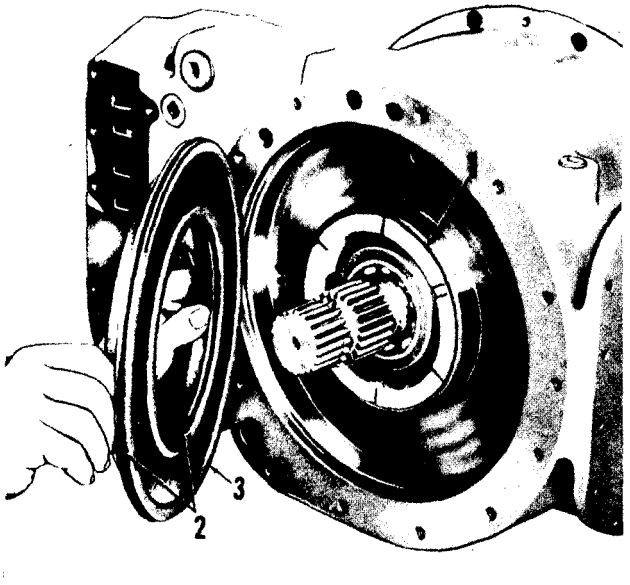


STEP 42

Position converter housing 1 to rest on its right side. Install hook-type seal rings 2 onto converter shaft 3. Install bearing 4, if it was removed. Install the shaft assembly into the rear of housing 1 and tap on the outer race of bearing 4 to seat it in its bore.

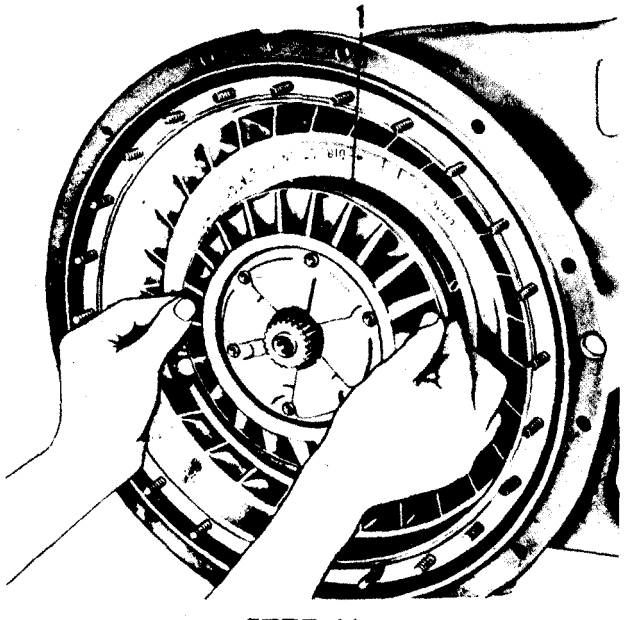
ME 3930-243-34/3-97 (11)

Figure 3-97. Transmission reassembly (sheet 11 of 15).



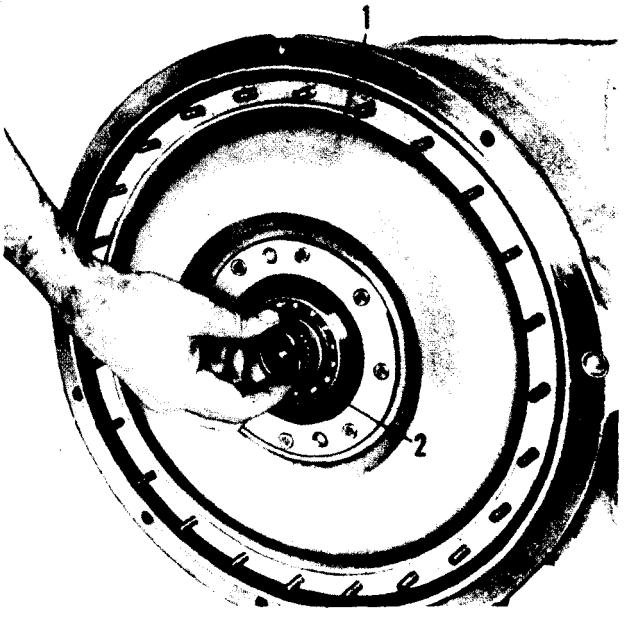
STEP 43

Grease spacer 1 with oil-soluble grease and install it with the recesses clearing the ground sleeve bolt heads. Grease seal rings 2. Install reverse-range piston 3 into the converter housing.



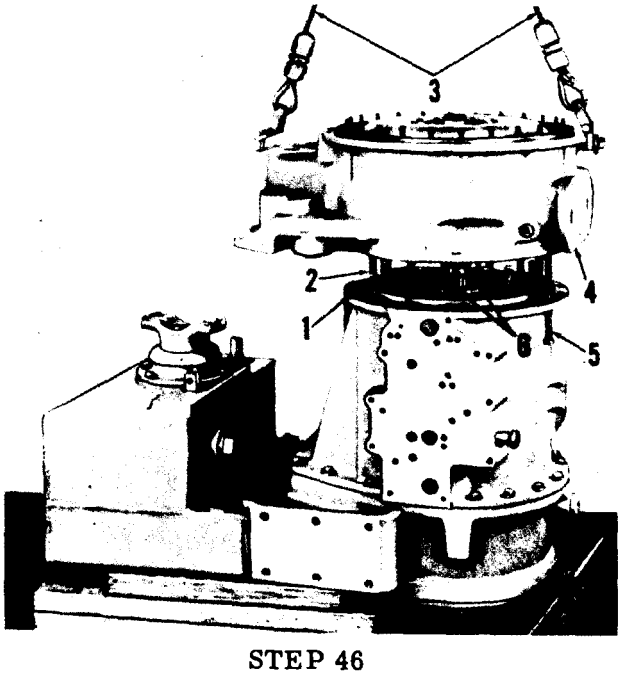
STEP 44

Grasp stator assembly 1. Hold freewheel roller race in position. Turn stator 1 on edge and install it onto the ground sleeve 6 (step 41).



STEP 45

Install turbine assembly 1 and secure it with snap ring 2.



STEP 46

Install gasket 1. Install twelve piston return springs and spring guides 2. Attach lifting sling 3 to converter housing 4 and lower it into position. Use guide bolt 5 to aline bolt holes. If necessary, rotate the turbine to aline the turbine shaft splines 6 with forward-range sun gear and the reverse-range pinions.

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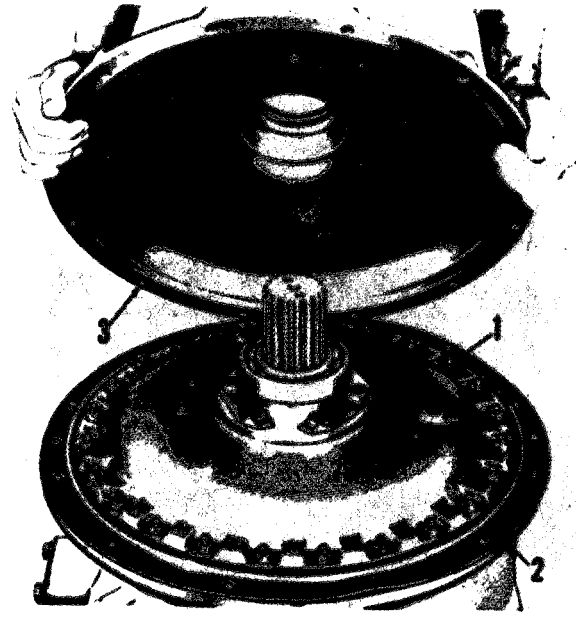
Figure 3-97. Transmission reassembly (sheet 12 of 15).

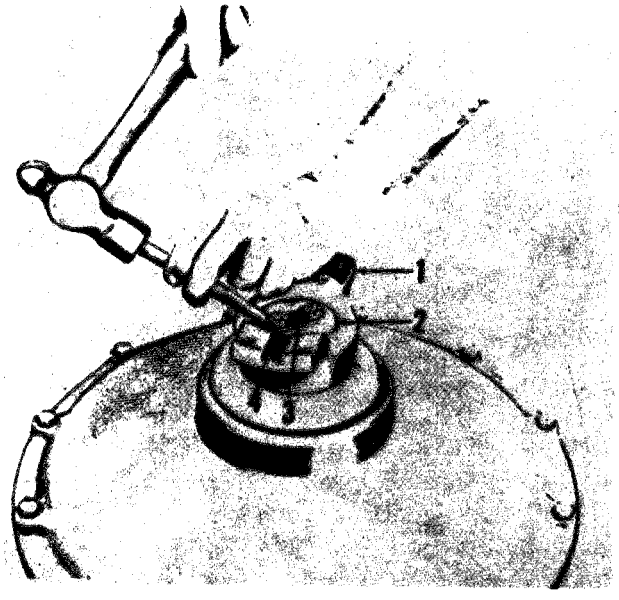
STEP 47

Secure converter housing with 13 bolts and lock washers 1. Install converter pump cover assembly 2. Using a soft hammer, tap on cover 2 to seat bearing 3 in its bore 4.



STEP 48

Install 24 self-locking nuts 1. Install gasket 2 and transmission front cover assembly 3.

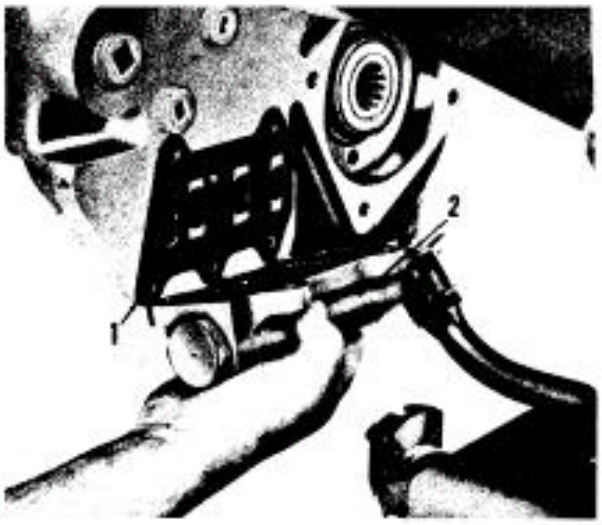


STEP 49

Install input flange 1 onto the converter drive shaft. Install flange retainer washer 2 with the machined side next to the shaft. Install lock strip 3 and two self-locking bolts 4. Bend the ends of lock strip 3 around bolts 4.

ME 3930-243-34/3-97 (13)

Figure 3-97. Transmission reassembly (sheet 13 of 15).



STEP 55

Install gasket 1 and pressure regulator valve body assembly 2 onto the lower rear surface of the torque converter housing.

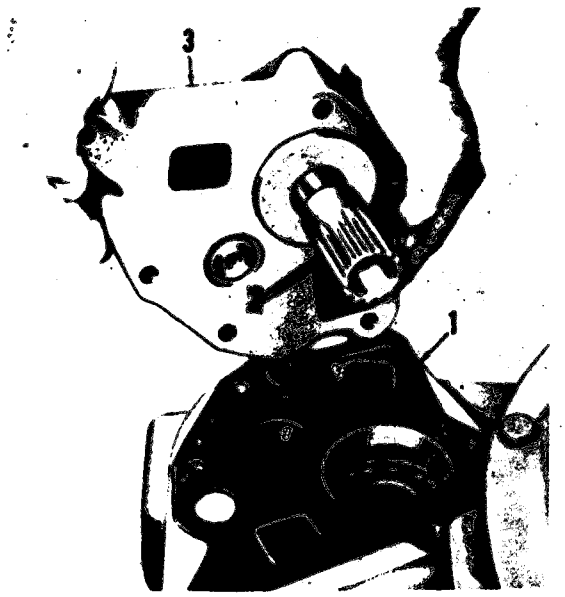
STEP 57

Install gasket 1 and oil cooler core 2 onto the top of the converter housing. Install gasket 3 and oil cooler cover 4 onto the top of core 3. Secure cover 4 with twelve bolts.

Note: Drain plug on cover 4 is located toward the left side of the transmission.

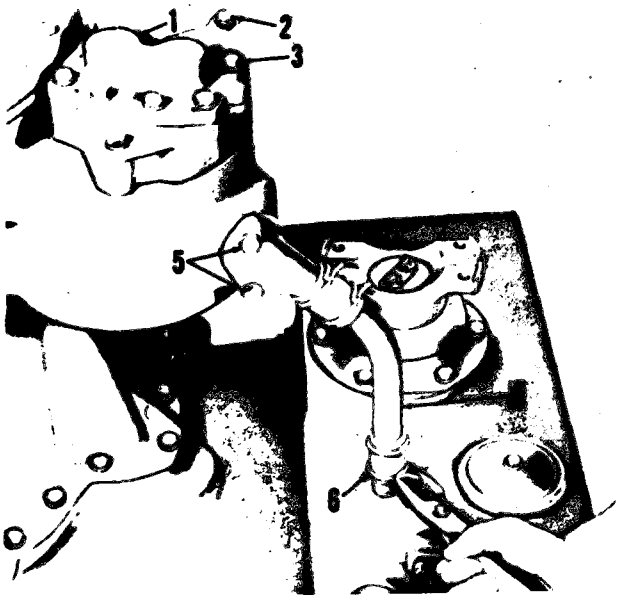
ME 3930-243-34/3-97 (15)

Figure 3-97. Transmission reassembly (sheet 14 of 15).



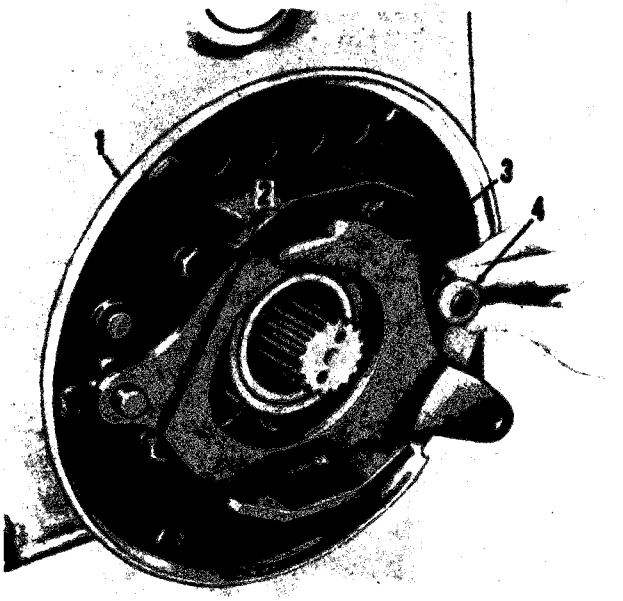
STEP 50

Install pump gasket 1. Install coupling 2 on the pump shaft and install input charging oil pump assembly 3.



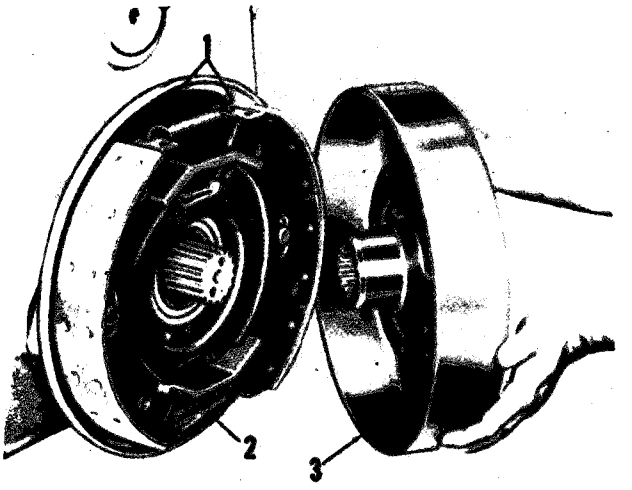
STEP 51

Secure oil pump 1 with two short bolts and lock washers 2 and four long bolts and lock washers 3. Assemble oil drain tube assembly 4 and install it on the transmission. Secure the assembly with two bolts and lock washers 5 and hose clamp 6. Be sure there is a gasket under the converter drain tube flange.



STEP 52

Attach a lifting sling to the front lifting hole in the top of the converter housing and raise the transmission to a vertical position. Install brake back plate 1 and secure it with three bolts and lock washers 2. Install brake lever 3 and brake roller 4.



STEP 53

Install two brake shoe assemblies 1 and two springs 2. Install brake drum and flange assembly 3 onto the rear-output shaft.

ME 3930-243-34/3-97 (14)

Figure 3-97. Transmission reassembly (sheet 15 of 15).

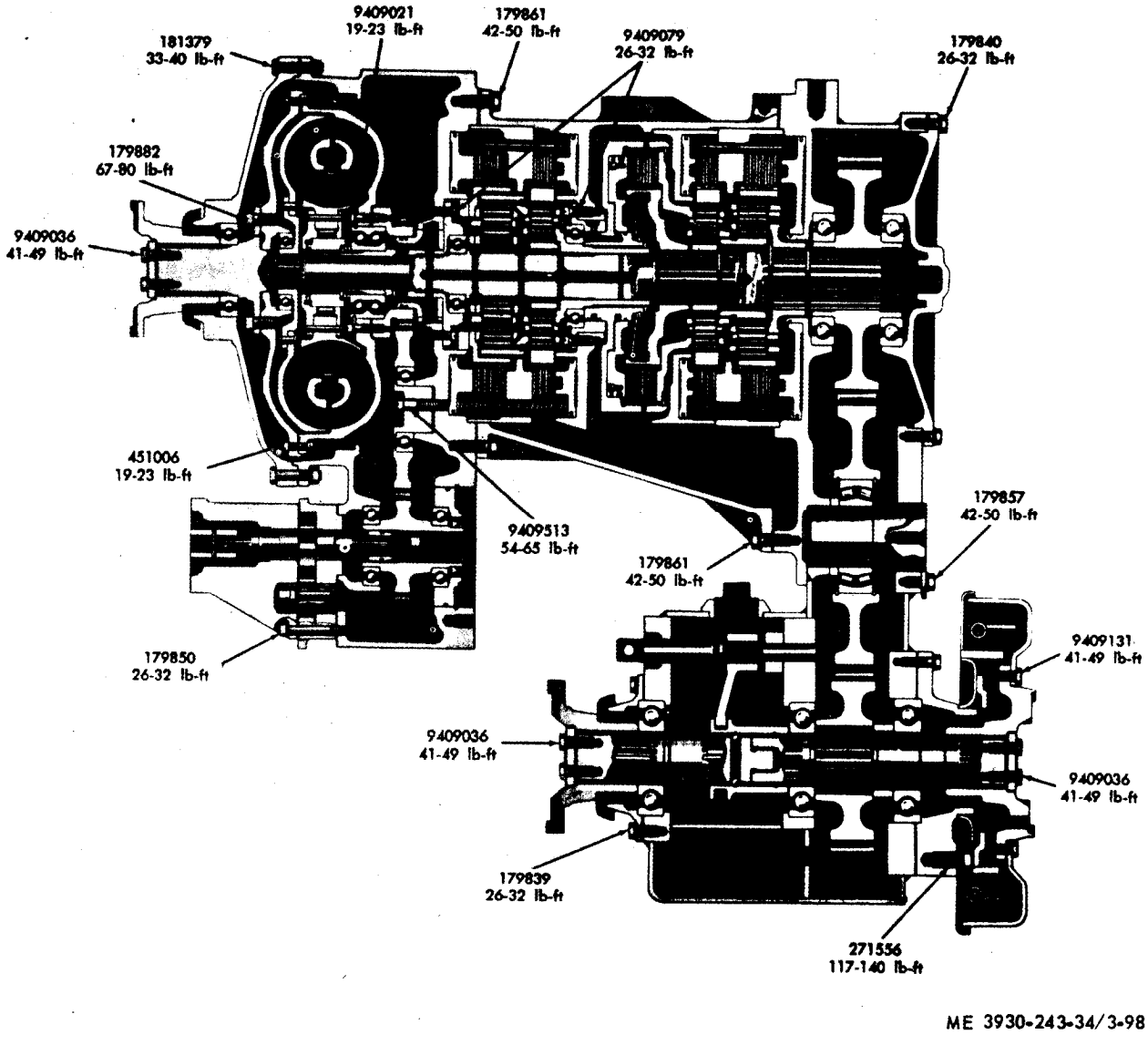


Figure 3-98. Transmission torque valves.

f. Pressure Checking.

(1) *Main pressure check.*

(a) The main pressure may be checked by the gage on the instrument panel.

(b) The main pressure at full throttle stall should be approximately 110 to 135 psi.

(2) *Converter-out-pressure check.*

(a) The converter-out-pressure may be checked at the point provided for attaching the temperature gage sending unit at the upper left side of the converter housing.

(b) Maximum converter-out-pressure at full throttle top speed is 65 psi, with transmission at normal operating temperature (180° to 200° F.).

(3) *Lubrication oil pressure.* The lubrication oil pressure should be 20 to 25 psi when the transmission is in low range, forward, with the output stalled and the transmission at normal operating temperatures (180° to 200° F.) and the engine running at 1,000 rpm.

g. Linkage Adjustment.

(1) *Range selector linkage.* The linkage must be adjusted so that the operator's control is positioned to correspond exactly to the detent positions of the range selector valve. With the linkage disconnected, place both the selector valve and the operator's control in neutral position. Adjust the linkage so that it can be freely connected without moving the valve or the control. Then try the control in each range position. Make minor adjustments, if necessary, to insure that the selector valve detent seats at every range position of the operator's control.

(2) *Forward-reverse linkage.* The forward and reverse control linkage must be adjusted so that the neutral, forward. and reverse detent positions of the

valve correspond exactly with those of the operator's control. This adjustment is made in a manner similar to the adjustment of the range selector linkage ((1)above).

(3) *Inching control linkage,* The inching control valve is linked to a manual control valve, expressly for inching. This valve is the transmission disconnect control valve. The transmission disconnect control valve is located under driver's floor board. For removal and installation, refer to TM 10-3930-243-12. The linkage must be adjusted to insure full application and full release. The inching control valve has a total linear movement of 2.02 inches from full retract (released) to full extension (applied).

(4) *Output disconnect linkage.* There are two points of adjustment for the rear output disconnect on the transmission. The shifter shaft must be-adjusted first, and then the linkage. Put the shifter shaft in (rearward) until the engaged detent seats. Adjust the shifter shaft by rotating it until the center of the linkage connection hole is 0.610 to 0.650 inch from the front surface of the transfer case. When the shifter shaft is pulled outward (rearward), the disconnect detent should seat when the center of the shaft hole is approximately 23/8 inches from the transfer case surface. Adjust the linkage so that the engaged and disconnect positions of the operator's control correspond exactly with the detent positions of the shaft.

3-39. Converter Stall Test

a. General. The converter stall test is a test of the engine and transmission as a unit, wherein the transmission output is stalled while the engine is operated at full throttle. This test will indicate, by the speed which the engine reaches, whether the engine and transmission are performing satisfactory under full load. A lower or higher speed than that established as normal are indications of either engine or transmission malfunction.

b. Procedures.

(1) The test is made while the engine and transmission are installed. The vehicle wheels must be blocked securely to prevent movement. The brakes should be applied except on those in-stallations which include a clutch cutoff valve.

(2) Start the engine and allow the transmission to warm up to normal operating temperature (180° to 200° F.).

(3) Shift the transmission controls to high range and forward.

(4) Increase the engine speed to full throttle. Converter out pressure should be 25 psi minimum.

NOTE

Do not allow converter out temperature to exceed 250° F. Do not maintain full stall condition longer than 30 seconds.

(5) Use a tachometer and record the engine speed attain at full throttle operation.

(6) The only reading derived from the stall test is engine speed. The difference between established normal speed and actual speed recorded is significant only if it exceeds 150 rpm.

3-40. Transmission Main Oil Pressure Regulating Valve

a. General. The main pressure regulating valve is located on lower side of transmission secured to the torque converter housing and supplies pressure to the control valve.

b. Removal. Refer to figure 3-96, step 4, and remove transmission main oil pressure regulating valve,

c. Disassembly. Refer to figure 3-99 and disassemble transmission main oil pressure regulating valve in numerical sequence.

d. Cleaning and Inspection,

(1) Clean all parts.

(2) Clean oil passages by working a piece of wire back and forth through passages and flush with cleaning solvent,

(3) Inspect bores for wear, grooves, scratches, and dirt. Remove scratches and burs with crocus cloth .

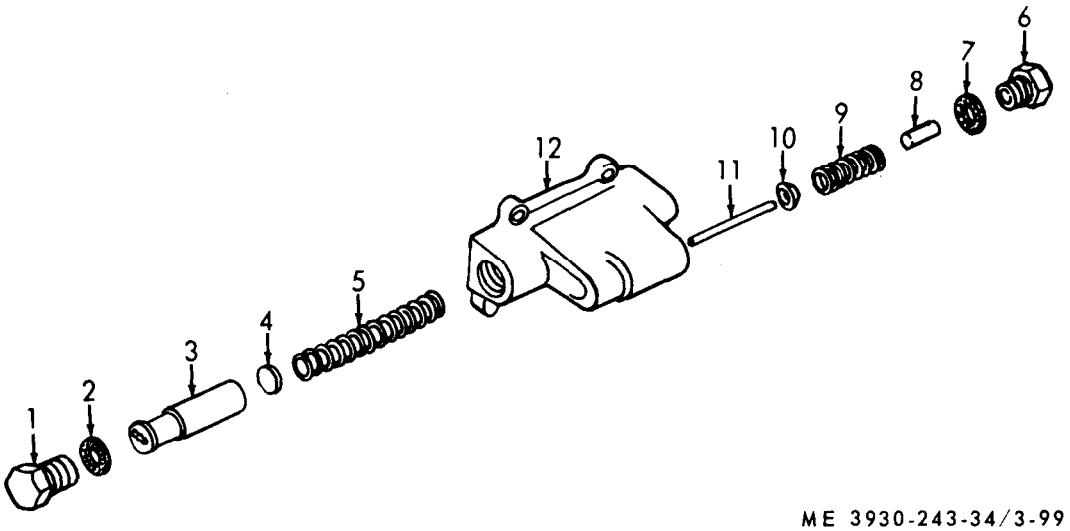
(4) Clean and inspect gasket area. Replace a defective part.

e. Reassembly. Refer to figure 3-99 and reassemble the transmission main oil pressure regulating valve.

NOTE

The main oil pressure regulating valve may be adjusted by adding or removing shims. Each shim will raise or lower pressure approximately 10 psi.

f. Installation. Refer to figure 3-97, step 55, and reinstall transmission main oil pressure regulating valve.



1 Plug
2 Gasket
3 Valve
4 Shim
5 Spring
6 Plug
7 Gasket
8 Tube
9 Spring
10 Valve
11 Pin
12 Body

Figure 3-99. Transmission main oil pressure regulating valve, disassembly and reassembly.

3-41. Transmission Control Valve

a. General. The transmission control valve is secured to the side of transmission housing by 11 bolts and lockwashers. The control valve body assembly houses the forward-reverse control valve assembly, the range selector valve and the clutch cut off valve.

b. Removal. Refer to figure 3-96, step 4, and remove control valve.

c. Disassembly. Refer to figure 3-100 and disassemble control valve in numerical sequence.

d. Cleaning and Inspection.

(1) Clean all parts.

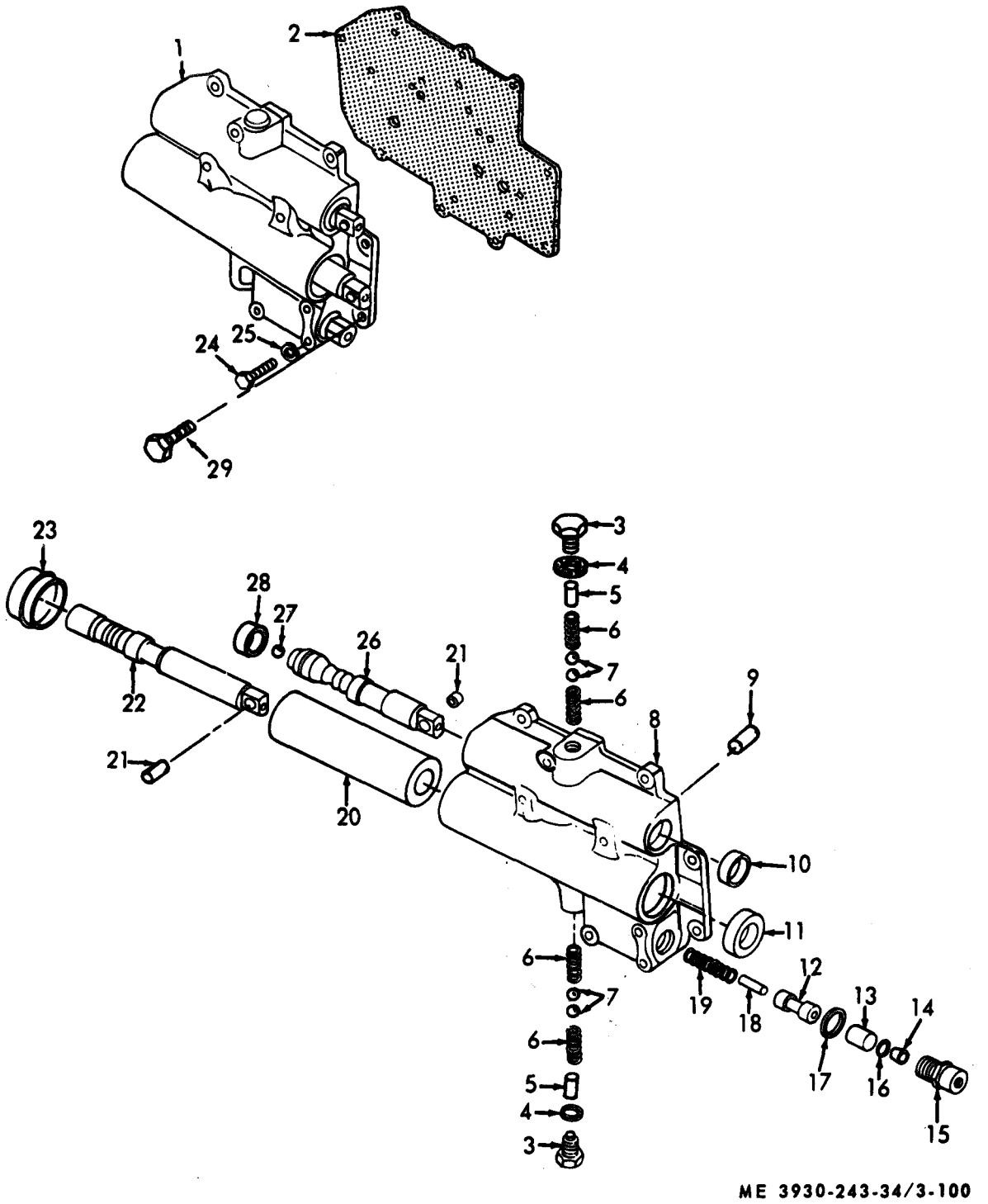
(2) Clean all oil passages.

(3) Inspect cast for nicks, scratches, and grooves. Remove burs with crocus cloth. Replace parts that are deeply grooved or scratched.

(4) Inspect threaded openings for damaged threads.

e. Reassembly. Refer to figure 3-100 and reassemble control valve. Reassemble in the reverse order of disassembly.

f. Installation. Refer to figure 3-97, step 56, and install control valve.



1 Valve assembly
2 Gasket
3 Plug
4 Gasket
5 Pin
6 Spring
7 Ball
8 Body
9 Pin
10 Seal
11 Seal
12 Cut-off valve
13 Plug
14 Cup
15 Plug
16 O-ring
17 Gasket
18 Pin
19 Spring
20 Sleeve
21 Bushing
22 Valve
23 Cup
24 Bushing
25 Range valve
26 Ball
27 Cap
28 Bolt
29 Washer
30 Bolt

Figure 3-100. Transmission control valve, disassembly and reassembly.

Section VIII. PROPELLER SHAFTS

3-42. General

This section contains information on the maintenance of the propeller shafts. This includes the front propeller shaft, rear propeller shaft, and the engine propeller shaft. The front propeller shaft drives the front wheels, the rear propeller shaft drives the rear wheels, and the engine propeller shaft is mounted to the engine and the input shaft on the transmission. The universal joints are disconnected in order to remove the shafts.

3.43. Engine Propeller Shaft

a. Removal. Refer to figure 3-101 and remove the engine propeller shaft.

b. Disassembly. Refer to figure 3-102 and disassemble the engine propeller shaft in numerical sequence.

c. Inspection.

(1) Inspect universal joints for cracks, wear, looseness, rough or binding operation.

(2) Inspect drive shaft and yokes for cracks, distortion or other damage.

(3) Replace excessively worn or damaged parts.

d. Reassembly. Refer to figure 3-102 and reassemble the engine propeller shaft.

e. Installation. Refer to figure 3-101 and install the engine propeller shaft. Torque universal joint bearing capscrews to 55-60 ft. lbs.

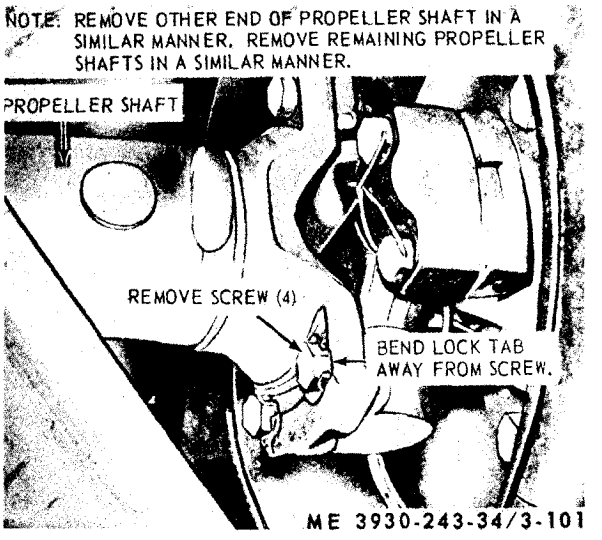
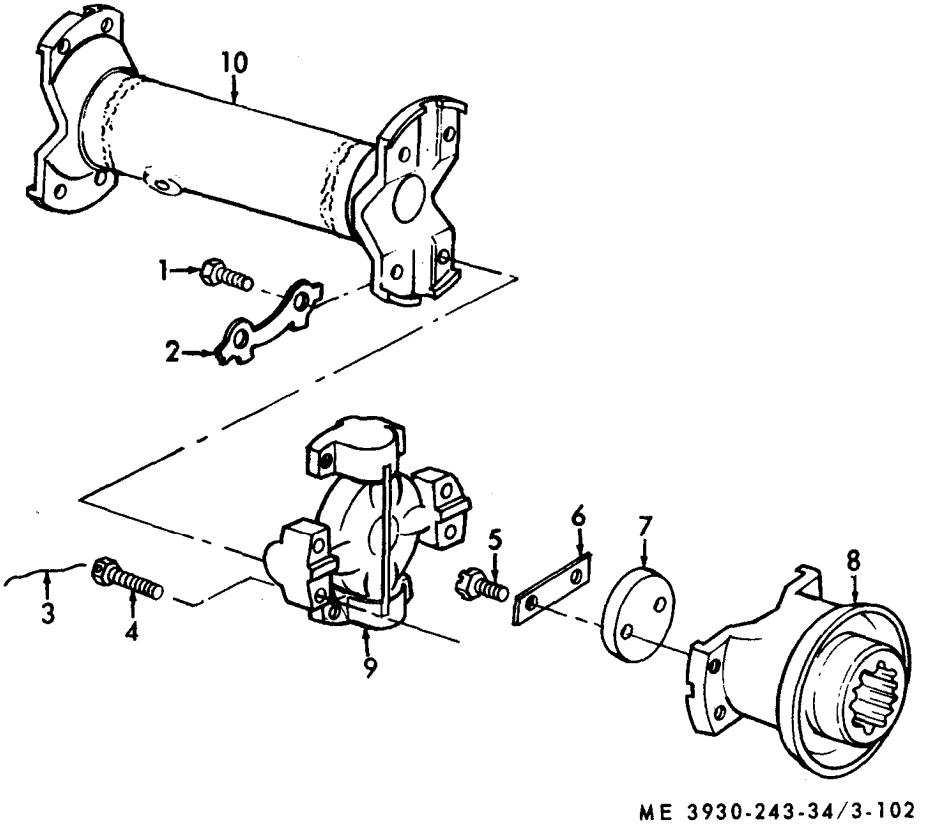


Figure 3-101. Propeller shaft, removal and installation.



1 Screw
2 Lockplate
3 Lockwire
4 Screw
5 Screw
6 Strap
7 Washer
8 Flange
9 Spider assembly
10 Tube assembly

Figure 3-102. Propeller shaft engine to transmission, disassembly and reassembly.

3-44. Front Propeller Shaft

a. Removal. Remove the front propeller shaft (fig. 3-101).

b. Disassembly. Refer to figure 3-103 and the front propeller shaft.

c. Cleaning and Inspection.

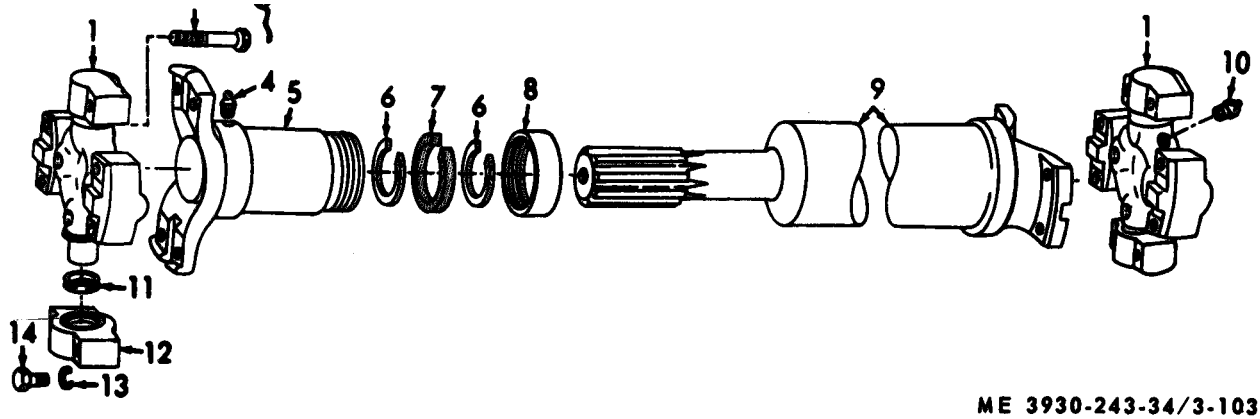
(1) Clean all parts.

(2) Inspect all parts for cracks, abrasions, scoring, and looseness.

(3) Replace unserviceable parts with serviceable parts.

d. Reassembly. Refer to figure 3-103 and assemble front propeller shaft.

e. Installation. Install front propeller shaft (fig. 3-103). Torque universal joint bearing capscrews to 55-60 ft. lbs.



ME 3930-243-34/3-103

1 Speeder assembly
2 Screw
3 Lockwire
4 Lubrication fitting
5 Slip yoke
6 Washer
7 Felt
8 Dust cap
9 Tube assembly
10 Lubrication fitting
11 Retainer
12 Dust shield
13 Lockwasher
14 Bolt

Figure 3-103. Front propeller shaft, disassembly and reassembly.

3-45. Rear Propeller Shaft

a. Removal. Remove the rear propeller shaft (fig. 3-101).

b. Disassembly. Refer to figure 3-104 and disassemble the rear propeller shaft.

c. Cleaning and Inspection.

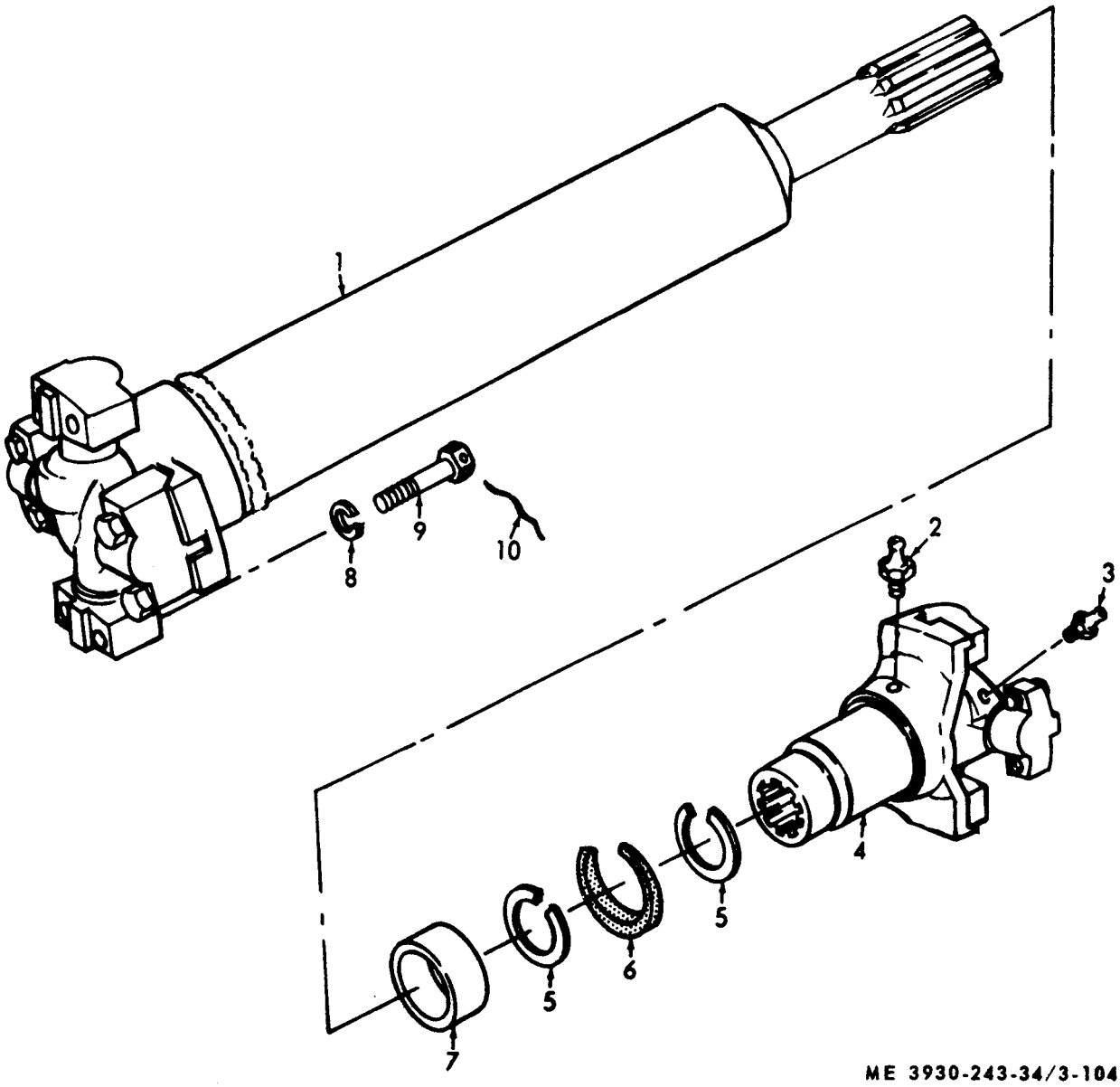
(1) Clean all parts.

(2) Inspect all parts for cracks, breaks, excessive wear, or any other damage.

(3) Replace any unserviceable part with a serviceable part.

d. Reassembly. Refer to figure 3-104 and reassemble the rear propeller shaft.

e. Installation. Install the rear propeller shaft (fig. 3-101). Torque universal joint bearing capscrews 55-60 ft. lbs.



1 Tube assembly
2 Lubrication fitting
3 Lubrication fitting
4 Slip yoke
5 Split washer
6 Felt
7 Dust cap
8 Lockwasher
9 Capscrew
10 Lockwire

Figure 3-104. Rear propeller shaft. removal and installation,

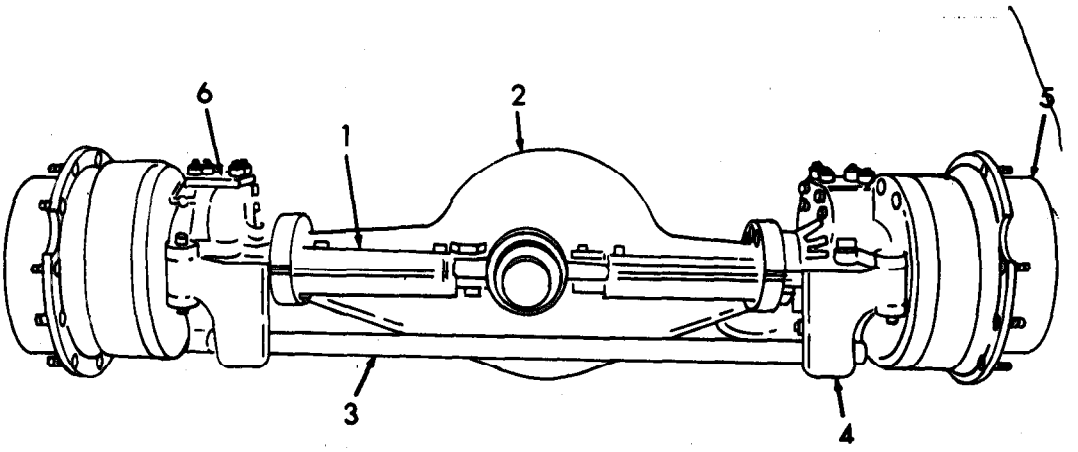
Section IX. FRONT AND REAR AXLE ASSEMBLIES

3-46. General

This section contains information on the maintenance of the front and rear axle assemblies. The maintenance on the front and rear axle assemblies are almost identical. Only one axle will be discussed in this section.

3-47. Front Axle Assembly

a. Removal. Refer to paragraph 2-12 and remove the front axle assembly as an assembly (fig. 3-105).



1 Steering cylinder
2 Axle housing
3 Tie rod
4 Tie rod yoke
5 Planetary gear housing
6 Ballhousing

Figure 3-105. Axle *assembly, removal and installation.*

b. Disassembly. Refer to figure 3-106 and disassemble the front axle assembly as described below.

NOTE

Before disassembly of axle, remove plug (28) and drain oil from the hub assembly (27) and remove plug and drain oil from the axle housing (124).

(1) Remove the planetary gears and hub (1 thru 20). Do not disassemble the spider assembly unless necessary.

(2) Remove the planetary drive gear and hub assembly (21 thru 35).

(3) Remove the brake hose at fitting connector (39) and remove the brake assembly (36 thru 40).

(4) Remove the spindle assembly (41 thru 45) and remove the axle (46) from housing (58) and (61).

(5) Remove and disassemble the front housing (47 thru 59) and remove the socket (60) and remove the rear housing (61 thru 63).

(6) Remove opposite axle and steering support in the same manner as described above.

NOTE

Both axles must be removed in order to remove the differential carrier.

(7) Remove the carrier assembly (921. Break carrier loose from the axle housing (124) with a rawhide mallet.

NOTE

Do not disassemble the carrier assembly unless absolutely necessary.

(8) Center punch cm differential carrier leg (92) and bearing cap (91) to identify for proper reassembly and remove the differential assembly.

(9) Remove differential yoke, bearings and pinion gear (64 thru 84).

(10) Disassemble the differential assembly (93 thru 115).

NOTE

Punch mark case (97), gear (114) and case (115) to identify for proper reassembly.

c. Inspection and Repair.

(1) Inspect all bearings, cups, cones, and gears for excessive wear, looseness, ridges, pitting and scoring.

(2) Inspect axle shafts for torsional fractures, stress, excessive wear or other impending failures.

(3) Inspect housing for cracks or damage.

(4) Replace parts if worn, pitted or damaged. Replace all gaskets and seals with new parts.

(5) Remove nicks, burrs, and mars from machined or ground surfaces with crocus cloth. Insure that threads are clean and free and not worn beyond limitations.

d. Reassembly.

NOTE

Refer to current lubrication order for bearings, shaft. gear, differential oil and other intricate moving parts which require proper lubrication.

(1) Refer to figure 3-106 and reassemble the axle assembly. Reassemble in the reverse order of disassembly.

(2) Install mounting hardware 116 thru 123 on axle housing (124).

(3) Reassemble the differential assembly (93 thru (115) as follows:

(a) Attach ring gear (114) to case (115) with screws (111 and 113) and nut (114).

(b) Press bearing (94) on differential case (97) and (115).

(c) Assemble no spin assembly (98 thru 110) and place this assembly on flanged differential case (115).

(d) Tap plain differential case (97) into place, aligning punch marks made during disassembly. Install screw (95) and nuts (96). Tighten to correct torque.

(4) Assemble the differential pinion and bearing (64 thru 92) as follows:

(a) Press pilot bearing (84) on drive pinion (83), then stake in four places.

(b) Press bearing cone (79) on pinion. Lubricate bearing.

(c) Press bearing cup (72) into pinion bearing case (73). Install new gasket (72) and oil seal (71) in oil seal retainer (70).

(d) Install yoke assembly (67).

(5) Reassemble differential assembly in carrier (92). Insure that punch marks on carrier leg (92) and cap (91) are aligned for proper fit. Tighten to specified torque (para 1-4).

(6) Adjust backlash 0.006 to 0.016 as follows:

(a) If backlash is too great, back off adjusting nut on plain half case 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.

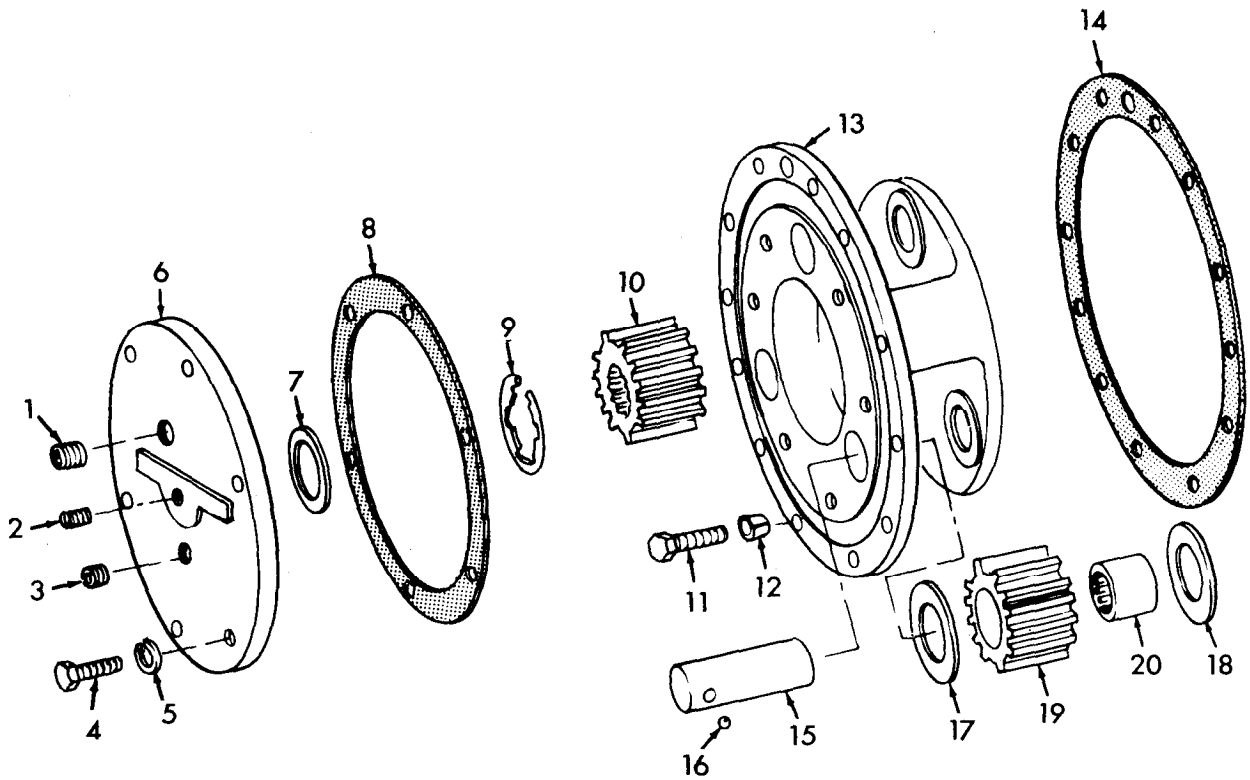
(c) Tighten carrier cap bolts to specified torque. Recheck backlash. If backlash is not within limits repeat above procedure to correct. Install bearing adjusting nut locks and secure with screw and lockwasher; lockwire to prevent loosening. Refer to figure 3-107 for correct tooth contact.

(7) Install carrier housing (92) to axle housing (124).

(8) Reassemble axle assembly in reverse order of disassembly.

NOTE

Torque all bolts to specified torque as shown in

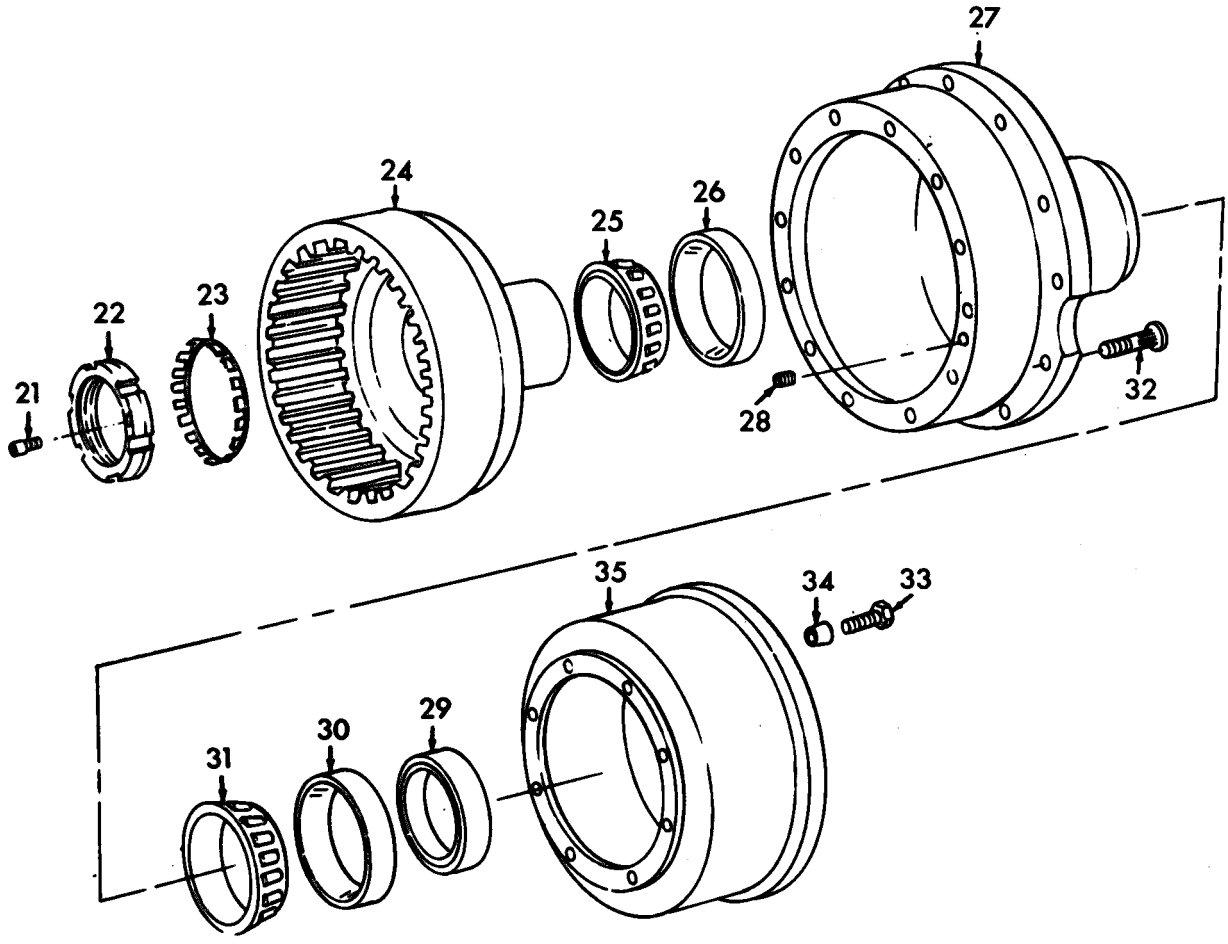


A. PLANETARY GEAR

ME 3930-243-34/3-106 (1)

1 Plug
2 Plug
3 Plug
4 Screw
5 Lockwasher
6 End cover
7 Washer
8 Gasket
9 Ring
10 Sun gear
11 Screw
12 Bushing
13 Planetary case
14 Gasket
15 Pin
16 Ball
17 Washer
18 Washer
19 Gear
20 Needle bearing

Figure 3-106. Axle assembly, disassembly and reassembly (sheet 1 of 6).

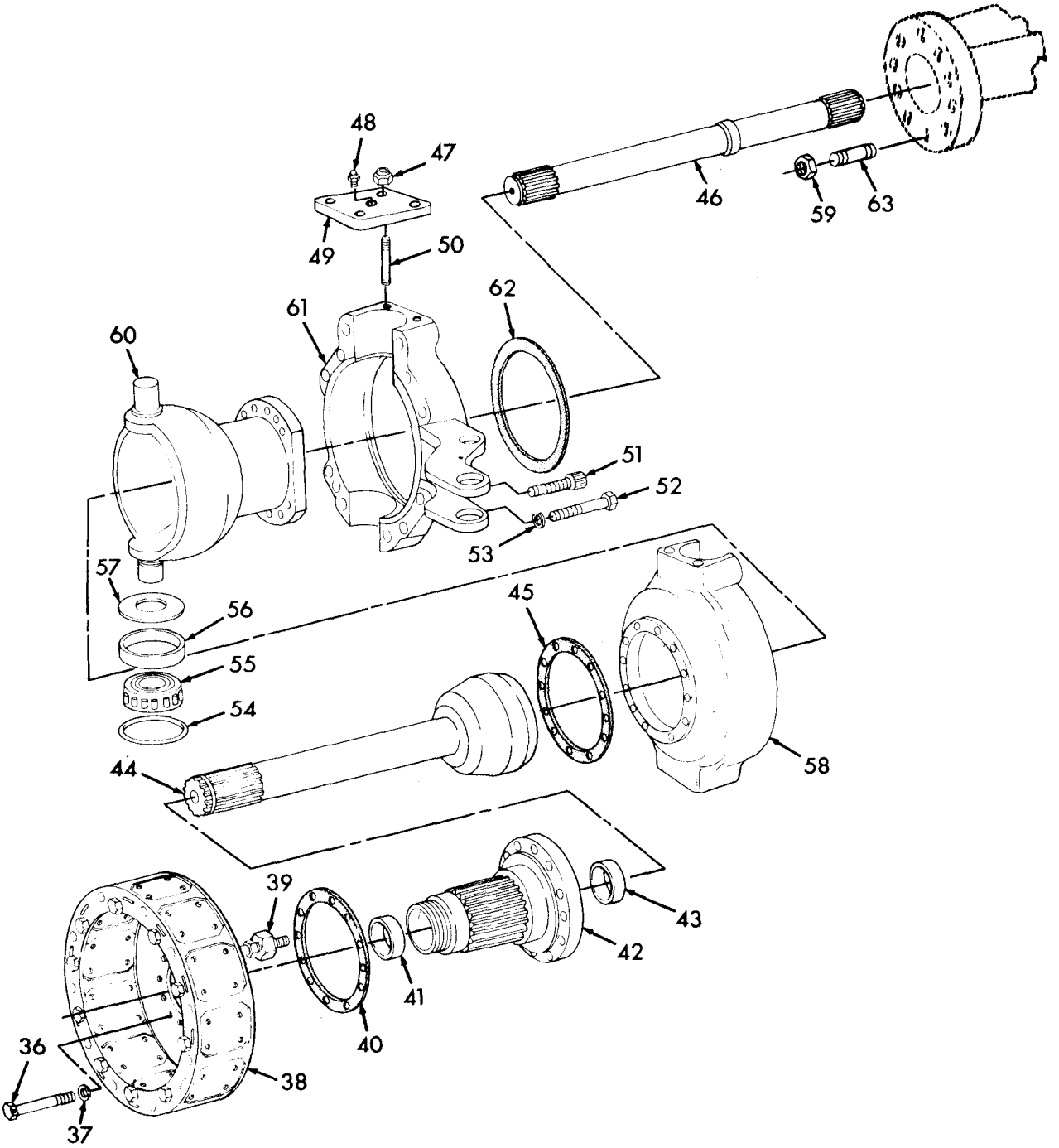


B. PLANETARY GEAR AND HUB ASSEMBLY

ME 3930-243-34/3-106 (2)

21 Screw
22 Nut
23 Washer
24 Gear
25 Bearing
26 Bearing cup
27 Wheel hub
28 Drain plug
29 Seal
30 Bearing cup
31 Bearing
32 Bolt
33 Screw
34 Wedge
35 Brake drum

Figure 3-106. Axle assembly, Disassembly and reassembly (sheet 2 of 6).

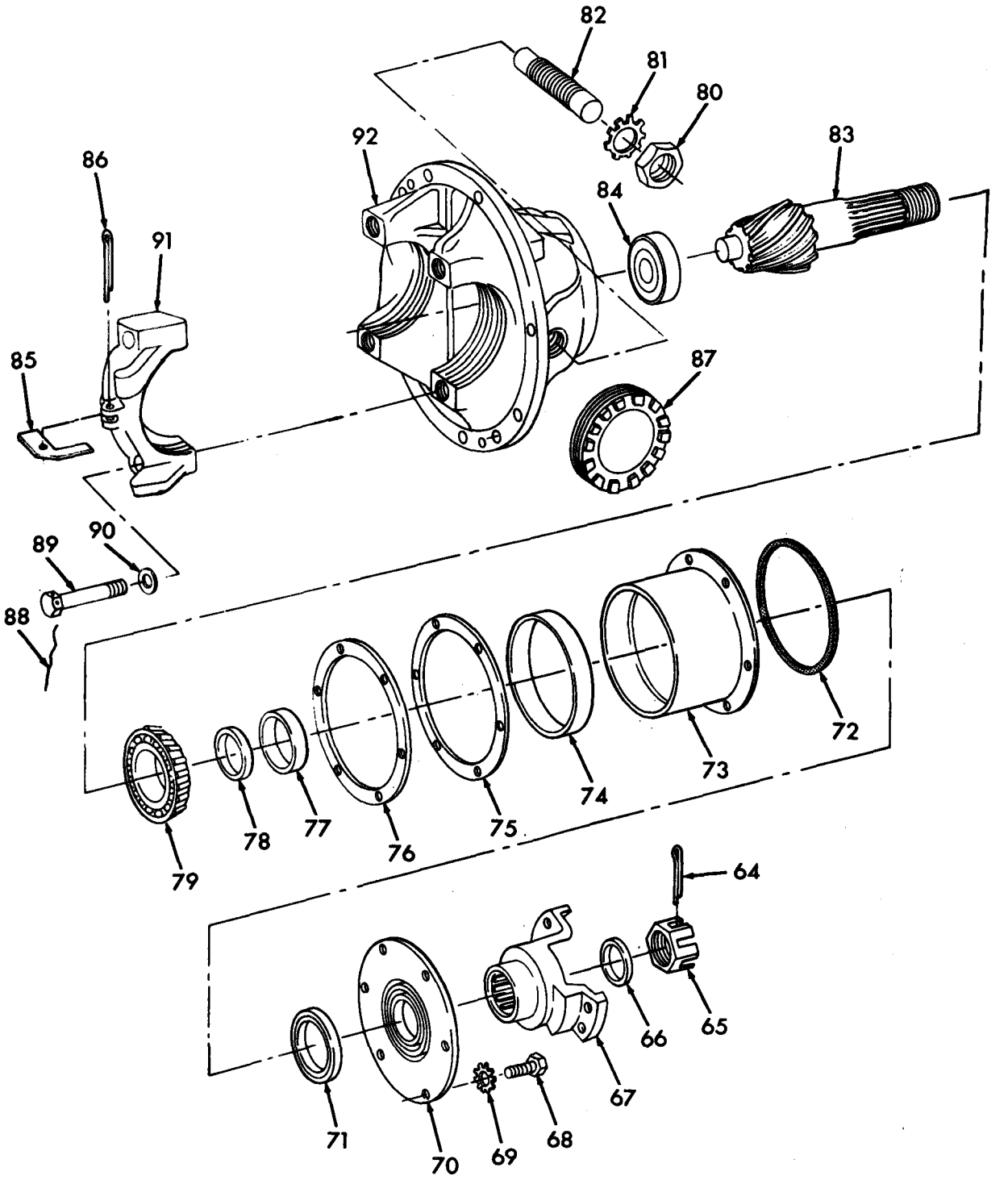


C. STEERING SUPPORT, AXLE AND BRAKE ASSEMBLY

ME 3930-243-34/3-106 (3)

36 Screw
37 Washer
38 Brake assembly
39 Connector
40 Gasket
41 Seal
42 Spindle
43 Seal
44 Shaft
45 Gasket
46 Axle
47 Nut
48 Grease fitting
49 Cover
50 Stud
51 Screw
52 Screw
53 Lockwasher
54 Spacer
55 Bearing
56 Bearing cup
57 Grease retainer
58 Housing
59 Nut
60 Socket
61 Housing
62 Gasket
63 Stud

Figure 3-106. Axle assembly, disassembly and reassembly (sheet 3 of 6).

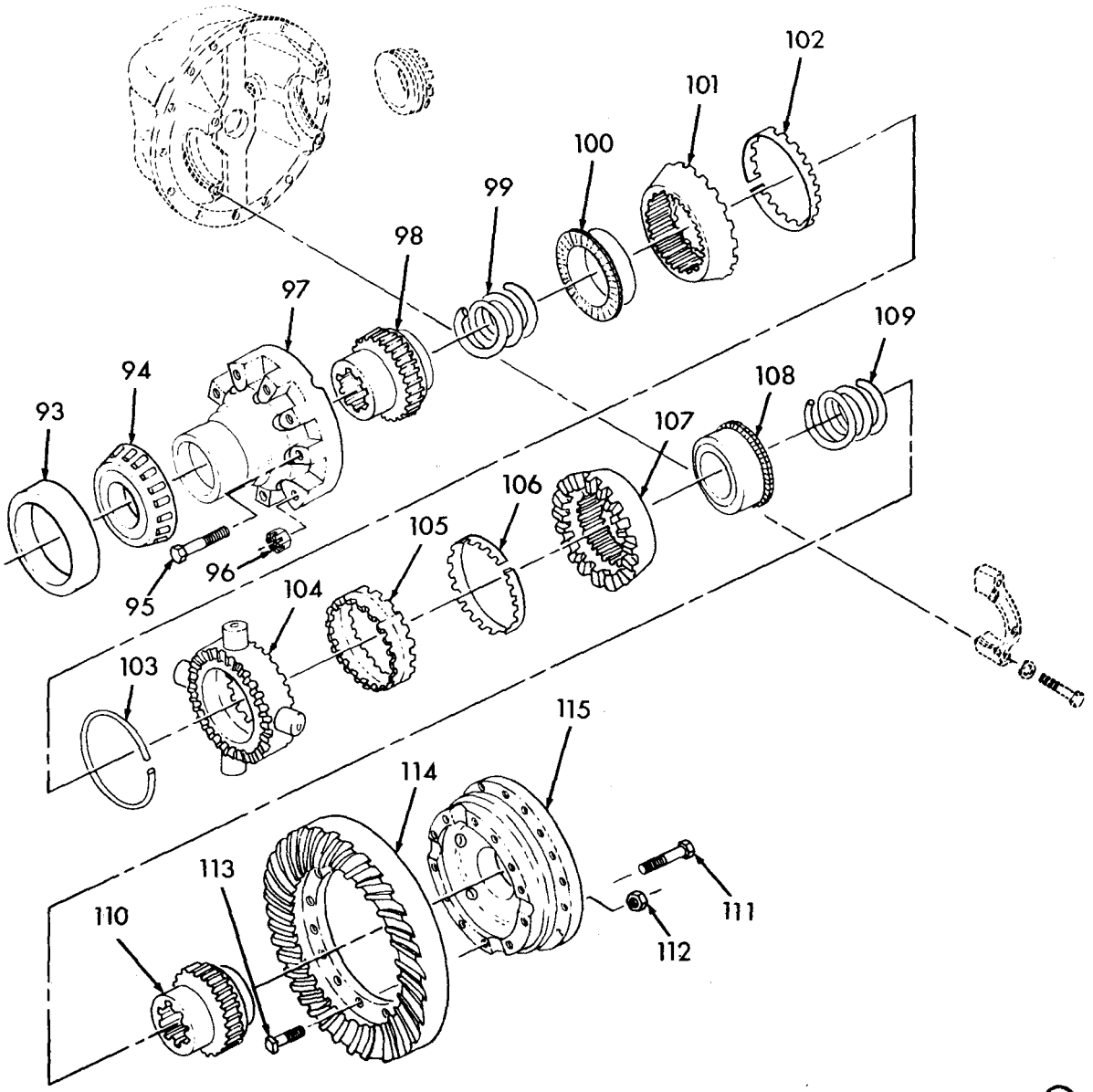


D. DIFFERENTIAL PINION AND BEARING

ME 3930-243-34/3-106 (4)

64 Cotter pin
65 NUt
66 Washer
67 Yoke drive
68 Screw
69 Washer
70 Retainer
71 Oil seal
72 Gasket
73 Cage
74 Bearing cup
75 Washer
76 Shim
77 Spacer
78 Washer
79 Bearing
80 Nut
81 Washer
82 Screw
83 Pinion gear
84 Bearing
85 Lock
86 Pin
87 Nut
88 Lockwire
89 Screw
90 Washer
91 Cap
92 Differential carrier

Figure 3-106. Axle assembly, disassembly and reassembly (sheet 4 of 6).

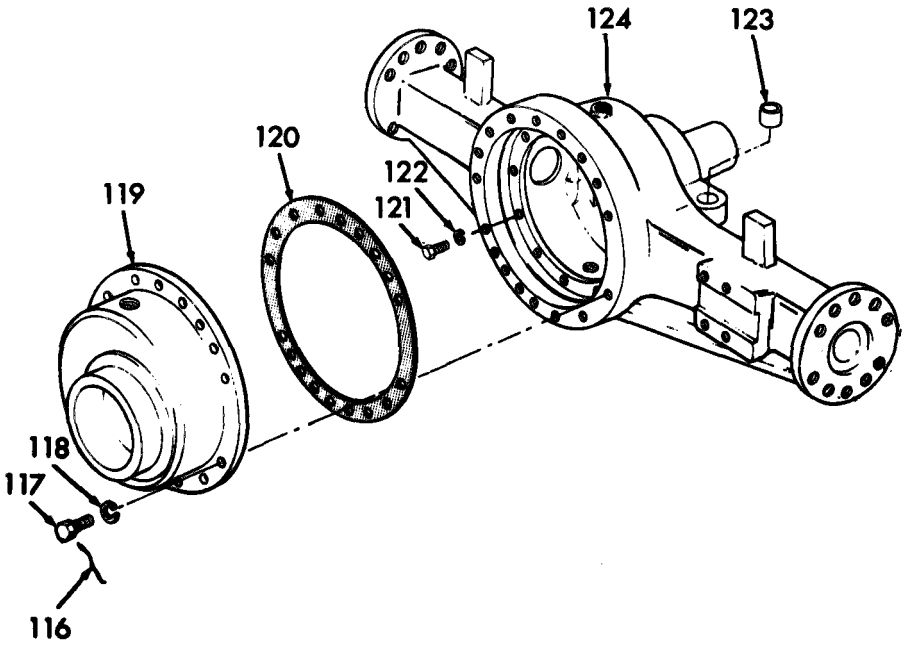


E. DIFFERENTIAL ASSEMBLY

ME 3930-243-34/3-106 (5)

93 Bearing cup
94 Bearing
95 Screw
96 Nut
97 Case
98 Gear
99 Spring
100 Spring retainer
101 Clutch
102 Ring
103 Snap ring
104 Spider
105 Cam
106 Ring
107 Clutch
108 Spring retainer
109 Spring
110 Gear
111 Screw
112 Nut
113 Screw
114 Gear
115 Case

Figure 3-106. Axle assembly, disassembly and reassembly (sheet 5 of 6).

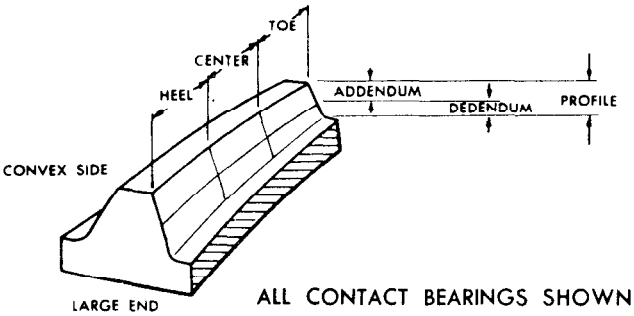


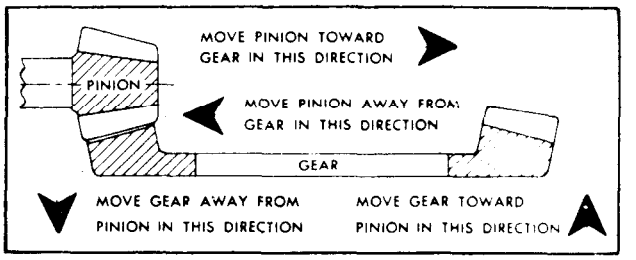
F. AXLE HOUSING ME 3930-243-34/3-106 (6)

116 Lockwire
117 screw
118 Lockwasher
119 Trunnion
120 Gasket
121 Screw
122 Lockwasher
123 Bushing
124 Axlehousing

Figure 3-106. Axle assembly, disassembly and reassembly (sheet 6 of 6).

SPIRAL BEVEL AND HYPOID TOOTH BEARING CONTACT CHART





ALL CONTACT BEARINGS SHOWN BELOW ARE ON **LEFT HAND** SPIRAL RING GEAR — THE DRIVE IS ON THE CONVEX SIDE OF THE TOOTH.

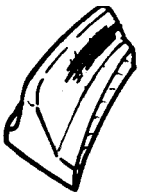


FIG. 1

TYPICAL PREFERRED BEARING ON BOTH SIDES OF TOOTH WHILE UNDER A LIGHT LOAD

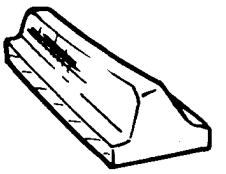


FIG. 2

TOE BEARING ON BOTH SIDES OF TOOTH - GEAR SET NOISY. TO MOVE BEARING TOWARD HEEL INCREASE BACKLASH WITHIN LIMITS BY MOVING GEAR AWAY FROM PINION.

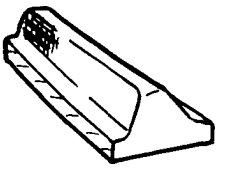
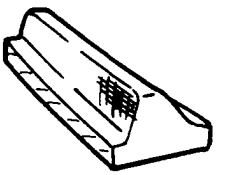


FIG. 3

HEEL BEARING ON BOTH SIDES OF TOOTH-GEARSET NOISY AND COULD RESULT IN EARLY GEAR FAILURE. TO MOVE BEARING TOWARD TOE DECREASE BACKLASH WITHIN LIMITS BY MOVING GEAR TOWARD PINION.



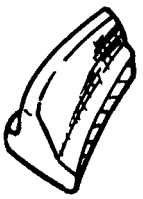
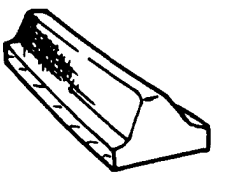


FIG. 4

LOW BEARING ON GEAR AND HIGH BEARING ON PINION. CORRECT BY PULLING PINION AWAY FROM GEAR (INCREASE MOUNTING DISTANCE.



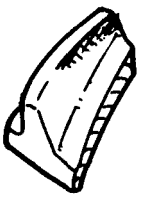
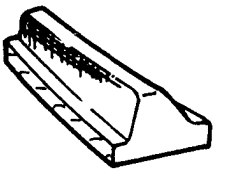


FIG. 5

HIGH BEARING ON GEAR AND LOW BEARING ON PINION. CORRECT BY MOVING PINION IN TOWARD GEAR (DECREASE MOUNTING DISTANCE.



BACKLASH

BACKLASH SHOULD BE MEASURED WITH A DIAL INDICATOR RIGIDLY MOUNTED WITH THE STEM PERPENDICULAR TO THE TOOTH SURFACE AT THE EXTREME HEEL.

ME 3930-243-34/3-107

Figure 3-107. Correct tooth contact patterns.

Section X. HYDRAULIC BRAKE SYSTEM

3-48. General

This section contains information on the maintenance of the hydraulic brake system. This includes the hand brake assembly, the hydraulic brake system, hydraulic pump, brake valve, adjuster, accumulator, and the hydraulic oil tank.

3-49. Hand Brake Assembly

a. General. The parking brake assembly is mounted to the transmission and connected to a control lever handle on the right hand side of the driver's seat (TM 10-3930-243-12).

b. Removal. Refer to figure 3-96, step 6 through step 9, and remove the parking brake assembly.

c. Inspection.

(1) Inspect the brake shoe for excessive wear:

(2) Inspect all hardware for breaks or damage.

(3) Replace a defective part.

d. Installation.

(1) Refer to figure 3-97, steps 52 thru 54, and install parking brake assembly.

(2) Adjust parking brake (TM 10-3930-243-12).

3-50. Hydraulic Brake System

a. General. The brake assembly on the rough terrain forklift is the expander tube brake, 360° segmented, shoe type actuated by an expander tube. Its components include a cast torque plate upon which the expander tube is mounted and an inlet connection into which the nozzle of the expander tube is inserted. Steel side frames with welded steel torque bars are attached to both sides of the torque plate. Brake linings mounted on steel shoes are inserted between the torque bars and side frames and held in position by retracting springs. Steel shields are used to bridge the gap between shoes and protect the expander tube. The spring inserted under the center of the linings and over the steel brakeshoes withdraw the block, and shoe assemblies from the surface of the brakedrum after the actuation pressure has been released. This brake system receives its oil supply (OE 10), from the forklift's main hydraulic oil supply tank. Pressure is provided by an engine driven pump and application is controlled by an applicator valve. An accumulator is incorporated in the braise system to provide operating pressure although the engine has stopped. Check lining frequently for wear. To check wear, apply brakes and look into the spring openings in the brake frames. If the brakeshoe tends to shear the spring at a point between the frame and shoe (approximately 1/8 inch space between top of spring opening and the ledge of the shoe upon which spring rests), travel is at a maximum. Replace linings and springs before this condition is reached. Continued operation in this condition will damage brake structure..

b. *Removal.*

(1) Remove wheel (TM 10-3930-243-12).

(2) Refer to figure 3-106 (1 thru 40) and remove the brake assembly in numerical sequence.

c. Disassembly. Refer to figure 3-108 and disassemble the brake assembly as follows:

(1) Hold the brake either vertically or horizontally so that both frames (8 and 9) are exposed.

(2) Place a screwdriver against the hook of the retracting spring (7) and with a sharp blow, disengage spring from the frame. Drive the springs through the brake and out of the assembly.

(3) Lift the block and shoe assembly (5) from the frame.

(4) Remove brake frame bolts (2).

(5) Use center punch to mark upper and lower frames for same location on reassembly and lift upper half of frame from torque plate (11).

(6) Slide expander tube (12) and inlet connection (10) from the torque plate.

NOTE

If expander tube is stuck to the torque plate, work a thin piece of steel between the torque plate and expander tube and draw it around the plate to free tube.

(7) Remove inlet connection from nozzle of expander tube, and remove O-rings (3 and 4) from nozzle.

d. Cleaning, Inspection, Repair, and Replacement.

(1) Clean the brake assembly.

(2) Inspect expander tube for signs of excessive heat shown by brittleness, or loose fabric or rubber around the nozzle base that might permit fluid leakage.

(3) Check for loose expander tube shields. Recement all shields (6) as described in (11) below.

(4) Inspect brake block and shoe assemblies for separation of lining from shoe.

NOTE

The friction or braking surface of the lining may develop ridges and grooves, The leading edge, that which is in the direction of rotation, tends to wear slightly unevenly. Either of these conditions is normal.

(5) Inspect frame assemblies for unusual wear or distortion of torque bars, cracks at the welds of torque bars, and for cracks or elongation of frame bolt holes. Frames should not have more than 1/16 inch longation of the bolt holes.

(6) Check for broken or distorted retracting springs, comparing questionable springs with new ones.

(7) Inspect inlet connection block bore where O-rings seal for scratches and grooves.

(8) Inspect brakedrums for cracks, checks, distortion, and scored surfaces. Scored brakedrums can be repaired by turning on a lathe. No brake lining is any better than the drum it contacts. The maximum brakedrum should be turned is 0.060 to 0.080 inch.

(9) If any linings have come loose from the shoes, re-rivet them.

(10) If the frame assembly is cracked or broken, replace.

(11) Recement expander tube shields. If any shields are loose, all shields should be removed and recemented, reversing the block and shoe assemblies from their original installation. Procure a good neoprene base adhesive compound and use per instructions.

(a) Clean shields with lacquer thinner or acetone. Do not use petroleum base solvents.

(b) Place one shoe in brake assembly. Reverse shoe to expose a clean section of tube, free from initial cement. Mark the position of the extended end of the shoe on the tube. Note the position of the m ark in relation to the torque bar of the frame assembly. Mark relative positions for remaining shields.

(c) Coat cement on the tube at each of the twelve marks. Coat a spot 3 x 1½ with the 1½ inch dimension being centered over the mark. The 3 inch dimension should be centered between the frames.

(d) Coat the inside, or concave side, of the shields with cement. Keep cement confined to the center 3 inches of the shields.

(e) Allow cement to dry for 5 minutes.

(f) Place a shield on the tube so that one half of the shield protrudes from under the end of the shoe.

(g) Remove the shoe assembly and press shield firmly to the tube.

(h) Install the next shoe with a shield centered under the protruding end of the shoe. Press shield firmly to tube and install retracting spring.

(i) Continue in same manner with the balance of the shields, shoes and springs until all brakeshoes and shields are in place.

(12) Replace expander tube if cracked, charred, or if the nozzle is loose.

(13) Replace brake lining if worn beyond the minimum thickness if torque bar forms ridges on the end face of the linings that may cause the block and shoe assemblies to hang up, or if excessive cracking or chipping is evident.

(14) Replace the frame assemblies if distorted from any crack or damage.

(15) Replace retracting springs if they are broken or distorted, and when new linings are installed to replace worn out linings. Replace all twelve springs to insure uniform retraction.

e. Reassembly. Refer to figure 3-108 and reassemble the brake assembly as follows:

(1) Install two new O-rings (3 and 4) on expander tube nozzle (12), lubricating them with vaseline, and install inlet connection (10).

(2) If torque plate (11) has been removed from axle housing, install with opening at top. Slide expander tube (12) with inlet connection over the torque plate.

CAUTION

Be sure that the inlet connection opening faces the vehicle, and that the inlet connection drum bolt clearance notch faces the wheel side of the torque plate.

(3) Position lower half of frame (9) over expander tube and torque plate (11), and secure with bolts (1). Tighten bolts 3/8"-38 to 42, ½"-95 to 100, 5/8''-l70 to 185 ft.-lbs. torque; dry thread.

NOTE

If necessary to line up frame bolt holes, start at one end and install five bolts; then install a clamp across the frame to line up the last two holes, and install these bolts.

(4) Position upper half of frame (8) over expander tube and torque plate, making sure that inlet connection lines up with frame cutout. Install bolts. Tighten bolts 3/8"-38 to 42, ½"-95 to 100, 5/8''-l70 to 185 ft.-lbs. torque; dry thread.

(5) Place a block and shoe assembly (5), between the torque bars so that projecting end of shoe is approximately centered on a shield (6). Partially insert retracting spring (6) to temporarily hold the lining assembly in place.

(6) Dovetail a second block and shoe assembly into the first block and shoe, and partially insert a second retracting spring. Drive the first spring fully into position.

(7) Install remaining block and shoe assemblies in similar manner, that is, always keep one shoe assembly ahead of the one in which the retracting spring is being completely inserted.

f. Installation.

(1) Refer to figure 3-108 and reinstall the brake assembly. Reinstallation is the reverse order of removal.

(2) Replace wheel (TM 10-3930-242-12).

g. Bleeding.

(1) Fill reservoir with hydraulic oil (OE 10).

NOTE

Reservoir must be free of dirt. A screen should be provided in the reservoir to keep out foreign particles.

(2) With engine idling, open each bleeder valve (located on top of automatic slack adjuster

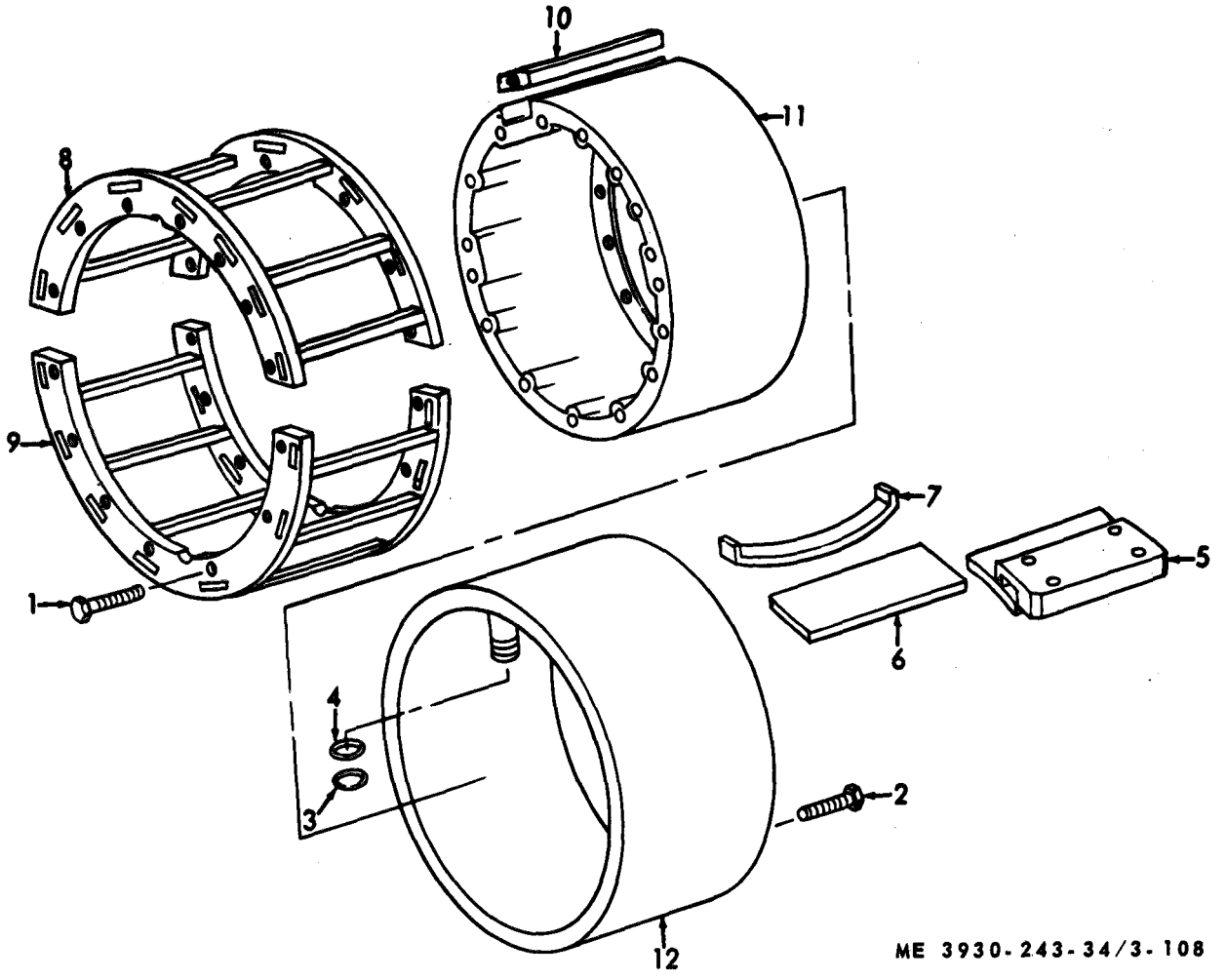
and depress brake pedal until oil flows free of air. Close bleed valves.

(3) Apply brakes, holding pedal down for at least 10 seconds. Repeat this cycle three times allowing 30 seconds between applications.

(4) Release brakes and open all four bleeder valves. Bleed fluid from brakes until flow stops, then close bleeder valve.

(5) Repeat steps 3 and 4 until no air can be detected escaping from fluids.

(6) Repeat the entire bleeding procedure if the brakes show any evidence of dragging or overheating during the first few hours of operation.



1 Bolt
2 Bolt
3 O-ring
4 O-ring
5 Block and shoe
6 Shield
7 Retracting spring
8 Upper frame
9 Lower frame
10 Inlet connection
11 Torque plate
12 Expander tube

Figure 3-108. Brake assembly, disassembly and reassembly.

3-51. Lock Steering and Hydraulic Brake Pump

a. General. The lock steering and hydraulic brake pump is mounted to the transmission. The pump is a dual pump. One portion of the pump supplies hydraulic pressure to the lock steering cylinders and the other portion of the pump furnishes hydraulic pressure to the brakes.

b. *Removal.* Refer to figure 3-109 and remove the lock steering and hydraulic brake pump.

c. Disassembly. Refer to figure 3-110 and disassemble the lock steering and hydraulic brake pump as follows:

(1) Scribe a match mark on body front (31) and rear (1) covers to insure that pump will be reassembled in exactly the same manner as it was before disassembly.

(2) Disassemble in numerical sequence.

d. Inspection.

(1) Inspect gears for broken or damaged teeth.

(2) Inspect bearing for excessive wear.

(3) Inspect housing and covers for cracks and damage.

(4) Inspect coupling and adapter for damage.

e. Reassemble.

(1) Lubricate each part with clean, SAE No. 10 oil.

(2) Refer to figure 3-110 and reassemble the lock steering and hydraulic brake pump assembly.

(3) Tighten the screws that secure front and rear covers to the housing to 28 to 32 foot-pounds torque.

NOTE

After overhaul, run pump for 30 minutes at 2000 rpm while pumping SAE No. 10 oil at 0 psi outlet pressure.

f. Test. Bench-test pump by driving it at 2800 rpm and load pump to 1600 psi. Pump capacities are: large, 35 Gallons Per Minute, and small, 15 gallons per minute.

g. Installation. Refer to figure 3-109 and install lock steering and hydraulic brake pump assembly.

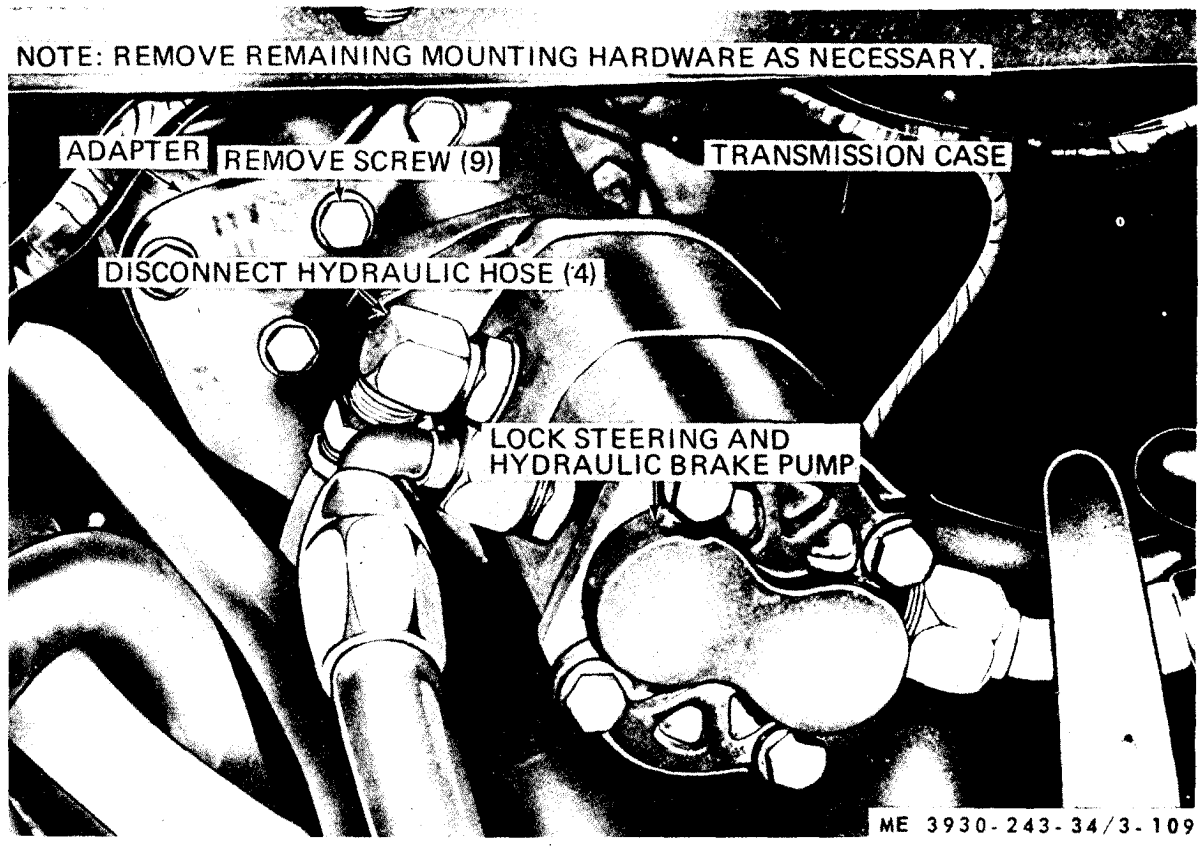
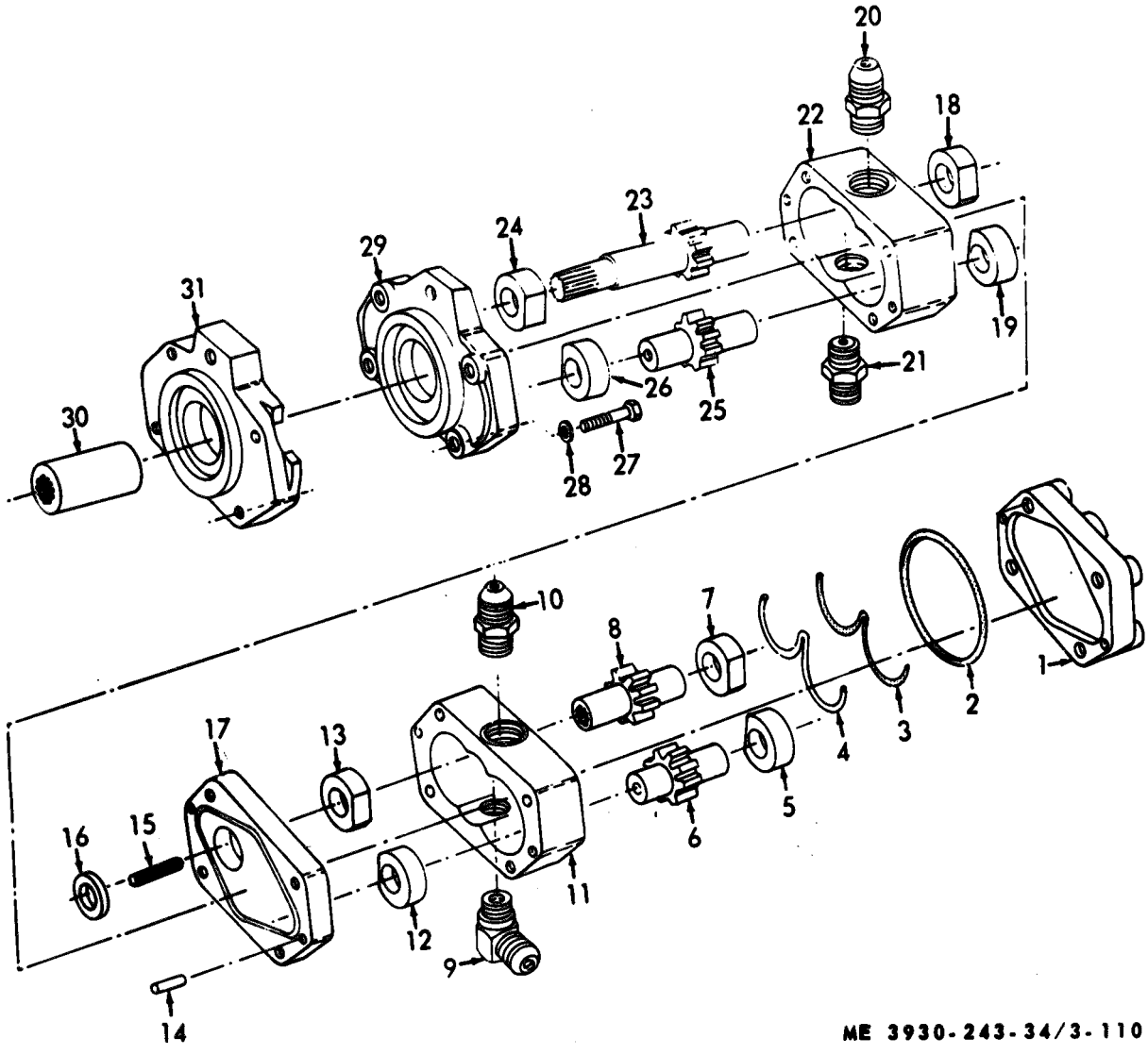


Figure 3-109. Lock steering and hydraulic brake pump, removal and installation.



1 Cover
2 Seal
3 Seal
4 Seal
5 Bearing
6 Gear
7 Bearing
8 Gear
9 Elbow
10 Adapter
11 Housing
12 Bearing
13 Bearing
14 Pin
15 Coupling
16 Seal
17 Adapter
18 Bearing
19 Bearing
20 Adapter
21 Adapter
22 Housing
23 Gear
24 Bearing
25 Gear
26 Bearing
27 Screw
28 Washer
29 Cover
30 Coupling
31 Adapter

Figure 3-110. Lock steering and hydraulic brake pump, disassembly and reassembly.

3-52. Brake Valve

a. General. The brake valve is located under the brake pedal and inching pedal floor board panel. The valve is essentially two valves in one. The closed center ball type valve operates the brake with the power being furnished by the accumulator. A pilot valve and charging valve control the flow from the pump to charge the accumulator within its operating range. The number of brake applications after the engine is stopped is limited only to the size of the accumulator.

b. Remove.

(1) Remove the ladder and access panel on the driven side (TM 10-3930-243-12).

(2) Refer to figure 3-111 and remove the brake valve.

cmbly of Brake Valve. Refer to figure 3-112 and disassemble the brake valve assembly in numerical sequence as follows:

NOTE

Measure the depth that the adjusting plug (32) is below the surface of valve body (3). Scribe a mark in line with plug slot. Record this information, as it must be used in reassembly of valve.

(1) The piston (6) pulls out of the valve body (3).

(2) Shims (7 and 8) will be found inside piston. The shims are used for adjusting the brake line pressure and must be used in the reassembly of valve. Never mix parts from another valve.

(3) Remove O-ring (10) from valve body.

(4) Remove snap ring (11) and washer (12).

(5) Remove plunger (13) from valve.

(6) Remove plug (15) from valve and remove spring (20) and guide (21).

(7) Use a wooden dowel or other soft material to push out ball valve and seat (22).

(8) Remove plug (24) and remove pilot valve spring (26), ball (27), spool (28) and seat (29).

(9) Remove pilot valve plug (32) and remove spring (34), seat (35) and ball (36).

(10) Remove plug (38) and remove spring (40), stop (41), and charging valve spool (42).

(11) Loosen locknut (45). Remove screw (46) and remove spring (48), poppet (49), seat (50) and filter (52).

c. Cleaning and Inspection.

(1) Clean all parts.

(2) Inspect the piston (6, fig. 3-112) for nicks and scratches.

(3) Inspect surface of the valve seat in the plunger (13) for proper seating and outside signs of wear.

(4) Inspect the seat in the bronze plunger.

(5) Inspect valve seat in end of pilot valve insert (29).

(6) Assemble pilot valve spool (28) inside pilot valve insert (29) and place the steel balls (27) in their respective seats and measure with a micrometer. Record this measurement.

(7) Remove spool and place the steel balls in their respective seats and measure. Subtract the smaller dimension. If difference is less than 0.004 inch, replace the spool.

(8) Inspect the nylon pins in the charging valve plug and the pilot valve adjusting plug for wear or damage. These pins are used to keep the plugs from working loose.

d. Reassembly.

NOTE

Always use new seals when overhauling the brake valve.

(1) Install the filter (52, fig. 3-112) into the valve body (3).

(2) Install the steel washer (51).

(3) Install O-ring (25).

(4) Install the check valve seat (50), check valve (49), spring (48), and screw plug (46) on which a new O-ring (47) has been placed into the valve body (3).

(5) Torque the screw plug (46) to 35 to 40 ft. lbs.

(6) Install the locknut (45) and torque to 35 to 40 ft. lbs.

(7) Install the ball valve and seat (22) in the valve body with the flange up. Be sure that the seat is properly placed in the valve body. Use a wooden dowel to push this assembly into place.

(8) Place the spring (20) on the ball guide (21) and then the washer (19). seal (18) (with lip toward the steel washer) and the teflon backup ring (17).

(9) Place a new O-ring (16) on the plug (14) and place the assembled parts inside the plug and assemble to the body.

(10) Tighten the plug (15) to 35 to 40 ft. lbs.

(11) Place a new O-ring (30) on the pilot valve seat (29) and install in the valve body (3).

(12) Push the pilot valve seat into place with a wooden dowel.

(13) Install the pilot valve spool (28), the long end of the spool in the "up" position.

(14) Place the steel ball (¼ inch diameter) on its seat in the pilot valve insert.

(15) Install a new O-ring (25) on the plug (15). Place a small amount of grease on the end of the spring (26) and insert it into the plug. The grease is to hold the spring in the plug during assembly.

(16) Tighten the plug (15) to 30 to 35 ft. lbs.

(17) Install the spring (34), ball seat (35), and steel ball (36) (¼ in. diameter) using grease to hold the ball and seat to the spring.

CAUTION

Be sure that the steel ball is on the seat before proceeding further.

(18) Install the pilot valve adjusting plug (32) on which a new O-ring (33) has been installed.

(19) Screw the plug (32) down to the dimension. which was recorded at the time of disassembly. and line up the slot in the plug with the mark on the face of the valve body (3). If new parts have been used to service the valve at this point. there is a possibility that the accumulator charging limits have charged. This is checked when the brake valve is installed on the vehicle. One full turn of the adjusting plug changes the high limit by 200 psi. The high limit is raised by screwing the plug into the body and lowered by screwing the plug out of the body.

(20) Install a new quad ring seal (42) on the charging valve spool (43) and install the spool in the body. Use extra care in installing this spool so as not to damage the lands on either the spool or the body. Be sure that the spool is pushed all the way into the body so that the end of the spool contracts the plug in the end of the valve. At no time is it necessary to force this spool.

(21) Install the charging valve spring (40).

(22) Install the stop (41) inside the spring.

(23) Install a new O-ring (39) on the charging valve plug (38) and insert it into the valve body. Install retainer ring (37).

(24) Install a new "V" block seal (14) on the plunger (13) with the edge of the seal toward the valve seat (22). Install the plunger.

(25) Install the washer (12).

(26) Install the snap ring (11) and engage it in the groove about the washer.

(27) Install the O-ring (10).

(28) Install the shims (7 and 8) and spring (9) in the piston (6) and push it into the valve body.

(29) Make sure the piston is operating freely, and then slowly release it. Check the clearance under the flange of the piston. If new parts have been used, it may be necessary to either add or subtract shims (7 and 8) from inside the piston (6) in order to get the proper clearance at this point. Proper clearance is from 0.199 to 0.211 inch.

(30) Install the boot (5) and ring (4).

e. Test Procedure.

(1) Before the brake valve is installed in the forklift, gage test it on work bench to insure that it is properly assembled. Brake pressure is the regulated accumulator pressure allowed to pass through the valve to apply brakes. It is at maximum when the brake valve piston is completely depressed. Maximum pressure at the valve is controlled by shims assembled beneath the operating piston. Add shims to increase pressure, remove shims to decrease pressure. Use a 0-2,000 pound per square inch (psi) gage to test valve.

(a) Screw gage into brake port on valve.

(b) Fill pump with hydraulic oil, and attach it to accumulator port on valve.

(c) Pump up valve to 1,900 psi.

(d) Remove boot (5) and depress operating piston (6) all the way in and read gage. The correct brake line pressure should read 225 to 275 psi.

(2) Accumulator pressure is the pressure of the oil in the accumulator used for applying the brakes. The maximum accumulator or high limit pressure is controlled by the pilot valve spring. This is purposely set below the steering relief valve for safety reasons, otherwise the components beyond the brake would not operate. After the brakes have been applied a number of times, the pressure decreases to a low limit, at which time the accumulator recharges. The pressure is the low limit that valve starts to recharge the accumulator. The high limit is the adjustable pressure, and once this is set, it automatically, by brake valve design, determines the low limit or cut in pressure to start the recharge cycle. The high limit is adjusted by turning the pilot valve adjusting plug (32). One full turn of the plug changes the limit by 200 psi, ½ turn by 100 psi and ¼ by 50 psi. The high limit is raised by screwing the plug into the body and lowered by screwing the plug out of the body.

(a) Fill pump with hydraulic oil and attach it to accumulator port on valve.

(b) Pump up valve until a decisive click is heard, caused by shifting of pilot valve, and note gage reading. The reading should be 1,300 psi, if not adjust the pilot valve plug (32).

(c) After adjusting high limit pressure let the pressure leak down until another click is heard when the low pressure reaches between 650 to 550 psi.

(3) While pressure testing valve, check for leakage. Leakage from either the brake port or return port should be less than 60 drops per minute. No leakage is permissible from the pressure port (38). It is not necessary to exceed 1,900 psi for testing pressure as system pressure is always less.

f. Installation.

(1) Refer to figure 3-111 and install the brake valve.

(2) Install the access panel and the ladder assembly (TM 10-3930-243-12).

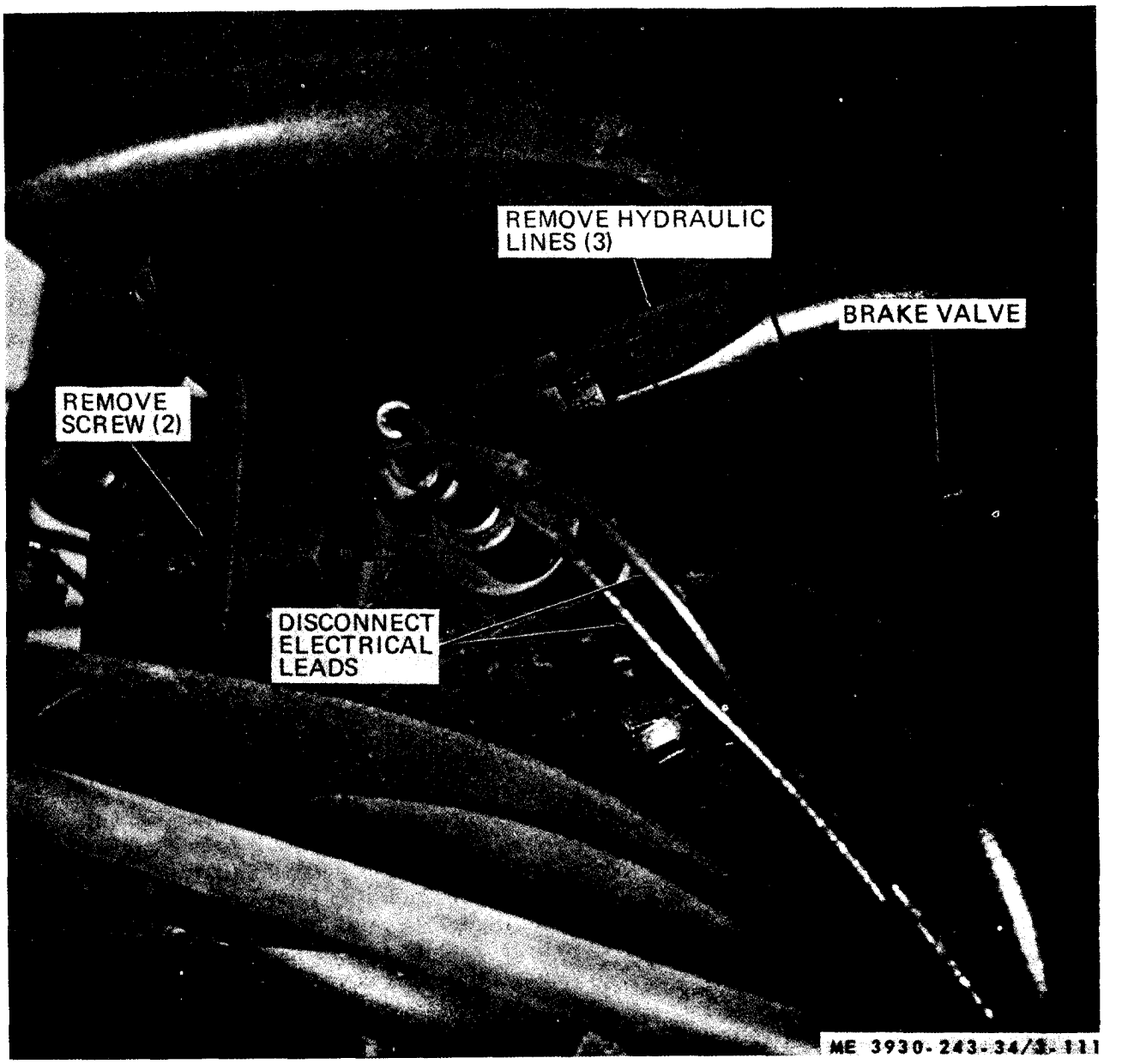


Figure 3-111. Brake valve, removal and installation.

KEY to figure 3-112:

1 Screw
2 Washer
3 Body
4 Ring
5 Boot
6 Piston
7 Shim
8 Shim
9 Spring
10 O-ring
11 Retainer ring
12 Washer
13 Plunger
14 Seal
15 Plug
16 O-ring
17 Backup ring
18 Packing
19 Washer
20 Spring
21 Ball guide
22 Ball valve and seat
23 O-ring
24 Pilot valve plug
25 O-ring
26 Pilot valve spring
27 Ball
28 Pilot valve spool
29 Pilot valve seat
30 O-ring
31 O-ring
32 Pilot adjusting plug
33 O-ring
34 Spring
35 Ball seat
36 Ball, ¼'' diameter
37 Retainer ring
38 Adjusting plug
39 O-ring
40 Spring
41 Stop
42 Seal
43 Charging valve spool
44 Ball
45 Locknut
46 Screw
47 O-ring
48 Spring
49 Poppet
50 Check valve seat
51 Washer
52 Filter
53 Plug
54 Bushing
55 Ring
56 Pin

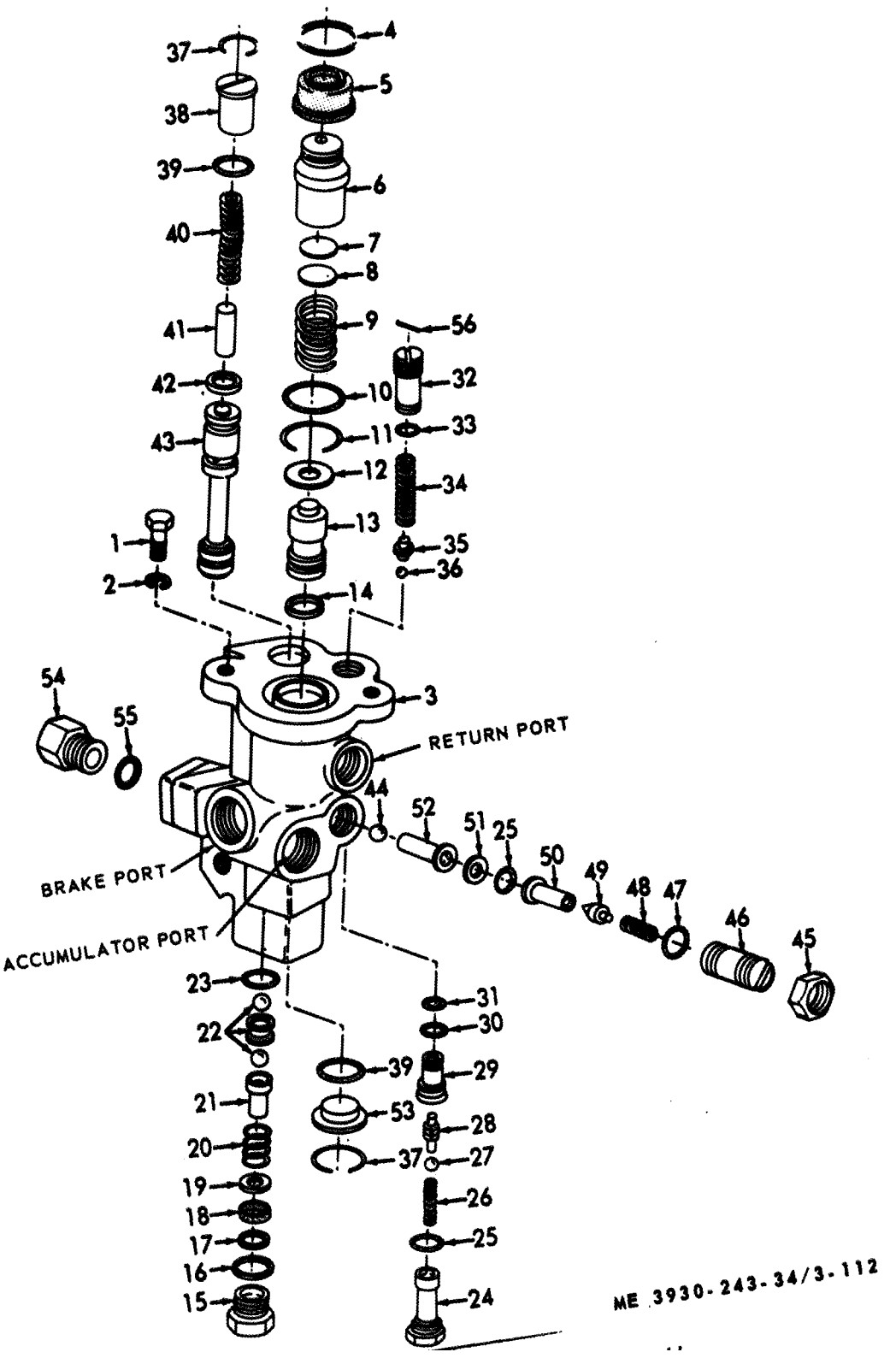


Figure 3-112. Brake valve, disassembly and reassembly

3-53. Automatic Slack Adjuster

a. General. The brake system is supplied with oil (OE10) from the main hydraulic reservoir. Brake adjustment is accomplished automatically by slack adjusters located in the hydraulic lines between the brake valve and the wheel brake assemblies. No provision is made for manual adjustment. The automatic slack adjuster maintains required clearance between linings and drum.

WARNING

Bleed the brake system pressure by repeated application of the brakes with the engine stopped, until the low pressure warning buzzer sounds. Continue to apply brakes several times to further reduce accumulator pressure. Carefully open bleed valves at each automatic slack adjuster to bleed off pressure. Failure to bleed pressure from brake system before servicing or performing maintenance function may result in damage to equipment and serious injury to personnel.

b. Removal. Refer to figure 3-113 and remove the automatic slack adjuster.

NOTE
Cap all lines when disconnected.

c. Disassembly. Refer to figure 3-114 and disassemble the automatic slack adjuster.

d. Inspection.

(1) Inspect the automatic slack adjuster housing (3) for cracks and breaks.

(2) Inspect the diaphragm (8) for damage.

(3) Inspect hardware for damage.

e. Reassembly. Refer to figure 3-114 and reassemble the automatic slack adjuster.

f. Installation. Refer to figure 3-113 and install the automatic slack adjuster.

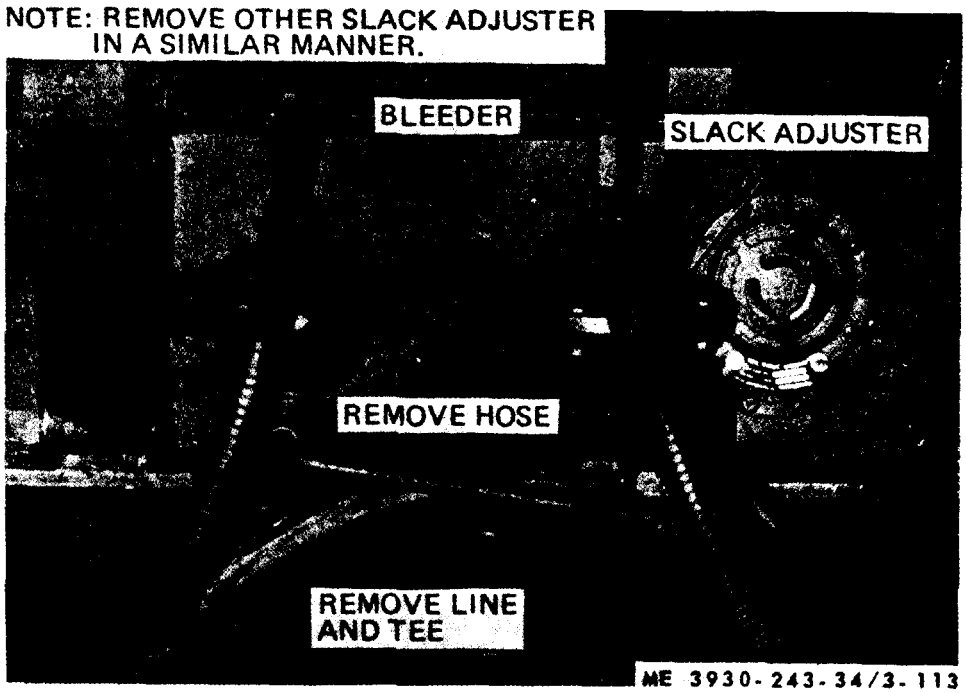
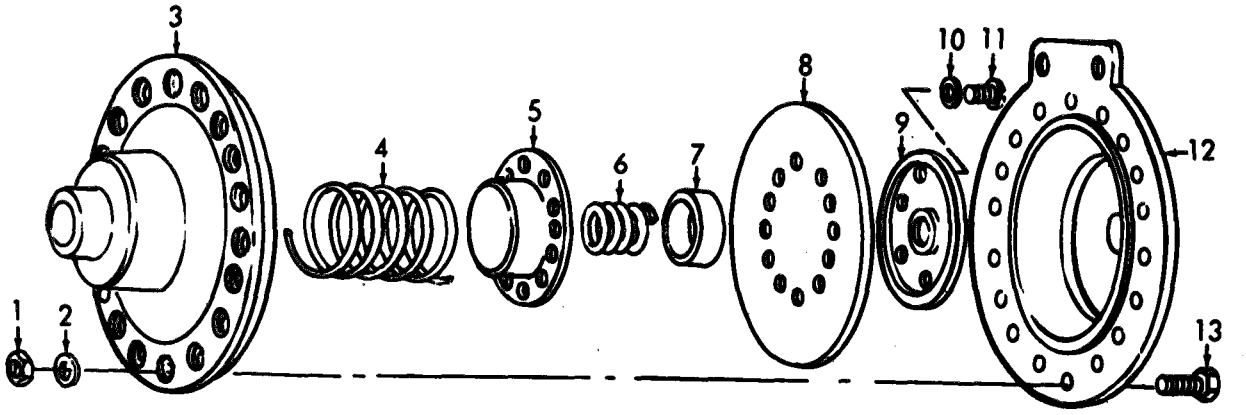


Figure 3-113. Automatic slack adjuster, removal and installation.



ME 3930-243-34/3-114

1 Nut
2 Washer
3 Housing
4 Spring
5 Piston
6 Spring
7 Piston
8 Diaphragm
9 Piston
10 Washer
11 Bolt
12 Cap
13 Bolt

Figure 3-114. Automatic slack adjuster, disassembly and reassembly.

3-54. Hydraulic Brake Accumulator

a. General. The accumulator is provided to store energy for a limited number of brake applications in case the engine stops running. The accumulator cylinder has a free riding piston. Nitrogen is introduced through a valve on one end of cylinder and at the opposite end of cylinder, oil from the hydraulic system enters cylinder forcing the piston toward the nitrogen, compressing it to approximately 1,300 psi. The accumulator is located behing the operator's access ladder panel.

WARNING

Bleed the brake system pressure by repeated application of the brakes with the engine stopped, until the low pressure warning buzzer sounds. Continue to apply brakes several times to further reduce accumulator pressure. Carefully open bleed valves at each automatic slack adjuster to bleed off pressure. Failure to bleed pressure from brake system before servicing or performing maintenance function may result in damage to equipment and serious injury to personnel.

b. Removal. Refer to figure 3-115 and remove the hydraulic brake accumulator.

c. Disassembly. Refer to figure 3-116 and disassemble the hydraulic brake accumulator.

d. Inspection.

(1) Inspect tubing and connectors for cracks or damage.

(2) Inspect piston for scores and scratches.

(3) Inspect body for cracks or any damage. Replace a defective part.

e. Reassembly. Refer to figure 3-116 and reassemble hydraulic brake accumulator.

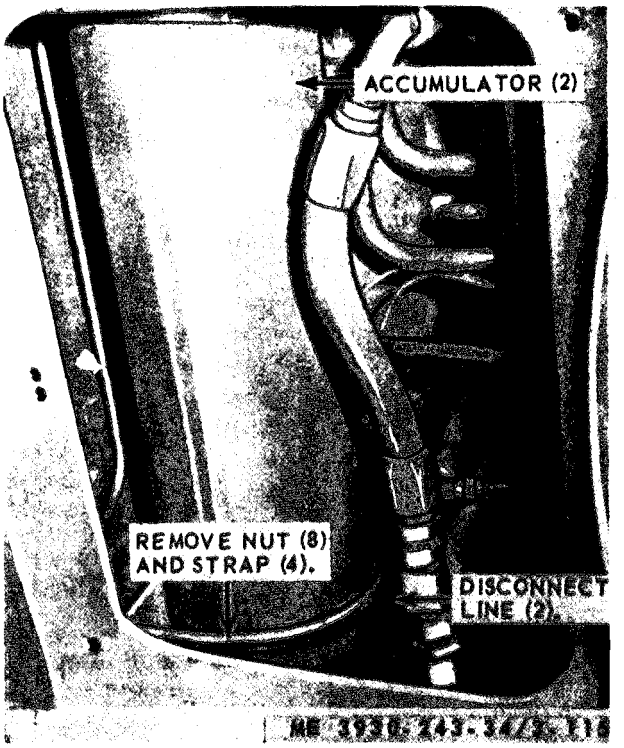
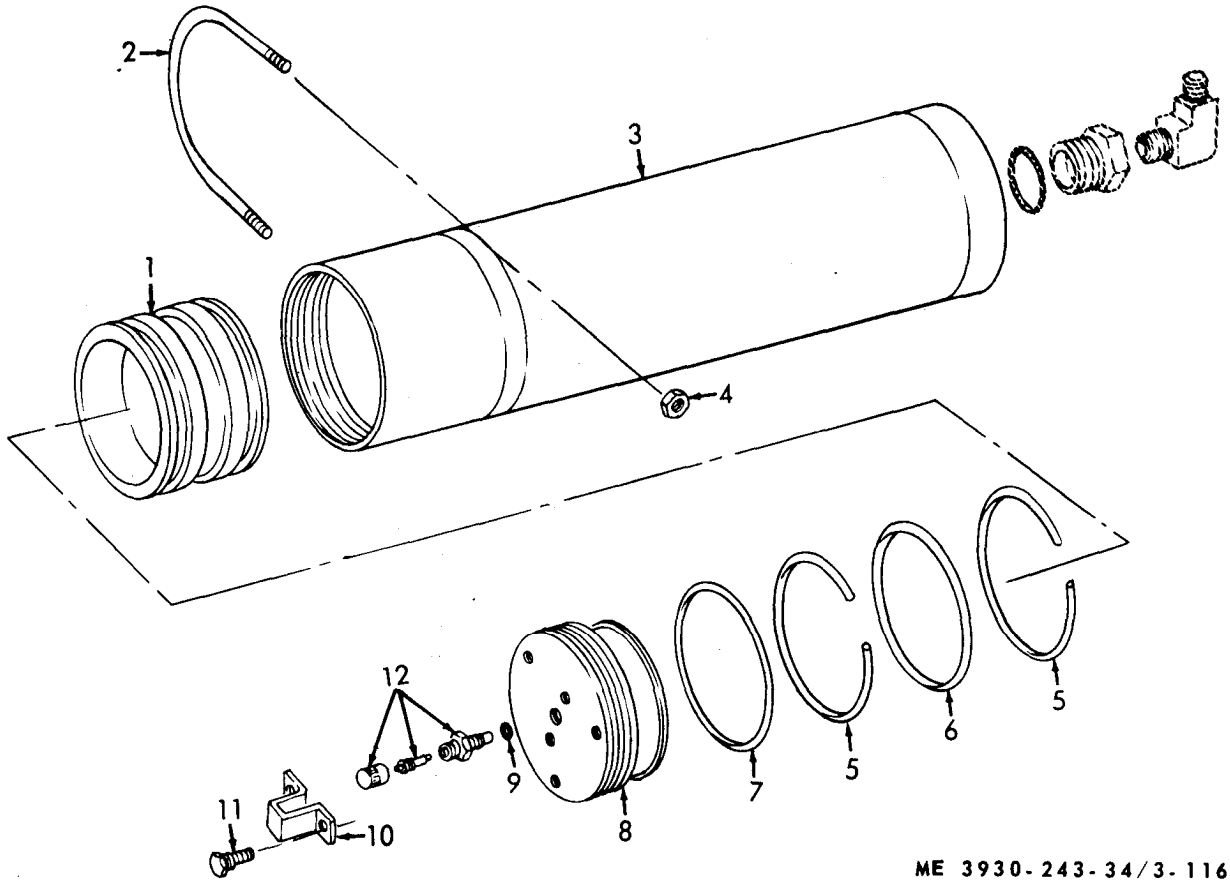


Figure 3-115. Hydraulic brake and steering system accumulators, removal and installation.



1 Piston
2 U-bolt
3 Accumulator body
4 Nut
5 Piston ring
6 O-ring
7 O-ring cap
8 End gas cap
9 O-ring
10 Protector strap
11 Screw
12 Gas valve assembly

Figure *Figure 3-116. Hydraulic brake and steering system accumulator, disassembly and reassembly.*

f. Charging the Accumulator. Exercise caution when testing or charging accumulator.

WARNING

Use only dry nitrogen gas. Bleed the brake system pressure as described above. Failure to bleed pressure from brake system before servicing may result in damage to equipment and serious injury to personnel.

(1) Remove protector strap.

(2) Attach charging kit to gas valve assembly.

(3) Open accumulator valve to read pressure.

(4) Open valve on nitrogen bottle and charge accumulator cylinder to 350 psi.

(5) Close nitrogen bottle valve and detach charging kit.

(6) Replace protector strap.

3-55. Hydraulic Brake Reservoir (Model RTL10)

a. General. The hydraulic brake reservoir is located behind the left front wheel in the fender well. It supplies hydraulic fluid to the brake system

NOTE

The hydraulic brakes on Model RTL10-1 gets its supply of hydraulic fluid from the main hydraulic tank, located behind the driver's seat.

b. Removal. Remove hydraulic brake reservoir (TM 10-3930-243-12).

c. Disassembly. Refer to figure 3-117 and disassemble the hydraulic brake reservoir.

d. Inspection.

(1) Inspect mounting hardware for any damage.

(2) Inspect filler cap for cracks.

(3) Inspect access cover for cracks or damage.

(4) Inspect reservoir assembly for cracks and corrosion.

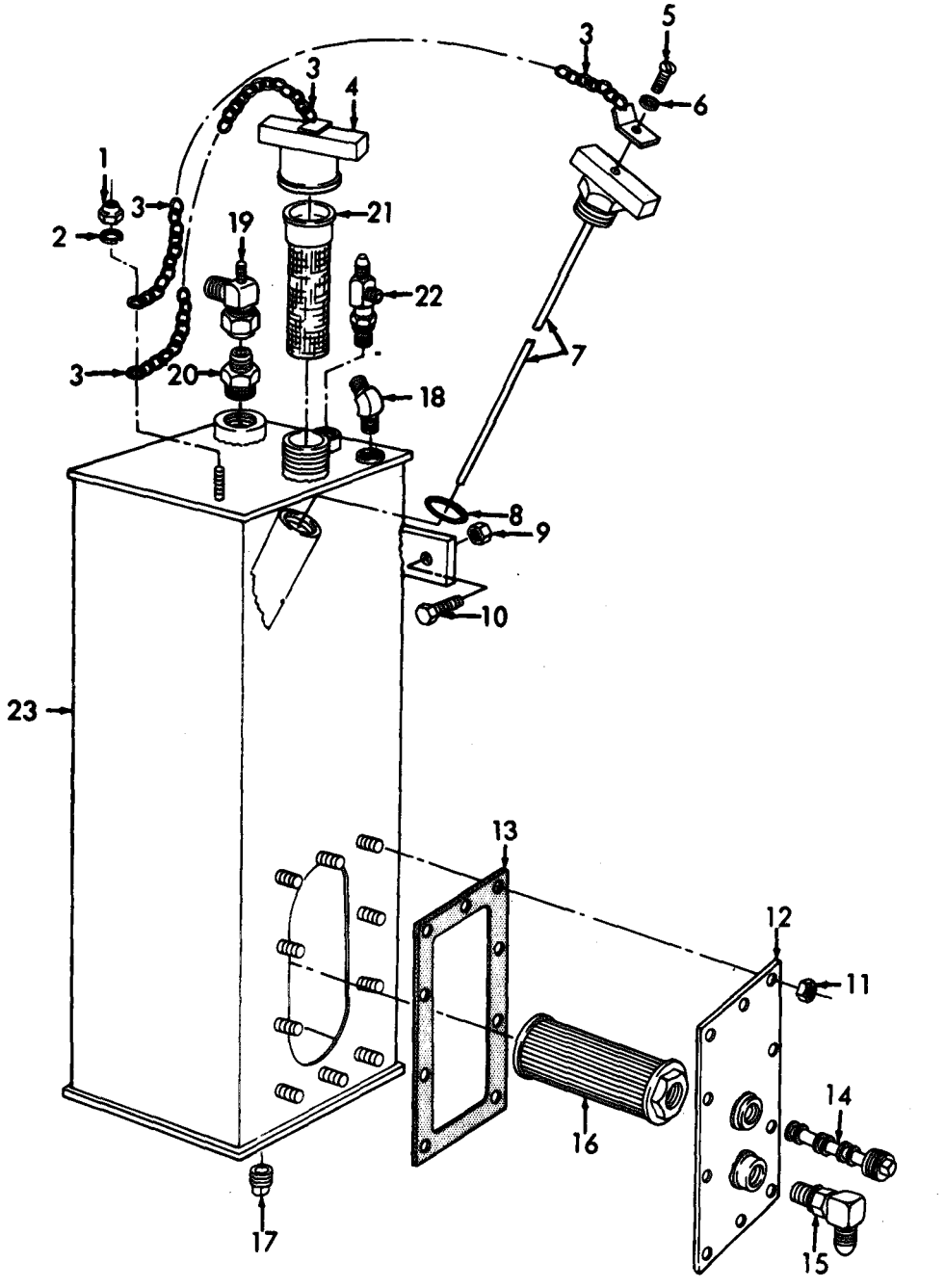
e. Repair.

(1) Repair reservoir assembly by welding.

(2) Replace filter.

(3) Replace gasket.

f. Reasessembly. Refer to figure 3-117 and reassemble hydraulic brake reservoir.



1 Locknut
2 Lockwasher
3 Chain
4 Filler cap
5 Screw
6 Washer
7 Dipstick
8 Ring
9 Nut
10 Screw
11 Nut
12 Access cover
13 Gasket
14 Magnetic plug
15 Elbow
16 Filter
17 Drain plug
18 Connector
19 Tee
20 Connector
21 Filter
22 Tee
23 Reservoir

Figure 3-117. Hydraulic brake reservoir, disassembly and reassembly.

g. Installation. Install hydraulic brake reservoir (TM 10-3930-243-12).

Section XI. STEERING SYSTEM

3-56. General

The steering system is fully hydraulic. The system consists of a hydraulic pump, selector valve, control valve, steering column, accumulator, steering cylinders and drag link assembly. The fork lift has a two-or four-wheel steering capability.

3-57. Hydraulic Steering Pump

a. General. The hydraulic steering pump is mounted to the engine accessory section. The pump supplies hydraulic pressure to the steering cylinders.

b. Removal. Refer to figure 3-118 and remove the hydraulic steering pump.

c. Disassembly. Refer to figure 3-119 and disassemble the hydraulic steering pump.

NOTE

Scribe a match mark on tbe body and front and rear covers to insure that pump is reassembled in exactly the same manner as it was before disassembly.

d. Inspection.

(1) Inspect gears for broken teeth.

(2) Inspect bearings for wear.

(3) Inspect body and covers for cracks.

(4) Inspect adapter for damage.

e. Reassembly.

(1) Lubricate each part with clean, SAE No. 10 oil.

(2) Refer to figure 3-119 and reassemble the hydraulic steering pump.

(3) Tighten cover bolts to 28 to 32 foot-pounds torque.

NOTE

After overhaul, run pump for 30 minutes at 2000 rpm while pumping SAE No. 10 oil at 0 pressure.

f. Test. Bench-test pump by driving it at 2800 rpm and load pump to 1600 psi. Pump capacity is 30 gallons per minute.

g. Installation. Refer to figure 3-118 and install hydraulic steering pump.

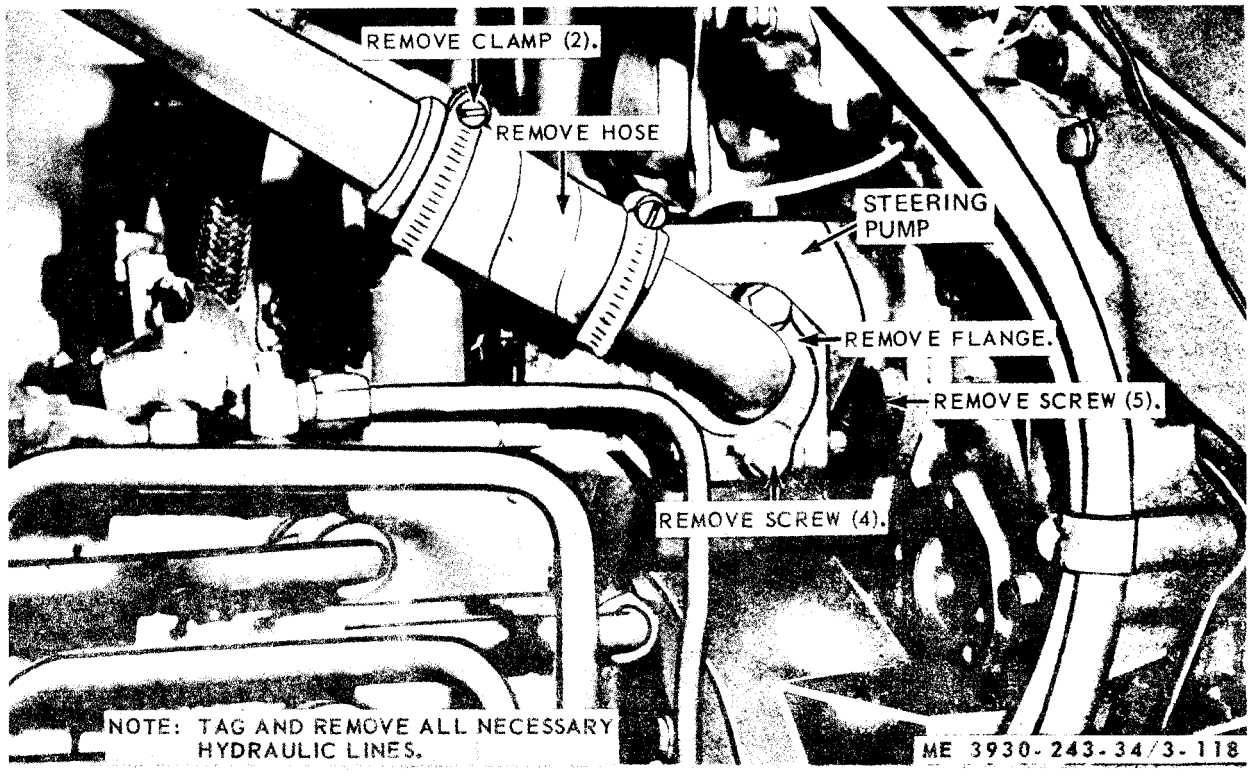


Figure 3-118. Hydraulic steering pump, removal and installation.

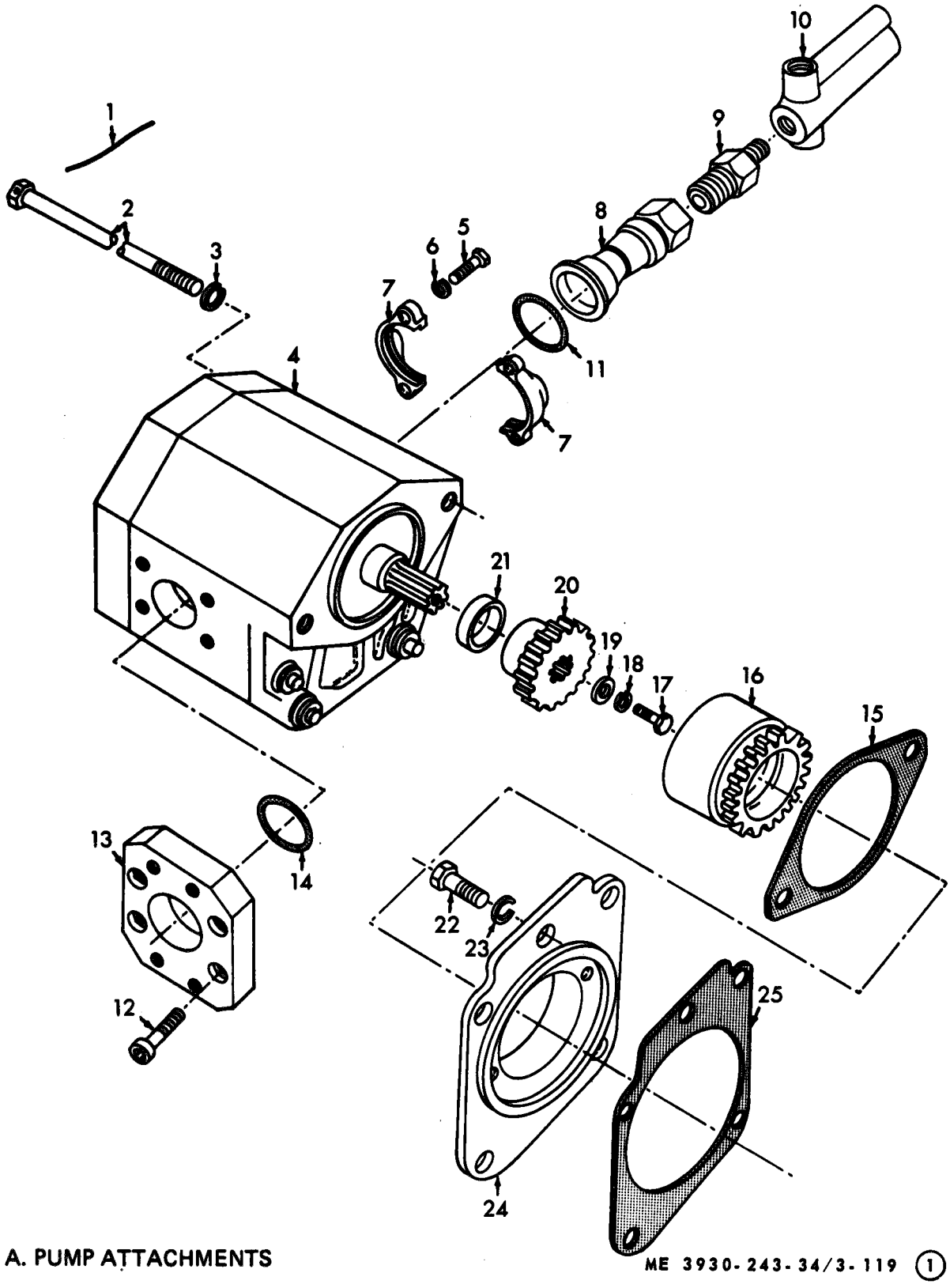


Figure 3-119. Hydraulic steering pump, disassembly and reassembly (sheet 1 of 2).

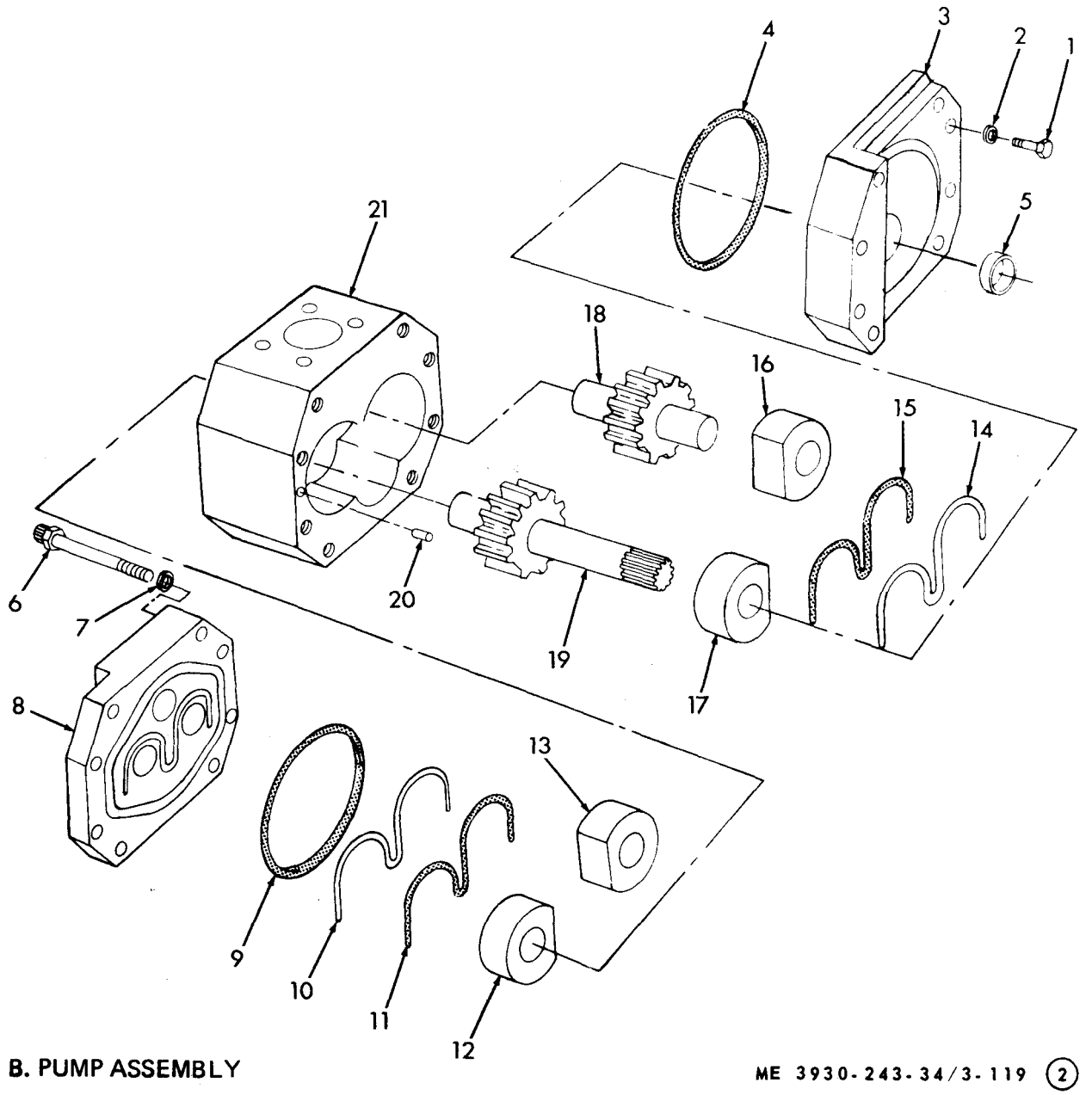


Figure 3-119. Hydraulic steering pump, disassembly and reassembly (sheet 2 of 2).

KEY to figure 3-119 (sheet 1 of 2):

1 Lockwire
2 Screw
3 Lockwasher
4 Pump assembly
5 Screw
6 Lockwasher
7 Split clamp
8 Tube
9 Connector
10 Relief valve
11 O-ring
12 Screw
13 Adapter port
14 Seal
15 Gasket
16 Drive coupling
17 Screw
18 Lockwasher
19 Washer
20 Drive sprocket
21 Spacer
22 Screw
23 Lockwasher
24 Adapter plate
25 Gasket

KEY to figure 3-119 (sheet 2 of 2):

1 Screw
2 Washer
3 Front cover
4 Seal
5 Shaft seal
6 Screw
7 Washer
8 Rear cover
9 Seal
10 Seal
11 Ring
12 Bearing
13 Bearing
14 Seal
15 Ring
16 Bearing
17 Bearing
18 Driven gear
19 Drive gear
20 Dowel pin
21 Pump body

3-58. Steering Selector Valve

a. General. The steering selector valve is located under the driver's compartment behind the driver's ladder. The selector valve is used to select the mode of steering (two-wheel or four-wheel steering).

b. Removal. Refer to figure 3-120 and remove the steering selector valve.

c. Disassembly. Refer to figure 3-121 and disassemble the steering selector valve.

d. Inspection.

(1) Inspect housing (15 and 33) for cracks and breaks.

(2) Inspect rotor (22) for damage.

(3) Inspect disc (6) for excessive wear.

(4) Inspect linkage and lever (3) for wear.

e. Reassembly. Refer to figure 3-121 and reassemble steering selector valve.

f. Installation. Refer to figure 3-120 and install the steering selector valve.

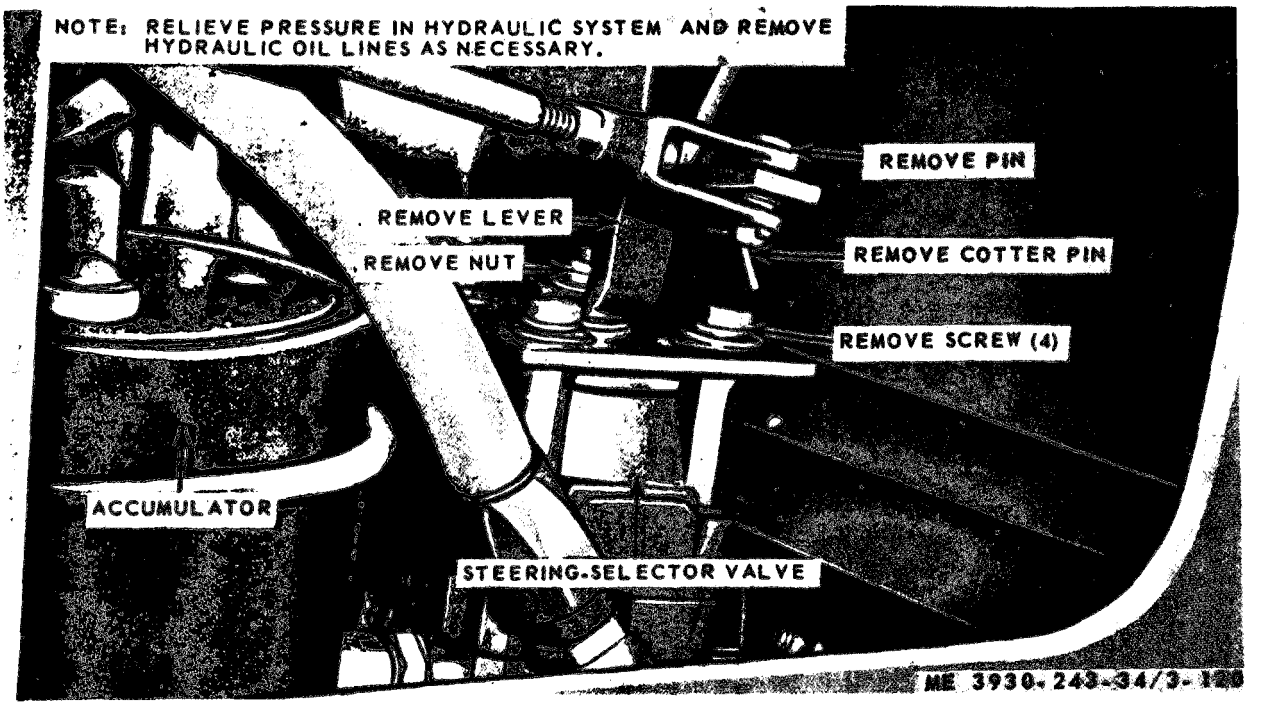
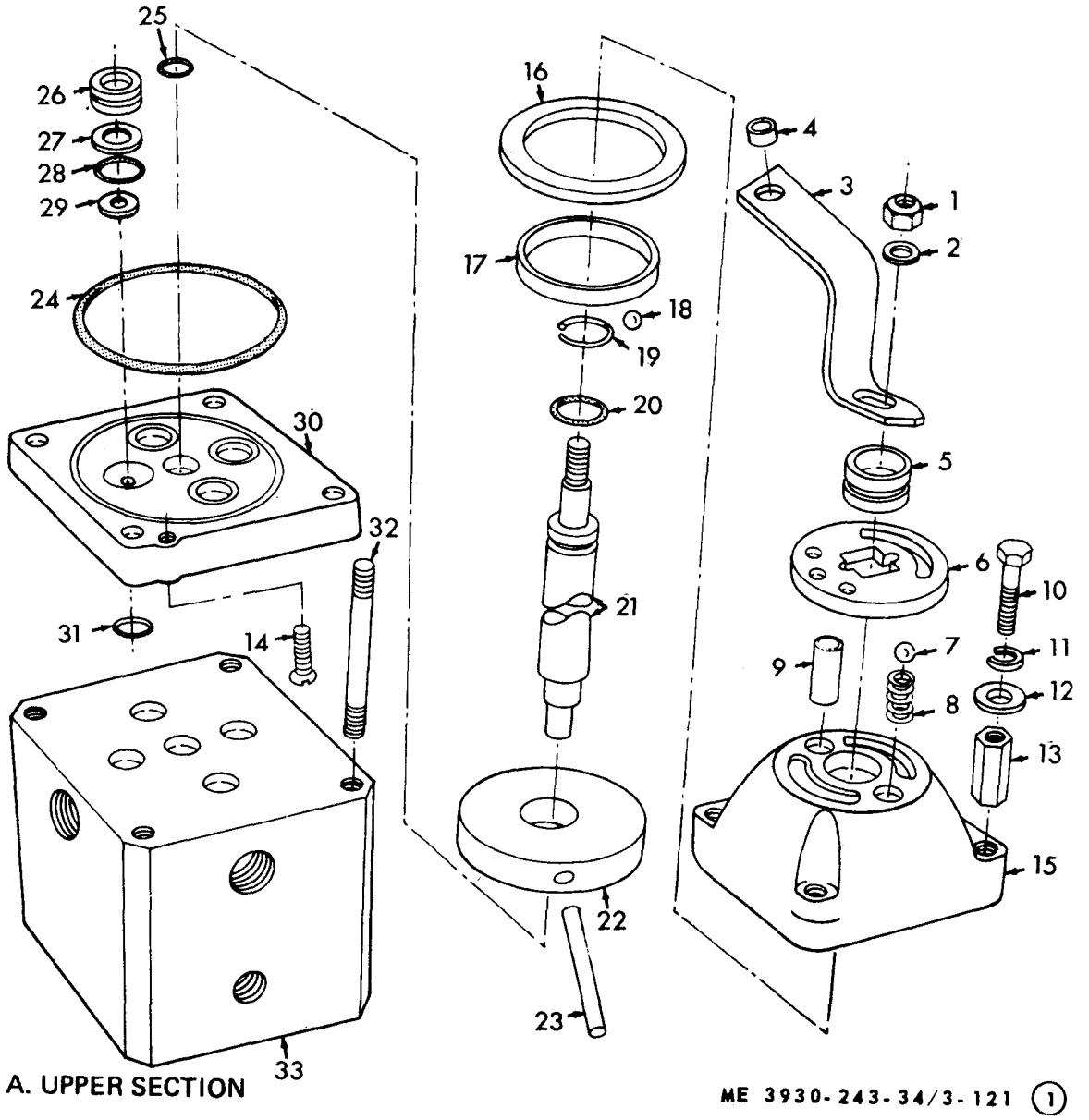
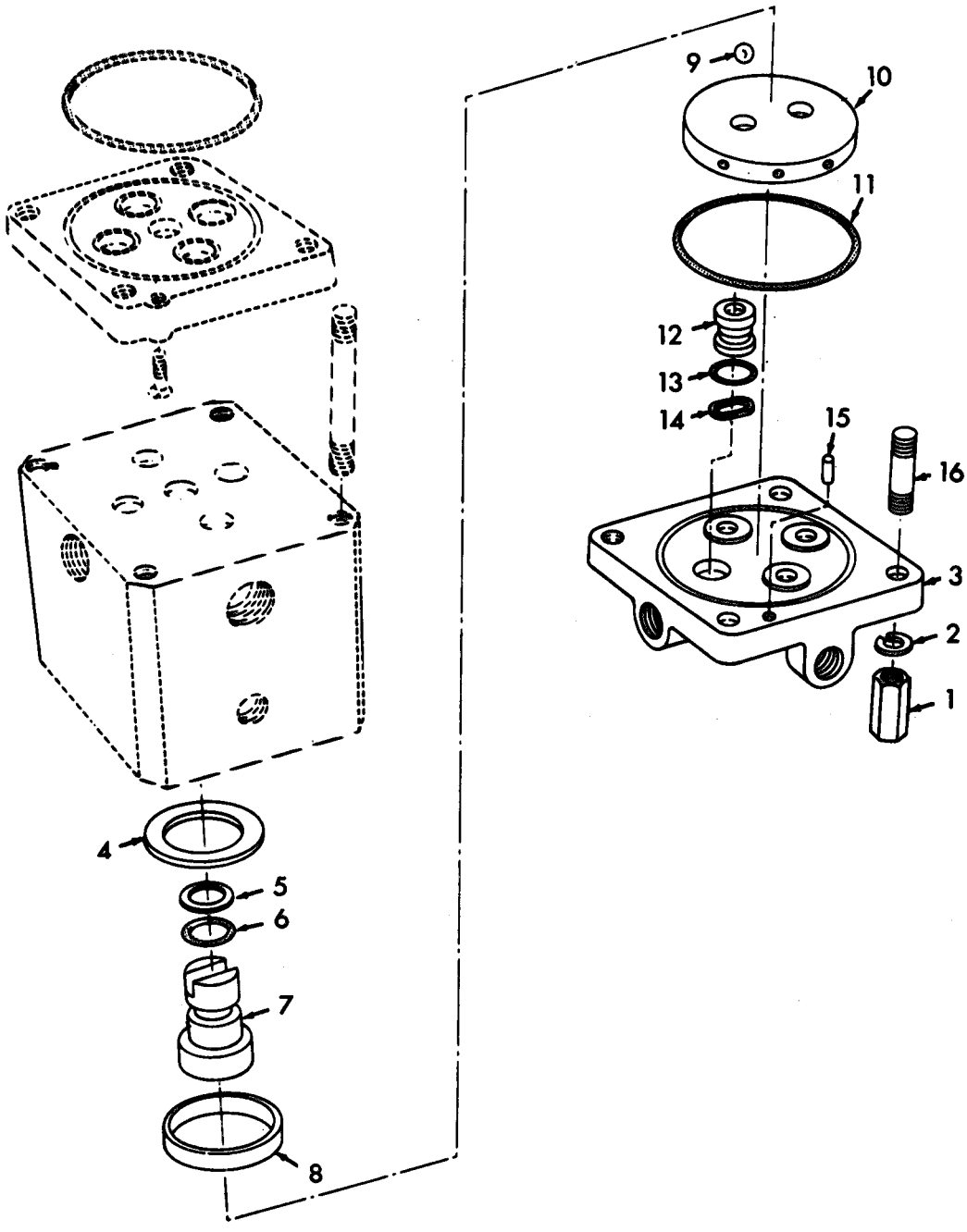


Figure 3-120. Steering selector valve, removal and installation.



1 Nut
2 Washer
3 Lever
4 Bushing
5 Spacer
6 Disc
7 Ball
8 Spring
9 stop pin
10 Screw
11 Lockwasher
12 Washer
13 Bolt stud
14 Screw
15 Housing
16 Thrust washer
17 Retainer
18 Ball
19 Retainer
20 O-ring
21 Shaft
22 Rotor
23 Pin
24 O-ring
25 O-ring
26 Seat
27 O-ring
28 O-ring
29 Washer
30 Upper body
31 O-ring
32 Stud
33 Housing

Figure 3-121. Steering selector valve, disassembly and reassembly (sheet 1 of 2)



1 Bolt stud
2 Lockwasher
3 Lower body
4 Thrust washer
5 Shim
6 O-ring
7 Lower shaft
8 Retainer
9 Ball
10 Rotor
11 O-ring
12 Seat
13 Ring
14 Washer
15 Dowel pin
16 Stud

Figure 3-121. Steering selector valve, disassembly and reassembly (sheet 2 of 2).

3-59. Steering Control Valve

a. General. The steering control valve is mounted to the lower steering column. The steering control valve channels hydraulic pressure to provide power steering for the fork lift.

b. Removal. Refer to figure 3-122 and remove the steering control valve.

NOTE

Mark the two cap screw holes so that the port will be in proper direction when reassembled.

c. Disassembly. Refer to figure 3-123 and disassemble steering control valve as follows:

(1) Clamp unit in vise across mounting plate edge (25) with meter end up and remove 7 cap screws (9) and remove pump drive (1) and pump assembly (2 thru 8).

(2) Place clean wood block across vise throat to support spool parts and clamp unit across port face with control end up.

(3) Remove screws and lift off end cap (25).

(4) Remove cap locator bushing (23).

(5) Place housing (11) on solid surface with port face down so that it can be held securely and remove spool-sleeve assembly (12 thru 16) from the 14 hole end of housing.

(6) Place housing (11) in vise, control end up, and unscrew check valve seat (19) with 3/16 hex wrench.

(7) Up end the housing (11) and tap slightly with butt of hand and remove check ball (20) and spring (21).

d. Inspection.

(1) Inspect mating surfaces for obvious leakage path, wear, and seal conditions.

(2) Inspect all moving surfaces to insure that they have not been scored or abraded by dirt particles or otherwise disrupted.

(3) Insure that all edges of parts for metered section are burr free. Use 600 grit abrasive paper to remove burrs and scratches.

e. Reassembly. Refer to figure 3-123 and reassemble steering control valve in reverse order of disassembly as follows:

(1) Install spring (21), ball (20) and check seat (19). Torque check seat to 150 inch-pound torque. Install seal plug (18) and O-ring (17).

(2) Reassemble spool-sleeve assembly (12 thru 16).

(3) Install spool assembly so that the splined end of spool enters the 14 hole end of the housing (11) first. Bring spool assembly entirely within housing bore until parts are flush at meter end or 14 hold end of housing. Do not pull spool assembly beyond this point to prevent the cross pin from dropping into discharge groove of housing, With spool assembly in this flush position, check for free rotation within housing by turning with light finger force at the spliced end.

(4) Position the cap locator bushing (23) with large outside diameter chamfer up. Place mounting plate (25) over spool shaft. Install bolts and torque to 250 inch pounds.

(5) Place plate (2) on metered end of housing (11) and place meter gear ring (3) on housing so that holes align.

(6) Place the splined end of the drive (1) within the meter gear star (3) so that the slot at the control end of drive is in alignment with the valleys between the meter gear teeth. Push the splined end of the drive through the gear so that the spline extends about one half its length beyond the meter gear star and hold it in this position while installing into the unit. Note position or direction of cross pin (13) within unit. Enter meter gear star into the meter gear ring and wiggle the parts slowly in position so that the drive (1) does not become disengaged from the meter gear star (3). Hold the plate (2) and meter gear ring (3) in position on the housing (11) while the star is being installed. Rotate meter gear star slightly to bring the cross slot of the drive (1) into engagement with cross pin (13) and splined end of the drive will drop against the plate.

CAUTION

Alignment of the cross slot in the drive with valley between the teeth of the meter gear star determines proper valve timing of the unit. There are 12 teeth on the spline and 6 pump teeth on the star. Alignment is exactly right in 6 positions and exactly wrong in 6 positions. If the parts slip out of position during this part of reassembly, repeat step 6 above until you are certain that correct alignment is obtained.

(7) Place the spacer (4) in position within the end of the meter gear star. If spacer does not drop flush with gear surface, the drive has not properly engaged the cross pin. Recheck.

(8) Place the meter end cap (8) over the assembly and install two capscrews, finger tight, to maintain alignment of parts.

(9) Install all seven cap screws and bring them gradually and evenly to 150 inch-pounds torque.

f. Installation.

(1) Check condition of the steering column assembly.

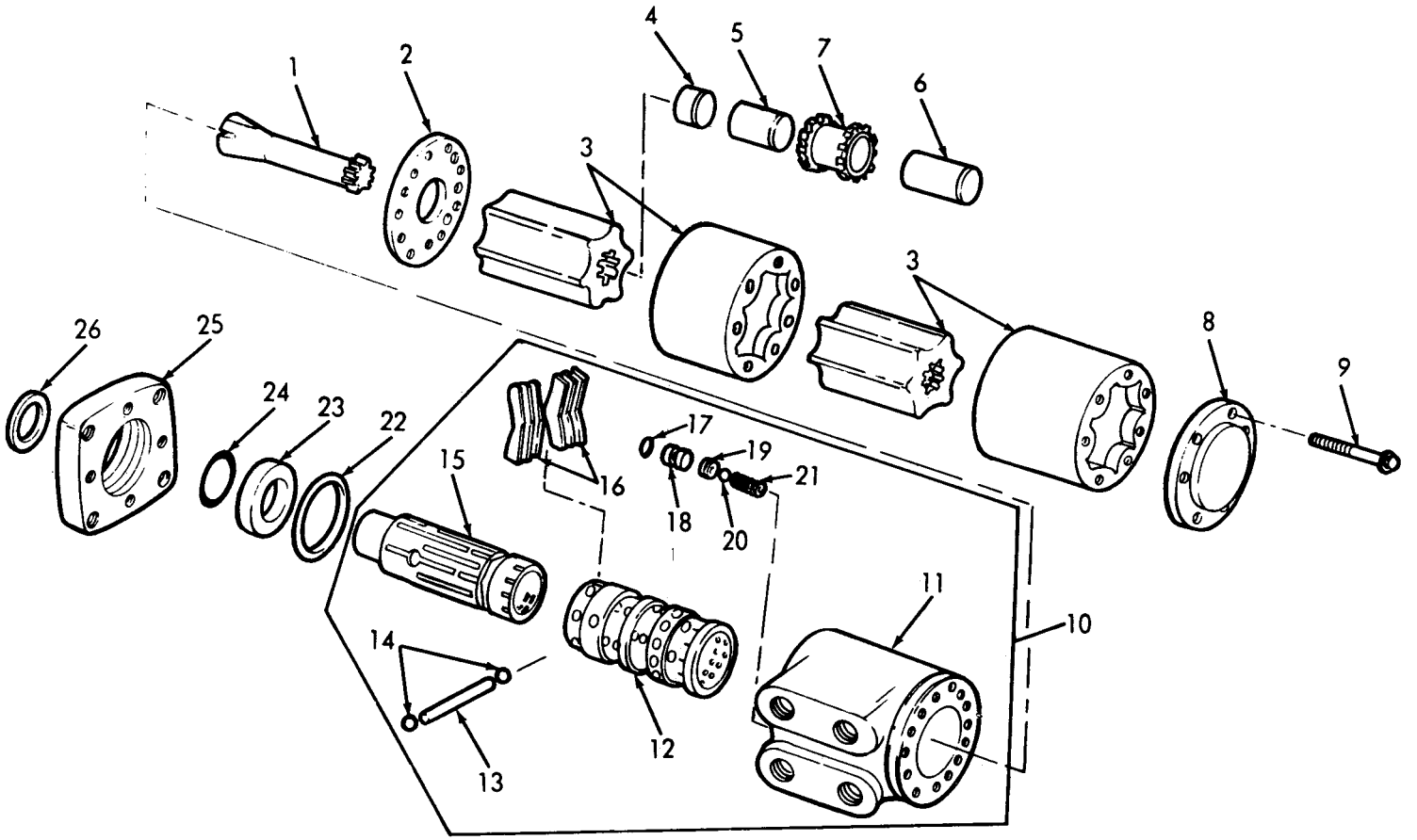
(2) Refer to figure 3-122 and install the steering control valve.

NOTE

Rotate the steering shaft while bringing the surfaces into contact to allow splines to engage.

(3) Torque capscrews to 280 inch pounds.

Figure 3-122. Steering control valve, removal and installation.



ME 3930-243-34/3-123

1 Drive
2 Plate
3 Gear set
4 Spacer
5 Spacer
6 Spacer
7 Spline
8 End cap
9 Screw
10 Control parts assembly
11 Housing
12 Sleeve control
13 Centering pin
14 Disc pin
15 Control spool
16 Spring
17 O-ring
18 Seal
19 Seat
20 Ball
21 Spring
22 O-ring
23 Bushing
24 Seal
25 Mounting plate
26 Oil seal

Figure 3-123. Steering control valve disassembly and reassembly.

3-60. Steering Column

a. General. The steering column m mainly consists of the column jacket, shaft and bearings. It is held in place by a lower and upper support bracket. The power steering unit is mounted to the base of the steering column.

b. Removal.

(1) Remove the steering wheel (TM 10-3930-243-12).

(2) Refer to figure 3-124 and remove the column.

c. Disassembly. Refer to figure 3-125 and disassemble the steering column.

NOTE

The shaft (18) and bearing (16) can be removed from the tube (27) by pushing on the lower end of shaft. Do not use a hammer to pound shaft free.

e. Inspection.

(1) Inspect bearings for wear or damage.

(2) Inspect tube for cracks and damage.

(3) Inspect all hardware for damage.

(4) Inspect wiring for cuts, breaks or deterioration.

f. Reassembly. Refer to figure 3-125 and reassemble steering column in reverse order of disassembly.

g. Installation.

(l) Refer to figure 3-124 and install the steering column.

(2) Install steering wheel (TM 10-3930-243-12).

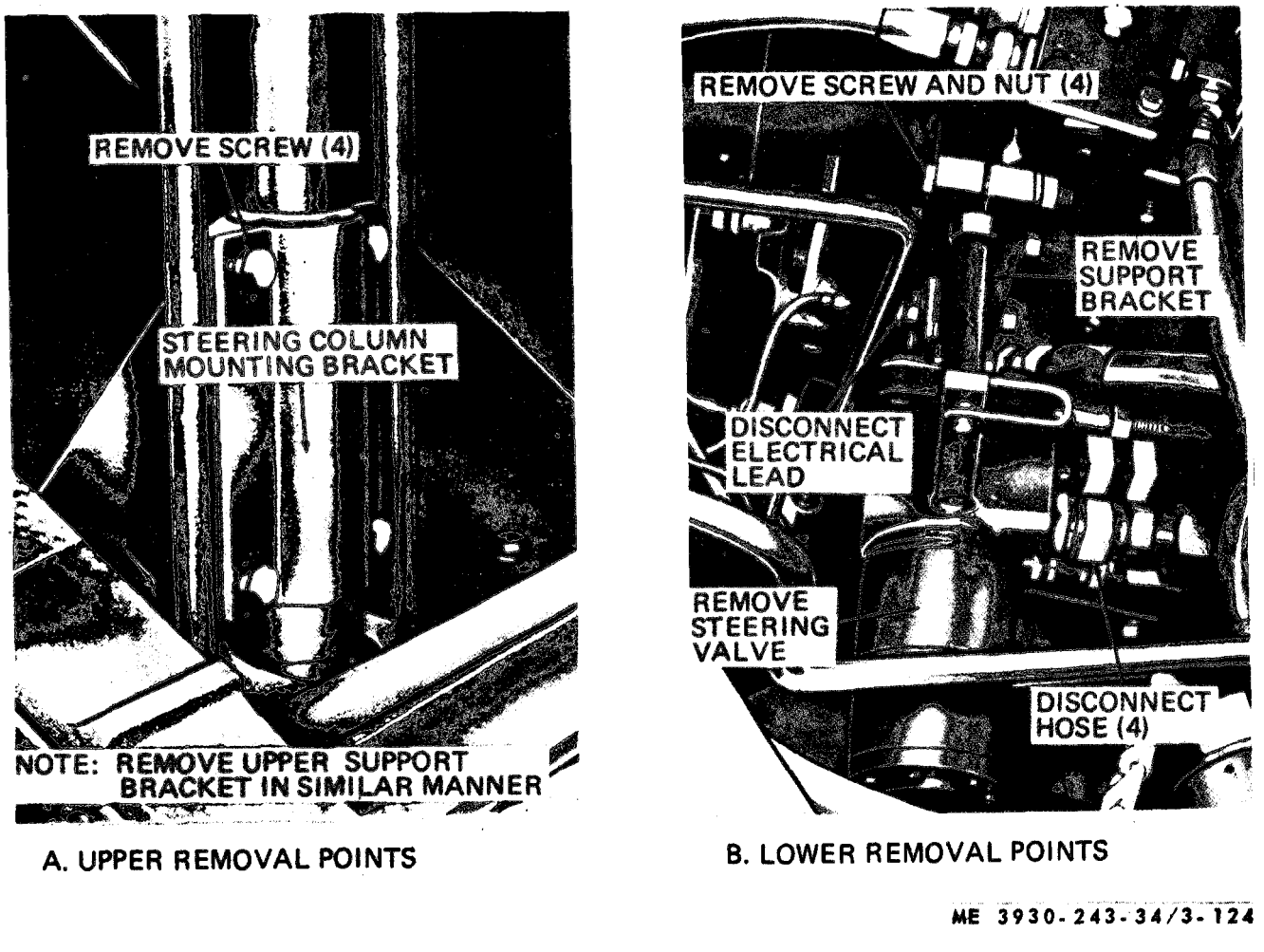
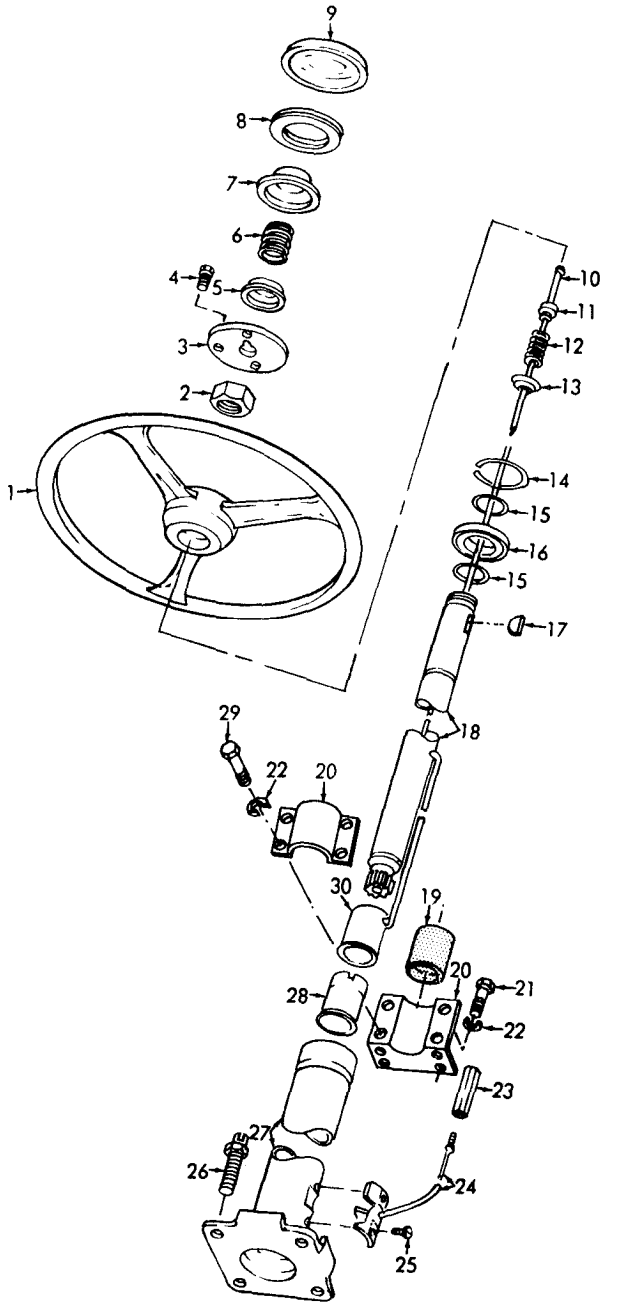


Figure 3-124. Steering column, removal and installation.



1 Steering wheel	16 Bearing
2 Nut	17 Key
3 Cap	18 Shaft
4 Screw	19 Hose
5 Cup	20 Bracket
6 Spring	21 Screw
7 Cap	22 Washer
8 Horn button	23 Brush
9 Cap	24 Wire
10 Terminal wire	25 Screw
11 Insulator	26 Screw
12 Spring	27 Tube
13 Washer	28 Insulator
14 Ring	29 Screw
15 Ring	30 Contact ring

Figure 3-125. Steering column, disassembly and reassembly.

3-61. Steering System Accumulator

a. General. The accumulator is provided to store energy for a limited time to the power steering in case of engine failure. The accumulator is charged with nitrogen and hydraulic oil under high pressure. It is located behind the operator's access ladder panel. The steering system accumulator is mounted next to the brake system accumulator and is identical in construction, removal, and disassembly.

WARNING

Bleed all pressure from the steering system with the engine stopped. Carefully open bleed valve. Failure to bleed pressure from accumulator before performing maintenance function may result in damage to equipment and serious injury to personnel.

b. Removal. Refer to figure 3-115 and remove steering system accumulator.

c. Disassembly. Refer to figure 3-116 and disassemble steering system accumulator.

d. Reassembly. Refer to figure 3-116 and reassemble steering system accumulator.

e. Installation. Refer to figure 3-115 and install steering system accumulator.

f. Charging the Accumulator. Exercise caution when testing or charging accumulator.

WARNING

Use only dry nitrogen gas. Bleed all pressure as described above. Failure to do so could result in serious damage to equipment and injury to personnel.

(1) Remove screw and remove protector strap.

(2) Attach charging kit to accumulator gas valve assembly.

(3) Open accumulator valve to read pressure.

(4) Open valve on nitrogen bottle and charge accumulator cylinder to 900 psi.

(5) Close nitrogen bottle valve and detach charging kit.

(6) Replace protector strap.

3-62. Tie Rods

a. General. The tie rod is of a three piece construction consisting of the rod and two tie rod end yokes. The rod is screwed into the threaded yokes and are locked in place by tightening the bolt and nut. Right and left hand threads on the rod end provide for toe in adjustment.

b. Removal. Refer to figure 3-126 and remove the tie rod and tie rod end yokes.

c. Disassembly. Refer to figure 3-127 and disassemble the tie rod assembly.

d. Inspection.

(1) Inspect rod (6) and rod end (8) for stripped threads.

(2) Inspect rod for bend or damage

(3) Inspect bushing (7) for excessive wear.

(4) Replace a defective part.

e. Reassembly. Refer to figure 3-127 and reassemble tie rod assembly.

g. Installation. Refer to figure 3-126 and install tie rod assembly.

h. Adjustment. Adjust tie rods so that the wheels are parallel with no toe in or toe out.

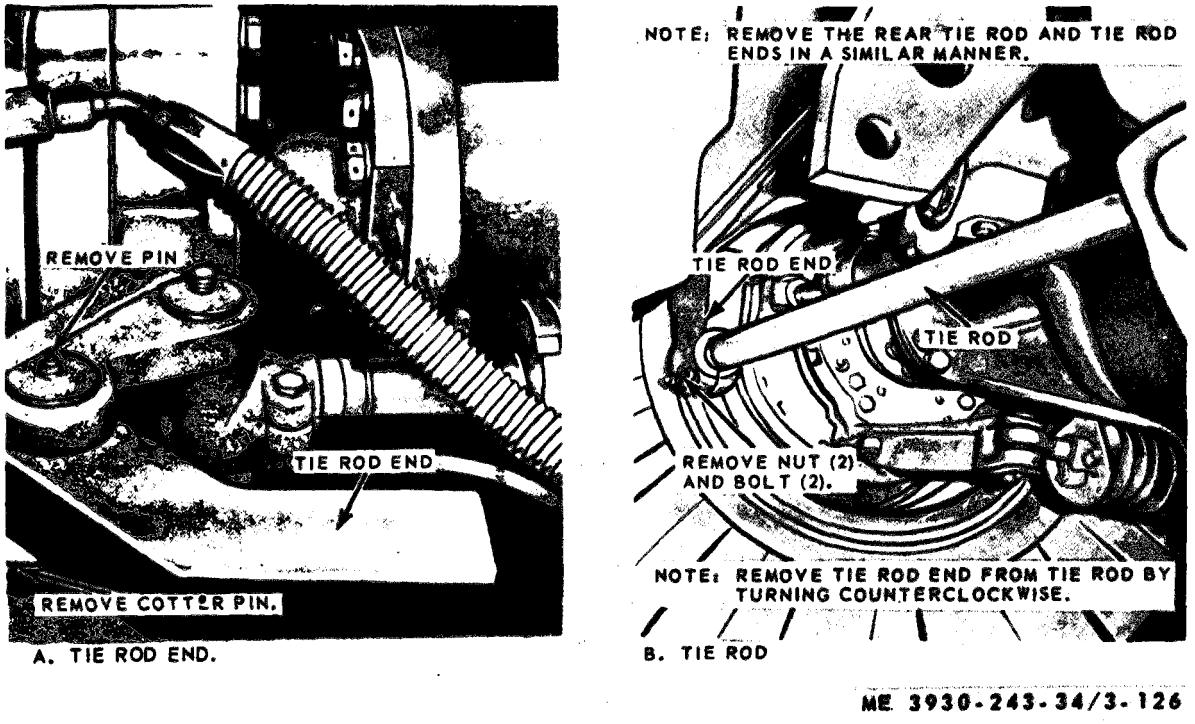
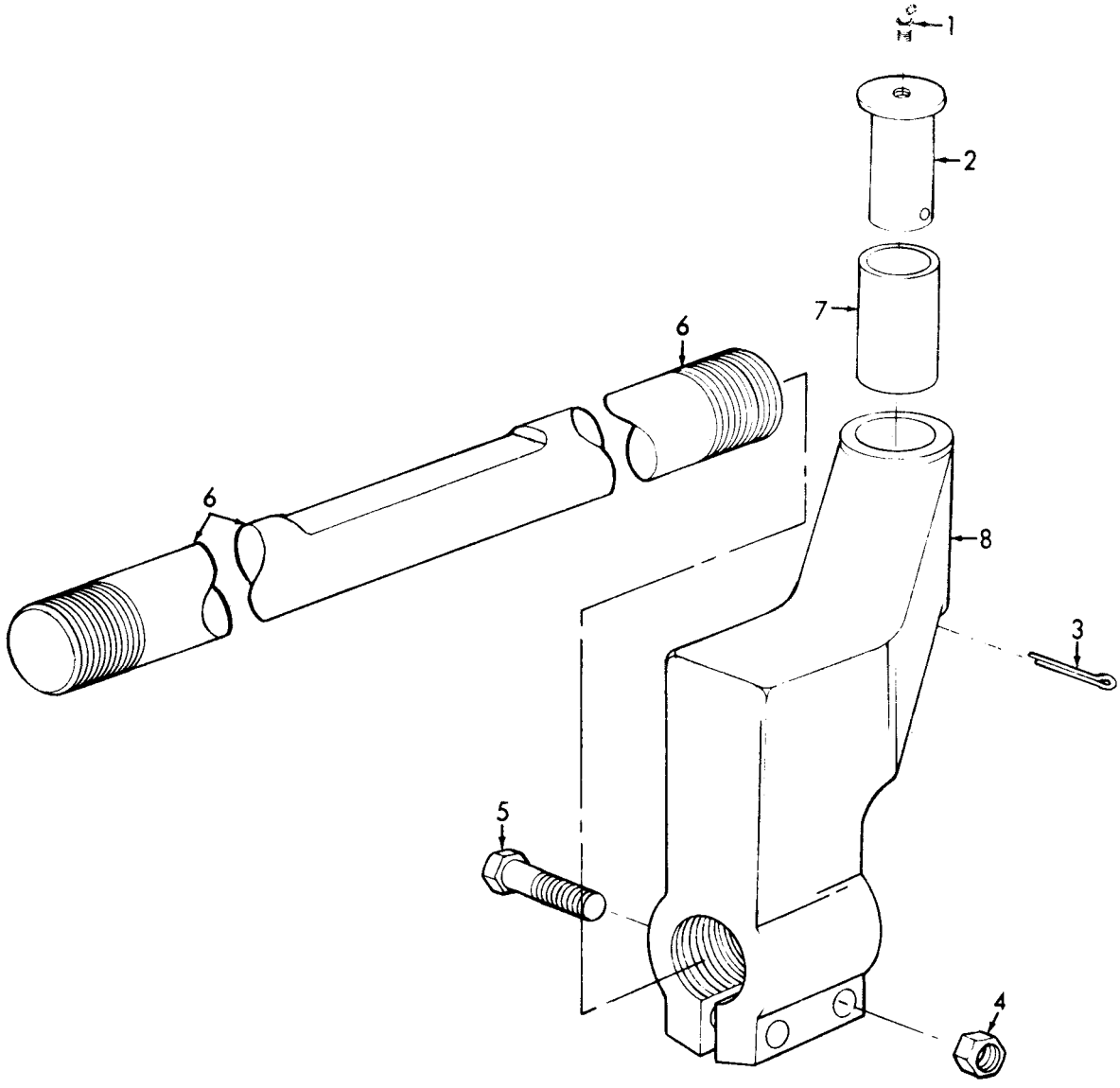


Figure 3-126. Tie rod assembly, removal and installation.



ME 3930-243-34/3-127

1 Lubrication fitting
2 Headed pin
3 Cotter pin
4 Lock nut
5 Screw
6 Tie rod
7 Bushing
8 End yoke

Figure 3-127. Tie rod assembly, disassembly and reassembly.

3-63. Drag Link

a. General. The drag link is a tubular pipe threaded on each end. Rod ends are threaded into each end of the tube. One end of the drag link hooks to the front steering arm and the other end connects to the lever assembly. The lever assembly is mounted to the frame assembly. The hydraulic steering lock cylinder is connected to the lever assembly.

b. Removal. Refer to figure 3-128 and remove the drag link assembly.

c. Disassembly. Refer to figure 3-129 and disassemble drag link assembly.

d. Inspection.

(1) Inspect rod ends (8 and 6) for wear.

(2) Inspect pivot pins (2 and 14) for wear and scoring.

(3) Inspect tube (9) for cracks or damage.

(4) Inspect lever (14) for cracks.

(5) Inspect all hardware. Replace a defective part.

e. Reassembly. Refer to figure 3-129 and reassemble drag link assembly.

f. Installation. Refer to figure 3-128 and install drag link assembly.

g. Adjustment. Adjust drag link assembly so that each steering cylinder must make a full stroke (6 7/8 inch).

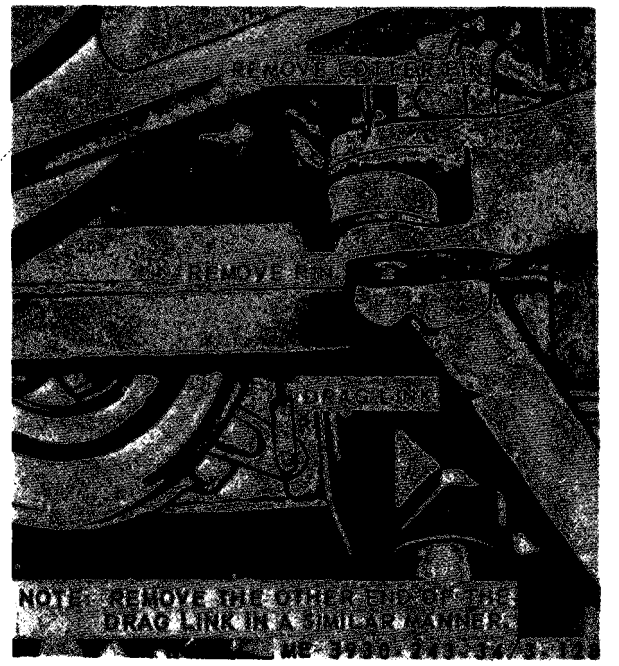
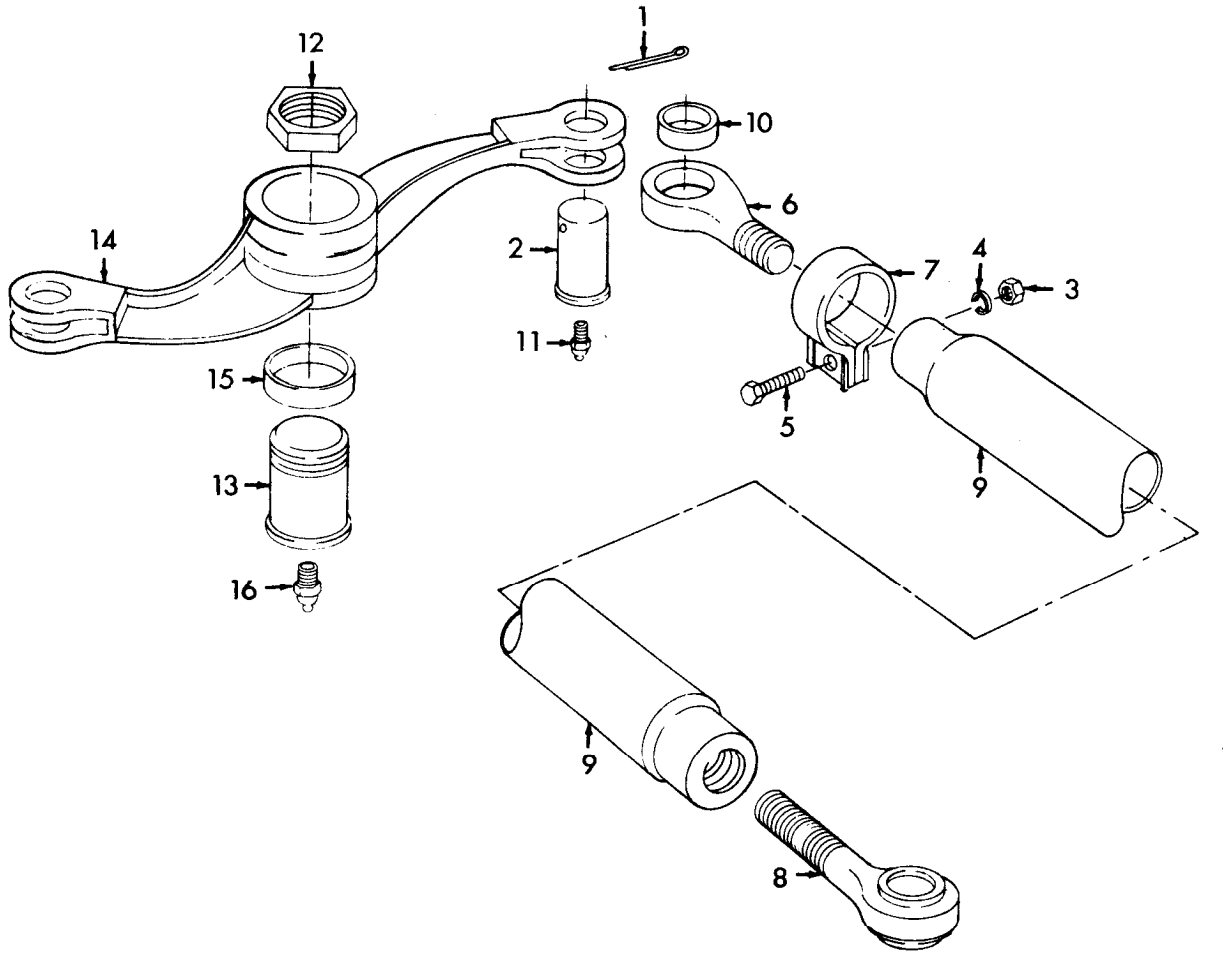


Figure 3-128. Drag link assembly, removal and installation.



ME 3930-243-34/3-129

1 Cotter pin
2 Pivot pin
3 Nut
4 Lockwasher
5 Screw
6 Rod end
7 Clamp
8 Rod end
9 Tube assembly
10 packing
11 Fitting
12 Nut
13 Pivot pin
14 Lever assembly
15 Sleeve
16 Fitting

Figure 3-129. Drag link assembly, disassembly and reassembly.

3-64. Steering Cylinder

a. General. The steering cylinders are mounted to three of the four wheels of the fork lift. The cylinder that is attached to the right rear wheel is the two wheel lock cylinder. Power is supplied to the steering cylinder by the engine mounted hydraulic steering pump. The three steering cylinders are identical in make. Model RTL10 uses a different cylinder than Model RTL10-1 as shown in figures 3-131 (sheet 1 of 2) and 3-131 (sheet 2 of 2).

b. Removal.

(1) Relieve all hydraulic pressure.

(2) Refer to figure 3-130 and remove hydraulic steering cylinders.

NOTE

Cap all hydraulic lines after removal.

c. Recommended Procedure for Repacking all Cylinders.

(1) Area the cylinder is to be disassembled in should be as clean as possible to prevent any contamination getting into the cylinder or hydraulic system.

(2) Pull piston rod out until it bottoms, loosen

hex socket setscrew in packing nut. With a spanner wrench loosen and unscrew packing nut.

(3) All internal parts can now be taken out cm the piston rod.

(4) Hold rod end with pin through the eye to prevent turning. Protect rod from damage. Remove nut on piston end, slide parts off removing O-rings.

(5) Thoroughly wash all parts in solvent (Fed P-D-680) and wipe or blow dry.

(6) Install new back up rings and O-rings with a minimum amount of stretching. Thoroughly lubricate all seals and packing with hydraulic oil.

(7) Reinstall bushing into retainer and slide packing nut and assembled retainer onto piston rod.

(8) Install new packing and rider on piston half and slide on rod, slide O-ring into place and lubricate. Install washer, slide next O-ring into place.

(9) Check cylinder bore to be sure it is clean and free of any contamination.

(10) Use a length of brass shim stock to guide packing over threads. Apply another coat of lubricant to all exposed seals and carefully insert assembly into shell. Push retainer into position and tighten packing nut.

(11) Tighten setscrew firmly in place and reinstall cylinders in truck.

(12) Actuate hydraulic system, remove blocks and cycle through all functions to purge air from system.

NOTE

Internal loos of pressure in the cylinder can be caused by a damaged O-ring between the piston half and rod or the piston packing.

NOTE

Cylinders having the spherical bearing in the ends have a press fit but are also staked to prevent working loose.

d. Disassembly. Refer to figure 3-131 and disassemble h hydraulic steering cylinders.

e. Inspection.

(1) Inspect cylinder rod for nicks and damage. Damaged rods will shorten packing life.

(2) Inspect shell for cracks and damage.

(3) Inspect piston for nicks and scratches.

(4) Remove nicks and scratches with crocus cloth.

(5) Replace a defective part.

f. Reassembly. Refer to figure 3-131 and reassemble hydraulic steering cylinder as described above.

g. Test.

(1) *Packing drag test.*

(a) With cylinder horizontal, fill rod end of the cylinder with oil.

(b) Open head end part of the piston to the atmosphere.

(c) With rod end under no load except normal seal and wiper drag, pressurize the rod end of the cylinder and record the maximum pressure reached before piston moves.

(d) Repeat the above for head end of the cylinder.

(e) The piston may be operated as necessary for wear in.

(f) Piston rod will extent with maximum of 15 PSI on piston. Piston rod will retract with maximum of 25 PSI on rod side of piston.

(2) *Piston Leakage Test.*

(a) Fill cylinder with oil. Seal rod end and load the head end of the piston to not less than 2000 PSI and hold this pressure for 15 minutes.

(b) Measure and record the travel of the piston during the 15 minutes.

(c) Repeat procedure for rod end of cylinder.

(d) Maximum piston rod drift not to exceed 1 inch per hour.

h. Adjustment. The steering cylinders must be adjusted so each steering cylinder has an equal amount of travel of the piston rods. The tie rods must be adjusted to no toe in or toe out. Retract the steering cylinder rod shaft. Mark (with tape) the rod shaft against the face of the cylinder. Fully extend the cylinder rod shaft and measure this distance from. the face of the cylinder to the mark made with the rod retracted. Mark ½ this distance (with tape outside the ½ mark). Retract the cylinder rod to ½ the stroke (or edge of tape). The wheels must be in line. Screw on the cylinder rod end until the cylinder rod end lock pin can be inserted in the lock pin hole. Torque the rod end locking bolt to 40 ft. lbs. Adjust other steering cylinders in a similar manner.

i. Installation. Refer to figure 3-130 and install hydraulic steering cylinder.

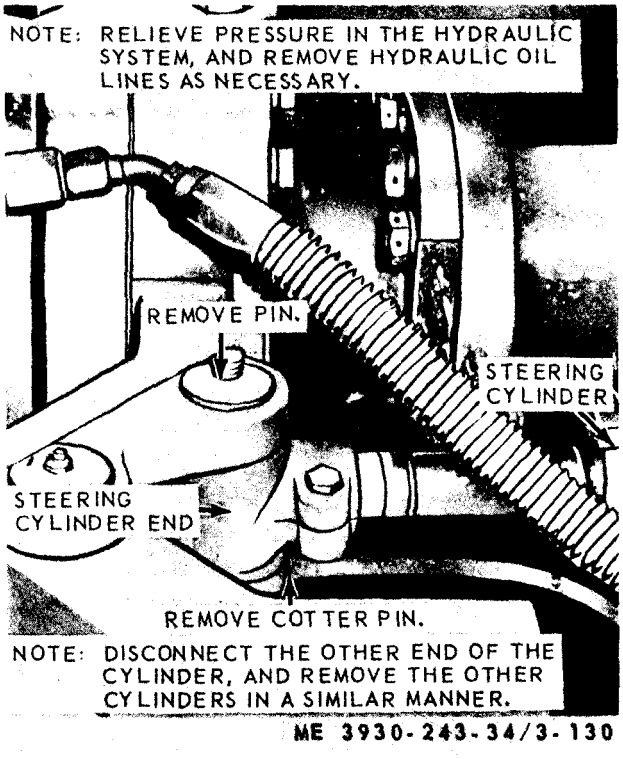
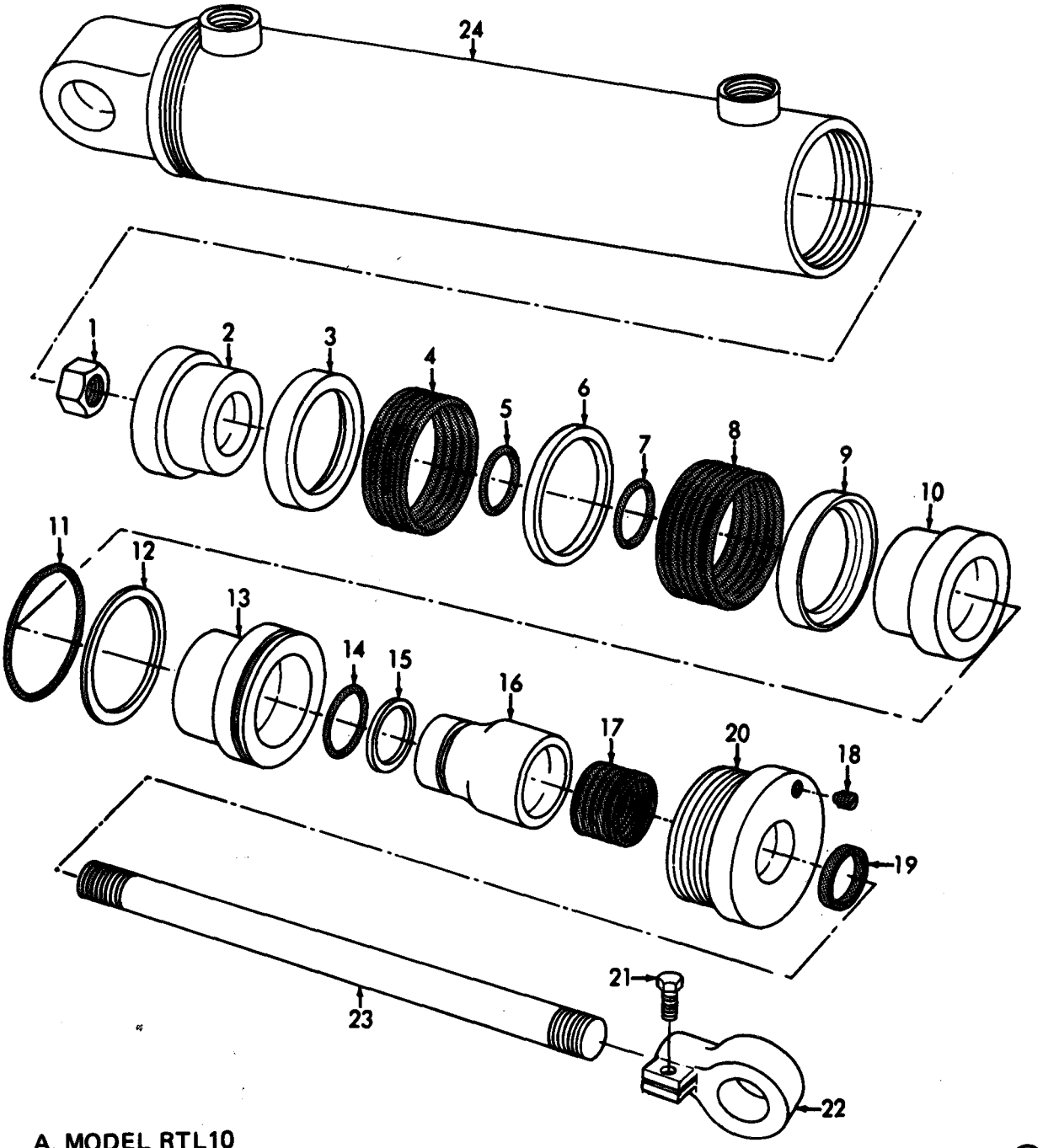
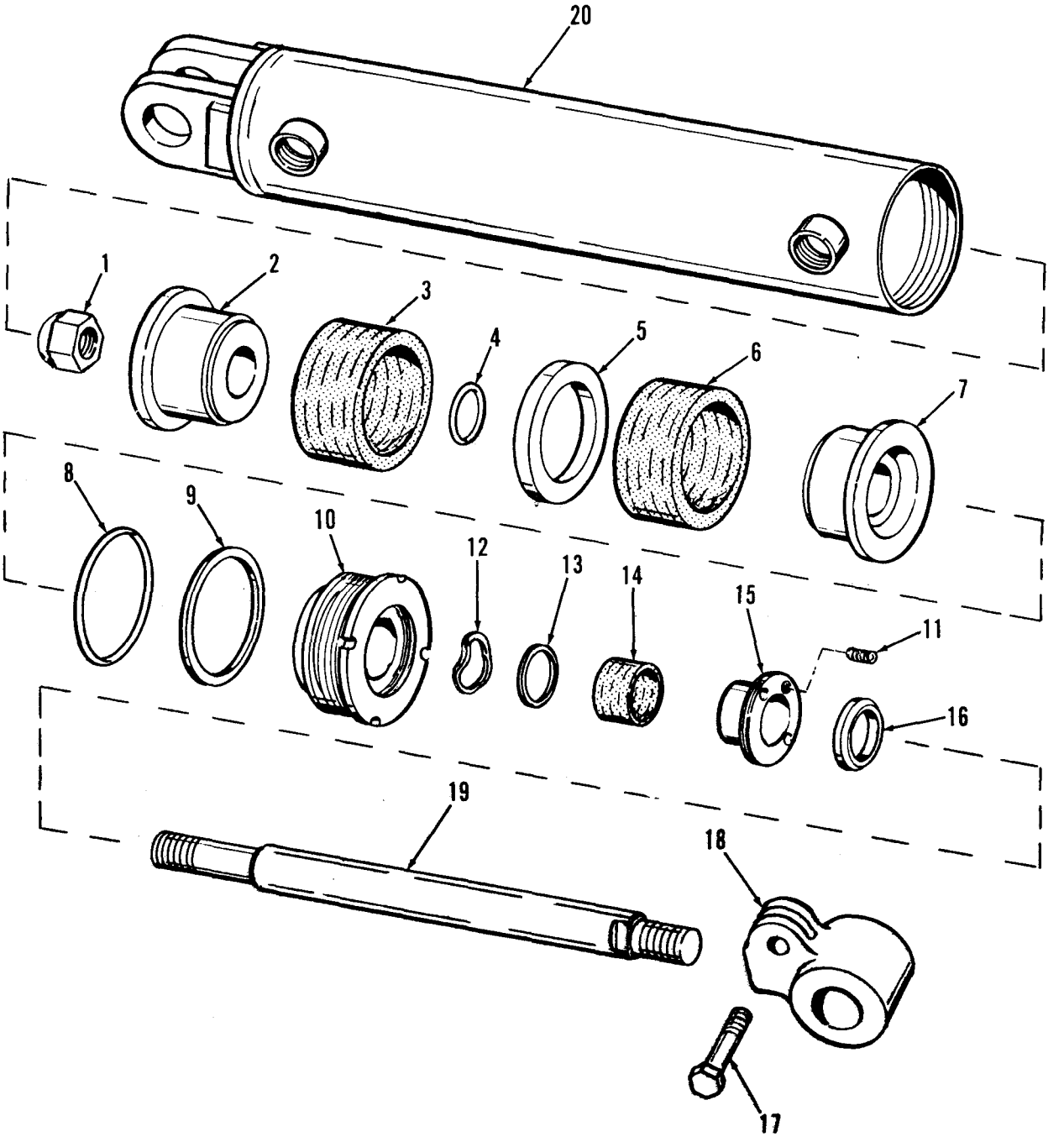


Figure 3-130. Hydraulic steering cylinder, removal and installation.



1 Nut	13 Retainer
2 Piston	14 O-ring
3 Rider	15 Ring
4 Packing	16 Bushing
5 O-ring	17 Packing
6 Washer	18 Setscrew
7 O-ring	19 Wiper
8 Packing	20 Nut
9 Rider	21 Screw
10 Piston	22 Rod end
11 O-ring	23 Rod
12 Ring	24 Shell

Figure 3-131. Hydraulic steering cylinder, disassembly and reassembly (sheet 1 of 2).



B. MODEL RTL10 - 1

ME 3930-243-34/3-131 (2)

Figure 3-131. Hydraulic steering cylinder, disassembly and reassembly (sheet 2 of 2).

KEY to figure 3-131 (sheet 2 of 2):

1 Nut	11 Setscrew
2 Piston	12 Spring washer
3 Packing assembly	13 Washer
4 O-ring	14 Packing assembly
5 Adapter	15 Flange
6 Packing assembly	16 Wiper
7 Piston	17 Screw
8 O-ring	18 Rod end
9 Backup ring	19 Rod
10 Nut	20 Shell

3-65. Two Wheel Steering Lock Cylinder

a. General. The 2-wheel steering lock cylinder is mounted to the right rear wheel. The cylinder hydraulically locks the rear wheel in the no-steering position and the front wheels are used for steering.

b. Removal. Refer to figure 3-132 and remove two wheel steering lock cylinder.

c. Disassembly. Refer to figure 3-133 and disassemble two wheel steering lock cylinder.

d. Repacking Cylinder. Refer to paragraph 3-64c for repacking procedures.

e. Inspection.

(1) Inspect rod for nicks and scratches.

(2) Inspect head for cracks.

(3) inspect piston for nicks and burrs.

(4) inspect shell and lug end for cracks and dam age.

(5) Replace a defective part.

(6) Remove scratches and nicks with crocus cloth.

f. Reassembly. Refer to figure 3-133 and reassemble two wheel steering lock cylinder.

g. Test. Refer to paragraph 3-64g and test the cylinder.

h. Installation. Refer to figure 3-132 and install two wheel steering lock cylinder.

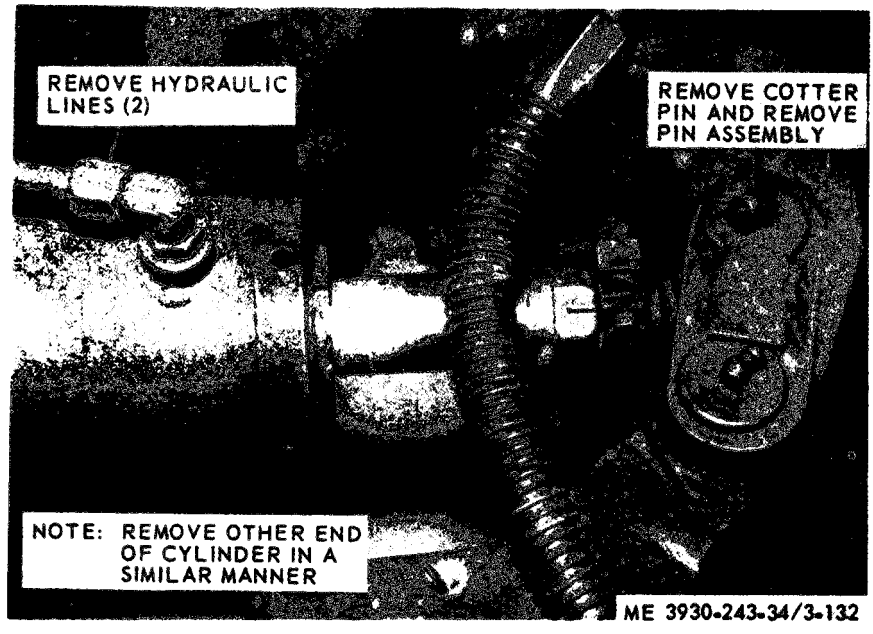
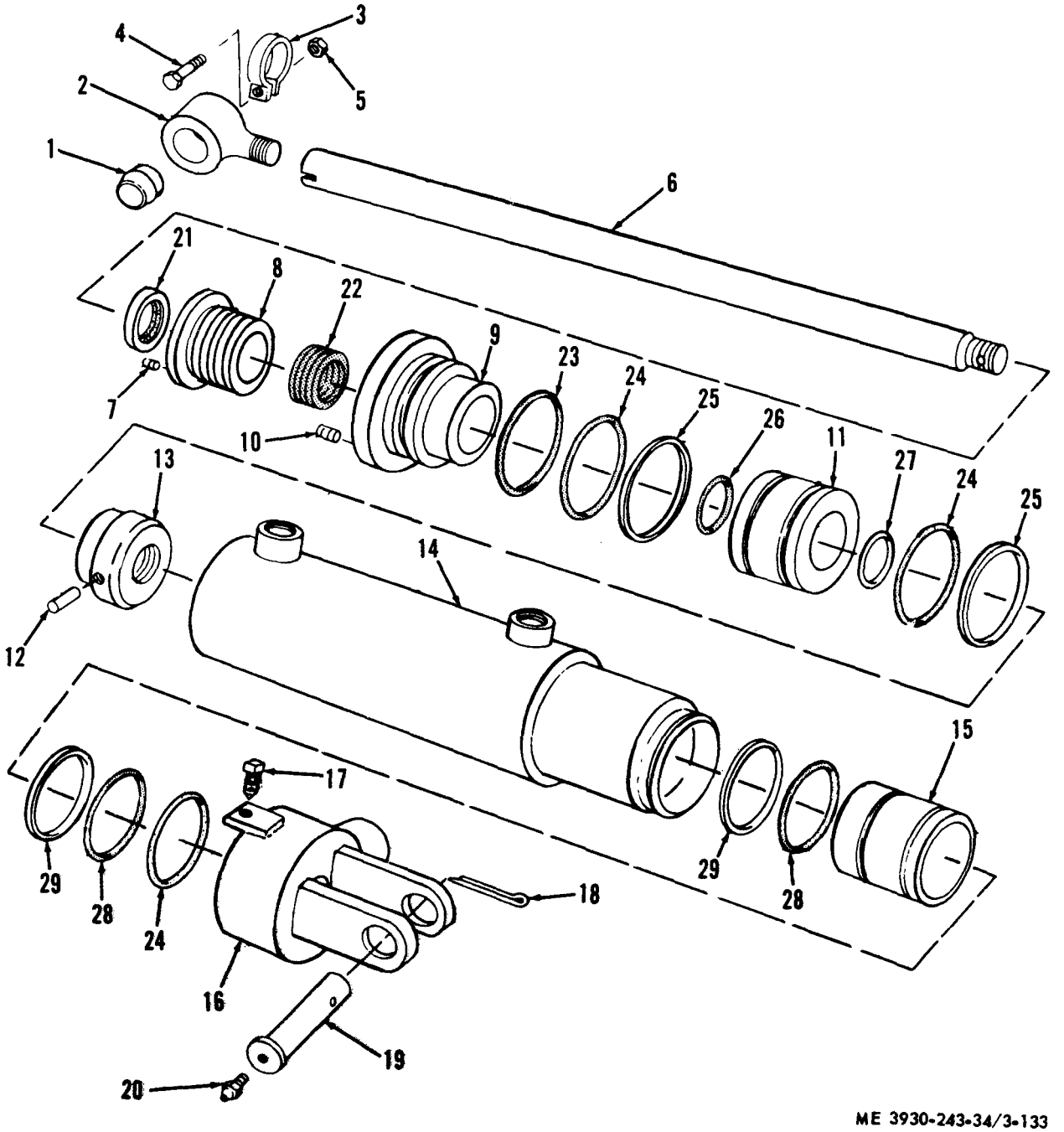


Figure 3-132. Two wheel steering lock cylinder, removal and installation.



1 Bushing
2 Rod end
3 Clamp
4 Screw
5 Nut
6 Rod
7 Setscrew
8 Packing gland
9 Head
10 Setscrew
11 Piston
12 Pin
13 Collar
14 Shell
15 Piston
16 Lug end
17 Setscrew
18 Pin
19 End pin
20 Fitting
21 Wiper
22 Packing set
23 O-ring
24 O-ring
25 Backup ring
26 O-ring
27 Backup ring
28 O-ring
29 Backup ring

Figure 3-133. Two wheel steering lock cylinder, disassembly and reassembly.

3-66. Four Wheel Steering Lock Cylinder

a. General. The four wheel steering lock cylinder is connected to the drag link lever and the left rear wheel and is used when the steering is placed in the four wheel position.

b. Removal. Refer to figure 3-134 and remove four wheel lock steering cylinder.

c. Disassembly. Refer to figure 3-135 and disassemble four. wheel lock steering cylinder.

d. Repacking Cylinder. Refer to paragraph 3-64c for repacking procedures.

e. Inspection.

(1) Inspect rod assembly for damage.

(2) Inspect tube for cracks or damage.

(3) Inspect piston for scratches and nicks.

(4) Inspect end plug for damage.

(5) Replace a defective part.

(6) Remove scratches, burrs and nicks with crocus cloth.

f. Reassembly. Refer to figure 3-135 and reassemble four wheel steering lock cylinder.

g. Test. Refer to paragraph *3-64g* and test the cylinder.

h. Installation. Refer to figure 3-134 and install four wheel steering lock cylinder.

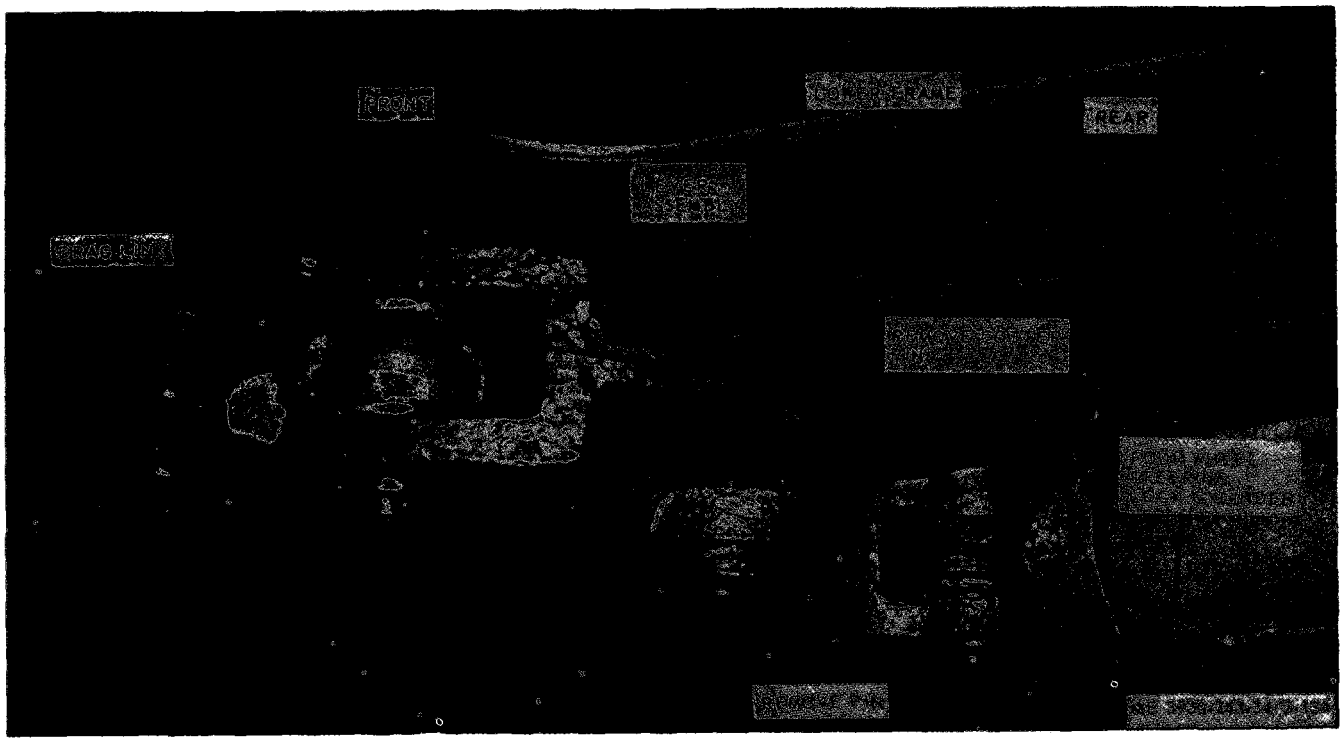
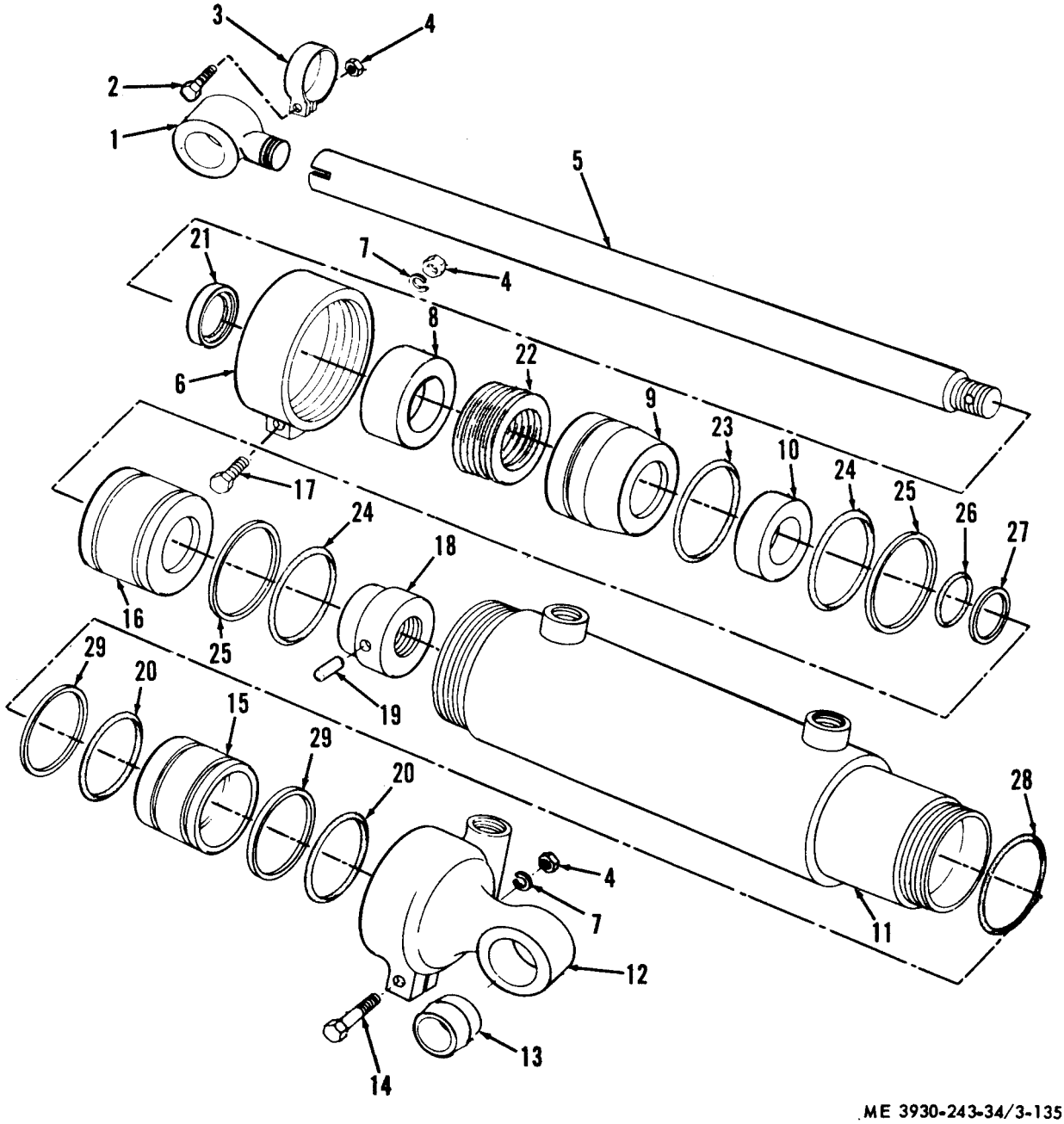


Figure 3-134. Four wheel steering lock cylinder, removal and installation.



1 Rod end
2 Screw
3 Clamp
4 Nut
5 Rod
6 Cylinder nut
7 Washer
8 Bushing
9 Packing gland
10 Spacer
11 Tube
12 End lug
13 Bushing
14 Screw
13 Piston
16 Piston
17 Screw
18 Collar
19 Pin
20 O-ring
21 Wiper
22 Packing set
23 O-ring
24 Piston ring
25 Backup ring
26 O-ring
27 Backup ring
28 O-ring
29 Backup ring

Figure 3-135. Fourwheel steering lock cylinder, disassembly and reassembly.

3-67. Crab Lock Cylinders (Model RTL10)

a. General. The crab lock cylinder is mounted to the right front wheel and the right rear wheel. This cylinder is placed in operation when the steering selector handle is placed in the crab position.

b. Removal. Refer to figure 3-136 and remove crab lock cylinder.

c. Disassembly. Refer to figure 3-137 and disassemble crab lock cylinder.

d. Repacking Cylinder. Refer to paragraph *3-64c* for repacking procedures.

e. Inspection.

(1) Inspect the rod for nicks and scratches.

(2) Inspect rod ends for wear and damage.

(3) Inspect piston for scratches.

(4) Inspect cylinder ends for cracks.

(5) Inspect cylinder tube for cracks and damage.

(6) Remove scratches and burrs with crocus cloth.

(7) Replace a defective part.

f. Reassembly. Refer to figure 3-137 and reassemble crab lock cylinder.

g. Test. Refer to paragraph *3-64g* and test the cylinder.

h. Installation. Refer to figure 3-136 and install crab lock cylinder.

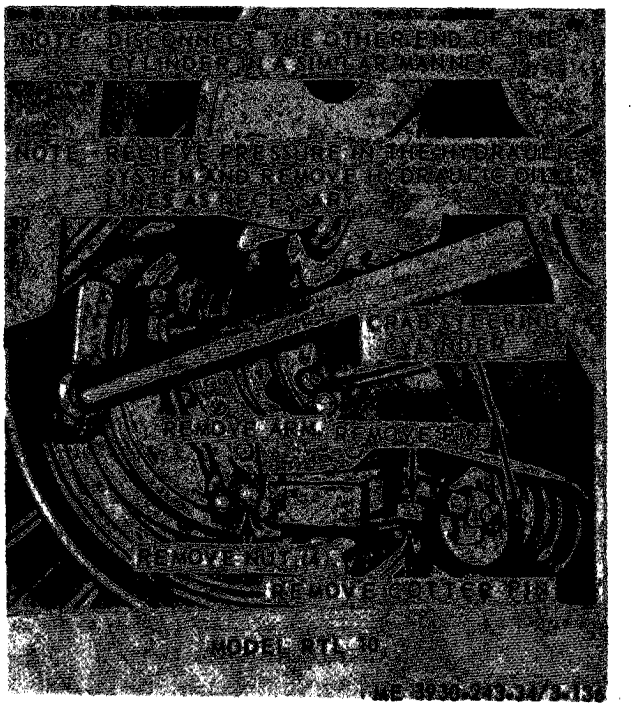
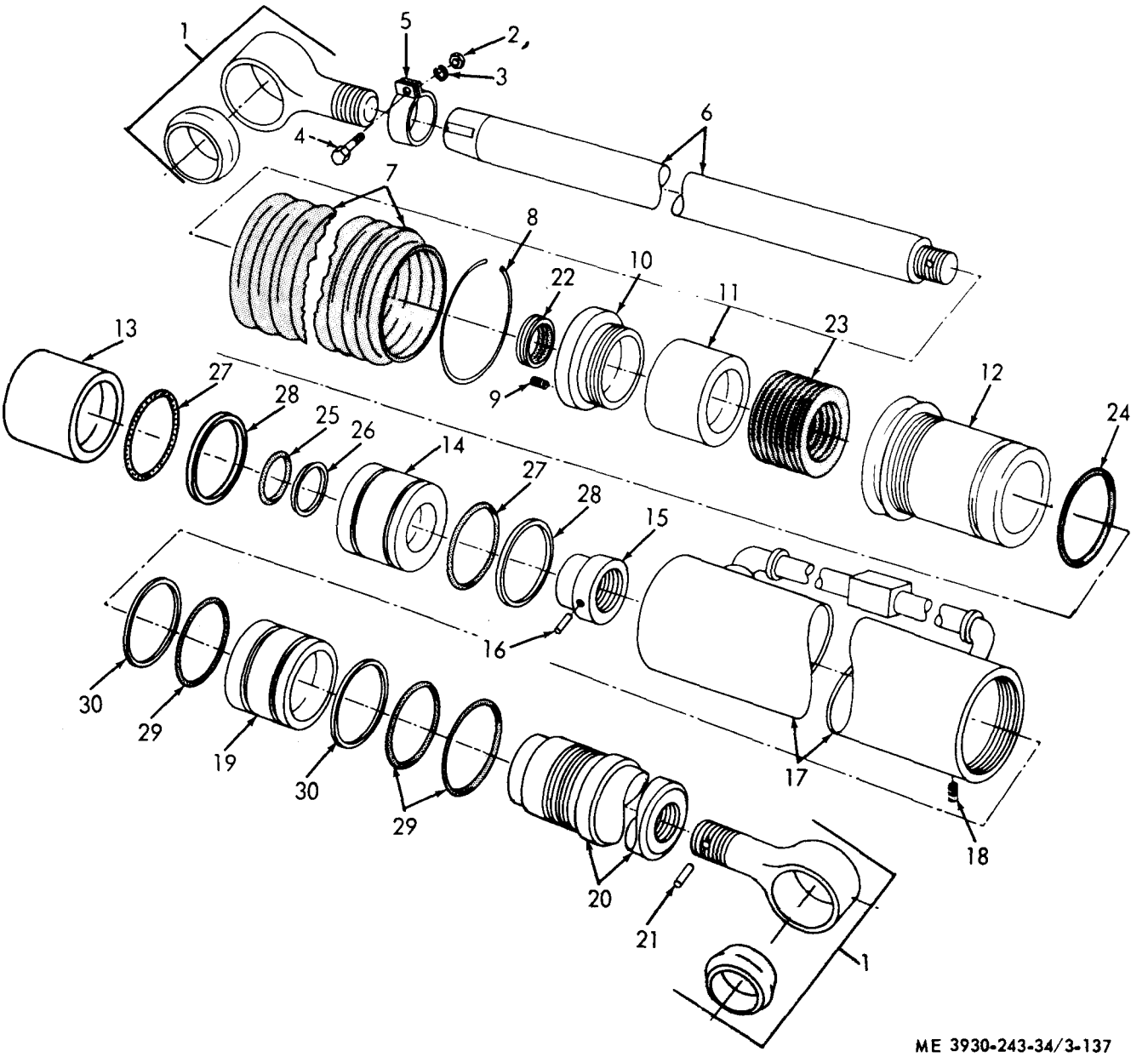


Figure 3-136. Crab lock cylinder, removal and installation.



1 Rod end	16 Roll pin
2 Nut	17 Cylinder tube
3 Lockwasher	18 Setscrew
4 Screw	19 Floating piston
5 Clamp	20 End lug
6 Cylinder rod	21 Roll pin
7 Bellows	22 Wiper
8 Spring	23 Packing set
9 Setscrew	24 Ring
10 Gland nut	25 Ring
11 Bushing	26 Backup ring
12 Packing gland	27 Ring
13 Spacer	28 Backup ring
14 Piston	29 Ring
15 Collar	30 Backup ring

Figure 3-137. Crab lock cylinder. disassembly and reassembly.

3-68. Hydraulic Steering Manifold

a. General. The hydraulic steering manifold is mounted to the left side of the fork lift, aft of the engine. The manifold consists of the unloader valve, relief valves and piping.

b. Removal. Refer to figure 3-138 and remove the hydraulic steering manifold assembly.

c. Disassembly. Refer to figure 3-139 and disassemble hydraulic steering manifold assembly.

d. Inspection.

(1) Inspect the tubing for cracks, kinks and breaks.

(2) Inspect the relief valve for cracks and damage.

(3) Inspect unloader valve for damage.

e. Reassembly. Refer to figure 3-139 and reassemble the hydraulic steering manifold.

f. Installation. Refer to figure 3-138 and install the hydraulic steering manifold.

g. Test. For test procedures, refer to figure 1-5.

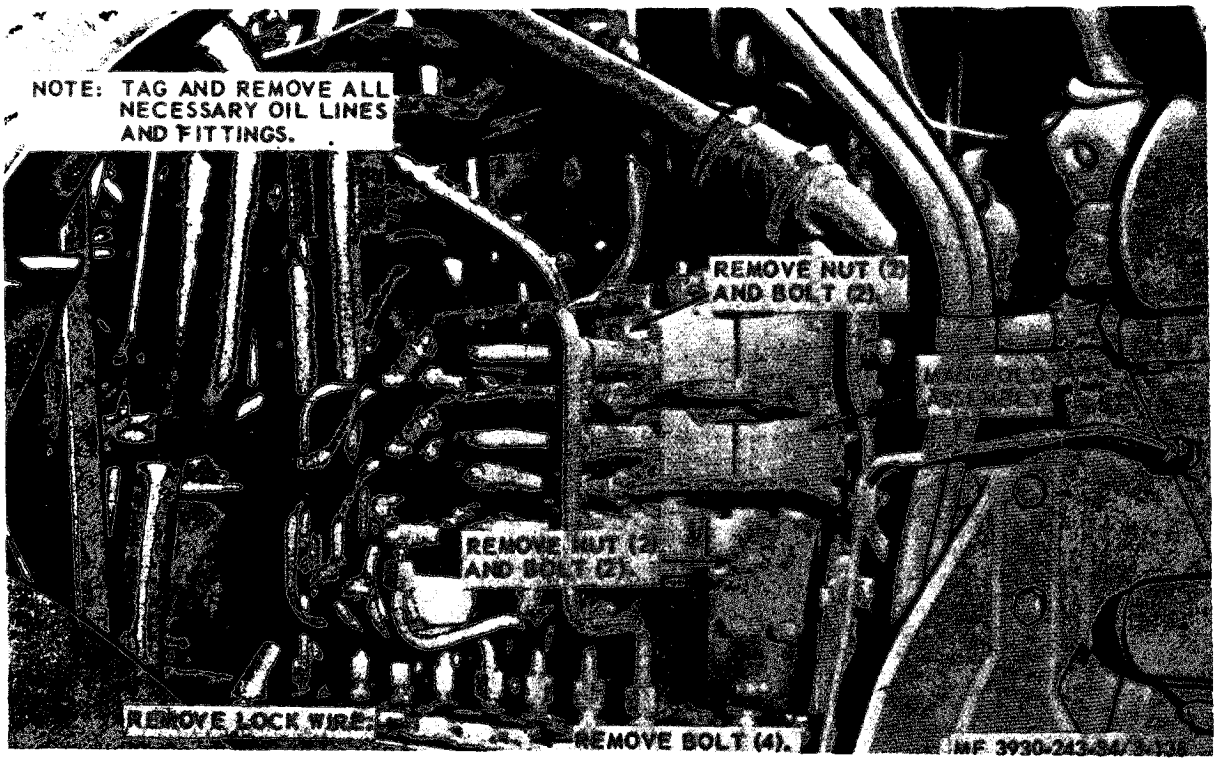
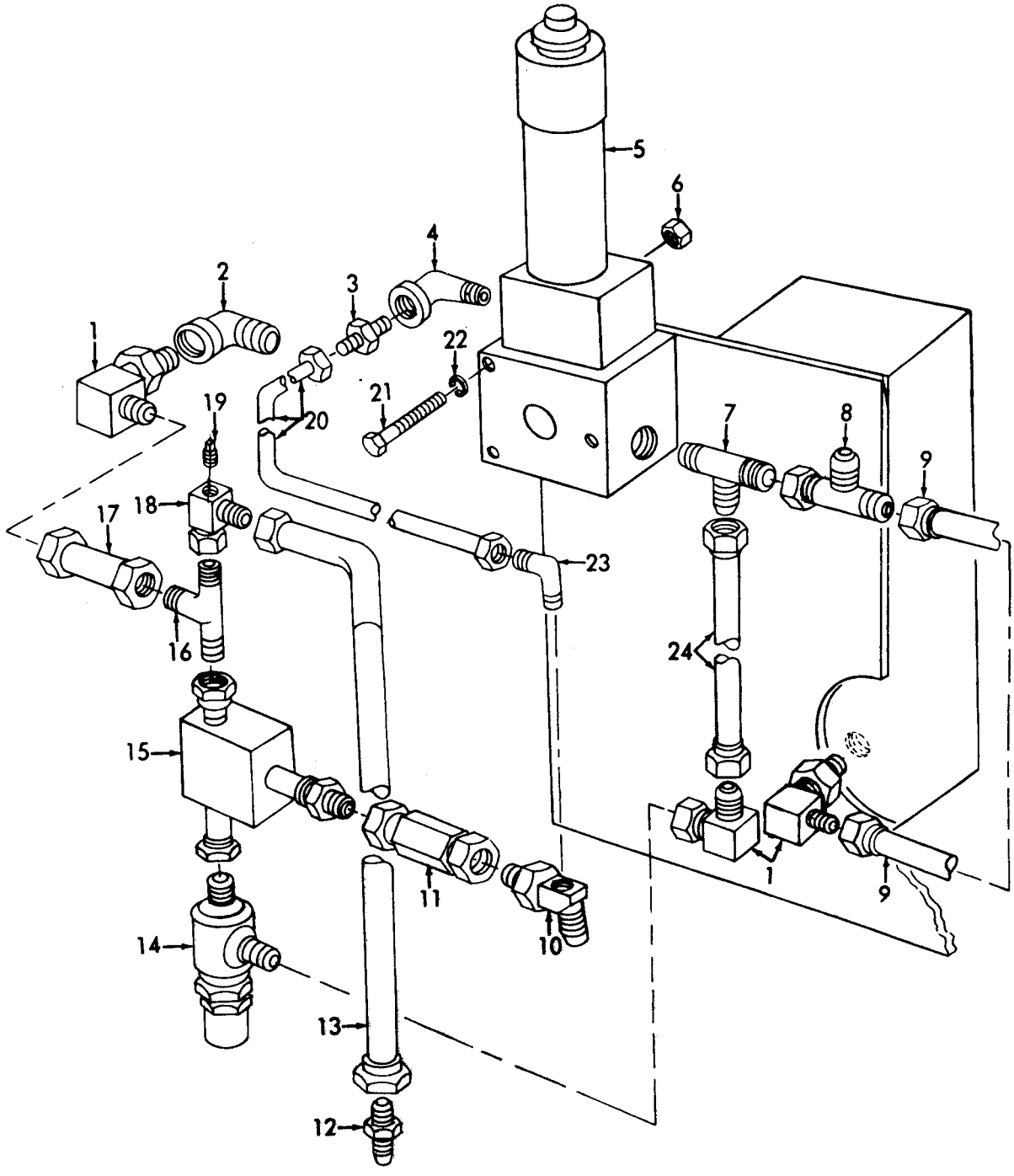


Figure 3-138. Hydraulic steering manifold, removal and installation.



ME 3930-243-34/3-139

1 Swivel elbow
2 Elbow
3 Connector
4 Elbow
5 Unloading valve
6 Nut
7 Tee
8 Swivel tee
9 tube
10 Elbow
11 Check valve
12 Union
13 Tube
14 Relief valve
15 Tee assembly
16 Tee
17 Tube
18 Elbow
19 Plug
20 Tube
21 Screw
22 Lockwasher
23 Elbow
24 Tube

Figure 3-139. Hydraulic steering manifold, disassembly and reassembly.

3-69. Hydraulic Reservoir

a. General. The hydraulic reservoir is located on the left hand side of the fork lift, directly behind the driver's seat. The tank supplies hydraulic oil to the steering system, brake system and the lift system.

b. Removal. Remove the hydraulic reservoir (TM 10-3930-243-12).

c. Disassembly. Refer to figure 3-140 and disassemble hydraulic reservoir.

d. Inspection.

(1) Inspect reservoir for cracks and dents.

(2) Inspect reservoir for missing or broken hardware.

(3) Inspect cover for cracks.

W A R N I N G

Be sure the interior of the tank to be repaired by welding, has been properly cleaned to eliminate any hazard to personnel.

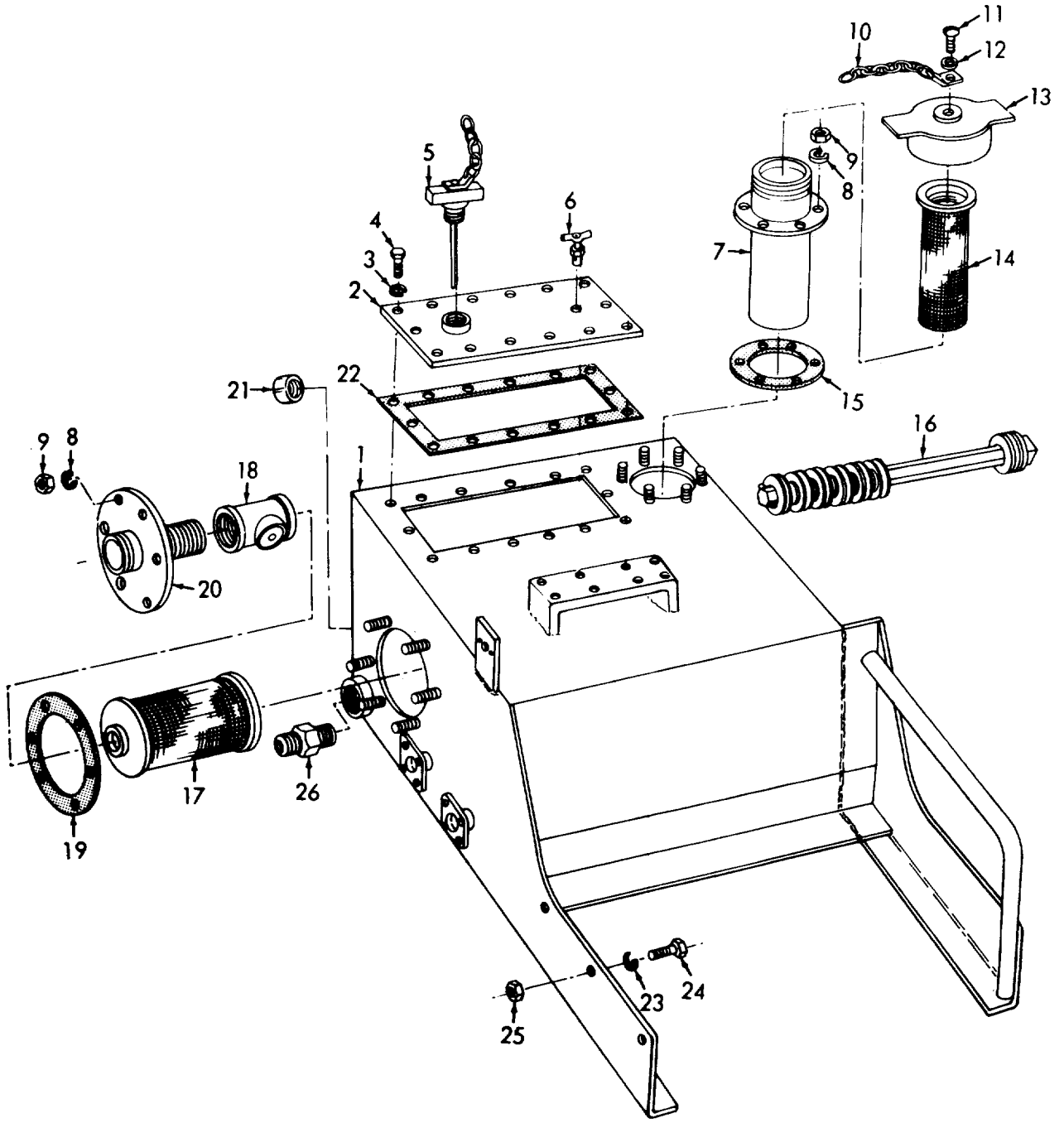
e. Repair.

(1) Replace all broken or missing hardware.

(2) Repair hydraulic reservoir by welding.

f. Reassembly. Refer to figure 3-140 and reassemble hydraulic reservoir.

g. Installation. Install the hydraulic reservoir (TM 10-3930-243-12).



1 Reservoir
2 Cover plate
3 Lock washer
4 Bolt
5 Dipstick
6 Drain cock
7 Filler tube
8 Lockwasher
9 Nut
10 Chain
11 Screw
12 Washer
13 Cap
15 Strainer
15 Gasket
16 Magnetic plug
17 Filter
18 Valve
19 Gasket
20 Pipe flange
21 Pipe cap
22 Gasket
23 Lock washer
24 Screw
25 Nut
26 Adapter

Figure 3-140. Hydraulic reservoir, disassembly and reassembly.

Section XII. HYDRAULIC LIFT SYSTEM

3-70. General

The hydraulic lift system consists of the main hydraulic pump, hydraulic control valves, lift cylinder, slave cylinder, tilt cylinder, extension cylinder, oscillation cylinder and the side shift cylinder. The purpose of the hydraulic pump is to pick up and force oil thru the hydraulic system, by displacing hydraulic oil from one side of the piston to the other side thru the sump tank. When oil is forced into one end of a hydraulic cylinder it moves the cylinder piston toward the opposite end of the cylinder. By this means it is possible to move a load which is attached to the cylinder piston rod. All of the hydraulic cylinders on the fork lift are of the double acting type. The main control valve is installed in the hydraulic circuit, where it serves to direct the hydraulic oil to selected points in the hydraulic system. With all operating valve spools in neutral position, oil flow from the pump will circulate freely through the various valve section back to the hydraulic reservoir.

3-71. Main Hydraulic Pump

a. General. The main hydraulic pump is mounted to the rear section of the transmission. This pump supplies hydraulic pressure to the hydraulic lifting system.

b. Removal. Refer to figure 3-141 and remove main hydraulic pump.

c. Disassembly. Refer to figure 3-142 and disassemble main hydraulic pump.

e. Inspection.

(1) Inspect housing for cracks, damage and excessive wear.

(2) Inspect gears for damage.

(3) Inspect bearings for excessive wear.

f. Reassembly. Refer to figure 3-142 and reassemble main hydraulic pump.

NOTE

After overhaul, run pump for 30 minutes at 2000 rpm while pumping SAE No. 10 oil at 0 psi outlet pressure.

g. Test. Bench test pump by driving it at 2800 rpm, and load pump to 1800 psi. Pump capacities are 6 gallons per minute for front outlet and 6 gallons per minute at rear outlet.

h. Install. Refer to figure 3-141 and install main hydraulic tank.

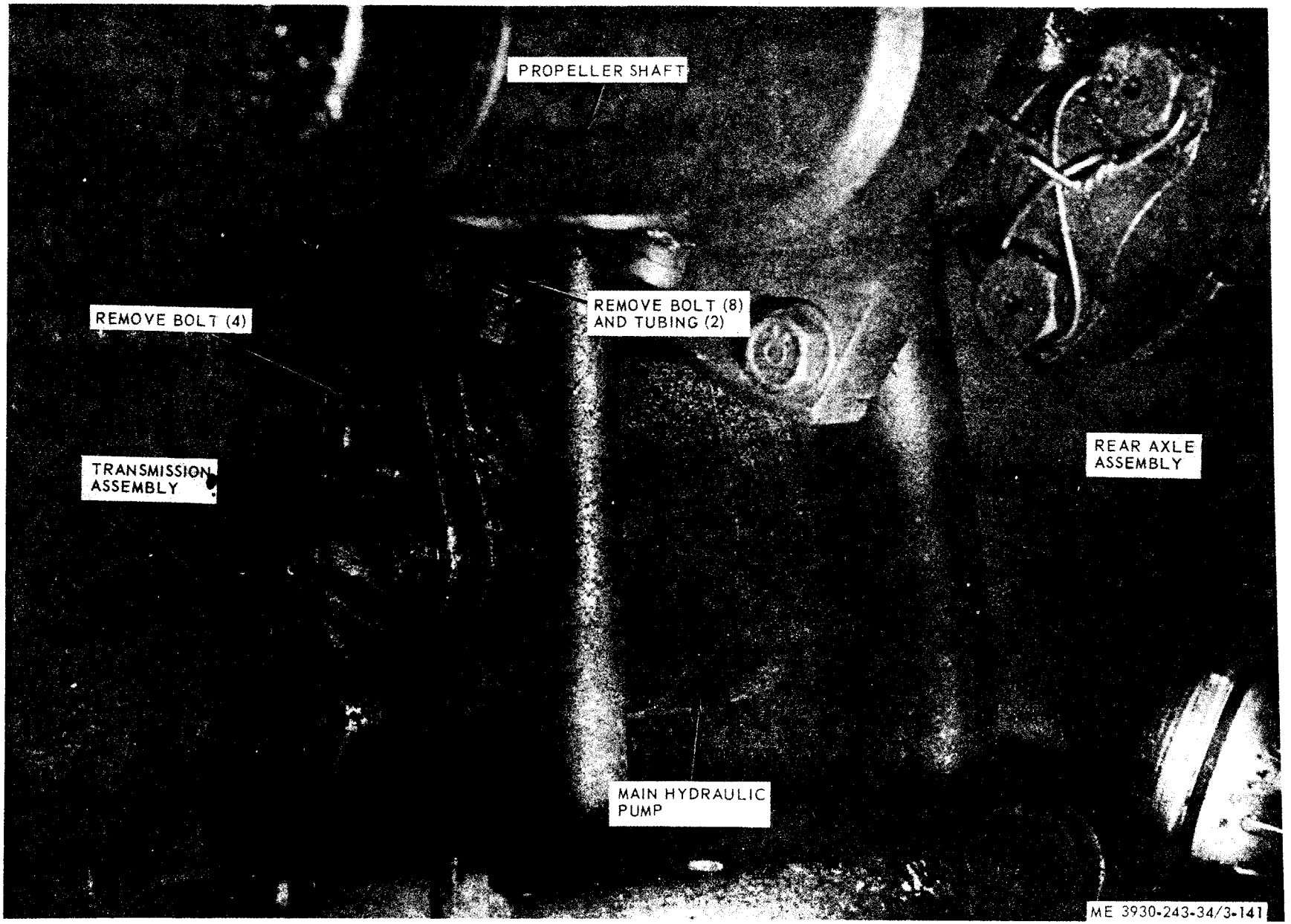
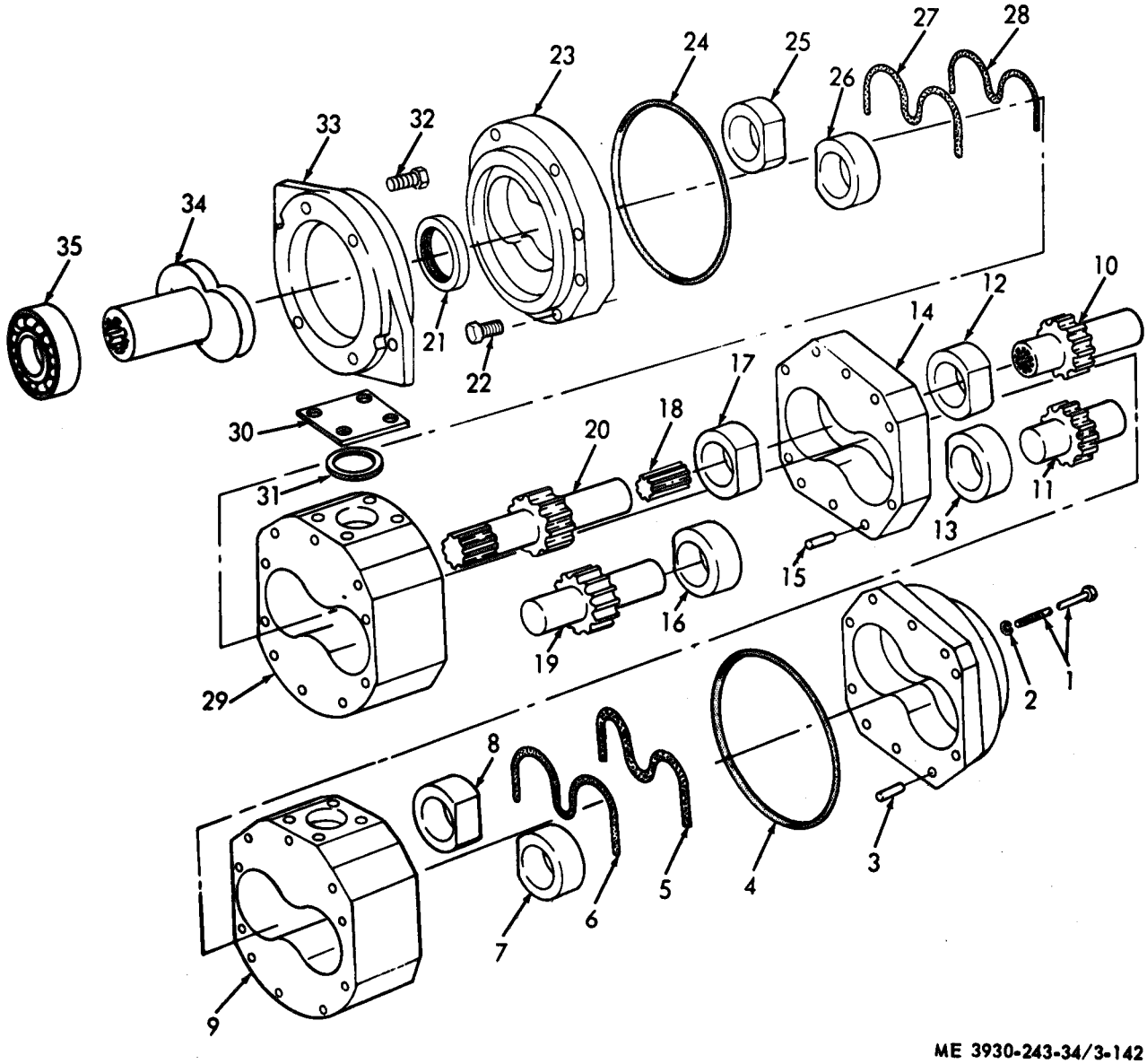


Figure 3-141. Main hydraulic pump, removal and installation.



1 Screw
2 Lockwasher
3 Dowel pin
4 Ring seal
5 Seal
6 Pressure seal
7 Bearing
8 Bearing
9 Rear body
10 Drive gear
11 Driven gear
12 Bearing
13 Bearing
14 Adapter plate
15 Dowel pin
16 Bearing
17 Bearing
18 coupling
19 Driven gear
20 Drive gear
21 Shaft seal
22 Screw
23 Front cover
24 Ring seal
25 Bearing
26 Bearing
27 Pressure seal
28 Seal
29 Front body
30 Adapter plate
31 Seal
32 Screw
33 Adapter
34 Drive coupling
35 Bearing

Figure 3-142. Main hydrsaulic pump, disassembly and reassembly.

3-72. Lift System Main Control Valve

a. General. The main control valves are mounted next to the driver's compartment. The control valves are: lift, tilt, extension, oscillating, and side shift. On RTL10 model there is a crane winch valve. Each valve is hydraulically operated. The valving arrangement is such that, with all operating valve spools in neutral position, the oil flow from the pump will circulate freely through the various valve sections back to the tank.

b. Removal. Refer to figure 3-143 and remove main control valves.

c. Disassembly. Refer to figure 3-144 and disassemble the main control valve. Mark relief valve to indicate adjustment side of control valve.

d. Inspection.

(1) Inspect the housing for cracks or damage.

(2) Inspect the load check for nicks and burrs.

(3) Inspect the plunger for flaking of chrome plating, cracking or other damage.

(4) Inspect the poppet valve for erosion and wear. Normal operation will show only an acceptable light line at the point of contact at the cartridge hole. Replace poppet valve that is eroded or excessively worn.

NOTE

An eroded poppet valve indicates a contaminated hydraulic system.

(5) Inspect each plunger bore for scratches, burrs or gouges. Rotate plunger a complete revolution to determine if plunger fits without binding. Plungers are a select fit in their bores.

(6) Check the plunger eye for damaged threads or wear at the pin hole. Repair or replace a defective plunger eye.

(7) Replace all seals, fiber back up rings and springs.

c. Reassembly. Refer to figure 3-144 and reassemble main control valves as follows:

(1) Grease new O-ring seal on the relief cartridge and install this end of cartridge into adjustment side of valve body. Tap slightly with a rawhide mallet until cartridge bottoms.

CAUTION

Do not damage the relief poppet hole in the end of the cartridge.

(2) Tighten relief cap to 45 foot-pounds torque.

(3) Place relief poppet valve and spring in the relief cap. Be sure the poppet valve is seated in the cartridge hole.

(4) Install remaining parts of relief valve and tighten cap to 45 foot-pounds torque.

(5) Install each operating plunger in its respective bore and center each plunger equidistant from each side of valve housing. Be sure wrench flats are on operating side of the valve.

(6) Install plunger seal in seal bore until it bottoms. Absolute flatness of seal is necessary. Do not distort seal or damage it in any manner.

(7) Tighten seal retainer plate screws to 15 to 20 foot-pounds torque.

(8) Use a new backup ring with each new seal. Use the same care on all seals as used in step (6). If a seal is bottomed correctly, backup ring will be flush with valve housing surface.

(9) Torque plunger cap by holding plunger eye with a suitable tool and tighten to 30 foot-pounds torque. This method will torque both the cap and eye.

(10) Tighten plunger cover screws to 15 to 20 foot-pounds torque.

f. Adjustment. Adjust relief valve to 2000 psi with adjusting screw.

g. Installation. Refer to figure 3-143 and install main control valve.

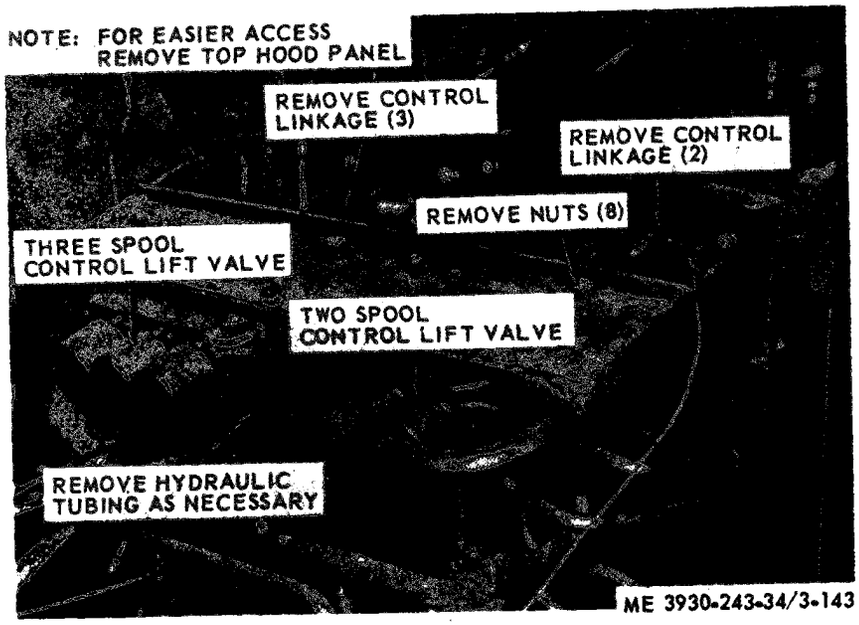
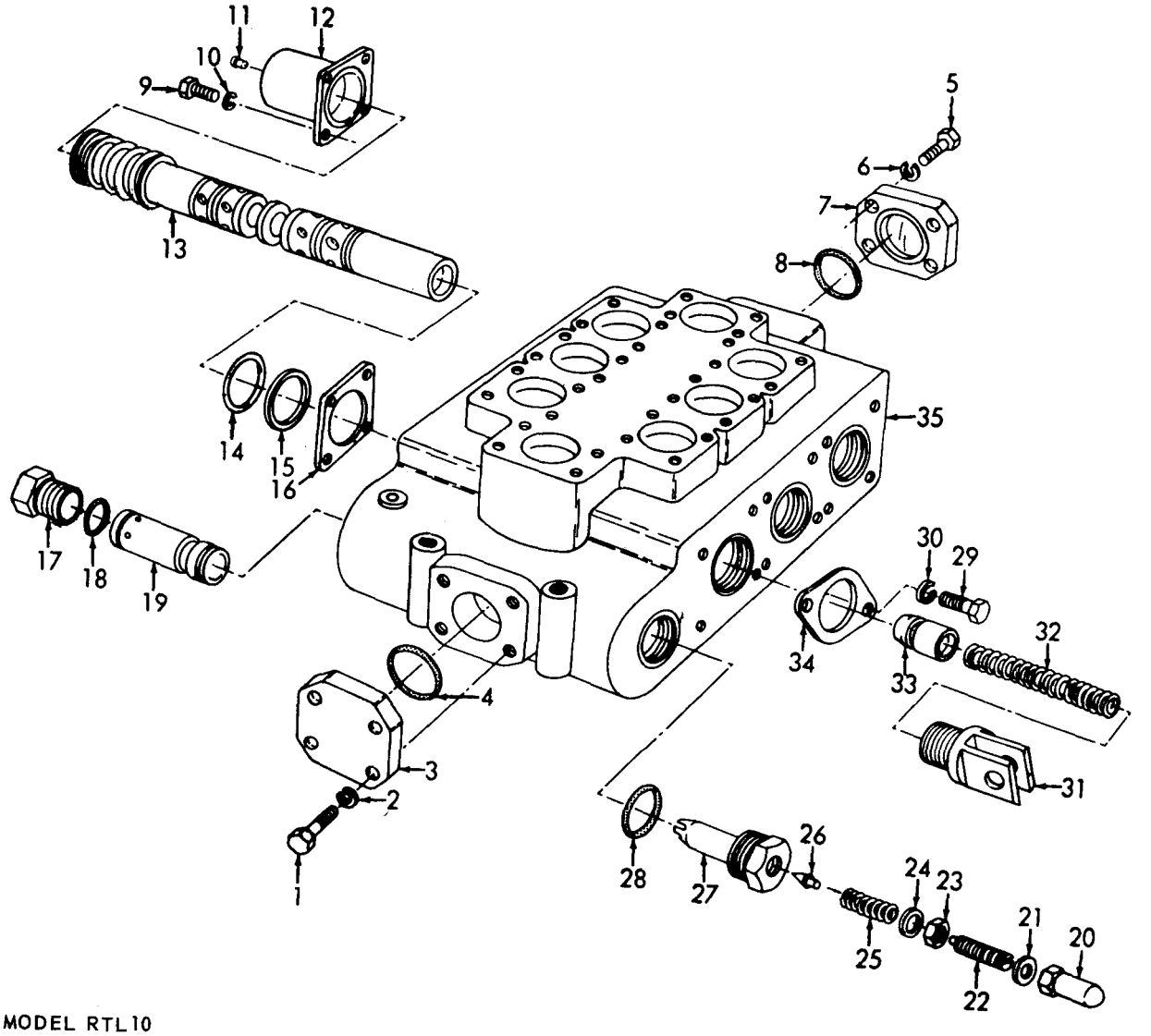


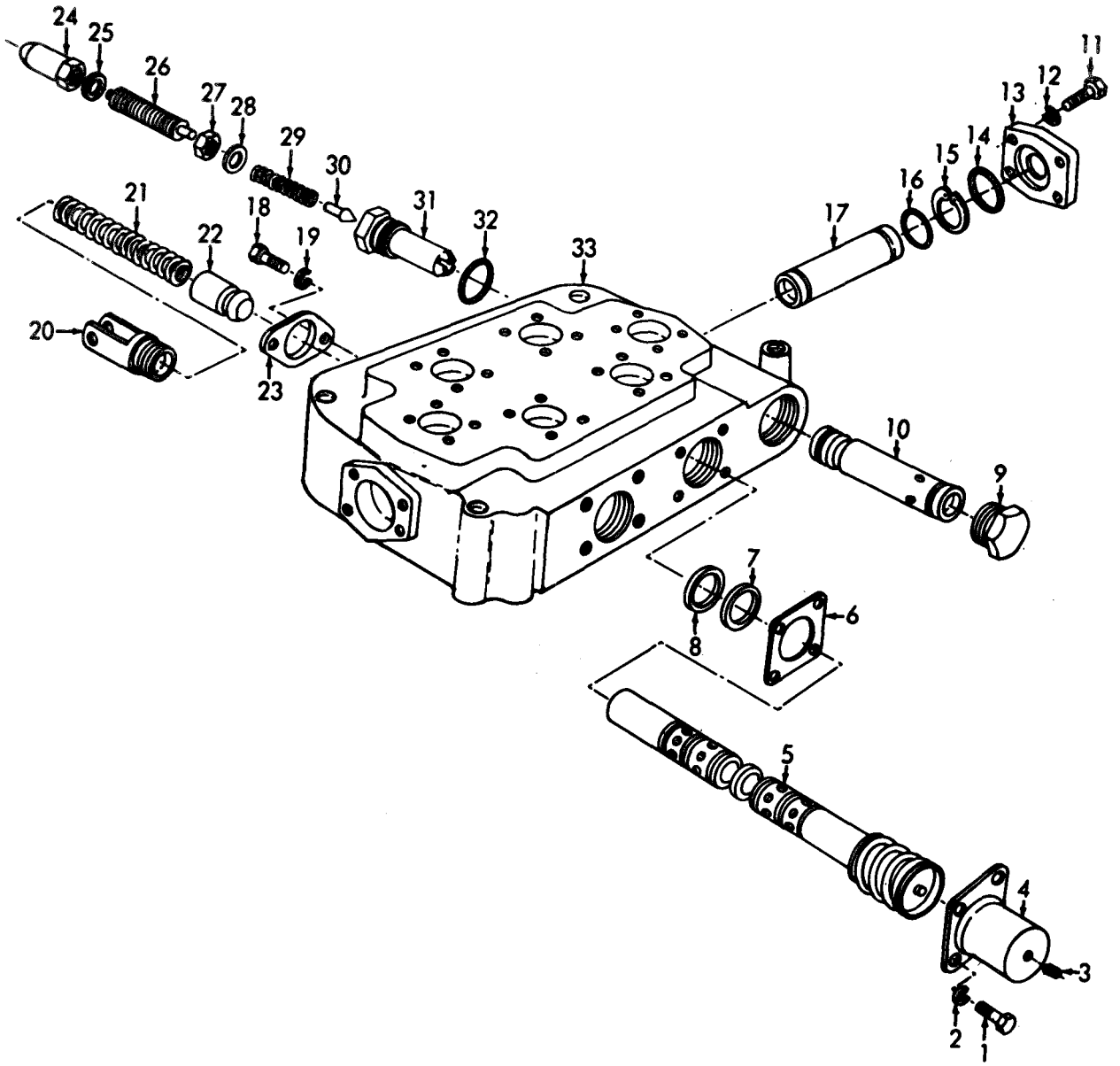
Figure 3-143. Main control valves, removal and installation.



1	Screw	19	Valve
2	Washer	20	Nut
3	Cover	21	Washer
4	O-ring	22	Screw
5	Screw	23	Nut
6	Washer	24	Washer
7	Cover	25	Spring
8	O-ring	26	Poppet
9	Screw	27	Cap
10	Washer	28	O-ring
11	Plug	29	Screw
12	Cover	30	Washer
13	Plunger	31	Eye
14	Ring	32	Spring
15	Seal	33	Check
16	Plate	34	Wiper
17	Cap	35	Housing
18	O-ring		

(1) Lift, tilt, and extension valve

Figure 3-144. Main control valves, disassembly and reassembly (sheet 1 of 4).



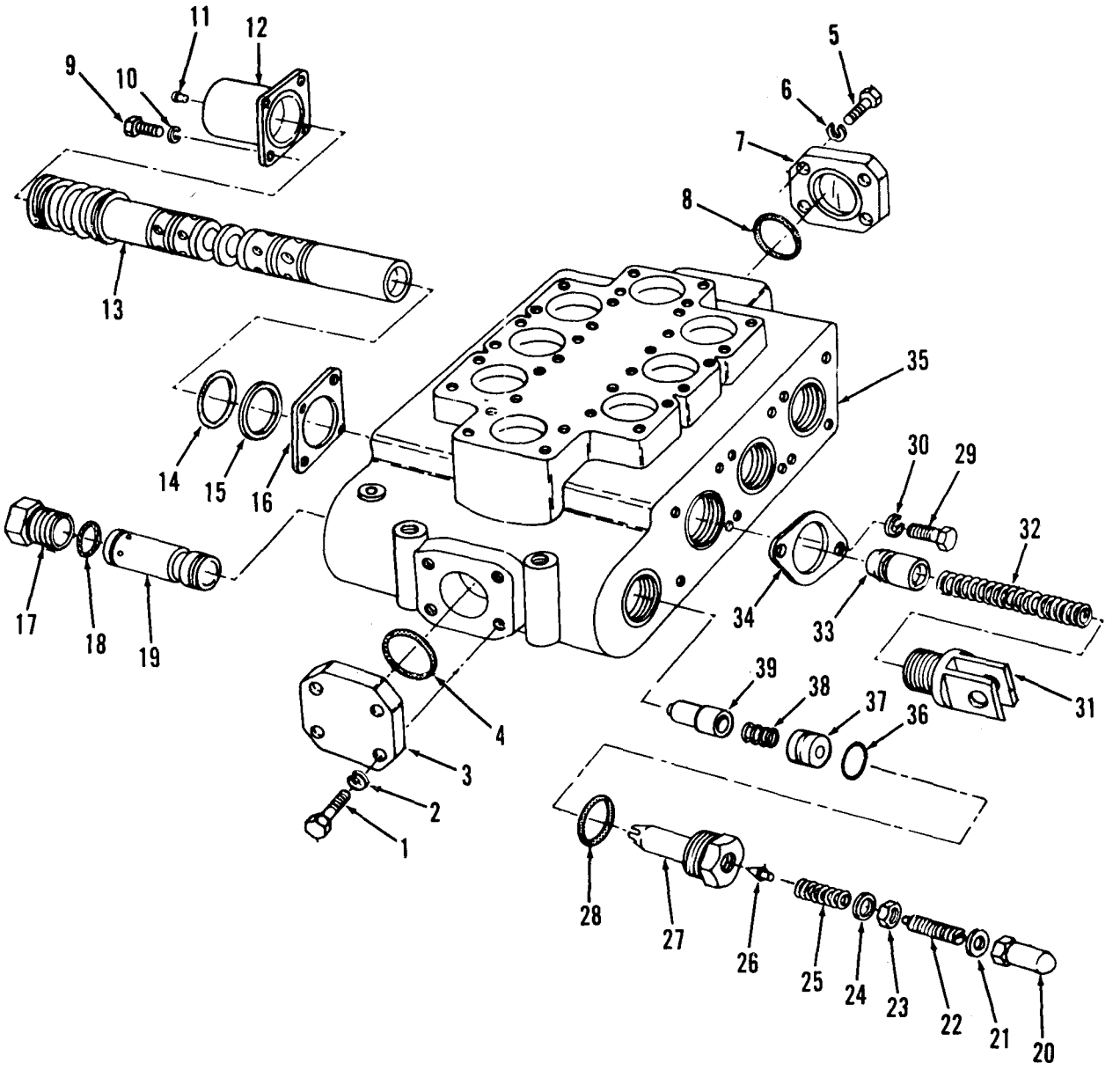
MODEL RTL10

ME 3930-243-34/3-144 (2)

1 Screw	18 Screw
2 Washer	19 Washer
3 Plug	20 Eye
4 Cover	21 Spring
5 Plunger	22 Check
6 Plate	23 Wiper
7 Ring	24 Nut
8 Seal	25 Washer
9 Cap	26 Screw
10 Valve	27 Nut
11 Screw	28 Washer
12 Washer	29 Spring
13 Cover	30 Poppet
14 O-ring	31 Nut
15 Ring	32 O-ring
16 O-ring	33 Housing
17 Sleeve	

(2) Oscillating and side shift valve

Figure 3-144. Main control valves, disassembly and reassembly (sheet 2 of 4).



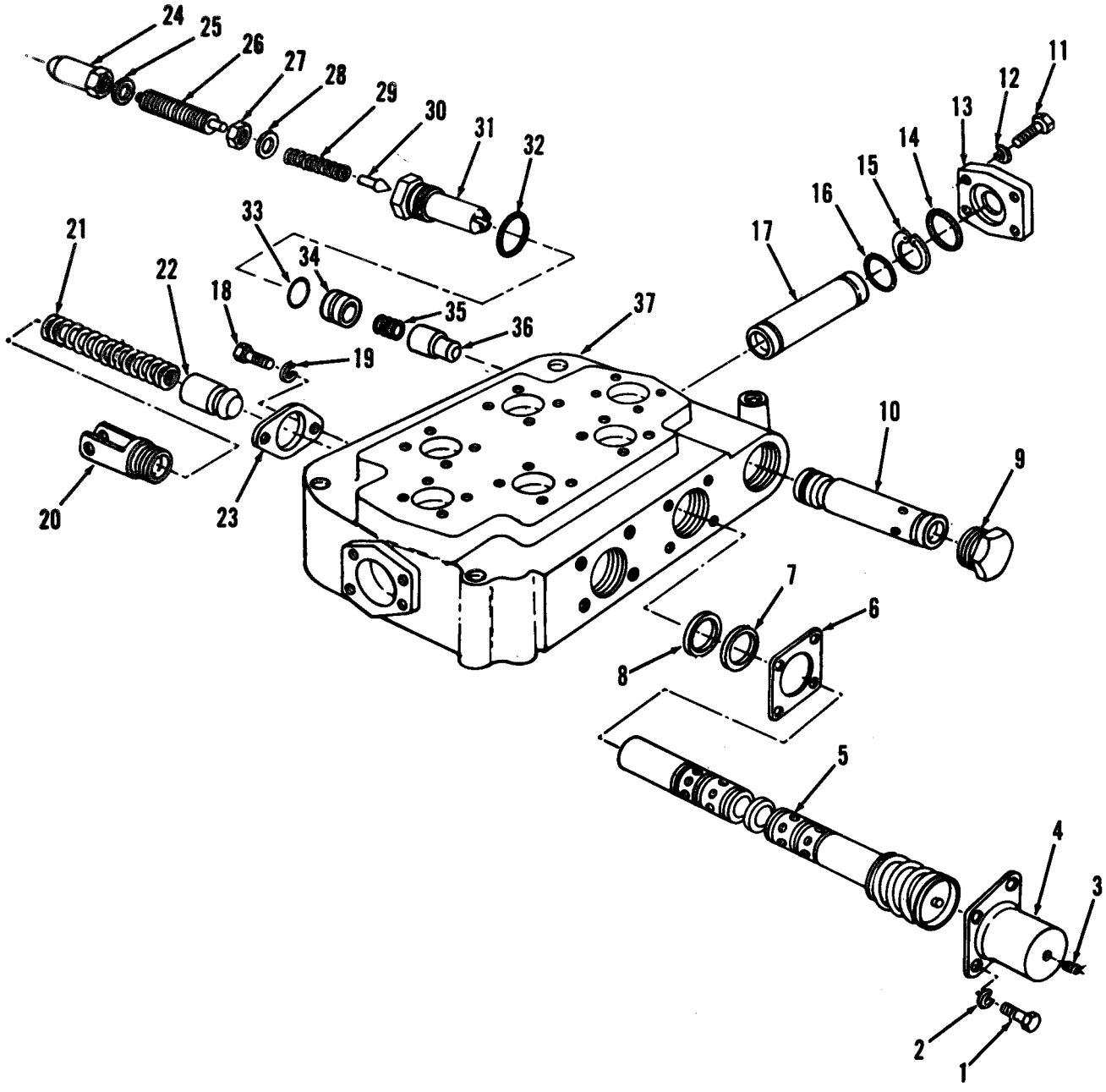
MODEL RTL10-1

ME 3930-243-34/3-144 ③

1 Screw	11 Plug	21 Washer	31 Eye
2 Washer	12 Cover	22 Screw	32 Spring
3 Cover	13 Plunger	23 Nut	33 Check
4 O-ring	14 Ring	24 Washer	34 Wiper
5 Screw	15 Seal	25 Spring	35 Housing
6 Washer	16 Plate	26 Poppet	36 O-ring
7 Cover	17 Cap	27 Cap	37 Seat
8 O-Ring	18 O-ring	28 O-ring	38 Spring
9 Screw	19 Value	29 Screw	39 Poppet
10 Washer	20 Nut	30 Washer	

(1) Lift, tilt, and extension valve

Figure. 3-144. Main control valves, disassembly and reassembly (sheet 3 of 4).



1 Screw
2 Washer
3 Plug
4 Cover
5 Plunger
6 Plate
7 Ring
8 Seal
9 Cap
10 Valve
11 Screw
12 Washer
13 Cover
14 O-ring
15 Ring
16 O-ring
17 Sleeve
18 Screw
19 Washer
20 Eye
21 Spring
22 Check
23 Wiper
24 Nut
25 Washer
26 Screw
27 Nut
28 Washer
29 Spring
30 Poppet
31 Nut
32 O-ring
33 O-ring
34 Seat
35 Spring
36 Poppet
37 Housing

(2) Oscillating and sideshift valve

Figure 3-144. Main control valves, disassembly and reassembly (sheet 4 of 4).

3-73. Hydraulic Lift Cylinder

a. General. The purpose of the lift cylinder is to either raise or lower the lift mechanism. The lift cylinders are attached to the boom assembly by brackets; on each side of the boom, at the end of the cylinder piston rod, and to the frame at the base of the cylinder.

b. Removal. Refer to figure 3-145 and remove hydraulic lift cylinder.

c. Disassembly. Refer to figure 3-146 and disassemble hydraulic lift cylinder.

d. Repacking Cylinder. Refer to paragraph *3-64c* for repacking procedures.

e. Inspection.

(1) Inspect shell assembly for cracks or damage.

(2) Inspect piston for nicks and scratches.

(3) Inspect end nut for cracks or damage.

(4) Inspect rod assembly for nicks and scratches.

(5) Remove burrs and scratches with crocus cloth.

(6) Replace a defective part.

f. Reassembly. Refer to figure 3-146 and reassemble hydraulic lift cylinder.

g. Test. Refer to paragraph *3-64g* and test the hydraulic cylinder.

h. Installation. Refer to figure 3-145 and install the hydraulic lift cylinder.

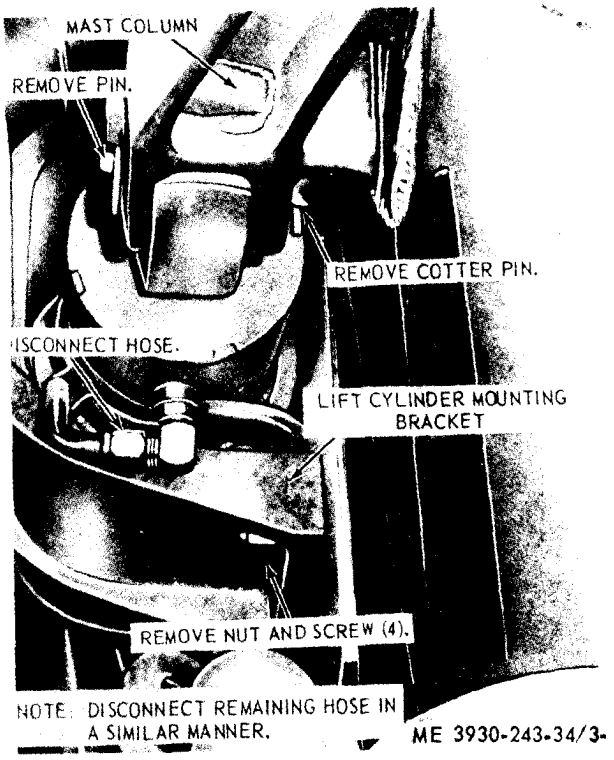
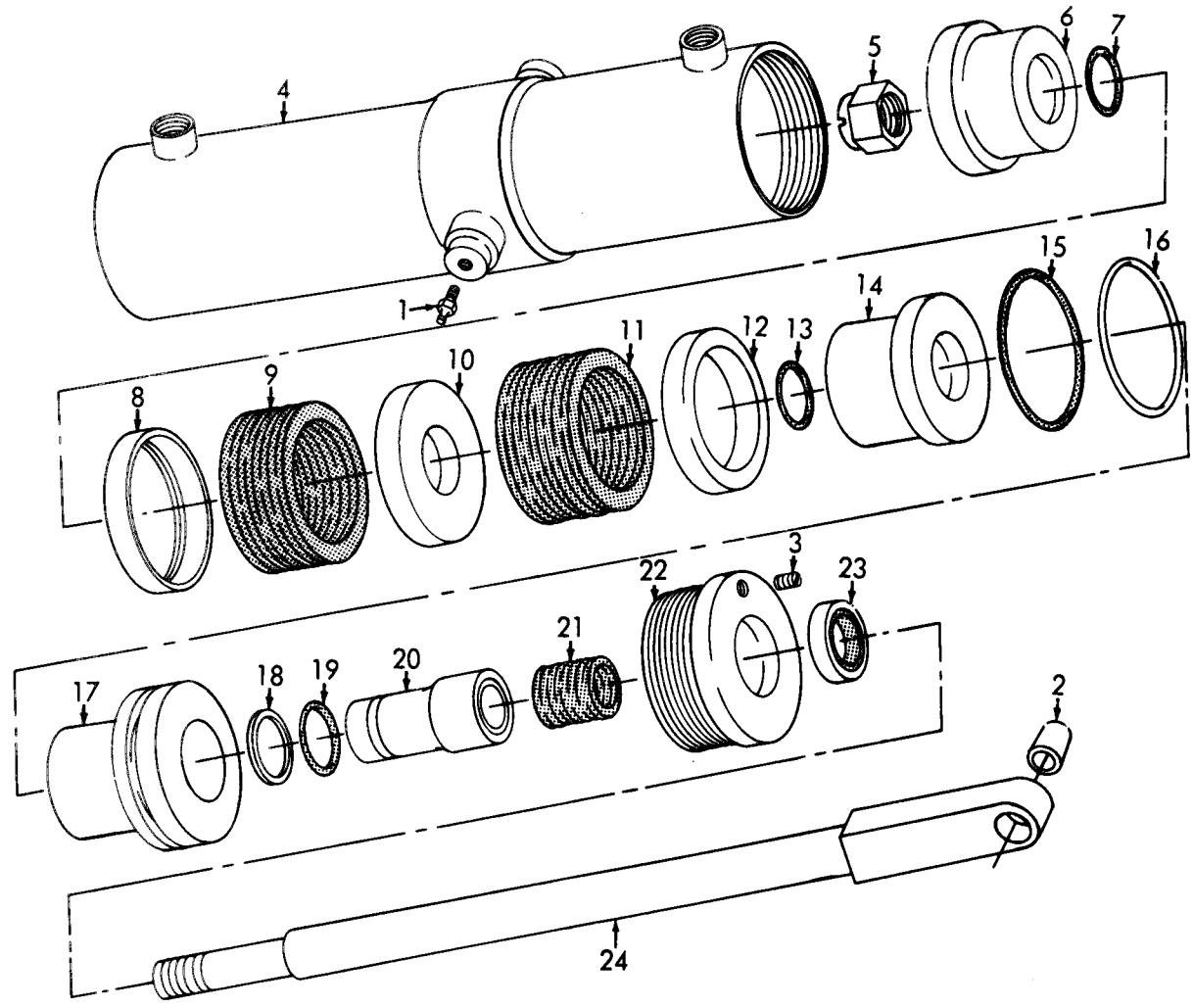
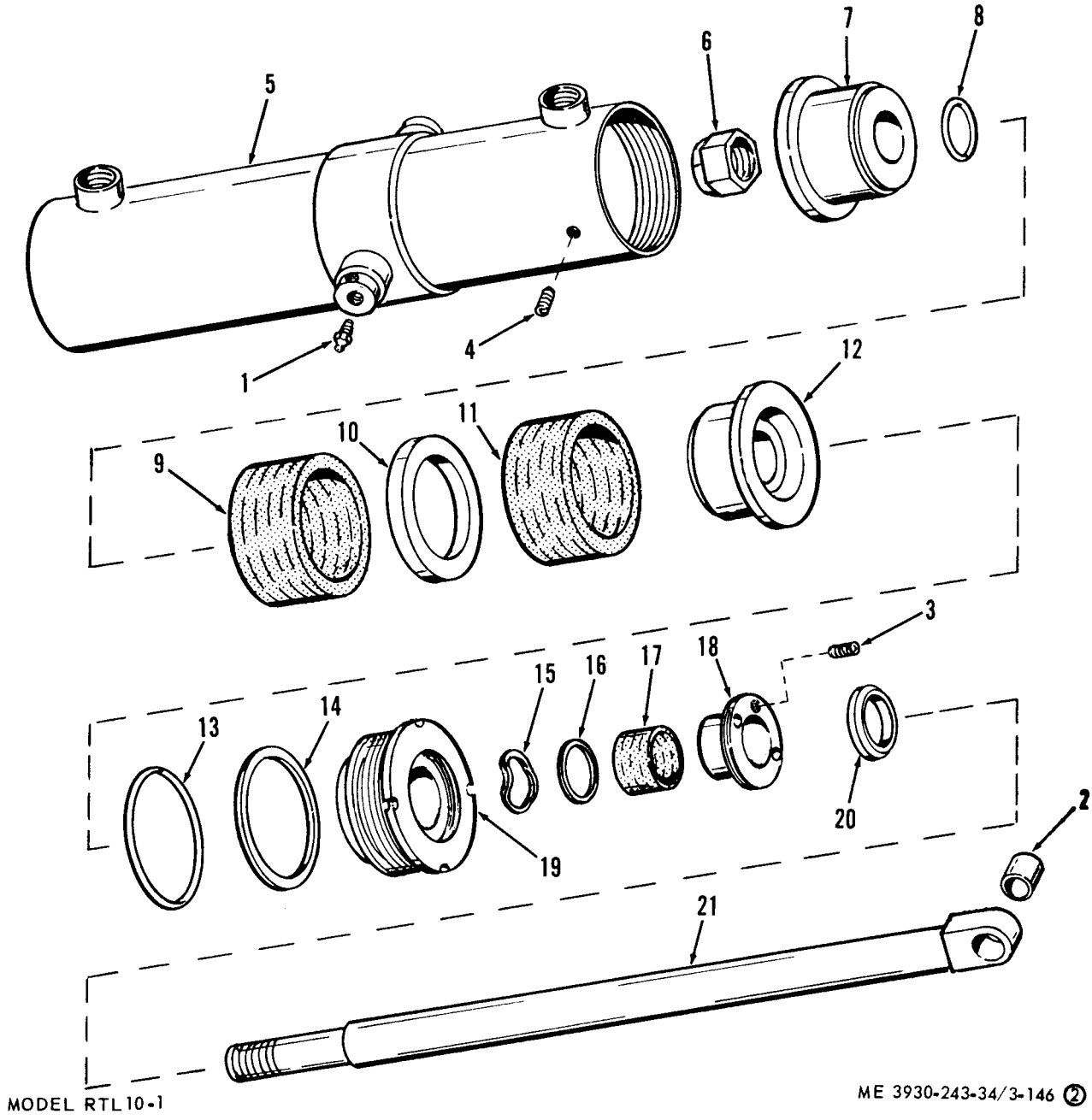


Figure 3-145. Hydraulic lift cylinder, removal and installation.



1 Fitting	13 Packing
2 Bearing	14 Piston
3 Setscrew	15 O-ring
4 Shell assembly	16 Ring
5 Nut	17 Retainer
6 Piston	18 Ring
7 Packing	19 O-ring
8 Rider	20 Bearing
9 Packing assembly	21 Packing
10 Washer	22 Nut
11 Packing assembly	23 Wiper
12 Rider	24 Rod

Figure 3-146. Hydraulic lift cylinder, disassembly and reassembly (sheet 1 of 2).



1 Fitting
2 Bearing
3 Setscrew
4 Setscrew
5 Shell assembly
6 Nut
7 Piston
8 O-ring
9 Packing assembly
10 Adapter
11 Packing assembly
12 Piston
13 O-ring
14 Backup ring
15 Spring washer
16 Washer
17 Packing assembly
18 Flange
19 Nut
20 Wiper
21 Rod

Figure 3-146. Hydraulic lift cylinder, disassembly and reassembly (sheet 2 of 2).

3-74. Slave Cylinder

a. General. The slave cylinder piston rod is attached to, and driven by, the boom as it moves up or down. The slave cylinder base is attached to the frame. The slave and tilt cylinder work together to perform their particular operation. This being, as far as possible, to maintain the same degree of either forward or backward tilt in the fork carriage as the boom assembly is being raised or lowered.

b. Removal. Refer to figure 3-147 and remove the hydraulic slave cylinder.

c. Disassembly. Refer to figure 3-148 and disassemble the hydraulic slave cylinder.

d. Repacking Cylinder. Refer to paragraph *3-64c* for repacking procedures.

e. Inspection.

(1) Inspect shell assembly for cracks and damage.

(2) Inspect rod for nicks and scratches.

(3) Inspect piston for scratches and burrs.

(4) Inspect end nut for cracks.

(5) Remove burrs and scratches with crocus cloth.

(6) Replace a defective part.

f. Reassembly. Refer to figure 3-148 and reassemble the hydraulic slave cylinder.

g. Test. Refer to paragraph *3-64g* and test hydraulic slave cylinder.

h. Installation. Refer to figure 3-147 and install hydraulic slave cylinder.

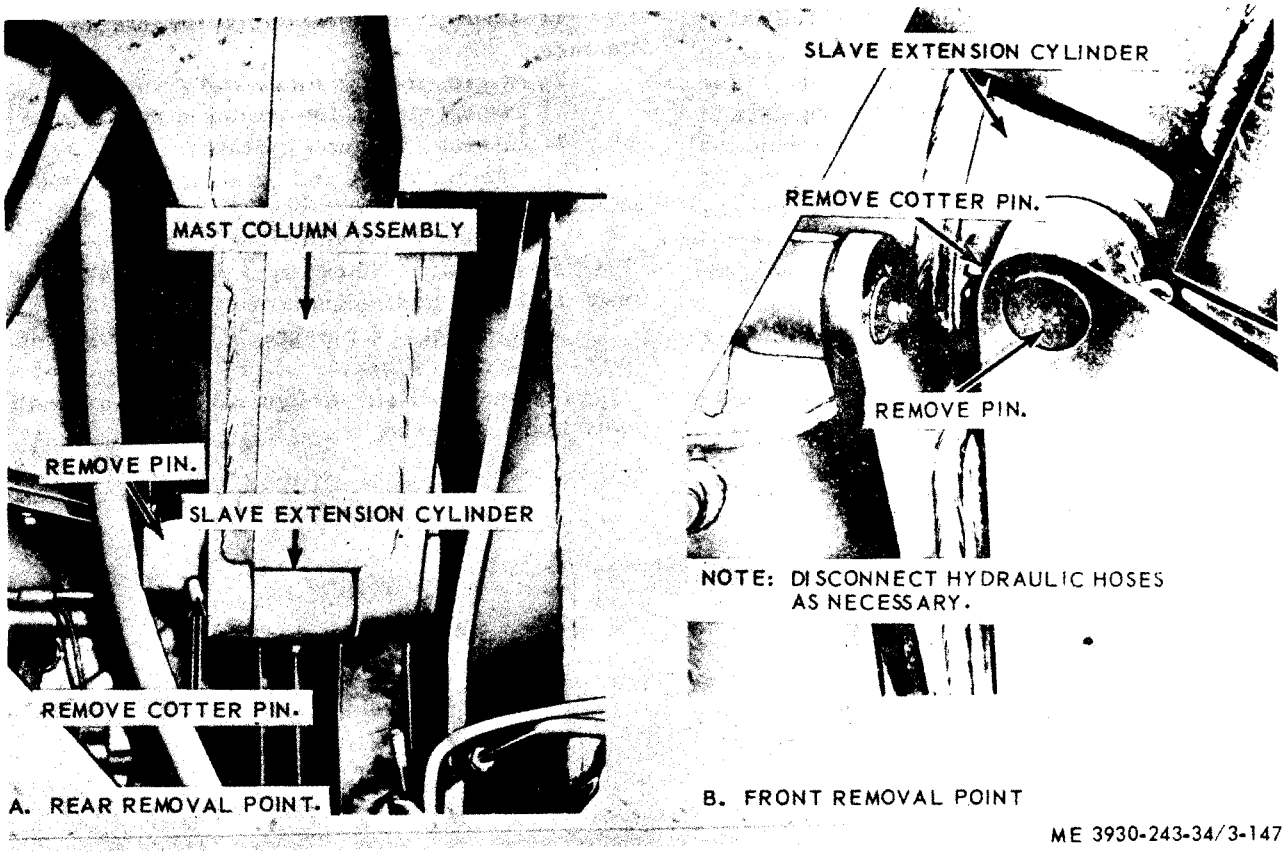
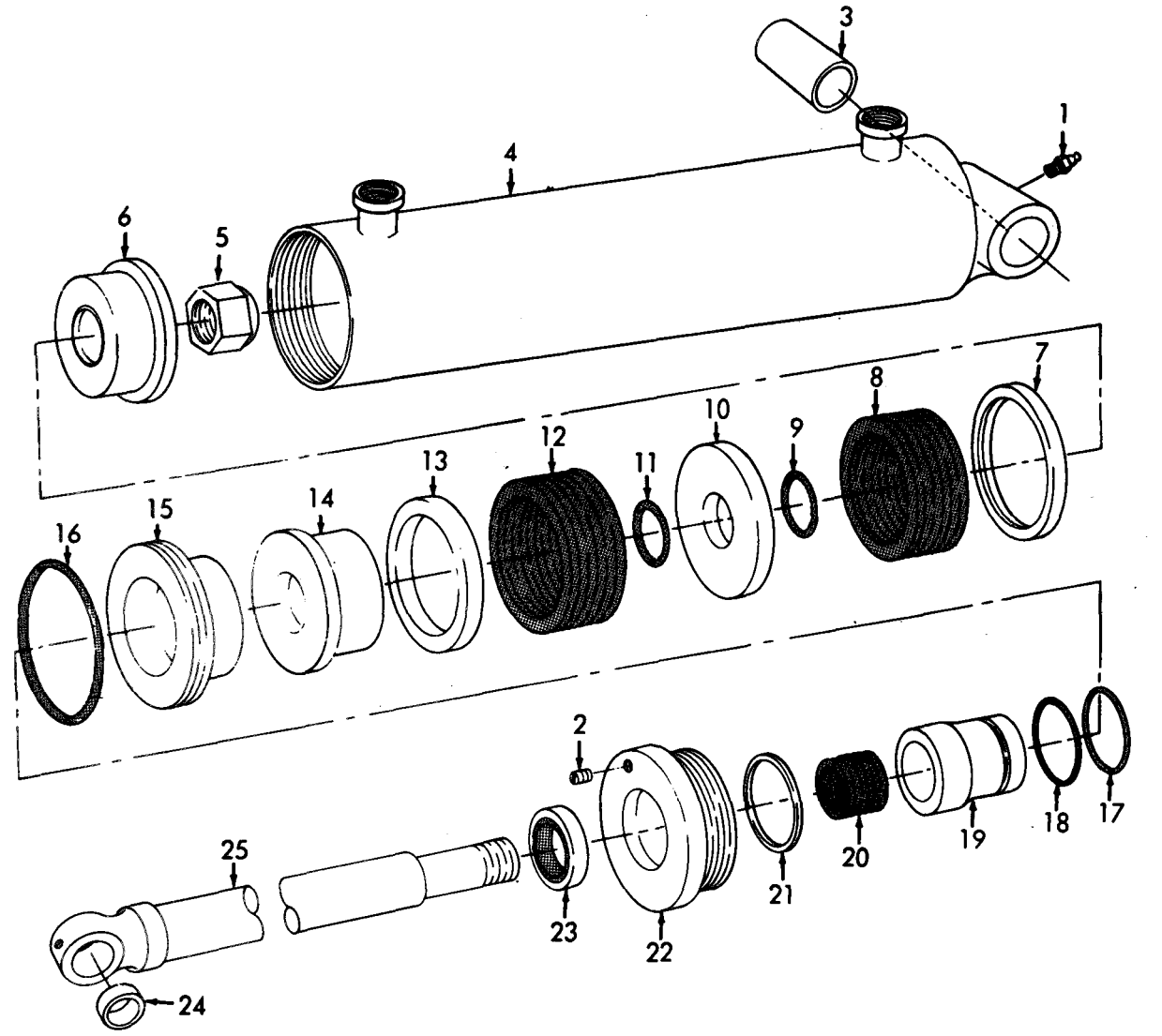


Figure 3-147. Hydraulic slave cylinder, removal and installation.

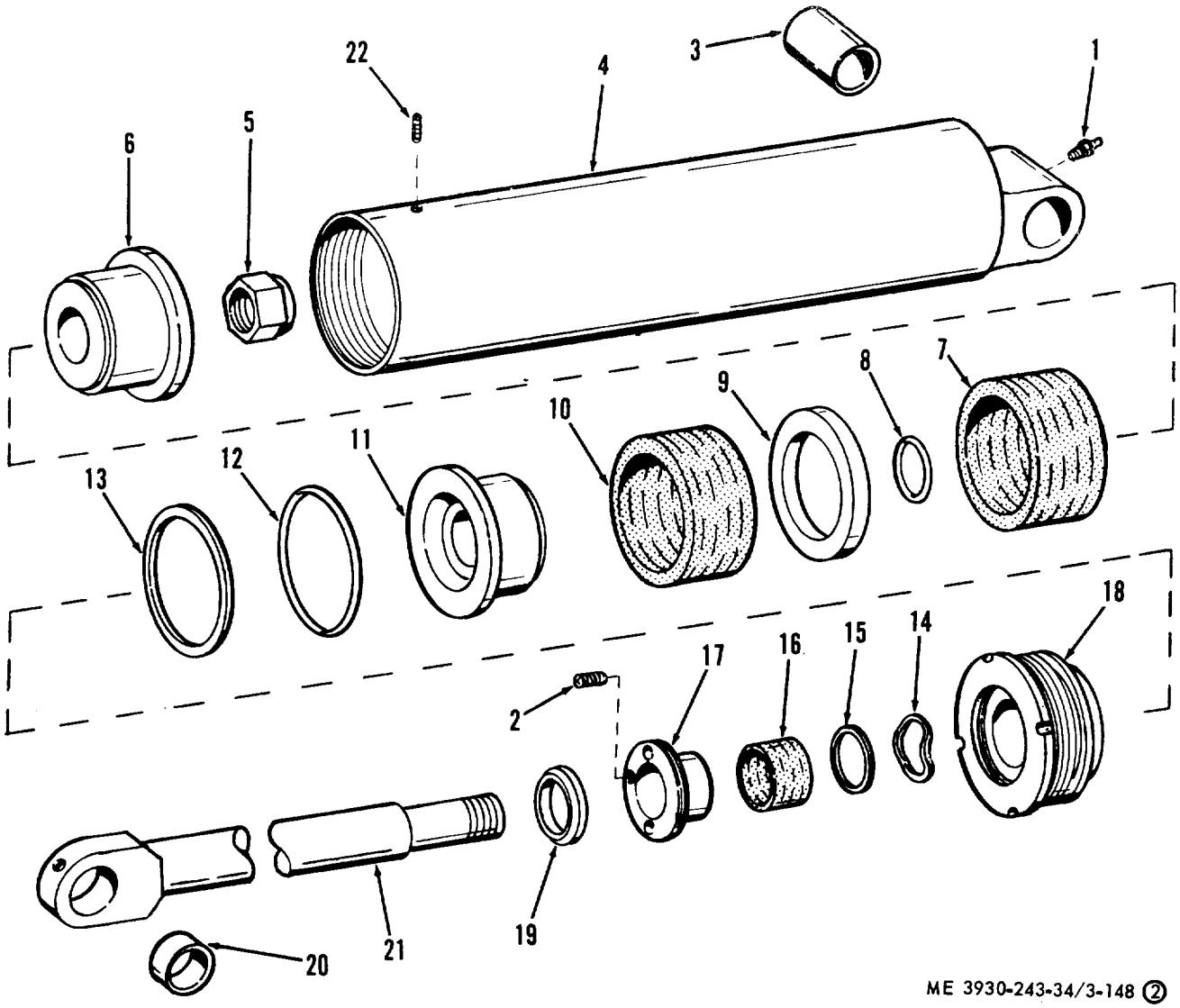


MODEL RTL10

ME 3930-243-34/3-148 ①

1 Fitting
2 Setscrew
3 Bearing
4 Shell assembly
5 Nut
6 Piston
7 Rider
8 Packing assembly
9 Packing
10 Washer
11 Packing
12 Packing assembly
13 Rider
14 Piston
15 Retainer
16 O-ring
17 Ring
18 Packing
19 Bushing
20 Packing assembly
21 Ring
22 Nut
23 Wiper
24 Bearing
25 Rod

Figure 3-148. Hydraulic slave cylinder, disassembly and reassembly (sheet 1 of 2).



1 Fitting
2 Setscrew
3 Bearing
4 Shell assembly
5 Nut
6 Piston
7 Packing assembly
8 O-ring
9 Adapter
10 Packing assembly
11 Piston
12 O-ring
13 Backup ring
14 Spring washer
15 Washer
16 Packing assembly
17 Flange
18 Nut
19 Wiper
20 Bearing
21 Rod
22 Setscrew

Figure 3-148. Hydraulic slave cylinder, disassembly and reassembly (sheet 2 of 2).

3-75. Hydraulic Tilt Cylinder

a. General. The tilt cylinder is attached between the top of the fork carriage and the innerslide assembly. This cylinder is hooked up hydraulically with the slave cylinder in such a way that the lift forks are able to maintain the same degree of tilt either raised or lowered. The tilt cylinder is used to tilt the lift forks.

b. Removal. Refer to figure 3-149 and remove the tilt cylinder.

c. Disassembly. Refer to figure 3-150 and disassemble tilt cylinder.

d. Repacking Cylinder. Refer to paragraph *3-64c* for repacking procedures.

e. Inspection.

(1) Inspect the shell assembly for cracks or damage.

(2) Inspect the rod for nicks and scratches.

(3) Inspect end nut for cracks or damage.

(4) Inspect piston for scratches.

(5) Remove burrs and scratches with crocus cloth.

(6) Replace a defective part.

f. Reassembly. Refer to figure 3-150 and reassemble the tilt cylinder.

g. Test. Refer to paragraph *3-64g* and test the tilt cylinder.

h. Installation. Refer to figure 3-149 and install the tilt cylinder.

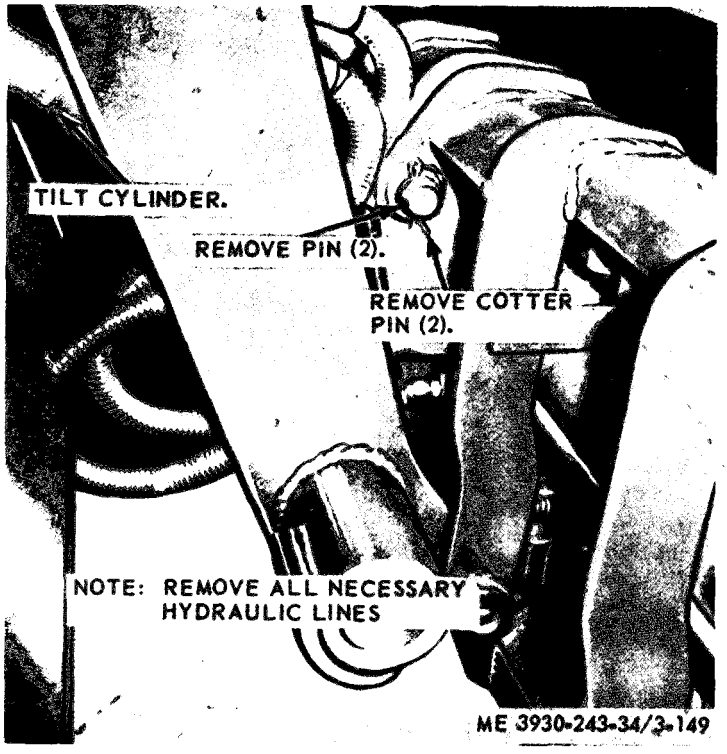
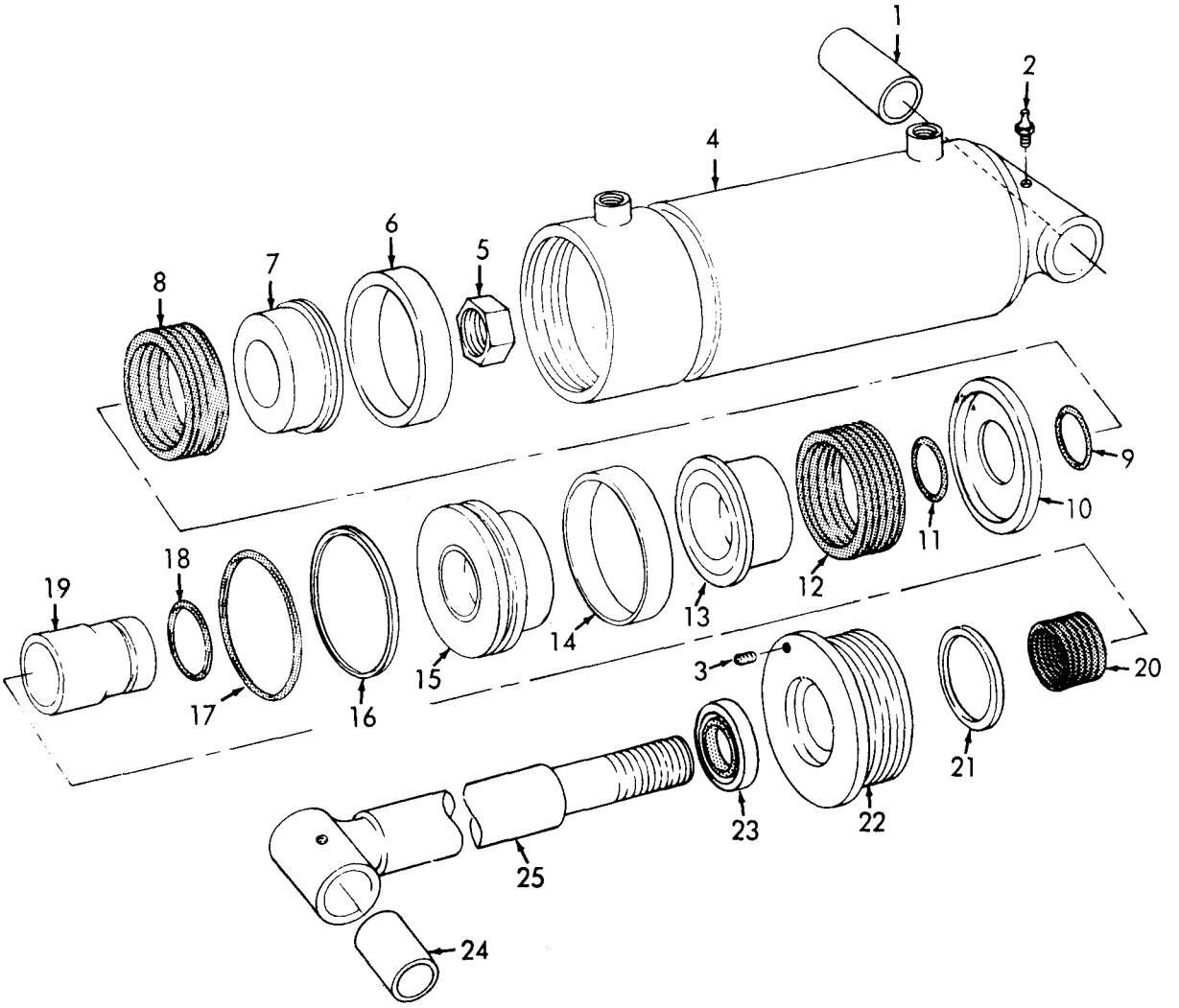


Figure 3-149. Hydraulic tilt cylinder, removal and installation.

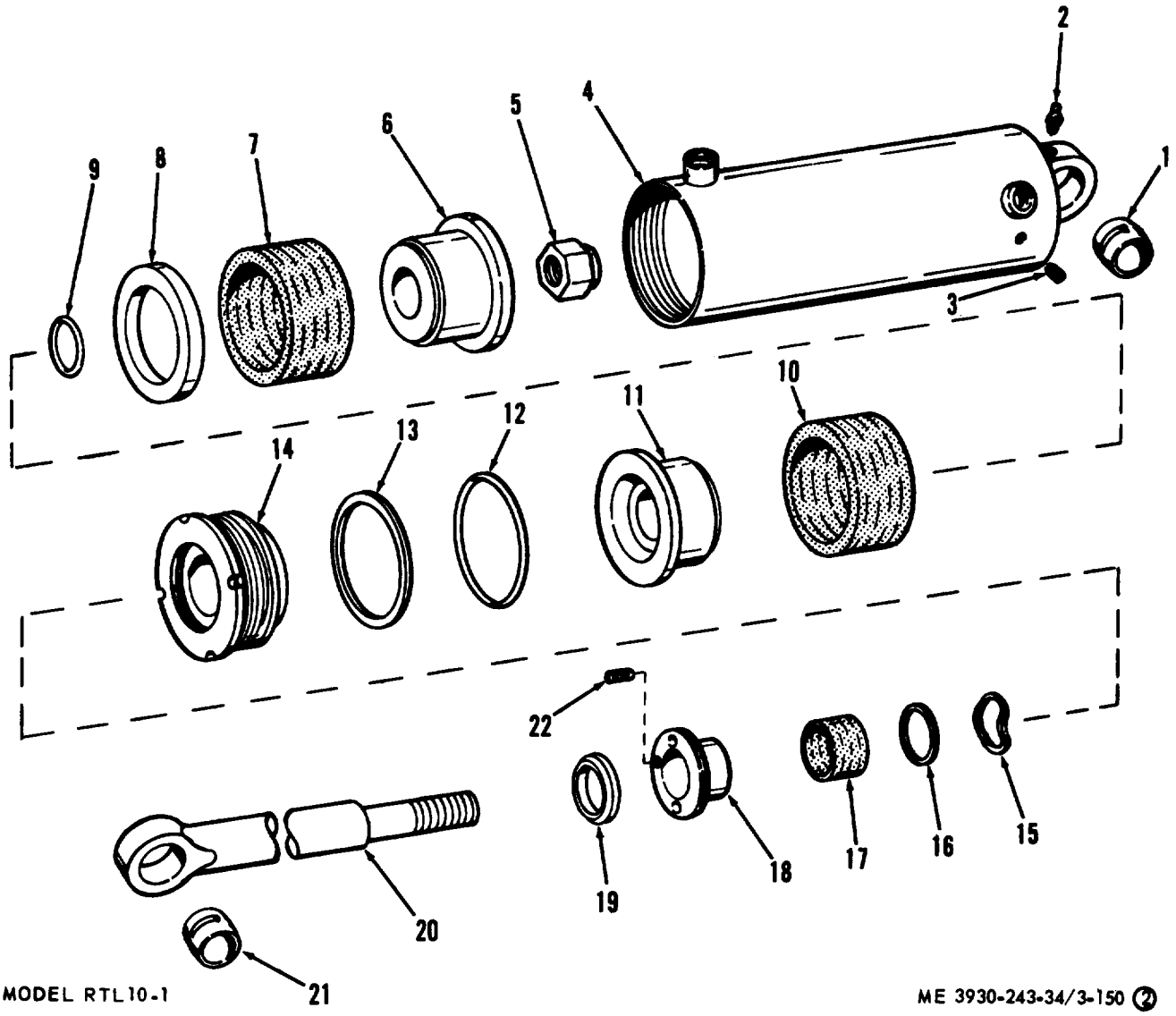


MODEL RTL10

ME 3930-243-34/3-150 ①

1	Bearing	14	Rider
2	Fitting	15	Retainer
3	Setscrew	16	Ring
4	Shell assembly	17	O-ring
5	Nut	18	O-ring
6	Rider	19	Bushing
7	Piston	20	Packing
8	Packing assembly	21	Ring
9	Packing	22	Nut
10	Washer	23	Wiper
11	Packing	24	Bearing
12	Packing assembly	25	Rod
13	Piston		

Figure 3-150. Hydraulic tilt cylinder, disassembly and reassembly (sheet 1 of 2).



1 Bearing
2 Fitting
3 Setscrew
4 Shell assembly
5 Nut
6 Piston
7 Packing assembly
8 Adapter
9 O-ring
10 Packing assembly
11 Piston
12 O-ring
13 Backup ring
14 Nut
15 Spring washer
16 Washer
17 Packing assembly
18 Flange
19 Wiper
20 Rod
21 Bushing
22 Setscrew

Figure 3-150. Hydraulic tilt cylinder, disassembly and reassembly (sheet 2 of 2).

3-76. Hydraulic Extension Cylinder

a. General. The purpose of the extension cylinder is to extend and retract the boom assembly. The extension cylinder is attached to the innerslide at the rod end of the cylinder and to the base end of the boom assembly at the base end of the cylinder.

b. Removal. Refer to figure 3-151 and remove the extension cylinder.

c. Disassembly. Refer to figure 3-152 and disassemble extension cylinder.

d. Repacking Cylinder. Refer to paragraph *3-64c* for repacking procedures.

e. Inspection.

(1) Inspect the shell assembly for cracks or damage.

(2) Inspect the rod and piston for nicks and scratches.

(3) Inspect end cap for damage.

(4) Remove scratches with crocus cloth.

(5) Replace a defective part.

f. Reassembly. Refer to figure 3-152 and reassemble extension cylinder.

g. Test. Refer to paragraph *3-64g* and test extension cylinder.

h. Installation. Refer to figure 3-151 and install extension cylinder.

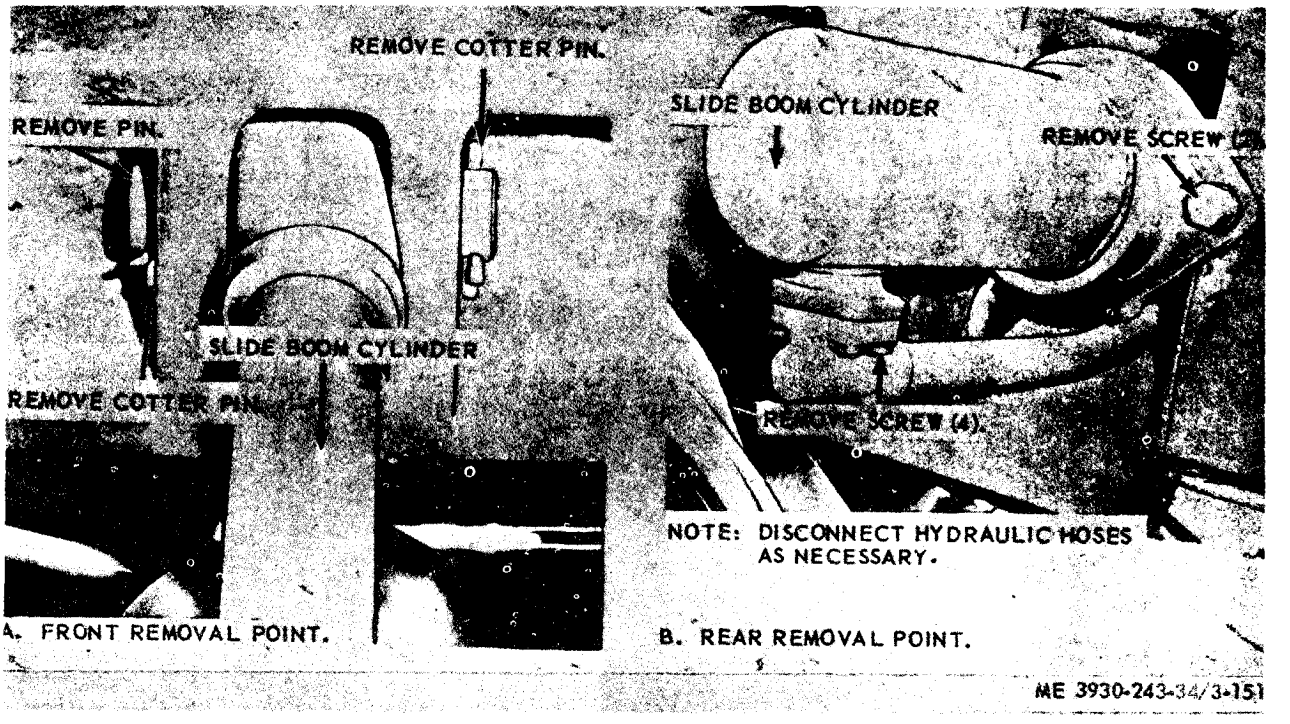
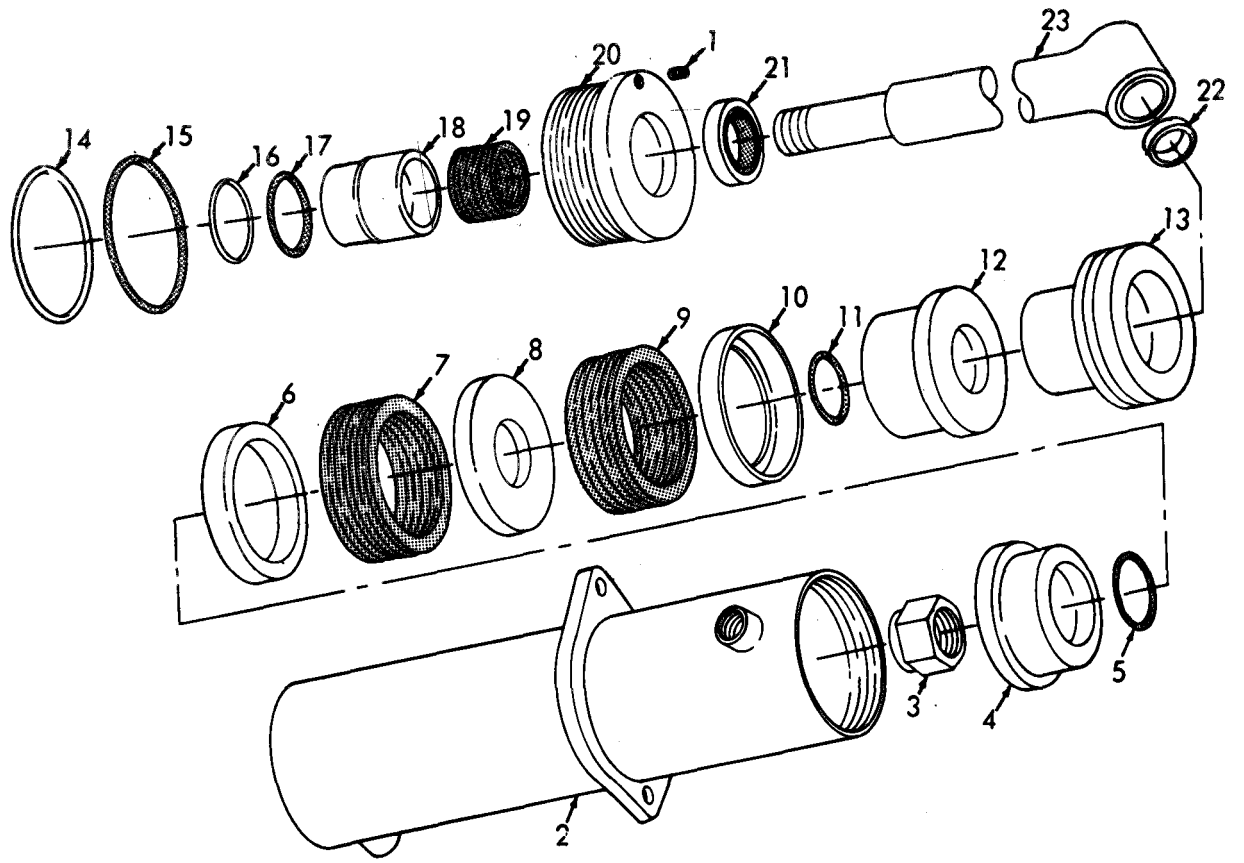


Figure 3-151. Hydraulic extension cylinder, removal and installation.

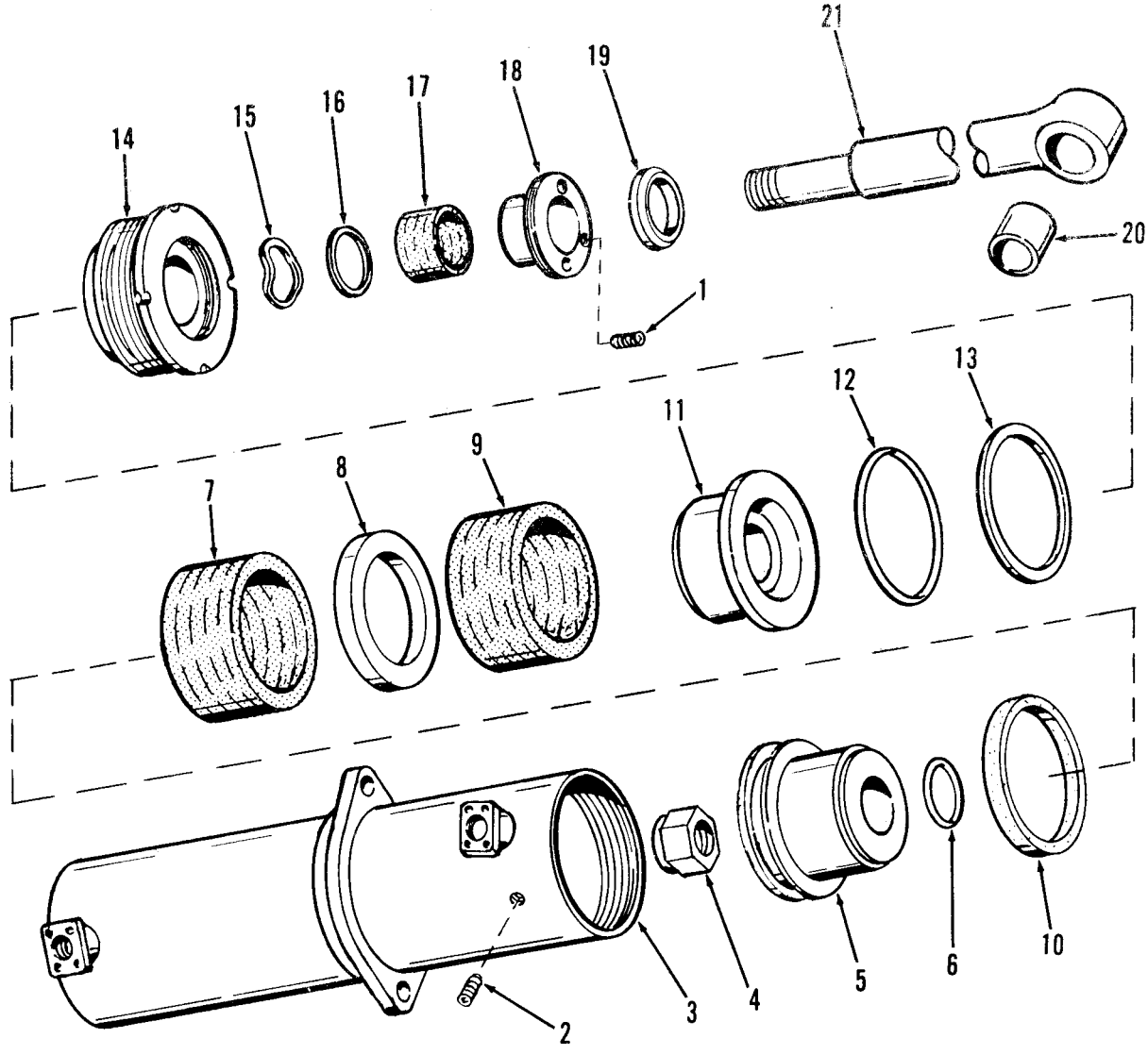


MODEL RTL10

ME 3930-243-34/3-152 ①

1 Setscrew
2 Shell assembly
3 Nut
4 Piston
5 Packing
6 Rider
7 Packing assembly
8 Washer
9 Packing assembly
10 Rider
11 Packing
12 Piston
13 Retainer
14 Ring
15 O-ring
16 Ring
17 O-ring
18 Bushing
19 Packing assembly
20 Nut
21 Wiper
22 Bearing
23 Rod

Figure 3-152. Extension cylinder, assembly and reassembly (sheet 1 of 2).



MODEL RTL10-1

ME 3930-243-34/3-152 ②

1 Setscrew
2 Setscrew
3 Shell assembly
4 Nut
5 Piston
6 O-ring
7 Packing assembly
8 Adapter
9 Packing assembly
10 Wear ring
11 Piston
12 Backup ring
13 O-ring
14 Nut
15 Spring washer
16 Washer
17 Packing assembly
18 Flange
19 Wiper
20 Bearing
21 Rod

Figure 3-152. Extension cylinder, disassembly and reassembly (sheet 2 of 2).

3-77. Oscillation Hydraulic Cylinder

a. General. The purpose of the oscillation cylinder is to tilt the machine either right or left in relation to the front axle. The oscillation cylinder is located on the front right hand side of the fork lift. (Model RTL10 also has an oscillation cylinder attached to the rear right hand side of the fork lift.) It is attached to the axle at the rod end and to the frame at the base end. The reason for tilting the forklift is to keep the load of the forks level, if necessary, while operating on at lateral slope, and to allow pick up of a canted pallet load.

b. Removal. Refer to figure 3-153 and remove the oscillation cylinder.

c. Disassembly. Refer to figure 3-154 and disassemble the oscillation cylinder.

d. Repacking Cylinder. Refer to paragraph *3-64c* for repacking procedures.

e. Inspection.

(1) Inspect rod for nicks and scratches.

(2) Inspect shell assembly for cracks or damage.

(3) Inspect piston for scratches.

(4) Inspect end nut for cracks.

(5) Remove scratches with crocus cloth.

(6) Replace a defective part.

f. Reassembly. Refer to figure 3-154 and reassemble the oscillation cylinder.

g. Test. Refer to paragraph *3-64g* and test the cylinder.

h. Installation. Refer to figure 3-153 and install the oscillation cylinder.

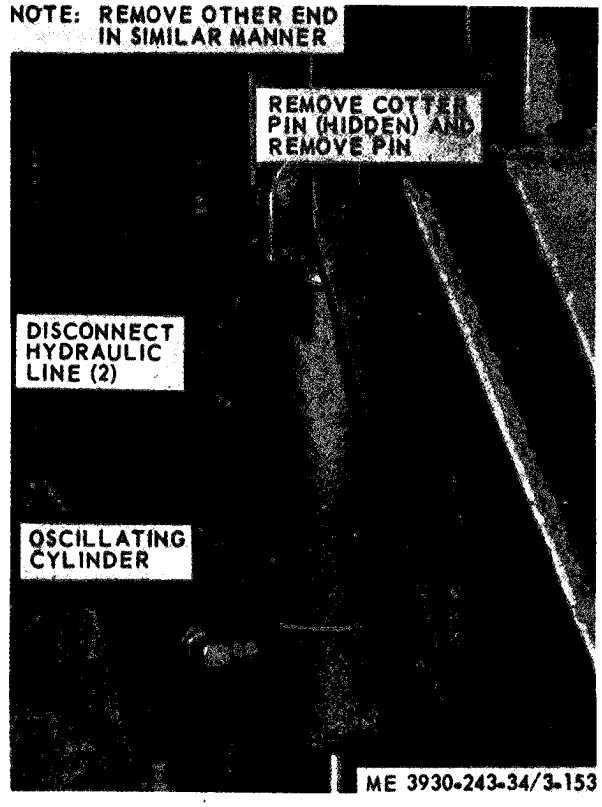
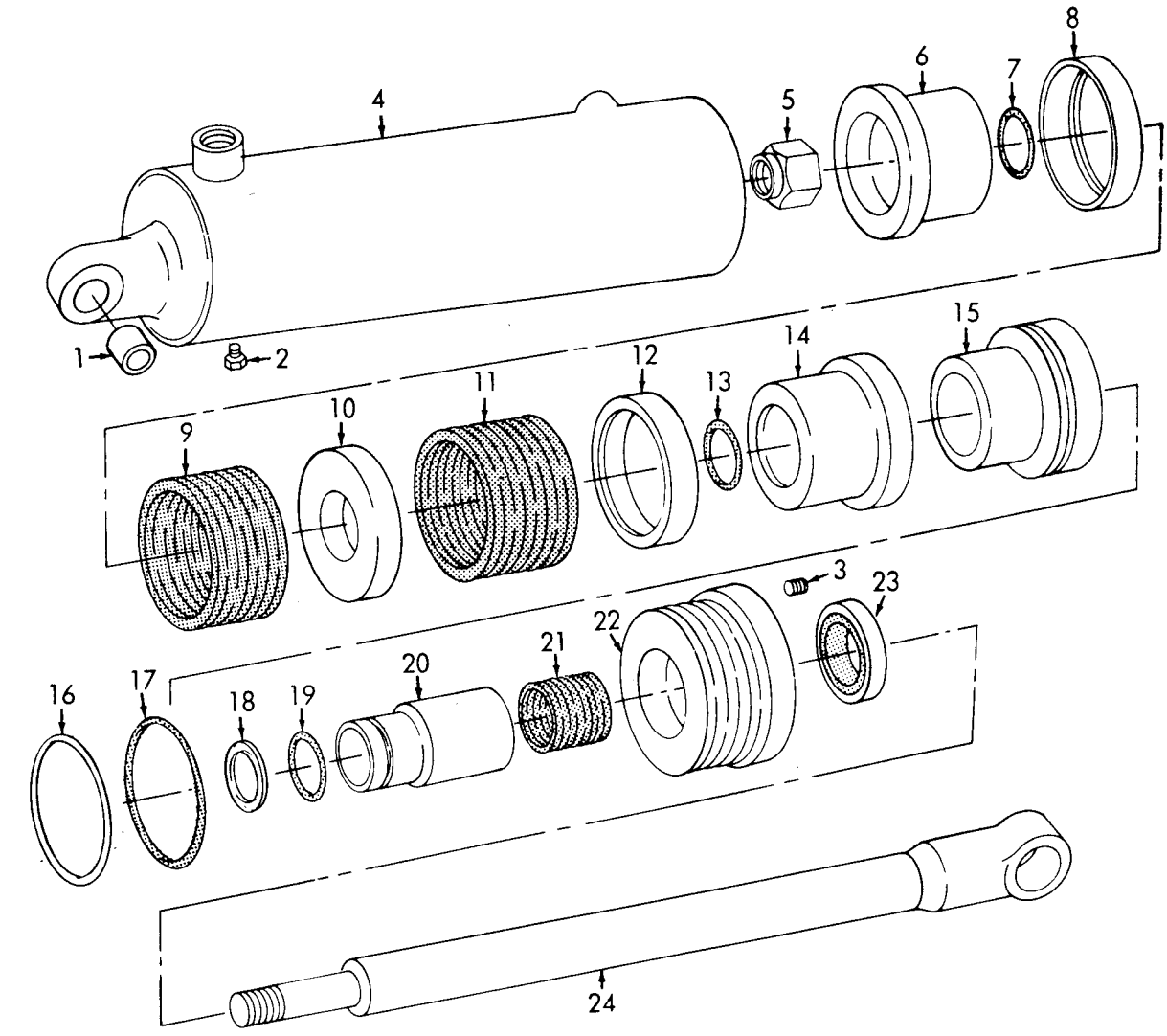
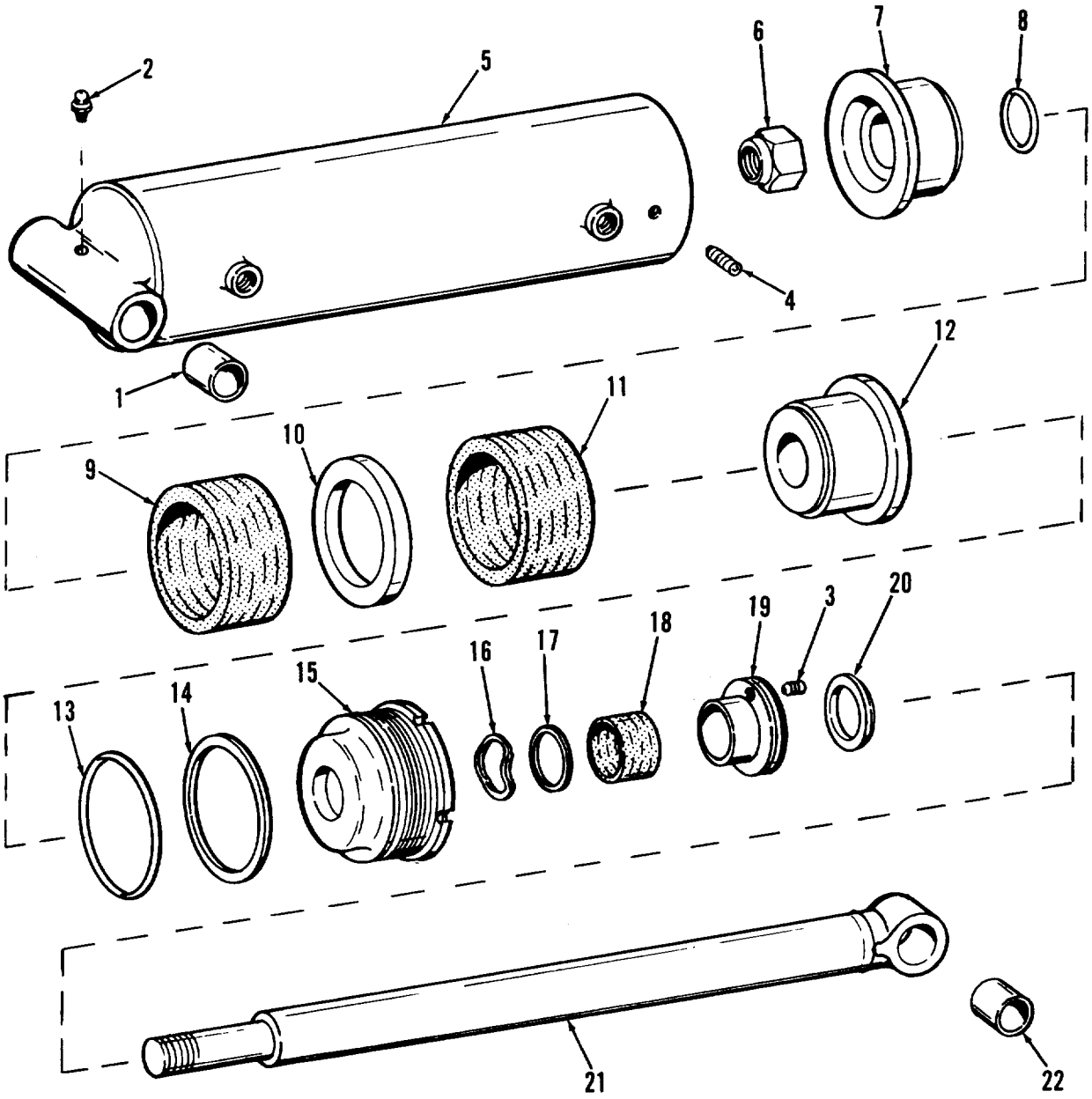


Figure 3-153. Oscillation cylinder, removal and installation



1 Bearing
2 Plug
3 Setscrew
4 Shell assembly
5 Nut
6 Piston
7 Packing
8 Rider
9 Packing assembly
10 Washer
11 Packing assembly
12 Rider
13 Packing
14 Piston
15 Retainer
14 Ring
17 O-ring
18 Ring
19 O-ring
20 Bearing
21 Packing assembly
22 Nut
23 Wiper
24 Rod

Figure 3-154. Oscillation cylinder, disassembly and reassembly (sheet 1 of 2).



MODEL RTL10-1

ME 3930-243-34/3-154 (2)

1 Bearing
2 Fitting
3 Setscrew
4 Setscrew
5 Shell assembly
6 Nut
7 Piston
8 O-ring
9 Packing assembly
10 Adapter
11 Packing assembly
12 Piston
13 O-ring
14 Backup ring
15 Nut
16 Spring washer
17 Washer
18 Packing assembly
19 Flange
20 Wiper
21 Rod
22 Bearing

Figure 3-154. Oscillation cylinder, disassembly and reassembly (sheet 2 of 2).

3-78. Oscillating Cylinder Check Valve

a. General. The purpose of the oscillating cylinder check valve is to hold the machine stable during any type of operation. It also restricts the flow of oil moving through the oscillating cylinder. Without the check valve, the oscillating cylinder would tilt the machine too fast and the operator would not be able to control the oscillation easily and accurately. The oscillating cylinder check valve is located on the outside of the main frame directly behind the front oscillation cylinder.

b. Removal. Refer to figure 3-154 (sheet 1 of 1) and remove oscillation cylinder check valve,

c. Disassembly. Refer to figure 3-154 (sheet 2 of 2) and disassemble oscillation cylinder check valve.

(1) Inspect housing for cracks or damage,

(2) Inspect shuttle for erosion and wear.

(3) Inspect sleeve and poppet for erosion and wear. Normal operation will show only an acceptable light line at the point of contact.

(4) Inspect springs for damage and wear.

(5) Check plugs for damaged threads.

d. Reassembly. Refer to figure 3-154 (sheet 2 of 2) and reassemble oscillation cylinder check valve.

(1) Replace O-ring seals. Grease O-rings before installing on sleeve and plug.

(2) Replace a defective part.

e. Installation. Refer to figure 3-154 (sheet 1 of 2) and install oscillation cylinder check valve.

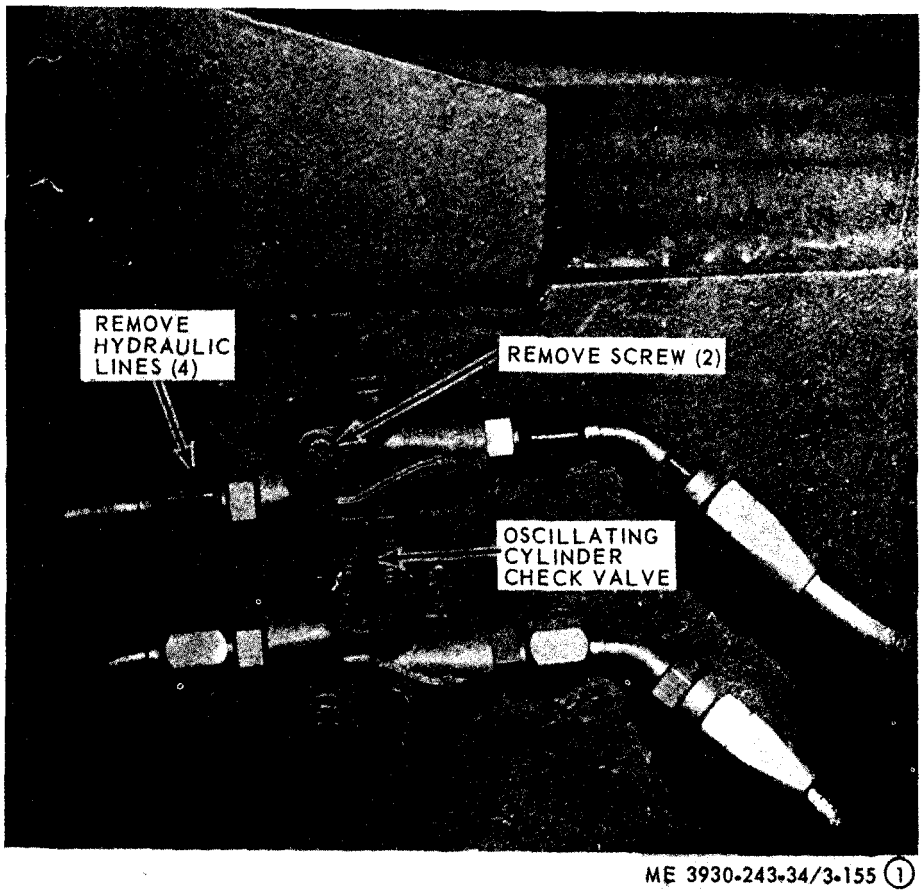
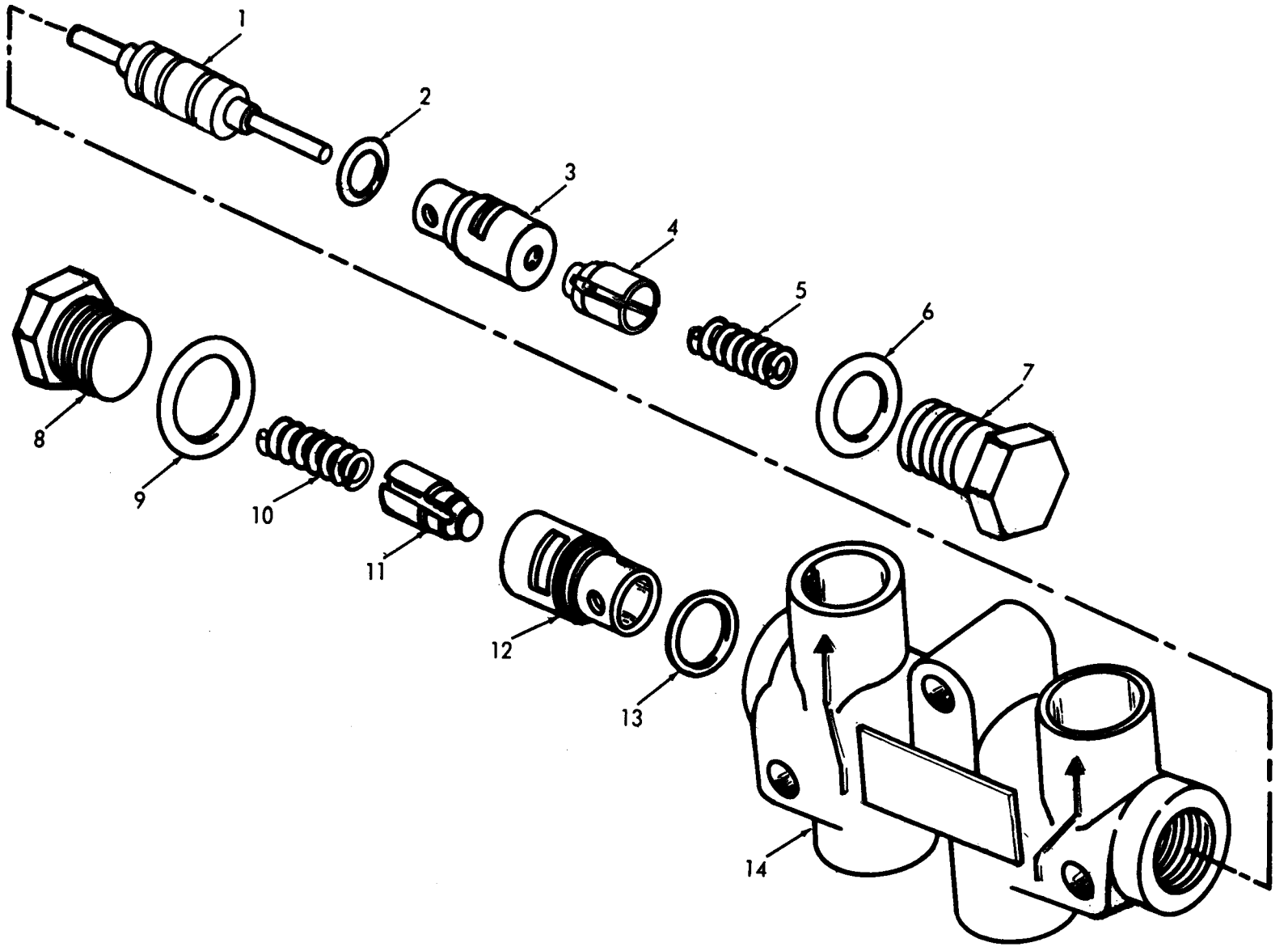


Figure 3-155. Oscillating cylinder check valve, removal and installation (sheet 1 of 2).

KEY to figure 3-155 (sheet 2 of 2):

1 Plug	8 Plug
2 O-ring	9 O-ring
3 Spring	10 Spring
4 Poppet	11 Poppet
5 Sleeve	12 Sleeve
6 O-ring	13 O-ring
7 Shuttle	14 Body



ME 3930-243-34/3-155 ②

Figure 3-155. Oscillating cylinder check valve, exploded view (sheet 2 of 2).

3-79. Side Shift Hydraulic Cylinder

a. General. The purpose of the side shift cylinder is to move the fork on the fork carriage either t the right or left. This is accomplished by means of a chain and sprocket set up attached to the cylinder, fork carrier and forks. When the cylinder is actuated the chain is moved. The forks which are attached to the chain are moved also.

b. Removal. Refer to figure 3-156 and remove the side shift cylinder.

c. Disassembly. Refer to figure 3-157 and disassemble the side shift cylinder.

d. Repacking Cylinder. Refer to paragraph *3-64c* for repacking procedures.

e. Inspection.

(1) Inspect shell assembly for damage.
(2) Inspect rod for nicks and scratches.
(3) Inspect end nut for cracks.
(4) Inspect piston for scratches.
(5) Remove scratches with crocus cloth.
(6) Replace a defective part.

f. Reassembly. Refer to figure 3-157 and reassemble the side shift cylinder.

g. Test. Refer to paragraph *3-64c* and test the cylinder.

h. Installation. Refer to figure 3-156 and install the side shift cylinder.

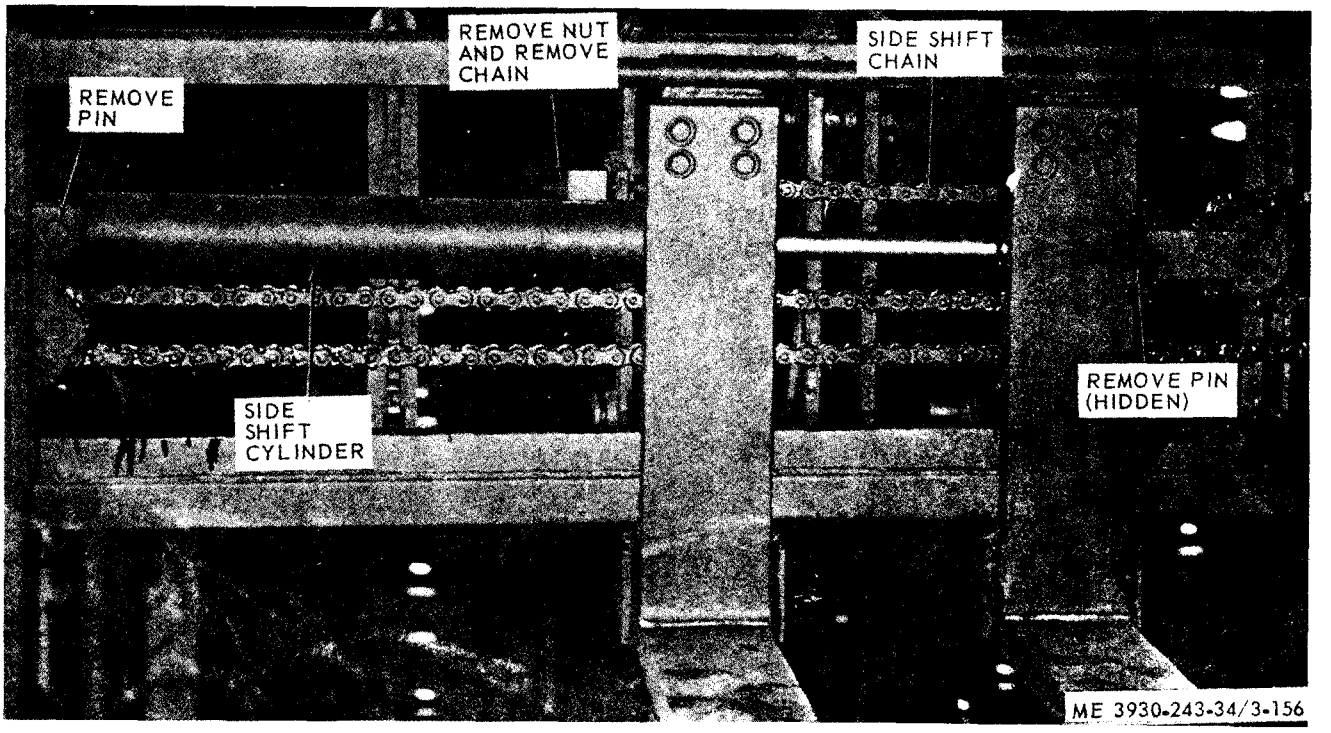
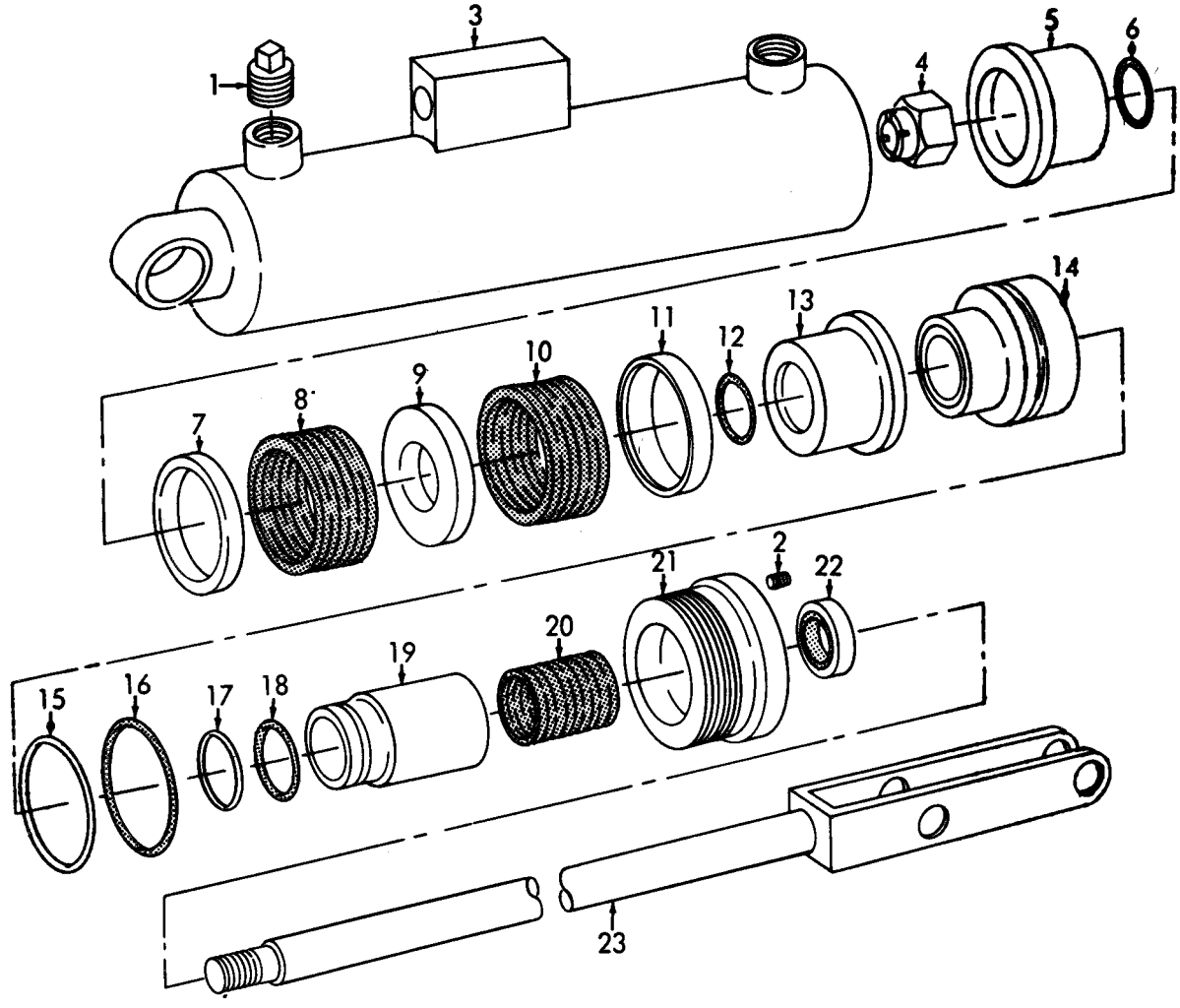


Figure 3-156. Side shift Cylinder, removal and installation.

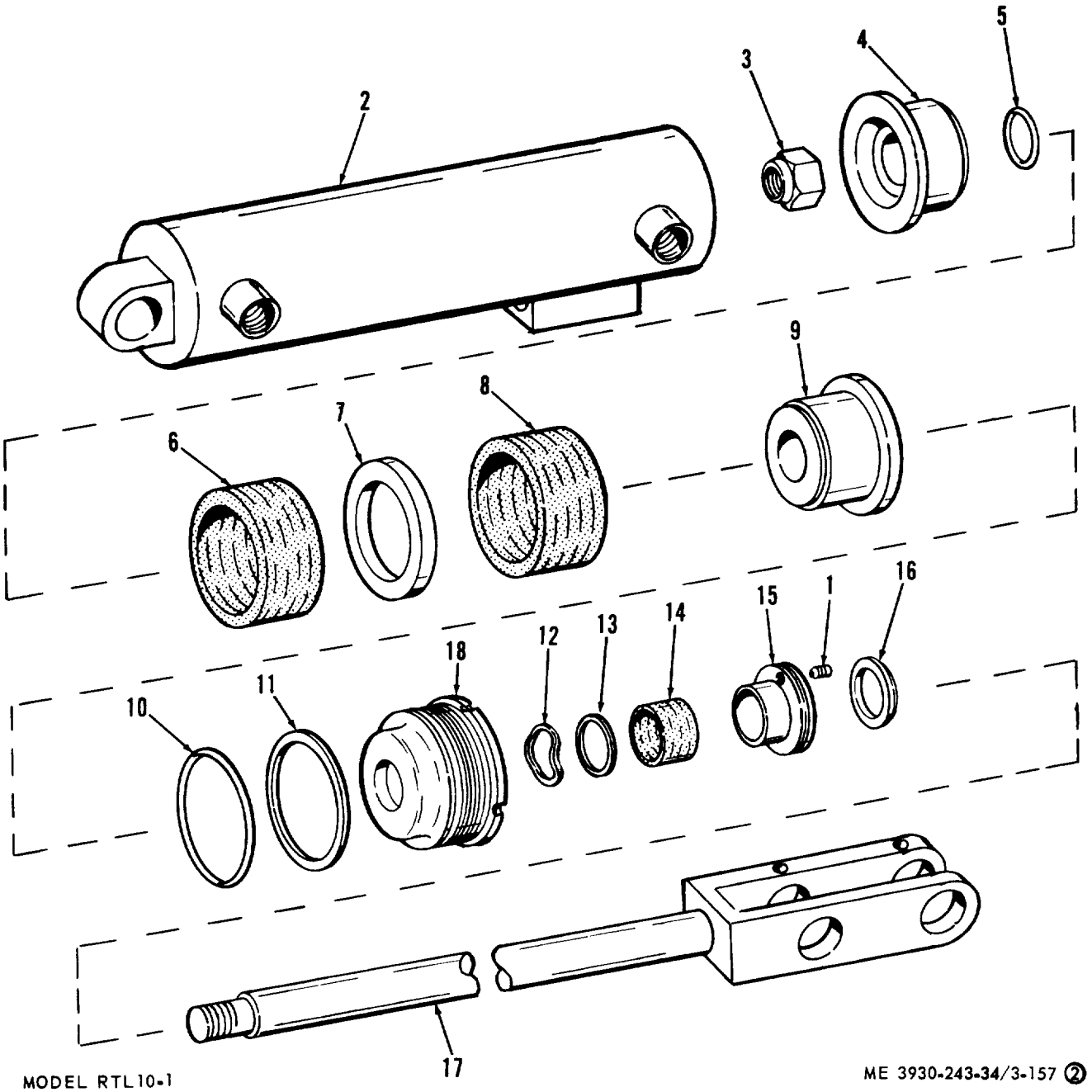


MODEL RTL10

ME 3930•243•34/3•157 ①

1 Plug
2 Setscrew
3 Shell assembly
4 Nut
5 Piston
6 Packing
7 Rider
8 Packing assembly
9 Washer
10 Packing assembly
11 Rider
12 Packing
13 Piston
14 Retainer
15 Ring
16 Packing
17 Ring
18 O-ring
19 Bushing
20 Packing assembly
21 Nut
22 Wiper
23 Rod

Figure 3-157. Side shift cylinder, disassembly and reassembly (sheet 1 of 2).



1 Setscrew
2 Shell assembly
3 Nut
4 Piston
5 O-ring
6 Packing assembly
7 Adapter
8 Packing assembly
9 Piston
10 O-ring
11 Backup ring
12 Spring washer
13 Washer
14 Packing assembly
15 Flange
16 Wiper
17 Rod
18 Nut

Figure 3-157. Side shift cylinder, disassembly and reassembly (sheet 2 of 2).

Section XIII. BOOM ASSEMBLY, INSTRUMENT PANEL AND FRAME

3-80. General

The boom assembly consists mainly of two parts, the outer boom, which mounts to the frame, and the innerslide. The various hydraulic cylinders are described in Section XII. The instrument panel contains all the instruments, gages, and switches for the proper operation of the forklift. The frame is constructed of heavy material to enable the forklift to be operated over rough terrain with a minimum of mechanical difficulty.

3-81. Boom Assembly (Mast Column)

a. General. The boom assembly is mounted to the front part of the forklift frame. There are two main parts to the boom assembly, the outer boom and the innerslide.

b. Removal. Remove the boom assembly (para 2-11).

c. Inspection.

(1) Inspect the outer boom and the innerslide for cracks and breaks.

(2) Inspect the mounting points and hardware for cracks and breaks.

d. Installation. Install the boom assembly (para 2-11).

3-82. Instrument Panel

a. General. The instrument panel is mounted to the front of the driver's compartment and contains all the instruments, gages and switches.

b. Removal.

(1) Remove clutch oil pressure gage, engine oil pressure gage, brake oil pressure gage (Model RTL-10), converter temperature gage, water temperature gage, brake pressure gage valve (Model RTL-10), ammeter, hourmeter, ignition switch, start button, bank indicator (Model RTL 10-1), flood light and headlight switches, and panel lights (TM 10-3930-243-12).

(2) Refer to figure 3-158 and remove instrument panel.

c. Inspection.

(1) Inspect the instrument panel for cracks and damage.

(2) Inspect all mounting hardware for damage or missing parts.

d. Installation.

(1) Refer to figure 3-158 and install the instrument panel.

(2) Install the clutch oil pressure gage, engine oil pressure gage, brake oil pressure gage (Model RTL-10), converter temperature gage, water temperature gage, brake pressure gage valves (Model RTL-10), ammeter, hourmeter, ignition switch, start button, bank indicator (Model RTL 10-1), flood light and head light switches, and panel lights (TM 10-3930-243-12).

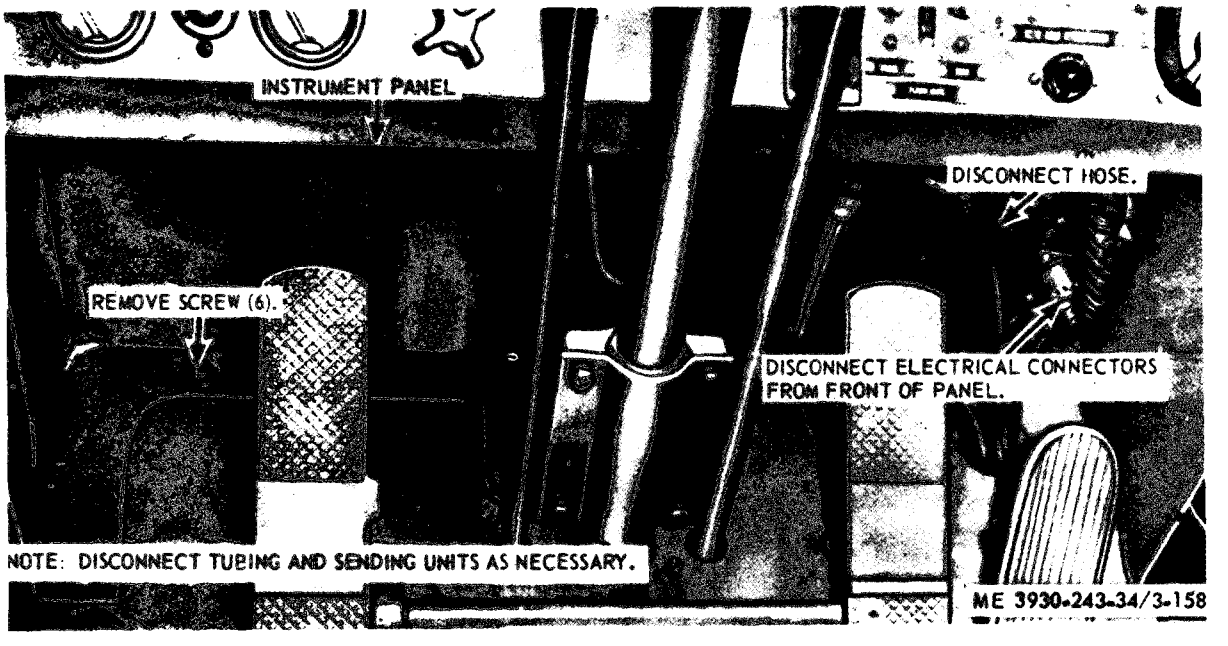


Figure 3-158. Instrument panel, removal and installation.

3-83. Frame, Hood and Panels

NOTE

This manual is set up in order of logical sequence of disassembly and reassembly. Previous sections and paragraphs describe the sequence of disassembly and reassembly of various major and minor components of the rough terrain forklift.

a. Disassembly. Refer to figure 3-159 for Disassembly of hood, panels and frame.

b. Inspection.

(1) Inspect the hood and panels for cracks or lam age.

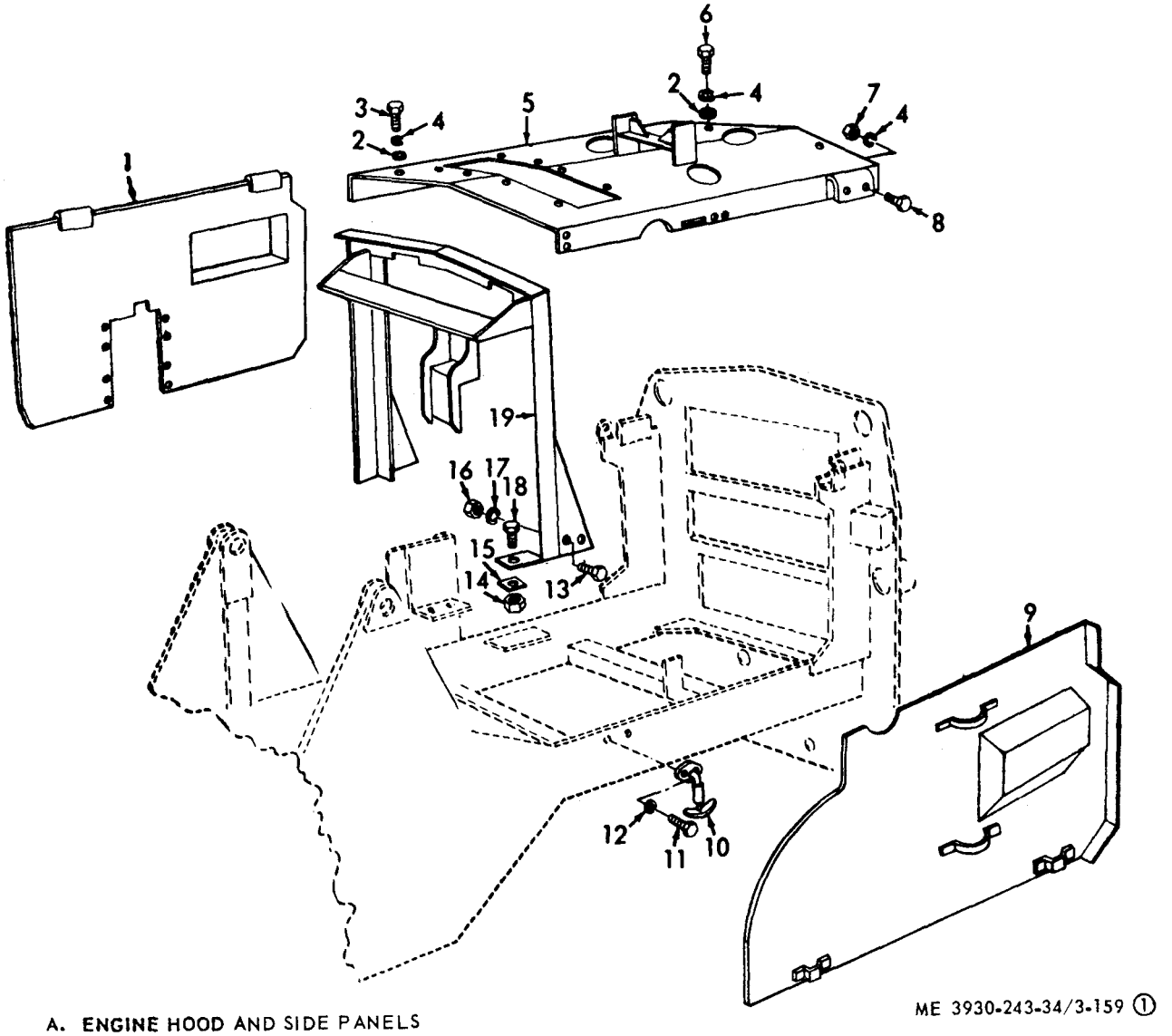
(2) Inspect attaching parts of frame for breaks, damage or excessive wear.

(3) Inspect frame for alignment, cracks in welds and other damage.

(4) Replace defective hardware and mounting attachments.

(5) Repair cracks or breaks by welding.

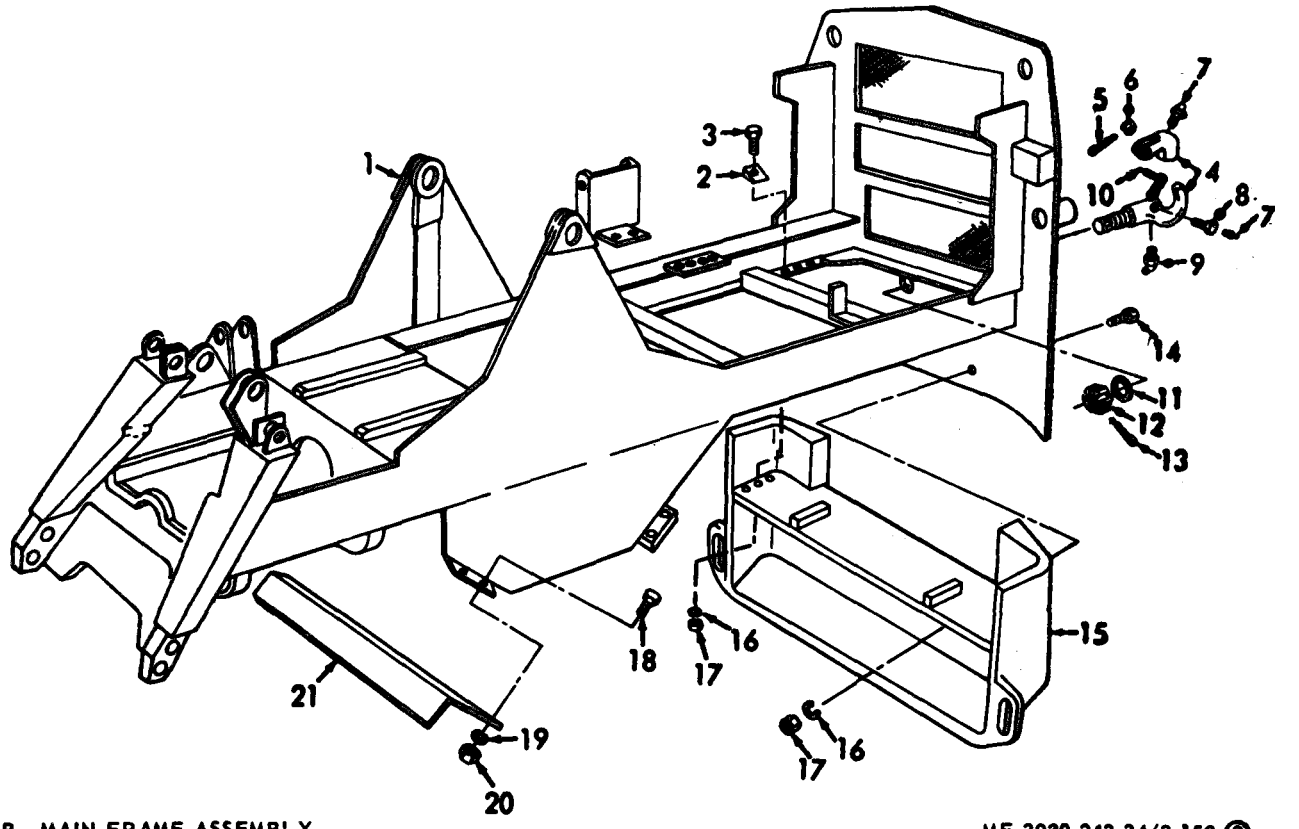
c. Reassembly. Refer to figure 3-159 and reassemble frame, hood, and panels.



A. ENGINE HOOD AND SIDE PANELS

1 Side panel
2 Washer
3 Cap screw
4 Lockwasher
5 Hood assembly
6 Cap screw
7 Nut
8 Cap screw
9 Side panel
10 Hood latch
11 Cap screw
12 Lockwasher
13 Cap screw
14 Nut
15 Bevel washer
16 Nut
17 Lockwasher
18 Cap screw
19 Bracket

Figure 3-159. Frame, hood and panels, disassembly and reassembly (sheet 1 of 2).



1 Main frame
2 Bevel washer
3 Cap screw
4 Pintle hook
5 Cotter pm
6 Nut
7 Lube fitting
8 Bolt
9 Lube fitting
10 Cotter pm
11 Washer
12 Nut
13 Cotter pin
14 Cap screw
15 Counterweight
16 Lockwasher
17 Nut
18 Cap screw
19 Lockwasher
20 Nut
21 Steel angle

Figure 3-159. Frame, hood and panels, disassembly and reassembly (sheet 2 of 2).

APPENDIX A

REFERENCES

A-1. Fire Protection

TB 5-4200-200-10	Hand Portable Fire Extinguishers Approved for Army Users

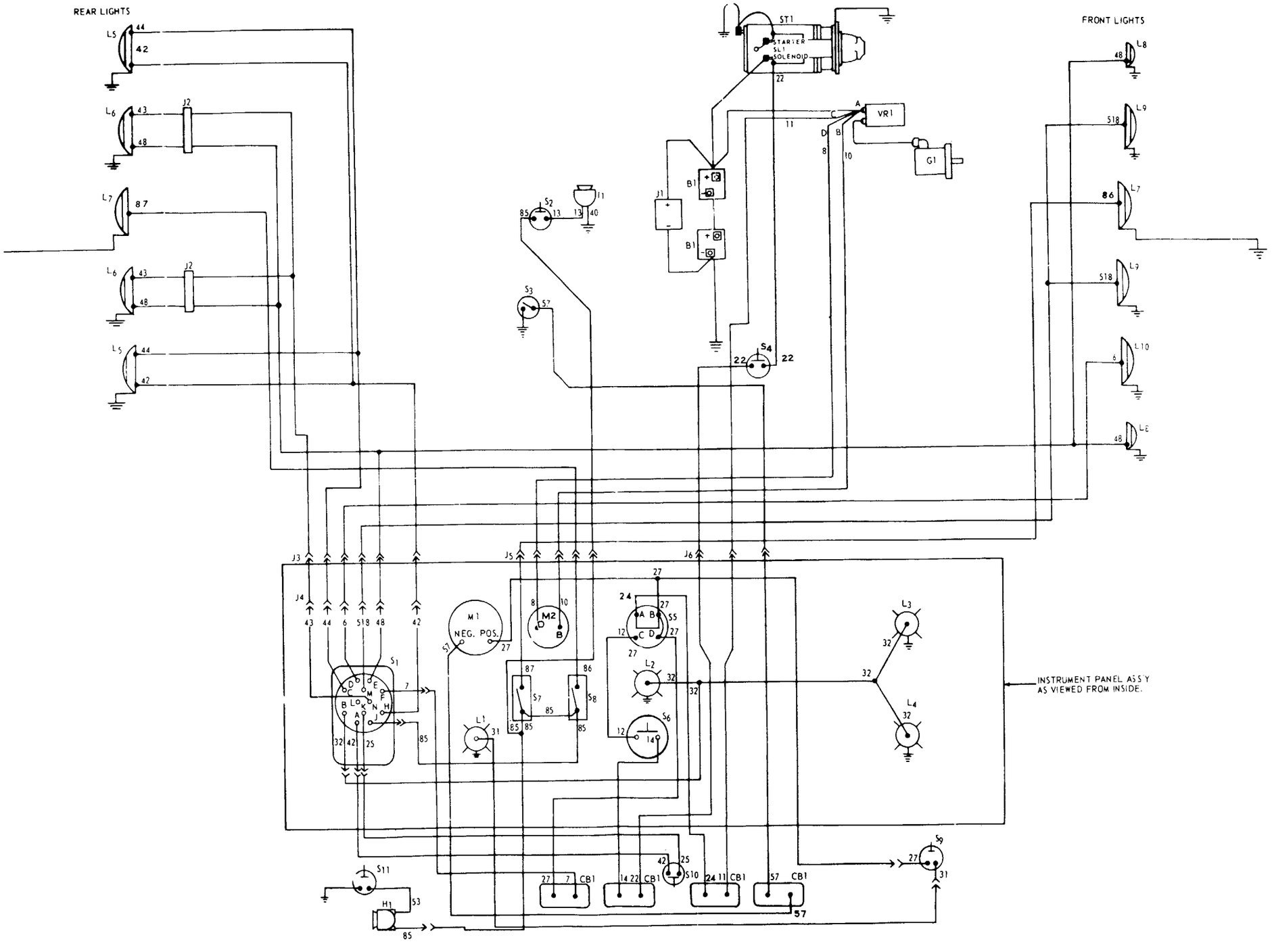
A-2. Lubrication

C9100-IL	Identification List for Fuels, Lubricants, Oil and Waxes
LO 10-3930-243-12	Truck, Lift, Fork, Diesel Engine, Pneumatic Tired Wheels, Rough Terrain, 10,000 lb. Capacity, 24 Inch Load Center (Pettibone-Mulliken Model RTL10, Army Model MHE 199) FSN 3930-903-0899 and Pettibone-Mulliken Model RTL 10-1, Army Model MHE 215) FSN 3930-465-5869 w/Engine General Motors Model 6V53

A-3. Maintenance

TM 38-750	The Army Maintenance Management System
TM 10-3930-243-12	Operator and Organizational Maintenance Manual, Truck, Lift, Fork, Diesel Engine, Pneumatic Tired Wheels, Rough Terrain, 10,000 Lb. Cacacity, 24 Inch Load Center (Pettibone-Mulliken Model RTL 10, Army Model MHE 199) FSN 3930-903-0899 and (Pettibone-Mulliken Model RTL 10-1, Army Model MHE 215) FSN 3930-465-5869
TM 10-3930-243-35P	Direct and General Support and Depot Maintenance Repair Parts and Special Tools List, Truck, Lift, Fork, Diesel Engine, Pneumatic Tired Wheels, Rough Terrain, 10,000 Lb. Capacity, 24 Inch Load Center (Pettibone-Mulliken Model RTL 10, Army Model 199) FSN 3930-903-0899 and (Pettibone-Mulliken Model RTL 10-1, Army Model MHE 215) FSN 3930-465-5869

ALPHABETICAL INDEX

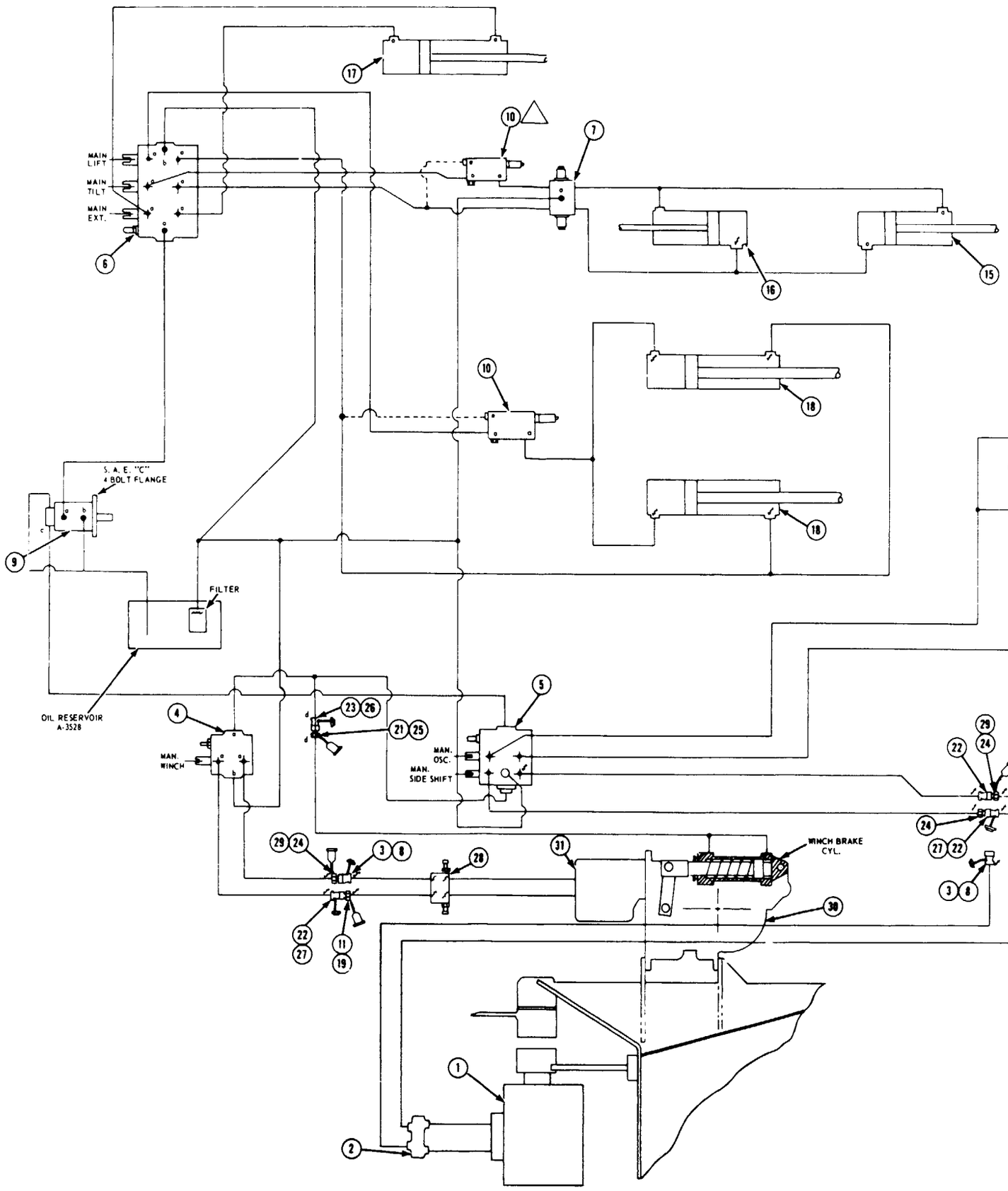


LEGEND

PREFIX	EXPLANATION
B1	BATTERIES, 12V
CB1	CIRCUIT BREAKERS
G1	GENERATOR
H1	HORN
I1	INDICATOR, AUDIBLE
J1	CONNECTOR, BATTERIES
J2	CONNECTOR, BLACKOUT STOP LIGHTS
J3	CONNECTOR, VEHICLE LIGHT SWITCH
J4	CONNECTOP, VEHICLE LIGHT SWITCH
J5	CONNECTOR, RECEPTACLE
J6	CONNECTOR, RECEPTACLE
L1	LIGHT, INDICATOR
L2	LIGHT, CONTROL PANEL
L2	LIGHT CONTROL PANEL
L3	LIGHT, CONTROL PANEL
L4	LIGHT, CONTROL PANEL
L5	STOP AND TAIL LIGHTS
L6	TAILLIGHTS, BLACKOUT, STOP
L7	FLOODLIGHTS, FRONT AND REAR
L8	BLACKOUT MARKER LIGHTS
L9	HEADLIGHTS
L10	BLACKOUT HEADLIGHT
M1	HOURMETER
M2	AMMETER
S1	SWITCH, VEHICLE
S2	SWITCH, LOW PRESSURE
S3	SWITCH, PRESSURE, HOURMETER
S4	SWITCH, IGNITION
S5	SWITCH, IGNITION
S6	SWITCH, ENGINE STARTING
S7	SWITCH, FLOODLIGHT, REAR
S8	SWITCH, FLOODLIGHT, FRONT
S9	SWITCH, REAR AXLE DISCONNECT
S10	SWITCH STOPLIGHT
S11	SWITCH HORN
ST1	STARTER
SL1	SOLENOID, STARTER
VR1	VOLTAGE REGULATOR

ME 3930-243-34/1-1

Figure 1-1. Schematic wiring diagram (Model RTL10).



ITEM	DESCRIPTION
1	CRANE OSCILLATION MOTOR
2	DUAL CHECK VALVE-(PILOT OPERATED)
3	QUICK DISCONNECT SOCKET
4	VALVE, CONTROL (RELIEF SETTING 2000 PSI)
5	VALVE, CONTROL (RELIEF SETTING 2000 PSI)
6	VALVE, CONTROL (RELIEF SETTING 2000 PSI)
7	RELIEF VALVE, DUAL-SETTING 2100 PSI
8	SOCKET DUST CAP
9	PUMP, DUAL
10	HOLDING VALVE (SETTING 3000 PSI)
11	QUICK DISCONNECT PLUG
12	CYLINDER, REAR OSCILLATION
13	CYLINDER SIDE SHIFT
14	CYLINDER, FRONT OSCILLATION
15	CYLINDER, SLAVE
16	CYLINDER, TILT
17	CYLINDER, EXTENSION
18	CYLINDER, LIFT
19	PLUG DUST CAP
20	CHECK VALVE, DUAL, PILOT OPERATED
21	QUICK DISCONNECT PLUG
22	QUICK DISCONNECT SOCKET
23	QUICK DISCONNECT SOCKET
24	QUICK DISCONNECT PLUG
25	PLUG DUST CAP
26	SOCKET DUST CAP
27	SOCKET DUST CAP
28	VALVE, COUNTERBALANCE-3000 P.S.I.
29	PLUG DUST CAP
30	WINCH ASS'Y
31	WINCH MOTOR

AREA SQ. IN.	O.D. TUBE	WALL THICKNESS	WORKING PRESS P.S.I.	SAFETY FACTOR	VELOCITY FT./SEC. 15 GPM	VELOCITY FT./SEC. 35 GPM
.073	3/8	.035	2000	6		
.127	1/2	.049	2000	6	38	
.515	1	.095			9.25	21.8
.302	3/4	.065			15	
.801	1 1/4	.120	2000	6		13.9
1.310	1 1/2	.095	500	6		8.6
	1/4	.035	2000	6		

△ SUCTION LINE

NOTE:
ALL HYDRAULIC FITTINGS, HOSE, TUBING, CYLINDERS AND OTHER COMPONENTS MUST CONFORM TO ALL MILITARY & OTHER SPECIFICATIONS AS SET FORTH IN GOV'T CONTRACT

CODE	PORTS TYPE	DIA.	"O" RING	O.D. TUBE
a	SPLIT FLANGE-4 BOLT	1"		
b	SPLIT FLANGE-4 BOLT	1 1/2		
c	J.I.C. 7/8-14		.	5/8
d	S.A.E. 9/16-18		.	3/8
e	S.A.E. 7/16-20		.	1/4
f	S.A.E. 1 1/16-12		.	3/4
g	J.I.C. 37° 1 5/8-12		.	1 1/4
h	S.A.E. 3/4-16		.	1/2
k	J.I.C. 37° - 1 1/16-12			3/4
l				
m	1 1/2 P. THD.			

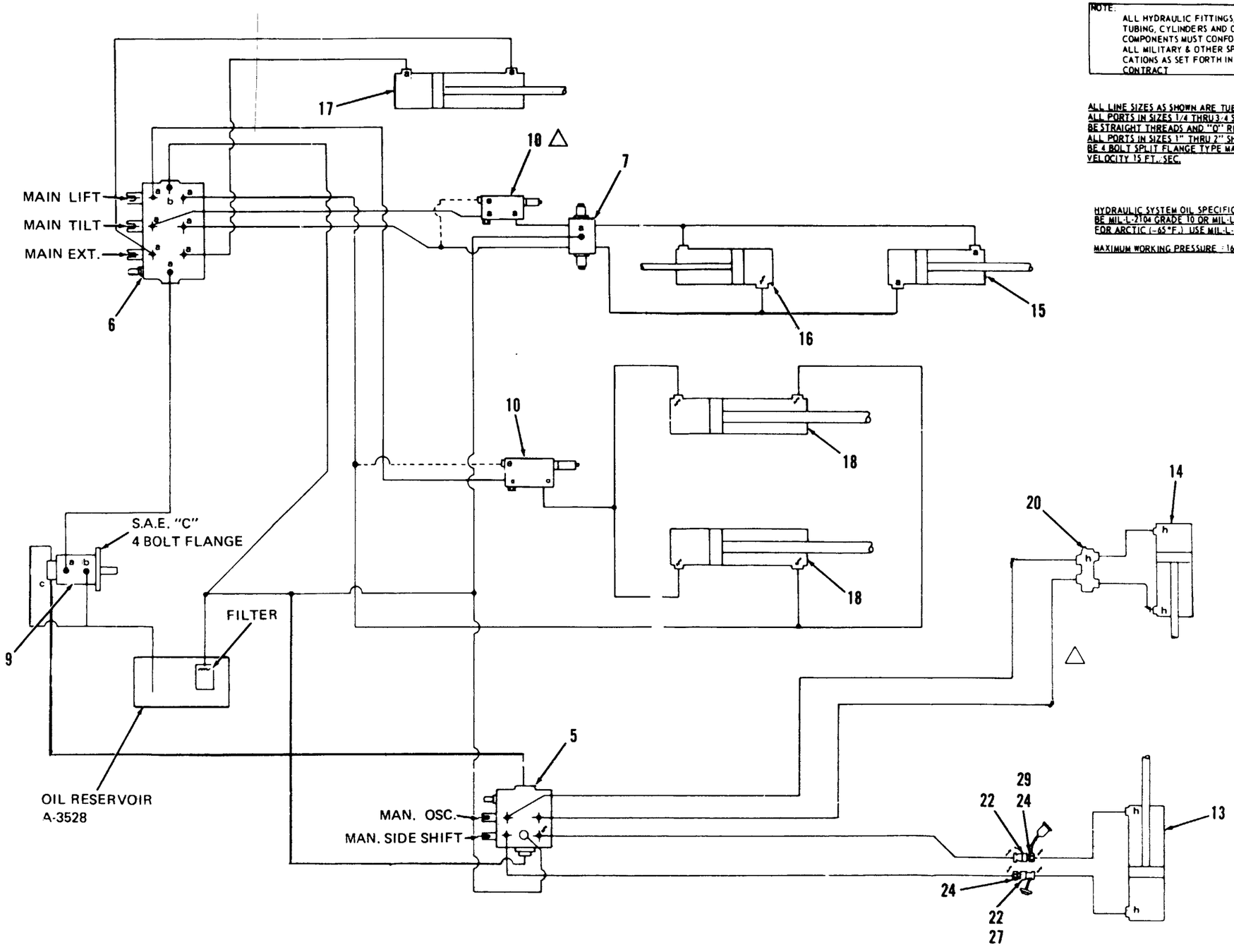
ALL LINE SIZES AS SHOWN ARE TUBE O.D.
ALL PORTS IN SIZES 1/4 THRU 3/4 SHALL BE STRAIGHT THREADS AND "O" RINGS.
ALL PORTS IN SIZES 1" THRU 2" SHALL BE 4 BOLT SPLIT FLANGE TYPE MAX. VELOCITY 15 FT./SEC.

HYDRAULIC SYSTEM OIL SPECIFICATION MUST BE MIL-L-2104 GRADE 10 OR MIL-L-45199 GRADE 10. FOR ARCTIC (-65°F.) USE MIL-L-10295 ONLY

MAXIMUM WORKING PRESSURE = 1600 P.S.I.

ME 3930-243-34/1-3

Figure 1-3. Hydraulic piping diagram (Model RTL10).



NOTE:
ALL HYDRAULIC FITTINGS, HOSE, TUBING, CYLINDERS AND OTHER COMPONENTS MUST CONFORM TO ALL MILITARY & OTHER SPECIFICATIONS AS SET FORTH IN GOV'T CONTRACT

ALL LINE SIZES AS SHOWN ARE TUBE O.D. ALL PORTS IN SIZES 1/4 THRU 3/4 SHALL BE STRAIGHT THREADS AND "O" RINGS. ALL PORTS IN SIZES 1" THRU 2" SHALL BE 4 BOLT SPLIT FLANGE TYPE MAX. VELOCITY 15 FT./SEC.

HYDRAULIC SYSTEM OIL SPECIFICATION MUST BE MIL-L-2104 GRADE 10 OR MIL-L-45199 GRADE 10. FOR ARCTIC (-65°F.) USE MIL-L-10295 ONLY

MAXIMUM WORKING PRESSURE - 1600 P.S.I.

ITEM	DESCRIPTION
1	
2	
3	
4	
5	VALVE, CONTROL (RELIEF SETTING 2000 PSI)
6	VALVE, CONTROL (RELIEF SETTING 2000 PSI)
7	RELIEF VALVE, DUAL-SETTING 2100 PSI
8	
9	PUMP, DUAL
10	HOLDING VALVE (SETTING 3000 PSI)
11	
12	
13	CYLINDER SIDE SHIFT
14	CYLINDER, FRONT OSCILLATION
15	CYLINDER, SLAVE
16	CYLINDER, TILT
17	CYLINDER, EXTENSION
18	CYLINDER, LIFT
19	
20	CHECK VALVE, DUAL, PILOT OPERATED
21	
22	QUICK DISCONNECT SOCKET
23	
24	QUICK DISCONNECT PLUG
25	
26	
27	SOCKET DUST CAP
28	
29	PLUG DUST CAP

AREA SQ. IN.	O.D. TUBE	WALL THICKNESS	WORKING PRESS P.S.I.	SAFETY FACTOR	VELOCITY FT. SEC. 15 GPM	VELOCITY FT. SEC. 35 GPM
.073	3/8	.035	2000	6		
.127	1/2	.049	2000	6	38	
.515	1	.095			9.25	21.8
.302	3/4	.065			15	
.801	1 1/4	.120	2000	6		13.9
1.310	1 1/2	.095	500	6		8.6
	1/4	.035	2000	6		

△ SUCTION LINE

CODE	PORTS TYPE	DIA.	"O" RING	O.D. TUBE
a	SPLIT FLANGE-4 BOLT	1"		
b	SPLIT FLANGE-4 BOLT	1 1/2		
c	J.I.C. 7 8-14			5/8
d	S.A.E. 9 16-18			3/8
e	S.A.E. 7 16-20			1/4
f	S.A.E. 11 16-12			3/4
g	J.I.C. 37° 15 8-12			1 1/4
h	S.A.E. 3 4-16			1/2
k	J.I.C. 37° - 11 16-12			3/4
l				
m	1 1/2 P. THD.			

ME 3930-243-34/1-4

Figure 1-4. Hydraulic piping diagram (Model RTL10-1).

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.

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