TM 5-2410-233-34

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT

MAINTENANCE MANUAL

TRACTOR, FULL TRACKED, LOW SPEED, DED MEDIUM

DRAWBAR PULL; OSCILLATING TRACK, 78-IN. GAGE

(CATERPILLAR MODEL D7F)

FSN 2410-177-7283 W/RIPPER

FSN 2410-177-7284 W/WINCH

This reprint includes all changes in effect at the time of publication; changes 1 and 2.

HEADQUARTERS, DEPARTMENT OF THE ARMY

OCTOBER 1971

WARNING

Take particular heed to specific cautions and warnings throughout this manual

DANGEROUS GASES

are generated as a result of operating of this equipment

DEATH

or severe injury may result if personnel fail to observe safety precautions

Utilize extreme caution, do not smoke, or use open flame in vicinity when servicing batteries.

Batteries generate explosive gas during charging.

Always maintain metal to metal contact when filling the fuel tank

Do not smoke or use open flame in vicinity when filling the fuel tank.

Do not attempt to fill fuel tank when tractor is running.

Do not operate tractor in inclosed areas unless exhaust gases are properly vented to the outside. Exhaust discharge contain noxious and deadly fumes.

LIQUIDS UNDER PRESSURE

are generated as a result of operation of this equipment.

INJURY

or severe burns may result if personnel fail to observe safety precautions.

Never remove radiator cap unless engine has stopped and cooled to reduce pressure.

Keep hands or other exposed areas of body away from any malfunction of high pressure fuel lines or fuel injectors.

HYDRAULIC OIL UNDER PRESSURE

1975+ PSI is used in the operation of this equipment. Death or severe injury may result if personnel fail to observe safety precaution.

PASSENGER HAZARD

Passengers are not permitted to ride other than in the seat as there is danger of being thrown into the tracks when tractor is in motion.

Change No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C. *30 April 1973*

Direct Support and General Support Maintenance Manual
TRACTOR, FULL-TRACKED, LOW SPEED; DED; MEDIUM DRAWBAR PULL; OSCILLATING TRACK, 78-IN. GAGE (CATERPILLAR MODEL D7F)
FSN 2410-177-7283 W/RIPPER
FSN 2410-177-7284 W/WINCH

TM 5-2410-233-34, 12 October 1971, is changed as follows:

Page 2-13. Paragraph 2-8*a*(1) is superseded as follows:

(1) Remove the hood, (para 5-2) side panels, and instrument panel supports. Drain the cooling system. Disconnect the negative battery cable from the battery.

Page 2-14. Paragraph 2-8*a*(7). In line 1, "6" bolts is changed to read "5".

Page 2-18. Paragraphs 2-8*a*(23.1), (23.2), (23.3), and (23.4) are added.

(23.1). Remove clamps securing tilt cylinder hoses to engine.

(23.2) Disconnect lift hoses, left side of engine, and tie back to clear engine.

(23.3) Disconnect voltage regulator and remove regulator.

(23.4) Remove lines from hydraulic and winch pumps.

Page 5-14. Paragraph 5-6*b*(3) is superseded as follows:

(3) Remove the four bolts which secure the water pump to the cylinder block and timing gear cover.

Paragraph 5-6*b*(5) is added as follows:

(5) Remove by-pass-line and 1/4-inch line between the pump and the block.

Page 5-32. Paragraph 5-16 is rescinded.

Figure5-25 is rescinded.

Page 5-44. Paragraph 5-20.1 is added as follows:

5-20.1. Generator Regulator

a. Inspection and Repair.

(1) Inspect all resistors, capacitors, contacts, and wiring for burned or defective condition. Replace as required.

(2) Clean regulator contact points with a fine riffler file. Do not use sandpaper or emery cloth to clean contact points.

CAUTION

When a regulator has been removed from the vehicle, or leads disconnected from the regulator, the generator must be polarized after leads are connected but BEFORE THE ENGINE IS STARTED. To polarize the generator insert the special test harness (TM 5-2410-233-20). Disconnect T-2 and T-3; also disconnect the battery cable from the regulator. Momentarily touch a jumper lead between T-3 of the harness and the prong of the battery cable. This allows a surge of current to flow through the generator field windings in the proper direction. Failure to do this may result in severe damage since reversed generator polarity causes vibration, arcing, or welding of cutout relay contact points.

b. Adjustments (fig. 5-35.1)

(1) *Cutout relay*. Three checks and adjustments are required on the cutout relay; air gap, point opening, and closing voltage. Air gap and point opening are checked with the battery disconnected.

(a) Air gap. Measure the air gap between the armature and the core — not between the brass pin in the armature and the core — with the contact points barely touching. If both sets of points do not close together, it will be necessary to realign the lower contact bracket slightly or to bend the spring fingers on the armature until points do meet simultaneously. Adjust air gap by loosening the two

screws attaching the lower contact bracket, and raise or lower the contact bracket as required to obtain a 0.048 inch measurement. Be sure the points are properly lined up and tighten the screws well after adjustment.

(b) Point opening. Measure the point opening and adjust by bending the upper armature stop to obtain a 0.035 inch measurement.

(c) Closing voltage. To check the closing voltage on the cutout relay, insert special test harness in the generator circuit, and connect a voltmeter between T-1 (armature) and the ground screw at the end of the regulator. Gradually increase generator speed and note the voltage at which the relay contact points close. Adjust the closing voltage, if necessary, by turning the adjusting screw at the base of the cutout relay frame. Voltage should be between 25- to 27- volts. Adjust to 26 volts. Increasing the spiral spring tension increases the relay closing voltage and decreasing the spiral spring tension lowers the closing voltage.

(2) *Voltage regulator.* Two checks and adjustments are required on the voltage regulator; air gap and voltage setting. Note that the AIR GAP and not the POINT OPENING is checked and adjusted.

(a) Air gap. The air gap should be measured between the armature and the part of the core (not the residual pin in the core) next to the residual pin, with the points just touching. The proper way to measure this air gap is to push the armature down until the points open, release until the points barely close, then measure the air gap. Do not measure the gap with the flat spring that supports the contact screw raised up off the fiber mounting plate. To adjust, loosen the locknut and turn the contact screw. The most convenient method of performing this operation is to insert the gage, press the armature down against it to hold it in place, and then turn the contact screw until the contacts barely touch. Adjust the air gap to a 0.084 inch measurement.

(b) Voltage setting. Disconnect battery cable from regulator, and connect voltmeter between regulator battery terminal, and ground screws in the end of the regulator. With the generator operating at approximately 3,000 RPM and the regulator at operating temperature, note the voltage setting. Adjust by turning the adjusting screw at the base of the unit, thereby changing the spiral spring tension. Increasing the spring tension increases the voltage setting. After each change of adjustment, reduce generator speed until cutout relay opens; then return to speed and read voltage. Voltage should be between 27.5- to 29.5-volts. Adjust to 28.2 volts.

(3) *Current regulator.* Two checks and adjustments are required on the current regulator; air gap and current setting.

(a) Air gap. The AIR GAP and not the POINT OPENING is checked and adjusted. Adjust the air gap to obtain a 0.115 inch measurement using the same procedure as for the voltage regulator.

(b) Current setting. To check the current regulator setting, it is necessary to keep the voltage regulator from operating so that the generator output can increase to the value for which the current regulator is adjusted, and thus cause the current regulator to operate. Regardless of the method used, disconnect battery cable from the regulator and connect an accurate ammeter in series between these junctions. The three methods of preventing voltage regulator operation are:

CAUTION

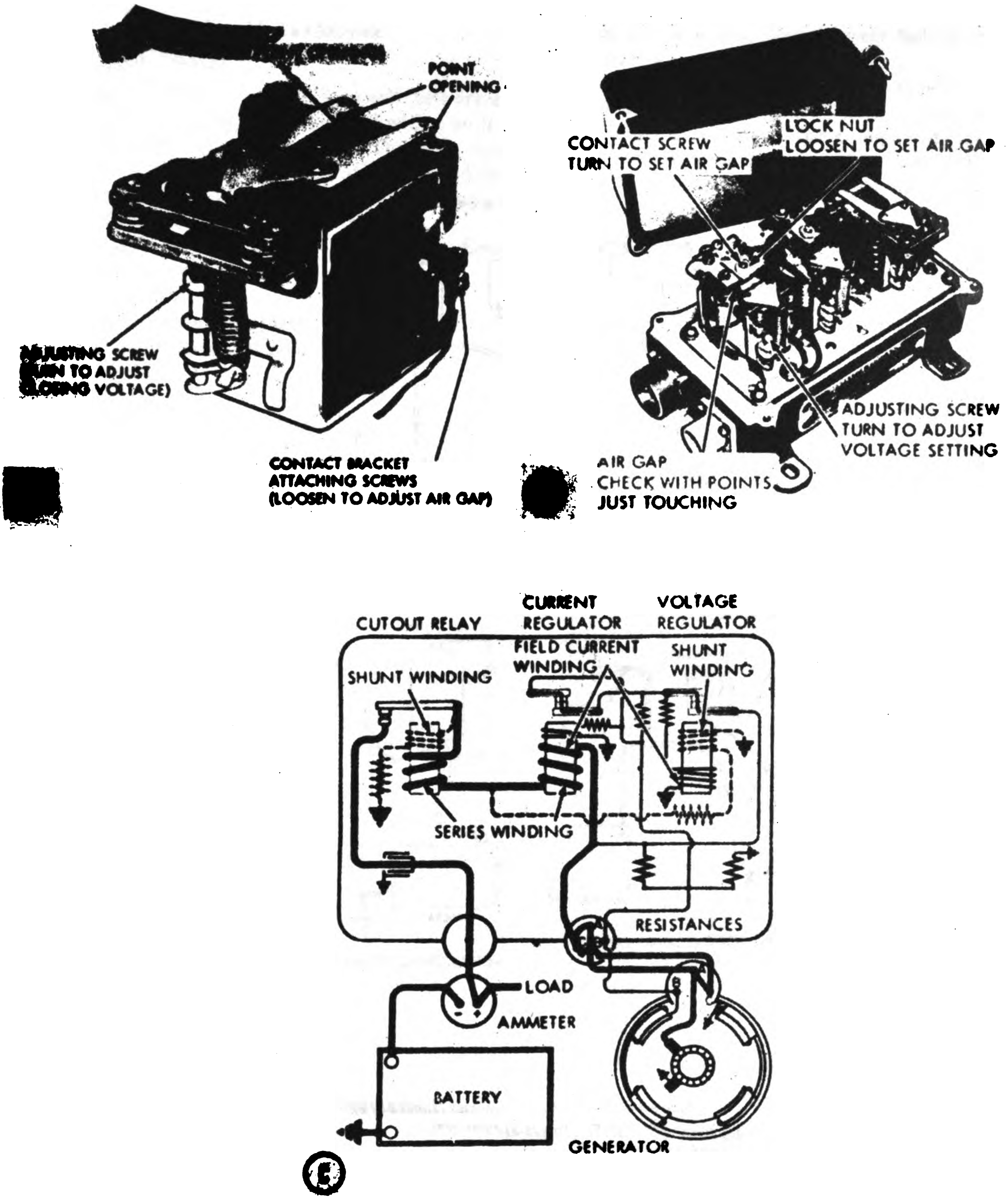
Never use the cranking motor for more than 30 seconds at a time without pausing to allow the cranking motor to cool.

1. Battery discharge method. Partly discharge the battery by cranking the engine for 30 seconds with the lights and accessories turned on. Start the engine and allow the generator output to increase to its maximum. Since the battery voltage recovers very quickly, this method requires prompt action.

2. Load method. If a load approximating the current regulator setting is placed across the battery during the time that the current regulator setting test is made, the voltage will not increase sufficiently to cause the voltage regulator to operate. This load may be provided by a carbon pile or other suitable resistance.

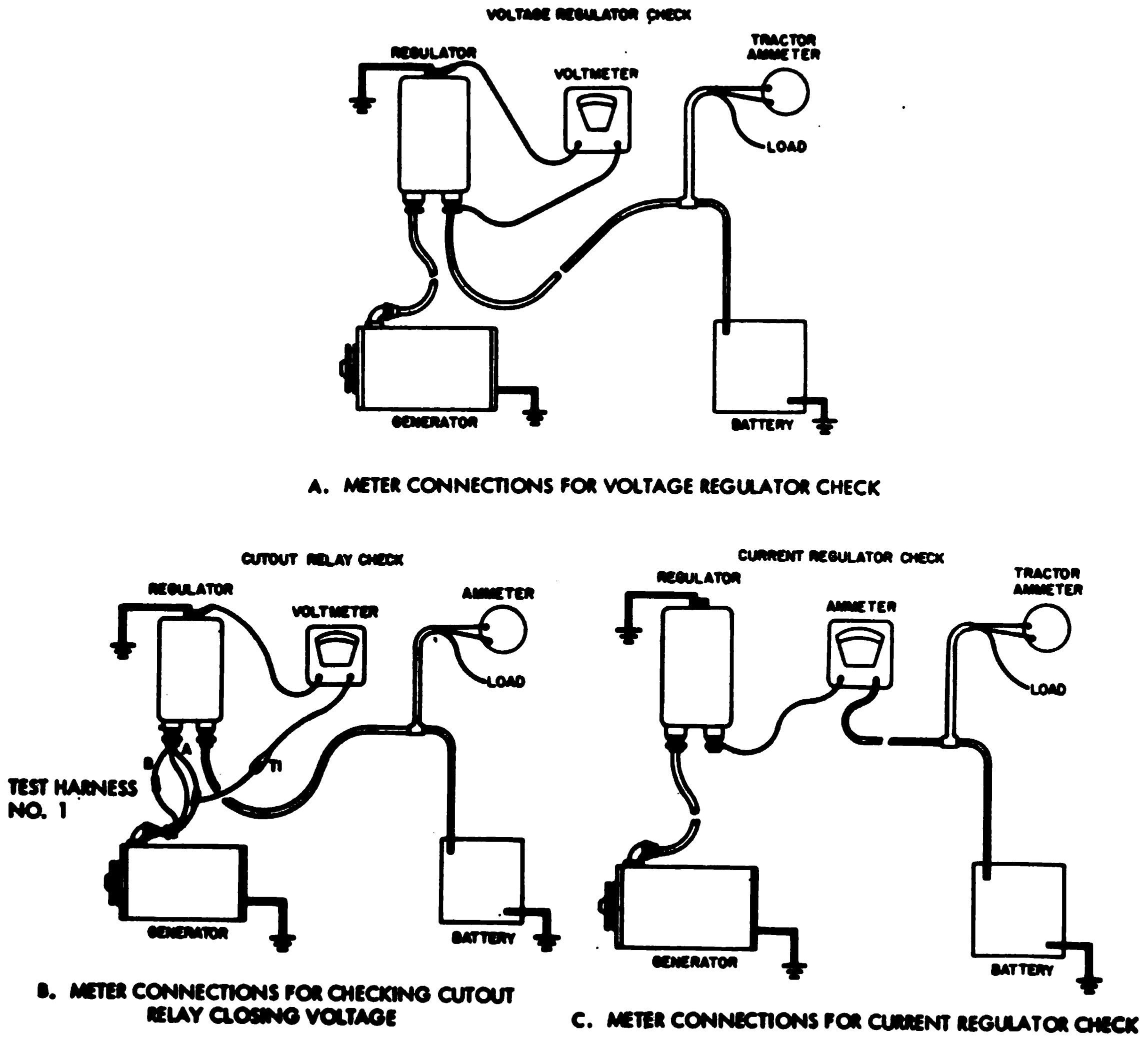
3. Jumper lead method. If the regulator cover is removed and a jumper lead placed across the voltage regulator contact points, the voltage regulator cannot operate. Consequently, the generator output will increase to its maximum as determined by the current regulator setting. Lights and accessories should be turned on during the test to prevent excessive voltage. To adjust the current regulator setting, turn the adjusting screw at the base of the unit, thereby changing the spiral spring tension. Increasing the tension will increase the current setting. After each change of adjustment, reduce generator speed until cutout relay opens, then return to speed and read current. (Higher residual magnetism resulting from uncontrolled voltage during this test will cause the voltage to regulate at an abnormally low voltage after the jumper is removed. To restore proper operation, the generator must be cycled, that is, stopped and restarted. Do not attempt to check voltage regulator after using jumper lead method until this condition has been corrected). Current should be 38- to 42- amperes. Adjust to 40 amperes.

4. Refer to figure 5-35.1 (1) for proper test instrument connections.



ME 2410-233-34 5-35.1 (1) C1

Figure 5-35.1. Generator regulator (sheet 1 of 2).
(ME 2410-233-34/5-35.1(1))



ME 2410-233-34/5-35.1 (2) C1

Figure 5-35.1. Generator regulator (sheet 2 of 2).
(ME 2410-233-34/5-35.1(2))

(c) Adjustment for high temperature.

1. When high battery temperatures are obtained, battery overcharge may be experienced even though the voltage regulator setting is within specifications and correct for all normal operating conditions. This overcharging condition may be relieved by reducing the voltage setting slightly. However, the voltage regulator setting must not be reduced unless it is actually necessary. The cutout relay likewise must be reduced so the voltage regulato setting is still safely above the setting of the cutou relay.

2. If such voltage reductions are made during hot weather, the voltage settings should be returned to normal for low temperature.

(d) Replacement. If voltage regulator cannot be adjusted, it must be replaced.

Paragraph 5-20.2 is added as follows:

5-20.2. Alternator

a. General. The alternator is a 24 volt, belt driven, 3 phase self-rectifying, brushless unit with a built in microminiature voltage regulator. The only movable part in the assembly is the rotor, mounted on a ball bearing at the drive end and a roller bearing at the rectifier end.

b. Removal. Refer to TM 5-2410-233-20 for the removal of the alternator.

c. Disassembly.

(1) Remove the cover plate.

(2) Remove cover and gasket.

(3) Remove the drive end frame from the rectifier end frame.

d. Cleaning. Clean the armature and field coils of any dirt or magnetized particles. To remove any grease and oil apply a light coat of cleaning solvent (Fed Spec P-D-680) with a brush. Wipe clean and then use compressed air to remove any remaining dirt film.

e. Inspection and Repair.

(1) *Diode Check.* Check each of the six diodes by removing each diode lead from the stud and connecting an ohmmeter, using the lowest range scale, to the diode lead and the case. Then reverse the ohmmeter lead connections to the diode case. If both readings are the same, replace the diode. A good diode will give one high and one low reading. See figure 5-35.2.

CAUTION

Do not use high voltage such as 110 volt test lamps, to check diodes.

Before replacing a diode in the rectifier end frame, the end frame must be separated from the drive end frame. Also before replacing a diode in the heat sink or end frame, it is necessary to remove the heat sink from the end frame by detaching the regulator from the heat sink, the heat sink mounting screws, and the generator output terminal. Note the round insulators under the heat sink mounting screws and the flat insulator located behind the heat sink. The silicone grease on both sides of the flat insulator provides the necessary heat transfer between heat sink and end frame.

Reapply silicone grease during assembly, tighten the heat sink mounting screws loosely, securely tighten the output terminal, then securely tighten the heat sink screws.

To replace a diode in the heat sink, support the heat sink and use an arbor press or vise to push the diode out. When installing a diode, use a suitable tool which will fit over the outer diode edge to push the diode in. Support the heat sink on end frame with a suitable tool.

CAUTION

Do not strike the diodes, as shock may damage it and the other diodes. Use only those diodes listed in the parts list for these units. Never use substitutes.

(2) *Stator check.* Use a 110-volt test lamp or an ohmmeter. If the lamp lights or if the meter reading is low when connected from any stator lead to the ground, the windings are grounded. See figure 5-35.2. If the lamp fails to light or if the meter reading is high when successively connected between each pair of stator leads, the windings are open.

A short circuit in the stator windings is difficult to locate without laboratory test equipment due to the low resistance of the windings. If all other electrical checks are normal and the generator fails to supply rated output, shorted stator windings are indicated. To replace the stator, separate drive end frame from rectifier end frame and pull leads and grommet through hole. Place grease on grommet and pull into hole during assembly.

(3) *Regulator replacement or repair (fig. 5-35.2).*

NOTE

Some 24- and 32- volt regulator models have a permanently connected separate transistor mounted onto the rectifier end frame. The installation of the regulator is the reverse of removal.

Disconnect the three identically colored regulator leads. Then regulator may be replaced by removing the attaching screws and disconnecting the regulator lead from the heat sink. (See fig. 5-35.3A).

NOTE

Some 24- and 32- volt regulator models have a permanently separated transistor mounted onto the rectifier end frame. Regulators may differ in appearance, but the various types are completely interchangeable.

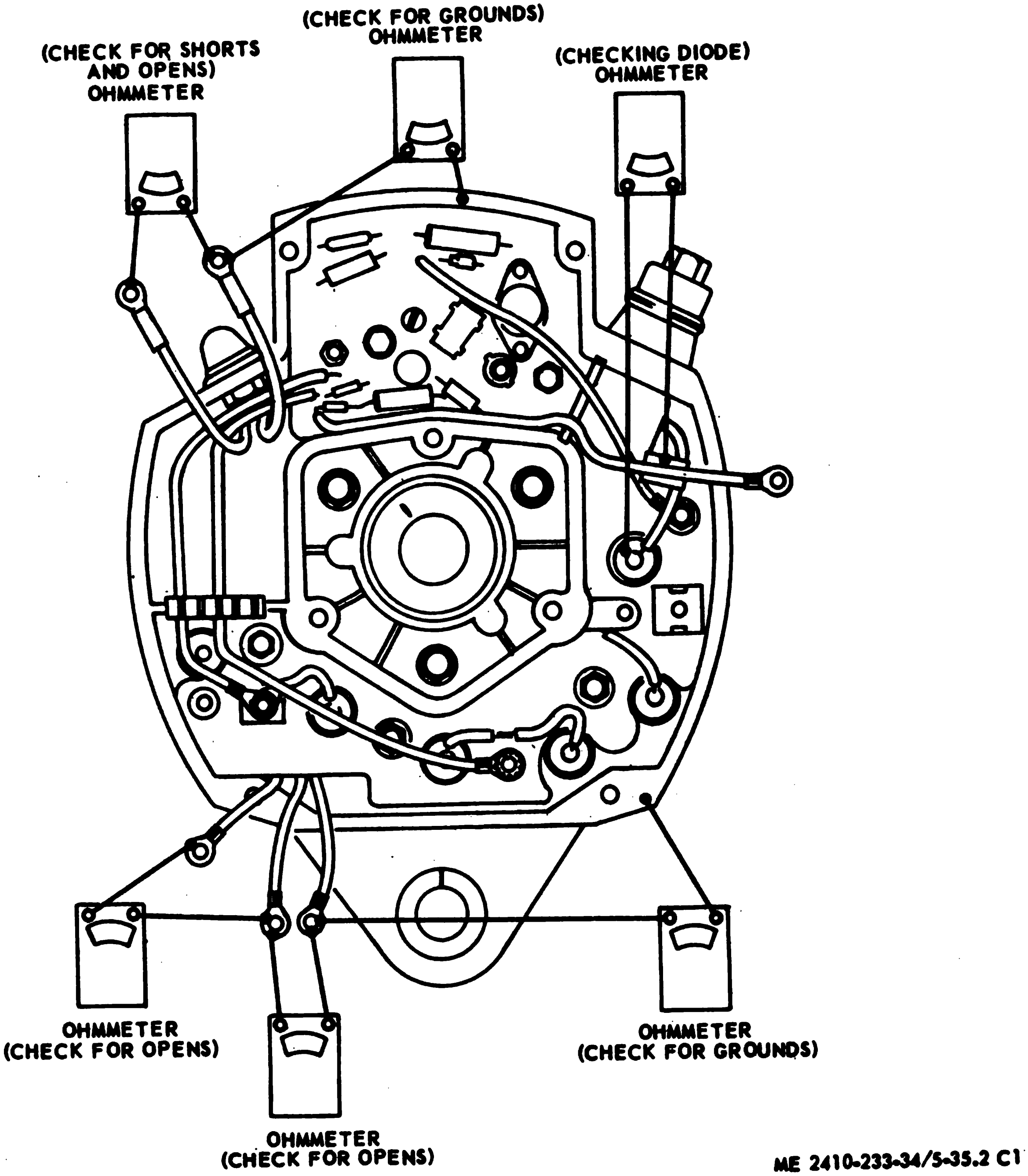
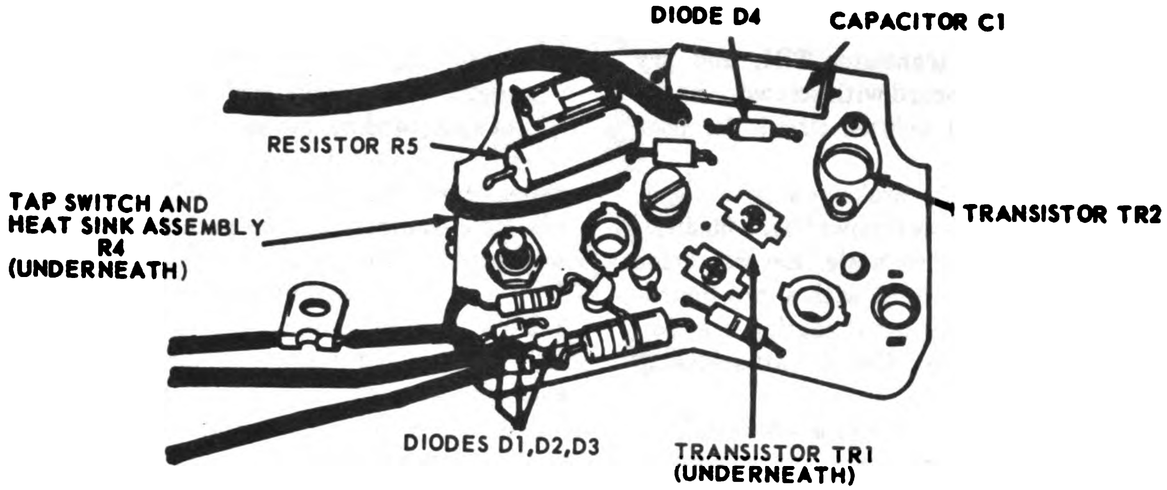
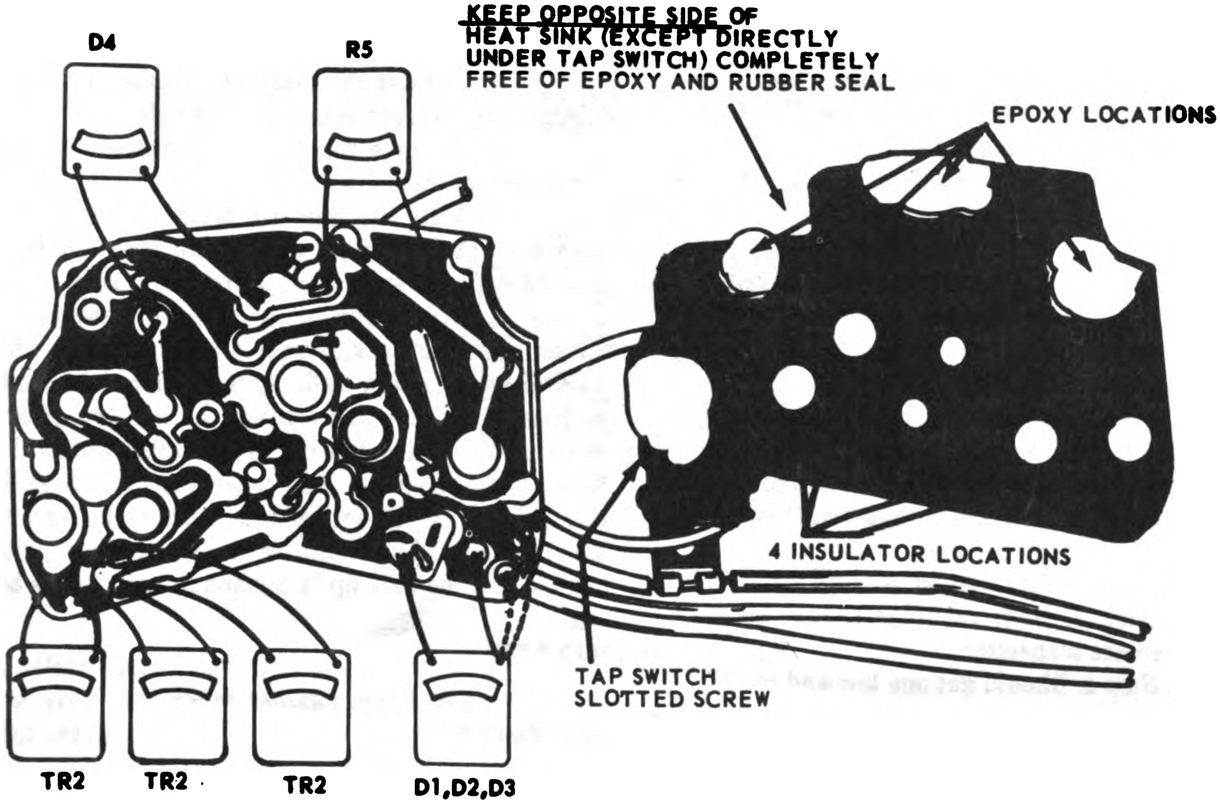


Figure 5-35.2. Electrical checks of alternator.



A. PANEL BOARD ASSEMBLY



B. CHECKING COMPONENTS

ME 2410-233-34/5-35.3 C1

Figure 5-35.3 Checking components and transistors
(ME 2410-233-34/5-35.3, C1)

If previous checks indicate the regulator should be repaired, proceed as follows:

(a) The panel is shown without the sealing compound so the seven serviceable parts can be easily identified (fig. 5-35.3A).

(b) Remove screw, transistor TR1, and pry apart heat sinks and panel board with screwdriver.

(c) Carefully inspect printed circuit for poor solder joints.

(d) Carefully inspect for broken parts.

(e) Check components as follows (fig. 5-35.3B). Use 1½-volt ohmmeter on low scale. Reverse leads to get (2) readings. Scratch hard with sharp instrument to break through transparent coating over solder to make ohmmeter contact. Use 50 watt soldering gun.

1. Tap switch and heat sink assembly. Turn slotted screw with screwdriver to 5 positions. If screw is loose, replace assembly. Also replace old type assemblies having brass slotted screw and attaching nut even if screw is not loose. New assemblies have aluminum slotted screw and no attaching nut. Make sure switch is expoxied to heat sink.

2. Resistor R5. If any reading is over 1 ohm, replace resistor. Cut away sealing compound with sharp blade.

3. Transistor TR2.

(a) *Step 1.* Should get one low reading and one high reading. If not, replace transistor.

(b) *Step 2.* Same as step 1.

(c) *Step 3.* Both readings should be very high. If not, replace transistor.

NOTE

The replacement transistor may be a red dot and a flat side. When assembled, the flat side should face towards diodes D1, D2, and D3. (See fig. 5-35.3A).

4. Diode D4. Should get one low and one high reading. If not, replace diode.

5. Diode D1, D2 and D3. Check each diode separately. Should get one low and one high reading. If not replace diode being checked.

6. Transistor TR1 (see fig. 5-35.4A).

a. Step 1. Both readings should be very high. If not, replace transistor.

b. Step 2. Should get one low and one high reading.

c. Step 3. Same as step 2.

7. Capacitor C1. Visually inspect for broken leads.

(f) If no defects have been found, replace complete regulator assembly.

(g) If regulator was repaired, reassemble as follows:

1. If heat sink is reused, burn away with soldering iron old epoxy separating heat sink from panel board. Apply new epoxy at all four (4) locations on old or new heat sink. (fig. 5-35.3B).

NOTE

Keep opposite side of heat sink (except under tap switch) perfectly clear and free of epoxy and rubber seal. (fig. 5-35.3B).

2. Using 4 insulators, assemble heat sink, panel board and transistor TR1. Use silicone grease available commercially on both sides of mica insulator located between transistor and heat sink.

3. Apply sealing compound as shown in figure 5-35.4B around components using Dow Chemical RTV Silastic 732 silicone rubber seal or equivalent, available at hardware, drug and paint stores. Keep metal clips perfectly clean and free of rubber seal.

(h) Test regulator to see if it works. If okay, return to service. If defective replace complete regulator assembly.

(4) Bearing replacement and lubrication. Bearings normally will operate between engine overhaul periods without attention. At time of engine overhaul, the bearings and seals should be replaced, and a fresh supply of lubricant added to the reservoirs.

(a) Drive end bearing replacement.

1. Remove the shaft nut, washer, pulley, fan, slinger, and the four retainer plate bolts.

2. Remove the rotor and bearing assembly from the end frame.

3. Pull the bearing from the rotor shaft, separate retainer plate and collar from shaft, and discard seals in retainer plate and end frame.

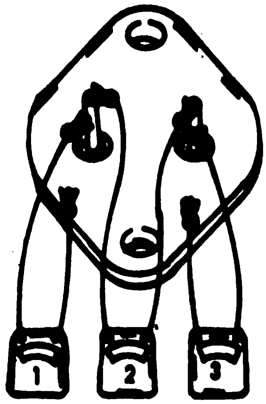
4. Add lubricants so each reservoir between the bearing and seal after assembly will be only three-quarters full. Arrange the lubricant so at least a portion will contact the bearing after assembly, otherwize the oil in the lubricant will not bleed to the bearing. Add lubricant to each seal lip and fill the cavity between the rubber lip and steel case of each seal with lubricant. The seals must be assembled so the seal lip is toward or next to the bearing.

5. Lubricate collar, then install collar and retainer plate. Press against inner race only to install the new bearing onto the shaft against the collar.

6. The remaining assembly procedure is the reverse of disassembly.

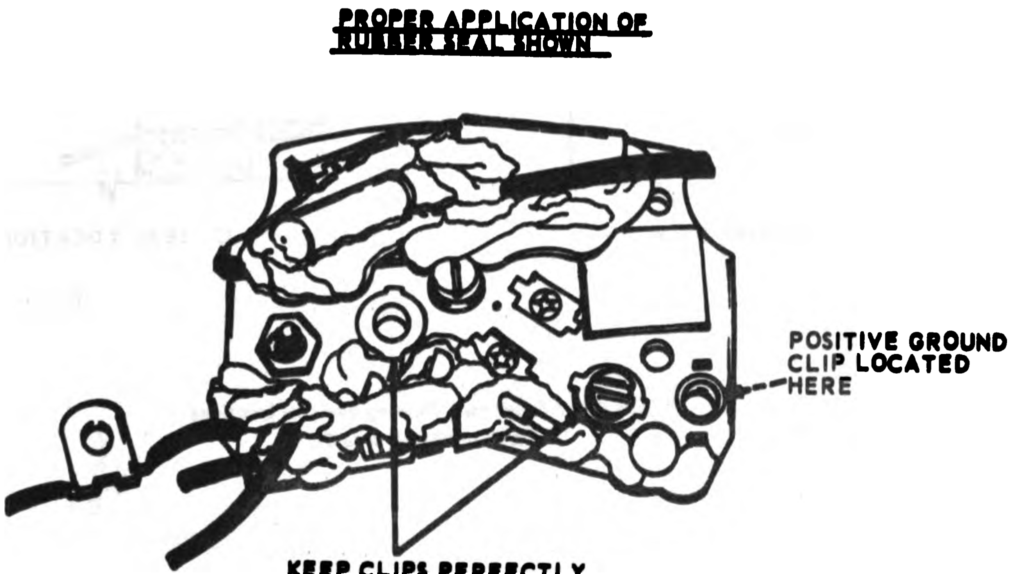
(b) Rectifier end bearing replacement.

1. Pull the old inner race from the shaft, and press the new inner race onto the dimension shown in figure 5-35.5.



A. CHECKING TRANSISTOR
FOR SHORTS

A. CHECKING TRANSISTOR TR1



B. RUBBER SEAL APPLIED

ME 2410-233-34/5-35.4 C1

Figure 5-35.4 Transistor checking
(ME 2410-233-34/5-35.4, C1)

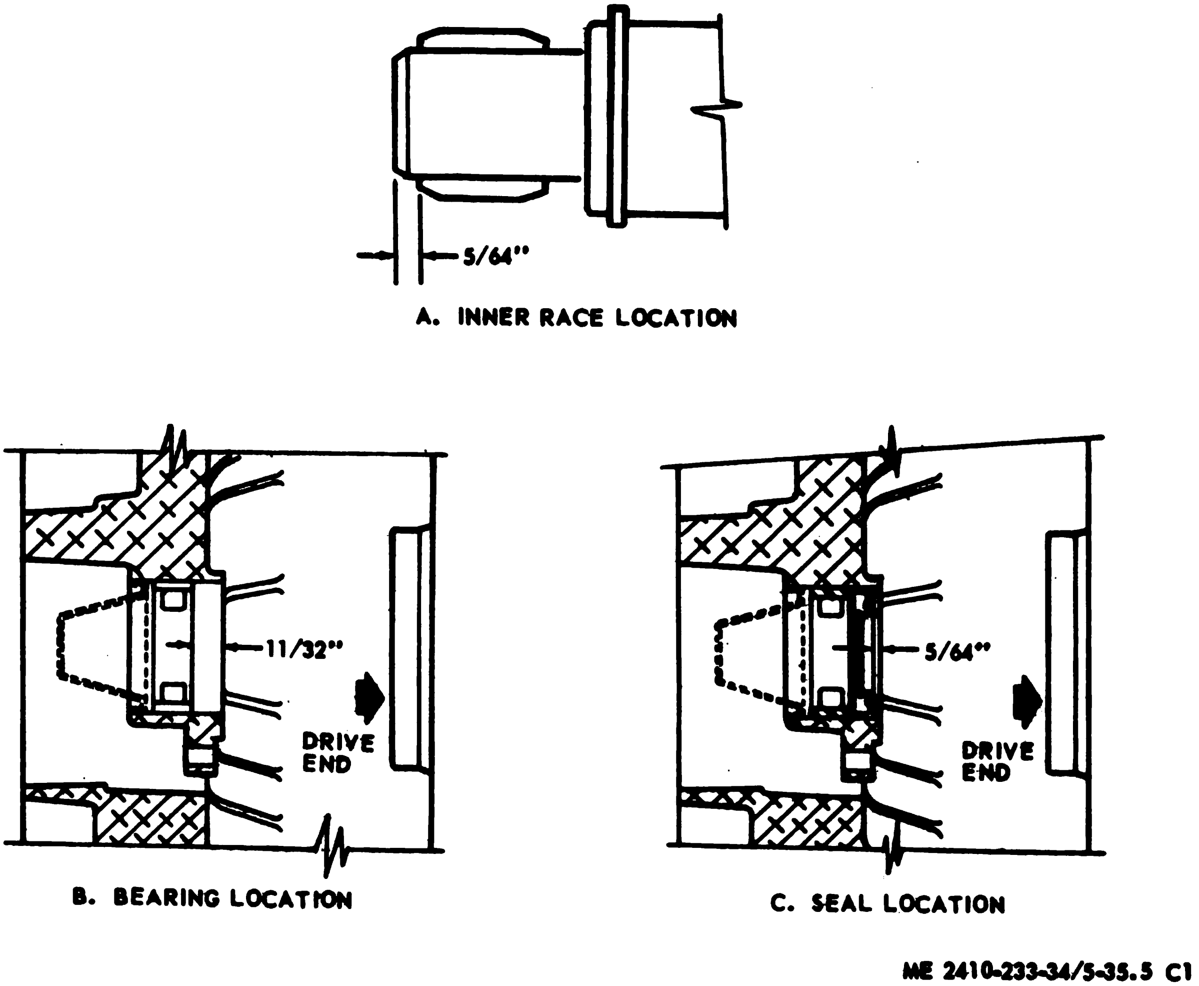


Figure 5-35.5 Inner race, bearing and seal locations (ME 2410-233-34/5-35.5)

2. Discard the old seal, and push the old bearing out of the housing from inside toward the outside.

3. Push against the race only to install the new bearing to the dimension shown in figure 5-35.5. To facilitate the installation heat the end frame in an oven to 200° to 300° F. This will not damage the regulator.

4. Add lubricant to the bearing well cover so it is only three-quarters full. Arrange the lubricant so at least a portion will contact the bearing after assembly, otherwise the oil in the lubricant will not bleed to the bearing. Press the cover into the housing.

5. Add lubricant to seal lip and fill the cavity with lubricant between the rubber lip and steel case of the seal. Install the seal with the lip toward the bearing. See figure 5-35.5.

6. Reassembly procedures are the reverse of disassembly. Torque the shaft nut to 70-80 ft.lb. Torque the output terminal bolt to 100-110 inch-pounds when attaching cable.

f. Reassembly. Reassembly of the alternator is reverse of disassembly.

By Order of the Secretary of the Army:

CREIGHTON W. ABRAMS
General, United States Army
Chief of Staff

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

Distribution:
To be distributed in accordance with DA Form 12-25B (qty rqr block No. 479) direct and general support maintenance requirements for Tractor, Tracked, Medium.

CHANGE No. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON DC, *29 October 1981*

Direct Support and General Support Maintenance Manual
TRACTOR, FULL TRACKED, LOW SPEED, DED; MEDIUM DRAWBAR PULL; OSCILLATING TRACK, 78-IN. GAGE (CATERPILLAR MODEL D7F)
WITH RIPPER: NSN 2410-00-177-7283
WITH RIPPER AND ROPS; NSN 2410-00-185-9794
WITH RIPPER, ROPS (CAB) WINTERIZED; NSN 2410-00-300-6665
WITH WINCH; NSN 2410-00-177-7284
WITH WINCH AND ROPS; NSN 2410-00-185-9792
WITH WINCH, ROPS (CAB) WINTERIZED; NSN 2410-00-300-6664

TM 5-2410-233-34, 12 October 1971, is changed as follows:

The title is change to read as shown above.
Page iii, list of illustrations.
Following 2-31, "Pareparing to remove engine (sheet 2 of 6)", add "2-31.1 Preparing to remove engine (w/ROPS) (sheet 2 of 6).
Following 4-1, "Hydraulic tank removal", add "4-1.1 Hydraulic tank removal (w/ROPS).
Page iv, following 5-23, "Fuel tank, removal and installation", add "5-23.1 Fuel tank, removal and installation (w/ROPS)
Page 1-1. Paragraph 1-3 is superseded as follows:

1-3. 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 Form 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 1-4, table 1-2. Add the following nut and bolt torque data between Ripper and Steering Clutch:

Roll-over Protective Structure:

Heavy duty fender support bolts	900 ± 100
Tractor frame support bolts	350 ± 50
Plate-side mounting bolts	210 ± 30

Page 2-13, paragraph 2-8a. Sub-subparagraph (1.1) is added as follows:
(1.1) Remove roll-over protective structure (TM 5-2410-233-20).

Page 2-15. Figure 2-31.1 (sheet 2 of 6) is added as follows:

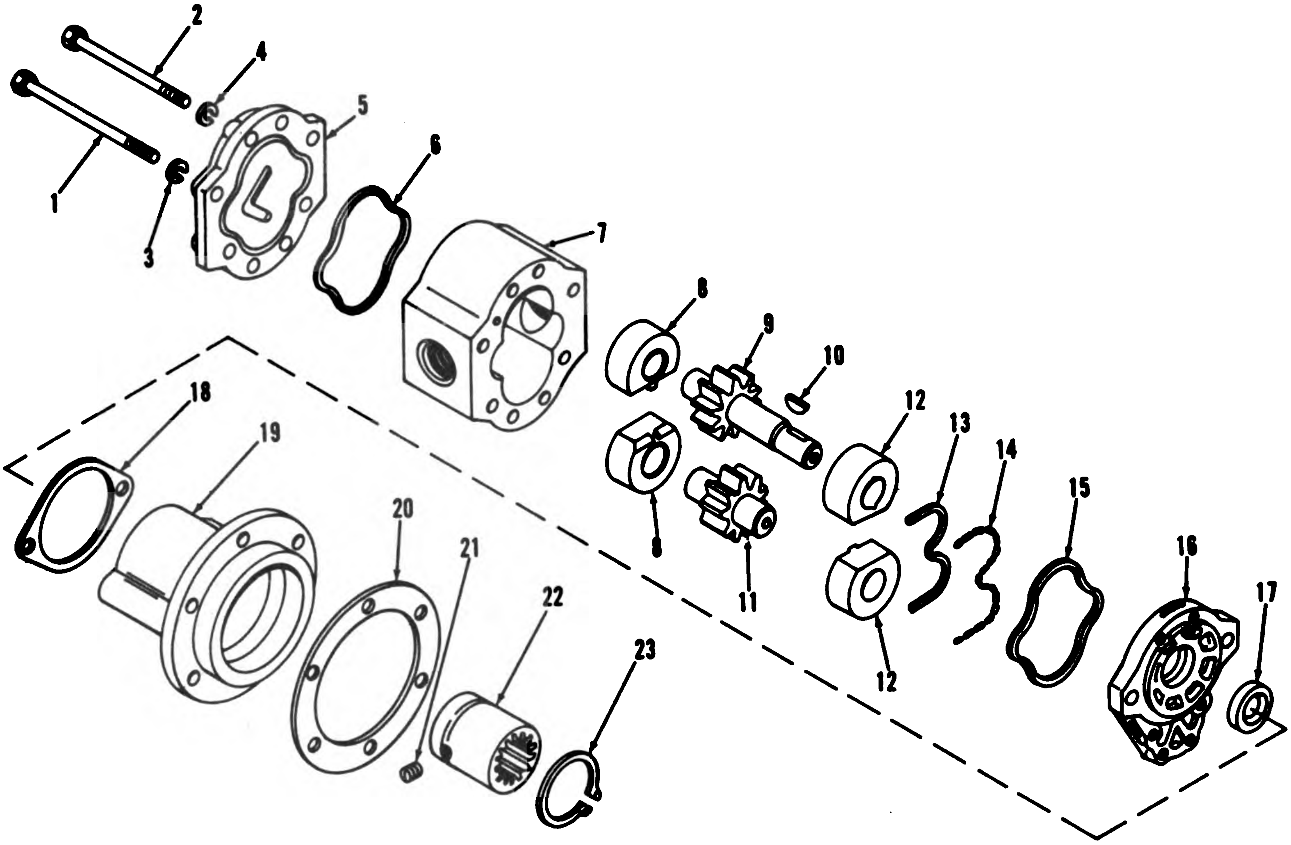
Figure 2-31.1. Preparing to remove engine (w/ROPS) (sheet 2 of 6).

Page 2-20, paragraph 2-9*a*. Sub-subparagraph (1.1) is added as follows:

(1.1) Remove roll-over protective structure (TM 5-2410-233-20).

Page 3-4, paragraph 3-12*b*. Delete subparagraph (3)

***Page* 3-5. Figure 3-4 is superseded as follows:**



1. BOLT	13. GASKET
2. CAPSCREW	14. SPACER
3. LOCKWASHER	15. SEAL
4. WASHER	16. COVER
5. COVER	17. SEAL
6. SEAL	18. GASKET
7. BODY	19. BRACKET
8. BEARING	20. GASKET
9. GEAR	21. SETSCREW
10. KEY	22. COUPLING
11. GEAR	23. RING
12. BEARING	

TA 170657

Figure 3-4. Winch hydraulic pump, exploded view.

Page 3-8. **Figure 3-7. is superseded as follows:**

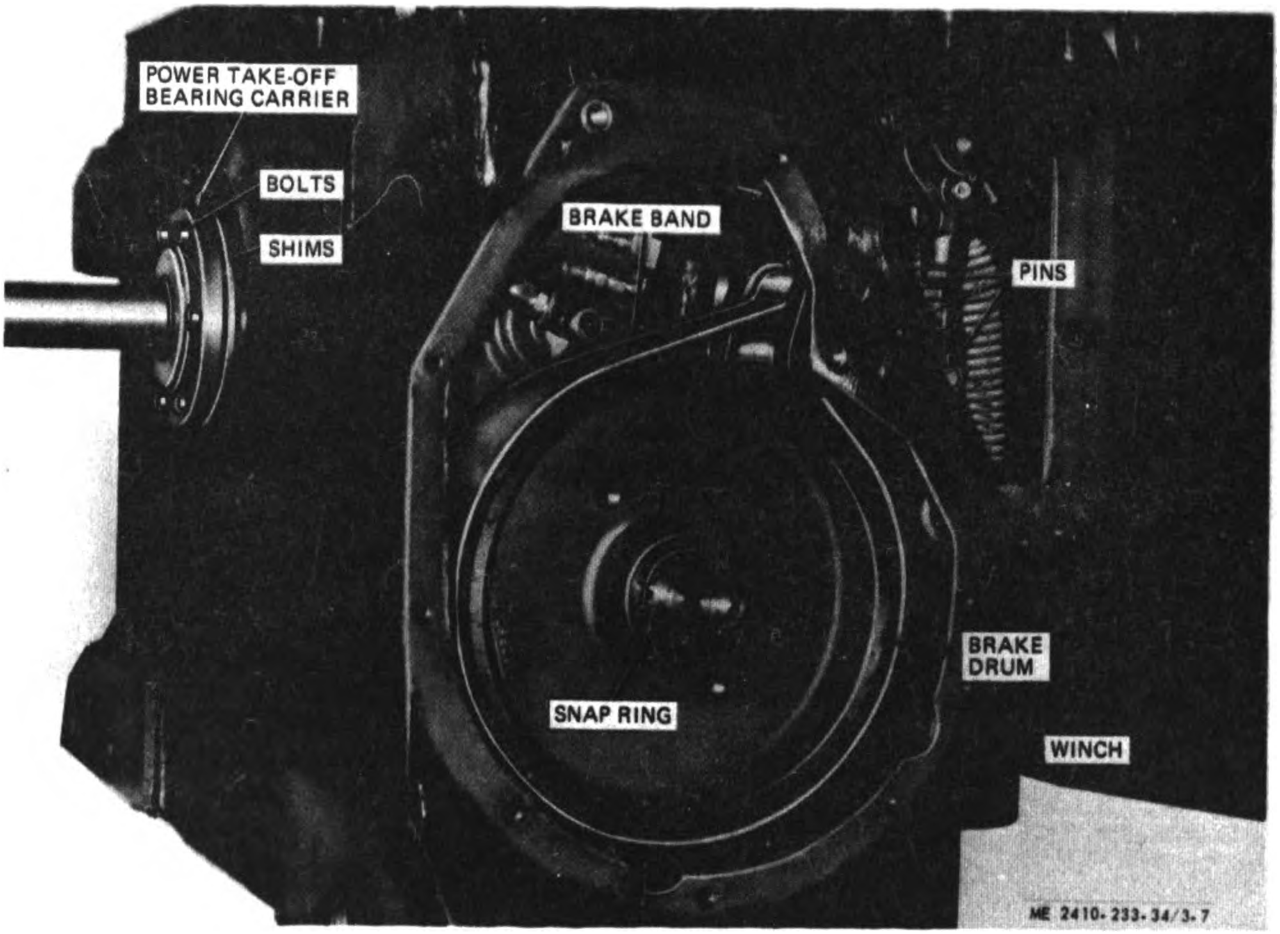


Figure 3-7. Power take off bearing and brake drum, removal and installation.

Page 4-3. Figure 4-1.1 is added as follows:

Figure 4-1.1. Hydraulic tank removeal (w/ROPS).

Change title of key from "Key to figure 4-1" to "Key to figure 4-1 and figure 4-1.1".

Page 5-30. Figure 5-23.1 is added as follows:

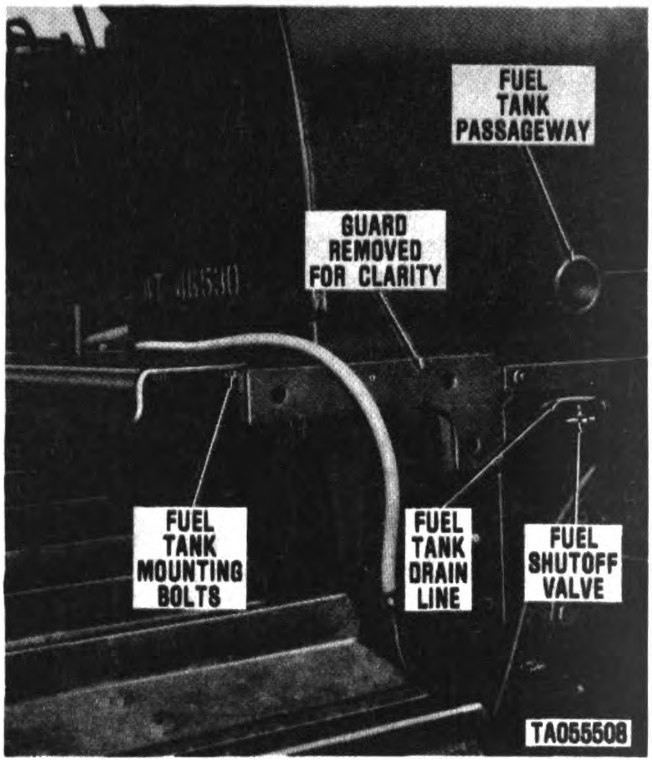


Figure 5-23.1. Fuel tank, removal and installation (w/ROPS).

Page 5-54, paragraph 5-27*d* (10).

(*b*) is changed from "170-180 foot-pounds" to "173-197 foot-pounds".

(*c*) is changed from "170-180 foot-pounds" to "173-197 foot-pounds".

Page 6-75, Paragraph 6-15*c*(3) is superseded as follows:

(3) Place the plate on the bolt, NSN 5306-00-426-4617. Insert the bolt thru the center of the steering clutch assembly and place the plate (2, fig. 6-86) over the bolt.

Page FO-1 (fold-out), figure FO-1, Chart A. Delete no. 3, "Quick Drop Valve".

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 12-25B Direct and General Support Maintenance requirements for Tractor, Tracked: Medium.

TECHNICAL MANUAL
NO. 5-2410-233-34

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *12 October 1971*

DIRECT AND GENERAL SUPPORT MAINTENANCE MANUAL

TRACTOR, FULL TRACKED, LOW SPEED, DED MEDIUM DRAWBAR PULL: OSCILLATING TRACK, 78-IN. GAGE (CATERPILLAR MODEL D7F) FSN 2410-177-7283 W/ RIPPER FSN 2410-177-7284 W/ WINCH

			Paragraph	Page
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	II.	Track assembly	7-1	7-2
	III.	Equalizer bar and track roller frame	7-9	7-9
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6-38	Clutch operation	6-39
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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

This manual contains instructions for the use of direct and general support maintenance personnel maintaining the Caterpillar Model D-7F Tractor as allocated by the Maintenance Allocation Chart. It provides information on the maintenance of the equipment which is beyond the scope of tools, equipment, personnel, or supplies normally available to organizational level maintenance personnel.

1-2. Maintenance Forms and Records

Maintenance forms, records and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

1-3. Reporting of Errors

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

Section II. DESCRIPTION AND DATA

1-4. Description

A general description of the Model D-7F tractor and plates is contained in TM 5-2410-233-10. A more detailed description of specific components and assemblies is contained in the applicable sections of this manual. Detailed descriptions of the components of the Model D-7F tractor are provided in the applicable maintenance paragraphs of this manual.

1-5. Differences Between Models

This manual covers only the Caterpillar Model D7F Tractor. No known differences exist for the Model covered by this manual.

1-6. Tabulated Data

a. Identification. The major identification plates of the tractor are described in TM 5-2410-233-20.

b. Nut and Bolt Torque Data. Tables 1-1 and 1-2 list the standard and specific nut and bolt torque data for the D7-F tractor.

c. Repair and Replacement Standards. Tables 1-3, 1-4, and 1-5 list manufacturer's dimensions, tolerances, clearances, and the maximum allowable wear clearance.

d. Electrical System Schematic Diagram. Figure 1-1 shows the schematic wiring diagram for this tractor.

e. Hydraulic System Circuit Diagram. FO-1 (Located in back of manual) shows the hydraulic flow schematic dlagram for this tractor.

LEGEND:	NOMENCLATURE	LEGEND	NOMENCLATURE	LEGEND	NOMENCLATURE
FL-F	FLOOD LIGHT-FRONT	CB2	CIPCUIT BREAKER	SW	SWITCH
FL-R	FLOOD LIGHT-REAR	ST	STARTER	PL	PANEL LIGHTS (INSTRUMENT)
PS	PRESSURE SWITCH	LS	LIGHT SWITCH	BI	AMMETER
GL	GLOW PLUG	CB	CIRCUIT BREAKER	TI	TEMPERATURE LIGHT INDICATOR
SO	SOLENOID	GE	GENERATOR	TT	TEMPERATURE SENDING UNIT
CB1	CIRCUIT BREAKER	RE	PEGULATOR	MS	MAGNETIC SWITCH

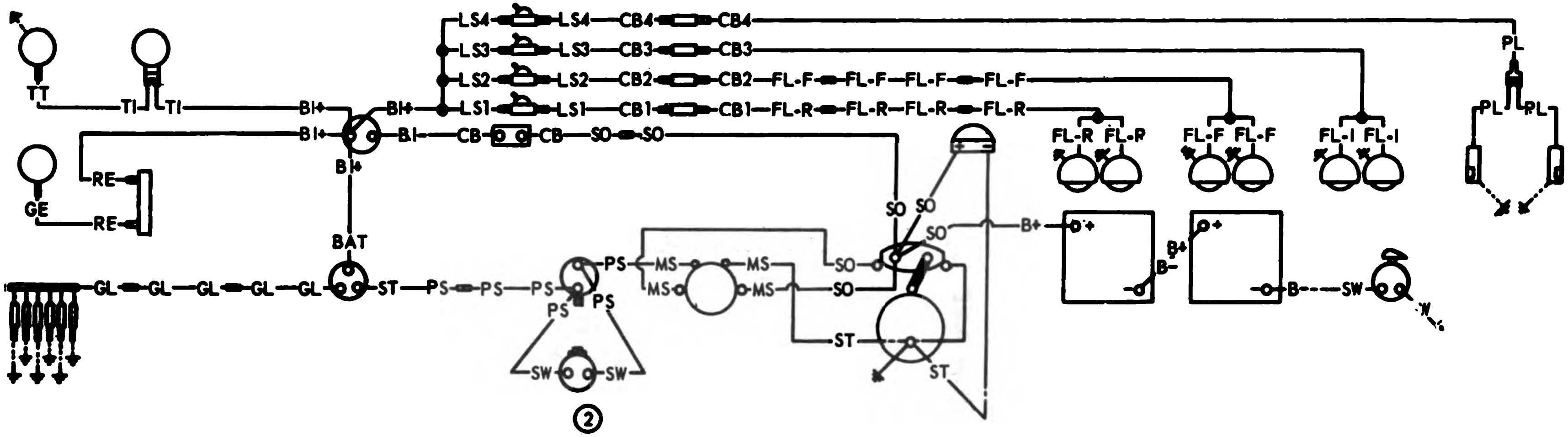

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Figure 1-1. Electrical system schematic diagram.

Table 1-1. Standard Torques

Size (inches)	Torque (ft-lbs)	Size (inches)	Torque (ft-lbs)
Bolts and Nuts			
1/4	9 ± 3	3/4	265 ± 35
5/16	18 ± 5	7/8	420 ± 60
3/8	32 ± 5	1	640 ± 80
7/16	50 ± 10	1 1/8	800 ± 100
1/2	75 ± 10	1 1/4	1000 ± 120
9/16	110 ± 15	1 3/8	1200 ± 150
5/8	150 ± 20	1 1/2	1500 ± 200
Taper lock Studs			
1/4	5 ± 2	3/4	110 ± 15
5/16	10 ± 3	7/8	170 ± 20
3/8	20 ± 3	1	260 ± 30
7/16	30 ± 5	1 1/8	320 ± 30
1/2	40 ± 5	1 1/4	400 ± 40
9/16	60 ± 10	1 3/8	480 ± 40
5/8	75 ± 10	1 1/2	550 ± 50
Hydraulic Valve Bolts and Nuts			
5/16	13 ± 2	1/2	60 ± 3
3/8	24 ± 2	5/8	118 ± 4
7/16	39 ± 2		

Table 1-2. Specific Nut and Bolt Torque Data

Item	*Lb-Ft*
Cylinder head:	
(first time)	115
(second time)	175 ± 5
(third time)	175 ± 5
Accessory drive retainer nut torque	90—110
Camshaft gear retainer bolt torque	14—20
Connecting rod bolt nuts torque	30 ± 3 (plus additional turn of 90°)
Main bearing bolt torque	30 ± 3 (plus additional turn of 90°)
Crankshaft pulley retaining screw torque	210—250
Flywheel retaining bolt torque	130—170
Flywheel housing bolt and nut torque	65—85
Fuel injection line nut torque	25—35
Fuel injection nozzle retaining nut torque	105 ± 5
Fuel injection precombustion chamber torque	140—160
Fuel transfer pump shaft retaining nut torque	17—27
Fuel injection pump retaining bushing	150 ± 10
Timing gear housing bolt torque	27—37
Turbocharger:	
Torque on housing band clamp	120 lb-in
Torque on impeller nut	15 ± 1
Turbocharger to manifold bolt	36—44
Water pump impeller retaining bolt torque	27—29
Torque divider:	
Scavenge pump:	
Drive gear-to-shaft retaining nut torque	36—44
Transmission hydraulic controls:	
Control valve-to-transmission retaining bolt, torque	32—38
Safety valve-to-directional valve, torque (installed using liquid lock)	35—45
Pressure control valve cover-to-body retaining bolts, torque	32—38
Transmission:	
Clutch housing retaining bolts	80—90
Transmission case to transfer gear case retaining nut	70—80
Bearing cage to No. 1 carrier retaining bolt	37—43
Bearing cage to No. 2 carrier retaining bolts	37—43

Table 1-2. Specific Nut and Bolt Torque Data—Continued

Item	*Lb-Ft*
Bevel gear:	
Hub to drum bolts	200 ± 20
Hub to bevel gearshaft retaining nut	700 ± 100
Ripper:	
Mounting bracket stud nut	1500
Hydraulic cylinder piston rod nut	1600 ± 120
Steering clutch:	
Steering clutch hub-to-steering clutch inner drum bolt, torque	180—220
Glow plug	120 ± 24 lb-in.
Steering clutch outer drum-to-pinion flange bolt torque	180—220
Final drive:	
Track roller frame outer bearing retaining nut torque	500—600
Final drive case-to-steering clutch and bevel gear case bolt, torque	200—220
Final drive flange-drum screw	180—220
Track rollers mounting bolt	550 ± 50
Lubrication plug, torque	110—140
Front idlers and recoil springs:	
Taper lockpins bolt torque:	
Initial to seat parts	65
Hammer lock pins into place, then tighten to torque value of	50 ± 10
Lubrication plug torque	110—140
Fill valve torque	20—30
Ball check valve torque	20—30
Relief valve torque	20—30
Track:	
Track shoe bolt torque	180—260 (plus additional 120°)
Minimum torque after 120° turn	420

Table 1-3. Engine Repair and Replacement Standards

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
ACCESSORY DRIVE SHAFT:					
Backlash between accessory drive and accessory drive idler gear	0.002	0.014			
Backlash between accessory drive and idler gear and camshaft gear	0.002	0.014			
CAMSHAFT:					
Bearing journal diameter	2.3105	2.3115			
Bearing clearance			0.002	0.006	0.008
End clearance			0.004	0.010	0.025
CONNECTING ROD:					
Connecting rod bearing clearance (measured vertically)			0.0042	0.0071	0.010
Center to center distance	9.594	9.596			
Piston pin bearing should be machined to ID of	1.7009	1.7015			
CRANKSHAFT:					
Main journal diameter	3.499	3.500			0.0008
Main bearing clearance			0.0030	0.0059	0.010
End clearance			0.0025	0.0145	0.005
Connecting rod journal diameter	2.999	3.000			0.008
Permissible journal wear					0.008
Permissible out-of-roundness (journal)					0.004
CYLINDER BLOCK:					
Main bearing original bore dimension	3.8155	3.8165			
Camshaft bearing bore	2.5625	2.5635			

Table 1-3. Engine Repair and Replacement Standards—Continued

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
CYLINDER LINER:					
Inside diameter	4.750	4.752			
Permissible liner wear (increase in diameter at top of ring travel)					0.008
Liner flange thickness	0.4040	0.4056			
Counterbore dimension in block	0.400	0.402			
FUEL INJECTION EQUIPMENT:					
Fuel injection pump timing (before top center) 13° 30'					
Fuel injection pump lifter setting (on engine with 8S7167 Gauge) 4.2179 ± .0020					
Fuel injection pump lifter setting (off engine) 4.2675 ± .0005					
Fuel pump plunger length	2.5931	2.5937			
Permissible wear (decrease in length of plunger)					0.005
Fuel injection camshaft bearing bore	1.875	1.876			
Camshaft bearing clearance					0.010
FUEL TRANSFER PUMP:					
Clearance between gears and covers, total			0.001	0.003	
Bearing bore	0.4950	0.4956			
Bearing clearance			0.001	0.002	0.005
GOVERNOR:					
Backlash between bevel drive and driven gears			0.002	0.006	
Clearance between top cover bearing and shaft			0.001	0.003	0.005
Dimension (X)—see test 2.125—2.145					
Decelerator low idle speed adjustment 600—700 rpm					
OIL PUMP:					
Clearance between gears and end covers			0.002	0.004	
Drive gear shaft diameter	0.8745	0.8749			
Bearing bore	0.743	0.744	0.0020	0.0035	0.006
PISTON PINS:					
Pin bore			1.6999	1.7003	0.0025
PISTON RINGS:					
Piston ring side clearance:					
Top ring			0.0028	0.0046	0.007
2d ring			0.023	0.0041	
Oil ring			0.0015	0.0033	
Ring gap, top			0.017	0.023	
Ring gap, 2d			0.017	0.023	
Ring gap, oil			0.013	0.023	
REAR POWER TAKEOFF AND PUMP DRIVE:					
Backlash					
Oil pump drive gear to oil pump driven gear			0.002	0.016	
Power takeoff shaft drive gear to camshaft gear			0.003	0.016	
Bearing clearance			0.003	0.006	0.010
End clearance			0.010	0.020	0.035
ROCKER ARMS:					
Bore bearing	0.7260	0.7266			
Shaft diameter	0.7240	0.7250			
Maximum permissible clearance (bearing-shaft)					0.008
SERVICE METER:					
Permissible bearing clearance					0.012
TURBOCHARGER:					
Clearance between impeller and bearing housing (shaft pushed toward impeller end)	0.020	0.022			
End clearance	0.0045	0.0015			0.008
Bearing diameter (ID)	0.6880	0.6883			
Bearing diameter (OD)	0.8718	0.8722			0.006

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
TURBOCHARGER—Continued					
Note. Bearing clearance is satisfactory if compressor wheel and / or turbine wheel have not rubbed governor housing					
Journal diameter	0.5612	0.5615			
Housing bore diameter	0.8762	0.8767			
Thickness of thrust bearing	0.210	0.212			
VALVE AND VALVE SEAT SPECIFICATIONS:					
Valve seat angle [2]	30°	30°			
Inlet valve seat insert diameter	2.1280	2.1290			
Bore for inlet valve seat insert	2.1250	2.1260			
Exhaust valve seat insert diameter	2.0030	2.0040			
Bore for exhaust valve seat insert	2.0000	2.0010			
Valve head diameter—					
Inlet	2.015	2.025			
Exhaust	1.891	1.901			
Outside diameter of valve seat face (new)—inlet	1.934	1.984			
Exhaust	1.810	1.860			
Outside diameter of valve seat face (after reconditioning)					
Inlet		1.984			
Exhaust		1.860			
Stem diameter	0.3712	0.3722			
Valve guide bore—inlet [1]	0.3736	0.3756			
Exhaust	0.3736	0.3756			
Valve lip thickness—inlet	0.057				
Exhaust	0.070				
Measurement from top of valve to face of head with valve seated—inlet	0.088	0.134			
Exhaust	0.111	0.157			
Depth of bore for valve seat inserts	0.448	0.450			
Valve seat width—inlet	0.030	0.076			
Exhaust	0.030	0.076			
Valve face angle [2]	29¼°	29¼°			
VALVES:					
Valve stem clearance in guide					0.009
Exhaust valve clearance (hot)			0.025	0.025	
Inlet valve clearance (hot)			0.015	0.015	
VALVE LIFTERS:					
Lifter diameter	1.3100	1.3110			
Bearing bore	1.3135	1.3155			0.010
VALVE SPRING:					
Free length 2.05 in.					
Pounds force 54.8—60					
When compressed to 1.766 in.					
Outside diameter 1.386 in.					
WATER TEMPERATURE REGULATOR:					
Opening temperature 164° — 166°					
Fully open temperature 180°					

[1] Measure valve guide bore in portion of guide which is pressed into cylinder head closest to valve head.
[2] If valve seat face exceeds the maximum width after grinding, narrow the seat face by using 15° stone or fly cutter.

Table 1-4. *Power Transmission Units Repair and Replacement Standards*

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
Torque Divider:					
Engine rpm at torque converter stall 755—885					
Converter type single stage					
Converter size 21 in.					
Clearance between torque converter stator and turbine (see text for correct method of measuring)			0.012	0.018	0.030
Clearance between torque converter stator and impeller, (see text for correct method of measuring			0.009	0.015	0.024
Torque Converter Inlet Relief Valve:					
Mounting location Directional valve housing within transmission (BENCH TEST ONLY)					
Set to bypass 4-6 gpm					
At pressure of 135—145 psi					
Inlet relief valve spring:					
Test force .476—.558 lb.					
When compressed to .48 in.					
Free length after test .89 in.					
Spring diameter .300 in.					
Torque Converter Outlet Relief Valve:					
Mounting location Upper rear face of torque divider housing					
Set to bypass 19—21 gpm					
At pressure of (when converter is stalled 40—44 psi					
Outlet relief valve spring:					
Pounds force 36.38—42.70					
When compressed to 2 in.					
Free length (after test) 2.98 in.					
Spring diameter .880 in.					
Scavenge and Circulating Pump:					
Type Gear					
Capacity (scavenge) 3.2 gpm					
Based on speed of 500 rpm					
Pressure 120 psi					
Transmission Hydraulic Controls:					
Safety valve spring ((3), fig. 6-27)					
Pounds force 36—44					
When compressed to 5.74 in.					
Free length after test 8.20 in.					
Spring diameter 1.44 in.					
Check valve spring ((4), fig. 6-26)					
Pounds force 38.5—45.1					
When compressed to 3.19 in.					
Free length after test 4.38 in.					
Spring diameter .81 in.					
Pressure control valve spring ((17), fig. 6-26)					
Pounds force 22.5—26.9					
When compressed to 3.728 in.					
Free length after test 4.77—4.89 in					
Spring diameter .784—.816 in.					
Control linkage adjustment:					
Dimension between washer and lever on selector lever control shaft (see text for correct method of adjusting) .002—.022 in.					

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
Control linkage adjustment—Continued					
Dimension between centerline of transmission hydraulic control shafts and face of lever on selector lever control shaft (see text for correct method of adjusting) 1.98 in.					
Transmission					
Transmission clutches:					
Nos. 1, 3, and 4 clutches:					
Overall width of 3 new disc assemblies and 2 new plates 1.172—1.202 in.					
No. 2 clutch:					
Overall width of 4 new disc assemblies and 3 new plates 1.650—1.692 in.					
No. 5 clutch:					
Overall width of 2 new disc assemblies and 1 new plate .694—.712 in.					
Clutch piston release springs Nos. 1 and 2 clutches:					
Pounds force 28.60-33.60 in.					
When compressed to 4.0937 in.					
Free length after test 5.0937 in.					
Spring diameter .5625 in.					
Clutch release springs Nos. 3, 4, and 5 clutches:					
Pounds force 26.45—31.05					
When compressed to 1.837 in.					
Free length after test 2.469 in.					
Spring diameter .563 in.					
Clutch reaction pins Nos. 1 and 2 clutches:					
Length 5.781 in.					
Clutch reaction pins Nos. 3, 4, and 5 clutches:					
Length 8.25 in.					
Shafts (planet gear) outside diameter	1.3877	1.3883			
Bevel gear					
Bevel gear and pinion backlash as marked on pinion gear (with pinion held in forward position).			0.015	0.016	
Bevel gear bearing preload:					
Shims to be removed after end clearance taken up, approximately 0.013 in.					
Steering clutch					
Clutch springs:					
Outer:					
Pounds force 286-316					
When compressed to 3.90 in.					
Inner:					
Pounds force 185-205					
When compressed to 3.71 in.					
Steering clutch hub-to bevel gear shaft press fit, tons 35—40					
Dimension between the face of the hub and the shoulder of the bevel gear shaft when pressed on with 35-40 tons .095—.155 in.					
Steering clutch (.134 in. thick discs):					
Overall width of 10 new disc assemblies and 9 new discs	2.923	3.189			
Minimum overall width of 10 disc assemblies and 9 discs (worn) 2.744 in.					

Table 1-4. *Power Transmission Units Repair and Replacement Standards Continued*

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
Pressure relief valve set to bypass at 350—400 psi					
Steering clutch control valve minimum pressure with clutch disengaged, engine at low speed 265—300 psi					
Steering clutch and transmission hydraulic pump					
Permissible clearance between pump shafts and bearings					0.006
Capacity at 2,080 rpm (pump speed at 1,200 rpm engine speed) 42.7 gpm					
When developing pressure of 350 psi					
Brakes:					
Adjustment:					
Tighten down adjusting socket until band is tight and back off 1 turn					
Distance between top of pin and the milled notch in the engaging mechanism support			0.860	0.900	
Distance between front face of seat armrest support and center line of parking brake lever			0.820	0.940	
Distance between front face of seat support and rear face of brake pedal 17.67-17.87 in.					
Final drive:					
Flange-to-final drive press fit, tons 35—40					
Dimension between face of flange and the shoulder of the pinion shaft when pressed on to 35—40 tons 0.124—0.154 in.					
Sprocket-to-hub press fit, tons 60—65					
Dimension between face of sprocket and the end of the splines on the final drive hub when pressed on to 60-65 tons 0.440—0.560 in.					
Sprocket shaft-to-case press fit, tons 55—60					
Sprocket shaft must be straight within 0.125 in.					

Table 1-5. Track Roller Frame Units Repair and Replacement Standards

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
Track roller frame					
Inner bearing clearance			0.012	0.015	0.040
Minimum thickness of wear strip for front idler 0.125 in.					
Clearance between yoke and wear plate			0.028	0.032	
Track rollers					
Shaft clearance			0.008	0.012	0.050
End clearance			0.011	0.029	0.050
Permissible bend in shaft 0.005 in.					
Track carrier rollers					
Adjustment:					
Tighten nut until resistance is felt, then back off to nearest locking position					
End clearance			0.000	0.0045	0.030
Front idlers and recoil springs:					
Shaft clearance			0.008	0.012	0.050
End clearance			0.011	0.029	
Recoil spring (outer) free length	31.17	32.23			
Recoil spring (inner) free length	21.50	22.50			
Recoil springs, from rear face of front pilot to front face of rear pilot, assembled length 24.50 in.					
Recoil springs, from rear face of front pilot to front face of rear pilot, installed length 25.00 in.					
Clearance between frame and guides			0.010	0.050	
Clearance between yoke and plate assembly			0.030	0.060	
Track					
Wear (external bushing and pitch increase) on pins and bushings permissible before turning (see text)					
Measured across 4 track links 33.84 ± 0.08 in.					
Track adjustment, sag 1-1 1/2 in.					
Limit of adjusting track, measurement between stops on shaft assembly, and back of equalizer bar support not to exceed 0.062 in.					

CHAPTER 2

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT

2-1. Special Tools and Equipment

The special tools required to perform direct and general support maintenance on the Caterpillar Model D-7F Tractor are listed in appropriate TDA of the organization performing the maintenance.

2-2. Maintenance Repair Parts

Repair parts and equipment required to perform direct and general support maintenance of the D-7F tractor are listed and illustrated in TM 5-2410-233-34P.

Section II. TROUBLESHOOTING

2-3. General

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the tractor and its components.

2-4. Troubleshooting

Malfunctions which may occur are listed in Chart 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. Refer to TM 5-2410-233-20 for initial troubleshooting. Any trouble that is beyond the scope of direct and general support maintenance must be reported to depot maintenance personnel.

Chart 2-1. Troubleshooting

Malfunction	Probable Cause	Corrective Action
1. Engine fails to start	*a.* Worn injector pump	*a.* Replace injector pump (para 5-11).
	b. Fuel transfer pump defective	*b.* Check pump pressure (para 5-13), if below 10 psi, replace fuel transfer pump (para 5-13).
	c. Slipping fuel injector pump drive	*c.* Remove fuel transfer pump (para 5-13), crank engine and observe if shaft rotates. If shaft rotates, remove the small cover (fig. 5-42) from the front of timing gear cover and tighten the accessory drive gear retaining nut. If tightening eliminates the slipping, retime fuel injector pump (para 5-11 and 5-28).
	d. Engine improperly timed	*d.* Retime engine (para 5-28).
2. Irregular firing of engine	*a.* Valves not seating properly	*a.* Recondition valves (para 5-27).
	b. Worn piston rings	*b.* Replace piston rings (para 5-33).
	c. Defective fuel injection nozzle	*c.* Locate misfiring cylinder by momentarily loosening each fuel line nut on injection pump. Replace defective fuel injection nozzle of misfiring cylinder (para 5-10).
	d. Broken or leaking high pressure line.	*d.* Replace high pressure fuel line (para 5-11).
3. Erratic engine speed	Governor failure	Check for damaged or broken springs, linkages, or other governor related components. Replace a defective governor.

Malfunction	Probable Cause	Corrective Action
4. Excessive engine vibration	*a.* Loose, worn, or defective engine mounts	*a.* Align engine mounts (para 2-8) and tighten all mounting bolts securely.
	b. Loose pulley and damper	*b.* Tighten pulley mounting bolt (para 5-29).
	c. Defective pulley or damper	*c.* Replace defective pulley or damper (para 5-29).
	d. Misfiring	*d.* Refer to (1) above.
	e. Unbalanced fan	*e.* Remove fan belts for short duration. If vibration is no longer evident, replace fan (para 5-4).
5. Engine smokes	*a.* Worn piston rings	*a.* Replace piston rings (para 5-33).
	b. Defective valves	*b.* Recondition valves and seats (para 5-27).
6. Engine knocks excessively	*a.* Broken valve spring	*a.* Replace valve spring (para 5-27).
	b. Carbon build-up on pistons	*b.* Clean carbon from pistons (para 5-33).
	c. Loose connecting rod or main bearing bolts or worn bearings	*c.* Tighten bolts or replace bearing (para 5-33).
7. Low or no lubricating oil pressure indication	*a.* Worn main bearing	*a.* Replace bearing (para 5-34).
	b. Worn oil pump gears	*b.* Replace pump gears (para 5-24).
	c. Pressure regulating valve worn or stuck thus restricting the flow of oil	*c.* Repair or replace a defective pressure regulating valve (para 5-24 .
8. Starter will not crank engine	Armature burned out	Disassemble starter and replace armature (para 5-21).
9. Generator not charging	*a.* Generator shorted	*a.* Disassemble generator and replace armature (para 5-20).
	b. Brush spring tension too low	*b.* Replace a defective generator brush spring (para 5-20).
10. Fully charged battery and a high charging rate	*a.* Short circuit in generator	*a.* Disassemble generator and repair or replace as necessary (para 5-20).
	b. Generator regulator not operating properly	*b.* Adjust (Refer to TM 5-2410-233-20).
11. Transmission does not operate in any speed	*a.* Leakage in external lines	*a.* Refer to TM 5-2410-233-20.
	b. Leakage within transmission	*b.* Check pressures at test points (para 6-11).
	c. Pressure relief valve in hydraulic control valve stuck open.	*c.* Remove valve for inspection and repair (para 6-4).
	d. Check valve stuck in bore	*d.* Remove valve for inspection and repair (para 6-8).
	e. Differential valve sticking closed	*e.* Remove valve for inspection and repair (para 6-4).
	f. Safety valve improperly adjusted	*f.* Adjust safety valve (para 6-4).
	g. Torque divider failure	*g.* Refer to paragraph 6-3.
12. Tractor remains in gear with selector valve in neutral	*a.* Obstruction preventing directional clutch from releasing.	*a.* Inspect directional valve and remove any obstruction (para 6-3).
	b. Control linkage improperly adjusted	*b.* Adjust linkage (para 6-4).
	c. Speed and safety valve improperly adjusted	*c.* Adjust valves (para 6-4).
13. Ripper will not raise	*a.* Defective relief valve in hydraulic control	*a.* Remove valve for inspection and repair (para 4-5).
	b. Improper relief valve setting	*b.* Adjust valve (para 4-4).
14. Ripper will not lower	Defective relief valve in hydraulic control	Remove and inspect valve (para 4-4).
15. Ripper will not stay in ground	Worn cylinder piston rod packing and seals	Inspect and repair cylinder (para 4-10).
16. Winch brake not holding properly	*a.* Broken brake spring	*a.* Replace broken brake spring (para 3-14).
	b. Sticking or damaged piston in winch control valve	*b.* Remove valve for inspection and repair (para 3-13).

Malfunction	Probable Cause	Corrective Action
	c. Worn poppet on valve selector spool	c. Remove valve for inspection and repair (para 3-13).
17. Winch clutch pressure low	a. Broken seal ring on bevel gearshaft	a. Remove winch for inspection and replace broken seal ring (para 3-14).
	b. Damaged preformed packing in clutch pack	b. Remove winch for inspection and replace preformed packing (para 3-14).

Section III. GENERAL MAINTENANCE

2-5. General

This section provides direct support and general support maintenance personnel with general repair instructions applicable to the Caterpillar D-7F tractor. The following instructions will prove helpful to disassemble and assemble the tractor components.

2-6. General Instructions

a. *Cleanliness.*

(1) Whenever hydraulic, fuel, lubricating oil or air lines are disconnected, clean the point of disconnection and the adjacent area. As soon as the disconnection is made, cap, plug or tape the line or opening to prevent entry of foreign material. The same recommendations for cleaning and covering apply when access covers or inspection plates are removed.

(2) Clean and inspect all parts. Be sure all passages and holes are open. Cover all parts to keep them clean. Be sure parts are clean when installed. Leave new parts in their containers until ready for assembly.

b. *Removal and Installation.*

(1) Unless otherwise specified, all removals should be accomplished using an adjustable lifting beam. All supporting members (chains and cables) should be parallel to each other and as near perpendicular as possible to the top of the object being lifted (fig. 2-1).

(2) When it is necessary to remove a component on an angle, remember that the capacity of an eyebolt diminishes as the angle between the supporting members and the object becomes less than 90°. Eyebolts and brackets should never be bent and should only have stress in tension. A length of pipe and a washer can be used (fig. 2-2), to help relieve these stresses on eyebolts.

(3) Some removals require the use of lifting fixtures to obtain proper balance and to provide safe handling.

(4) If a part resists removal, check to be certain all nuts and bolts have been removed and that an adjacent part is not interfering.

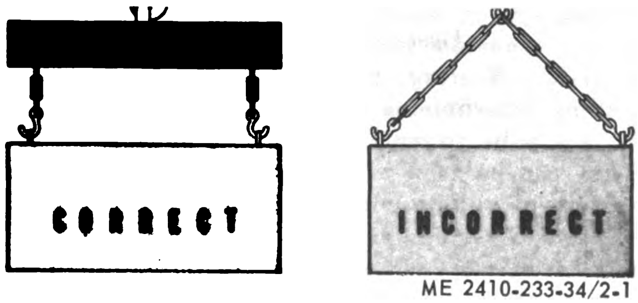
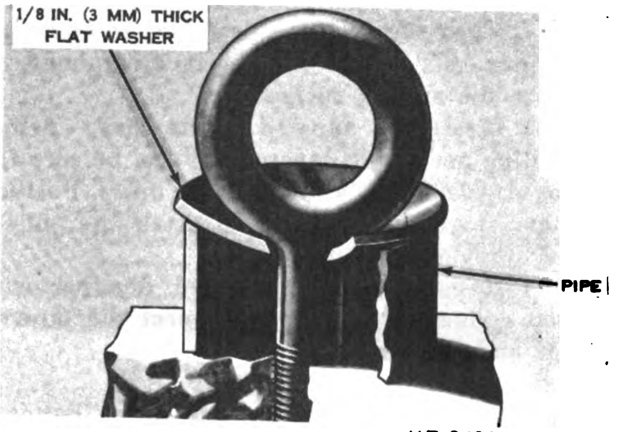


Figure 2-1. Lifting beam.

c. *Disassembly and Assembly.* When assembling a machine, complete each step in turn. Do not partially assemble one part and start assembling some other part. Make all adjustments as recommended. Always check the job after it is completed to see nothing has been overlooked.

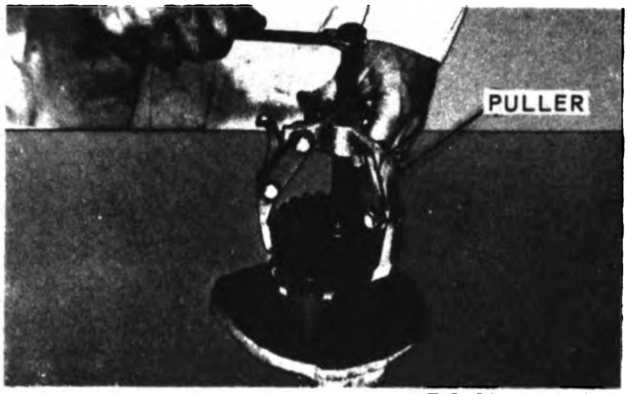
d. *Service Tools.*

(1) *Puller assembly (2 or 3 arm).* Two or three arm puller assemblies (figs. 2-3 and 2-4) can be used to remove gears, bearing cages, hubs, bearings, shafts, etc.



ME 2410-233-34/2-2

Figure 2-2. Lifting eyelet.



ME 2410-233-34/2-3

Figure 2-3. Puller assembly.

(2) *Bearing pulling attachment.* Bearing pulling attachments (fig. 2-4) can be used with forcing bolts, to remove shafts, bearings, gears, etc. They can be used with Push Pullers to provide a variety of pulling combinations.

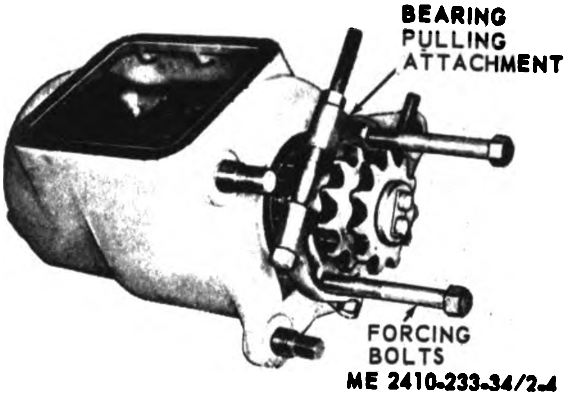


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Figure 2-4. Bearing pulling attachment.

e. Pressing Parts.

(1) When pressing one part into another, use Fed. Spec. TT-A-580 Anti-Seize Compound to lubricate the mating surfaces.

(2) Assemble tapered parts dry. Before assembling parts with tapered splines, be sure the splines are clean, dry and free from burrs. Position the parts together by hand to mesh the splines before applying pressure.

(3) If parts which are fitted together with tapered splines are not tight, inspect the tapered splines and discard if worn.

f. Bolts and Bolt Torque.

(1) A bolt which is too long may "bottom" before the head is tight against the part it is to hold. The threads can be damaged when a "long" bolt is removed.

(2) If a bolt is too short, there may not be enough threads engaged to hold the part securely.

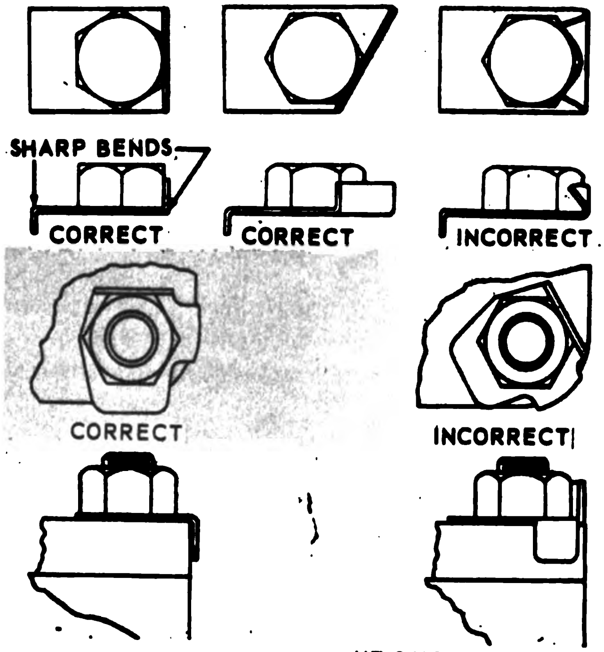
(3) Apply proper torque values to all bolts and nuts when assembling Caterpillar equipment. When a specific torque value is required, the value is listed in the SPECIFICATION section of the Service Manual. Tighten all other bolts and nuts for general usage, hydraulic valve bodies, or taperlock studs to the torque values given in the charts.

g. Locks.

(1) Flat metal locks must be installed properly (fig. 2-5) to be effective. Bend one end of the lock around the edge of the part. Bend the other end against one flat surface of the nut or bolt head.

(2) Always install new locks in compartments which house moving parts.

(3) When installing lockwashers on housings made of aluminum, use a flat washer between the lockwasher and the housing.



ME 2410-233-34/2-5

Figure 2-5. Installing metal locks.

h. Lines and Wires. When removing or disconnecting a group of lines or wires, tag each one to assure proper assembly.

i. Shims. When shims are removed, tie them together and identify them as to location. Keep shims clean and flat until they are reinstalled.

j. Bearings.

(1) *Anti-friction bearings.*

(a) When an anti-friction bearing (fig. 2-6) is removed, cover it to keep out dirt and abrasives. Wash bearings in nonflammable cleaning solution and allow them to drain dry. The bearing may be dried with compressed air but DO NOT SPIN THE BEARING.

(b) Discard the bearings if the races and balls or rollers are pitted, scored or burned. If the bearing is serviceable, coat it with oil and wrap it in

clean paper. Do not unwrap new bearings until time of installation.

(c) The life of an anti-friction bearing will be shortened if not properly lubricated.

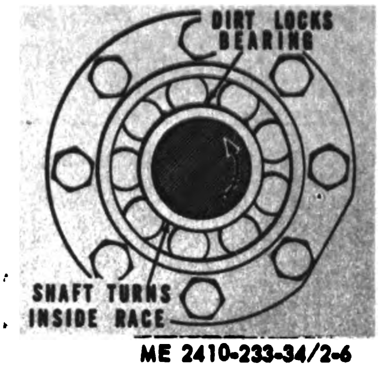


Figure 2-6. Locked anti-friction bearing.

(2) *Double row, tapered roller.* Double row, tapered roller bearings are precision fit during manufacture and the components are not interchangeable. The cups, cones and spacers are usually etched with the same serial number and letter designator. If no letter designators are found, wire the components together to assure correct installation. Reusable bearing components should be installed in their original positions.

(3) *Heating bearings.* Bearings which require expansion for installation should be heated in oil not to exceed 250°F. (121 C°). When more than one part is heated to aid in assembly, they must be allowed to cool and then pressed together again. Parts often separate as they cool and shrink.

(4) *Installation.* Lubricate new or used bearings before installation. Bearings that are to be preloaded must have a film of oil over the entire assembly to obtain accurate preloading. When installing a bearing, spacer or washer against a shoulder on a shaft, be sure the chamfered side is toward the shoulder (fig. 2-7). When pressing bearings into a retainer or bore, apply pressure to the outer race. If the bearing is pressed on the shaft, apply pressure on the inner race.

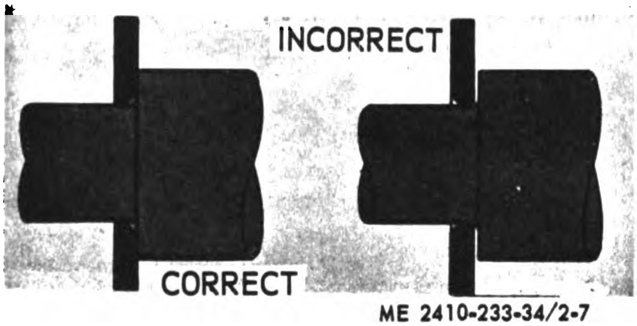


Figure 2-7. Chamfer on a shouldered shaft.

(5) *Preload.* Preload is an initial force placed on the bearing at the time of assembly. Determine preload or end clearance from the SPECIFICATIONS. Care should be exercised in applying preload. Misapplication of preload to bearings requiring end clearance can result in bearing failure.

(6) *Sleeve bearings.* DO NOT INSTALL SLEEVE BEARINGS WITH A HAMMER. Use a press if possible and apply the pressure directly in line with the bore. If it is necessary to drive on a bearing use a driver or a bar with a smooth flat end. If a sleeve bearing has an oil hole, align it with the oil hole in the mating part.

k. Gaskets. Be sure the holes in the gaskets correspond with the lubricant passages in the mating parts. If it is necessary to make gaskets, select stock of the proper type and thickness. Be sure to cut holes properly. Blank gaskets can cause serious damage.

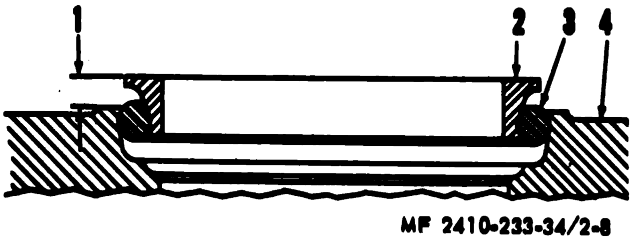
l. Seals.

(1) *Floating seals.*

(a) Floating ring seals have highly finished surfaces and are held together by toric sealing rings. The flexibility of the toric sealing rings makes the floating ring seals self aligning and compensates for wear on the metal faces.

(b) During disassembly, tape the metal floating ring seals together so they will be kept in matched sets. Always install the metal floating ring seals in pairs; that is, two new seals together or two seals that have previously run together. Never reinstall a used toric sealing ring.

(c) Figure 2-8 shows the dimension (1) to be checked, the metal floating ring seal (2), the rubber toric sealing ring (3) and the toric sealing ring retainer (4). The dimension must be uniform around the entire circumference of the floating ring seal. Check the dimension at 90° intervals.



1 Dimension
2 Metal floating ring seal
3 Rubber toric sealing ring
4 Toric sealing ring retainer

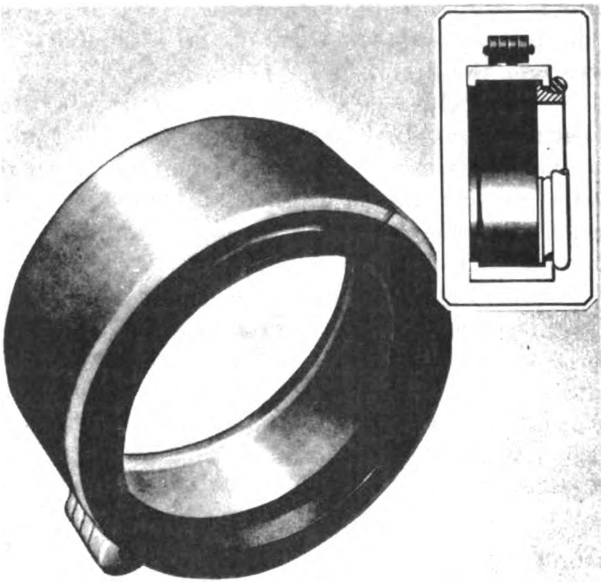
Figure 2-8. Floating seal installation.

(d) Handle all parts with care to avoid nicks. File smooth any parts, other than the sealing faces, that have nicks that may make assembly difficult or questionable. Wash used parts. Use a wire brush to clean dirt or rust from the bore of the seal retainers to assure they are clean and smooth. Remove all oil or the protective coating from floating ring seals and retainers with a nonflammable cleaning solvent. Be sure the ramp on the retainers and on the floating ring seals are dry.

(e) Check the ramps for tool marks and nicks. On used parts, remove dirt or rust deposits from the ramps. Smooth the surface with emery cloth.

(f) Install new toric sealing rings or floating ring seals. Seat the toric sealing ring uniformly in the relief of the ring seal. Be sure the toric sealing ring is not twisted. It must set straight against the lip which keeps it from falling off the floating ring seal.

(g) Floating seal installation tools are available for various size seals. A typical installation tool is shown in figure 2-9.

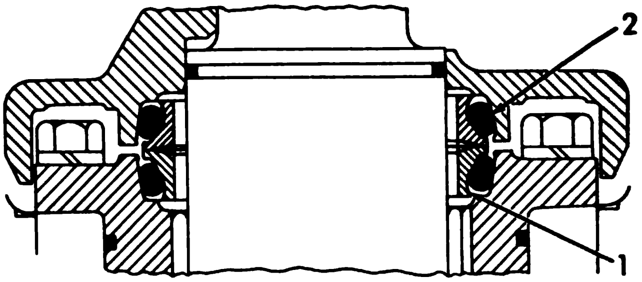


ME 2410-233-34/2-9

Figure 2-9. Floating seal installation tool.

(h) If an installer tool is not used, install the toric sealing ring and floating ring seal as an assembly by pressing on the toric sealing ring (fig. 2-10). Use finger pressure only. Be sure the toric sealing ring is seated uniformly in the recess of both the floating ring seal and the retainer. Make sure it sets in the bore straight and against the lip that keeps it from falling out of the retainer. DO NOT USE A SCREWDRIVER OR STICK TO ASSEMBLE THE TORIC SEALING RING IN THE RETAINER.

(i) Before assembling floating ring seals together, wipe faces of seals with lint-free tissue to remove any foreign material and fingerprints. Place one drop of oil on the cleaning tissue and coat the sealing surfaces of the seals. Be careful to prevent any oil from contacting the toric sealing ring or its mating surfaces.



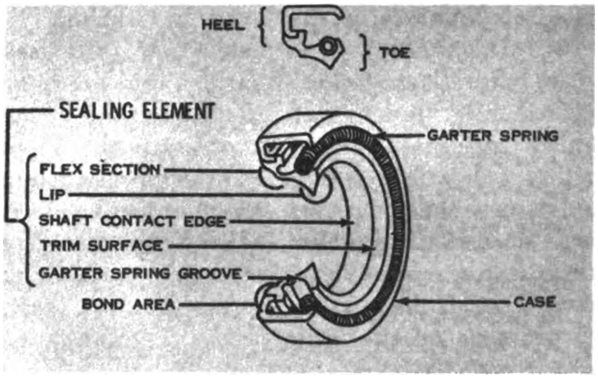
ME 2410-233-34/2-10

1 Metal floating ring seal
2 Toric sealing ring

Figure 2-10. Floating seals installed with metal floating ring seal and toric sealing ring properly positioned.

(2) *Lip-type seals.*

(a) Generally the toe or spring-loaded lip of an oil seal faces the oil being sealed or the oil having the higher pressure. The toe or lip of a grease seal faces away from the lubricant being sealed. Unless otherwise specified, use the preceding rules for installing lip-type seals (fig. 2-11).



ME 2410-233-34/2-11

Figure 2-11. Lip-type seal.

(b) The main parts of a lip-type seal are the case, sealing element, and garter spring. The picture illustrates the construction of a simple lip-type seal. The cross sections show the terms "heel" (fig. 2-12) and "toe" used to identify the sides of various types of seals.

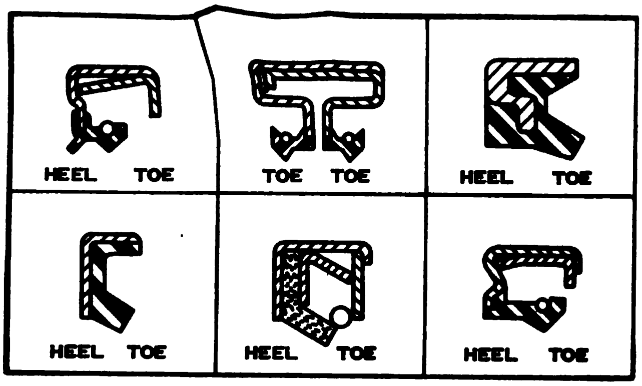


Figure 2-12. Heel and toe type seals.

(c) Lubricate the lips of lip-type seals before installation. Use the same type lubricant in which the seal will be operating. Do not use grease on any seal except a grease seal.

(d) If, during installation, the seal lip must pass over a shaft that has splines, a keyway, rough surface or a sharp edge, the lip can be easily damaged. Shim stock or other such material can be formed around the area to provide a smooth surface over which to slide the seal.

m. Hydraulic Systems.

(1) *Cleanliness.*

(a) When removing components of a hydraulic system cover all openings in both the component and the machine.

(b) If evidence of metal or rubber particles are found in the hydraulic system, flush the entire system.

(c) Disassemble and assemble hydraulic components on a clean surface. Clean all metal parts in a nonflammable cleaning fluid. Then lubricate all components to aid in assembly.

(2) *Safety.* Before servicing the hydraulic system, NEUTRALIZE THE HYDRAULIC PRESSURE.

PROCEDURE:

(a) Lower components to the ground. In some instances a removal procedure may require the component to be blocked in a certain position.

(b) With the engine shut off, move the hydraulic control levers to all positions to insure there is no pressure in the system.

(c) Place all control levers in HOLD position.

NOTE

When attached hydraulic equipment is removed from a machine which will continue to be used, the hydraulic system lines must be securely blocked. High pressure protective covers are available. One O-ring seal is required with each protective cover.

(3) *Sealing elements.* Inspect all sealing elements (O-rings, gaskets, etc.), when disassembling and assembling hydraulic system components. Install new elements if necessary.

(4) *Hydraulic lines.*

(a) When installing metal tubes, tighten all bolts finger-tight. Then, in this order, tighten the bolts at the rigid end, the adjustable end, and the mounting brackets. After the tubes are mounted, install the hoses. Connect both ends of the hose with all bolts finger-tight. Position the hose so it does not rub the machine or another hose and has a minimum of bending and twisting. Tighten bolts in both couplings.

(b) Due to manufacturing methods there is a natural curvature to a hydraulic hose. Install the hose so any bend is with this curvature. In case of replacement hoses with angled-stem and reusable fittings, the hose curvature must be taken into consideration when assembling and positioning the angled stems.

(c) After the hoses are installed, follow this procedure: With the diesel engine running, move the appropriate control levers to move the component to every possible position. Observe the hoses during the cycle. Then lower the component to the ground. Shut off the diesel engine and eliminate any twisting, rubbing and / or excessive drooping of hoses by rotating the stem of the hoses.

(5) *Hydraulic fittings.*

(a) Fitting bodies with straight threads and O-ring seals.

1. This type of fitting is used in several applications. The tube end of the body will vary in design depending upon the application. However, the installation procedure of the fitting body into its mating boss will be the same. If the tube end of the fitting body is as illustrated (either elbow (fig. 2-13) or straight body (fig. 2-14)) a presetting procedure is necessary to assemble the sleeve onto the tube before connecting the tube to the end. See *(b)* below.

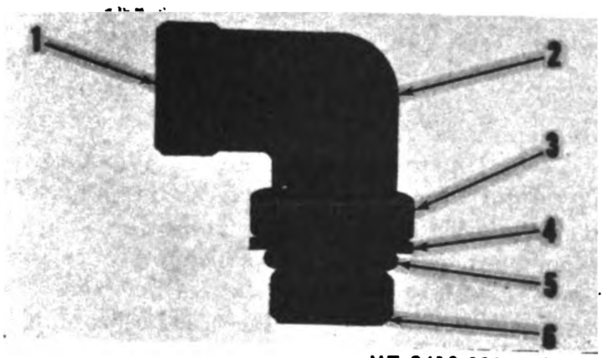
2. Place the nut, washer and seal as far back on the fitting body as possible. Hold the components in this position and screw the fitting into its boss until washer just contacts the face of the boss.

3. Place the fitting assembly in its correct angular position by turning the body out (counterclockwise), a maximum of 359°. Tighten the nut finger-tight.

NOTE

If the fitting is a connector (straight fitting), the hex on the body takes the place of the nut. Install this type fitting by tightening the hex against the face of the boss.

4. **Install the assembled tube onto the tube end of the body, finger-tight. Tighten the nut positioning the body. Then tighten the nut on the tube assembly.**



ME 2410-233-34/2-13

1 End of fitting body (connects to tube)
2 Fitting body
3 Locknut
4 Backup washer
5 O-ring seal
6 End of fitting (screws into mating boss)

Figure 2-13. Elbow body assembly.

b. Assembly of sleeves onto tubes.

1. Type A. **It is necessary to preset this type of sleeve (fig. 2-18) onto the tube before the tube assembly is installed on the fitting body.**

(a) Lubricate the sleeve and the threads on presetting tool and nut.

(b) Place the nut on the tube with the threaded end of the nut toward the end of the tube.

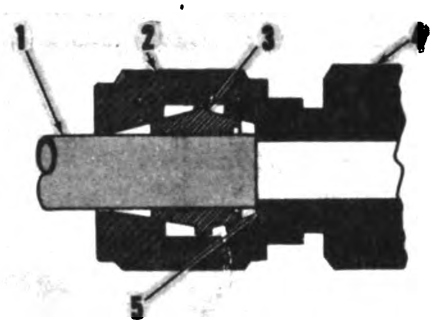
(c) Place the sleeve onto the tube so the short-tapered heavy end faces the presetting tool as illustrated.

(d) Bottom the tube end against shoulder of the tool.

(e) Assemble the nut to the tool finger-tight. Then tighten the nut until the threads on the tool are no longer visible.

(f) Remove the tube from the presetting tool. Check to be certain sleeve does not move longitudinally. (The sleeve can rotate on the tube).

(g) When the tube assembly is assembled onto the fitting body, tighten the nut until the threads on the body are no longer visible. Refer to (5) ***(a)*** **above for the installation of the fitting bodies.**



ME 2410-233-34/2-14

1 Tube
2 Nut
3 Sleeve
4 Presetting tool
5 Shoulder of tool (4)

Figure 2-14. Sleeve type fitting.

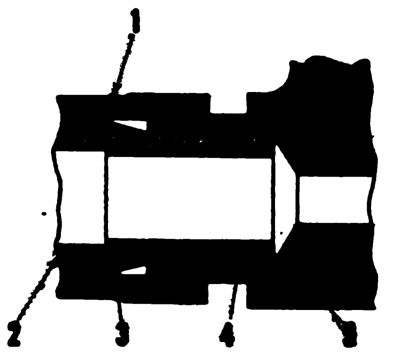
2. Type B.

(a) Place the nut and sleeve (fig. 2-15) onto the tube. Install the sleeve so the thick end faces away from the body.

(b) Install the insert into the tube.

(c) Bottom the tube and insert the body as illustrated.

(d) Tighten the nut 1½ turns past finger-tight.



ME 2410-233-34/2-15

1 Nut
2 Tube
3 Sleeve
4 Insert
5 Fitting body

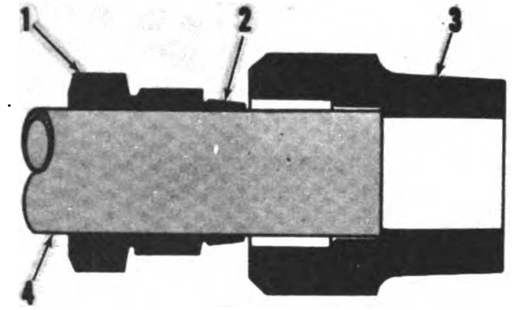
Figure 2-15. Sleeve and insert-type fitting.

3. Type C.

(a) With the nut and sleeve installed loosely in the body (fig. 2-16), install the tube through the nut and sleeve until the end of the tube is seated against the shoulder in the fitting body.

(b) Grip the tube firmly to prevent twisting or turning and tighten nut until a slight "give" or decreased resistance is felt. The "give" indicates that the sleeve has been sheared from the

nut. Tighten the nut an additional 1½ turns. It is not necessary to tighten the nut all the way down.



1. Nut
2. Sleeve
3. Fitting body
4. Tube

Figure 2-16. Shear-type fitting.

(6) *Hydraulic valves.*

(a) Examine all valves, valve bores and valve seats for nicks, burrs and/or scratches. (Rough spots may be removed with a crocus cloth or fine emery cloth). All valves which operate in bores must slide freely in their bores. Be certain all passages are clean and open.

(b) On control valve spools having bolt-retained centering or return springs (fig. 2-17) the bolt should be removed while the valve spool is in the valve body. This procedure will prevent spool distortion and possible damage to the spool lands.

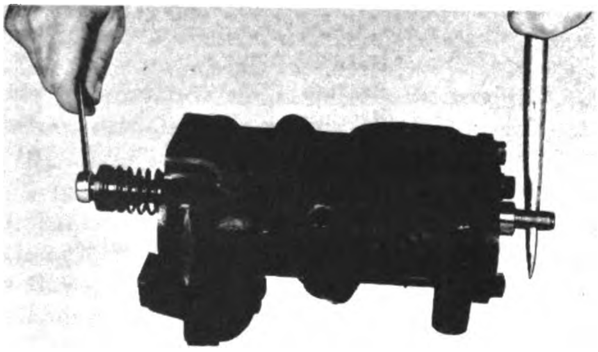
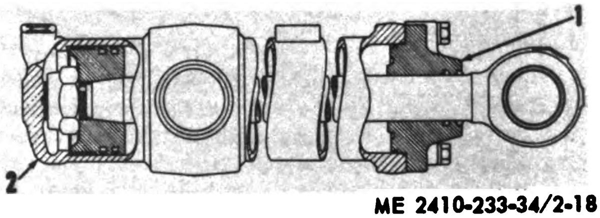


Figure 2-17. Removing bolt-retained spring.

(c) When installing shims to adjust pressure settings, always place the thick shim or spacer against the spring.

(7) *Cylinders.*

(a) Rod end and head end. The "rod end" (1, fig. 2-18) of a cylinder is that end that has the rod extending. The "head end" (2, fig. 2-18) is the other end of the cylinder—the blind end. The rod end line directs oil to the rod end of the cylinder to retract the rod. The head end line directs oil to the head end of the cylinder to extend the rod.



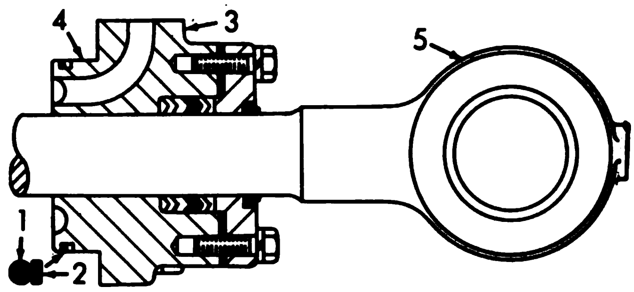
1 Rod end
2 Head end

Figure 2-18. Hydraulic cylinder rod and head ends.

(b) Removal. The hydraulic system need not be drained to remove any or all cylinders. Only the oil in the lines between the cylinder and its control valve will be lost. However, the control lever must remain in HOLD position or oil can drain from the tank in some instances.

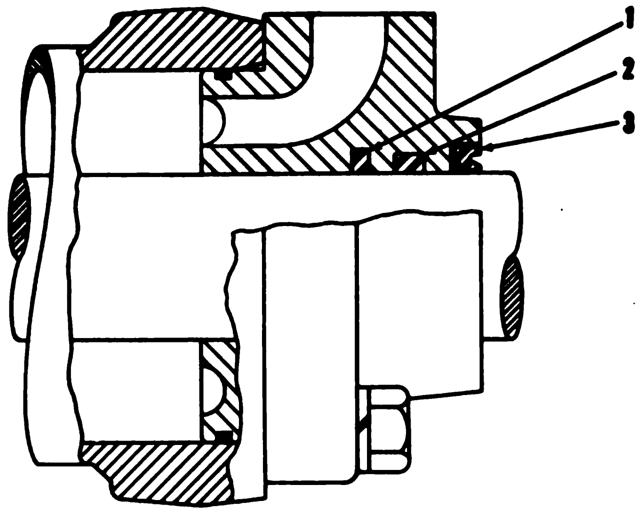
(c) Disassembly and assembly. Remove and install the bolts securing the cylinder head to the cylinder with the piston rod fully extended.

(d) Cylinder head seals. The rubber O-ring seal (1, fig. 2-19) and the backup ring (2) which form the seal between the head (3) and cylinder bore (4) are all assembled as illustrated. Note that the toe or lip of all wiper seals (3, fig. 2-20) on all cylinders faces away from the cylinder head.



1 O-ring
2 Back up ring
3 Cylinder head
4 Cylinder bore
5 Piston rod

Figure 2-19. Cylinder head seals.



ME 2410-233-34/2-20

1 Buffer seal
2 U-cup seal (always installed with lip facing the oil)
3 Wiper seal

Figure 2-20. Three seal cylinder head.

(e) Cylinder head packing adjustment.

1. Oil leakage between the rod and the hydraulic cylinder packing can be the result of worn, cut, and / or distorted packing. Leakage can often be stopped by removing shims (2, fig. 2-21) located between retainer (1) and the cylinder head; this will allow the packing to be compressed against the rod when the retainer is tightened.

2. Remove the bolts securing retainer to the cylinder head. Move the retainer away from the cylinder head to allow the shims to be cut and removed.

3. Remove one shim (2); install retainer (1) and operate the cylinder. If leakage is still apparent, repeat the procedure. If the cylinder leaks after removing two shims, remove and disassemble the cylinder and replace the packing.

NOTE

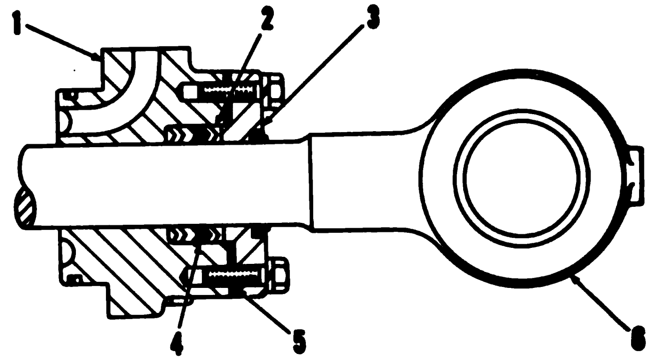
Remove only the shims which measure 0.010 in (2,54 mm) in thickness. The thicker shims should not be removed to adjust the packing.

ME 2410-233-34/2-21

1 Retainer
2 Shims

Figure 2-21. Removing cylinder head shims.

(a) Place retainer (3, fig. 2-22) on rod (6). Separate and oil all the rings of packing (2). Place the packing on the rod so the open part of the V will be facing toward head (1) when the head is installed. Be sure rubber pressure ring (4) is located as shown.



ME 2410-233-34/2-22

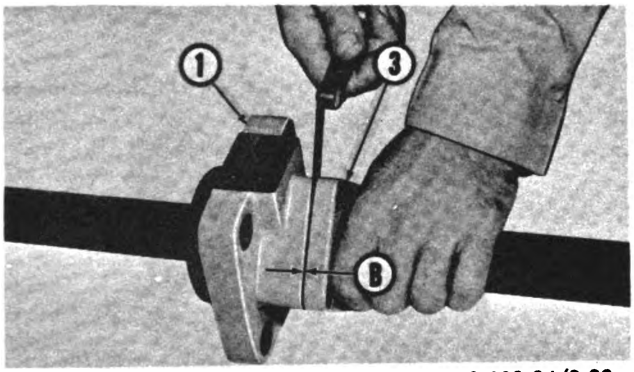
1 Head
2 Packing
3 Retainer
4 Rubber pressure ring
5 Shims
6 Piston rod

Figure 2-22. Packing and shims installed.

(b) Place the head on the rod and insert one ring of packing at a time into the head.

(c) Tap packing firmly into the head with the retainer (3).

(d) Hold retainer (3) firmly against the packing and measure clearance (B, fig. 2-23) between the retainer and the head with a thickness gauge. Sufficient shims must be installed between the retainer and head to obtain a total thickness of .010 in. to .015 in. (2,54 to 3,81 mm) less than the measured clearance (B). The shims will preload the packing properly when the retainer bolts are tightened.



ME 2410-233-34/2-23

1 Head
3 Retainer
B Clearance to be measured between head and retainer

Figure 2-23. Measuring cylinder head clearance.

(e) Remove the head (1, fig. 2-22) and contained packing (2) from the rod (6). Install the correct amount of shims (5) and reinstall the head.

CAUTION

Be careful not to damage packing (2) when reinstalling head (1) on the rod.

(8) *Solid seal assemblies.*

(a) Each solid seal assembly consists of a solid, rubber, inner expansion ring and a solid, plastic outer seal. Since these seals are continuous rings (no split joint), special tools and procedures are required for installation.

(b) The following is a typical installation procedure for the solid seal assemblies. This procedure can be used for all hydraulic cylinders which use the solid seal assemblies. A piston may have one or two seal assemblies.

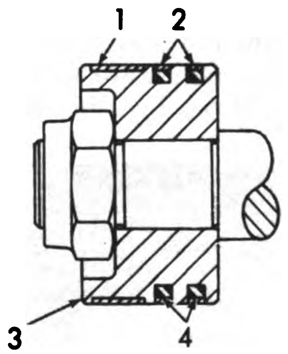
(c) The tools needed to install the outer seals of the piston seal assemblies are: one Expander Assembly (1, fig. 4-33), one Clamp Assembly (2) (two clamp assemblies are required on the larger diameter pistons), and one seal compressor (3). Measure the diameter of the piston to select the correct seal compressor. Compressors are marked for nominal ranges. The actual usable range can be calculated by reducing the low figure 1 / 16 in. (1,5 mm) and increasing the high figure 3 / 16 in. (4, 7 mm).

NOTE

Be certain all hydraulic cylinder components have been inspected and new components installed where necessary before installing the seal assemblies. The installation of the seal assemblies is the last step before the piston is installed in the cylinder.

1. For ease of seal installation, remove the wear ring (1, fig. 2-24).

2. Install the inner expansion rings (4) on the piston (3).



ME 2410-233-34/2-24

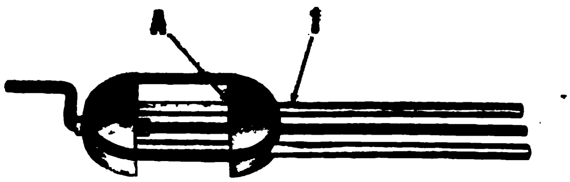
1 Wear ring
2 Solid, plastic, outer seals
3 Piston
4 Solid, rubber, inner expansion rings

Figure 2-24. Solid seal assemblies installed on piston.

3. Measure the diameter of the piston to determine the diameter to which the seal must be expanded. The outer seals of the seal assembly must be expanded to a diameter slightly larger than the diameter of piston to allow the seal to be placed over the piston. Be careful not to over-expand the seals or they can be ruined.

NOTE

The bars of the expander (1, fig. 2-25) are graduated, representing piston diameters. If the seal can be slipped off the expander when the inside face of the movable block is at point (A) (indicated piston diameter) the seal is expanded sufficiently.



ME 2410-233-34/2-25

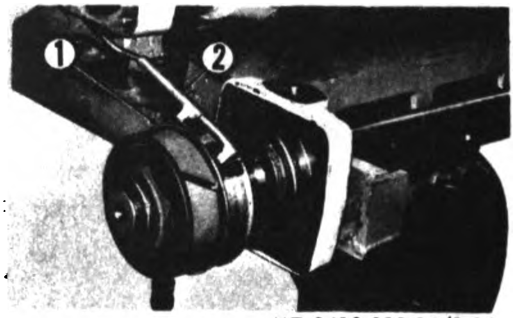
1 Expander assembly
A Indicated piston diameter

Figure 2-25. Seal on expander.

4. Place a seal on the expander. Turn the crank on the expander until the inside face of the movable block is slightly past point (A). Then return to point (A). Rotate the seal 90° on the expander and expand again. Check to see if the seal will slip off the expander. If not, repeat the procedure, expanding the seal farther each time, until the seal will slip off the expander when block is returned to point (A).

5. Lubricate the outer seals and place them on the piston. Install and lubricate the wear ring.

6. Select the applicable compressor (1, fig. 2-26) and install the clamp (2) on the compressor. Place the compressor loosely over the outer seals (fig. 2-26). Place the compressor on the piston so the rolled side of the compressor will be facing the cylinder when the piston is installed in the cylinder.



ME 2410-233-34/2-26

1 Seal compressor
2 Clamp assembly

Figure 2-26. Compressing seals.

7. Slowly turn the handle on the clamp and force the seals into their grooves. Be certain the seals are being seated in their grooves as they are being compressed.

8. Place the piston assembly into the cylinder bore as illustrated; be certain the piston is square in the bore.

9. Drive on the piston rod until the entire piston assembly is in the cylinder bore. Remove the clamp and the compressor.

10. Install the bolts securing the cylinder head to the cylinder with the piston rod fully extended. Tighten the bolts to the torque value in the SPECIFICATIONS.

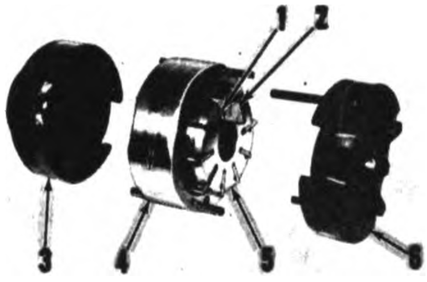
(9) *Cylinder installation*. Before installing a hydraulic cylinder, apply FED SPEC TT-A-580 Anti-Seize Compound to the cylinder pins and pin bores to aid in future removal. After the cylinder has been installed, start the engine and operate the cylinder to remove air from the hydraulic system. When the system is functioning properly, check the level of the oil in the hydraulic oil supply tank.

CAUTION

Under no circumstances should welding be done on the wall of the cylinder except the welded area at the head end of the cylinder. Welding on the cylinder wall can cause enough bore distortion to cause interference between the piston and the cylinder wall and can result in severe scoring of the cylinder wall.

(10) *Vane type pumps.*

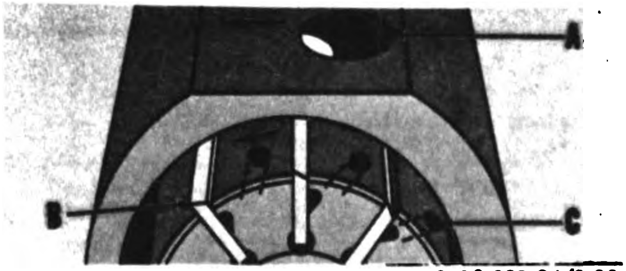
(a) Before disassembling a pump, mark the pump body and cover to insure correct assembly with respect to port relationship.



ME 2410-233-34/2-27

1 Inserts
2 Vanes
3 Pressure plate
4 Ring
5 Rotor
6 Wear plate

Figure 2-27. Pump cartridge.



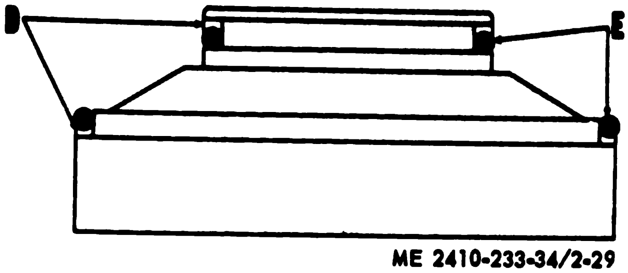
ME 2410-233-34/2-28

A Passage in ring
B Sharp edge of vane
C Passage in rotor

Figure 2-28. Ring, rotor and vane installation.

(b) Assemble the vanes (2, fig. 2-27) (and inserts (1)) in the rotor (5) and the rotor into the ring (4). The sharp edges of the vanes (2) and the arrows (fig. 2-28) on the ring and rotor must point in the direction of PUMP ROTATION when the cartridge is installed in the pump cover. Note that the passage (A) and passages (C) are angled toward the direction of pump rotation.

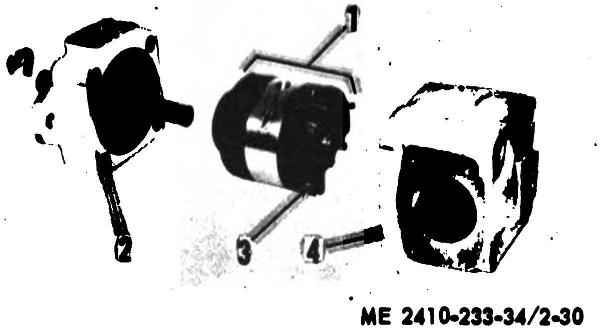
(c) If new O -ring seals and back-up rings are to be installed on the pressure plate, they must be installed as shown on figure 2-29. Lubricate the components and then install the back-up rings so the concave side faces the mating O -ring seal.



D Back-up rings
E O-ring seals

Figure 2-29. Back-up ring installation.

(d) Be certain the pins (3, fig. 2-30) in the cartridge (1) align with the holes in the pump cover (4). The arrow on the pump cartridge must point in the same direction as the pump shaft turns.



1 Pump cartridge
2 Pump body
3 Pins
4 Pump cover

Figure 2-30. Typical pump assembly.

Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS

2-7. General

The two major components of the tractor, are, the engine and the transmission. This section covers direct and general support maintenance instructions for the removal and installation of these components as authorized by the maintenance allocation chart.

2-8. Engine

a. Removal.

(1) Remove the hood (para 5-2), drain the cooling system and disconnect the negative battery cable from the battery (TM 5-2410-233-20).

(2) Drain the oil from the flywheel housing (LO 5-2410-233-12).

(3) Remove cross sheet guard from bottom of fuel tank (TM 5-2410-233-20) and shut off fuel supply line (fig. 5-23).

(4) Disconnect radiator water outlet line hose from the water pump (fig. 2-31, sheet 1) and disconnect top radiator hose from radiator (para 5-2).

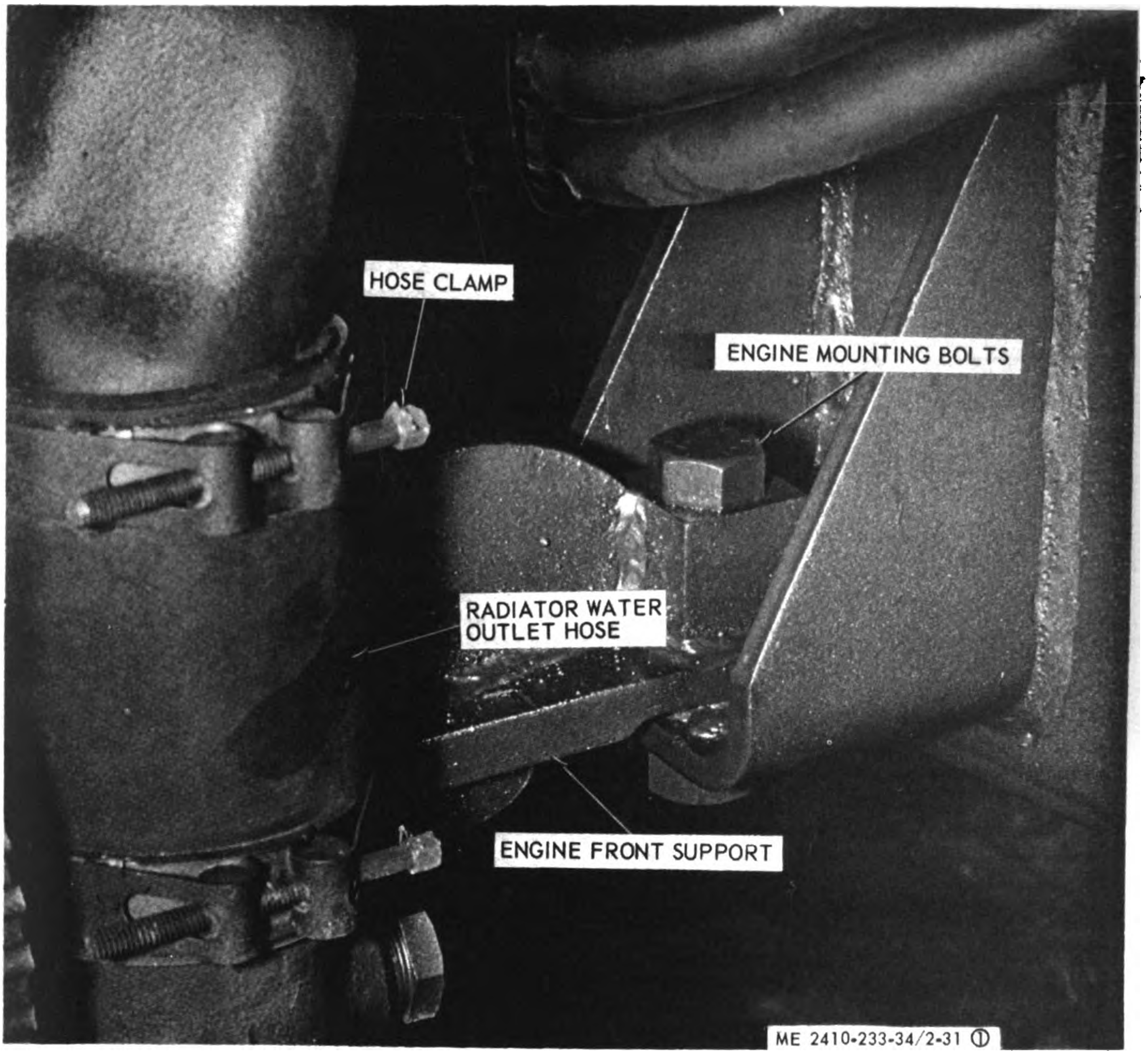


Figure 2-31. Preparing to remove engine (sheet 1 of 6).

(5) Remove the 8 fan adapter mounting bolts, (fig. 5-7) and lay the fan and adapter inside the radiator guard.

(6) Loosen fan belts (TM 5-2410-233-20) and remove the fan belts from engine (para 5-5).

(7) Remove 6 bolts and remove the fan drive assembly (para 5-8).

(8) Disconnect the fuel supply line (fig. 5-21) from the accessory drive housing.

(9) Disconnect starter ground cable from the starter (TM 5-2410-233-20).

(10) Disconnect the positive cable from the starter and pull the cable through to the left side of tractor.

(11) Remove capscrews (fig. 2-31, sheet 2) and remove the floor plates.

(12) Disconnect the transmission oil cooler oil inlet line (fig. 2-31, sheet 3).

(13) Disconnect the power take-off drive gears lubrication line from oil inlet line (fig. 2-31, sheet 4).

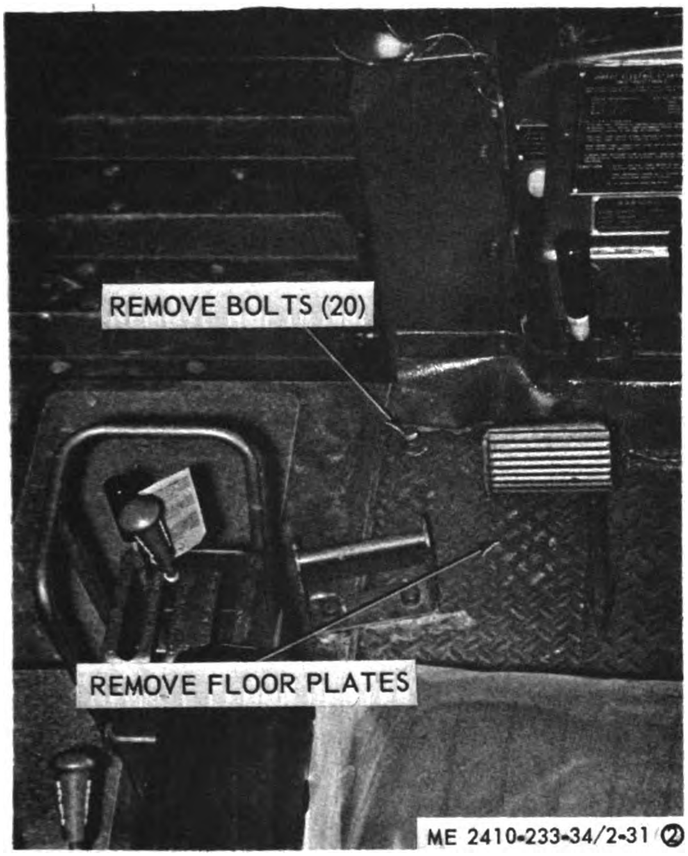


Figure 2-31. Preparing to remove engine (sheet 2 of 6).

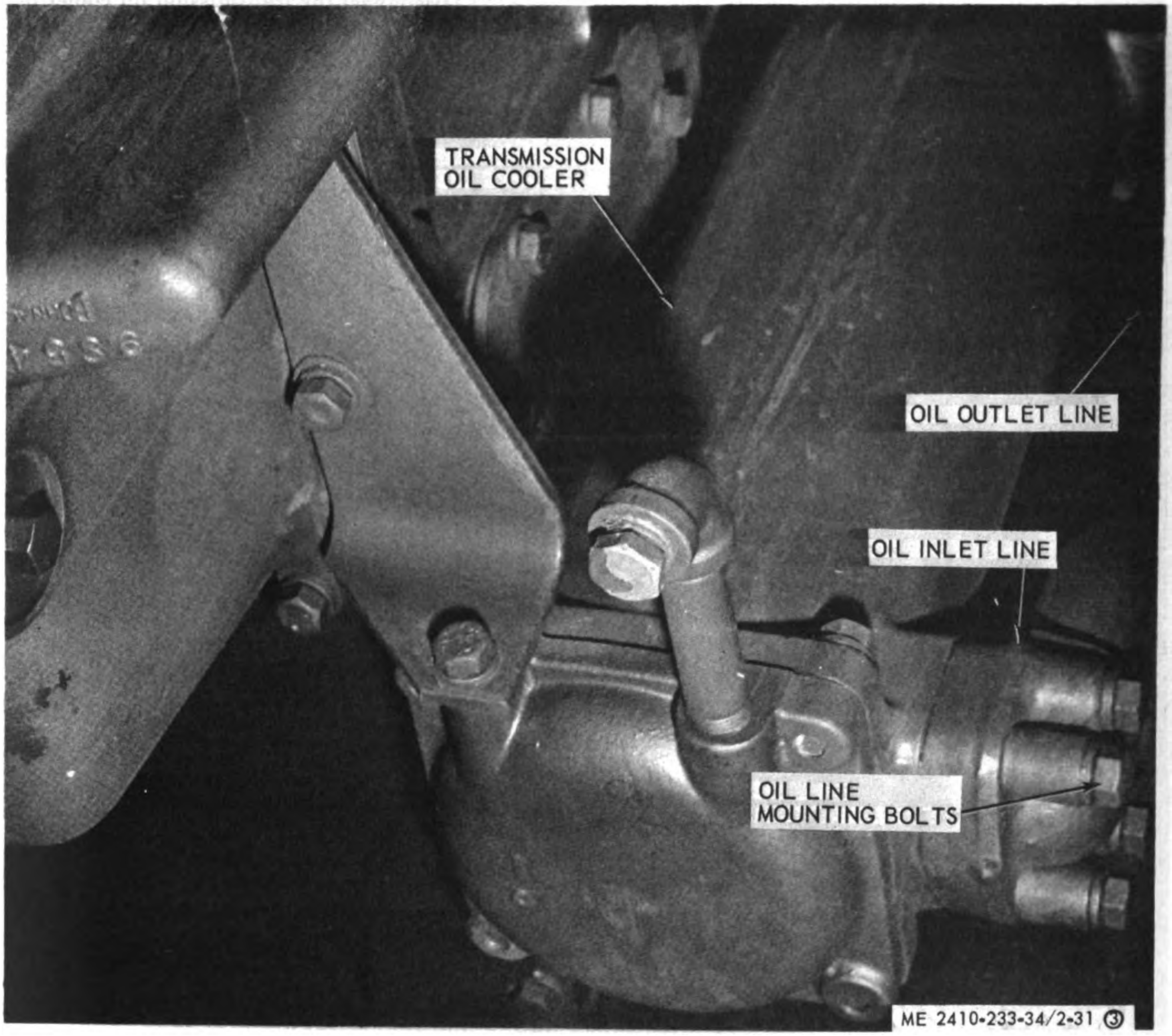


Figure 2-31. Preparing to remove engine (sheet 3 of 6).

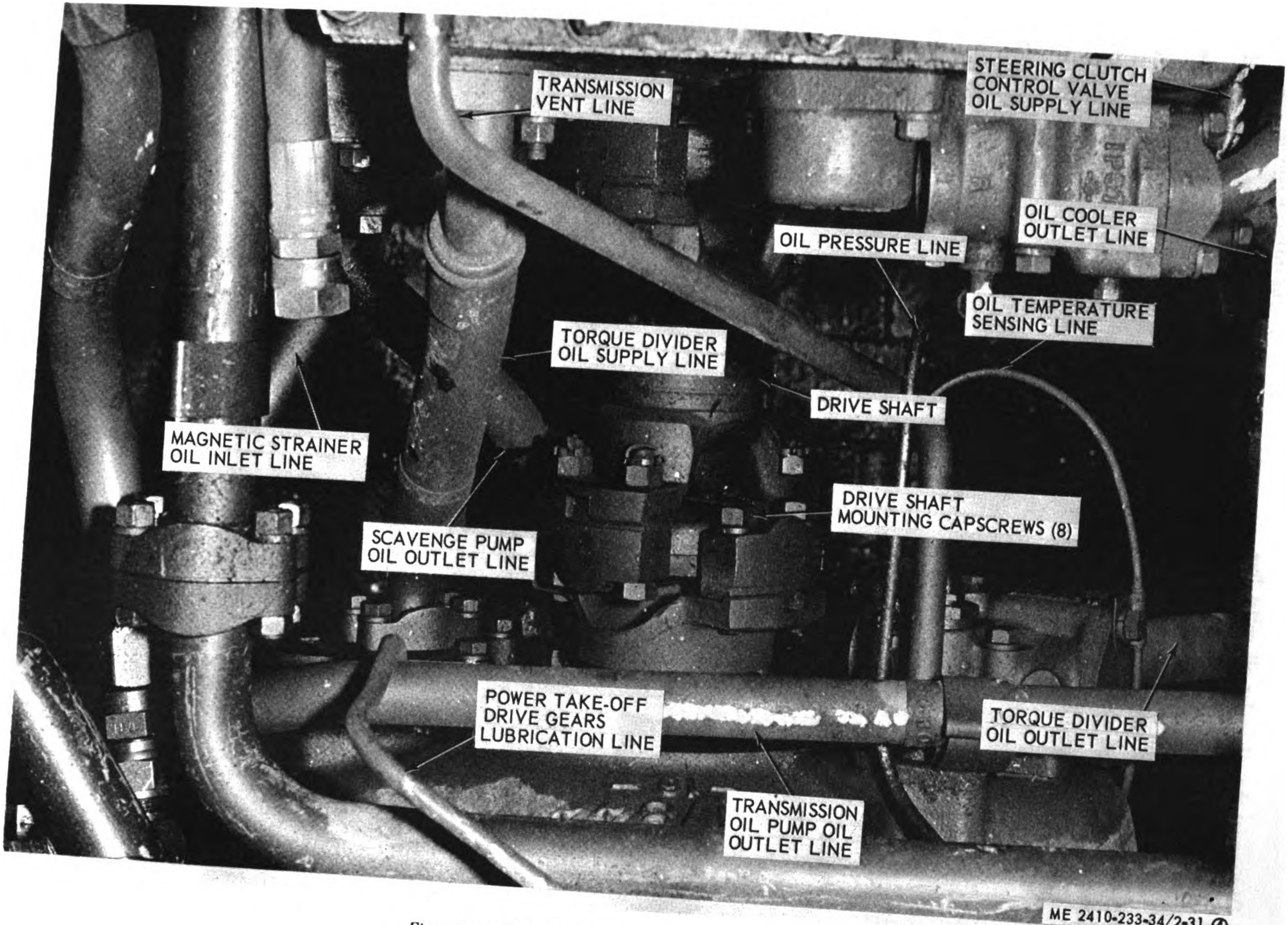


Figure 2-31. Preparing to remove engine (sheet 4 of 6).

(14) Disconnect the oil cooler oil outlet line from the oil cooler (fig. 2-31, sheet 3).

(15) Disconnect the steering clutch control rods at both ends (fig. 2-31, sheet 5) and slide the rods toward the rear of tractor.

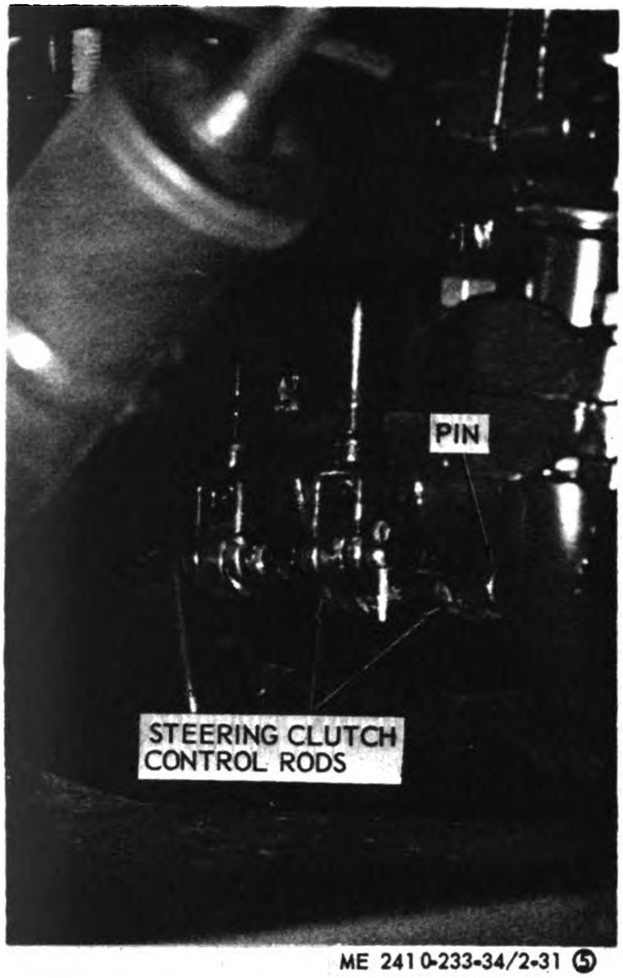


Figure 2-31. Preparing to remove engine (sheet 5 of 6).

(16) Remove the transmission vent line (fig. 2-31, sheet 4).

(17) Remove oil pressure line from engine and transmission.

(18) Remove 8 capscrews and remove the drive shaft.

(19) Disconnect oil temperature sensing line from the torque divider.

(20) Remove the transmission oil pump oil outlet line.

(21) Disconnect the oil outlet line from the scavenge pump.

(22) Disconnect the torque divider oil supply line from the torque divider.

(23) Remove the two engine front support to frame mounting bolts (fig. 2-31, sheet 1).

(24) Remove the four engine rear support-to frame mounting bolts (fig. 2-31, sheet 6). Remove the two dash support brace mounting bolts.

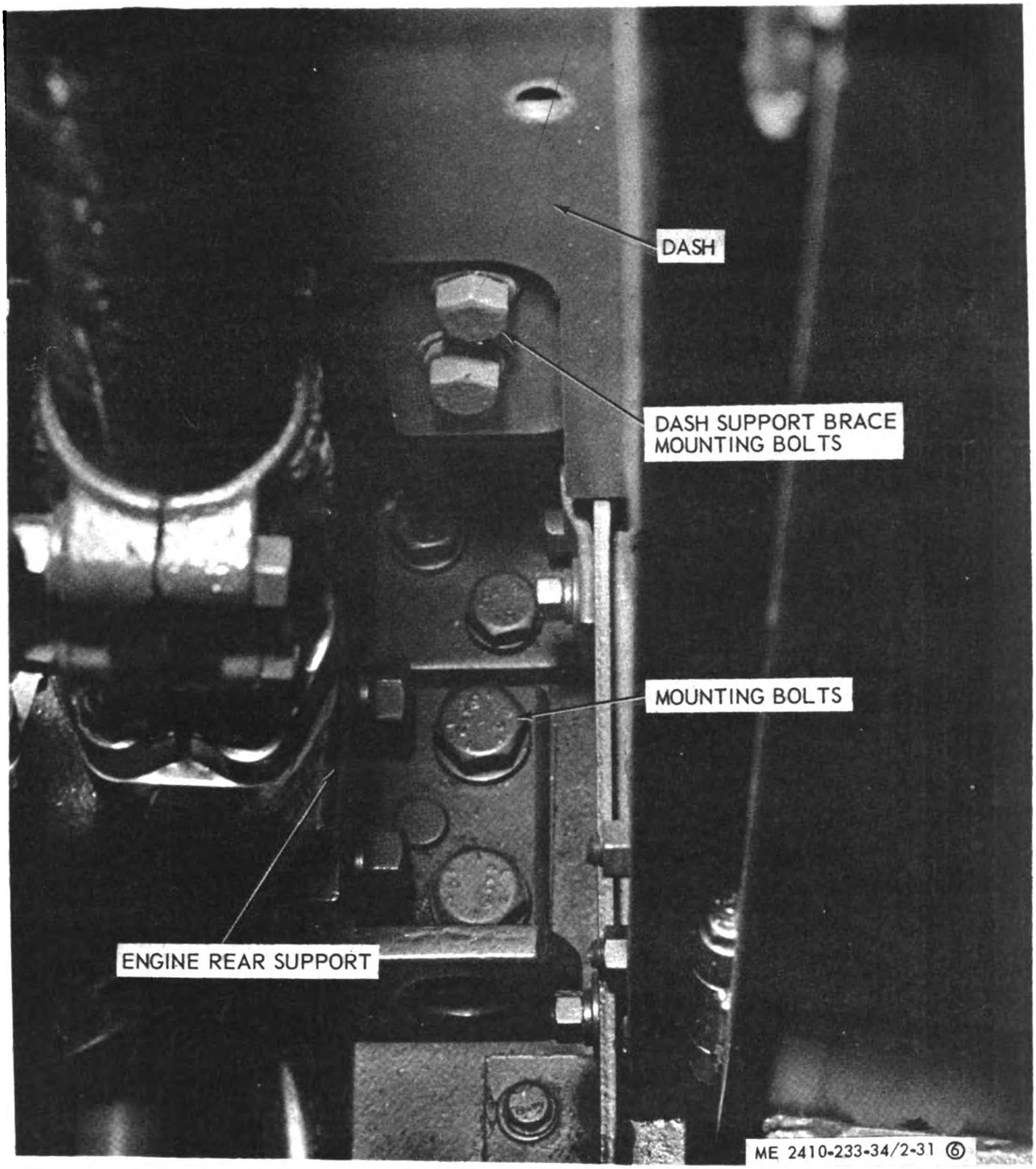
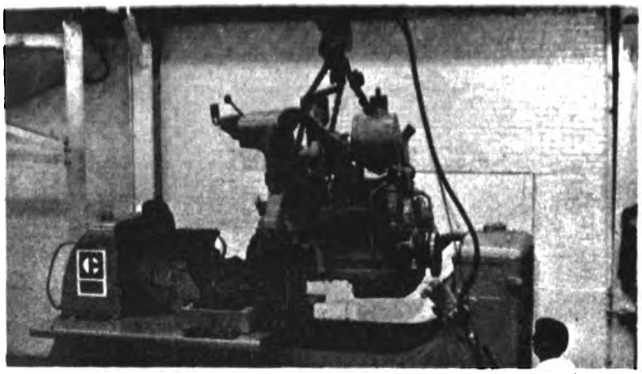


Figure 2-31. Preparing to remove engine (sheet 6 of 6).

(25) Attach a suitable hoist and remove the engine (fig. 2-32).

NOTE
Engine weighs 2700 lbs.



ME 2410-233-34/2-32

Figure 2-32. Engine removal.

b. Installation. Reverse removal procedure and install the engine. Fill cooling system (TM 5-2410-233-20). Fill transmission with oil to specified level (LO 5-2410-233-12).

c. Engine Alignment.

(1) Place the quantity of shims required between the engine supports and the tractor frame in order to align the universal joint as closely as possible.

(2) After installation of the engine and universal joint is complete, a visual check of the alignment can be made while rotating the universal joint.

(3) If universal joint wobbles perceptibly, closer alignment is needed.

d. Misalignment.

(1) Normally misalignment can be corrected by adding or removing shims as necessary between the frame and the engine supports.

(2) If it is necessary to shift the engine from one side to the other in the frame, loosen the holddown bolts and shift the engine accordingly.

(3) If the holes for the holddown bolts are enlarged, dowels should be installed to hold the engine in the proper location after it is bolted down.

(4) Extreme misalignment is probably the result of bent main frame channels, in which case they should be replaced. Extreme wear in the engine front support will also cause misalignment.

2-9. Transmission

a. Removal.

(1) Remove the brake pedal assembly (para 6-30).

(2) Drain oil from transmission (LO 5-2410-233-12).

(3) Disconnect wiring from the disconnect switch mounted on the seat frame assembly (fig. 2-33, sheet 1).

(4) Disconnect the transmission hydraulic control linkage (fig. 6-71) from the seal frame assembly.

(5) Remove the seat frame assembly mounting bolts (fig. 2-33, sheet 1). Attach a hoist and remove seat frame assembly.

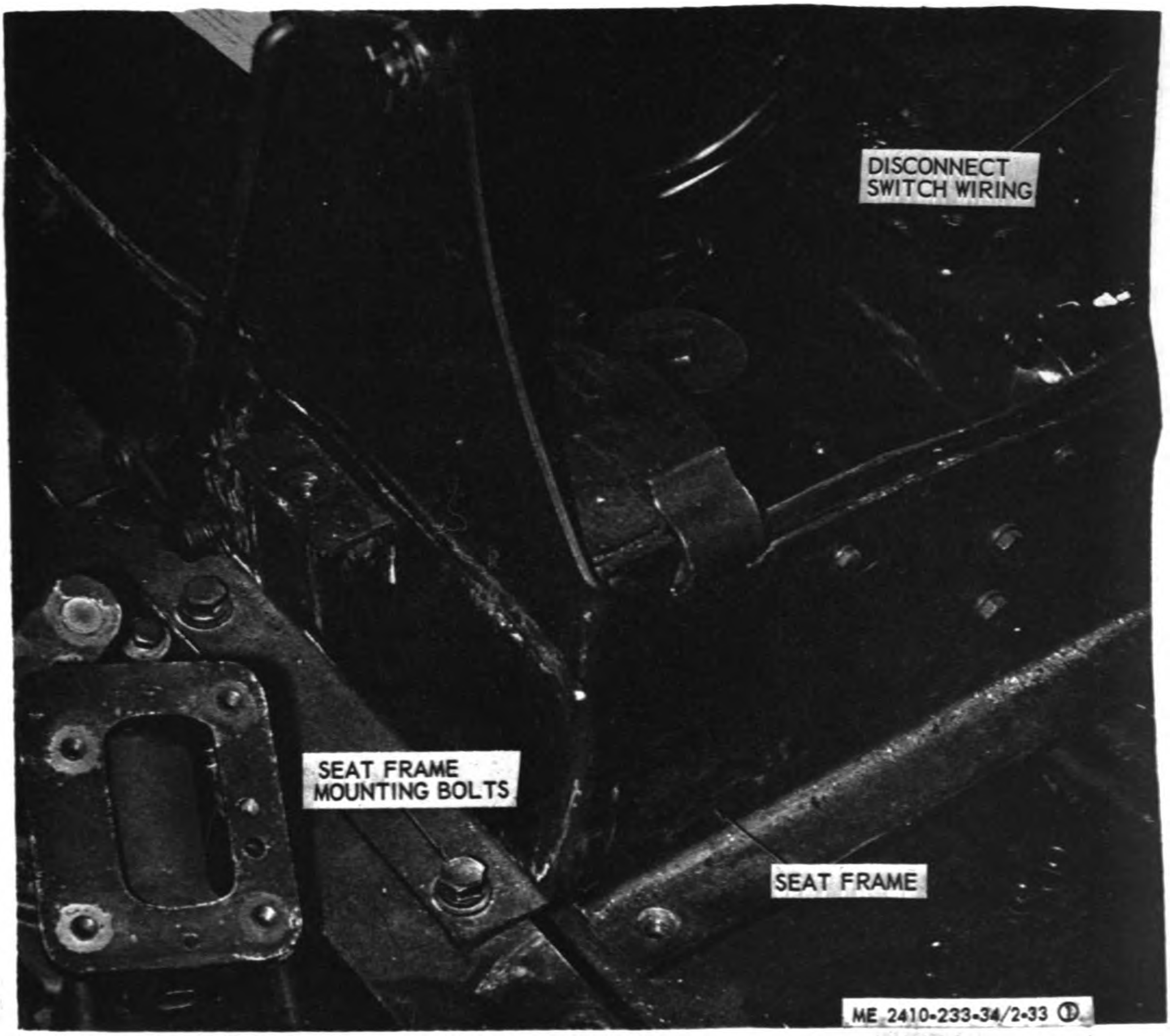


Figure 2-33. Preparing to remove transmission (sheet 1 of 3).

(6) Remove transmission vent line (fig. 2-33, sheet 2).

(7) Remove the torque divider oil supply line and the scavenge pump oil outlet line (fig. 2-31, sheet 4).

(8) Disconnect oil temperature sensing unit from the torque converter.

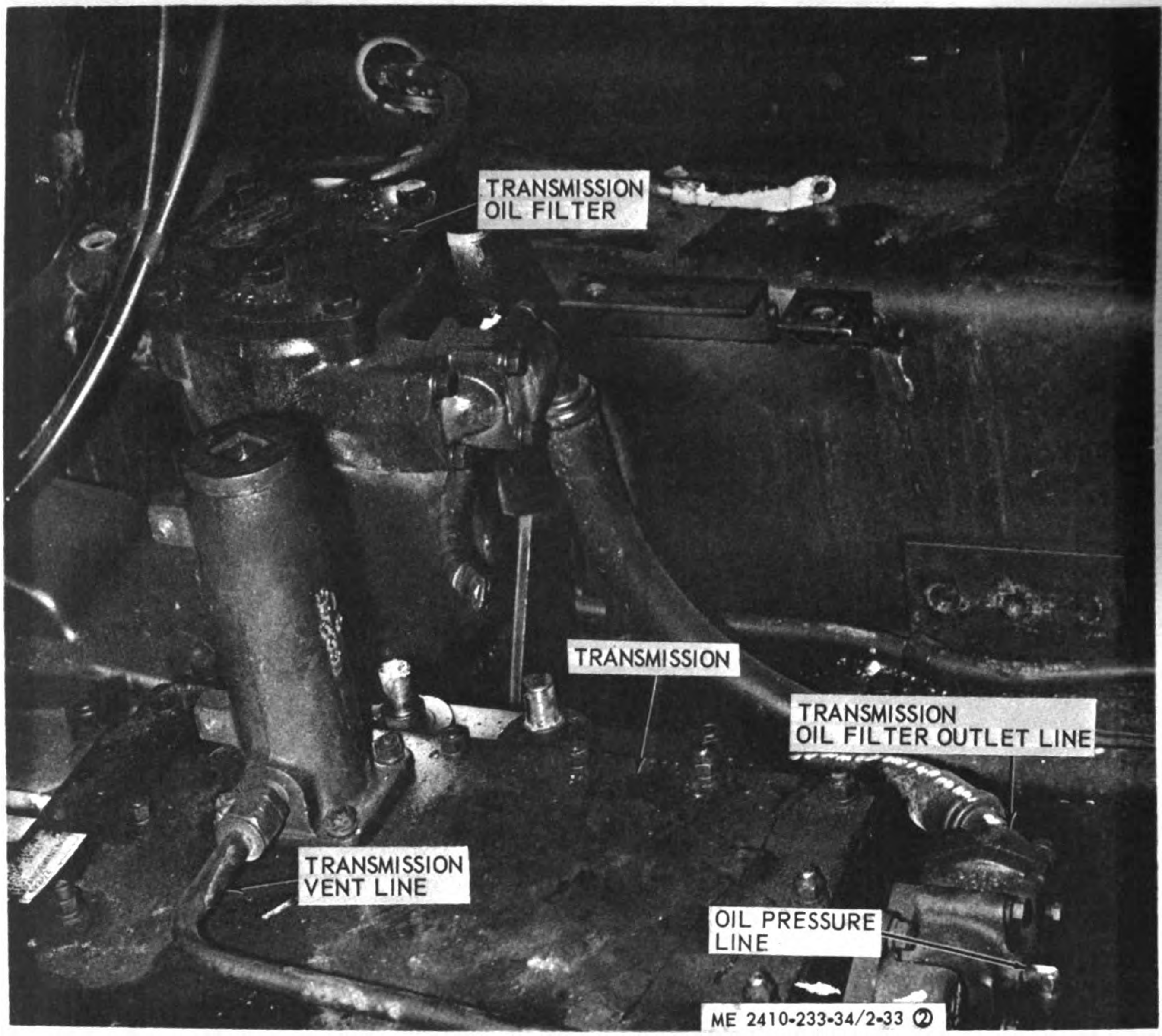


Figure 2-33. Preparing to remove transmission (sheet 2 of 3).

(9) Remove 8 capscrews and remove the drive shaft.

(10) Disconnect the transmission oil filter oil outlet line and oil cooler oil outlet line from transmission (fig. 2-33, sheet 2).

(11) Remove the steering clutch control valve oil supply line (fig. 2-31, sheet 4).

(12) Disconnect magnetic strainer oil inlet line from transmission. Loosen one hose clamp, and rotate oil line out of way.

(13) Disconnect oil pressure line from transmission.

(14) Install four ¾ in. - 10 NC eyebolts in top of transmission, and attach a hoist. Remove the transmission mounting bolts (fig. 2-33, sheet 3).

Figure 2-33. Preparing to remove transmission (sheet 3 of 3).

(15) Remove the transmission from tractor.

b. Installation. Reverse removal procedure and install the transmission in tractor. Fill transmission with oil to specified level (LO 5-2410-233-12).

CHAPTER 3

REPAIR OF EARTH MOVING EQUIPMENT AND WINCH

Section I. BULLDOZER

3-1. General

The bulldozer group includes the bulldozer blade assembly, braces, push arm assembly and trunnions. The bulldozer blade assembly includes the moldboard, cutting edge, and end bits. Scarifiers are mounted on the back of the moldboard. The bulldozer hydraulic system (chapter 4) furnishes lift and tilt control for the bulldozer.

3-2. Moldboard (Blade) Assembly (fig. 3-1)

a. *Removal.* Refer to TM 5-2410-233-20 and remove the moldboard (blade) assembly.

b. *Cleaning.* Scrape, wash and clean moldboard thoroughly with hot water. Remove oily deposits with cleaning solvent (Fed. Spec. P-D-680).

c. *Inspection.*

(1) Inspect moldboard for broken weldments, cracks, wear and distortion. Weld minor cracks (TM 9-237) or replace an excessively damaged moldboard (blade) assembly.

(2) Inspect the attaching hardware for breaks or damaged threads. Replace all defective hardware.

d. *Installation.* Refer to TM 5-2410-233-20 and install the moldboard (blade) assembly on the bulldozer.

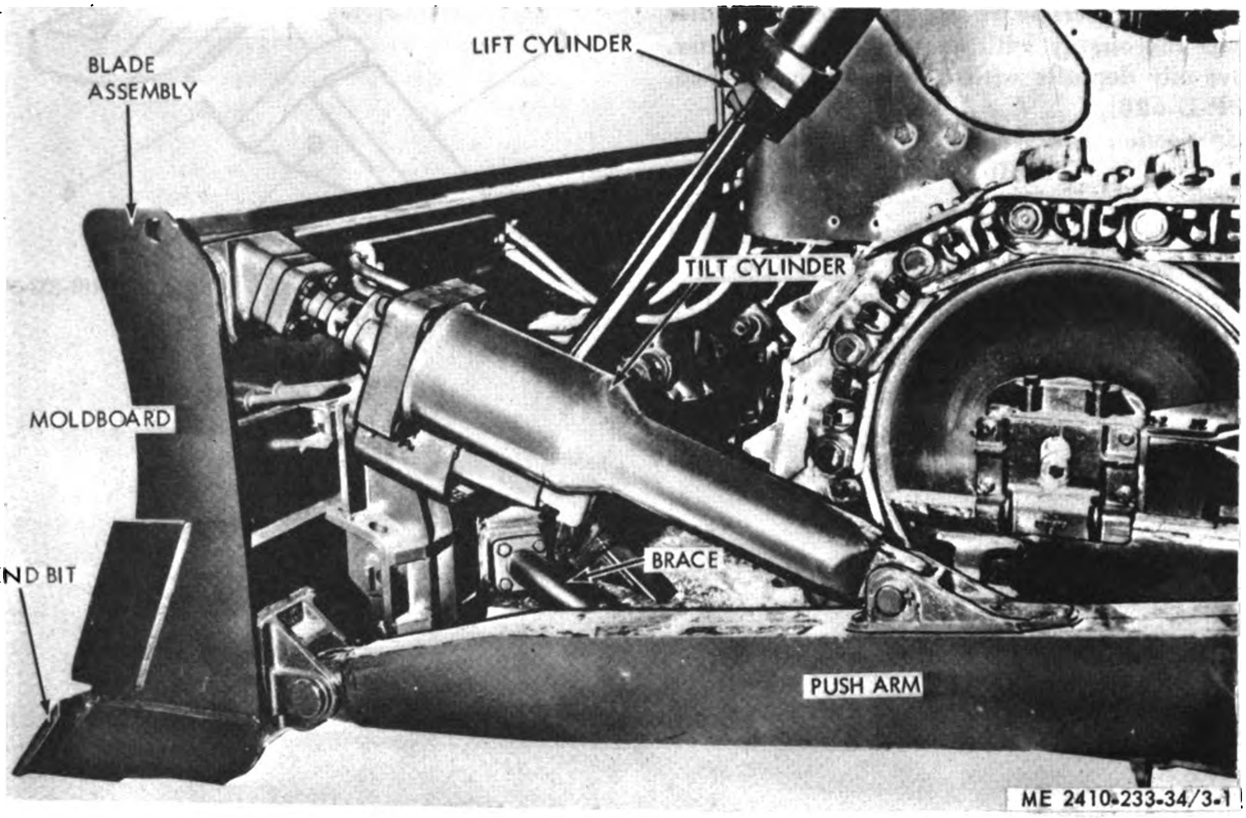


Figure 3-1. Bulldozer blade assembly.

3-3. Push Arms and Braces (fig. 3-1)

a. Removal. Refer to TM 5-2410-233-20 and remove the push arms and braces from bulldozer.

b. Cleaning. Scrape, wash and clean all parts thoroughly with soap and warm water. Remove oily deposits with cleaning solvent (Fed. Spec. P-D-680).

c. Inspection and Repair.

(1) Inspect arm assemblies for broken weldments, cracks, bends and damage to trunnions. Weld broken weldments and cracks (TM 9-237).

(2) Inspect caps, bearings, and pivots for wear, corrosion or damage.

(3) Inspect the links for cracks, distortion and wear.

(4) Inspect brace assembly for wear, bends and damaged screw threads.

(5) Replace all defective parts.

d. Installation. Refer to TM 5-2410-233-20 and install the push arms, and braces on the bulldozer.

3-4. Scarifiers (fig. 3-2)

a. Removal. Refer to TM 5-2410-233-20 and remove the scarifier housings.

b. Cleaning. Scrape, wash and clean scarifier housings thoroughly with soap and warm water. Remove oily deposits with cleaning solvent (Fed. Spec. P-D-680).

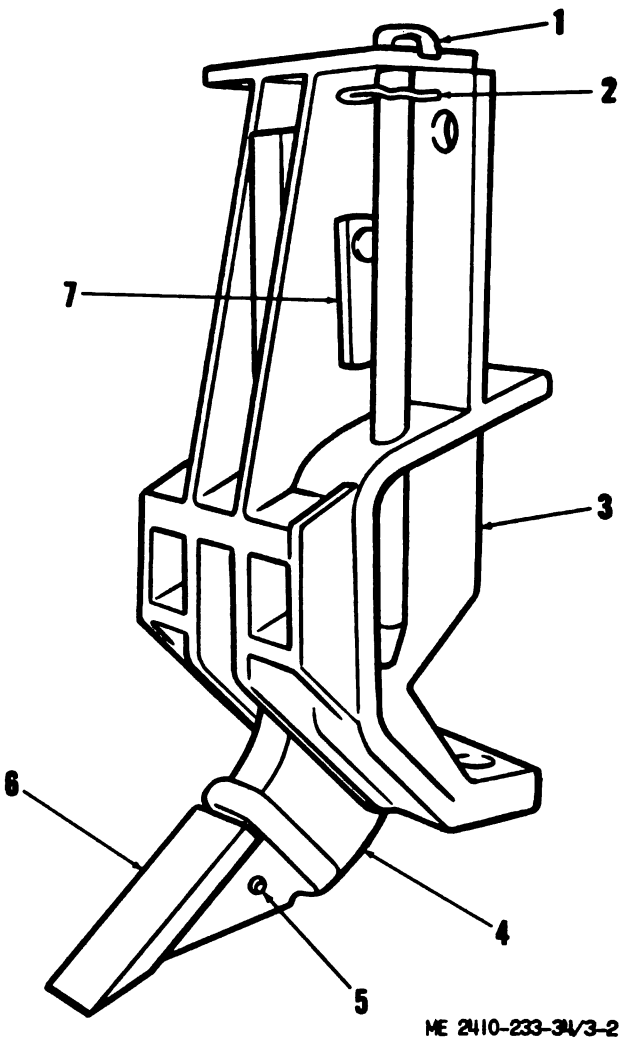
c. Inspection and Repair.

(1) Inspect scarifier housing for cracks, distortion, or wear.

(2) Weld minor cracks in housing (3, fig. 3-2) according to TM 9-237.

(3) Replace a defective housing (3), shank (4), tooth (6), or lock rod (1).

d. Installation. Refer to TM 5-2410-233-20 and install the scarifier on the bulldozer.



1 Lock rod
2 Lock pin
3 Housing
4 Shank
5 Pin
6 Tooth
7 Hinge pin

Figure 3-2. Scarifier.

3-5. General

The ripper is rear mounted and is hydraulically operated by a control lever located to the right of the operator's seat (TM 5-2410-233-20). The ripper has three detachable teeth. One, two, or three teeth may be used as working conditions permit. The hydraulic pump supplies (chapter 4) power for ripper raising and lowering operations.

3-6. Removal and Disassembly

a. Refer to TM 5-2410-233-20 and remove the ripper from the tractor.

b. Attach a hoist to cylinder assembly.

c. Pull pins (fig. 3-3) far enough to allow cylinder removal and still support beam assembly.

d. Remove the pins on the opposite ends of link arm and beam assembly removed in *a* above.

e. Remove partially removed pins and remove the link arm and beam assembly from ripper.

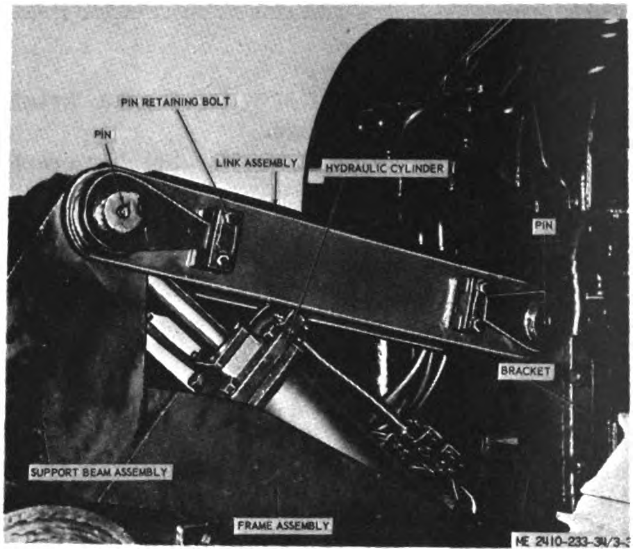


Figure 3-3. Hydraulic cylinder, link arm, and beam assembly, removal and installation.

3-7. Cleaning

Clean all parts with soap and warm water. Remove oily deposits with cleaning solvent (Fed. Spec. P-D-680).

3-8. Inspection

(1) Inspect ripper surfaces for cracks, breaks, excessive wear and damage.

(2) Inspect hydraulic hoses for breaks, cracks, kinks, or a damaged connector. Replace a defective hose.

(3) Inspect tips and protectors for wear and damage. Replace a worn or defective tip or protector (TM 5-2410-233-20).

(4) Inspect all pins for wear, fatigue and peening.

3-9. Reassembly and Installation

Reverse removal and disassembly procedure to reassemble and install the tripper on the tractor.

Section III. WINCH

3-10. General

The power-shift winch is a single drum unit that mounts on the rear face of the tractor bevel gear case, and is driven by a power takeoff shaft from the tractor transmission. The winch clutches (forward and reverse) and the brake are hydraulically actuated. A separate hydraulic pump supplies power for clutch and brake operation. The control valve is in the winch and is operated by cables which are connected to the two, lever control mounted near the operator's seat.

3-11. Removal

Refer to TM 5-2410-233-20 and remove the winch, winch pump, and winch controls.

3-12. Winch Pump

a. General. The pump contains two steel gears, a drive and driven shaft, and four bearing assemblies. The machined covers support the gear shafts and are provided with oil seal rings. When servicing the pump, extreme care must be taken to prevent foreign matter from entering the unit and causing damage to the machined surfaces.

b. Disassembly.

(1) Refer to figure 3-4 and remove the eight bolts, screws, and washers and lift cover from body. If cover sticks, tap lightly with rawhide mallet.

(2) Cover bearings may remain in either the body or cover, but should be match marked in their respective locations for reassembly.

(3) Remove relief valve spring and ball from cover.

(4) Identify gears with match marks for correct reassembly.

(5) Remove oil seal from body assembly using an arbor press and suitable dowel rod.

c. Cleaning. Wash all parts in a cleaning solvent (Fed. Spec. P-D-680) and dry with filtered compressed air.

d. Inspection and Repair.

(1) Inspect gears for chipping or evidence of wear.

(2) Inspect bearing bore for scoring or wear.

(3) Inspect bearing surfaces for deep grooving or scoring and refinish if necessary. Bearing surfaces may be dressed on a piece of fine abrasive paper held to a true flat surface plate. Do not dress enough to remove oil groove.

(4). Check bearing flats and bearing for wedging in their respective covers. If bearings wedge in the covers or new bearings are installed, proceed as follows: Hold the bearings at extreme ends of a discarded gear shaft from which the teeth have been removed and dress the flats lightly against a piece of fine abrasive paper held to a true flat surface plate. Dress a little at a time and repeat. Check in the cover until the bearings slide into place freely. The clearance between the flats, when assembled in their cover, should not exceed 0.005 to prevent turning of the bearing, resulting in lowering the pump efficiency.

(5) Inspect relief valve ball and seat in cover for grooving.

e. Reassembly.

(1) Lubricate drive gear journal with HDO 10 oil before installing through shaft seal.

(2) Discard all rubber seal rings.

(3) Press a new seal assembly into the body with an arbor press, taking care that seal enters at right angles to the body recess and does not damage the body.

(4) Insert body bearings in their previously match-marked positions.

(5) Insert drive gear into body bearing.

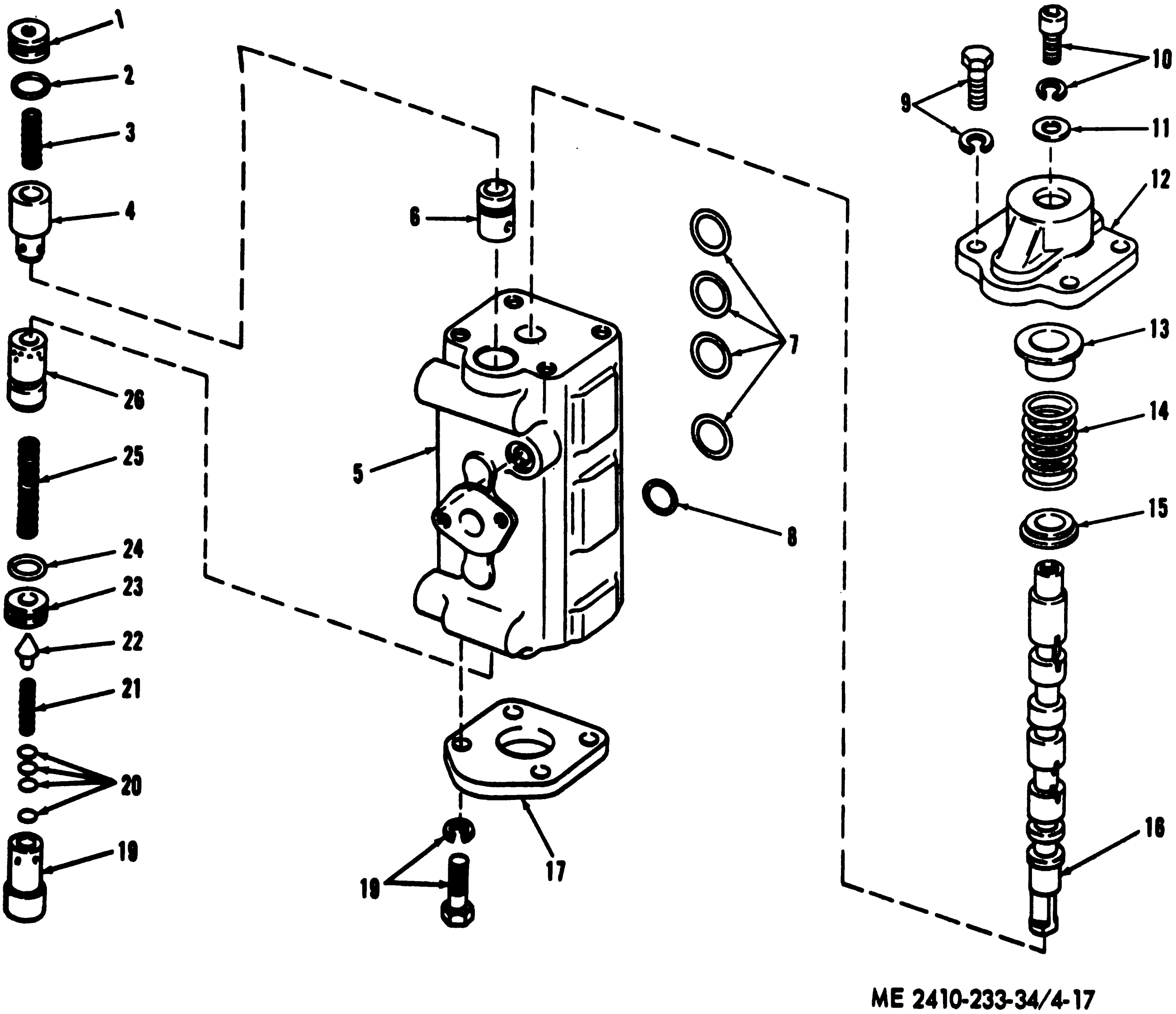
(6) Insert driven gear into body bearing at the same position from which it was removed. (Do not invert driven gear.)

(7) Slide cover bearings on gear journals in their previously match-marked positions.

(8) Insert seal ring in body recess.

(9) Insert relief valve ball and spring body, tapping lightly to insure seating.

(10) Secure cover to body with the eight screws torqued to 28—32 foot-pounds.



1	Bolt	13	Gasket
2	Capscrew	14	Spacer
3	Lockwasher	15	Seal
4	Washer	16	Cover
5	Cover	17	Seal
6	Seal	18	Gasket
7	Body	19	Bracket
8	Bearing	20	Gasket
9	Gear	21	Setscrew
10	Key	22	Coupling
11	Gear	23	Ring
12	Bearing		

Figure 3-4. Winch hydraulic pump, exploded view.

3-13. Winch Control Valve

a. Removal.

(1) Remove valve cover setscrews ((1), fig. 3-5) and loosen push-pull cable locknuts on the valve spools.

(2) Remove cables from handlever bracket on tractor and unscrew the cable ends from the valve spools by turning the free ends of the cables "B".

(3) Remove the pump supply hose (3) and nipple (4).

(4) Remove the valve cover.

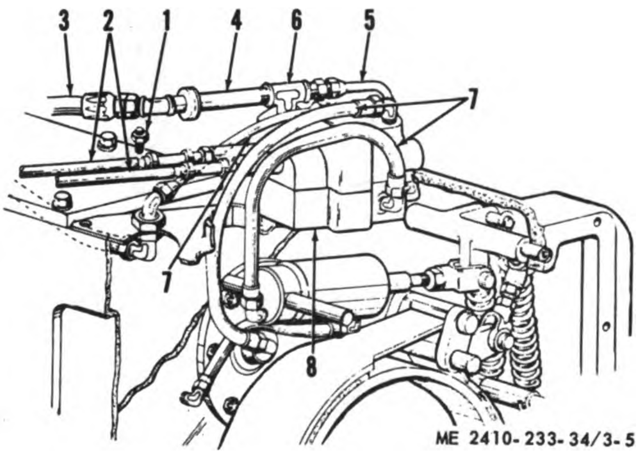
(5) Detach tube assembly (5) and remove tee (6).

(6) Disconnect the clutch and brake hoses (7).

(7) Remove socket head capscrews attaching valve (8) to winch.

(8) Remove valve (8) from winch. Remove or secure the preformed packing that seals between the valve and the winch. Be sure preformed packing is replaced when reinstalling valve on winch to avoid seepage around base of control valve.

(9) Reverse above procedure for valve installation and check for proper stroke adjustment between the push-pull cables and spools.



1 Setscrew
2 Cable
3 Hose
4 Nipple
5 Tube assembly
6 Tee
7 Hose
8 Valve

Figure 3-5. Control valve removal.

b. Disassembly and Reassembly.

(1) *Selector spool removal.*

NOTE

This may be accomplished without removing the valve body ((29), fig. 3-6) from the support (30).

(a) Remove the snap ring (12), washer (11) and spring (10).

(b) Remove the plug (23), spring (24) and ball (25).

(c) Remove the spool (7), by pushing the rod end through the valve body as shown.

CAUTION

Do not pull the rod end of the spool after the ball (25) has been removed or the preformed packing (8) on the spool will come in contact with a dump port and be damaged.

(2) *Selector spool inspection and reinstallation.*

(a) Inspect for nicks on the spool. Light nicks may be removed by lapping but if there are deep nicks spool must be replaced.

(b) Replace preformed packings (8) and (9).

(c) Use a light oil on all parts before reassembly. Install preformed packing (9) and install spool in reverse manner from removal. Preformed packing (8) is replaced last and does not pass over port.

CAUTION

Do not pull on spool (7) to get preformed packing (8) compressed into spool bore. Tap end of spool to accomplish this, and avoid overtravel causing damage to preformed packing (8) in internal ports.

(3) *Brake inching spool removal.*

(a) Plug (16) or spring (15) may be removed without removing the inching spool (13) by removing snap ring (17).

(b) To remove spool (13) remove capscrews (5) and detach the valve body (29) from the support (30).

(c) Remove the spool stop capscrew (18) on the under side of the valve body while pressing gently on the inching spool to take the load off the stop.

(d) Remove the spool and return spring (14).

(4) *Inching spool inspection and assembly.*

(a) Check bore and spool (13) for dirt or nicks. Remove light nicks by lapping. Deep nicks necessitate new parts.

(b) Oil all parts generously. Place new preformed packing firmly in groove and install spring (14) and spool. Tap spool gently to pass over preformed packing and while holding in position, replace spool stop capscrew (18).

(c) Clean out socket for travel spring (15), grease lightly and replace spring and cable plug (16).

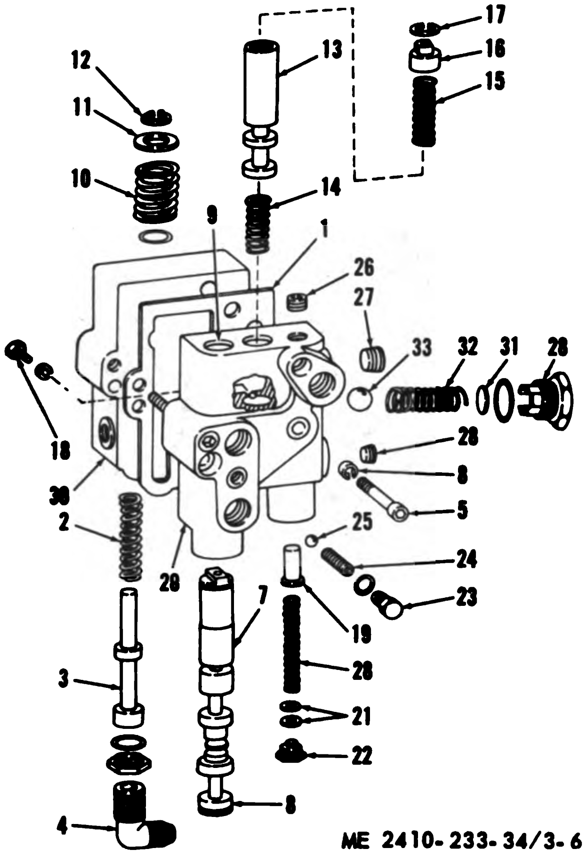
(5) *Relief valve and quick release valve.*

(a) Remove retainer (22), washers (21), spring (20), and piston (19). The washers (21) regulate relief valve pressure. Add washers to

increase pressure, remove washers to decrease pressure. The relief valve is as follows: 225 psi at 6½ gpm—1,000 rpm—Oil Temperature 70°.

(b) To check quick release valve spring (2), remove fitting (4) and piston (3).

(c) After checking and cleaning all parts thoroughly, lubricate with SAE No. 10 engine oil and assemble in the reverse order of disassembly. Replace pistons (19) and (3) with new parts if there are deep nicks, and remove light nicks by lapping.



ME 2410-233-34/3-6

1	Gasket	18	Capscrew
2	Spring	19	Piston
3	Piston	20	Spring
4	Fitting	21	Washers
5	Capscrews	22	Retainer
6	Spacer	23	Plug
7	Spool	24	Spring
8	Preformed packing	25	Ball
9	Preformed packing	26	Plug
10	Spring	27	Plug
11	Washer	28	Retainer
12	Snapring	29	Valve body
13	Spool	30	Support
14	Spring	31	Washer
15	Spring	32	Spring
16	Plug	33	Ball
17	Snapring		

Figure 3-6. Winch control valve, exploded view.

3-14. Winch Disassembly

a. Power Takeoff Assembly Removal. Unbolt the power takeoff bearing carrier (fig. 3-7) and remove the complete power takeoff assembly. Be careful not to damage shims behind bearing carrier.

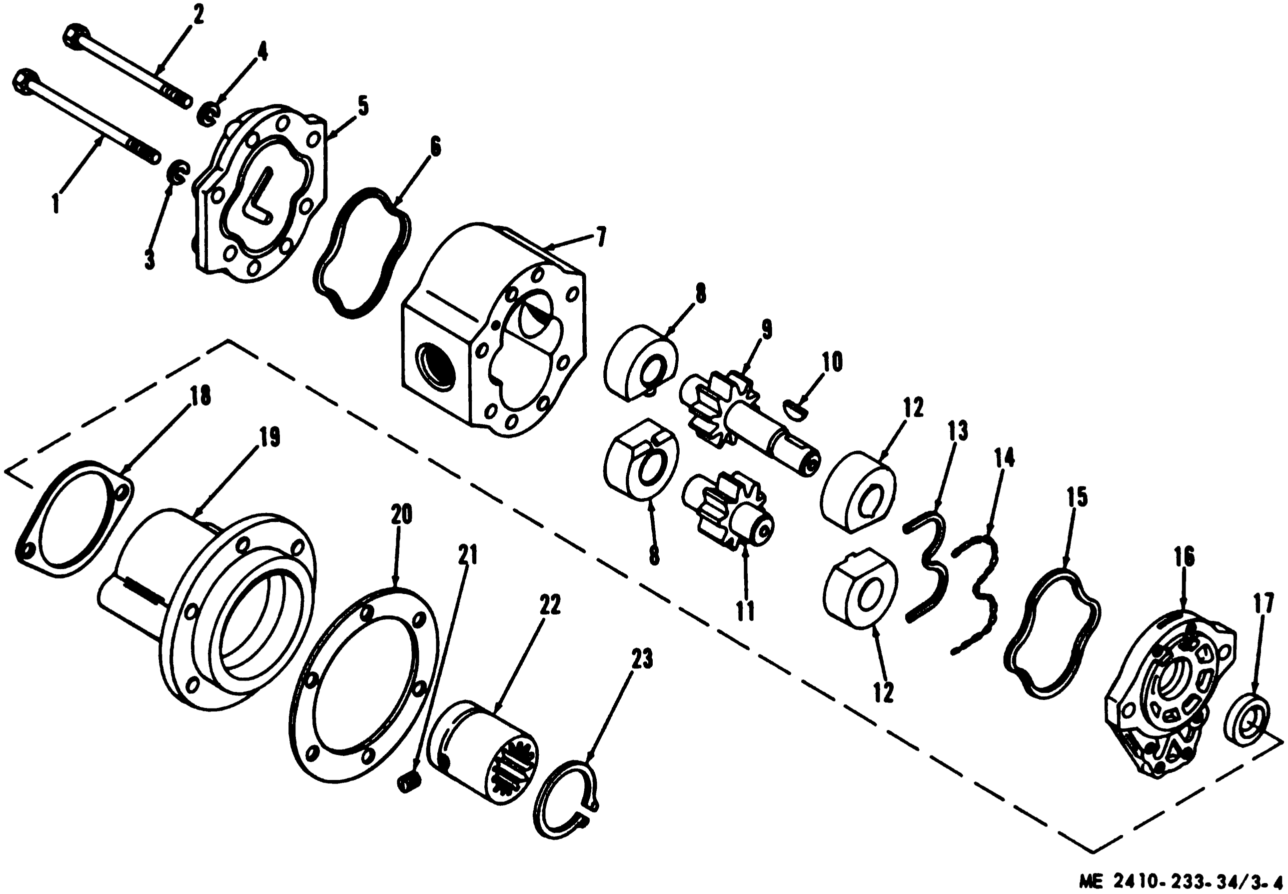


Figure 3-7. Power takeoff bearing carrier and brake drum, removal and installation.

b. Brake Band Removal.

(1) Remove both covers on lh side of winch (fig. 3-7).

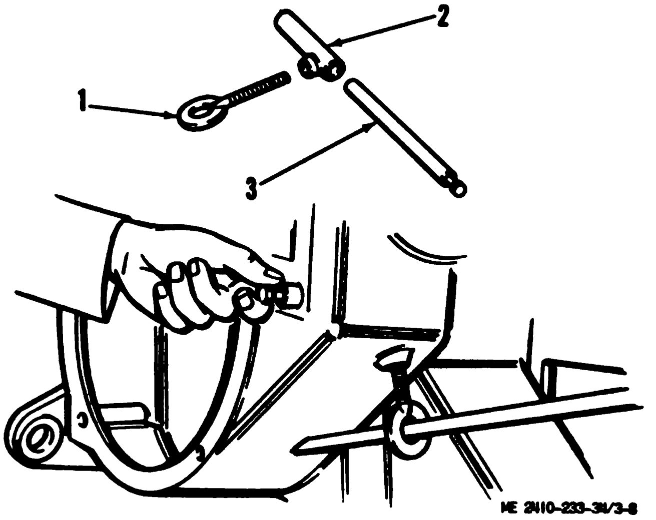
(2) Release brake (subpara *c* (2) below).

(3) With brake band in released position, remove snap ring.

(4) Remove pins and slide the drum from the shaft with the brake band and crank attached.

c. Brake Shaft Removal.

(1) To remove brake springs, remove pipe plug from housing and insert an eyebolt as shown in figure 3-8.



1 Eyebolt
2 Sleeve
3 Pin

Figure 3-8. Brake shaft removal.

(2) Thread eyebolt (1) into spring anchor sleeve (2) and, using a pry bar as shown (to relieve tension on spring), remove anchor pin (3).

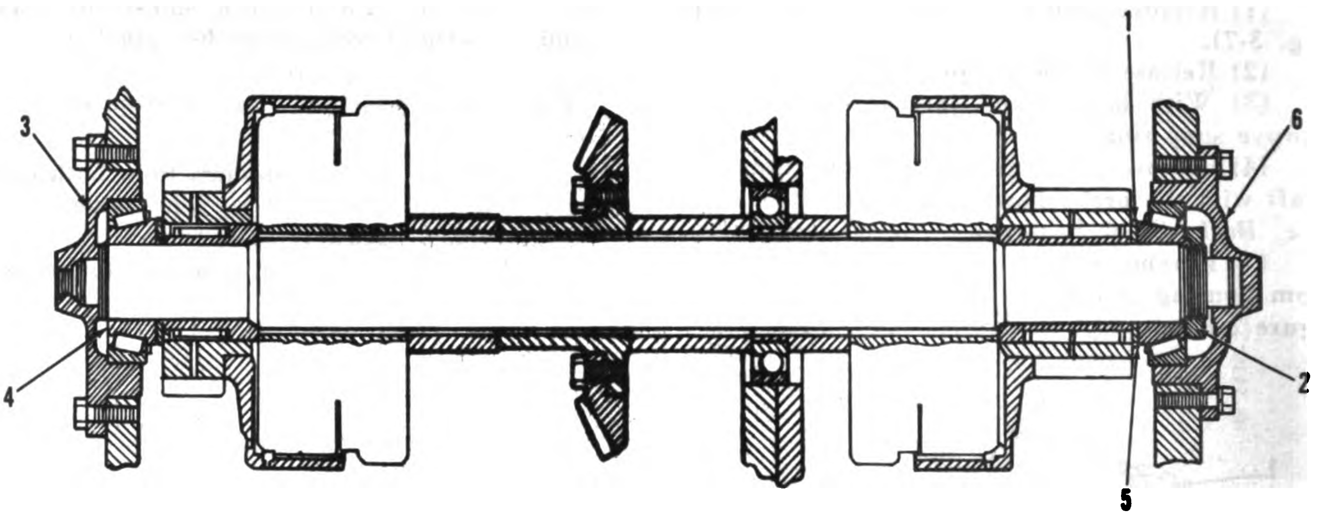
NOTE

Eyebolt may be made by welding a cut washer to a ½ UNF x 4-inch capscrew.

(3) Remove bearing retainers from both ends of shaft through opening in rh side frame.

d. Bevel Gear Shaft Removal.

(1) Disconnect the hydraulic line to bearing retainer ((3), fig. 3-9).



1 Washer
2 Nut
3 Retainer
4 Snapring
5 Snapring
6 Retainer

Figure 3-9. Bevel gear shaft, cross sectional view.

(2) Remove bearing retainer taking care to protect shims.

(3) Remove the rh bearing retainer (6).

(4) Loosen bearing nut (2) enough to permit removal of snap ring (4).

(5) Replace bearing retainer (3) for support. (If drum is to be removed, remove lh drum shaft nut).

(6) Turn winch on its left side.

(7) Remove the top side frame cover and disconnect the hydraulic line.

(8) Remove bearing nut ((2), fig. 3-9).

(9) Slide roller bearing and the spacer washer (1) from the shaft.

(10) Remove the internal snap ring (4) retaining the bearing and clutch drive gear as shown in figure 3-10.

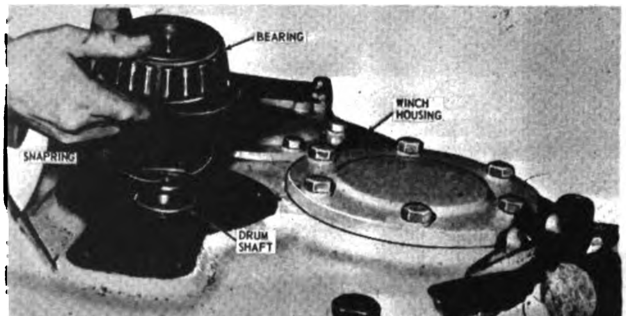


Figure 3-10. Bearing and clutch drive gear removal.

(11) Insert a ⅝ inch (UNF) bolt (with a ring or washer welded to it) into the threaded end of the bevel gear shaft.

(12) Pull shaft slowly as shown in figure 3-11.

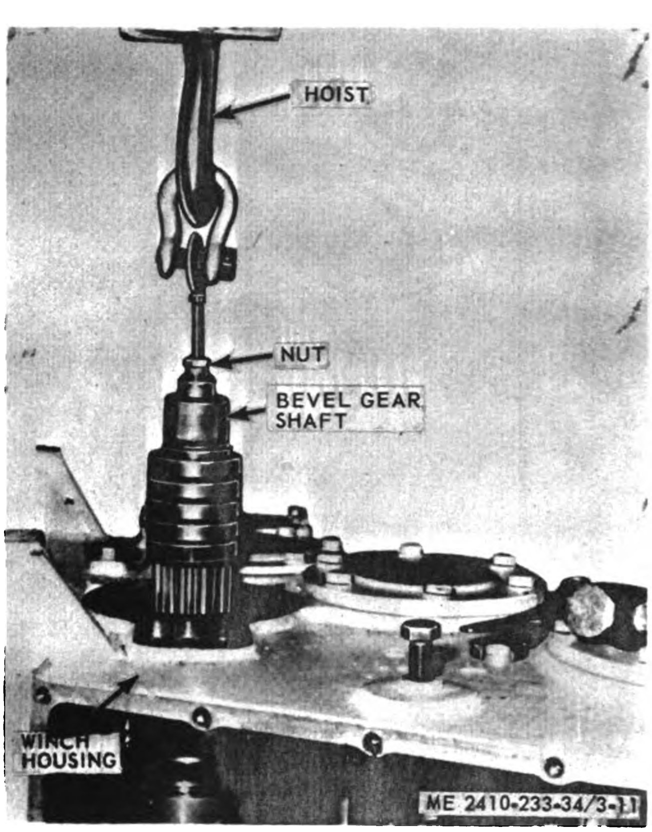


Figure 3-11. Bevel gear shaft removal.

(13) Do not pound or drive on the ends of the bevel gear shaft.

(14) Slide the shaft completely away from the unit freeing all component parts on the shaft.

e. Intermediate Shaft Removal.

(1) Remove bearing retainer.

(2) Insert puller screw in shaft.

(3) Pull shaft.

(4) Remove intermediate gear and drum pinion shown in figure 3-12.

Figure 3-12. Intermediate gear and drum pinion removal.

f. Drum Shaft Removal.

(1) Unscrew drum shaft nut.

(2) Remove bearing retainer shown in figure 3-13.

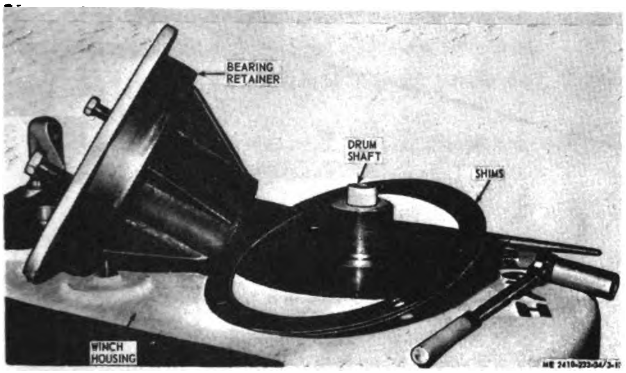


Figure 3-13. Bearing retainer removal.

(3) Remove place bolts in drum gear.

(4) Rethread nut on shaft.

(5) Sling shaft using nut.

(6) Pull shaft straight up as shown in figure 3-14.

NOTE

Place pan under drum shaft to catch oil that is in the drum. Be sure to add two quarts of oil to drum at reassembly.

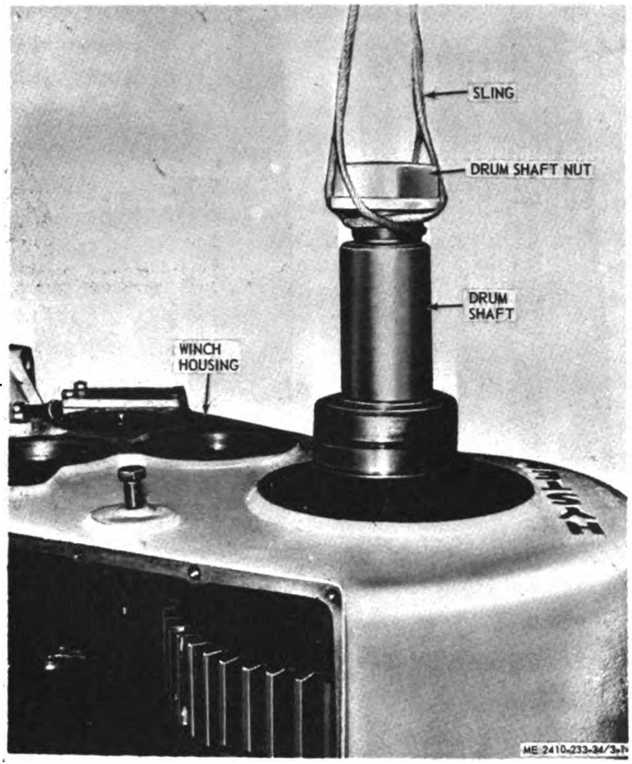


Figure 3-14. Drum shaft removal.

g. Clutch Disassembly.

(1) Overheating due to slipping or lack of cooling oil will cause most damage to the discs and separator plates. Overheating causes both parts to warp which causes clutch drag. The clutch discs are flat. The separators are hardened steel with a slight dish built into them as shown in figure 3-15.

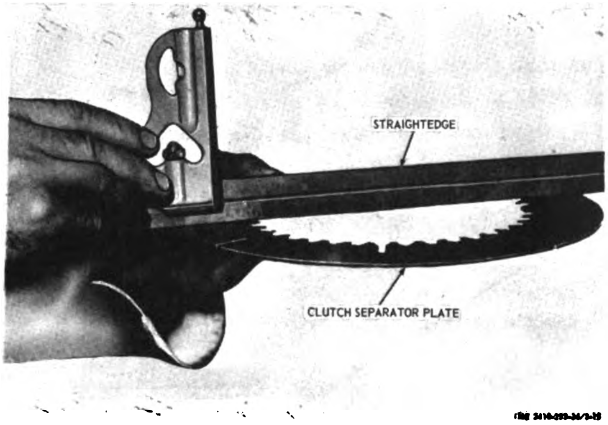
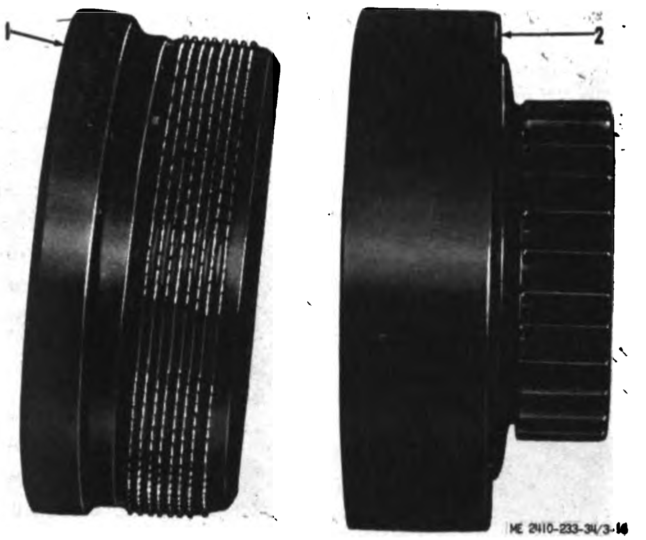


Figure 3-15. Clutch separator plates.

NOTE

THE HYDRAULIC CLUTCH MUST BE SERVICED IN A CLEAN AREA. The clutch pack contains two parts: The clutch ((1), fig. 3-16) contains friction discs and separator plates, and the clutch spider (2). The two parts are not fastened together and may be separated by sliding them apart as shown. The clutch is held together by six flathead capscrews that are locked on the back side by six setscrews.



1 Clutch
2 Spider

Figure 3-16. Hydraulic clutch.

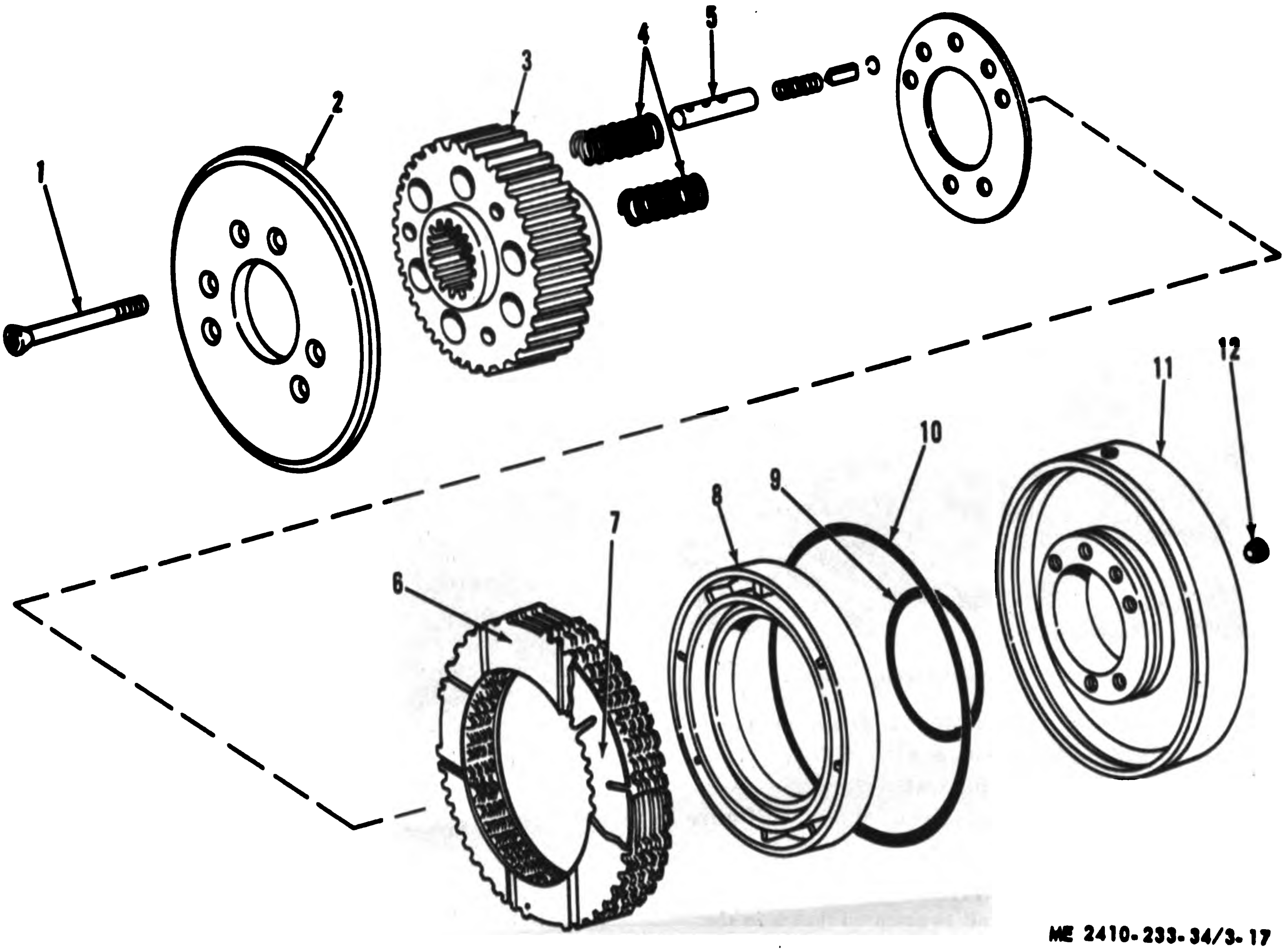
(2) Remove the setscrews ((12), fig. 3-17).

(3) Turn clutch over and remove flathead capscrews (1), remove end plate (2), exposing the clutch discs (6) and return springs (4).

(4) Lift discs (6) and separator plates (7) from the drive hub (3).

(5) Lift drive hub (3) and clutch piston (8) from retainer plate (11).

(6) The cross drilled stud with three holes is the cooling valve (5). Remove by unscrewing to the left and disassemble for cleaning.



1	Capscrew	5	Valve body	9	O-ring
2	Plate	6	Discs	10	O-ring
3	Hub	7	Plates	11	Plate
4	Spring	8	Piston	12	Setscrew

Figure 3-17. Hydraulic clutch, exploded view.

h. Inspection and Repair.

(1) Inspect bearings for corrosion, roughness, and wear. Replace corroded, rough, or excessively worn bearings (para 2-6).

(2) Inspect all gears for chipped, pitted, cracked, or excessively worn teeth. Replace gears which are chipped, cracked or excessively worn or pitted. TB-ENG-364 may be used as a guide for determining gear replacement.

(3) Inspect housing and covers for cracks, breaks and other damage. Repair by welding (TM 9-237), or replace the part.

(4) Inspect clutch disks for scoring, cracks, damaged teeth, warpage, or a burned blue-black appearance. Replace burned, warped, or excessively worn disks. Replace disks which have:

(a) Chipping on the edge of the disk.

(b) Cracks at the root of any of the teeth.

(c) Worn teeth only when wear has obviously changed tooth contour.

(d) Excessive foreign material imbedded in the face.

3-15. Winch Reassembly

a. Clutch Reassembly.

NOTE

Reassembly is opposite of disassembly. Observe the following precautions during reassembly.

(1) Dish in separator plate must all face same way as a unit. The direction of the unit is unimportant.

(2) The forward and reverse clutch packs are interchangeable but the spiders are not.

(3) Never assemble a clutch pack dry. Presoak all parts in oil.

(4) Small parts and passages must be free of dirt and foreign matter.

(5) When sliding the clutch piston into the retainer plate, be certain that the O-rings (9) and (10) are well lubricated and are seated in their respective grooves.

(6) When assembled, the holes in the clutch hub will be in line with the oil cooling valve.

(7) Blanked out teeth on friction discs ((6), fig. 3-17) must be in line.

(8) Assembled clearance to be from 0.040 inch to 0.070 inch. Use shims as required.

(9) Torque capscrews (1) with 70 ft-lb, setscrews (12) with 40 ft-lb.

b. Drum Shaft Assembly.

(1) Check all oil seals and install drum and drum shaft.

(2) Add two quarts of HDO 30 oil to drum cavity before installing rh bearings.

(3) Bolt drum gear to drum torquing the bolts to 146 ft-lb lubed or 225 ft-lb dry.

c. Intermediate Shaft Assembly. Install intermediate shaft with 0.004 inch to 0.007 inch end play bearings.

d. Bevel Gear Shaft Assembly.

(1) Place all parts into winch case in the same order they were removed.

(2) Line up the marked pipe plugs in outer diameter of the retainer plate in the clutch packs, with holes in the bevel gear shaft splines. (Only one of the plugs will be correct as cross hole goes through one major diameter and one miner diameter of spline).

(3) Sling the bevel gear shaft.

(4) Lower the shaft through side frame, being certain that the match marks on the shaft line up with the match marks on the clutches. The two holes in the shaft (for hydraulic oil to the clutches) shown in figure 3-18 will then line up with the holes in the clutch retainer plate. Do not use a hammer to drive the shaft through the component parts.

NOTE

Coat side and top of seals with Lubriplate before inserting in shaft.

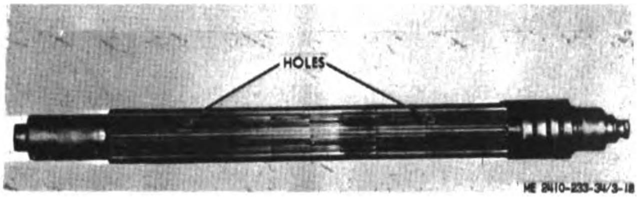


Figure 3-18. Bevel gear shaft.

(5) Fix the shaft in place and revolve winch to upright position.

(6) Lock the bearings on the end of the shaft that is towards brake compartment with snap rings provided.

(7) Install the bearing nut on the opposite end (torque to 200 ft-lb ±25) and lock it with lockwasher provided. (Always use new lockwasher). Do not install metal seal rings on ends of shaft.

(8) Adjust end play to 0.000—0.004 by use of shims under each bearing retainer.

(9) Remove bearing retainers and install metal seal rings on ends of shafts. Be sure these seal rings are not broken or damaged when reinstalling bearing retainers.

e. Brake Shaft Assembly.

(1) Install brake shaft with 0.006 inch to 0.009 inch end play in bearings.

(2) Apply Plastic Lead Seal No. 2 or equivalent to threads of capscrews holding oil seal retainer at brake end of shaft.

f. Power Takeoff Assembly.

(1) Install the power takeoff shaft. Be sure the bevel pinion is in place and snapring properly installed.

(2) Recheck the backlash and gear mesh of the bevel gear set. This is best done by painting the gears with white lead and obtaining a gear pattern as shown in figure 3-19.

(3) After the correct gear pattern is obtained, move the bevel ring gear away from the pinion to obtain 0.005 — 0.014 backlash.

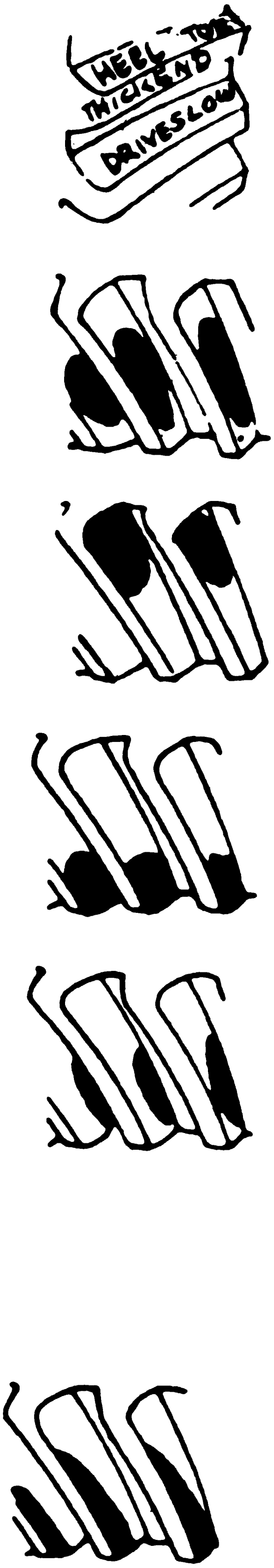


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Figure 3-19. Pinion depth.

3-16. Installation

Refer to TM 5-2410-233-20 and install the winch, winch pump, and winch controls on the tractor.

Refer to LO 5-2410-233-12 and fill winch gear case with oil.

CHAPTER 4

REPAIR OF HYDRAULIC SYSTEM

Section I. HYDRAULIC TANK

4-1. General

The hydraulic system consists of the hydraulic tank and valves, a two-section pump, two lift cylinders, a bulldozer blade tilt cylinder, and the hydraulic lines necessary for bulldozer operation. It also has provisions for hydraulic operation of a rear mounted ripper attachment.

4-2. Hydraulic Tank

a. Removal.

(1) Remove guard from around the bottom of the hydraulic tank.

(2) Drain the hydraulic tank. Refer to TM 5-2410-233-20.

(3) Remove bolts (1, fig. 4-1) and disconnect hydraulic lines (3, fig. 4-1) and (6,) below tank.

(4) Remove bolts (2) and (4) and drain line (5).

(5) Refer to paragraph 6-30 and follow a (1) through (4).

(6) Disconnect hydraulic lines (6), (7), (8), (9), and (11).

(7) Disconnect hose from elbow assembly (10).

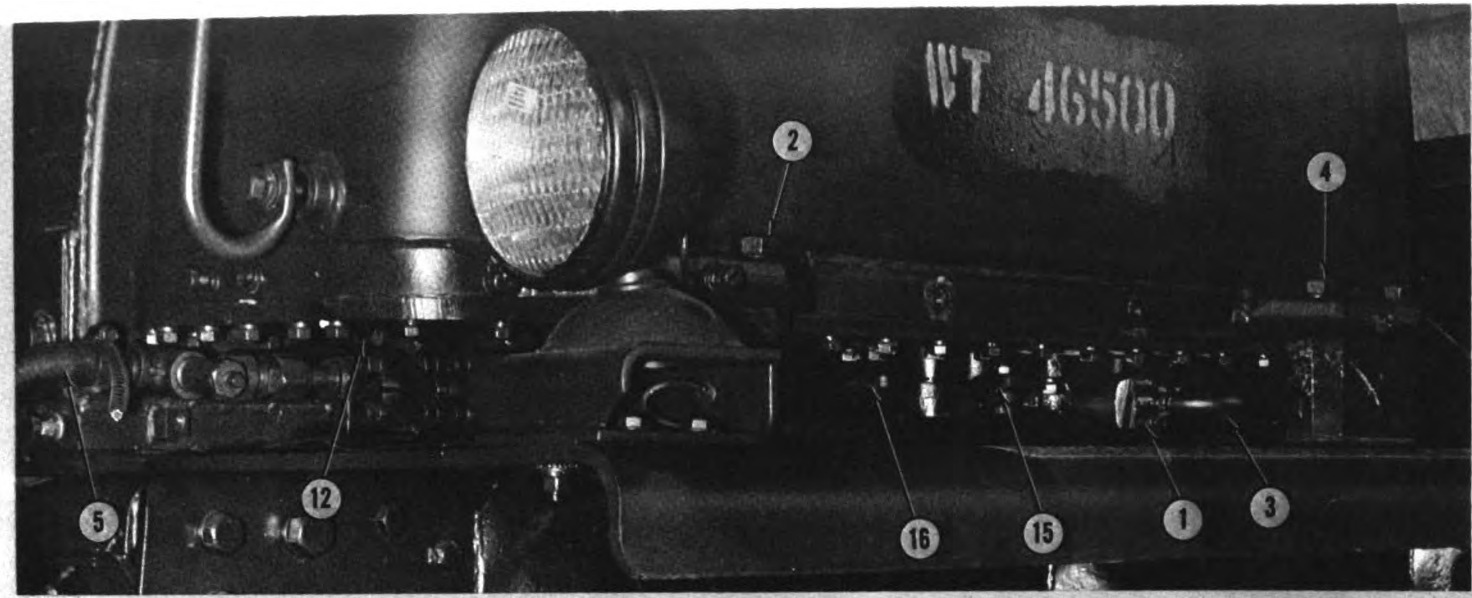
(8) Disconnect bulldozer control linkages (14, 15), and ripper control linkage (16) (TM 5-2410-233-20).

NOTE

The fuel tank and the cross members that support the seat frame and floor plates have been removed for better illustration only.

(9) Install an eyebolt in the hole provided in the top of the tank and attach a hoist to the eyebolt.

(10) Remove bolts (12 and 13) and remove the hydraulic tank from tractor.



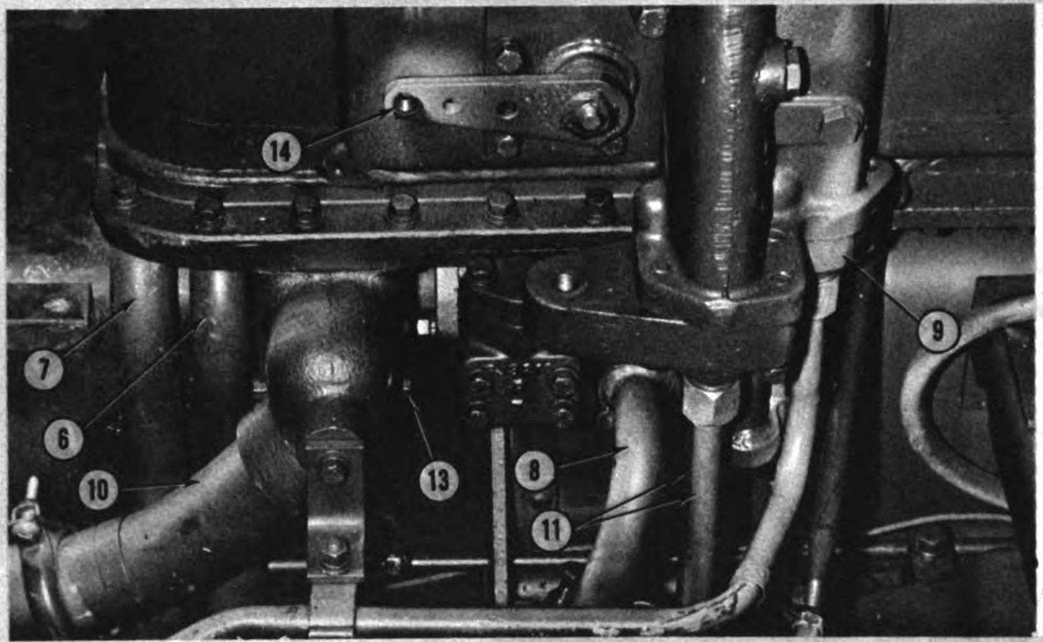


Figure 4-1. Hydraulic tank removal.

Key to figure 4-1.
1 Bolts
2 Bolts
3 Hydraulic lines
4 Bolts
5 Drain lines
6 Hydraulic lines
7 Hydraulic lines
8 Hydraulic lines
9 Hydraulic lines
10 Elbow assembly
11 Hydraulic lines
12 Bolts
13 Bolts (2)
14 Bulldozer tilt control linkage
15 Bulldozer control linkage
16 Ripper control linkage

b. Disassembly.

(1) Remove bolts (2, fig. 4-2) and remove mounting plate (3) and manifold (6) as a unit (weighs approx 70 lb).

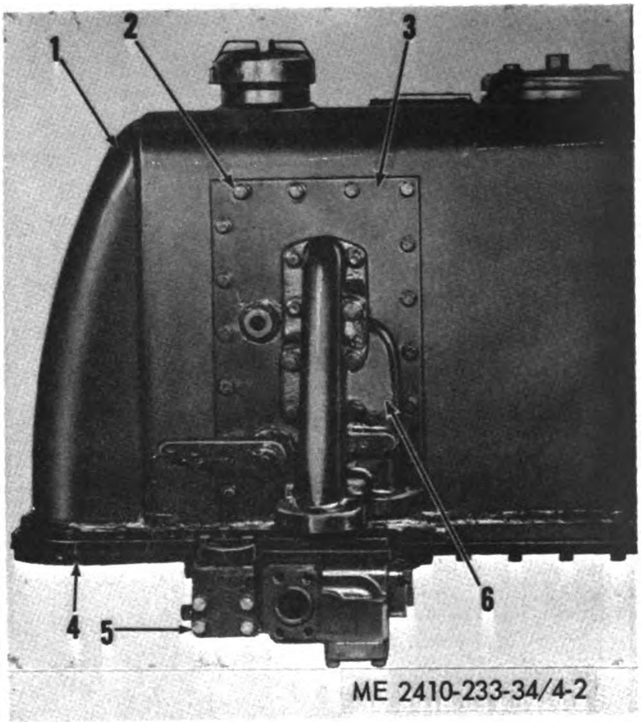
(2) See paragraph 4-4 for the removal of pressure relief valve (5).

(3) Remove bolts (2, fig. 4-3) securing line (1) to filter (3). At assembly, it may be necessary to loosen hose clamp (4) to align bolt holes.

(4) Remove all bolts securing tank assembly (1, fig. 4-2) to bottom plate (4).

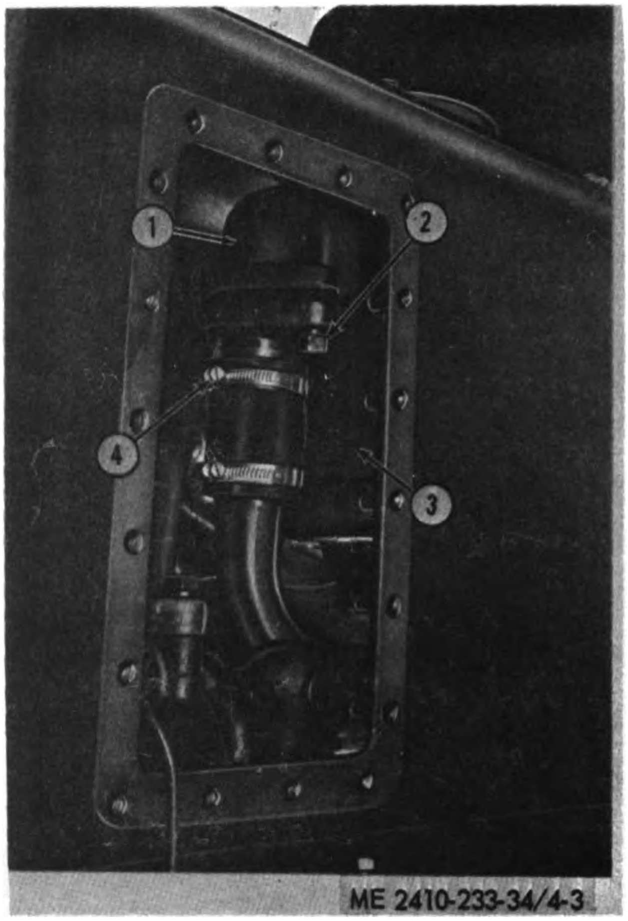
(5) Install a ½-inch — 13 (NC) forged eyebolt in top of tank assembly (1) and attach a hoist. Remove tank assembly (1) which weighs approximately 300 pounds.

(6) Refer to TM 5-2410-233-20 for filter cap and filter removal.



1 Tank assembly
2 Bolts
3 Blade tilt control valve mounting plate
4 Bottom plate
5 Bulldozer relief valve
6 Manifold

Figure 4-2. Preparing to disassemble tank.



1 Filter inlet oil line
2 Bolts
3 Oil filter
4 Hose clamp

Figure 4-3. Filter inlet line disconnect.

c. Cleaning. Flush and clean inside of hydraulic tank with cleaning solvent (Fed. Spec. P-D-680). Wipe outside of tank with a cloth dampened with cleaning solvent. Wipe dry using a lint-free cloth.

d. Inspection.

(1) Inspect hydraulic tank for cracks, breaks, dents, broken welds, and corrosion. Tank will be free of major dents and distortion that will affect serviceability, capacity or appearance. Replace a tank that is uneconomical to repair.

(2) Inspect hydraulic tank cap, gasket, strainer, gage, filter springs, seat, and filter by-pass valve for damage or distortion. Replace all defective parts.

e. Repair. Weld minor cracks and broken welds per TM 9-237. Paint welded and other barren areas per TM 9-213.

f. Reassembly and Installation. Reverse disassembly and removal procedure and reassemble and install the hydraulic tank on the tractor. Replace all damaged gaskets and seals.

Section II. HYDRAULIC CONTROL VALVES AND HYDRAULIC PUMP

4-3. Bulldozer Control Valve

a. Removal.

(1) Remove the hydraulic control tank from the tractor (para 4-2).

(2) Remove the tank assembly from bottom plate ((6), fig. 4-4).

(3) Remove bolts (3) and (14) and remove oil line (5).

(4) Disconnect rod (4) from end of control valve spool.

(5) Remove bolt (9) and remove oil line (1).

(6) Remove bolts (7) and (8) and remove elbows (10) and (11).

(7) Remove bolts (12) and remove bulldozer control valve (2). The bulldozer control valve weighs approximately 70 pounds.

b. Valve Spool Removal.

(1) Remove and inspect plug assemblies (2, fig. 4-5) for broken springs. The balls encased in the end of the plugs engage detent (1, fig. 4-5) to hold valve spool (4, fig. 4-5) in the FLOAT position.

(2) Remove bolt and lockwasher (5).

CAUTION

Valve body (3) and spool (4) are machined to close tolerances. To avoid distortion of spool (4), leave spool in valve body when loosening or tightening bolt (5).

(4) Disassemble spool as shown in figure 4-6.

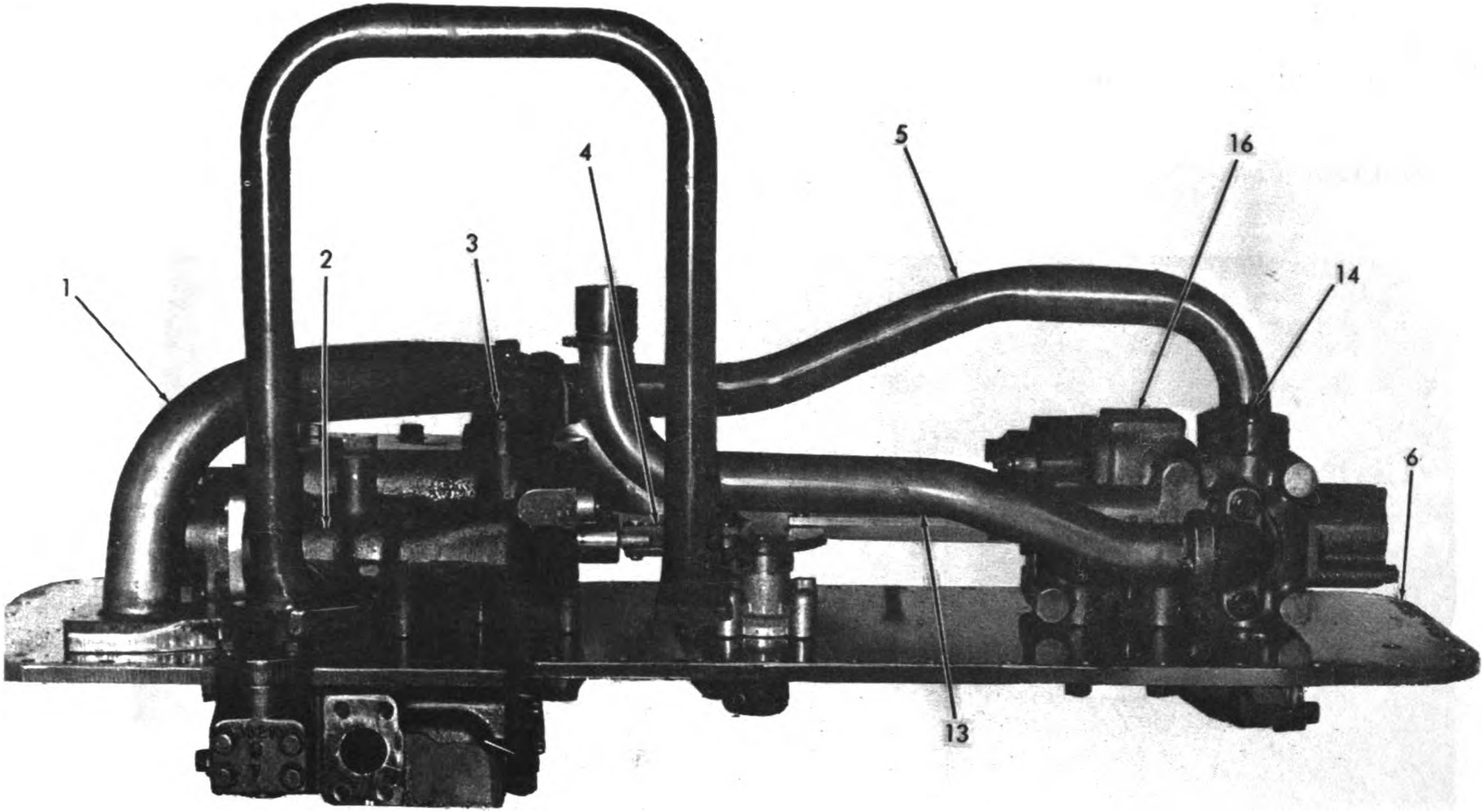


Figure 4-4. Bulldozer and ripper control valves (sheet 1 of 2).

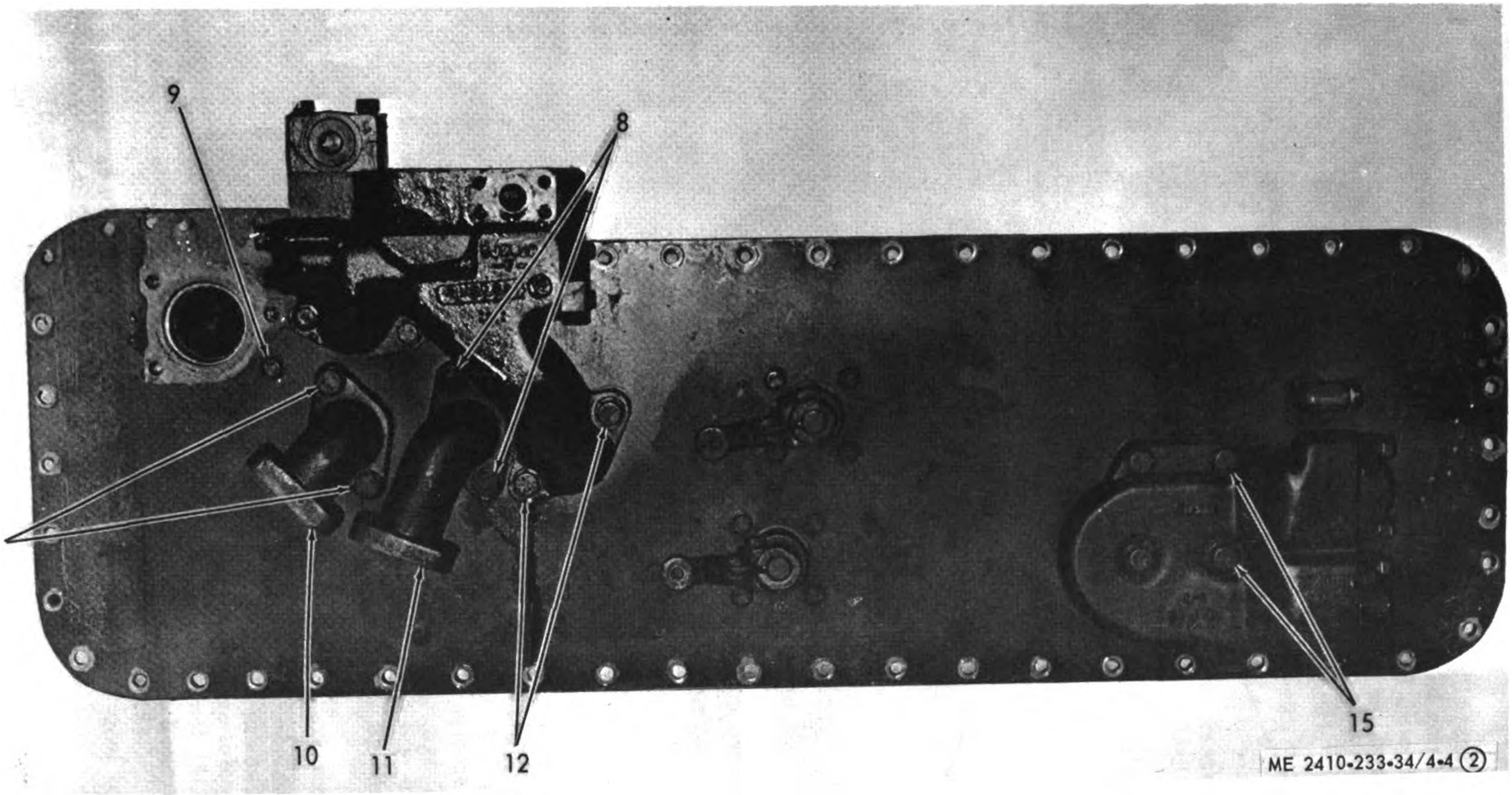
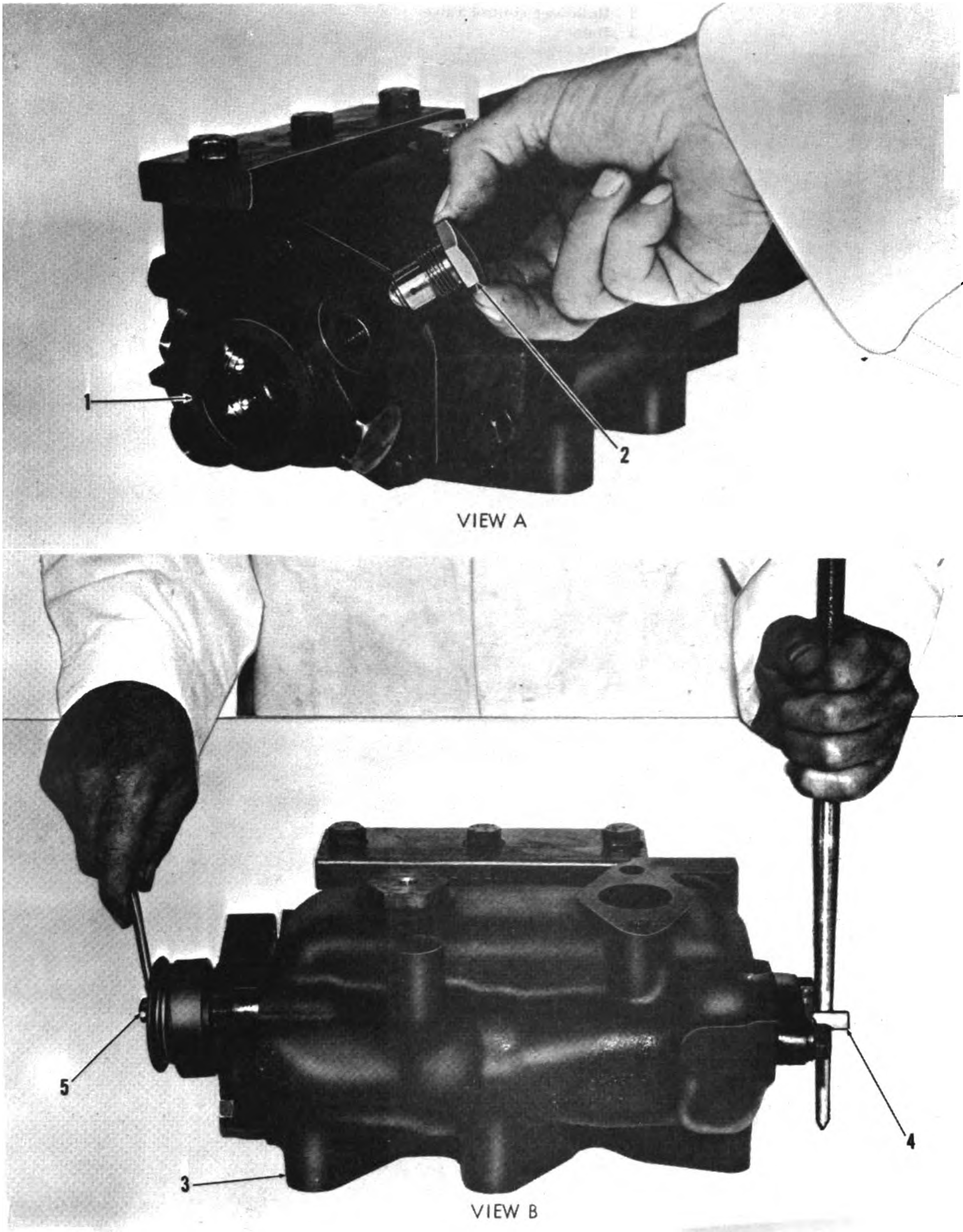


Figure 4-4. Bulldozer and ripper control valves (sheet 2 of 2).

Key to figure 4-4.

1 Pump suction line
2 Bulldozer control valve
3 Bolts
4 Rod
5 Pressure oil line from bulldozer control valve to ripper control valve
6 Bottom plate
7 Bolts
8 Bolts
9 Bolt
10 Elbow
11 Elbow
12 Bolts
13 Rod
14 Bolt
15 Bolt
16 Ripper control valve



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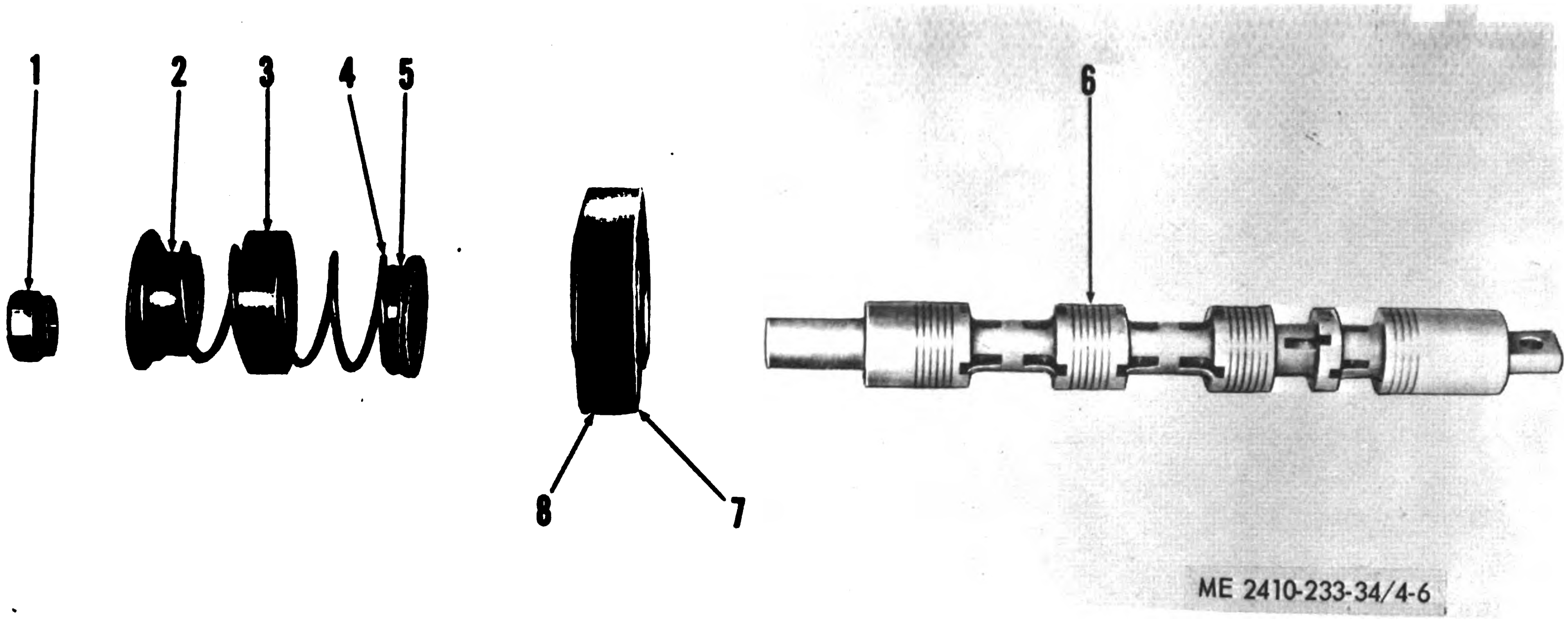
1 Housing
2 Plug assemblies
3 Valve body
4 Valve spool
5 Bolt and lockwasher

Figure 4-5. Valve spool removal.



1 Detent
2 Retainer
3 Spacer
4 Spring
5 Retainer
6 Spool
7 Spacer
8 Shims

Figure 4-6. Valve spool disassembled.

c. Check Valve Removal.

(1) Remove the bulldozer control valve and remove the valve spool.

(2) Remove bolts, (1, fig. 4-7) and flange (2).

(3) Use a ¼ inch—20 (NC) eyebolt to remove plug (5). Inspect preformed packing (3).

(4) Remove spring (4) and check valve (6).

Key to figure 4-7.

1 Bolts
2 Flange
3 Preformed packing
4 Spring
5 Plug
6 Check valve
7 Valve body

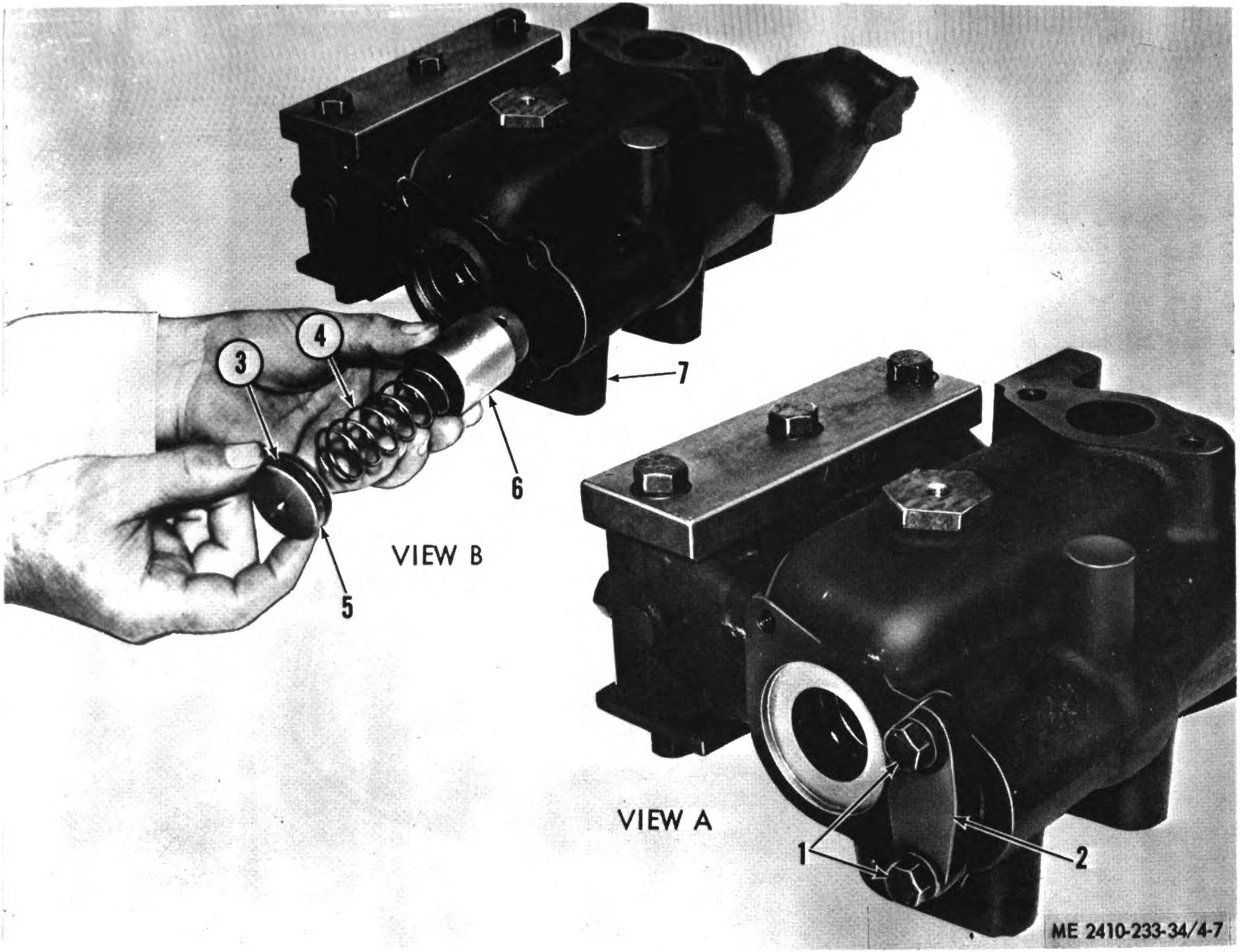


Figure 4-7. Check valve removal.

d. Makeup Valves.

(1) *General.* Makeup valves are provided to supply tank oil directly to the bulldozer cylinder lines whenever the line pressure is less than tank pressure. This occurs when the bulldozer blade raises or lowers rapidly. The valves are located in a common valve body bolted to the bulldozer control valve. A spring holds each valve seated during normal operation. When oil pressure in the bulldozer circuit is reduced, oil in the tank overcomes the spring, opens a valve and flows into the bulldozer circuit.

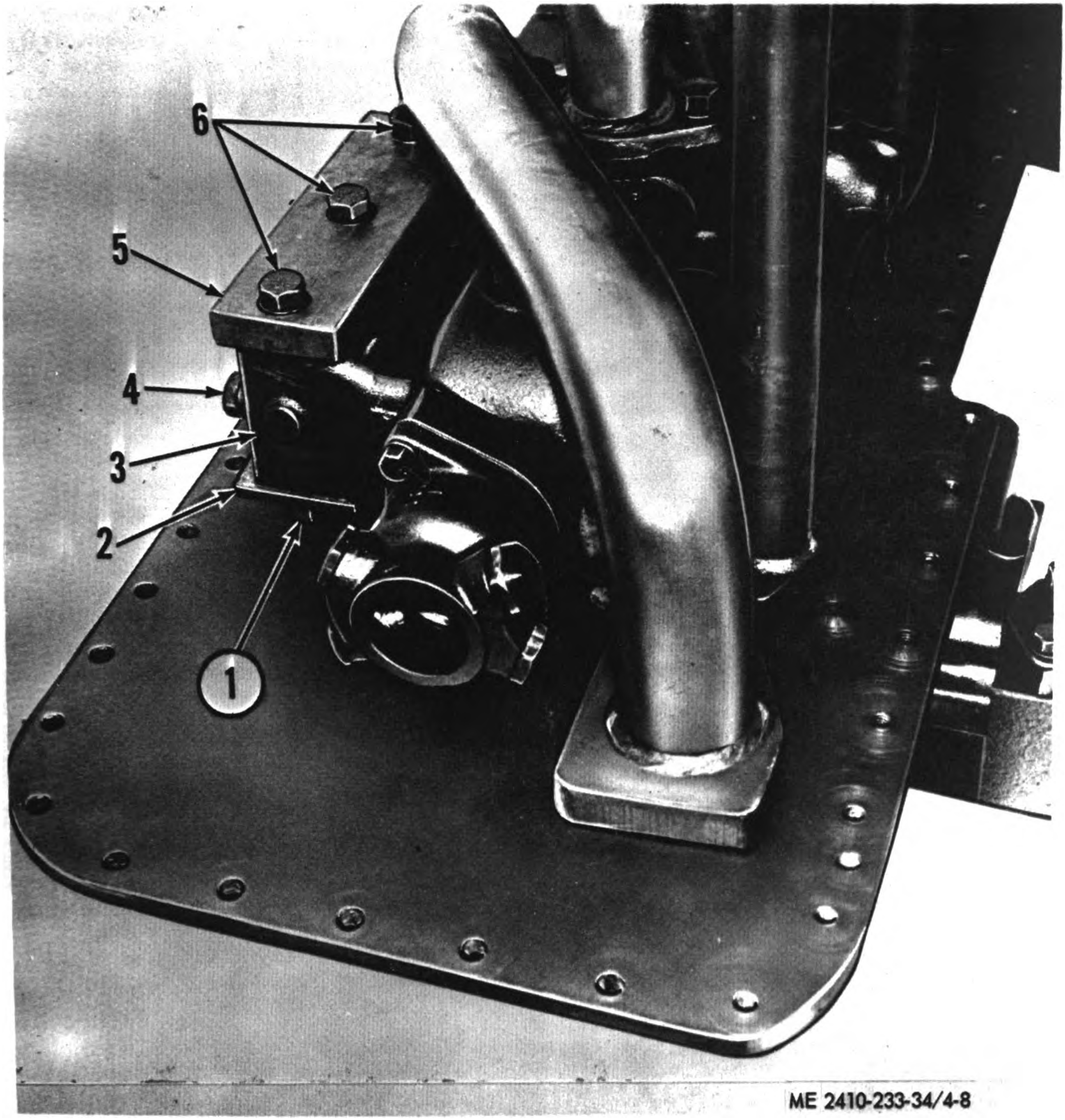
(2) *Removal.*

(a) Remove the hydraulic tank from tractor and remove the tank assembly from bottom plate (para 4-2).

(b) Remove bolts (4, fig. 4-8) and remove makeup valve body (3).

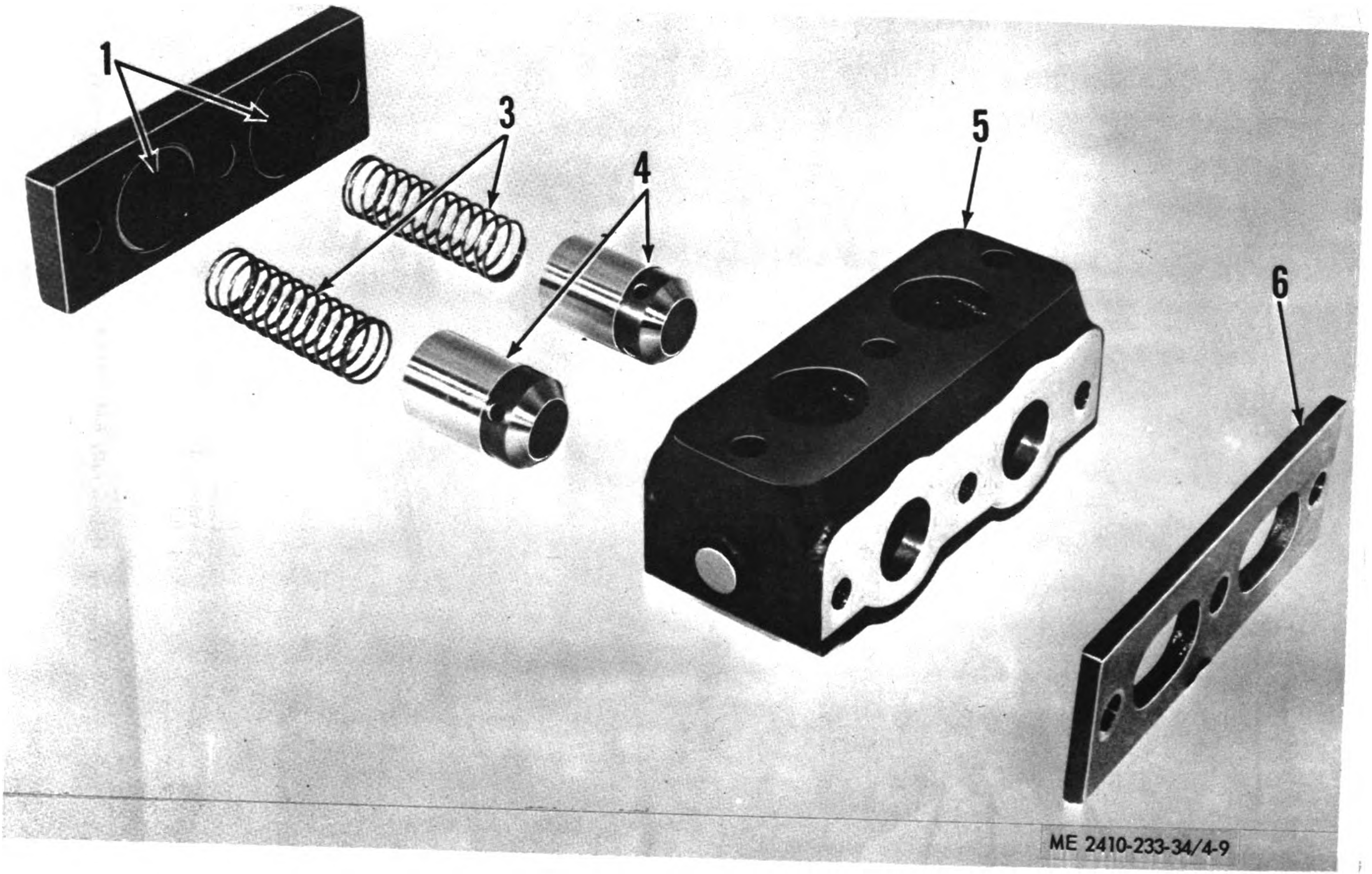
(c) Remove bolts (1) and (6) and remove covers (2) and (5).

(d) Remove springs (3, fig. 4-9) and valves (4).



1 Bolts (3)
2 Cover
3 Valve body
4 Bolts (3)
5 Cover
6 Bolts

Figure 4-8. Makeup valve body removal.



1 Preformed packing
2 Cover
3 Springs
4 Makeup valves
5 Valve body
6 Cover

Figure 4-9. Makeup valves disassembled.

e. Control Lever.

(1) *Removal.*

(a) Remove the hydraulic tank from the tractor and remove the tank assembly from bottom plate (para 4-2).

(b) Remove and inspect pin (1, fig. 4-10).

(c) Loosen bolt (3) and remove lever (4).

(d) Remove bolts (5) and remove lever assembly (2).

(e) Remove key (2, fig. 4-11) and washer (1).

(f) Remove lever (3) and adapter (4).

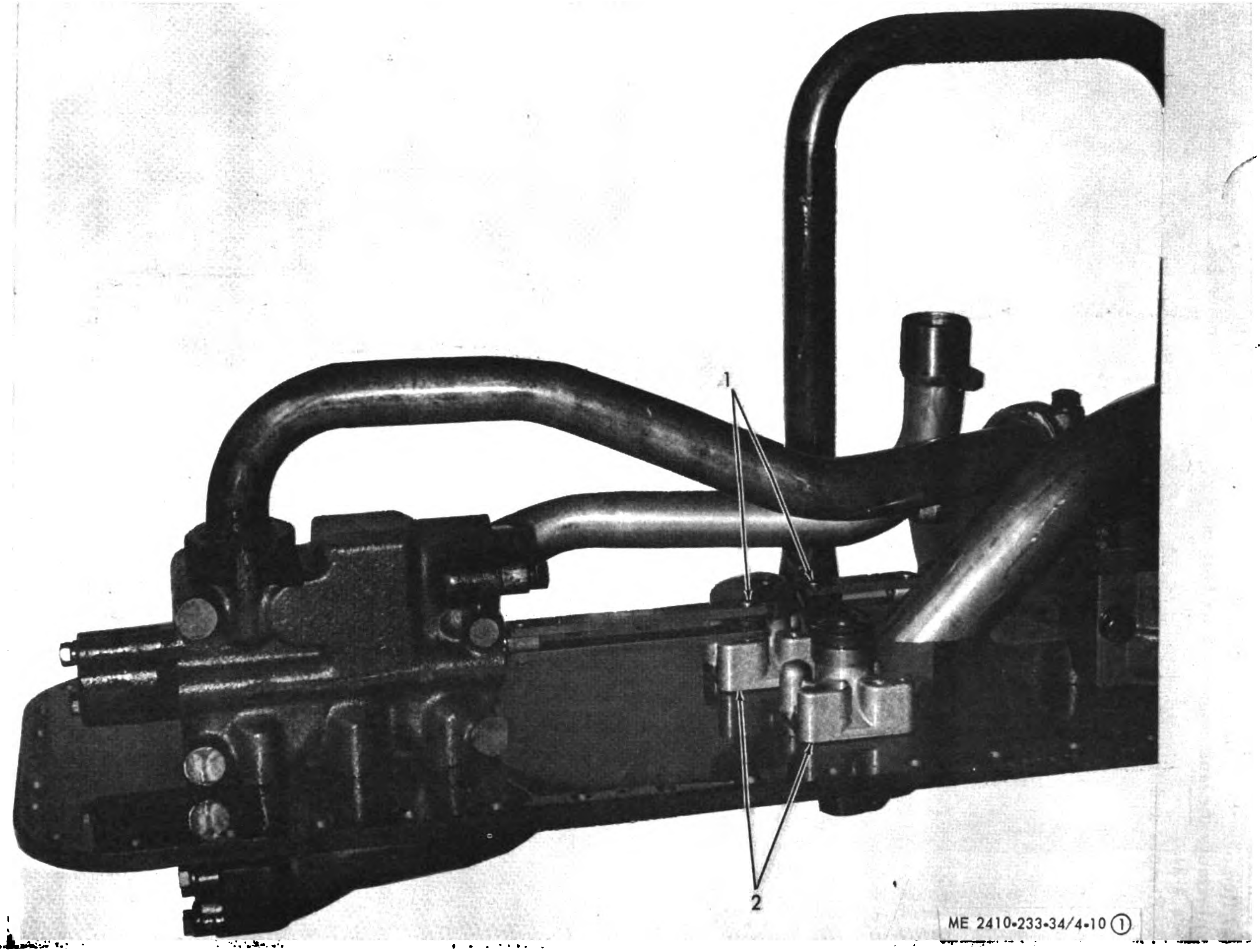
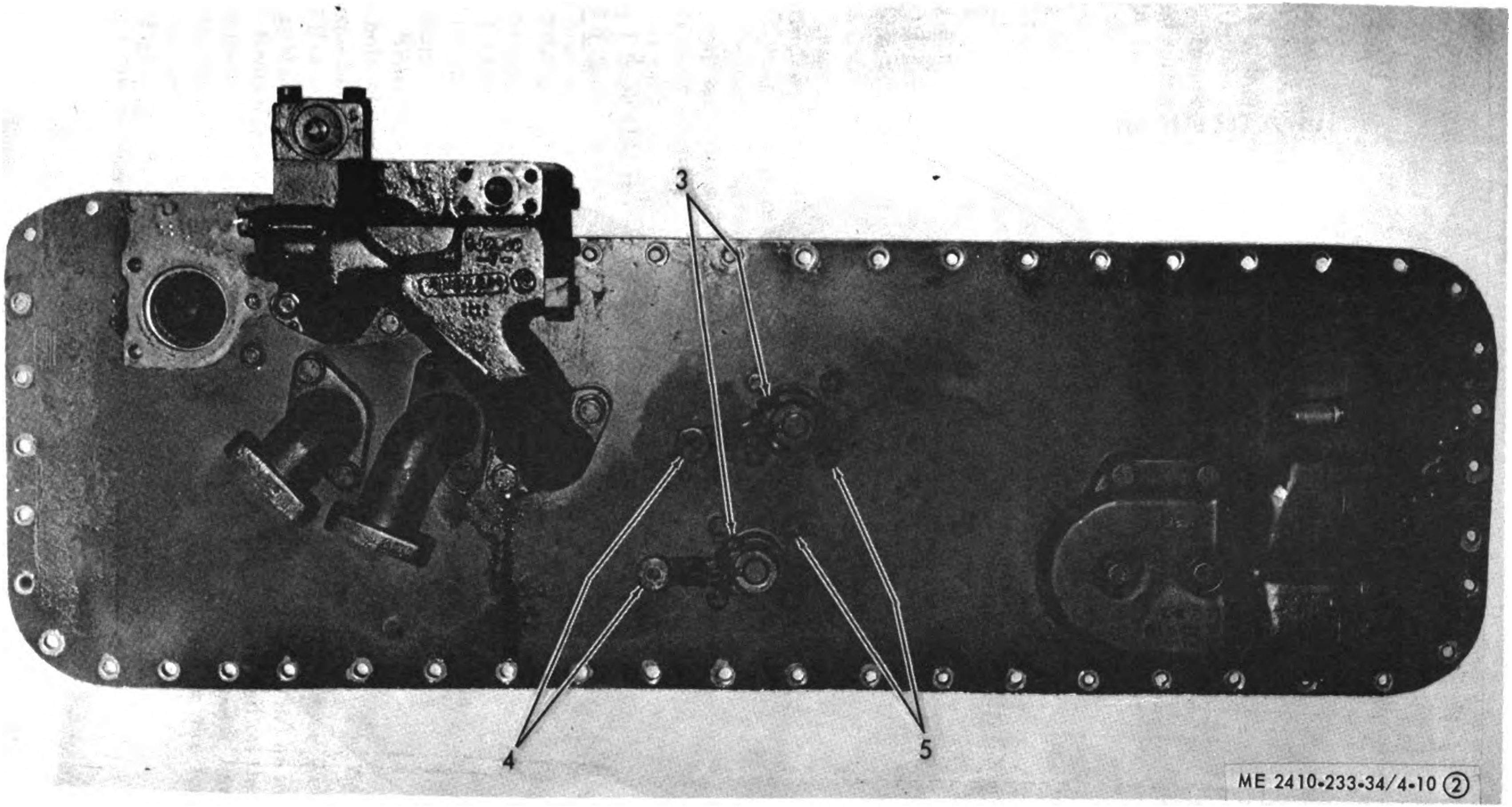
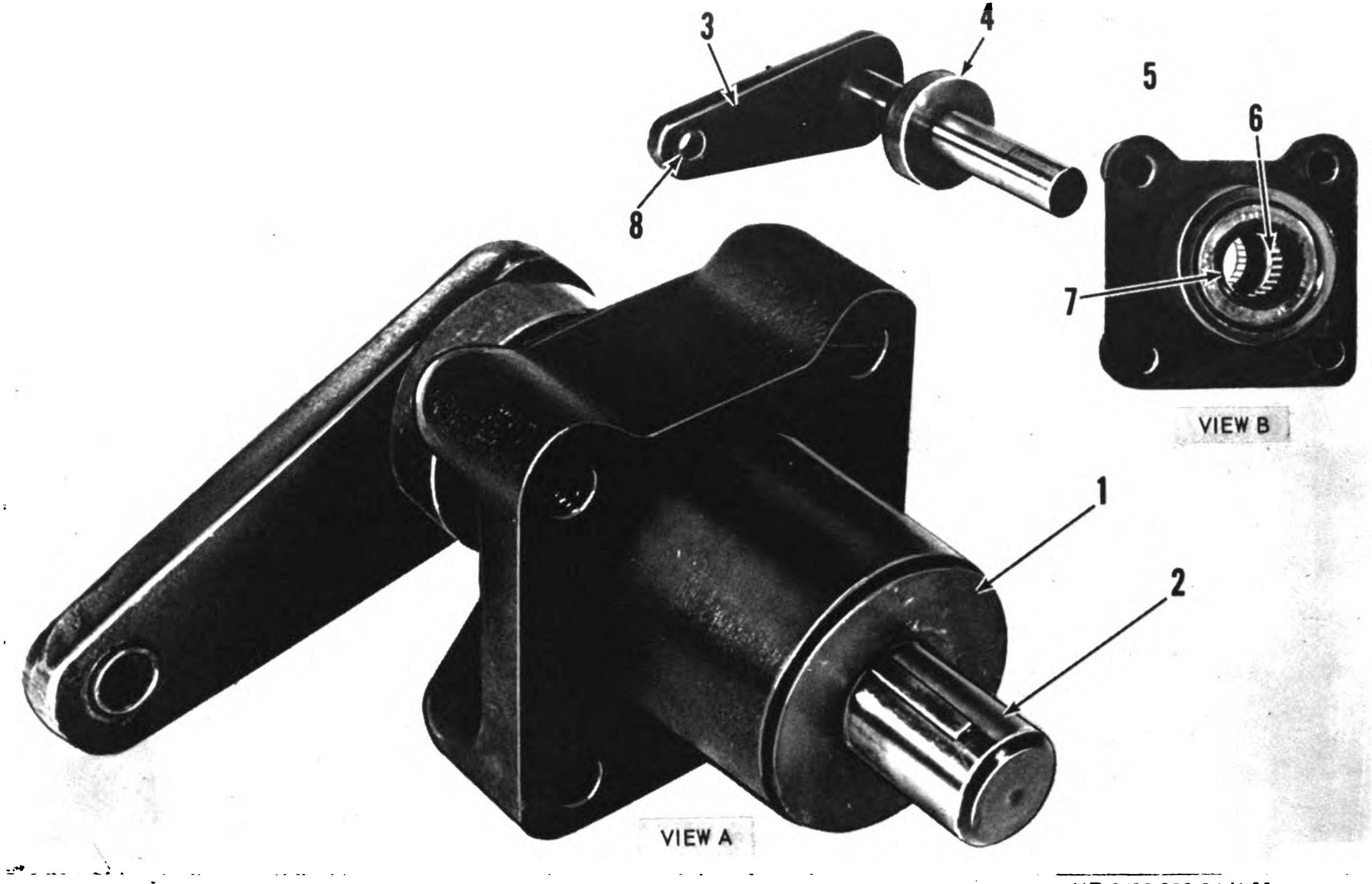


Figure 4-10. Control lever assembly (sheet 1 of 2).



1 Pin
2 Lever assembly
3 Bolt
4 Lever
5 Bolt (4)

Figure 4-10. Control lever assembly (sheet 2 of 2).



1 Washer	5 Housing
2 Key	6 Bearings
3 Lever	7 Lip-type seal
4 Adapter	8 Bearing

Figure 4-11. Control lever disassembly.

f. Cleaning. Clean all parts with cleaning solvent (Fed. Spec. P-D-680) and dry with clean compressed air or wipe dry using a lint-free cloth.

g. Inspection and Repair.

(1) Inspect valve body and spool for nicks, burrs, pitting, and wear. Light scratches or a light grey wear appearance are not harmful to the valve. Examine the valve land edges for wear. If wear or damage exists, the complete valve assembly must be replaced.

(2) Inspect detent plug assemblies (2, fig. 4-5) for weak or damaged springs and worn or damaged balls. Replace as required.

(3) Inspect the check valve for weak or damaged spring (4, fig. 4-7) and free movement of valve in bore. Inspect valve chamfered seating surface and valve seat in body (7), for nicks, burrs and proper contact. Replace as required.

(4) Inspect the make-up valves for weak or damaged springs (3, fig. 4-9) and free movement of valve (4) in bores. Inspect valve chamfered seating surfaces and valve seats in body (5) for nicks, burrs, and 100 percent contact. Finger pressure against the face of the valve should open it and the spring should return the valve to closed position. Replace defective springs or valves.

(5) Inspect control shaft bearings (6, fig. 4-11) for corrosion, roughness, and wear. Replace corroded, rough, or worn bearings.

(6) Replace control shaft oil seal (7). Examine control shaft for wear due to seal contact. Replace shaft if deeply grooved.

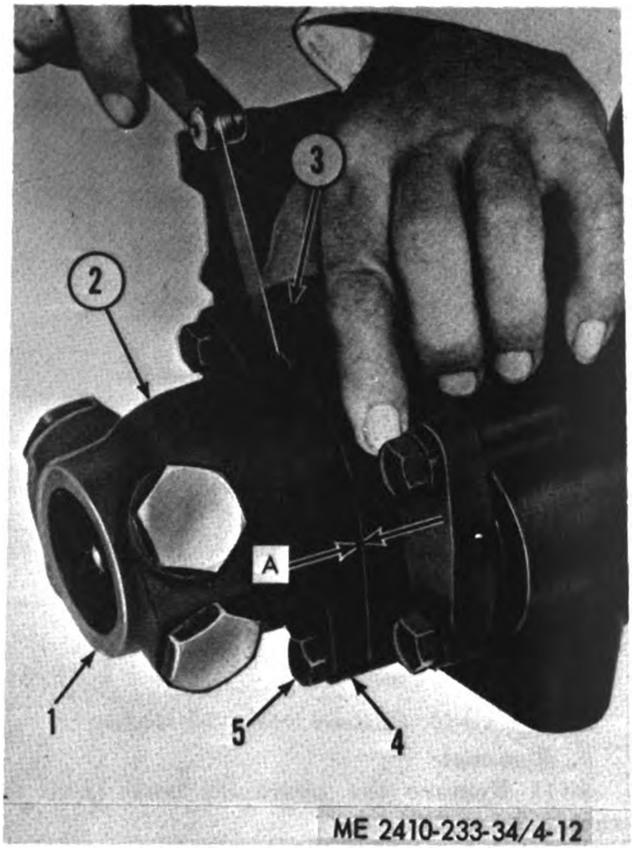
h. Reassembly.

(1) Reassemble the control lever using figure 4-11 as a guide. Install the seal (7), with the lip toward bearings (6) and the metal case flush with the outside face of the housing (5). Position and install the outer lever (4, fig. 4-10) on control lever (3, fig. 4-11) until it is snug but not tight against washer (1), then tighten bolt (3, fig. 4-10). Check for binding.

(2) Reassemble make-up valves and springs. Torque bolts (1) and (6), Figure 4-8, to 60 ± 2 ft-lbs. Torque bolts (4) to 60 ± 2 ft-lbs.

(3) Reassemble the check valve using figure 4-7 as a guide. Install valve in housing.

(4) Reassemble and install the control valve using figures 4-5 and 4-6 as guides. To obtain the correct thickness of shims required, assemble and install the valve spool. Install housing without shims. Tighten bolts (5), figure 4-12, until the shoulder in the housing just contacts retainer (2), figure 4-6, and starts to compress the spring. Hold spacer (3), figure 4-12, tight against the valve body and measure clearance (A) between housing (2) and spacer (3) with a thickness gage. Install shims (4) with a thickness equal to this measurement.



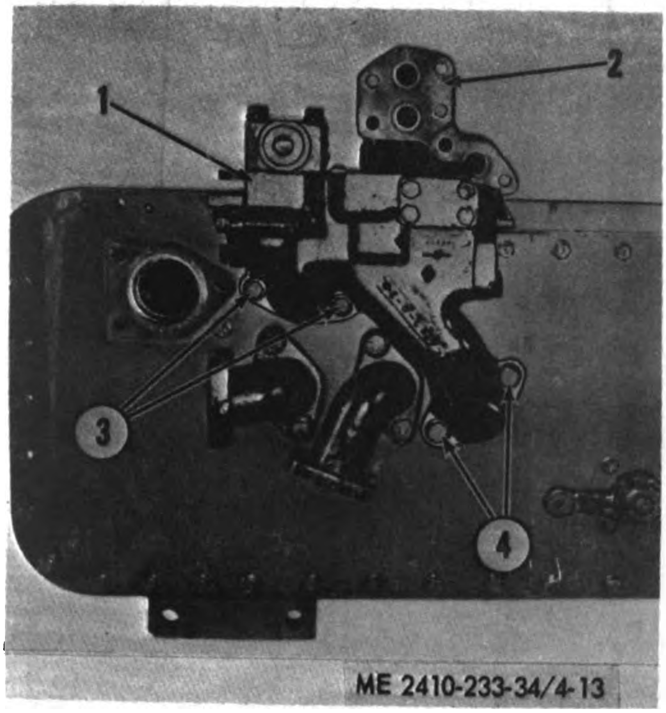
1 Spool
2 Housing
3 Spacer
4 Shims
5 Bolts (2)
A Clearance to be measured

Figure 4-12. Measuring clearance.

i. Installation. Reverse removal procedure, install bulldozer control valve and torque bolts (3), (7), (8) and (12), figure 4-4, to 60 ±2 ft-lbs.

4-4. Bulldozer Relief Valve

a. General. The bulldozer relief valve ((1), fig. 4-13) mounted on the bottom plate of the hydraulic tank, prevents excessive pressures from being imposed on the large section of the two-section pump and other components of the bulldozer circuit.



1 Relief valve assembly
2 Manifold
3 Bolts
4 Bolts

Figure 4-13. Bulldozer relief valve removal.

b. Removal.

(1) Remove the hydraulic tank from the tractor (para 4-2).

(2) Remove the blade tilt control valve, mounting plate and manifold (2) (para 4-2).

(3) Remove bolts (3) and (4).

NOTE

Bolts (3) secure the relief valve discharge tube (on inside of tank) to the tank bottom plate.

c. Disassembly.

(1) Remove bolts and lockwashers (6, fig. 4-14) and cover (7).

(2) Remove bolts and lockwashers (13) to remove pilot valve body (14).

(3) Remove shims (10) from between cover (7) and spring (11). The total thickness of the shims determines the pressure at which the relief valve opens (1,975 ± 25 psi).

(4) Remove spring (11) and pilot valve (12). Use a small magnetized rod to remove the pilot valve.

NOTE

The seat (15) for pilot valve (12) is a press fit in body (14). If replacement is necessary, remove plug assembly (17) and press the seat downward, removing it through the opening for the plug assembly. Chill the replacement seat before installing it in body (14).

(5) Remove bolts (1) and cover (2). Use a ¼-inch—20 (NC) eyebolt to remove plug (4) beneath cover (2).

(6) Partially remove bolts (19) securing cover (18) to dump valve body (5).

(7) Insert a ½ inch diameter rod 10 inches long into the plug opening until the rod contacts dump valve (23). Push against rod, compressing spring (22), until dump valve contacts plug (20). Tap on end of rod, forcing plug (20) out of body (5).

(8) Remove bolts (19), cover (18), plug (20), spring (22), and dump valve (23).

d. Cleaning. Clean all parts with cleaning solvent (Fed. Spec. P-D-680). Dry parts with a lint free cloth. Clear all passages in relief valve of restrictions with filtered compressed air.

e. Inspection and Repair.

(1) Inspect springs for weak or damaged condition and free movement of valves in the bores. Inspect valve seating surface and seats in body for nicks, burrs, and proper contact. Replace defective parts.

(2) Inspect preformed packing (16, fig. 4-14) for cuts, breaks or deterioration. Replace all defective packing.

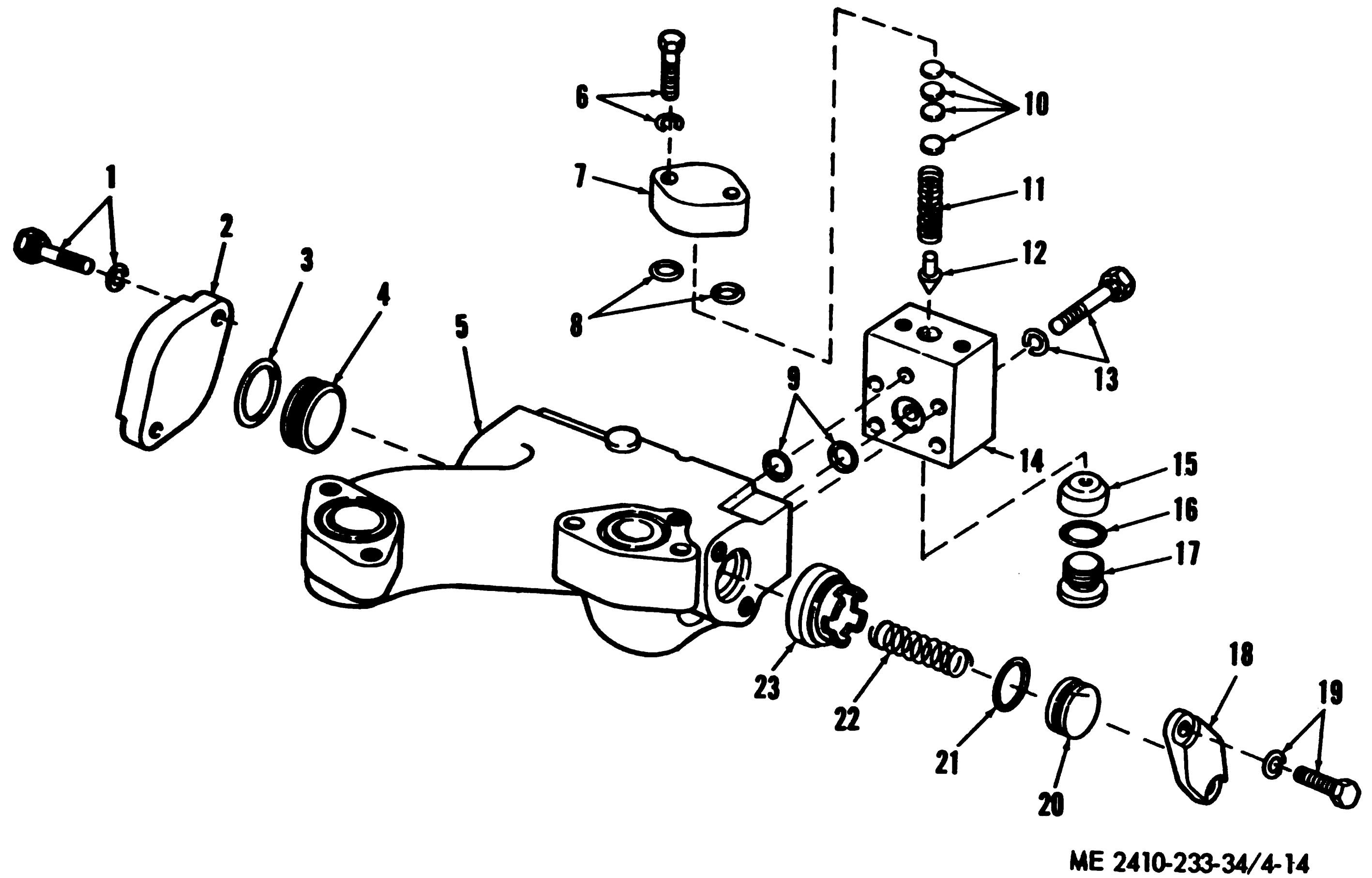
f. Reassembly.

(1) Reassemble relief valve using figure 4-14 as a guide.

(2) Torque bolts (13) to 24 ± 2 ft-lbs.

(3) Install sufficient shims (10) to provide a relief valve opening pressure of 1,975 ± 25 psi.

g. Installation. Install relief valve in reverse of removal. Torque bolts (3) figure 4-13, to 43 ± 2 ft-lbs. and bolts (4) to 60 ± 2 ft-lbs.



1 Bolt and lockwasher
2 Cover
3 O-ring seal
4 Plug assembly
5 Dump valve body
6 Bolt and lockwasher
7 Cover
8 O-ring seals
9 O-ring seals
10 Shims
11 Spring
12 Pilot valve
13 Bolt and lockwasher
14 Pilot valve body
15 Pilot valve seat
16 O-ring seal
17 Plug assembly
18 Cover
19 Bolt and lockwasher
20 Plug
21 O-ring seal
22 Spring
23 Dump valve

Figure 4-14. Relief valve disassembly.

4-5. Ripper Control Valve

a. Removal.

(1) Remove hydraulic tank from tractor (para 4-2) and separate bottom plate from tank (para 4-2 *b*).

(2) Remove bolts (3 and 14, fig. 4-4) and remove oil lines (1) and (5).

(3) Disconnect rod (13) from ripper control valve bell crank.

(4) Remove bolts (15) and remove ripper control valve (16) from bottom plate (6)

b. Disassembly.

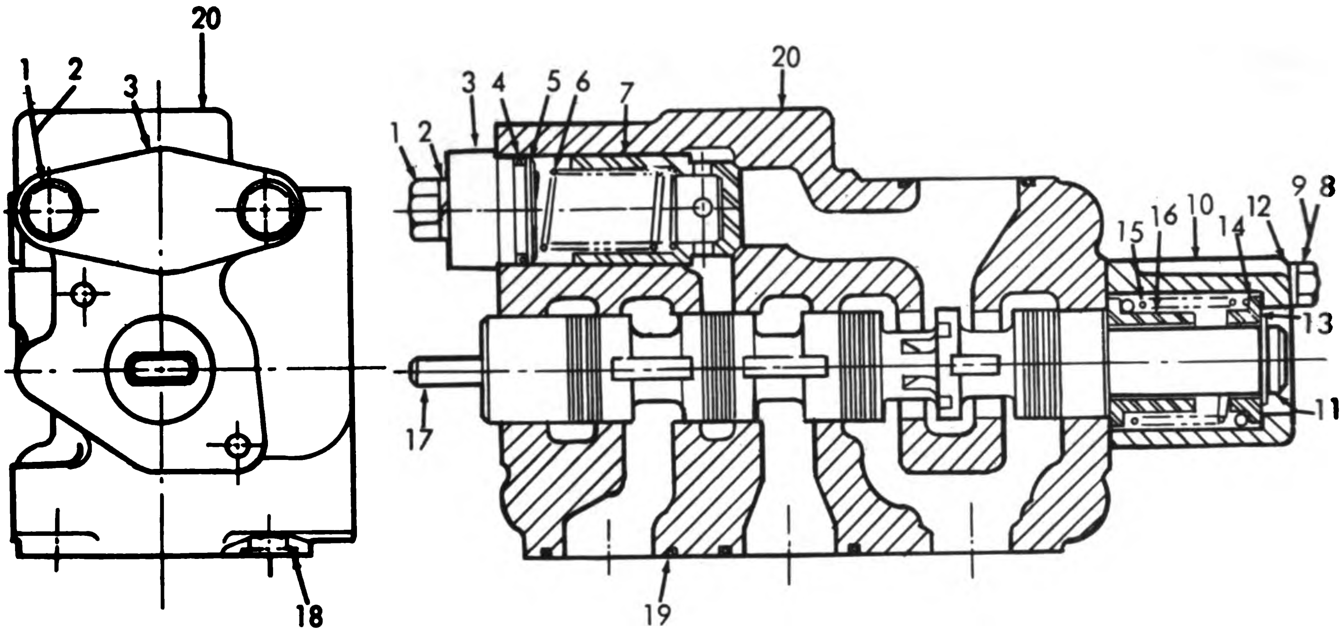
(1) Remove bolt (1, fig. 4-15), lockwasher (2), and remove bracket (3) from ripper control valve.

(2) Remove seal (4), plug (5), spring (6), and valve (7) from valve body (20).

(3) Remove 2 bolts (8), and lockwashers (9) and remove retainer (10).

(4) Slide spool (17) from body (20).

(5) Remove bolt (11), lockwasher (12) from spool and remove washer (13), retainer (14) spring (15), and spacer (16) from spool (17).



1	Bolt	11	Bolt
2	Lockwasher	12	Lockwasher
3	Bracket	13	Washer
4	Seal	14	Retainer
5	Plug	15	Spring
6	Spring	16	Spacer
7	Valve	17	Spool
8	Bolt	18	Seal
9	Lockwasher	19	Seal
10	Retainer	20	Body

Figure 4-15. Ripper control valve disassembly.

c. Cleaning. Clean all parts with cleaning solvent (Fed. Spec. P-D-680) and wipe dry using a lint free cloth. Clear passages in valve body with filtered compressed air.

d. Inspection and Repair.

(1) The valve (7) must slide freely in its bore in valve body (20). Inspect chamfered seating surface of valve (7) and mating seat in body for nicks or burrs.

(2) Inspect seals (18) and (19) and replace if deteriorated.

(3) Inspect body (20) for smooth bores. Replace if bore surfaces are nicked, scored, or pitted.

e. Reassembly and Installation. Reverse disassembly and removal procedure and assemble and install the ripper control valve in the hydraulic tank.

4-6. Tilt Control Valve

a. Removal.

(1) Drain the hydraulic tank. Refer to TM 5-2410-233-20.

(2) Remove the blade tilt control valve mounting plate and manifold from the tank (para 4-2).

(3) Remove bolts (1, fig. 4-16) securing manifold (3) to plate (2).

NOTE

Bolt (5) must be in place before installing manifold (3) on plate (2).

(4) Remove bolt (4) and remove tilt control valve (7) from plate (2). At installation, be sure bolt holes in valve body are aligned with bolt holes in plate to receive bolts (1).

(5) Remove bolts (9) and baffle tube (10).

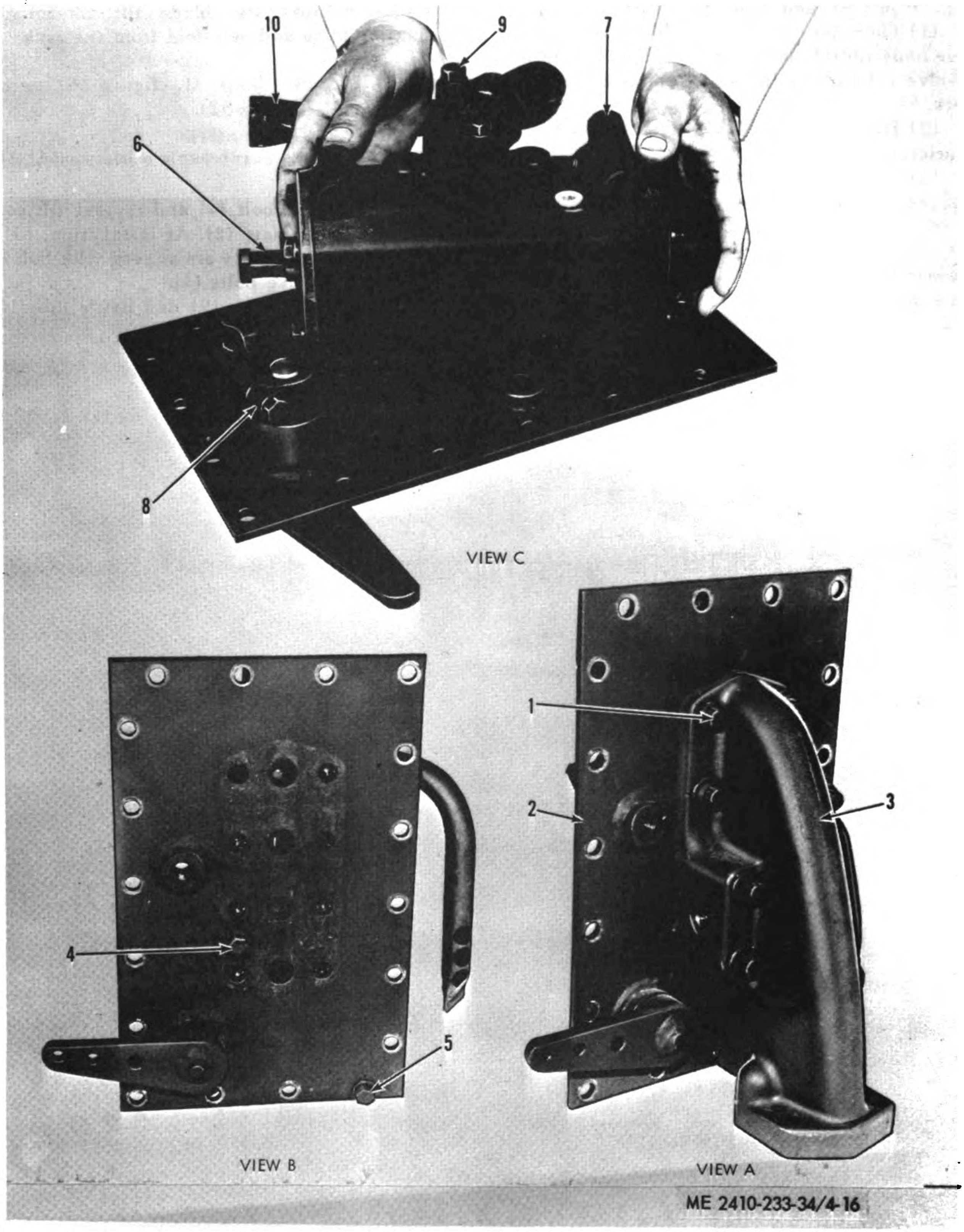


Figure 4-16. Blade tilt manifold and valve removal.

Key to figure 4-16.
1 Bolts
2 Blade tilt control valve mounting plate
3 Manifold
4 Bolt
5 Bolt
6 Flat on valve spool
7 Blade tilt control valve
8 Lever
9 Bolts
10 Baffle tube

b. Disassembly.

(1) Remove bolts and lockwashers (9, fig. 4-17) securing housing (12) to valve body (5).

(2) Remove plug (1) with a ⅜ inch — 16 (NC) eyebolt.

(3) Remove spring (3) and check valve (4).

(4) The check valve (4) must slide freely in its bore in valve body (5). Inspect chamfered seating surface of check valve (4) and mating seat (6) in valve body for nicks or burrs.

(5) Inspect O-ring (2) and replace if necessary.

(6) Remove bolt and lockwasher (10), washer (11), spacer (13), spring (14) and spacer (15) from spool (16).

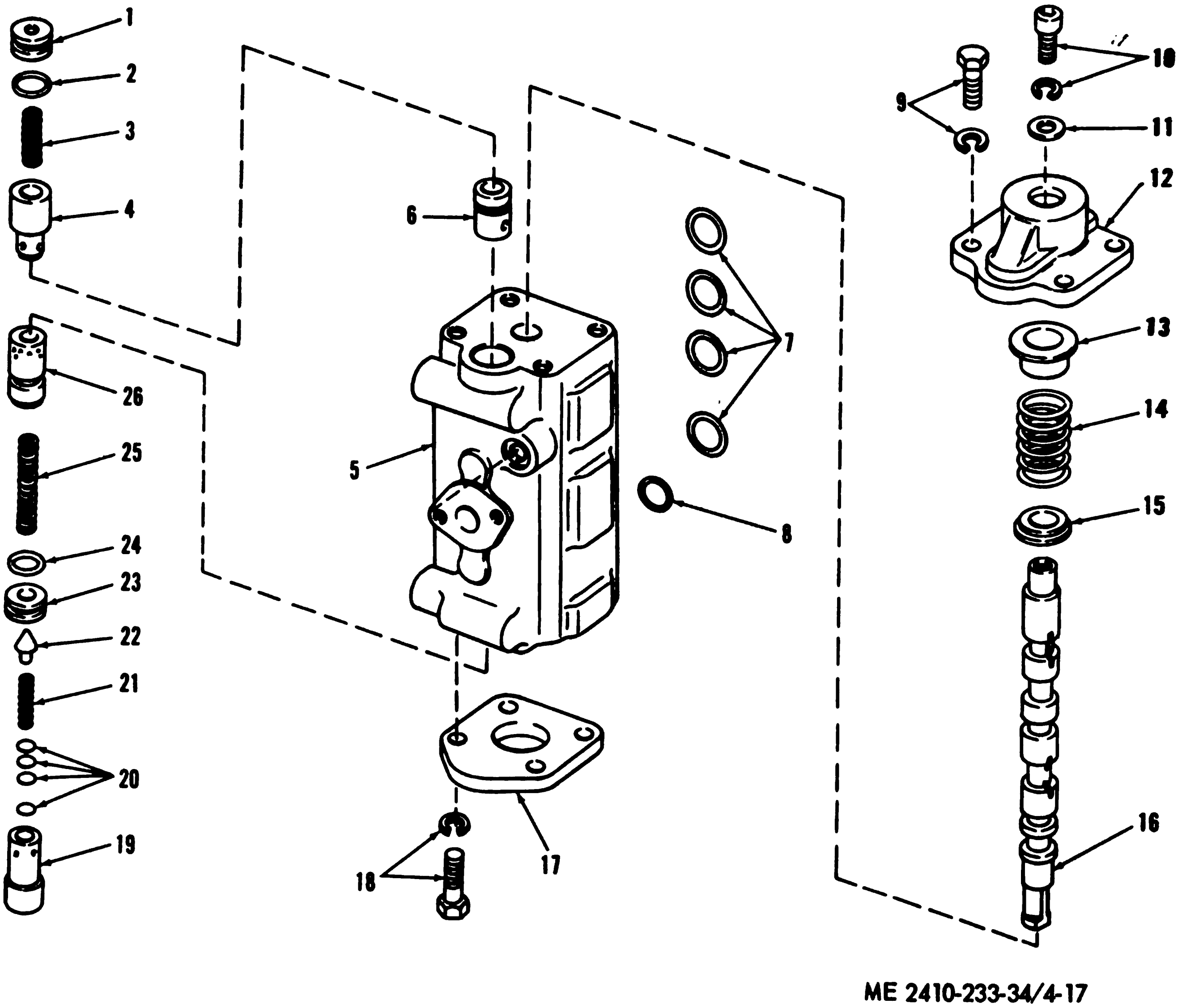
CAUTION

Valve body (5) and spool (16) are machined to close tolerances. To avoid distortion of spool (16), leave spool in valve body when loosening or tightening bolt (9).

(7) Remove bolts and lockwashers (18) and cover (17).

(8) Remove sleeve (19), spring (21), and pilot valve (22). Remove shims (20) from between spring (21) and sleeve (19). Be sure to install same number of shims (20) as were removed. The total thickness of shims determines the pressure at which the relief valve opens (1,975±25 psi).

(9) Dump valve (26), spring (25) and seat (23) are retained in control valve body (5) by friction of O -ring (24). To remove, insert a ½-inch diameter rod 10-inches long into check valve bore until it contacts dump valve (26). Push against dump valve, compressing spring (25), until dump valve contacts seat (23). While holding dump valve firmly against seat, tap against rod, forcing seat, spring and dump valve out of control valve body.



1	Plug	14	Spring
2	O-ring	15	Spacer
3	Spring	16	Valve spool
4	Check valve	17	Cover
5	Valve body	18	Bolt and lockwasher
6	Check valve seat	19	Sleeve
7	O-ring seals	20	Shims
8	O-ring seal	21	Spring
9	Bolt and lockwasher	22	Pilot valve
10	Bolt and lockwasher	23	Seat
11	Washer	24	O-ring
12	Housing	25	Spring
13	Spacer	26	Dump valve

Figure 4-17. Tilt control valve disassembly.

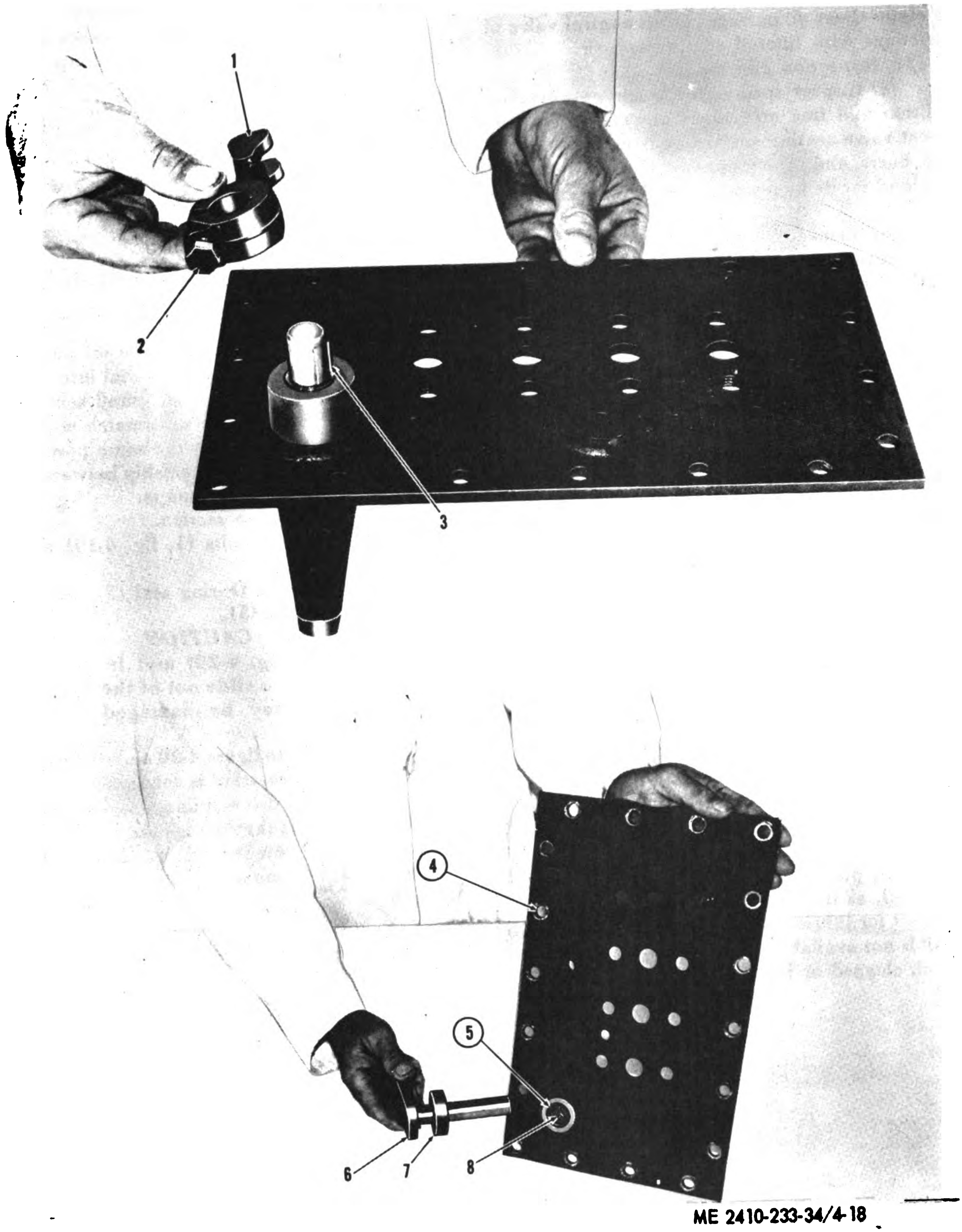
c. *Tilt Control Lever.*

(1) *Removal and disassembly.*

(a) Loosen bolt (2, fig. 4-18) and remove lever (1).

(b) Remove key (3).

(c) Remove lever (6) and washer (7) from plate (4).



1 Lever
2 Bolt
3 Key
4 Blade tilt control valve mounting plate

5 Lip-type seal
6 Lever
7 Washer
8 Bearing (2)

Figure 4-18. Tilt control lever removal.

(2) *Cleaning.* Clean all parts with cleaning solvent (Fed. Spec. P-D-680). Dry parts with a lint free cloth. Clear all passages in tilt control valve of restrictions with filtered compressed air.

(3) *Inspection and repair.*

(a) Inspect springs for weak or damaged condition and free movement of valves in bores. Inspect valve seating surface and seat in bore for nicks, burrs, and proper contact. Examine edges of valve land for damage and wear. Replace defective parts.

(b) Inspect O -ring seals (7 and 8, fig. 4-17) for cuts, breaks, or deterioration. Replace all defective packing.

(4) *Reassembly.*

(a) Reassemble the tilt control valve using figure 4-17 as a guide.

(b) Install sufficient shims (20) to provide a relief valve opening pressure of 1,975±25 psi.

(c) Be sure pilot valve seat (23) is bottomed square against the shoulder in control valve body (5) and spring is in its recess in seat (23).

(d) Torque bolts (9, fig. 4-17) to 25±1 ft-lb.

(5) *Installation.*

(a) Install tilt control valve in reverse of removal.

(b) Torque bolts (1, fig. 4-16) to 60±2 ft-lbs.

NOTE

Bolt (5) must be in place before installing manifold (3) on plate (2).

4-7. Hydraulic Pump

a. General.

(1) The double section, insert vane-type hydraulic pump is bolted on the engine rear power takeoff housing and is driven by the rear power takeoff idler gear.

(2) The pump must have an adequate supply of clean oil, as it is dependent upon a continuous flow of oil for lubrication of closely fitted parts. If inlet oil is not available to the pump because of low oil level, clogged or leaking inlet lines, or for any other reason, the pump may seize or otherwise be damaged when the engine is started.

(3) The pump assembly consists of a small section pump and a large section pump, utilizing a common inlet, within the same pump assembly.

(4) The large section of the pump provides hydraulic power for the blade lift circuit, which is controlled by a valve located within the hydraulic tank and for the scraper circuit which is controlled by an external valve. The small pump section powers the blade tilt circuit through a control valve mounted in the tank.

b. Removal. Refer to TM 5-2410-233-20 and remove the hydraulic pump from the tractor.

c. Disassembly.

(1) When disassembling the oil pump, avoid introducing dirt or foreign material into the pump.

(2) Before removing the small section cover, mark both section covers with match marks so the covers can be installed in the same position. This will insure the proper relationship between the inlet and outlet ports of the pumps.

(3) *Small pump section.*

(a) Remove bolts (1, fig. 4-19) and cover (2).

(b) Remove O -ring seal (3), wave washer (4), and cartridge (5).

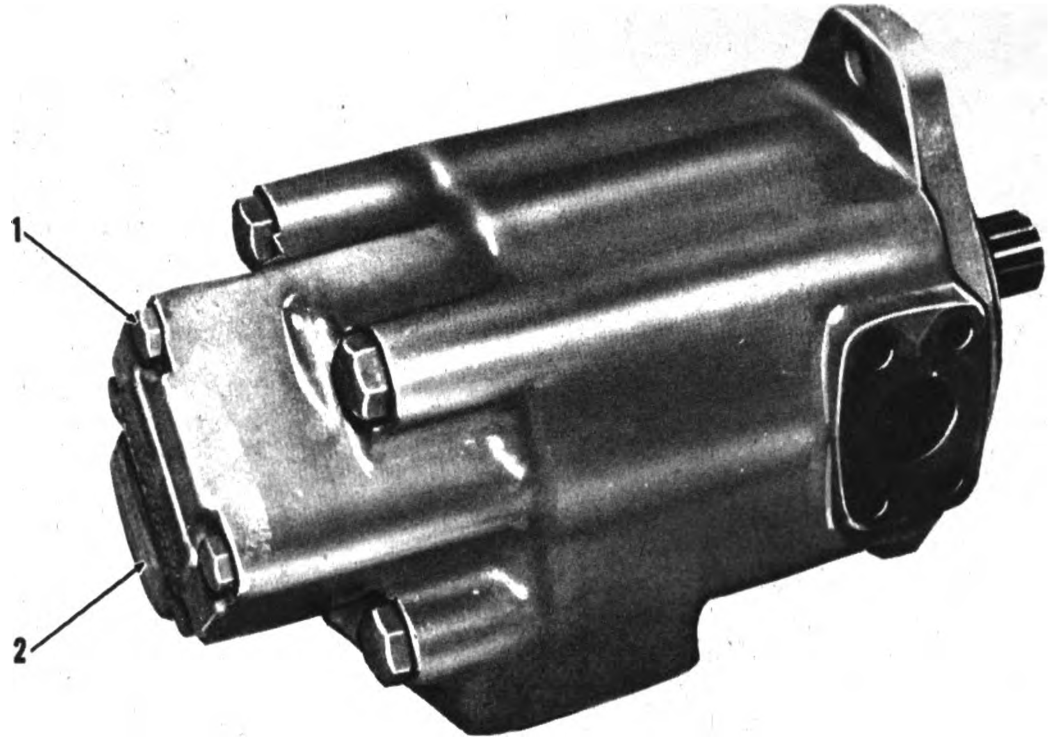
CAUTION

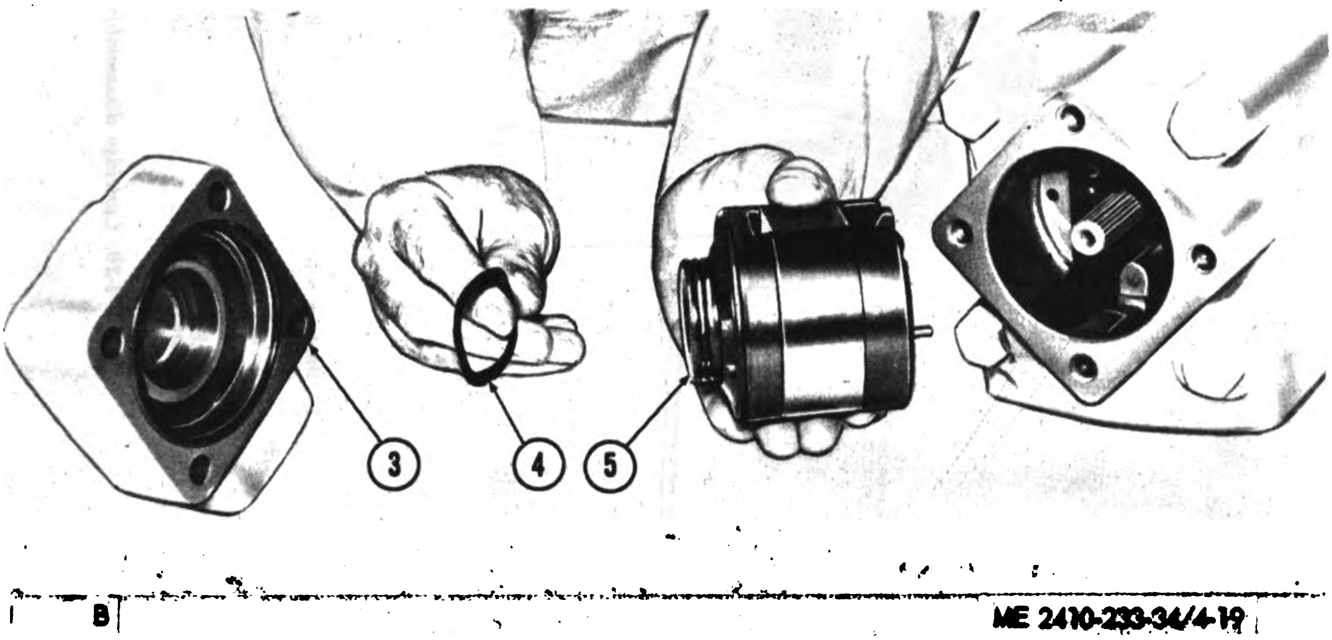
Vanes (11, fig. 4-20) and insert vanes (12) are free to slide out of the rotor and ring, and may be damaged if dropped.

(c) Refer to figure 4-20 and disassemble the cartridge. Pump rotation is counterclockwise when viewed from the drive spline end. Correct pump assembly requires that the leading chamfered edge of vanes (11), arrow (6) on ring (5) and the arrow on rotor (13) all point in the direction of pump rotation.

CAUTION

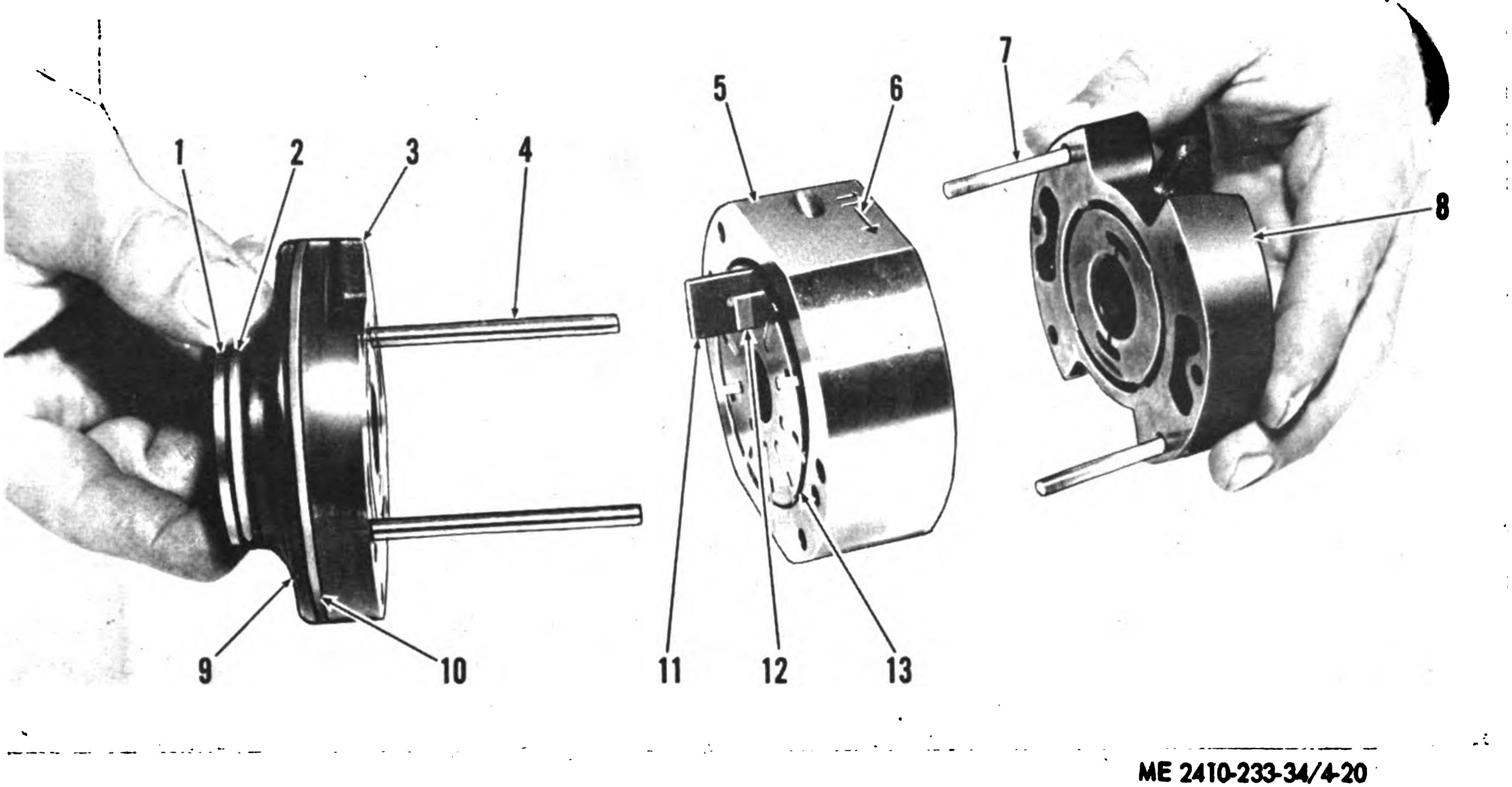
Tighten bolts (1) only after large section cover bolts have been tightened.





1 Bolts
2 Cover
3 O-ring seal
4 Wave washer
5 Cartridge

Figure 4-19. Cover and cartridge removal, small pump section.



1	Backup ring	8	Plate
2	O-ring seal	9	Preformed packing
3	Plate	10	Backup ring
4	Dowels	11	Vanes
5	Ring	12	Insert vanes
6	Arrow	13	Rotor
7	Screws		

Figure 4-20. Cartridge disassembly, small pump section.

(4) *Large pump section.*

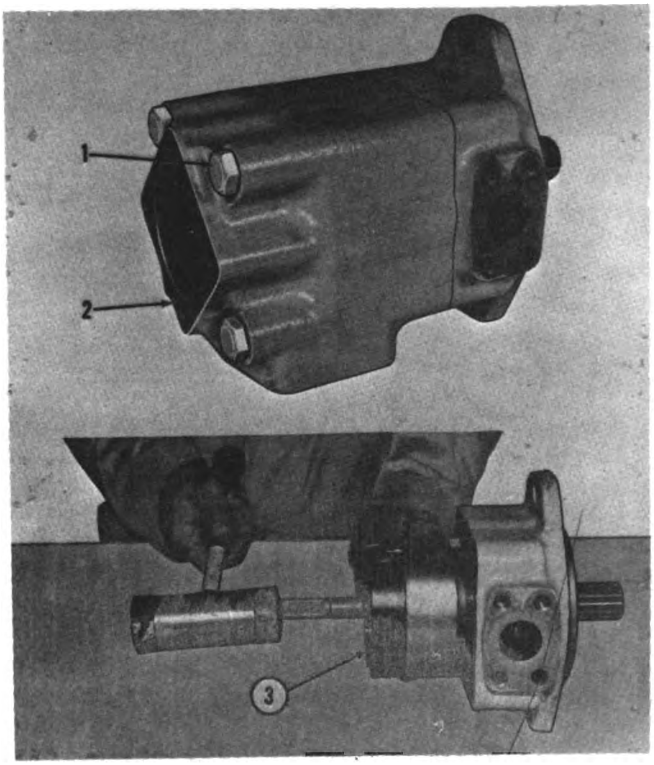
(a) Remove bolts (1, fig. 4-21) and cover (2).

(a) Hold cartridge (3) and, using a plastic hammer, tap on the end of the shaft to force the body and shaft from the cartridge.

CAUTION

Vanes (11, fig. 4-22) and insert vanes (10) are free to slide out of the rotor and ring, and may be damaged if dropped.

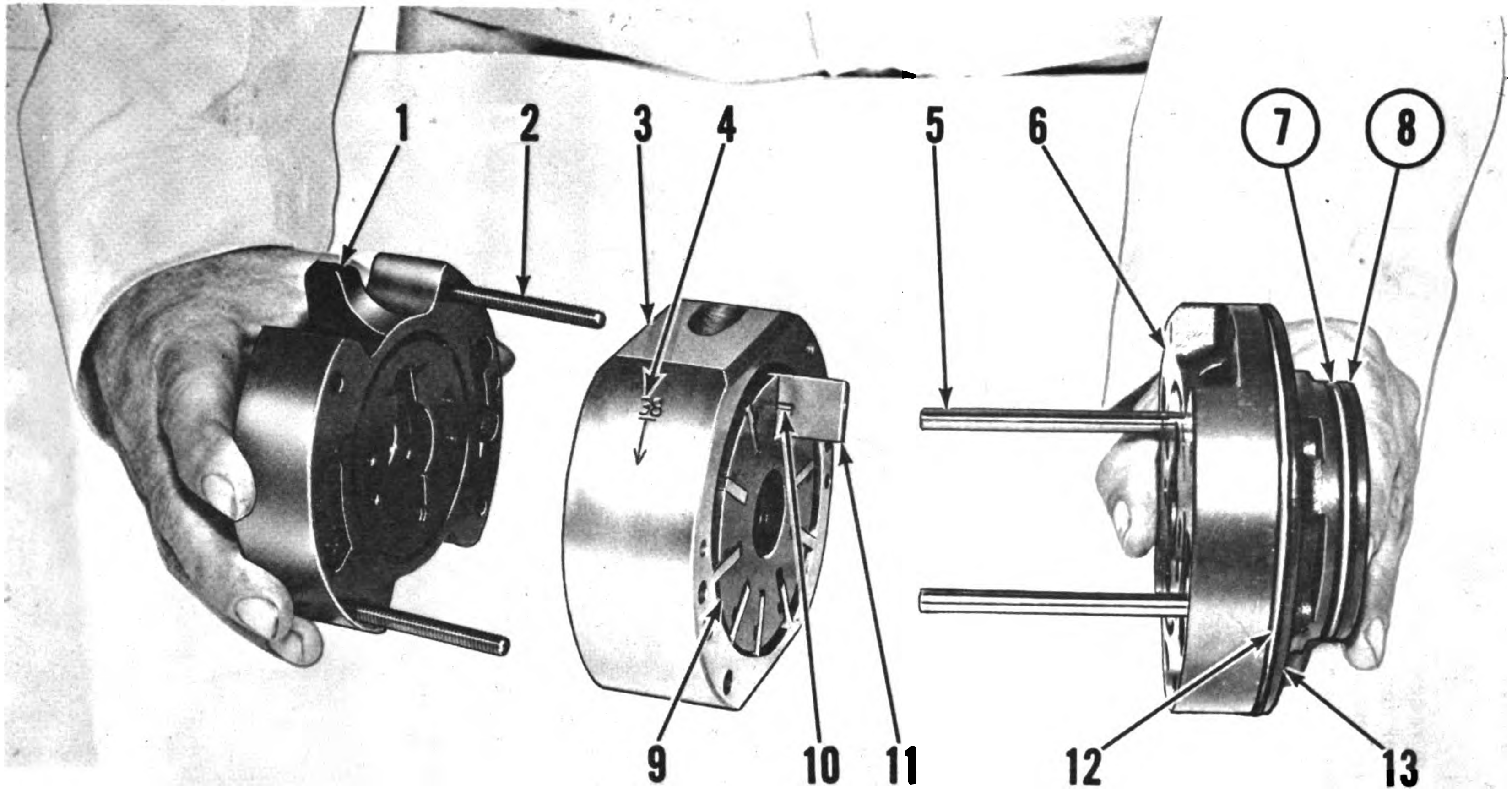
(c) Refer to figure 4-22 and disassemble the cartridge.



ME 2410-233-34/4-21

1 Bolts
2 Cover
3 Cartridge

Figure 4-21. Cover and cartridge removal, large pump section.

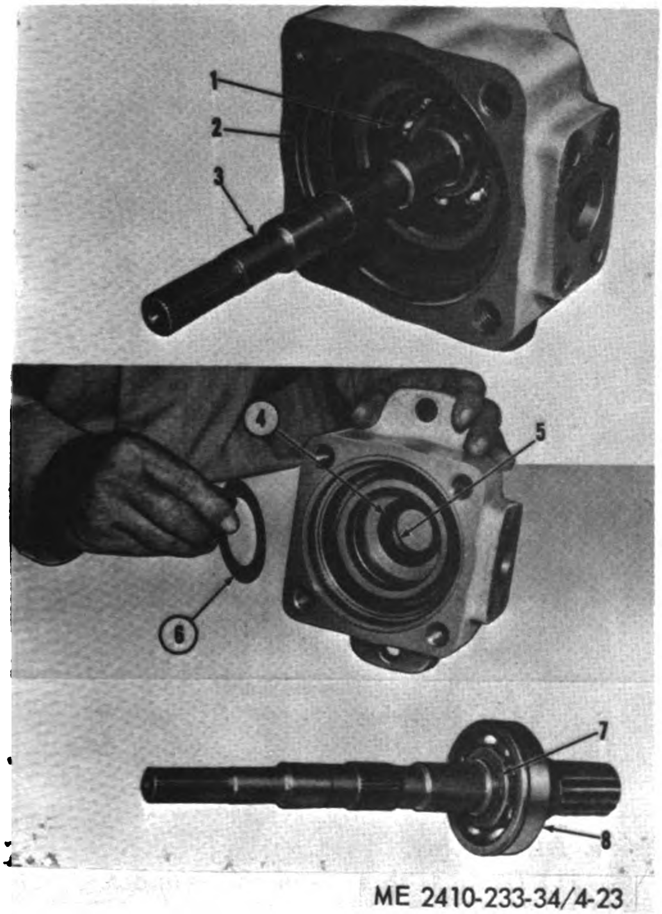


ME 2410-233-34/4-22

1	Plate	8	Backup ring
2	Screws	9	Rotor
3	Ring	10	Insert vane
4	Arrow	11	Vane
5	Dowels	12	Backup ring
6	Plate	13	O-ring seal
7	O-ring seal		

Figure 4-22. Cartridge disassembly, large pump section.

(5) *Pump shaft removal.* Refer to figure 4-23 and remove the shaft, seal and bearing.



1 Lockring
2 O-ring seal
3 Shaft
4 Lip-type seal
5 Wiper
6 Washer
7 Snapring
8 Bearing

Figure 4-23. Shaft, seal, and bearing removal.

d. Cleaning. Clean all parts with cleaning solvent (Fed. Spec. P-D-680). Dry parts with a lint free cloth. Clear all passages in hydraulic pump of restrictions with filtered compressed air.

e. Inspection and Repair.

(1) Inspect the pump bearings for scoring, damage, and wear. Replace bearings which are scored, damaged or worn excessively.

(2) Inspect the plates, ring, rotor, and vanes for damage and wear. Install cartridge kits if parts are found damaged or worn excessively.

(3) Inspect pump housing for cracks, breaks, and other damage. Replace defective parts.

(4) Install new seals, washers, and packing.

f. Reassembly.

(1) Reverse disassembly procedure and assemble the hydraulic pump. During assembly, immerse each pump part in clean hydraulic oil.

(2) Pump rotation is counterclockwise when viewed from the drive spline end. Be sure that the leading chamfered edge of the vanes, arrow on the ring, and arrow on the rotor, all point in the direction of pump rotation.

(3) Tighten bolts to torque valve given in table 1-2.

g. Installation. Refer to TM 5-2410-233-20 and install the hydraulic pump on the tractor.

Section III. HYDRAULIC CYLINDERS

4-8. Hydraulic Lift Cylinders

a. General. Both blade lift cylinders are removed and installed in a similar manner. The hydraulic system need not be drained to remove cylinders; however, do not move the control lever from neutral position after disconnecting cylinder oil lines.

b. Removal.

(1) Lower the bulldozer blade to the ground.

(2) Remove bolt (3, fig. 4-24) securing lockpin (2) to the bulldozer blade bracket.

(3) Remove pin (4) securing piston rod (1) to the bulldozer blade.

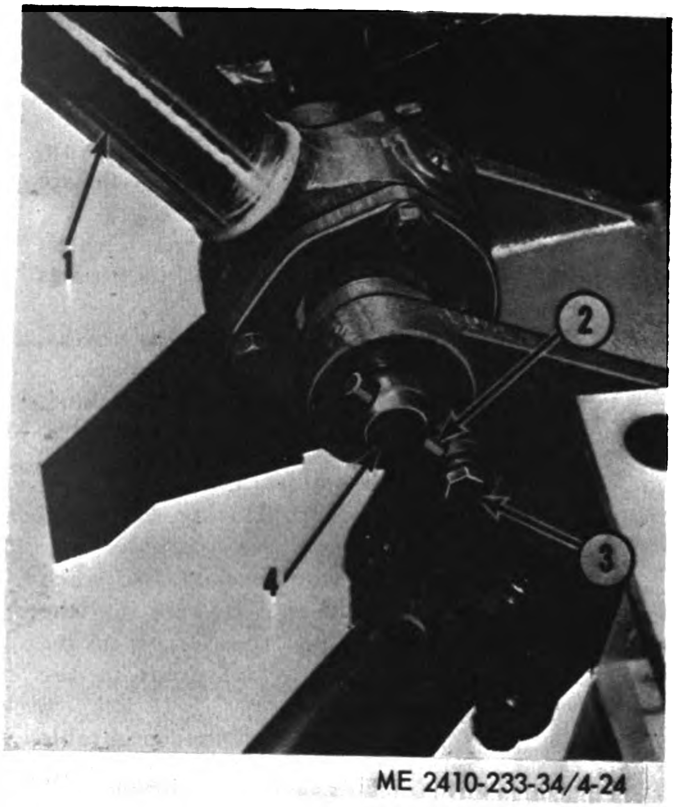
(4) Retract piston rod (1) and wire the rod end to the head of the cylinder. Remove the cylinder with the rod in the retracted position.

(5) Attach a hoist to the cylinder (3, fig. 4-25).

(6) Disconnect the hydraulic oil lines (1) and mark them in relation to their openings to assure proper connections when installing the cylinder (3).

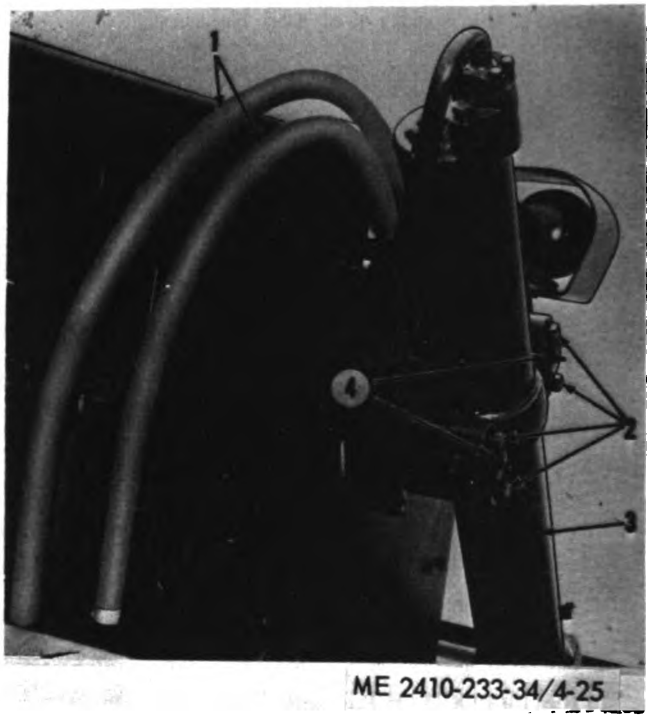
(7) Cover all openings to prevent the entry of dirt into the hydraulic system.

(8) Remove bolts (2) and trunnion caps (4), and lift cylinder (3) away from the tractor.



1 Piston rod
2 Lockpin
3 Bolt
4 Pin

Figure 4-24. Disconnecting piston rod.



1 Hydraulic oil lines
2 Bolts
3 Cylinder
4 Trunnion caps

Figure 4-25. Lift cylinder removal.

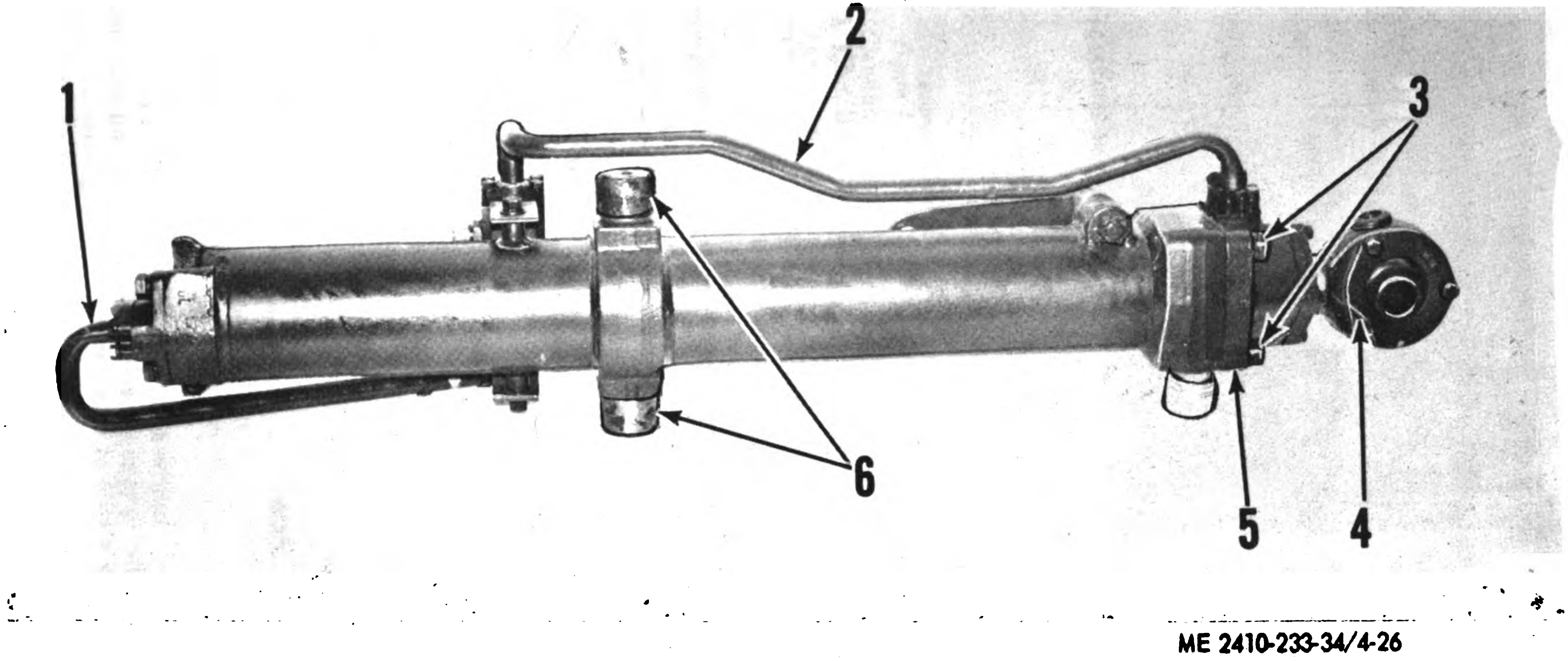
c. *Disassembly.*

(1) Drain both ends of the cylinder.

(2) Remove tube assemblies (1 and 2, fig. 4-26).

(3) Remove and inspect bearings (6). Replace if necessary.

(4) Remove bolts (3) securing the head (5) to the cylinder.



1 Tube assembly
2 Tube assembly
3 Bolts
4 Piston rod
5 Head
6 Bearings

Figure 4-26. Preparing to disassemble cylinder.

CAUTION

Extend piston rod (4) out of the cylinder before removing bolts (3). This will prevent possible scoring of cylinder walls when removing the piston from the cylinder.

(5) Remove the head, piston rod, and piston.

(6) Remove nut (1, fig. 4-27) and washer (2).

(7) Remove piston (10).

(8) Remove wear ring (3) by expanding it slightly and sliding it off piston (10).

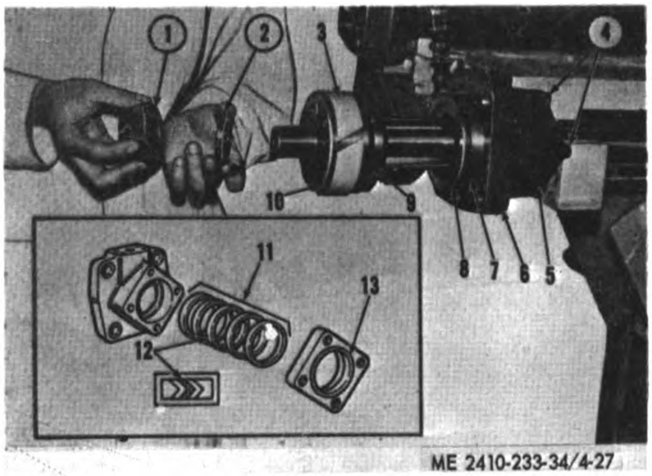
(9) Expand the outer ring of seal assembly (9) and remove the outer and inner rings.

(10) Press plungers (1, fig. 4-28) inserts (2) and (3) from piston (4), using a driver fabricated as shown in figure 4-29).

(11) Remove preformed packing (8, fig. 4-27) and backup ring (7).

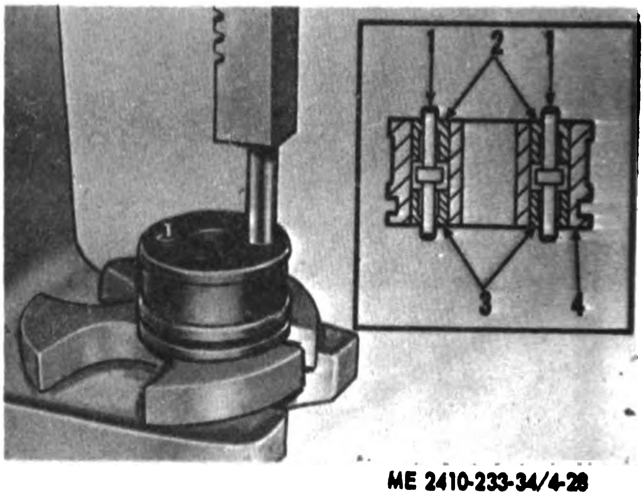
(12) Remove head (6).

(13) Remove bolts (4) securing retainer (5) to the head.



1 Nut
2 Washer
3 Wear ring
4 Bolts
5 Retainer
6 Cylinder head
7 Backup ring
8 Preformed packing
9 Seal assembly
10 Piston
11 Packing rings
12 Rubber pressure ring
13 Seal

Figure 4-27. Disassembling piston and head.



1 Plunger
2 Insert
3 Insert
4 Piston

Figure 4-28. Relief valve removal.

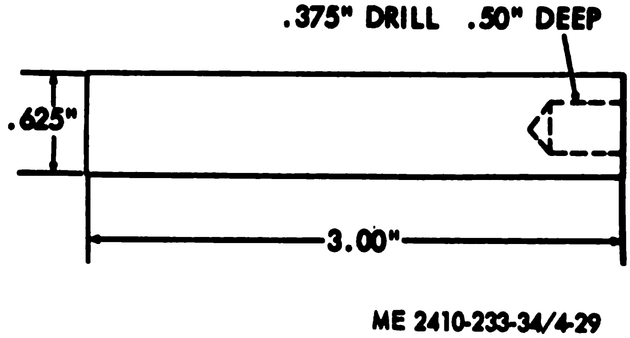
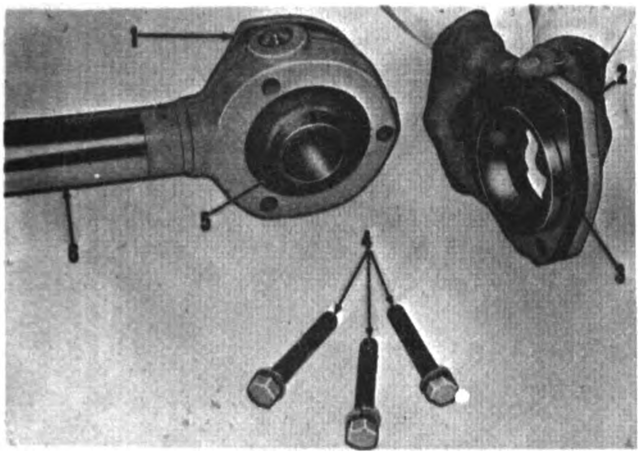


Figure 4-29. Driver dimensions.

(14) Remove packing rings (11), rubber pressure ring (12), and seal (13).

(15) Remove bolts (4, fig. 4-30) securing bearings (1) and (2) and shims (3) to piston rod (6).

(16) Remove trunnion (5) from piston rod (6).



1 Bearing
2 Bearing
3 Shims
4 Bolts
5 Trunnion
6 Piston rod

Figure 4-30. Piston rod bearing disassembly.

d. Cleaning. Clean all parts with cleaning solvent (Fed. Spec. P-D-680) and dry with lint-free cloth.

e. Inspection and Repair.

(1) Inspect the cylinders for scoring, pitting, and wear. Inside diameter (new) is 4.7495 ± 0.0015 inches. Maximum permissible inside diameter is 4.7645 inches. Repair or replace a damaged or worn cylinder.

CAUTION

Do not weld on the cylinder assemblies as scoring may result from the bore shrinkage.

(2) Replace all seals, packing, and wear rings.

(3) Inspect the rod end bearing for scoring, damage, and wear. Replace as required.

(4) Inspect the piston rod for nicks, burrs, pitting, distortion, and wear. Repair or replace a damaged or distorted rod. Remove minor nicks and burrs using a fine emery stone. Pitted, scored, or worn rods may be repaired by metalizing or chrome-plating and regrinding to original size. A non-corrosive metal will be used to metalize shafts.

(5) Inspect trunnion arm bearings for damage and wear. Replace all defective parts.

f. Reassembly.

(1) Assembly trunnion (5) and bearings (2) and (1) in piston rod (6). Use shims (3) as required (between bearings and piston rod eye) to obtain a free running fit between trunnion and bearings.

(2) Install seal (13, fig. 4-27) in retainer (5) with the lip of the seal facing away from the retainer.

(3) Place retainer (5), packing (11) and head (6) on the piston rod.

(4) Separate and oil all of the rings in packing (11). Install one ring of packing at a time into head (6) so the open part of the V is facing toward head. Be sure rubber pressure ring (12) is located as shown.

(5) Using retainer (5), tap the packing firmly into place in the head.

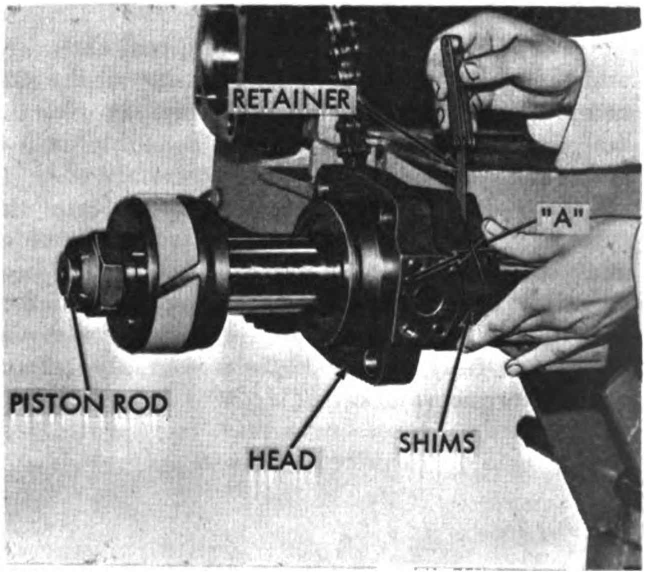
(6) While holding retainer firmly seated against packing, measure clearance (A, fig. 4-31) between retainer and head with a thickness gage.

(7) Remove the head with the packing from the piston rod, leaving the retainer on the rod.

(8) Install shims on the rod with a total thickness of 0.010 inch to 0.015 inch less than the measured clearance (A). This will preload the packing properly when the retainer is tightened into place.

CAUTION

When installing the head on the rod, be careful not to damage the packing.



ME 2410-233-34/4-31

Figure 4-31. Measuring clearance.

(9) Install new backup ring (7, fig. 4-27) and preformed packing (8) on the head.

(10) Install inserts (3 and 4, fig. 4-32) with the milled end pointing away from the piston surface, and positioned as shown.

NOTE

The bores in piston (1) which contain inserts and plungers must be free of dirt or foreign matter.

(11) Chill the inserts before installing. Install one insert into the piston until it is flush with the piston surface. Turn the piston over and place plunger (2) into the piston. Position and press the other insert into the piston until it is flush with the piston surface. Check the plunger for moving freely. Install remaining inserts and plunger in a similar manner.

(12) Assemble wear ring (3, fig. 4-27) to piston (10).

(13) Install piston (10), washer (2) and nut (1) on the piston rod. Tighten nut (1) to 750-850 lb-ft.

(14) Install the rubber inner ring of seal assembly (9) into the groove on the piston (10).

(15) Place the outer sealing ring of the seal assembly on the expander assembly (1, fig. 4-33).

(16) Stretch until point "A" is slightly above the 4.75 mark "B" which is the diameter of the ring.

(17) Back point "A" to the 4.75 mark "B" and try to lift the seal ring from the expander assembly (1). If the seal ring will not slip off easily, rotate the seal ring 90° and stretch as before. When ring will slip off the expander assembly easily, with point "A" set at the 4.75 inch mark "B", the ring can be assembled on the piston, over the rubber inner ring.

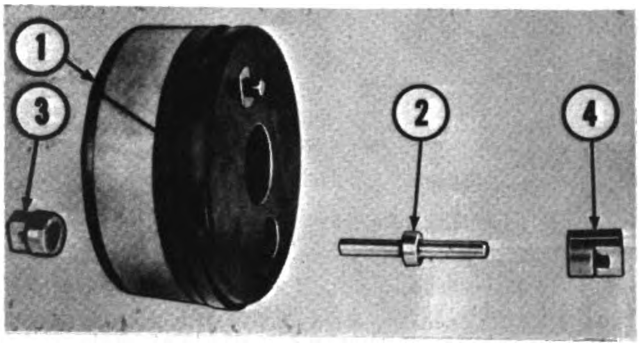
CAUTION

Do not over-stretch the seal ring.

(18) Oil the piston, wear ring, seal assembly, and the inside of the cylinder, and install the seal compressor (3) and clamp assembly (2) over the seal assembly. Compress the seal assembly until it is equal to the od of the piston.

(19) Install the piston assembly into the cylinder, allowing the seal compressor to shoulder against the cylinder and be forced off the seal assembly, as the piston is pushed into the cylinder.

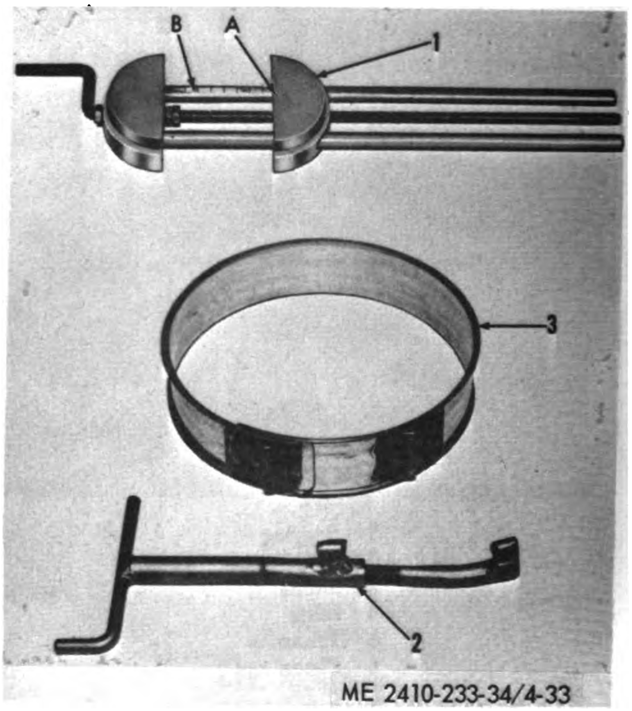
(20) Tighten the cylinder head bolts with the piston rod fully extended. Refer to table 1-2 for correct torque values.



ME 2410-233-34/4-32

1 Piston
2 Plunger
3 Insert
4 Insert

Figure 4-32. Piston reassembly.



ME 2410-233-34/4-33

1 Expander assembly
2 Clamp assembly
3 Seal compressor
A Edge of adjustable block
B Seal diameter scale

Figure 4-33. Seal assembly installation tools.

g. Packing Adjustment. Hydraulic cylinder packing leakage can be caused by wear, cuts, and / or distortion of the packing. If the cylinder leaks around the rod, shims can be removed to tighten the packing around the rod.

(1) Lower the hydraulically controlled equipment to the ground to relieve cylinder pressure.

(2) Remove bolts holding retainer (2, fig. 4-34) to cylinder head.

(3) Pry or tap retainer out to permit cutting and removing shims (1).

(4) Remove one shim at a time. If, after removing two shims, the cylinder still leaks, disassemble cylinder and replace packing.

NOTE

Only remove shims (1) which measure 0.010 inch thickness. The thicker shim should not be removed to adjust the packing.

1 Shims
2 Retainer

Figure 4-34. Removing shims.

h. Installation. Reverse removal procedure and install the hydraulic cylinders on the tractor.

4-9. Hydraulic Tilt Cylinder

a. General. The hydraulic system need not be drained to remove the tilt cylinder, however, do not move the bulldozer tilt control lever from the HOLD position after disconnecting the cylinder oil lines.

b. Removal.

(1) Lower the bulldozer blade to the ground and remove the cylinder oil line guard.

(2) Attach a hoist to cylinder (1, fig. 4-35) and remove the bolts (2) securing cap (3) to the blade.

(3) Disconnect cylinder oil lines (5). Cover the openings in the oil lines and cylinder to prevent dirt from entering system.

(4) Remove pin (6) and lift off the cylinder.

c. Disassembly.

(1) Drain both ends of the cylinder.

(2) Remove bolts (3, fig. 4-36) securing the head (1) to the cylinder.

CAUTION

Extend the piston rod (2) out of the cylinder before removing bolts (3). This will prevent possible scoring of the cylinder walls when removing the piston from the cylinder.

(3) Remove the head, piston rod and piston.

(4) Inspect bearing (4) and mating pin.

(5) Remove retaining ring and pin securing nut (1, fig. 4-37) to the piston rod (2).

(6) Remove nut (1) with a wrench as shown.

NOTE

When removing or installing nut (1) secure piston rod (2) with a wrench on flats A.

(7) Remove piston (1, fig. 4-38).

(8) Remove wear ring (8).

(9) Expand the outer ring of seal assemblies (7) and remove the outer and inner rings.

(10) Remove preformed packing (2) and backup ring (3).

(11) Remove head (4).

(12) Remove bolts (5) securing retainer (6) to head (4).

(13) Remove packing rings (9) and seal (10).

(14) Inspect all parts, replacing worn or damaged parts.

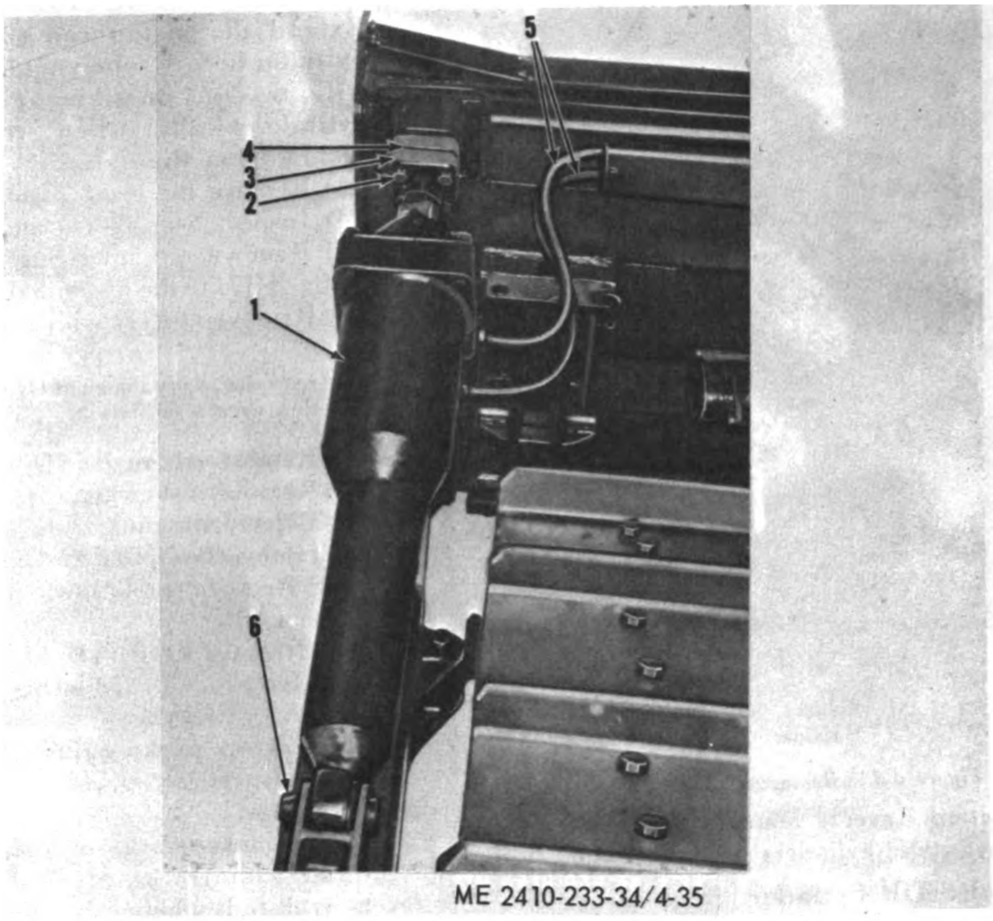
(15) Remove marks or rough spots on the piston rod with crocus or fine emery cloth to prevent seal and packing damage.

(16) Inspect walls of cylinder bore for scoring marks. Any scoring marks which cannot be removed with a minimum of light honing will require replacement of cylinder assembly.

CAUTION

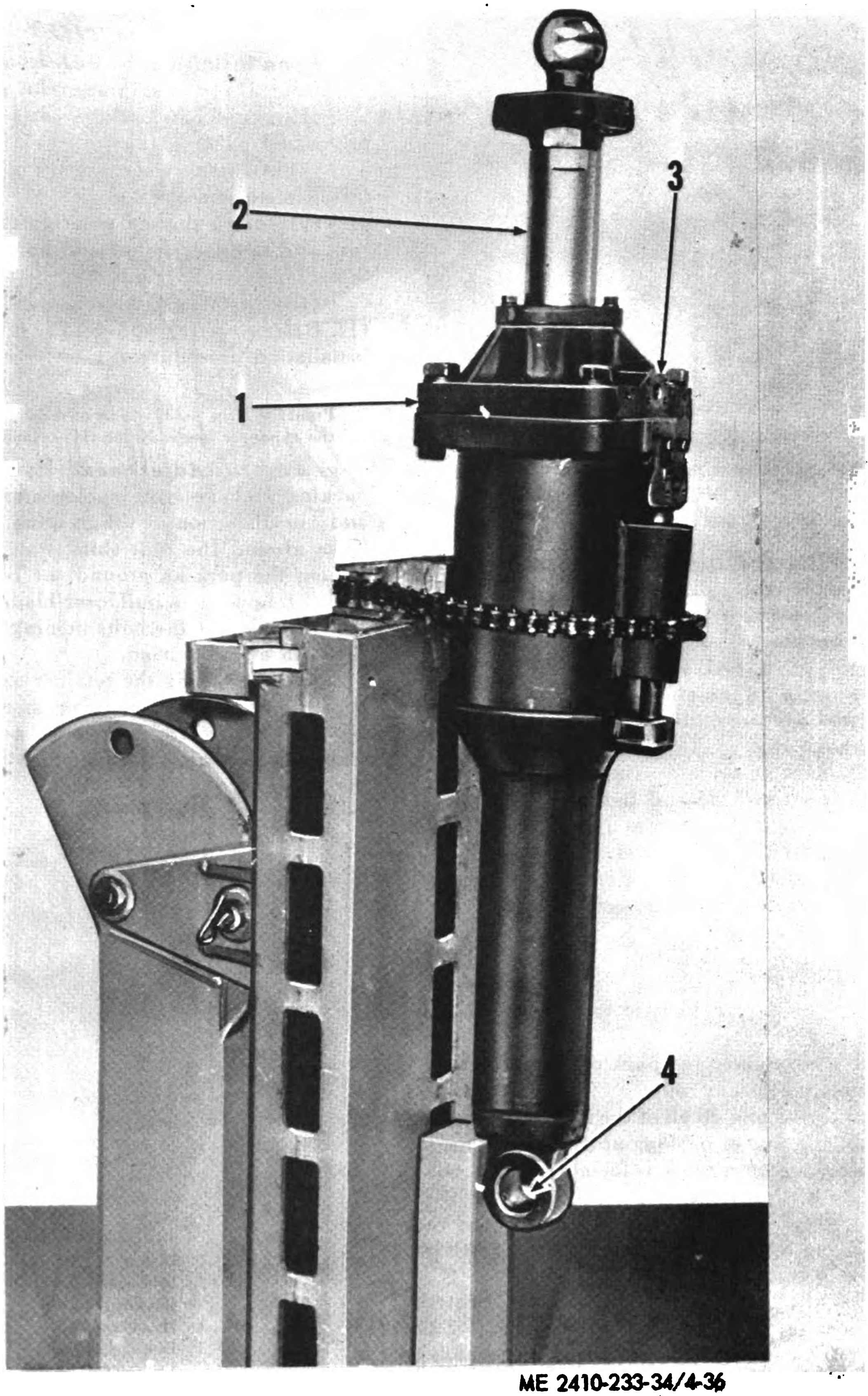
Under no circumstances should welding be done on cylinder. Welding on cylinder may cause enough shrinkage to cause interference between piston and cylinder wall and result in severe scoring of cylinder walls and piston.

d. Cleaning. Clean all parts with cleaning solvent (Fed. Spec. P-D-680). Dry parts with a lint-free cloth.



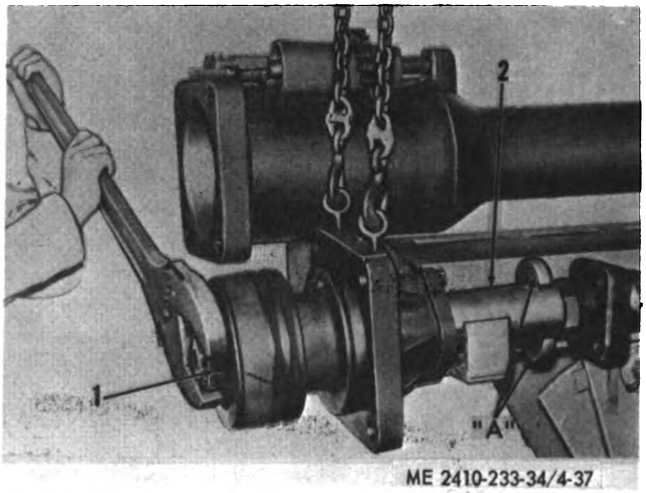
1 Tilt cylinder
2 Bolts
3 Cap
4 Shims
5 Cylinder oil lines
6 Pin

Figure 4-35. Tilt cylinder removal.



1 Cylinder head
2 Piston rod
3 Bolts
4 Bearings

Figure 4-36. Preparing to disassemble cylinder.



1 Nut
2 Piston rod
"A" Flats on piston rod

Figure 4-37. Removing nut.

e. Inspection and Repair.

(1) Inspect the cylinder for scoring, pitting, and wear. Replace a cylinder which cannot be made serviceable with light honing.

CAUTION

Do not weld on the cylinder assembly as scoring may result from the bore shrinkage.

(2) Replace all seals, packing, and wear rings.

(3) Inspect the rod end bearing for scoring, damage, and wear. Replace as required.

(4) Inspect the piston rod for nicks, burrs, pitting, distortion, and wear. Repair or replace a damaged or distorted rod. Remove minor nicks and burrs using a fine emery stone. Pitted, scored, or worn rods may be repaired by metalizing or chrome-plating and regrinding to original size. A non-corrosive metal will be used to metalize shafts.

f. Reassembly.

(1) Place retainer (6) packing rings (9) and head (4) on the piston rod.

(2) Separate and oil all of the rings in packing (9). Install one ring of packing at a time into head (4) so the open part of the V is facing toward head. Be sure rubber pressure ring (11) is located as shown.

(3) Using retainer (6), tap the packing firmly into place in the head.

(4) While holding retainer firmly seated against packing, measure clearance (B, fig. 4-39) between retainer and head with a thickness gage.

(5) Remove the head with the packing from the piston rod, leaving the retainer on the rod.

(6) Install shims on the rod with a total thickness of 0.010 inch to 0.015 inch less than the measured clearance (B). This will preload the packing properly when retainer is tightened into place.

CAUTION

When installing the head on the rod, be careful not to damage the packing.

(7) Install new backup ring (3, fig. 4-38) and preformed packing (2).

(8) Assemble wear ring (8) on piston (1), and install piston on the rod.

(9) Install the nut securing the piston to the rod, and tighten per nut and bolt torque chart in table 1-2.

(10) Install seal assemblies (7) to the piston (1). Refer to paragraph 4-8*f* (14 through 20) for installation procedures.

NOTE

Point "B" (fig. 4-33) will be at the 8.25 inch mark on the expander assembly for this cylinder.

g. Packing Adjustment. Hydraulic cylinder packing leakage can be caused by wear, cuts, and/or distortion of the packing. If the cylinder leaks around the rod, shims can be removed to tighten the packing around the rod.

(1) Lower the bulldozer blade to the ground.

(2) Remove the bolts holding retainer (1, fig. 4-40) to cylinder head.

(3) Pry on tap the retainer out far enough to permit cutting and removing shims (2).

(4) Remove one shim at a time. If, after removing two shims the cylinder still leaks, replace the packing.

Key to figure 4-38.
1 Piston
2 Preformed packing
3 Backup ring
4 Head
5 Bolts
6 Retainer
7 Seal assemblies
8 Wear ring
9 Packing ring
10 Lip-type seal
11 Rubber pressure ring

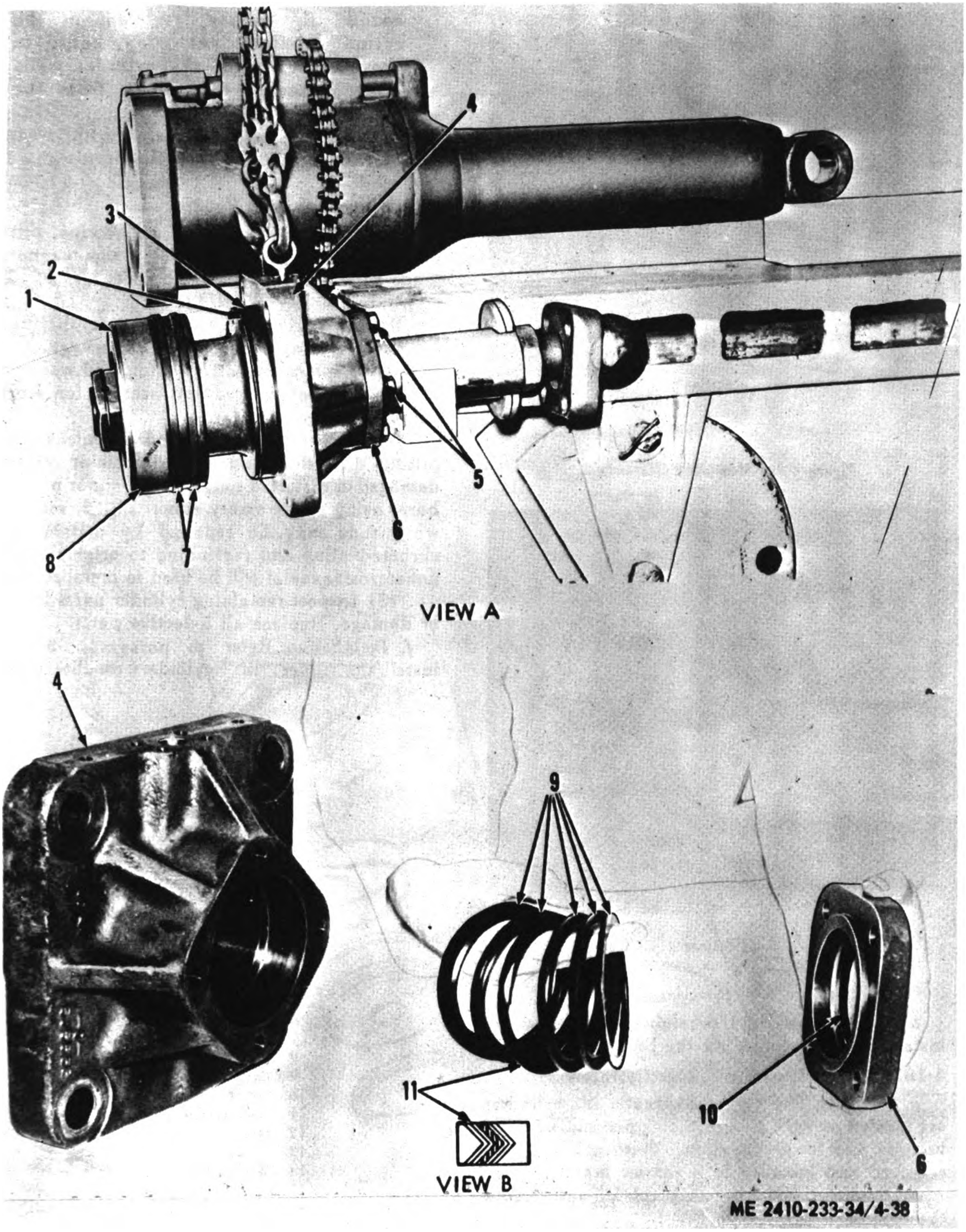


Figure 4-38. Disassembling piston head.

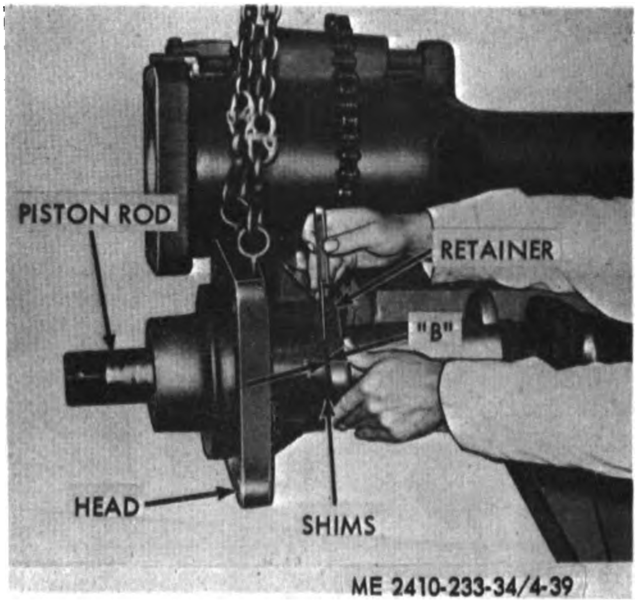
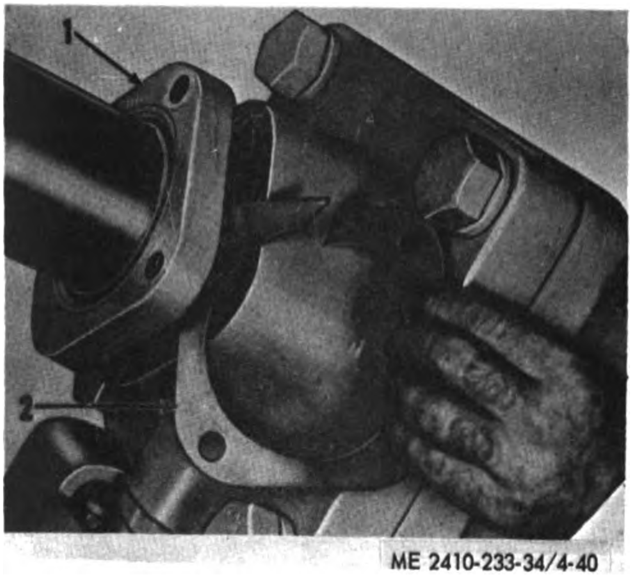


Figure 4-39. Measuring clearance.



1 Retainer
2 Shims

Figure 4-40. Removing shims.

h. Installation. Reverse removal procedure and install the tilt cylinder on the bulldozer.

4-10. Ripper Hydraulic Lift Cylinder

a. General. The ripper hydraulic lift cylinders are located on each side of the ripper and are used to raise and lower the ripper. Both cylinders are removed and installed in a similar manner.

b. Removal. Refer to paragraph 3-6 and remove the cylinders.

c. Disassembly. Disassemble the ripper lift cylinders according to sequence of index numbers assigned to figure 4-41.

CAUTION

Extend the piston rod out of the cylinder before removing bolts, to prevent scoring of the cylinder walls when removing the piston from the cylinder.

d. Cleaning. Clean all parts with cleaning solvent (Fed. Spec. P-D-680). Dry parts with a lint-free cloth.

e. Inspection and Repair.

(1) Inspect the cylinder for scoring, pitting, and wear. Replace a cylinder which cannot be made serviceable with light honing.

CAUTION

Do not weld on the cylinder assembly as scoring may result from shrinkage.

(2) Replace all seals, packing, and wear rings.

(3) Inspect the rod end bearing for scoring, damage, and wear.

(4) Inspect the piston rod for nicks, burrs, pitting, distortion, and wear. Repair or replace a damaged or distorted rod. Remove minor nicks and burrs using a fine emery stone. Pitted, scored, or worn rods may be repaired by metalizing or chrome-plating and regrinding to original size. A noncorrosive metal will be used to metalize shafts.

(5) Inspect remaining cylinder parts for wear or damage. Replace all defective parts.

f. Installation. Refer to paragraph 3-9 and install the ripper "lift" cylinders on the ripper.

Key to figure 4-41.
1 Bearing
2 Rod
3 Seal
4 Bolt
5 Lockwasher
6 Retainer
7 Shim
8 Shim
9 Packing
10 Screw
11 Lockwasher
12 Head
13 Packing
14 Washer
15 Seal assembly
16 Piston
17 Ring
18 Nut
19 Fitting
20 Cylinder assembly

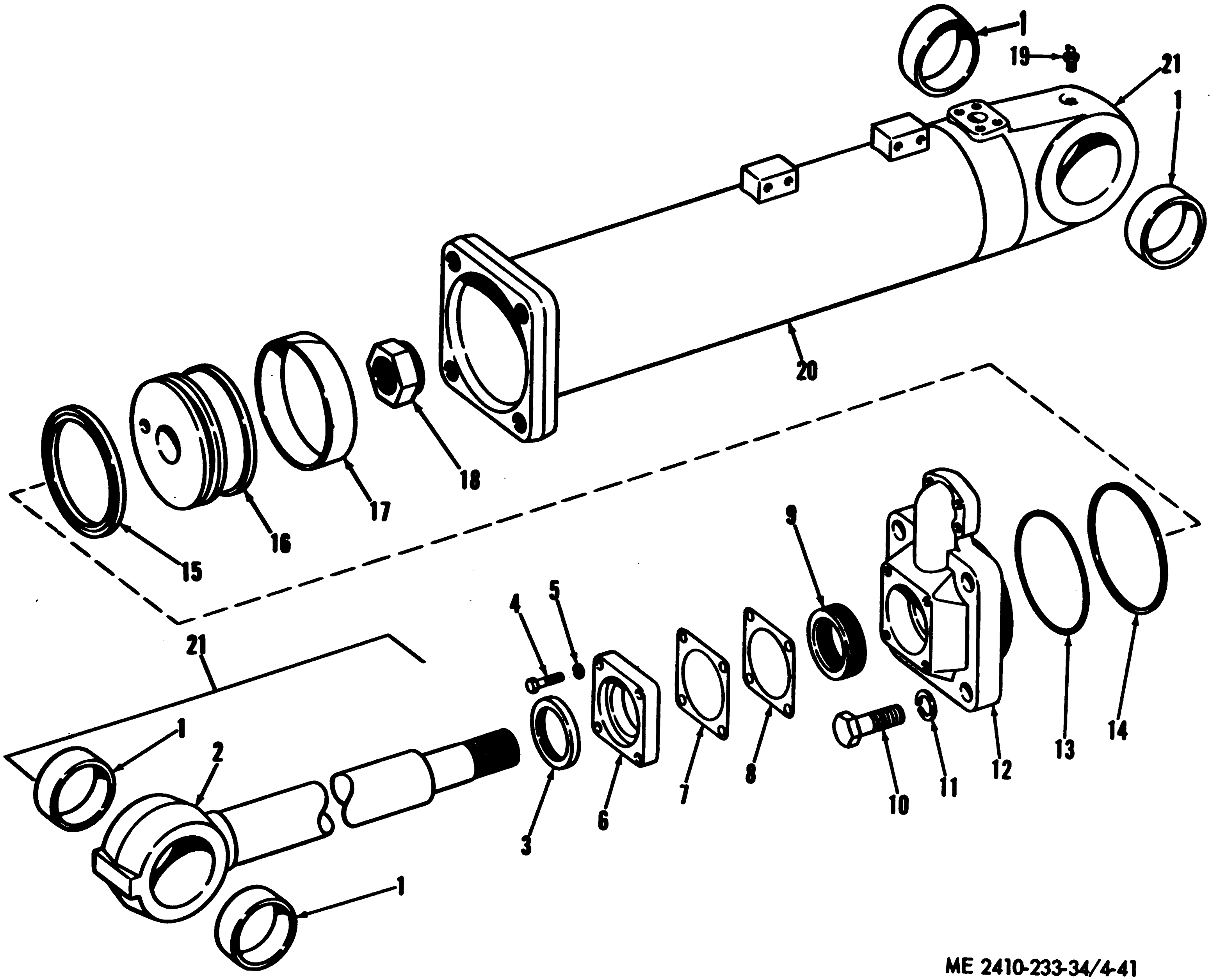


Figure 4-41. Ripper lift cylinder, exploded view.

CHAPTER 5

REPAIR OF THE POWER PLANT

Section I. COOLING SYSTEM

5-1. General

Cooling system components are the radiator, water pump, water temperature regulator, oil cooler and lines, fittings and passages. Coolant pumped from the outlet side of the water pump flows directly into the front of the cylinder block and to the oil cooler. The coolant passes through the oil cooler, returns to the block, and flows around the cylinder liner walls to the precombustion chambers. The coolant then flows to the water temperature regulator. When the coolant becomes sufficiently warm, the regulator opens to permit the coolant to return to the radiator. The coolant is cooled by air forced through the radiator core. The cooling system is pressurized to permit safe operation at temperatures higher than the normal boiling point, prevent cavitation in the water pump and reduce the possiblity of air pockets in the coolant passages. Refer to figure 5-1 for the cooling system schematic diagram.

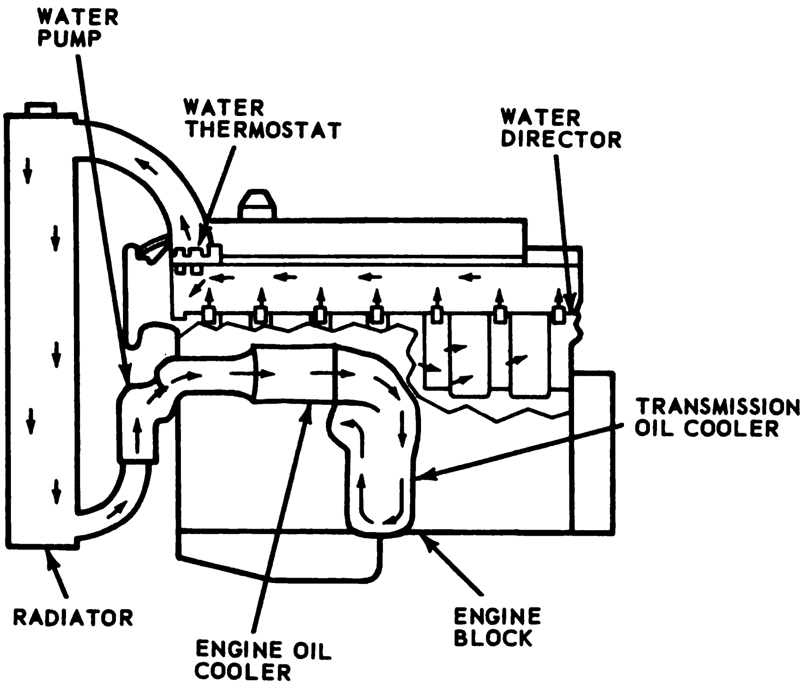


Figure 5-1. Cooling system schematic diagram.

5-2. Radiator

a. Removal.

(1) Drain the cooling system (TM 5-2410-233-10) and remove engine upper right guard assembly (TM 5-2410-233-20).

(2) Remove the hood, headlight brackets (fig. 5-2) and radiator top guard.

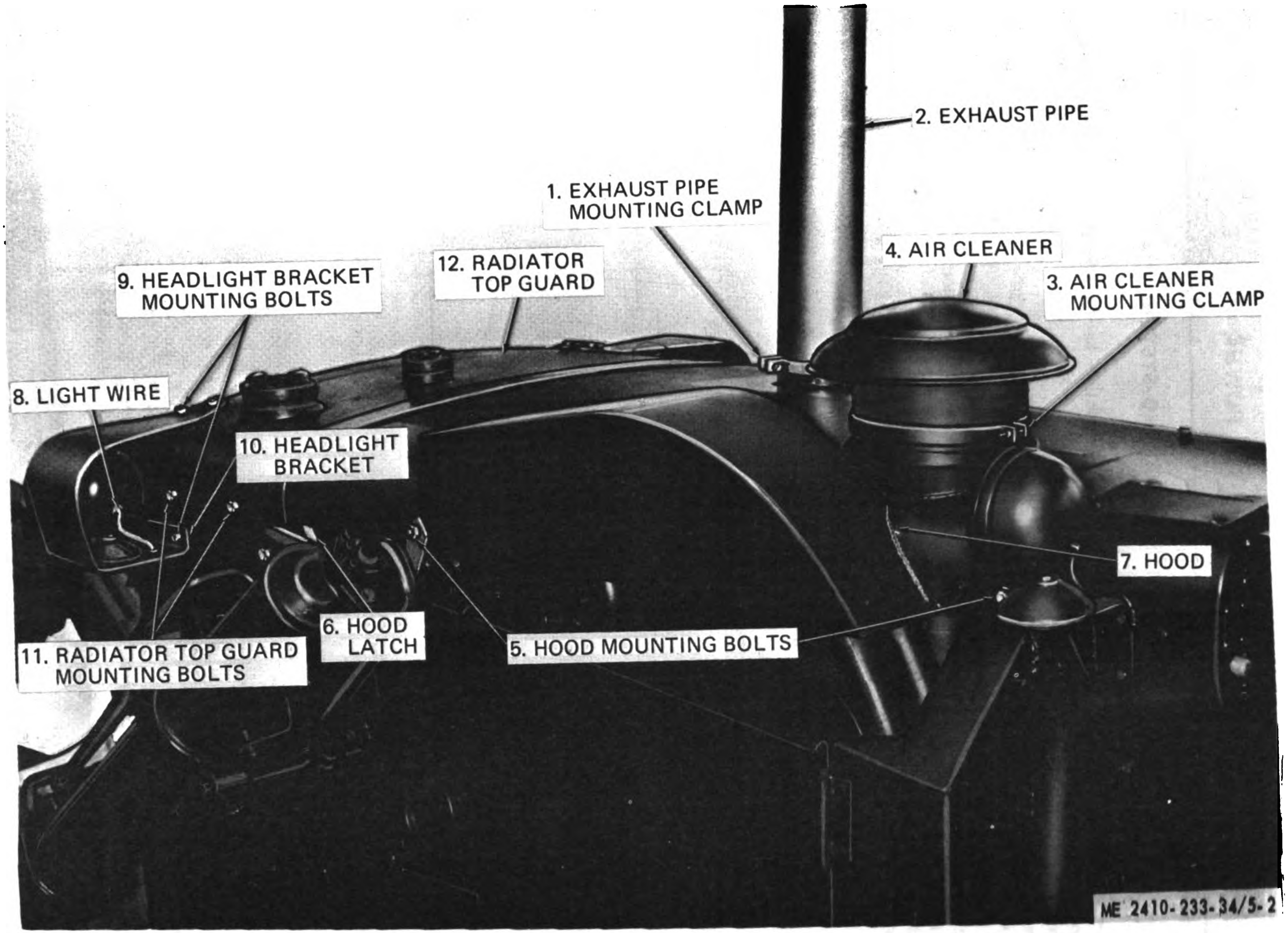


Figure 5-2. Hood, headlight brackets and radiator top guard, removal and installation.

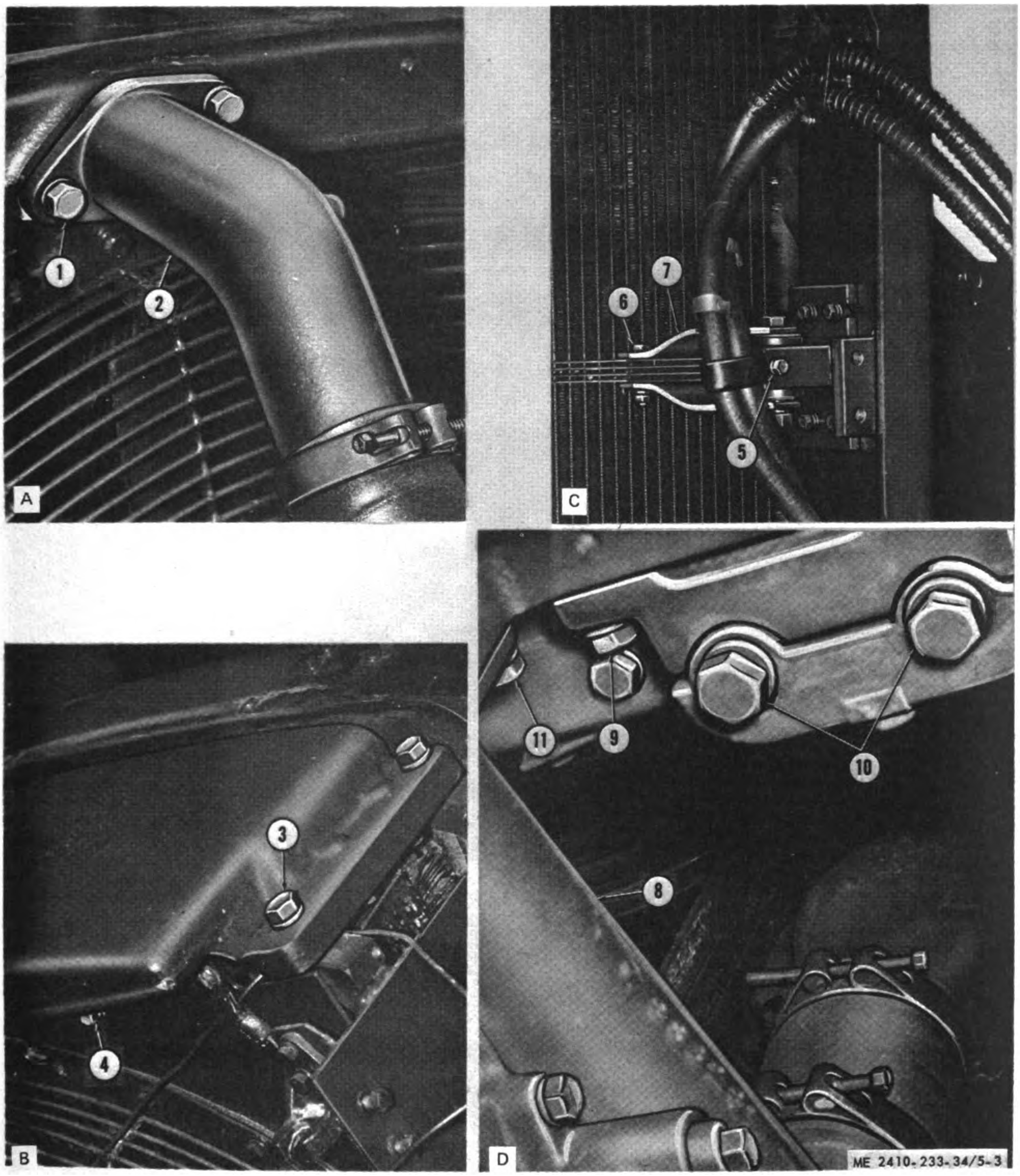
(3) Remove two capscrews (1, fig. 5-3) and remove elbow (2).

(4) Remove four bolts (3) and six bolts (4).

(5) Remove bolts (6).

(6) Rotate bracket (7) away from the radiator core after loosening bolt (5).

(7) Remove bolts (11) and disconnect elbow (8).



1 Capscrew
2 Elbow
3 Bolts
4 Bolts
5 Bolt
6 Bolt
7 Bracket
8 Elbow
9 Bolts
10 Bolts
11 Bolts

Figure 5-3. Preparing to remove radiator.

(8) Attach a hoist (fig. 5-4) and remove the radiator (approx. weight 425 lbs.).

(9) Tilt the radiator sideways so the bottom tank will pass the top tank mounting pads.

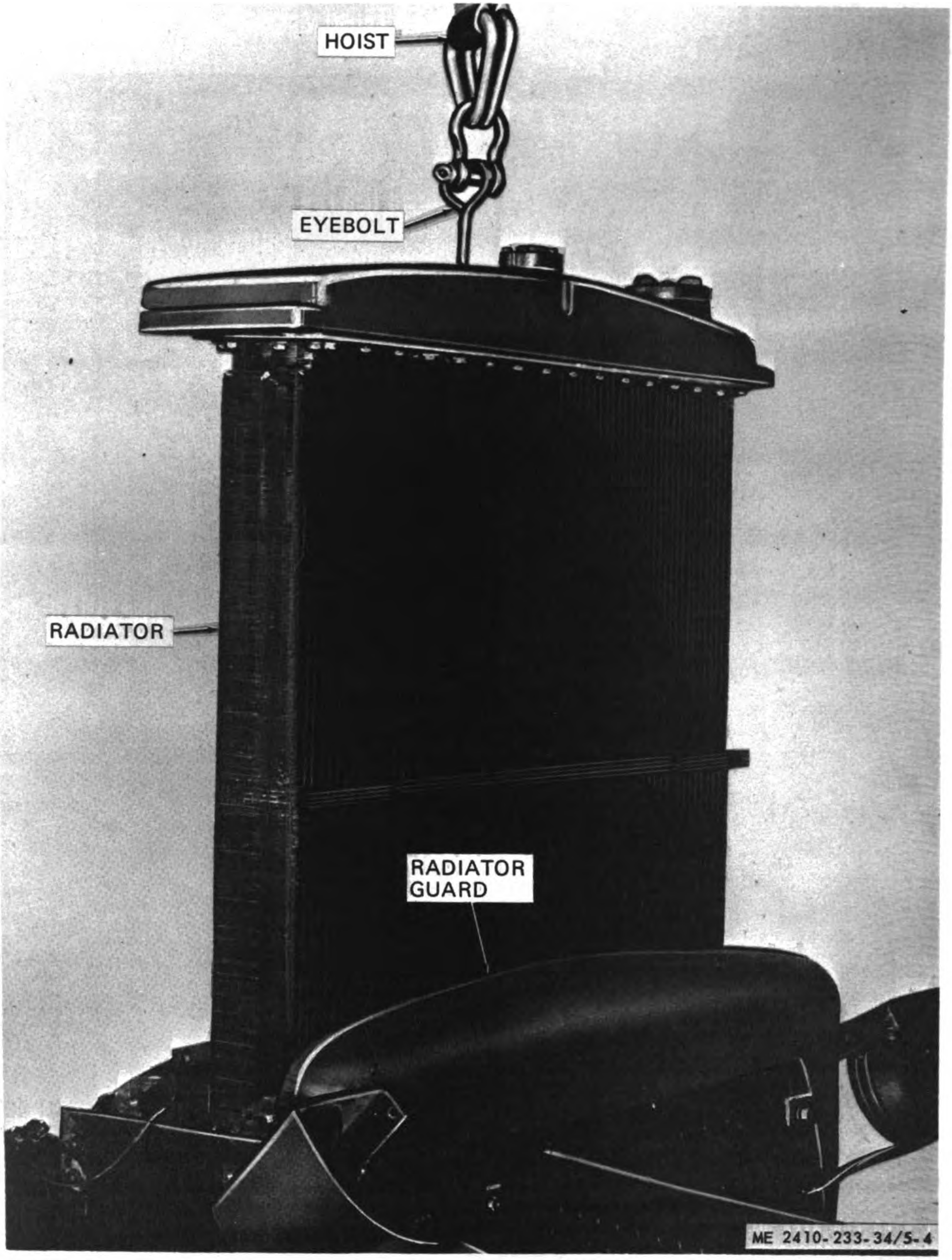


Figure 5-4. Lifting radiator from radiator guard.

b. Disassembly.

(1) Remove top tank (fig. 5-5) by removing the bolts holding reinforcing strips and radiator core to the top tank.

(2) Remove bottom tank in similar manner.

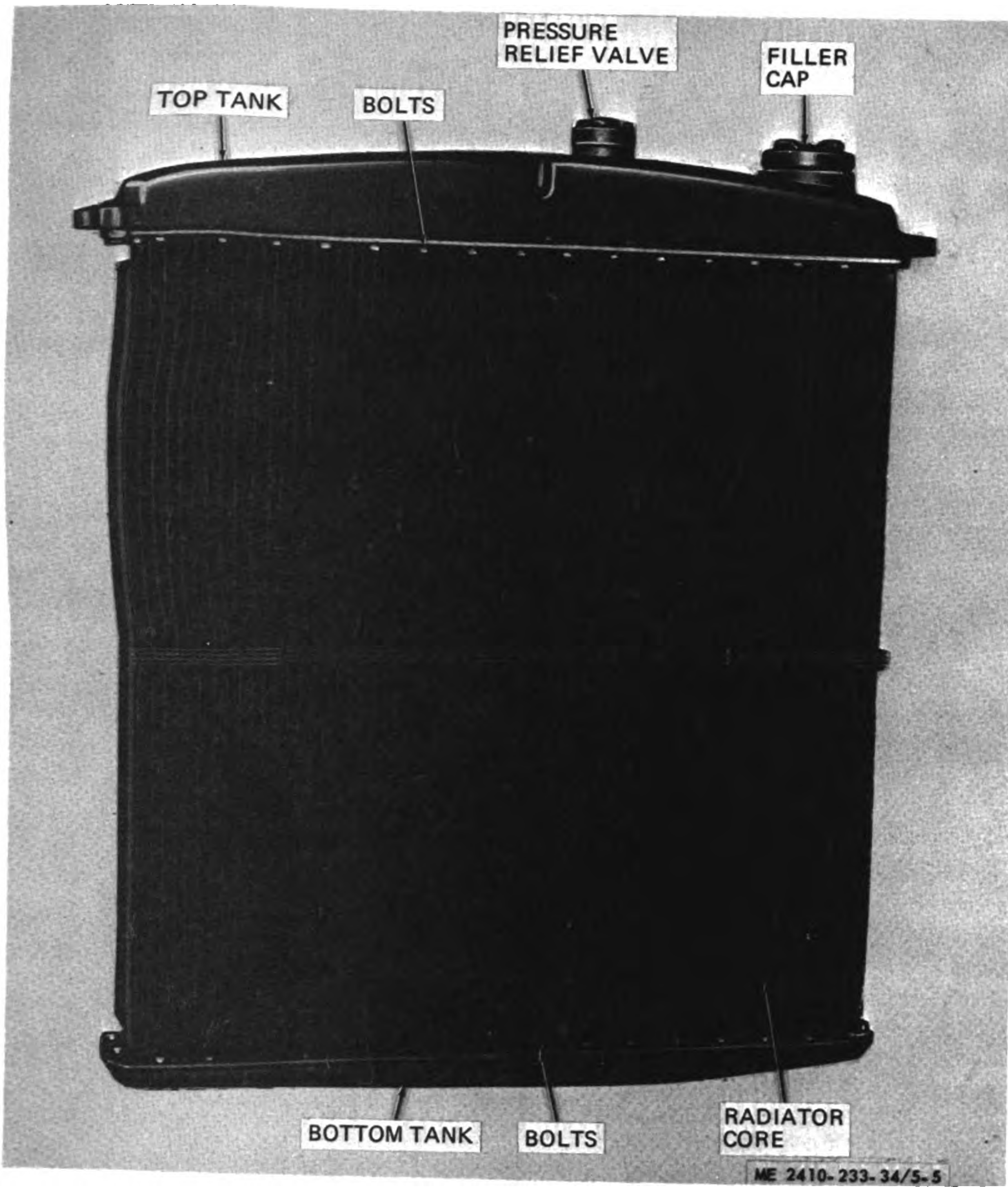


Figure 5-5. Radiator disassembly.

c. Cleaning.

(1) Clean the radiator core of all accumulation of debris between the fins and tubes with water or compressed air.

(2) Clean the inside of the radiator core, bottom tank and top tank using a steam cleaner. Flush steam cleaner solvent from core and tanks with fresh water.

d. Inspection and Repair. Assemble radiator core and tanks. Cap openings and test radiator under water with 8 to 10 pounds air pressure. Note source of air bubbles and solder the leaks. Be sure to wash off the acid after soldering as the acid will corrode the tubes. Be careful not to bend the fins and straighten any that may be bent.

e. Installation. Install radiator in reverse order of removal procedure.

f. Relief Valve Test.

(1) Tighten the radiator cap to seal the cooling system. Install a pressure gage capable of indicating 25 psi into the radiator tank top using appropriate fittings. Connect an air pressure regulating valve and an air source.

CAUTION

Do not apply a pressure greater than 16 psi.

(2) Slowly pressurize the radiator top tank. The highest pressure gage indication is the relief valve opening pressure. Indication should be 10 to 16 psi.

(3) If relief valve (fig. 5-5), does not open within the specified limits, replace the valve.

5-3. Radiator and Radiator Guard

a. Removal.

(1) Drain the cooling system (TM 5-2410-233-10) and remove the engine upper right guard assembly (TM 5-2410-233-20).

(2) Remove the hood (fig. 5-2), radiator bottom guard (fig. 5-6) and lower the front section of the crankcase guard (TM 5-2410-233-20).

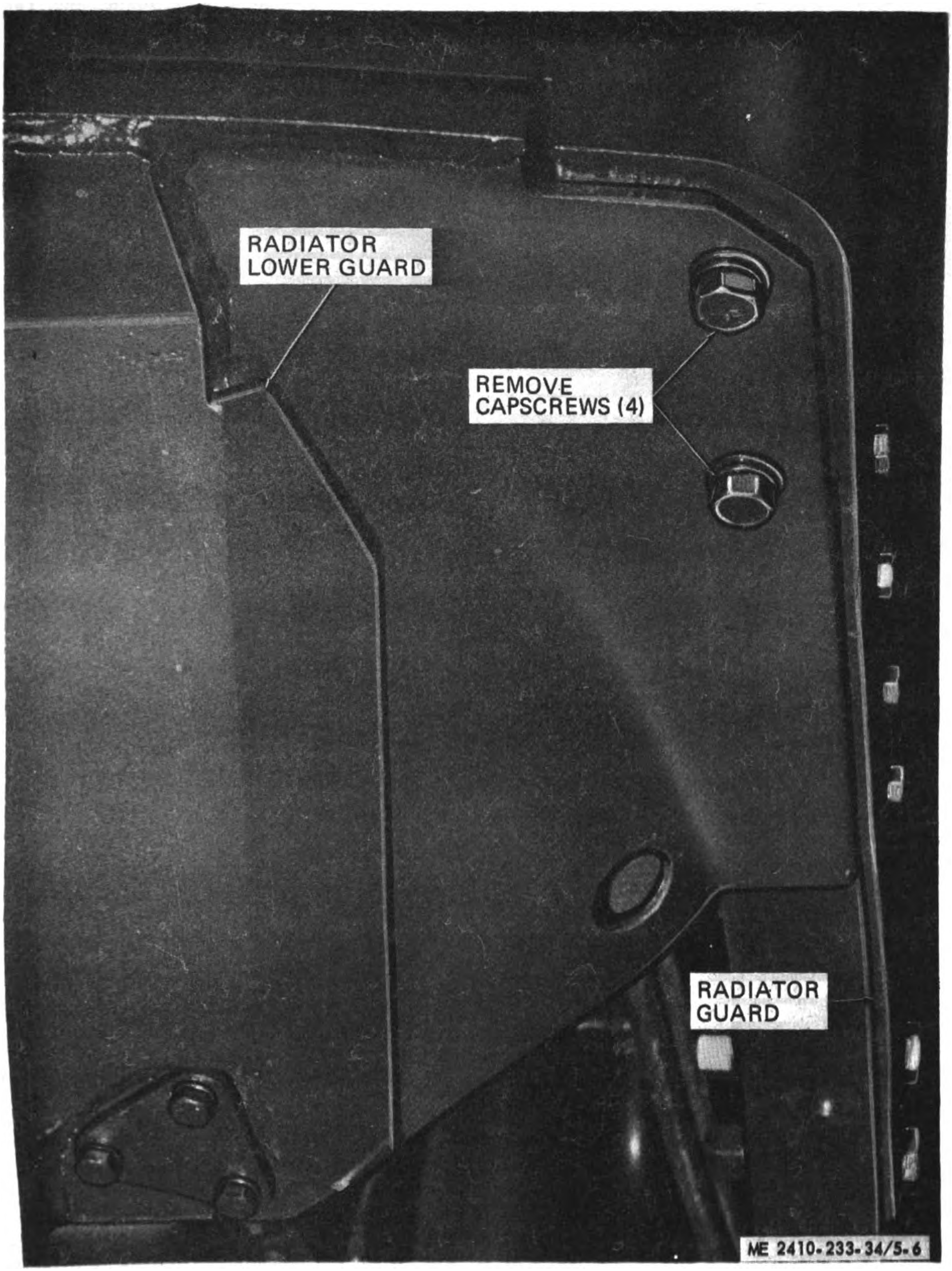


Figure 5-6. Radiator bottom guard, removal and installation.

(3) Disconnect the upper elbow ((2), fig. 5-3) from the radiator top tank.

(4) Disconnect the lower elbow (8) from the radiator.

(5) Support fan assembly by placing a wooden block between bottom fan blade and radiator shroud. Remove eight bolts from fan adapter (fig. 5-7) and separate from fan drive assembly.

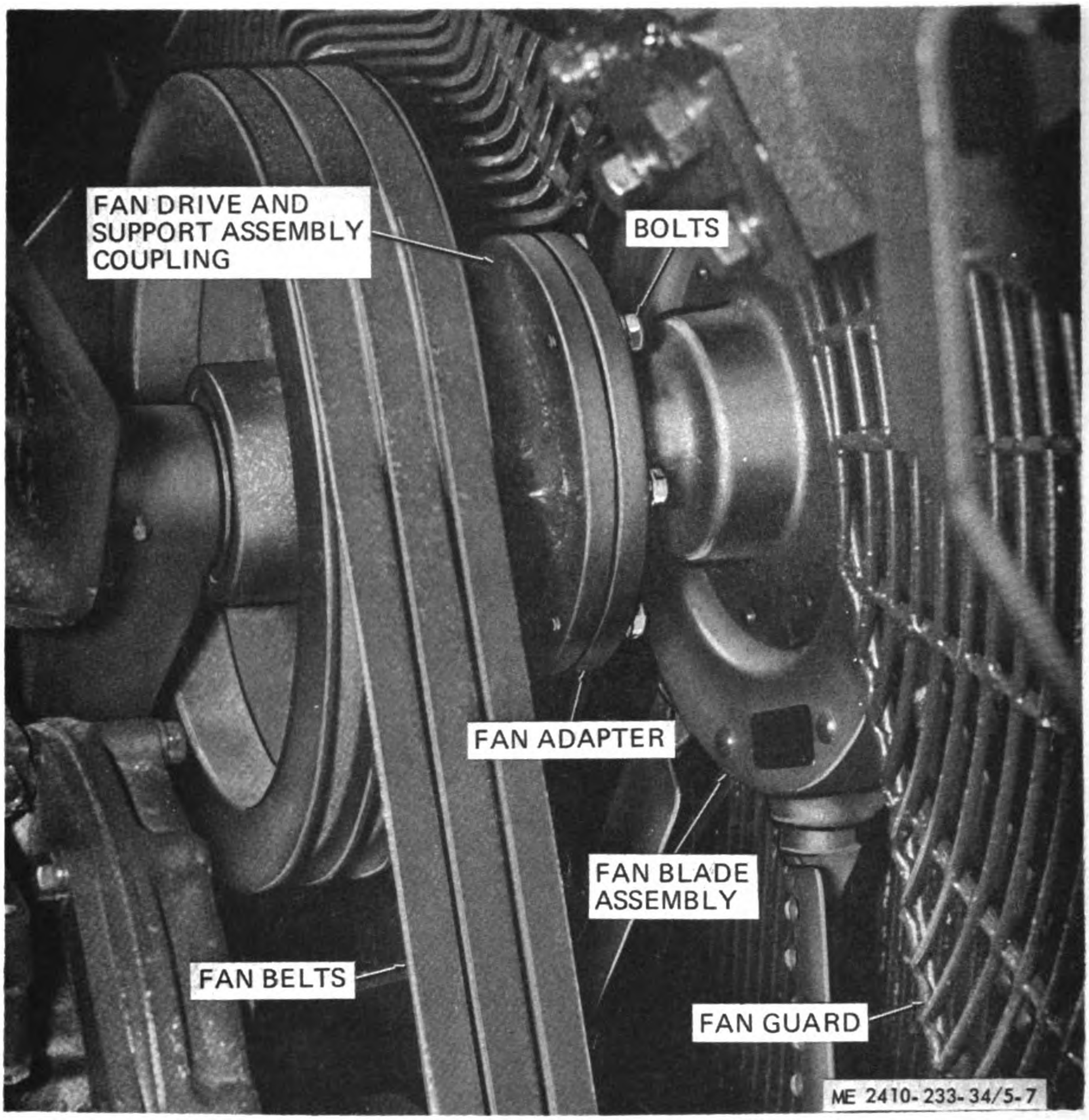


Figure 5-7. Fan adapter and fan drive and support assembly coupling.

(6) Disconnect and loop bulldozer lift cylinder hydraulic lines (fig. 5-8).

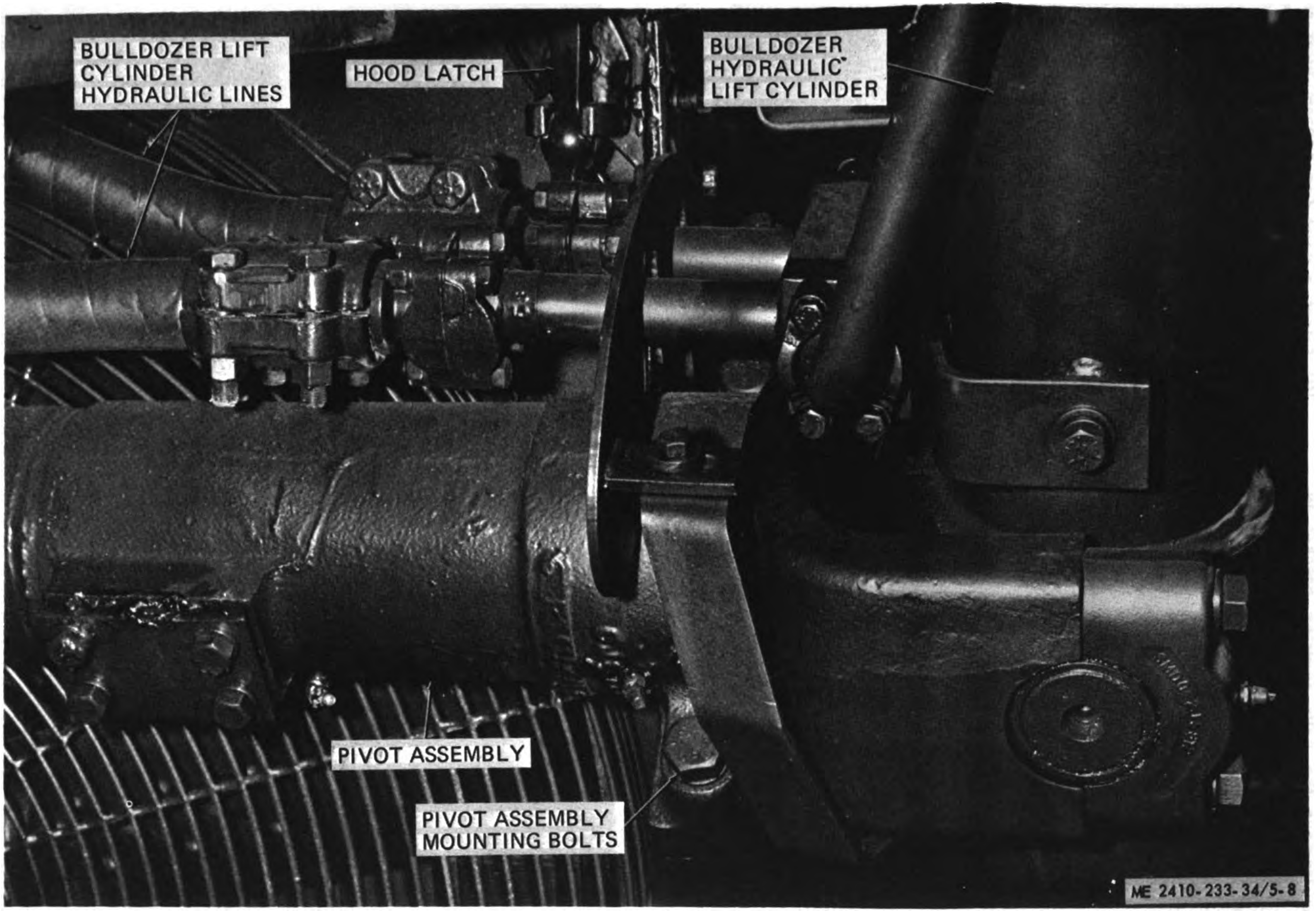


Figure 5-8. Bulldozer lift cylinder hydraulic lines disconnect couplings.

(7) Remove the bolts securing bracket to frame (fig. 5-9).

(8) Tag and disconnect headlight leads and remove leads from radiator guard (fig. 5-2).

(9) Attach a hoist for support, block crankcase guard hinge and remove the bolts that secure the radiator guard to the tractor (fig. 5-9).

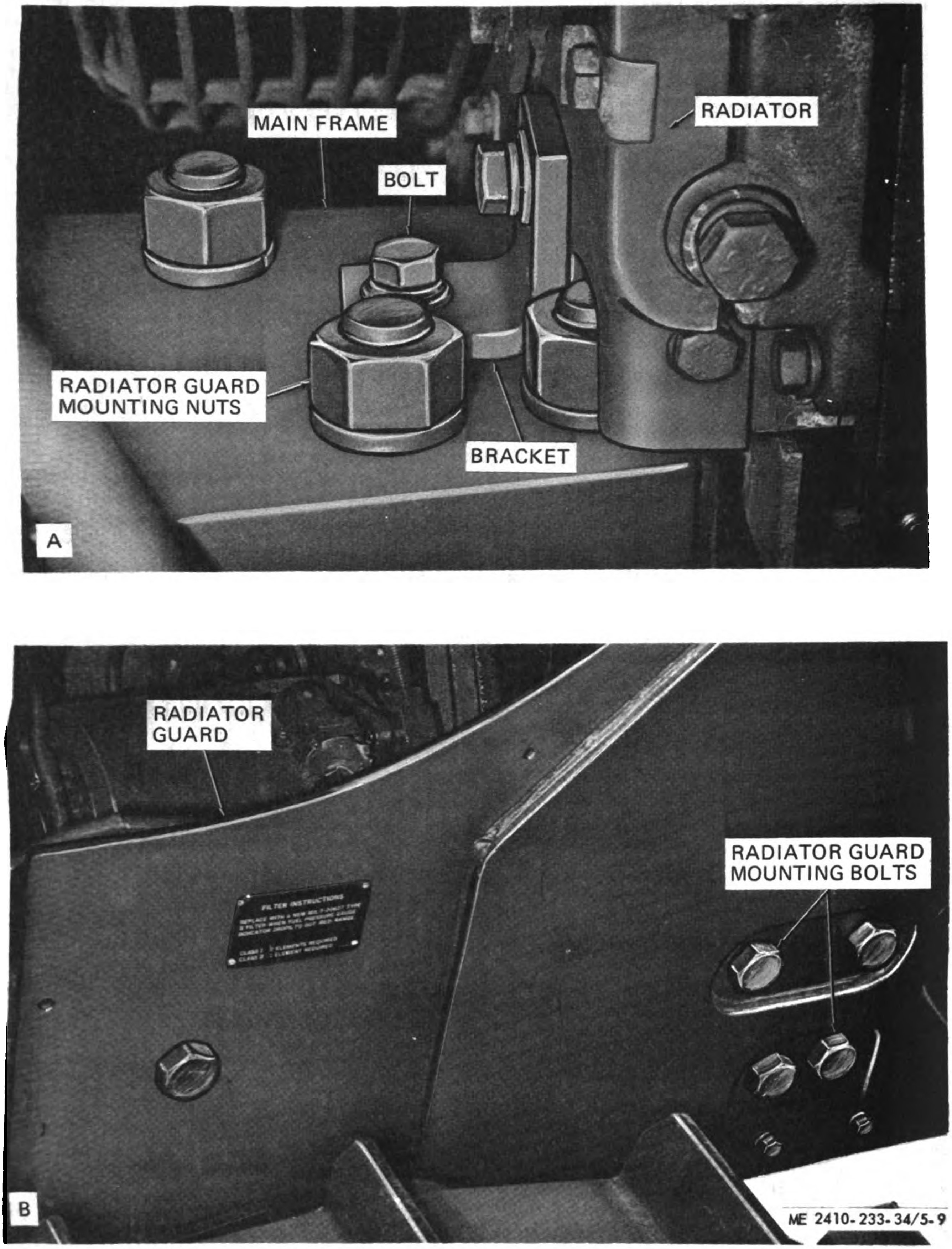


Figure 5-9. Radiator and radiator guard, removal and installation.

(10) Remove the radiator guard and radiator from the tractor as shown in figure 5-10.

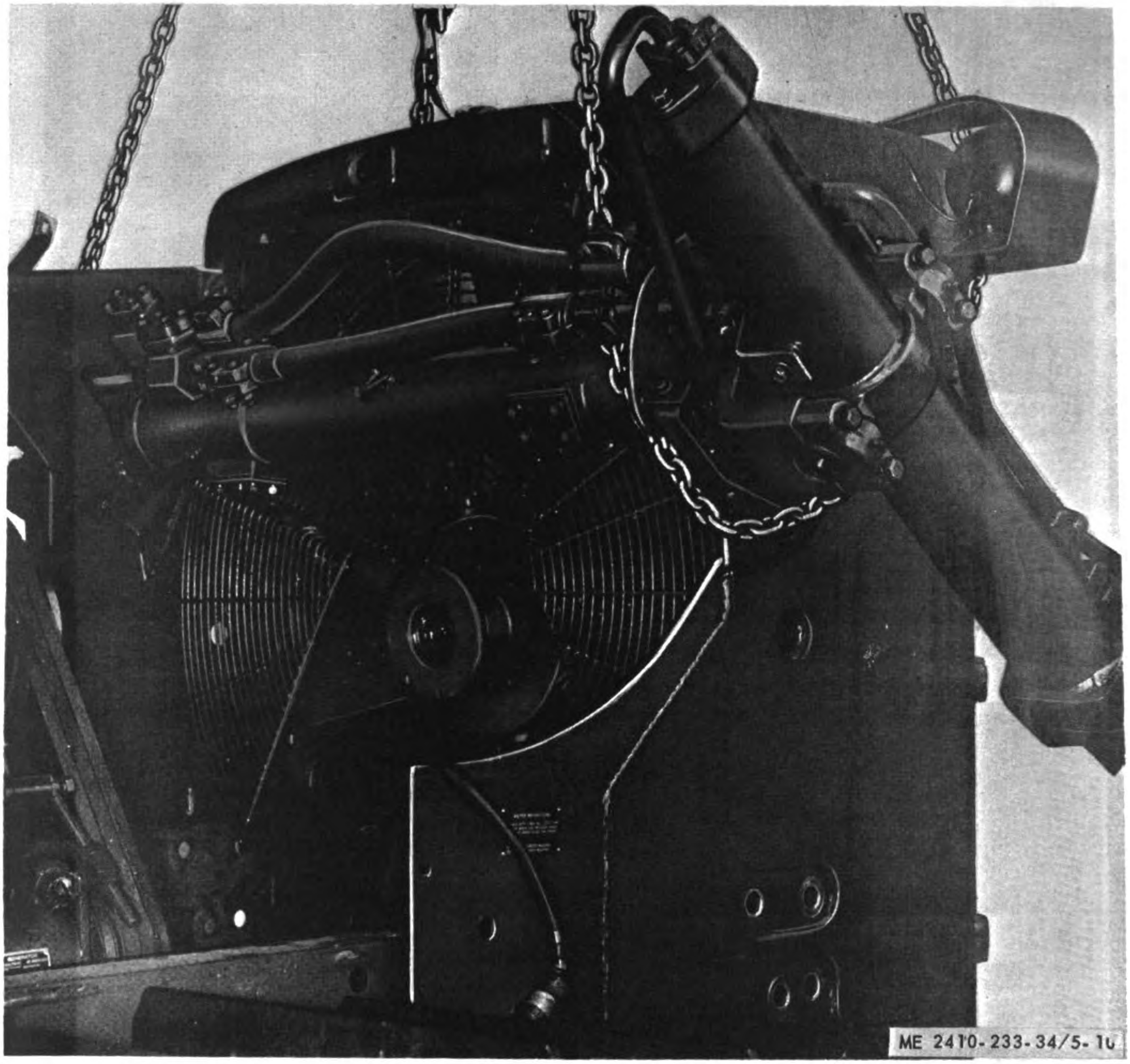


Figure 5-10. Lifting radiator guard and radiator from tractor.

b. Disassembly.

(1) Remove hydraulic cylinders and pivot assembly from radiator guard (TM 5-2410-233-20).

(2) Remove radiator from radiator guard (para 5-2).

c. Cleaning. Clean radiator guard with soap and hot water. Dry with a lint-free cloth.

d. Inspection and Repair. Inspect radiator guard for dents, cracks, distortion, broken welds, corrosion, or other damage. Weld cracks and broken welds according to TM 9-237. Remove excessive corrosion by sand blasting and repaint according to TM 9-213.

e. Installation. Reverse removal procedure and install the radiator guard assembly on the tractor.

5-4. Fan

a. Removal.

(1) Remove the radiator and radiator guard from the tractor (para 5-3).

(2) Remove hydraulic cylinders and pivot assembly from radiator guard (TM 5-2410-233-20).

(3) Remove fan guard mounting bolts (fig. 5-7) and remove fan guard from radiator guard.

(4) Attach a hoist to the fan and lift fan from radiator guard.

b. Inspection. Inspect fan and adapter assembly for bent, missing, or loose blades. Replace a defective fan and adapter assembly.

c. Installation. Reverse removal procedure and install the fan and adapter assembly onto the fan support assembly coupling.

5-5. Fan Belts

a. Removal.

(1) Remove engine upper guard assemblies (TM 5-2410-233-20).

(2) Loosen fan belts (TM 5-2410-233-20).

(3) Slip forward belt off the generator and crankshaft pulleys. Pass belt over fan blade stationed in expanded portion of fan guard (fig. 5-11). Rotate fan assembly by hand and slip belt around each blade as it enters expanded cage. When fan has been rotated approximately ¾ of a revolution, the belt should drop between the fan blade assembly and the radiator core. The belt may be withdrawn by passing below the lowest fan blade. Repeat procedure with other two belts.

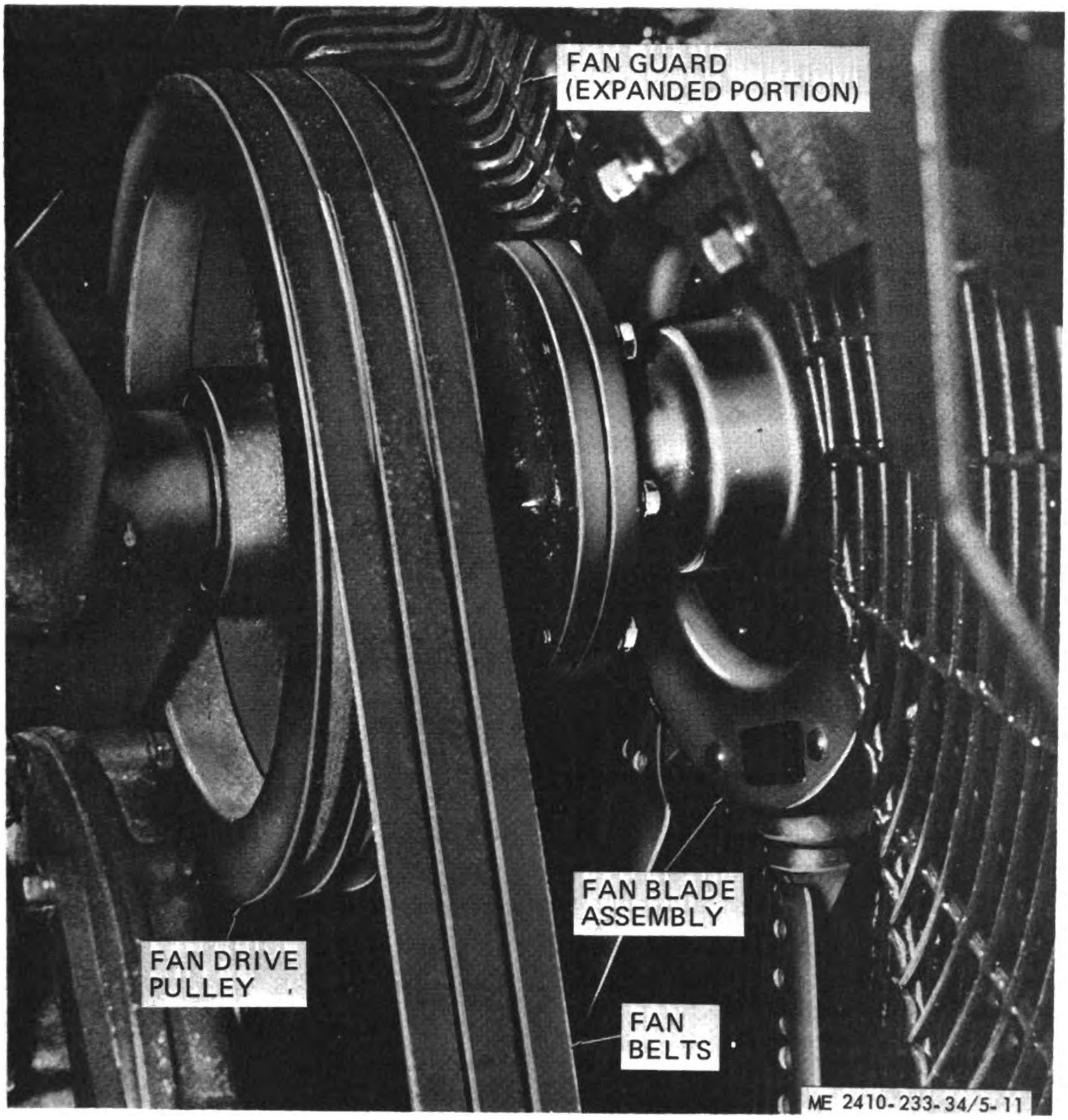


Figure 5-11. Fan belt removal and installation.

b. Installation.

(1) Place belt over a fan blade within the expanded portion of the fan guard.

(2) Rotate fan assembly by hand and slip belt around each fan blade as it enters expanded cage. When fan belt drops to pulley spindle, repeat procedure with other 2 belts.

NOTE

The fan belts must be replaced as a set.

c. Adjustment. Place belts on appropriate pulleys and adjust belt tension (TM 5-2410-233-20).

5-6. Water Pump

a. General. The gear driven centrifugal type water pump is mounted on the left front of the timing gear housing. Figure 5-13 shows an exploded view of the water pump.

b. Removal.

(1) Drain the cooling system (TM 5-2410-233-10).

(2) Disconnect the water inlet and outlet hoses (fig. 5-12).

(3) Remove the bolts which secure the water pump to the cylinder block and timing gear cover.

(4) Remove the water pump from engine and clean gasket material from water pump and gear housing.

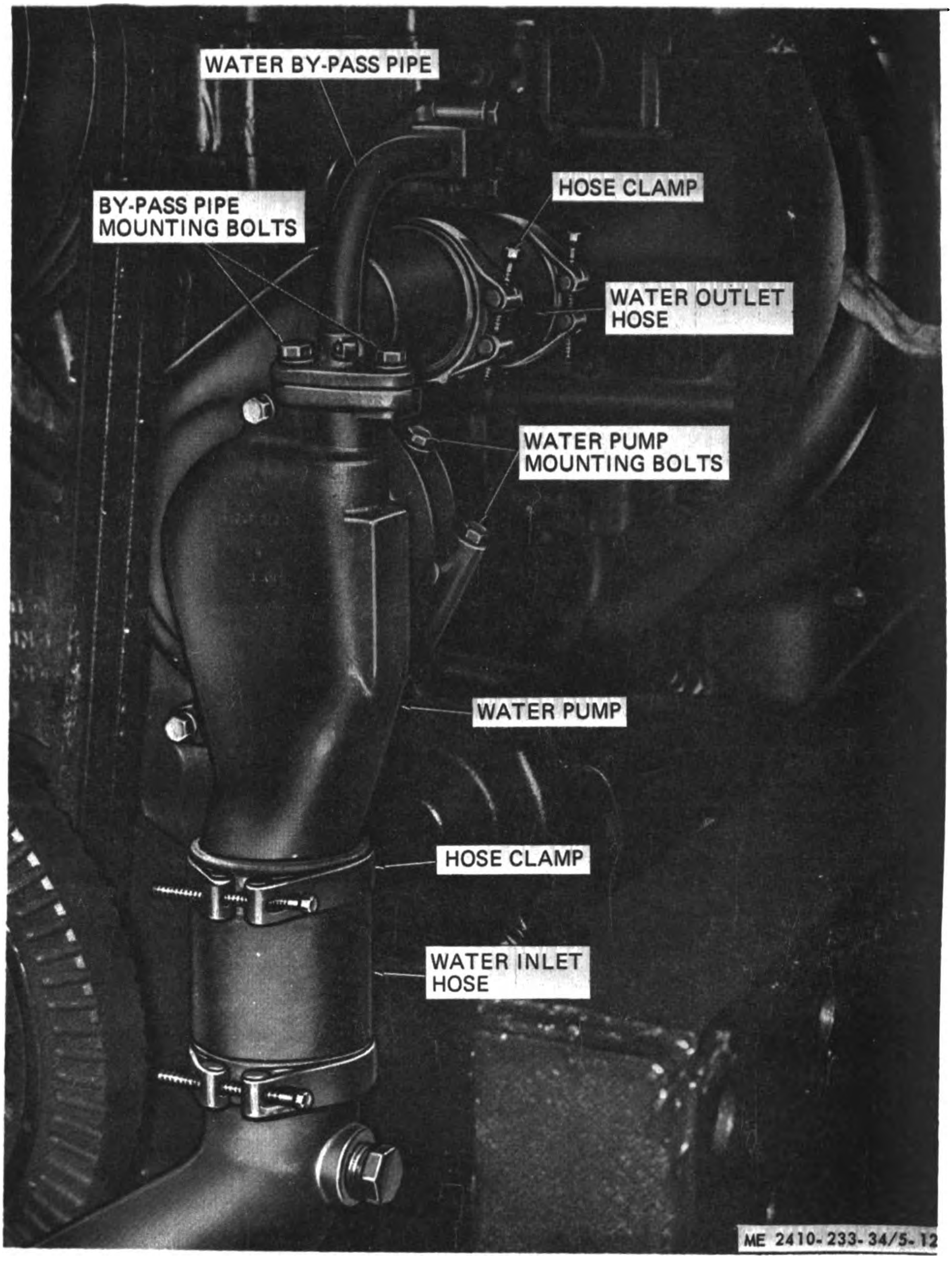


Figure 5-12. Water pump, removal and installation.

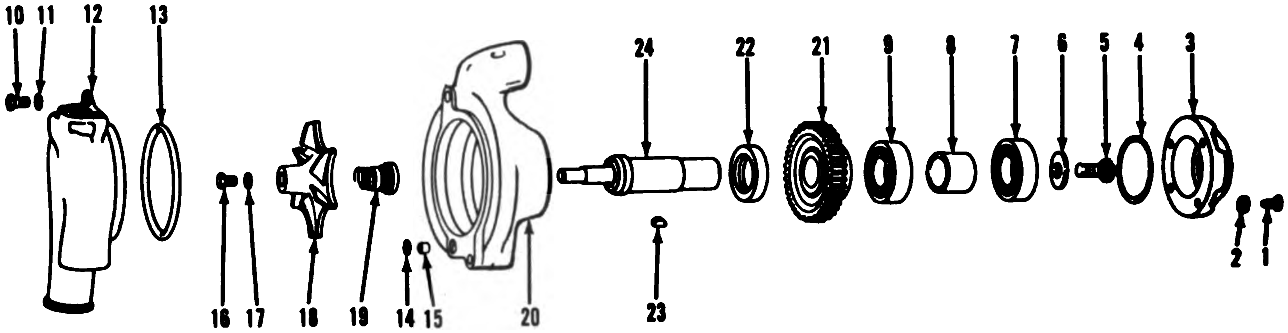
c. Disassembly.

(1) Remove the bolts ((1), fig. 5-13) and lockwashers (2) and remove the cover (3) from the water pump. Remove the seal (4).

(2) Remove the bolt (5) and washer (6).

(3) Using a suitable puller, remove the bearing (7) from the impeller shaft. Remove the spacer (8) and bearing (9).

(4) Remove the bolts (10) and lockwashers (11). Remove the cover (12) from the body. Remove the seal (13), seal (14), and dowel (15).



1	Bolt	13	Seal
2	Lockwasher	14	Seal
3	Cover	15	Dowel
4	Seal	16	Bolt
5	Bolt	17	Washer
6	Washer	18	Impeller
7	Bearing	19	Spring
8	Spacer	20	Body
9	Bearing	21	Gear
10	Bolt	22	Seal
11	Lockwasher	23	Key
12	Cover	24	Impeller shaft

Figure 5-13. Water pump, exploded view.

(5) Remove the bolt (16) and washer (17). Remove the impeller (18) and spring (19) from the impeller shaft.

(6) Remove the impeller shaft from the body (20).

(7) Remove the gear (21), seal (22), and key (23) from the impeller shaft (24).

c. Cleaning. Clean all components except bearings in P-D-680 cleaning solvent and dry with compressed air. Clean bearings as instructed in paragraph 2-6.

d. Inspection and Repair.

(1) Check the housings for cracks at the mounting flanges. Repair or replace as required.

(2) Inspect the impeller for dents, nicks, cracks, chips and bent or broken splines. Repair or replace as necessary.

(3) Inspect the bearing for scoring, wear, scratches, pitting and other damage. Replace as required.

(4) Replace all seals and gaskets.

e. Reassembly. Assemble the water pump in the reverse order of disassembly. Grease the seals before installing and use a seal installation tool to insert the seals. Tighten the impeller bolt (16, fig. 5-15) to a torque of 27 to 29 foot-pounds.

f. Installation. Reverse removal procedure and install the water pump on the engine.

5-7. Engine Oil Cooler

a. Removal.

(1) Drain cooling system (TM 5-2410-233-10).

(2) Loosen the water inlet bonnet hose clamps (fig. 5-14) and slide the hose back on the bonnet.

(3) Remove oil filters (TM 5-2410-233-20).

(4) Remove the oil level gauge guide clamp mounting bolt.

(5) Remove the oil cooler-to-elbow assembly mounting bolts.

(6) Remove the two support bracket mounting bolts and remove the engine oil cooler and oil filter base as a unit.

(7) Separate the oil filter base from oil cooler.

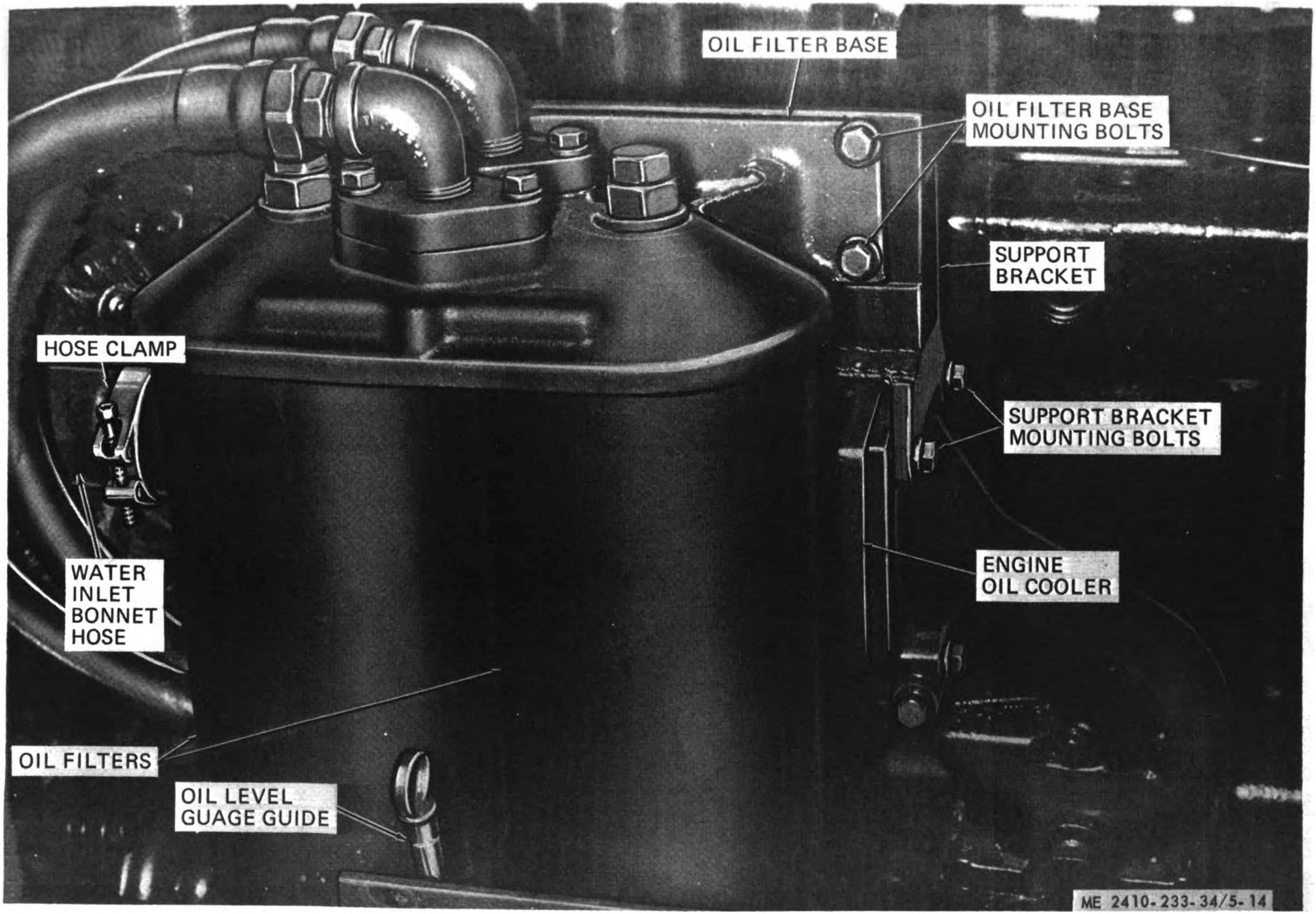


Figure 5-14. Engine oil cooler, removal and installation.

b. Cleaning, Inspection, and Repair.

NOTE

If oil cooler core has excessive scale deposits, the cooling system must be cleaned (TM 5-2410-233-20).

(1) Discard all gaskets, clean all parts with dry cleaning solvent (Fed Spec. P-D-680) and dry with compressed air.

(2) Inspect oil cooler core and oil filter base for cracks, breaks, leaks or other defects. Replace a defective core or oil filter base.

(3)Inspect all mounting hardware or hose for damage or defects. Replace all defective parts.

(4) Repair all small leaks in oil cooler core by brazing or silver soldering.

c. Test. The oil cooler core will be immersed in water and compressed air applied to test for leaks. Cap both openings of core and apply 10-12 lbs. of air on the coolant side of the core.

d. Installation. Reverse removal procedure and install the engine oil cooler on the engine. Install new gaskets and oil filters. Start engine and check oil level and replenish if low (LO 5-2410-233-12).

5-8. Fan and Fan Drive Assembly

a. Removal.

(1) Remove the radiator and radiator guard from the tractor (para 5-3).

(2) Loosen and remove fan belts (para 5-5).

(3) Remove the fan guard (para 5-4) and lift the fan assembly from radiator guard.

(4) Attach a hoist to the fan drive assembly (fig. 5-7).

(5) Remove the bolts (18, fig. 5-15) securing the fan drive assembly and remove from the engine.

b. Disassembly.

(1) Remove 2 bolts (7, fig. 5-15) and washers (8) and remove the large washer (9) from bracket assembly (17).

(2) Pull the hub (13) with bearing (11) and seal (10) from bracket assembly (17).

(3) Remove seal (15), bearing (14), and spacer (16) from bracket assembly (17).

c. Cleaning. Clean all parts except bearings with cleaning solvent (Fed. Spec. P-D-680). Refer to paragraph 2-6 for the care and cleaning of bearings.

d. Inspection and Repair.

(1) Inspect the fan assembly (3) for bent, cracked, or missing blades. Rotate each blade thru both the suction and blower positions and note if blade shaft detent securely locks blade at the correct attitude.

(2) Inspect fan drive assembly for cracks, a bent shaft, or other damage. Weld minor cracks according to TM 9-237.

(3) Replace fan assembly or fan drive assembly if defective.

e. Reassembly and Installation. Reverse disassembly and removal procedure and reassemble and install the fan and fan drive assembly on the engine. Refer to LO 5-2410-233-12 and lubricate fan hub.

NOTE

Be certain all blades are in the same position (suction or blower) in the fan assembly.

Key to figure 5-15.

1 Bolt
2 Washer
3 Fan assembly
4 Bolt
5 Washer
6 Adapter
7 Bolt
8 Washer
9 Washer
10 Seal
11 Bearing
12 Spacer
13 Hub
14 Bearing
15 Seal
16 Spacer
17 Bracket assembly
18 Bolt

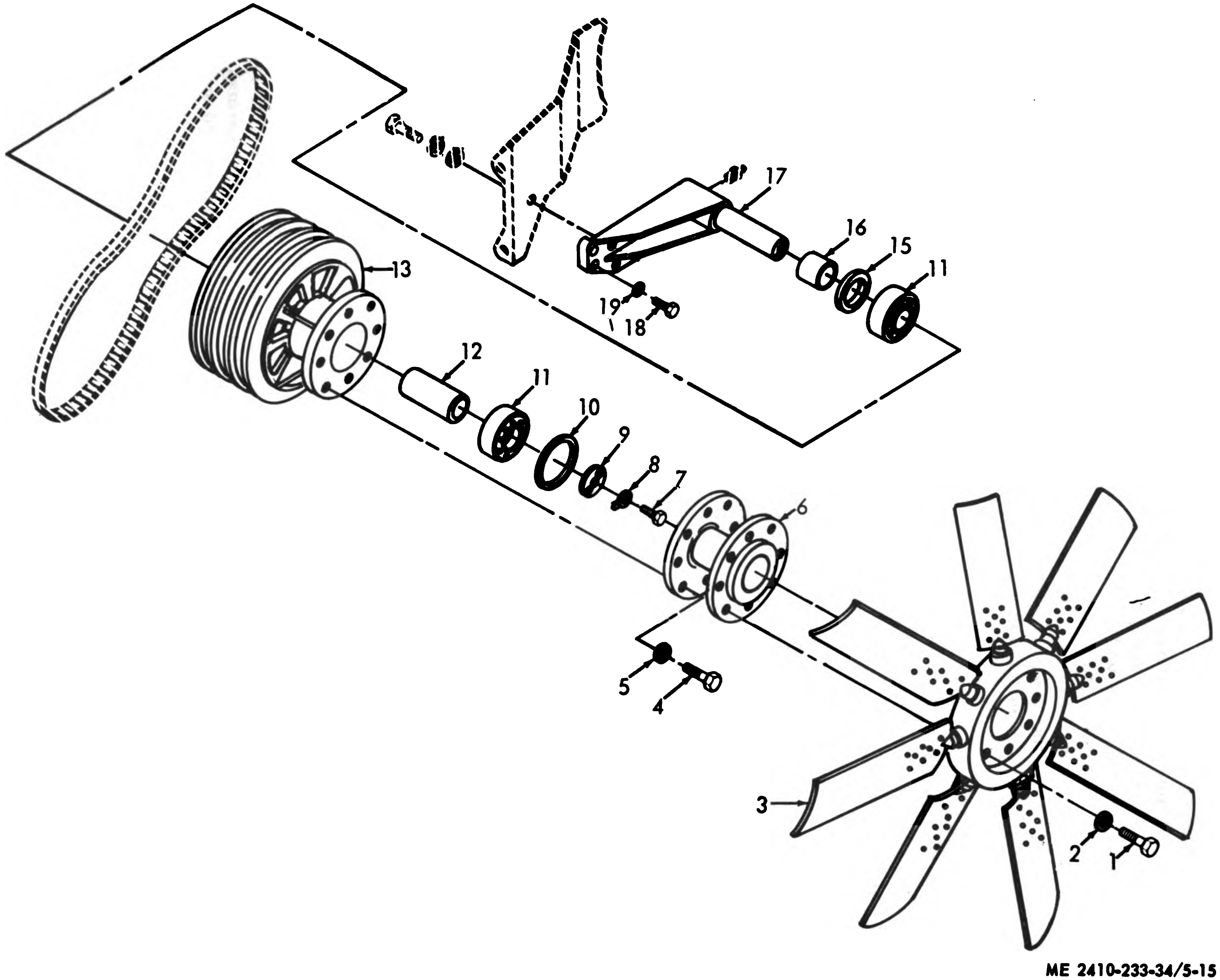


Figure 5-15. Fan and fan drive, disassembly.

5-9. General

The fuel system consists of a supply tank, fuel injection valves, fuel injection pump, pressure gage, fuel filters, transfer pump, vent valve and primer pump. The transfer pump draws fuel from the fuel tank and delivers the fuel through the primary and secondary fuel filters to the fuel injection pump. The injection pump delivers the fuel under high pressure to the injection valves, where it is sprayed into the engine precombustion chambers. The accessory drive shaft drives the governor, fuel injection pump camshaft, service meter and fuel transfer pump.

5-10. Fuel Injectors and Glow Plugs

a. Removal and Disassembly.

(1) Disconnect the fuel line (fig. 5-16) at the fuel injectors. Cap or plug openings.

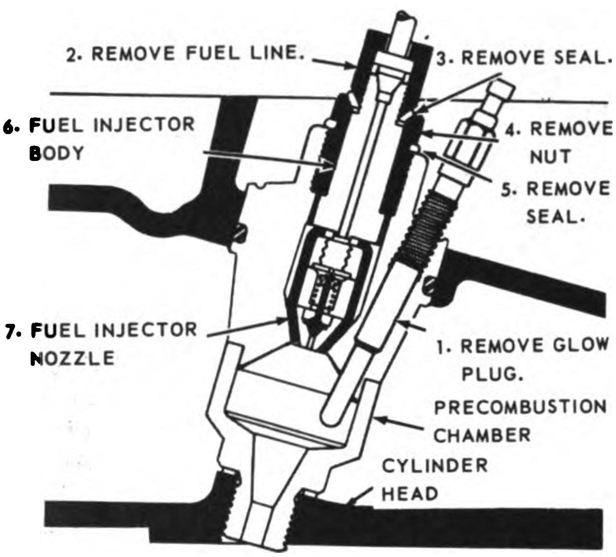


Figure 5-16. Fuel injector, removal and installation.

(2) Tag and disconnect electrical lead and remove glow plug from precombustion chamber.

(3) Remove the nut securing the nozzle and body in the precombustion chamber.

(4) Lift out the nozzle (5, fig. 5-17) and body (1) and discard the two seals (2 and 4).

(5) Unscrew the nozzle (5) from the body (1).

b. Cleaning. Clean the fuel discharge hole in the nozzle. Remove any carbon deposits.

c. Repair. Inspect the nozzle for an accumulation of carbon, eroded orifice and plugged screen. Replace the nozzle if necessary.

d. Testing. Test fuel injector for proper operation by mounting injector in test fixture examining the spray pattern, and checking the injector unseating pressure. Unseating pressure must be between 400 and 800 psi. If pressure fails to reach 400 psi, replace the injector. Test for leakage by applying 300 psi pressure. If pressure falls more than 100 psi in 30 seconds replace the injector. Replace an injector that does not produce an even atomized spray pattern after the orifice has been cleaned. If screen filter in the injector is broken or clogged, replace the injector nozzle.

NOTE

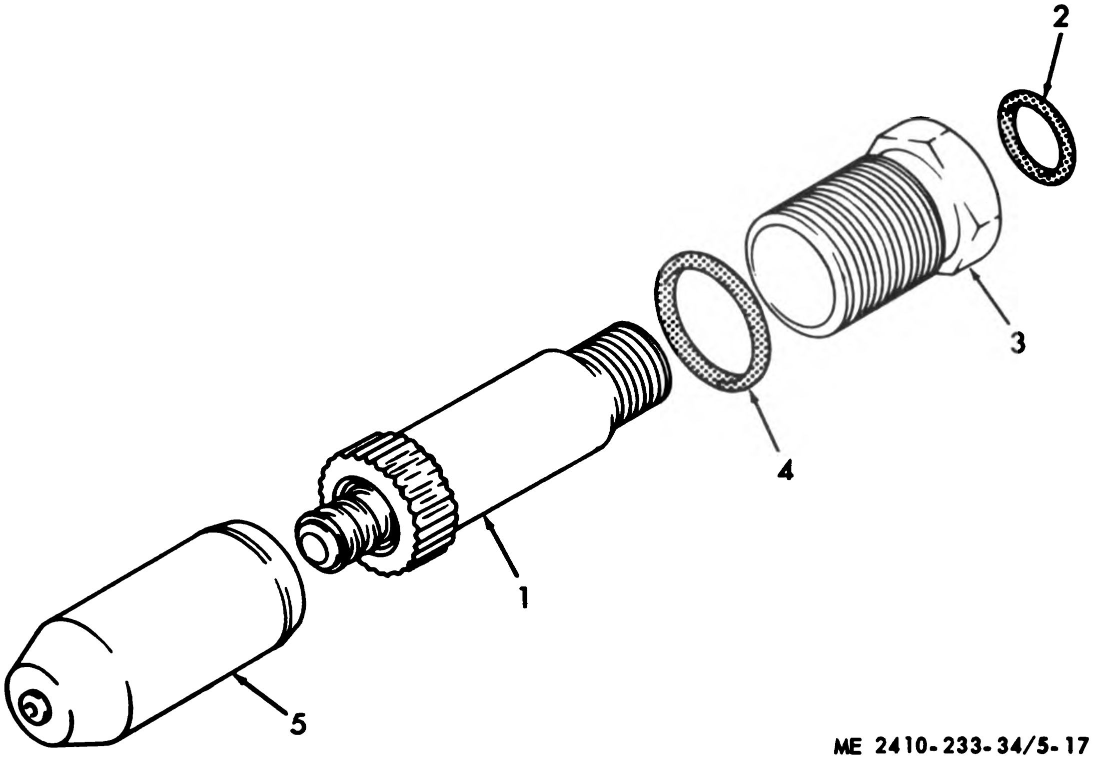
Only the capsule type nozzle and injector body need be replaced. Tighten nozzle in valve body only finger tight.

e. Reassembly and Installation.

(1) Install the nozzle (5, fig. 5-17) to the body (1) and tighten finger-tight. Insert the injector into the opening in the precombustion chamber (fig. 5-16).

(2) Install new seals (2 and 4, fig. 5-17).

(3) Secure with the nut (3) and tighten to a torque of 100 to 110 foot-pounds.



1 Body
2 Seal
3 Nut
4 Seal
5 Nozzle

Figure 5-17. Fuel injector, disassembly and reassembly.

(4) Connect the fuel line (fig. 5-16).

(5) Bleed the fuel system as instructed in TM 5-2410-233-20.

5-11. Fuel Injection Pump

a. General.

(1) The fuel injection pump (fig. 5-19) is composed of six individual pumps installed in the fuel injection pump housing.

(2) The pump is camshaft operated and driven by an adapter from the accessory drive shaft. Fuel enters the fuel injection pump housing through an inlet port from the fuel filter. The pump plungers and lifters are actuated by lobes on the pump camshaft. The lifters are held against the cam lobes by springs.

(3) Each pump measures the amount of fuel to be injected into the cylinder and delivers it to the fuel injection nozzle in the precombustion chamber.

(4) The amount of fuel pumped per stroke is varied by the turning of the plunger (9, fig. 5-19) in the pump barrel (6). The plunger is turned by governor action through the circular rack (12) which turns the gear segment on the bottom of the pump plunger (9).

b. Removal. Refer to figure 5-18.

(1) Disconnect the linkage at the governor control lever.

(2) Disconnect the fuel injection lines at the housing. Cap or plug openings.

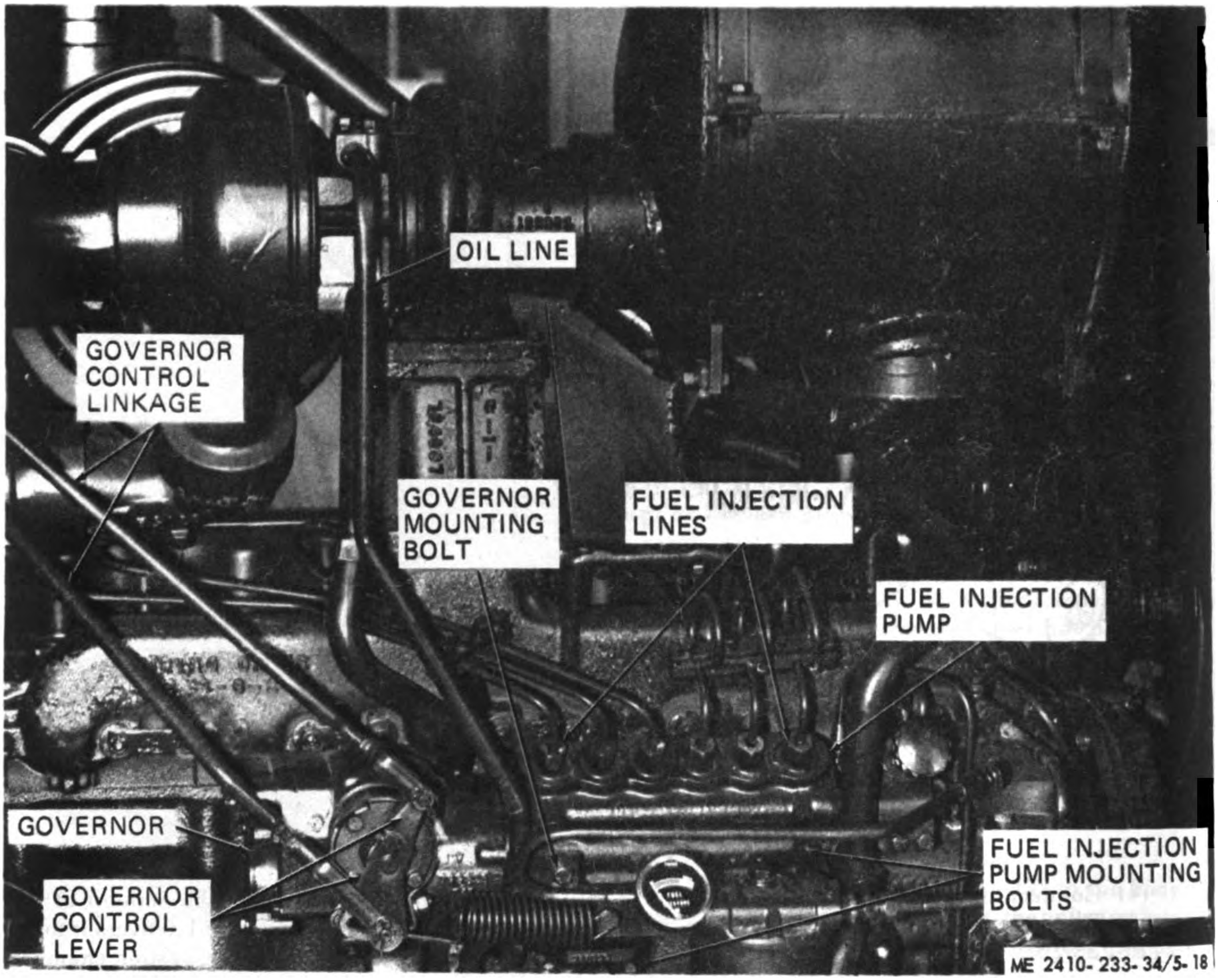


Figure 5-18. Fuel injection pump, removal and installation.

(3) Disconnect the oil line at the housing. Cap or plug openings.

(4) Remove the bolts which secure the fuel injection pump housing to the bracket. Remove the fuel injection pump housing and governor as an assembly.

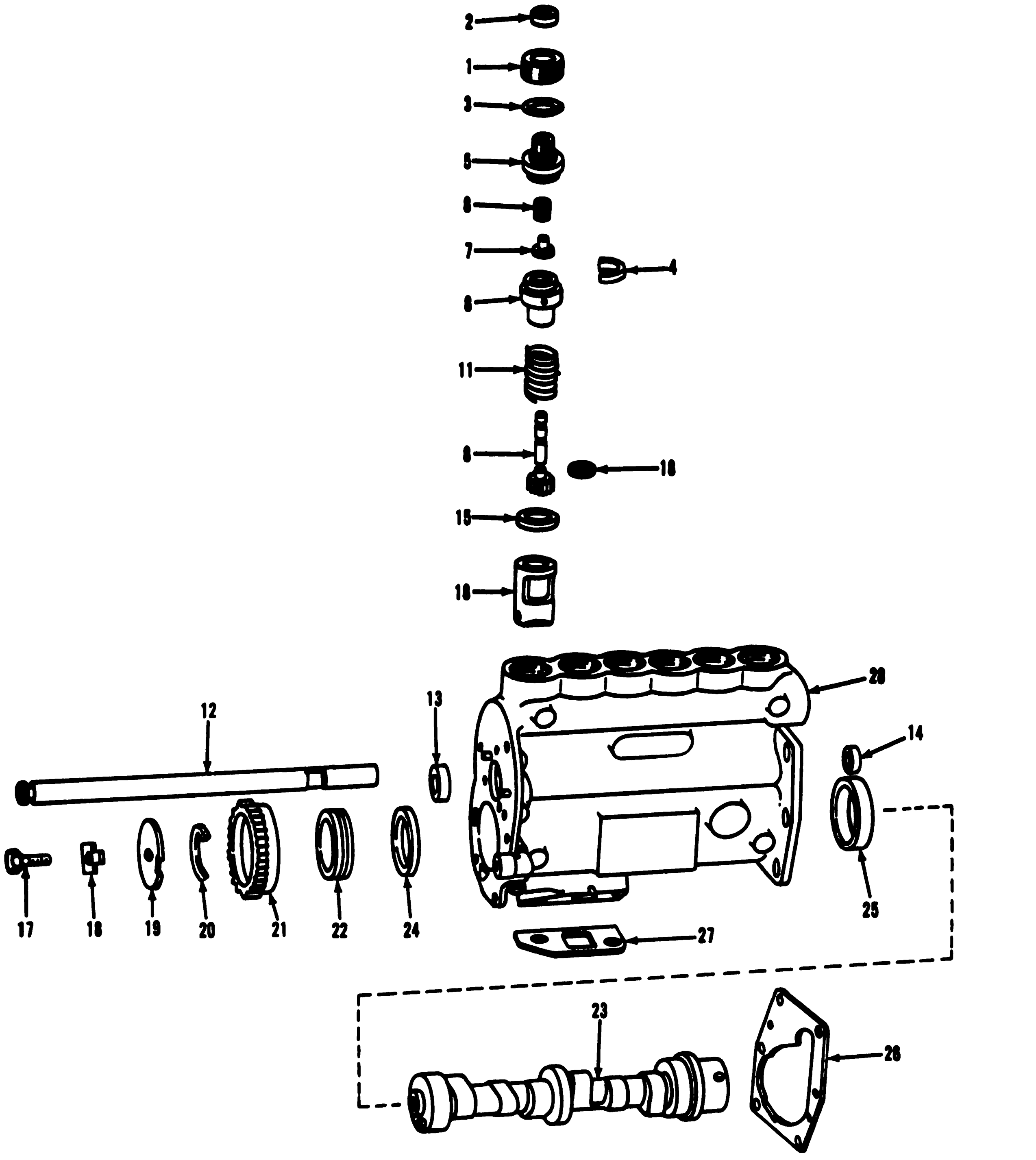
(5) Remove the bolts securing the governor housing to the fuel injection pump housing, and separate the housings. Remove the gasket from the mounting face.

c. *Disassembly.* Refer to figure 5-19.

NOTE

Clean the fuel injection pump housing with cleaning solvent (Fed. Spec. P-D-680) thoroughly before disassembly.

(1) Remove the cap (1) and the felt washer (2).



1	**Cap**	8	**Spring**	15	**Spacer**	22	**Spacer**
2	**Washer**	9	**Plunger**	16	**Lifter**	23	**Camshaft**
3	**Bushing**	10	**Keeper**	17	**Bolt**	24	**Bearing**
4	**Retaining ring**	11	**Spring**	18	**Lock**	25	**Bearing**
5	**Bonnet**	12	**Fuel rack**	19	**Retainer**	26	**Gasket**
6	**Barrel**	13	**Bearing**	20	**Spring**	27	**Gasket**
7	**Check valve**	14	**Bearing**	21	**Ring gear**	28	**Housing**

Figure 5-19. Fuel injection pump, exploded view.

(2) Remove the fuel injection pump retaining bushing (3) from the housing.

(3) Using an extractor, remove the fuel injection pump from the housing.

NOTE

Components of the fuel injection pumps cannot be interchanged. Tag parts for assembly with the same parts and installation in the same bore in the fuel pump housing.

(4) Remove the retaining ring (4) and separate the bonnet (5) from the barrel (6).

(5) Remove the check valve (7) and spring (8) from the bonnet.

(6) Remove the plunger (9), keeper (10) and spring (11) from the barrel (6).

(7) Remove the fuel rack (12) from the housing.

(8) Remove the bearing (13) from the housing.

(9) Scribe two marks on the housing above the groove on the bearing (14) and in line with the lubrication passage. Remove the bearing.

(10) Remove the spacer (15) and the valve lifter (16).

(11) Remove the bolt (17), lock (18), spring retainer (19) and spring (20).

(12) Remove the ring gear (21) and spacer (22).

(13) Remove the camshaft (23) from the housing.

(14) Remove the bearing (24 and 25). Scrape the gaskets (26 and 27) from the housing (28).

d. Cleaning. Clean all components except bearings with Fed. Spec. P-D-680 cleaning solvent and dry with compressed air. Clean bearings as instructed in paragraph 2-6.

e. Inspection and Repair.

(1) Inspect all components for cracks, chips, nicks, grooves, scores, pitting and wear. Repair or replace parts as required.

(2) Inspect the sliding surfaces of pump plungers for grooves and scratches. Ensure that edges are not rounded.

(3) Inspect the check valve collar for grooves and scratches. Replace if surfaces cannot be smoothed with emery cloth.

(4) Replace pump plungers and barrels as a unit.

(5) Replace the check valve as a unit.

(6) Inspect camshaft cams and camshaft bearings for wear. Replace as necessary.

(7) Inspect the control rod for worn notches.

(8) Replace pump plunger washers which show signs of wear.

(9) Measure pump plungers using a micrometer. Replace any plunger less than 2.5881 inches long.

f. Reassembly (fig. 5-19).

NOTE

Immerse all parts in clean diesel fuel before reassembling.

(1) Install the bearing (25) so that the hole in the bearing aligns with the oil passage in the housing. Install the bearing (24). Ensure that the bearings are flush with the face of the housing.

(2) Install the camshaft (23) in the housing.

(3) Install the spacer (22), ring gear (21), spring (20), spring retainer (19), lock (18) and bolt (17).

(4) Install the valve lifter (16) and spacer (15).

(5) Install the bearing (14) so that the hole in the bearing aligns with the marks made on the housing before removal. Install the bearing (13).

(6) Install the fuel rack (12).

(7) Install the spring (11), keeper (10) and plunger (9) in the barrel (6).

(8) Install the spring (8) and check valve (7) in the bonnet (5).

(9) Secure the bonnet (5) to the barrel (6) using retaining ring (4). Install the barrel and bonnet assembly in the fuel pump housing. Align the notches in the bonnet and barrel with the mark 180° from the gear center tooth. Align the notches with the guide pins in the housing bore. Align the pump gear center tooth with the fuel rack center notch.

(10) Press down on the barrel and bonnet assembly and install the retaining bushing (3) flush with the top of the housing. If the bushing cannot be properly installed, remove the barrel and bonnet, realign and reinstall. Tighten the bushing to a torque of 140 to 160 foot-pounds.

(11) Install the felt washer (2) and the cap (1).

g. Installation. Install the fuel injection pump in the reverse order of removal. Tighten bolts and fittings securely. Check and adjust timing (subpara *h*, *i*, or *j*) and fuel rack setting (subpara *k*).

h. Checking Fuel Injection Pump Timing (On Engine, Using a Timing Set).

(1) Remove the rocker arm cover.

(2) Install a timing indicator set in the precombustion chamber of the pump to be tested. Follow instructions included with the indicator set. Disconnect the fuel line to the precombustion chamber. Cap or plug openings.

(3) Move the governor control to the full load position.

(4) Maintain a 10 to 15 psi fuel pressure with the fuel priming pump or shop air.

CAUTION

If shop air is used, connect a relief valve which will release pressure above 15 psi. Open the fuel shutoff valve.

(5) Rotate the crankshaft in its direction of normal rotation from 30° before top dead center until the inlet port closes. At this point fuel flow is reduced to 6 to 12 drops per minute. Zero the dial indicator.

(6) Rotate the crankshaft until the indicator reaches maximum value. At this point the piston is at top dead center.

(7) At proper timing, the indicator reading should be 0.1091 (+0.0040) inch.

i. Checking Fuel Injection Pump Timing (On Engine, Using a Gage).

(1) Locate the top dead center compression position for the No. 1 piston.

(2) Remove the No. 1 fuel injection pump (subpara c above). Insert a timing gage, into the fuel pump bore.

(3) Ensure that the higher step of the pump plunger is slightly above the top surface of the gage body and that the lower step of the plunger is just below the top surface of the gage body. If the gage cannot be correctly positioned, check accessory drive shaft timing (para 5-28).

(4) If the gage is correctly installed, the fuel pump is correctly timed.

j. Setting Fuel Injection Pump Timing (Off Engine).

NOTE

The fuel pump can be adjusted while removed from the engine.

(1) Install a pointer on the fuel injection pump housing.

(2) Place the timing plate on the drive end of the camshaft and secure.

(3) Refer to table 5-1 and select the timing plate degree setting for the lifter to be set. Set the lifter to be set. Set the timing plate by rotating it counterclockwise until the proper degree setting aligns with the pointer. Lock in position with the setscrew.

(4) The fuel injection pump timing dimension is 4.2675 (+0.0005) inches. Remove the individual fuel pumps and add spacers below the lifters as necessary to adjust timing.

k. Setting Fuel Rack.

(1) Remove the rack cover from the front of the accessory drive housing rear flange (para 5-28). Remove the cover from the rear of the governor housing (para 5-10).

(2) Install a rack setting gage over the front end of the fuel rack.

(3) Loosely install a plug and push rod in the governor plug (59, fig. 5-20) hole. Force the speed limiter away from the plug hole.

(4) Move the governor control lever forward until the stop collar on the fuel rack just touches the stop bar on the torque spring. If necessary, insert a 0.003 inch feeler gage between the stop and spring to help determine the point of contact.

Table 5-1. Lifter Setting

Lifter number	Timing plate degrees
1	179° 30'
2	59° 30'
3	299° 30'
4	119° 30'
5	239° 30'
6	359° 30'

(5) Position the rack setting gage from the zero position until it contacts the rack. Total rack travel should be 0.650 inch.

(6) To adjust the rack, loosen the locknut (37, fig. 5-20) and turn the adjusting setscrew (38) to obtain the desired setting. Tighten the locknut.

5-12. Engine Speed Governor

a. Removal. Remove the engine speed governor with the fuel injection pump. Refer to paragraph 5-11.

b. Disassembly. Refer to figure 5-20 and disassemble the governor according to sequence of index numbers assigned to figure.

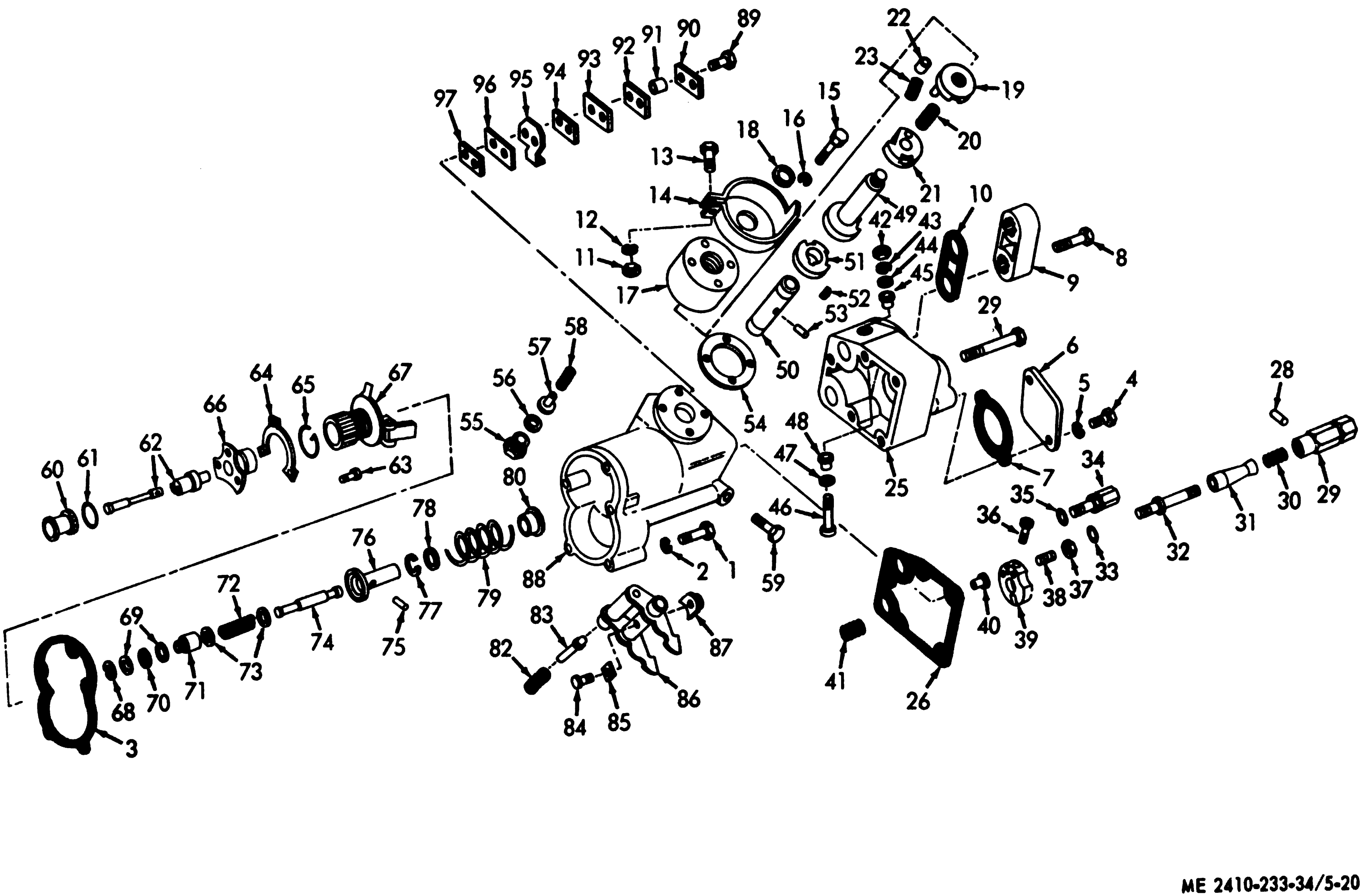


Figure 5-20. Engine speed governor, exploded view.

Key to figure 5-20.

1 Bolt
2 Washer
3 Gasket
4 Bolt
5 Washer
6 Cover
7 Gasket
8 Bolt
9 Cover
10 Gasket
11 Nut
12 Washer
13 Bolt
14 Clamp
15 Capscrew
16 Lockwasher
17 Ring
18 Seal
19 Plate assembly
20 Spring
21 Pin
22 Roller
23 Spring
24 Bolt
25 Cover
26 Gasket
27 Screw assembly
28 Pin
29 Screw
30 Spring
31 Spacer
32 Screw
33 Packing
34 Screw
35 Packing
36 Bolt
37 Nut
38 Setscrew
39 Collar
40 Collar
41 Spring
42 Nut
43 Lockwasher
44 Washer
45 Insulator
46 Screw
47 Washer
48 Insulator
49 Shaft assembly
50 Shaft assembly
51 Guide
52 Key
53 Pin
54 Gasket
55 Plug
56 Washer
57 Plunger
58 Spring
59 Plug
60 Spacer
61 Packing
62 Piston and valve assembly
63 Bolt
64 Locking plate
65 Ring
66 Cylinder
67 Weight assembly
68 Ring
69 Bearing race
70 Bearing
71 Seat
72 Spring
73 Washer
74 Pin
75 Pin
76 Seat
77 Ring
78 Washer
79 Spring
80 Plunger
81 Pin
82 Spring
83 Plunger
84 Bolt
85 Lockplate
86 Lever assembly
87 Band assembly
88 Housing assembly
89 Bolt
90 Locking plate
91 Spacer
92 Retainer
93 Spacer
94 Spacer
95 Contact
96 Spring
97 Bar

c. Cleaning. Clean all components with cleaning solvent (Fed. Spec. P-D-680) and dry with compressed air.

d. Inspection and Repair.

(1) Inspect the housing and cover for breaks, cracks and rough mating surfaces. Repair by welding.

(2) Inspect control levers for cracks, breaks and worn bores. Inspect pins for wear and damage. Replace worn parts.

(3) Inspect springs for cracks and other damage. Replace weak or damaged springs.

(4) Inspect rollers and bushings for wear. Replace bushings if worn or loose. Replace rollers if worn or out-of-round.

e. Reassembly (fig. 5-20).

(1) If the guide was removed, press a new guide into position in the housing (88). Form the guide against the chamfer in the governor housing. Install the band assembly (87).

(2) Install the spring (82), plunger (83) and pin (81) to the lever (86). Install the lever assembly in the housing and secure with the lock plate (85) and bolt (84).

(3) Install the governor control shaft (49) and seal (18).

(4) Install the low idle stop plunger (57), spring (58), washer (56) and plug (55). Install the plug (59).

(5) Install a new gasket (26). Install the low

idle adjusting screw (34), high idle adjusting screw (29) and spring (30).

(6) On the face of the fuel injection pump housing, install the packing (61), piston and valve assembly (62), servo cylinder (66), locking plate (64) and bolts (63).

(7) Install the weight assembly to the servo cylinder (66) and secure with the snap ring (65).

(8) Install the ring (68), bearing races (69), bearing (70), spring (72) and seat (71). Install the washers (73) and full load stop pin (74). Install the seat (76) and secure with pin (75). Install the spring washer (78), spring (79), and plunger (80).

(9) Install the adjusting screw (38) and bolt (36) in the collar (39). Install the locknut (37). Install the cover (9) with the bolts (8).

(10) Complete reassembly of engine governor by reversing disassembly procedure.

f. Installation. Install the governor in the reverse order of removal. Check and adjust the idle speed settings (subpara *g*) as necessary.

g. Adjustment.

(1) Using a tachometer known to be accurate, check engine speed with the governor set in the low idle rpm position. Tachometer indication should be 650 rpm.

(2) If necessary, remove the governor cover (item 9, fig. 5-20). Turn the low idle adjusting screw (34) counterclockwise or clockwise as required to correct low idle speed.

(3) Check engine speed with the governor set in the high idle rpm position. Tachometer indication should be 2000 rpm.

(4) Turn the high idle adjusting screw (29) as necessary to correct the high idle speed.

(5) Place the governor control lever in an intermediate setting rpm then recheck low idle and high idle settings. Repeat adjustments as necessary.

5-13. Fuel Transfer Pump

a. General. The self priming positive displacement gear type transfer pump delivers a constant supply of diesel fuel. The fuel transfer pump forces fuel through a drilled passage to the outside of the fuel filter element. A spring loaded by-pass valve is located in the fuel filter housing to maintain a maximum pressure of 15 psi.

b. Removal. Refer to figure 5-21 and remove the fuel transfer pump from the engine.

c. Disassembly (fig. 5-22).

(1) Remove the bolt (1), gasket (2), spring (3) and plunger (4).

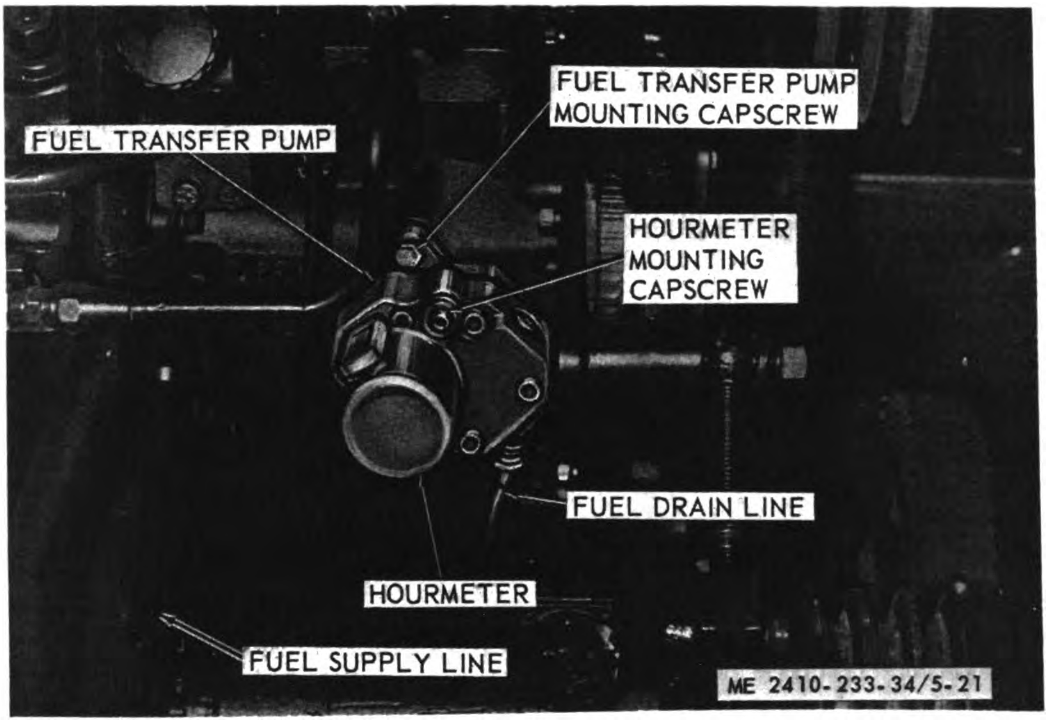
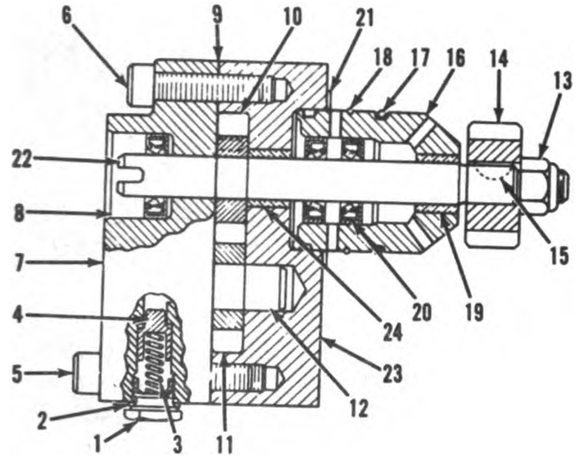


Figure 5-21. Fuel transfer pump, removal and installation.



1	Bolt	13	Nut
2	Gasket	14	Gear
3	Spring	15	Key
4	Plunger	16	Bearing cage
5	Screw	17	Seal
6	Screw	18	Ring
7	Cover	19	Bearing
8	Seal	20	Seal
9	Gasket	21	Gasket
10	Gear	22	Shaft
11	Gear	23	Body
12	Shaft	24	Bearing

Figure 5-22. Fuel tansfer pump.

(2) Remove the screws (5 and 6) and remove the cover (7). Remove the seal (8) from the cover. Remove the cover mounting gasket (9).

(3) Remove the gear (10) from the shaft (22). Remove the gear (11) and shaft (12).

(4) Remove the nut (13). Pull the gear (14) from the shaft and remove the key (15).

(5) Remove the bearing cage (16). Remove the seal (17), ring (18) and the bearing (19). Remove the gasket (21).

(6) Remove the shaft (22) from the body (23). Press out the bearing (24).

d. Cleaning. Clean all components except bearings with cleaning solvent (Fed. Spec P-D-680) and dry with compressed air. Clean bearings as instructed in paragraph 2-6.

e. Inspection and Repair.

(1) Inspect the cover and housing for cracks, chips, nicks, and other damage. Check for cracks and rough spots at the mating surface. Repair or replace as required.

(2) Inspect the spring for cracks and weak condition. Replace if necessary.

(3) Inspect the gears for chipped or broken teeth and for wear. Repair or replace as required.

(4) Inspect the drive shaft for dents, nicks, and scratches and for excessive or uneven wear. Repair surface if possible or replace the shaft.

(5) Inspect the bearings for wear, nicks, scratches, pitting and other damage.

f. Reassembly. Assemble the pump in the reverse order of disassembly. Observe the following:

(1) Install the bearings so that the tapered edges are toward seals.

(2) Soak seals (8 and 17, fig. 5-22) in a solution of 1 part SAE 30 oil to one part diesel fuel to soften the seals. Tamp the seals firmly into the pump body bore and around the shaft using a tamping tool.

(3) Install the gear (14) so that the grooved side is out.

(4) Tighten the nut (13) to a torque of 10 foot-pounds.

(5) Apply a thin film of sealant to the mating surfaces of the pump body (23) and cover (7). Do not allow excess sealant to enter the pump.

g. Installation. Reverse removal procedure and install the fuel transfer pump on engine.

5-14. Fuel Tank

a. General. Refer to TM 5-2410-233-20 for fuel tank service instructions.

b. Removal.

(1) Remove guard from tractor (fig. 5-23).

(2) Close fuel shutoff and remove the fuel supply and drain lines at the tank.

(3) Remove the seat (TM 5-2410-233-20) and seat frame (para 2-9).

(4) Disconnect fuel tank ground wire located on fuel tank just behind right rear corner of seat support (fig. 2-33, sheet 1).

(5) Remove bolt, wire clip, and pull light wire away from fuel tank.

(6) Remove 4 fuel tank mounting bolts.

(7) Pass a chain through each of the two passageways in the tank. Attach chain ends to a hoist and remove fuel tank from tractor.

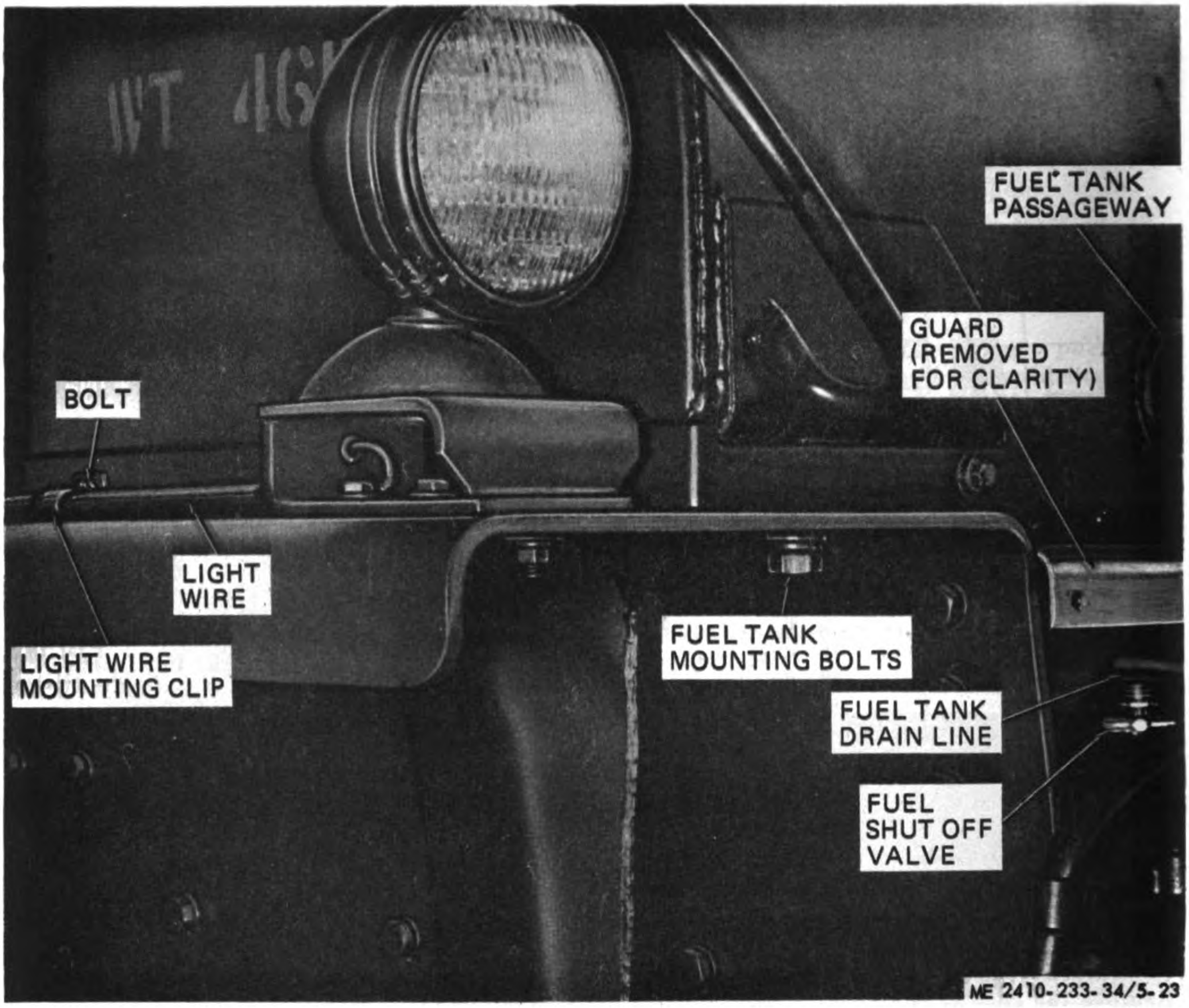


Figure 5-23. Fuel tank, removal and installation.

c. *Cleaning.*

(1) Drain the fuel tank (TM 5-2410-233-20).

(2) Flush the tank with cleaning solvent (Fed. Spec. P-D-680) and rinse with clean diesel fuel.

d. *Inspection and Repair.*

(1) Inspect the fuel tank for corrosion, cracks, punctures, dents, or other damage. Inspect cap, strainer, and drain valve for damage.

(2) Weld cracks and punctures according to TM 9-237.

CAUTION

Fill tank with water prior to welding tank.

(3) Remove corrosion with sandpaper or by sand blasting and paint tank according to procedures in TM 9-213.

(4) Replace a defective cap, strainer, drain valve, or a severely dented or otherwise defective fuel tank.

d. *Installation.* Reverse removal procedure and install the fuel tank on the tractor.

Section III. AIR INDUCTION AND EXHAUST SYSTEM

5-15. Air Cleaner

a. *Removal.*

(1) Refer to TM 5-2410-233-20 and remove air cleaner element.

(2) Remove 5 bolts (fig. 5-24), loosen 2 hose clamps, precleaner clamp, and remove precleaner, air cleaner body and elbows.

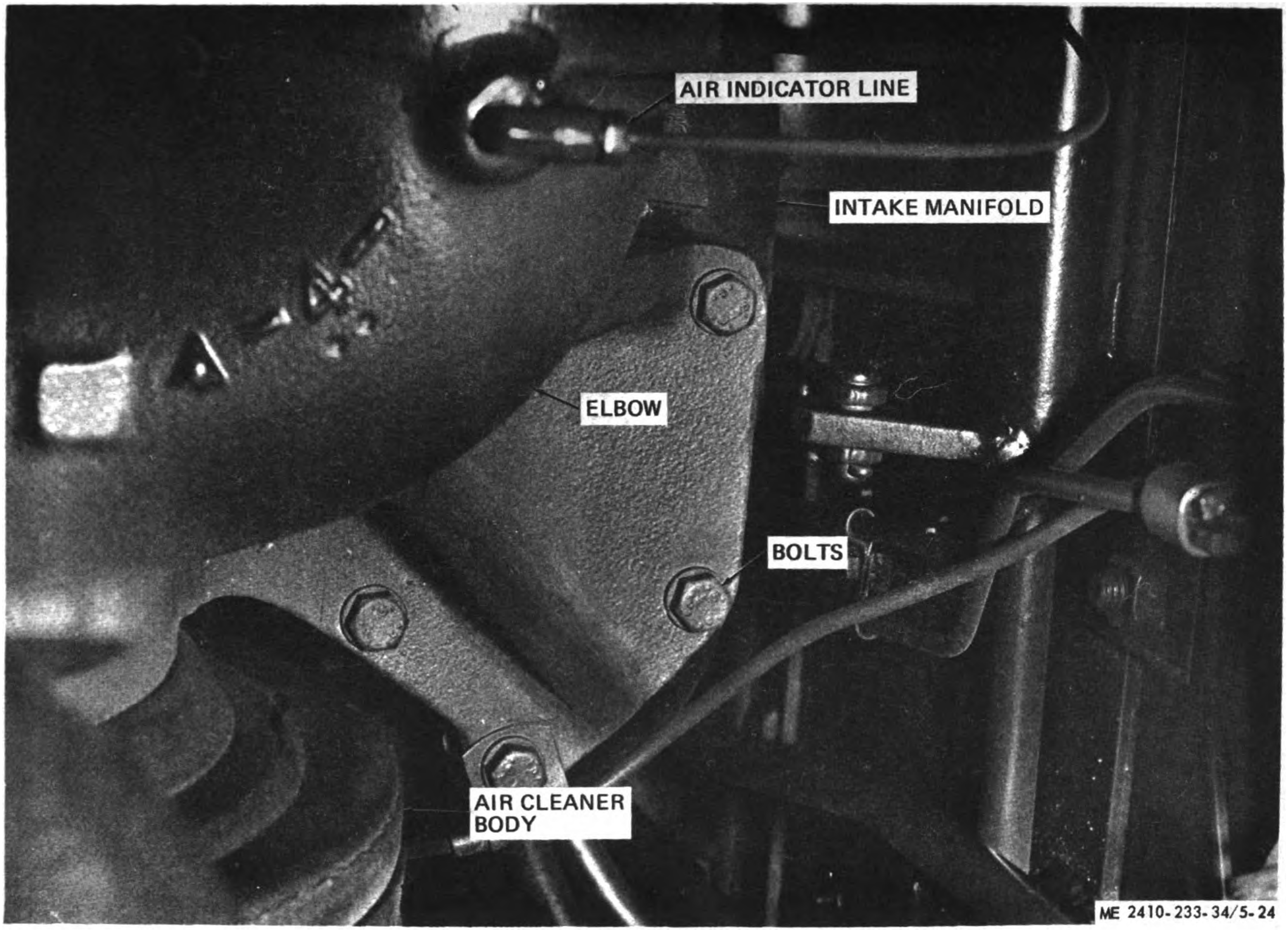


Figure 5-24. Air cleaner body, removal and installation.

b. Cleaning. Refer to TM 5-2410-233-20 for the cleaning of the air cleaner elements and air cleaner body interior.

c. Inspection. Inspect air cleaner for dents, cracks, or other damage. Replace a defective air cleaner.

d. Installation. Reverse removal procedure and install the air cleaner.

5-16. Muffler

a. Removal.

(1) Remove the hood (para 5-2).

(2) Remove 2 bolts (fig. 5-25) and remove exhaust tube assembly from muffler.

(3) Remove 4 nuts and bolts securing muffler straps and remove the top half of the straps from muffler.

(4) Slide muffler with coupling from turbocharger housing and remove muffler from engine.

b. Inspection. Inspect muffler for cracks, dents, corrosion, broken welds or ruptures. Replace a defective muffler.

c. Installation. Reverse removal procedure and install the muffler on the tractor.

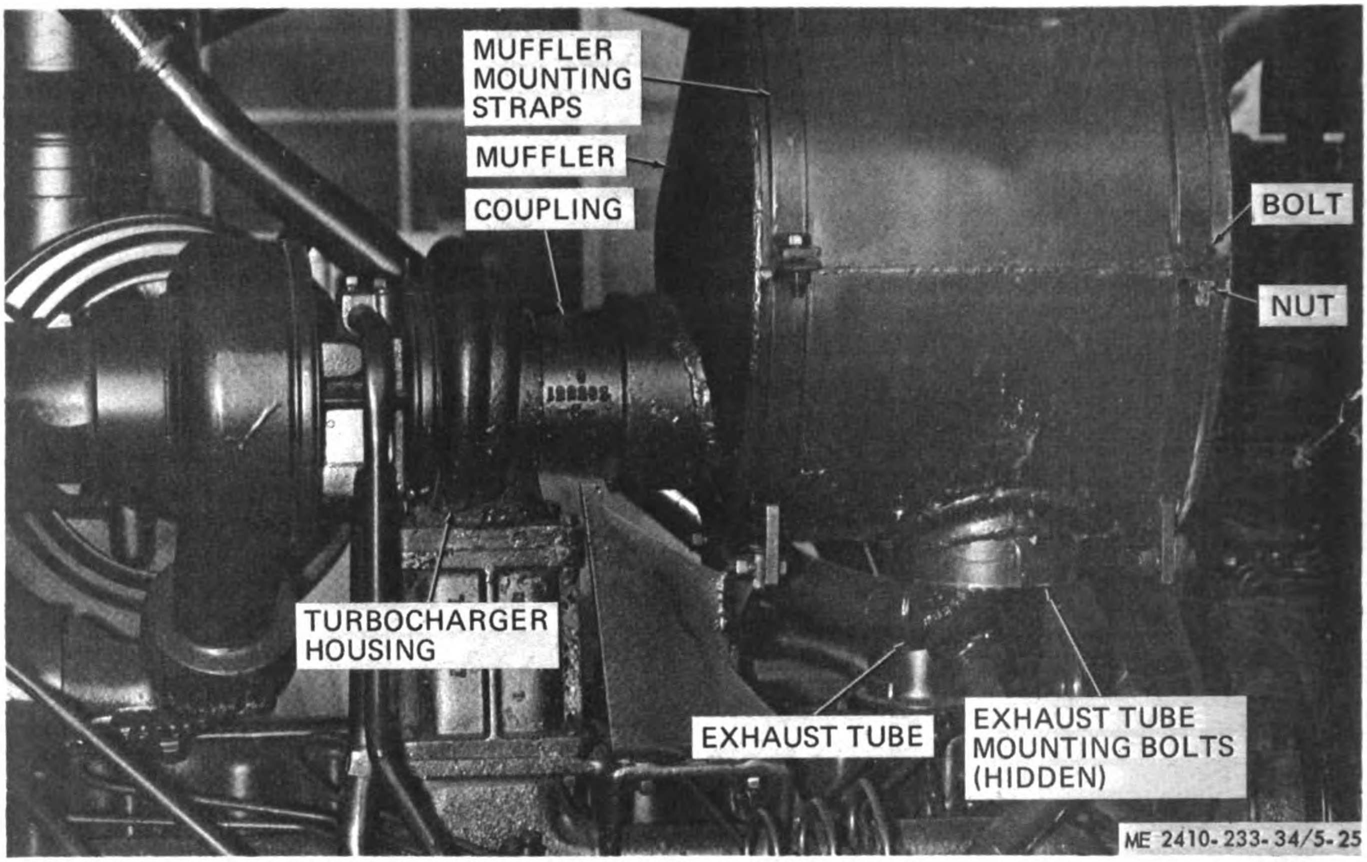


Figure 5-25. Muffler, removal and installation.

5-17. Turbocharger

a. General.

(1) The engine is equipped with an exhaust gas driven turbocharger. Energy originally lost by the diesel engine exhaust is used to drive the turbocharger.

(2) As the engine starts the flow of exhaust gases from the exhaust manifold is directed to the turbine wheel through vanes on the nozzle. The turbine wheel and impeller are mounted on a common shaft. The exhaust gages pass over the turbine wheel forcing it and the impeller to rotate. The gases then exhaust through the outlet opening. Refer to figure 5-26 for an exhaust flow diagram.

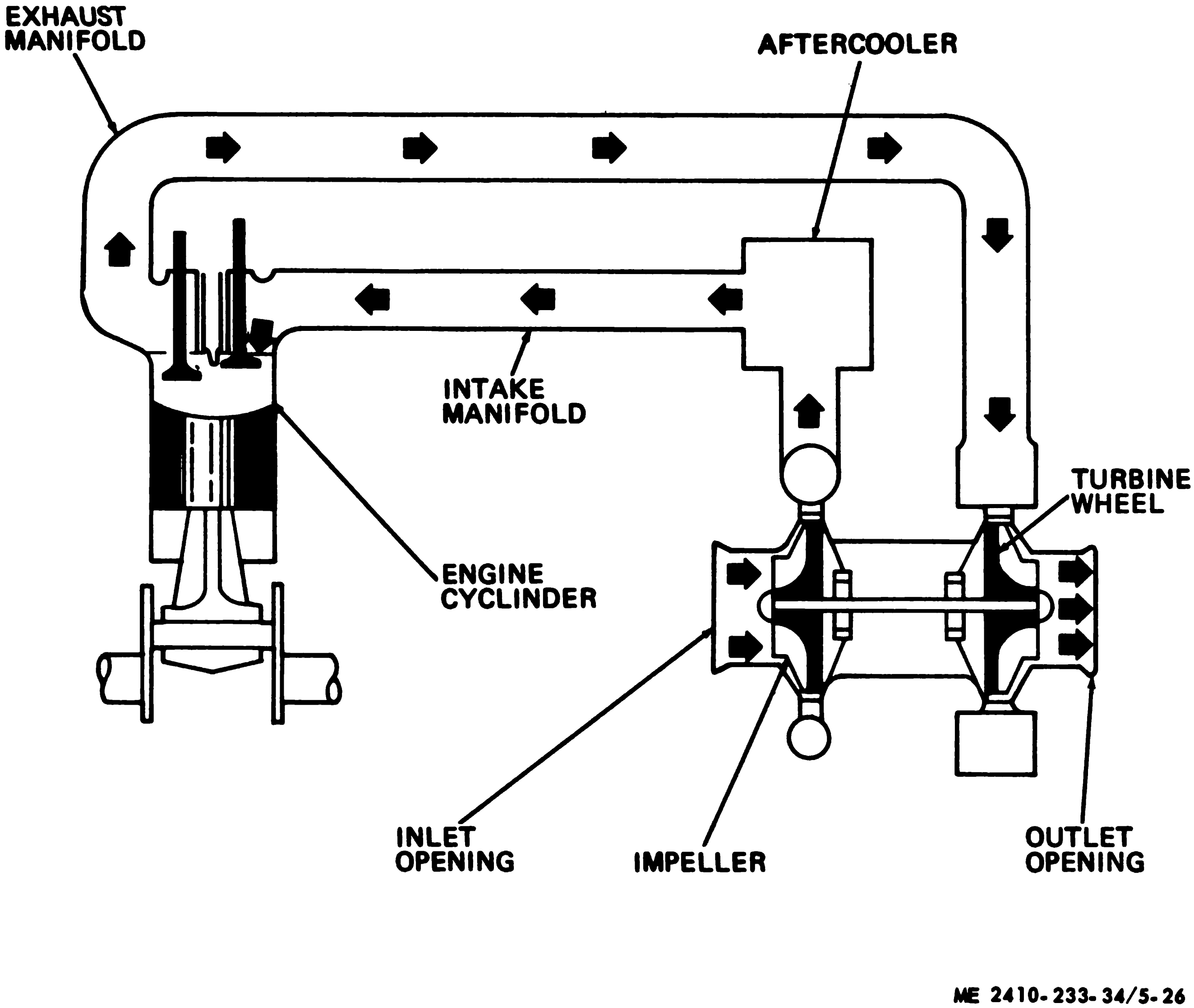


Figure 5-26. Engine exhaust flow diagram.

(3) Air drawn through the air cleaner enters around the center of impeller through the inlet opening. The rotating impeller compresses the air and forces it to the intake manifold and cylinder head.

b. Removal.

(1) Remove the hood (para 5-2) and the engine upper right guard assembly (TM 5-2410-233-20).

(2) Remove air cleaner body (para 5-15).

(3) Remove turbocharger oil supply line (fig. 5-27) and oil drain line.

(4) Remove the turbocharger air outlet pipe.

(5) Install a ⅜ inch—16NC eyebolt in top of turbocharger.

(6) Attach a hoist and remove the four turbocharger mounting bolts and nuts, and remove the turbocharger.

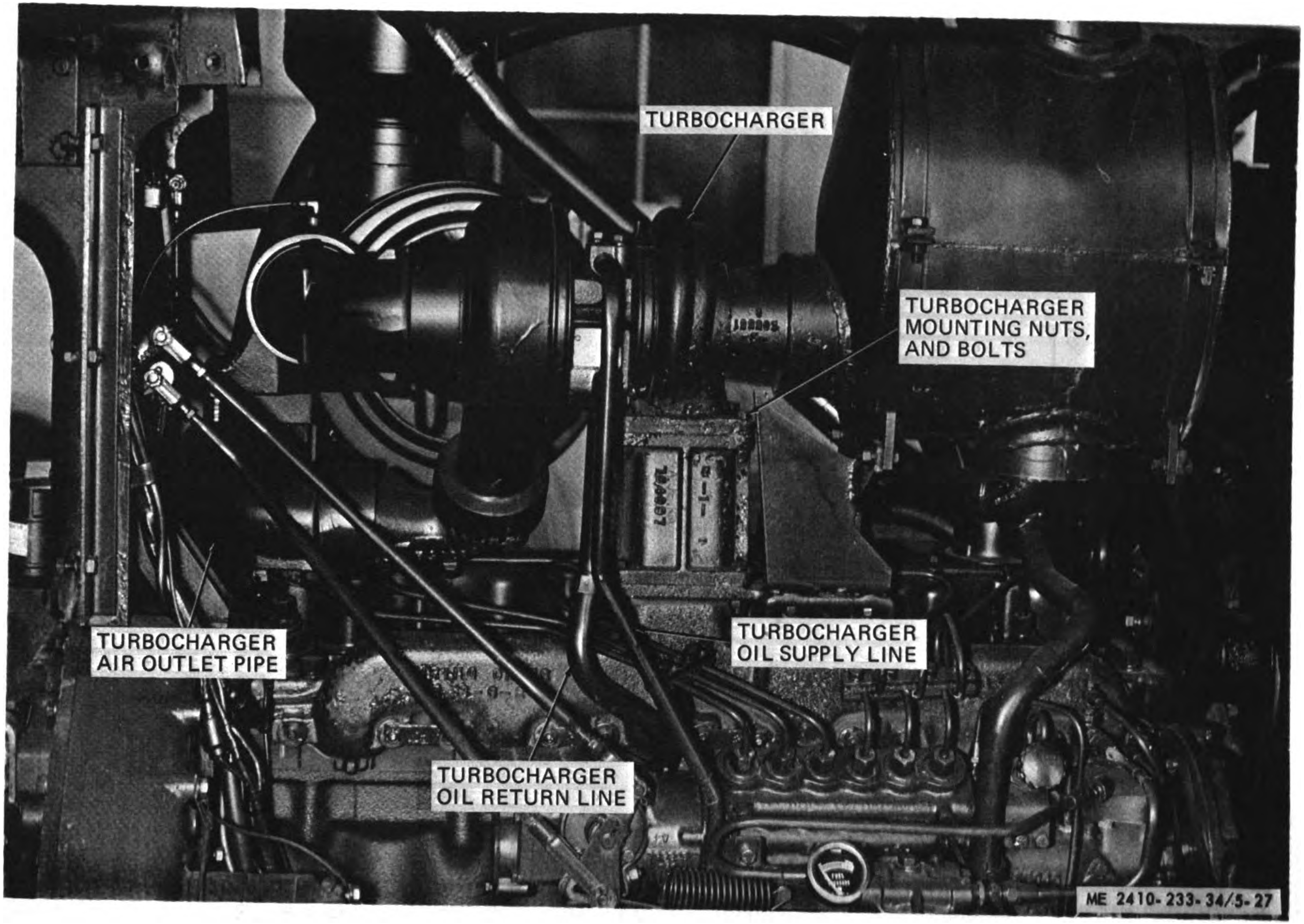


Figure 5-27. Turbocharger, removal and installation.

c. *Disassembly.*

(1) Mount the turbocharger in the holding fixture (fig. 5-28).

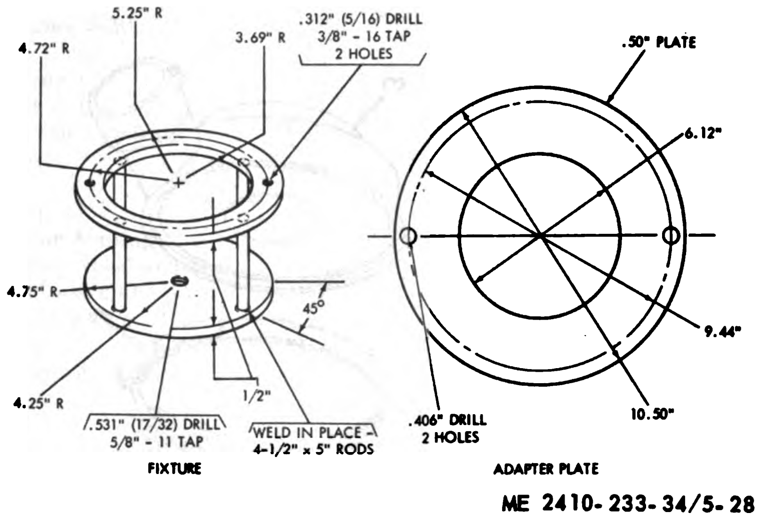


Figure 5-28. Turbocharger mounting fixture and adapter plate.

(2) Note and mark related positions of parts as illustrated in figure 5-29.

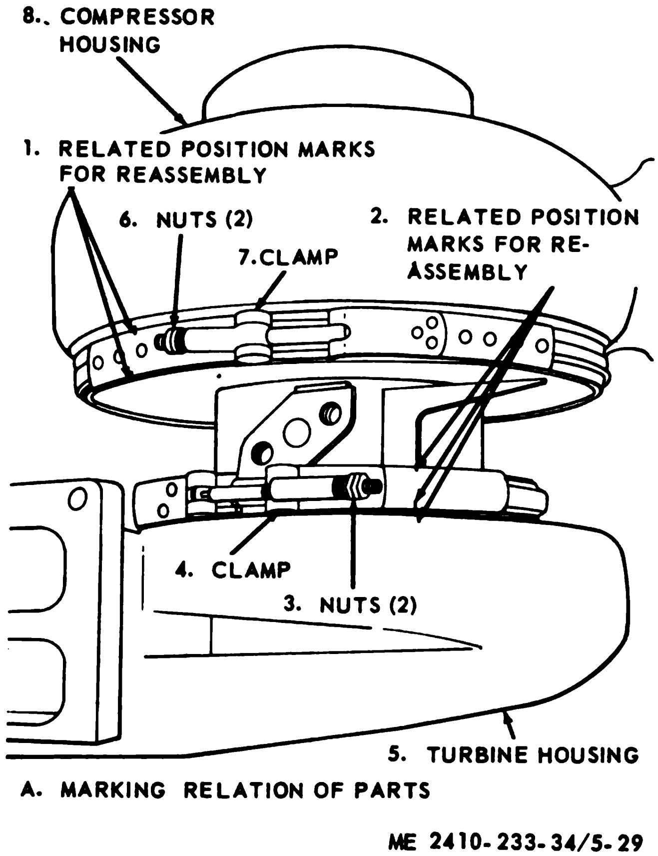


Figure 5-29. Matchmarking turbocharger parts relation.

(3) Remove nut ((1), fig. 5-30) and clamp (2) securing compressor cover (3) and remove the housing and packing (4).

(4) Remove nut (5) while holding turbine wheel (9) as illustrated in figure 5-31.

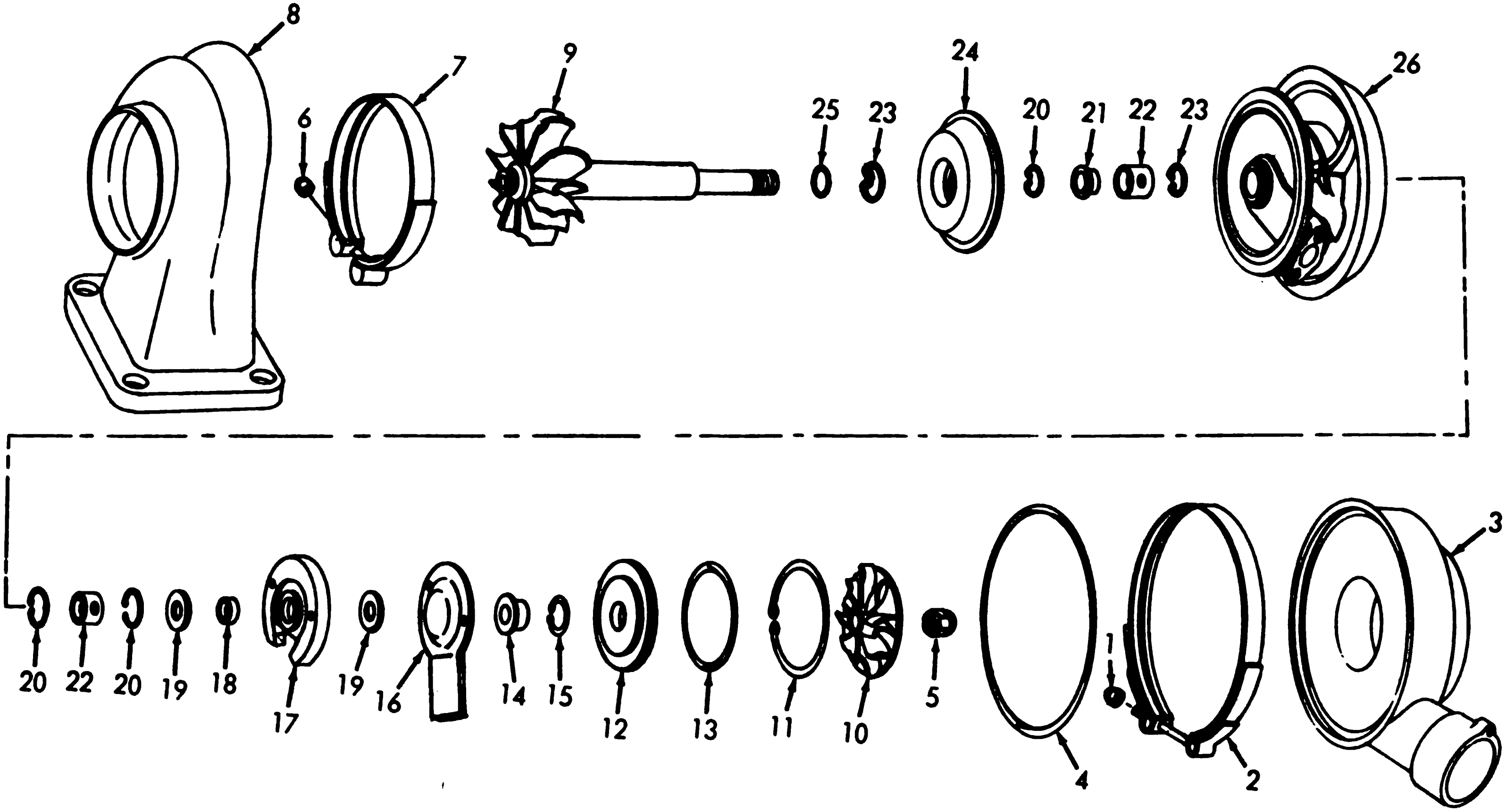


Figure 5-30. Turbocharger, disassembly and reassembly.

Key to figure 5-30.

1	Nut	14	Dirt deflector ring
2	V-clamp	15	Seal
3	Cover	16	Oil deflector
4	Preformed packing	17	Thrust bearing
5	Nut	18	Retainer
6	Nut	19	Ring
7	Clamp	20	Shaft ring
8	Turbine housing	21	Sleeve
9	Turbine wheel and shaft	22	Bearing
10	Wheel assembly	23	Retaining ring
11	Retaining ring	24	Shroud
12	Insert	25	Seal ring
13	Preformed packing	26	Bearing housing

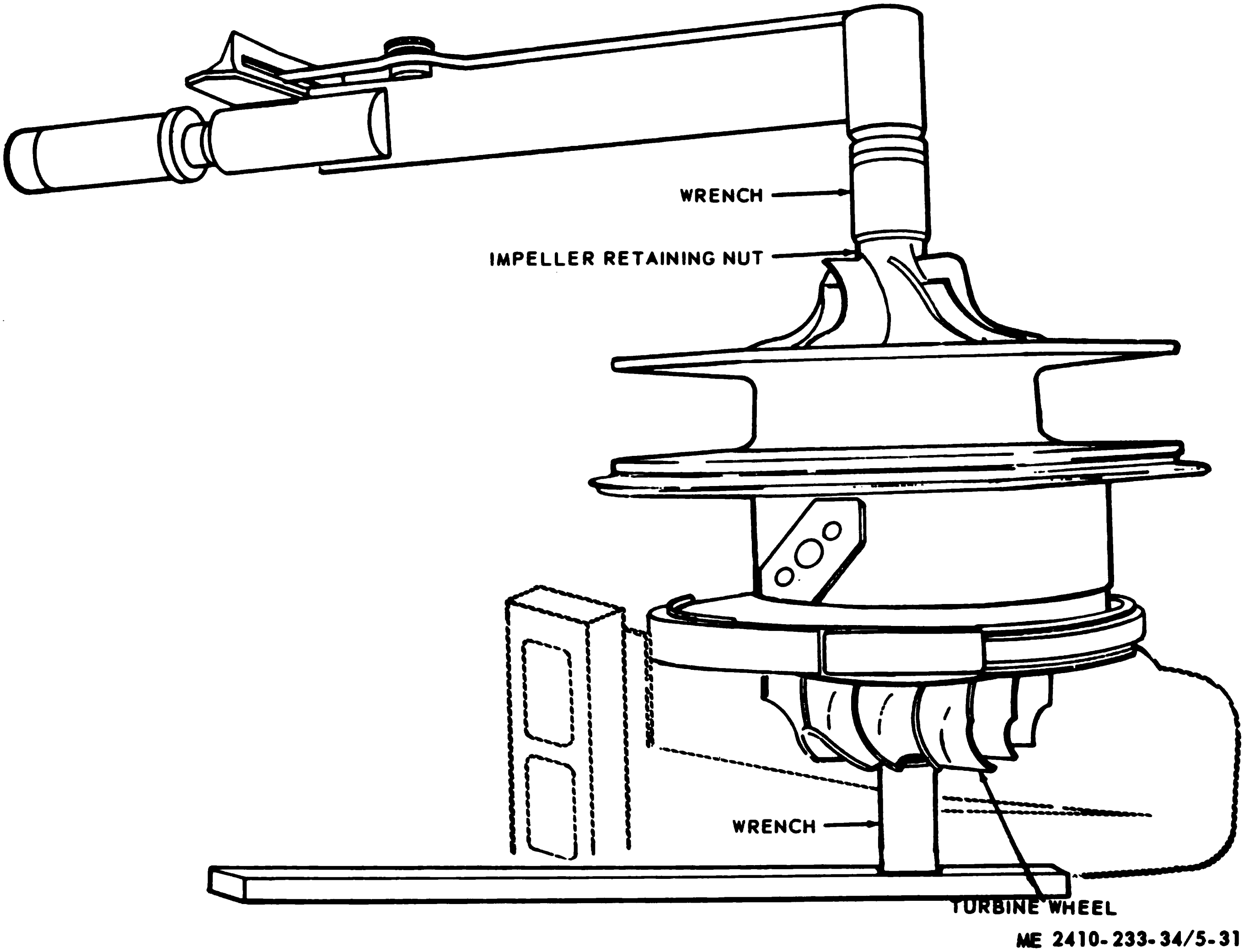


Figure 5-31. Turbocharger retaining nut, removal and installation.

(5) Remove nut (6) (fig. 5-30), expand clamp (7) and lift the center section out of the turbine housing (8).

(6) Place the unit in an arbor press as illustrated in figure 5-32. Make sure the turbine wheel will clear base of press during removal. Place a pin or dowel on end of shaft, hold the turbine wheel by hand, press against the pin until shaft is free and remove the turbine wheel shaft (9) and wheel assembly (10, fig. 5-30).

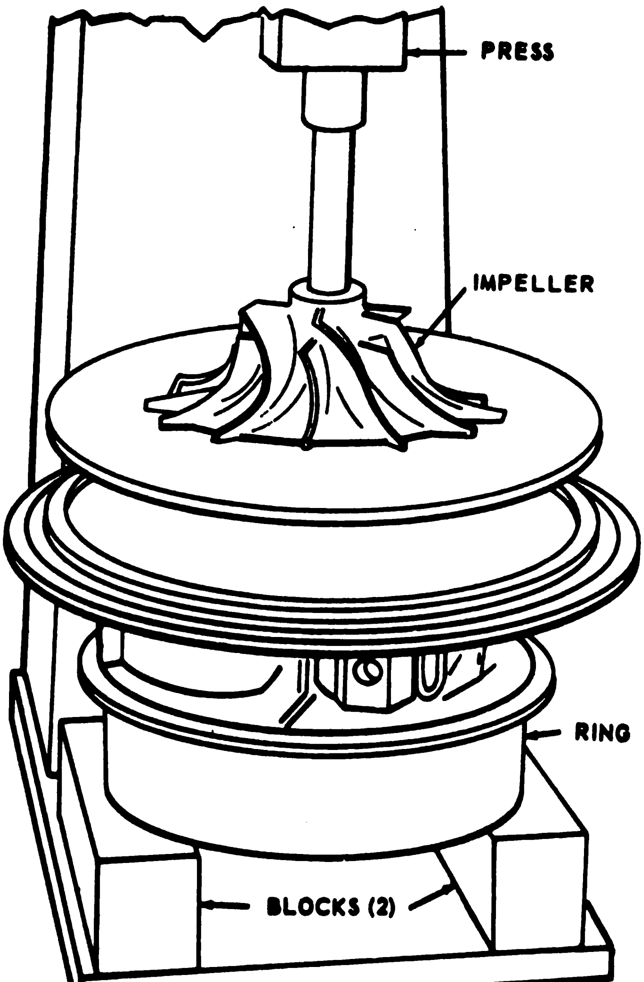


Figure 5-32. Pressing turbocharger shaft from turbine wheel.

(7) Remove the unit from the press and place on bench, compressor end down.

(8) Remove insert retaining ring (11) from bearing housing (26). Install two No. 10—24 screws in shaft insert (12) and pull insert out of bearing housing (26). Push out ring (14) and remove seal (15).

(9) Remove the oil deflector (16). Remove thrust bearing (17), sleeve (18), and ring (19).

(10) Remove four shaft rings (20), and bearing (22) and sleeve (21) from bearing housing (26).

(11) Remove retaining ring (23) and shroud (24) from bearing housing (26).

(12) Remove seal (25) from shaft of wheel assembly (10).

d. Cleaning.

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

(2) Use a soft brush, plastic blade scraper, or compressed air to remove deposits. Do not use a wire brush or steel blade scraper to clean trubocharger components.

NOTE

Make sure the wheels are thoroughly cleaned. Deposits left on these parts will affect their balance.

e. Inspection and Repair.

(1) Inspect wheel assembly and compression wheel for cracked, bent or damaged blades.

CAUTION

Do not attempt to straighten wheel blades.

(2) Refer to table 1-3 and inspect bearing journals and shaft for excessive wear.

(3) Inspect seal groove walls for scoring or scratches.

(4) Inspect bearings for wear, looseness, corrosion and binding. Replace a defective bearing.

(5) Refer to table 1-3 and inspect housing bore for scratches or excessive wear. Replace housing if bearing bores are excessively scratched or worn beyond the maximum allowable wear limits.

(6) Inspect dirt deflector ring (14) (fig. 5-30) for wear or other damage to seal grooves or deflector is damaged.

(7) Inspect sleeve (18), thrust bearing (17) and ring (19) for excessive wear or damage. Replace parts if faces are mutilated. Replace thrust bearing if worn beyond maximum allowable wear limits listed in table 1-3. The small drilled oil holes in the thrust bearing must be clean and free of obstruction.

(8) Inspect oil deflector (16) for excessive wear or scoring. Replace a defective oil deflector.

(9) Inspect shaft insert (12) for wear or scoring. Replace if bore is scored or worn beyond maximum allowable wear limits listed in table 1-3.

(10) Inspect retaining ring (11) for proper spring tension. Replace a defective ring.

(11) Discard and replace all seal rings and packing. Replace all defective parts.

f. Reassembly. The turbocharger must be assembled in accordance with the following procedures. Measure all clearances accurately. Lubrication, unless otherwise specified, will be a clean, light oil OE10.

(1) Clamp the turbine housing (8, fig. 5-30) in a vise or fixture.

(2) Place turbine wheel and shaft assembly (9) with shaft upright in housing. Place seal ring (25) over shaft.

(3) Install shroud (24) in bearing housing (26) and secure with retaining ring (23) with flat side of ring resting against plate.

(4) With the compressor end of housing (26) up, install shaft ring (20) with flat side of ring

facing up. Lubricate and install bearing (22) and second ring (20), the third ring (20), bearing (22) and fourth ring (20).

NOTE

Use pliers to install retaining rings. Compress rings sufficiently to prevent their ends from scoring bore. Make sure retaining rings are secure in grooves.

(5) Lubricate shaft and rings. Place clamp assembly (7) over turbine housing (8). Install bearing housing assembly (26) over shaft, and lower to assembly position.

(6) Align assembly marks and clamp (fig. 5-29) over flanges on both housings. Apply a graphite base grease to clamp threads and face of nut. Install and torque clamp nut to 10 ft-lbs.

(7) Lubricate bearing (17) and compressor end bore and install ring (19) and sleeve retainer (18) and oil deflector (16). Lubricate thrust face of thrust bearing (17).

(8) Using finger pressure only, carefully install dirt deflector ring (14), with seal (15) entering bore of insert (12).

CAUTION

Do not force. If seal does not enter bore easily, remove deflector and recenter sleeve.

(9) Place shaft insert (12) over turbine wheel shaft (9) and carefully lower into position.

(10) Install insert retaining ring (11) in groove with flat side of ring resting against insert.

(11) Apply a film of grease to threads and face of self locking nut (5, fig. 5-30), install and torque nut to 30 ft-lbs. Check clearance between block and face of housing with two sets of thickness as illustrated in figure 5-33. Clearance must be 0.019 to 0.0222 in. Shims 0.003, 0.005 and 0.010 in. thickness are available to obtain correct clearance.

NOTE

Torque self locking nut (5, fig. 5-30) to 30 ft-lbs. each time clearance is checked.

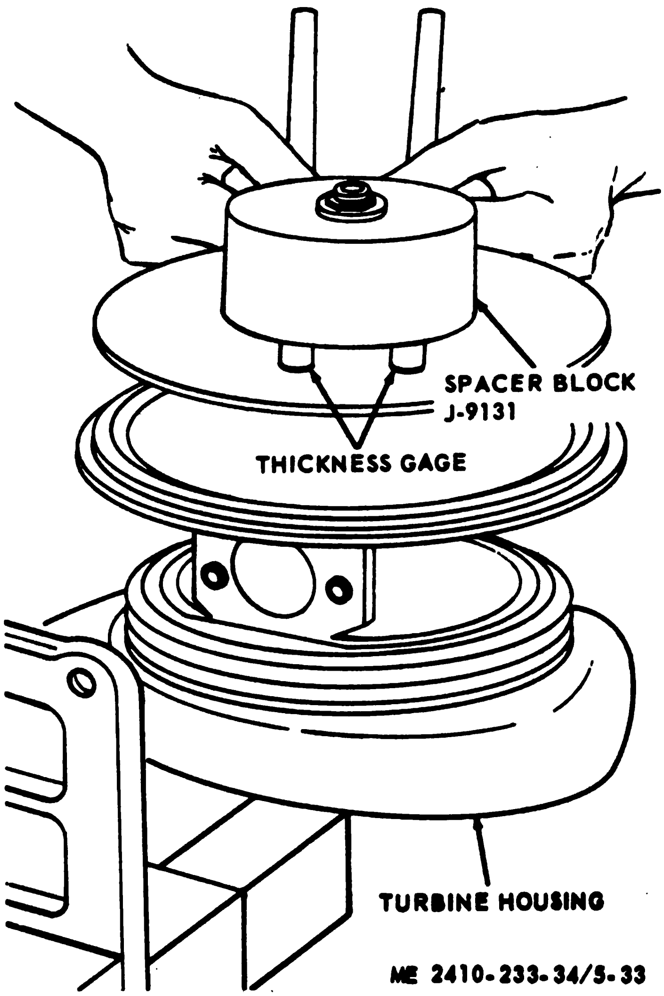


Figure 5-33. Turbocharger clearance check, between spacer block and housing face.

(12) With spacer block in place, check the shaft end play. End play must be 0.004 to 0.006 in. Correct end play can be obtained by adding or removing shims.

(13) Remove nut (5) and spacer block.

(14) Apply a film of grease to bore in compressor wheel (10) and install the wheel on shaft. Position the unit in an arbor press with square extension on turbine wheel resting on block and place tool on wheel. Make sure wheel is starting squarely on shaft, press against tool until wheel bottoms. Remove tool and place unit in vise.

(15) Apply a film of grease to threads and back face of nut (5, fig. 5-30). Install nut and torque to 30 ft-lbs (fig. 5-31).

(16) Recheck for 0.0019 to 0.022 in. clearance between compressor and housing as illustrated in figure 5-33. Recheck end play.

(17) Position clamp (7, fig. 5-30) over bearing housing.

(18) Install packing and compressor cover on bearing housing. Earlier models have no groove for preformed packing. Align assembly marks (fig. 5-29) and position clamps on flanges.

(19) Lubricate clamp threads and face of nut. Install clamp nut and torque to 10 ft-lbs.

g. Installation. Reverse removal procedure and install the turbocharger on the engine.

5-18. Exhaust Manifold

a. Removal.

(1) Remove air cleaner (para 5-15), muffler (para 5-16), and turbocharger (para 5-17).

(2) Remove the crankcase breather pipe (fig. 5-34).

(3) Remove 6 capscrews and remove the turbocharger air outlet pipe.

(4) Remove the fuel injection lines.

(5) Remove the turbocharger oil lines.

(6) Remove the muffler support bracket mounting bolts and remove the support brackets from engine.

(7) Remove the exhaust manifold retaining nuts, washers, and locks. Remove exhaust manifold from engine and remove exhaust manifold gaskets.

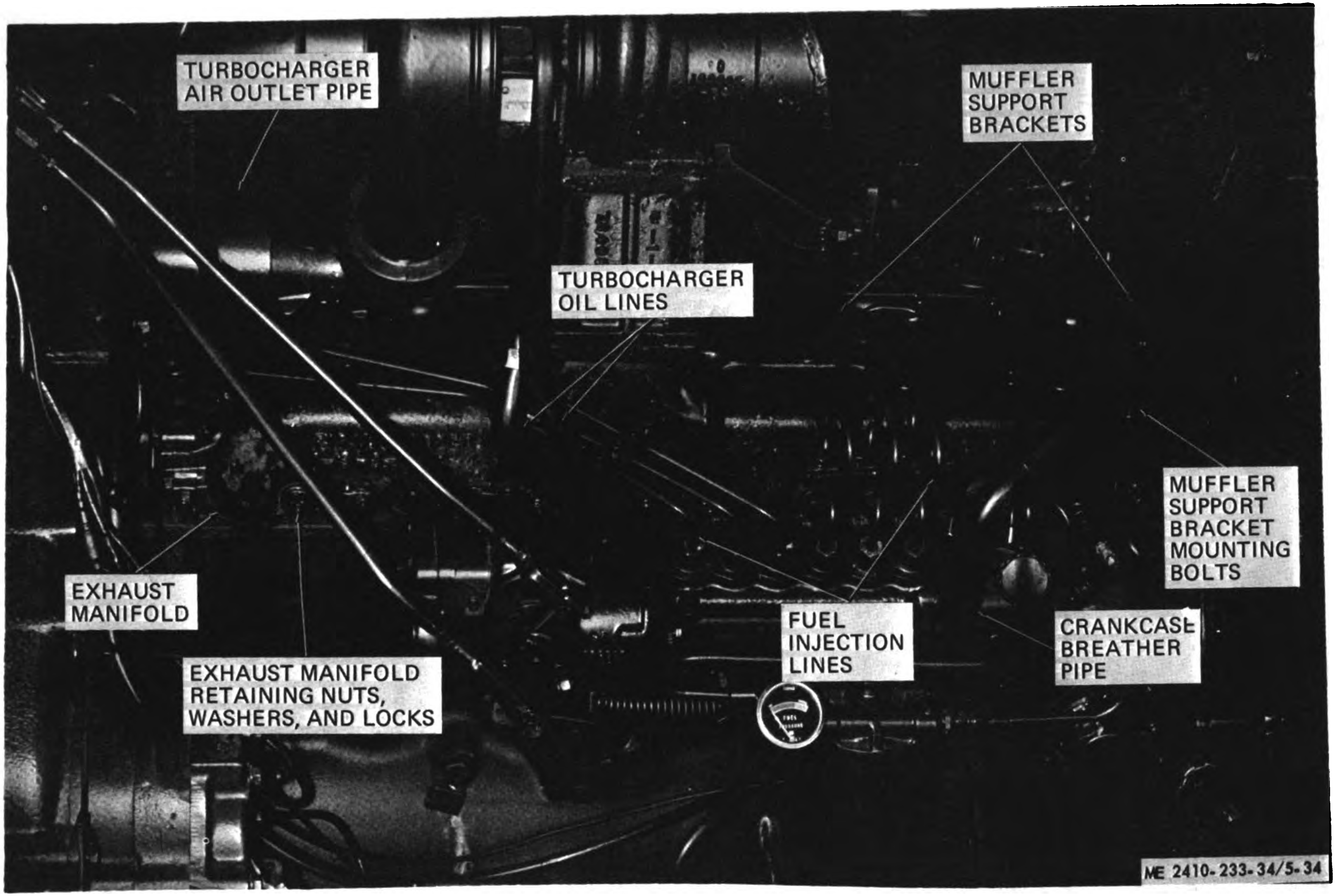


Figure 5-34. Exhaust manifold, removal and installation.

b. Inspection and Repair. Inspect exhaust manifold for cracks, broken mounting flanges, or other damage. Weld cracks and other minor damage according to TM 9-237. Replace an excessively damaged exhaust manifold.

c. Installation. Reverse removal procedure and install the exhaust manifold on engine.

Section IV. ELECTRICAL SYSTEM

5-19. General

The tractor electrical system supplies the power to start the engine and operate the lights and instruments. The system consists of batteries, generator, starting motor with solenoid, and wiring, switches, and other electrical components. Refer to figure 1-1 for the tractor schematic wiring diagram.

5-20. Generator

a. General. The generator is a 24 volt, 40-ampere type mounted on the right-front of the engine. It is fungus and corrosion resistant and is arranged for B-type circuit with the field grounded inside the generator.

b. Removal. Refer to TM 5-2410-233-20 for the removal of the generator.

c. Disassembly.

(1) Remove nut ((29), fig. 5-35) flat washer (30) and collar (35).

(2) Remove screw (44), nut (42) and cover band (43).

(3) Scribe marks across end frames and housing for use in aligning parts in reassembly.

(4) Remove six hex-head bolts (6) and lockwashers (7) securing commutator end frame (8) to housing.

(5) Remove assembled washer screws (15) and remove lead (16). Mark leads and brush holders to assure correct connections are made in reassembly.

(6) Remove assembled end frame (8) and brush plate assembly (10).

(7) Remove six hex-head bolts (6) and lockwashers (7) securing drive end frame (34) to housing. Remove end frame.

(8) Remove armature (40), bearings (5) and (36) and inner bearing retaining plate (37).

(9) Remove brushes (14). Remove four screws (46), nuts (2), lockwashers (1) and separate brush plate assembly (10) from end frame.

(10) Remove four springs (13), electric contact arms (12), and flat washers (11) from brush plate assembly (10).

(11) Remove four screws (3) and remove end frame plate (4).

(12) Remove six screws (31), lockwashers (32) and remove retaining plate (33) from drive end frame (34).

(13) Remove dowel pins (9) only if they require replacement.

(14) Remove screw (45). Remove four screws (21), receptacle connector (22) and leads (27) and (28). Remove leads only if they require replacement.

(15) Remove four screws (23), elbow (24) and elbow spacer (26).

(16) If coil assemblies (20), (38), (39) and (41) require replacement, remove two screws (17) securing each pole shoe (18) to housing. Remove pole shoes, windings and insulators (19).

d. Cleaning.

(1) Clean the armature and field windings of any dirt or magnetized particles. To remove grease and oil, apply a light coat of cleaning solvent (Fed. Spec. P-D-68) with a brush. Wipe clean, then use compressed air to remove any remaining dirt film. Do not use any degreasing compounds or submerge the armature in a degreasing tank as this would damage the insulation.

(2) Clean the commutator with 00 sandpaper and remove sand particles with compressed air.

(3) Clean the commutator end frame, drive end frame, and components with cleaning solvent (Fed. Spec. P-D-680) and dry thoroughly.

CAUTION

Do not soak insulators.

Key to figure 5-35.

1	Lockwasher	23	Screw
2	Nut	24	Elbow
3	Screw	25	Gasket
4	Plate	26	Spacer
5	Bearing	27	Lead assembly
6	Bolt	28	Lead assembly
7	Lockwasher	29	Nut
8	Frame	30	Washer
9	Dowel	31	Lockwasher
10	Plate assembly	33	Plate
11	Washer	34	Frame
12	Arm	35	Collar
13	Spring	36	Bearing
14	Bursh	37	Plate assembly
15	Screw	38	Coil assembly
16	Lead assembly	39	Coil assembly
17	Screw	40	Armature assembly
18	Pole	41	Coil assembly
19	Insulator	42	Nut
20	Coil assembly	43	Band assembly
21	Screw	44	Screw
22	Receptacle assembly	45	Screw
		46	Screw

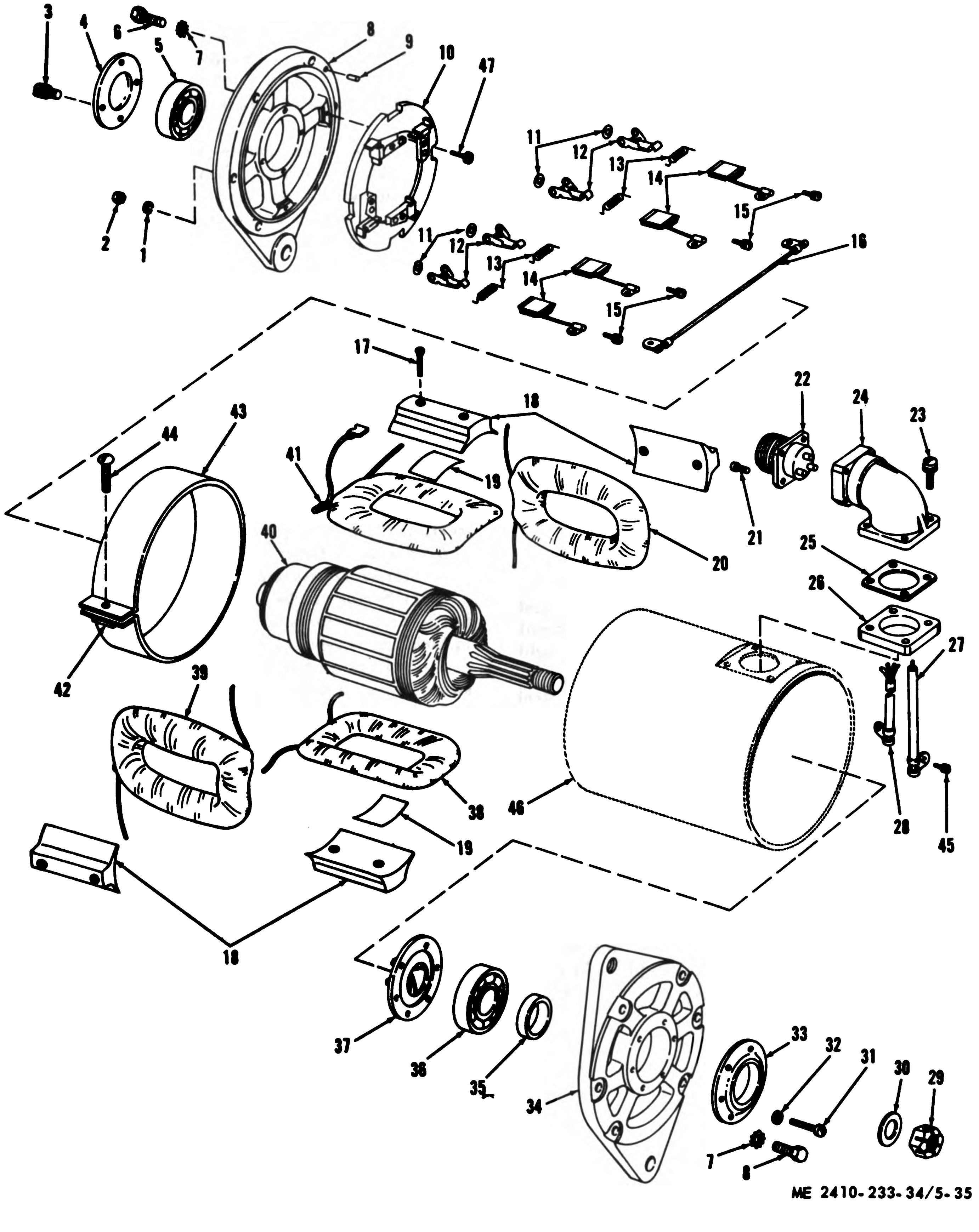


Figure 5-35. Generator disassembly.

e. Inspection and Repair.

(1) Inspect the commutator for roughness, high mica, loose winding, burrs, or pits. Smooth the commutator with 00 sandpaper or undercut on a lathe. Replace the armature if the commutator bars are less than 1/16 inch thick after undercut. Undercut the mica between the bars to a depth of 1/32-inch.

CAUTION

Do not widen commutator slots by removing metal from bars when undercutting. Use only solder with a rosin core flux.

(2) Inspect the armature shaft for wear, pits, bends, corrosion, or breaks.

(3) Place the armature ends in V-blocks and measure the commutator for out-of-round with a dial indicator. Turn down if in excess of 0.001 inch out-of-round.

(4) Inspect for windings grounded to core with a continuity tester. Touch one probe of the tester to the armature shaft and the other to each commutator riser. An indication of continuity indicates the armature is grounded.

CAUTION

Do not touch the probes to the commutator bars or shaft bearing surfaces as arcing may score the smooth surface.

(5) Inspect for open windings with a test lamp. Touch the probes to a pair of adjacent commutator risers. Failure of the lamp to light indicates an open winding.

(6) Inspect for shorts with a growler and steel strip. The steel strip will vibrate against the armature over a shorted area as the armature is turned.

(7) Inspect the field windings for worn or frayed insulation, defective connections, opens, and field current draw.

(8) Inspect end frames for cracks and damaged or worn bearing surfaces.

(9) Inspect brush plate for cracks and loose rivets. Inspect insulated brush holders for grounds.

(10) Inspect brush springs for tension and signs of breaks or other damage. Replace brushes.

(11) Inspect the ball bearings for smooth operation. Inspect for excessive side play and damaged surfaces.

(12) Inspect the generator field frame for breaks, cracks, and damaged threads.

(13) Inspect all hardware for damaged threads.

(14) Replace or repair all defective parts as necessary.

f. Assembly. Reassemble generator in direct reversal of disassembly. Seat brushes using a seating hone or sandpaper wrapped around commutator. Clean commutator thoroughly and complete assembly.

5-21. Starting Motor

a. General. This electrical component is a heavy-duty, 24-volt, submersion proof, fungus and corrosion resistant, solenoid-operated, enclosed shift-lever-type engine starter with eight brushes retained in four brush holders. The drive clutch is a heavy-duty overrunning type and the pinion clearance is adjustable. The principal components of the starter are the frame, armature commutator end plate assembly, brush holder assembly, brushes, drive clutch assembly, drive housing, shift lever, and solenoid plunger.

b. Removal. Refer to TM 5-2410-233-20.

c. Starter Disassembly.

(1) Scribe marks across drive housing ((104), fig. 5-36), lever housing (84), frame assembly (45), to facilitate reassembly in the correct relationship.

(2) Remove five socket head capscrews (100) and one socket head capscrew (99) and pull drive housing assembly from starter. Remove gasket (96).

(3) Disassemble housing assembly only if parts require replacement. Press out sleeve bearing. Remove pipe plugs, expansion plug, and wick.

(4) Loosen terminal screw on solenoid relay and disconnect terminal of lead (37). Remove hex nut and remove lead.

(5) Remove plugs (13) and gaskets (12). Remove brush and field coil connection and attaching screws from each of the holes. Mark screw holes to identify them during assembly of brushes.

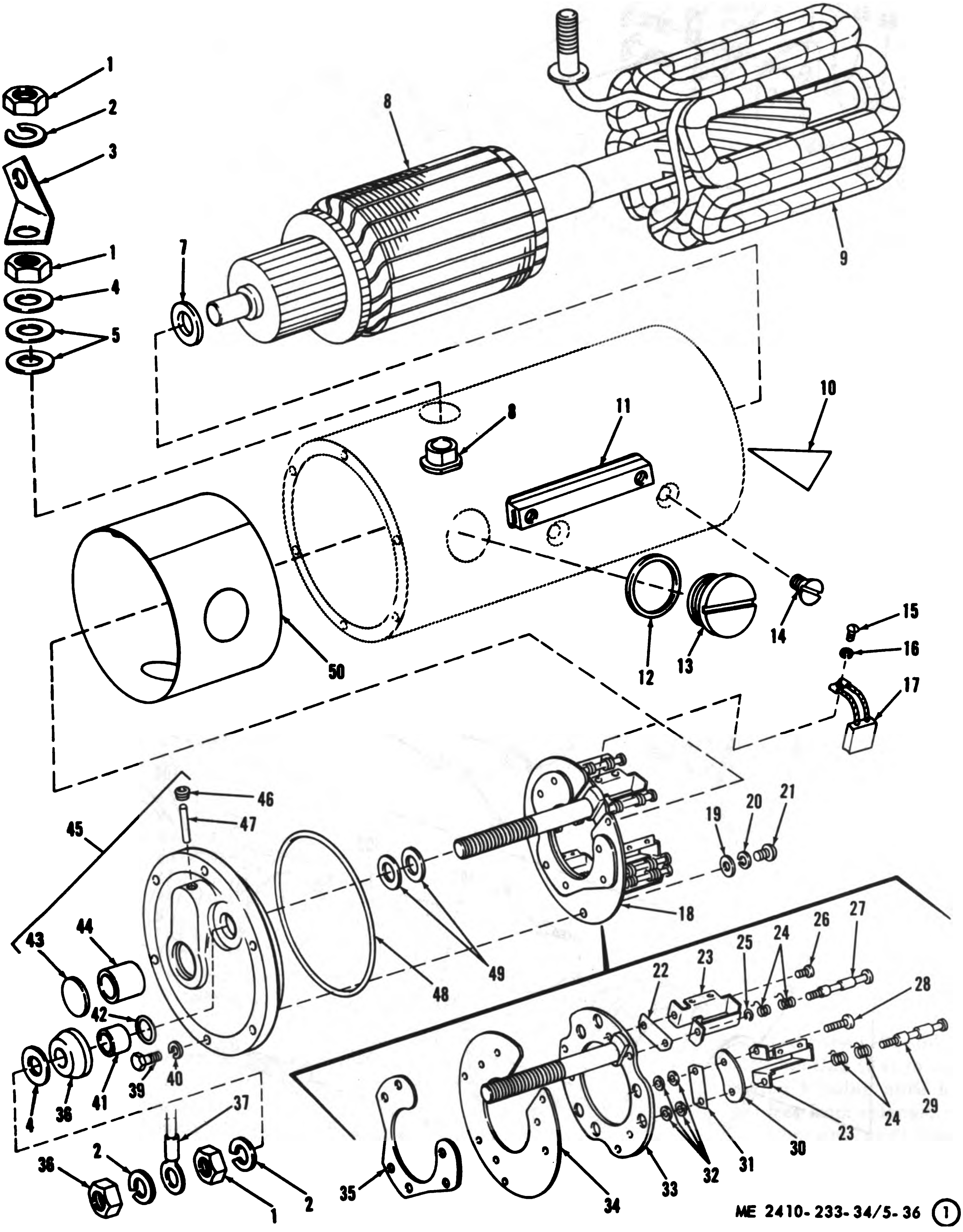


Figure 5-36. Starter motor, exploded view (sheet 1 of 2).

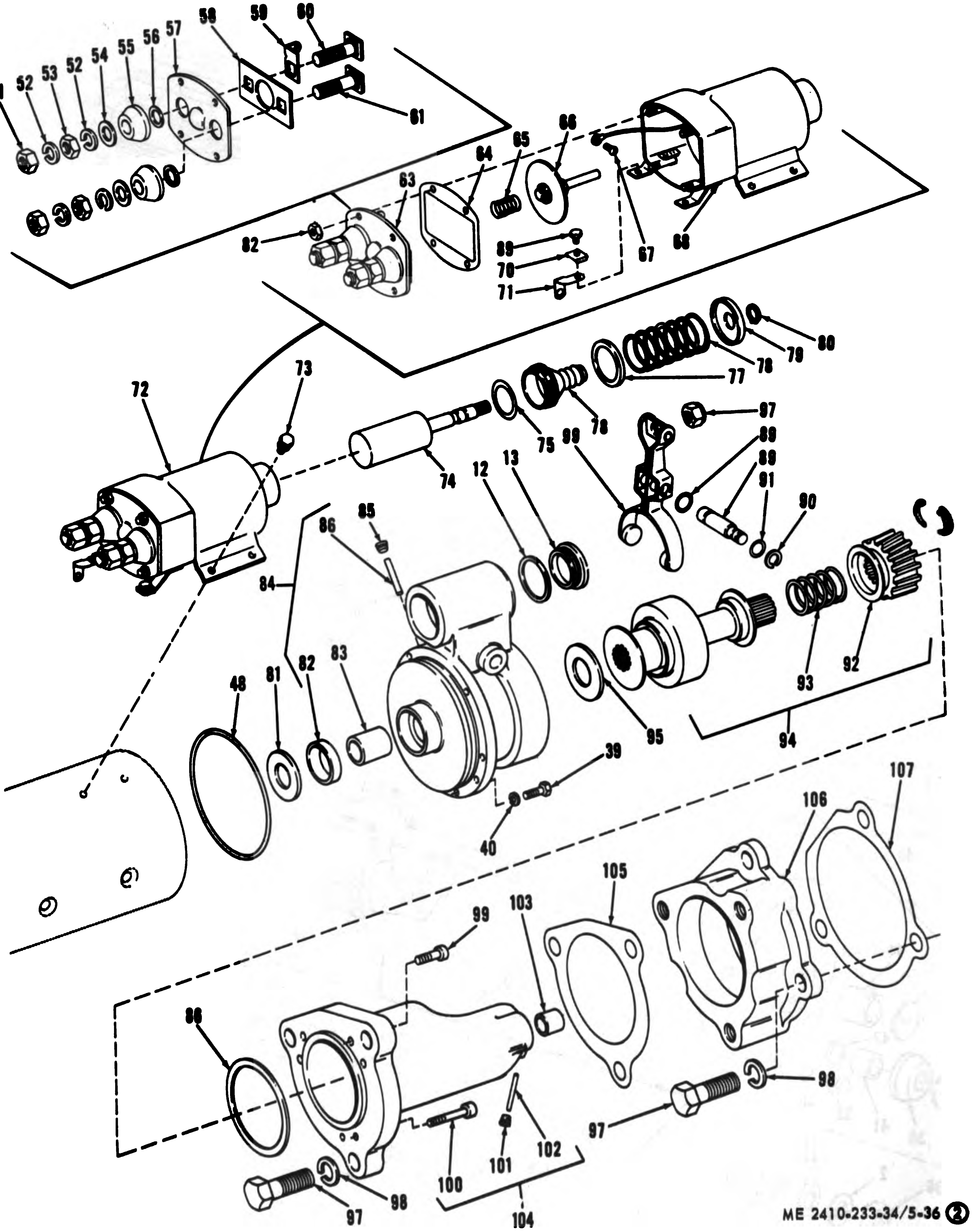


Figure 5-36. Starter motor, exploded view (sheet 2 of 2).

Key to figure 5-36.

1 Nut
2 Lockwasher
3 Connector
4 Washer
5 Washer
6 Bushing
7 Washer
8 Armature assembly
9 Coil assembly
10 Insulation
11 Pole shoe
12 Gasket
13 Plug
14 Screw
15 Screw
16 Lockwasher
17 Brush assembly
18 Plate assembly
19 Washer
20 Lockwasher
21 Screw
22 Plate
23 Holder
24 Spring
25 Lockwasher
26 Screw
27 Bolt
28 Screw
29 Screw
30 Plate
31 Plate
32 Washer
33 Plate assembly
34 Plate
35 Plate
36 Nut
37 Lead assembly
38 Insulator
39 Bolt
40 Lockwasher
41 Bearing
42 Seal
43 Plug
44 Bearing
45 Frame assembly
46 Plug
47 Felt
48 Packing
49 Washer
50 Insulator
51 Nut
52 Lockwasher
53 Nut
54 Washer
55 Insulator
56 Bushing
57 Plate
58 Strip
59 Terminal
60 Stud
61 Stud
62 Nut
63 Terminal assembly
64 Gasket
65 Spring
66 Contact assembly
67 Screw
68 Case and coil assembly
69 Screw
70 Clip
71 Connector
72 Switch assembly
73 Screw assembly
74 Plunger assembly
75 Washer
76 Bellows
77 Ring
78 Spring
79 Retainer
80 Ring
81 Spacer
82 Seal
83 Bushing
84 Housing assembly
85 Plug
86 Wick
87 Nut
88 Seal
89 Shaft
90 Lever assembly
91 Seal
92 Pinion
93 Spring
94 Clutch assembly
95 Washer
96 Gasket
97 Bolt
98 Lockwasher
99 Screw
100 Screw
101 Plug
102 Wick
103 Bushing
104 Housing assembly
105 Gasket
106 Adapter
107 Gasket

(6) Remove six hex-head bolts (39) and lockwasher (40) securing commutator end bell assembly to frame. Using a screwdriver, pry end frame away from frame.

(7) Pull commutator end bell assembly, attached brush holder assembly, and armature (8) from frame. Remove flat washer (7) and pull armature from bearing. Remove spacer (81). Remove preformed packing (48) from end bell. Remove seal (82) and bushing (83) as necessary. Refer to d below for disassembly of end bell and brush holder assembly.

(8) Remove five hex-head bolts (39) and lockwashers (40) securing lever housing (84) to frame. Using a block of wood, tap housing until loose. Work end of bellows (76) free from solenoid relay and pull outward on lever housing until housing and attached parts are free. Remove preformed packing (48).

(9) Remove clutch assembly (94) and nonmetallic washer (95).

(10) Remove inspection plug (13) and gasket (12). Place solenoid plunger into relay to prevent plunger from rotating and loosen hex-locking nut

(87). Remove nut and guide and pull plunger and attached parts from lever housing.

(11) Using retaining ring pliers, remove retaining ring (80), retainer (79), lever spring (78), retainer ring (77), bellows (76) and flat washer (75) from plunger (74).

(12) Remove retaining ring (80) and remove lever shaft (89) and lever (90). Remove seals (88) and (91) from shaft.

(13) Disassemble lever housing only if parts require replacement. Remove oil seal and press out sleeve bearing in lever housing. Remove pipe plug (85) and wick (86).

(14) Remove hex nut and lockwasher securing connector to solenoid switch (72). Remove four assembled washer screws (73) securing relay to frame and slide relay out of connector.

(15) Remove hex nut (1), lockwasher (2), connector (3), hex nut (1), flat washer (4), two non-metallic washers (5) and bushing (6).

(16) Do not remove field coil assembly unless inspection indicates coils are defective. Remove two pole shoes screws (14) from each of the six pole shoes (11). Remove field coil assembly (9), terminal screw and bushing. Unsolder terminal screw from coil assembly.

(17) Remove commutator end insulator and two insulators from drive end of frame.

d. Disassembly of End Bell and Brush Holder Plate.

(1) Remove nuts (36) and (1), and lockwashers (2), flat washer (4) and insulator (38) from terminal stud. Remove three roundhead screws (21), lockwashers (20), and flat washers (19) and pull plate assembly (18) from commutator frame assembly (45).

(2) Remove bushing (41), seal (42) and two flat washers (49) from terminal stud.

(3) Disassemble end bell assembly only if parts require replacement. Remove pipe plug (46) and wick (47), from end frame and bearing assembly.

(4) If sleeve bearing (44) is worn, remove expansion plug (43) and press sleeve bearing from end frame.

(5) Remove screws (15) and lockwashers (16) securing brush leads to brush holders. Lift each spring in turn and remove eight brushes (17).

(6) Remove long brush holder bolt (27) and lockwasher (25) from each of two insulated brush holders (23). Remove two springs (24) from each screw. Remove short screw (26) and lockwasher (25) from each insulated brush holder. Remove two brush holders and spacer plates (22).

(7) Remove long brush holder screw (29) and lockwasher (32) from each of two grounded brush holders (23). Remove two springs (24) from each screw. Remove short screw (28) and washer (32) from each brush holder and remove two grounded brush holders, spacer plates (31) and non-metallic plates (30).

(8) Separate plate assembly (33), insulation plate (34), and support plate (35).

e. Cleaning.

(1) Clean all metal nonelectrical parts in an approved cleaning solvent and dry with compressed air.

(2) Clean field coils thoroughly with a clean cloth dampened with an approved cleaning solvent. Be careful not to damage protective insulation coating. Dry thoroughly with compressed air.

(3) Remove loose particles from armature with compressed air and wipe with a clean cloth dampened in an approved cleaning solvent. Clean commutator lightly with No. 00 sandpaper and remove all traces of dust with low-pressure compressed air.

(4) Clean solenoid relay, insulation plates, and non-metallic washers with a clean cloth dampened with an approved cleaning solvent and dry with compressed air.

(5) Clean brushes with a dry, clean cloth only. Do not permit solvent to contact brushes.

f. Inspection and Repair.

(1) Inspect housings and frames for cracks and distribution. Inspect threads in tapped holes for damage. Replace defective parts.

(2) Inspect sleeve bearings for wear, gouges, and grooves. Replace bearing if defective. Check for looseness in housing or end bell. Replace worn or defective bearings. If new bearing is loose in bore, replace housing or end bell.

(3) Inspect wicks for tests, fraying, or wear. Replace wick if defective.

(4) Inspect armature for gounds with a test light by touching one probe to armature core and other to commutator risers. If test light glows, the armature is grounded and must be replaced.

(5) Inspect armature for short circuits using a growler fixture and a steel strip. Strip will vibrate against armature over a shorted area as the armature is turned. Replace armature if a short circuit is found.

(6) Turn down commutator if grooved or out of round. Undercut mica to a depth of 0.025 to 0.032 inch below surface of commutator. Do not widen slots when undercutting mica.

(7) Check field winding in frame for insulation breakdown with an ohmmeter. Attach one probe of ohmmeter to frame and other to one of the field winding terminals. The reading should not be less than one megohm. Replace defective coil.

(8) Inspect drive pinion for broken or badly worn teeth. Inspect clutch splines for wear and

damage. Inspect shell for cracked or broken condition. Check to make sure pinion will drive in one direction and will slip in opposite direction. Replace drive clutch if defective.

(9) Inspect shift lever, shaft, and solenoid plunger for cracks or distortion. Replace defective parts.

(10) Inspect bellows for tears, punctures and deterioration.

(11) Inspect solenoid relay windings for shorts or grounds with a pair of test probes. Inspect case for cracks or other damage. Replace solenoid relay if defective.

g. Assembly of End Bell and Brush Holder Plate.

(1) If wick was removed during disassembly, saturate a new wick and plug with oil and install in end bell. Wick must not be in fill hole.

(2) Apply sealer to expansion plug hole and install plug. Fill reservoir with oil and install pipe plug.

(3) If sleeve bearing was removed, press a new bearing in end bell and install expansion plug.

(4) Assemble brush holder plate and end bell in the reverse order of disassembly but do not install brushes.

h. Starter Assembly.

(1) If wicks were removed during disassembly, install wicks and plugs following same instructions specified for end bell (subparas *g*(1) and (2) above).

(2) If bearings were removed, press new bearings into housings.

(3) Assemble starter in reverse order of disassembly with the following exceptions and additions.

(4) If field windings were removed, coat threads of pole shoe screws with a suitable thread sealer before installation. Varnish inside of frame and winding assembly. Leave 0.38 inch from end of frame free of varnish.

(5) Partially install lever housing, lever, and solenoid plunger before installing drive clutch. With frame in vertical position and lever housing upward, install non-metallic washer (95) and install drive clutch. Tilt clutch to engage lugs on shift lever. Seat housing making sure bellows is not crimped.

(6) If new brushes are being installed, cover commutator with No. 00 sandpaper temporarily, install armature, brushes, and end bell (subpara (7) below) and turn in brushes. Disassemble, remove sandpaper, and clean armature and brush holder plate assembly.

(7) Install spacer (81) on armature shaft and install preformed packing on end bell. Install frame assembly (45) with assembled brush holder assembly (18) on commutator and install brushes. Install flat washer on armature shaft and install armature and end bell as a unit into frame.

i. Adjusting Drive Clutch Pinion Clearance.

(1) Remove plug.

(2) With starter pinion in engaged position, press clutch inward toward lever to take up slack.

(3) Adjust hex self-locking nut (87) until clearance between outer face of pinion and inner face of housing overhand is 23 / 64 inch ±1 / 32 inch.

5-22. Wiring and Wiring Harness Repair

a. Replace or repair broken, frayed or cracked insulation.

b. Resolder or replace broken terminals.

c. Repair shorted connections.

d. Replace broken wires and connections.

e. Clean corroded terminals with abrasive cloth or replace as necessary.

f. Replace defective wiring harness.

g. Replace broken or defective battery cables.

Section V. ENGINE LUBRICATING SYSTEM

5-23. General

The engine lubricating system consists of the oil pump, oil cooler and filter, oil pan and lubricating passages within the engine block. The oil pump provides pressurized oil to lubricate the engine components and draws the oil back to the engine oil pan.

5-24. Oil Pump

a. Removal.

(1) Lower the front section of the crankcase guard (TM 5-2410-233-20) and drain the engine lubricating oil (TM 5-2410-233-10).

(2) Remove the oil pan (para 5-25).

(3) Disconnect oil lines to the oil pump (fig. 5-37). Cap or plug openings.

(4) Remove the bolts and locks which secure the oil pump to the cylinder block and remove the oil pump (fig. 5-37).

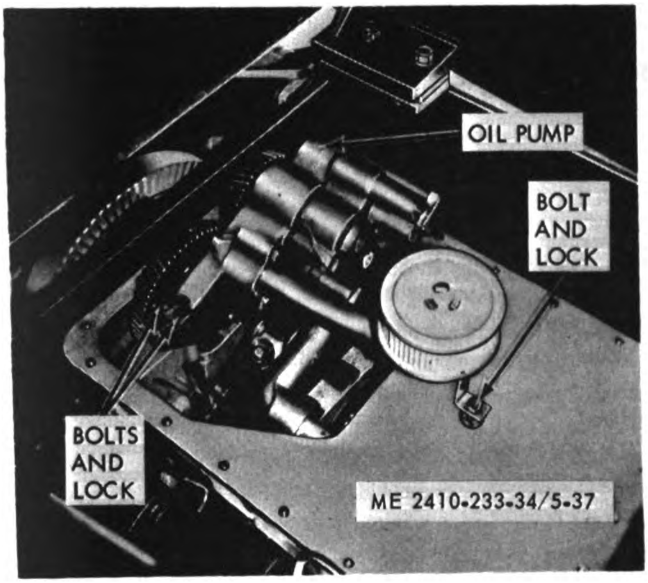


Figure 5-37. Oil pump, removal and installation.

b. Disassembly (fig. 5-38).

(1) Remove the bolts (1), lock (2) and cover (3). Remove the spring (4) and plunger (5).

(2) Remove the bolts (6), lock (7), elbow (8) and gasket (9).

(3) Remove the bolts (10, 11 and 12) and locks (13, 14, and 15). Remove the scavenge pump body (16) from the oil pump body and press out the bearings (17) and pins (18).

Key to figure 5-38.

1 Bolt
2 Lock
3 Cover
4 Spring
5 Plunger
6 Bolt
7 Lock
8 Elbow
9 Gasket
10 Bolt
11 Bolt
12 Bolt
13 Lock
14 Lock
15 Lock
16 Body
17 Bearing
18 Pin
19 Bolt
20 Lock
21 Suction bell
22 Gasket
23 Gear
24 Key
25 Gear
26 Spacer
27 Cotter pin
28 Nut
29 Washer
30 Gear
31 Key
32 Shaft and gear assembly
33 Bearing
34 Gear
35 Shaft
36 Dowel
37 Shaft and gear assembly
38 Bearing
39 Bearing
40 Ball
41 Body

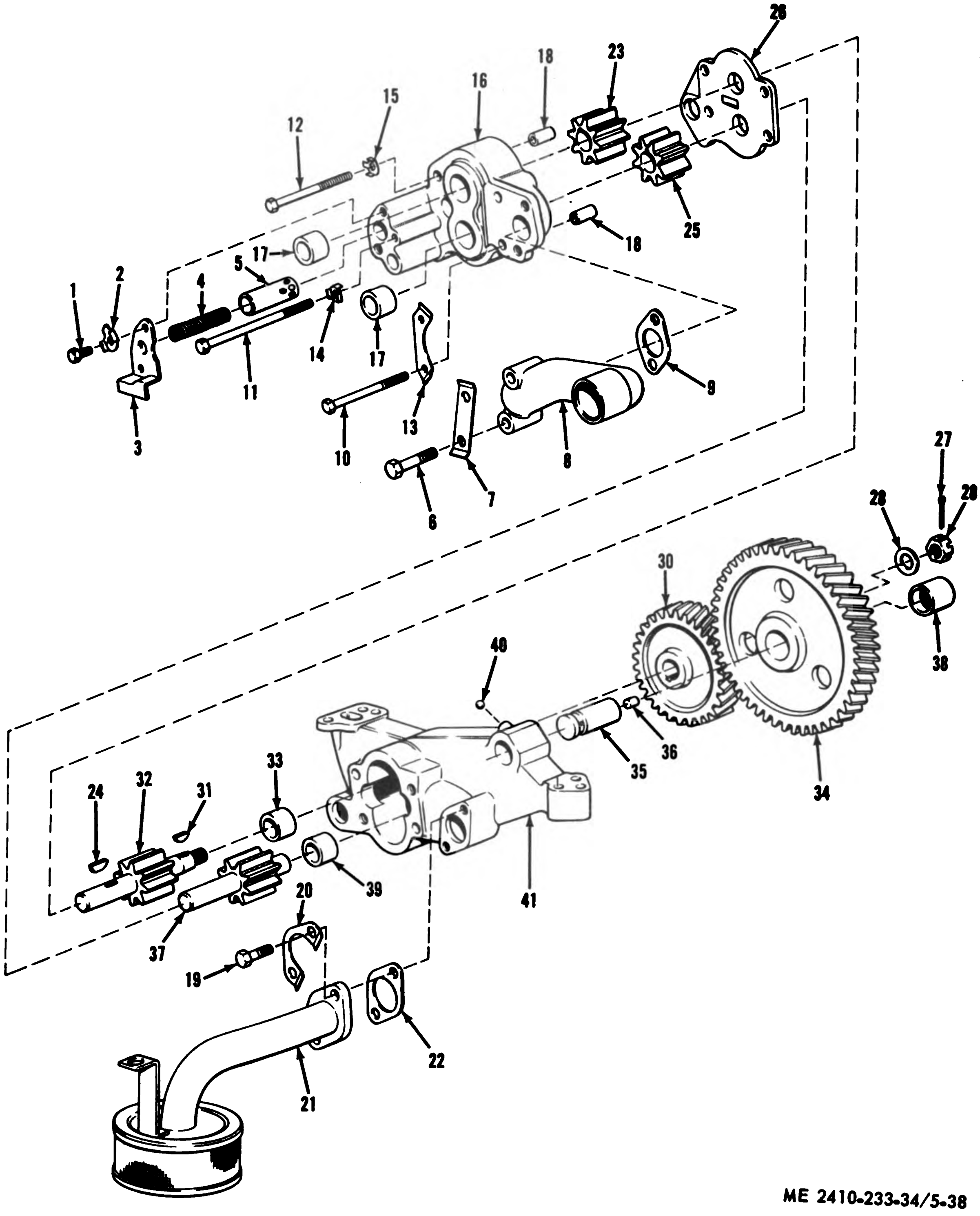


Figure 5-38. Oil pump, exploded view.

(4) Remove the bolts (19), lock (20), suction bell (21) and gasket (22).

(5) Remove the scavenge pump drive gear (23), key (24), driven gear (25) and spacer (26).

(6) Remove the cotter pin (27), nut (28) and washer (29). Using a puller, remove the drive gear (30) and key (31). Remove the shaft (32) from the oil pump body (41). Drive out the bearing (33).

(7) Remove the idler gear (34), shaft and gear assembly (35), dowel (36) and shaft and gear assembly (37). Remove the bearings (38 and 39).

(8) Remove the ball (40) from the oil pump body (41).

c. Cleaning. Clean all parts except bearings with cleaning solvent (Fed. Spec. P-D-680) and dry with clean, lint-free cloths or compressed air. Clean bearings as instructed in paragraph 2-6.

d. Inspection and Repair.

(1) Inspect all parts for nicks, burrs, cracks or other damage. Remove small nicks or burrs with a hone or crocus cloth.

(2) Inspect all parts for wear. If any part is excessively worn, replace the pump.

e. Reassembly. Assemble the pump in the reverse order of disassembly. Observe the following:

(1) Ensure that all parts, tools and the work area are clean.

(2) Lubricate parts in engine oil before assembling.

(3) Tighten the nut (28, fig. 5-38) to a torque of 60 foot-pounds.

f. Installation.

(1) Install the oil pump in the reverse order of removal. Install new gaskets at oil line connections.

(2) Check the backlash between the oil pump idler gear and the crankshaft gear. If backlash exceeds 0.008 inch, replace the idler gear.

(3) Install the oil pan (para 5-25) and service the engine with lubricating oil (LO 5-2410-233-12).

5-25. Oil Pan and Oil Pan Plate

a. Removal (fig. 5-39).

(1) Lower the front section of the crankcase guard (TM 5-2410-233-20) and drain the lubricating oil from the oil pan (TM 5-2410-233-10).

(2) Remove the oil level dipstick.

(3) Remove the bolts and lockwashers that secure the oil pan to the timing gear cover and the oil pan plate.

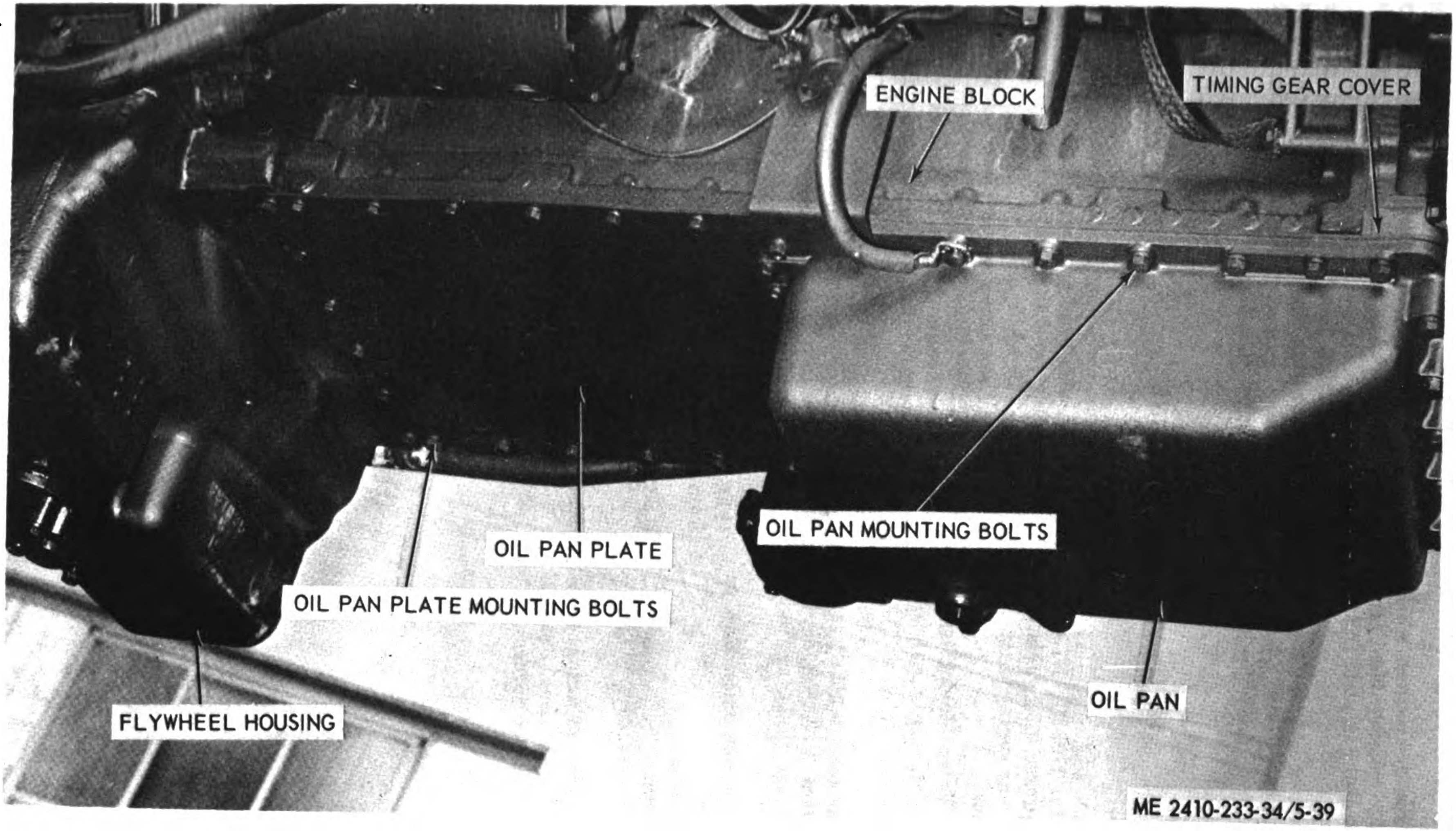


Figure 5-39. Oil pan and oil pan plate, removal and installation.

(4) Separate the oil pan gasket from the oil pan so that the gasket remains with the oil pan plate. Remove the oil pan.

(5) Remove the bolts and lockwashers which secure oil pan plate to the cylinder block and flywheel housing. Remove the oil pan plate and oil pan gasket.

b. Cleaning. Clean the oil pan and oil pan plate with cleaning solvent (Fed. Spec. P-D-680). Ensure that all sediment is removed from the sump in the oil pan.

c. Inspection and Repair. Inspect the oil pan and oil pan plate for chips, cracks, weld damage, warpage and other damage. Smooth contact surfaces with a hone or file. Repair cracks by welding (TM 9-237). Replace parts if warpage is excessive.

d. Installation. Install the oil pan and oil pan plate by reversing the removal procedure. Use a new oil pan gasket. Service the engine with lubricating oil (LO 5-2410-233-12).

Section VI. DIESEL ENGINE

5-26. General

The tractor is powered by the D333C, 4.75 inch bore x 6 inch stroke, six cylinder, 638 cubic inch turbocharged diesel engine. The engine is rated at 180 horsepower at 2000 rpm.

5-27. Cylinder Head and Valve Mechanism

a. Removal and Disassembly (fig. 5-40).

(1) Drain the engine coolant. Refer to TM 5-2410-233-10.

(2) Remove the exhaust tube, muffler, (para 5-16), exhaust manifold (para 5-18), air cleaner (para 5-15), turbocharger (para 5-17), and hood (para 5-2).

(3) Remove the fuel injection lines. Cap or plug openings (para 5-10).

(4) Remove the glow plugs.

(5) Steam-clean the engine.

(6) Remove the rocker arm cover (TM 5-2410-233-20).

(7) Loosen the rocker arm adjusting screw locknut (3) from each of the rocker arms. Back off the adjusting screws (4) one or two turns.

(8) Remove the bolt (1) and washer (2) from each rocker arm bracket. Carefully pry the rocker arm assembly from the cylinder head.

NOTE

Tag rocker arm components for proper installation. Do not mix parts from one assembly to another.

(9) Disassemble the rocker arms as follows:

(a) Remove the locknut (3) and adjusting screw (4).

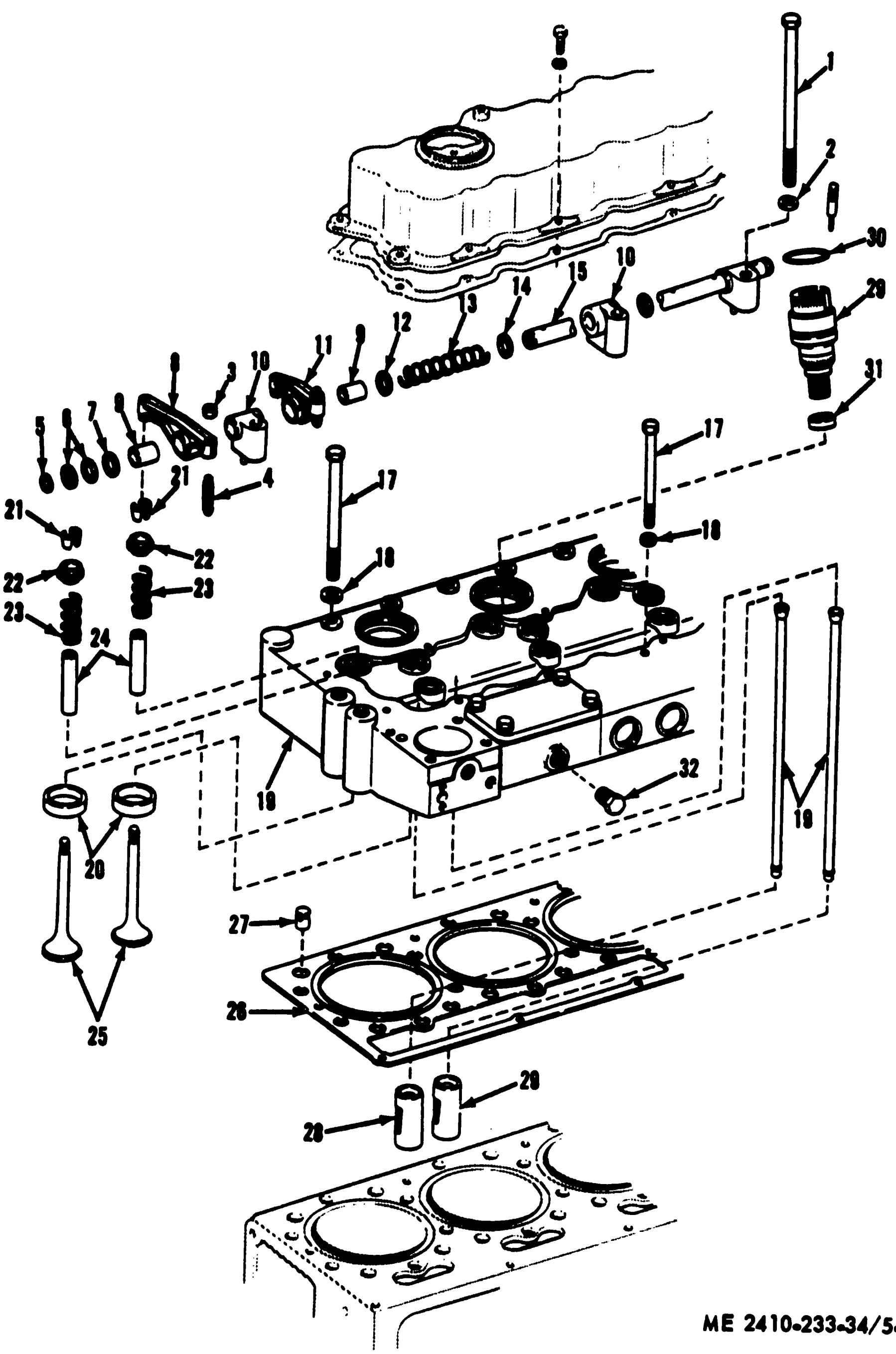
(b) Remove the ring (5), washer (6) and spring (7).

(c) Remove the rocker arm (8) and pull the bushing (9).

(d) Remove the bracket (10), rocker arm (11), washer (12), spring (13) and washer (14) from the rocker arm shaft (15).

(10) Remove the push rods (16) and tag them for proper installation.

(11) Remove the cylinder head bolts (17) and washers (18).



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1	Bolt	9	Bushing	17	Bolt	25	Valve
2	Washer	10	Bracket	18	Washer	26	Seat
3	Locknut	11	Rocker arm	19	Cylinder head	27	Dowel
4	Adjusting screw	12	Washer	20	Gasket	28	Valve lifter
5	Ring	13	Spring	21	Retainer	29	Precombustion chamber
6	Washer	14	Washer	22	Retainer	30	Seal
7	Spring	15	Rocker arm shaft	23	Spring	31	Seal
8	Rocker arm	16	Push rod	24	Guide	32	Plug

Figure 5-40. Cylinder head and valves, exploded view.

(12) Install two ¾ in. —10NC forged eyebolts and attach a hoist to the cylinder head (19) and remove from the tractor. Discard the cylinder head gasket (20).

(13) Using a spring compressor, compress the springs (23). Remove the retainers (21). Release the spring compressor and remove the retainers (22), springs (23) and guides (24).

(14) Remove the valves (25) and valve seats (26). Remove the locating dowels (27).

(15) Using a wire about 15 inches long with a hook at one end, remove the valve lifters (28) from the block.

(16) Remove the precombustion chambers (29) and seals (30 and 31).

(17) Remove the plug (32) from the cylinder head.

b. Cleaning. Remove all traces of carbon and other deposits with a clean cloth dampened with cleaning solvent (Fed. Spec. P-D-680). Blow out oil and coolant passages with compressed air.

c. Inspection and Repair.

(1) Inspect the rocker arm shaft for scoring or wear. If the shaft has been damaged by rocker arm movement, replace the shaft.

(2) Check rocker arm bushings for scratches, pitting or scoring. Replace the bushings if damaged.

(3) Place each rocker arm in position on the shaft. The rocker arm must rest freely on the shaft without side wobble. If wobble exists, replace the rocker arm.

(4) Inspect the springs for cracks and weakness. Replace springs as necessary.

(5) Inspect the cylinder head for fretting, erosion and warping in excess of 0.005 inch. Resurface the head if necessary.

(6) Inspect the push rods for straightness, cracks and worn ends. Replace if bent.

(7) Using a micrometer, measure the valve guide inner diameter. The diameter should be 0.3736 to 0.3756 inch and must not exceed 0.3766 inch. Replace if wear is excessive.

(8) Inspect and repair the valves as follows:

(a) Inspect the valves for damage. If the valve faces are pitted or do not properly contact the valve seats, reface the valves. Ensure that there is enough metal on the head of the valve to prevent dishing. Replace the valves if they are excessively damaged or worn.

(b) Using a micrometer, measure the valve stem diameter at three places. Diameter must not be less than 0.3702 inch at any point.

CAUTION

While handling valves, be careful not to scratch or nick the area between the valve face and stem. A small nick can cause the valve head to break off during service.

d. Reassembly and Installation (fig. 5-40).

(1) Install the seals (30 and 31) onto the precombustion chambers (29).

(2) Coat the chamfered portion of the cylinder head and the rubber seals (30) with liquid soap. Install the precombustion chambers in the cylinder head and tighten to a torque of 140 to 160 foot-pounds.

(3) Install the dowels (27) in the block. Install a new gasket (20). Install the plug (32).

(4) Install the valve lifters (28).

(5) Press the valve guides (24) into the cylinder head using an arbor. Resurface the valve seats after installing in the cylinder head. Lap valves and seats together to obtain a proper seal.

(6) Shrink the valve seats (26) in dry ice and install in the head. Drive into place with a suitable driver.

(7) Lubricate the valves (25) with clean engine oil and install.

(8) Install the valve springs (23) and retainers (22). Compress the springs and install the retainers (21).

(9) Coat the push rods (16) with clean engine oil and install in the block.

(10) Install the cylinder head (19) and secure with the washers (18) and bolts (17). Coat the threads of the bolts with a sealant. Refer to figure 5-41 and tighten as follows:

(a) Step 1. Tighten bolts in numerical order to 115 foot-pounds.

(b) Step 2. Retighten bolts in numerical order to 170 to 180 foot-pounds.

(c) Step 3. Retighten bolts in numerical order (hand torque only) to 170 to 180 foot-pounds.

(d) Step 4. Tighten bolts in alphabetical order to 22 foot-pounds.

(e) Step 5. Retighten bolts in alphabetical order to 27 to 37 foot-pounds.

(f) Step 6. Retighten bolts in alphabetical order (hand torque only) to 27 to 37 foot-pounds.

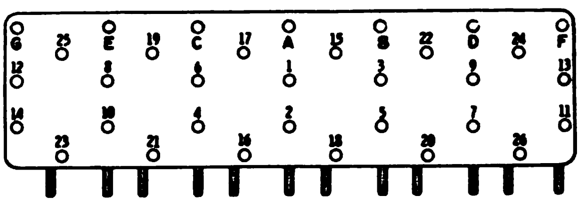

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Figure 5-41. Cylinder head bolts torque sequence.

(11) Install the washer (14, fig. 5-40), spring 13, washer (12), rocker arm (11), bracket (10), rocker arm (8) bushing (9), spring (7), washer (6) and ring (5) on the rocker arm shaft (15). Install the adjusting screw (4) and locknut (3).

(12) Secure the rocker arm assembly to the cylinder head using the washer (2) and bolt (1).

(13) Adjust the valve lash as instructed in TM 5-2410-233-20 and tighten the adjusting screw locknut (3).

(14) Install the glow plugs and the fuel injection lines (para 5-10).

(15) Install exhaust manifold (para 5-18), muffler (para 5-16), air cleaner (para 5-15), and exhaust pipe and hood (para 5-2).

(16) Service the cooling system as instructed in TM 5-2410-233-10.

(17) Start the engine (TM 5-2410-233-10). Ensure that the rocker arms are receiving lubricating oil.

(18) Operate the engine for approximately one hour (uner load if possible) to thoroughly warm up the engine and seat the head gasket.

(19) Shut down the engine and retighten the cylinder head bolts (table 1-2). Check and readjust the valve lash (TM 5-2410-233-20).

(20) Install the rocker arm cover (TM 5-2410-233-20).

5-28. Accessory Drive.

a. Removal.

(1) Remove the fuel transfer pump (para 5-13) and fuel filter housing.

(2) Remove the fuel injection pump housing and governor (para 5-11).

(3) Remove the accessory drive gear cover located on the front of the timing gear cover (fig. 5-42).

NOTE

The accessory drive shaft can be removed without removing the timing gear cover.

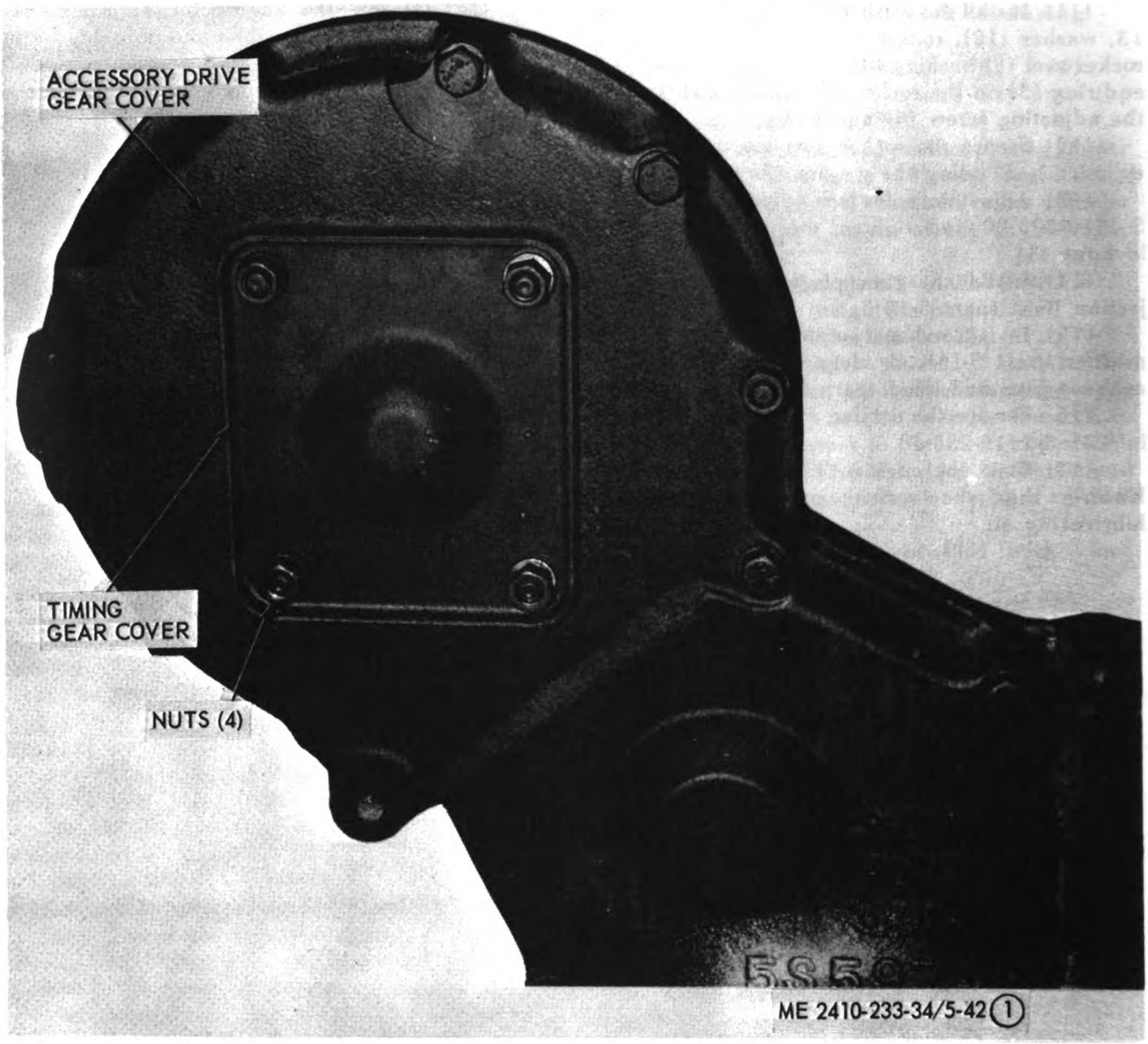


Figure 5-42. Accessory drive shaft, removal and installation (sheet 1 of 2).

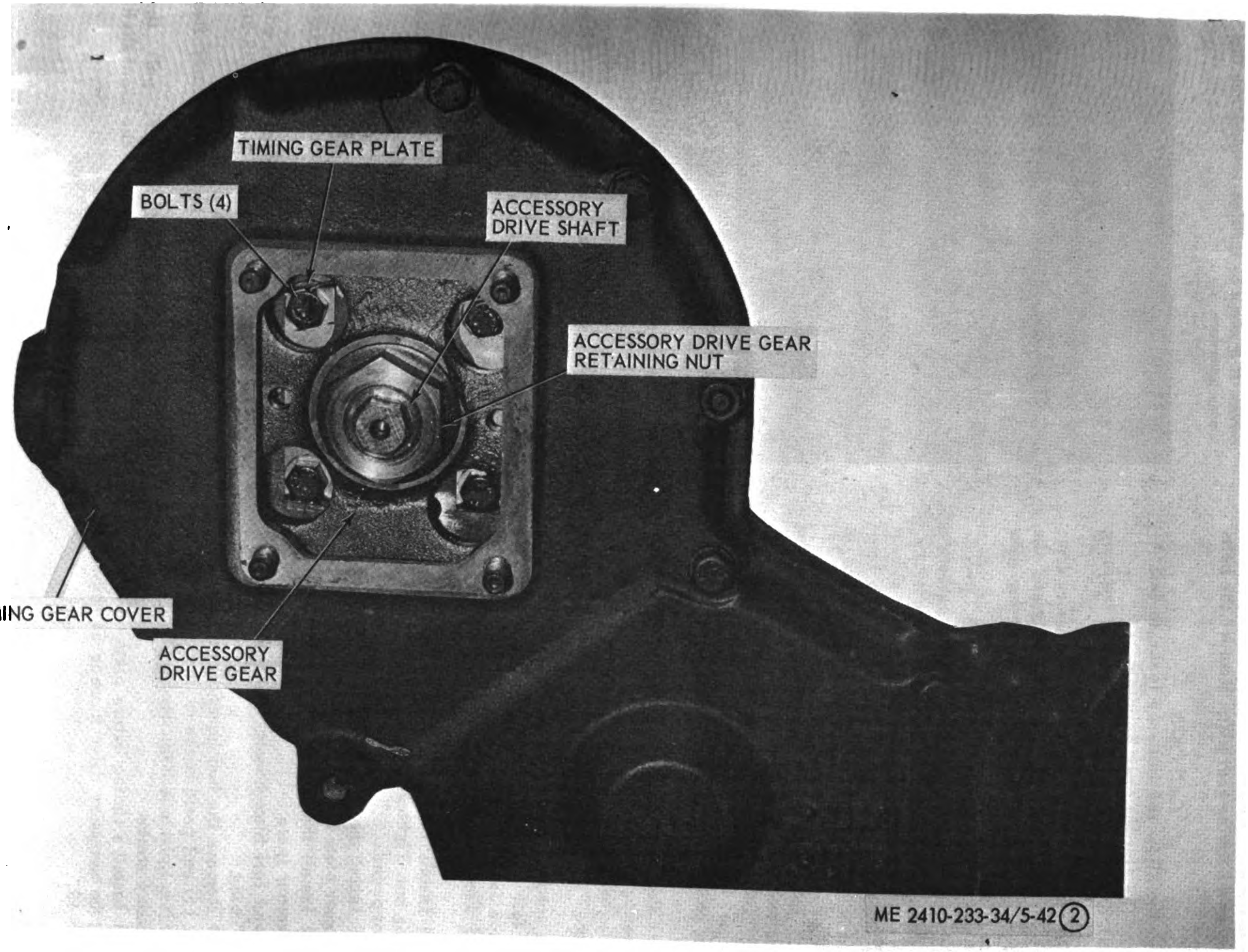


Figure 5-42. Accessory drive shaft, removal and installation (sheet 2 of 2).

(4) Position the accessory drive gear to allow access to the bolts which secure the accessory drive housing to the timing gear plate. Remove the bolts and locks.

CAUTION

Do not allow the bolts or locks to fall into the timing gear housing.

(5) Remove the accessory drive gear retaining nut.

(6) Install puller and push the accessory drive shaft until the gear comes off the shaft and the accessory drive is removed from the timing gear housing.

(7) Pull the bearing from the shaft.

(8) Discard the housing mounting gasket.

b. Cleaning, Inspection and Repair.

(1) Clean the shaft, cover and gear in solvent and dry with clean, lint-free cloths or with compressed air. Clean the bearing as instructed in paragraph 2-6.

(2) Inspect the gear for broken, damaged or missing teeth. Replace as necessary.

(3) Inspect the shaft for damage, distortion and wear. Inspect the bearing contact surface for uneven or excessive wear. Repair as required.

c. Installation.

(1) Press the bearing onto the shaft. Install the bearing retaining plate.

(2) Install the drive shaft into the timing gear housing.

CAUTION

Do not allow the bearing retaining plate to fall into the timing gear housing when installing the drive shaft.

(3) Time the accessory drive shaft (subpara *d*).

(4) Install the gear and secure with the retaining nut. Tighten the nut to a torque of 90 to 110 foot-pounds.

(5) Install the accessory drive housing to the timing gear plate and secure with bolts and locks.

(6) Install the fuel injection pump housing and governor (para 5-11). Install the fuel transfer pump and fuel filter housing (para 5-13).

d. Timing.

(1) Remove the fuel injection pump housing (para 5-11) and position the engine crankshaft so that the No. 1 piston is at top dead center (TDC) of compression stroke.

(2) Install a timing fixture plate on the rear face of the accessory drive housing as shown in figure 5-43.

NOTE

If the timing fixture plate can be installed, timing is correct. If it cannot be installed, continue with this timing procedure.

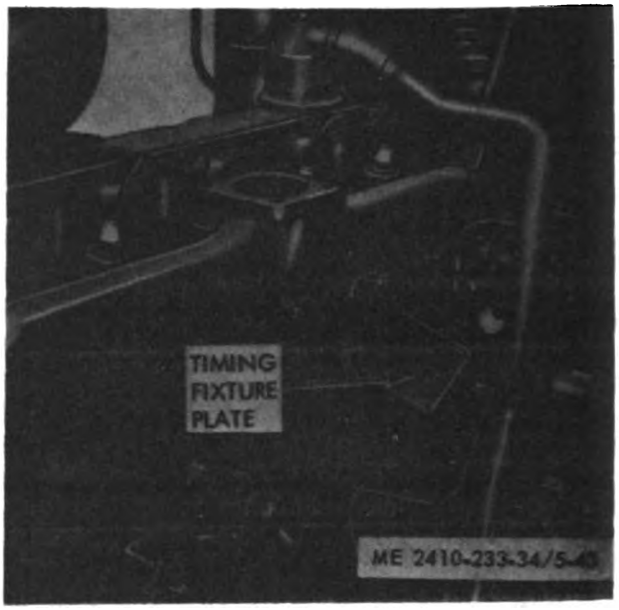


Figure 5-43. Timing fixture plate installed.

(3) Remove the small cover from the front of the timing gear housing (fig. 5-42). Remove the accessory drive gear retaining nut and washer.

(4) Separate the gear from the accessory drive shaft.

(5) Rotate the accessory drive shaft as necessary to permit installation of the timing fixture plate.

(6) Insert the shaft through the gear. Tighten the gear retaining nut to a torque of 90 to 110 foot-pounds and remove the timing plate. Install the fuel injection pump housing (para 5-11).

5-29. Timing Gears and Cover

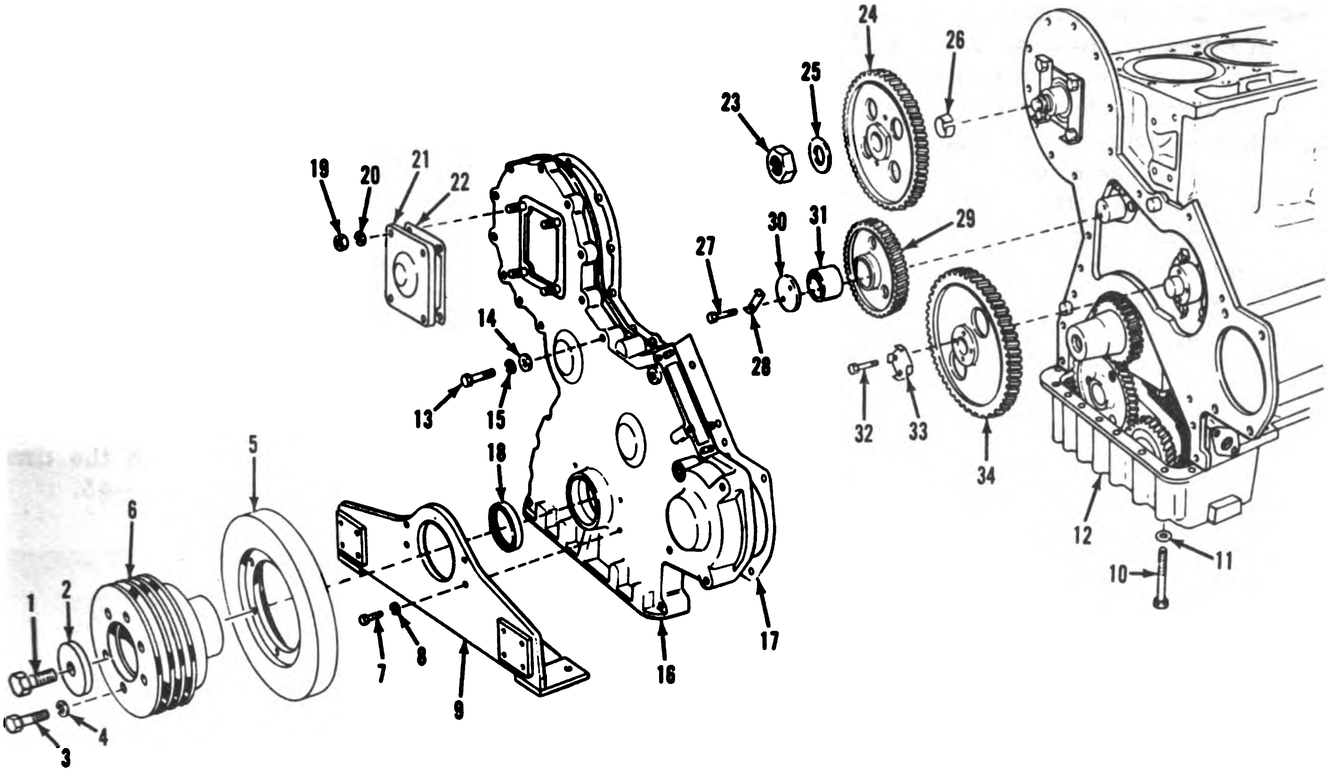
a. Removal and Disassembly (fig. 5-44).

(1) Remove the engine from the tractor (para 2-8), and block in position.

(2) Remove the water pump (para 5-6), and generator as instructed in TM 5-2410-233-20. Remove the fan belts (para 5-5).

(3) Loosen the bolt (1) approximately five turns.

(4) Using a hydraulic puller, pull the crankshaft pulley assembly from the crankshaft.



ME 2410-233-34/5-44

1	Bolt	18	Seal
2	Washer	19	Nut
3	Bolt	20	Washer
4	Lockwasher	21	Cover
5	Vibration damper	22	Gasket
6	Pulley	23	Nut
7	Bolt	24	Accessory drive gear
8	Lockwasher	25	Washer
9	Support	26	Retainer
10	Bolt	27	Bolt
11	Lockwasher	28	Lock
12	Oil pan	29	Accessory drive idler gear
13	Bolt	30	Plate
14	Washer	31	Spacer
15	Lockwasher	32	Bolt
16	Timing gear cover	33	Lock
17	Gasket	34	Camshaft gear

Figure 5-44. Timing gears and cover, exploded view.

(5) Remove the bolt (1) and washer (2) and remove the pulley assembly. Remove six bolts (3) and lockwashers (4) and separate the vibration damper (5) from the pulley (6).

(6) Remove four bolts (7) and lockwashers (8) and remove the front support (9).

(7) Remove the bolts (10) and lockwashers (11) which secure the oil pan (12) to the timing gear cover. Loosen the remaining bolts which secure the oil pan to the cylinder block. Using a thin knife or screwdriver, carefully separate the oil pan and gasket from the timing gear cover.

b. Inspection and Repair.

(1) Inspect the timing gear cover for chips, cracks, and other damage and for distortion. Repair as required.

(2) Inspect the timing gears for broken or missing teeth, excessive or uneven wear and cracks, chips and other damage. Repair or replace as required.

(3) Inspect the seal (item 18, fig. 5-44) for damage and deterioration and replace if necessary.

(4) Inspect the crankshaft pulley and vibration damper for damage and wear. Repair or replace as required.

c. Reassembly and Installation (fig. 5-44).

(1) Heat the camshaft gear (34) and install on the camshaft. Align the timing marks (subpara *e*). Secure with four camshaft gear retaining bolts (32) and the lock (33). Check the gear backlash (subpara *f*).

(2) Install the plate (30), spacer (31), and accessory drive idler gear (29). Secure with two bolts (27) and locks (28).

(3) Install the washer (25), retainer (26), and the accessory drive gear (24) on the accessory drive shaft. Align the timing mark on the gear with the timing mark on the idler gear (28). Refer to subparagraph *e*. Install the retaining nut (23) and tighten to a torque of 90 to 110 foot-pounds.

(4) Install a new mounting gasket (17). Install the timing gear cover (16) to the engine block and plate, and secure with bolts (13), washers (14) and lockwashers (15).

(5) Install the bolts (10) and lockwashers (11) which secure the oil pan (12) to the timing gear cover. Tighten the remaining bolts which secure the oil pan to the cylinder.

(6) Install a new seal (18) in the timing gear cover (16) if the old seal was removed. Using a sleeve to protect the seal, install the seal with the spring-loaded lip toward the cylinder block.

(7) Install the front support (9), securing with four bolts (7) and lockwashers (8).

(8) Press on the pulley (6) and secure with the bolt (1) and washer (2). Tighten the bolt to a torque of 210 to 250 foot-pounds. Tap the pulley with a soft hammer and retighten to the same torque.

(9) Install the vibration damper (5) to the pulley (6) and secure with six bolts (3) and lockwashers (4).

(10) Install the cover (21) and a new gasket (22) and secure with four nuts (19) and washers (20).

(11) Install the water pump (5-6), fan belts (5-5) and generator (TM 5-2410-233-20).

(12) Install the engine (para 2-8).

d. Timing Mark Alignment.

(1) Remove the timing gear cover (subpara *a*, above).

(2) Rotate the crankshaft in the direction of engine rotation until the No. 1 piston is at top dead center on the compression stroke and the timing marks are matched. Refer to figure 5-45.

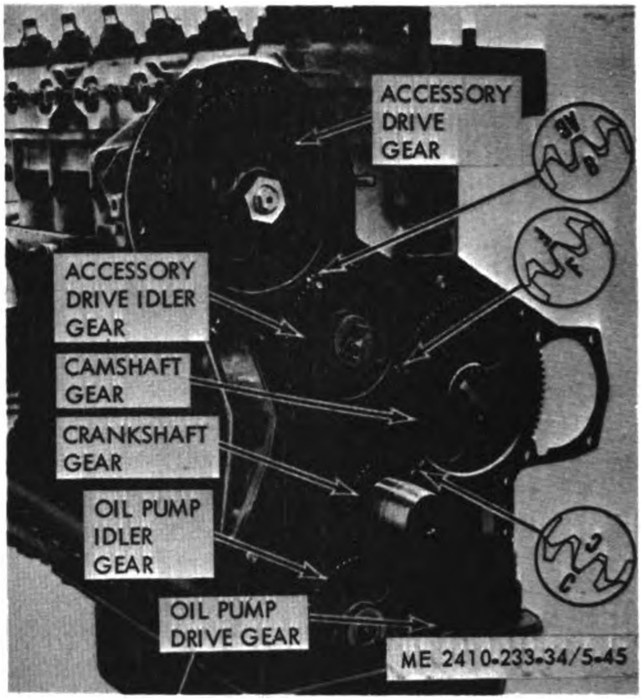


Figure 5-45. Timing gears and marks.

(3) If the timing marks are not properly aligned, remove and reinstall the gears as necessary.

e. Checking Camshaft Gear Backlash.

(1) Check the backlash between the camshaft gear and the crankshaft gear by installing a dial indicator. Backlash should be 0.001 to 0.010 inch.

(2) If backlash is excessive, check for worn timing gears, bearings or camshaft bearings (para 5-27).

(3) Compensate for worn timing gears by adjusting the fuel injection pump lifters (para 5-11).

(4) If the backlash measurement is low, check for a burr or rough spot on one of the gears and smooth as required.

5-30. Camshaft

a. Removal and Disassembly (fig. 5-46).

(1) Remove the engine from the tractor (para 2-8).

(2) Remove the pushrods (para 5-27) and lift the valve lifters clear of the camshaft.

(3) Remove the timing gear cover (para 5-29).

(4) Remove two bolts and the washer and pull the camshaft and camshaft gear from the block. Be careful not to damage the camshaft bearings.

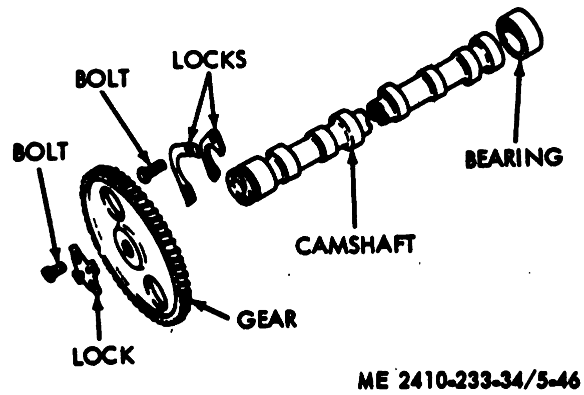


Figure 5-46. Camshaft assembly, exploded view.

(5) Remove four bolts and the lock and pull the gear from the camshaft.

(6) If camshaft bearings are to be removed, remove the flywheel housing (para 5-31) and press the bearings out of the block.

b. Cleaning.

(1) Clean the camshaft thoroughly with cleaning solvent (Fed. Spec. P-D-680). Blow out the oil holes with compressed air. Dry with clean, lint-free cloths or with compressed air.

(2) Clean bearings as instructed in paragraph 2-6.

c. Inspection and Repair.

(1) Using a magnetic particle technique, inspect the camshaft for cracks. Replace if any cracks are detected.

(2) Inspect the camshaft for roughness, scoring, scratches, grooves or wear. Replace if worn or damaged. Measure the camshaft bearing surfaces using a micrometer. If any diameter is less than 1.40 inches, replace the camshaft.

(3) Inspect the camshaft bearings for wear and surface damage. Repair if possible or replace bearings as required.

(4) Inspect the camshaft gear for broken teeth, cracks, scratches, scoring and wear. Repair or replace as required.

d. Reassembly and Installation.

(1) Install the camshaft bearings in the cylinder block. Align the oil holes in the front bearing with the oil hole in the block. Install the front and rear bearings so that there is a ⅛-inch clearance between the cylinder block and the bearing.

(2) Install the flywheel housing, if removed (para 3-31).

(3) Install the gear to the camshaft. Secure with the lock and four bolts.

(4) Install the camshaft and camshaft gear in the block and secure with the washers and two bolts.

(5) Check the camshaft gears backlash (para 5-29).

(6) Check the camshaft end clearance (subpara *e*).

(7) Install the timing gear cover (para 5-29) and the pushrods (para 5-27).

(8) Install the engine in the grader (para 2-8).

e. Checking Camshaft End Clearance.

(1) Push the washer forward against the camshaft gear.

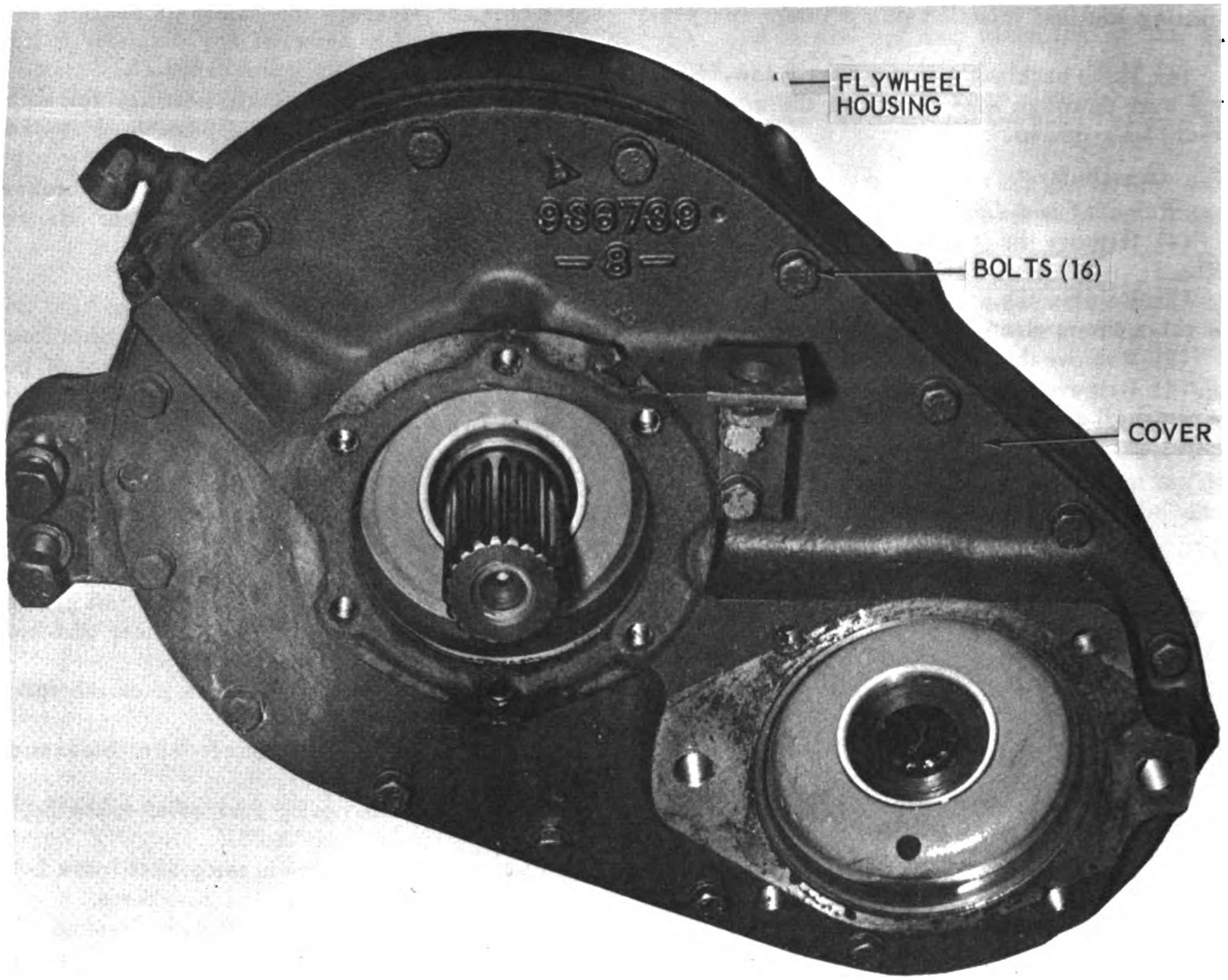
(2) Using a thickness gage, measure the distance between the washer and the end of the camshaft bearing journal. The clearance should be 0.004 to 0.010 inch and must not exceed 0.025 inch.

5-31. Power Take-Off Drive Gears and Bearings

a. Removal.

(1) Remove transmission oil pump, winch hydraulic pump, and bulldozer hydraulic pump (TM 5-2410-233-20).

(2) Remove bolts (fig. 5-47) and remove cover from flywheel housing. Remove the thrust washers from the cover assembly.



ME 2410-233-34/5-47

Figure 5-47. Power takeoff cover, removal and installation.

(3) Remove two drive gears (fig. 5-48) from flywheel housing; pull each gear shaft from flywheel housing bearing.

(4) Remove the bearings from cover assembly (fig. 5-49) and the bearings and thrust washers from the flywheel housing.

NOTE

If idler gear and drive gear on crankshaft are to be removed, it will be necessary to remove the flywheel (para 5-32).

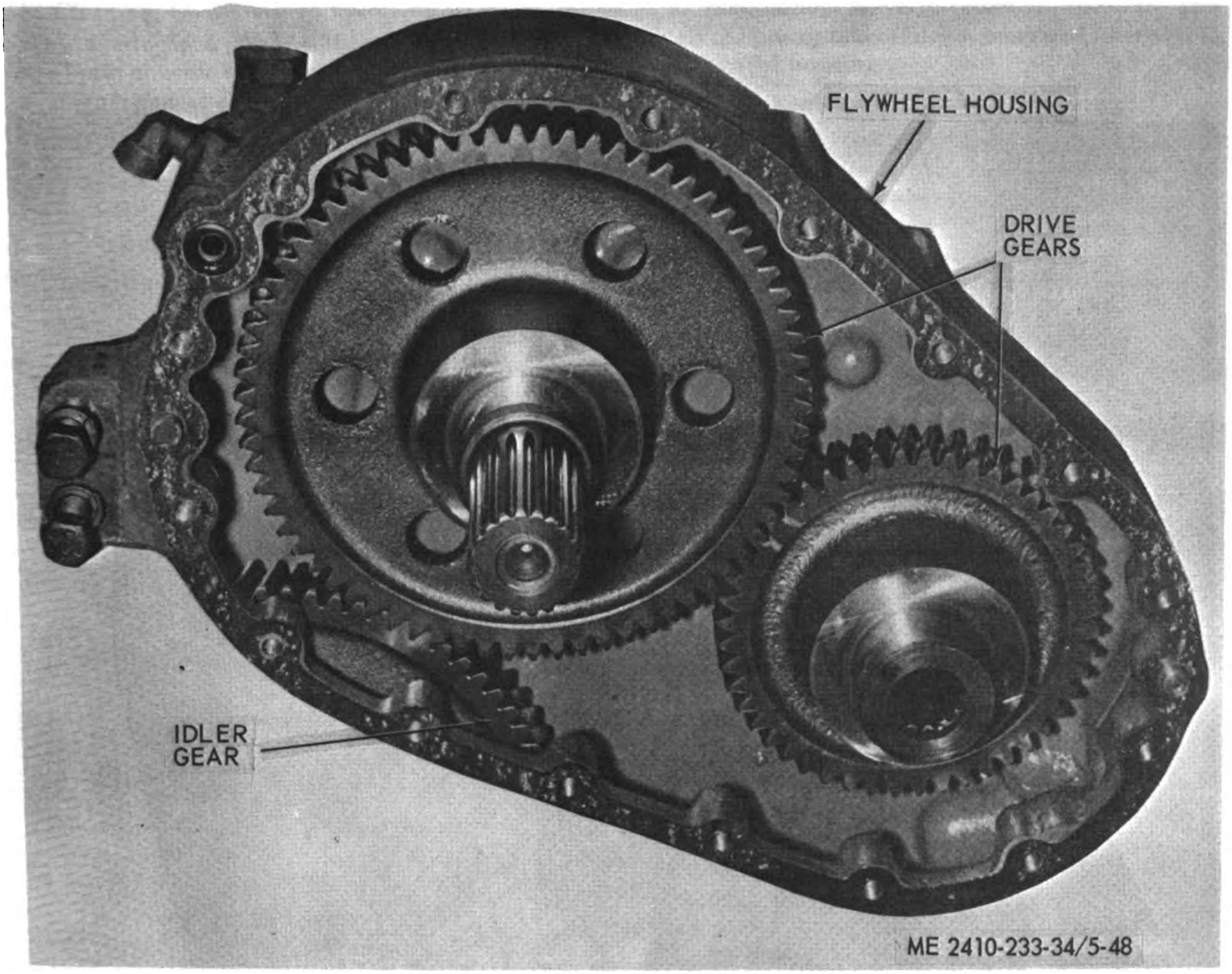


Figure 5-48. Power takeoff drive gears.

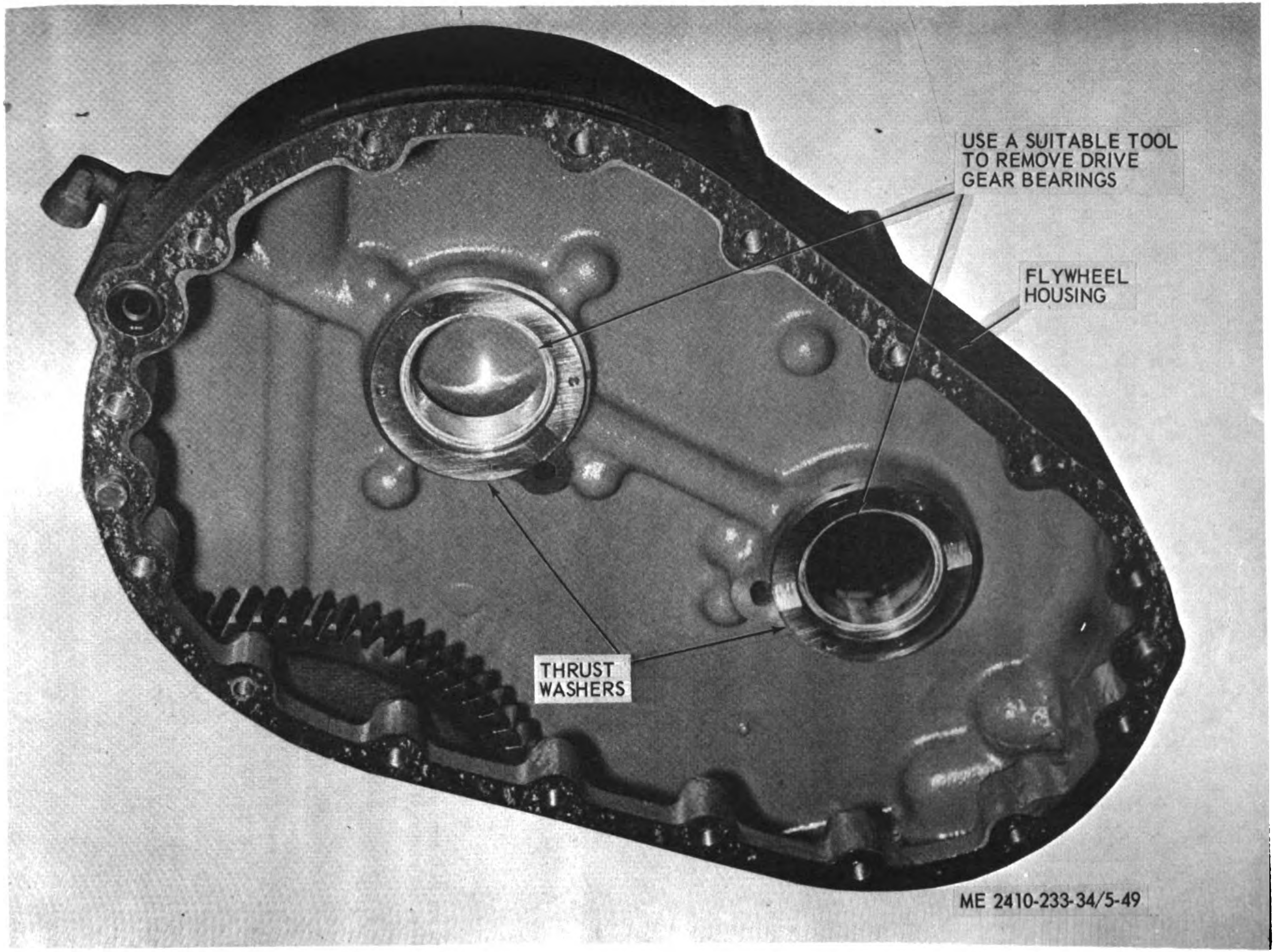


Figure 5-49. Removing power takeoff drive gear bearings.

b. Cleaning. Clean all components in cleaning solvent (Fed. Spec. P-D-680). Dry with compressed air or with soft, lint-free cloths.

c. Inspection and Repair.

(1) Inspect power take-off cover for chips, cracks, and other damage and for distortion. Repair or replace as required.

(2) Inspect the drive gears for broken or missing teeth, excessive or unevern wear and cracks, chips, and other damage. Repair or replace as required.

(3) Inspect the bearings and thrust washers for excessive or uneven wear, cracks, pitting or other damage. Replace all defective parts.

d. Installation. Reverse removal procedure and install the power takeoff drive gears and bearings in the flywheel housing.

5-32. Flywheel and Flywheel Housing

a. Removal and Disassembly.

(1) Remove the engine from the tractor (para 2-8), and block in position.

(2) Remove the starting motor as instructed in TM 5-2410-233-20.

(3) Remove power takeoff drive gears, bearings and cover (para 5-31).

(4) Remove torque divider (para 6-3).

(5) Remove all but one of the flywheel retaining bolts (fig. 5-50). Install a ⅝ inch — 18NF guide bolt in the crankshaft.

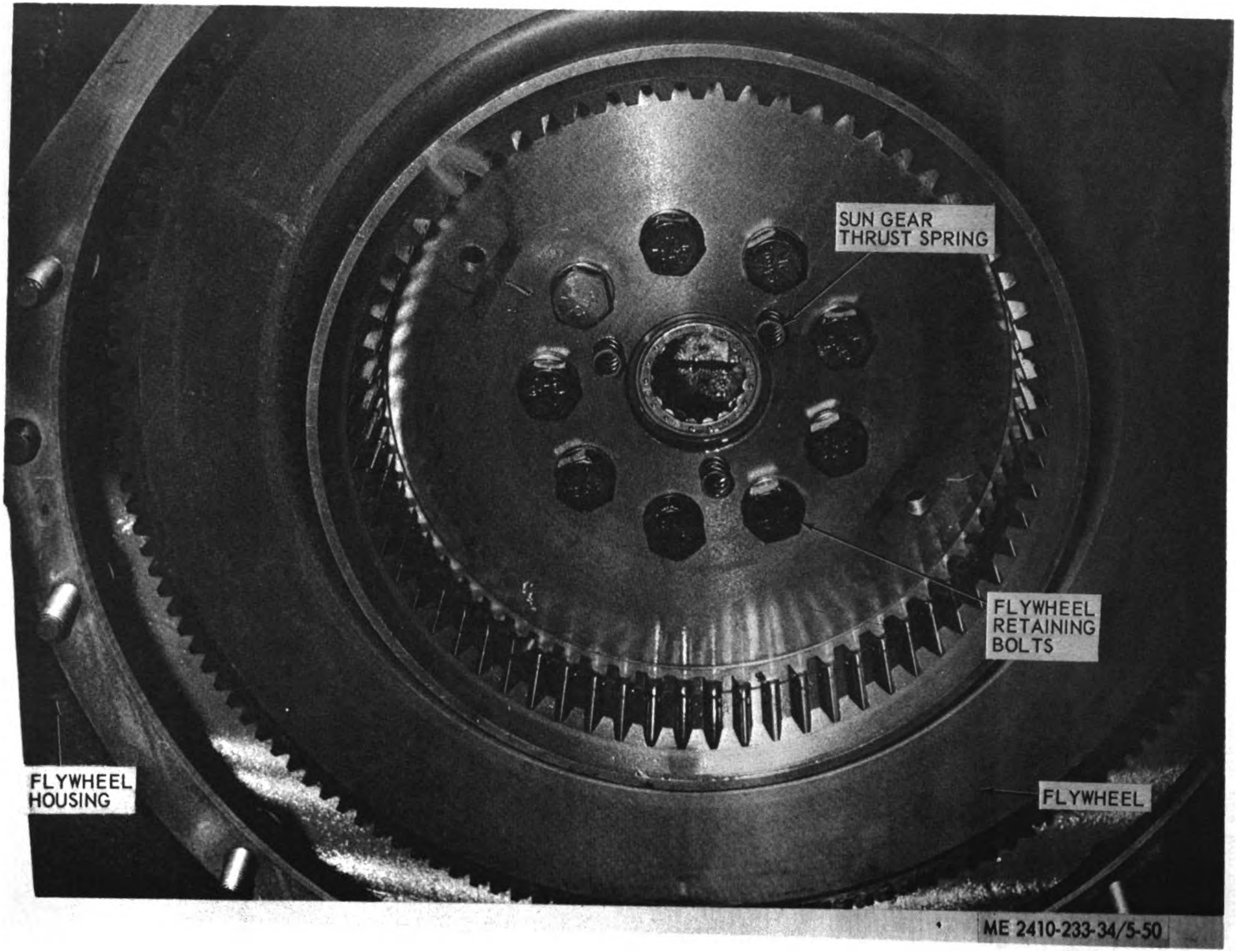


Figure 5-50. Flywheel, removal and installation.

(6) Install a ½ inch — 13NC forged eyebolt in the flywheel. Attach a hoist and remove the flywheel.

CAUTION

Keep the flywheel level during removal in order to prevent gear from falling off front of flywheel (fig. 5-51).

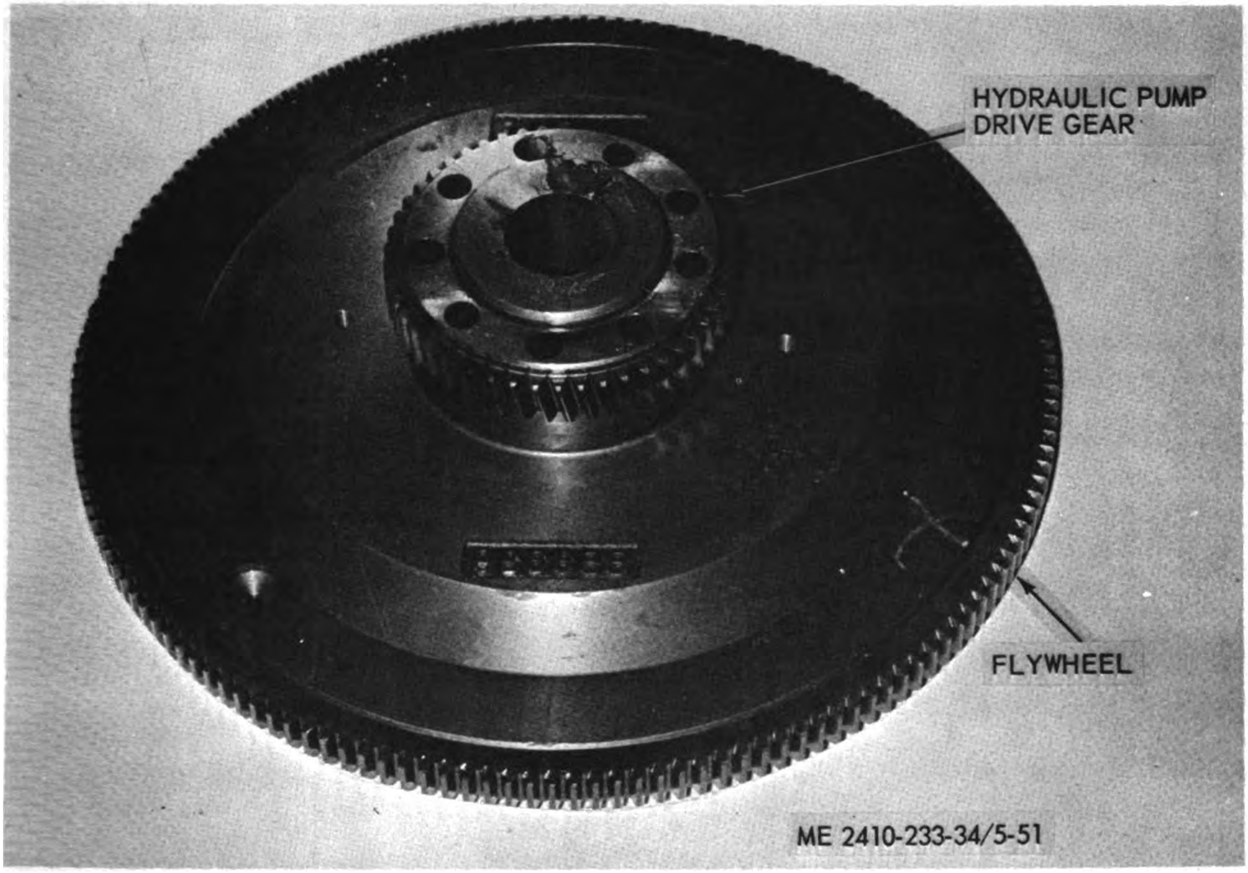


Figure 5-51. Flywheel and hydraulic pump drive gear.

(7) Remove the hydraulic pump drive gear from front of flywheel.

(8) Remove the oil pan plate (para 5-24).

(9) Remove transmission oil pump (TM 5-2410-233-20).

(10) Remove the hydraulic pump drive idler gear retaining bolts (fig. 5-52) and lock. Remove the idler gear and shaft.

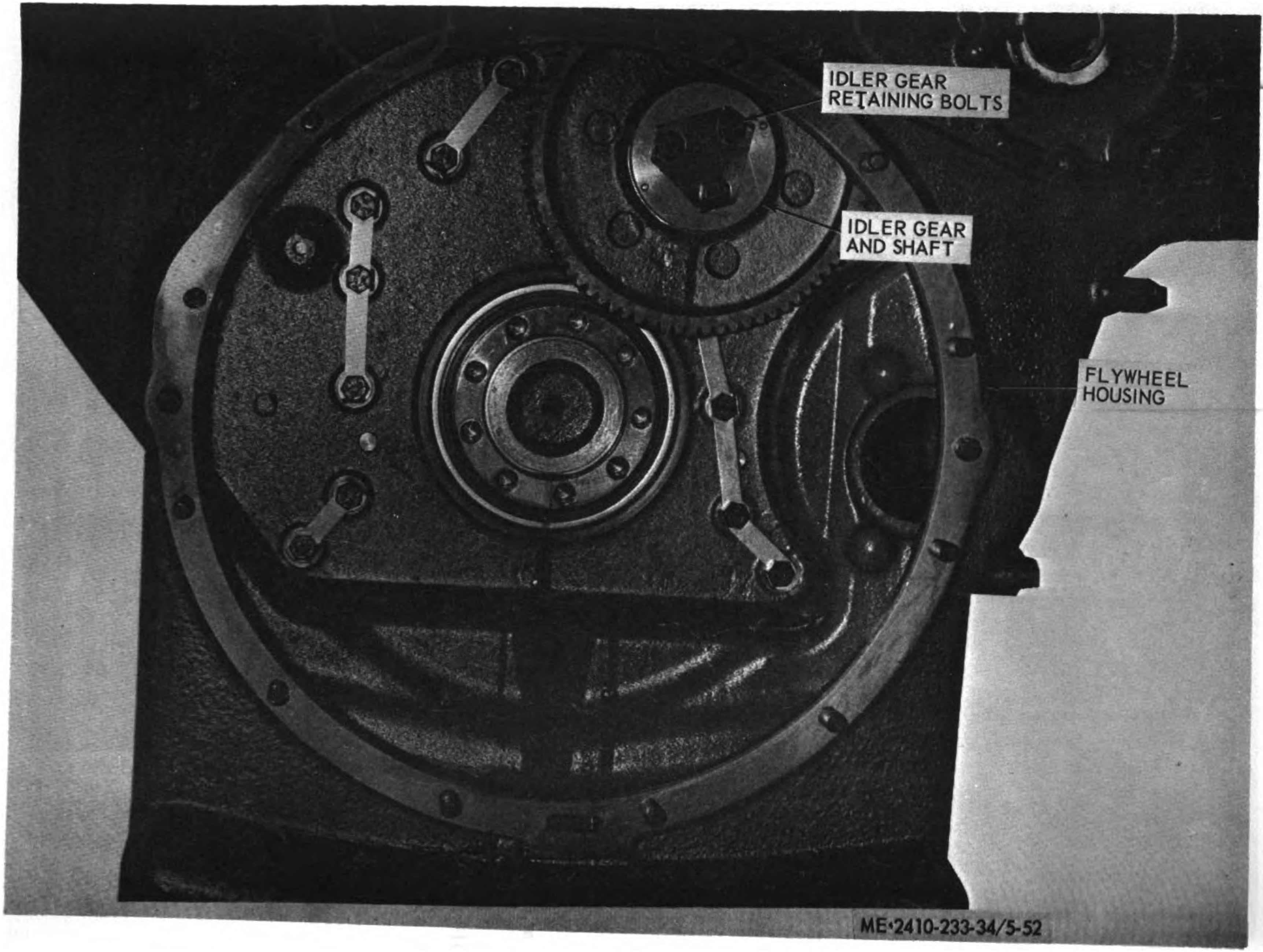


Figure 5-52. Hydraulic pump idler gear, removal and installation.

(11) Loosen the bolts which secure the oil pan plate to the cylinder block (para 5-25).

(12) If the engine is being supported by the oil pan and oil pan plate, raise the cylinder block and insert two ¼ inch shims between the cylinder block and oil pan at the rear of the engine. Be careful not to damage the oil pan plate gasket.

(13) Attach a hoist to the flywheel housing, and remove the flywheel housing mounting bolts (fig. 5-53). Remove the flywheel housing and discard mounting gasket.

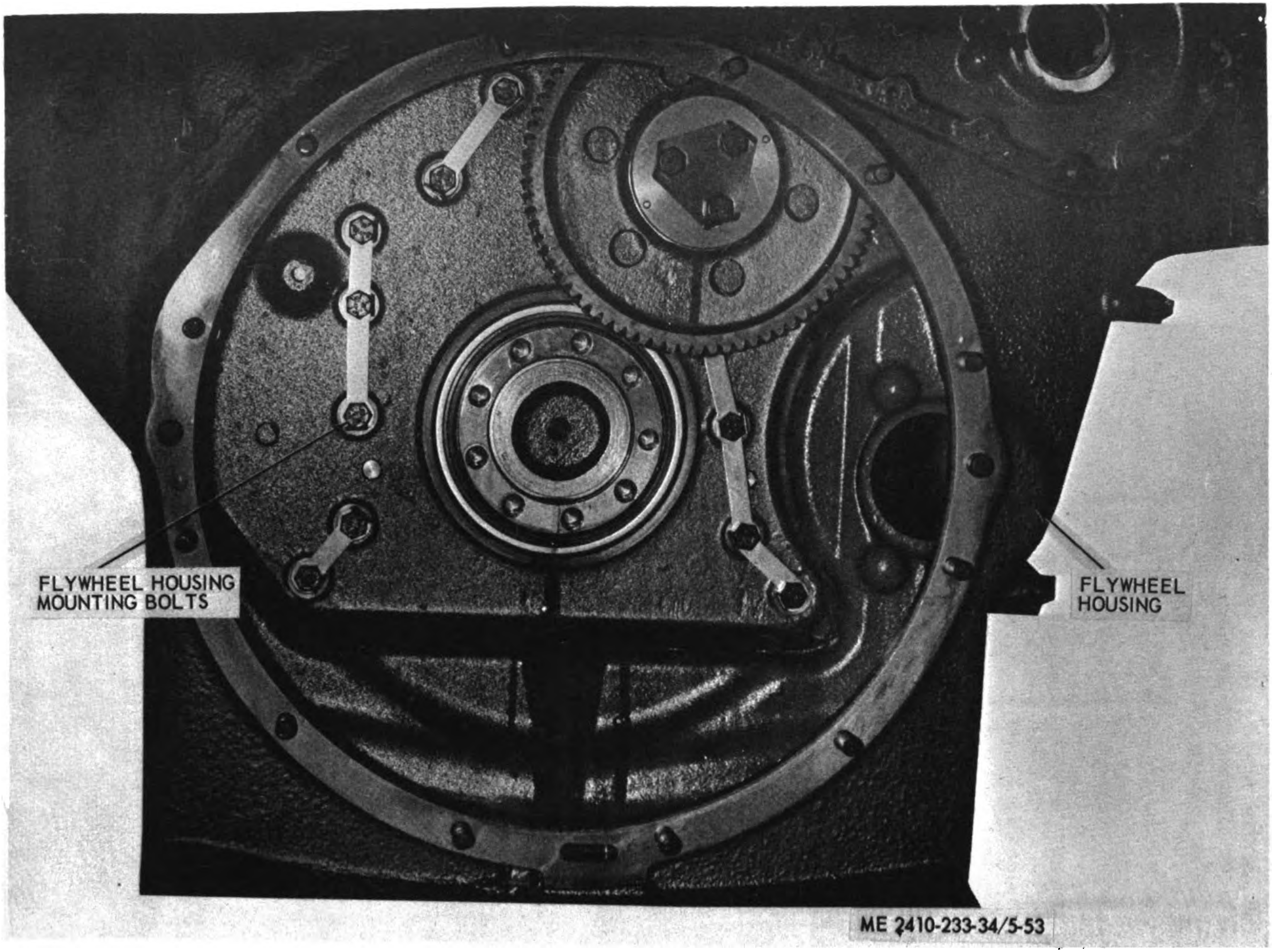


Figure 5-53. Flywheel housing, removal and installation.

b. Cleaning. Clean all components in cleaning solvent (Fed. Spec. P-D-680). Dry with clean, lint-free cloths.

c. Inspection and Repair.

(1) Inspect the housing for nicks, chips, cracks, weld damage and other damage. Repair or replace if necessary.

(2) Inspect the ring gear for damaged or missing teeth. Replace if defective.

(3) Check the flywheel housing runout (subpara *d*) and flywheel runout (subpara *e*). Repair or replace as necessary.

d. Checking Flywheel Housing Runout. Mount a dial indicator to the flywheel housing as shown in figure 5-54. Total runout must not exceed 0.010 inch.

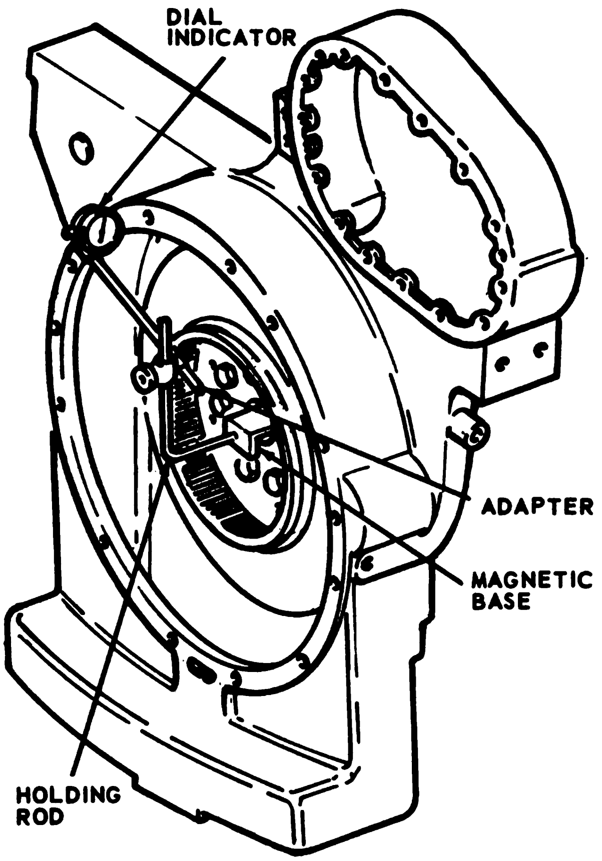


Figure 5-54. Checking flywheel housing runout.

e. Checking Flywheel Runout. Mount a dial indicator to the flywheel bore as shown in figure 5-55 and check the runout. Total runout must not exceed 0.006 inch.

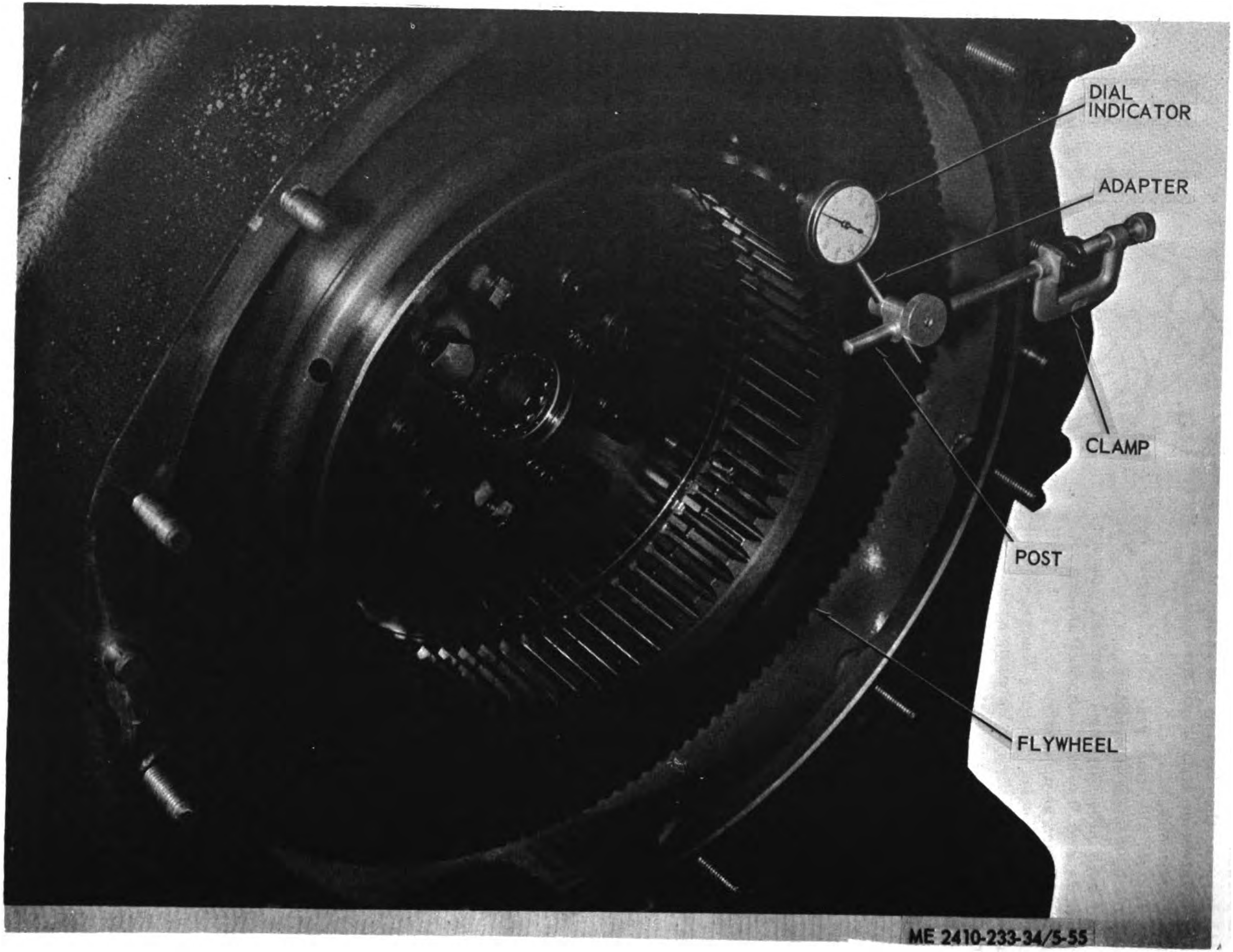


Figure 5-55. Checking flywheel runout.

f. Reassembly and Installation.

(1) Install a new mounting gasket and the flywheel housing (fig. 5-53). Secure with locks and the retaining bolts. Tighten the bolts to a torque of 65 to 85 foot-pounds.

(2) Tighten the bolts which secure the oil pan and oil pan plate to the engine block and flywheel housing.

(3) If removed, heat the ring gear (fig. 5-51) to not more than 600°F and install on the flywheel. The chamfered side of the gear teeth should face the starter pinion when the flywheel is installed.

(4) Insert one ⅝ in.—18NF guide pin into the flywheel housing and install the flywheel (fig. 5-50). Secure with lock and retaining bolts. Tighten the retaining bolts to a torque of 130 to 170 foot-pounds.

(5) Install the torque divider (para 6-3).

(6) Install winch, bulldozer and transmission hydraulic pumps and power take-off drive gears, bearings and cover on the flywheel housing (para 5-31).

(7) Install the starting motor on the flywheel housing (TM 5-2410-233-20).

(8) Install the engine in the tractor (para 2-8).

5-33. Pistons, Connecting Rods and Cylinder Liners

a. Removal and Disassembly (fig. 5-56).

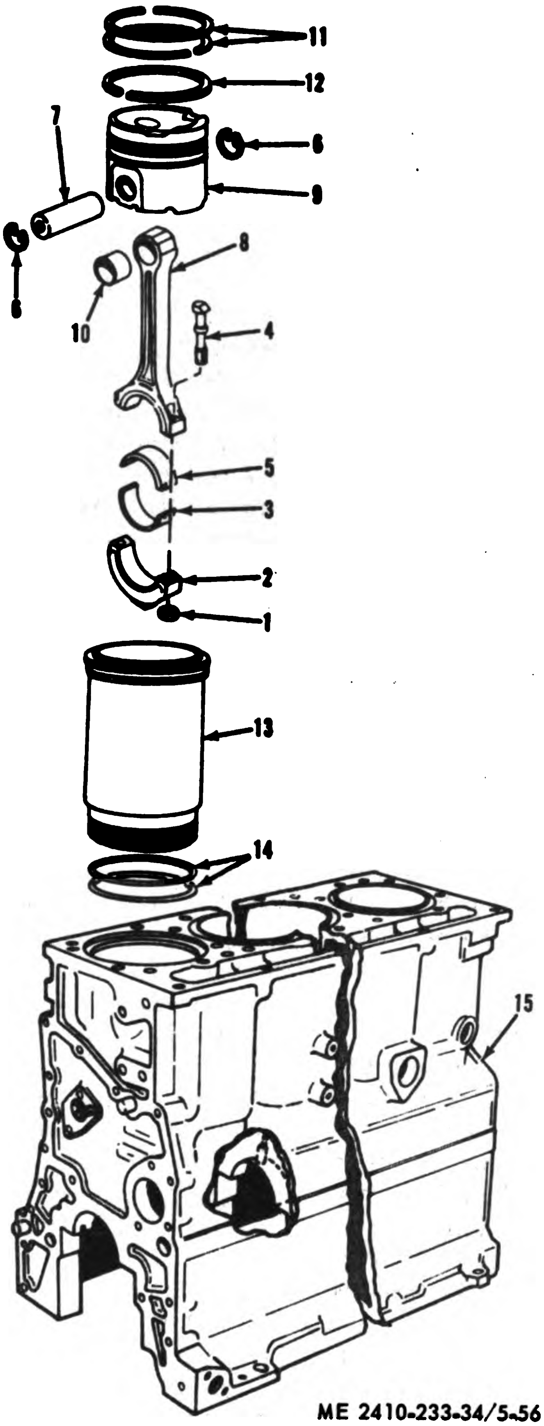
(1) Drain the engine lubricating oil and coolant (TM 5-2410-233-10).

(2) Remove the cylinder head and valves (para 5-27).

(3) Remove carbon deposits from the inside top surfaces of the cylinder liner.

(4) Remove the cylinder block inspection covers or the oil pan to gain access to the connecting rod bearings (3 and 5). Turn the crankshaft until the nuts (1) are accessible.

(5) Remove the nuts (1) from the bolts (4) and remove the cap (2) and bearing lower half (3). Rotate the crankshaft and remove the bolts (4) and upper bearing half (5).



1 Nut
2 Cap
3 Bearing lower half
4 Bolt
5 Bearing upper half
6 Retaining ring
7 Piston pin
8 Connecting rod
9 Piston
10 Bearing
11 Piston ring
12 Piston ring
13 Liner
14 Ring
15 Block

Figure 5-56. Piston and connecting rod, exploded view.

(6) Rotate the crankshaft to place the piston to be removed at top dead center. Push the connecting rod upward until the piston rings are out of the cylinder. Lift out the piston and connecting rod assembly.

(7) Remove the piston pin retaining rings (6) from the piston pin (7) and press out the piston pin. Separate the connecting rod (8) from the piston (9). Remove the bearing (10) from the connecting rod (8) if replacement is necessary.

(8) Using a piston ring expander, remove the piston rings (11 and 12) from the piston (9).

CAUTION

Cover the crankshaft and main bearings before removing the sleeves. Sediment from the block could damage the crankshaft and bearings.

(9) Using a liner puller assembly and an adapter plate, remove the liner (13) from the block (15). Discard the rings (14).

b. Cleaning. Clean all components except pistons with cleaning solvent (Fed. Spec. P-D-680) and dry with clean, lint-free cloths. Remove carbon deposits from pistons with fresh, cold water. Soak the pistons in water overnight and allow to dry in sunlight. Ensure that ring grooves are clean.

c. Inspection and Repair.

(1) Inspect connecting rod bearings for burrs and rough spots. Light scratching will not impair operation. Smooth minor roughness with a soft hone or crocus cloth. Replace very rough bearings. If one bearing must be replaced, replace all bearings if possible.

(2) Replace bent connecting rods.

(3) Press the piston pin into position into the bearing. Measure the clearance. Replace the pin and bearing if clearance exceeds 0.004 inch.

(4) Inspect the piston pin for cracks, score marks or pitting. Discard the pin if surfaces are dull, rough or checked by acid corrosion.

(5) Inspect the bearing liners for wear, scratches, pitting and metal failure. Replace as required.

(6) Inspect the piston for grooves, scoring, pitting and other damage and for wear. Replace piston if surface damage is excessive.

(7) Inspect the cylinder sleeve for scratches, scoring, grooving and wear. Measure the inside diameter using a micrometer. Replace the sleeve if diameter exceeds 4.758 inch at any point.

d. Reassembly and Installation (fig. 5-56).

(1) Ensure that the engine block is clean.

(2) Install new rings (14) on the cylinder liner (13).

(3) Carefully lower the liner into the cylinder block. Drive into place until the liner bottoms.

NOTE

The liner should protrude 0.0020 to 0.0056 inch above the face of the cylinder block.

(4) Press the bearing (10) into place in the connecting rod (8). Secure the piston (9) to the connecting rod using the piston pin (7). Install the retaining rings (6).

(5) Using a piston ring expander, install the piston rings (11 and 12) in their grooves. Install the middle ring with the "top" mark up.

(6) Oil the piston and rings. Place the piston and connecting rod assembly in the cylinder liner. Use a piston ring compressor to aid in installation. Position the V-mark on top of the piston so that it is aligned with the V-mark on the block.

(7) Install the bearing upper half (5), bearing lower half (3) and cap (2). Secure with bolt (4) and nut (1). Lubricate the threads with crankcase oil and tighten to a torque of 27 to 33 foot-pounds. Then tighten an additional 85 to 95 degrees.

(8) Install the cylinder block inspection covers or the oil pan, if removed.

(9) Install the cylinder head and valves (para 5-27).

(10) Service the engine lubricating system and cooling system. Refer to TM 5-2410-233-10.

5-34. Crankshaft and Main Bearings

a. Removal and Disassembly.

(1) Remove the engine from the tractor. Refer to paragraph 2-8. Place the engine on a suitable work stand.

(2) Remove the water pump (para 5-6). Remove the timing gear cover (para 5-29) and the flywheel and housing (para 5-32).

(3) Place the engine on its side and remove the oil pan and oil pan plate (para 5-25) and the oil pump (para 5-24).

(4) Remove the connecting rod bearings and caps (para 5-33). Push the piston and rod assemblies upward into the cylinders to clear the crankshaft.

(5) Wrap a heavy cloth around the number two and five connecting rod bearing sufaces on the crankshaft.

(6) Place a cable around the cloth and attach a hoist to the cable. Tighten the cable just enough to prevent the crankshaft from moving when the main bearing caps are removed.

(7) Remove the bolts and washers that secure the bearing caps to the block. Refer to figure 5-57.

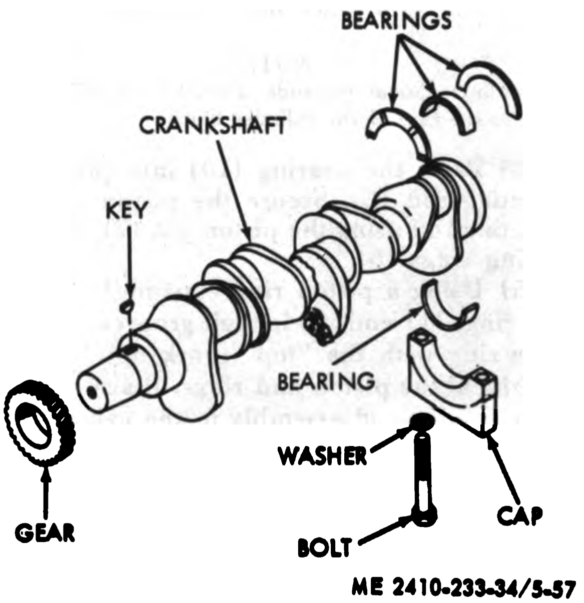


Figure 5-57. Crankshaft and main bearings.

(8) Grasp the bearing cap at the recessed portion and pull outward. Tap the cap lightly with a soft hammer to aid in removal.

NOTE
Mark the upper and lower bearing caps for location.

(9) Place a main bearing removal tool in the drilled oil hole of the crankshaft journal. Rotate the crankshaft and roll out the bearing upper half. Roll out the bearing tab end first. Remove the liners from the bearings.

(10) Cover the bearing cap studs with rubber hose or cloth to protect the crankshaft when it is removed.

(11) Lift the crankshaft from the engine. Lubricate and wrap the bearing surfaces.

(12) Using a hydraulic puller, pull the crankshaft gear from the crankshaft. Remove the key.

b. Cleaning. Clean the crankshaft and bearings with cleaning solvent (Fed. Spec. P-D-680) and dry with clean, lint-free cloths. Clean the oil holes in the block and ensure that the block is clean.

c. Inspection and Repair.

(1) Inspect the bearing caps for burrs and high spots. Smooth surfaces with a soft hone or crocus cloth. Scratches on the bearing surfaces will not impair operation. Replace bearings if the surface is excessively rough and abrasive. If one bearing is replaced, replace all bearings if possible.

(2) Check the main bearing journals with a micrometer for out-of-round condition or excessive wear. If crankshaft journals are worn more than 0.008 inch, grind the journals with precision equipment, checking diameter frequently with a micrometer. Grind the journals undersize 0.030 inch. At installation use undersize main and connecting rod bearings.

(3) After grinding, clean the crankshaft thoroughly. Check for runout with a dial indicator. If crankshaft runout exceeds 0.008 inch, replace the crankshaft.

(4) Inspect the crankshaft gear for cracks, broken teeth, burrs, scoring and wear. Remove burrs and light scoring with a soft hone or crocus cloth or replace the gear if necessary.

d. Reassembly.

(1) Position the key in the crankshaft. Using a hydraulic pump, press the crankshaft gear onto the crankshaft.

(2) Install the crankshaft in the block. Align the crankshaft gear as instructed in paragraph 5-29.

(3) Install the bearing liners and lubricate the inside surfaces of the bearings. Rotate the upper bearings into position in the reverse order of removal. Ensure that bearings are installed in the same positions they were removed from.

(4) Install the lower bearing caps and secure with nuts. Tighten the nuts to a torque of 155 foot-pounds.

(5) Check the bearing clearance (subpara *e*) and the crankshaft end clearance (subpara *f*).

(6) Install the oil pump (para 5-24) and oil pan and oil pan plate (para 5-25). Install the flywheel and housing (para 5-32) and timing gear cover (para 5-29). Install the water pump (para 5-6).

(7) Install the engine in the tractor (para 2-8).

e. Main Bearing Clearance Check.

NOTE
If bearing clearance is checked while the crankshaft is installed and the engine is upright, hold the crankshaft against the upper halves of the bearings.

(1) Place a soft lead wire between the lower bearing half and the crankshaft. Coat two 1-inch lengths of the wire with grease and place them diagonally on the bearing. The grease will hold the wires in position.

(2) Turn the crankshaft one complete revolution.

(3) Remove the bearing cap and measure the thickness of the compressed wire using a micrometer. Clearance should be 0.0030 to 0.0059 inch. Replace bearings if the proper clearance is not obtained.

f. Crankshaft End Clearance Check.

(1) Push the crankshaft as far as it will go to one end of the cylinder block.

(2) Using a thickness gage, measure the clearance between the machined face of the crankshaft flange and the flange of the lower half of

the rear main bearing. End clearance should be 0.0025 to 0.0145 inch.

5-35. Cylinder Block

a. Removal and Disassembly.

(1) Remove the engine from the tractor (para 2-8).

(2) Remove the water pump (para 5-6), generator (TM 5-2410-233-20) and fuel transfer pump (para 5-13).

(3) Remove the fuel injection pump (para 5-11), transmission oil cooler (TM 5-2410-233-20), oil pump (para 5-24) and oil pan and oil pan plate (para 5-25).

(4) Remove the timing gears and cover (para 5-29), flywheel and flywheel housing (para 5-32), cylinder head and valves (para 5-27), pistons, connecting rods and cylinder liners (para 5-33), crankshaft (para 5-34) and camshaft (para 5-30).

(5) Remove the inspection covers from the block.

b. Cleaning. Steam-clean the block. Wipe with a cloth dampened with solvent. Remove all corrosion and scale from water jackets and passages using high pressure water and steam. Flush oil passages with water and dry with compressed air.

c. Inspection and Repair.

(1) Inspect threaded holes for damage. Chase with a tap or die if damaged.

(2) Inspect the block thoroughly for cracks, wears, signs of strain or other damage. Replace block if damage cannot be repaired by welding or minor machining.

(3) Inspect gasket surfaces for warpage, nicks or burrs. Smooth by grinding. Replace block if excessively warped.

d. Reassembly and Installation. Assemble the engine in the reverse order of disassembly. Install in the tractor (para 2-8).

CHAPTER 6

REPAIR OF DRIVE TRAIN

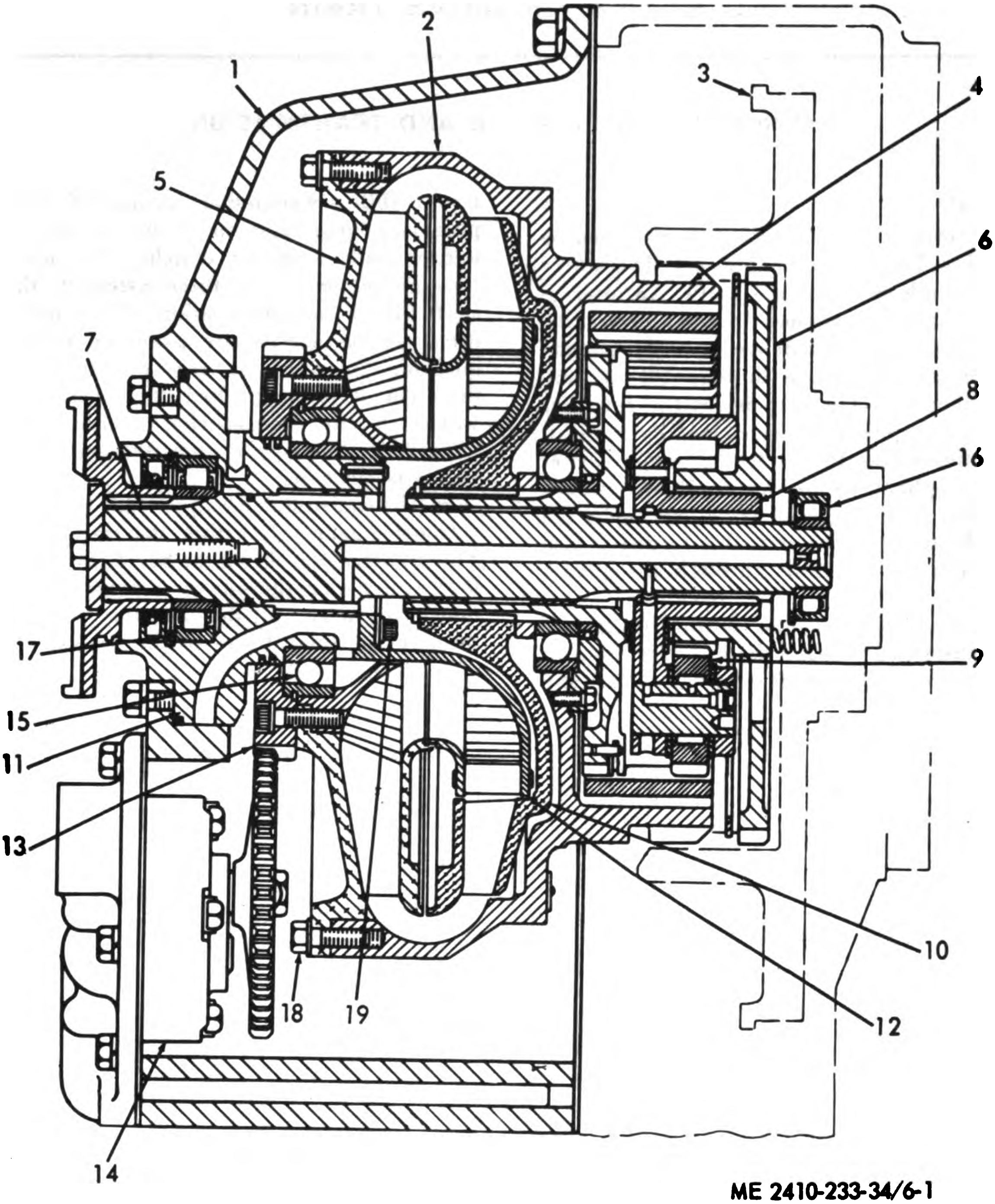
Section I. TORQUE DIVIDER AND TRANSMISSION

6-1. General

a. Power from the diesel engine is transmitted by the flywheel (3, fig. 6-1) to the torque divider where it travels through two separate paths. An internal coupling gear on the engine flywheel drives the rotating housing (2), which delivers a larger portion of the diesel engine torque through torque converter. Another coupling gear drives the sun gear (6) on a planetary gear set to mechanically transmit a lesser portion of the torque to the planet carrier (8), which is splined to the torque divider output shaft (7). Since the ring gear (4) is driven by the turbine of the torque converter, this torque is also applied to the output shaft through the planet carrier (8).

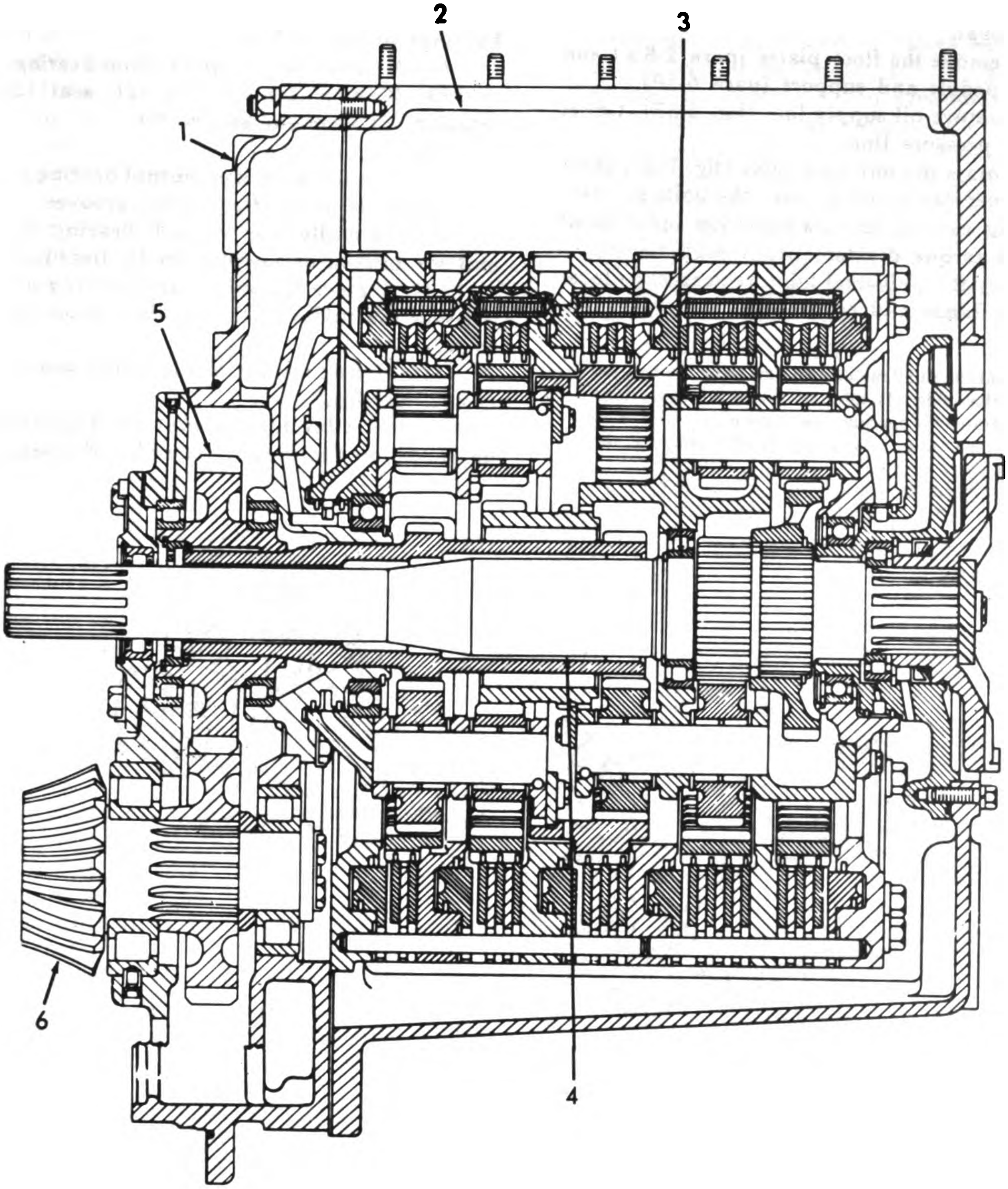
b. From the torque divider output shaft (7), torque is transmitted through the universal joint to the transmission input shaft (3, fig. 6-2). The power shift transmission consists of five sets of planetary gear systems each of which has a hydraulically actuated clutch. The power flows through two or more of these systems to the output shaft (4) of the transmission. Three forward and three reverse speeds are available in the transmission. Selection of the desired speed and direction is accomplished by positioning spool valves in the transmission hydraulic controls, located in the upper compartment (2) of the transmission case.

c. The transmission output shaft (4) is splined to a transfer gear (5), within the transfer case (1). This transfer gear drives the bevel pinion (6). From the bevel pinion the power is transmitted through the bevel gear, to the steering clutches, then through the final drives to the tracks.



1 Torque divider housing
2 Rotating housing
3 Diesel engine flywheel
4 Ring gear
5 Impeller
6 Sun gear
7 Output shaft
8 Planet carrier
9 Planet gear
10 Turbine
11 Carrier
12 Stator
13 Torque converter gear
14 Scavenge pump
15 Bearings
16 Pilot bearing
17 Output shaft bearing
18 Bolt
19 Bolt

Figure 6-1. Torque divider.



ME 2410-233-34/6-2

1 Transfer case
2 Upper compartment of transmission case
3 Transmission input shaft
4 Transmission output shaft
5 Transfer gear
6 Bevel pinion

Figure 6-2. Cross sectional view of transmission.

6-2. Universal Joint

a. Removal.

(1) Remove the floor plates (para 2-8 a) and the brake pedals and support (para 6-30).

(2) Remove oil supply line (fig. 2-33), (sheet 2) and oil pressure line.

(3) Rotate the universal joint (fig. 2-31, sheet 4 of 6) as necessary and remove the bolts securing the bearing caps to the transmission input shaft flange and torque divider output shaft flange.

(4) Pry the universal joint bearing caps loose from each flange and remove the universal joint.

NOTE

Do not cut the small metal straps securing the bearing caps to the spider. If they are cut or missing, temporarily fasten the bearing caps to the universal joint to prevent them from sliding off or dirt entering the bearings.

b. Disassembly (fig. 6-3).

(1) Remove the bolts which secure the bearings to the spiders.

(2) Remove the strap (4) from bearings (1).

(3) Remove the bearing (1), seal (2) and retainer (3) from the spider (5).

c. Inspection.

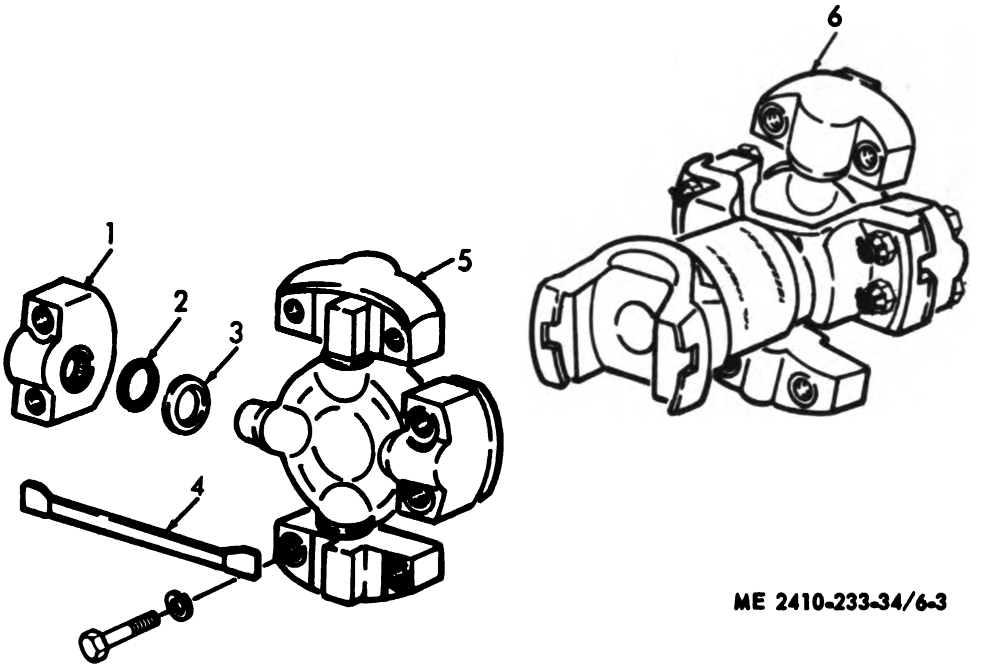
(1) Inspect the spider journal bearing surfaces for roughness or needle bearing grooves.

(2) Carefully inspect each bearing for wear and for broken or missing needle bearings.

(3) Replace the spider and bearing assembly if either the spider or the bearings show excessive wear.

(4) Light brineling of the spider bearing area is not harmful.

d. Reassembly and Installation. Reassemble the universal joint in the reverse order of disassembly.



ME 2410-233-34/6-3

1 Bearing
2 Seal
3 Retainer
4 Strap
5 Spider
6 Shaft

Figure 6-3. Universal joint disassembly.

6-3. Torque Divider

a. General (fig. 6-1). The torque divider is mounted in the torque divider housing (1). It pilots into the diesel engine flywheel (3) and is supported in the housing (1) by a bearing mounted in a carrier (11).

b. Operation.

(1) The torque divider is driven by the diesel engine through a rotating housing (2, fig. 6-1) and sun gear (6) to direct the torque output of the engine through two separate paths. Most of the torque is transmitted by the rotating housing (2) and impeller (5) through a medium of oil to the stator or reactionary member (12) which directs the oil to rotate the turbine (10). Since the turbine is splined to the same hub as the ring gear (4), the torque is transferred through the planet carrier (8) to the output shaft (7). A lesser amount of torque is transmitted from the engine flywheel (3) through the sun gear (6) and planet carrier (8) to the output shaft (7).

(2) The planetary system is composed of a sun gear (6) that turns with the diesel engine flywheel (3), a planet carrier (8) which is splined to the output shaft (7) and supports the planet gears (9) that mesh with the ring gear (4).

(3) The major components of the torque converter are the rotating housing (2), impeller (5), turbine (10) and stator (12).

(4) Oil for operation of the torque converter is supplied by the transmission and steering clutch control oil pump and enters the housing (1), passes through the inlet port in the carrier (11) to the torque converter. The pressure of this oil is held to 40-44 psi at stall speed by a torque converter outlet relief valve. Refer to paragraph 6-11 for the correct testing and adjusting procedure. Oil leaves the torque converter through outlet port in the carrier. From here it flows through the oil cooler and returns to the transmission lubrication system.

(5) The energy imparted by the impeller (5) transmits torque to the turbine (10) and consequently the output shaft (7). Under normal operating conditions, the oil passes through the converter easily and quickly striking each blade at a very slight angle. When a load is encountered, the speed of the turbine is reduced, and the oil strikes the turbine blades at a sharper angle. This multiplies the torque delivered to the output shaft of the torque divider.

c. Lubrication.

(1) Oil for lubrication of the torque divider bearings and planetary system is furnished from the supply used for operation of the torque converter. The bearings (15) are constantly running in oil. The bearings and gears in the planetary system (4) and the pilot bearing (15) receive lubrication through drilled passages in the output shaft (7). The output shaft rear bearing (17) receives lubrication from normal oil leakage past a piston ring-type seal.

(2) Normal oil leakage past the bearings and piston ring-type seals falls to the bottom of the torque divider housing and is picked up by the scavenge pump and returned to the transmission lubricating system.

d. Torque Divider Reconditioning.

(1) To obtain maximum service, cleanliness must be the rule. Be careful to avoid introducing dirt into the torque divider or the fluid system when reconditioning and filling the fluid system.

(2) Protect all internal parts of the torque divider during reconditioning to avoid bumping, burring, scratching, or damaging.

(3) Oil all parts before installation and be sure there is oil in the bevel gear sump before starting the diesel engine. Run the diesel engine at one half engine speed for several minutes before putting the machine to work.

CAUTION

Whenever a torque converter fails, the entire torque converter fluid system must be cleaned thoroughly to remove all metal chips and particles before the converter is returned to operation. All lines, including those to the gages, should be removed and cleaned. It is essential that the torque converter cooler be absolutely clean. Failure to take these precautions will probably result in a recurrent failure. Any foreign material left in the torque converter fluid system will be circulated through the transmission lubrication valve and into the transmission lubricant circuit.

NOTE

The torque divider unit weighs approximately 550 pounds.

e. Removal.

(1) Drain the oil from transmission and torque divider (TM 5-2410-233-20).

(2) Remove the floor plates (para 2-8*a*), seat frame (para 2-9), and brake pedal assembly (para 6-30).

(3) Remove transmission vent line (fig. 2-31, sheet 4 of 6), transmission oil pump oil outlet line.

(4) Disconnect the oil temperature sensing unit from the torque converter.

(5) Disconnect the torque divider oil outlet line from the torque divider and from the oil cooler (fig. 2-31, sheet 3 of 6) and remove from tractor.

(6) Remove the torque divider oil inlet line (fig. 2-31, sheet 4 of 6).

(7) Remove the scavenge pump oil outlet line.

(8) Remove power take-off gears oil supply line.

(9) Remove drive shaft (para 6-2).

(10) Install two ⅝ in. — 11 NC forged eyebolts in top of torque divider. Attach a hoist to eyelets.

(11) Remove the twelve retaining nuts (fig. 2-31, sheet 4 of 6) and install two ⅜ in. — 16 NC forcing screws to separate torque divider from flywheel housing. Remove the torque divider from the tractor.

WARNING

Secure the planet carrier (8, fig. 6-1) to the torque divider housing with a wire to prevent possible serious personal injury as a result of the carrier sliding out of location and falling from the torque divider output shaft.

(12) Mark the mating teeth of sun gear (fig. 6-4) and flywheel. Remove the sun gear retaining ring and remove the sun gear.

(13) Remove the three springs (located behind the sun gear) from the flywheel (fig. 5-50).

(14) Remove the pilot bearing retaining ring and remove pilot bearing from the flywheel.

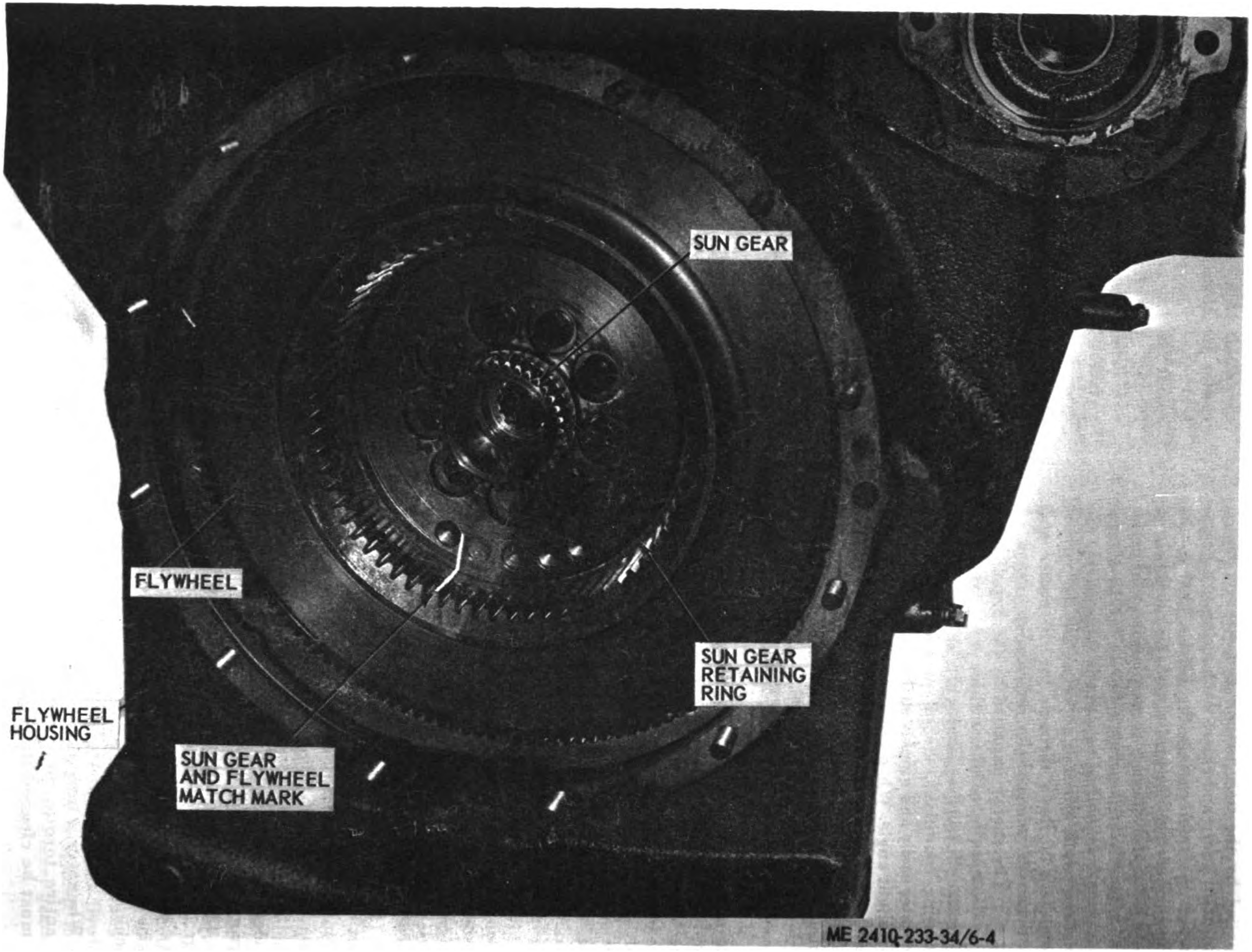


Figure 6-4. Preparing to remove sun gear.

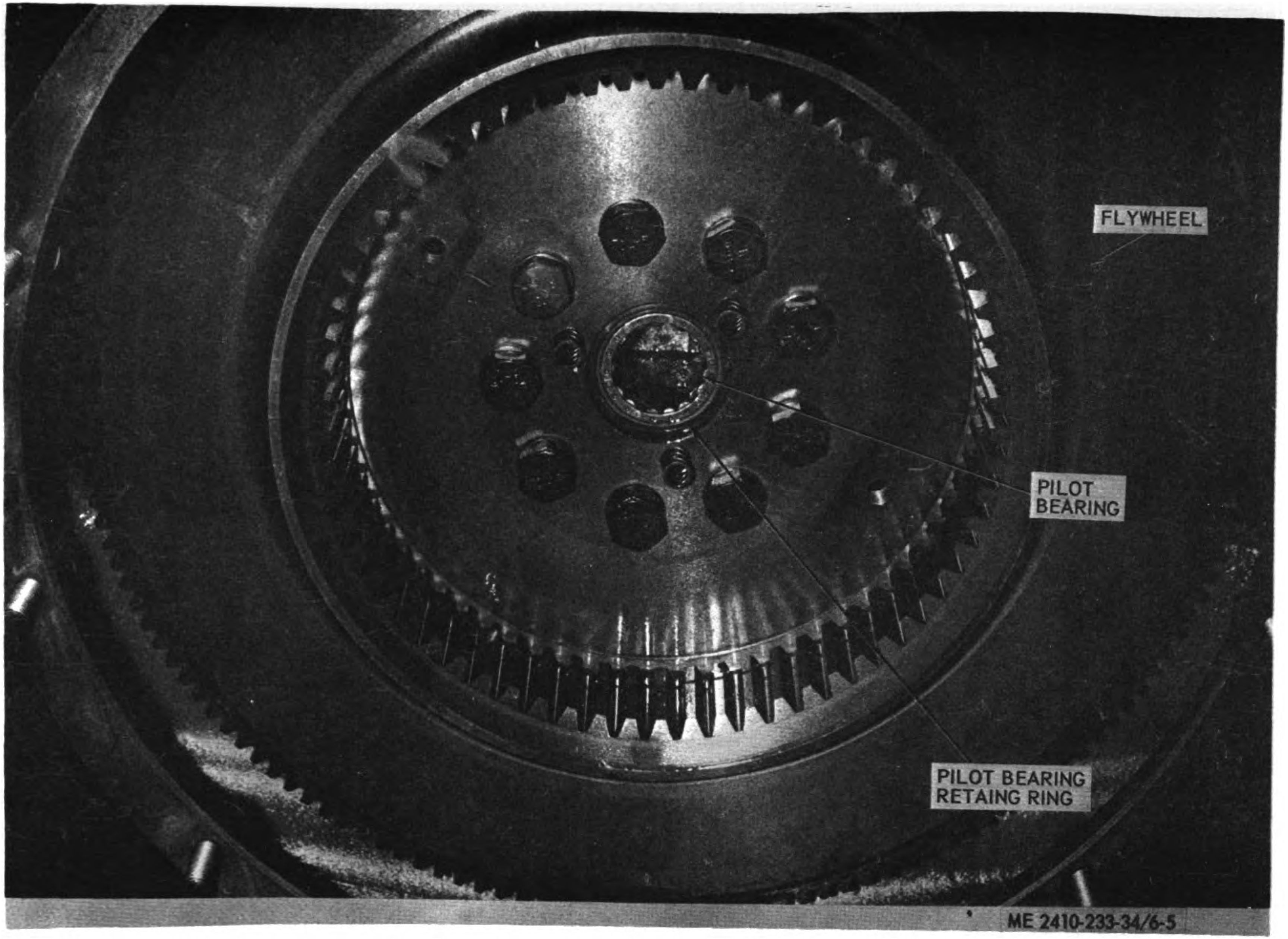


Figure 6-5. Pilot bearing and retaining ring, removal and installation.

f. Torque Divider Disassembly and Assembly.

(1) Remove planet carrier from the torque divider (fig. 6-6).

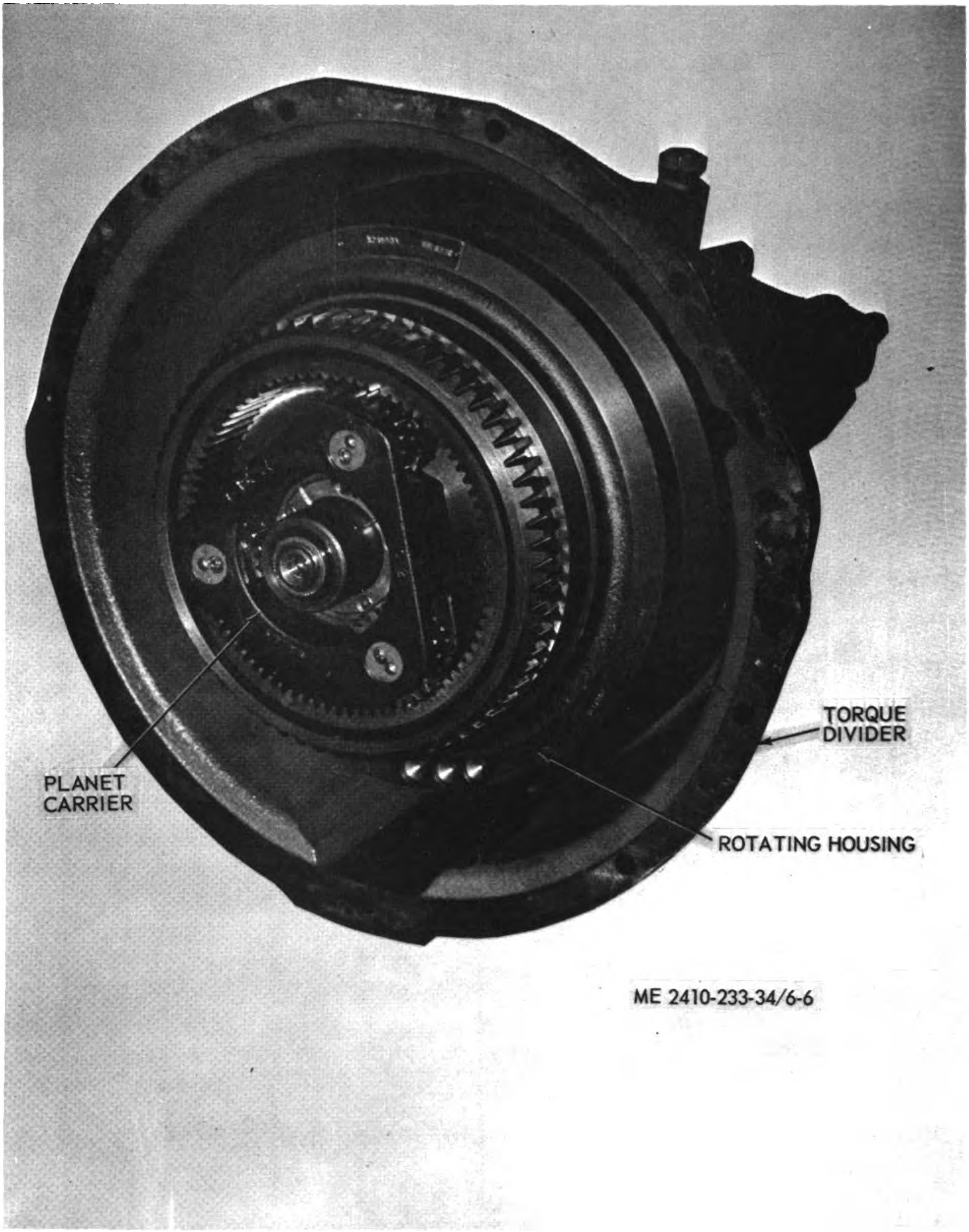
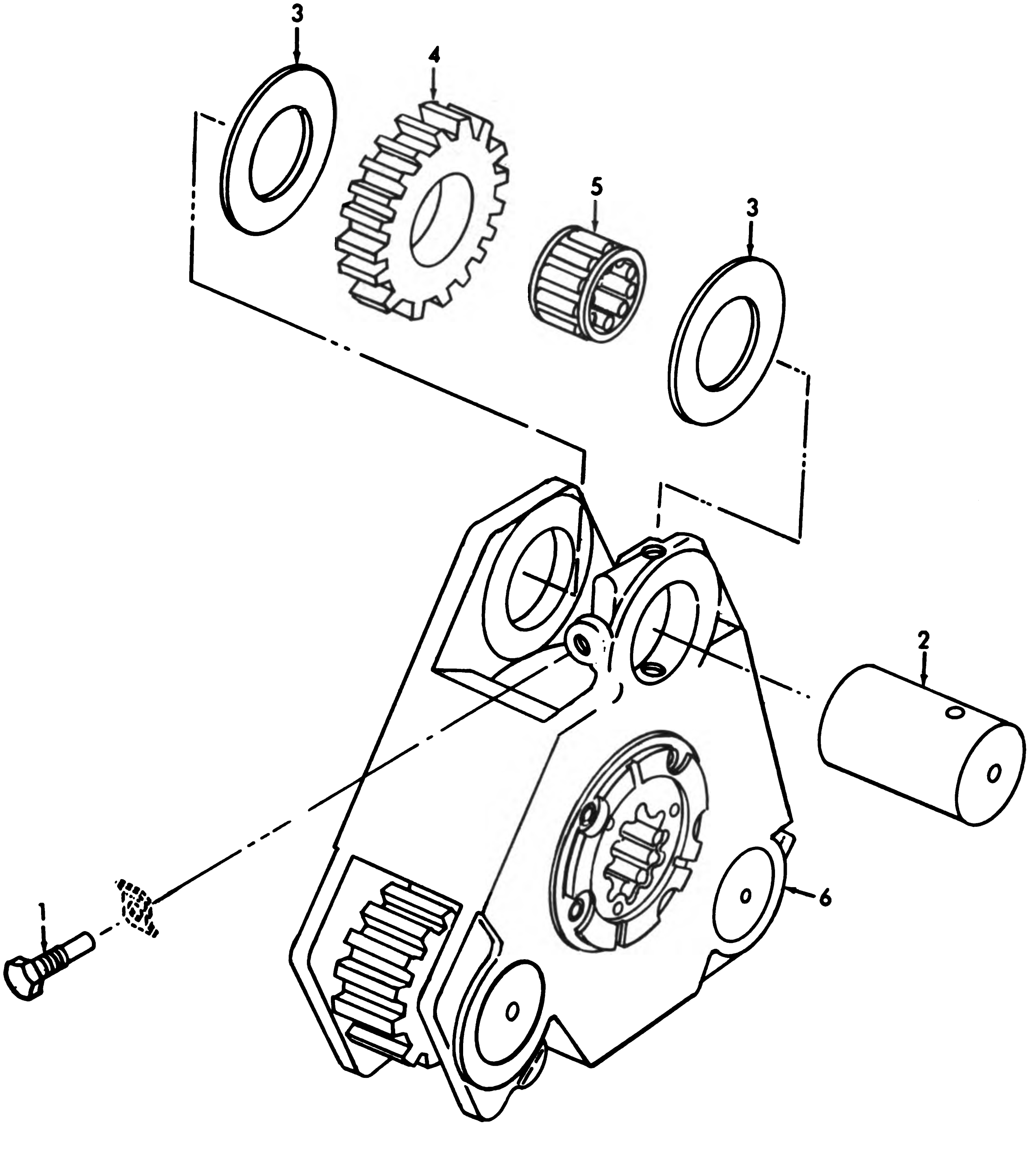


Figure 6-6. Planet carrier, removal and installation.

(2) Disassemble planet carrier assembly as follows:

(a) Remove the three shaft retaining bolts (1, fig. 6-7) and locks.

(b) Remove the shafts (2), washers (3), gears (4), and bearing assemblies (5).



1 Bolts
2 Planet gear shafts (3)
3 Washers (6)
4 Planet gears
5 Bearing assembly
6 Planet carrier

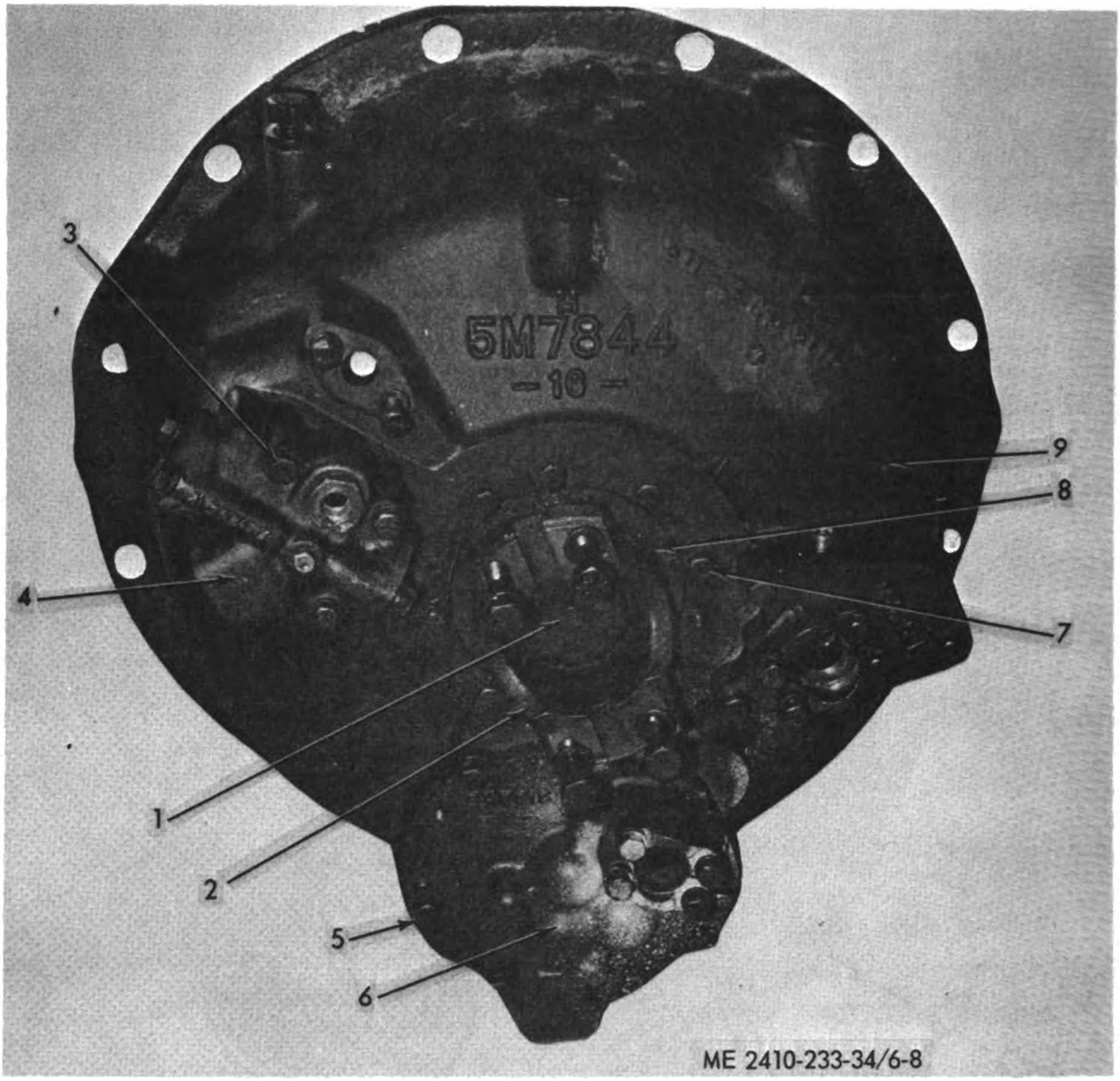
Figure 6-7. Planet carrier, disassembly and reassembly.

(3) Remove the output shaft assembly and disassemble shaft assembly as follows:

(a) Remove retaining bolt (1, fig. 6-8) and washer.

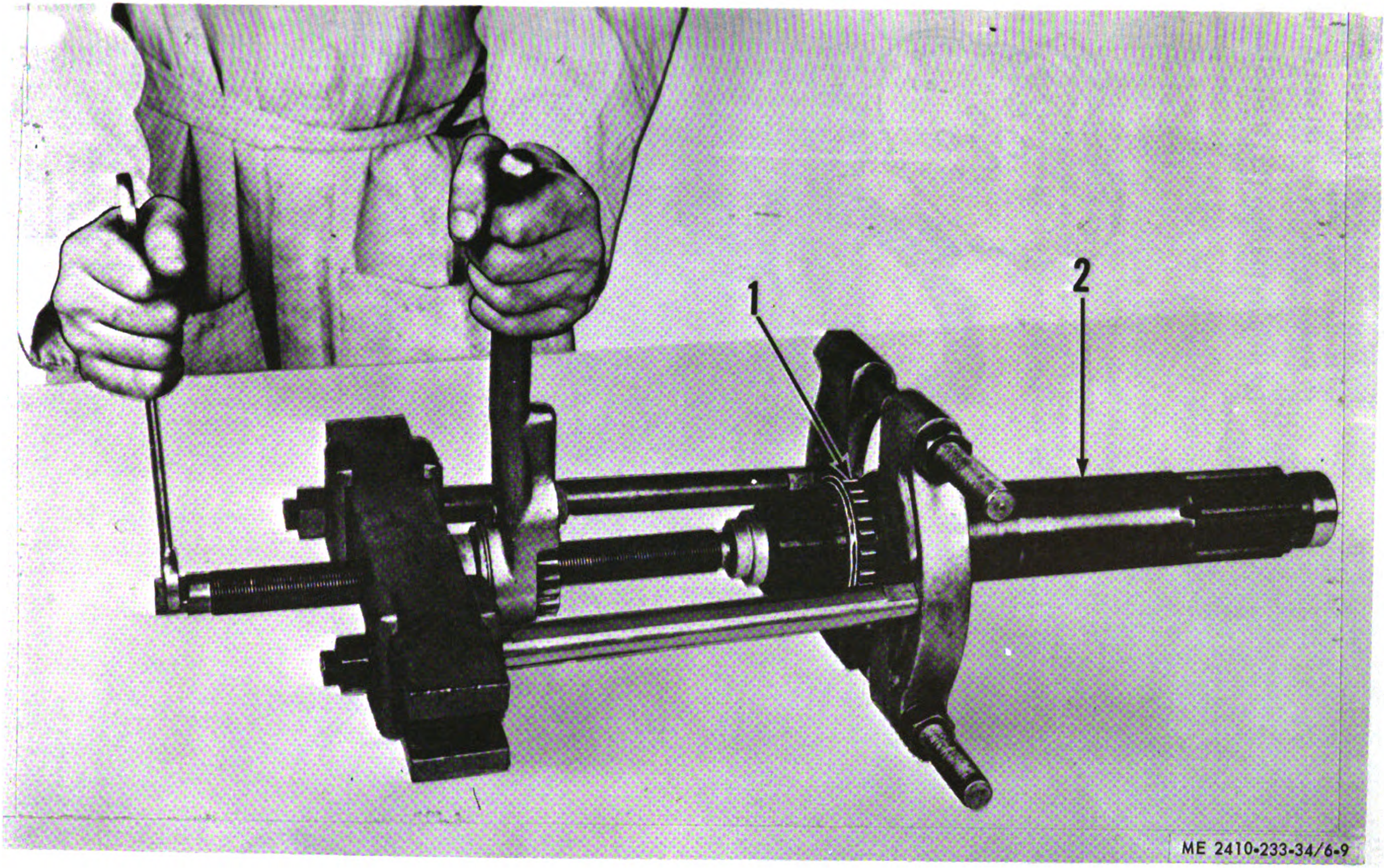
(b) Remove flange (2) and bearing race from output end of shaft.

(c) Remove the bearing (1, fig. 6-9) from the output shaft (2) using a puller, a bearing pulling attachment, a step plate, and a wrench.



1 Bolt
2 Flange
3 Bolt
4 Outlet relief valve
5 Bolt
6 Scavenge pump
7 Bolts
8 Carrier assembly
9 Torque divider housing

Figure 6-8. Torque divider housing, removal and installation.



1 Bearing
2 Output shaft

Figure 6-9. Removing output shaft bearing.

(4) Remove bolts (3, fig. 6-8) and remove the torque converter outlet relief valve from torque divider housing (9).

(5) Remove bolts (5) and remove the scavenge pump (6) from torque divider housing (9).

(6) Disassemble the scavenge pump as follows:

(a) Remove cotter pin (1, fig. 6-10) and nut (2).

(b) Invert nut and install flush with shaft threads to make a flat surface.

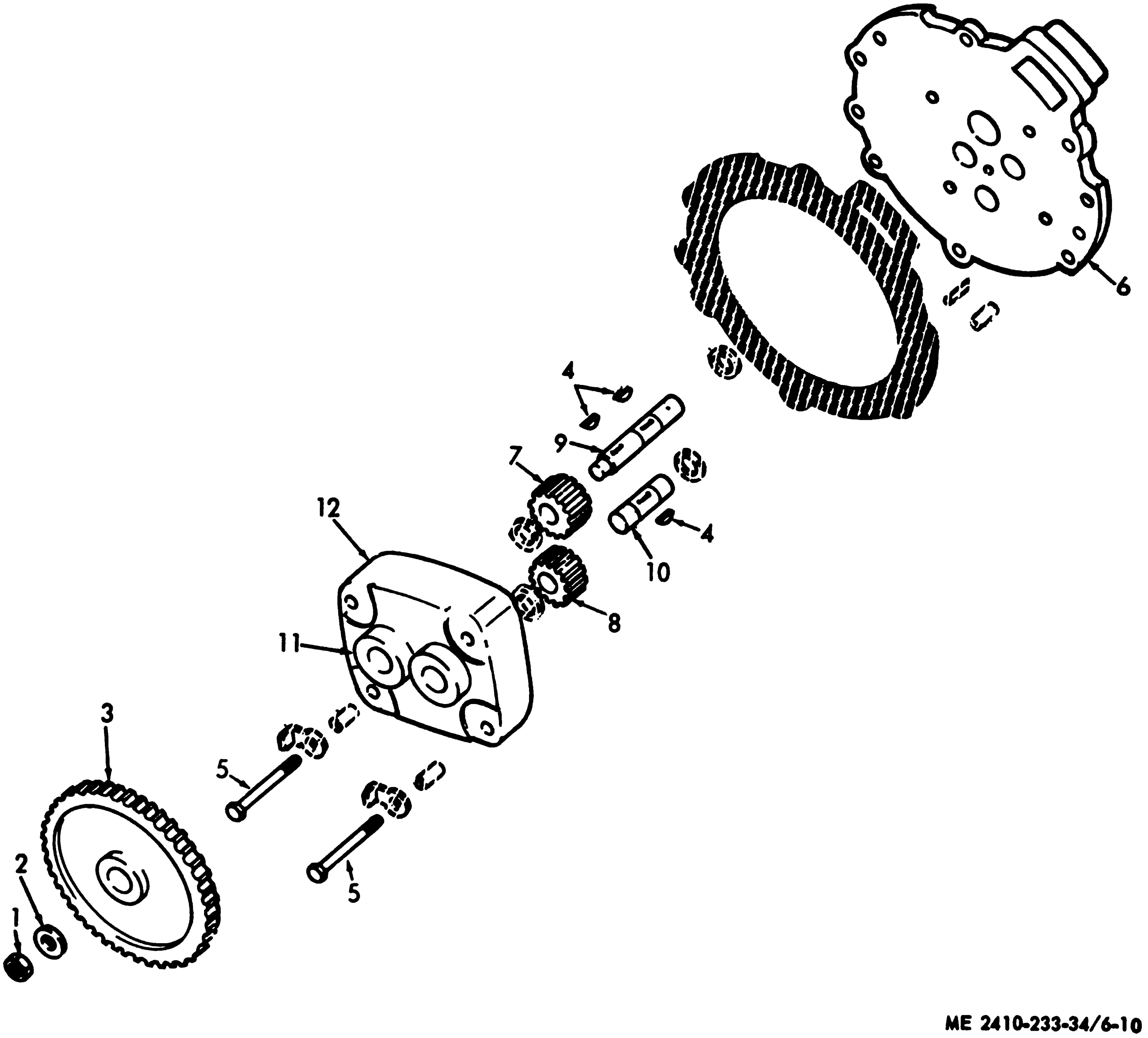
(c) Pull gear (3) from scavenge pump shaft.

(d) Remove woodruff key (4) and bolts (5).

(e) Remove end cover (6).

(f) Remove gears (7) and (8) and shafts (9) and (10).

(g) Remove bearings (11) if replacement is required.



1	Cotter pin	7	Gear
2	Nut	8	Gear
3	Gear	9	Drive shaft
4	Woodruff key	10	Idler shaft
5	Bolts	11	Bearings
6	End cover	12	Pump body

Figure 6-10. Scavenge pump, exploded view.

(7) Remove the 8 torque converter carrier to cover mounting bolts (7, fig. 6-8).

(8) Install two ⅜ in.—16 NC forcing screws and separate the housing (9) from carrier assembly (8).

(9) Remove the forcing screws and install two ⅜ in.—16 NC forged eyebolts. Attach a hoist and remove torque divider housing (9) from carrier assembly (8).

(10) Remove the impeller assembly retaining bolts (18, fig. 6-1).

(11) Remove the impeller assembly (5).

(12) Remove the eight stator assembly-to-carrier assembly retaining bolts (19).

(13) Remove the stator as shown in figure 6-11 by placing two wood blocks on the impeller and prying upward.

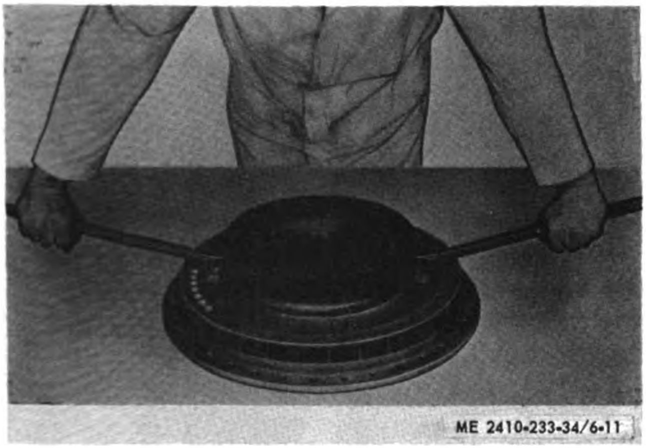
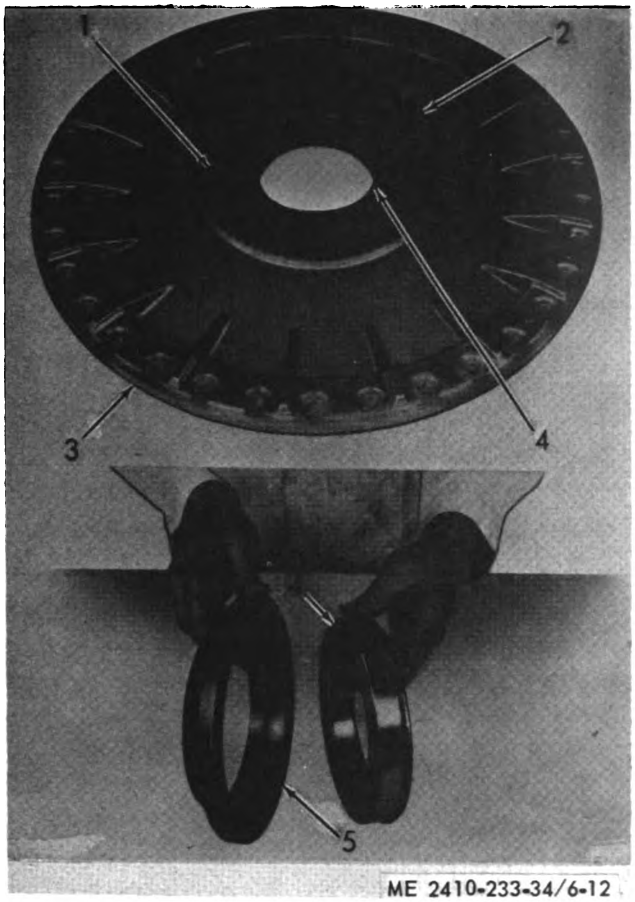


Figure 6-11. Removing stator.

(14) Disassemble the impeller assembly as follows:

(a) Remove the scavenge pump drive gear retaining bolts (1, fig. 6-12).



1 Bolts
2 Gear
3 Impeller
4 Bearing
5 Carrier
6 Bearing retaining ring

Figure 6-12. Impeller disassembly.

(b) Remove the drive gear (2).

(c) Remove the bearing retainer (6) and bearing (4) from impeller (3).

(d) Remove the bearing from retainer.

(e) Remove the retaining ring (6) from bearing.

(15) Disassemble the carrier assembly as follows:

(a) Using a hammer and punch, remove the lip type seal from carrier assembly.

(b) Remove the bearing assembly retaining ring.

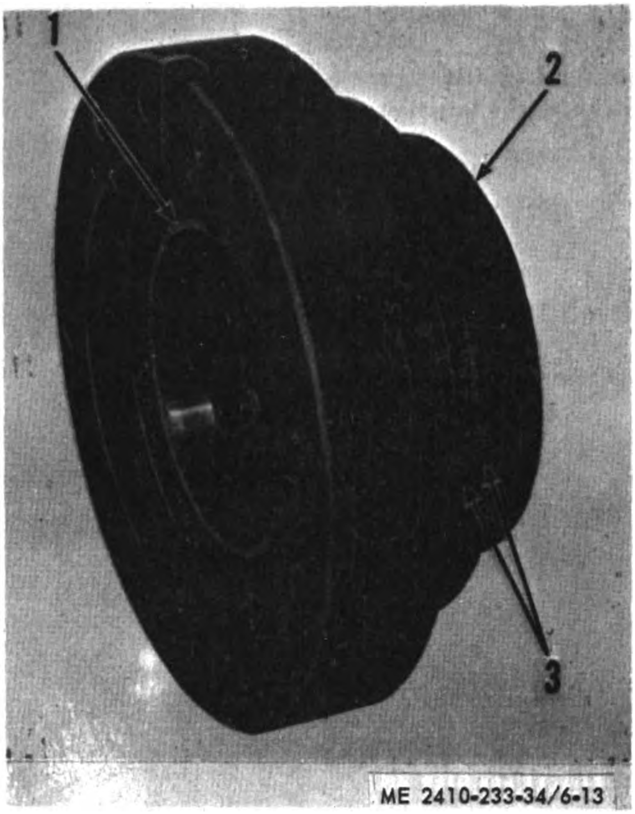
(c) Using hammer and punch, remove the bearing assembly (1, fig. 6-13) from carrier (2).

(d) Remove the sleeve from carrier.

(e) Remove the ring seals (3) from the carrier.

(16) Remove the turbine retaining ring.

(17) Turn the housing over, and drive the retaining pins (fig. 6-14) down flush with the face of the flange assembly.



1 Bearing outer race
2 Carrier
3 Ring seals

Figure 6-13. Carrier disassembly.

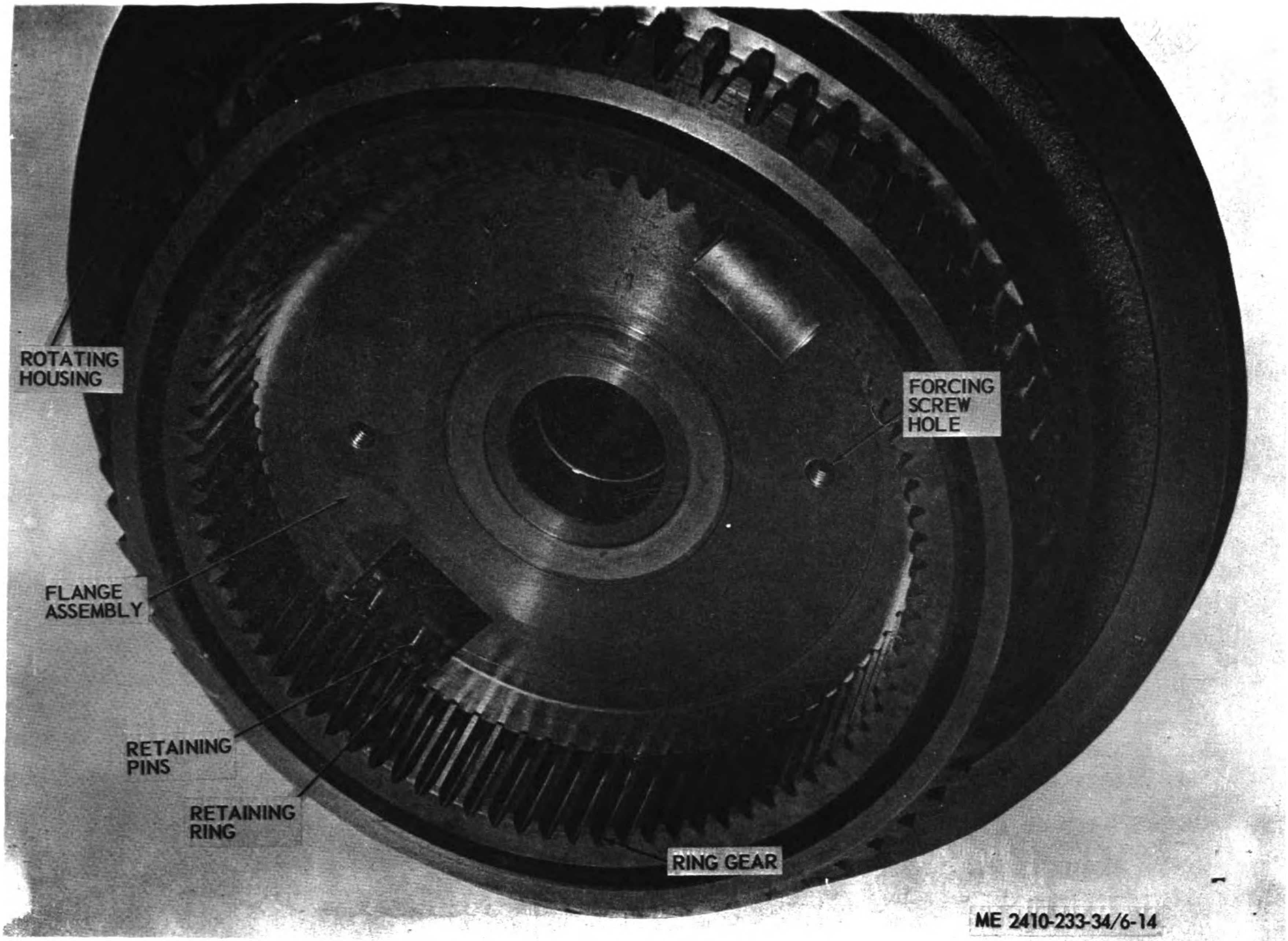


Figure 6-14. Ring gear removal.

(18) Compress the retaining ring and remove the ring gear.

(19) Remove the retaining ring.

(20) Remove turbine retaining ring (fig. 6-15).

(21) Heat the rotating housing and turbine assembly (fig. 6-15) in oil at a temperature of 280°F—300°F for ten minutes.

CAUTION

Do not exceed 300°F or damage to the turbine may result.

(22) Immediately after heating the rotating housing and turbine assembly, turn 180° and install two ⅜ in.—16 NC forcing screws in the flange assembly; separate the turbine, spacer, and flange assembly from rotating housing.

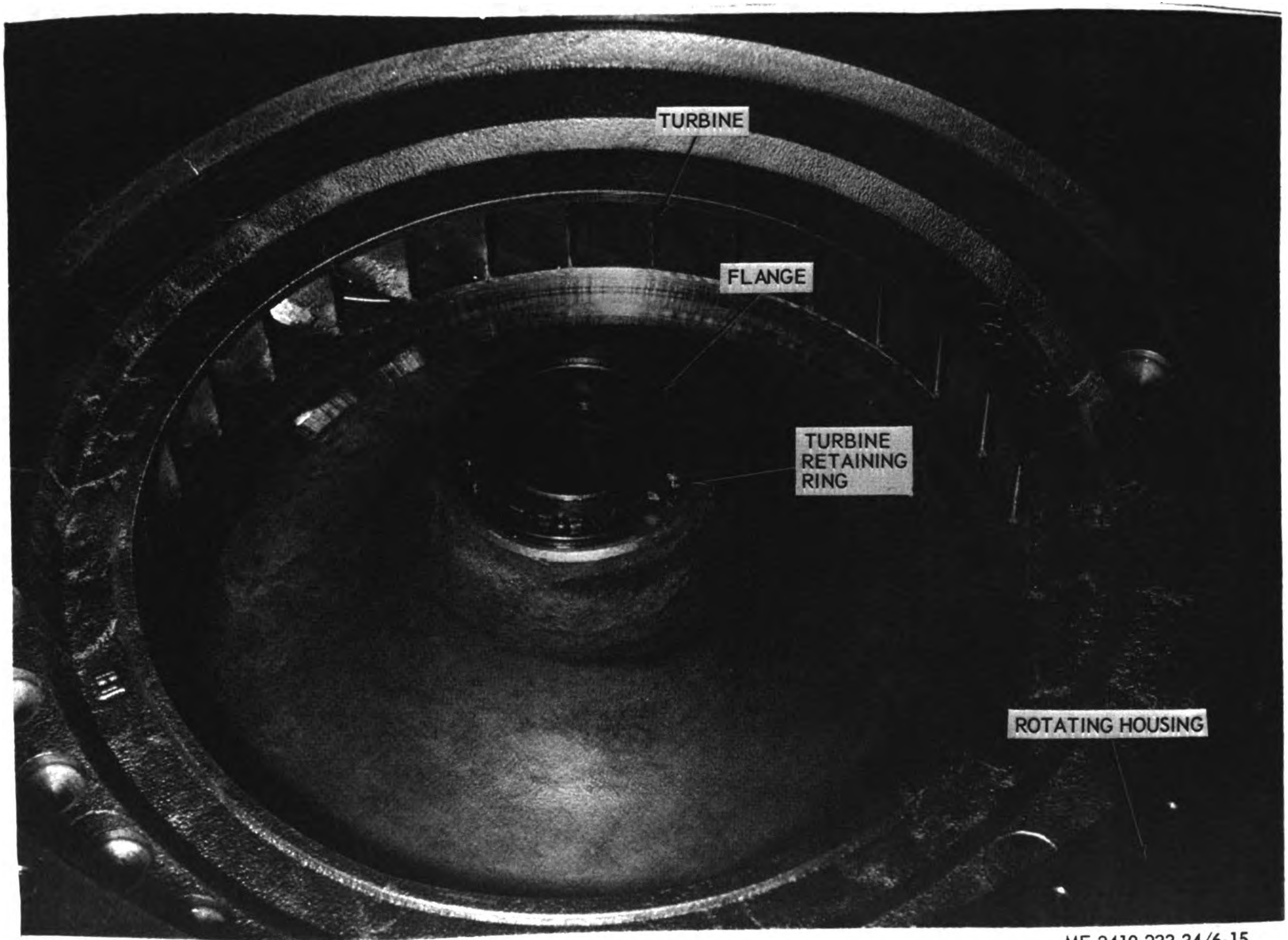


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Figure 6-15. Turbine, flange assembly and rotating housing removal.

(23) Remove the bearings (fig. 6-16) from flange assembly.

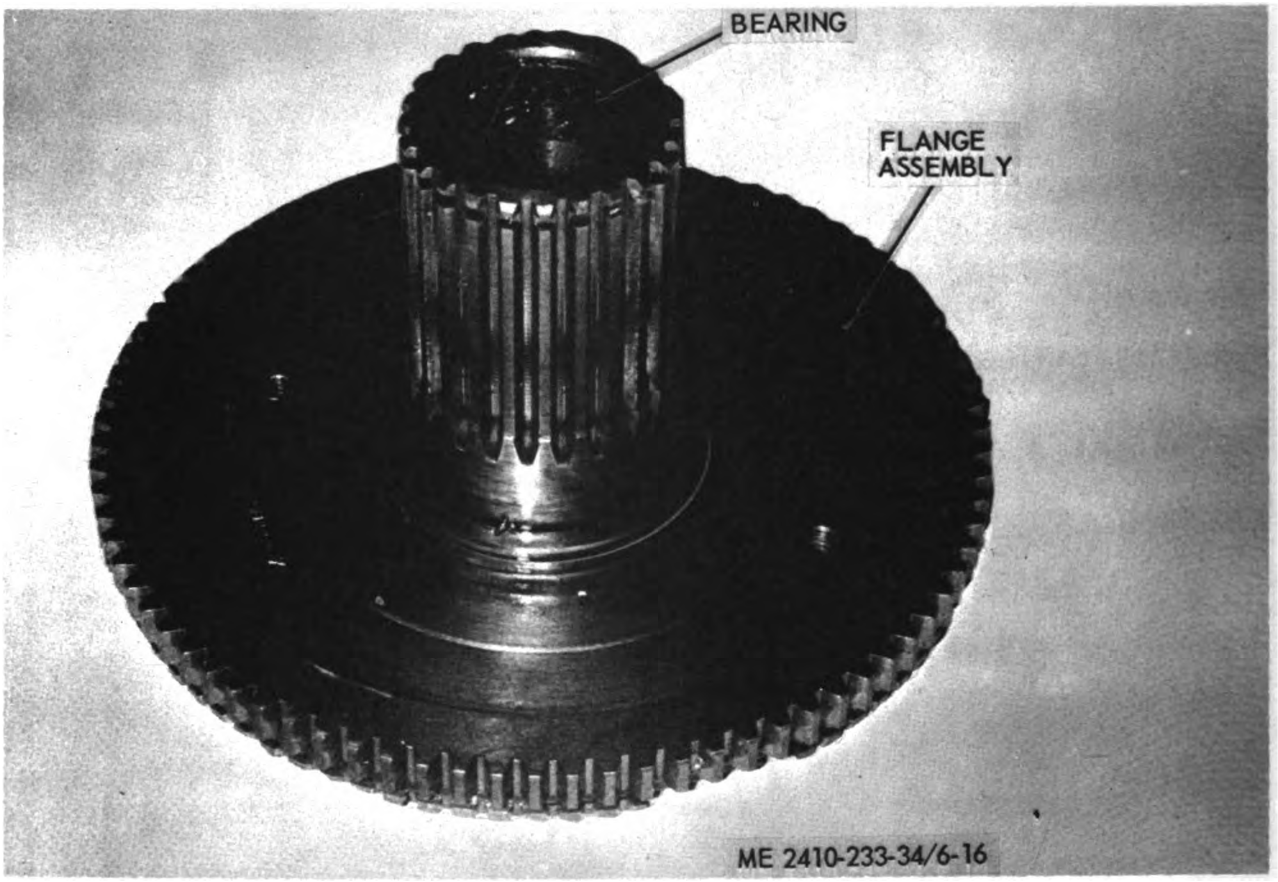


Figure 6-16. Flange assembly.

(24) Remove the seal ring from carrier on the flange assembly.

(25) Remove the bearing assembly retainer mounting bolts (fig. 6-17) and remove retainer.

(26) Turn the housing over, and drive the bearing assembly and retaining ring out of housing.

(27) Remove the retaining ring from bearing assembly.

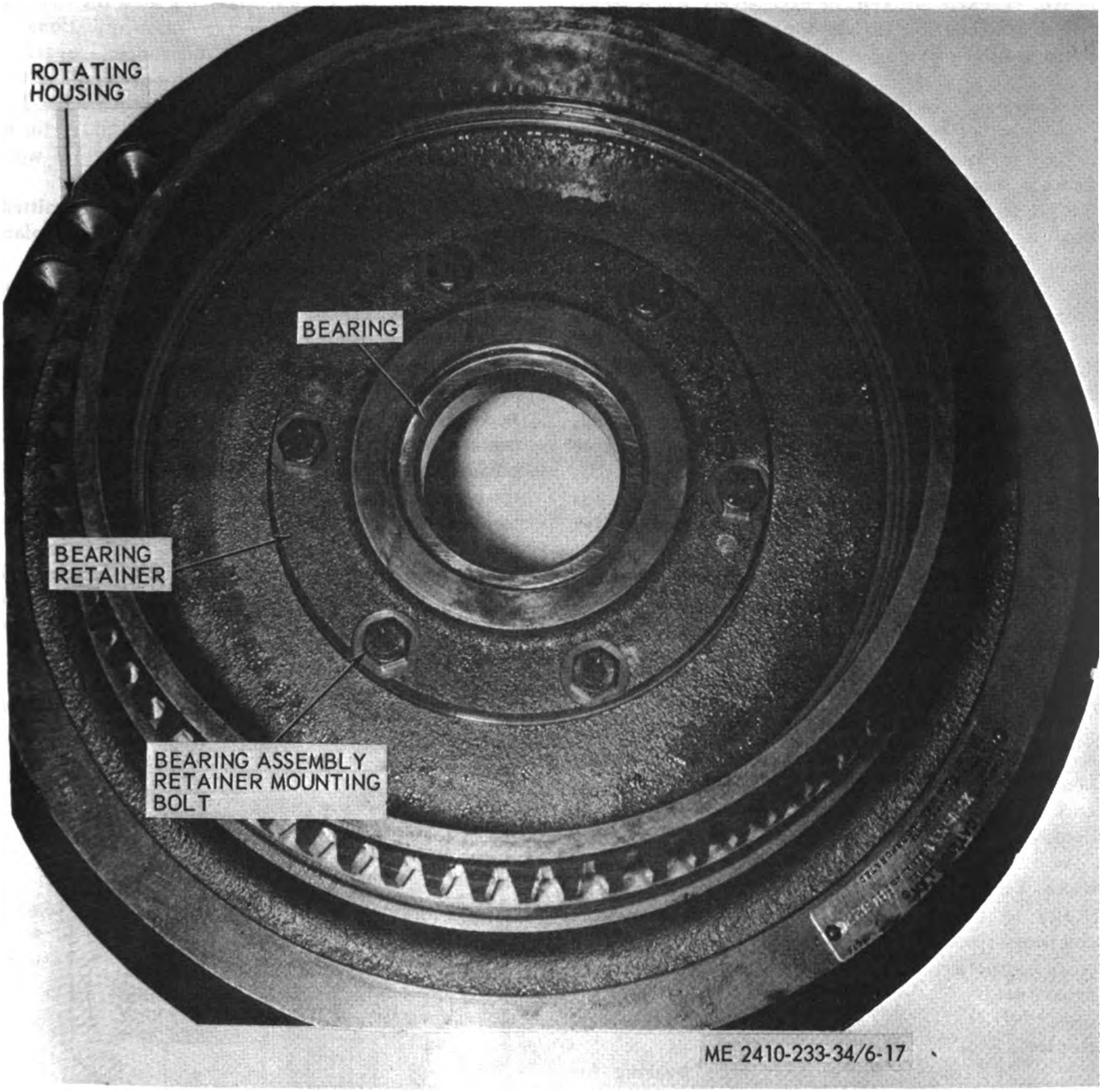


Figure 6-17. Rotating housing bearing and bearing retainer removal.

g. Inspection and Repair.

(1) *Scavenge pump.*

(a) Inspect manifold, spacer, and end cover for cracks, breaks, scoring, and wear. Replace as required.

(b) Inspect the pump gears for scored, chipped, pitted, cracked, or worn teeth.

(c) Inspect sleeve bearings for damage and wear. Bearing I.D. (new) is 0.7422 to 0.7428 inch. Replace damaged or excessively worn bearings.

(d) Inspect pump drive gear for chipped, pitted, cracked, broken, or worn teeth. Replace damaged or excessively worn drive gear.

(2) *Torque divider.*

CAUTION

If an inspection indicates a failure has occurred in the torque converter, the entire fluid system must be thoroughly cleaned.

NOTE

The inspection and repair data is listed in the same sequence as the disassembly procedure.

(a) Inspect the planet gear shafts and bearings for scoring, pitting, and wear. Replace scored, pitted, or excessively worn or rough shafts or bearings.

(b) Inspect the planet gears for chipped,

pitted, cracked, broken, or excessively worn teeth. Inspect the bearing surface for scoring, pitting, and wear. Replace damaged or excessively worn gears.

NOTE

Replace the planet gears in sets only, to prevent possible overloading of a single gear.

(c) Inspect the non-metallic washers for damage and wear. The washer thickness (new) is 0.073 ± 0.002 inch. Replace damaged or worn washers. Minimum allowable thickness is 0.065 inch.

(d) Inspect the planet carrier for cracks, breaks, and distortion. Replace a defective carrier.

(e) Inspect the carrier thrust washers for damage and wear. Replace the thrust washer if damaged or if considerable wear is indicated.

(f) Inspect the planet sun gear for chipped, pitted, broken, or worn teeth. Replace the sun gear if damaged or worn excessively.

(g) Inspect the sun gear positioning springs for breaks or damaged condition. Replace defective springs.

(h) Inspect the pilot bearing for scoring, pitting, and wear. Replace a scored, pitted, rough, or excessively worn bearing.

(i) Replace the output shaft rear seal. Install the seal with the lip facing the torque divider.

(j) Inspect the output shaft bearings for scoring, pitting, and wear. Replace defective bearings. Examine the shaft splines for distortion and wear. Replace a defective shaft. Replace a damaged or questionable ring seal.

(k) Inspect the impeller for damage and wear. The desired impeller to stator clearance is 0.009 to 0.015 inch. The maximum allowable clearance is 0.023 inch. Replace a damaged or worn impeller, (see (3) below for measuring procedure).

(l) Inspect the stator for damage and wear. Replace a damaged or worn stator.

(m) Inspect the carrier inner bearing for scoring, pitting, and wear. Replace a scored, pitted, rough, or excessively worn bearing. Examine the carrier ring type seals for damage and wear. Replace worn, damaged, or questionable ring seals.

(n) Inspect the carrier bearing for scoring, pitting, and wear. Replace a scored, pitted, rough, or excessively worn bearing.

(o) Inspect the turbine for damage and wear. The desired stator to turbine clearance is 0.012 to 0.018 inch. The maximum allowable clearance is 0.030 inch. Replace a damaged or worn turbine (See subpara (3) below for measuring procedure).

(p) Inspect the turbine bearing for scoring, pitting, and wear. Replace a scored, pitted, rough, or excessively worn bearing.

(q) Inspect the flange ring seals for damage and wear. Replace damaged, worn, or questionable ring seals. Inspect the flange inner sleeve bearings for scoring, damage, and wear. The desired shaft to bearing clearance is 0.002 to 0.005 inch. The maximum allowable clearance is 0.015 inch. Replace scored, damaged, or excessively worn sleeve bearings.

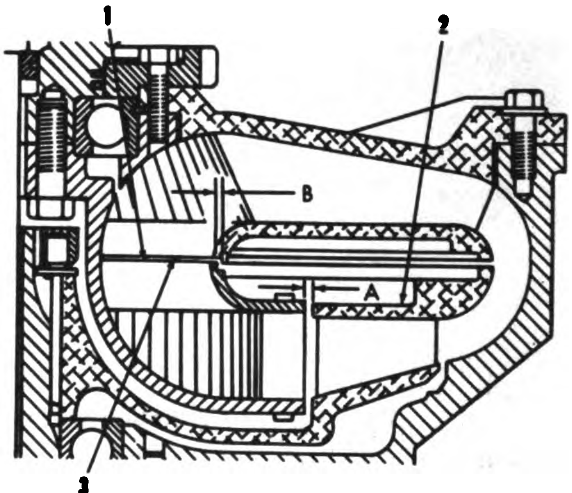
(r) Inspect all gears for chipped, pitted, broken, or excessively worn teeth. Replace defective or excessively worn gears.

(s) Inspect the torque divider and rotating housings for cracks, breaks, and wear. Repair or replace as dictated by the extent of damage.

(3) *Checking torque converter clearance.* To maintain efficiency of the torque converter, it is necessary that maximum wear limits between certain components be observed and used as a guide when determining parts replacement. At the time of reassembly, use the procedure listed below to check the clearance. The measured distances are total diametral clearances which are twice the actual running clearances (A) and (B), figure 6-18. Refer to table 1-4 for correct diametral clearances.

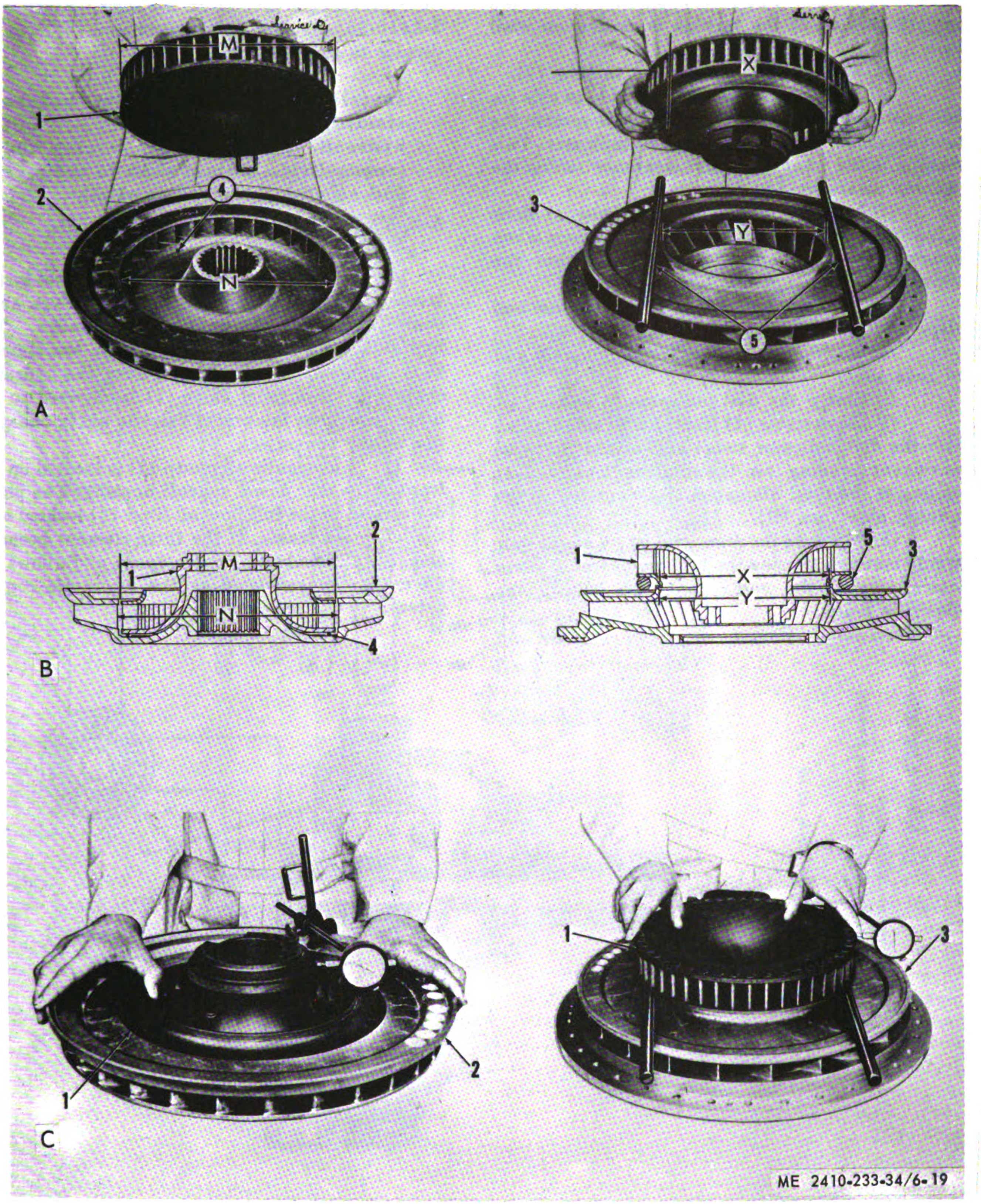
(a) Equally space steel balls (4), figure 6-19, between blade ends in turbine flange, as illustrated.

(b) Position stator (1) in turbine (2) being careful not to move steel balls (4).



1 Stator
2 Turbine
3 Impeller
A Dimension to be checked (clearance between stator and turbine).
B Dimension to be checked (clearance between outside of flange on stator and inside of flange impeller)

Figure 6-18. Torque converter clearances.



1 Stator
2 Turbine
3 Impeller
4 Steel balls (4. 1 / 16 in. dia)
5 Steel rods (2⅝ in. dia—20 in. long)

M Outside diameter of stator
N Inside diameter of turbine
X Outside diameter of stator inner flange
Y Inside diameter of impeller flange

Figure 6-19. Checking torque converter clearances.

(c) Rotate stator (1) slightly until the smooth surface of the turbine is resting on steel balls (4).

(d) Clamp dial indicator to turbine (2).

(e) Move the stator (1) from side to side (in line with the dial indicator stem) and record the total movement reading on the dial indicator. This reading is the total diametral clearance (twice the running clearance (A)).

(f) Measure diametral clearance at four equidistant points. Use the highest clearance when determining if the components are within the allowable limits.

(g) Position impeller (3) as shown and place steel rods (5) on the impeller.

(h) Position stator (1) into impeller (3) and on rods (5).

(i) Clamp the dial indicator to bolt.

(j) Move stator (1) from side to side (in line with the dial indicator stem) and record the total movement reading on the dial indicator. This reading is the total diametral clearance (twice the running clearance (B)).

(k) Measure the diametral clearance at four equidistant points using the highest clearance when determining if the components are within the allowable limits.

h. Installation. Reverse removal procedure and install the torque divider on the engine. Refer to LO 5-2410-233-12 and fill transmission and torque divider to specified level.

CAUTION

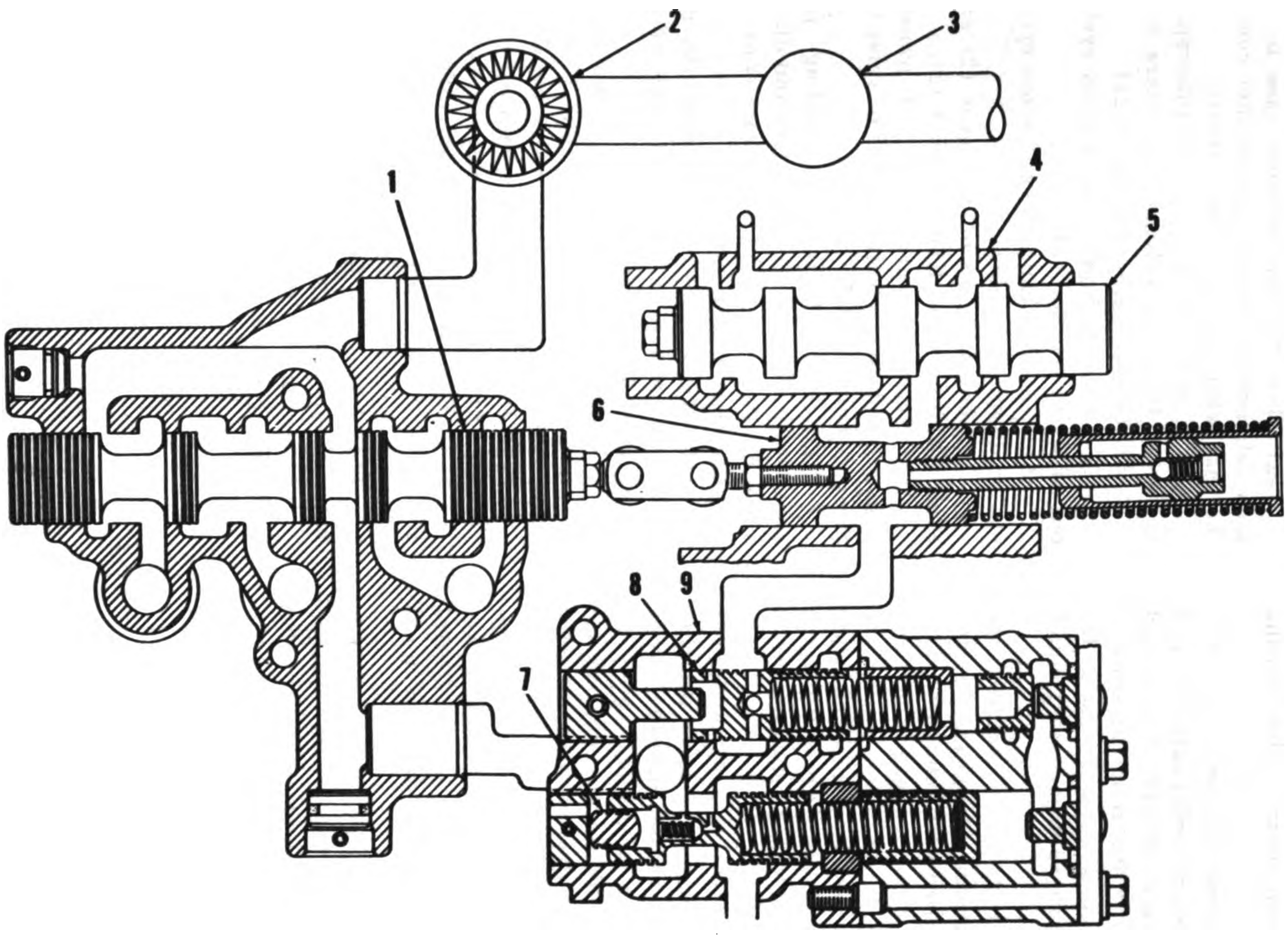
Install the universal joint before starting diesel engine to prevent hydraulic pressure from forcing the torque divider output shaft to the rear and causing a rapid loss of oil.

6-4. Transmission Hydraulic Controls

a. General (fig. 6-20).

(1) The transmission hydraulic control system is composed of a pump, filter, series of valves, and a control lever and linkage mechanism. The hydraulic control system directs oil to the clutches in the transmission. Bypass oil from the hydraulic control pressure relief valve (7) is directed to the torque converter inlet relief valve to aid in charging the torque converter.

(2) A hydraulic oil pump (3) is located on the front of the rear power takeoff housing. The pump delivers oil to the full flow oil filter (2) located near the left main frame. If the filter element becomes clogged, a filter bypass valve opens and allows the oil to flow unrestricted to the hydraulic control valve.



1 Speed selector spool valve
2 Filter
3 Pump
4 Safety and directional valve housing
5 Directional spool valve
6 Safety valve
7 Pressure relief valve
8 Differential valve
9 Pressure control valve housing

Figure 6-20. Hydraulic control (schematic).

(3) From the filter, oil is directed to the control valves in the top compartment of the transmission case. The first valve the oil contacts is the speed spool selector valve (1). The valve is a four position spool valve which is positioned by mechanical linkage to direct oil to one of the three speed clutches (No. 3, No. 4, or No. 5). A parallel passage in the speed selector valve housing directs the oil flow to the pressure control valve housing (9).

(4) The pressure control valve is composed of two valve systems; the pressure relief valve (7), and the pressure differential valve (8). These valves act in combination to limit the maximum pressure of the system, control the rate of pressure rise in the system, and insure the proper sequence of clutch engagement.

(5) The differential valve (8) allows the selected speed clutch to become engaged before any oil is directed to the directional clutches. This arrangement provides smooth engagement and allows most of the load to be taken up by the directional clutches (No. 1 or No. 2). The pressure relief valve (7) maintains the proper pressure in the system and by-passes the oil to the torque converter inlet relief valve.

(6) The safety valve (6) is a spring-loaded spool valve that shifts the selector lever into the neutral position whenever the oil pressure drops below 100 psi and remains for approximately 15 seconds. This valve also blocks the oil passage leading to the directional valve when the selector lever is in neutral.

(7) The directional spool valve (5) is contained in the same housing (4) as the safety valve. The directional valve is positioned by the control linkage to direct oil to one of the directional clutches (No. 1 or No. 2).

(8) The gear selector lever is located at the left side of the operator's seat. Mechanical linkage connects the lever to the speed selector spool valve and to the directional spool valve. Speed shifts are made by moving the selector lever forward or backward, and direction is selected by moving the selector lever to the left or right.

b. Hydraulic Control Removal. The transmission hydraulic controls can be removed from the transmission case without removing the transmission from the tractor.

(1) Remove the seat cushion and backrest (TM 5-2410-233-20), floor plates (para 2-8 *a*), floor plate framework and the seat frame (para 2-9).

(2) Clean the transmission case to remove accumulations of dirt and grease that could enter the case when the cover is removed.

(3) Remove transmission oil filler spout and top cover from transmission case (para 6-8).

(4) Remove spring (4, fig. 6-21).

(5) Loosen locknut (5) and screw eyebolt (6) out of speed selector valve.

(6) Loosen locknut (13) and screw eyebolt (7) out of directional valve.

(7) Loosen clamp bolt of lever (2) and pull shaft (3) from case. Remove lever (2).

(8) Remove cover at front of transmission case and slide safety valve (9) out of valve housing through hole in case.

(9) Remove bolts (14) holding pressure control valve housing (15) to safety and directional valve housing (8), and lift pressure control valve housing from transmission.

(10) Remove torque converter inlet pressure relief valve and pry tube 1/16 forward until it clears valve housing (8).

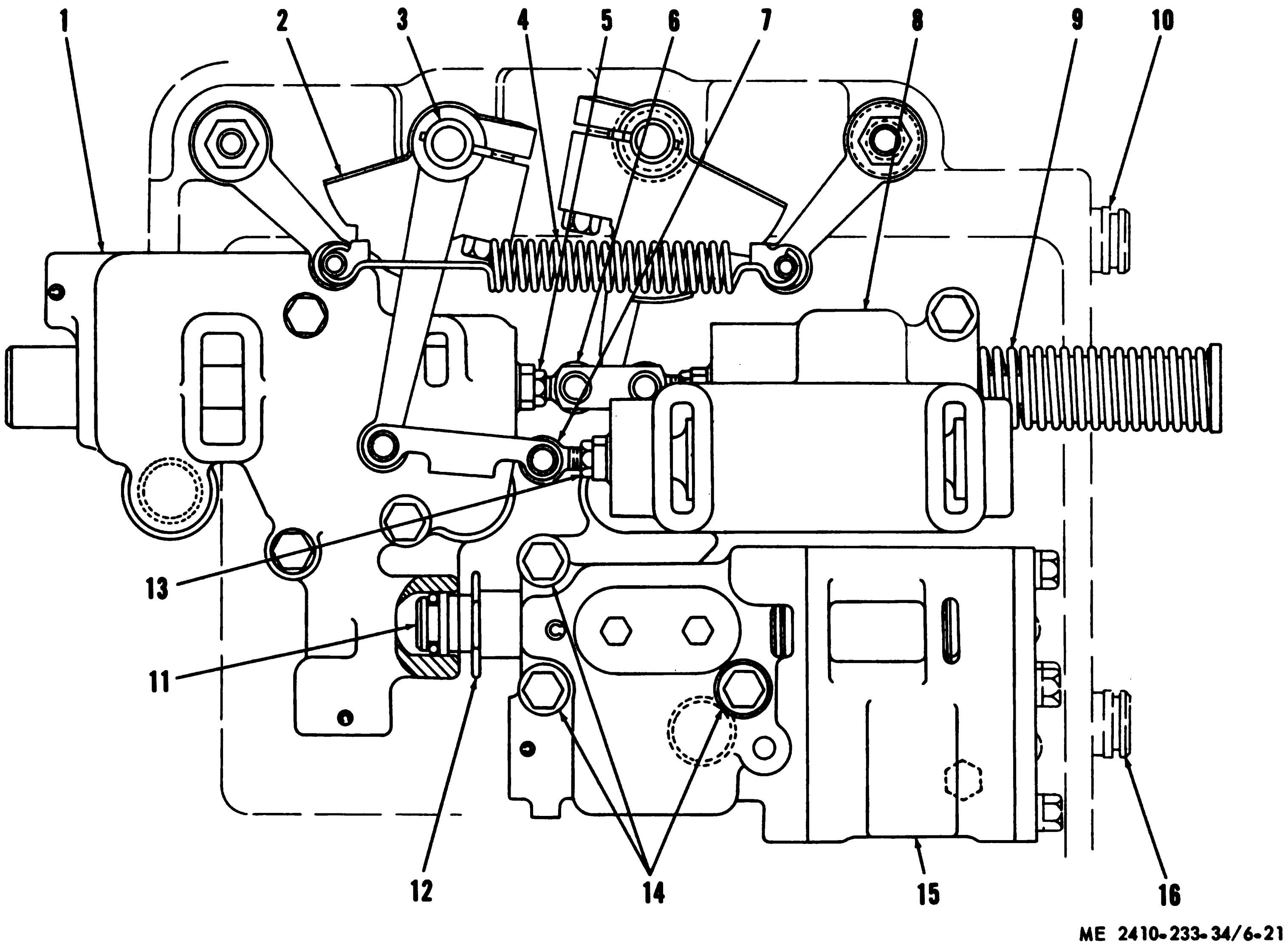
(11) Disconnect inlet pressure line from filter at transmission case and pry tube (10) forward until it clears speed selector valve housing (1).

(12) Remove bolts holding two valve housings (1) and (8) to transmission clutch housings.

(13) Remove clip (12) from tube (11), and slide tube (11) into speed selector valve housing (1) until tube clears housing (8).

(14) Lift valve housings up to clear tubes below them, and remove valve housings from case.

(15) Replace transmission top cover while hydraulic controls are out of transmission.



1 Speed selector valve housing
2 Lever
3 Shaft
4 Spring
5 Locknut
6 Eyebolt
7 Eyebolt
8 Safety and directional valve housing
9 Safety valve
10 Tube
11 Tube
12 Clip
13 Locknut
14 Bolts
15 Pressure control valve housing
16 Tube

Figure 6-21. Hydraulic control removal.

c. Hydraulic Control Disassembly and Assembly.

(1) *Pressure control valve disassembly.*

(a) Remove bolts (1, fig. 6-22) and cover (2).

(b) Separate housing (3) from housing (10).

(c) Remove springs (4) and (7).

(d) Remove retainer (5).

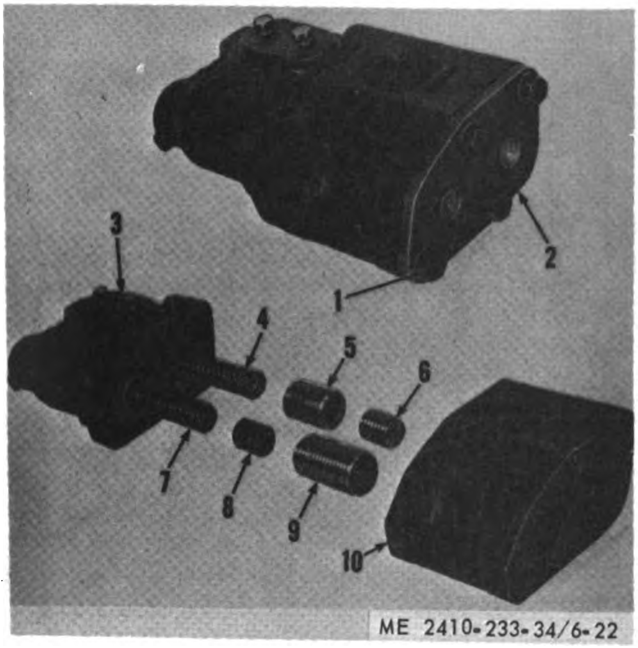
(e) Remove pistons (6) and (9) and spacers (8).

NOTE

Spacers (8) in piston (9) are used for pressure adjustment. Keep these spacers together, since they will be needed at time of assembly.

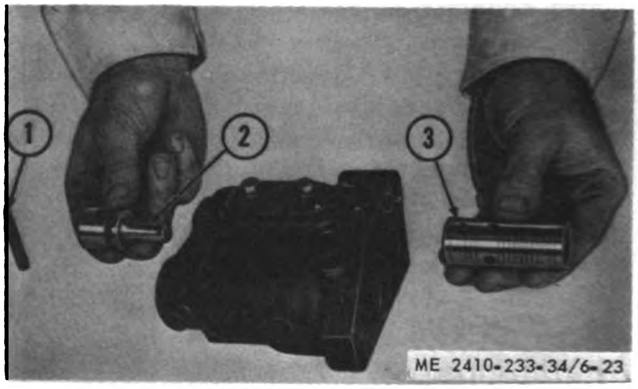
(f) Remove pin (1, fig. 6-23), stop (2) and piston (3).

(g) Remove pin (1, fig. 6-24) stop (2), slug (3), relief valve piston (4) and stop (5).



1 Bolts
2 Cover assembly
3 Housing
4 Spring
5 Retainer
6 Piston
7 Spring
8 Spacers
9 Piston
10 Housing

Figure 6-22. Disassembly of pressure control valve.

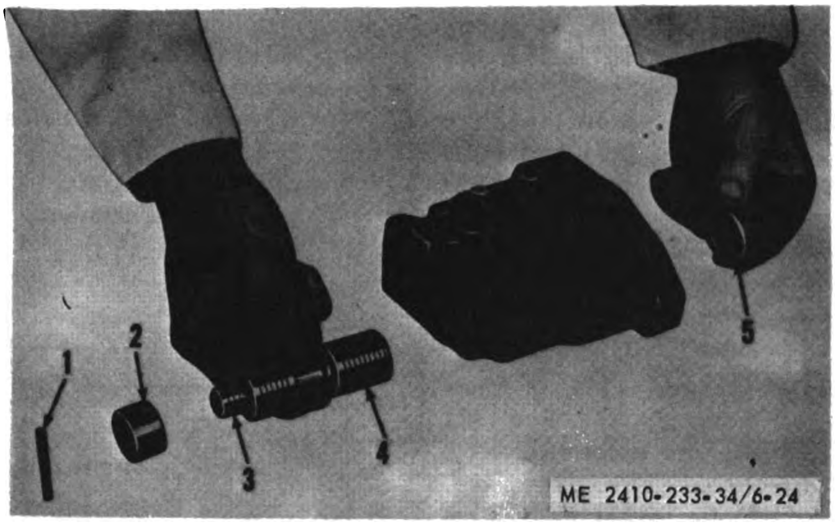


1 Pin
2 Stop
3 Differential valve piston

Figure 6-23. Differential valve removal.

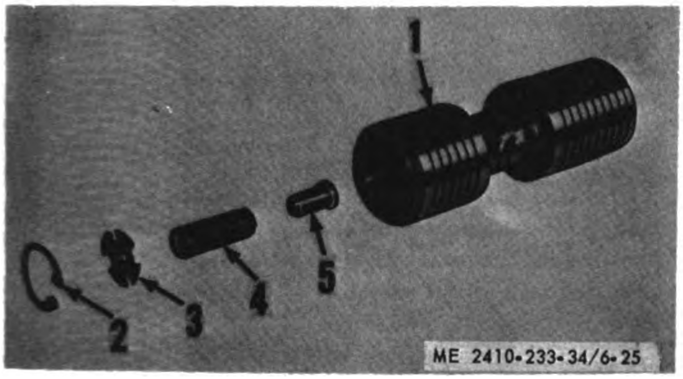
(h) Remove slug (3) from end of relief valve piston (4).

(i) Remove retainer ring (2, fig. 6-25) retainer (3), spring (4), and plunger (5) from relief valve piston (1).



1 Pin
2 Stop
3 Slug
4 Relief valve piston
5 Stop

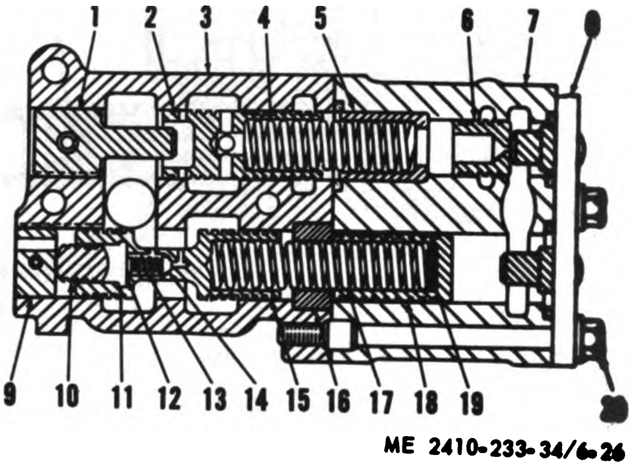
Figure 6-24. Pressure relief valve removal.



1 Relief valve piston
2 Retainer ring
3 Retainer
4 Spring
5 Plunger

Figure 6-25. Pressure relief valve disassembly.

(2) ***Pressure control valve inspection and repair.*** Inspect valve housings and pistons for nicks, burrs, or pitting. Inspect the valve body land edges for wear caused by recirculating of abrasive particles. Light scratches and light grey wear appearance are not detrimental to valve. Replace all springs when reconditioning a valve with appreciable service hours. Valves must move freely in housings. Be sure slug (10, fig. 6-26), is free to move in relief valve piston (15). Inspect pistons (6) and (15) to make certain orifices are open. Check drain hole in stop (9) to be sure it is open. Install new preformed packings when assembling control valve.



1 Stop
2 Differential valve piston
3 Housing
4 Spring
5 Retainer
6 Piston
7 Housing
8 Cover
9 Stop
10 Slug
11 Retainer ring
12 Retainer
13 Spring
14 Plunger
15 Relief valve piston
16 Stop
17 Spring
18 Piston
19 Spacers
20 Bolts

Figure 6-26. Pressure control valve assembly.

(3) *Pressure control valve reassembly.*

(a) Install plunger (14, fig. 6-26) spring (13), and retainer (12), into piston (15), and secure in place with retainer ring (11).

(b) Install slug (10) into piston (15).

(c) Install pistons (2) and (15) and stops (1), (9), and (16), into housing (3). Secure stops in place with pins.

(d) Install piston (6), retainer (5), and piston (18), into housing (7).

NOTE

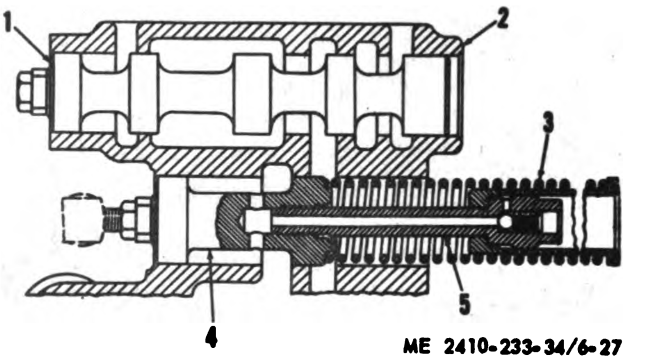
Install spacers (19) inside piston (18).

(e) With springs (4) and (17) in their proper location, fasten housings (3) and (7) together with bolts (20) through cover (8).

(4) *Safety and directional valve.*

(a) Safety valve (4, fig. 6-27) and directional valve (1) can be removed from valve housing (2) for inspection.

(b) Screw center stem out of valve (4) to remove spring (3).



1 Directional valve
2 Valve housing
3 Spring
4 Safety valve
5 Stem

Figure 6-27. Safety and directional valve disassembly.

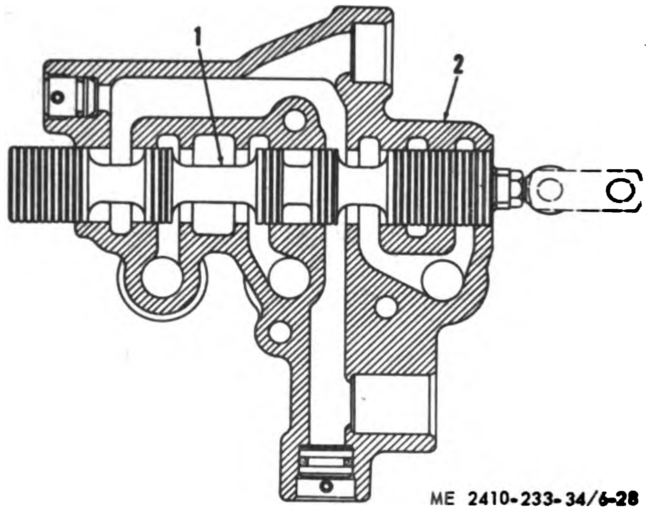
CAUTION

Valve stem (5) may be thrown with considerable force by spring (3) when threads are disengaged.

(c) When assembling safety valve, apply Liquid Lock on threads of valve stem (5), install valve stem into valve (4), and tighten to torque value listed in table 1-2. Do not hold valve (4) by finished lands.

(5) *Speed selector valve.* Speed selector valve stem (1, fig. 6-28) can be removed from valve housing (2) if necessary.

d. Linkage Adjustment.



1 Valve stem
2 Valve housing

Figure 6-28. Speed selector valve.

(1) *Internal adjustment.*

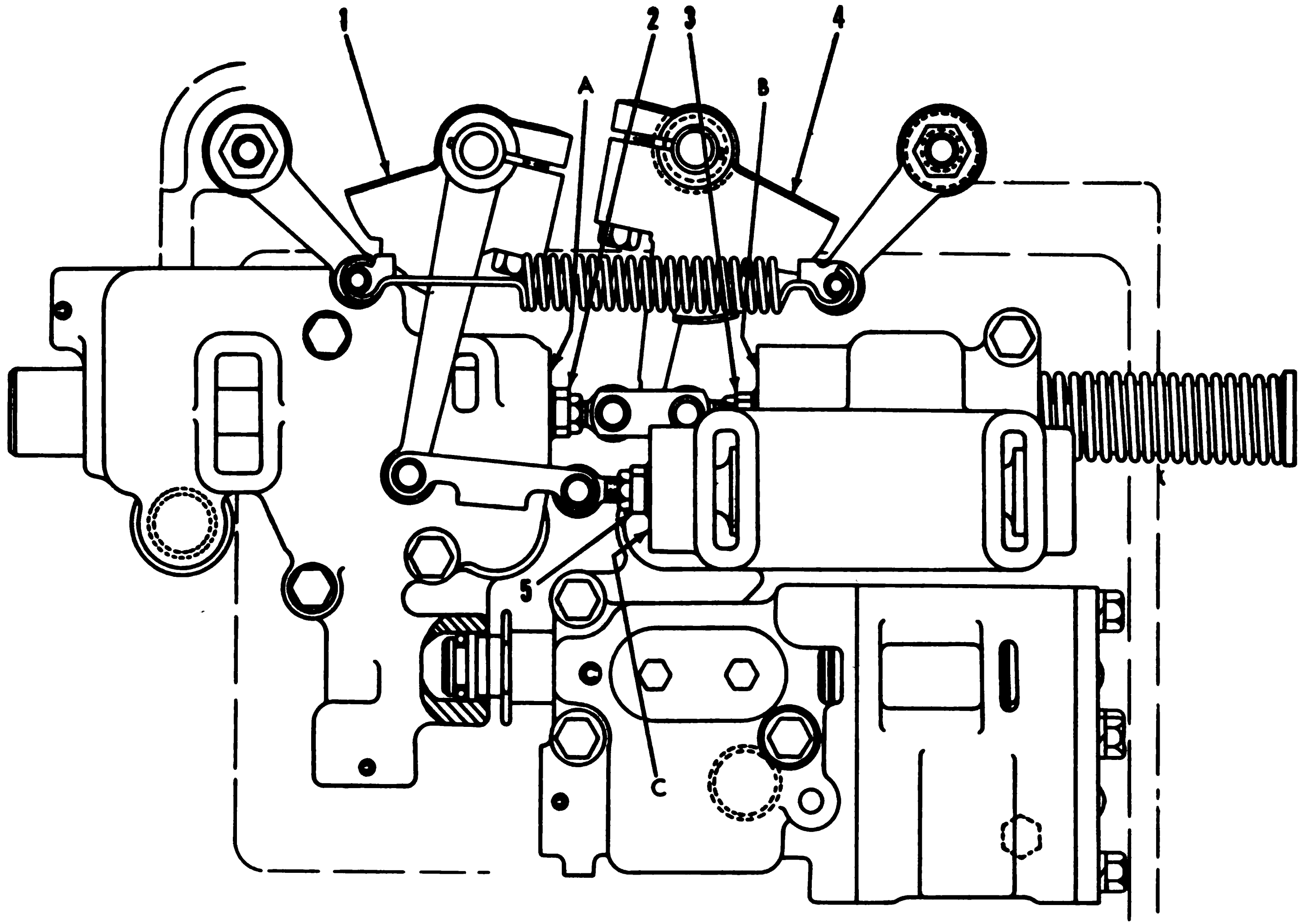
(a) When hydraulic controls are installed in transmission, control linkage should be adjusted to position directional valve stem (5, fig. 6-29), safety stem (3) and speed selector valve stem (2) properly in their selective housings.

(b) With levers (1) and (4) in positions shown, adjust threaded drag links in ends of valve stems so end of first land of each valve is flush with machined face of valve housing; the end of first land of valve stem (2) must be flush with surface (A), (3) with surface (B), and (5) with surface (C).

(2) *External adjustment.*

WARNING

Do not adjust linkage with engine running.



ME 2410-233-34/6-29

1	Lever	5	Directional valve stem
2	Speed selector valve stem	A	Surfaces of valve housing
3	Safety valve stem	B	Surfaces of valve housing
4	Lever	C	Surfaces of valve housing

Figure 6-29. Linkage adjustment.

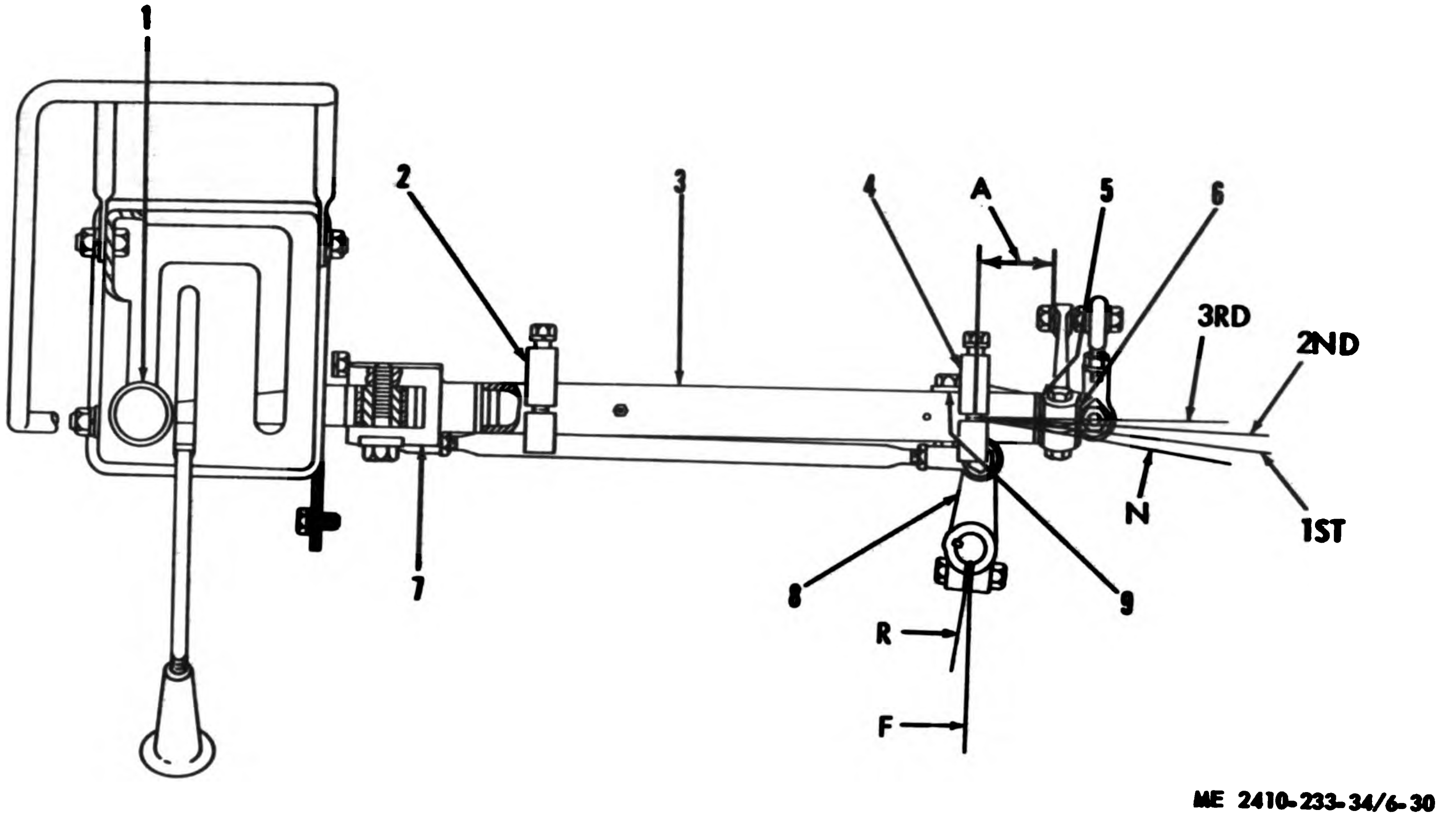
(a) Loosen clamp bolt in lever (6, fig. 6-30) on selector lever control shaft and, using a thickness gage between washer (5) and lever, position lever to obtain dimension given in table 1-4. Tighten clamp bolt.

(b) Loosen bolts in clamps (2) and (4) and position support (3) to obtain dimension (A) listed in table 1-4.

(c) With the connecting link disconnected, position lever (8) in forward detent.

Key to figure 6-30.

1 Selector lever
2 Clamp
3 Support
4 Clamp
5 Washer
6 Lever
7 Shaft assembly
8 Lever
9 Lever



A Dimension between centerline of transmission control shafts and left face of lever (6).

Figure 6-30. Linkage adjustment (top view).

(*d*) With the connecting link disconnected, position lever (9) in NEUTRAL detent.

(*e*) Position lever (1) in center of neutral slot.

(*f*) Adjust length of short rod to enter ends of levers (6) and (9).

(*g*) Place selector lever (1) in NEUTRAL position of forward slot.

(*h*) Adjust length of longer rod to enter the ends of levers (1) and (8).

NOTE

The chamfered side of the nuts which retain the connecting links to the levers should always face the ball section on the swivel ends.

6-5. Hydraulic Pump

a. General. The steering clutch and transmission hydraulic pump is a single section gear type pump which is bolted to the front of the rear power takeoff housing.

b. Removal and Installation. Refer to TM 5-2410-233-20 and remove or install the hydraulic pump.

c. Disassembly and Assembly.

(1) Refer to figure 6-31 and disassemble the pump.

(2) When the pump is disassembled, inspect oil seal (20) in cover assembly (18).

(3) Bolts (5) have flat washers which must be in place when the pump is assembled.

(4) Assemble the pump in the reverse order of disassembly.

(5) Fill the pump with clean oil and rotate the drive gear prior to installation. This will place a film of oil on the pump gears and body, and aid in priming the pump.

(6) Inspect the preformed packings and replace if necessary before connecting the hydraulic lines.

Key to figure 6-31.

1 Bolt
2 Washer
3 Screw
4 Washer
5 Bolt
6 Washer, flat
7 Manifold assembly
8 Packing
9 Bearing
10 Body assembly
11 Packing
12 Gear
13 Gear
14 Bearing
15 Bearing
16 Bolt
17 Washer
18 Cover assembly
19 Packing
20 Seal
21 Plug

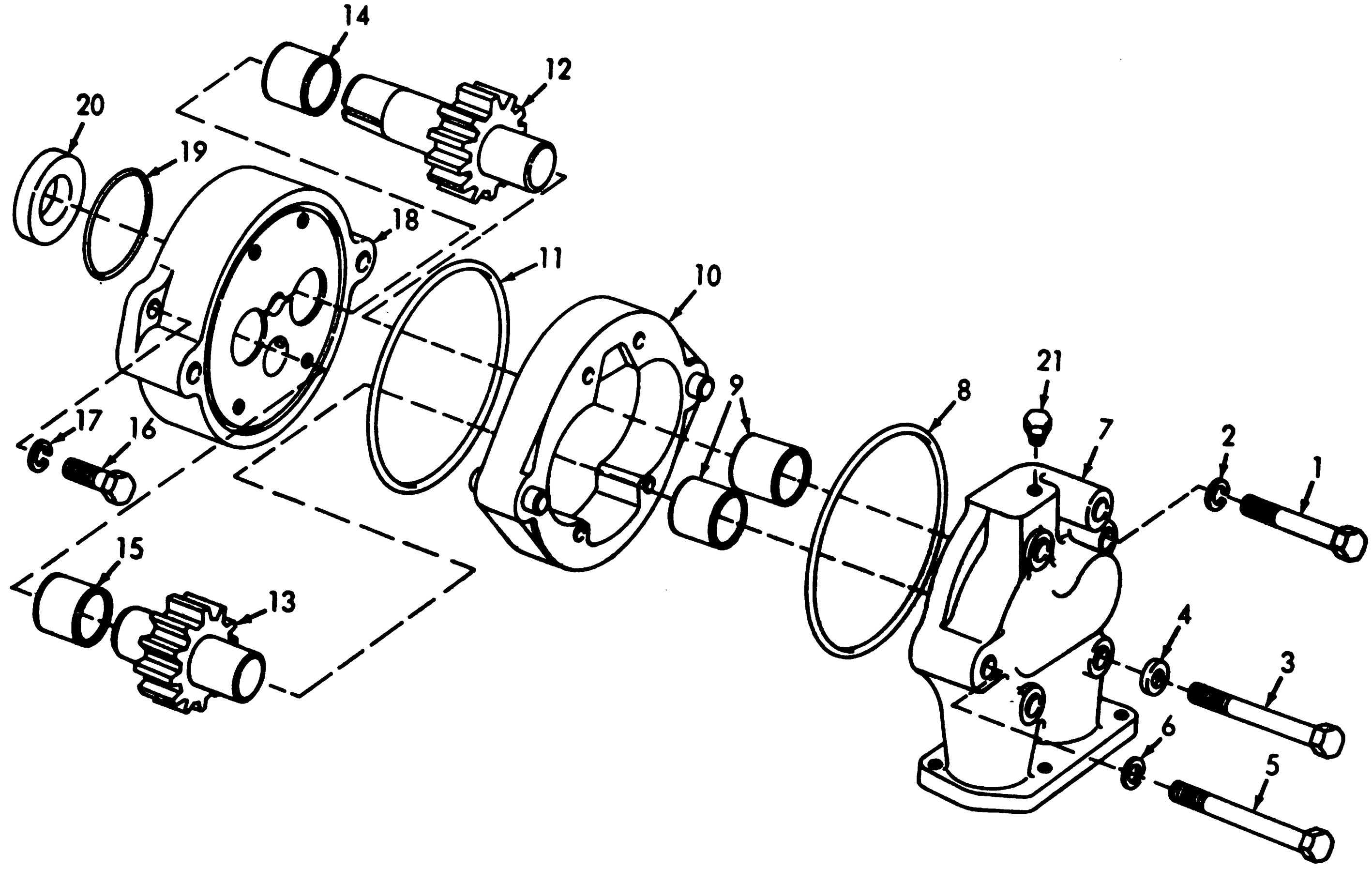


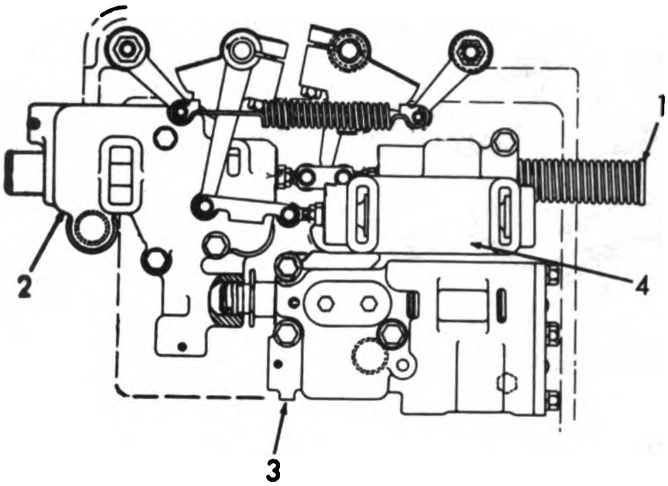
Figure 6-31. Hydraulic pump disassembly.

6-6. Torque Converter Inlet Relief Valve

a. General. The torque converter inlet relief valve is an integral part of the directional valve body assembly and is also located within the transmission case (fig. 6-32).

b. Removal. Refer to paragraph 6-4 and remove the directional valve body assembly from transmission case.

c. Disassembly. Refer to figure 6-33 and disassemble the inlet relief valve from directional valve body.



ME 2410-233-34/6-32

1 Safety valve
2 Speed selector body
3 Torque converter inlet relief valve
4 Directional valve body

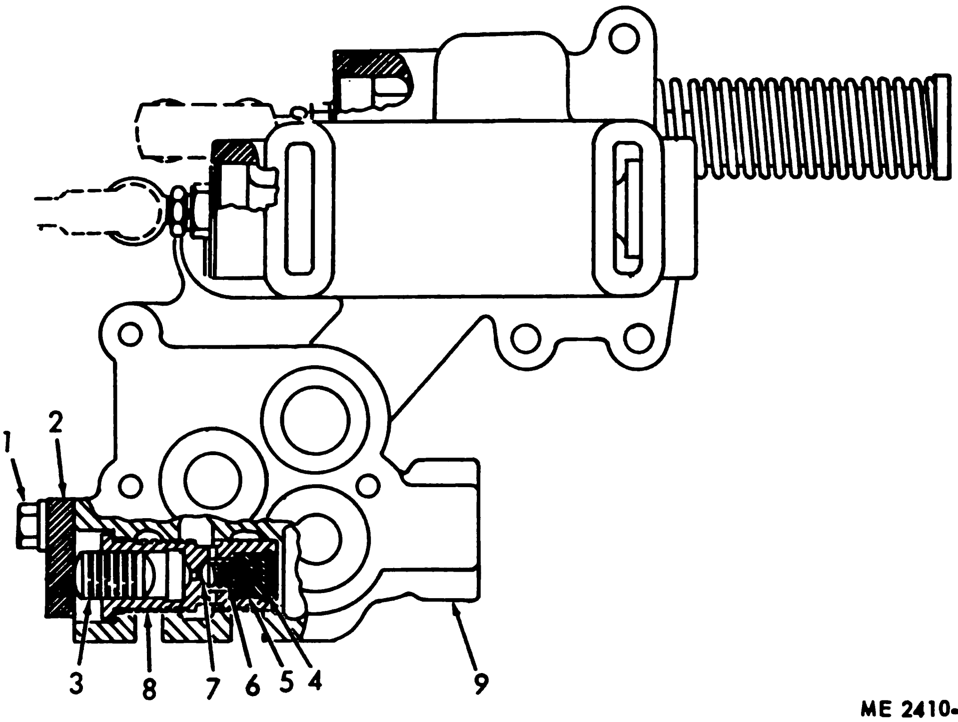
Figure 6-32. Torque converter inlet relief valve and directional valve body.

d. Inspection and Repair.

(1) Inspect the valve housing and valve for nicks, burrs, pitting and wear. Light scratches or a light grey wear appearance are not harmful to the valve. Examine the valve edges for wear. If wear or damage exists, replace valve assembly.

(2) Inspect inlet relief spring for damage and proper tension. Replace a defective or weak spring.

e. Reassembly and Installation: Reverse disassembly and removal procedure and assemble and install the torque converter inlet relief valve.



1 Bolt and washer
2 Cover
3 Slug
4 Ring
5 Stop
6 Spring
7 Plunger
8 Spool assembly
9 Directional valve body

Figure 6-33. Torque converter inlet relief valve.

6-7. Torque Converter Outlet Relief Valve

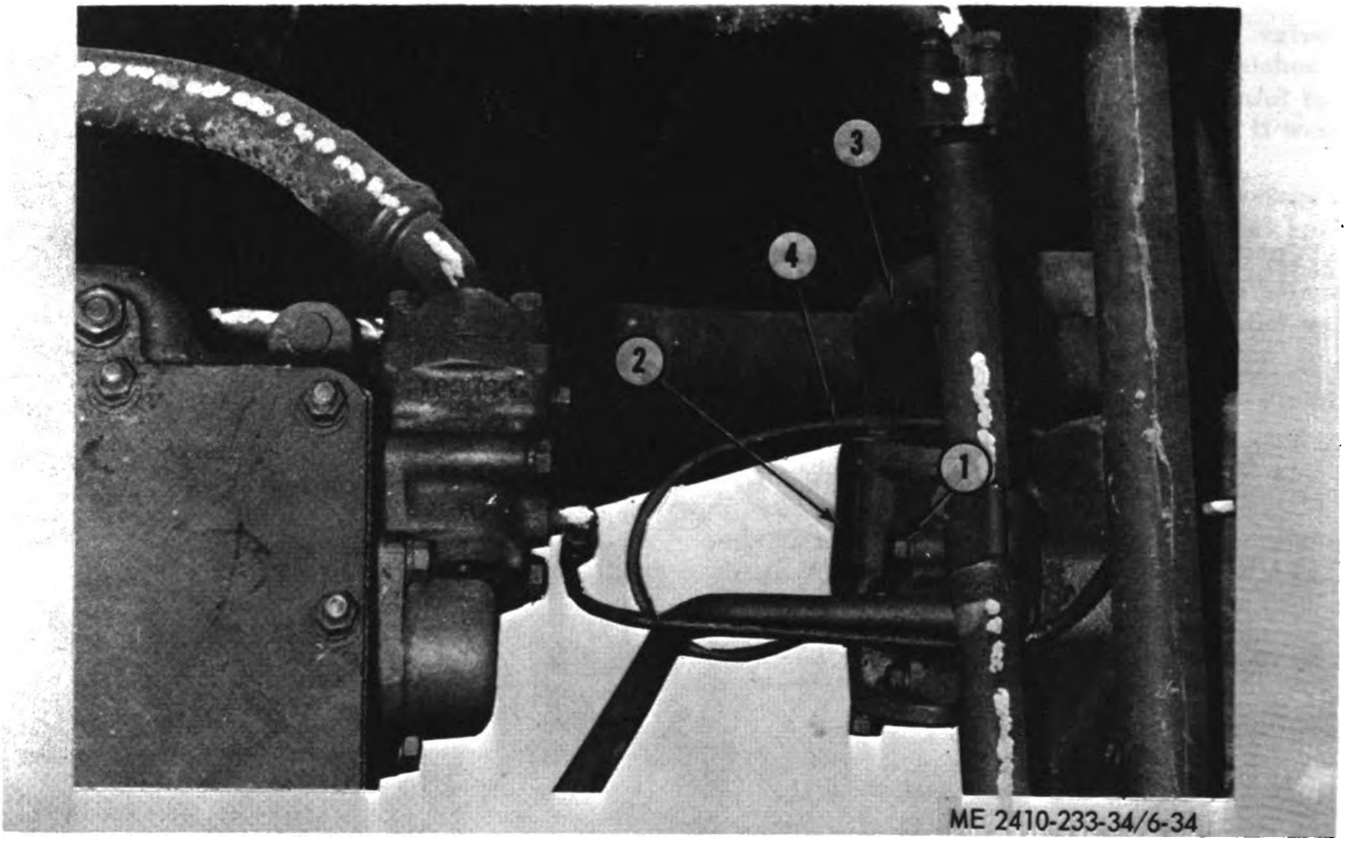
a. Removal and Installation.

(1) Remove the left front and center floor plates.

(2) Refer to TM 5-2410-233-20 and drain the torque converter hydraulic system.

(3) Disconnect oil lines (3, 4, fig. 6-34).

(4) Remove bolts (1) and outlet relief valve (2).



1 Bolts
2 Torque converter outlet relief valve
3 Torque divider to oil cooler line
4 Torque converter oil temperature bulb and gage line

Figure 6-34. Torque converter outlet relief valve removal.

b. Disassembly and Reassembly.

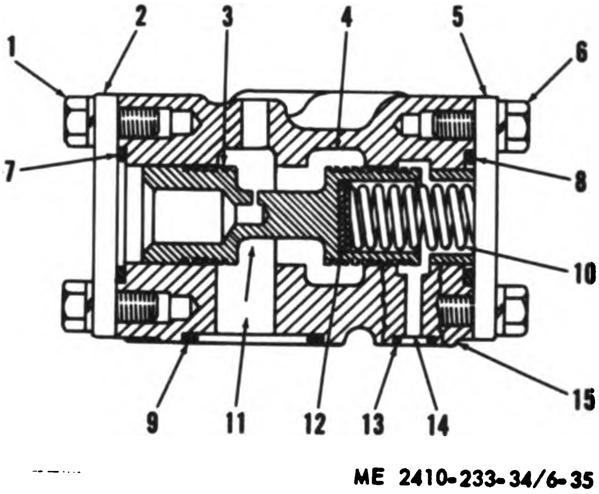
(1) Refer to figure 6-35 and disassemble the left outlet relief valve.

(2) Replace any damaged or worn part.

(3) Reassemble the outlet relief valve in the reverse order of disassembly.

NOTE

The orifice in valve (3) must be open and the valve installed in the body as illustrated.



1	Bolts	6	Bolt	11	Cavity
2	Cover	7	O-ring seals	12	Washers
3	Valve	8	O-ring seals	13	O-ring seal
4	Cavity	9	O-ring seals	14	Bleed passage
5	Cover	10	Spring	15	Valve housing

Figure 6-35. Outlet relief valve assembly.

c. Inspection and Repair.

(1) Inspect the valve housing and valve for nicks, burrs, pitting, and wear. Light scratches or a light grey wear appearance are not harmful to the valve. Examine the valve land edges for wear. If wear or damage exists, the complete valve assembly must be replaced.

(2) Inspect outlet relief valve spring for damage and proper tension. The outlet relief valve spring should exert 39.54 ± 3.16 pounds of force when compressed to 2.00 inches. Free length after test should be 2.98 inches. Spring diameter is 0.88 inch. Replace defective or weak spring.

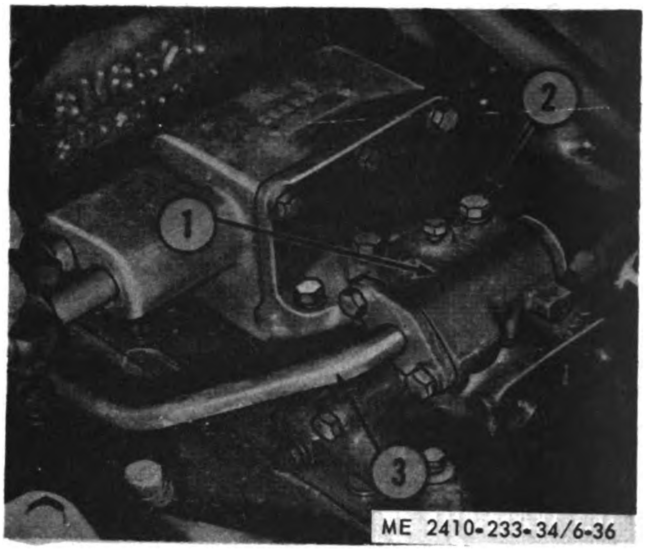
6-8. Transmission and Steering Clutch Control Check Valve

a. Removal and Installation.

(1) Refer to TM 5-2410-233-20 and drain the transmission and steering clutch hydraulic system.

(2) Disconnect oil supply line (3, fig. 6-36).

(3) Remove bolts (2) and check valve (1).

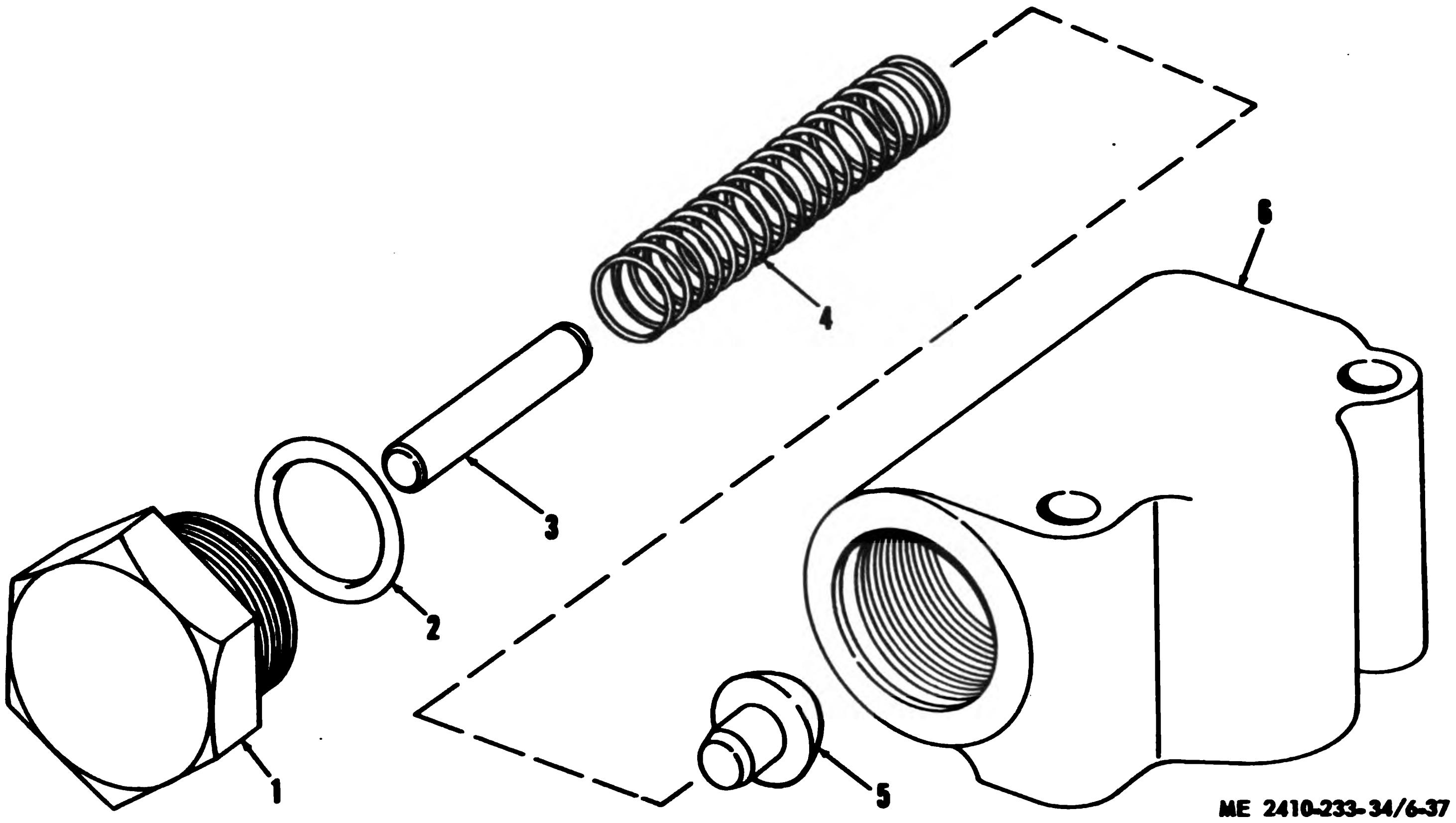


1 Check valve
2 Bolts
3 Oil supply line

Figure 6-36. Check valve removal.

(4) Install the relief valve in the reverse order of removal using new preformed packings.

b. Disassembly and Reassembly. Refer to figure 6-37 to disassemble and reassemble check valve.



1 Plug
2 Packing
3 Pin
4 Spring
5 Valve
6 Housing

Figure 6-37. Check valve disassembly.

c. Inspection and Repair.

(1) Inspect valve housing and valve for nicks, burrs, pitting, and wear. Examine the valve seat and valve for damage and proper seating. If wear or damage exists, replace the complete valve assembly.

(2) Inspect the check valve spring for damage and proper tension. The check valve spring should exert 5.75±0.50 pounds of force when compressed to 2.00 inches. Free length after test should be 3.281 inches. Spring diameter is 0.50 inch. Replace defective or weak spring.

NOTE

The minimum operating pressure for the steering clutch control valve (clutch disengaged, engine at low idle) is 265±15 psi.

6-9. Transmission

a. General.

(1) The power shift transmission utilizes planetary gearing and five hydraulically actuated clutches to provide three fo ard and three reverse speeds.

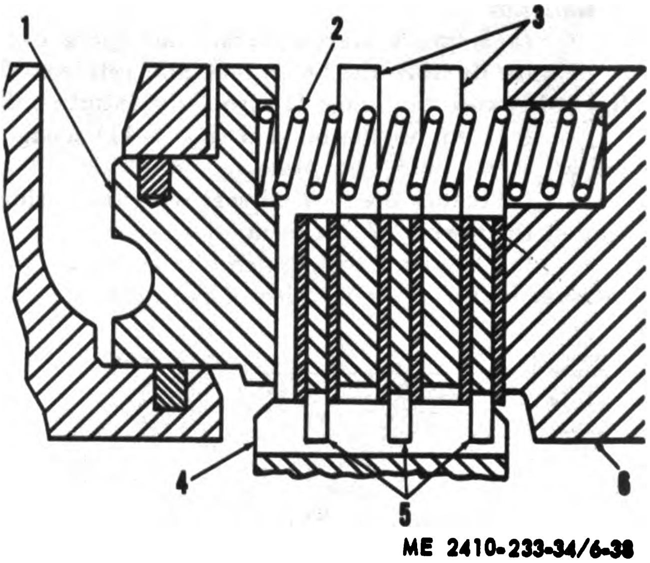
(2) The five transmission clutches are of the multiple disc type, and are contained in separate housings surrounding the ring gears of the transmission. The clutches have alternate discs (5, fig. 6-38) and plates (3). The discs (5) have internal teeth which mesh with external teeth on the ring gear (6). The plates (3) are notched to fit around pins in the clutch housings which prevent the plates from turning.

(3) The clutches are held disengaged by springs (2) which act between the clutch housing (4) and piston (1). To engage the clutch, oil is directed into the space behind the piston (1). Hydraulic pressure then moves the piston outward, pressing the plates (3) and discs (5) together and preventing the ring gear (6) from turning.

(4) The two front clutches (No. 1 and No. 2, fig. 6-39) are directional clutches, determining forward or reverse direction, and the three rear clutches (No. 3, No. 4 and No. 5) are speed clutches providing second, third and first speed respectively.

(5) Two clutches must be engaged in order to transmit power through the transmission. The following chart shows the combination of clutches engaged for each forward or reverse speed.

Speed	*Clutches engaged*
First forward	1-5
Second forward	1-3
Third forward	1-4
First reverse	2-5
Second reverse	2-3
Third reverse	2-4



1 Piston
2 Spring
3 Plates
4 Clutch housing
5 Discs
6 Ring gear

Figure 6-38. Clutch operation.

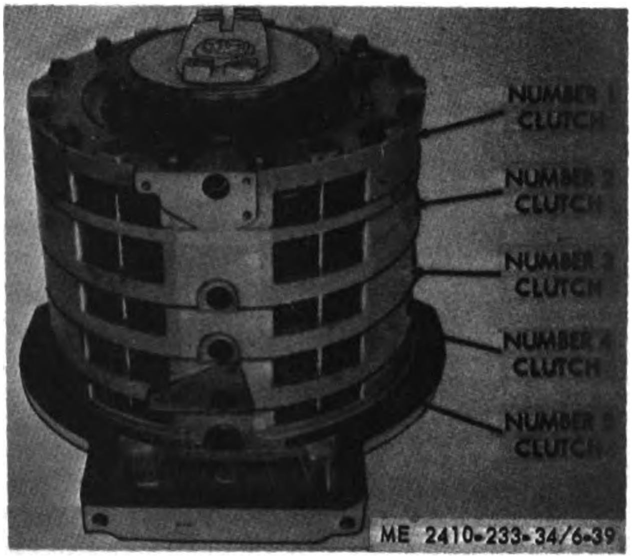


Figure 6-39. Clutch designation.

b. Transmission Reconditioning.

(1) Before disassembling the transmission, all dirt and grease accumulations should be removed from the exterior of the transmission case. The transmission should be disassembled and assembled in clean surroundings with clean tools. Dirt or grit introduced into the transmission will cause erratic operation and will shorten the service life of the transmission.

(2) *Input shaft front oil seal removal and installation.*

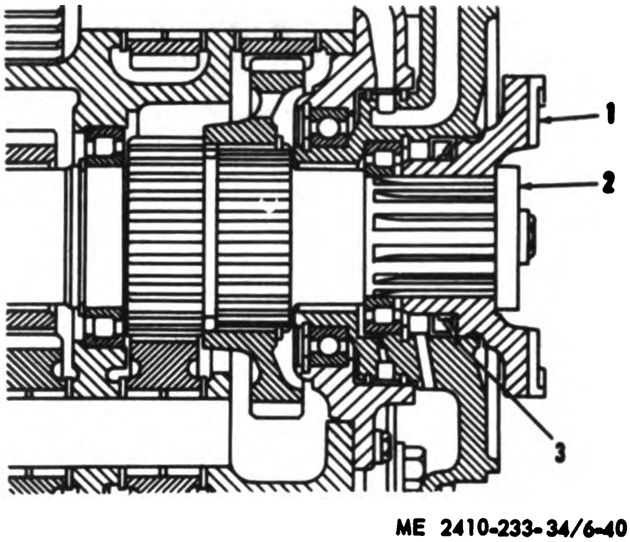
(a) Remove the universal joint (para 6-2).

(b) Remove the bolts, lock and retainer (2, fig. 6-40) and the flange (1) from the input shaft.

(c) Remove the oil seal (fig. 6-41) using a puller, screw, and step plate.

(d) Install the new oil seal with the spring-loaded lip toward the transmission.

(e) Replace the flange, bolts, lock, and retainer in the reverse order of removal.



1 Flange
2 Bolts, lock, and retainer
3 Oil seal

Figure 6-40. Preparing to remove input shaft front oil seal.

Figure 6-41. Removing input shaft front oil seal.

c. Transmission Case Removal.

(1) Position the transmission assembly on end, input end up.

(2) Remove control levers from shafts (6, fig. 6-42).

NOTE

The keys which position the control levers on the shafts (6) should be removed after the levers are removed.

(3) Remove covers (1) and (4).

(4) Remove tube (2) and tube from under cover (1).

(5) Inspect O-ring seal (3) and preformed packing at other end of tubes. Replace if damaged.

(6) Remove lubrication valve (5) nuts and lockwashers (7).

(7) Remove transmission cover (8).

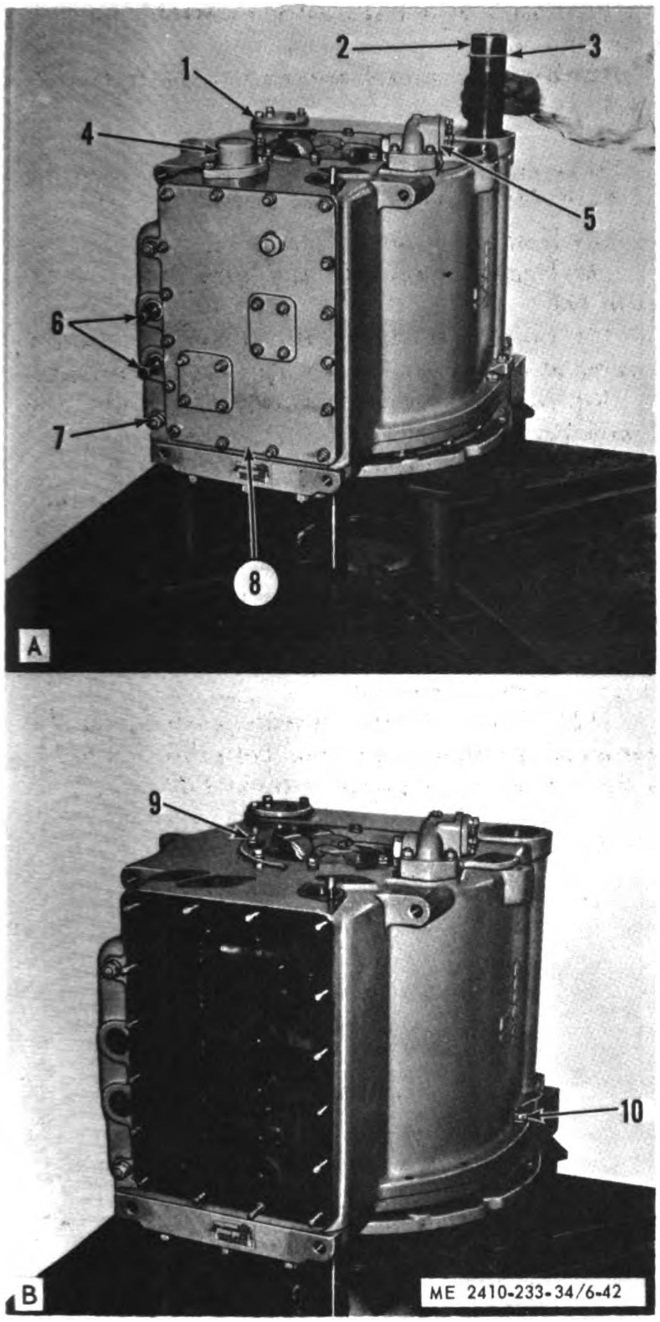
(8) Remove the transmission hydraulic controls (para 6-4).

(9) Remove bolts (9), nuts and bolts (10).

(10) Install two ¾ inch (NC) eyebolts and lift off the transmission case (fig. 6-43).

(11) Install the transmission case in the reverse order of removal.

(12) Tighten the transmission case to transfer gear housing retaining nuts and bolts (10, fig. 6-42) to the torque value given in table 1-2.



1 Cover
2 Tube
3 O-ring seal
4 Cover
5 Lubrication valve
6 Control shafts
7 Nuts and lockwashers
8 Transmission cover
9 Bolts
10 Nuts and bolts

Figure 6-42. Preparing to remove transmission case.

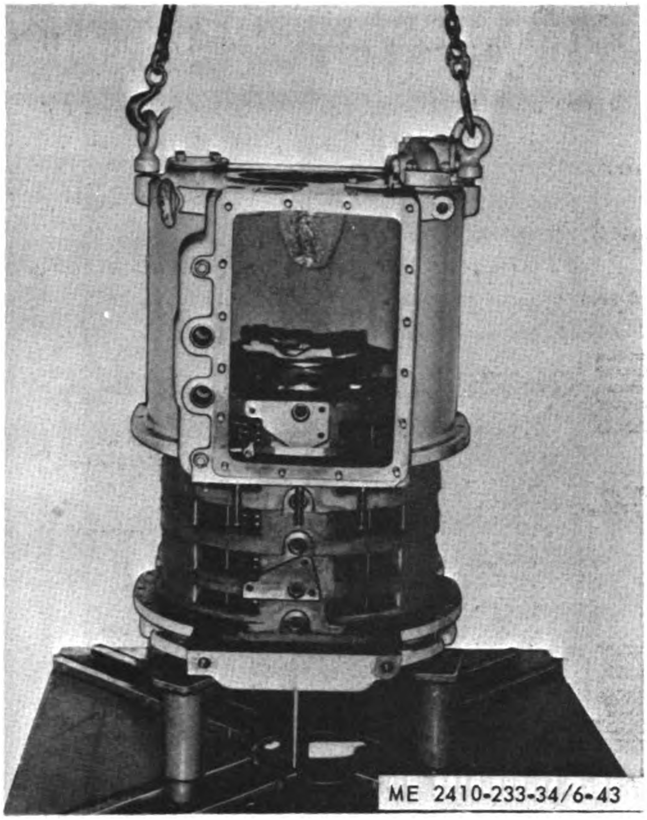


Figure 6-43. Removing transmission case.

d. Checking Transmission Clutches With Air.

(1) After assembly of a power shift transmission (prior to installation of the transmission case) each clutch piston can be checked with the aid of a simple tool setup and compressed air. This preliminary check points out assembly problems which can be easily corrected at this stage, but are very difficult to repair once the unit is installed in the machine.

(2) The checking tool is fabricated from a sleeve, seal, bushing, and pipe nipple, (fig. 6-43), special tool.

(3) The clutch packs can be checked, one at a time, by inserting the tool sleeve into the inlet port as shown in figure 6-44 and injecting air under pressure. If the clutch pistons are operating properly, there should be approximately ⅛ inch — ¼ inch travel in each piston, with very little leakage. If any of the pistons fail to move, this is an indication of binding and the transmission should be disassembled to determine the cause.

(4) To check the input shaft seals, insert the air tool into the opening shown in figure 6-44 and inject air under pressure (not to exceed 80 psi).

NOTE

The input shaft assembly must be installed in the transmission before performing this check. The seals will leak very slowly if properly installed.

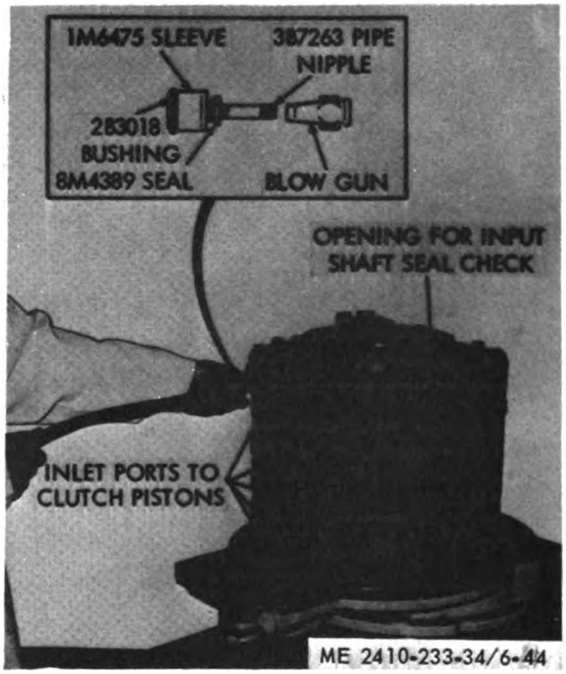


Figure 6-44. Checking clutch operation.

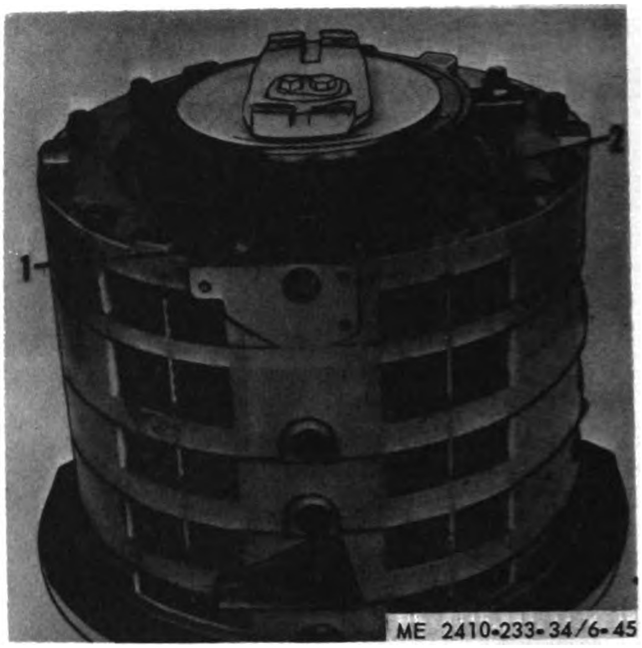
e. Input Shaft Removal and Installation.

(1) Remove bolts (1, fig. 6-45) that secure the cage (2) to the No. 1 carrier.

(2) Install two ⅜ inch — 16 (NC) eyebolts and lift the input shaft from the transmission (fig. 6-46).

(3) Install the input shaft in the reverse order of removal.

(4) Tighten the bearing cage to No. 1 carrier retaining bolts (1) to the torque value given in table 1-2.



1 Bolts
2 Cage

Figure 6-45. Preparing to remove input shaft.

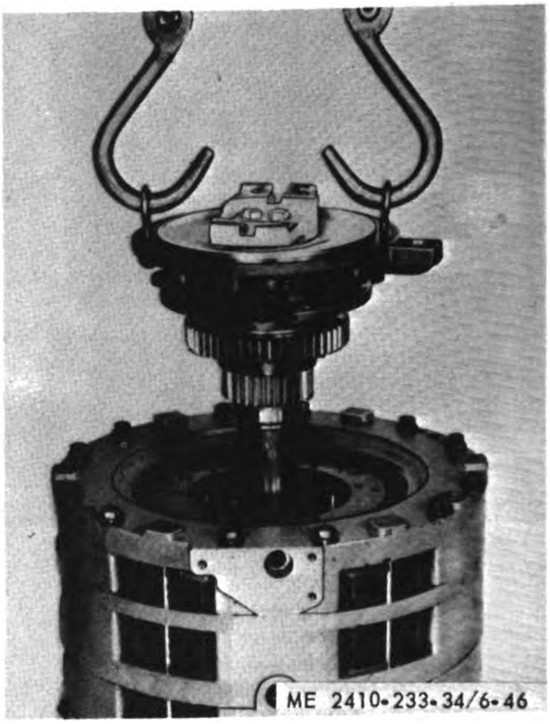


Figure 6-46. Removing input shaft.

f. Removal and Installation of Clutches and Carriers.

NOTE

Prior to disassembly, identify and mark each of the clutch housings. They must be installed in the same position and location from which they are removed.

(1) Remove bolts (1, fig. 6-47).

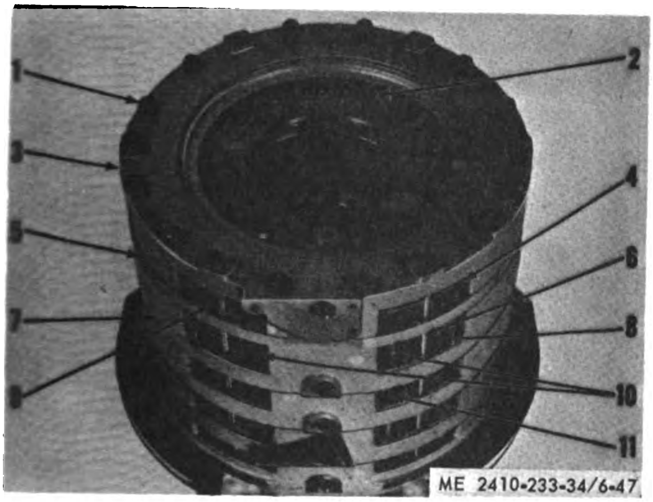
CAUTION

During removal and installation of the No. 1 clutch housing (3) and piston (4), fold the piston securely inside the clutch housing to prevent it from falling out and causing damage to parts.

(2) Remove No. 1 clutch housing (3), piston (4), and No. 2 clutch housing (7).

NOTE

Removal of the No. 1 and No. 2 clutch housings can be facilitated by the use of ½ inch—13 (NC) eyebolts. During removal of the No. 2 clutch housing, some of the springs (11) may drop out. There are twelve of these springs between No. 2 and No. 3 clutch housings. There are also twelve springs between No. 3 and No. 4, as well as No. 4 and No. 5 clutch housings.



1 Bolts
2 No. 1 clutch ring gear
3 No. 1 clutch housing
4 No. 1 clutch piston
5 Plate assembly
6 Clutch reaction pins
7 No. 2 clutch housing
8 No. 2 clutch plates and disc assemblies
9 No. 1 clutch plates and disc assemblies
10 Springs
11 Springs

Figure 6-47. Removal of No. 1 and No. 2 clutch.

(3) Remove No. 1 clutch ring gear (2), plate assembly (5), clutch reaction pins (6), No. 1 clutch plates and disc assemblies (9).

(4) Remove No. 2 clutch plates and disc assemblies (8) and springs (10) and (11).

(5) Install ⅜ inch — 16 (NC) eyebolts and remove the No. 1 carrier (fig. 6-48).

(6) Remove bolts, locks, and plates (1, fig. 6-49) and No. 2 clutch ring gear (2).

(7) Install ½ inch — 13 (NC) eyebolts and lift off the No. 3 clutch housing (3) disc assemblies and plates as a unit.

NOTE

The No. 4 and No. 5 clutch housings (4) and (7) can be removed in the same manner as the No. 3 clutch housing (3).

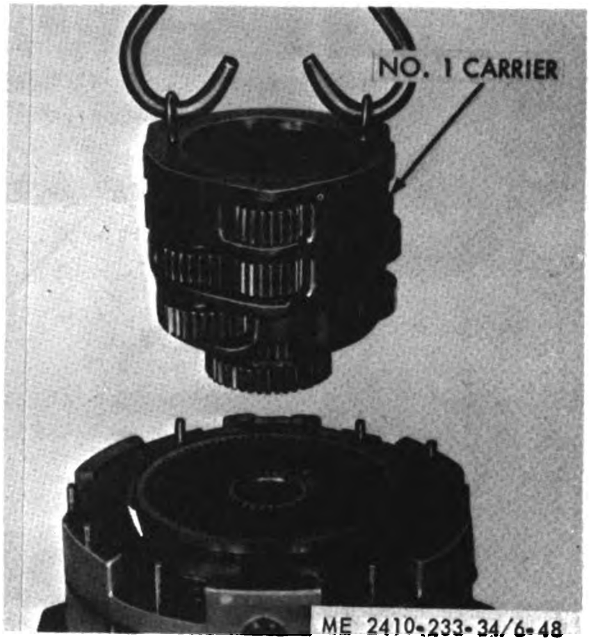
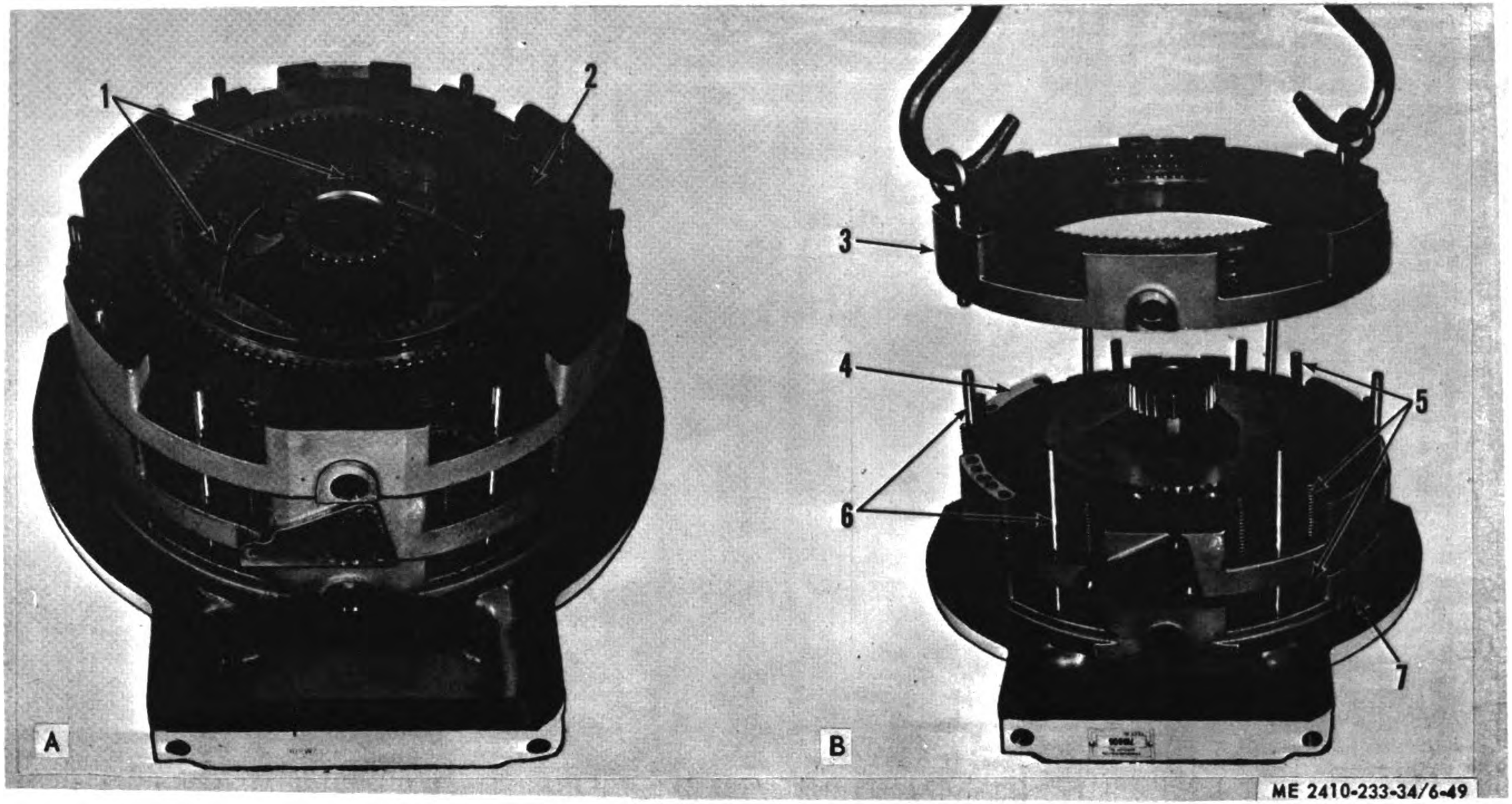


Figure 6-48. Removing No. 1 carrier.



1 Bolts, locks, and plates
2 No. 2 clutch ring gear
3 No. 3 clutch housing
4 No. 4 clutch housing
5 Springs
6 Clutch reaction pins
7 No. 5 clutch housing

Figure 6-49. Removing No. 3 clutch housing.

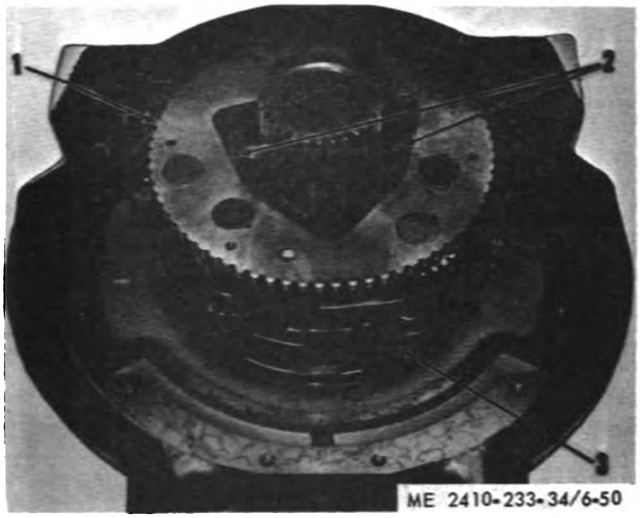
(8) Remove the No. 2 carrier (1, fig. 6-50), bolts (2), and bolts and locks (3).

(9) Remove bolts and locks (1, fig. 6-51).

(10) Install ⅜ inch-16 (NC) eyebolts in the tapped holes provided and remove the output shaft (2).

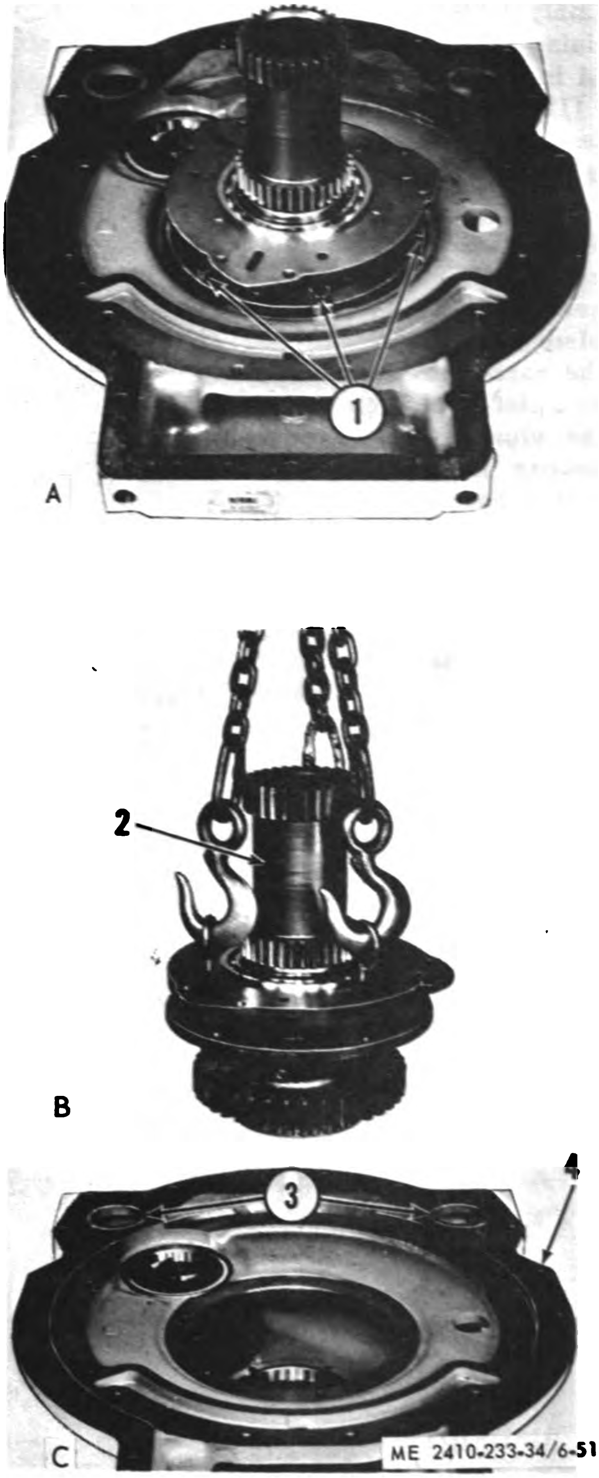
NOTE

Cover the openings (3) when installing the carriers and clutches to prevent the loss of parts into the transfer gear case.



1 No. 2 carrier
2 Bolts
3 Bolts and locks

Figure 6-50. No. 2 carrier removal.



1 Bolts and locks
2 Output shaft
3 Openings
4 Transfer gearcase

Figure 6-51. Removing output shaft.

(11) Inspect and replace all worn parts before assembling the transmission. At the time of assembly tighten the No. 2 carrier to bearing cage, retaining bolts (2, 3, fig. 6-50) to the torque value listed in table 1-2.

(12) All worn, damaged, or warped clutch plates and disc assemblies should be replaced when installing the clutches.

CAUTION

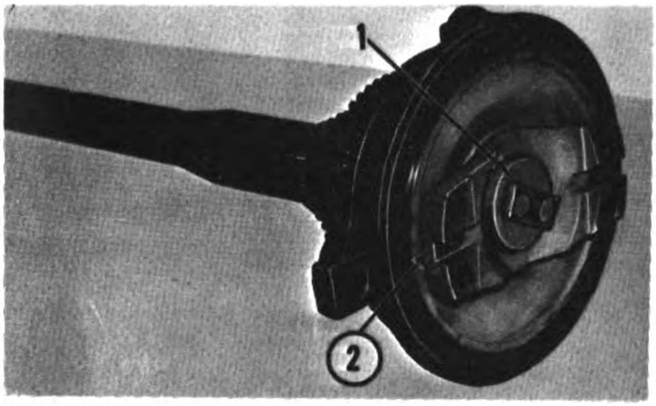
When installing the clutches, install the clutch housing first, then install the ring gear followed by a disc assembly and plate alternately (subpara *j* below) for the correct number of disc assemblies and plates for each clutch. Make certain the clutch reaction pins are in their proper location and the springs are seated correctly. The ring gear for the No. 5 clutch should be installed with the face having the smaller outer diameter toward the input end of the transmission. The clutch housing for the No. 1 clutch is installed inverted with respect to the other clutches. Installation of the clutch housings can be facilitated by using three of the long retaining bolts as guide pins.

(13) Complete the installation in the reverse order of removal and tighten the clutch housing retaining bolts (1, fig. 6-47) to the value given in table 1-2.

g. Input Shaft Disassembly and Assembly.

(1) Remove bolts, lock, and retainer (1, fig. 6-52), and input flange (2).

(2) Slide the bearing cage (2, fig. 6-53) and bearing cage and oil manifold (3) from the input shaft (1) while removing the ring (4) at the same time.



ME 2410-233-34/6-52

1 Bolts, lock, and retainer
2 Input flange

Figure 6-52. Preparing to disassemble input shaft.

ME 2410-233-34/6-53

1 Input shaft
2 Bearing cage
3 Bearing cage and oil manifold
4 Ring

Figure 6-53. Bearing cage removal.

(3) Remove the oil seal (fig. 6-54) by tapping it from the rear with a small block of wood.

(4) Remove the retainer ring (fig. 6-55).

NOTE

The oil seal is correctly installed with the spring-loaded lip toward the rear of the transmission.

Figure 6-54. Oil seal removal.

Figure 6-55. Retainer ring removal.

(5) Separate the bearing cage (1, fig. 6-56) from the bearing cage and oil manifold (2).

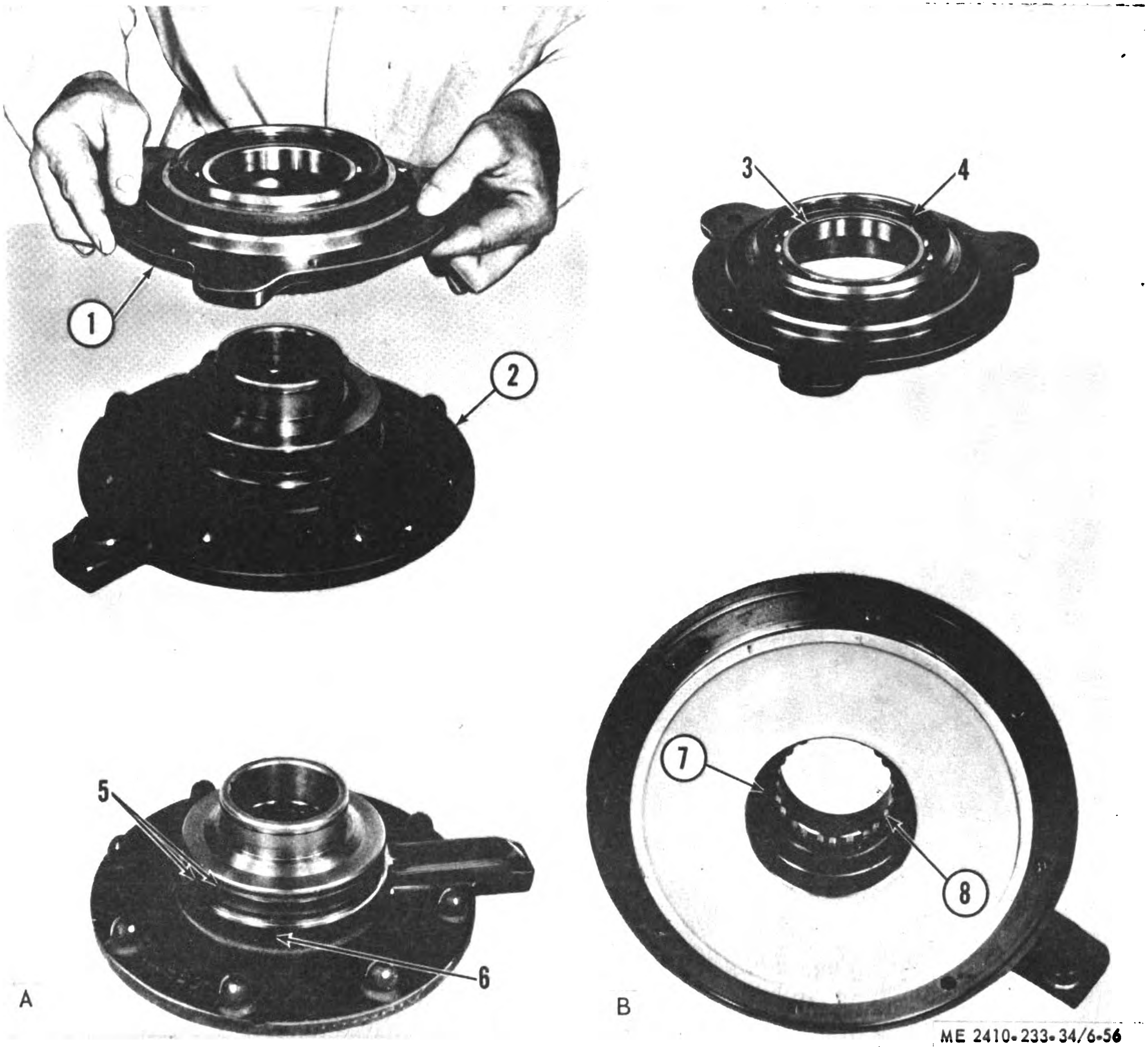


Figure 6-56. Bearing cage disassembly.

Key to figure 6-56.
1 Bearing cage
2 Bearing cage and oil manifold
3 Bearing
4 Lockring
5 Piston ring-type seals
6 Seal drain hole
7 Lockring
8 Bearing

(6) Inspect the bearing (3) for wear or damage. Remove the lockring (4) if bearing replacement is necessary.

(7) Inspect the piston ring-type seals (5) for wear or damage and replace them, if necessary.

NOTE

Be sure the seal drain hole (6) is not plugged.

(8) Inspect the bearing (8) for wear or damage. If replacement is necessary, remove the lockring (7) and press out the bearing.

(9) Remove No. 1 sun gear (1, fig. 6-57) lockrings (2) and (3) and bearing race (4) if necessary.

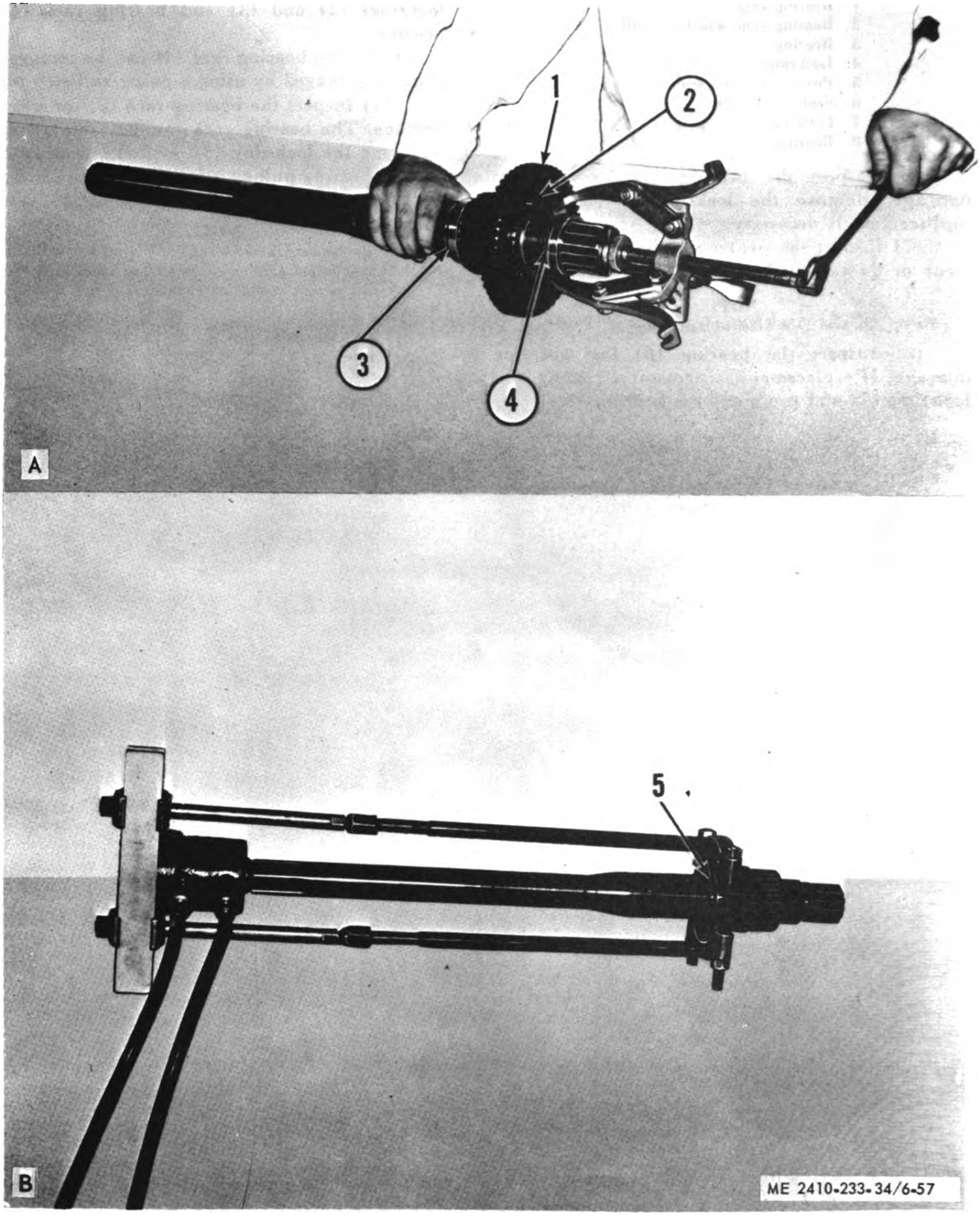
(10) The bearing race (4) can be removed if worn or damaged by using a puller and step plate.

(11) Inspect the bearing race (5) for wear or damage. The bearing race can be removed after removing the lock-ring (3). Pull the bearing race using a bearing pulling attachment, a puller and a hydraulic puller.

NOTE

Heat the bearing races (4) and (5) in oil to facilitate their installation. Chilling the bearings (3 and 8, fig. 6-56) will permit easier installation into the bearing cages.

(12) Assemble the input shaft in the reverse order of disassembly.



1 No. 1 sun gear
2 Lockring
3 Lockring
4 Bearing race
5 Bearing race

Figure 6-57. Bearing race and sun gear removal.

h. No. 1 Carrier Disassembly and Assembly.

(1) Position the No. 1 carrier (4, fig. 6-58) with the No. 4 sun gear (1) on top.

(2) Remove No. 4 sun gear (1), bolts and locks (2) and plates (3).

(3) Position the No. 1 carrier on its side.

(4) Pull the planet gear shaft (1, fig. 6-59) part of the way out of the carrier and remove the No. 2 inner planet gear (9), washers (10) and bearings (8).

(5) Pull the shaft (1) from the carrier and remove the No. 3 planet gears (7) complete with bearings and washers.

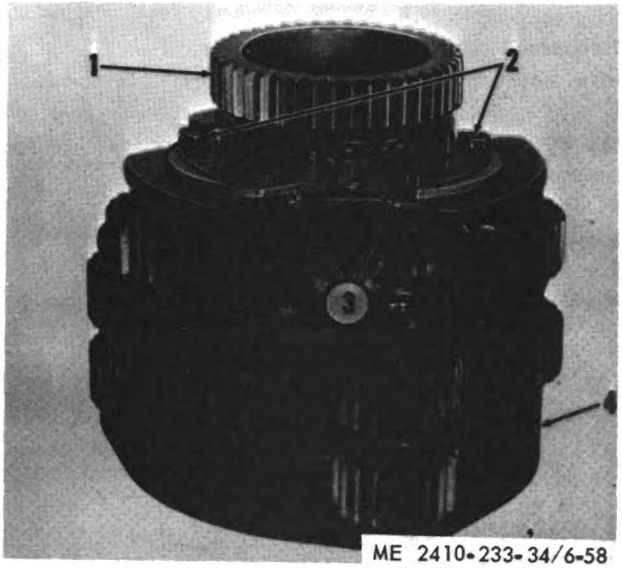
NOTE

Use care to avoid loss of the balls (2) and (4) in each of the shafts (3) and (1). Two bearings (8) and two washers (10) one on either side of each planet gear, are provided with each planet gear in the carrier. Three planet gear shafts are removed from each end of the carrier. The No. 2 outer planet gears (5) and No. 1 planet gears (6) can be removed after removing the planet gear shafts (3).

(6) Inspect all gears, bearings, washers and shafts in the carrier and replace any that are worn or damaged.

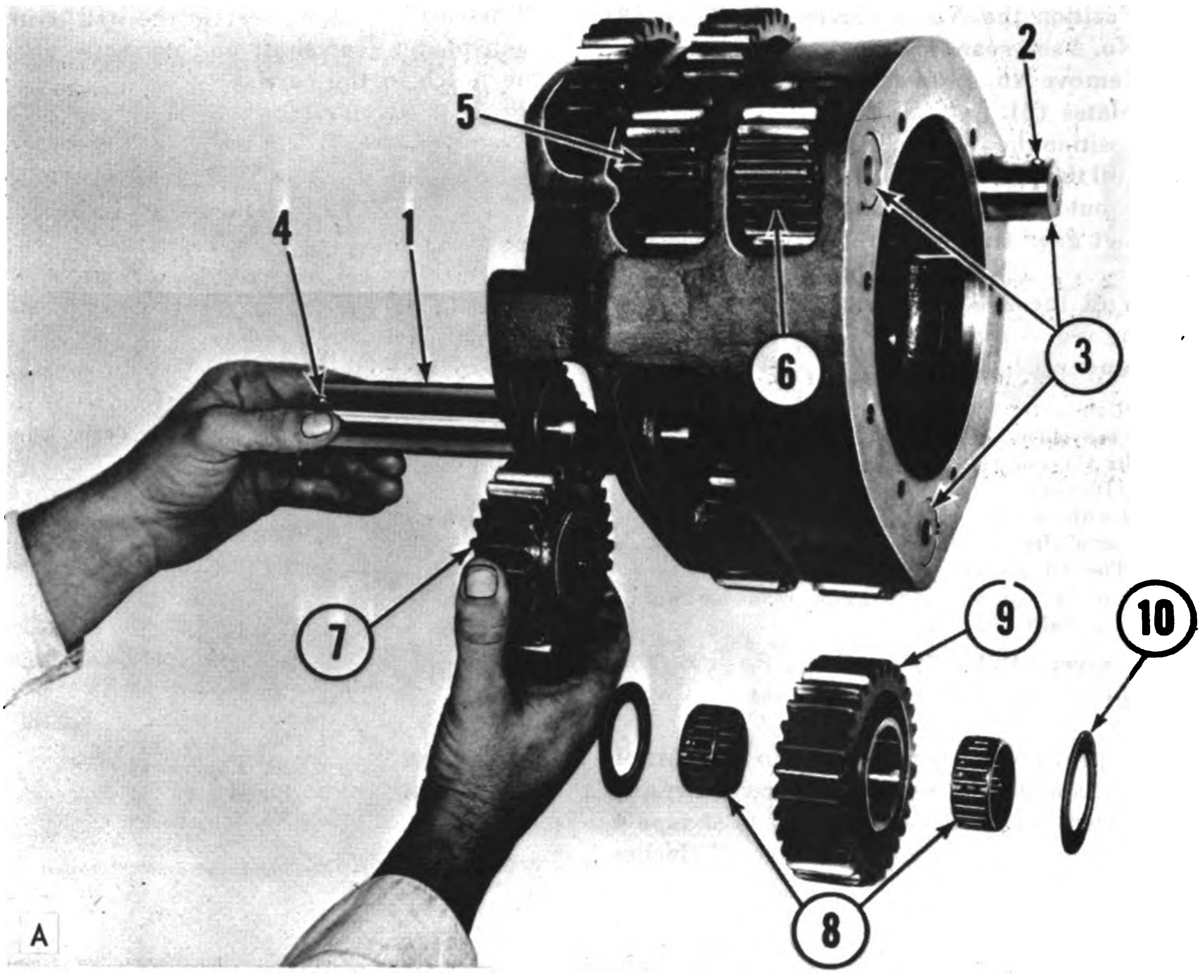
(7) Inspect the support bearing in the carrier for wear or damage and replace it if necessary, by pressing it from the carrier, using a piece of pipe 4 inches in diameter and approximately 5 inches long.

(8) Assemble the carrier in the reverse order of disassembly making certain the ball is in place in each planet gear shaft and correctly aligned with the notch in the carrier.



1 No. 4 sun gear
2 Bolts and locks
3 Plates
4 No. 1 carrier

Figure 6-58. No. 4 sun gear removal.



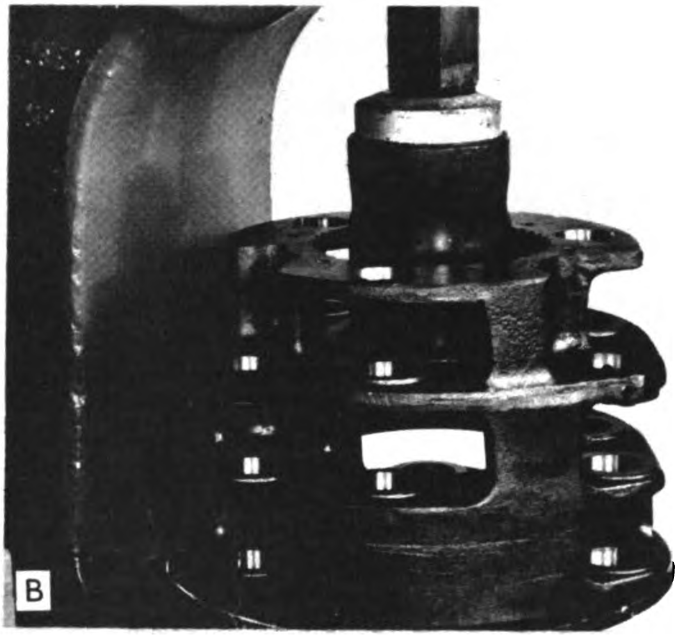


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Figure 6-59. No. 1 carrier disassembly.

Key to figure 6-59.

1 Planet gear shaft
2 Ball
3 Planet gear shafts
4 Ball
5 No. 2 outer planet gear
6 No. 1 planet gear
7 No. 3 planet gear
8 Planet gear bearings
9 No. 2 inner planet gear
10 Washer

i. No. 2 Carrier Disassembly and Assembly.

(1) Position the No. 2 carrier (1, fig. 6-60) as shown.

(2) Pull the planet gear shafts (2) part of the way out of the carrier and remove the No. 5 planet gears (3), washers (6) and bearings (7).

(3) Pull the shafts (2) from the carrier and remove the No. 4 inner planet gears (5) together with the bearings and washers.

NOTE

Use care to avoid loss of the balls (4) and (9) in the planet gear shafts (2) and (8). Two bearings (7) and two washers (6), one on either side of each planet gear, are provided with each planet gear in the carrier.

(4) The No. 4 outer planet gears (10) complete with bearings and washers can be removed after removing the planet gear shafts (8).

(5) Inspect all gears, bearings, washers and shafts in the carrier and replace any that are worn or damaged.

(6) Assemble the carrier in the reverse order of disassembly making certain the ball is in place in each planet gear shaft and correctly aligned with the notch in the carrier.

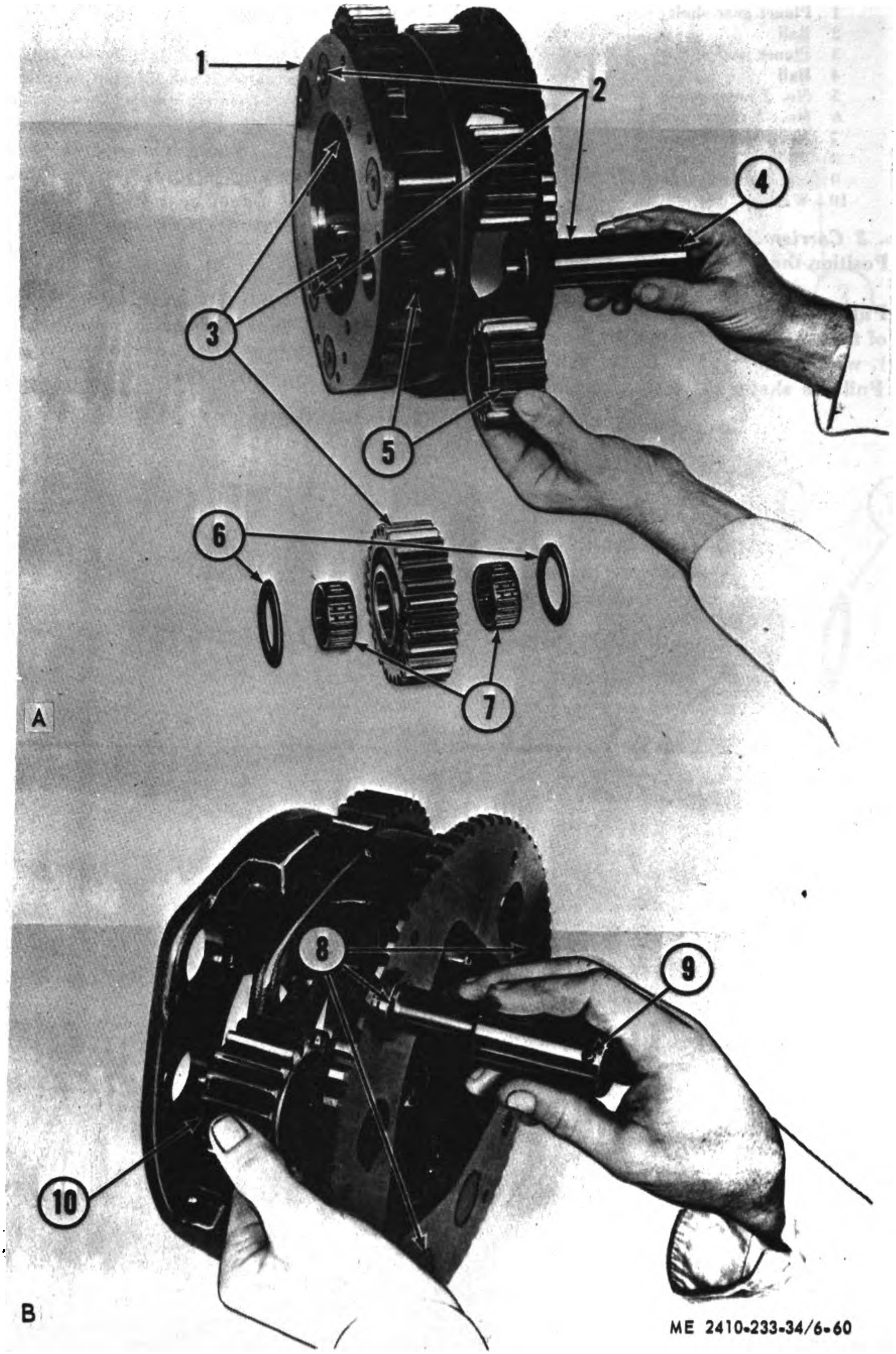


Figure 6-60. No. 2 carrier disassembly.

Key to figure 6-60.
1 No. 2 carrier
2 Planet gear shafts
3 No. 5 planet gears
4 Ball
5 No. 4 inner planet gears
6 Washers
7 Bearings
8 Planet gear shafts
9 Ball
10 No. 4 outer planet gear

j. Clutch Disassembly and Assembly. The five clutches are identical except for the number of disc assemblies and plates used. No. 1, No. 3, and No. 4 clutches have three disc assemblies and two plates, No. 2 clutch has four disc assemblies and three plates and No. 5 clutch has two disc assemblies and one plate. Disassembly of the No. 3 clutch is shown for illustration.

(1) Remove the ring gear (1, fig. 6-61).

(2) Remove the clutch disc assemblies (2) and plates (3).

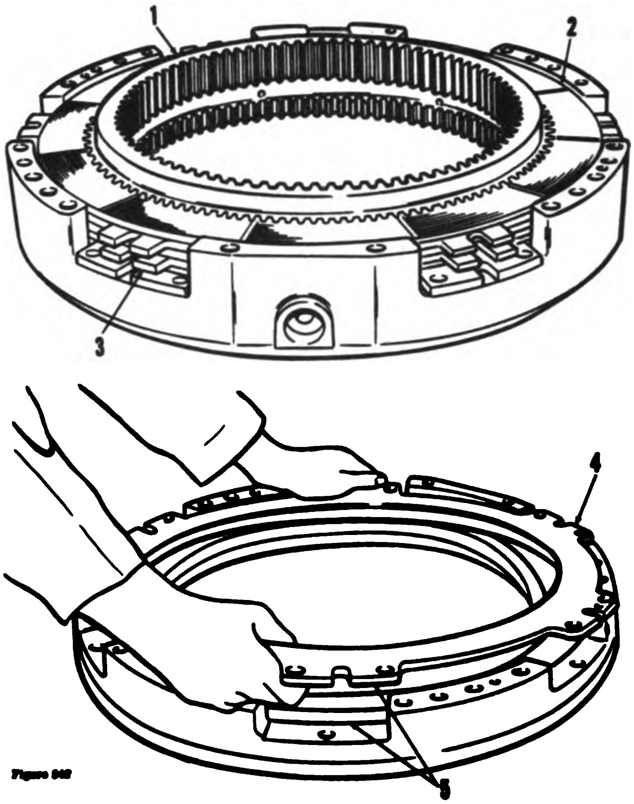
(3) Remove the piston (4) from the clutch housing.

(4) Inspect the piston rings (5) on the piston and in the clutch housing. Replace the rings if damaged.

(5) Assemble the clutches in the reverse order of disassembly. To install the piston, center the piston rings and tap the clutch housing with a soft hammer while gently pushing the piston into the housing.

CAUTION

Under no circumstance should the piston be hammered into place. Broken piston rings will result from such action.



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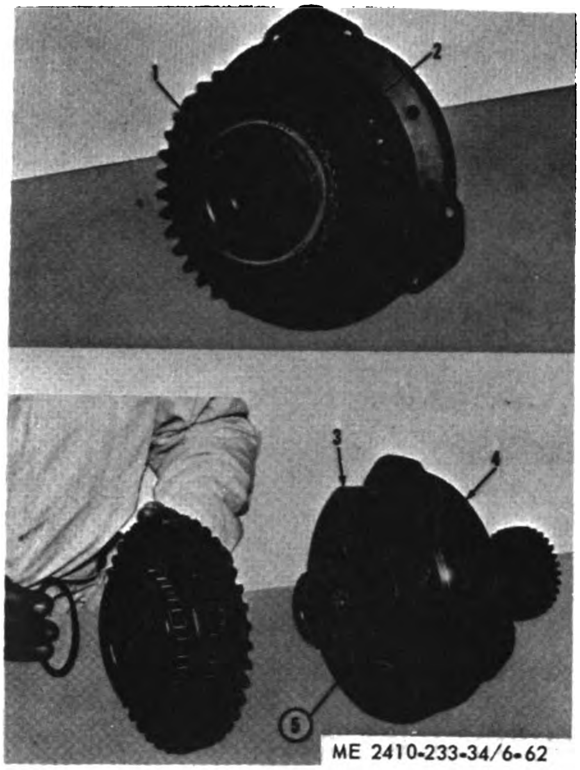
1 Ring gear
2 Disc assembly
3 Plate
4 Piston
5 Piston rings

Figure 6-61. Clutch disassembly.

k. Output Shaft Disassembly and Assembly.

(1) Remove the retainer ring (1, fig. 6-62) and transfer gear (2).



1 Retainer ring
2 Transfer gear
3 Bearing cage assembly
4 Bearing cage
5 Bearing outer race

Figure 6-62. Transfer gear removal.

(2) Remove the bearing cage assembly (3) and the bearing cage (4).

(3) Inspect the transfer gear outer bearings for wear or damage and remove, if necessary, using a bearing pulling attachment, a puller, a hydraulic puller, and a suitable spacer having an outside diameter of 4-inches and about 4-inches in length as illustrated in figure 6-63.

NOTE

The bearing cage assembly (3, fig. 6-64) and bearing cage (4) are removed as a unit from the output shaft.

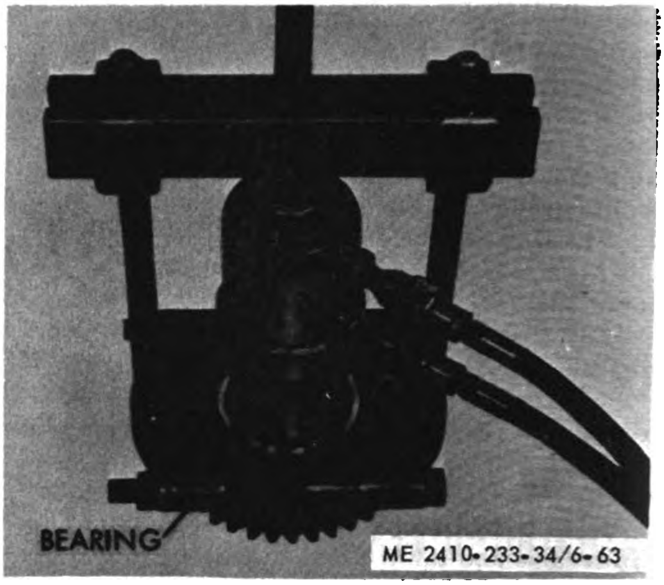


Figure 6-63. Removing transfer gear outer bearings.

Key to figure 6-64.
1 Lockring
2 Bearing
3 Bearing cage assembly
4 Bearing cage
5 Piston ring-type seals
6 Plug

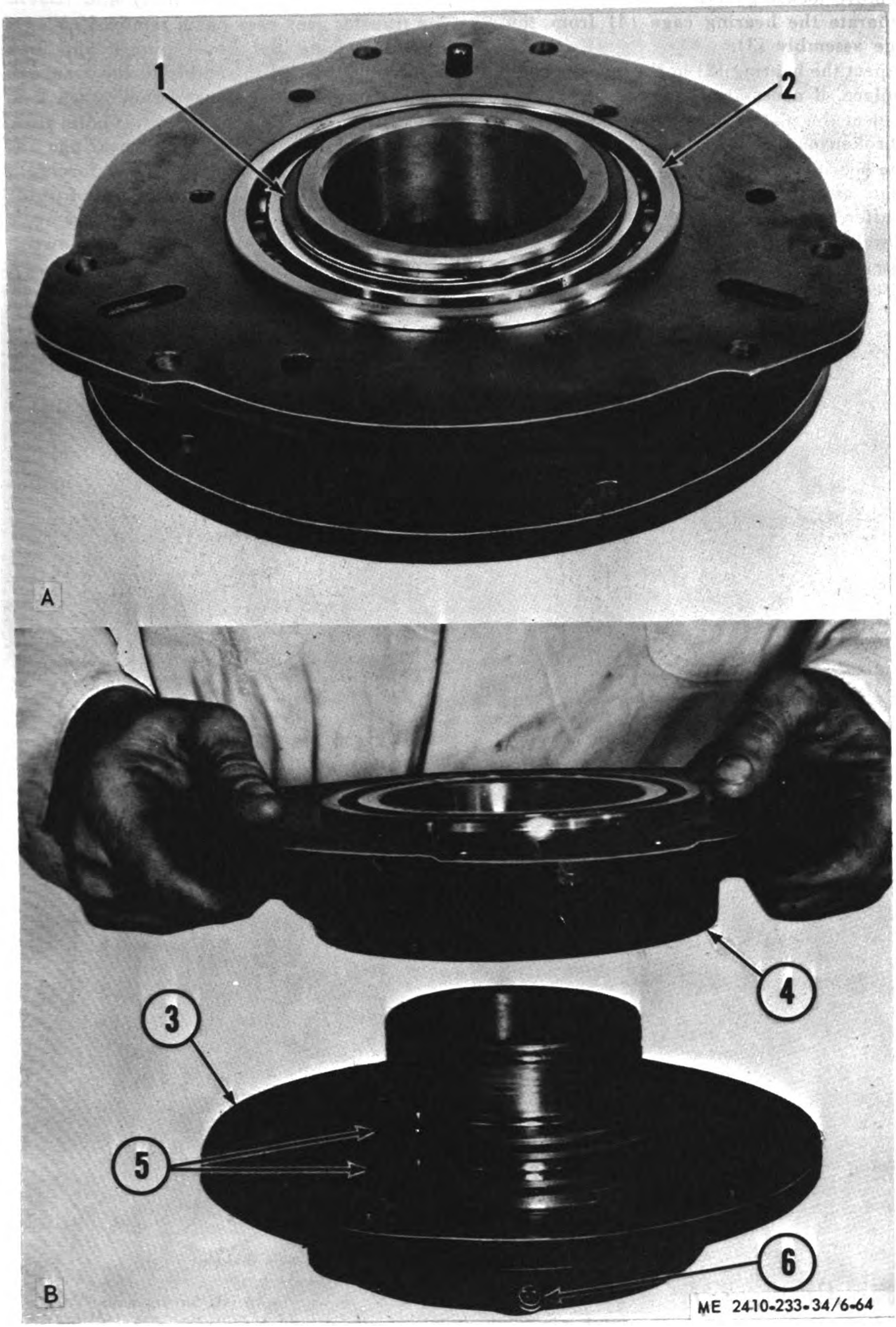


Figure 6-64. Separating cages.

(4) Remove lockring (1).

(5) Separate the bearing cage (4) from the bearing cage assembly (3).

(6) Inspect the bearing (2) in the bearing cage (4) and replace, if necessary.

(7) Inspect the piston ring-type seals (5) and replace if broken or damaged.

(8) The bearing outer race (5, fig. 6-62) in the bearing cage assembly (3) can be removed if necessary, after removing the plug (6, fig. 6-64) and the dowel under the plug.

(9) Assemble the output shaft in the reverse order of disassembly.

l. Transfer Gear Disassembly and Assembly. The transfer gear case has a removal cover which allows servicing the bevel pinion and bearings without complete disassembly of the transmission.

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

(2) Remove bolts (1, fig. 6-65) bolts and locks (2), lockring (3), cage (5), and bearings (4).

(3) Remove dowels (6) with a forcing screw (8), nut (9), washers (10), and length of pipe (11).

(4) Refer to figure 6-65 and remove the transfer gear case cover with a hoist as shown.

(5) Remove plate (1, fig. 6-66) bolts (2), and lock (3).

Key to figure 6-65.

1 Bolts
2 Bolts and locks
3 Lockring
4 Bearing
5 Cage
6 Dowels (hidden)
7 Locks
8 ⅜ in—16 NC forcing screws
9 Nut
10 Washer
11 2 in. length of ¾ in. id pipe
12 Transfer gear case cover

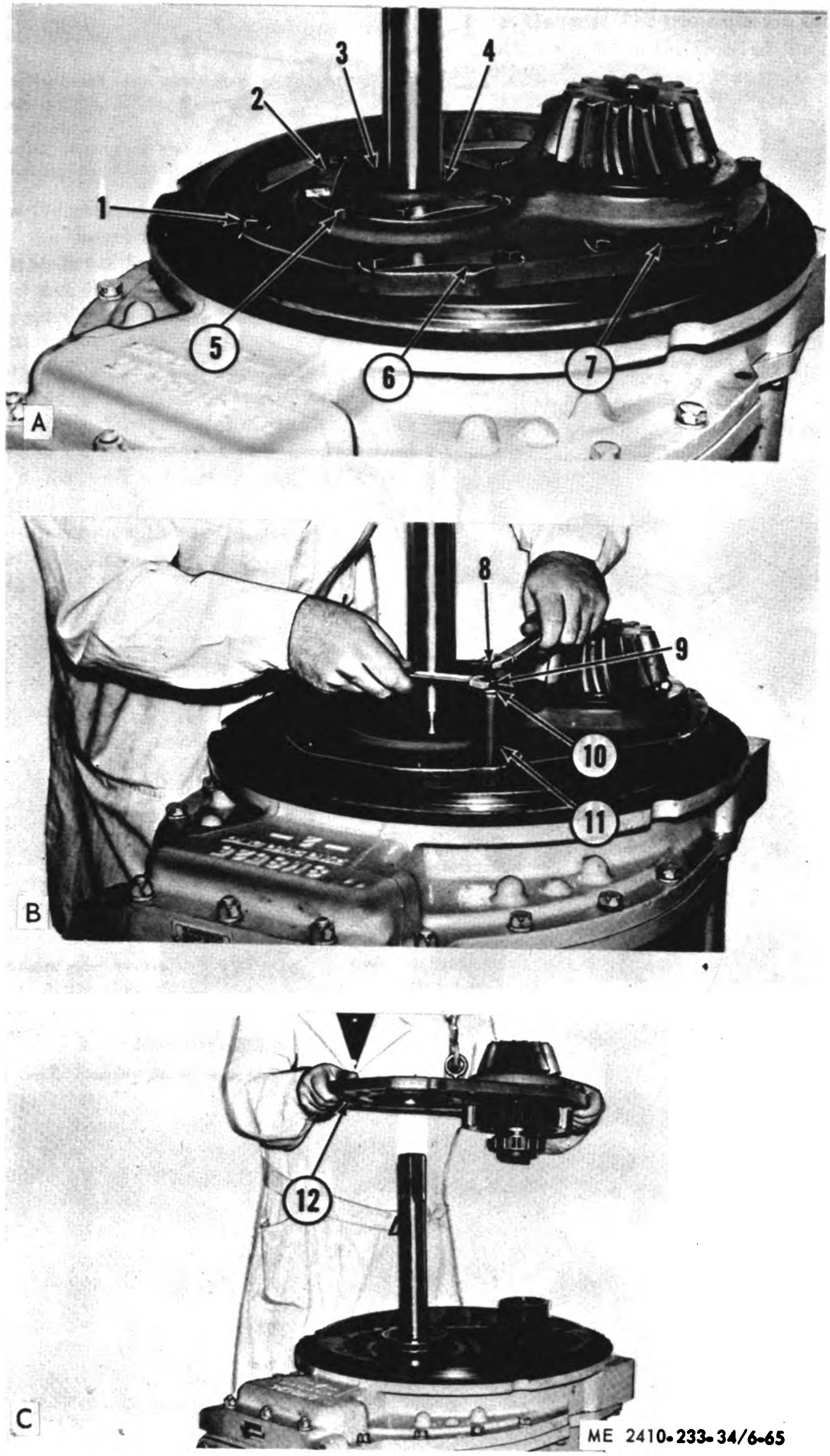


Figure 6-65. Removing cover.

Figure 6-66. Removing bevel pinion.

Key to figure 6-66.
1 Plate
2 Bolts
3 Lock
4 Bearing inner race and roller assembly
5 Gear
6 Spacer
7 Bearing inner race and roller assembly
8 Bevel pinion

(6) Place the cover on blocks and also place a block under the bevel pinion shaft to prevent damage to the teeth on the shaft when it is removed.

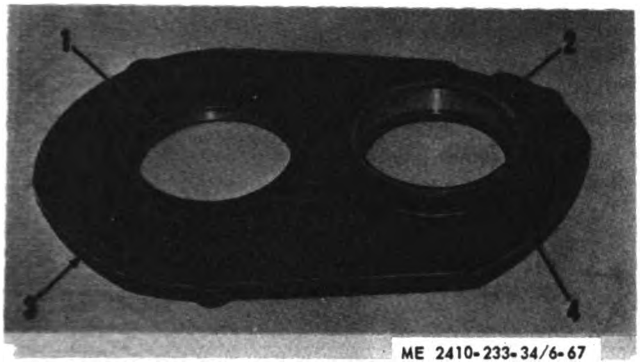
(7) Drive out bevel pinion (8).

(8) Inspect bearing inner race and roller assembly (4).

(9) Remove gear (5) and spacer (6).

(10) Inspect bearing inner race and roller assembly (7) on the bevel pinion shaft. If the bearing needs to be replaced, it can be removed with a push puller and a bearing cup pulling attachment.

(11) Remove plugs (3, 4, fig. 6-67) and the dowels beneath the plugs, then remove the bearing outer races (1) and (2).



1 Transfer gear bearing outer race
2 Bevel pinion shaft bearing outer race
3 Plug
4 Plug

Figure 6-67. Bearing outer race removal.

6-10 Transmission Lubrication Junction Block

a. General. The transmission lubrication junction block, located on the front of the transmission case, directs the flow of the transmission lubricating oil.

b. Removal and Installation.

(1) Remove the floor plates.

(2) Refer to TM 5-2410-233-20 and drain the transmission lubrication system.

(3) Disconnect the junction block outlet line (fig. 6-68) and the inlet line.

CAUTION

Cover all openings to prevent the entry of dirt or other foreign matter into the hydraulic system.

(4) Remove the junction block.

(5) Replace all damaged or worn parts.

(6) Install in the reverse order of removal.

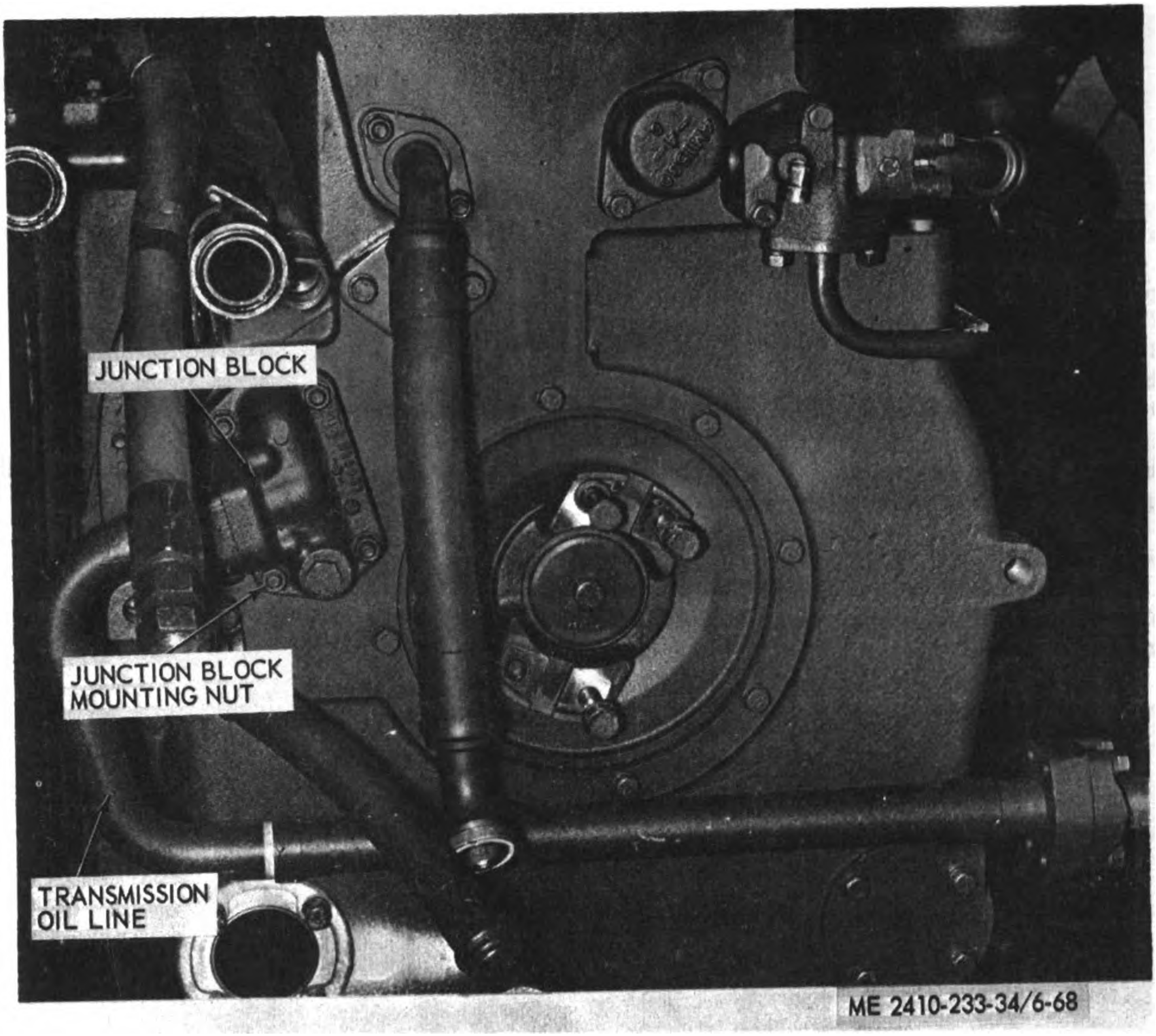


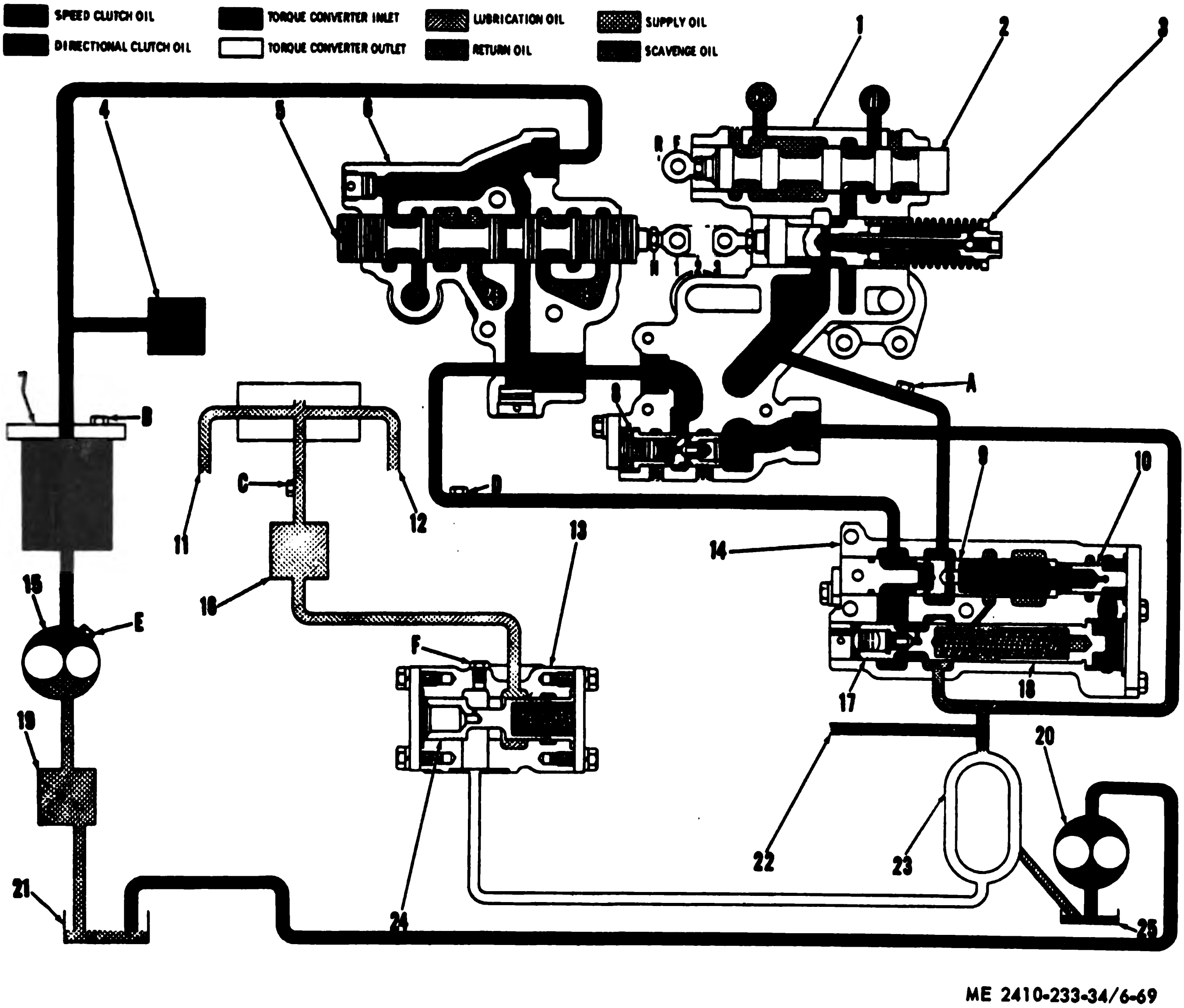
Figure 6-68. Junction block removal.

6-11. Transmission Hydraulic System Testing and Adjustment

a. *General.* The hydraulic control system oil supply (fig. 6-69 and 6-70) is common to the entire system. Tests and adjustments can be performed using individual pressure gages or a hydraulic test box. All pressure taps use 1/8 inch — 27 NPT plugs except the transmission oil pump pressure tap (E, fig. 6-69 and 6-70) on the filter (B) and the transmission lubricating oil pressure tap (C). Use adapter assemblies when making connections to these taps.

CAUTION

All tests and adjustments must be made with the oil in the hydraulic control system at normal operating temperature. The low and high idle engine speeds for this machine are 660 rpm and 2210 rpm respectively. It is important that the transmission hydraulic control linkage is properly adjusted before making any tests. Refer to paragraph 6-4 for linkage adjustments.



1 Directional valve body
2 Directional valve spool
3 Safety valve
4 Steering clutch controls
5 Speed selector valve spool
6 Speed selector valve body
7 Oil filter
8 Torque divider ratio valve spool
9 Pressure differential valve spool
10 Check valve
11 Lubrication line to rear of transmission
12 Lubrication line to front of transmission
13 Torque divider outlet relief valve
14 Pressure control valve body
15 Transmission oil pump
16 Oil cooler
17 Pressure modulating relief valve spool
18 Load piston
19 Magnetic strainer
20 Scavenge oil pump
21 Oil pump
22 Lubrication line to bevel gear and bevel pinion
23 Torque divider
24 Torque divider outlet relief valve spool
25 Torque divider oil sump
A Directional clutch oil pressure tap
B Transmission oil filter pump pressure tap
C Lubrication oil pressure tap
D Speed clutch oil pressure tap
E Transmission oil pump pressure tap
F Torque divider outlet oil pressure tap

Figure 6-69. Transmission hydraulic control system schematic (First forward).

b. Steering Clutch Control Tests. Refer to table 6-1 and figure 6-70 to make necessary tests.

c. Transmission and Torque Converter Hydraulic Controls Tests. Refer to table 6-2 and figures 6-69 and 6-70.

Key to figure 6-70.

A

A Directional clutch oil pressure tap
B Transmission oil pressure tap
C Lubrication oil pressure tap
D Speed clutch oil pressure tap
F Torque converter outlet oil pressure tap

B

E Transmission oil pump pressure tap
15 Transmission pump

C

G Left steering clutch oil pressure tap
H Right steering clutch oil pressure tap
I Transmission oil pump pressure tap

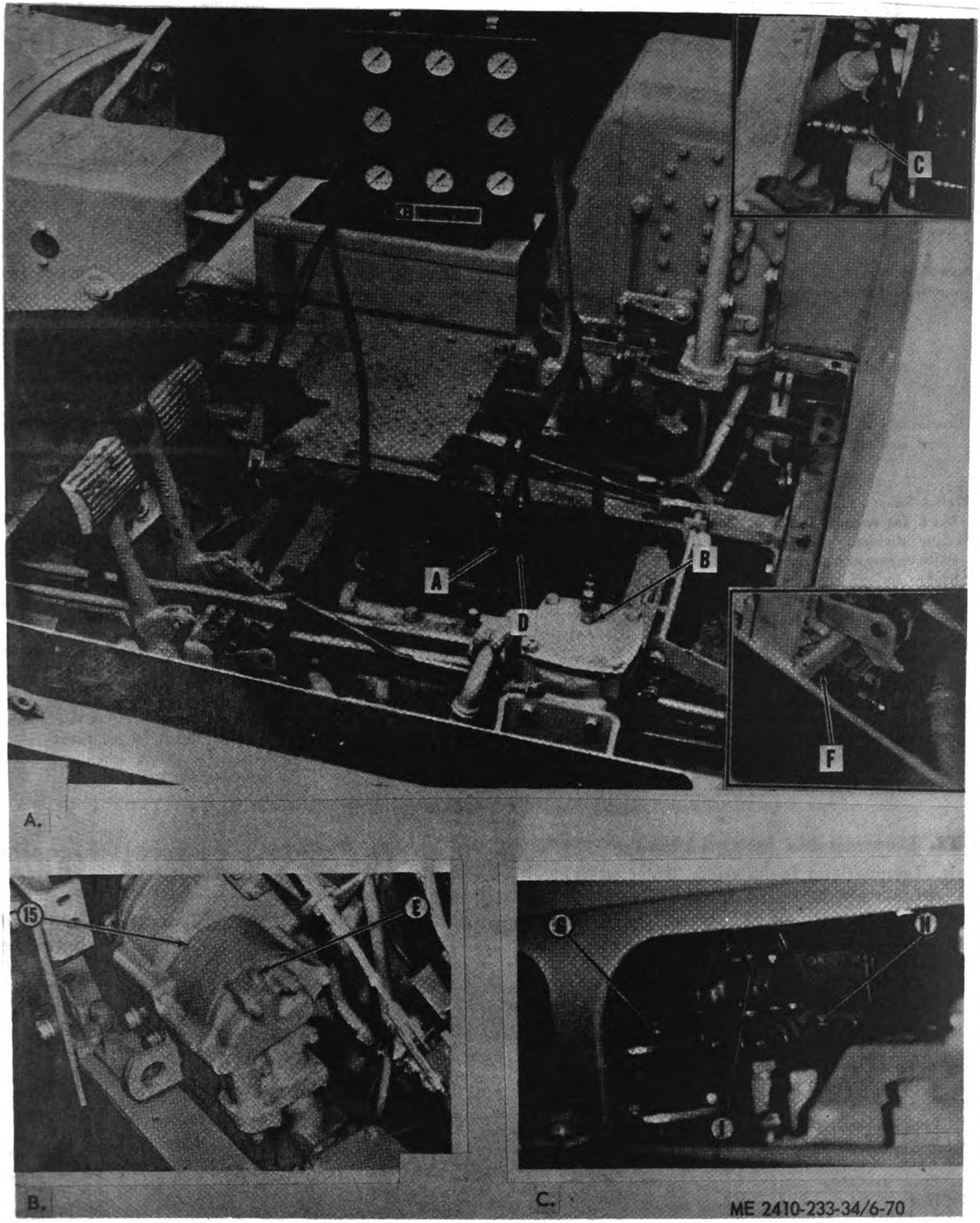


Figure 6-70. Hydraulic control system pressure tap locations.

Table 6-1. Steering clutch control tests

Pressure	Location	Value
Steering clutch pistons (steering clutches disengaged and engine at low idle).	G-H	290 psi
Hydraulic oil pump (engine at high idle).	E	350 psi

Table 6-2. Transmission and torque divider hydraulic control test

Pressure	Location	Value	Adjustment
Transmission oil pump (engine at high idle and transmission selector lever in neutral).	B Filter E Pump	350 psi	None
Speed clutch (engine at high idle speed and clutch engaged).	D	270-290 psi	Add or remove spacers (5M9622, 5M9623, 5M9624) located inside piston in the pressure control valve assembly. *Spacer* / *Chg in psi*: 5M9622 15.0; 5M9623 8.5; 5M9624 2.5
Directional clutch (engine at high idle speed and clutch engaged)	A	47-63 psi less than speed clutch pressure reading	None
Transmission lubrication junction block (at engine high idle speed)	C	9-15 psi	None
Torque divider outlet relief valve (with engine at high idle speed and brakes locked, move transmission selector lever to third range. Watch tachometer, engine speed should be 921—1051 rpm.	F	37-47 psi	Add or remove washers from valve. Adding 4B5270 washers adds 6 psi. Note. If engine is below the listed values, check engine performance. If engine speed is above the listed values the torque divider may have to be disassembled and causes for loss of efficiency determined.
Torque converter inlet relief valve (bench test only, see the adjustment column)		135-145 psi	Bench test: Supply oil at the pump port at 280 ± 10 psi ratio valve bypass to drain when pressure exceeds 140 ± 5 psi.

6-12. Transmission Control Linkage

a. Removal and Installation. Refer to figure 6-71 to remove and install transmission control linkage parts as required.

b. Inspection. Inspect parts for breaks, cracks, distortion, damage or excessive wear.

c. Repair. The transmission control linkage parts are to be repaired by replacement only. Replace worn or defective parts.

d. Adjustment. Refer to paragraph 6-4 and adjust the transmission control linkage between the control levers and the transmission

Key to figure 6-71.

1 Spring
2 Nut
3 Lockwasher
4 Screw
5 Knob
6 Lever assembly
7 Nut
8 Lockwasher
9 Nut
10 Screw
11 Bolt
12 Lock
13 Pin
14 Clevis
15 Knob
16 Bushing
17 Spacer
18 Lever assembly
19 Nut
20 Lockwasher
21 Nut
22 Bolt
23 Nut
24 Bolt
25 Lever
26 Key
27 Washer
28 Nut
29 Nut
30 End
31 End
32 Rod
33 Nut
34 Lockwasher
35 Nut
36 Nut
37 Lever
38 Key
39 Washer
40 Nut
41 End
42 Nut
43 Lockwasher
44 Nut
45 Bolt
46 End
47 Nut
48 Bolt
49 Lever
50 Key
51 Bolt
52 Lockwasher
53 Bolt
54 Lockwasher
55 Clamp
56 Calmp
57 Washer
58 Seal
59 Bearing
60 Bearing
61 Seal
62 Washer
63 Shaft
64 Fitting
65 Support

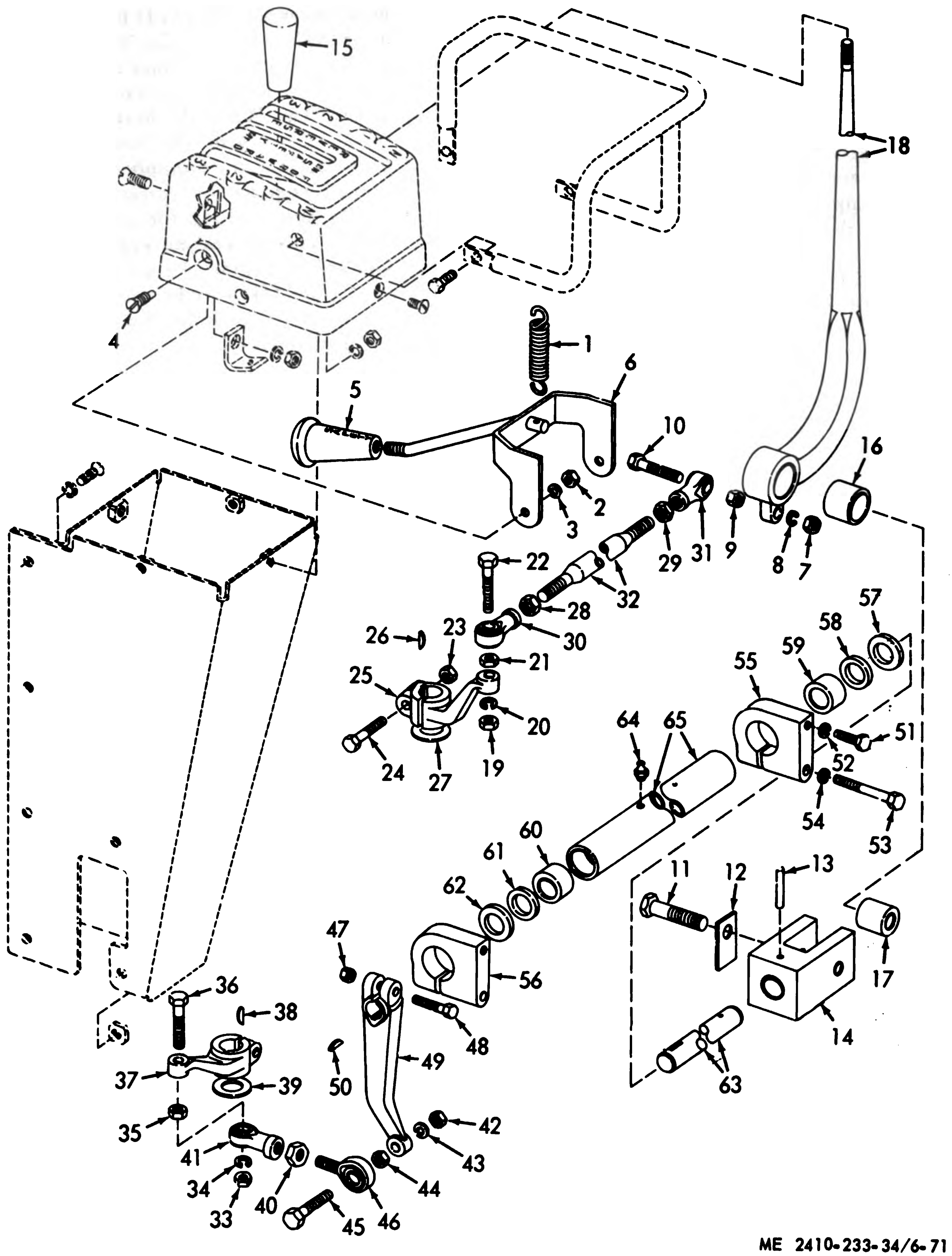


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Figure 6-71. Transmission control linkage, exploded view.

6-13. General

This section contains information on the brakes, steering clutches, steering clutch hydraulic controls, and bevel gear.

6-14. Brakes

a. General. Two contracting-band-type brakes, which operate independently of one another, are used to supplement the action of the steering clutch or to stop the tractor. Either or both brakes can be held in the locked position by the brake lock pawls (7, fig. 6-72). These pawls are actuated by a single hand lever. The operation of both brakes is the same. When the brake pedal (8) is depressed, the brake control linkage moves the brake control lever (5) forward. The brake shaft (4) and brake lever (3) rotate and pull up on the brake link (9). This flattens the brake toggle links (16) and causes the brake strut support lever assembly (10) and the brake lever assembly (14) to rotate about the brake lever shafts (11 and 12). The struts (15) and (17) are forced against the lugs on the brake band (18), causing the band to contract on the steering clutch outer drum. When the brake pedal is released, the spring (2) returns the brake pedal, linkage and brake band to the unapplied position. The parking brake is engaged by depressing either or both brake pedals and pushing the parking brake lever (1) down. This moves the parking brake linkage (6) forward, engaging the pawl (7) with the ratchet (13). The brakes are held in the applied position by the pawls that hold the brake linkage in the engaged position.

CAUTION

The brake pedals should be depressed before the lever (1) is pulled upward to release the brakes. This will prevent damage to the ratchet teeth or the pawl.

Key to figure 6-72.

1 Parking brake lever
2 Spring
3 Brake lever
4 Brake shaft
5 Brake control lever
6 Parking brake linkage
7 Brake lock pawl
8 Brake pedal
9 Brake link
10 Brake lever assembly
11 Brake lever shaft
12 Brake lever shaft
13 Ratchet
14 Brake strut support lever assy
15 Brake band strut
16 Brake toggle link
17 Brake band strut
18 Brake band

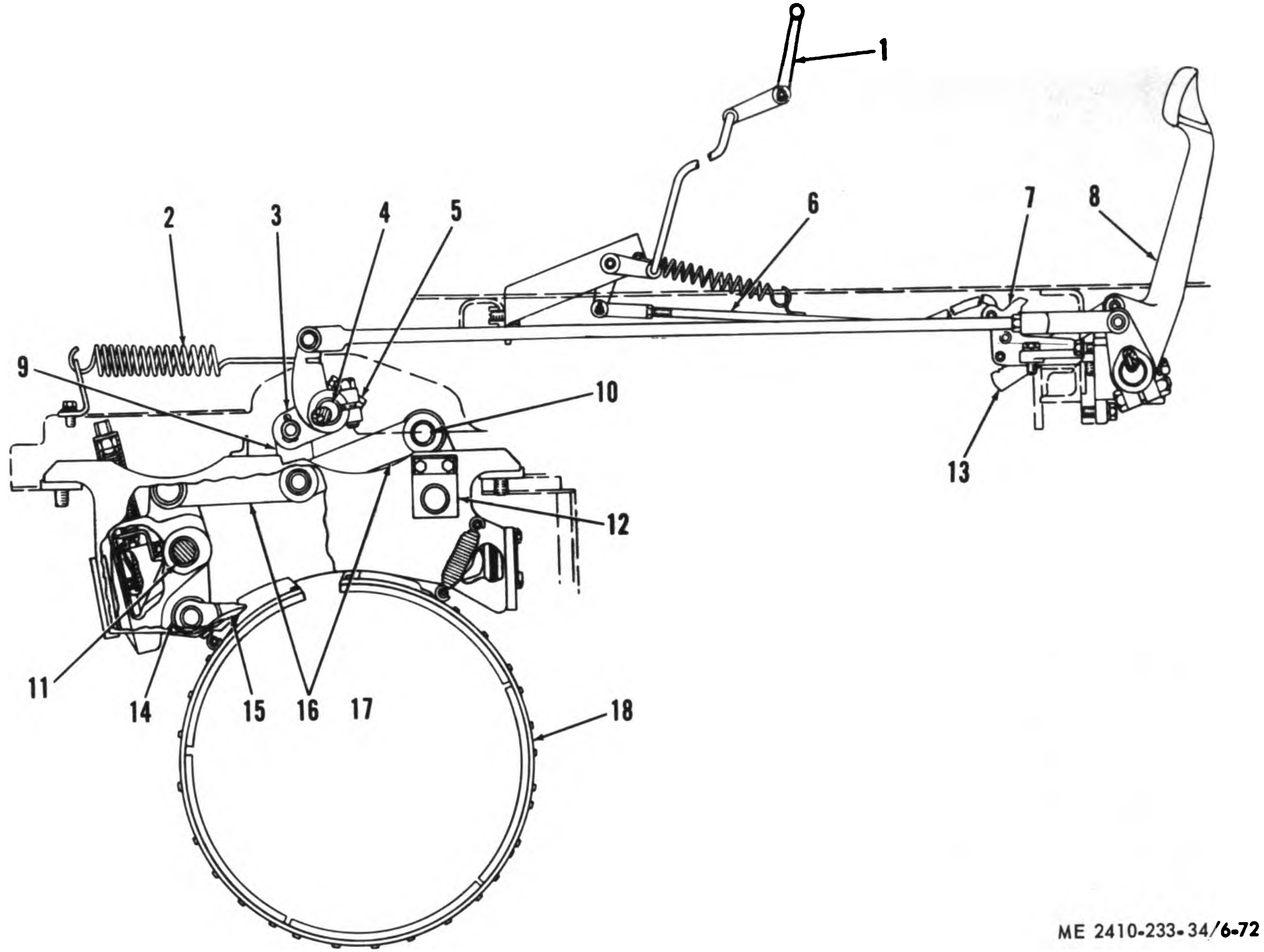


Figure 6-72. Brake operation.

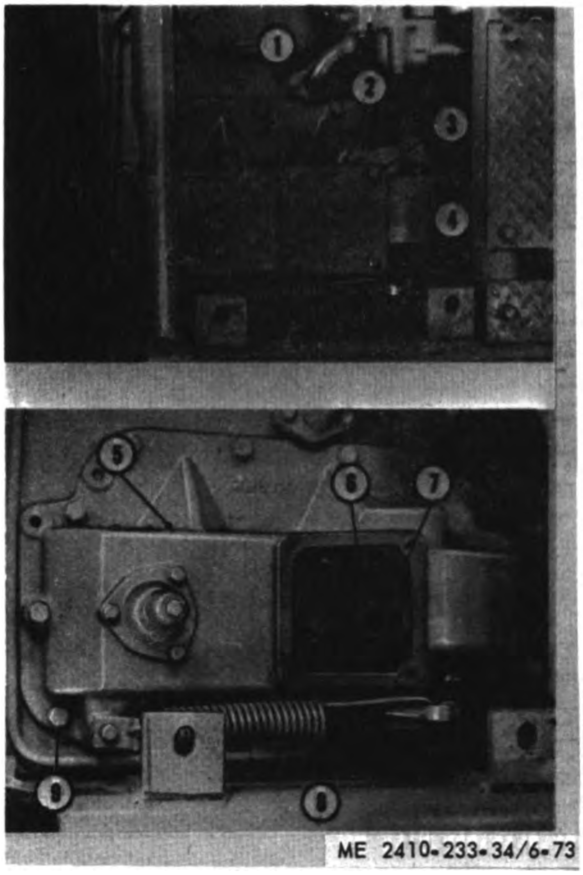
b. Removal and Installation.

(1) Remove the fuel tank (para 5-14).

(2) Remove rear support (1, fig. 6-73)

(3) Remove bolts (3) and cover (2).

(4) Disconnect the brake rod attached to the brake control lever (4).



1 Rear support
2 Cover
3 Bolts
4 Brake control lever
5 Steering clutch cover
6 Pin and cotter pin
7 Brake lever
8 Spring
9 Bolts

Figure 6-73. Preparing to remove brake engaging mechanism.

(5) Remove the pin and cotter pin (6) securing the brake link to the brake lever (7).

(6) Remove brake lever return spring (8).

(7) Remove bolts (9) and steering clutch cover (5).

(8) Remove the bolts securing brake engaging mechanism to the bevel gear case, and lift the engaging mechanism to the bevel gear case, and lift the engaging mechanism straight up.

NOTE

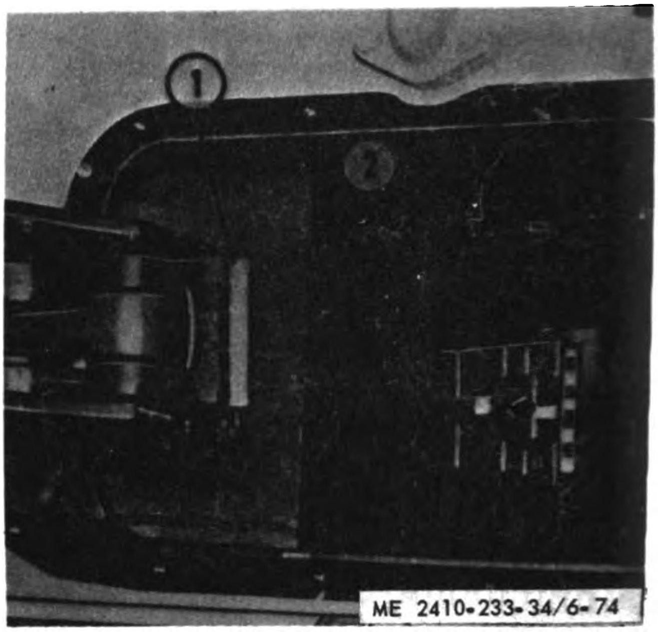
The brake band struts (1, fig. 6-74) will disengage from the brake band. Be sure the struts engage the lugs (2) on the brake band at the time of installation.

(9). Install in reverse order of removal.

NOTE

If the brake engaging mechanism has been disassembled and parts replaced, adjust the mechanism as described in *e* below.

(10) Tighten bolts (9, fig. 6-73) securing steering clutch cover (5) to the bevel gear case, to 100 ± 5 lb-ft.



1 Strut
2 Lug

Figure 6-74. Brake engaging mechanism removed.

c. Disassembly and Reassembly.

(1) Remove the adjusting screw socket assembly (2, fig. 6-75).

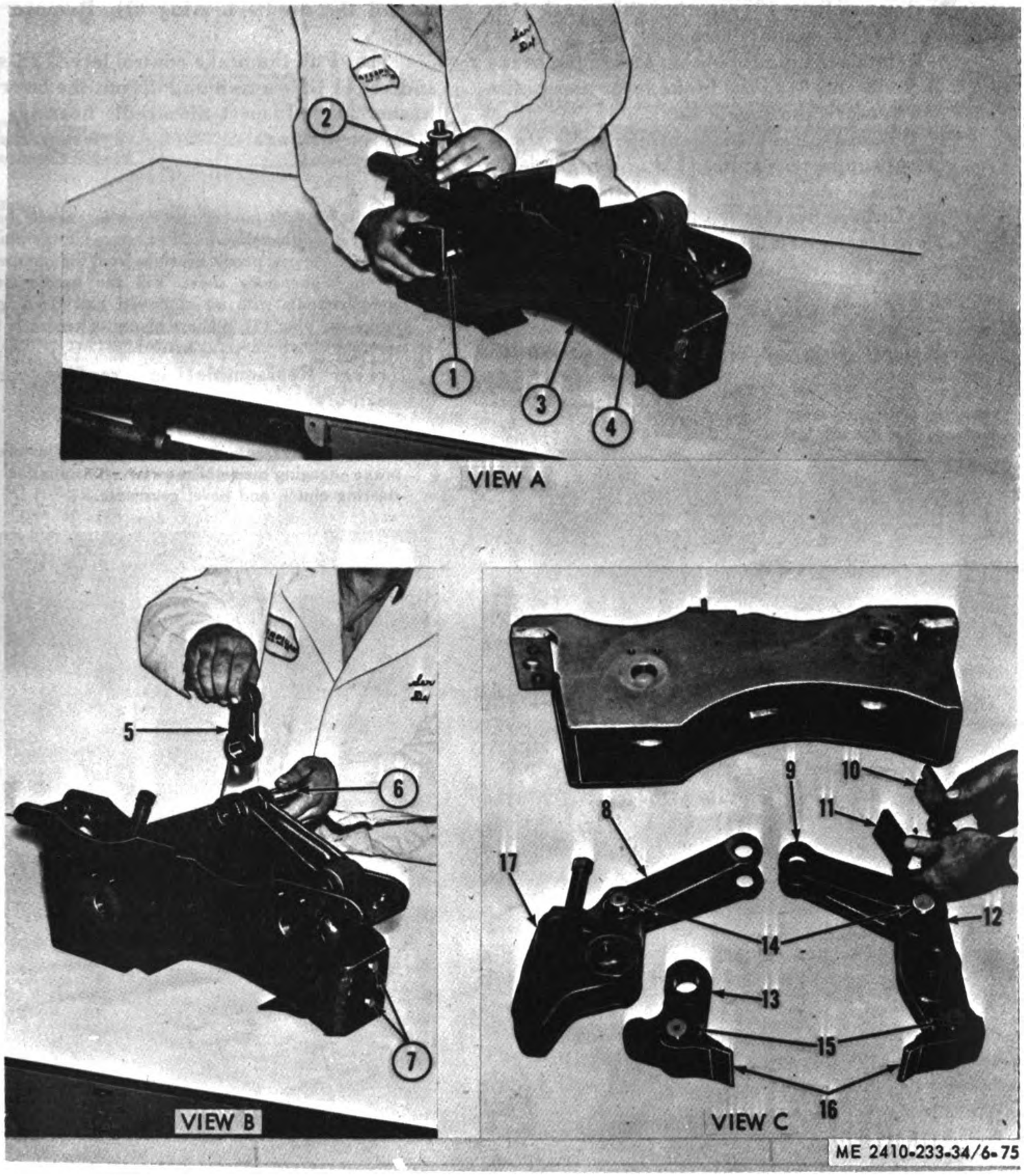
(2) Remove brake lever shaft (1) which joins the brake lever (17) and the brake strut support assembly (13) and secures them to the brake linkage support assembly (3).

(3) Remove brake lever shaft (4).

(4) Remove the retaining ring and pull the pin (6) securing the brake toggle links (8) and (9) to the brake link (5).

(5) Remove brake toggle link (9) and front brake lever assembly (12) as a unit.

(6) Guide the links (8) between the two support assembly braces, and lift off the support assembly (3).



1 Brake lever shift
2 Adjusting screw socket assembly
3 Brake linkage support assembly
4 Brake lever shaft
5 Brake link
6 Pin
7 Bolts
8 Brake toggle link
9 Brake toggle link
10 Shim pack
11 Stop
12 Brake lever assembly
13 Strut support assembly
14 Pins
15 Pins
16 Struts
17 Brake lever assembly

Figure 6-75. Brake engaging mechanism disassembly.

(7) Remove bolts (7) securing shim pack (10) and stop (11) to support assembly (3).

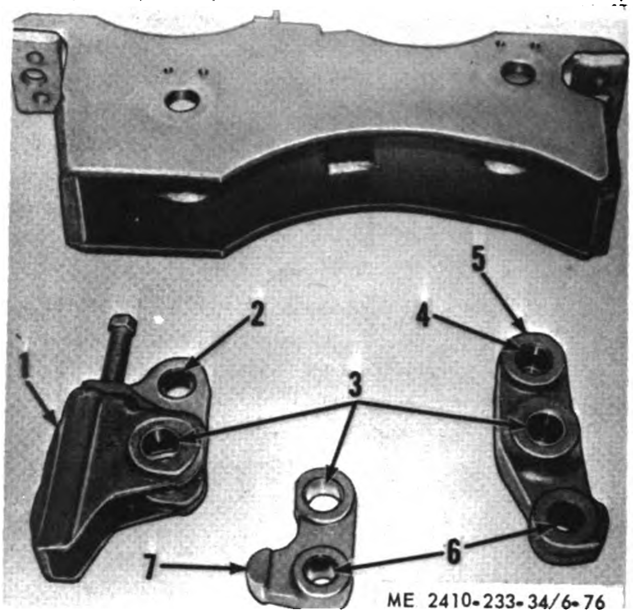
(8) Remove the pins (14) that secure the brake toggle links (8 and 9) to the brake lever assemblies (12), and remove the toggle links.

(9) Remove pins (15) securing brake struts (16) to strut support assembly (13) and brake lever (12).

(10) Inspect bearings (2), (3), (4), and (6), fig. 6-76 in lever assemblies (1) and (5), and strut support (7). Replace bearings if they are worn or damaged.

NOTE

An arbor press can be used for all bearing removal and installation.



1 Brake lever
2 Bearing
3 Bearings (5)
4 Bearings (2)
5 Brake lever
6 Bearings (2)
7 Strut support

Figure 6-76. Brake lever bearings.

(11) Place adjusting screw (1, fig. 6-77) in as low a position as is necessary to remove wedge support (4) and brake adjustment wedge (5).

(12) Remove adjusting screw (1), bolt (3), which secures wedge support (4) to brake lever (2), and adjusting wedge (5).

(13) Remove bolt (6) and adjusting screw spring (7) from adjusting wedge.

(14) Remove bolt (5, fig. 6-78) securing the brake lever (6) to the brake shaft (1) in steering clutch cover (8).

(15) Slide the lever (6) along the shaft (1) toward the needle bearing (7). Remove the key (10).

(16) Pull the brake control lever (2), shaft (1) and key (13) as a unit and lift out the lever (6) and washer (11). Inspect the needle bearings (7) and (12) for damage or excessive wear. Replace if necessary.

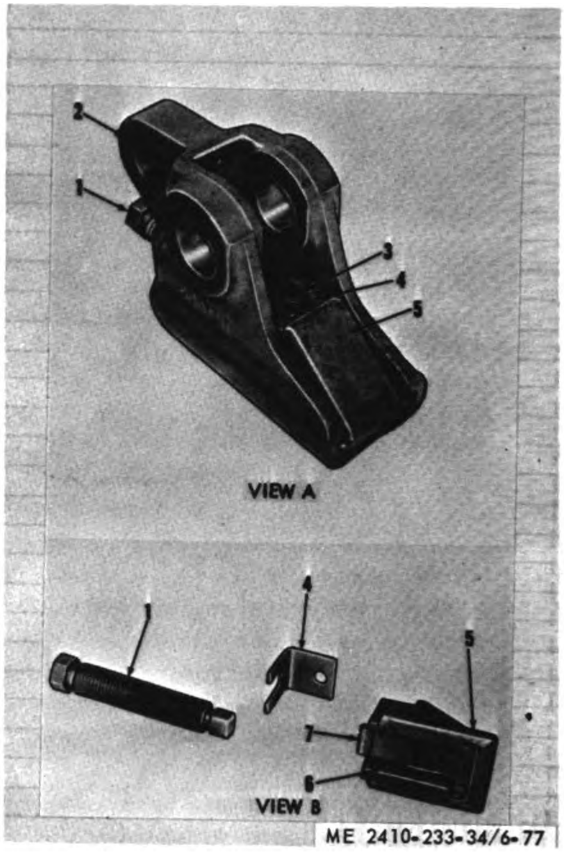
NOTE

A suitable drift pin can be used for needle bearing removal and installation, after removing the plug (9). Drive in the new needle bearings from the stamped end to the dimensions show. Fill the needle bearing compartments with an approved ball GAA grease. Stake the plug (9) in three places to secure it to the steering clutch cover at assembly.

(17) Reassemble in reverse order of disassembly.

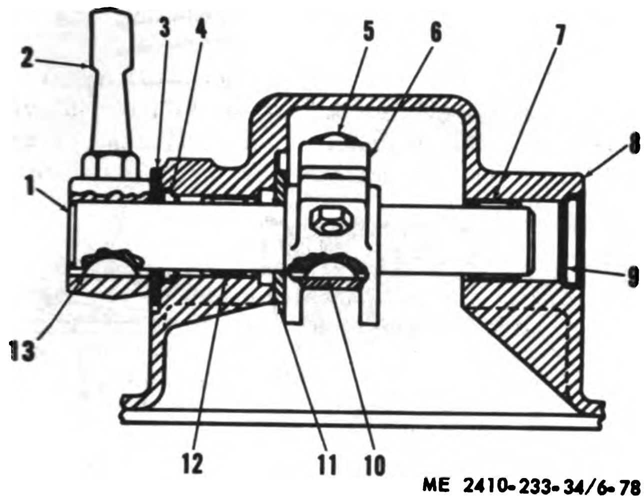
NOTE

Refer to subparagraph *e* below for adjustment of brake engaging mechanism prior to installation in the steering clutch and bevel gear case.



1 Adjusting screw
2 Brake lever
3 Bolt
4 Wedge support
5 Adjusting wedge
6 Bolt
7 Adjusting wedge spring

Figure 6-77. Brake adjusting mechanism.



1 Brake shaft
2 Brake control lever
3 Washer
4 Oil seal
5 Bolt
6 Brake lever
7 Needle bearing
8 Steering clutch cover
9 Plug
10 Key
11 Washer
12 Needle bearing
13 Key

Figure 6-78. Disassembling clutch cover brake linkage.

d. Inspection and Repair.

(1) Inspect all supports, links, levers, and pins for cracks, breaks, distortion and wear. Repair by welding, straightening, or replace the part.

(2) Inspect all needle bearings for corrosion, roughness, and wear. Replace damaged or excessively worn bearings.

(3) Inspect all sleeve bearings for damage and wear. Sleeve bearing to pin clearance (new) is approximately 0.003 to 0.005 inch. The maximum allowable clearance is 0.015 inch. Replace damaged or excessively worn bearings or pins.

(4) Inspect the brake linings for damaged or worn condition. Replace the linings if damaged or worn to within 3/32 inch of rivet heads.

(5) Inspect the brake drums for scoring, damage and wear. Replace a damaged, badly scored, or excessively worn drum.

NOTE

Steering brake drums which are not scored, cracked, or otherwise damaged, may be considered serviceable, from the wear standpoint, if the following condition is met: after installing new brake linings, at least one half of the band adjustment travel must remain. If one half or more of the adjustment travel does not remain, replace the drum.

(6) Inspect washers (3) and (11), fig. 6-78, for damage and wear. Replace if damaged or worn excessively.

(7) Inspect all springs for cracks, breaks, and distortion. Replace defective springs.

e. Adjustment.

(1) Install a wood block as shown in figure 6-79 and turn the adjusting screw clockwise until the lever assemblies are firmly against their stops.

(2) Lift brake link with a pull of approximately 30 pounds.

(3) Measure the distance "A" from the top of the pin, which joins the brake link to the brake toggle links, to the milled flat on the support assembly.

(4) Add or remove shims behind the stop to obtain a distance "A" of 0.860 inch to 0.900 inch.

(5) Install the support assembly in the steering clutch and bevel gear case (subpara a above).

(6) Turn the adjusting screw socket assembly until the brake band is tight on the steering clutch outer drum. Back off the socket assembly 1½ turns or nine clicks.

(7) Install the remaining brake linkage.

(8) The parking brake lever (1, fig. 6-80) can be adjusted by disengaging the parking brake and adjusting the parking brake linkage (4) to obtain dimension (B), which is the distance between the front face of the seat arm rest support and centerline of parking brake lever (0.82 to 0.94 inches). The brake pedal (2) can be adjusted by disengaging the parking brake and adjusting the brake linkage (3) to dimension (C) which is the distance between the front face of the seat support and the rear face of the brake pedal (17.63 to 17.87 inches).

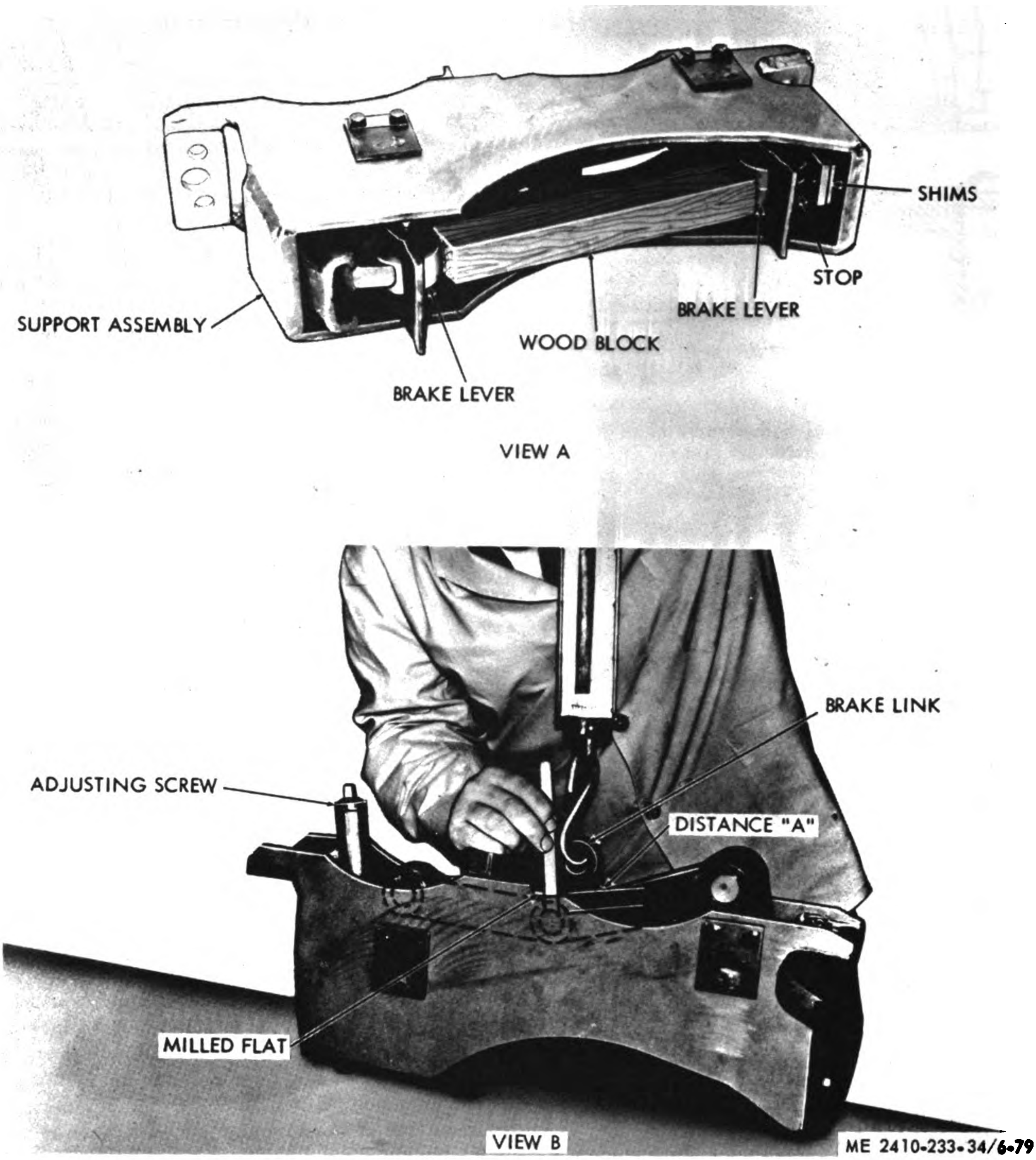
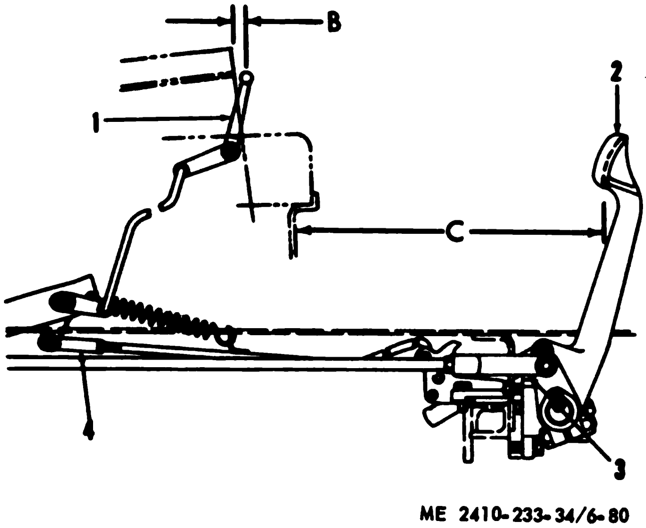


Figure 6-79. Adjusting brake engaging mechanism.



1 Parking brake lever
2 Brake pedal
3 Brake linkage
4 Parking brake linkage

Figure 6-80. Adjusting brake linkage.

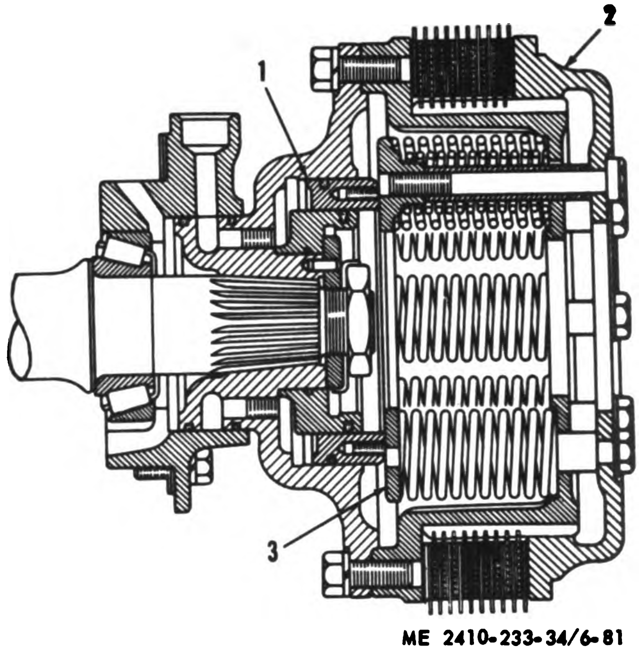
6-15. Steering Clutches

a. General.

(1) The multiple disc, oil-type steering clutches are held in engagement by springs, and are disengaged hydraulically.

(2) The steering clutch disc assemblies have teeth on the outer diameter which mesh with splines in the outer drum. The steering clutch driving discs have lugs on the inside diameter which interlock with the tapered recesses of the inner drum.

(3) The steering clutches are disengaged by oil pressure acting behind the steering clutch piston (1, fig. 6-81) which causes the piston to move outward against the steering clutch spring retainer (3). This moves the steering clutch pressure plate (2) out of contact with the discs to disengage the clutch.



1 Steering clutch piston
2 Steering clutch pressure plate
3 Steering clutch spring retainer

Figure 6-81. Steering clutch operation.

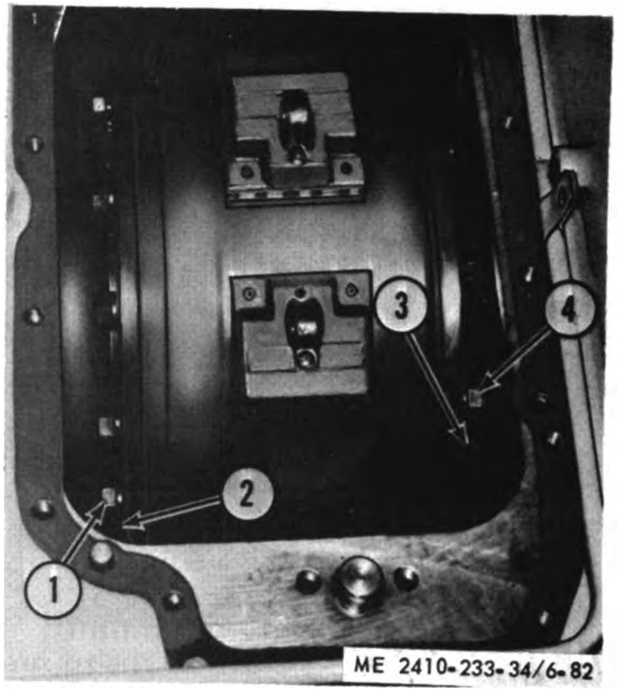
b. Removal and Installation.

(1) Remove the fuel tank, (para 5-14) the rear crossmember, and brake engaging mechanism (para 6-14).

(2) Rotate the track by placing a hydraulic jack under track grouser and remove the bolts (1, fig. 6-82) and bolts (4).

NOTE

To prevent the possiblity of the outer drum slipping off the steering clutch driven drum flange (3, fig. 6-82) and the inner drum slipping off the steering clutch driving hub (2), causing steering clutch assembly to drop, leave two bolts (1) securing the inner drum to the hub until a sling is attached. The bolts holding the outer drum to the flange can be removed, replaced, and torqued through the opening in the side of the steering clutch and bevel gear case, after removing the plug. Rotate the steering clutch assembly after each bolt is removed to gain access to the next one.



1 Bolts
2 Steering clutch driving hub
3 Steering clutch driven drum flange
4 Bolts

Figure 6-82. Preparing to remove steering clutch assembly.

(3) Attach a suitable hoist and sling to the brake band and pry the outer drum away from the flange.

(4) Remove the two bolts securing the inner drum to the hub, pry the drum away from the hub, and remove the steering clutch assembly as shown in figure 6-83.

CAUTION

Keep the steering clutch assembly level since the clutch is free to slide out of the outer drum.

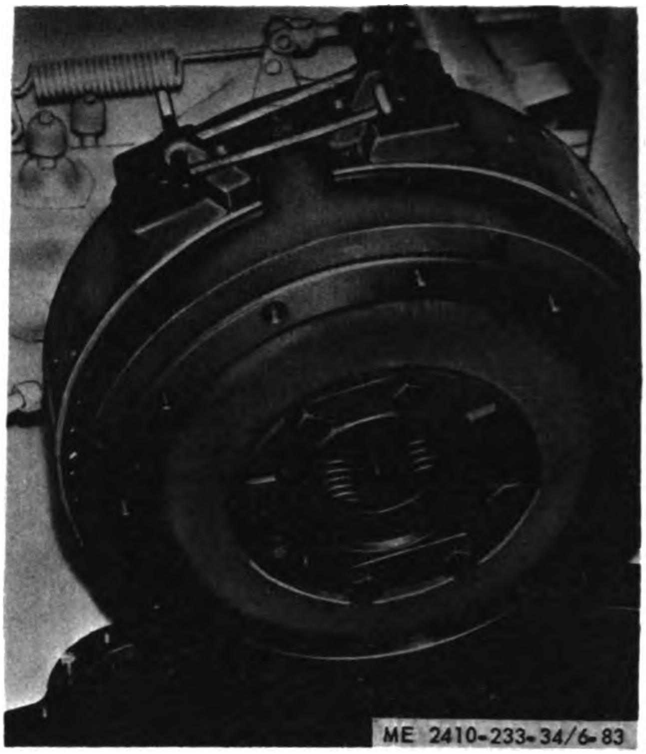


Figure 6-83. Removing steering clutch assembly.

(5) Before installing the steering clutch assembly, inspect the splines of the outer drum and the teeth of the discs for roughness and excessive wear. Replace if not reusable.

NOTE

The following procedure will permit the flange on the pinion shaft and the steering clutch outer drum to draw together without binding at the time of installation.

(6) Install one bolt that secures the outer drum to the flange, but do not tighten the bolt too tight.

(7) Rotate the steering clutch 180° by moving the machine or the sprocket.

(8) Install a second bolt that secures the outer drum to flange. Tighten this bolt securely.

(9) Complete the installation in reverse order of removal. Torque the bolts (1, fig. 6-82) and (4) to the value given in table 1-2.

(10) Refer to paragraph 6-14 and adjust the brakes.

c. Disassembly.

NOTE

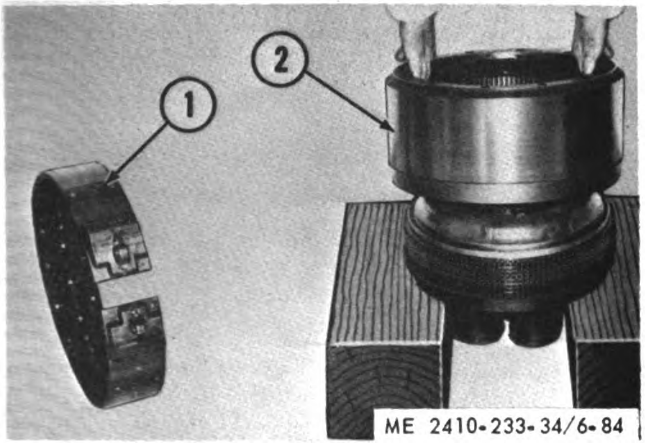
Position the steering clutch assembly on blocks, allowing at least 5 inches of clearance.

(1) Remove the brake band (1, fig. 6-84) from the outer drum (2)

(2) Remove the outer drum from the steering clutch assembly.

NOTE

The overall thickness of ten new disc assemblies and nine new driving discs is given in table 1-4. If the overall thickness is less than the minimum overall width, they should be replaced.



1 Brake band
2 Steering clutch driven drum (outer drum)

Figure 6-84. Removing outer drum.

(3) Place the plate on the bolt, insert the bolt through the center of the steeering clutch assembly and place the plate (2, fig. 6-86) over the bolt.

(4) Place a hydraulic puller over the bolt so that the base is against the plate. Extend the ram about 1½ inches.

(5) Install a heavy washer and a nut onto the bolt and tighten it until it is against the puller.

(6) Apply just enough pressure with the puller to hold the clutch springs compressed and remove the bolts.

(7) Relieve the pressure on the puller and remove the puller and the steering clutch pressure plate (1, fig. 6-86).

(8) Remove the clutch disc assemblies (1, fig. 6-85) and the clutch driving discs (4) from the inner drum (5), numbering the disc assemblies and discs as they are removed.

NOTE

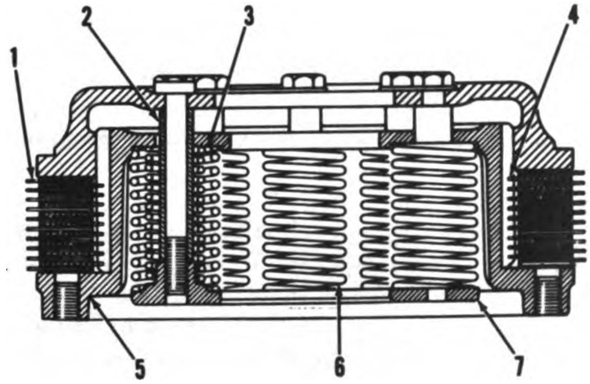
If the same driving discs are reused, they must be replaced on the inner drum with the same face up, but better wear distribution can be obtained if they are switched from the top to the bottom of the clutch stack.

(9) Remove the clutch springs (3) and (6) and the clutch spring sleeves (2).

(10) The steering clutch spring retainer (7), over which the springs and sleeves are placed, can now be removed.

NOTE

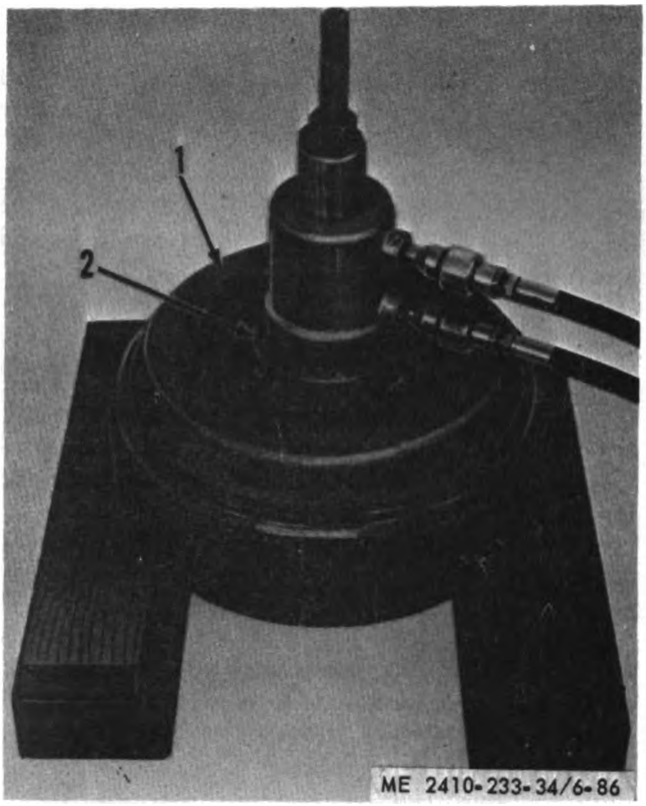
Before assembly, check the discs for warping and check, also, the disc assemblies for excessive wear and roughness. Inspect for broken springs and excessive wear on retainer.



ME 2410-233-34/6-85

1 Clutch disc assembly
2 Clutch spring sleeve
3 Clutch spring
4 Clutch driving disc
5 Steering clutch inner drum
6 Clutch spring
7 Steering clutch spring retainer

Figure 6-85. Cross section of clutch assembly.



1 Steering clutch pressure plate
2 Plate

Figure 6-86. Holding steering clutch spring in compression.

d. Inspection and Repair.

(1) Inspect the clutch disks for damage and wear. The clutch disk stack height of 10 disk assemblies and 9 disks (new) is 2.536 to 2.802 inches. The minimum clutch disk stack height of 10 disk assemblies and 9 disks (worn) is 2.356 inches. Replace the disks and / or disk assemblies if worn excessively. Replace disk assemblies which have:

(a) Chipping on the edge of the disk.

(b) Cracks at the root of any of the teeth.

(c) Worn teeth only when wear has obviously changed tooth contour.

(d) Excessive foreign material imbedded in the face. Replace warped disks.

(2) Inspect the clutch inner and outer springs for damage, distortion, and proper tension. The outer clutch springs should exert 286 to 316 pounds of force when compressed to 3.90 inches. The inner clutch springs should exert 185 to 205 pounds of force when compressed to 3.71 inches. Replace damaged, distorted, or weak clutch springs.

(3) Inspect the clutch spring retaining bolts, sleeves, and retainer for damage and wear. Replace defective parts as required.

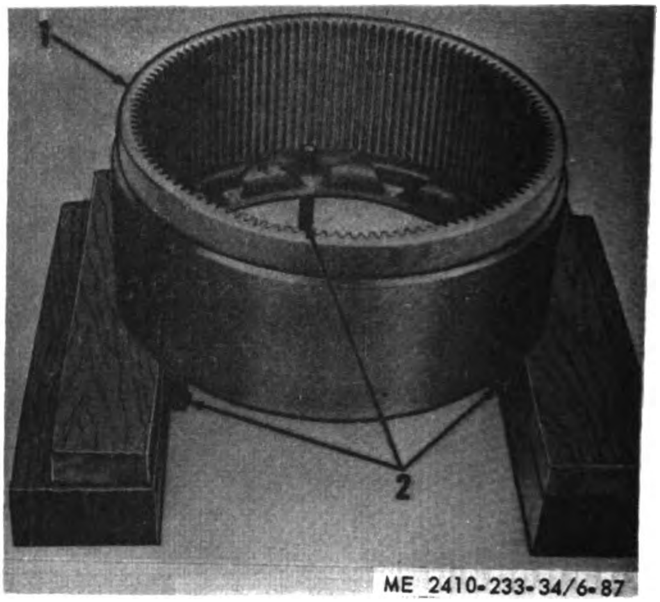
(4) Inspect the clutch inner drum for cracks, breaks, and worn lug recesses. Repair or replace as dictated by the extent of damage.

(5) Inspect the clutch outer drum for cracks, breaks, and worn splines. Repair or replace as dictated by the extent of damage. Refer to paragraph 6-14 for inspection of drum braking surface.

e. Assembly.

NOTE

To prevent the first clutch disc assembly from dropping below the end of the splines on the outer drum (1, fig. 6-87) insert three ⅝ inch 11 (NC) forcing screws (2) in the bolting flange of the outer drum, until they touch the splines.



1 Steering clutch driven drum (outer drum)
2 Forcing screws

Figure 6-87. Preparing to assemble clutch assembly.

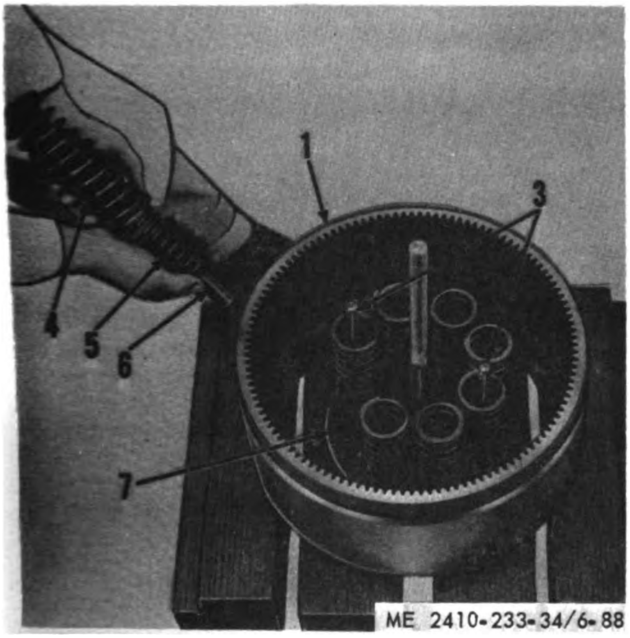
(1) Place the outer drum (1, fig. 6-87) on blocks as a guide to assemble the disc assemblies and discs onto the inner drum (1, fig. 6-89).

(2) Install two 5 / 8 inch 11 (NC) guide pins (2, fig. 6-88) into the clutch spring retainer (6).

(3) Insert the bolt through the plate and place the retainer on the plate and over the bolt. Place this assembly into the outer drum on blocks about 2 inches lower than the outer drum.

(4) Insert the clutch spring sleeves (5) into the smaller clutch springs (4), and then place the small springs and sleeves into the large clutch springs (3).

(5) Place the springs and sleeves over the bosses on the retainer.



1 Steering clutch driven drum (outer drum)
2 Guide pins
3 Large clutch spring
4 Small clutch spring
5 Clutch spring sleeve
6 Clutch spring retainer

Figure 6-88. Assembling springs and sleeves to retainer.

1 Steering clutch inner drum.

Figure 6-89. Installing inner drum.

(6) Place the inner drum (1, fig. 6-89) on the guide pins and over the spring and sleeve assemblies as shown.

(7) Install the clutch discs, starting with a clutch disc assembly (1, fig. 6-90) followed by a clutch driving disc. Alternate from one to the other until all are installed.

NOTE

If new driving discs are installed, no precaution is necessary as to which face is up. If the same discs are installed, they must be replaced with the same face up, and the top discs should be switched to the bottom of the stack.

(8) Place plate (2, fig. 6-91) over the clutch discs. Use the two guide pins (1) to align the holes in the plate with the tapped holes in the retainer.

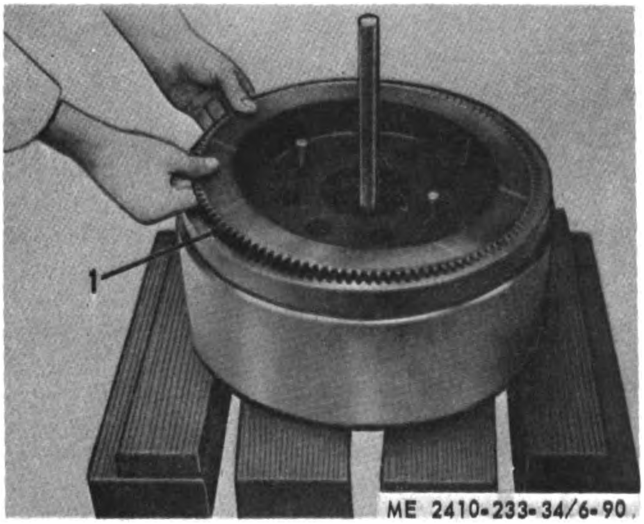
(9) Install as many of the retaining bolts (3) and locks as possible to serve as guides for the spring and sleeve assemblies.

(10) Compress the springs with the same tool arrangement used to disassemble the clutch assembly, and tighten the retaining bolts.

(11) Remove the compressor tools and guide pins and install the remaining bolts. Torque all the bolts to 600—800 lb-ft and bend the metal locks.

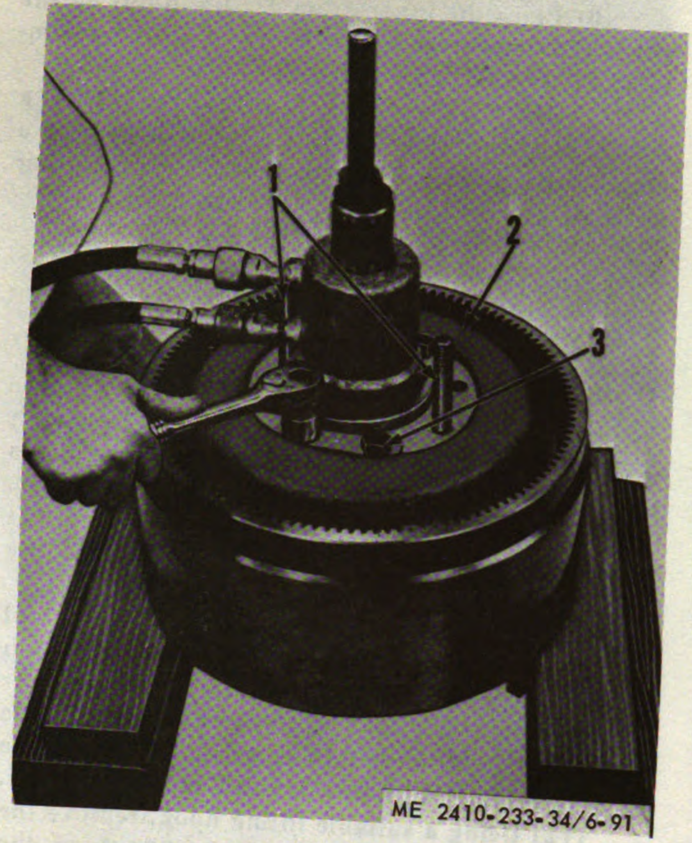
(12) Using a suitable lifting hook, remove the steering clutch assembly (1, fig. 6-92) from the outer drum. Invert the outer drum, remove the forcing screws (3) and replace the outer drum on the steering clutch assembly.

(13) Install the brake band.



1 Installing clutch disc assemblies

Figure 6-90. Installing clutch disc assemblies.



1 Guide pins
2 Steering clutch pressure plate
3 Bolts

Figure 6-91. Compressing steering clutch springs.

1 Steering clutch assembly
2 Steering clutch driven drum (outer drum)
3 Forcing screws

Figure 6-92. Removing steering clutch assembly from outer drum.

6-16. Steering Clutch Driving Hub

a. Removal.

(1) Install two 5/16 inch 18 (NC) bolts approximately 3 inches long in the steering clutch piston (1, fig. 6-93). Remove the piston by pulling toward the outside of the tractor.

(2) Straighten the lock (11, fig. 6-96) securing the hub retaining nut (3, fig. 6-94).

(3) Remove the retaining nut (3).

NOTE

To facilitate nut removal, with both steering clutches removed, install two ⅝ inch—11 (NC) bolts (1, fig. 6-95) approximately 3 inches long, into the opposite clutch hub clearance holes and insert a bar to retain the steering clutch shaft (2, fig. 6-94). Using the wrench (2, fig. 6-95) remove the retaining nut. This procedure can be used when installing the retaining nut, after placing the opposite clutch hub on the shaft temporarily, and inserting the bolts (1) to retain the clutch shaft. With one steering clutch removed, the clutch shaft can be retained by applying the opposite brake.

1 Steering clutch piston

Figure 6-93. Removing steering clutch piston.

1 Steering clutch driving hub
2 Steering clutch shaft
3 Retaining nut
4 Retaining washer

Figure 6-94. Preparing to remove hub retaining hub.

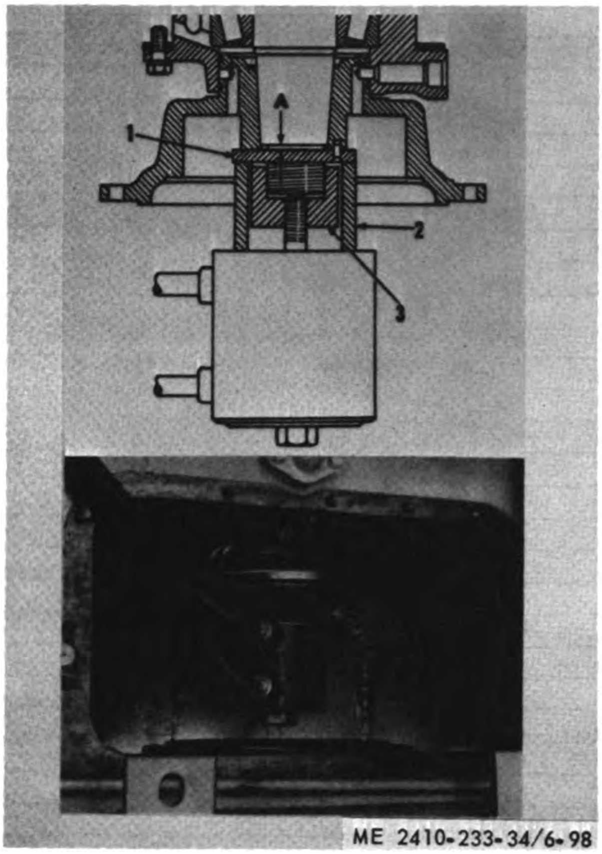
(2) Align the locating dowel in the retainer washer (1, fig. 6-98) with the dowel hole in the hub. Install the washer.

(3) Assemble bolt adapter (3) to the hydraulic puller and install the adapter (3) on the clutch shaft.

(4) Place the spacer (2) over the adapter as shown.

(5) Press the hub onto the shaft to the pressure given in table 1-4. Measure the distance (A, fig. 6-98) from the shoulder on clutch shaft to the face of the clutch hub. Refer to table 1-4 for the correct dimension.

(6) Install the pilot (7, fig. 6-96) lock (11), nut (4), and piston (2) in reverse order of removal.



1 Retainer washer
2 Spacer
3 Adapter
A Dimension to be checked

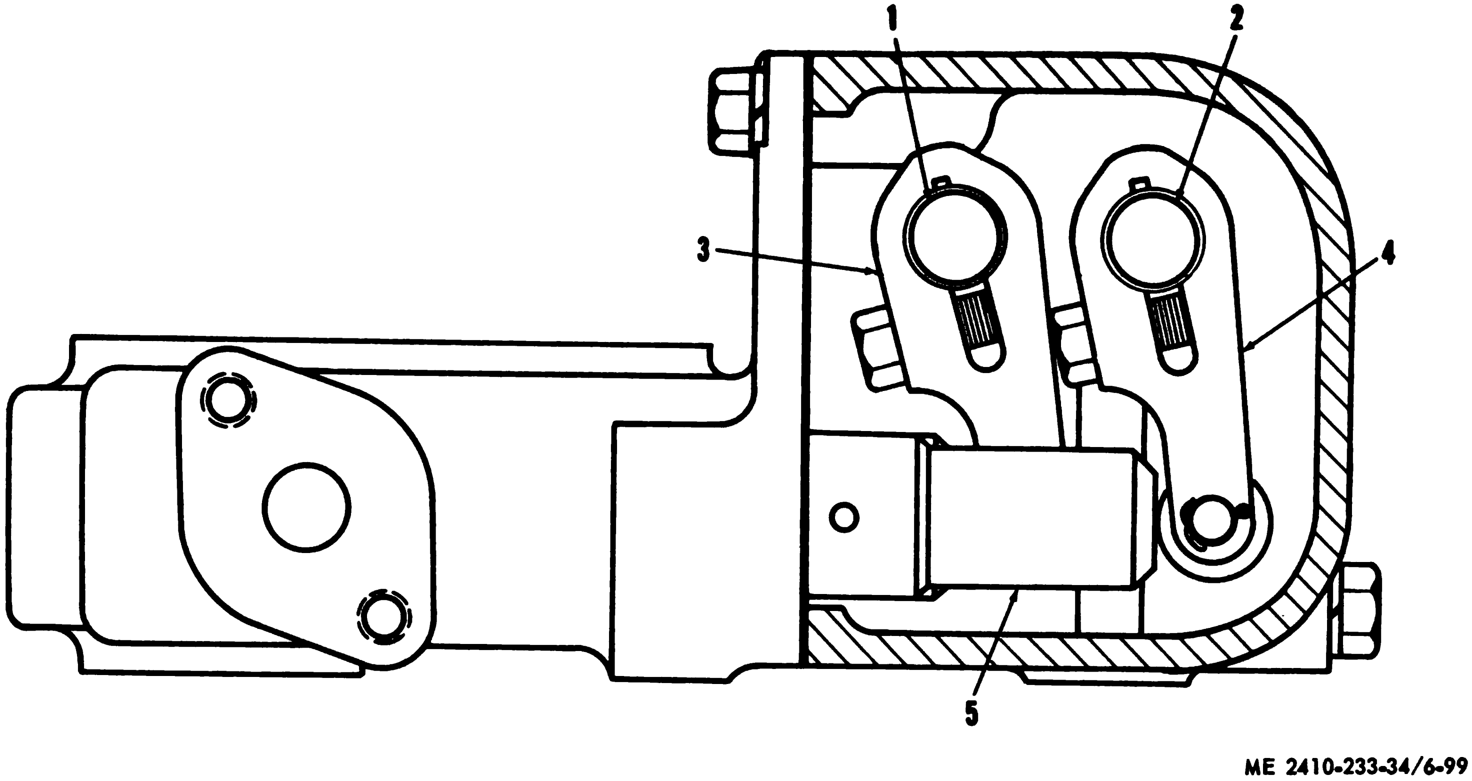
Figure 6-98. Installing hub.

6-17. Steering Clutch Hydraulic Controls

a. General.

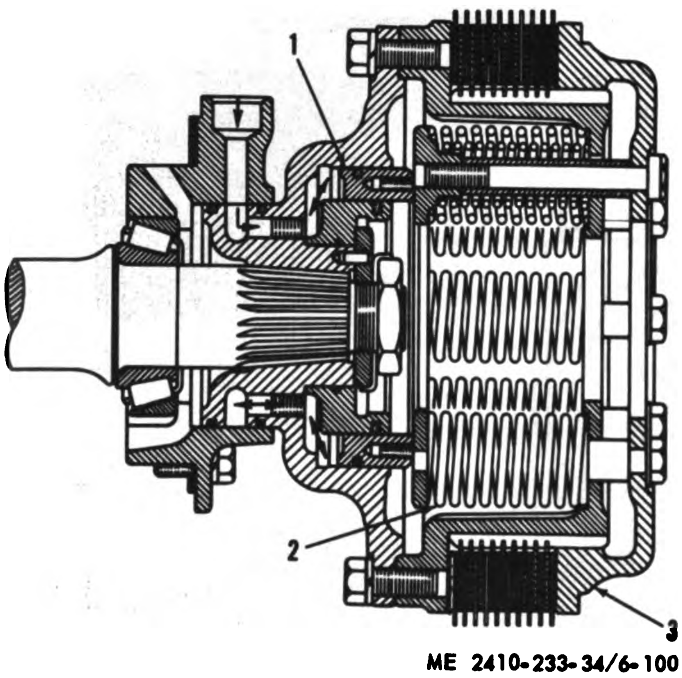
(1) Filtered oil is delivered by the steering clutch hydraulic oil pump to the steering clutch control valve housing.

(2) The steering clutch control levers are connected, through mechanical linkages, to levers on the shafts (1, fig. 6-99). When the control levers are pulled to release the steering clutches, the shafts (1, and 2) are rotated causing the levers (3 and 4) to contact the plungers (5) and move them to the rear. The plungers operate the control valves which direct oil to the control pistons (1, fig. 6-100) in the steering clutch hubs. The oil behind the piston moves them toward the steering clutches, compressing the steering clutch springs (2) and moving the pressure plate (3) out of contact with the clutch discs.



1 Shaft
2 Shaft
3 Lever
4 Lever
5 Plunger

Figure 6-99. Steering clutch hydraulic control (side view).



1 Piston
2 Spring
3 Pressure plate

Figure 6-100. Control piston operation.

b. Removal and Installation.

(1) Remove the fuel tank (para 5-14).

(2) Disconnect steering clutch control rods (para 2-8).

(3) Disconnect oil supply tube (5, fig. 6-101) and remove check valve (2).

(4) Remove elbows (4 and 6).

(5) Remove mounting bolts (3) and lift control valve (1) from the bevel gear case.

(6) Install in reverse order of removal replacing damaged gaskets and seals.

c. Disassembly and Assembly.

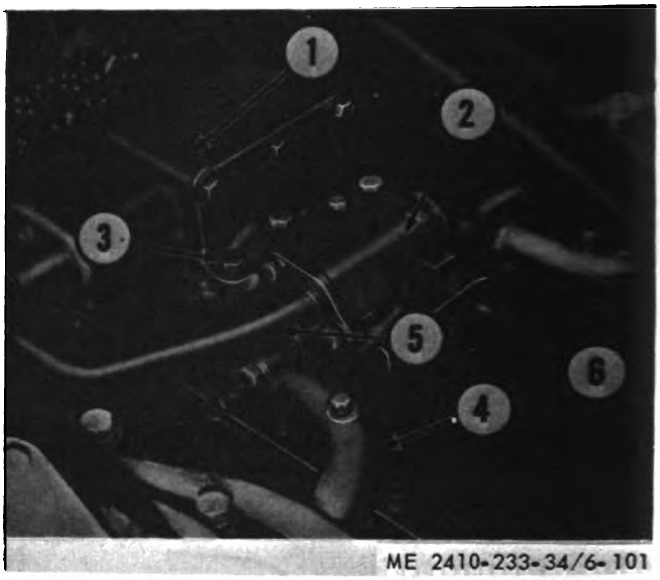
(1) Remove five bolts (1, fig. 6-102) and separate the control valve housing (2) from the control lever housing (3).

(2) Remove plungers (6 and 7), valves (5) and springs (4) from housing (2).

(3) Remove lockring (3, fig. 6-103) washer (4) and spring (5) from inside of plunger (1) and remove bushing (2) from outside of plunger.

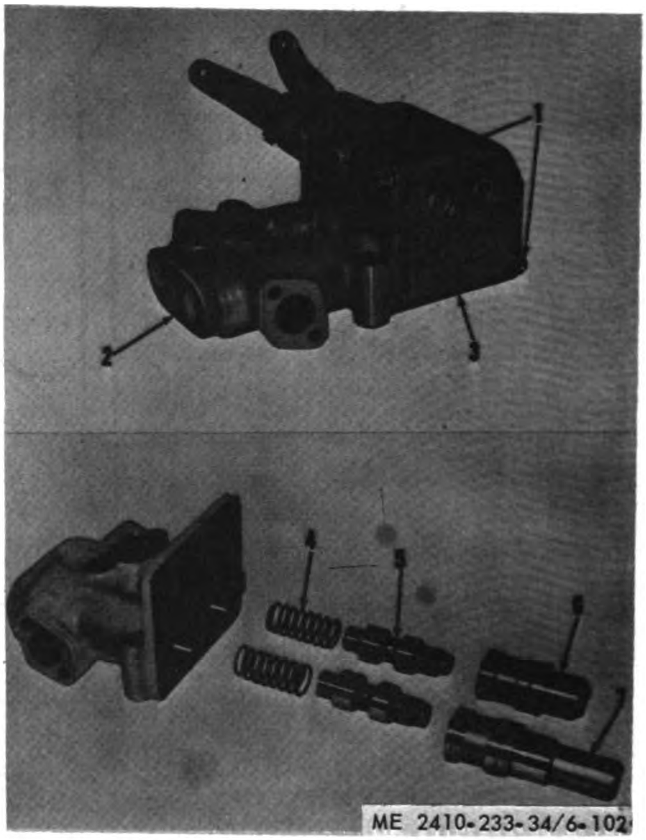
NOTE

Plunger (1) is identical to plunger (6, fig. 6-102) except for length. Disassembly is the same since all parts are the same.



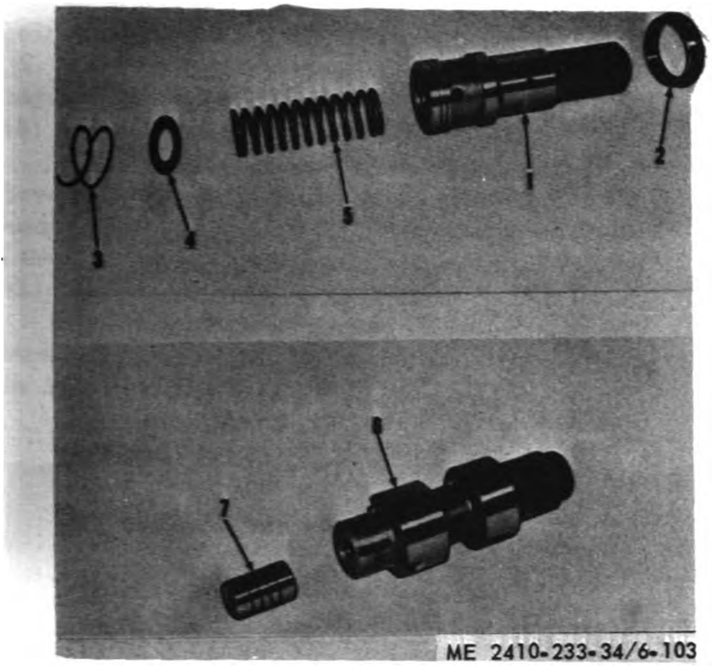
1 Control valve
2 Check valve
3 Bolt
4 Elbow
5 Supply tube
6 Elbow

Figure 6-101. Control valve removal.



1 Bolts
2 Control valve housing
3 Control lever housing
4 Spring (2)
5 Valve (2)
6 Plunger
7 Plunger

Figure 6-102. Control valve housing disassembly.



1 Plunger
2 Bushing
3 Lockring
4 Washer
5 Spring
6 Valve
7 Slug

Figure 6-103. Plunger and valve disassembly.

(4) Remove slugs (7, fig. 6-103) from both valves (6).

(5) Replace worn or damaged parts and assemble valves and plungers back into housing in reverse order of removal.

CAUTION

Extreme care should be taken to avoid introducing dirt into the housing when assembling the plungers and valves.

(6) Remove lever and key (1, fig. 6-104) and loosen bolt (2).

(7) Tap end of shaft (5) to remove spacer (6) and bearing (7) from control lever housing (12).

(8) Remove snapring (4).

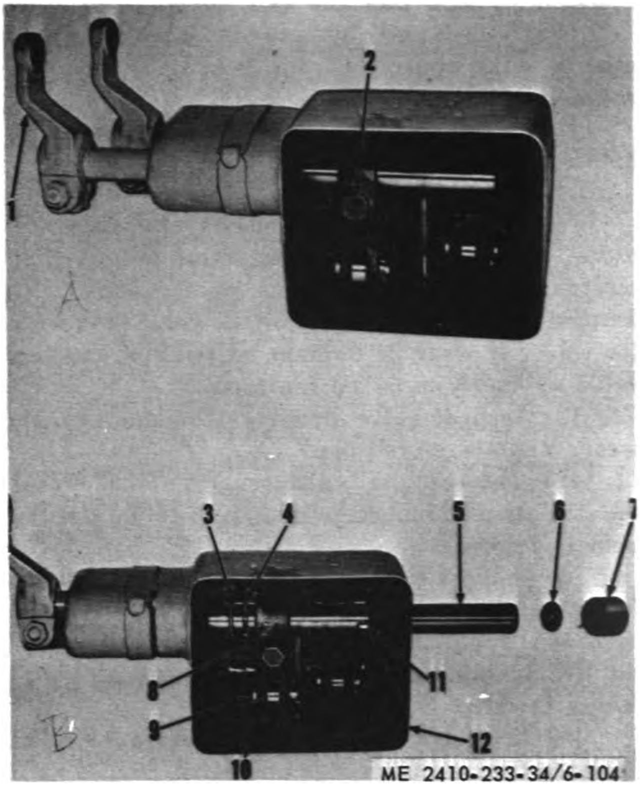
(9) Remove washer (3), lever (8) and key (11) while pulling shaft from housing.

(10) Remove pin (9) and roller (10).

(11) Remove seal and bearing from control lever end of housing.

NOTE

Seal should be installed with lip facing inward.



1 Lever and key
2 Bolt
3 Washer
4 Snapring
5 Shaft
6 Spacer
7 Bearing
8 Lever
9 Pin
10 Roller
11 Key
12 Control lever housing

Figure 6-104. Control lever housing disassembly.

1 Rings
2 Control valve housing
3 Plugs (hidden)

Figure 6-105. Plug removal.

(12) Assemble housing in reverse order of disassembly and bolt the two housings together.

(13) Valves and plungers can be removed from control valve housing (2, fig. 6-105) by removing rings (1) and plugs (3).

(14) Inspect preformed packings on plugs before assembly.

d. Inspection and Repair.

(1) Inspect the valve housing and valves for nicks, burrs, scoring, pitting, and wear. Light scratches or a light grey wear appearance are not harmful to the valve. Examine the valve land edges for wear. If wear or damage exists, the complete valve assembly must be replaced.

(2) Inspect valve bushings for damage and wear. Replace as required.

(3) Inspect the valve springs for cracks, breaks, distortion, or weak condition. Replace defective springs.

(4) Inspect control lever shafts and bearings for corrosion, roughness and wear. Replace corroded, rough, or worn shafts and bearings.

(5) Install control lever shaft seals with the lip facing inward.

(6) Inspect the pressure relief valve for nicks, burns, scoring, and proper operation. Relief valve should bypass at 350 to 400 psi pressure. Replace a defective relief valve.

e. Adjustment. Adjust the steering clutch control linkage as instructed in TM 5-2410-233-20.

6-18. Bevel Gear

a. Removal and Installation.

(1) Drain the oil from the transmission, steering clutch compartment, and bevel gear compartment. Refer to TM 5-2410-233-20.

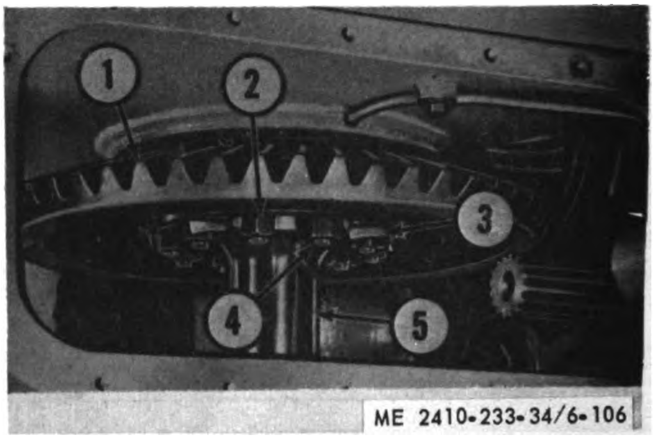
(2) Remove the seat frame (para 2-9) and the fuel tank (para 5-14).

(3) Remove the steering clutch hydraulic control (para 6-17), steering clutches (para 6-15) and the steering clutch driving hubs, (para 6-16).

(4) Remove bevel gear compartment plate. At installation, apply liquid gasket to bevel gear case and tighten bolts to 45 ± 3 lb-ft.

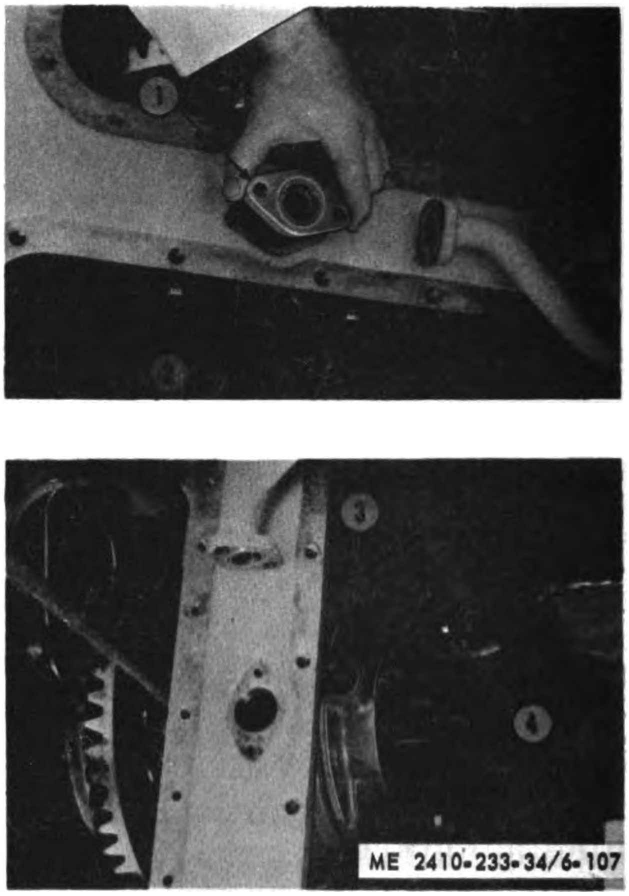
(5) Remove nuts (2, fig. 6-106) and locks (3).

(6) Remove oil tube (1, fig. 6-107). At installation apply liquid gasket to bevel gear case under tube flange.



1 Bevel gear
2 Nuts
3 Locks
4 Bolts
5 Bevel gear shaft

Figure 6-106. Preparing to remove bevel gear and bevel gear shaft.



1 Oil tube
2 Bolts
3 Bearing cage
4 Forcing screws

Figure 6-107. Removing bearing cage.

(7) Attach a suitable hoist to support the bevel gear shaft.

(8) Remove bolts (2), and remove bearing cage (3) using two ½ inch 13 (NC) forcing screws (4) as shown.

(9) Slide the bevel gear (1, fig. 6-106) and the bevel gear shaft (5) out of the left bearing cage, far enough to permit removal of bolts (4) securing the bevel gear (1) to the flange on the bevel gear shaft (5).

(10) Move the bevel gear shaft into the right steering clutch compartment and lift out as shown in figure 6-108.

(11) Lift out the bevel gear.

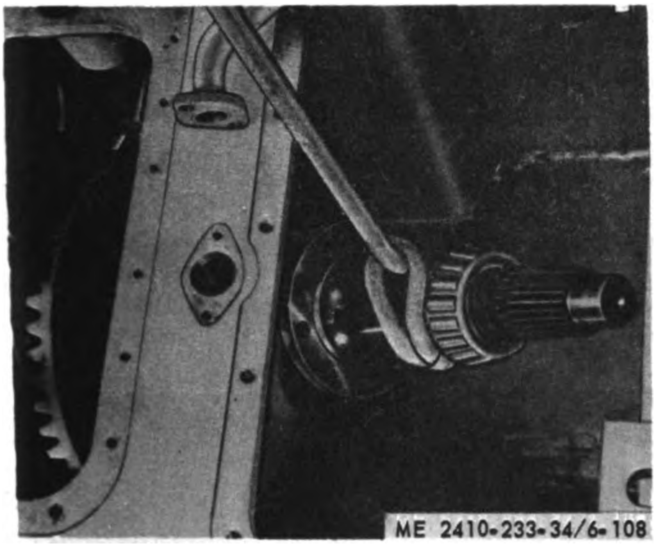


Figure 6-108. Removing bevel gear shaft.

(12) Install the bevel gear and shaft in the reverse order of removal. Adjust the bevel gear and pinion backlash as described in subparagraph *d* below.

b. Disassembly and Reassembly.

(1) Remove the bearing cones from the shaft with a hydraulic puller, a puller, a bearing pulling attachment and a step plate.

(2) Heat the bearing cones in oil prior to reassembly.

(3) Remove the cups from the bearing cages using a puller, two adapters and a bearing cup pulling attachment with an adapter.

(4) Chill the cups in dry ice prior to reassembly.

c. Inspection and Repair.

(1) Inspect all bearings for corrosion, roughness, and wear. Replace worn or defective bearings.

(2) Inspect the bevel gear and pinion for chipped, pitted, broken or worn teeth. Replace a damaged or excessively worn gear set. TB-ENG 364 may be used as a guide for determining gear replacement.

(3) Inspect the bearing cages for cracks, breaks, and other damage. Replace defective or damaged bearing cages.

d. Bevel Gear and Pinion Setting.

(1) *General.* The bevel pinion is free to float in the transfer case of the transmission and seeks its own running position with respect to the bevel gear in forward speeds, and is located by the rear bearing in reverse. The only adjustments necessary are the bevel gear shaft bearing preload (subpara 2 and 3 below), and the backlash (subpara 4 below), between the bevel gear and pinion. The correct amount of backlash for each bevel pinion, installed at the factory, is marked on the end of the bevel pinion. If the pinion is not marked, refer to table 1-4. After adjusting the bevel gear shaft bearing preload, the backlash should be set as described below.

(2) *Bevel gear shaft bearing adjustment (transmission removed).*

NOTE

It is preferred that the bevel gear shaft bearing preload be set with the transmission removed. This permits adjusting the bearings to a definite preload.

(a) Install a full shim pack under the bearing cage farther from the bevel gear. Tighten all bolts.

(b) Install the other bearing cage without shims and tighten the bolts evenly while slowly rotating the bevel gear until a torque, given in table 1-4 is required to rotate it.

(c) Rotate the bevel gear shaft bearings several times before making the final adjustment.

(d) To determine the torque required to rotate the shaft, weld a strap of metal across a steering clutch hub retaining nut and weld a small nut on the strap; then thread the retaining nut onto the bevel gear shaft, and apply a torque wrench to the small nut.

(e) Use a thickness gage as shown in figure 6-109 to determine the clearance between the flange of the bearing cage and the face of the bevel gear case at each bolt location making sure the clearance is the same all around the cage.

Figure 6-109. Measuring clearance.

(f) Remove the cage and install shims with a total thickness the same as the measured clearance. Install the cage and tighten the bolts.

(g) Recheck the torque required to rotate the bevel gear shaft.

(h) After the transmission is in place, adjust the backlash as described in (4) below, moving the shims from one cage to the other as required, but not changing the total number of shims.

(3) Bevel gear shaft adjustment (transmission installed).

NOTE

If the transmission is in place and it is not feasible to remove it, the bevel gear shaft bearings can be preloaded in the following manner. An approximate adjustment for backlash can be made at the same time.

(a) Install enough shims behind the bearing cage nearer the bevel gear to give approximately the amount of backlash indicated on the end of the bevel pinion or in table 1-4.

(b) Install the other bearing cage without shims or lockwashers and tighten the bolts evenly while slowly rotating the bevel gear until a definite preload is noticeable on the bevel gear shaft bearings.

(c) Evenly back off the bolts on the bearing cage without shims until approximately 0.002 inch end clearance has been reached on the bevel gear shaft, being sure there is backlash between the bevel gear and pinion.

NOTE

To determine end clearance, pry against the ends of the bevel gear shaft.

(d) Use a thickness gage to determine the clearance between the flange of the bearing cage and the face of the bevel gear case at each bolt location making sure the clearance is the same all around the cage.

(e) Remove the cage and install the shims with a total thickness the same as the clearance determined in subpara (4) less 0.015 inch to give the required preload to the bevel gear shaft bearings.

NOTE

The 0.015 inch shim removal includes 0.002 inch end clearance as left in *(c)* above, plus the 0.013 inch normal preload.

(f) Again install the cage and lockwashers and securely tighten the bolts.

(4) ***Backlash adjustment.***

(a) Mount a dial indicator with a universal attachment on one of the pinion gear teeth as shown in figure 6-110.

(b) Block the bevel gear.

(c) Move the pinion as far forward as possible and rock the pinion gear back and forth. The backlash between the bevel gear and pinion will be the difference in readings on the dial indicator.

Figure 6-110. Measuring backlash.

(d) Check the backlash at four points around the bevel gear to determine the point of least backlash. Be sure the pinion is held forward while rocking it back and forth to take the backlash readings.

NOTE

The correct amount of backlash is marked on the end of the bevel pinion, if installed in the machine at the factory. If the bevel pinion is not marked, refer to table 1-4.

(e) If the reading is too great at the point of least backlash, remove shims from the bearing cage on the right side and install them on the left side.

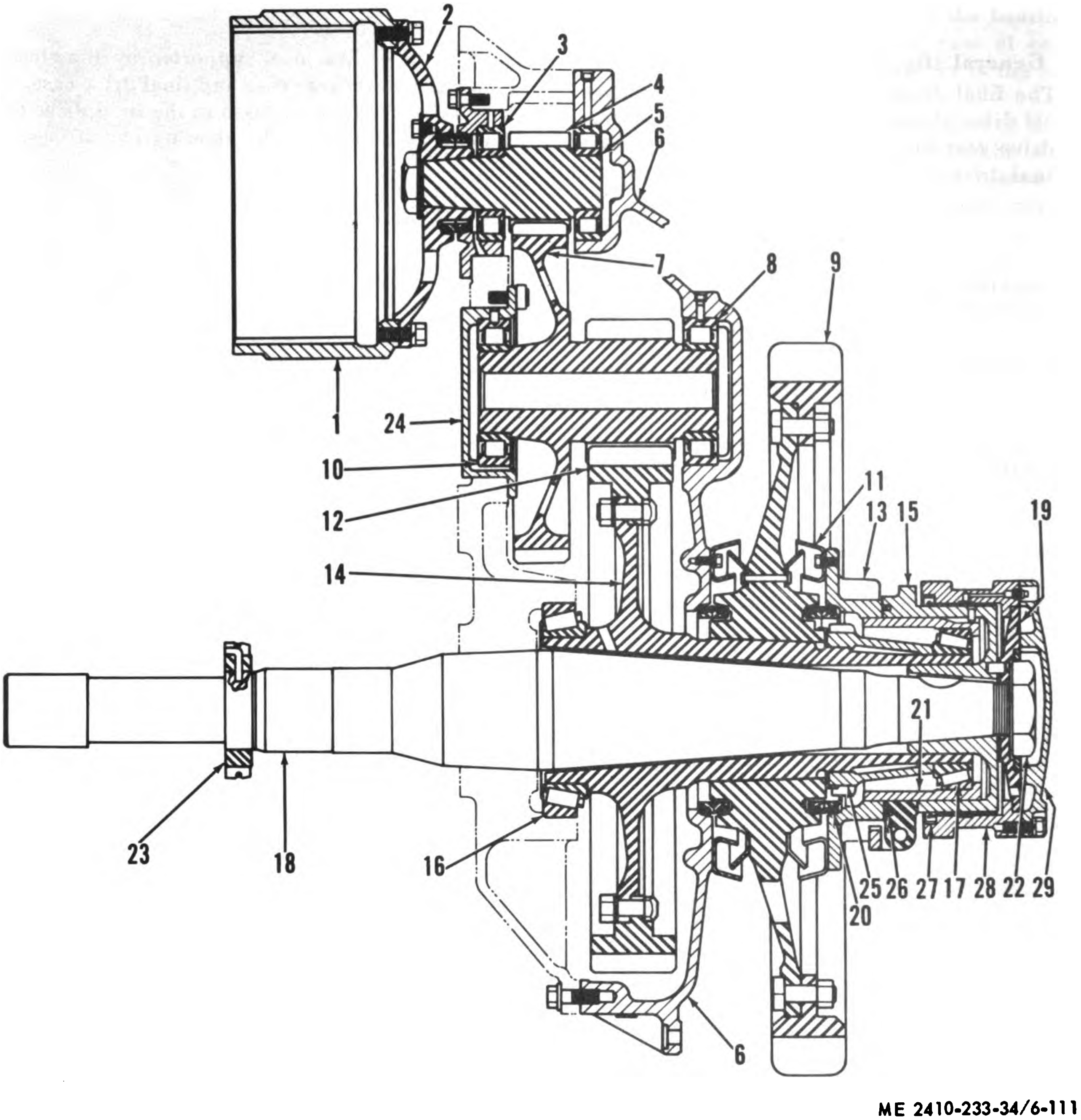
NOTE

The preload on the bevel gear shaft bearings will not be changed by moving shims from one side to the other if the same total number of shims is maintained.

(f) To increase the backlash, move shims from the left side to the right side.

6-19. General (fig. 6-111)

a. The final drive group consists principally of the final drive pinion, idler pinion, final drive gear, final drive gear hub, sprocket shaft and sprocket. The final drive group is contained by tapered and straight roller bearings, supported by the steering clutch and bevel gear case and final drive case. The final drive group is enclosed in the final drive case, which is mounted to the steering clutch case.



1 Brake drum
2 Final drive pinion flange
3 Final drive pinion inner bearing
4 Final drive pinion
5 Final drive pinion outer bearing
6 Case
7 Idler pinion
8 Idler pinion outer bearing
9 Sprocket
10 Idler pinion inner bearing
11 Dirt guard
12 Final drive gear
13 Outer bearing adjusting nut
14 Final drive gear hub
15. Bearing cage holder
16 Hub inner support bearing
17 Hub outer support bearing
18 Sprocket shaft
19 Retainer
20 Floating duo-cone seals
21 Bearing cage
22 Retaining nut
23 Sprocket shaft retaining nut
24 Bearing cage
25 Sprocket retaining nut
26 Gasket
27 Lip-type seal
28 Outer bearing assembly
29 Bearing cap

Figure 6-111. Final drive.

b. The final drives are splash lubricated. Each final drive case provides an oil sump for each final drive group. The oil level in the sump is established by the filler plug located in the steering clutch and bevel gear case.

6-20. Track Roller Frame Outer Bearing

a. *Removal.*

(1) Drain the final drive compartment (TM 5-2410-233-20).

(2) Remove the track roller frame (para 7-10).

(3) Remove the outer bearing cap (1, fig. 6-112).

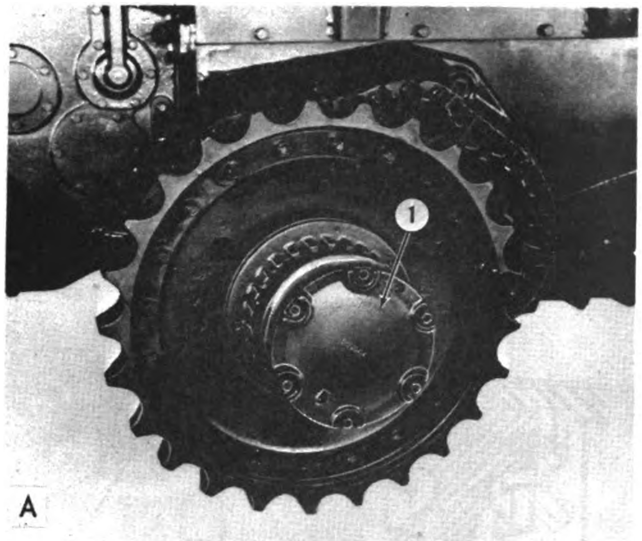
(4) Remove retainer (2), lock (3), and nut (4).

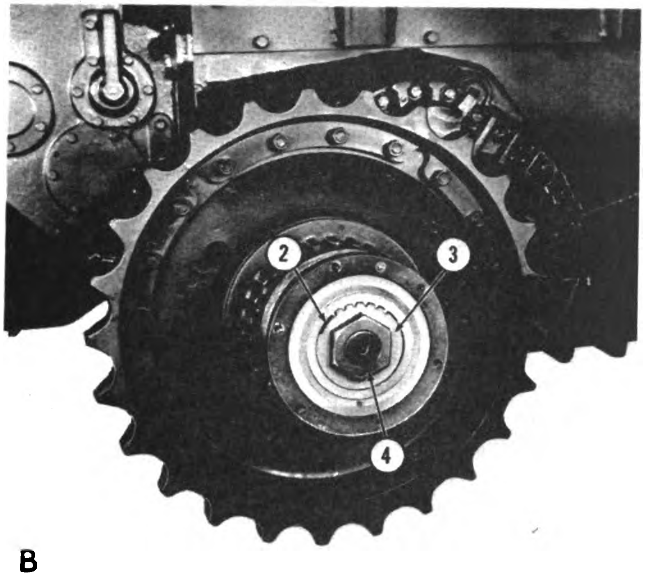
(5) Remove the outer bearing assembly (7).

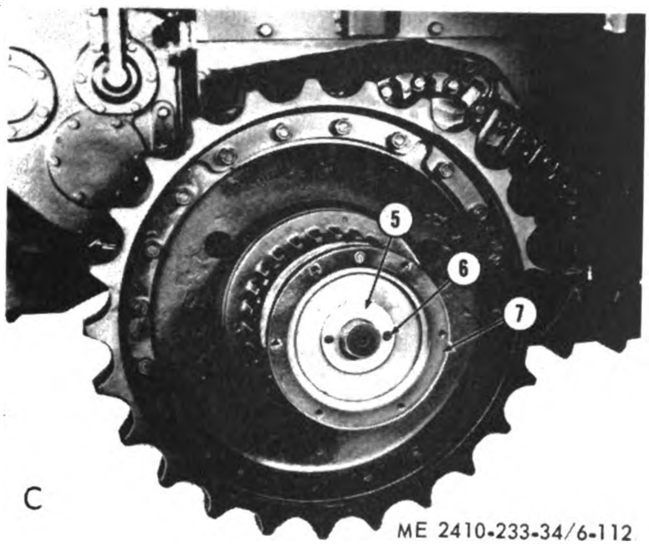
(6) Remove track roller frame outer bearing alignment shims (5) from locating dowels (6).

CAUTION

When separating the track roller frame outer bearing assembly (7, fig. 6-113) from bearing cage holder (10), hold bearing assembly (7) level to prevent damage to seal (8) contained in the bearing assemblies (7).

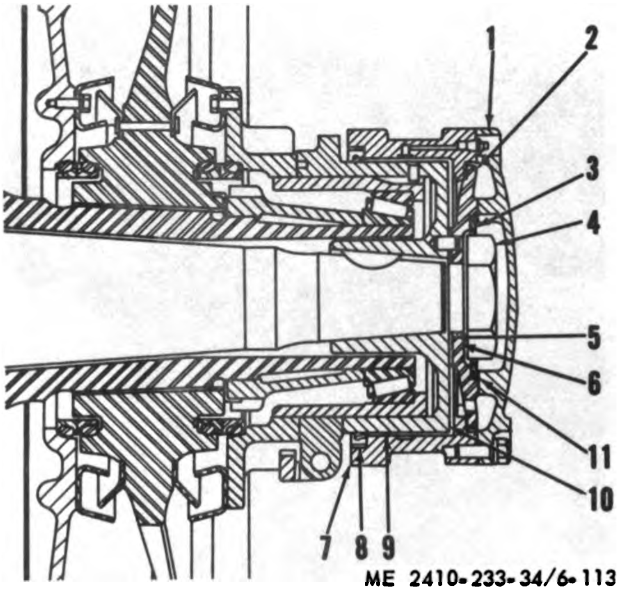






Key to figure 6-112.
1 Cap
2 Retainer
3 Lock
4 Nut
5 Shims
6 Dowels
7 Track roller frame outer bearing assembly

Figure 6-112. Outer bearing removal.



1 Cap
2 Retainer
3 Lock
4 Nut
5 Shims
6 Dowels(2)
7 Bearing assembly
8 Seal
9 Bearings
10 Holder
11 Dowels (2)

Figure 6-113. Outer bearing installation.

b. Inspection and Repair.

(1) Inspect bearing for corrosion, pitting, and wear. Replace a corroded, rough or worn bearing.

(2) Inspect bearing cap (1, fig. 6-113) for cracks, breaks, or other damage. Replace a defective or damaged bearing cap.

c. Installation.

(1) Replace seal (8, fig. 6-113) in bearing assembly (7). Install seal (8) with the lip facing the outside of bearing assembly (7).

NOTE

Lubricate seal (8) with ball and roller bearing lubricant (LO 5-2410-233-12). Install seal (8) with lip facing out.

(2) Using ball and roller bearing lubrication, lubricate mating surfaces of bolder (10) and bearing (9). Install bearing assembly (7).

(3) Place shims (5) and retainer (2) on locating dowels (6).

(4) Install retaining nut (4) and tighten to 1100—1200 lb-ft.

NOTE

Check track roller frame alignment and correct if necessary. Correct alignment by adding or removing shims (5), whichever is needed (para 6-29).

(5) Install lock (3) on locating dowels (11). Six lock positions can be obtained by reversing the lock.

(6) Using ball and roller bearing lubricant, hand pack the bearing and install cap (1).

(7) Install the track roller frame (para 7-10) and fill final drive compartment with lubricant to the specified lever (LO 5-2410-233-12).

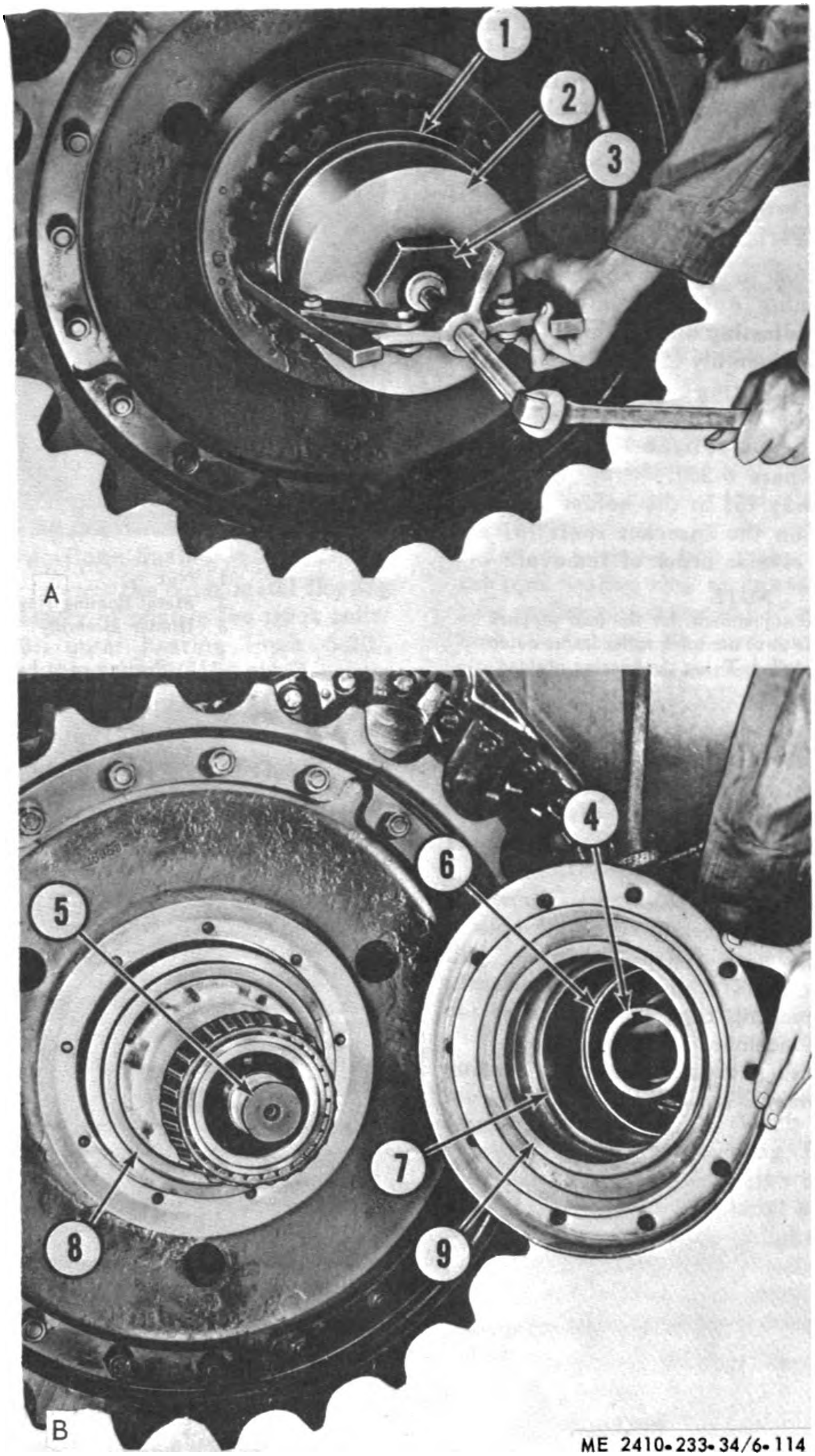
6-21. Bearing Cage Holder Assembly

a. Removal.

(1) Remove track roller frame outer bearing (para 6-20).

NOTE

Replace nut (3, fig. 6-114) on the sprocket shaft (5) to retain bearing cage holder assembly (2) during removal. Leave approximately ½ inch clearance between the nut and holder assembly.



1 Nut
2 Holder assembly
3 Nut
4 Keyway
5 Shaft
6 Cup
7 Cage
8 Metal floating ring seal
9 Metal floating ring seal

Figure 6-114. Bearing cage holder removal.

(2) Remove the clamping bolt and lock securing bearing cage holder assembly (2) to outer bearing adjustment nut (1).

(3) Using a puller and a step plate, force holder assembly (2) from taper on sprocket shaft (5).

NOTE

It may be necessary to strike the holder assembly with a soft hammer to free it from the taper on the shaft.

(4) Attach a hoist to support holder assembly (2). Remove retaining nut (3), and the holder assembly. Remove adjusting nut (1), metal floating ring seal (9), holder assembly (2), and gasket (10), bearing cage (7), and bearing cup (6) as a unit.

(5) Inspect the mating surfaces of metal floating ring seals (8, and 9, fig. 6-114) for damage or excessive wear (para 6-22).

(6) Align keyway (5) in the holder assembly hub with the key on the sprocket shaft (6) and install the unit in reverse order of removal.

NOTE

The bearing preload adjustment, for the hub support bearings, is not made until the track roller frame outer bearing has been installed. To set the bearing preload, refer to paragraph 6-28.

b. Disassembly.

(1) Remove the dust guard.

(2) Remove metal floating ring seal (2, fig. 6-115), if replacement is necessary (para 6-22).

(3) Remove outer bearing adjusting nut (1) from bearing cage holder assembly (3).

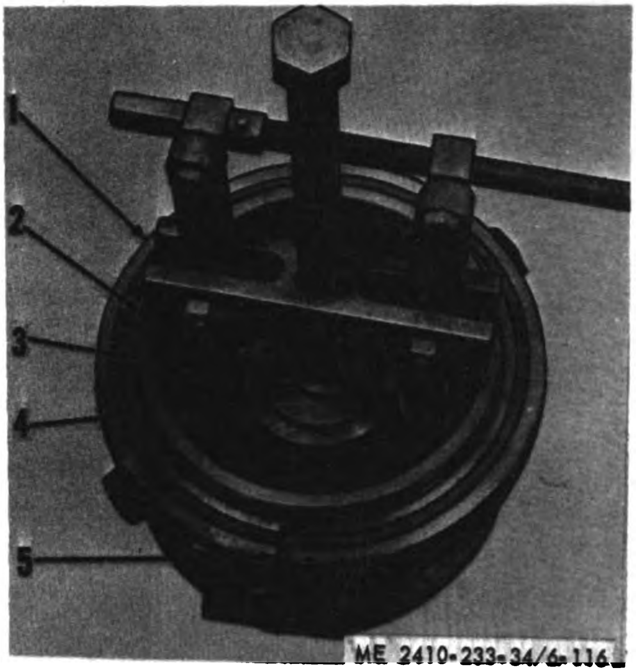
(4) Using a bearing cup pulling attachment, a forcing bolt, a suitable spacer to cover the hole in the holder assembly hub, and a step plate, pull bearing cage (2, fig. 6-116) and cup (3) as a unit.

(5) Remove bearing cage holder gasket (4) and seal (5) if replacement is necessary.

(6) Using a puller, an adapter and a bearing cup pulling attachment, remove the cup (3) from the bearing cage.

1 Nut
2 Metal floating ring seal
3 Holder assembly

Figure 6-115. Bearing cage holder assembly.



1 Holder assembly
2 Cage
3 Cup
4 Gasket
5 Seal

Figure 6-116. Removing bearing cage.

CAUTION

At assembly, align the milled slot in bearing cage with the dowel in bearing cage holder assembly (1, fig. 6-116). This is not a press fit and can be assembled by using a soft hammer. Invert the assembly to see that bearing cage (2) has bottomed in the bearing cage holder.

c. Inspection and Repair.

(1) Inspect bearings for corrosion, pitting, and wear. Replace corroded, rough, or worn bearings.

(2) Inspect holder assembly (2, fig. 6-114) for cracks, breaks, and other damage. Replace a defective or damaged holder assembly.

d. Reassembly and Installation. Reverse disassembly and removal procedure and assemble and install the bearing cage holder assembly on the final drive assembly.

6-22. Floating Duo-Cone Seals

a. Removal. To remove the outer metal floating ring seal, it is necessary to remove the track roller frame (para 7-10), outer bearing (para 6-20), holder and outer bearing adjusting hub outer bearing cage holder and outer bearing adjusting nut (para 6-20). The sprocket must be removed to service or replace the inner metal floating ring seal (para 6-23).

b. Cleaning.

(1) Wash off all dirt accumulation from used parts using cleaning solvent (Fed. Spec. P-D-680). It may be necessary to use a wire brush to clean the accumulations of dirt or rust from the bore of the seal mounting grooves to assure they are clean and smooth.

(2) Remove all oil or the protective coating from the floating seals with cleaning solvent.

c. Inspection. Inspect the metal floating ring seals (8 and 9, fig. 6-114) for damage. Replace the seals if there are scratches across the sealing bands or if contact is not clearly defined around the outer edges. If either floating ring seal is damaged, both must be replaced.

CAUTION

To obtain maximum service, cleanliness must be the rule. Avoid introducing dirt into the parts during installation or filling with oil.

d. Installation.

(1) Handle all parts with care to avoid nicks in critical areas. File smooth any parts, other than the sealing faces, that have nicks that may make assembly difficult or questionable.

(2) Be sure the ramps on the seal mounting grooves and on the floating ring seal are dry and with no oil present. Check the ramps for rough tool marks and nicks. On used parts, remove all dirt or rust deposits from the ramps with a scraper or wire brush and smooth the surface with emery cloth.

(3) Always install new rubber toric sealing rings (1, fig. 2-8) on floating ring seals (2). Never install a used toric sealing ring on a new or used floating ring seal.

NOTE

Use seal installer tool (fig. 2-9) to install metal floating ring seal (2, fig. 2-8), and toric sealing ring (3) into seal mounting groove (4). Be sure not to bump the floating ring seal when removing the installer tool.

(4) Install toric sealing ring (3) so it seats uniformly in the relief of floating ring seal (2). Be sure the toric sealing ring is not twisted and that it sets straight and against the lip that keeps it from falling off the floating seal (fig. 2-10).

(5) If the installer tool is not used, install the toric sealing ring (3, fig. 2-8) and floating ring seal (2) as an assembly into groove (3) by pressing on the toric sealing ring at location (3). Be sure the toric sealing ring is seated uniformly in the recess of both the floating ring seal and the groove. Make sure that it sets in the bore straight and against the lip that keeps it from falling out of the retainer (fig. 2-10).

CAUTION

If installer tool is not used, do not use a screwdriver or stick to assemble the toric sealing ring in the groove. Use finger pressure only.

(6) Instal the floating ring seal to a uniform depth in the groove. The dimension (1, fig. 2-8) must be uniform around the entire circumference of the floating ring seal.

(7) Always install the floating ring seals (fig. 2-10) in pairs, that is, two new seals together or two seals that have previously run together. Never assemble one new seal and one used seal or two seals that have not previously run together.

(8) Before assembling floating ring seals together, wipe faces of seals with lint-free tissue to remove any foreign material and finger prints.

(9) Place one drop of light oil on the cleaning tissue and coat the sealing surfaces of the seals. Be careful not to let any oil come in contact with the toric sealing ring or its mating surface.

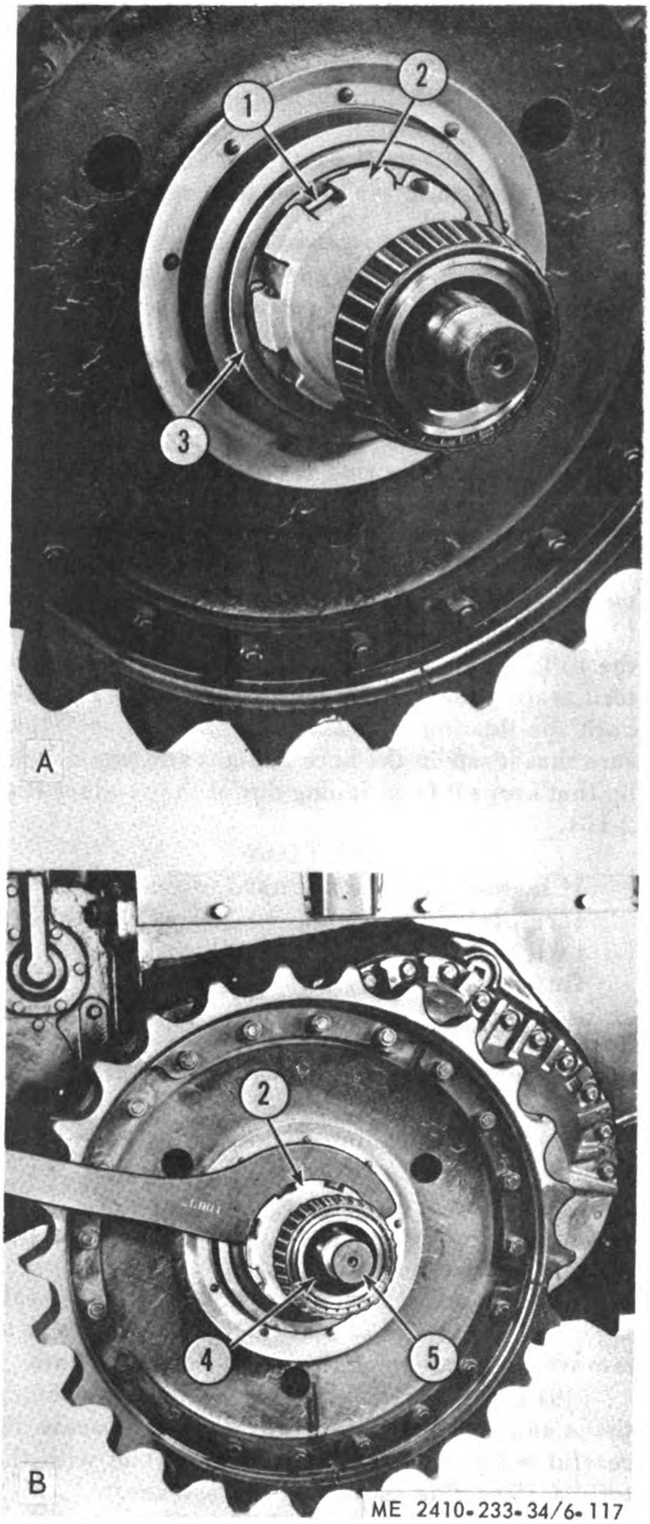
6-23. Sprocket and Sprocket Segments

a. Sprocket.

(1) *Removal.*

(a) Remove floating ring seal (3, fig. 6-117) as described in paragraph 6-22.

(b) Bend lock (1) securing retaining nut (2).



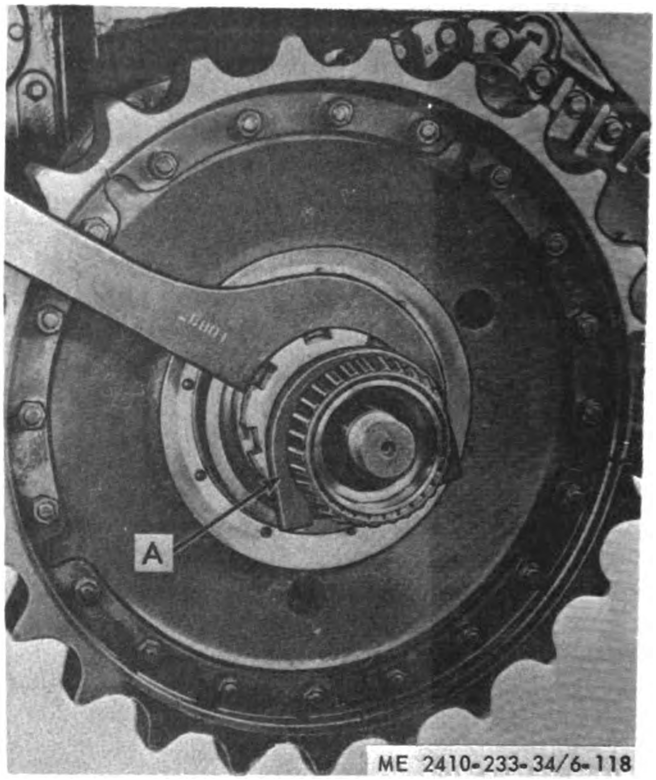
1 Lock
2 Bearing nut
3 Metal floating ring seal
4 Bearing cone
5 Final drive hub

Figure 6-117. Removing outer bearing cone.

(c) Using a spanner wrench, back off retaining nut (2) approximately 7/8 inch. Turn the nut back toward the sprocket and install yoke (A fig. 6-118) between the nut and bearing cone as shown. Remove bearing cone by unscrewing nut (2, fig. 6-117) with the yoke in place.

CAUTION

After the outer bearing cone has been forced off, install sprocket retaining nut (2) on the final drive hub, leaving approximately 1/4 inch clearance between the retaining nut and sprocket. This will keep the sprocket from jumping off final drive hub (5) during pulling.



A Yoke

Figure 6-118. Removing nut with yoke installed.

(d) Attach the Cylinder Group to the Pump Group. Place sleeve assembly (5, fig. 6-119) over the sprocket shaft and against final drive gear hub. Attach the cylinder group to the sprocket with arms (2), adapters and nuts (4) and pins (3) and pull the sprocket loose from hub.

(e) Relieve the pressure on the cylinder group and remove puller arrangement from the sprocket.

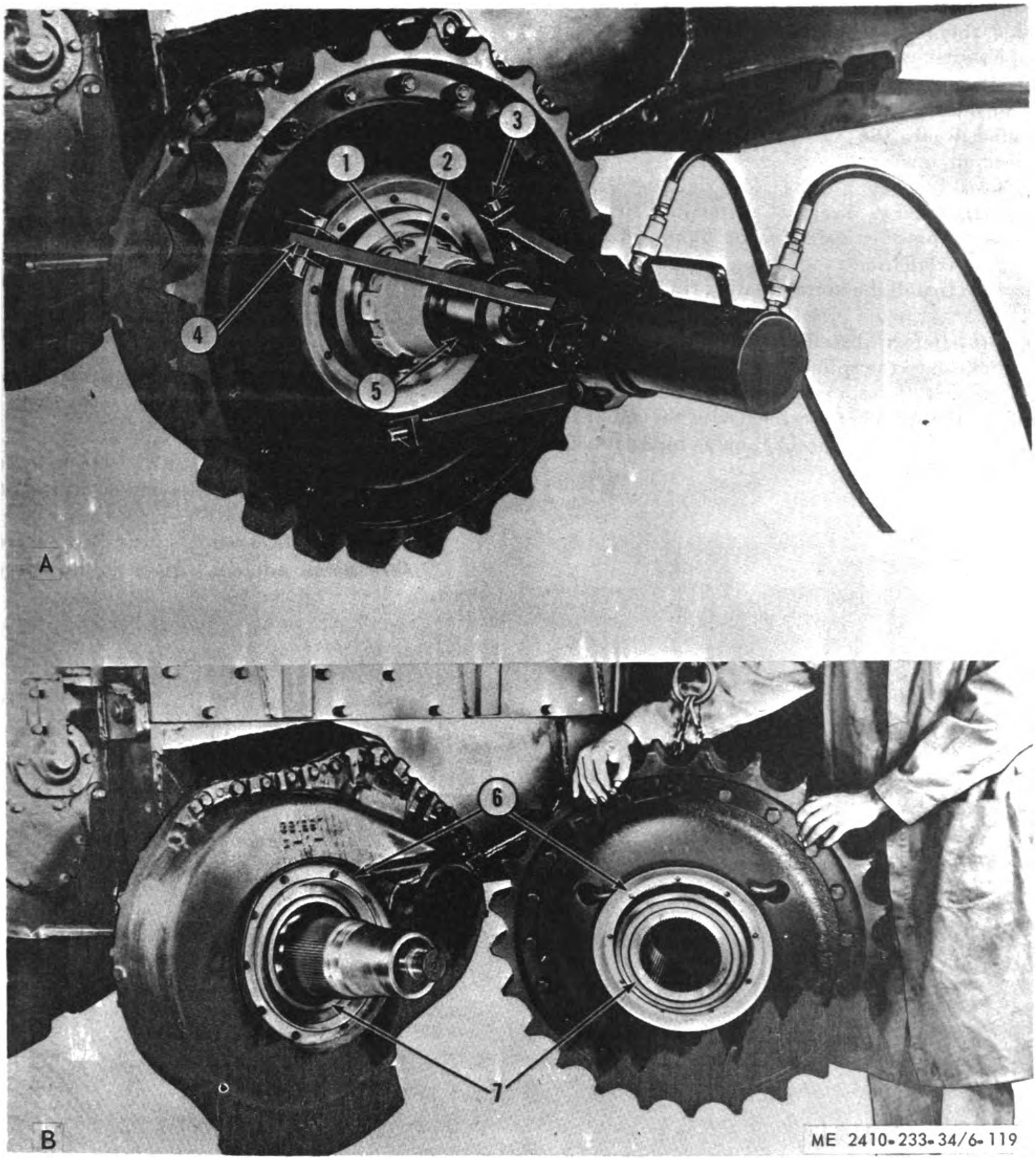
(f) Attach a hoist to the sprocket and remove retaining nut (2, fig. 6-117) and lock (1).

(g) Remove sprocket (weight approximately 300 lb).

NOTE

Inspect the splines on hub (5) and splines in the sprocket for wear, if the sprocket pulls off easily.

(h) Remove metal floating ring seals (7, fig. 6-119) as soon as the sprocket has been removed. Tie the mating seals together to assure installation of the same mating seal surfaces.



1 Retaining nut
2 Arms
3 Pins
4 Adapters and nuts
5 Sleeve assembly
6 Guards
7 Metal floating ring seal

Figure 6-119. Sprocket removal.

(2) *Inspection.*

(a) Inspect sprocket and sprocket hub splines for damage and wear. If the sprocket is removed easily, the splines in one or both may be worn and should be replaced.

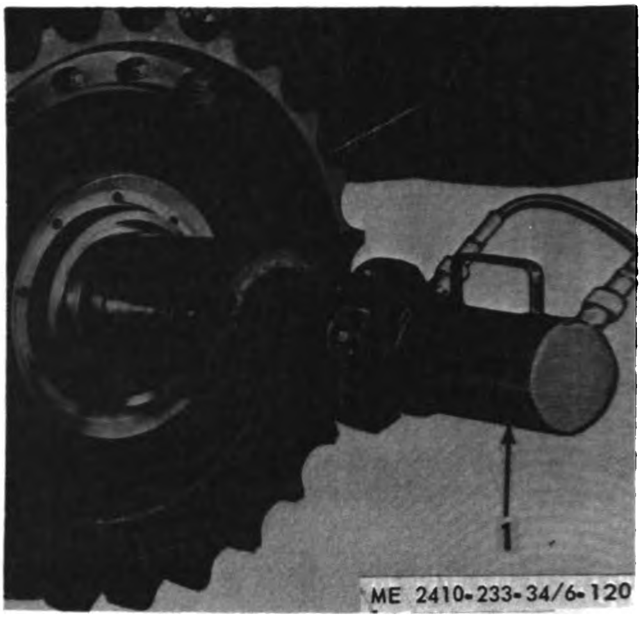
(b) Inspect the sprocket segments for damage and wear. Segments with teeth having considerably more wear on one face than the other, may be switched from one side of the tractor to the other. If sprocket segments faces are worn 3 / 16 inch or more, replace sprocket. To prevent accelerated wear, the sprocket segments must be replaced in sets only.

(c) Inspect guards (6, fig. 6-119) for corrosion, cracks, breaks, distortion or other damage. Replace a defective or damaged guard.

(3) *Installation*

(a) Install the metal floating ring seals (para 6-22).

(b) Before installing the sprocket (fig. 6-120) make sure the splines are clean, dry, and free of burrs. Set the sprocket on the hub with the splines in the sprocket meshing with the splines on the hub and push the sprocket on as far as possible by hand.



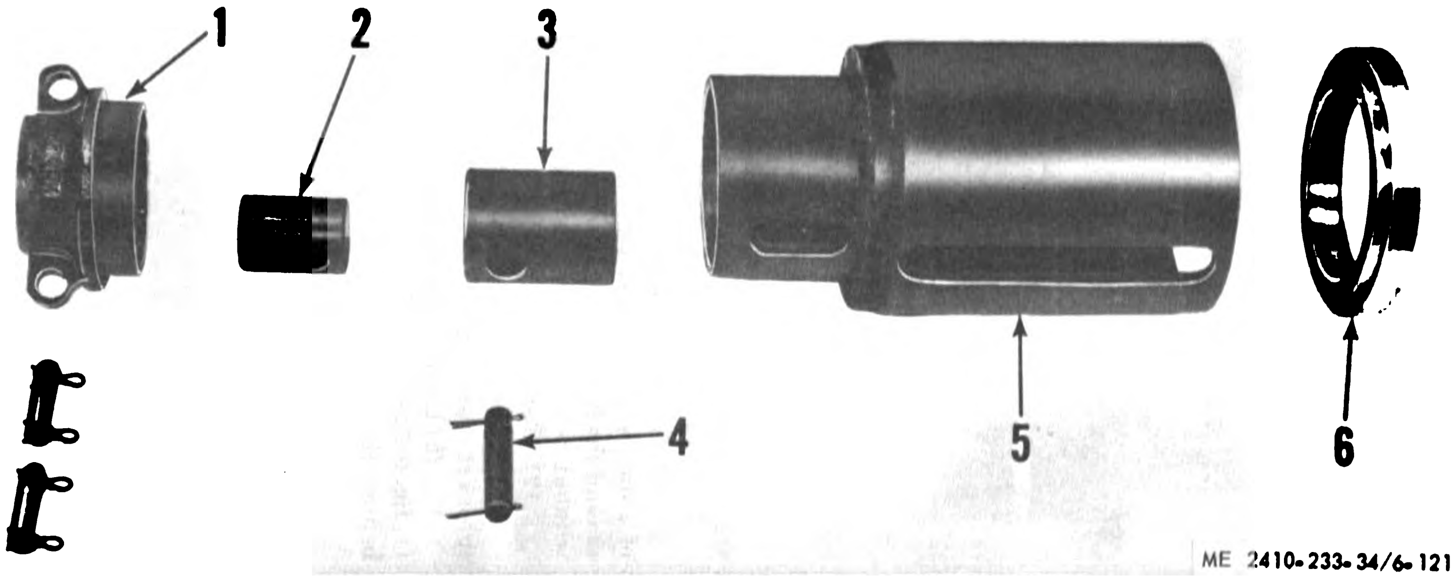
1 Cylinder group

Figure 6-120. Installing sprocket.

(c) Install adapter (2, fig. 6-121) on cylinder group and extend the ram to its limit with the pump group.

(d) Assemble head (1) to cylinder group.

(e) Install adapter (3) onto the sprocket shaft.



1 Head
2 Adapter
3 Adapter
4 Coupling pin
5 Sleeve
6 Ring

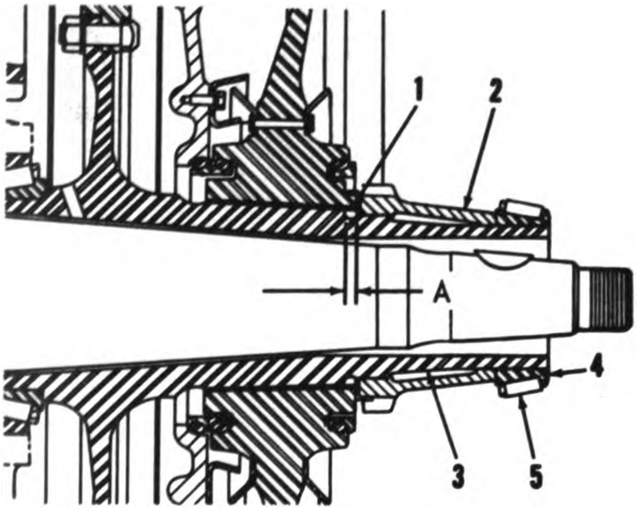
Figure 6-121. Sprocket installing tools.

(f) Place ring (6) and sleeve (5) over adapter (3) and hub (3, fig. 6-122) and connect adapter (2, fig. 6-121) and adapter (3) with pin (4).

(g) Place the pump control in the pulling position and apply a slight press to the sprocket. Rock the sprocket back and forth to equalize the load.

(h) Press the sprocket on to 60-65 tons.

(i) When a new sprocket or final drive hub has been installed, measure distance (A, fig. 6-122) between the end of the sprocket and the end of the splines on the final drive hub. Distance (A) should be 0.44—0.56 inches.



1 Lock
2 Nut
3 Hub
4 Bearing cone
A Dimension to be checked

Figure 6-122. Checking sprocket location.

(j) Install lock (1, fig. 6-123) and using a spanner wrench, install sprocket retaining nut (2).

(k) After locking the retaining nut, heat outer bearing cone (preferably in oil) and drive it onto final drive gear hub (3) until it seats against retaining nut (2).

1 Lock
2 Nut
3 Hub

Figure 6-123. Installing retaining nut.

(l) Remove the installation tools and install the metal floating ring seals (para 6-22).

b. Sprocket Segments.

(1) *General.* The segmented sprockets consist of a hub with sprocket segments bolted into place around the hub. Sprocket segments can be replaced without removing the hub from the tractor.

(2) *Removal.*

(a) Remove dirt guards to provide access to sprocket segments.

(b) Loosen track adjustment and insert pin (1, fig. 6-124) in the last slot of the segment (3) just behind the segment (2) to be replaced.

WARNING

Refer to paragraph 7-2 for correct procedure on releasing pressure in the hydraulic track adjuster cylinder.

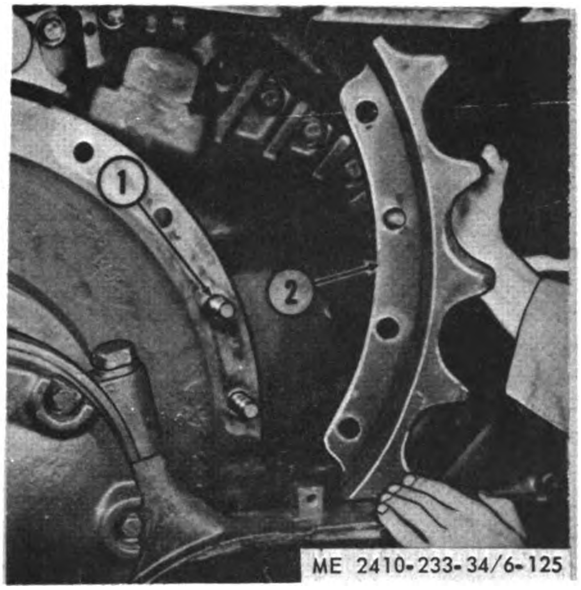
1 Pin
2 Segment
3 Segment
4 Nuts (4)
5 Bolts

Figure 6-124. Preparing to remove segment.

(c) Move the machine backward until pin lifts track and all of segment (2) is visible.

(d) Remove nuts (4, fig. 6-124) and lift segment (2) away as shown in figure 6-125.

(e) Bolts (1, fig. 6-125) can be removed if hub is rotated backward far enough so the bolts will not interfere with the final drive cover.



1 Bolt
2 Segment

Figure 6-125. Removing segment.

(3) *Inspection.* Refer to subparagraph 6-23 *a* (2).

(4) *Installation.* Install in reverse order of removal.

6-24. Final Drive Gear Case

a. Removal.

(1) Remove the final drive case metal floating ring seal (para 6-22).

(2) Remove the bolts securing final drive case (1, fig. 6-126) to the steering clutch and bevel gear case.

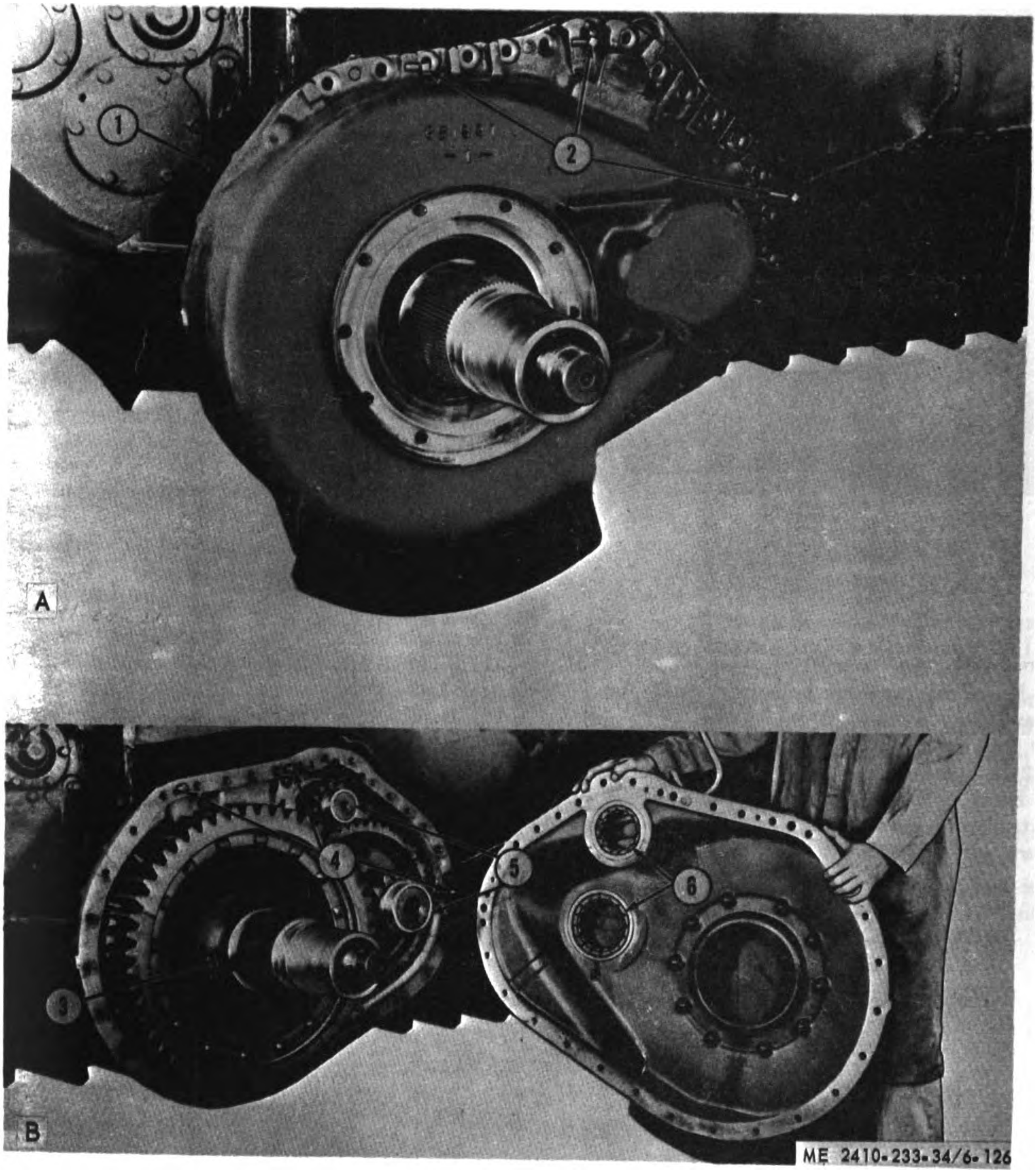
(3) Install three ½ inch 13 NC forcing screws (2) in the tapped holes. Force the final drive case away from the steering clutch case.

(4) Remove the center forcing screw and install a ½ inch 13 NC forged eyebolt. Attach a hoist to the final drive case (weight approx 350 lb).

(5) Guide final drive case (1) off dowels (4). Take care not to damage splines of final drive gear hub (3).

NOTE

Inspect the sump area of the final drive case for dirt and other foreign materials. Dirt in the sump area is an indication that the final drive seals are leaking. Clean entire area thoroughly before case installation.



1 Final drive case
2 Forcing screws
3 Final drive gear hub
4 Dowels
5 Inner races
6 Outer race and roller assemblies

Figure 6-126. Final drive case removal.

b. Inspection. Inspect gear cases, covers, bearing cages, and flanges for cracks, breaks, and damaged threads. Repair cracked or broken cases, covers, or cages by welding and grinding smooth, or replace the part. Repair thread damage by installing helical inserts.

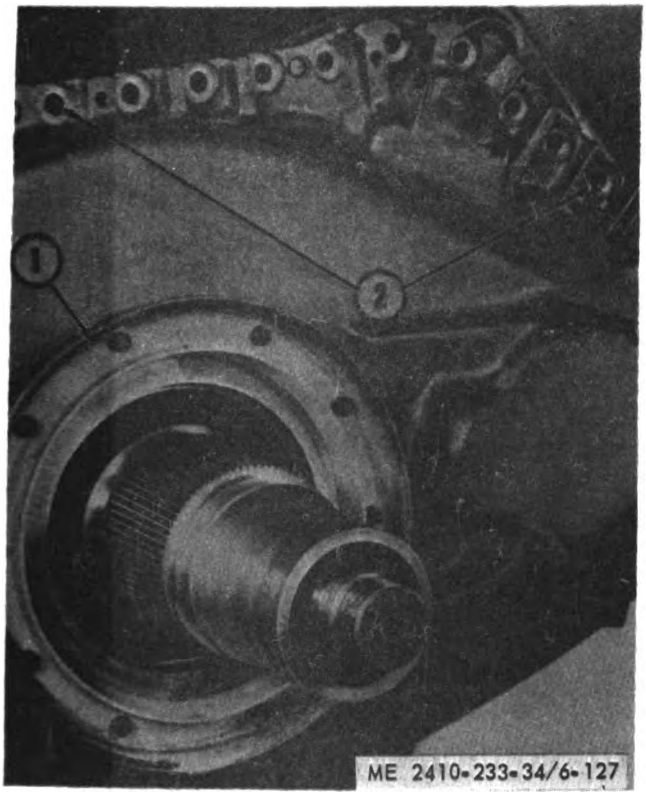
c. Installation.

(1) Install two 5/8 inch 11 NC guide pins (2, fig. 6-127) attach a hoist, align pinion outer bearing inner races (5, fig. 6-126) with pinion outer race and roller assemblies (6) and install the final drive case.

(2) Install the bolts securing the final drive case to the steering clutch case. Tighten the bolts to the torque value given in paragraph 1-4.

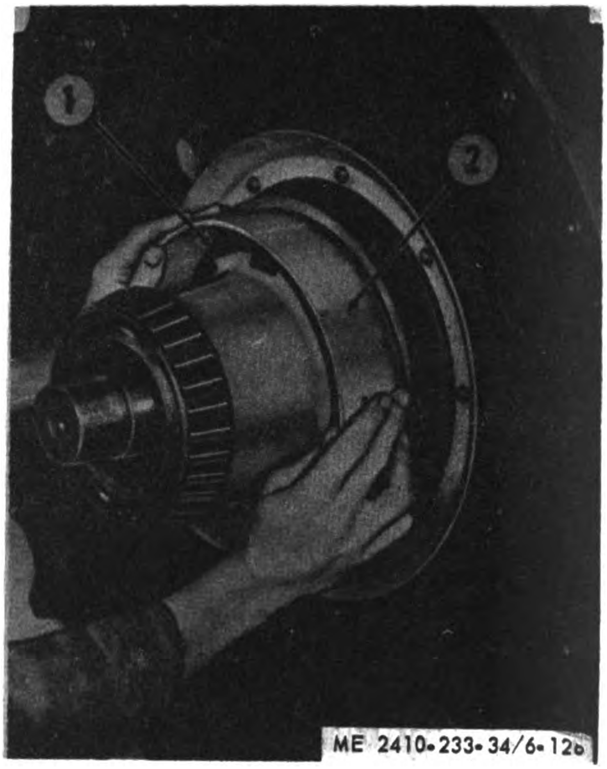
(3) Remove dirt guard (1, fig. 6-127) and clean thoroughly so dirt will not fall on the floating ring seals when the sprocket is installed.

(4) Install metal floating ring seal (1, fig. 6-128) using installer tool (2) as shown (para 6-22).



1 Dirt guard
2 Guide pins

Figure 6-127. Final drive case installation.



1 Metal floating ring seal
2 Seal installer

Figure 6-128. Installing metal floating ring seal.

6-25. Final Drive Gear, Idler Pinion, and Bearings

a. Removal.

(1) Remove the final drive gear case as described in paragraph 6-24.

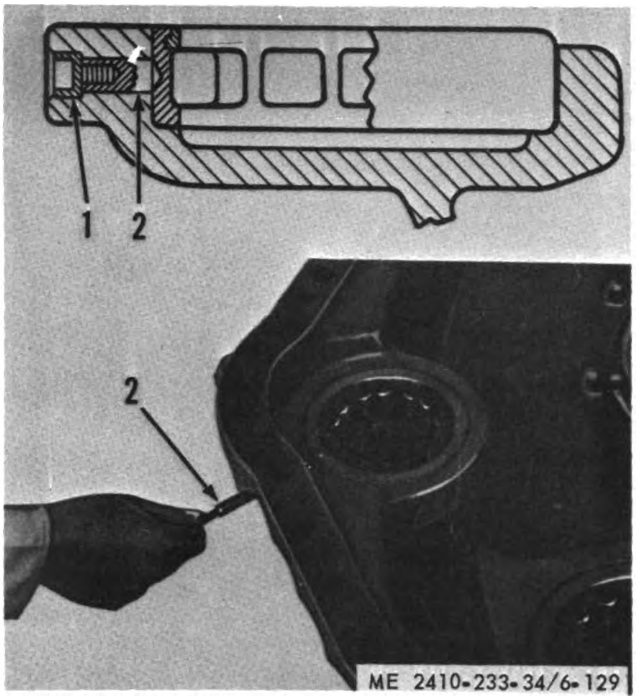
(2) Inspect drive pinion and idler pinion outer race and roller assemblies (6, fig. 6-126) for excessive wear.

(3) Remove both pinion outer race and roller assemblies from the final drive case after removing plugs (1, fig. 6-129) and dowels (2).

(4) Using a 1/4 inch 20 NC bolt, remove dowel (2) and remove pinion outer race and roller assembly as a unit. Remove both pinion outer race and roller assemblies in a like manner.

NOTE

All outer race and roller assemblies with snaprings are to be assembled with snap rings next to the gear teeth.



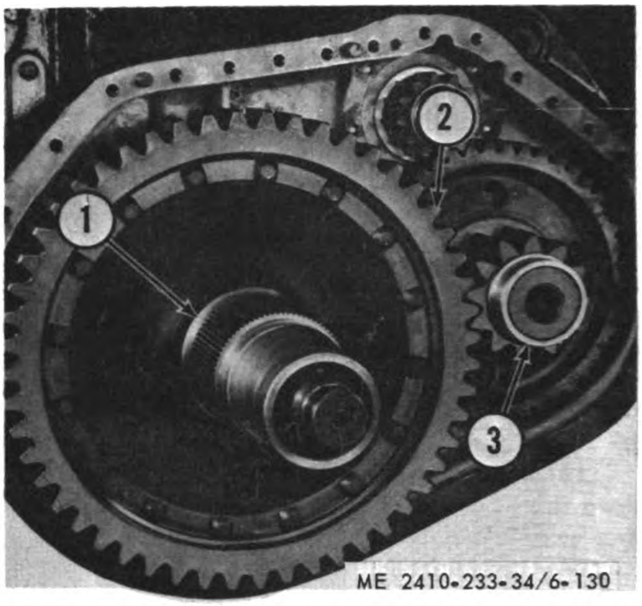
1 Plug
2 Dowel

Figure 6-129. Removing outer race and roller assemblies.

(5) Attach a hoist to support final drive gear (2, fig. 6-130) and final drive gear and hub off the sprocket shaft.

WARNING

Support idler pinion (3) during removal of final drive gear (2) and hub (1). The idler pinion is supported only by the idler pinion inner bearing and is free to fall.



1 Hub
2 Final drive gear
3 Idler pinion

Figure 6-130. Removing final drive gear and hub.

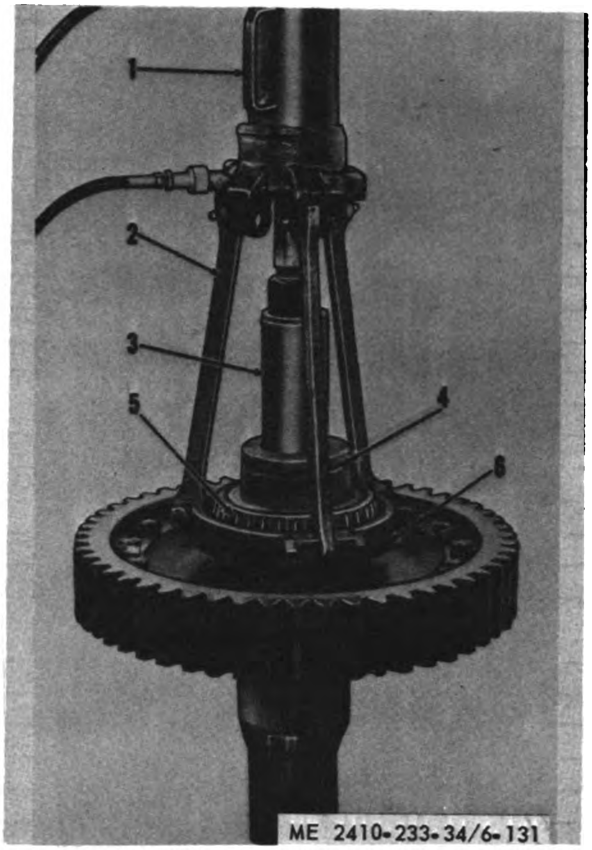
(6) Separate gear (2) from hub (1) after removing the bolts which hold the two together.

(7) Inspect hub inner bearing cone (5, fig. 6-131).

(8) Using puller assembly (4, fig. 6-132), three arms (1), spacer (3), cylinder group (1, fig. 6-131), a pump group, and an adequate spacer (3), remove bearing cone (5) from the final drive hub.

NOTE

Heat bearing cone (5) in oil at installation.



1 Cylinder group
2 Arm
3 Spacer
4 Spacer (5.75 in. diameter)
5 Bearing cone
6 Puller assembly

Figure 6-131. Hub inner bearing cone removal.

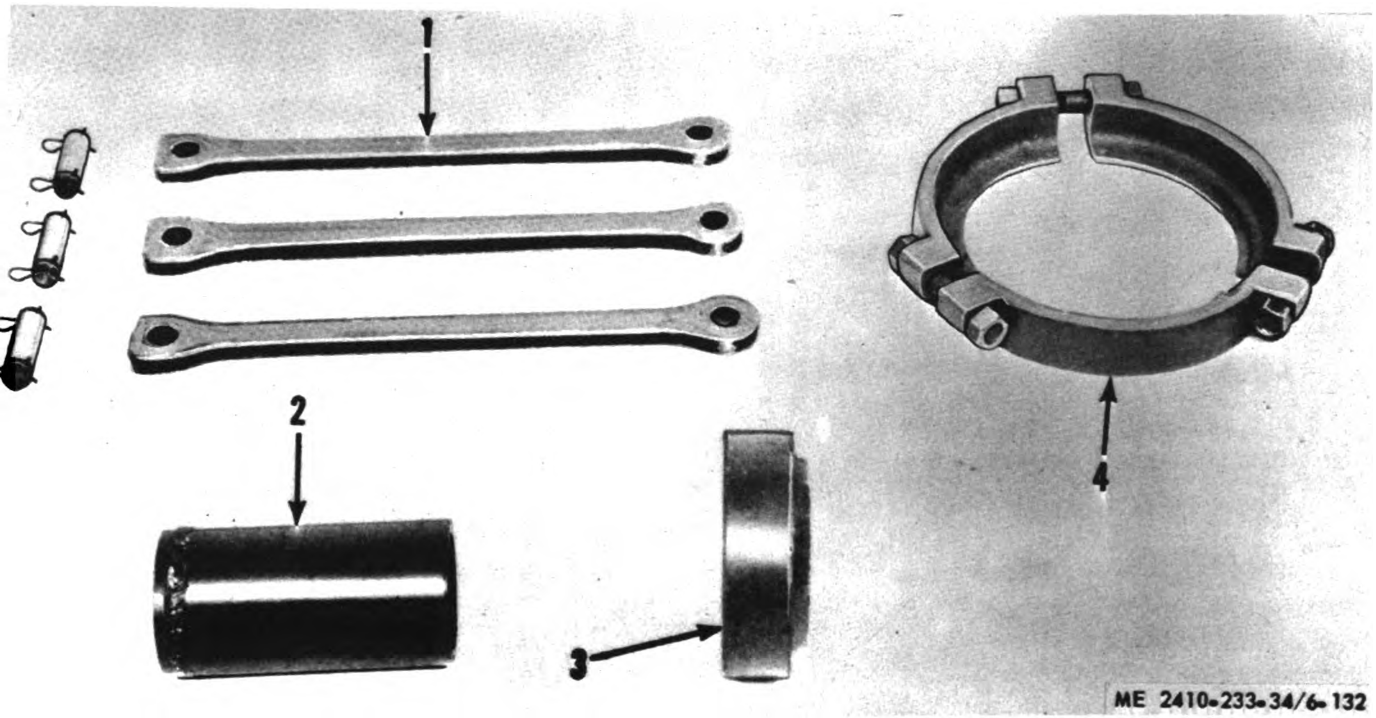


Figure 6-132. Bearing cone removal tools.

(9) Attach a puller to the idler pinion and remove.

(10) Inspect idler pinion outer race and roller assembly.

(11) Using a puller, a bearing pulling attachment, a hydraulic puller, a pump group, and a spacer, remove inner race. The idler pinion inner bearing inner race can be removed in a like manner.

NOTE

Heat bearings races to facilitate removal.

(12) Remove the bolts and locks (1, fig. 6-133).

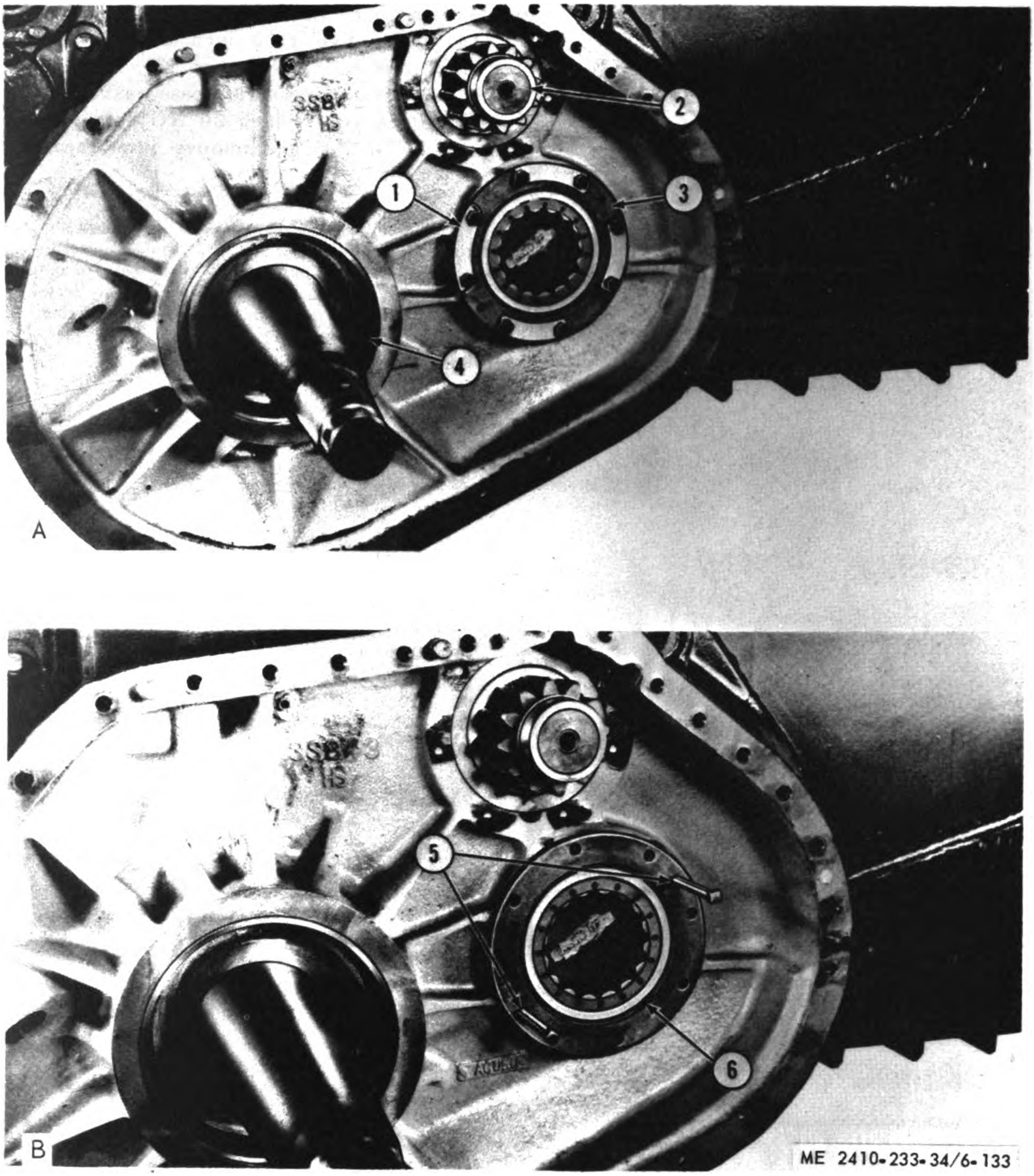
(13) Drain the oil in the steering clutch compartment before removing the idler pinion inner bearing cage (3).

(14) Using two 1/2 inch 13 NC forcing screws (5), remove bearing cage (3). Inspect the bearing cage-to-steering clutch case gasket.

(15) Using a 1/4 inch 20 NC bolt, remove dowel (2, fig. 6-134) and remove outer race and roller assembly (1).

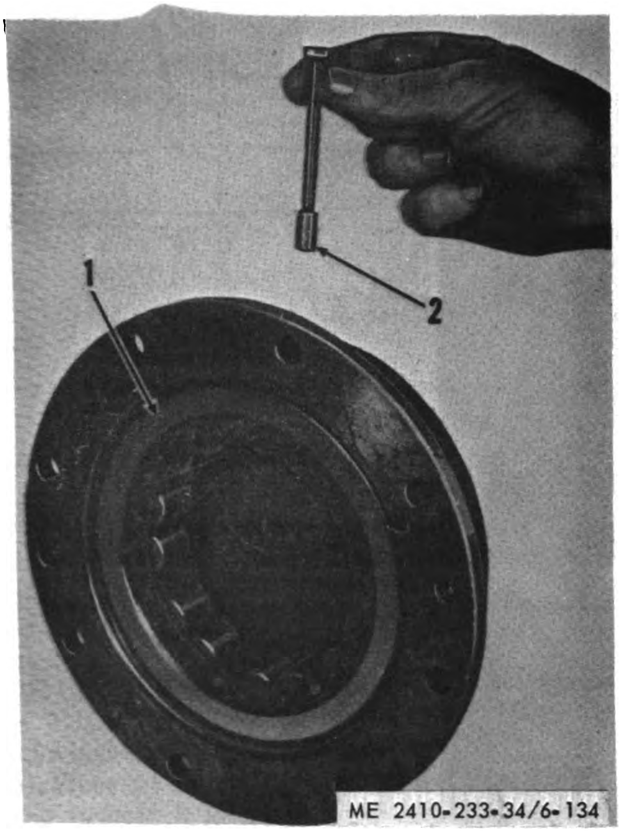
NOTE

When installing bearing cage (3, fig. 6-133) in the steering clutch and bevel gear case, position dowel to the top and oil drain passage (6) in the cage to the bottom. Final drive pinion (2) and bearings are serviced after the steering clutch and final drive pinion flange have been removed.



1 Bolts and locks
2 Pinion gear
3 Cage
4 Cup
5 Forcing screws
6 Oil drain passage

Figure 6-133. Removing bearing cage.



1 Roller assembly
2 Dowel

Figure 6-134. Removing outer race and roller assembly.

(16) Inspect hub inner bearing cup (4).

(17) Replace cup (4) if necessary.

NOTE

If the teeth of the final drive gears and pinions are worn considerably more on one face than on the other, they can be switched from one side of the tractor to the other. This will provide a longer service life for the gears and pinions, by wearing both faces of the teeth.

b. Installation. Install final drive gear, idler pinion and bearings in the reverse order of removal.

NOTE

Heat the bearing races in oil at installation.

6-26. Sprocket Shaft

a. Removal.

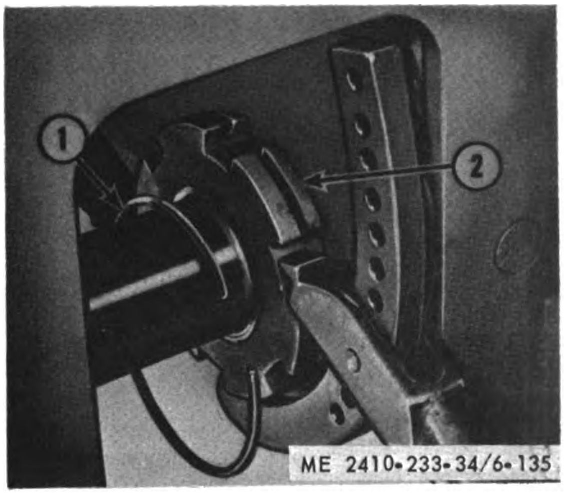
(1) Remove final drive gear (para 6-25).

(2) Remove the locking (1, fig. 6-135).

(3) Remove the pin securing sprocket retaining nut (2) to the sprocket shaft.

(4) Using a spanner wrench, remove the retaining nut (2).

(5) Remove sprocket shaft.



1 Lockring
2 Retaining nut and winch removed

Figure 6-135. Removing retaining nut.

b. Inspection. Inspect the sprocket shaft for damage and distortion. Shaft must be straight within 0.12 inch. Replace a defective sprocket shaft.

c. Installation.

(1) Attach a hoist to sprocket shaft and position it for installation.

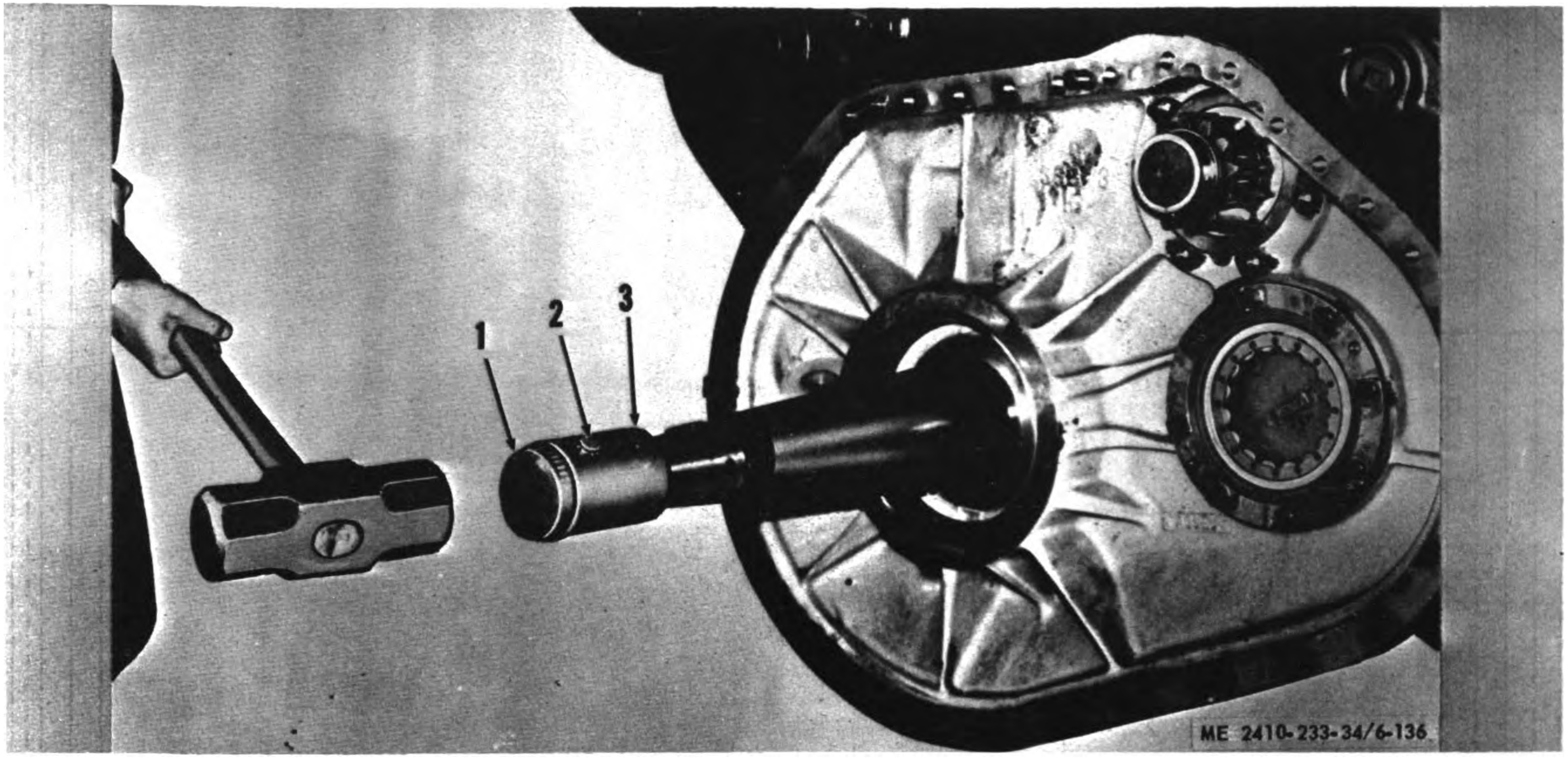
(2) Position sprocket shaft retaining nut and lockring.

(3) Instert sprocket shaft in the steering clutch and bevel gear case far enough to install the sprocket shaft retaining nut and lockring.

(4) Place the retaining nut and lockring on the shaft and install the sprocket shaft as far as possible into the steering clutch case.

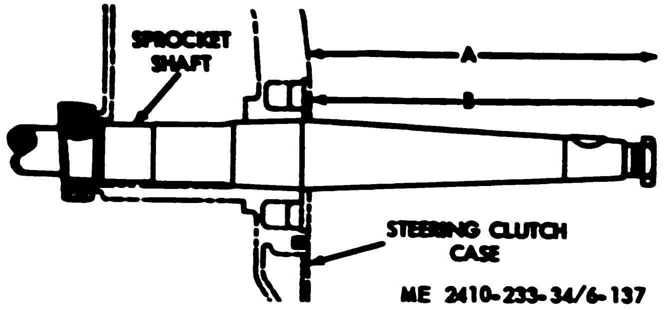
(5) Install adapter (3, fig. 6-136) plug (1), and coupling pin (2) as shown.

(6) Press the sprocket shaft into the steering clutch and bevel gear case with a pressure of 55-60 tons. Press until dimensions (A or B, fig. 6-137) is attained.



1 Plug
2 Coupling pin
3 Adatper

Figure 6-136. Installing sprocket shaft.



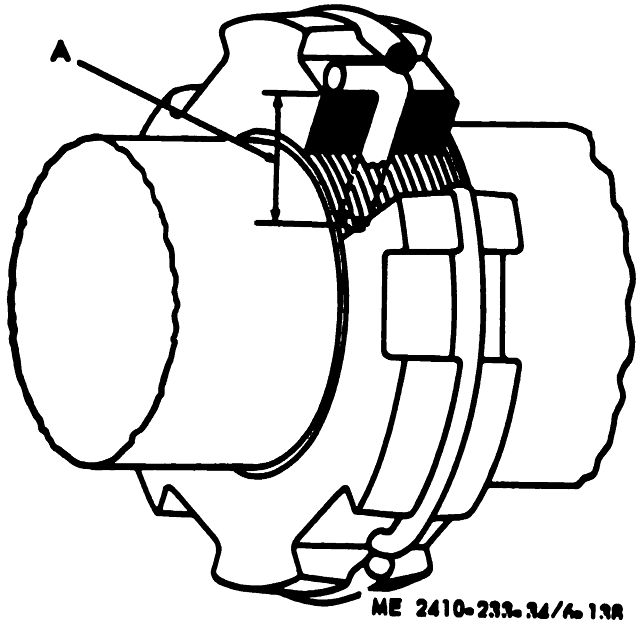
A 22.938 in.—23.062 in. dimension
B 23.485 in.—23.609 in. dimension

Figure 6-137. Dimensions with sprocket shaft properly installed.

(7) Maintaining the 55—60 tons pressure on the shaft, tighten retaining nut with a spanner wrench.

(8) When the retaining nut is securely tightened, lock it in the following manner.

(9) In one of the notches in the retaining nut, drill a 0.368 inch diameter hole through the nut and 0.56 inches deep into the sprocket shaft (A, fig. 6-138). Place the lockpin in the hole and install the lockring to hold it in place.



A 0.368 in. drill, 0.56 in. deep in shaft

Figure 6-138. Installing retaining nut lockpins.

d. Checking Sprocket Shaft. Check the final drive sprocket shaft to determine if it is straight.

NOTE

If the sprocket shaft is bent more than the allowable tolerance, the shaft should be removed and a new shaft installed.

6-27. Final Drive Pinion Group

a. Removal and Installation.

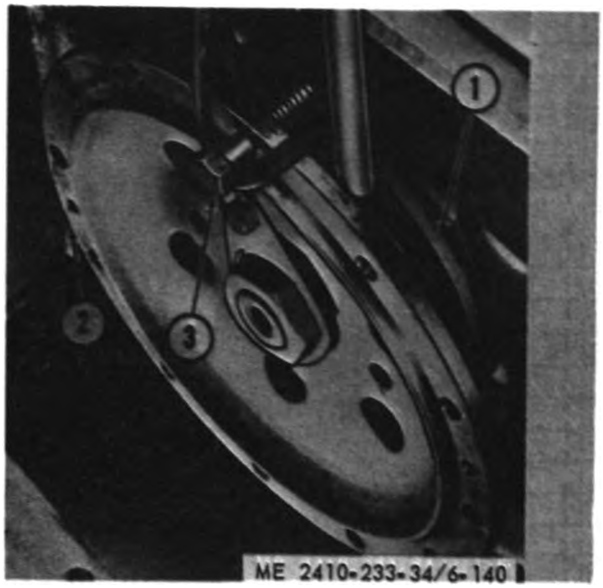
(1) Remove the steering clutch as outlined in paragraph 6-16.

(2) Remove bolts (1, fig. 6-139).

(3) Insert a bolt (3, fig. 6-140) in one of the steering clutch to pinion flange clearance holes and attach a hoist for support.

1 Bolts (7)

Figure 6-139. Preparing to remove final drive pinion.



1 Cage
2 Flange
3 Bolt

Figure 6-140. Removing final drive pinion gear.

(4) Using a suitable pry bar, remove final drive pinion flange (2), bearing cage (1), inner bearing and final drive pinion as a unit from the steering clutch and bevel gear case.

(5) At installation, insert a 1 / 2 inch 13 NC guide pin (2, fig. 6-141) to position the bearing cage.

1 Gasket
2 Guide pin

Figure 6-141. Installing final drive pinion gear.

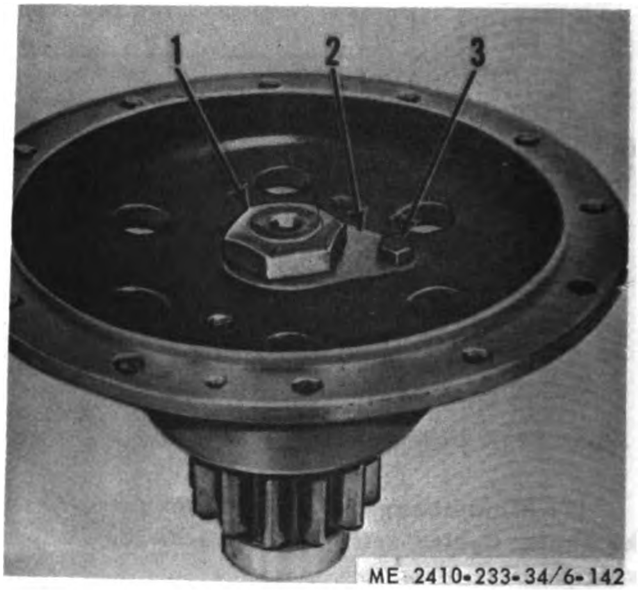
(6) Replace gasket (1).

(7) Attach a hoist for support and install the final drive pinion, bearing cage and final drive pinion flange in reverse order of removal. Position bearing cage (1, fig. 6-140) with oil drain hole at bottom.

b. Disassembly and Assembly.

(1) Position the final drive pinion assembly as shown in figure 6-142.

(2) Remove the nut (1), bolt (3), and lock (2).



1 Nut
2 Lock
3 Bolt

Figure 6-142. Preparing to remove pinion flange.

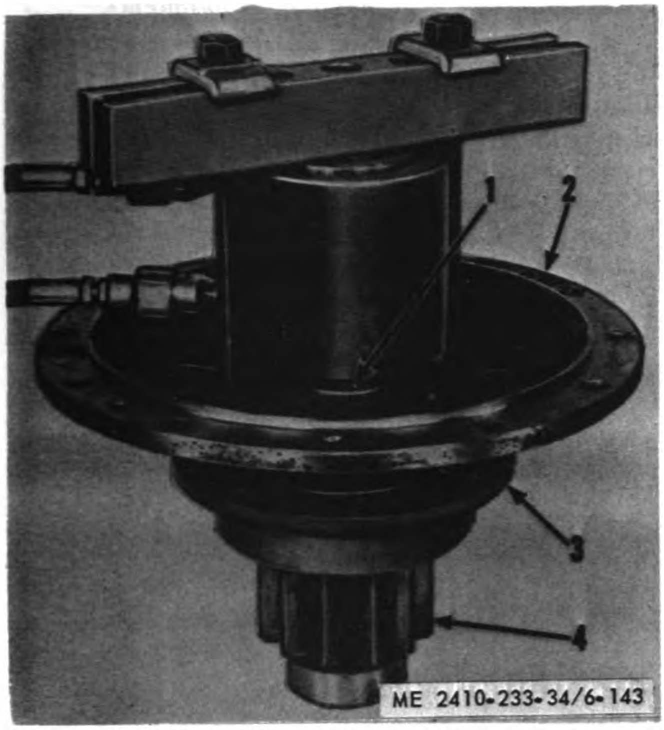
CAUTION

Before attempting to remove flange (2, fig. 6-143) install nut (1) flush with the end of the pinion gear shaft (4) to prevent the pinion flange from becoming damaged while being removed under hydraulic pressure.

(3) Using a hydraulic puller and a puller (with two ¾ inch 10 NC bolts approximately 7½ inches long) remove flange (2, fig. 6-143).

NOTE

The final drive pinion flange can be removed with the pinion installed, using the same tool group.



1 Nut
2 Flange
3 Cage
4 Pinion gear shaft

Figure 6-143. Removing pinion flange.

(4) Remove bearing cage (1, fig. 6-144) outer race and roller assembly (2) and seal (3) as a unit.

(5) Using a ¼ inch (20) NC bolt, remove dowel (4) and remove outer race and roller assembly.

1 Cage
2 Metal floating ring seal
3 Outer race and roller assembly
4 Dowel

Figure 6-144. Removing outer race and roller assembly.

NOTE

Chill the outer race and roller assembly before installation. When installing, align the hole in the outer race and replace dowel (4).

(6) Remove mating seal in pinion flange (para 6-22) using a seal installer tool.

(7) When installing the final drive pinion flange (fig. 6-145) make sure the splines are clean, dry, and free of burrs. Set the pinion flange on the pinion shaft with the splines in the flange meshing with the splines on the shaft and push the flange on as far as possible by hand.

(8) Install adapter (2, fig. 6-145) on the threads of the pinion gear shaft. Place bolt (3) through hydraulic puller and screw it into adapter (2). Insert sleeve (1) over the adapter.

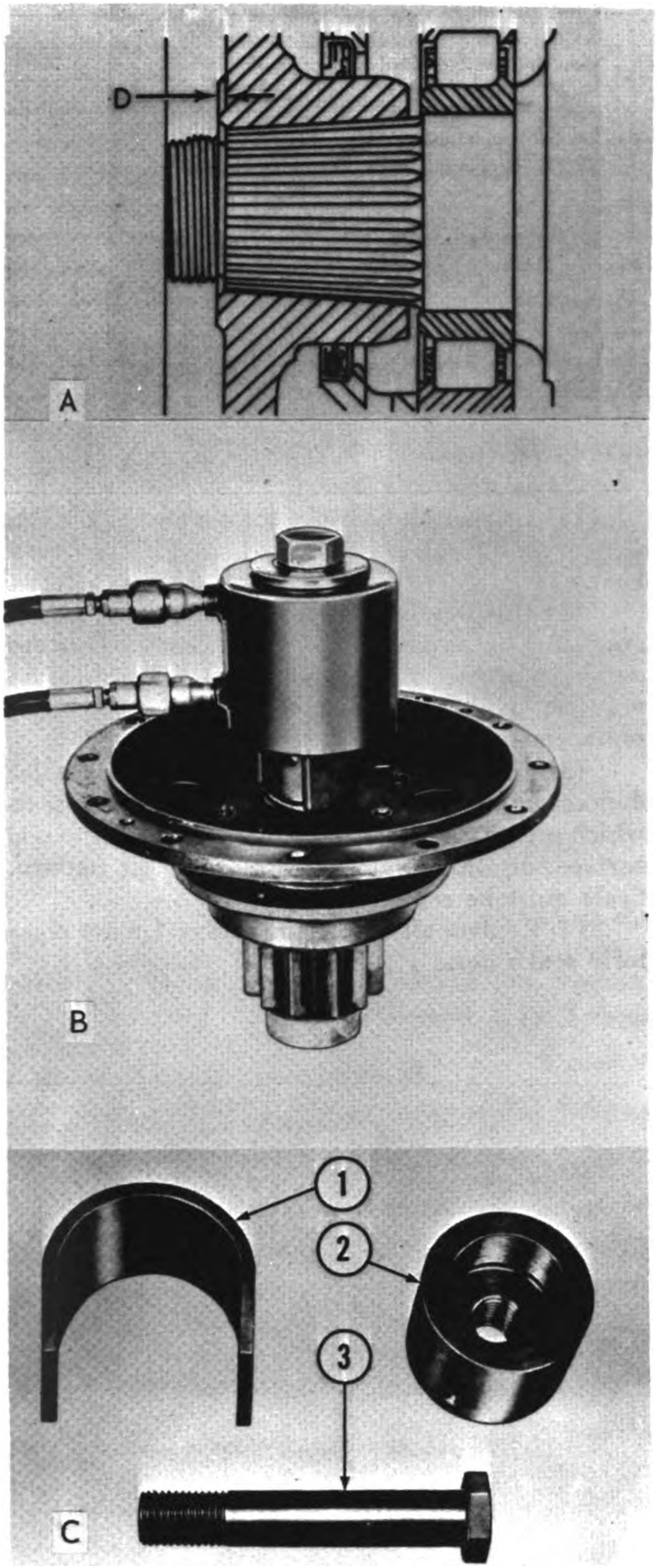
c. *Inspection and Repair.*

(1) Inspect all bearings for corrosion, pitting, and wear. Replace corroded, rough, or worn bearings.

(2) Inspect all gears for chipped, pitted, cracked, or excessively worn teeth. Replace damaged or excessively worn gears. TB-ENG-364 may be used as a guide for determining gear replacement.

(3) Inspect the metal floating ring seals for damage and proper wear pattern. Replace seals which are pitted, grooved, scratched across the seal surface, or which show an uneven wear pattern. Seals must be replaced in sets.

(4) Replace all toric sealing rings. Do not reuse toric seal rings.



ME 2410-233-34/6-145

1 Sleeve
2 Adapter
3 Bolt
D Dimension to be checked 0.094 in.—0.154 in.

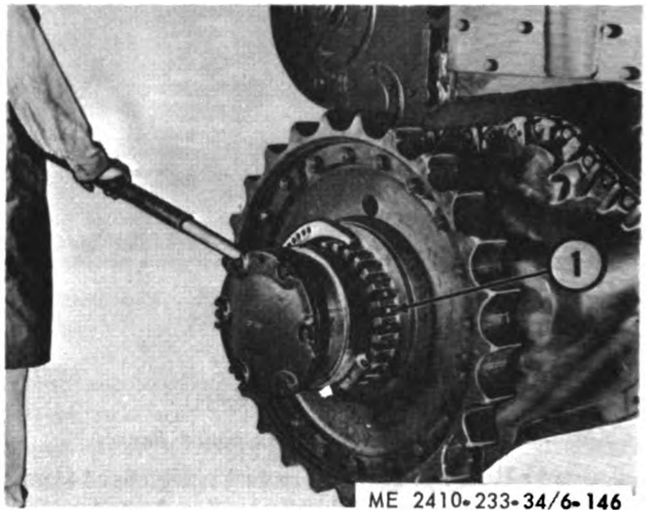
Figure 6-145. Installing pinion flange.

6-28. Final Drive Bearing Adjustments

a. After the final drive has been assembled and the track roller frame outer bearing installed and aligned, adjust the bearing preload on the sprocket support bearings. With the adjusting nut lock and clamping bolt removed, tighten the adjusting nut (1, fig. 6-146) in a counterclockwise direction to the torque value of 1200—1500 lb-ft.

b. Continue to tighten the nut until the lock can be installed in one of the recesses in the retaining nut.

c. Insert the clamping bolt and tighten to lock the retaining nut in position.



1 Retaining nut

Figure 6-146. Adjusting final drive bearings.

6-29. Aligning Track Roller Frame With Sprocket

a. When installing track roller frame (6, fig. 6-147) the center of the track rollers should be centered with final drive sprocket (8), so the track will lead straight off of rear roller (5) onto the final drive sprocket and not rub against either the sides of the sprocket or the rims of the track roller.

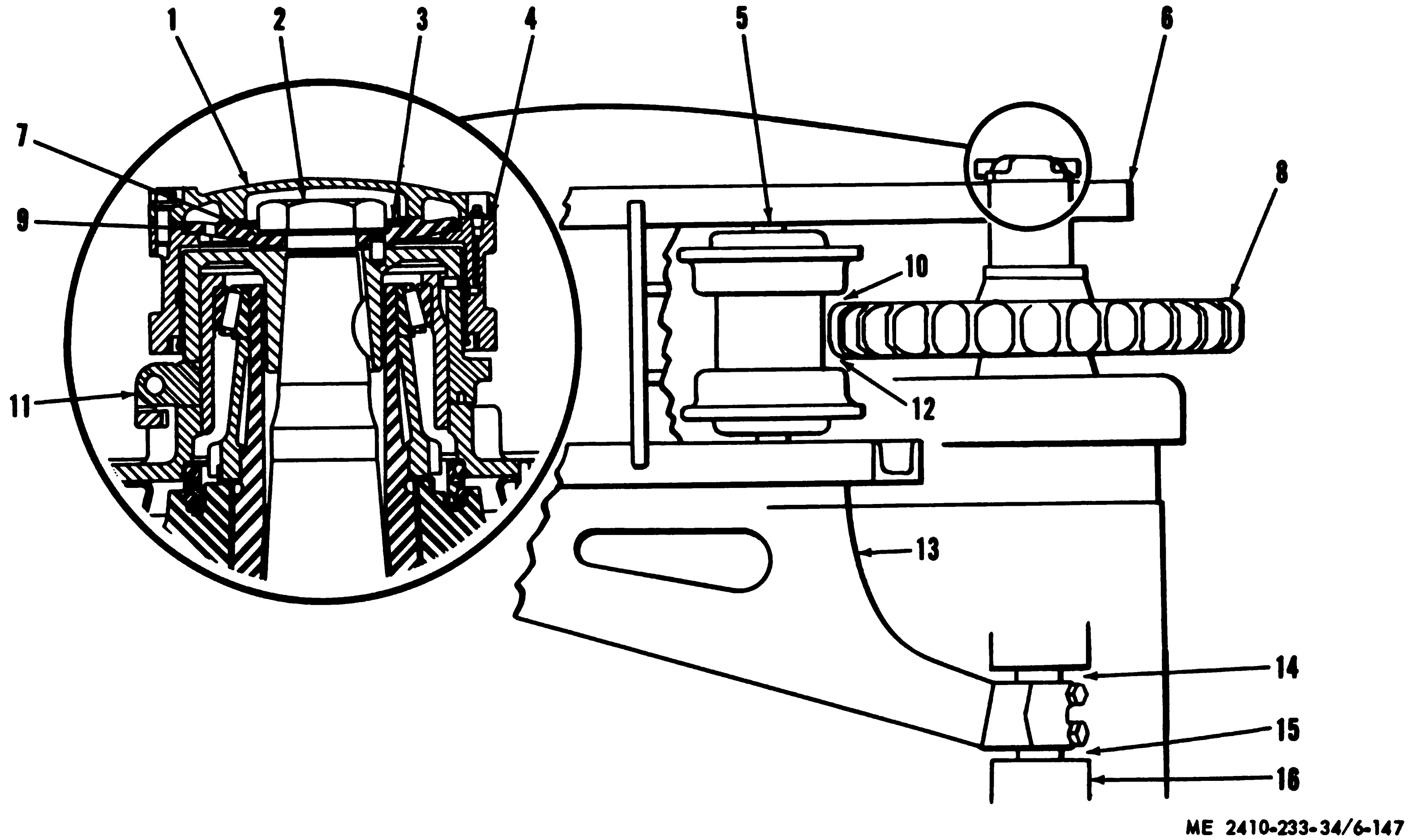
b. Final drive sprocket (8) should be centered in the recess of rear track roller (5) so clearances (10) and (12) between the outer face of the sprocket and the inner edge of the track roller are equal.

c. When this properly adjusted, diagonal brace (13) should be checked to see there is some clearance at (14) and (15) in the recess in steering clutch case (16).

d. To make this adjustment remove cap (1) from outer bearing assembly (4) and remove lockring (7), nut (2) and retainer assembly (9).

e. Add shims (3) between retainer assembly (9) and holder assembly (11) to move the track roller frame out, decreasing clearance (12) at the roller and at diagonal brace (13) and increasing clearance at (10) and (15).

f. Remove shims (3) to allow the track roller frame to move closer to the machine, decreasing the clearance at (10) and (15) and increasing the clearance at (12) and (14).



1	Cap	9	Retainer assembly
2	Nut	10	Clearance
3	Shims	11	Holder assembly
4	Outer bearing assembly	12	Clearance
5	Rear track roller	13	Diagonal brace
6	Track roller frame	14	Clearance
7	Lockring	15	Clearance
8	Final drive sprocket	16	Steering clutch case

Figure 6-147. Aligning track roller frame with sprocket.

6-30. Brake Pedal and Support Assembly

a. Removal.

(1) Remove the seat (TM 5-2410-233-20), seat frame (para 2-9), and floor plates.

(2) Disconnect brake lock rod (fig. 6-148) at foot pedal end.

(3) Disconnect steering clutch rods (fig. 2-31, sheet 5) at both ends and slide forward to clear brake support assembly (fig. 6-148).

(4) Remove brake control rods.

(5) Remove four bolts and attach hoist and remove brake and support assembly from tractor.

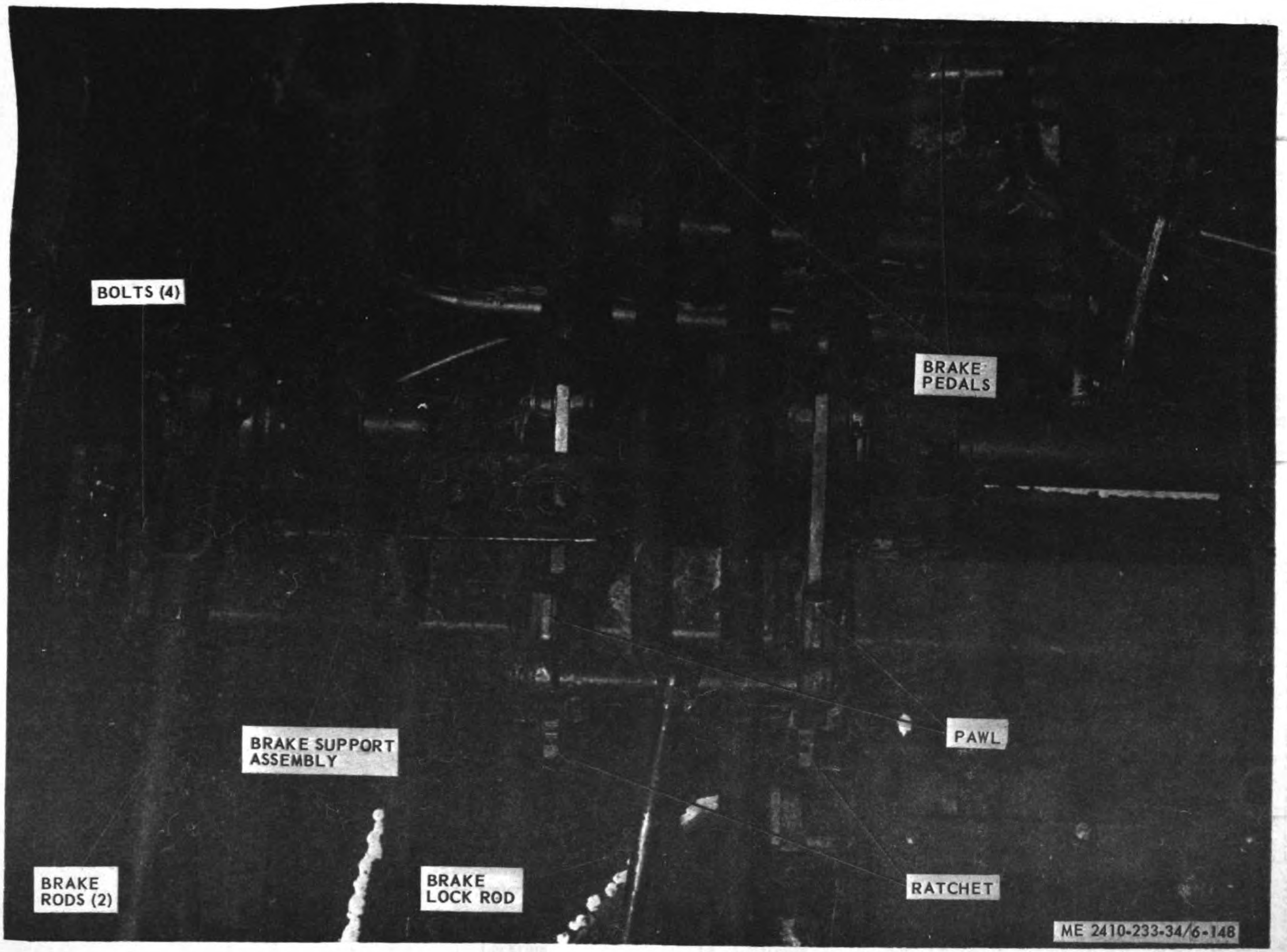


Figure 6-148. Brake pedal and support assembly, removal and installation

b. Inspection.

(1) Inspect ratchet and pawl for wear, rounded or missing teeth. Check action of ratchet and pawl to see that pawl engages ratchet teeth properly. Replace a defective or damaged ratchet.

(2) Inspect brake rods and levers for bends, cracks, or excessive wear (clevis pin holes elongated). Replace defective or damaged parts.

(3) Inspect support assembly for cracks, breaks, distortion or other damage. Replace a defective or damaged support assembly.

c. Installation. Reverse removal procedure and install the brake pedal and support assembly.

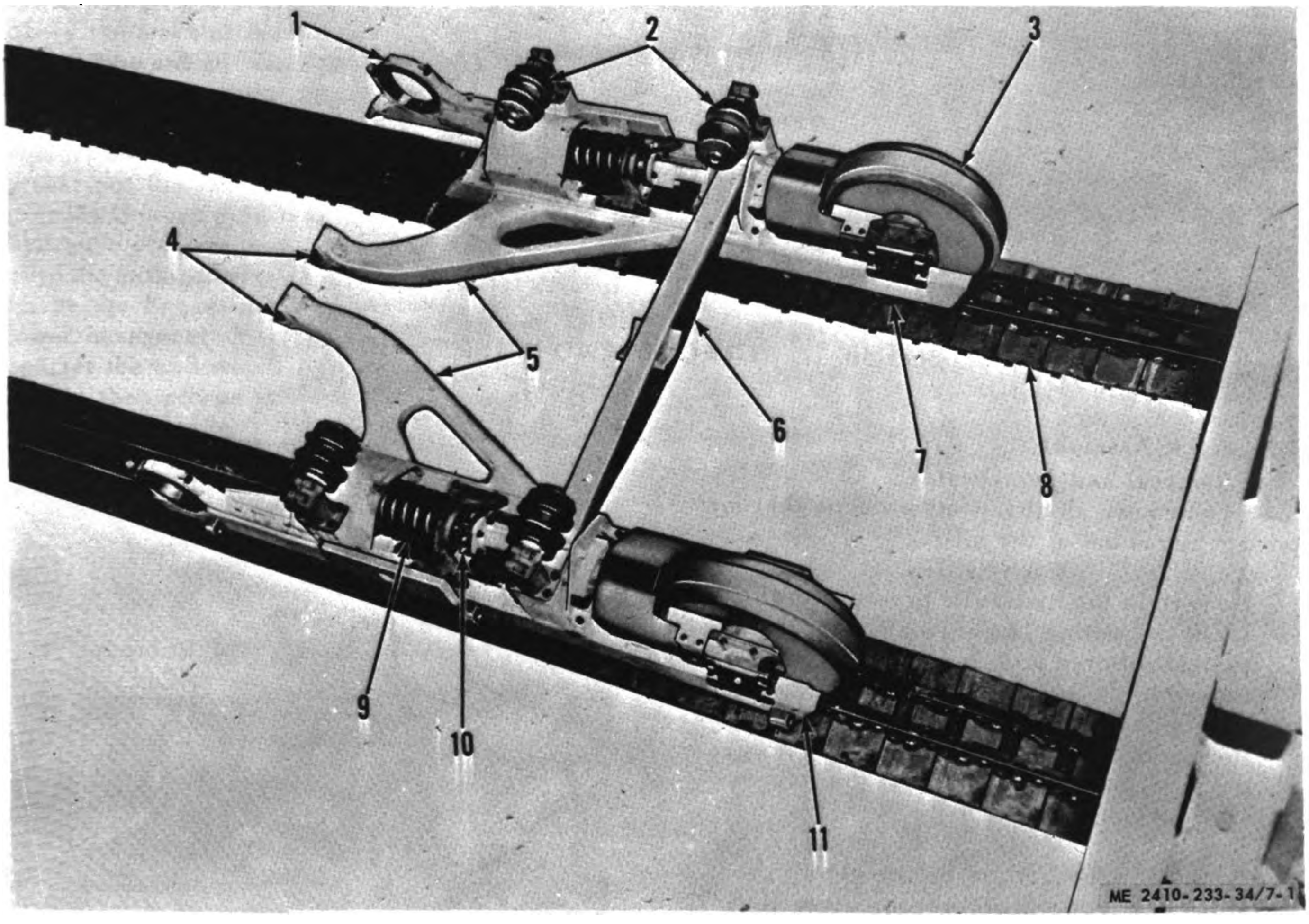
d. Adjustment. Refer to paragraph 6-14*e* and adjust the brake linkage.

CHAPTER 7

REPAIR OF TRACK ROLLER FRAME AND TRACKS

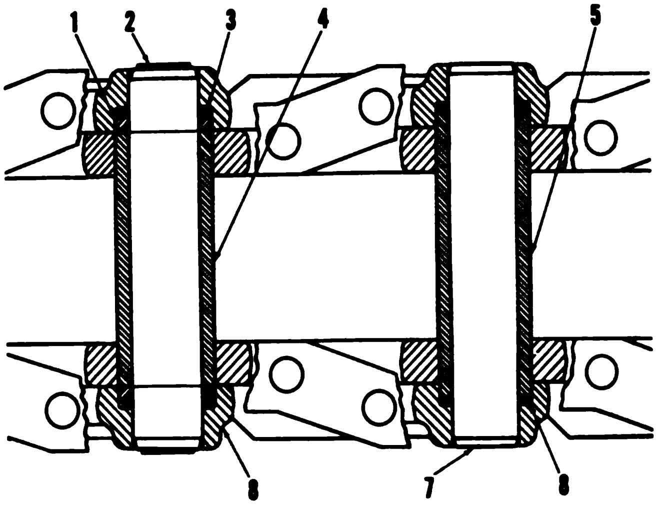
Section I. GENERAL

The track roller frame assembly (11, fig. 7-1) provides a mounting for the track rollers (7), track carrier rollers (2), hydraulic track adjusting mechanisms (10), front idlers (3), recoil springs (9) and equalizer bar (6). The weight of the tractor is carried through the frame to the rollers (7). The diagonal brace (5), welded to the inside of the frame, maintains correct track roller frame alignment. This construction allows each track frame to operate independently and to move up and down relative to one another by pivoting at the sprocket shaft. Figure 7-2 shows a cut away view of track pin and bushing.



1 Outer bearing cup
2 Track carrier rollers
3 Front idler
4 Diagonal brace bearings
5 Diagonal braces
6 Equalizer bar
7 Track roller
8 Track
9 Recoil spring
10 Hydraulic track adjusting mechanism
11 Track roller frame

Figure 7-1. Tractor roller frame group.



1 Spacer
2 Master pin
3 Coned-disc seal washers
4 Master bushing
5 Track bushing
6 Link
7 Track pin
8 Coned-disc seal washers

Figure 7-2. Track pin and bushing cutaway.

Section II. TRACKS AND SUSPENSION

7-1. Track Assembly

a. Removal and Disassembly.

(1) Remove all dirt or other debris that may prevent retraction of the idler.

WARNING

Be certain the hydraulic pressure in the track adjusting mechanism is completely relieved and the cylinder can be moved to the rear into the recoil spring front pilot before attempting to separate the track or remove the track adjusting mechanism. On machines that have badly worn track, it is possible for the hydraulic track adjuster to be adjusted forward to the limit of its travel and the stop will be against the equalizer bar support. The hydraulic cylinder could have high oil pressure in it even though the track is loose enough to remove the master pin without relieving the hydraulic track adjusting pressure.

(2) Remove the track roller frame guard from over the track adjusting mechanism. Clean vent holes (fig. 7-3) thoroughly.

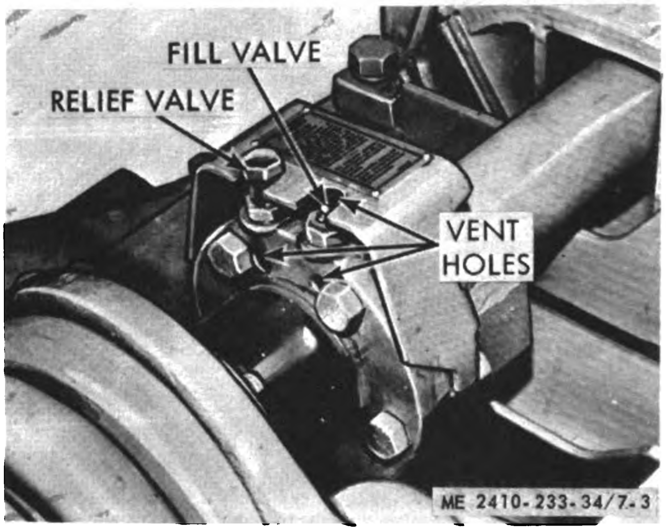


Figure 7-3. Preparing to separate tracks.

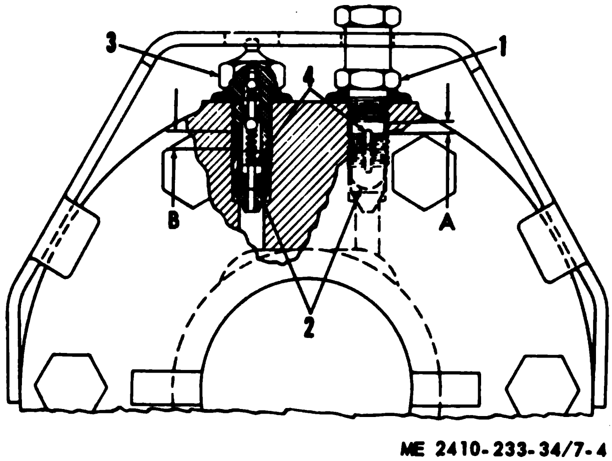
(3) Release the pressure in the hydraulic track adjuster cylinder, with CAUTION, as given in the following steps.

WARNING

Because of the hydraulic pressure in the track adjuster cylinder, never visually inspect the vent holes and valves to see if grease is escaping. Always observe the cylinder to see that it moves to the rear into the recoil spring front pilot.

(4) Turn relief valve one turn in a counterclockwise direction and allow grease to escape from vent hole just below relief valve. If grease does not appear when the relief valve is backed off one turn, turn fill valve one turn in a counterclockwise direction. If grease does not appear at the vent holes, the machine should be started and moved forward and backward. If grease still does not appear at the vent holes, insert a bar (such as a draw bar pin) between the track and sprocket. Move the machine backward so the track will be forced upward by the bar. This will apply additional tension to the track and move the front idler and track adjusting mechanism to the rear against the force of the recoil springs, thus forcing grease out the vent holes.

(5) If moving the machine does not relieve the hydraulic pressure, continue loosening relief valve until the unthreaded section (A, fig. 7-4) is exposed above the flange of the hydraulic cylinder. The lower hexagonal shoulder of the relief valve will contact the underneath side of the guard. Grease should then escape through slot (4) in the lower section of threads.



1 Relief valve
2 Vent holes
3 Fill valve
4 Slots
A and B—Unthreaded sections

Figure 7-4. Relief valve and fill valve.

(6) Loosen fill valve (3) until the unthreaded section (B) is exposed above the flange of the hydraulic cylinder. The hexagonal shoulder of fill valve (3) will contact the underneath side of the guard. Grease should then escape through slot (4) in the lower section of the threads.

NOTE

Detailed information concerning the hydraulic track adjusting mechanism can be found in paragraph 7-7.

(7) Position the master pin above and slightly behind the front carrier roller.

(8) Install the tools (fig. 7-5) and press the master pin from the links.

NOTE

An alternate method for master pin removal is as follows: Place a block approximately 12 inches high in front of the track and drive the machine forward so the track shoe below the master pin rides on the block, then using a suitable drive and a sledge hammer, drive the master pin out of the links.

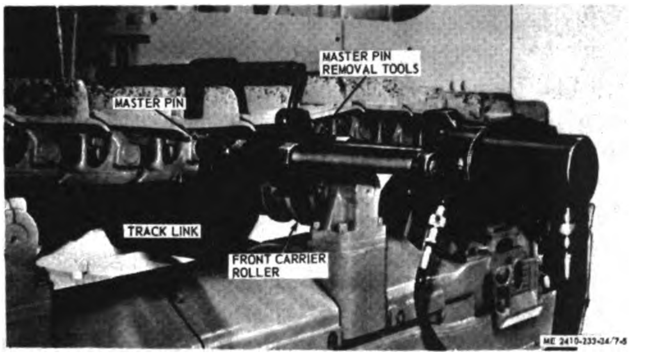


Figure 7-5. Master pin removal group.

(9) Separate the track and remove spacers (fig. 7-6) and coned disc seal washers from links.

(10) Back the machine slowly, allowing the track to ride over the carrier rollers and off the sprocket.

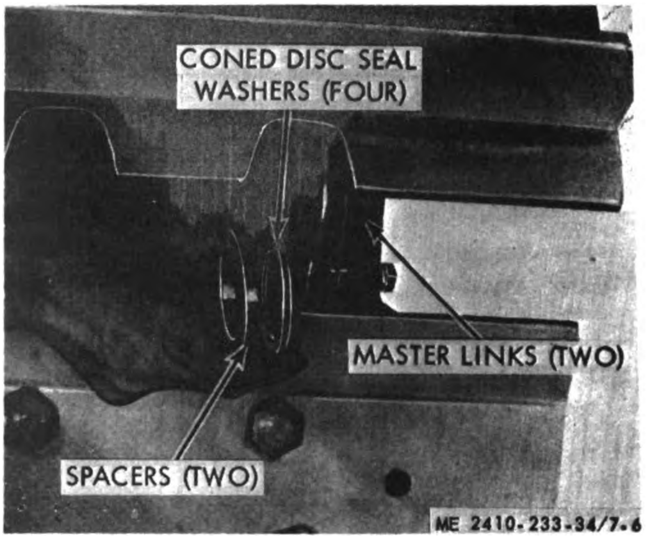


Figure 7-6. Track seal washers and spacers.

b. *Inspection and Repair.*

(1) Inspect the track links and grousers for cracks, breaks, and distortion. Repair or replace broken or damaged links and grousers.

(2) Refer to table 1-5 for track pin and bushing wear tolerances.

(3) Inspect the track links for wear. When the links are worn from 4.57 to 4.38 inches in height, they will be repaired by welding an overlay on the wear surface. Links worn 4.38 inches or less in height will be replaced. Link height new is 4.75 inches.

NOTE

Pin boss clearance new is 0.69 inch. Acceptable pin boss clearance is 0.35 inch.

(4) Inspect the grousers for wear. Grousers worn from 1.93—1.00 inches height will be repaired by installing applicator bars. Grousers worn to a height of less than 1 inch, or grousers uneconomical to repair, will be replaced. New grouser height is 2.56 inches. Applicator bars will be installed one time only.

c. *Reassembly and Installation.*

(1) Back the tractor until the sprocket is just ahead of the last link of the track.

(2) Attach a hoist to the outside link and raise the track as the tractor is driven forward.

NOTE

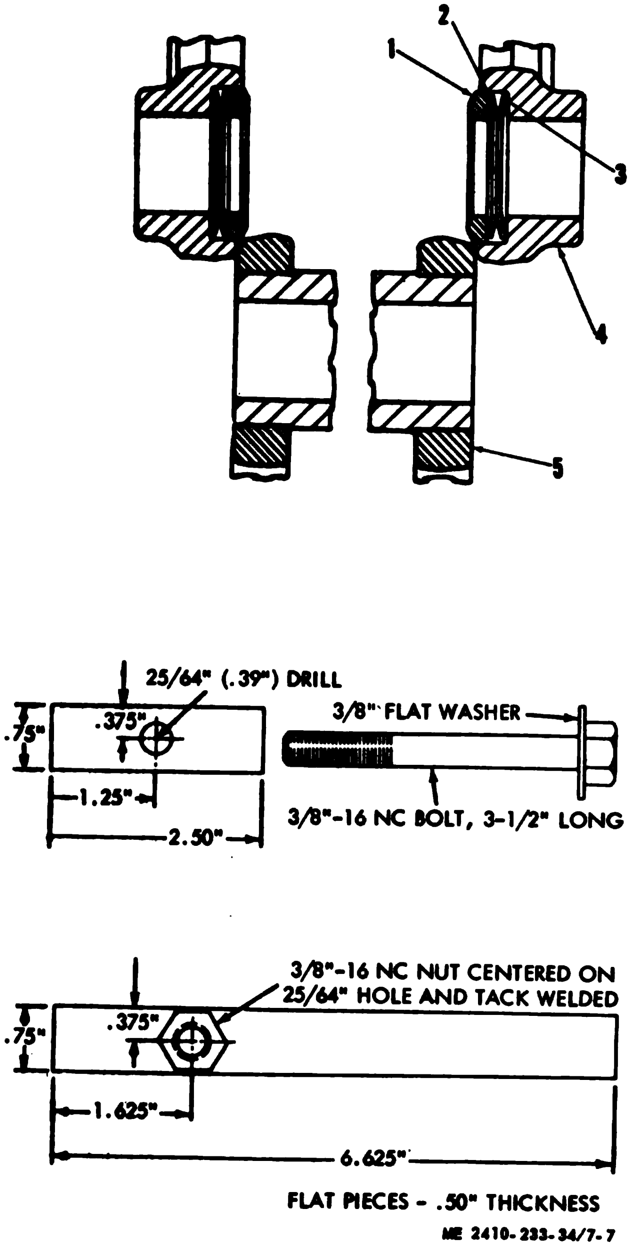
If a traveling hoist is not available, it may be necessary to block the track and reposition the hoist to complete the installation.

(3) Carry the track high enough to clear the rollers.

(4) Stop with the end of the track slightly behind the front carrier roller and raise the other end of the track up around front idler until the master links (4, fig. 7-7) and links (5) are approximately 1 inch apart and install coned disc seal washers (2) and (3) and spacers (1) in master links (4).

NOTE

If the master pin is to be driven in with a sledge hammer, block under the first shoe and drive forward until master links (4, fig. 7-7) and links (5) are approximately 1" apart and install coned disc seal washers (2) and (3) and spacers (1) in master links (4).



1 Spacers (2)
2 Coned disc seal washers (2)
3 Coned disc seal washers (2)
4 Master link
5 Track link

Figure 7-7. Installing seal washers and spacers.

(5) Install each set of coned disc seal washers with one outside diameter facing the counterbore in link (4) and one outside diameter facing spacer (1), with inside diameters against each other. Install spacer (1) with beveled edge toward the centerline of the track.

NOTE

Coned disc seal washers (2 and 3) and spacers (1) can be held in place in the counterbores of master links (4) with the use of two holding tools. Fabricate the tools to the dimensions given in figure 7-7.

(6) Assemble the tools on master links and tighten the bolt on each tool to compress seal washers. Spacers will be flush with inner face of links when seal washers are properly compressed.

(7) Force the track together until the spacers and seal washers are held in place by the track links.

NOTE

If master pin is to be driven in with a sledge hammer, move the machine forward and drive the track together until the spacers and seal washers are held in place by the track links.

(8) Remove the holding tools. Align the holes and install the master pin.

(9) Install the bolts in the track shoes. Refer to table 1-2 for track shoe bolt torque.

NOTE

Install the track shoe bolt nut with end having the 0.156 inch corner radii against the track link.

(10) Adjust the track (para 7-7).

7-2. Track Carrier Rollers

a. Removal.

(1) Loosen the track as outlined in paragraph 7-1.

(2) Lift the track to provide clearance for removal.

(3) Remove the bracket (fig. 7-8) and roller as an assembly by removing the (4) bracket to frame mounting bolts.

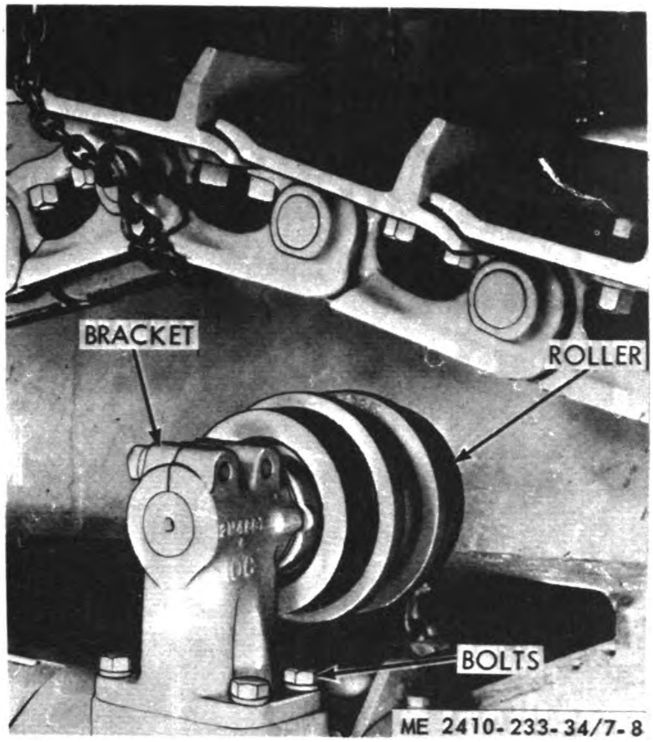


Figure 7-8. Preparing to remove carrier rollers.

b. Disassembly.

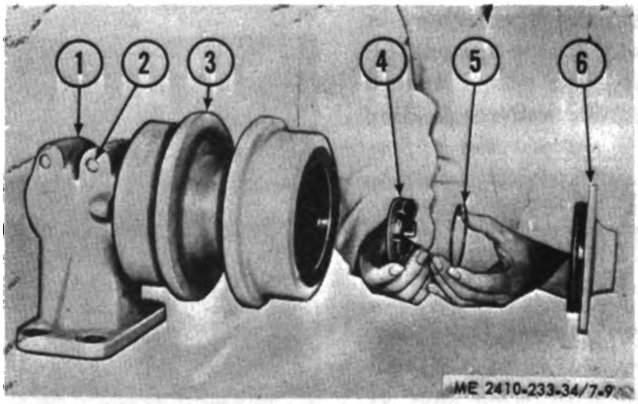
(1) Remove the cover (6, fig. 7-9) lockring (5) and nut (4) from the roller (3).

(2) Loosen the clamping bolts (2) and drive a suitable metal wedge into the slot of bracket (1) to free the carrier roller shaft and remove the bracket.

(3) Remove the lockring (4, fig. 7-10) end collar (3) and metal floating ring seals (2).

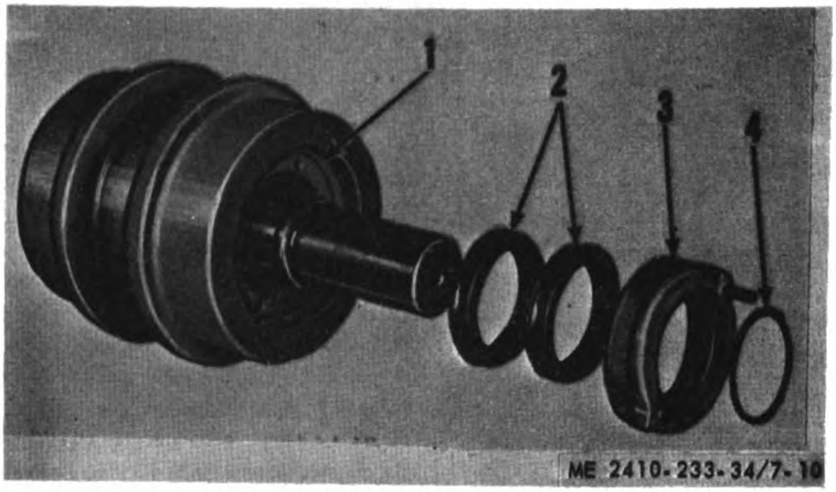
CAUTION

Tape the seals (2) together so they will be kept in matched sets. The floating ring seals (2) should always be installed in pairs, that is, two new seals together or two seals that have previously run together. Never assemble one new seal and one used seal together or two seals that have not previously run together.



1 Bracket
2 Bolt
3 Roller
4 Nut
5 Lockring
6 Cover

Figure 7-9. Removing nut.



1 Seal support
2 Metal floating ring seals
3 End collar
4 Lock ring

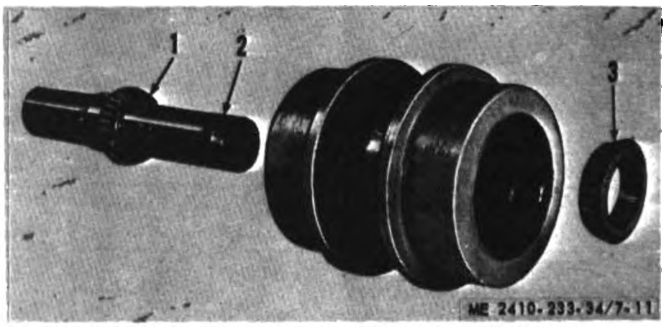
Figure 7-10. Removing metal floating ring seals.

(4) Install two 5/16 inch—18 (NC) bolts approximately 3 inches long into the seal support and attach a puller with a step plate and remove the seal support (1).

(5) Using a puller and a spacer, press the shaft from the roller.

(6) Remove the shaft (2, fig. 7-11) and bearing (1) and bearing (3) from the roller.

(7) The bearing races can be removed from the roller with a bearing cup pulling attachment and a puller.



1 Bearing
2 Shaft
3 Bearing

Figure 7-11. Removing bearings.

c. Cleaning.

(1) Clean all parts using cleaning solvent (Fed. Spec. P-D-680) and wipe dry with lint-free cloth.

(2) Remove all dirt and rust from the floating ring seal mounting grooves. Grooves must be clean, smooth, and dry.

(3) Wash protective coating from new ring seals with cleaning solvent.

d. Inspection and Repair.

(1) Inspect the carrier rollers for damage and wear. When the contact surface wear or flange wear exceed ¼ inch, or the roller is otherwise damaged, it will be replaced.

(2) Inspect the roller bearings for corrosion, roughness, and wear. Replace bearings which are pitted, rough, or worn excessively.

(3) Inspect the metal floating ring seals for damage and proper wear pattern. Replace seals which are pitted, grooved, scratched across the seal surface, or which show an uneven wear pattern. Seals must be replaced in sets.

(4) Replace all toric sealing rings. Do not reuse toric seal rings.

e. Reassembly and Installation.

(1) Heat the bearing cone (6, fig. 7-12) and install it on the shaft so that the inner race seats on the raised section of the shaft.

(2) Install the bearing outer races (4) in the roller.

(3) Install the shaft in the roller, heat the bearing cone (7) and install it on the shaft, and install the spanner nut.

(4) Tighten the nut (5) until all bearing end clearance is removed and a slight drag can be felt on the bearings when the shaft is rotated; then back off the nut until the nearest aligning hole aligns with the slot in the shaft and install the lockring (8).

(5) Install the end cover. Replace the preformed packing if it is damaged.

CAUTION

Before installing the end cover, remove any burrs from the bore of the roller to prevent damage to the preformed packing during installation.

CAUTION

Before installing the end cover, remove any burrs from the bore of the roller to prevent damage to the preformed packing during installation.

(6) Drive the seal support (3) into the roller until it seats in the bore. Lubricate the preformed packing on support (3) with liquid soap to facilitate installation.

NOTE

Be sure the dowel in the support (3) lines up with the milled slot in the roller.

(7) Install the floating ring seals in the end collar (2) and seal support (3) as outlined in paragraph 6-22.

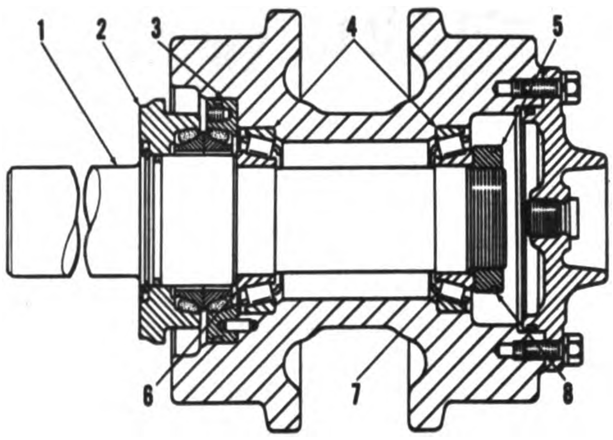
(8) Replace the preformed packing on the shaft, install the end collar on the shaft and install the retaining ring.

NOTE

Lubricate the preformed packing on the shaft (1) with liquid soap before installing the end collar (2).

(9) Lubricate the carrier roller.

(10) Reinstall the carrier roller and adjust the track (TM 5-2410-233-20).



1 Shaft
2 End collar
3 Seal support
4 Outer races
5 Nut
6 Bearing cone
7 Bearing cone
8 Lockring

Figure 7-12. Assembling carrier roller.

7-3. Track Rollers

a. Removal.

(1) Loosen the tracks as outlined in paragraph 7-1.

(2) Place a block approximately 12 inches high in front of the track and drive the tractor over the block until the block is beneath the front roller.

(3) Place a block approximately 12 inches high against the track in back of the sprocket and back the tractor until the track is resting on the block under the sprocket and the block under the idler.

(4) Push brake pedals down and apply brake lock.

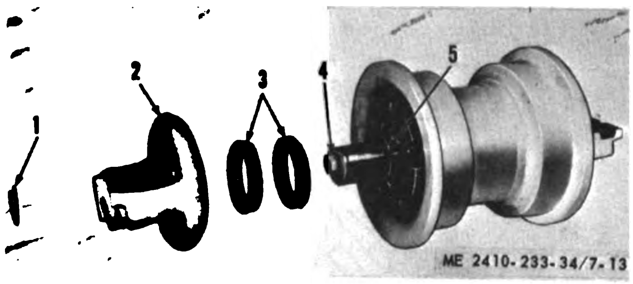
(5) Remove the bolts from the end collars (2, fig. 7-13) at each end of the roller to be removed and remove the roller.

NOTE

To facilitate removal of the front or rear rollers, the second roller from either end should be removed and rolled back on the rails out of the way.

CAUTION

Do not extend any part of body, legs or arms, between the track and rollers, or between ground and track during removal of lower track rollers.



1 Ring
2 Collar
3 Metal floating ring seals
4 Plug
5 Preformed packing

Figure 7-13. Track roller disassembly.

b. Disassembly.

(1) Remove the ring (1).

(2) Remove the collar (2), the metal floating ring seals (3), the plug (4) and the preformed packing (5).

CAUTION

The two metal floating ring seals (3) should be taped together so they will not become intermixed with seals from other rollers.

(3) The other end of the roller is disassembled in the same manner.

(4) Remove the bolts which secure the bushing assembly (fig. 7-14) to the roller.

(5) The bushing assembly can be pressed out of the roller by supporting the roller and pressing on the end of the shaft. The bushing assembly can then be removed from the shaft. Insert the shaft back into roller and repeat the procedure to press the bushing assembly from the opposite end.

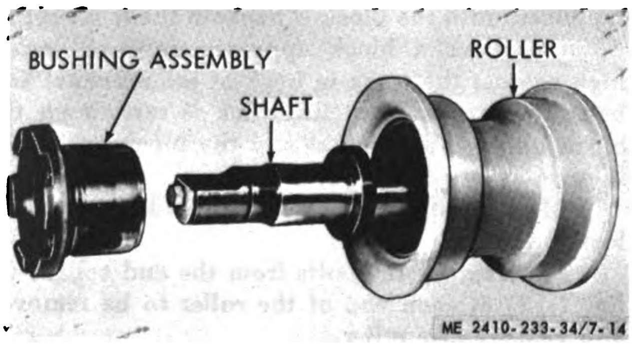


Figure 7-14. Bushing assembly removal.

(6) The bearing (fig. 7-15) can be pressed out and replaced provided the bushing is not damaged.

NOTE

Install new bearings if the shaft clearance exceeds that given in table 1-5.

(7) Press the bearing out of the bushing and cut off the projecting pins with a hacksaw.

(8) Smooth the face of bushing with a file.

(9) Press the new bearing into place making certain the lubricant holes are aligned.

(10) Drill two 9/32 inch holes 13/16 inch deep through the flange of the bearing and into the wall of the cast iron bushing.

CAUTION

Be sure the holes do not interfere with lubrication grooves in the face of the bearing flange.

(11) Install the proper pins so they do not extend above the face of the bearing.

(12) Smooth the face of the bearing flange.

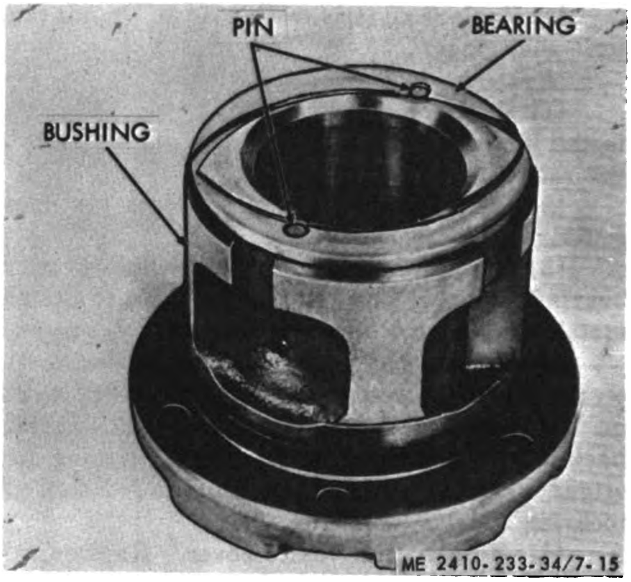


Figure 7-15. Bushing assembly.

c. Cleaning.

(1) Clean all parts using cleaning solvent (Fed. Spec. P-D-680) and wipe dry with a lint-free cloth.

(2) Remove all dirt and rust from the floating ring seal mounting grooves. Grooves must be clean, smooth and dry.

(3) Wash protective coating from new ring seals with cleaning solvent.

d. Inspection and Repair.

(1) Inspect the track rollers for damage and wear. When the contact surface of the roller is worn from 8.38 to 8.00 inches in diameter, the roller will be repaired by welding an overlay on the wear surface. Rollers worn to a diameter of 8.00 inches or less, or rollers uneconomical to repair, will be replaced. The diameter of a new roller is 8.75 inches.

(2) Inspect the roller sleeve bearings for pitting, roughness, and wear. The specified shaft to bearing clearance is 0.008—0.012 inch. The maximum allowable shaft to bearing clearance is 0.050 inch. The specified shaft end clearance is 0.011—0.029 inch. The maximum allowable shaft end clearance is 0.050 inch. Replace pitted, rough, or excessively worn bearings.

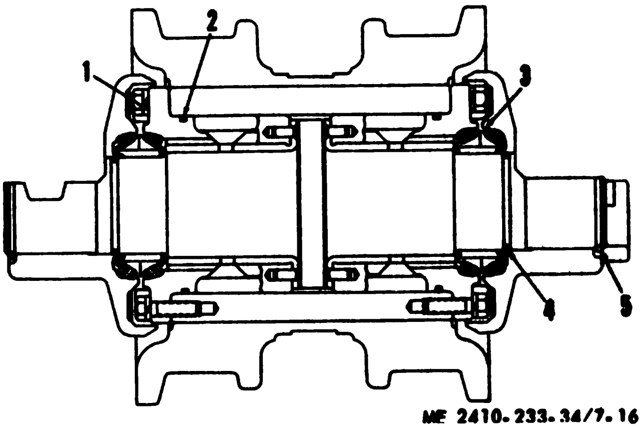
(3) Inspect the roller shaft for pitting, roughness, wear, and distortion. The maximum allowable bend in roller shaft is 0.005 inch. Replace a damaged, excessively worn, or bent roller shaft.

(4) Inspect the metal floating ring seals for damage and proper wear pattern. Replace seals which are pitted, grooved, scratched across the seal surface, or which show an uneven wear pattern. Seals must be replaced in sets.

e. Assembly.

NOTE

Care should be taken when pressing the bushing assembly (1, fig. 7-16) into place to see that the bolt holes in the bushing flange are held in alignment with the holes in the roller hub. This can be done by screwing three studs 120° apart into the roller hub to act as guides.



1 Bushing assembly
2 Preformed packing
3 Metal floating ring seal
4 Preformed packing
5 Retaining ring

Figure 7-16. Assembling track roller.

(1) Install the preformed packing (2) on the bushing (1) and remove any burrs from the roller to prevent damage to the preformed packing.

NOTE

White lead should be used on the outside diameter of the bushing assembly when pressing it into place.

(2) Install the shaft before pressing in the second bushing.

(3) Install the metal floating ring seals (3) in the roller and collars as outlined in paragraph 6-22.

(4) Install the preformed packing (4) on the track roller shaft and lubricate it to facilitate installation of the end collar.

(5) Remove any burrs, smooth the chamfer in the bore of the end collar and install the end collar and the retaining ring (5).

(6) Lubricate the roller.

f. Installation.

(1) Install the track roller with notched end collar toward the center of the tractor.

(2) Place the roller assemblies on the track in the proper relative locations and follow the reverse order of removal in completing the installation.

(3) Place the wedge-shaped lock strip in the notch in the end of the shaft and in the notch of the end collar and securely tighten the bolts which hold the end collars to the track roller frame. Some clearance will remain between the track roller frame and the end collars to insure that the ends of the track roller shaft will be held securely against the track roller frame.

7-4. Front Idler

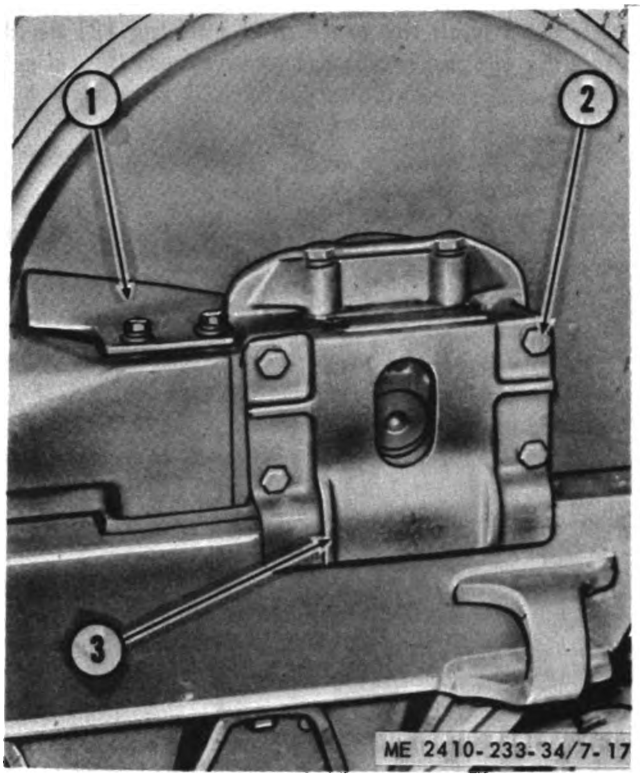
a. Removal.

(1) Separate the track and lay it out flat (para 7-1).

(2) Remove the guard (1, fig. 7-17) bolts (2), and guide plate (3).

NOTE

Keep the shims from beneath guide plate (3) together. The same shims will be used for assembly. The following removal procedure is applicable to both sides of the idler and for both front track idlers.

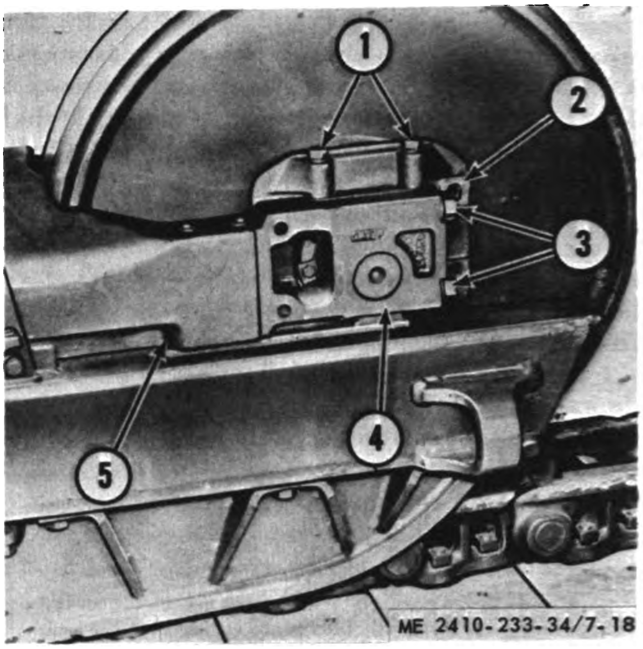


1 Guard
2 Bolts
3 Guide plate

Figure 7-17. Preparing to remove guide plate.

(3) Remove bolts (1, fig. 7-18) securing collar (2) to bearing (4) and yoke (5) and remove shims from between the bearing and the collar. Install one of the bolts (1) through the collar into bearing (4) to hold the collar in place.

(4) Remove bolts (3) securing bearing (4) to yoke (5). Support the idler and roll it forward.



1 Bolts
2 Collar
3 Bolts
4 Bearing
5 Yoke

Figure 7-18. Preparing to remove idler.

b. Disassembly.

(1) Remove the nuts and washers and drive out the tapered pins that secure bearings (1. fig. 7-19) and (4) to shaft (5).

(2) Remove bearings (1 and 4) from shaft (5).

(3) Remove floating duo-cone seals (2) from the bearings and from the bushing assemblies (6).

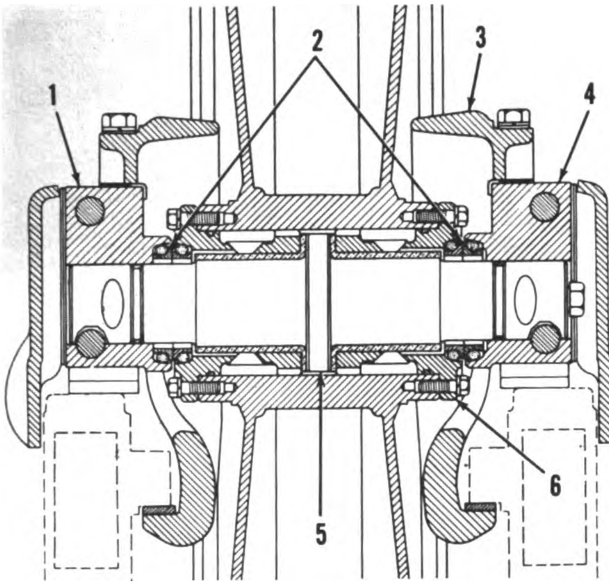
Be careful not to damage the metal floating ring seals as they are removed.

(4) Tape each pair of seals together to prevent intermixing them with other seals.

NOTE

When installing bearings (1) and (4), apply anti-seize compound in bearing bores and on bearing contact surfaces of shaft (5).

(5) Remove collars (3) from both sides of idler.



1 Bearing
2 Floating duo-cone seals
3 Collars (2)
4 Bearing
5 Shaft
6 Bushing assemblies (2)

Figure 7-19. Front idler disassembly.

c. Cleaning.

(1) Clean all parts using cleaning solvent (Fed. Spec. P-D-680) and dry with lint-free cloth.

(2) Remove all dirt and rust from the floating ring seal mounting grooves. Grooves must be clean, smooth, and dry.

(3) Wash protective coating from new ring seals with cleaning solvent.

d. Inspection and Repair.

(1) Inspect the front idlers for damage and wear. When the contact surfact of the idler is worn to the extent that the center flange height measure from 1.07—1.24 inches, the idler will be repaired by welding an overlay on the wear surface. Idlers worn to the extent that the center flange height measures 1.24 inches or more, will be replaced. Idler center flange height new is 0.88 inch.

(2) Inspect the idler sleeve bearings for pitting, roughness and wear. The specified shaft to bearing clearance is 0.008—0.012 inch. The maximum allowable shaft to bearing clearance is 0.050 inch. The specified shaft and clearance is 0.011—0.029 inch. Replace pitted, rough, or excessively worn bearings.

(3) Inspect the idler shaft for pitting, roughness, and wear. Replace a damaged, excessively worn, or bent idler shaft.

(4) Inspect the metal floating ring seals for damage and proper wear pattern. Replace seals which are pitted, grooved, scratched across the seal surface, or which show an uneven wear pattern. Seals must be replaced in sets.

(5) Replace all toris sealing rings. Do not reuse toric seal rings.

(6) Inspect bearings, guides, and collars for cracks, breaks, or other damage. Repair by welding and grinding smooth or replace the part.

e. Reassembly.

(1) Reassemble in the reverse order of disassembly.

(2) Install floating seals (2) using a metal seal installer assembly. Follow procedure outlined in paragraph 6-22.

NOTE

At assembly tighten the nuts on the tapered pins to the initial torque given in table 1-2. Use a hammer and punch to seat the tapered pins and then tighten the nuts to the final torque value.

(3) Lubricate the idler.

f. Installation.

(1) Install the idler in the reverse order of removal.

(2) Align the idler with the track rollers (para 7-5).

g. Repositioning Front Idler.

NOTE

The idler can be positioned from the HIGH to LOW or LOW to HIGH position.

(1) Remove the idler. Note the location of the recess, with the bearing in the LOW position (fig. 7-20).

(2) Remove the bolts, raise collars and revolve bearings and shaft 180° so recesses are toward the rear of the machine (fig. 7-21). Install the bolt.

(3) Rotate the idler 180° in the direction indicated by the arrows. This will position the idler properly for installation in the HIGH position. The bearing that was previously on the right side of the idler will now be on the left, and the recess will again be toward the front of the machine.

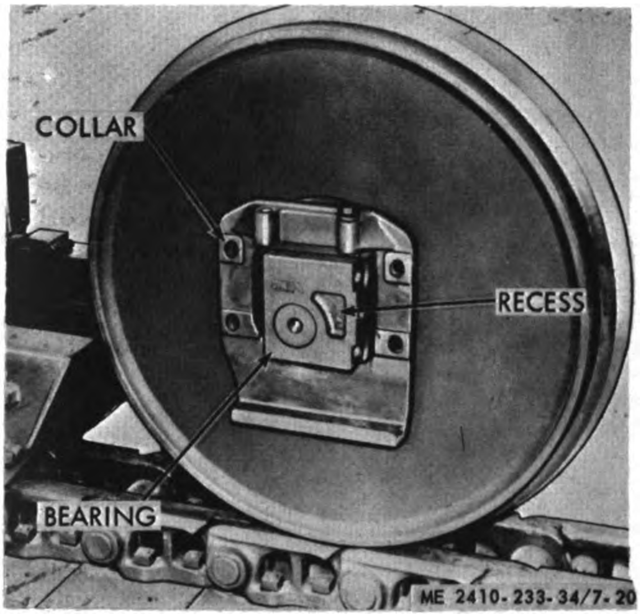


Figure 7-20. Idler bearing in low position.

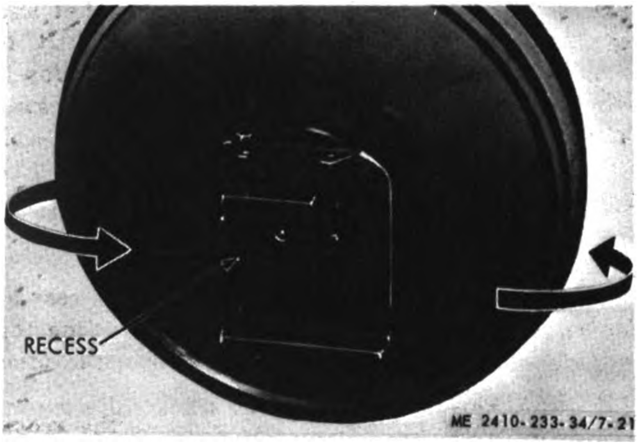


Figure 7-21. Repositioning bearings.

7-5. Front Idler Yoke Assembly

a. Removal.

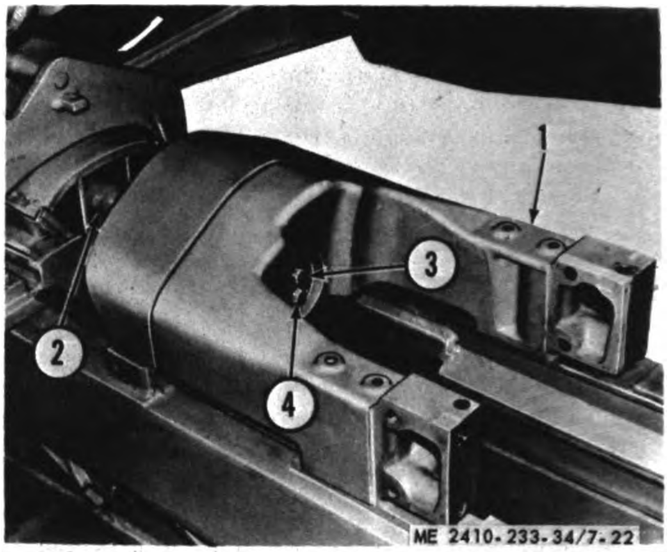
(1) Separate the track and lay it out flat (para 7-1).

(2) Remove front idler (para 7-4).

(3) Remove recoil rod (2, fig. 7-22) after removing bolts (4) and washer (3). Then strike recoil rod (2) with a hammer at rear of yoke (1) to unseat the taper fit in yoke. Separate rod and yoke.

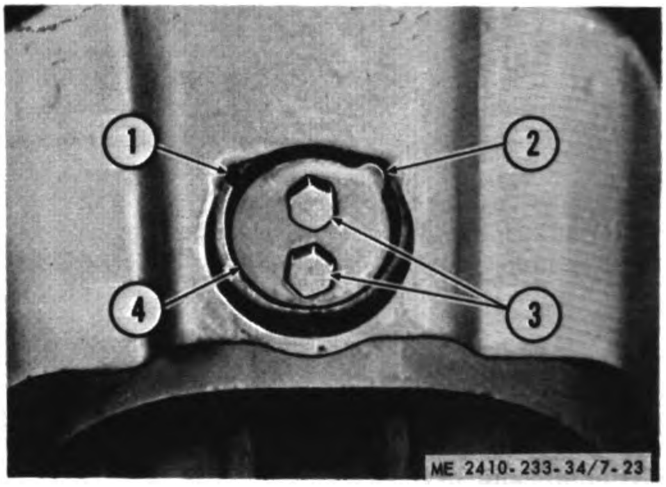
NOTE

Yoke (1) and recoil rod (2) can be assembled for use on either right or left side of the tractor. Align the ear on washer (4, fig. 7-23) in notch (1) in yoke for use on the right side of the tractor. Align ear on washer with notch (2) for the left side. Tapped holes in end of recoil rod must be in line with holes in washer and the milled flat (or guard) on the flange at the rear end of the rod must be up.



1 Front idler yoke assembly
2 Idler recoil rod
3 Washer
4 Bolts

Figure 7-22. Preparing to remove yoke assembly.



1 Notch for right side use
2 Notch for left side use
3 Bolts (2)
4 Washer

Figure 7-23. Idler recoil rod alignment.

b. Inspection and Repair.

(1) Inspect front idler yoke for cracks, breaks, distortion and other damage.

(2) Repair by welding (TM 9-237) or replace part.

c. Installation. Reverse removal procedure and install the front idler yoke. Adjust front idler according to subparagraph *d* below.

d. Front Idler Adjustment.

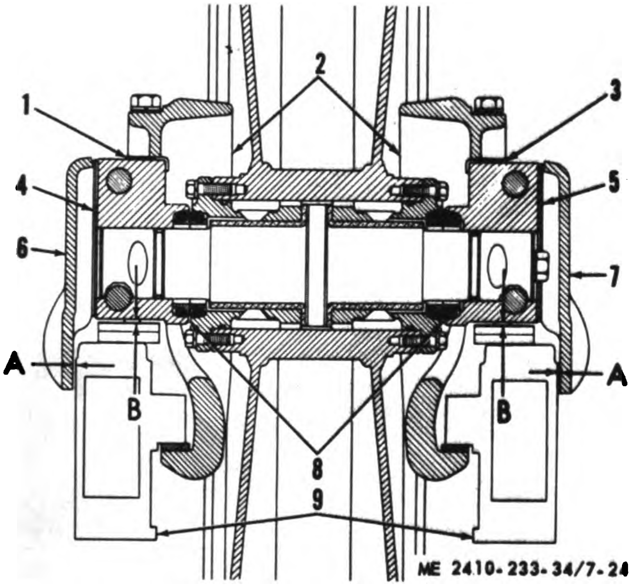
(1) Install shims (1, fig. 7-24) and (3) between collars (2) and bearings (8) to align the idler with the track rollers and keep clearance (B) between the yoke and the plate with tolerances given in table 1-5.

NOTE

Removing shims (1) or (3) from one end bearing will tilt the top of the idler away from that bearing. Adding shims to one end bearing will tilt the top of the idler toward that end bearing.

(2) Install enough shims (4) and (5) between bearings (8) and guide plates (6) and (7) to provide clearance (A) between guide plates (6) and (7) and the frame (9). Refer to table 1-5 for correct clearance.

(3) Shims (4) and (5) are used to shift the idler from side to side to align idler and track properly.



1 Shims
2 Collars
3 Shims
4 Shims
5 Shims
6 Guide plate
7 Guide plate
8 End bearings
9 Frame
A Dimension to be checked
B Dimension to be checked

Figure 7-24. Aligning idler with track rollers.

7-6. Recoil Springs

a. Removal.

WARNING

Be certain the hydraulic pressure in the track adjusting mechanism is completely relieved and the cylinder can be removed to the rear into the recoil spring front pilot before attempting to separate the track or remove the track adjusting mechanism. On machines that have badly worn track, it is possible for the hydraulic track adjuster to be adjusted forward to the limit of its travel and the stop will be against the equalizer bar support. The hydraulic cylinder could have high oil pressure in it even though the track is loose enough to remove the master pin without relieving the hydraulic track adjusting pressure.

(1) Remove guards (fig. 7-25). Install drawbar pin or hardwood block between the sprocket and the track, and back up the machine slightly to compress the recoil spring. When all the tension is removed from recoil spring stops, remove locking bolt and washer (4, fig. 7-26) and screw recoil spring bolt nut (1) tight against rear pilot (2). Remove the drawbar pin or hardwood block.

(2) Separate the track and lay it out flat (par 7-1).

(3) Move cylinder (5, fig. 7-27) to the rear as far as possible, into front pilot (2), separating the cylinder from idler recoil rod (4). Move the idler rod to the front as far as possible.

(4) Attach a hoist to and remove the recoil spring assembly.

(5) Inspect antiextrusion ring (2, fig. 7-31) and seal (1).

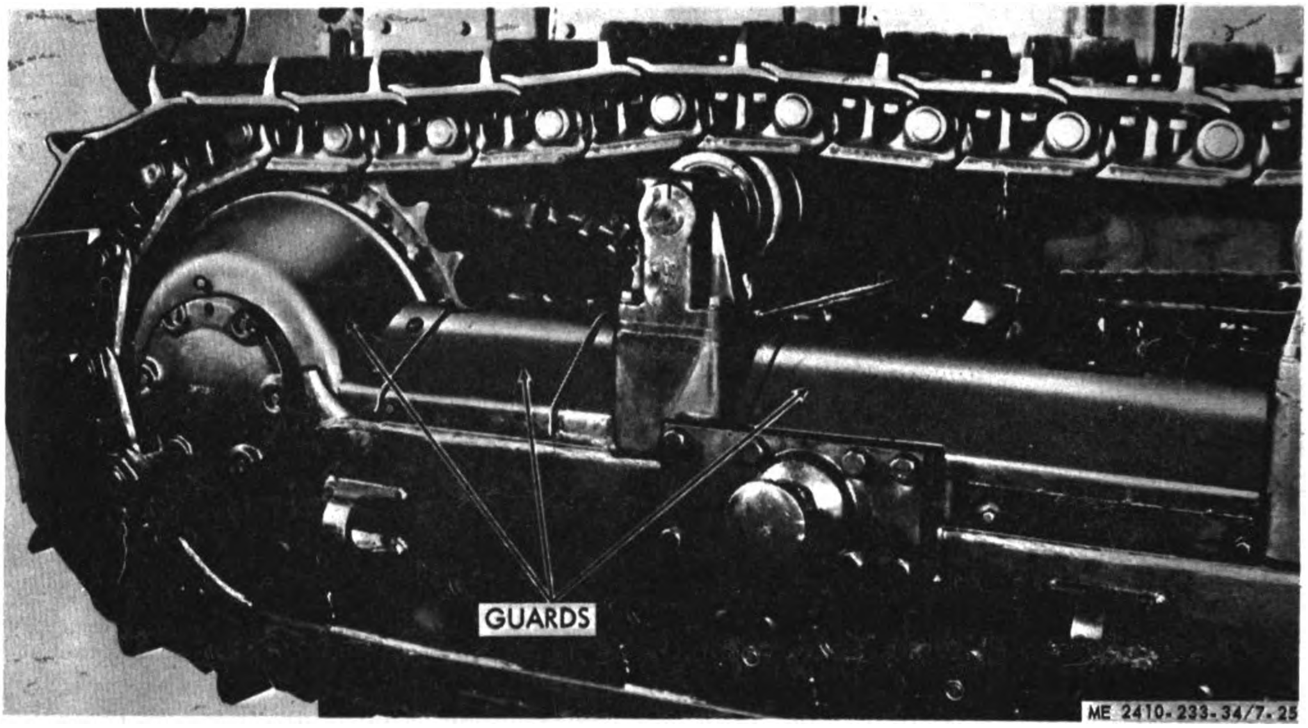
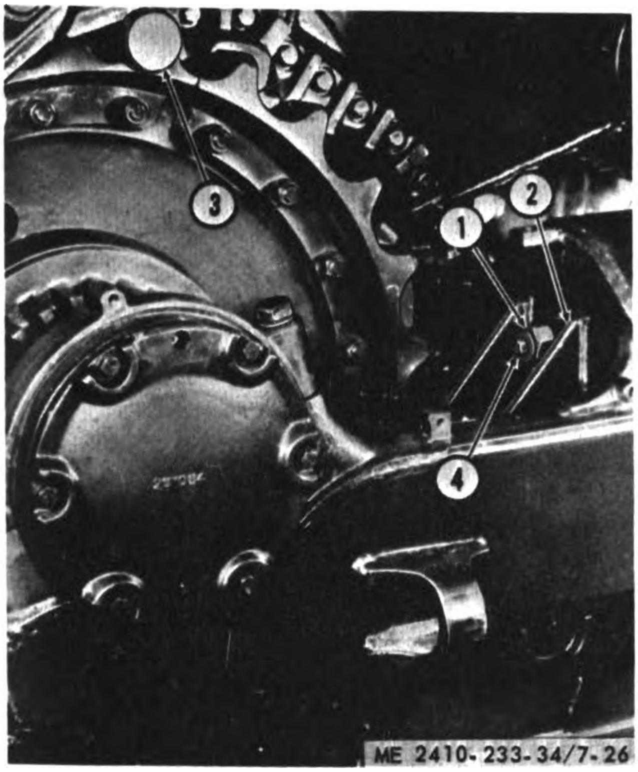
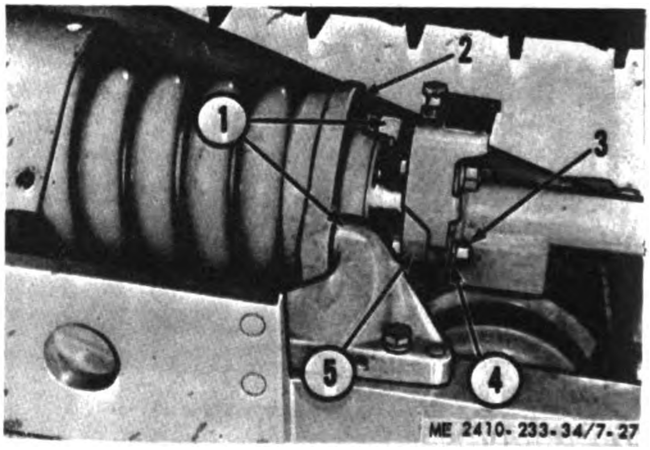


Figure 7-25. Removing guards.



1 Recoil spring bolt nut
2 Recoil spring rear pilot
3 Drawbar pin
4 Locking bolt and washer

Figure 7-26. Removing tension from recoil spring stops.



1 Recoil spring stops
2 Recoil spring front pilot
3 Nuts
4 Idler recoil rod
5 Cylinder

Figure 7-27. Removing recoil spring stops.

b. Disassembly.

WARNING

The springs in the recoil spring assembly are assembled under a force of several tons. During the process of disassembly and assembly, it is imperative that the proper tools be used in the proper manner when performing these operations.

(1) Remove bolt (1, fig. 7-28) and washer (2) securing retaining nut (6) to recoil spring bolt (9).

(2) Install the recoil spring assembly in a suitable press with rear pilot (7) positioned on the press bed and front pilot (3) centered with the press ram.

NOTE

A press with a minimum throat depth of 35-inches is required to disassemble recoil spring assembly.

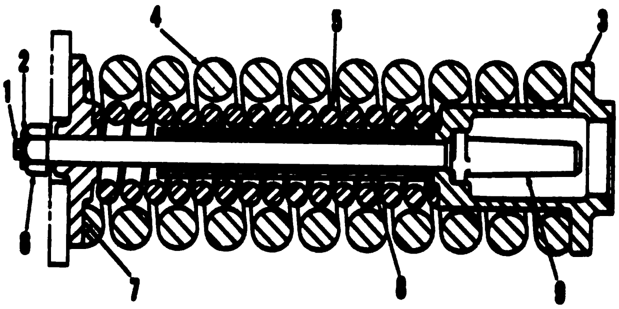
(3) Apply enough pressure to the recoil spring assembly to remove retaining nut (6).

(4) Remove retaining nut (6).

(5) Back off the press ram to decompress the recoil springs (4) and (5).

(6) Remove recoil spring bolt (9), front pilot (3) and sleeve (8).

(7) Attach a hoist and remove outer recoil spring (4). Remove inner recoil spring (5).



ME 2410-233-34/7-28

1 Bolt
2 Washer
3 Recoil spring front pilot
4 Idler recoil spring (outer)
5 Idler recoil spring (inner)
6 Recoil spring bolt retainer nut
7 Recoil spring rear pilot
8 Recoil spring bolt sleeve
9 Recoil spring bolt

Figure 7-28. Recoil spring assembly.

c. *Inspection.* Inspect recoil springs for damage and distortion. Free lengths are: Outer, 31.17—32.23 inches; inner, 21.50—22.50 inches. Replace a distorted or damaged spring.

d. *Reassembly.*

(1) Position rear pilot (7) over the choke in the press bed.,

(2) Install recoil springs (4) and (5).

(3) Install sleeve (7, fig. 7-29) in inner recoil spring (3) and install front pilot (1).

(4) Fabricate guide pin (5), as illustrated in figure 7-30 and screw it into the recoil spring bolt (4).

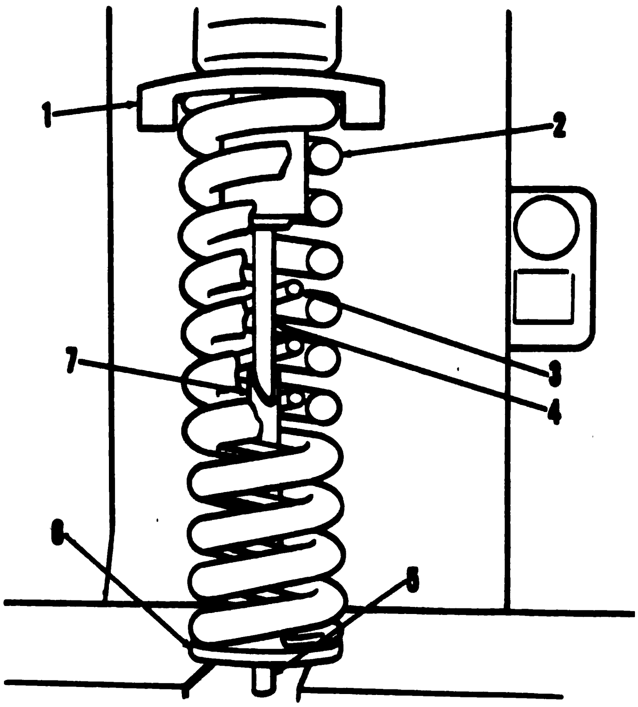
(5) Insert bolt (4, fig. 7-29) through front pilot (1), sleeve (7) and rear pilot (6).

(6) Center the recoil spring assembly beneath the press ram and compress the assembly to assembled length measured from the rear face of the front pilot to the front face of the rear pilot (table 1-5).

(7) Remove guide pin (5). Install retaining nut (6, fig. 7-28)

NOTE

Install bolt (1) and washer (2) to lock retaining nut (6), after the recoil spring assembly has been installed in the machine (A above).



ME 2410-233-34/7-29

1 Recoil spring front pilot
2 Idler recoil spring (outer)
3 Idler recoil spring (inner)
4 Recoil spring bolt
5 Guide pin
6 Recoil spring rear pilot
7 Recoil spring bolt sleeve

Figure 7-29. Assembling recoil spring assembly.

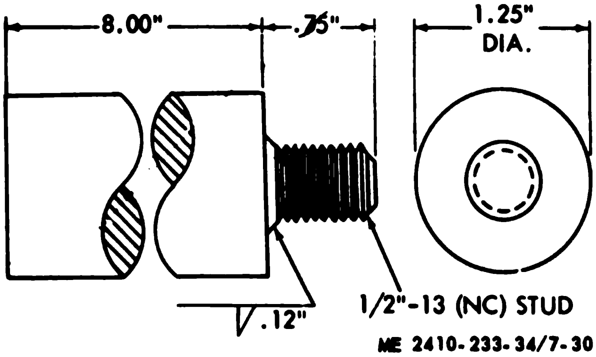


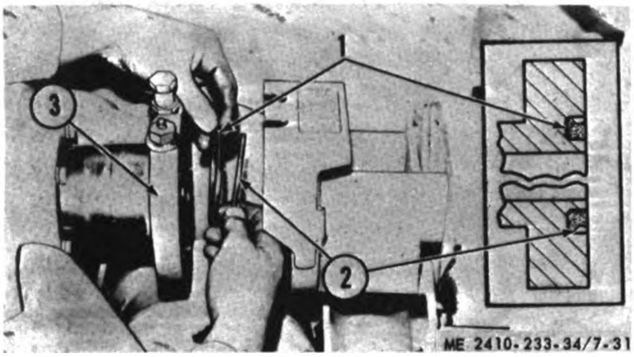
Figure 7-30. Spring bolt guide pin.

e. *Installation.*

(1) Install the recoil spring assembly in reverse order of removal.

NOTE

When installing (2, fig. 7-31), in cylinder (3), the beveled edge is placed toward the cylinder. Align the flat on the cylinder flange with the flat (or guard) on the idler recoil rod flange.



1 Seal
2 Antiextrusion ring
3 Cylinder

Figure 7-31. Installing seal and ring.

(2) After recoil spring stops (1, fig. 7-27) have been installed, loosen recoil spring bolt nut (6, fig. 7-28) releasing the recoil spring tension against the stops, continue turning nut (6) until the end of the nut extends 1 / 16 inch beyond the end of the recoil spring bolt. Install bolt (1) and washer (2) to lock nut (6) in place.

7-7. Track Adjusting Mechanism.

a. *Removal.*

WARNING

Be certain the hydraulic pressure in the track adjusting mechanism is completely relieved and the cylinder can be moved to the rear into the recoil spring front pilot before attempting to separate the track or remove the track adjusting mechanism. On tractors that have badly worn track, it is possible for the hydraulic track to be adjusted forward to the limit of its travel and the stop will be against the equalizer bar support. The hydraulic cylinder could have high oil pressure in it even though the track is loose enough to remove the master pin without relieving the hydraulic track adjusting pressure.

(1) Separate the track and lay it out flat (para 7-1).

(2) Remove guards (fig. 7-25).

(3) Remove either carrier roller support assembly (para 7-8) or recoil spring assembly (para 7-6).

(4) Remove bolts and nuts (fig. 7-32).

(5) Remove the seal (3, fig. 7-33) and antiextrusion ring (4).

NOTE

When installing antiextrusion ring (4), place the beveled edge toward the cylinder.

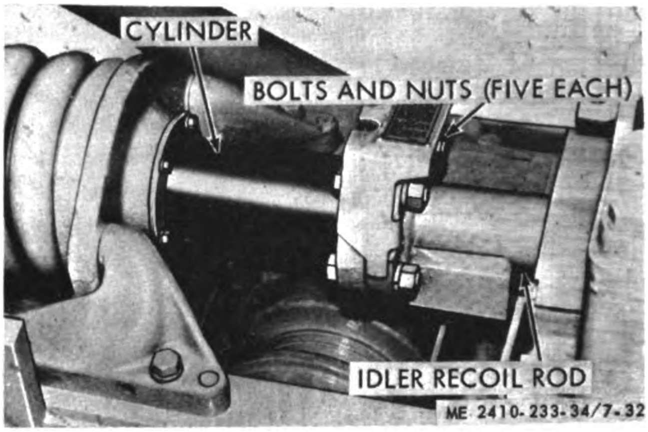
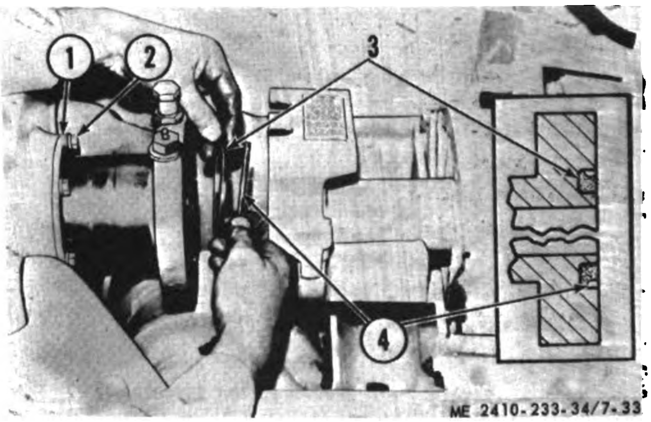


Figure 7-32. Preparing to remove cylinder.



1 Cover
2 Bolt (5)
3 Seal
4 Antiextrusion ring

Figure 7-33. Removing seal and ring.

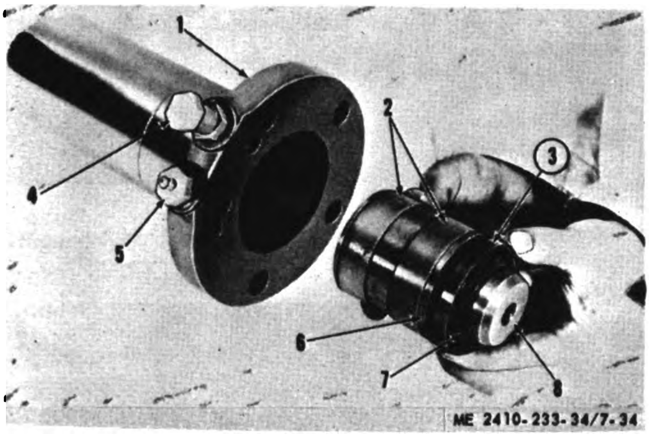
(6) Remove bolts (2) securing cover (1) to the recoil spring front pilot. Pull the cylinder out of the bore. Packing will come out with the cylinder.

b. Disassembly.

(1) Push piston (8, fig. 7-34) out of cylinder (1).

(2) Inspect packing (3) and rings (2).

(3) Remove packing (3) and washer (6) after removing snapring (7).



1 Cylinder	5 Fill valve
2 Rings	6 Washer
3 Packing	7 Snapring
4 Relief valve	8 Piston

Figure 7-34. Cylinder disassembly.

c. Reassembly.

(1) Install packing with the lip toward snapring (7).

(2) Lubricate the inside of cylinder (1) and install piston assembly.

d. Installation. Install in reverse order of removal, rotating the cylinder so the flat (or guard) on the recoil rod flange aligns with the flat on the cylinder. Install the adjusting mechanism. Install and adjust the track (*e* below).

e. Track Adjustment.

NOTE

Operate the tracks without excessive tension to minimize wear. When properly adjusted there should be 1-inch to 1½ inch sag measured at a point half way between the track carrier roller and front idler.

(1) Raise the inspection plate on the track roller frame guard.

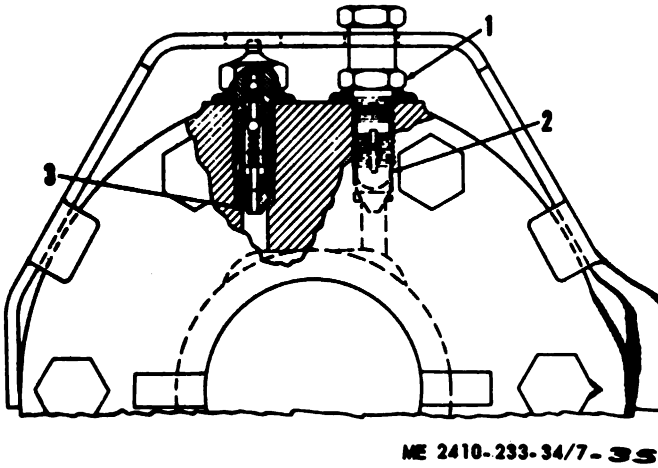
(2) With relief valve (1, fig. 7-35) opened one turn counterclockwise, force GAA lubricant through fitting in fill valve (3).

(3) When the grease coming out vent hole (2) from the opened relief valve (1) is thick, close the relief valve and continue filling with lubricant until the track has 1-inch to 1½ inch sag.

(4) Operate the machine backward and forward to equalize the adjustment. Recheck adjustment.

NOTE

The torque values for valves (1) and (3) are given in paragraph 1-6. (5) Make subsequent track adjustments as outlined in TM 5-2410-233-20.



1 Relief valve
2 Vent hole
3 Fill valve

Figure 7-35. Relief valve and fill valve.

7-8. Carrier Roller Support Assembly

a. Removal.

WARNING

Be certain the hydraulic pressure in the track adjusting mechanism is completely relieved and the cylinder can be moved to the rear into the recoil spring front pilot before attempting to separate the track or remove the track adjusting mechanism. On tractors that have badly worn track, it is possible for the hydraulic track adjuster to be adjusted forward to the limit of its travel and the stop will be against the equalizer bar support. The hydraulic cylinder could have high oil pressure in it even though the track is loose enough to remove the master pin without relieving the hydraulic track adjusting pressure.

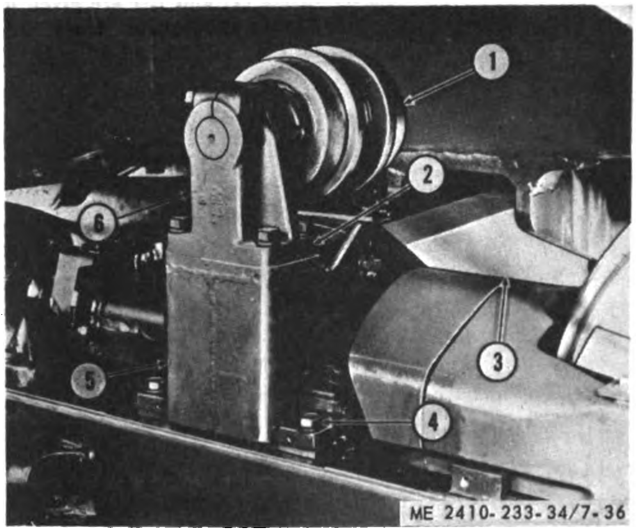
(1) Remove guards (fig. 7-25).

(2) Separate the track and lay it out flat (para 7-1).

(3) Raise the front of the tractor until equalizer bar (3, fig. 7-36) is against roll bar (2). Use blocking to support the front of the tractor.

(4) Remove bolts (4).

(5) Attach a hoist to and remove track carrier roller (1, carrier roller bracket (6) and support assembly (5) as a unit.



1 Track carrier roller
2 Roll bar
3 Equalizer bar
4 Bolts
5 Support assembly
6 Track carrier roller bracket

Figure 7-36. Preparing to remove support assembly.

b. Disassembly. Refer to paragraph 7-2 and remove the track carrier roller from support assembly.

c. Inspection and Repair.

(1) Inspect track carrier roller (para 7-2 d).

(2) Inspect carrier roller support for cracks, breaks, distortion or other damage. Repair minor cracks by welding (TM 9-237). Replace a damaged carrier roller support.

d. Installation. Install in reverse order of removal.

Section III. EQUALIZER BAR AND TRACK ROLLER FRAME

7-9. Equalizer Bar Inspection

Inspect equalizer bar (2, fig. 7-39) for cracks, breaks, distortion or other damage. Report any damage or defects of the equalizer bar to depot maintenance personnel.

7-10. Track Roller Frame

a. Removal.

(1) Separate the track and lay it out flat (para 7-1).

(2) Remove sprocket guard and rear track roller frame guard.

(3) Remove outer bearing cap (fig. 7-37), and brace bearing cap (fig. 7-38).

(4) Raise and support the front and rear of the tractor to allow the track rollers to clear the track rails.

WARNING

Support front of tractor under center of equalizer bar.

(5) Attach a suitable sling and hoist around the track carrier rollers, to support the track roller frame (3, fig. 7-39). The track roller frame weighs approximately 4350 pounds.

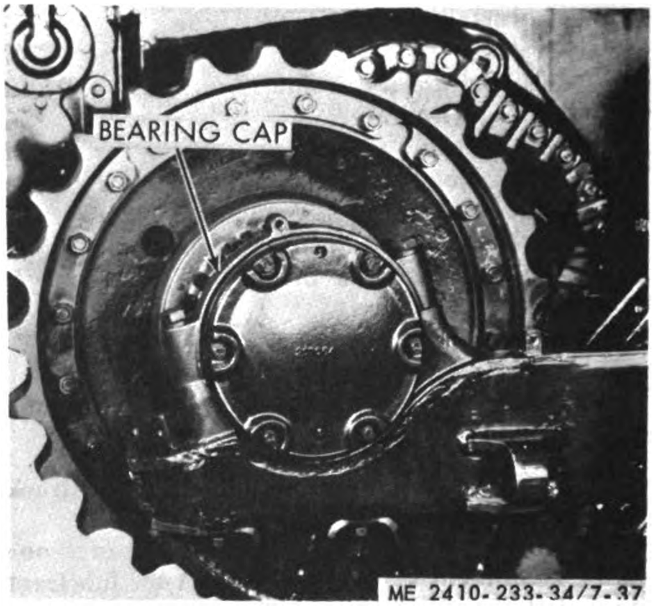


Figure 7-37. Removing outer bearing cap.

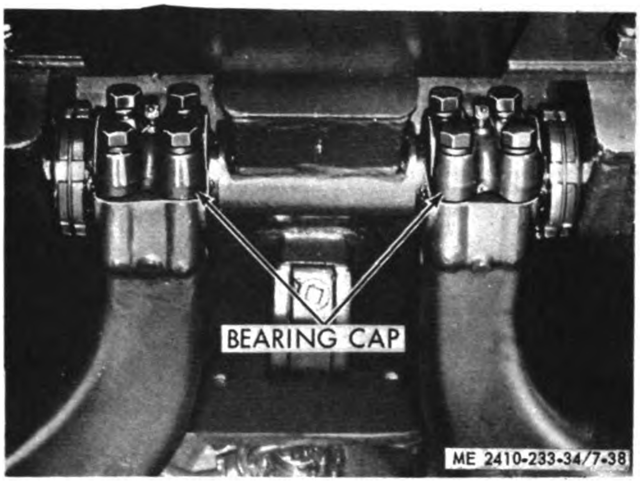
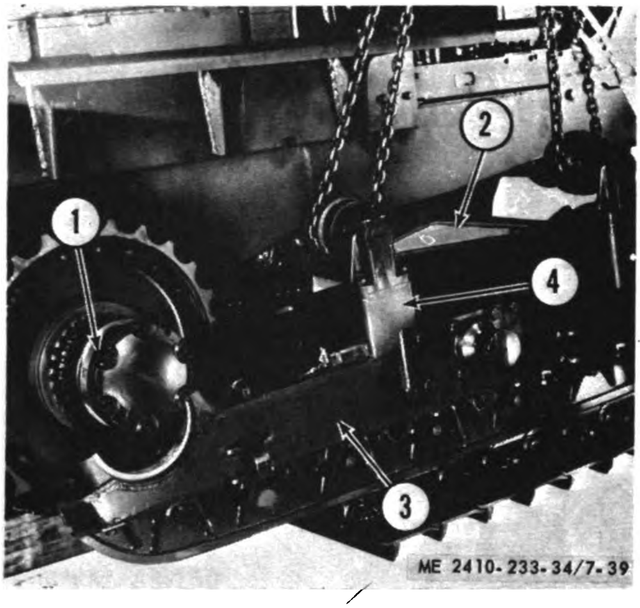


Figure 7-38. Removing diagonal brace bearing cap.



1 Track roller frame outer bearing
2 Equalizer bar
3 Track roller frame
4 Track carrier roller support

Figure 7-39. Removing track roller frame.

NOTE

Adjust the hoist sling to position the front of the track roller frame slightly higher than the rear.

(6) Raise the track roller frame to transfer the weight of the track roller frame, from the equalizer bar (2), to the hoist.

(7) Rock the track roller frame to separate it from the track roller frame outer bearing (1) and to separate the diagonal brace from the sprocket shaft.

(8) Remove the track roller frame by swinging the front end of the roller frame away from the tractor and guiding the track carrier roller support (4) off of the equalizer bar (2).

(9) Inspect the bearings (fig. 7-40) for damage or excessive wear. Replace if necessary.

NOTE

When replacing the bearings, align the dowel holes in the bearings with the dowels contained in the bearing cap and diagonal brace.

b. Inspection and Repair. Inspect the track inner bearing for scoring, pitting, and wear. The specified bearing clearance is 0.012—0.015 inch. The maximum allowable clearance is 0.040 inch. Replace excessively scored, pitted or worn bearings.

c. Installation.

(1) Install the track roller frame in the reverse order of removal.

(2) Install and adjust the track (subpara 7-7 d).

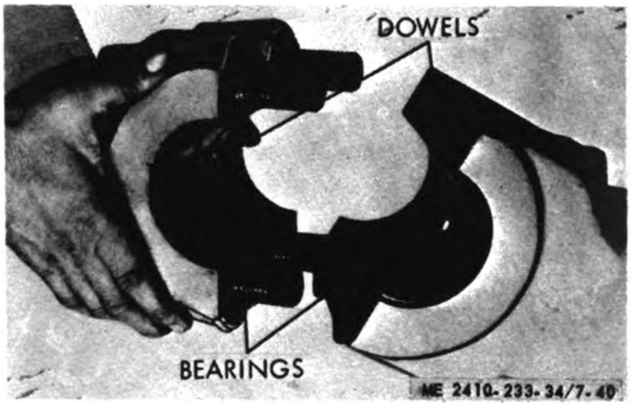


Figure 7-40. Bearing cap assembly.

APPENDIX A

REFERENCES

A-1. Fire Protection

TB 5-4200-200-10	Hand Portable Fire Extinguishers Approved for Army Users.

A-2. Lubrication

C91001L	Fuels, Lubricants, Oils, and Waxes.
LO 5-2410-233-12/1, 2, and 3	Tractor, Full Tracked, Caterpillar Model D7F W/Engine D333CT.

A-3. Painting

TB 746-93-1	Color and Marking of Military Vehicles.
TM 9-213	Painting Instructions for Field Use.

A-4. Cleaning

C68001L	Chemicals and Chemical Products.
SB 725-7930-1	Hard and Soft Water Cleaning Components

A-5. Welding

TM 9-237	Welding, Theory and Application.
TM 5-2410-233-10	Operator's Manual, D7F Caterpillar Tractor.

A-6. Maintenance

TB ENG 364	Gears Serviceability.
TM 5-2410-233-20	Organizational Maintenance Manual, D7F Caterpillar Tractor.
TM 5-2410-233-34P	Direct and General Support and Depot Maintenance Repair Parts and Special Tool List, D7F Caterpillar Tractor
TM 38-750	The Army Maintenance Management System.

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CHART A		
NO.	PART NAME	DESCRIPTION
1.	LIFT CYLINDER	BORE–4.75, STROKE–37.62, ROD–1.50
2.	TILT CYLINDER	BORE–6.50, STROKE–6.00, ROD–3.00
2.	TILT CYLINDER	BORE–6.00, STROKE–4.00, ROD–2.50
3.	QUICK DROP VALVE	MOUNTED ON LIFT CYLINDERS
4.	SELECTOR VALVE (R.H.)	R.H. RIP SHANK OR L.H. SELECTOR
5.	SELECTOR VALVE (L.H.)	L.H. RIP SHANK OR TILT CYLINDER
6.	TANK	CLOSED RESERVOIR
7.	LIFT VALVE	BULLDOZER
8.	MAIN RELIEF VALVE	2250 PSI
9.	TILT VALVE	2450 PSI
10.	CONTROL VALVE	RIPPER
11.	FILTER	1–5 X 9 10 MICRON
12.	PILOT VALVES	CONTROLS SELECTOR VALVES
13.	RIPPER CYLINDER	BORE–6.00, STROKE–19.70, ROD–1.75
14.	PUMP	SEE CHART C
15.	VALVE AS. PRESS REDUCING	300 PSI TO PILOT VALVE
16.	RIPPER CONTROL LEVER	
17.	PILOT VALVE LEVER	
18.	BULLDOZER CONT. LEVER	

CHART B – PRESSURE TAPS	
A	SMALL PUMP PSI
B	LARGE PUMP PSI

CHART C – PUMP DATA		
	SINGLE SEC.	TANDEM
SMALL PUMP RING	—	21
GPM @ RPM	60 @ 2080	34.5 @ 2080
LARGE PUMP RING	—	14
GPM @ RPM	—	24 @ 2080

ME 2410-233-34/FO-1

FO-1. Hydraulic flow schematic diagram.

PIN : 005390-000