TM 5-2410-214-35

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE MANUAL

TRACTOR,

FULL TRACKED, LOW SPEED, DIESEL ENGINE DRIVEN, MEDIUM DRAWBAR PULL; OSCILLATING TRACK; 78-INCH GAGE

[CATERPILLAR MODEL D-7]

FSN 2410-782-1130

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

HEADQUARTERS, DEPARTMENT OF THE ARMY

7 FEBRUARY 1969



5 SAFETY STEPS TO FOLLOW IF SOMEONE IS THE VICTIM OF ELECTRICAL SHOCK

1. DO NOT TRY TO PULL OR GRAB THE INDIVIDUAL

2. IF POSSIBLE, TURN OFF THE ELECTRICAL POWER

3. IF YOU CANNOT TURN OFF THE ELECTRICAL POWER, PULL, PUSH, OR LIFT THE PERSON TO SAFETY USING A WOODEN POLE OR A ROPE OR SOME OTHER INSULATING MATERIAL

4. SEND FOR HELP AS SOON AS POSSIBLE

5. AFTER THE INJURED PERSON IS FREE OF CONTACT WITH THE SOURCE OF ELECTRICAL SHOCK, MOVE THE PERSON A SHORT DISTANCE AWAY AND IMMEDIATELY START ARTIFICIAL RESUSCITATION

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *24 July 1974*

Direct and General Support and Depot Maintenance Manual
TRACTOR, FULL-TRACKED, LOW SPEED; DIESEL ENGINE DRIVEN; MEDIUM DRAWBAR PULL; OSCILLATING TRACK; 78-INCH GAGE (CATERPILLAR MODEL D-7E) FSN 2410-782-1130, W/WINCH: FSN 2410-928-3897, W/RIPPER

TM 5-2410-214-35, 7 February 1969, is changed as follows:

The title on the cover and contents page is changed as shown above.

Inside Front Cover. Add to Safety Precautions:

WARNING

Dry cleaning solvent, PD-680, used for cleaning is POTENTIALLY DANGEROUS CHEMICAL. Do not use near open flame. Flash point of solvent is 100°F 138°F.

Page 3, paragraph 1-1, line 4. Change "D-7" to read "D-7E." Change "D-7" to read "D-7E" wherever it appears in the manual.

Paragraph 1-2b is superseded as follows:

b. You can help to improve this manual by calling attention to errors and by recommending improvements. Your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) should be mailed direct to Commander, US Army Troop Support Command, ATTN: AMSTS-MPP, 4300 Goodfellow Blvd., St. Louis, MO 63120. A reply will be furnished direct to you.

Paragraph 1-4b. In right-hand-side data column under *Turbocharger,* change "lb-ft" to read "lb-in" in lines 1, 2, and 4.

Page 6, table 1-1, line 7. Under Service *Meter,* change "3975" to read "3.875".

Page 11, table 1-3. Under *Track Carrier Rollers,* change the end clearance minimum "0.000" to read "0.008".

Page 11. Add table 1-4 after table 1-3.

Table 1-4. Alternator Specification.

Alternator	Specifications	
	British engineering system	Metric system
24V-50A-DR 1117226	5S9088	5S9088
Circuit-negative ground	B	B
Belt adjustment (amount deflected)	0.875 ± 0.125 in.	22.0 ± 3.0 mm
force midway between pulleys	25 lb.	11.3 kg
RPM-testing	5000	5000
Rotation-clockwise		
Output - cold		
5000 RPM (load battery with carbon pile		
to obtain maximum output)	54A	54A
Rated output (hot)	50A	50A
Field current @ 24V 80°F (27°C)	2.5 - 2.9A	2.5 - 2.9A
Voltage regulator:		
Voltage setting range	26 - 30V	26 - 30V
Adjust voltage setting to	28 V	28V
then increase speed to produce		
maximum output	50A	50A
Torque - shaft nut	75 ± 5 lb. ft.	10.4 ± 0.7 mkg
Torque - output terminal bolt	10 ± 1 lb. ft.	1.38 ± 0.14 mkg

Page 12, figure 1-1(1). Change figure legend to read "Tractor wiring diagram (Serial nos. 75E1 through 75E1-300)."

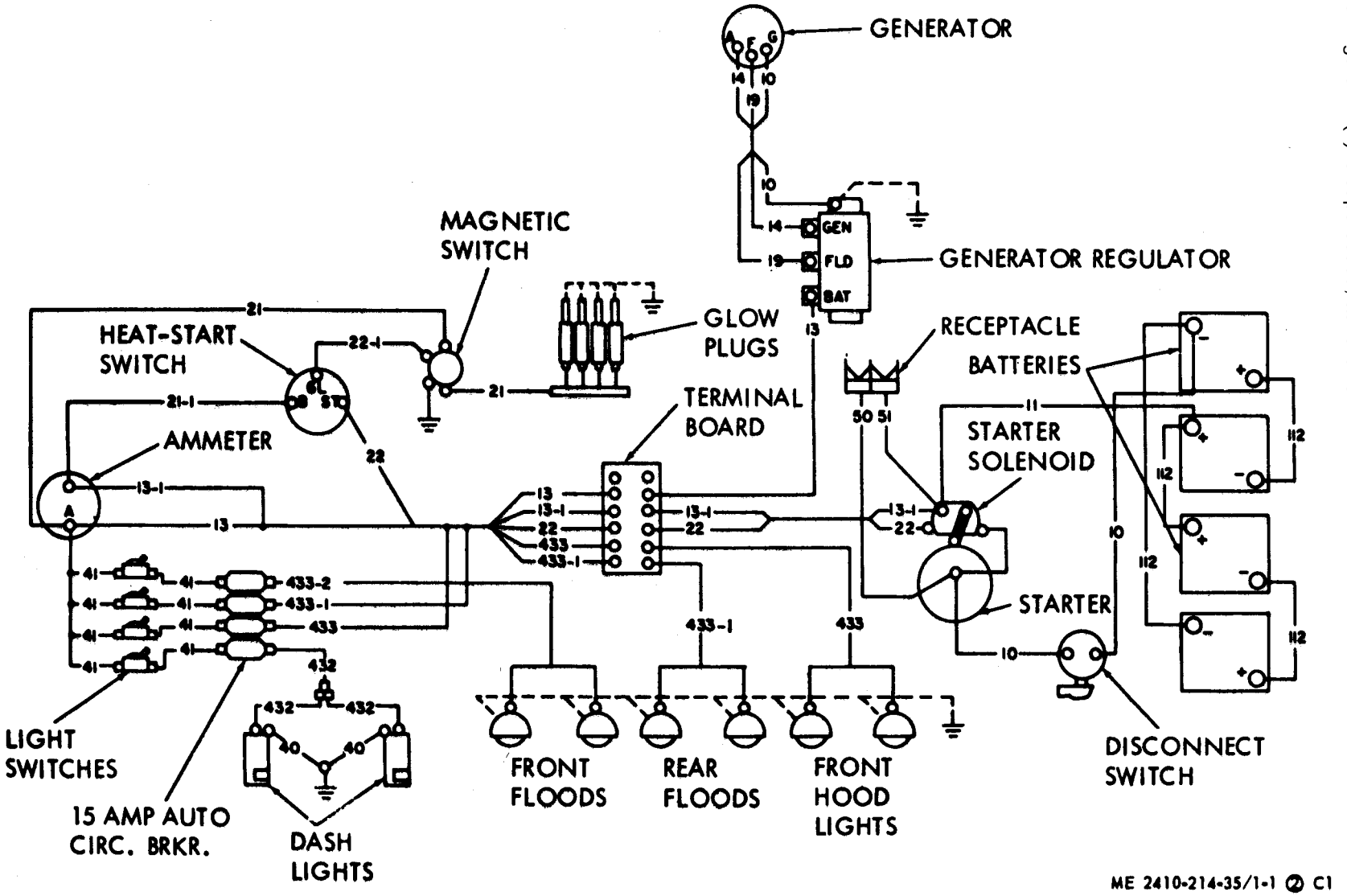


Figure 1-1(2). Tractor wiring diagram (Serial Nos. 75E1301-UP).

Figure 1-1.1 is added after figure 1-(2).

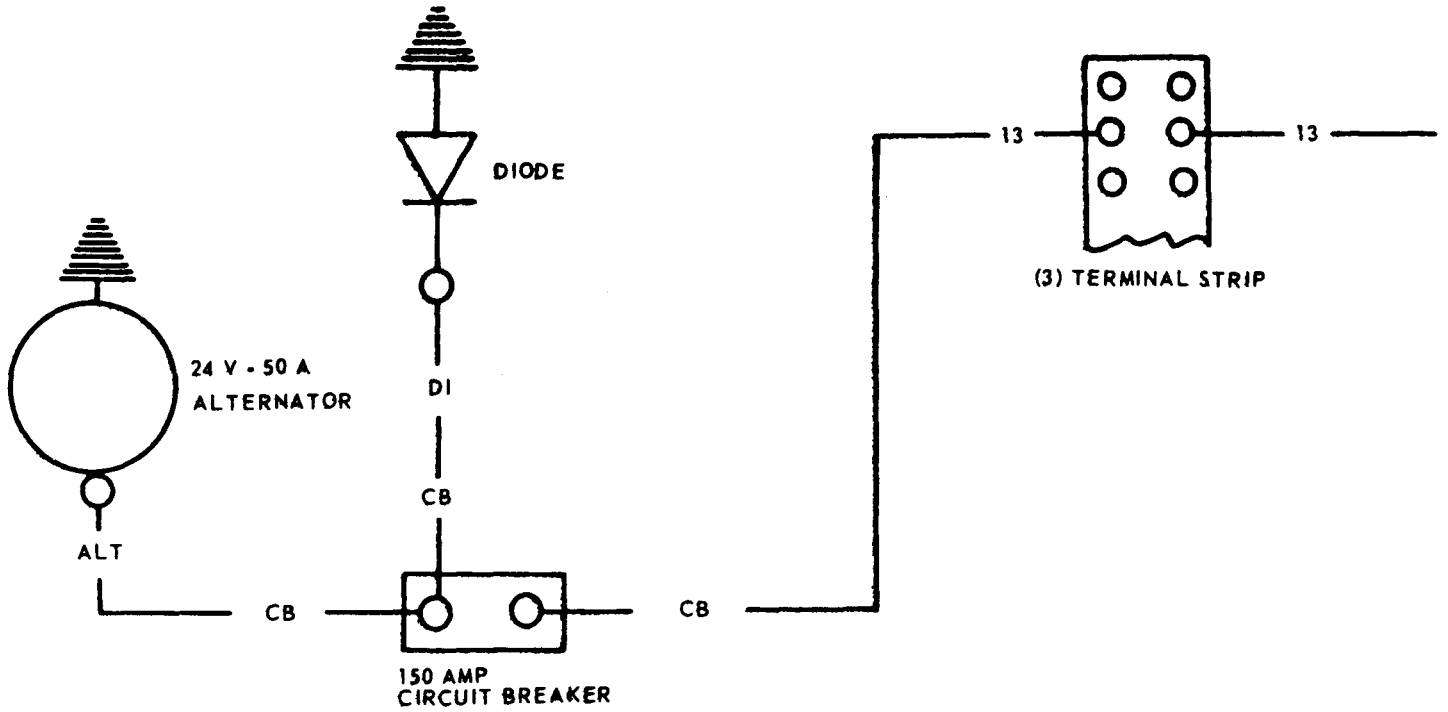


Figure 1-1.1. Alternator conversion wiring diagram for Caterpillar Model D-7E.

Page 15. Paragraph 2-1 is superseded, as follows:

2-1. Special Tools and Equipment

There are no special tools or equipment required to perform direct and general support and depot maintenance on the Caterpillar model D-7E tractor.

Paragraph 2-3 is rescinded.

Tables 2-1 and 2-2 are rescinded.

Page 67. Figure 3-96 is rescinded.

Paragraph 3-22e(2), line 4. Change "directio" to read "direction" and "cranshaft" to read "crankshaft".

Paragraph 3-22e(4) is superseded, as follows:

(4) Check distance (A, fig. 3-95) with a micrometer depth gage, and reset if necessary. Refer to table 1-1 for correct lifter setting.

Page 80, paragraph 3-26. Add subparagraphs g, *h, i,* and *j,* and paragraph 3-26.1 in alphanumerical order after paragraph *3-26f.*

g. *Regulator Inspection and Repair (Fig. 3-118.1).*

(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.

(3) Test specifications for regulator model 1118558 are as follows:

Voltage regulator:

Air gap	0.048 inch
satisfactory operating range	27.5-29.5 volts
If outside range, adjust to	28.2 volts

Current regulator:

Air gap	0.115 inch
Satisfactory operating range	38-42 amperes
If outside range, adjust to	40 amperes

Cutout relay:

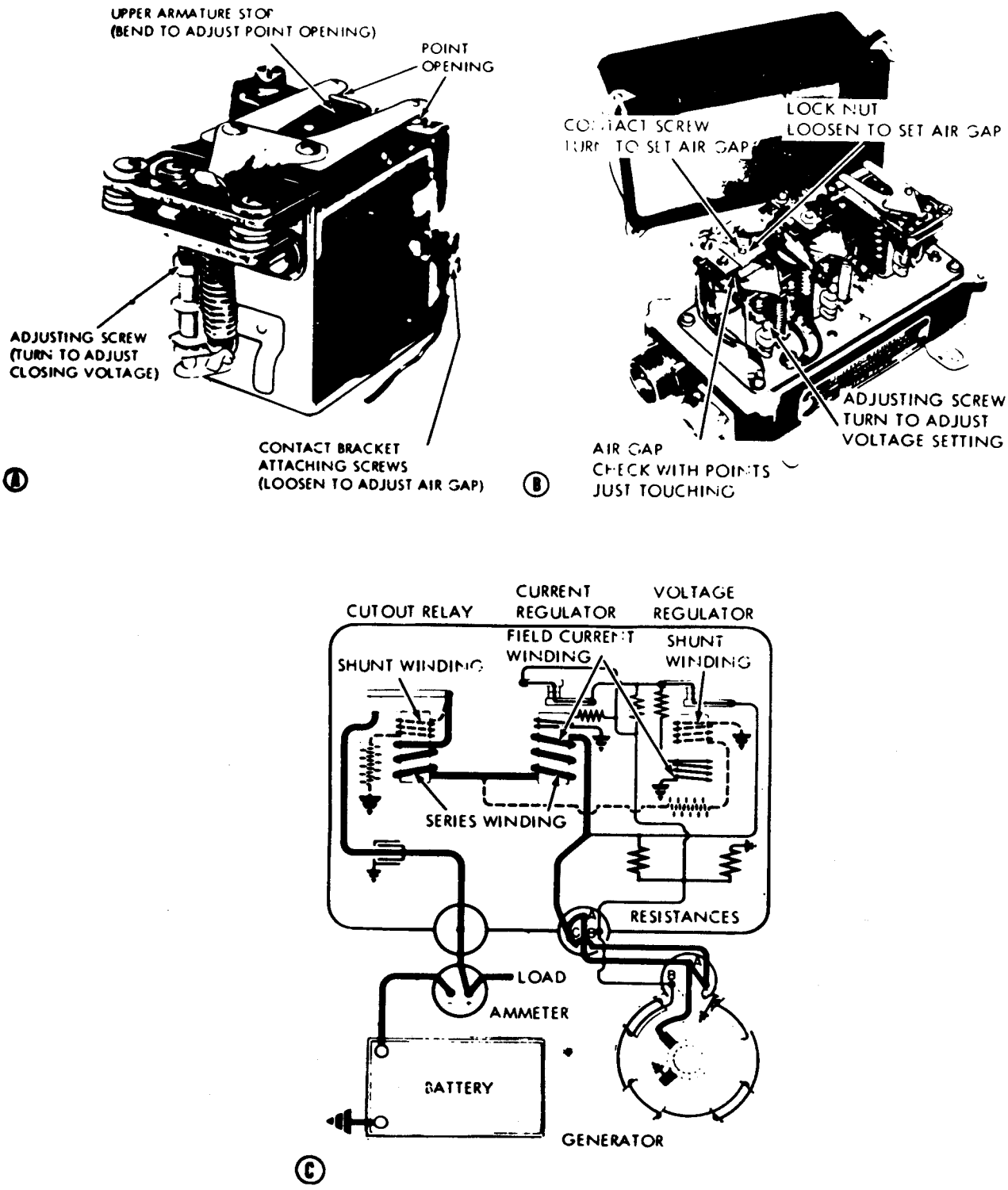
Air gap	0.048 inch
Point opening	0.035 inch
Satisfactory closing range	25-27 volts*
If outside range, adjust to	26 volts*

*These values apply only when the regulator is being tested at operating temperatures on the vehicle, and in accordance with the procedure described in the following paragraphs.

(4) Mechanical checks and adjustments (air gaps, point openings) must be made with the battery disconnected and the regulator preferably off the vehicle.

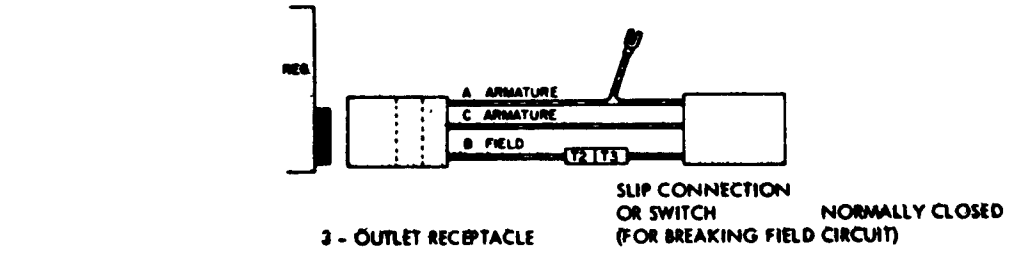
CAUTION

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 test harness no. 1 (fig. 3-118.2). Disconnect T-2 and T3; 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.

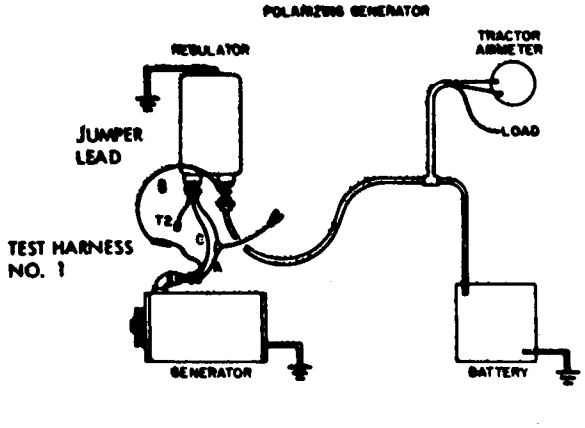


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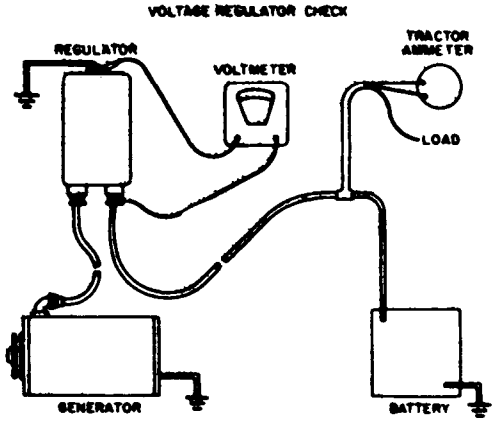
Figure 3-118.1. Generator regulator.



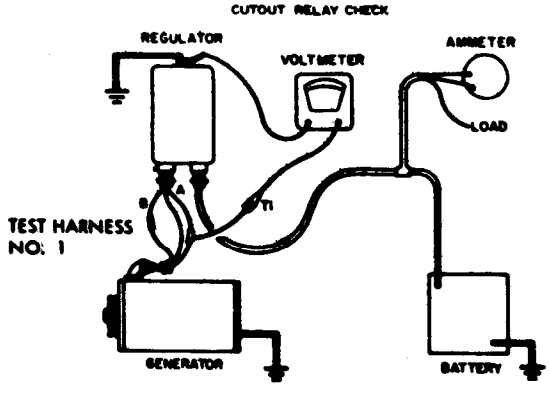
A. SUGGESTED SPECIAL TESTING HARNESS NO. 1 FOR ELECTRICAL CHECKING



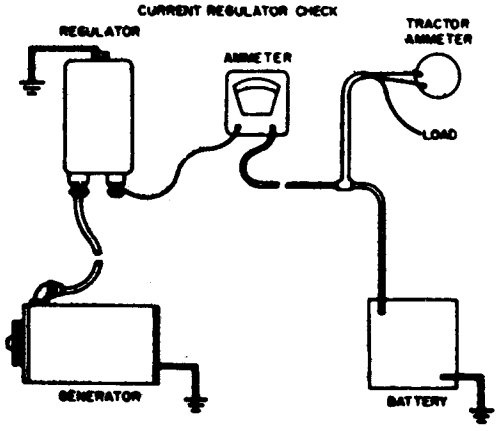
B. WIRING CONNECTIONS FOR POLARIZING GENERATOR



C. METER CONNECTIONS FOR VOLTAGE REGULATOR CHECK



D. METER CONNECTIONS FOR CHECKING CUTOUT RELAY CLOSING VOLTAGE



E. METER CONNECTIONS FOR CURRENT REGULATOR CHECK

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Figure 3-118.2. Wiring for generator regulator checks.

h. Quick Checks of Generator and Regulator. In analyzing complaints on generator-regulator operation any one of several basic conditions maybe found.

(1) A fully charged battery and a high charging rate. This condition indicates that the voltage regulator is not reducing the generator output as it should. A high charging rate to a fully-charged battery will damage the battery, and the accompanying high voltage is very damaging to all electrical units. This operating condition may result from:

(a) Improper voltage regulator setting.

(b) Defective voltage regulator unit.

(c) Short circuit between charging circuit and field circuit (in either generator, regulator, or wiring).

(d) Poor ground connection at regulator.

(e) High battery temperature which reduces the resistance to charge. The battery will then accept a high charging rate even though the voltage regulator setting is normal. If the trouble is not

caused by high temperature, determine the cause of trouble as follows Insert testing harness no. 1 (fig. 3-118.2), in generator circuit; open the field circuit at T-2 and T-3; then, operate generator at medium speed. If output remains high, the generator or wiring harness is at fault. If no output is obtained, the regulator is at fault, and it should be checked.

(2) A low battery and low-or no-charging rate. This condition could be caused by:

(a) Loose connections, frayed or damaged wires.

(b) Defective battery.

(c) High circuit resistance.

(d) Low regulator setting.

(e) Oxidized regulator contact points.

(f) Defects within the generator.

If the condition is not caused by loose connections, frayed or damaged wires, determine the cause of trouble as follows: With testing harness no. 1 inserted in generator circuit, generator operating at medium speed, and battery connected, momentarily connect T-3 to T-1 (armature) and increase generator speed. If the output does not increase, the generator is probably at fault and should be checked separately. If the generator output increases, the trouble is caused by the following

(a) A low voltage (or current) regulator setting.

(b) Oxidized regulator contact points which insert excessive resistance into the generator field circuit so that the output remains low.

(c) Generator field circuit open within the regulator at the connections or in the regulator winding.

(3) Burned resistances, windings, or contacts. Where burned resistances, windings, or contacts are found, always check the vehicle wiring before installing a new regulator. Otherwise the new regulator may fail in the same way.

(4) Burned relay contact points. The condition may be caused by reversed generator polarity.

i. Voltage Setting *for High Temperature Conditions Where* Continuous *Battery Overcharge is Experienced.*

(1) Where 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.

CAUTION

The voltage regulator setting must not be reduced unless it is actually necessary. The cutout relay likewise must be reduced so the, voltage regulator setting is still safely above the setting of the cutout relay.

(2) If such voltage reductions are made during hot weather, the voltage settings should again be increased to the standard specified settings at the beginning of cold weather. Otherwise the reduced settings, combined with low temperatures, may cause under charged batteries.

j. Regulator Checks and Adjustments (Fig. 3-118.3).

(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 bend the spring fingers on the armature until points meet simultaneously. Adjust air gap by loosening screws attaching the lower contact bracket, and raise or lower the contact bracket as required to obtain 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 no. 1 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 volts 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 next to the residual pin (not the residual pin in the core), 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 0.048-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 volts 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. Generator output can then increase to the value for which the current regulator is adjust. This will then cause the current regulator to operate. Regardless of the method used, disconnect battery cable from regulator and connect ammeter in series between 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 cm. 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. Current should be 38 amperes to 40 amperes. Adjust to 40 amperes.

NOTE

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.

4. Refer to figure 3-118.1 for proper test instrument connections.

(c) *Adjustment for high temperature.*

2. 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 reguiator setting must not be reduced unless it is actually necessary. The cutout relay likewise must be reduced so the voltage regulator setting is still safely above the setting of the cutout 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.

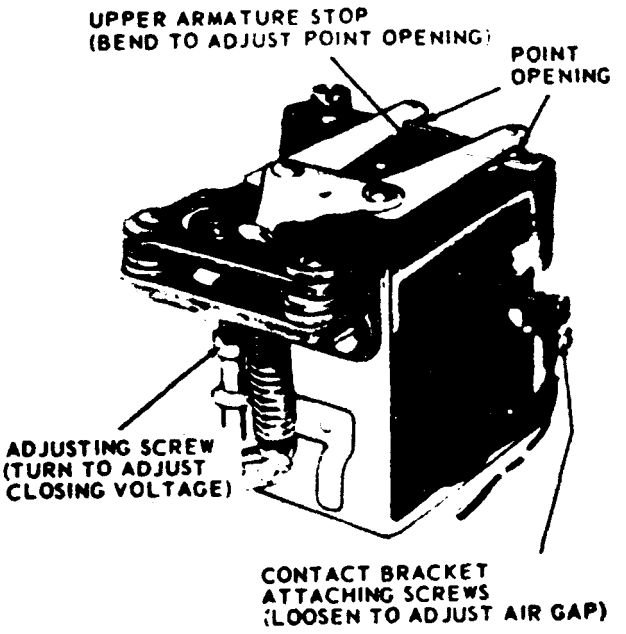


Figure 3-118.3. Generator regulator adjustments.

3-26.1. 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 5-2410-214-12 for the removal fo the alternator.

c. Disassembley (Fig. 3-118.3A)

(1) Remove the cover plate.

(2) Remove cover gasket.

(3) Separate 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.

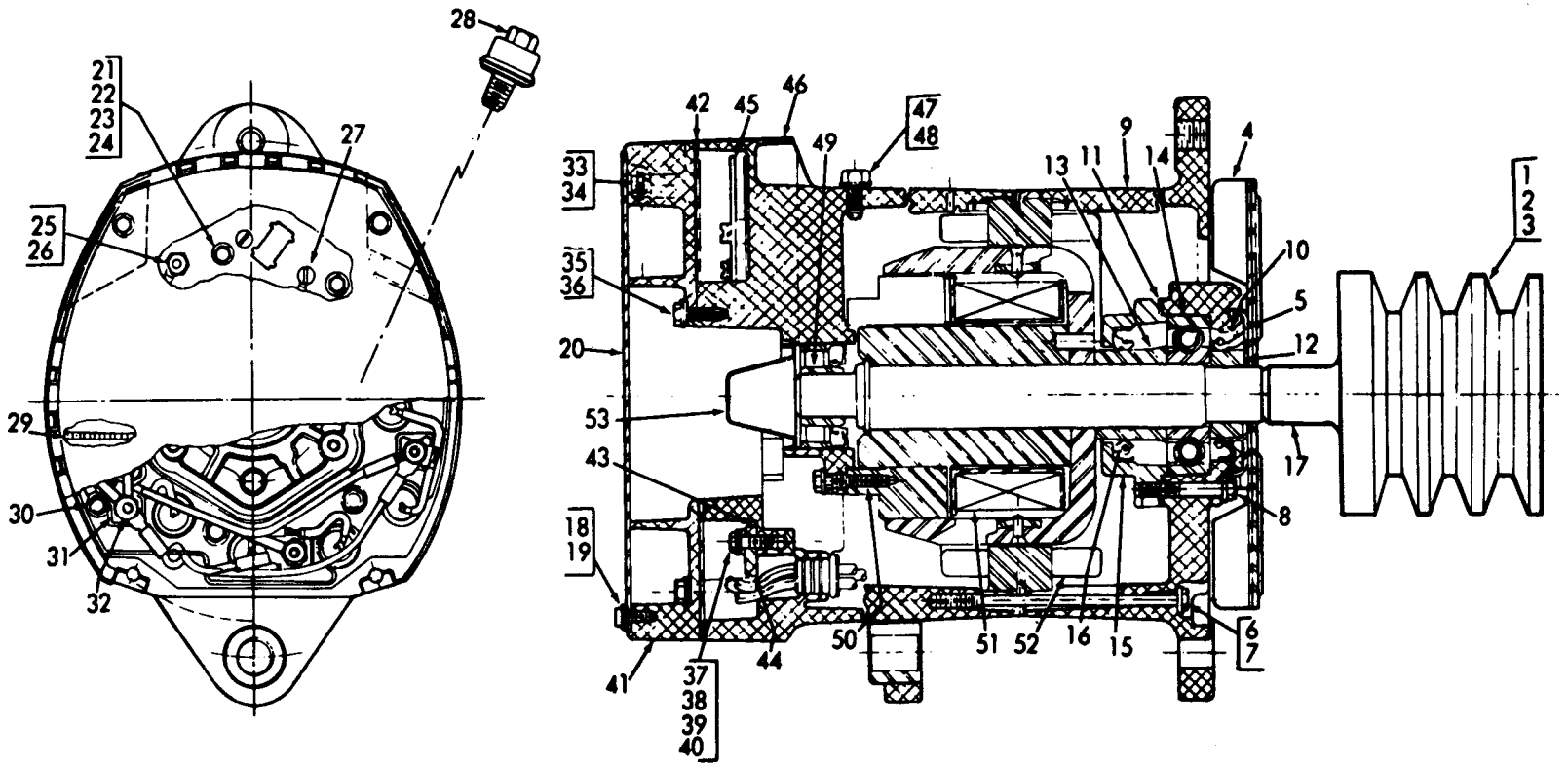
e. ***Inspection and Repair.***

(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 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 3-118.4.

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.



ME 2410-233-34P/37B

1 Nut
2 Washer
3 Pulley
4 Fan and baffle assy
5 Slinger
6 Screw (4)
7 Lockwasher (4)
8 Screw (4)
9 Frame
10 Seal
11 Gasket
12 Collar
13 Collar
14 Bearing
15 Retainer assembly
16 Seal
17 Rotor assembly
18 Capscrew (4)
19 Lockwasher (4)
20 Cover plate
21 Screw (2)
22 Lockwasher (2)
23 Washer (3)
24 Lockwasher (2)
25 Nut
26 Lockwasher
27 Screw assembly
28 Stud assembly
29 Grommet
30 Capscrew
31 Lead assembly
32 Nut (3)
33 Screw (2)
34 Lockwasher (2)
35 Capscrew (4)
36 Lockwasher (5)
37 Capscrew (4)
38 Washer (4)
39 Washer (4)
40 Insulator (4)
41 Cover
42 Gasket
43 Insulation
44 Heat sink assembly
45 Regulator assembly
46 Housing assembly
47 Screw
48 Lockwasher
49 Race
50 Screw (3)
51 Coil
52 Stator assembly
53 Bearing cover

Figure 3-118.3A. Alternator.

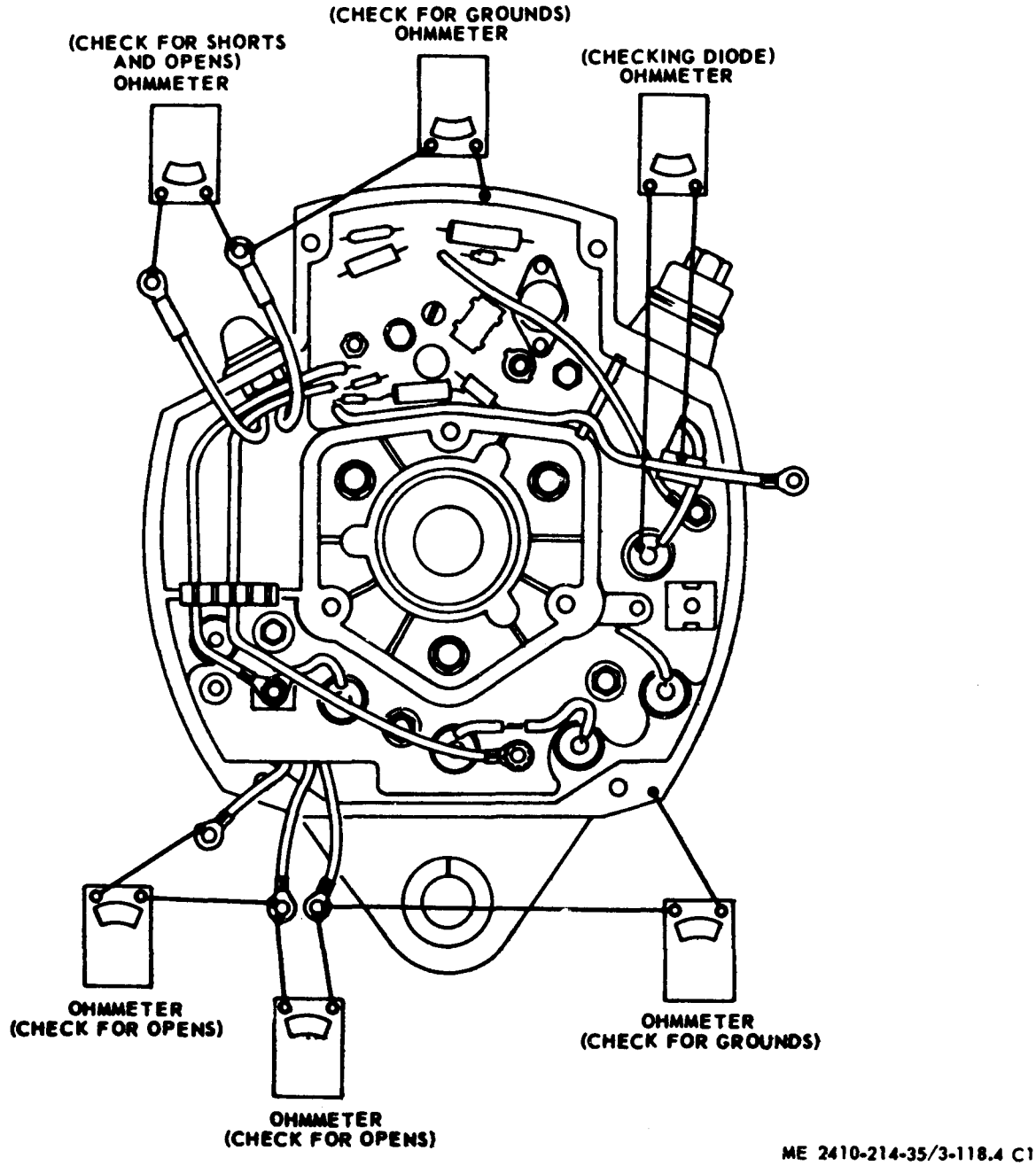


Figure 3-118.4. Electrical checks of alternator.

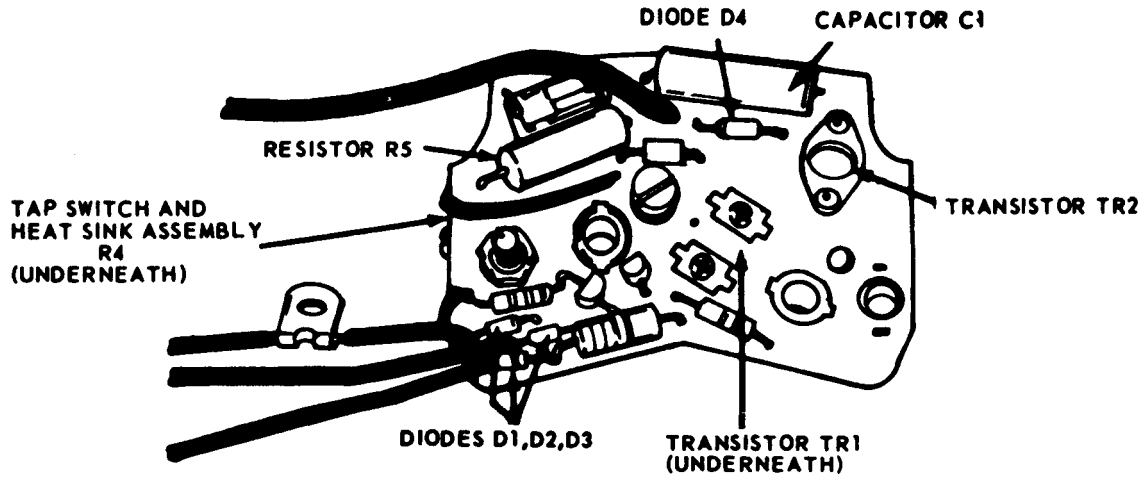
CAUTION

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

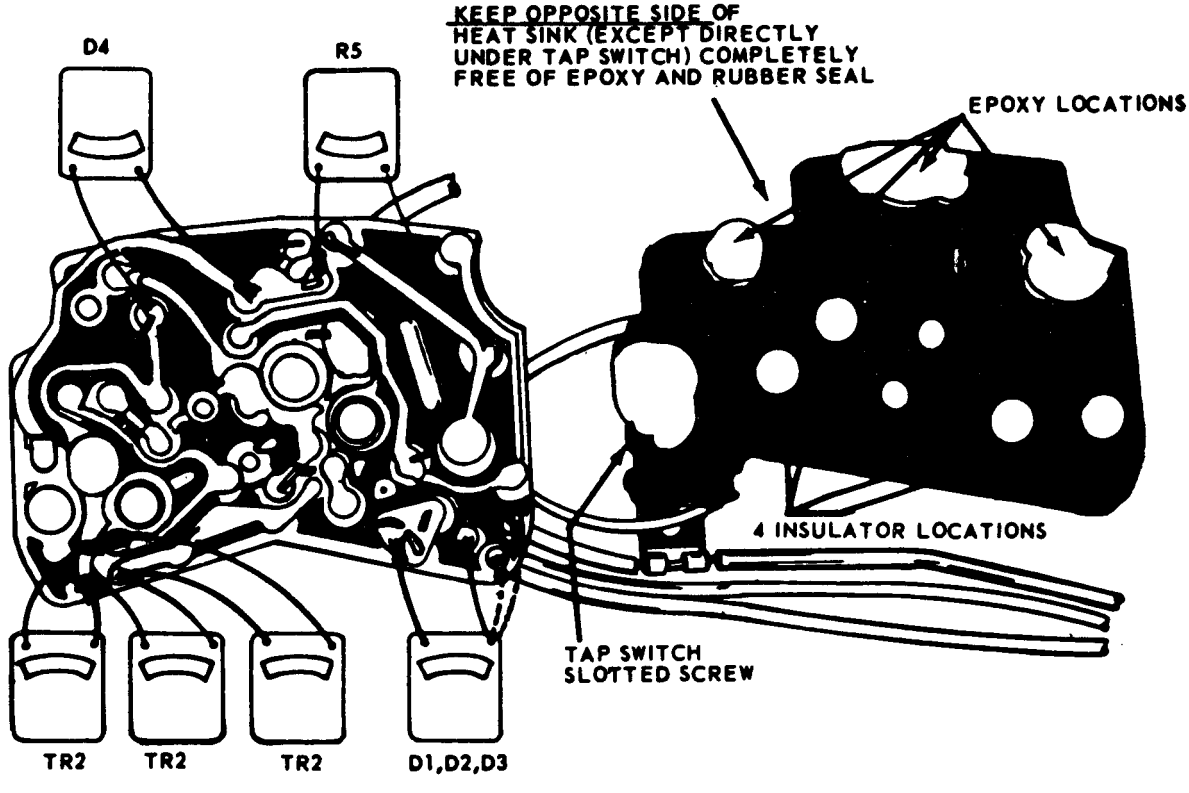
(2) Stator check.

(a) 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 3-118.4. 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.

(b) 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 reassembly.



A. PANEL BOARD ASSEMBLY



B. CHECKING COMPONENTS

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Figure 3-118.5. Checking components and transistors.

(3) Regulator replacement or repair (fig. 3-118.4). Disconnect the three identically colored regulator leads. The regulator may be replaced by removing the attaching screws and disconnecting the regulator lead from the heat sink (see figure 3-118.5). If previous checks indicate the regulator should be repaired, proceed as follows:

NOTE

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

(a) The panel is shown without the sealing compound so the seven serviceable parts can be easily identified (fig. 3-118.5).

(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. 3-118.5). Using 1 1/2-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.

(f) Use 50-watt soldering gun for soldering operations.

1. Tapswitch and heat sink assembly. Turn slotted screw with screwdriver to 5 positions. If screw is loose, replace assembly. Also replace 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 epoxied to heat sink.

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

3. Transistors. Test transistors with ohmmeter, reversing probes to obtain readings. Readings should give one low reading and one high reading. If not, replace transistor.

NOTE

The replacement transistor may be a small black unit with a red dot and a flat side. When assembled, the flat side should face towards diodes D1, D2, and D3 (See fig. 3-118.5).

4. Cupacitor Cl. 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. 3-118.5).

NOTE

Keep opposite side of heat sink (except under tap switch) perfectly clear and free of epoxy and rubber seal (fig. 3-118.5).

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 3-118.6 around components using Dow Chemical RTV Silastic 732 silicone rubber seal or equivalent. Keep metal clips perfectly clean and free of rubber seal.

(h) Test regulator to see if it works. 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 (6, fig. 3-118.3A).

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 will be only three-quarters full after assembly. 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. 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.

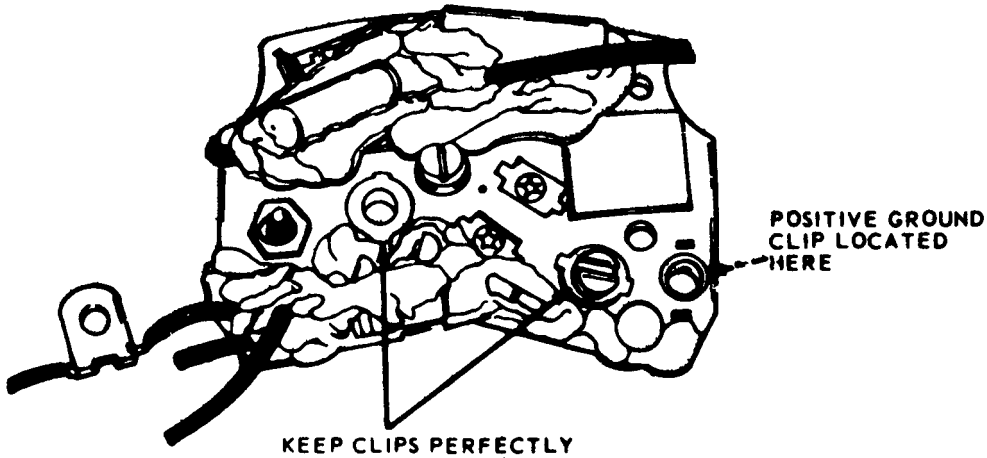
5. Lubricate collar, then install collar and retainer plate. Press against inner race only to install the new bearing onto the shaft against the collar.



A. CHECKING TRANSISTOR FOR SHORTS

A. CHECKING TRANSISTOR TR1

PROPER APPLICATION OF RUBBER SEAL SHOWN



B. RUBBER SEAL APPLIED

ME 2410-214-35/3-118.6 C1

Figure 3-118.6. Transistor checking.

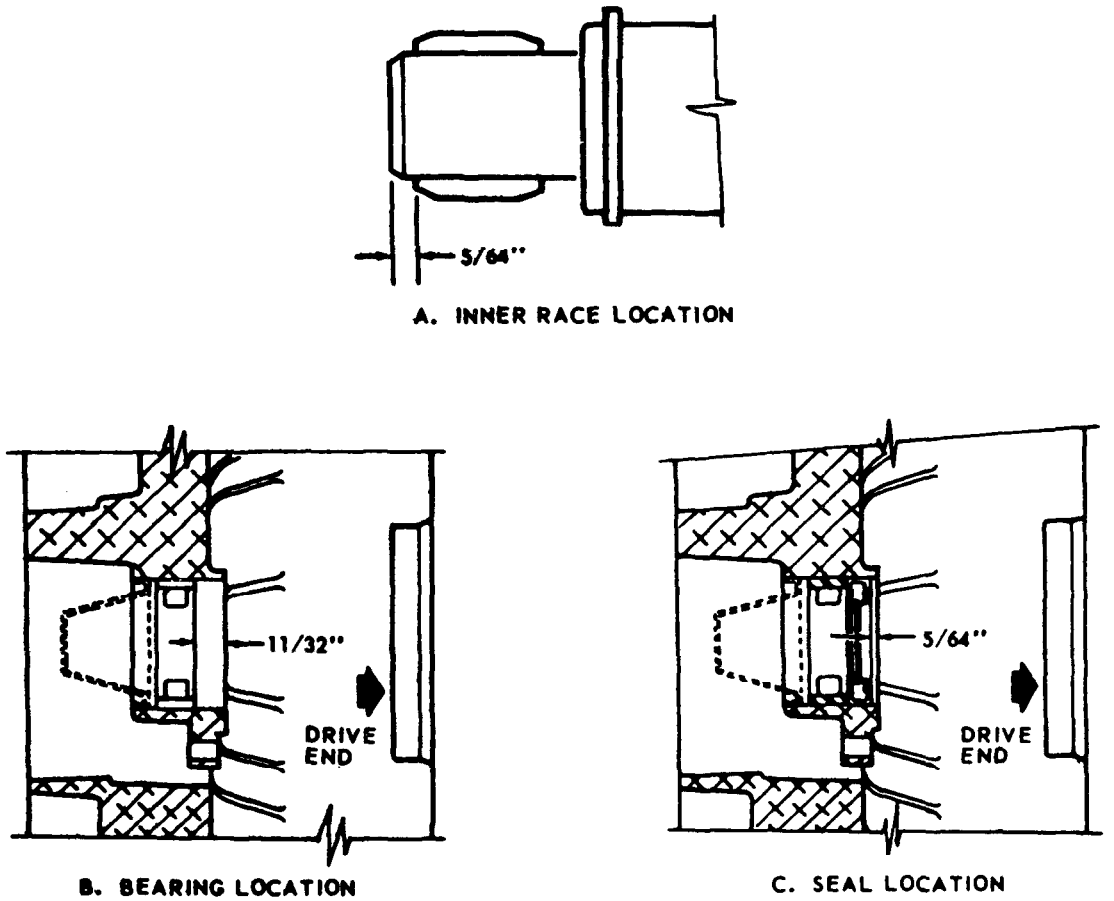


Figure 3-118.7. Inner race, bearing and seal locations.

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 on the shaft to the dimension shown in figure 3-118.7.

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 3-118.7. To facilitate the installation heat the end frame in an oven to 200F to 300F. This will not damage the regulator.

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

5. Add lubricant to seal lip and till 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 3-118.7.

f. Reassembly. Reassembly procedures are the reverse of disassemble y. Torque the shaft nut to 70-80 lb.-ft. (fig. 3-118.8). Torque the output terminal bolt to 10-11 lb.-ft. when attaching cable (see table 1-4).

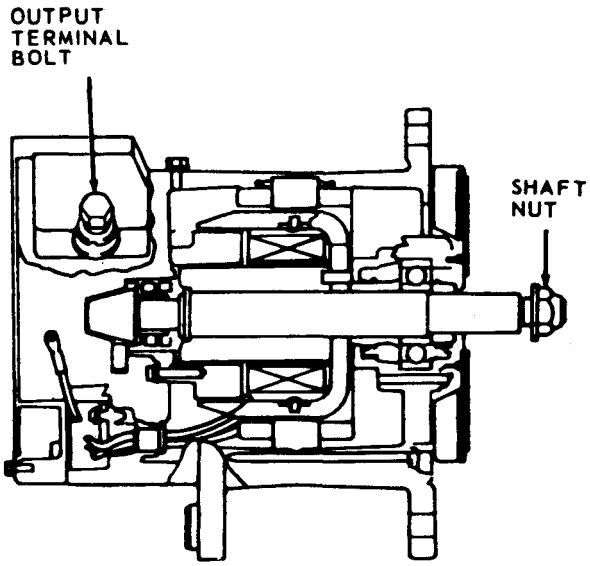


Figure 3-118.8. Alternator reassembly, showing shaft nut and output terminal bolt.

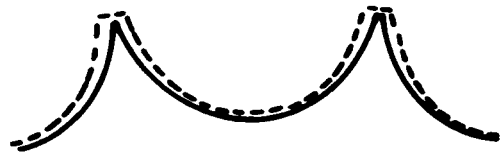
Page 105, **Caution. Change last sentence of paragraph to read "Any foreign material left in the torque converter fluid system will be circulated through the transmission lubrication valves and into the transmission lubricant circuit."**

Page **107, column 2. Delete 3 lines beginning with "system" and ending with "circuit."**

Page 172, **paragraph 3-59b. The following sentence is added at the end of subparagraph (l). "Replace sprocket segment rim tips if they are sharpened to a point (fig. 3-298.1)."**

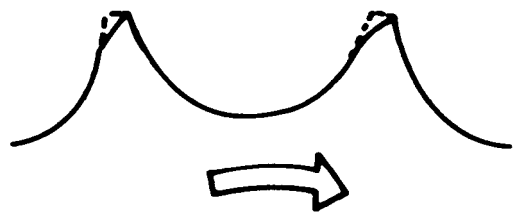
Figure 3-298.1 is added after paragraph 3-59.

Replace the rim when the tips have been sharpened to a point like this,



It is worn to the point where bushings may jump teeth in the sprocket before reaching their service limit and greatly increase external wear on the bushings. At this point, sprocket pitch has probably been reduced too much to match properly with pin and bushing pitch.

Tip wear of this type does not require sprocket rerimming.



This wear is caused by dirt packing in the sprocket teeth or around the bushings, temporariIy increasing sprocket pitch. NormalIy, this condition occurs only when sprockets, pins, and bushings are new. The problem is relieved after some internal wear has taken place. Because sprocket pitch has changed very little, If at all, there is no need to replace the sprocket rim.

ME 2410-214-35/3-298.1 C1

Figure 3-298.1. Sprocket segment rim tip wear.

Page 179, figure 3-317. Change figure legend to read "Adjusting sprocket hub bearings." and change item 1 "Retaining nut" to read "Adjusting nut".

Page *180,* paragraph 3-64. Change paragraph head to read "Sprocket Hub Bearing Adjustments"

Paragraph 3-6a, line 4. Change "sprocket support bearings" to read 'sprocket hub bearings".

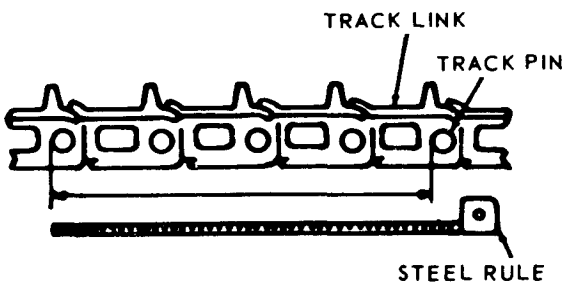
Paragraphs 3-64b and c. Change "Retaining nut" to read "adjusting nut".

Paragraph 3-67. The following note is added before subparagraph *a*.

NOTE

Before removal of track assembly, measure pin and bushing wear (fig. 3-318.1).

Figure 3-318.1 is added after note.



Measure from the side of any pin across four links to the same side of the fourth pin. Divide the measurement by 4 to determine present pitch length.

The sections measured should not be within two sections of the master pin and should be on the top half of the track rather than on the ground. Before measuring, take up the slack in the top half of the track by placing an old track pin in a sprocket tooth and backing up the tractor.

The measurement should be repeated, including the master track section, to determine whether the master pin and bushing should be replaced. In cases where rooster pins and bushings wear much faster than the other pins and bushings, they should be replaced once between pin-and-bushing turning or pin-and-bushing replacement.

Track pins and bushing measurement-new 34.04 inches.
Turn pins and bushings when measurement is 34.52 inches.
Replace pins and bushings when measurement is 34.64 inches.

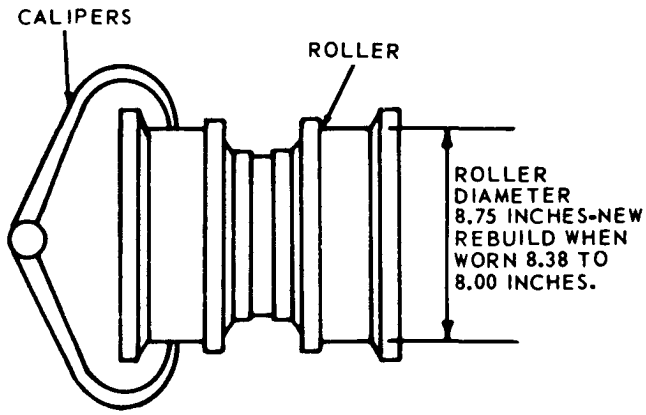
ME 2410 -214.35/3-318.1 Cl

Figure 3-318.1. Measuring pin and bushing wear.

Page 185. Paragraph 3-68b(8) is added.

(8) Measure roller wear (fig. 3-330.1). Repair roller when control surface of roller is worn to 8.38-to 8.00-inches in diameter. The roller will be repaired by welding an overlay on the wear surface. Replace rollers worn to a diameter of 8.00 inches or less, or rollers uneconomical to repair.

Figure 3-330.1 is added after paragraph 3-68*b*(8).



Use calipers to measure roller tread. The diameter thus obtained, when subtracted from the roller diameter when new, will indicate wear along the tread surface.

ME 2410-214-35/3-330.1 C1

Figure 3-330.1. Measuring roller wear.

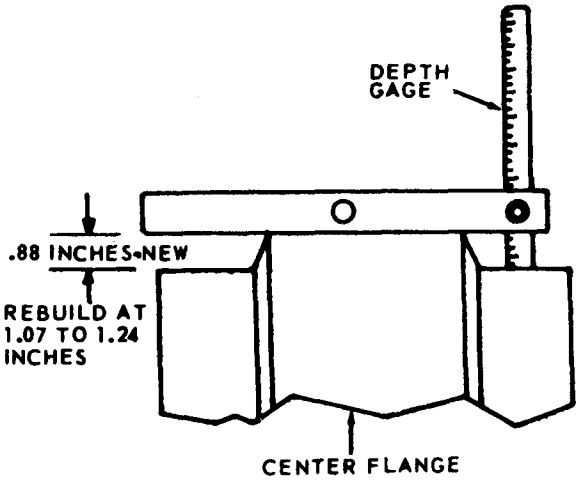
Page 186. Paragraph 3-69b(13) is added.

(13) Measure roller wear as instructed in paragraph 3-68b(8). Repair or replace as necessary.

Page 188. Paragraph 3-70b(6) is added.

(6) Measure idler tread wear (fig. 3-337.1). Idler center flange height new is 0.88 inch. When contact area is worn to 1.07- to 1.24-inches, repair by welding an overlay on wear surface.

Figure 3-337.1 is added after paragraph 3-70b(6).



Idler wear can be redetermined by comparing the measured height of the center flange with the new height shown on the wear chart.

CAUTION: If the center flange is worn you will not get an accurate measurement.

ME 2410-214-35/3-337.1 C1

Figure 3-337.1. Measuring idler tread wear.

Page 222, paragraph 3-87. In paragraph heading, (Serial Nos. 75E1301 UP) is rescinded.

Page 223, figure 3-403. In figure legend (Serial number 75 E1301 UP) is rescinded.

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.

TECHNICAL MANUAL
No. 5-2410-214-35

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *7 February 1969*

DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE MANUAL

TRACTOR, FULL TRACKED, LOW SPEED: DIESEL ENGINE DRIVEN; MEDIUM DRAWBAR PULL; OSCILLATING TRACK; 78-INCH GAGE (CATERPILLAR MODEL D-7) FSN 2410-782-1130

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*This manual supersedes TM 5-2410-214-35, 24 June 1966, including all Changes

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

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

1-2. Forms and Records

a. DA forms and procedures used for equipment maintenance will be only those prescribed by TM 38-750, Army Equipment Record Procedures.

b. The 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 DA Publications) and forwarded direct to the Commanding General, U.S. Army Mobility Equipment Command ATTN: AMSME-MPP, 4300 Goodfellow Boulevard, St. Louis, Mo. 63120.

Section II. DESCRIPTION AND DATA

1–3. Description

A general description of the Model D–7 tractor and information pertaining to the identification plates are contained in TM 5–2410–214–12. A more detailed description of specific components and assemblies is contained in the applicable sections of this manual. Detailed descriptions of the components of the Model D–7 tractor are provided in the applicable maintenance paragraphs of this manual.

1–4. Tabulated Data

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

b. Nut and Bolt Torque Data.

Cylinder head:
- 5/8-inch nuts (first time) ..... 60 lb-ft
- 7/8-inch nuts (first time) ..... 150 lb-ft
- 5/8-inch nuts (second time) ..... 120 lb-ft
- 7/8-inch nuts (second time) ..... 300 lb-ft

Accessory drive retainer nut torque ..... 150 lb-ft

Camshaft gear retainer bolt torque ..... 140—165 lb-ft

Connecting rod bolt nuts torque ..... 190 lb-ft

Main Bearing stud nut torque:
- 5/8-inch stud nuts ..... 95 lb-ft
- 7/8-inch stud nuts ..... 350 lb-ft

Crankshaft pulley retaining screw torque ..... 300—325 lb-ft

Flywheel retaining bolt torque ..... 210—250 lb-ft

Flywheel housing bolt and nut torque ..... 210—250 lb-ft

Fuel injection line nut torque ..... 25—35 lb-ft

Fuel injection nozzle retaining nut torque ..... 105 lb-ft

Fuel injection precombustion chamber torque ..... 200 lb-ft

Fuel transfer pump drive gear retaining nut torque ..... 10 lb-ft

Balancer gear retaining nut torque ..... 150—170 lb-ft

Balancer bracket assembly bolt torque ..... 130—170 lb-ft

Balancer front support bracket bolt torque:
- 3/8-inch ..... 42—50 lb-ft
- 1/2-inch ..... 115—125 lb-ft

Timing gear housing bolt torque ..... 80 lb-ft

Turbocharger:
- Torque on impeller housing band clamp ..... 110—130 lb-ft
- Torque on turbine housing bolts ..... 160—190 lb-ft
- Torque on thrust plate assembly retaining bolts ..... 30—40 lb-in.
- Torque on impeller nut (para 3–25) Initial (hot) ..... 120 lb-ft
- Final (room temperature or 150° max) push additional turn of ..... 120°

- Turbocharger-to-manifold bolt torque using anti-seize compound — 36—44 lb-ft
- Water pump impeller retaining nut torque — 70 lb-ft
- Torque divider
  - Scavenge pump:
    - Drive gear-to-shaft retaining nut torque — 36—44 lb-ft
- Transmission hydraulic controls:
  - Control valve-to-transmission retaining bolt, torque — 32—38 lb-ft
  - Safety valve-to-directional valve, torque (installed using liquid lock) — 35—45 lb-ft
  - Pressure control valve cover-to-body retaining bolts, torque — 32—38 lb-ft
- Transmission:
  - Clutch housing retaining bolts — 80—90 lb-ft
  - Transmission case to transfer gear case retaining nut — 70—80 lb-ft
  - Bearing cage to No. 1 carrier retaining bolt — 37—43 lb-ft
  - Bearing cage to No. 2 carrier retaining bolts — 37—43 lb-ft
- Bevel gear:
  - Bevel gear-to-shaft retaining bolt nut, torque — 118—142 lb-ft
- Ripper:
  - Mounting bracket stud nut — 1500 lb-ft
  - Hydraulic cylinder piston rod nut — 1600±120 lb-ft
- Steering clutch:
  - Steering clutch hub-to-steering clutch inner drum bolt, torque — 180—220 lb-ft
  - Steering clutch outer drum-to-pinion flange bolt, torque — 180—220 lb-ft
  - Clutch plate bolt — 600—700 lb-ft
  - Final drive:
    - Track roller frame outer bearing retaining nut torque — 500—600 lb-ft
    - Final drive case-to-steering clutch and bevel gear case bolt, torque — 200—220 lb-ft
    - Final drive flange-drum screw — 180—220 lb-ft
- Track rollers and track carrier rollers
  - Lubrication plug, torque — 110—140 lb-ft
- Front idlers and recoil springs:
  - Taper lockpins bolt torque:
    - Initial to seat parts — 65 lb-ft
    - Hammer lock pins into place, then tighten to torque value of — 65—85 lb-ft
- Lubrication plug torque — 110—140 lb-ft
- Fill valve torque — 20—30 lb-ft
- Ball check valve torque — 20—30 lb-ft
- Relief valve torque — 20—30 lb-ft
- Track:
  - Track shoe bolt torque — 180—260 lb-ft plus additional ⅓ turn
  - Minimum torque after ⅓ turn — 420 lb-ft

c. Repair and Replacement Standards. Tables 1-1, 1-2, and 1-3 list manufacturer's dimensions, tolerances, clearances, and the maximum allowable wear and clearance.

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

Table 1–1. 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 gear and camshaft gear	------	------	0.002	0.008	
Accessory drive shaft journal diameters (front and rear)	1.4335	1.4345			
Accessory drive shaft bearing clearance	------	------	0.0015	0.0035	0.007
Accessory drive shaft end clearance	------	------	0.006	0.008	0.015
CAMSHAFT:					
Bearing journal diameter	2.619	2.620			
Bearing clearance	------	------	0.003	0.006	0.010
End clearance	------	------	0.010	0.020	0.035
Gear backlash (camshaft to crankshaft)	------	------	0.003	0.017	
COMPRESSION RELEASE					
Distance between rocker arm and lifter rod	------	------	0.025	0.030	
CONNECTING ROD					
Connecting rod bearing clearance (measured vertically)	------	------	0.0042	0.0071	0.012
Center to center distance	14.999	15.001			
Piston pin bearing should be machined to ID of	2.3910	2.3915			

Table 1-1. 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	
CRANKSHAFT					
Main journal diameter	3.749	3.750			
Main bearing clearance	-------	------	0.0039	.0070	0.010
End clearance	-------	------	0.016	0.020	0.035
Connecting rod journal diameter	3.624	3.3625			
Permissible journal wear	-------	------	-----	-----	0.006
Permissible out-of-roundness (journal)	-------	------	-----	----	0.005
CYLINDER BLOCK					
Main bearing original bore dimension	4.1138	4.1148			
CYLINDER LINER					
Inside diameter	5.750	5.751			
Permissible liner wear (increase in diameter at top of ring travel).	------	----	-----	-----	0.080
Liner flanger thickness	0.489	0.500			
Counterbore dimension in block	0.492	0.494			
FUEL INJECTION EQUIPMENT					
Fuel injection pump timing (before top center)	13°				
Fuel injection pump lifter setting (one engine with piston at top center)	1.8140 ± .004.				
Fuel injection pump lifter setting (off engine)	1.8815 ± .001.				
Fuel pump plunger length	2.7571	2.7577			
Permissible wear (decrease in length of plunger)	-------	------	-----	-----	0.005
Injection nozzle orifice (Use 5B2178 drill for cleaning).	0.0249	0.0249			
Fuel injection camshaft bearing bore	1.4330	1.4340			
Camshaft bearing clearance	-------	------	-----	-----	0.010
FUEL TRANSFER PUMP					
Clearance between gears and covers, total	-------	------	0.0010	0.0020	
Bearing bore	0.4950	0.4955			
Bearing clearance	-------	------	0.001	0.002	0.005
GEAR-TYPE BALANCER					
Balancer drive shaft:					
Front bearing ID	1.230	1.231	-----	-----	0.008
Rear bearing ID	0.8125	0.8135	-----	-----	0.008
Shaft diameter—front	1.227	1.228			
Shaft diameter—rear	0.8105	0.8115			
Balancer weight bearing diameter	1.5005	1.5015	0.0020	0.0035	0.007
Balancer drive shaft end clearance	-------	------	0.006	0.013	
Idler gear shaft diameter	1.4975	1.4980			
Idler gear bearing clearance	-------	------	0.0020	0.0035	
GOVERNOR					
Blacklash 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 text 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	0.7405	0.7410			
Bearing bore	0.743	0.744	0.0020	0.0035	0.006
PISTON PINS					
Clearance in piston pin bearing	-------	------	0.001	0.002	0.006
Clearance in piston	-------	------	0.0004	0.0010	0.006
PISTON RINGS					
Piston ring side clearance:					
Top ring	-------	------	0.0050	0.006	0.012

Table 1-1. 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	
2d ring			0.0030	0.0045	
Oil ring			0.0015	0.0030	
Ring gap, top			0.023	0.028	
Ring gap, 2d			0.021	0.031	
Ring gap, oil			0.015	0.025	
REAR POWER TAKEOFF DRIVE SHAFT					
Blacklash					
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 ARM BEARINGS					
Clearance between shaft and bearings			0.0020	0.0035	0.010
ROCKER ARM SHAFT SUPPORT BRACKET					
Bracket bore	2.249	2.250			
Sleeve diameter	2.244	2.246			0.010
SERVICE METER					
Permissible bearing clearance					0.012
Turbocharger (AiResearch T12):					
Shaft end clearance			0.006	0.011	0.013
Permissible bearing clearance (satisfactory if impeller wheel and/or turbine wheel have not rubbed housing or housings.					
Bearing diameter (ID)	.6268	.6272			
Bearing diameter (OD)	.9780	.9785			
Journal diameter	.6250	.6254			
Housing bore diameter	.9827	.9832			
Depth from face-of-plate to thrust bearing			.3975	.4005	.401
Thrust collar thickness	.299	.300			
Minimum thrust collar thickness					.298
Thrust bearing thickness	.090	.092			
Oil seal ring gap			.003	.008	
VALVE AND VALVE SEAT SPECIFICATIONS					
Valve seat angle	45°	45°			
Valve guide length	5.252	5.252			
Valve seat insert diameter	2.5025	2.5035			
Bore for valve seat insert	2.4995	2.5005			
Valve head diameter—					
Inlet	2.338	2.348			
Exhaust	2.277	2.287			
Outside diameter of valve seat face (new)—inlet	2.296	2.296			
Exhaust	2.244	2.244			
Outside diameter of valve seat face (after reconditioning).					
Inlet		2.318			
Exhaust		2.257			
Stem diameter	.4950	.4960			
Valve guide bore—inlet	.499	.501			
Exhaust	.500	.502			
Valve lip thickness—inlet	.141				
Exhaust	.094				
Measurement from top of valve to face of head with valve seated—inlet.	.134	.185			
Exhaust	.076	.130			
Depth of bore for valve seat inserts	.508	.510			
Valve seat width—Inlet		.145			
Exhaust		.185			
Valve face angle	44 1/4°	44 1/4°			

Table 1–1. 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	
VALVES					
Valve stem clearance in guide					0.009
Exhaust valve clearance (hot)			0.020	0.020	
Inlet valve clearance (hot)			0.016	0.016	
VALVE LIFTERS					
Lifter diameter	0.996	0.997			
Bearing bore	0.999	1.000			0.008
VALVE SPRING					
Outer:					
Pounds force	62–68				
When compressed to	2 7/32 in.				
Inner:					
Pounds force	19–21				
When compressed to	1 51/64 in.				
VALVE TIMING					
With valve clearances set correctly hot, dial indicator mounted above valve stem, reading taken with valve .075 in. off its seat.					
Exhaust opening (BBC)	33°2'				
Exhaust closing (ATC)	1°28'				
Inlet opening (ATC)	3°58'				
Inlet closing (ABC)	14°28'				
WATER PUMP IDLER GEAR					
Backlash					
Water pump idler gear to water pump drive gear			0.004	0.016	
Waterpump idler gear to camshaft gear			0.003	0.019	
Shaft diameter	1.4320	1.4325			
	1.4940	1.4945			
Bearing clearance			0.0045	0.0060	0.008
WATER TEMPERATURE REGULATOR					
Opening temperature 177°–182°F.					
Fully open temperature 205°F.					

[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 1–2. 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

Table 1-2. 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	
Torque converter inlet relief valve:						
Mounting location	Upper front face of transmission case					
Set to bypass	4–6 gpm					
At pressure of	110–120 psi					
Inlet relief valve spring:						
Pounds force	19.1–22.5					
When compressed to	1.77 in.					
Free length after test	2.42 in.					
Spring diameter	.75 in.					
Torque converter outlet relief valve:						
Mounting location	Lower 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	.88 in.					
Scavenge and circulating pump:						
Type	Gear					
Capacity (scavenge)	18.0 gpm					
(Circulating)	21.3 gpm					
Based on speed of	2,480 rpm					
Pressure (circulating)	40 psi					
Transmission hydraulic controls:						
Safety valve spring ((3), fig. 3–195)						
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. 3–194)						
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. 3–194)						
Pounds force	22.5–26.9					
When compressed to	4.51 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.					
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:						

Table 1-2. 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	
No. 1 clutch, No. 3 clutch, and No. 4 clutch:						
Overall width of 3 new disc assemblies and 2 new plates	1.142–1.202 in.					
No. 2 clutch:						
Overall width of 4 new disc assemblies and 3 new plates	1.605–1.692 in.					
No. 5 clutch:						
Overall width of 2 new disc assemblies and 1 new plate	.679–.712 in.					
Clutch piston release springs Nos. 1 and 2 clutches:						
Pounds force	28.60–33.60 in.					
When compressed to	4.094 in.					
Free length after test	5.094 in.					
Spring diameter	.563 in.					
Clutch release springs Nos. 3, 4, and 5 clutches:						
Pounds force	26.45–31.05					
When compressed to	1.884 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	.013 in.					
Or, torque to rotate	6–7 lb-ft					
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			

Table 1–2. 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	
Minimum overall width of 10 disc assemblies and 9 discs (worn)	2.744 in.					
Pressure relief valve set to bypass at	350–400 psi					
Steering clutch control valve minimum pressure with clutch disengaged, engine at low idle speed	265–300 psi					
Steering clutch and transmission hydraulic pump						
Permissible clearance between pump shafts and bearings						.006
Capacity at 1,760 rpm (pump speed at 1,200 rpm engine speed)	22.5 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				.860	.900	
Distance between front face of seat armrest support and center line of parking brake lever				.820	.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 pinion press fit, tons	35–40					
Dimension between face of flange and the shoulder of the pinion shaft when pressed on to 35–40 tons	.094–.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	.440–.560 in.					
Sprocket shaft-to-case press fit, tons	55–60					
Sprocket shaft must be straight within	.12 in.					

Table 1–3. 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	.125 in.					
Clearance between yoke and wear plate				0.030	0.060	
Track rollers						
Shaft clearance				0.008	0.012	0.050
End clearance				0.011	0.029	0.050
Permissible bend in shaft	.005 in.					
Track carrier rollers						
Adjustment:						
Tighten nut until resistance is felt, then back off to nearest locking pasition.						
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)	.120 in. per link					
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	.062 in.					

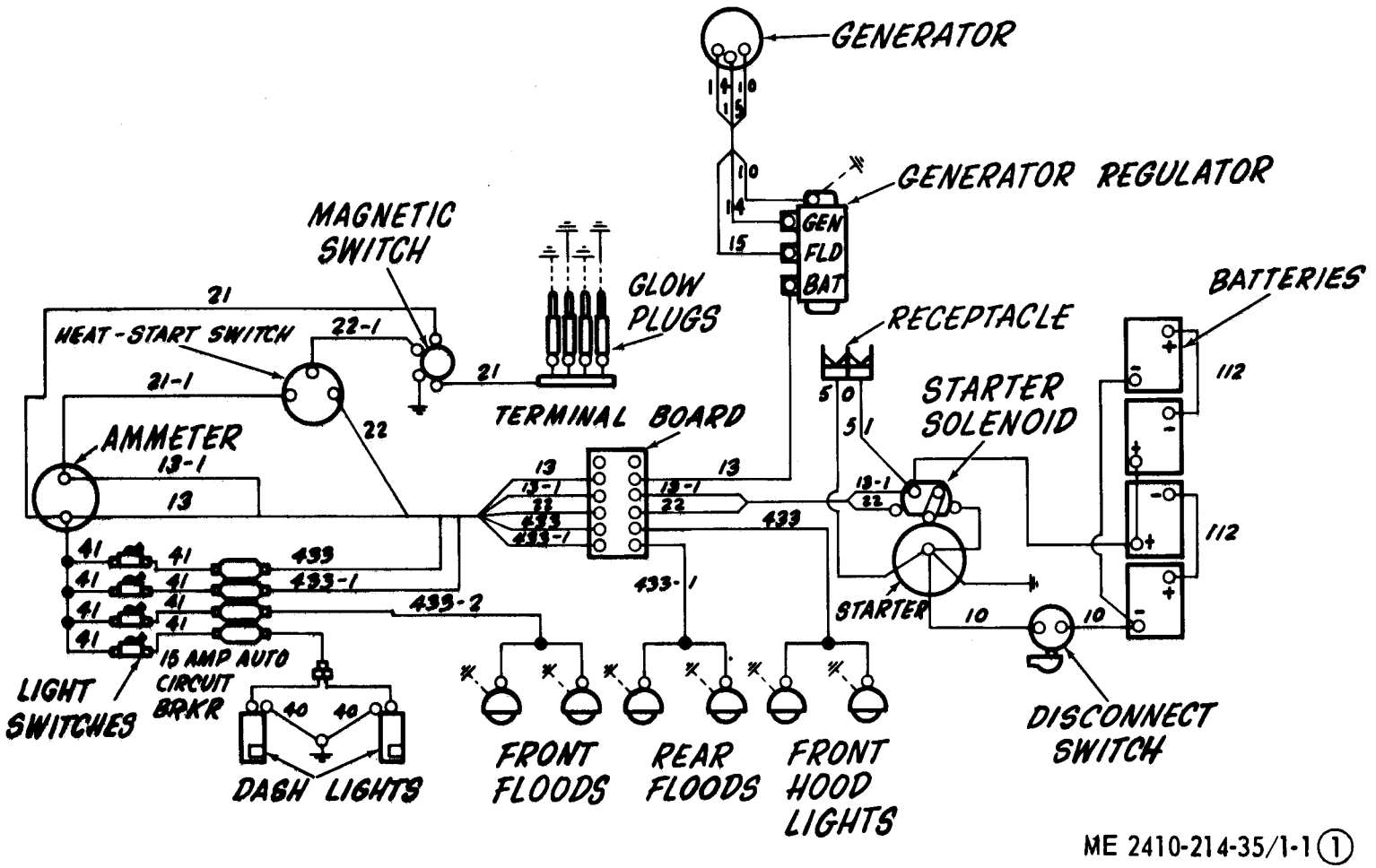


Figure 1–1(1). Tractor wiring diagram (Serial nos. 75E1 through 75E329, 75E560 through 75E1185).

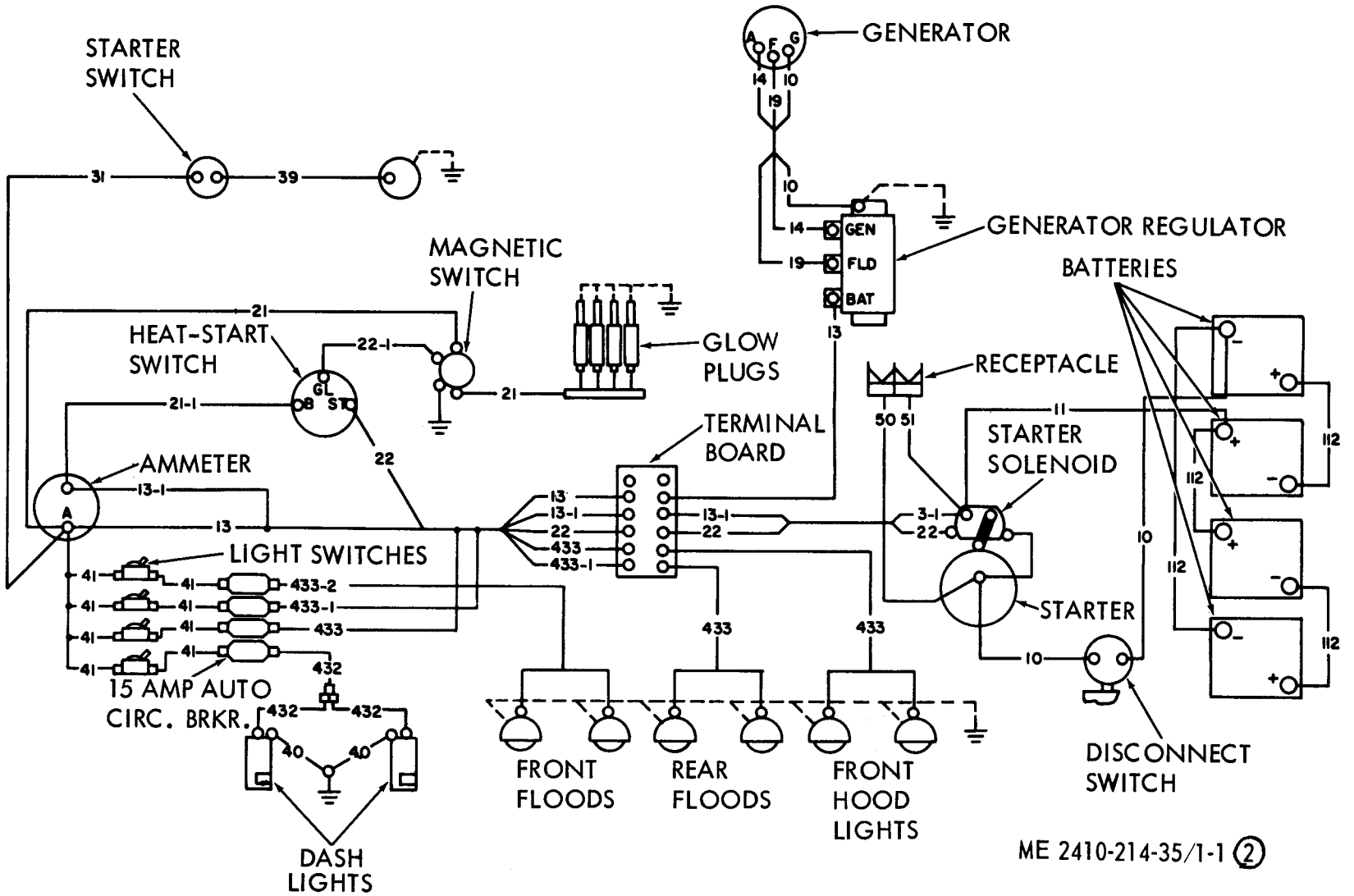


Figure 1-1(2). Tractor wiring diagram (Serial nos. 75E1301-UP).

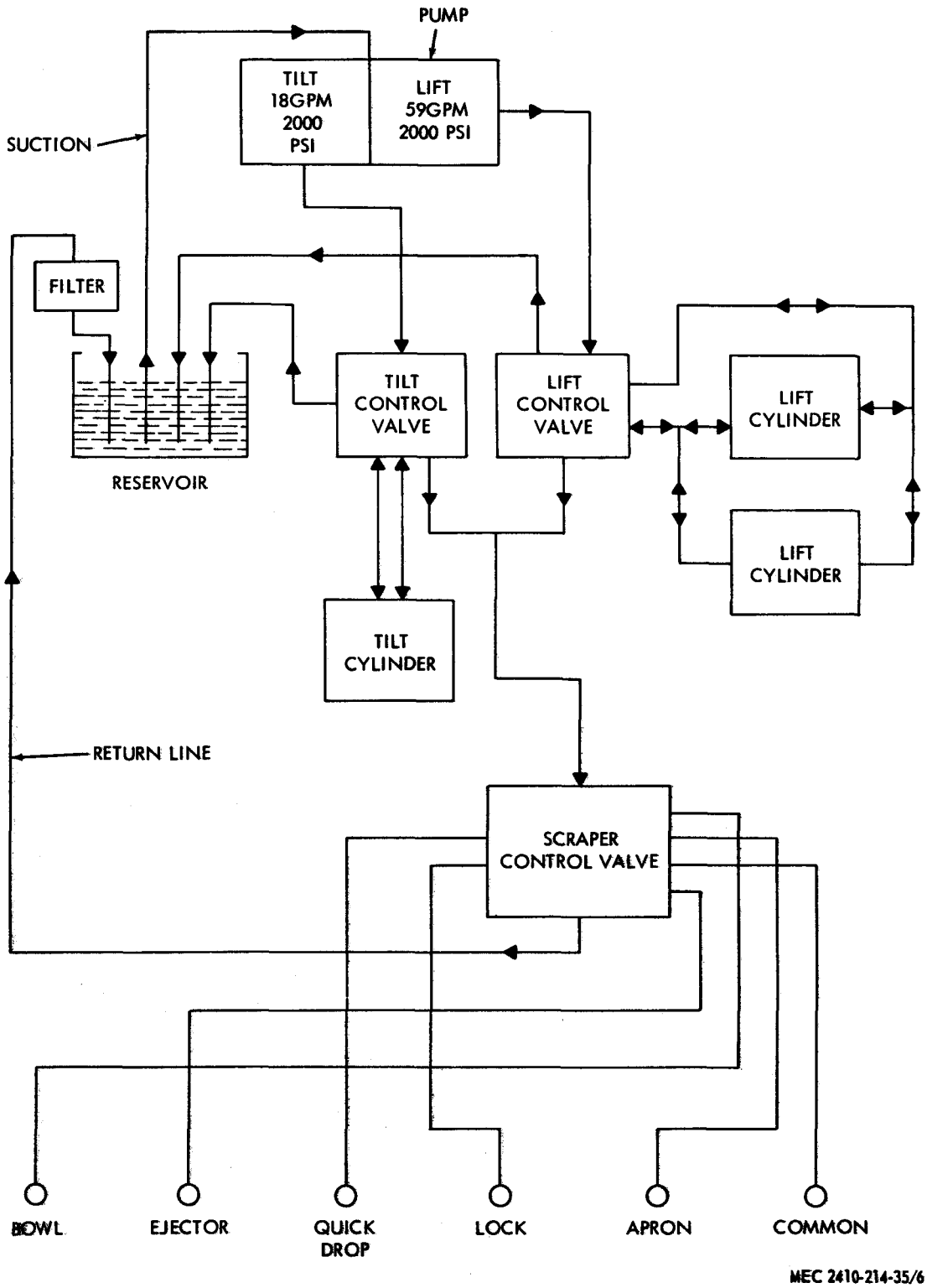


Figure 1-2. Hydraulic system circuit diagram.

CHAPTER 2

GENERAL 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 and depot maintenance on the Caterpillar Model D–7 Tractor are listed in table 2-1 and TM 5-2410-214-35P. References and illustrations indicating the use of these tools are listed in the table.

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

Direct and general support and depot maintenance repair parts are listed and illustrated in **TM 5-2410–214–35P.**

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

The specially designed tools and equipment listed in table 2-2 are for direct and general support and depot maintenance personnel performing major overhaul work on the D–7 tractor. The tools and equipment listed are not available for issue, but must be fabricated by direct and general support and depot maintenance personnel.

Table 2–1. Special Tools

Item	*FSN or part no.*	*Figure*	*Paragraph*	*Use*
Bolt	**(11083) 1A2208**	**3–12**	**3–4**	**Precombustion chamber removal.**
Spacer	**(11083) 5F9072**	**3–12**	**3–4**	**Precombustion chamber removal.**
Wrench adapter 5F8353	**5180–620–6235**	**3–12**	**3–4**	**Precombustion chamber removal.**
Washer 4B4285	**5310–194–7315**	**3–12**	**3–4**	**Precombustion chamber removal.**
Nut L1017	**5310–423–8057**	**3–12**	**3–4**	**Precombustion chamber removal.**
Screw	**(11083) 6F5515**	**3–12**	**3–4**	**Precombustion chamber removal.**
Sleeve	**(11083) 1M6475**	**3–213**	**3–46**	**Check transmission clutches operation.**
Reducer	**(11083) 7M1293**	**3–238**	**3–48**	**Transmission hydraulic tests.**
Installer tool	**(11083) 5M2162**	**3–315**	**3–63**	**Install metal floating ring seal.**
Installer tool	**(11083) 5M2158**	**3–328**	**3–68**	**Install metal floating ring seal.**
		3–334	**3–69**	
		3–337	**3–70**	

Table 2-2. *Specially Designed (Fabricated) Tools and Equipment.*

Item	*Figure*	*Paragraph*	*Use*
Installation tool	3-18	3-5	Install rocker arm bearings.
Valve holding tool	3-20	3-5	To hold valve in place while valve spring is installed.
Removal tool	3-29	3-7	Removing or installing main bearings.
Tamping tool	3-99	3-23	Transfer pump seal.
Tamping tool guide	3-99	3-23	Transfer pump seal.
Fixture	3-104	3-25	Turbocharger repair.
Adapter plate	3-104	3-25	Turbocharger repair.
Holding tool	3-115		Turbocharged turbine wheel.
Removal tool	3-133	3-30	Water seal case.
Lifting bracket	3-159	3-40	Torque divider.
Holding tools	3-325	3-67	Hold washers and spacers in master link.
Guide pin	3-348	3-72	Recoil spring assembly.
Driver	3-391	3-85	Lift cylinder piston relief valve removal.

Section II. TROUBLESHOOTING

2-4. General

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the D-7 tractor and its components. Malfunctions which may occur are listed in table 2-3. Each malfunction stated is followed by a list of probable causes of the trouble. The corrective action recommended is described opposite the probable cause.

Table 2–3. Troubleshooting

Malfunction	*Probable cause*	*Corrective action*
1. Irregular firing of engine.	a. Valves not seating properly.	a. Recondition valves (para 3–5).
	b. Worn piston rings.	b. Replace piston rings (para 3–12).
2. Engine smokes.	a. Worn piston rings.	a. Replace piston rings (para 3–12).
	b. Defective valves.	b. Recondition valves and seats (para 3–5).
3. Engine knocks excessively.	a. Broken valve spring.	a. Replace valve spring (para 3–5).
	b. Carbon build-up on pistons.	b. Clean carbon from pistons (para (3–12).
	c. Loose connecting rod or main bearing bolts or worn bearings.	c. Tighten bolts or replace bearing (para 3–12).
4. Low or no lubricating oil pressure indication.	a. Worn main bearing.	a. Replace bearing (para 3–7).
	b. Worn oil pump gears.	b. Replace pump gears (para 3–36).
5. Starter will not crank engine.	Armature burned out.	Disassemble starter and replace armature (para 3–27).
6. Generator not charging.	Generator shorted.	Disassemble generator and replace armature (para 3–26).
7. Fully charged battery and a high charging rate.	a. Short circuit in generator.	a. Disassemble generator and repair or replace as necessary (para 3–26).
	b. Generator regulator not operating properly.	b. Adjust. (Refer to TM 5–2410–214–12.)
8. Transmission does not operate in any speed.	a. Leakage in external lines.	a. Refer to TM 5–2410–214–12.
	b. Leakage within transmission.	b. Check pressures at test points (para 3–48).
	c. Pressure relief valve in hydraulic control valve stuck open.	c. Remove valve for inspection and repair (para 3–41).
	d. Check valve stuck in bore.	d. Remove valve for inspection and repair (para 3–45).
	e. Differential valve sticking closed.	e. Remove valve for inspection and repair (para 3–41).
	f. Safety valve improperly adjusted.	f. Adjust safety valve (para 3–41).
	g. Torque divider failure.	g. Refer to paragraph 3–40.
9. Tractor remains in gear with selector valve in neutral.	a. Obstruction preventing directional clutch from releasing.	a. Inpsect directional valve and remove any obstruction (para 3–41).
	b. Control linkage improperly adjusted.	b. Adjust linkage (para 3–41).
	c. Speed and safety valve improperly adjusted.	c. Adjust valves (para 3–41).
10. Ripper will not raise.	a. Defective relief valve in hydraulic control.	a. Remove valve for inspection and repair (para 3–41).
	b. Improper relief valve setting.	b. Adjust valve (para 3–45).
11. Ripper will not lower.	Defective relief valve in hydraulic control.	Remove and inspect valve (para 3–45).
12. Ripper will not stay in ground.	Worn cylinder piston rod packing and seals.	Inspect and repair cylinder (para 3–87).

Section III. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS

2-5. Engine

a. Removal and Installation.

(1) Remove the radiator and radiator guard as an assembly (para 3-29).

(2) Remove the seat and floor plates as described in TM 5-2410-214-12.

(3) Remove the brake pedals and brake pedal support bracket (para 3-50).

(4) Disconnect oil line ((1), fig. 2-1) winch pump pressure line (9), winch pump suction line (10), torque converter supply line (11), tilt valve pressure line (12), hydraulic pump suction line (13), and hydraulic pump pressure line (14).

(5) Remove fender bracket (3), transmission oil pump pressure line (5), bracket (6), torque converter vent line (7), U-joint (8), and fender bracket (15).

(6) Disconnect battery cables (2) at the starting motor.

(7) Disconnect the rear light wire inside junction box (4).

(8) Pull the head light wire back to the junction box (4).

(9) Disconnect the transmission lubrication line (16), drain line (17), and transmission pump oil supply line (18).

(10) Disconnect the electrical leads to the voltage regulator.

(11) Remove the engine side shields.

(12) Remove toolbox (19), junction blocks (21), (22), and (23).

Note. Close the fuel shutoff valve at the supply tank prior to disconnecting line (20).

(13) Disconnect fuel supply line (20).

(14) Attach a suitable lifting device and hoist as illustrated in figure 2-2.

Note. The engine and accessories approximate weight is 5,000 pounds.

(15) Remove the bolts ((1), (2), fig. 2-2) securing the engine to the main frame.

(16) Raise the engine slightly and check for components that may not have been disconnected.

(17) Move the engine forward and out of the machine.

(18) The shims which are under the engine supports should be wired together in individual groups and replaced in their original positions when installing the engine.

(19) Install the engine in the reverse order of removal.

(20) After the engine has been placed in position, its alignment should be checked as recommended below.

b. Engine Alignment.

(1) Place the amount of shims needed 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 the universal joint wobbles perceptibly, closer alignment is needed.

c. *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.

2-6. Transmission

a. *Removal.*

(1) Remove the torque divider (para 3-40).

(2) Disconnect hydraulic lines ((1), fig. 2-3) and move them toward the engine so they will not interfere with transmission removal.

(3) Remove tube assembly (2).

(4) Disconnect line (3) at steering clutch check valve and remove.

(5) Remove oil filter assembly (4) from bracket (5).

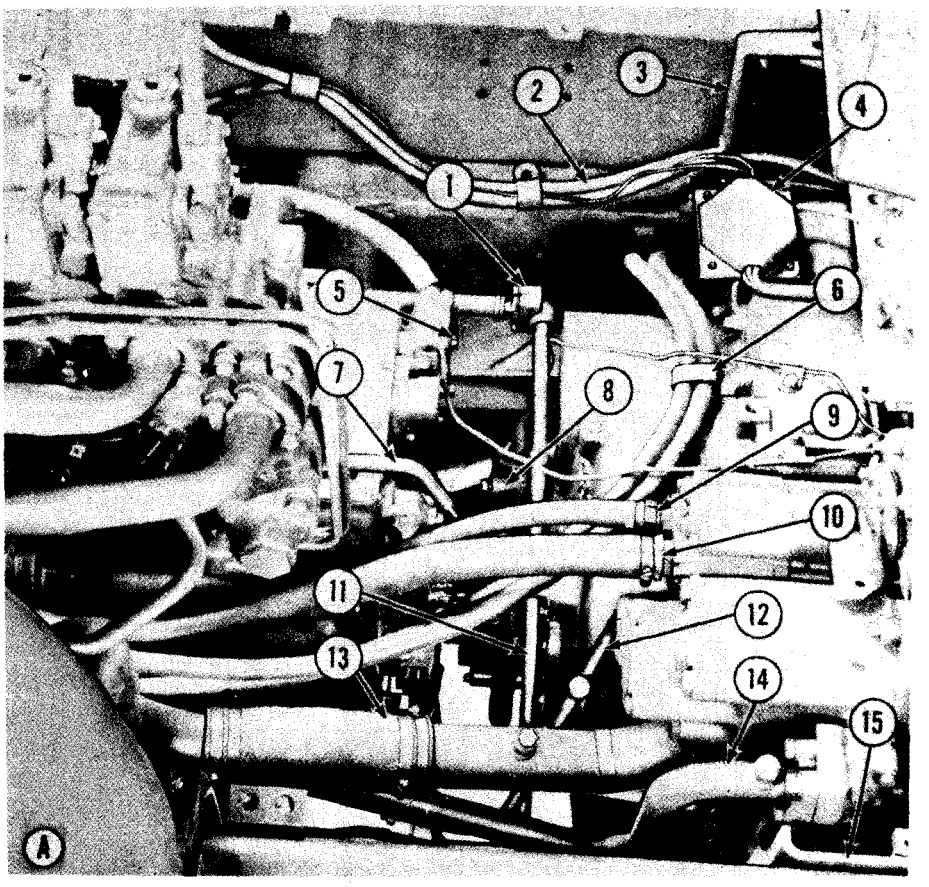
(6) Install 3/4-inch (NC) eyebolts and attach a suitable hoist to support the transmission assembly as shown in figure 2-4.

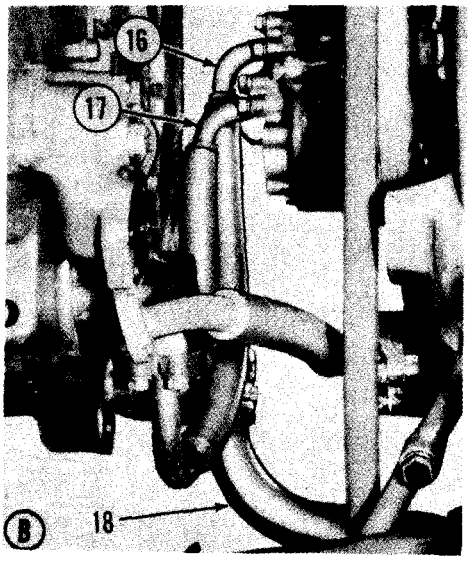
Note. The transmission weighs approximately 1,325 pounds.

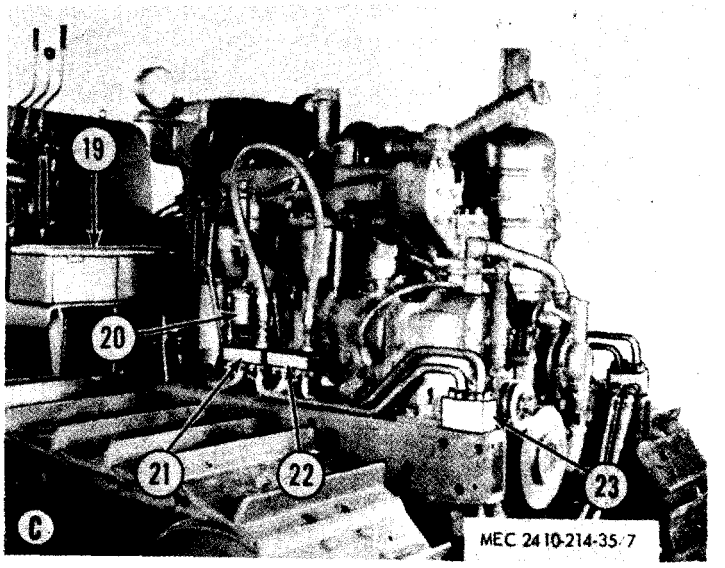
(7) Remove the nuts from the studs holding the transfer case to the bevel gear case, and force the transmission away from the bevel gear case using 1\2-inch–13 (NC) forcing screws.

(8) Lift the transmission from the tractor (fig. 2-4) .

b. Installation. Install the transmission in the reverse order to removal.

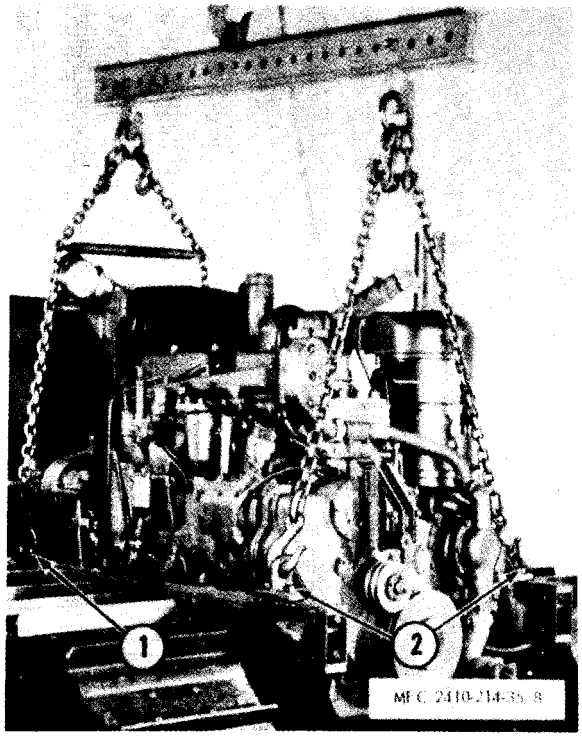






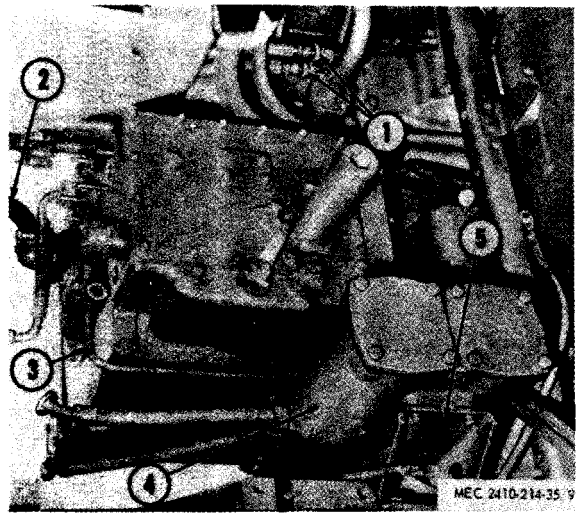
1 Oil supply line
2 Battery cable
3 Fender bracket
4 Junction box
5 Transmission oil pump pressure line
6 Bracket
7 Troque converter vent line
8 U-joint
9 Winch pump pressure line
10 Winch pump suction line
11 Torque converter supply line
12 Tilt valve pressure line
13 Hydraulic pump suction line
14 Hydraulic pump pressure line
15 Fender bracket
16 Transmission lubrication line
17 Drain line
18 Transmission pump oil supply line
19 Tool box
20 Fuel supply line
21 Junction block
22 Junction block
23 Junction block

Figure 2-1. Preparing to remove engine.



1 Bolts
2 Bolts

Figure 2–2. Engine Removal.



1 Hydraulic lines
2 Tube assembly
3 Line
4 Filter assembly
5 Bracket

Figure 2–3. Preparing to remove transmission.

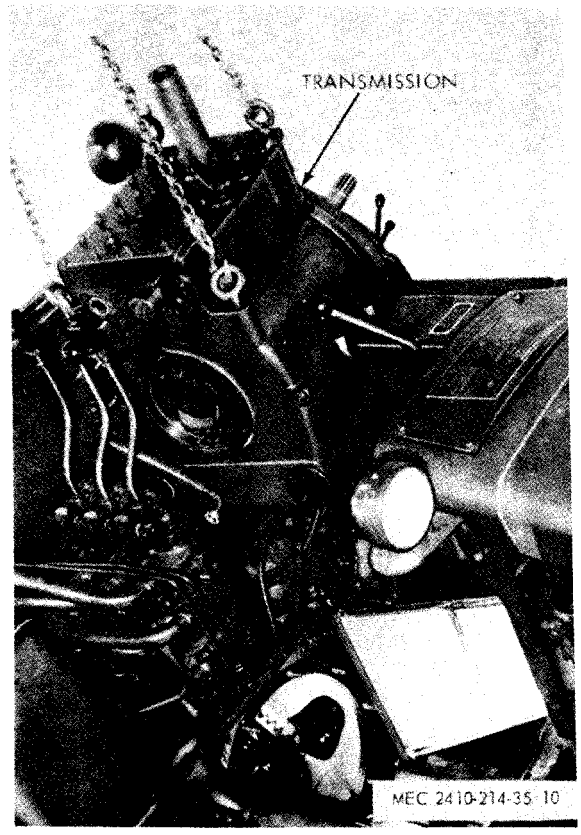


Figure 2–4. Transmission removal.

CHAPTER 3

REPAIR INSTRUCTIONS

Section I. ENGINE

3-1. General

The tractor is powered by a 4-cylinder, 4-stroke cycle, turbocharged, caterpillar diesel engine equipped with gear type balancers to counteract vertical inertia forces of the connecting rods and pistons. The engine components are fully described in the applicable paragraphs throughout this section.

3-2. Crankshaft Pulley and Front Support

a. Crankshaft Pulley.

(1) Removal.

(a) Remove the lock and bolt ((1), fig. 3-1) which has a left-hand thread.

(b) Use any proper size socket to remove the screw (2).

(c) Using a puller arrangement similar to that shown in figure 3-2, remove the crankshaft pulley.

(d) Remove the key from beneath the pulley.

(2) Inspection. Inspect for bends or damage and replace if necessary.

(3) Installation.

(a) Install in the reverse order of removal.

(b) When installing the pulley, tighten the screw to the recommended value, tap with a hammer and retighten (para 1-4g).

b. Front Support.

Note. The engine front support has an annular rubber bushing ((1), fig. 3-3 which is installed by a special process that gives a very tight fit between the rubber and the inner sleeve (4) and outer sleeve (2). The composite bushing is serviced only as a unit. The steel inner sleeve (4) is a .002-inch to .005 inch press fit on the timing gear housing (5). Should it become necessary to replace the bushing assembly for any reason, it is necessary to ruin the three parts of the assembly in the process. This bushing requires no lubrication.

(1) *Removal.*

(a) Remove the crankshaft pulley.

(b) Remove the bolts securing the front support to the timing gear housing cover.

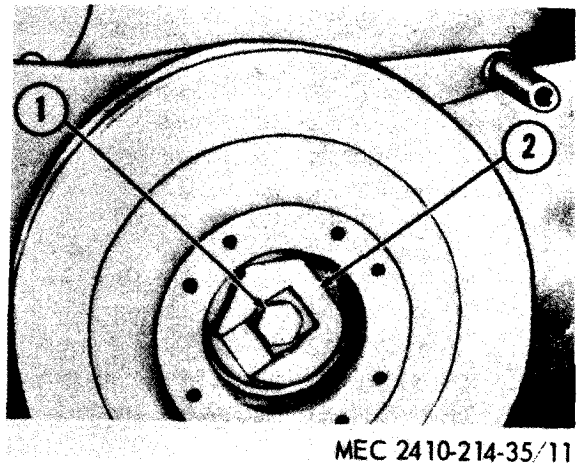
(c) Rotate the front support to clear the water pump and remove (fig. 3-4).

(d) Pull, burn off or cut off the front support bushing (fig. 3-5).

(2) *Installation.*

(a) When the bushing assembly is pressed on the front cover, use care to keep the top two holes for the bolts in a horizontal line. The assembly should be pressed onto the cover until the end of the inner sleeve contacts the cover. This will allow installation of the front support in the proper position so that it can easily be attached to the tractor frame.

(b) Install in the reverse order of removal.



1 Bolt
2 Screw

Figure 3-1. Crankshaft pulley.

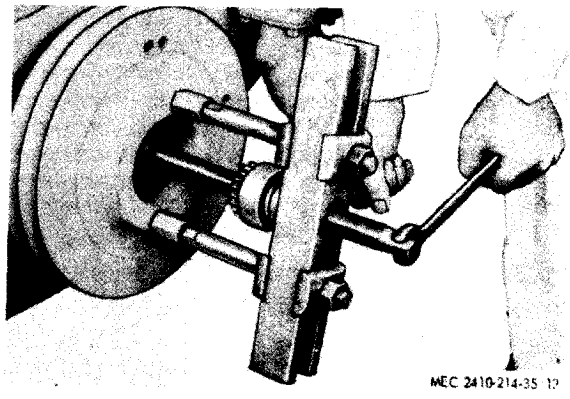
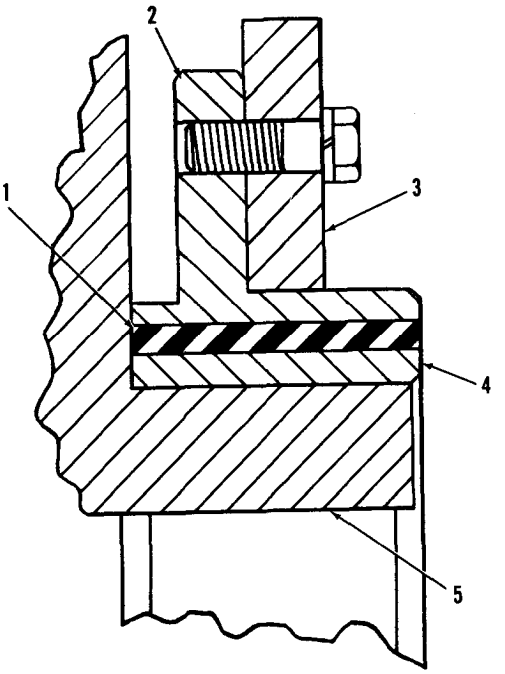


Figure 3-2. Crankshaft pulley removal.



1 Rubber bushing
2 Outer sleeve
3 Support
4 Inner sleeve
5 Timing gear housing

Figure 3–3. Front support bushing.

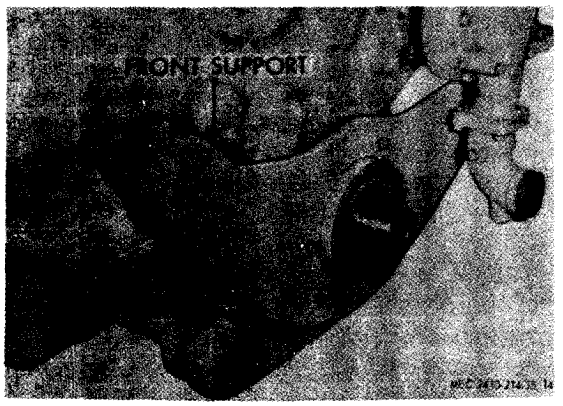


Figure 3-4. Front support removal.

3-3. Manifolds

a. Removal and Installation.

Note. The exhaust and inlet manifolds can be removed separately.

(1) Refer to paragraph 3-25 and remove turbocharger ((2), fig. 3-6).

(2) Remove bolts (5) and nuts (6).

(3) Using a suitable hoist, remove each manifold.

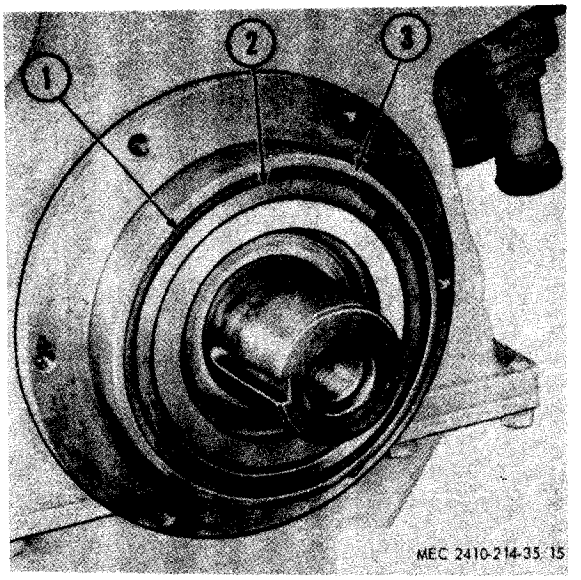
(4) Replace gaskets before installation.

Note. The use of antisieze thread compound is recommended on bolts subject to heat to ease future removal.

(5) Install in the reverse order of removal.

b. Cleaning and Inspection

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



1 Rubber bushing
2 Inner sleeve
3 Outer sleeve

Figure 3-5. Front support bushing.

(2) Inspect all parts for cracks, breaks, and other damage.

(3) Replace all damaged or defective parts.

3-4. Engine Cylinder Heads

Note. Two cylinder heads are used on this engine. Copper water directors direct the flow of coolant toward the valve ports and precombustion chambers. Rubber seals and ferrules seal the water passages between the cylinder head and cylinder block.

a. *Removal and Disassembly.*

(1) Drain the cooling system.

(2) Remove the hood.

(3) Remove the turbocharger (para 3-25) air cleaner (refer to TM 5-2410-214-12), inlet and exhaust manifolds (para. 3-3).

(4) Disconnect throttle linkage ((1), fig. 3-7), heat indicator bulb (2), and throttle linkage (4).

(5) Remove the water manifold (3) and breather (5).

(6) Remove the oil filter cover, case, and element.

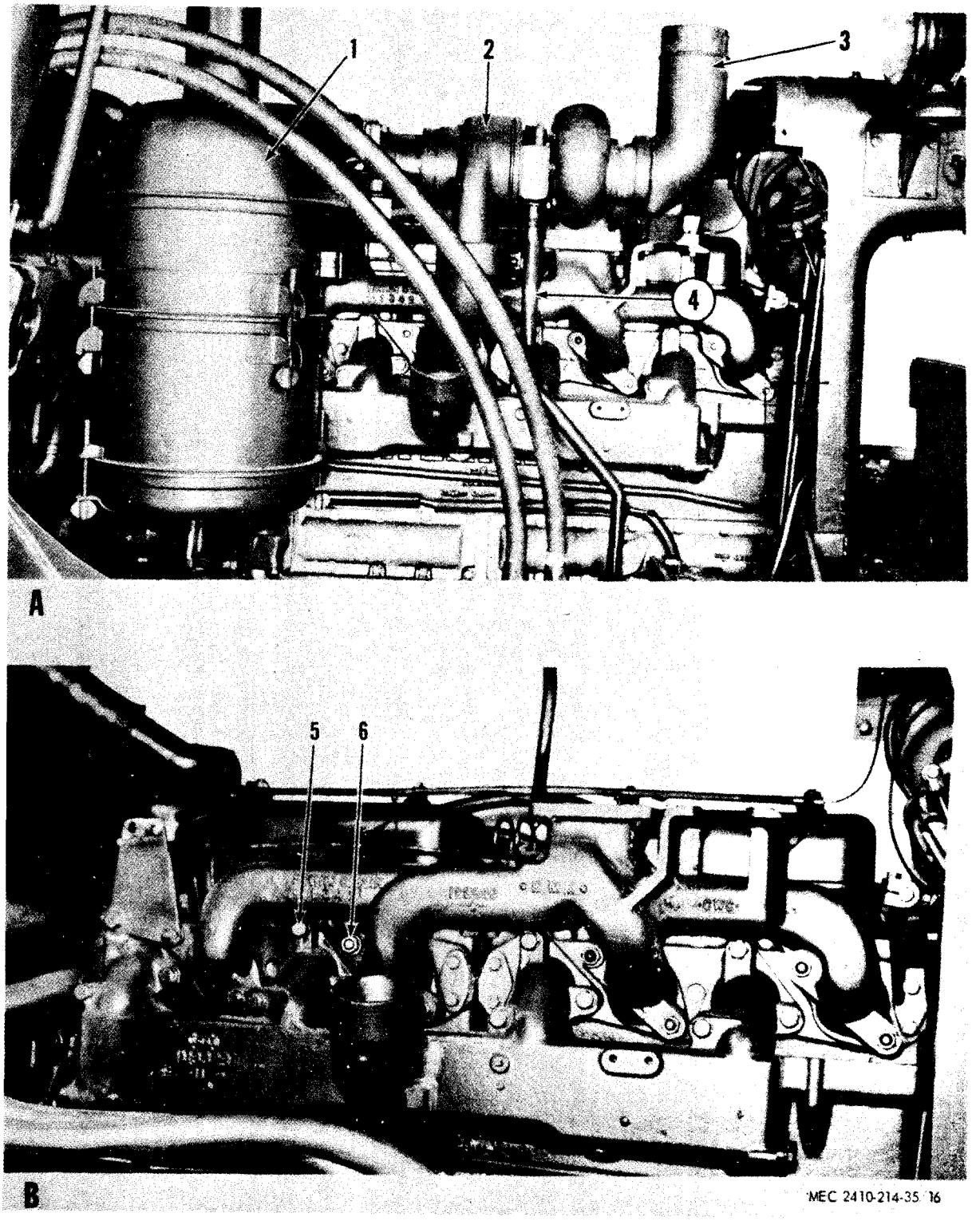
(7) Remove the turbocharger lubrication supply line.

(8) Remove the glow plug wiring (6).

(9) Remove the upper bolts securing the priming pump mounting bracket (9) and loosen the lower bolts.

(10) Tip the priming pump mounting bracket away from the cylinder blocks to aid in removing the fuel injecton lines (7). Remove the fuel injection lines.

(11) Remove the throttle linkage cross shaft (10).



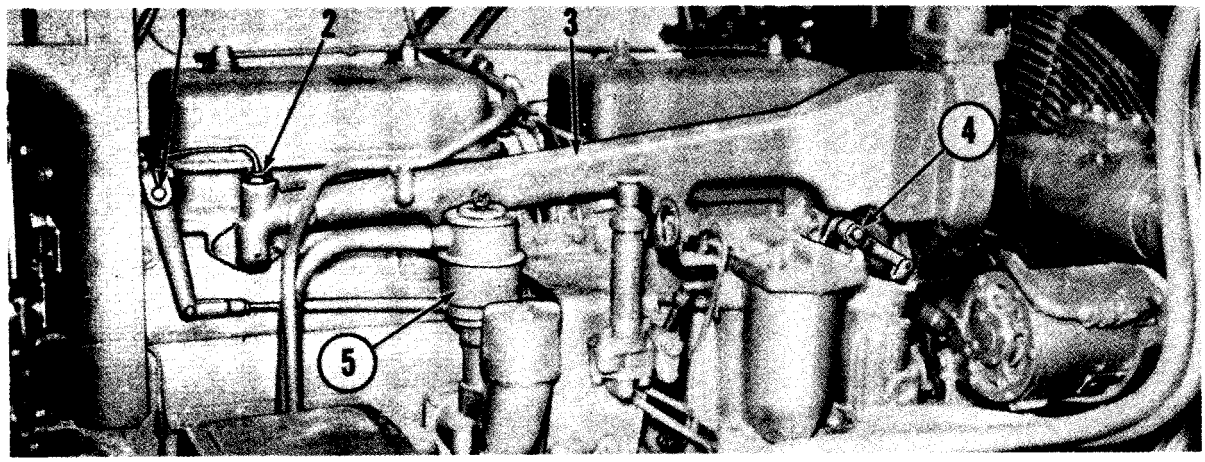
1 Air cleaner
2 Turbocharger
3 Exhaust pipe
4 Oil drain
5 Bolts
6 Nuts

Figure 3-6. Manifold removal.

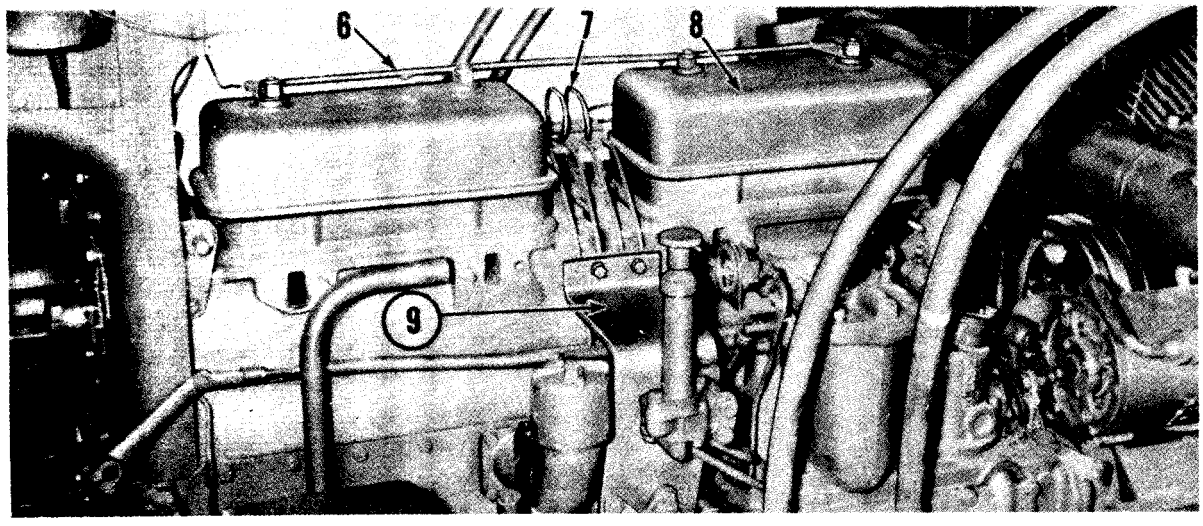
(12) Loosen the lower bolts securing the dash assembly and tip the dash assembly away from the engine.

(13) Remove the rocker arm covers, the rocker arm assemblies (fig. 3–8), push rods, and the compression release push rods.

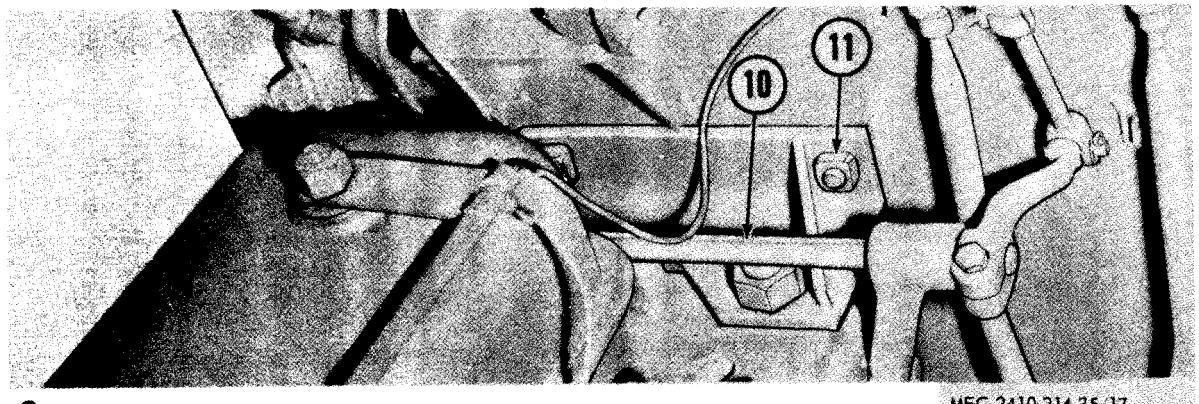
(14) Remove the valve cover base ((2), fig. 3–8).



A



B

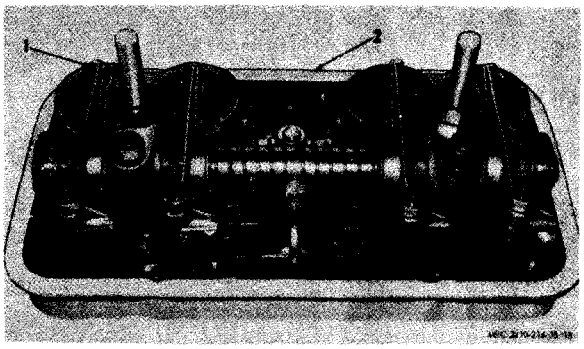


C

1 Throttle linkage
2 Heat indicator bulb
3 Water manifold
4 Throttle linkage bracket
5 Breather
6 Glow plug wiring
7 Fuel injection lines
8 Valve covers
9 Fuel pump mounting bracket
10 Throttle linkage cross shaft
11 Dash upper support bracket

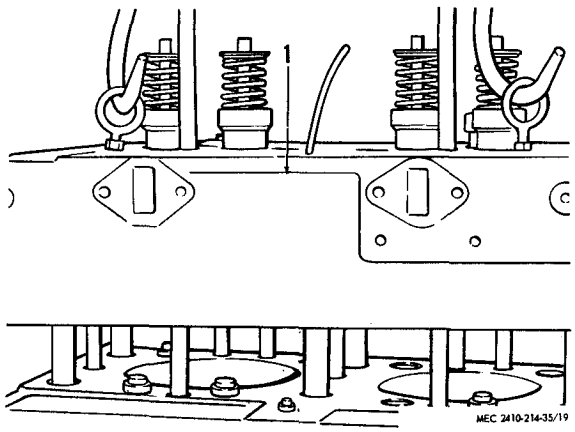
Figure 3–7. Preparing to remove cylinder heads.

(15) Remove the nuts from the head studs.
(16) Install two 3/8-inch NC eyebolts.
(17) With a suitable hoist, remove the head ((1), fig. 3–9).



1 Rocker arm assembly
2 Valve cover base

Figure 3-8. Preparing to remove cylinder heads.



1 Cylinder head

Figure 3-9. Removing cylinder head.

Note. Water directors ((1), fig. 3-10) are provided to direct the flow of coolant to critical areas for maximum cooling effectiveness. They are pressed into place in the head, after aligning the notch on the director with the V-mark on the head. The seal (2) and copper ferrules (3), which seal the water passages between the head and top of the block, are replaceable.

(18) Remove the fuel injection valve assembly Refer to TM 5-2410-214-12.

(19) Disconnect and remove the glow plugs.

Note. The precombustion chamber ((3), fig. 3-11) is threaded into the cylinder head (4) and sealed at the top of the head with a retainer (1) and two preformed packings (2). The preformed packings prevent leakage of coolant. The gasket (5) prevents combustion gases from entering the cooling system, as well as preventing the leakage of coolant into the cylinder.

(20) Place a spacer ((2), fig. 3-12) in the precombustion chamber and turn the bolt (1) in the retainer (3) against the spacer until the retainer comes out of the cylinder head.

(21) Place the wrench adapter (4) in the serrations of the precombustion chamber and screw the precombustion chamber cut of the head.

b. Cleaning, Inspection, and Repair.

(1) Remove all carbon deposits and rust from the head.

Note. If a cylinder head has collected an excessive amount of scale or rust within the water jacket, remove the cylinder head and clean it thoroughly. This is also an indication that the entire cooling system should be cleaned.

(2) Clean all parts in an approved solvent.

c. Reassembly and Installation.

(1) Place a new gasket, coated on the bottom side with a thin layer of grease, in the head. The grease will help retain the washer while installing the precombustion chamber.

(2) Coat the threads of the precombustion chamber with antiseize and sealing lubricant, then insert the chamber into the head and tighten with the wrench adapter (4) to the torque given in paragraph 1-4g.

(3) Coat the chamfered portion of the cylinder head and the new rubber seals with soap.

(4) Place the retainer over the precombustion chamber and start it into the cylinder head and onto the precombustion chamber.

Caution: When starting the retainer do not use force until the seals are properly started. If the seals are not started correctly, they will be damaged and will not seal effectively.

(5) Using the washer (6), the screw (8) and the nut (7) as illustrated, tighten the retainer until it is bottomed.

(6) Install the seal ((2), fig. 3-10) over the flange on the ferrule. This can be easily done if the inner surface of the seal is first coated with liquid soap.

Note. When installing the ferrules and seals, the rolled edge of the ferrule should be toward the head to facilitate installation of the head.

(7) Clean the cylinder liners with a lint free cloth and place a new cylinder head gasket on the cylinder block.

(8) Carefully lower the head on the block.

(9) Align the heads by placing a straightedge along the machined surface on either side of the heads. If the two heads are not in alignment, breakage of the water manifold or leaks can occur.

Note. Coat cylinder head stud nut threads with Moly-Coat and torque by hand.

(10) See figure 3-13 and tighten the 5/8-inch nuts in numerical sequence to 60 lb-ft.

(11) Tighten the 7/8-inch nuts in alphabetical sequence to 150 lb-ft.

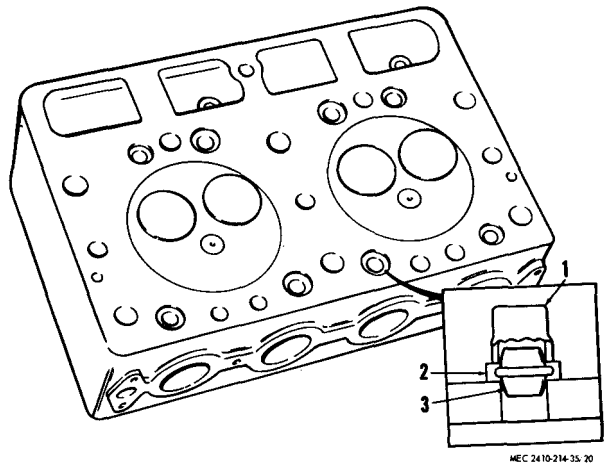
(12) Retighten the 7/8-inch nuts in alphabetical sequence to 300 lb-ft.

(13) Retighten the 5/8-inch nuts in numerical sequence to 120 lb-ft.

(14) Install the push rods and valve rocker mechanism. Securely tighten the nuts which hold the valve rocker mechanism in place. Set the valve clearance and the compression release clearance as given in table 1-1.

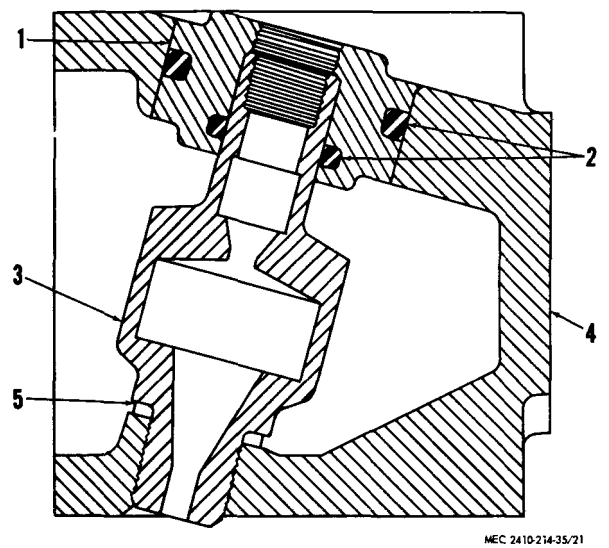
(15) Install the rocker arm covers.

(16) Complete the installation in the reverse order of removal.



1 Director 2 Seal 3 Ferrule

Figure 3-10. Cylinder heads showing water directors.

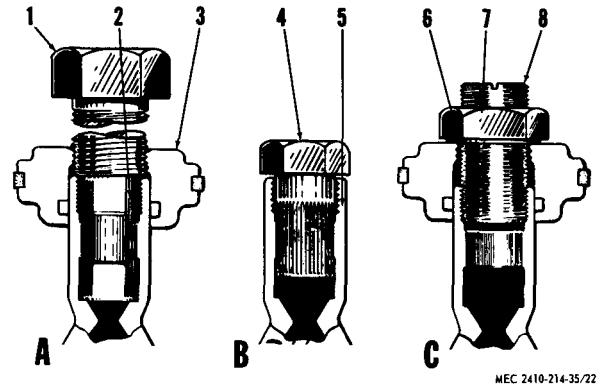


1 Retainer
2 Preformed packings
3 Precombustion chamber
4 Cylinder head
5 Gasket

Figure 3-11. Precombustion chamber.

3-5. Engine Valves and Valve Mechanism (fig. 3-14)

a. General. One inlet and one exhaust valve are used for each cylinder. The valve seats are hardened inserts ((4), fig. 3-15) in the cylinder head. Valves (12) are opened by cams on the camshaft. Lifters (3) follow the cams, and transmit this movement through push rods (2) and rocker arms (1) to valve cup sleeves (5), which contact the valves. Springs (8) and (9) close the valves. The springs are held compressed by retainer (7) and locks (6): Valve cup sleeves (5) in the rocker arm support bracket take the side thrust of the



A—Retainer removal
B —Precombustion chamber removal and installation
C—Retainer installation

1 Bolt
2 Spacer
3 Retainer
4 Wrench adapter
5 Precombustion chamber
6 Washer
7 Nut
8 Screw

Figure 3-12. Precombustion chamber tools.

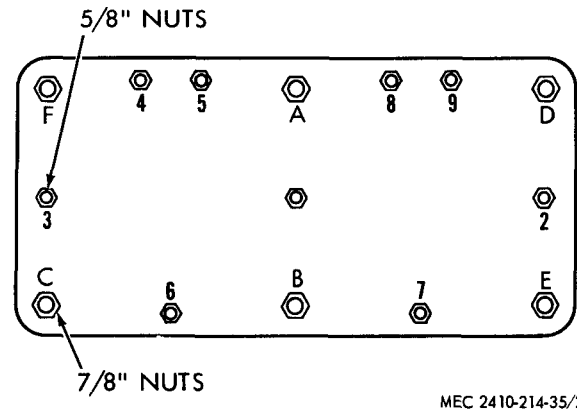
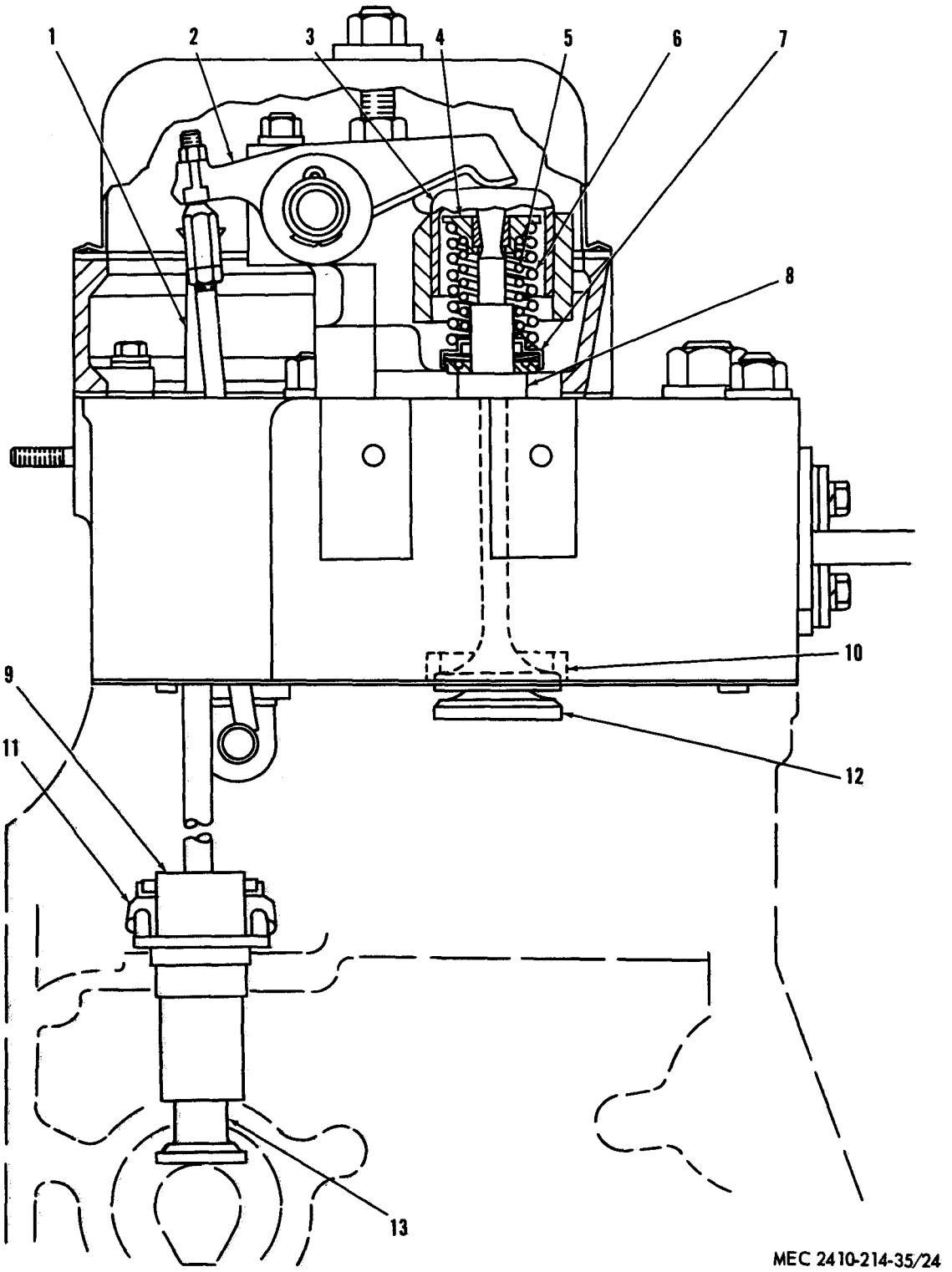


Figure 3-13. Cylinder head stud nut tightening sequence.

rocker arm. Valve stem guide (11) is a press fit in the head. The valve rotator (10), rotates the valve approximately 3° each time the valve is opened. As the valves are unseated, the valve springs are compressed, existing force against valve spring seating collar ((2), fig. 3-16) and compressing spring washer (1). As the spring washer is compressed, the steel balls (4) in retainer body (3) are forced down the incline, thus rotating the spring washer, the valve spring seating collar, the valve springs and the valve. As the valve closes, the tension is released from the spring tension is released from the spring washer so it no longer contacts the steel balls. The travel of the balls back to their original position has no rotating effect on the valve. To determine whether a valve rotator is operating, observe the serrations on the top of the valve spring retainer. If the retainer does not rotate during operation, replace the valve rotator.



1 Push rod
2 Rocker arm
3 Sleeve
4 Retainer
5 Inner spring
6 Outer spring
7 Rotator
8 Valve stem guide
9 Valve lifter guide
10 Insert
11 Retainer
12 Valve
13 Valve lifter

Figure 3–14. Valves and valve mechanism.

b. ***Rocker Arm Assembly.***

(1) ***Removal.***

(a) Remove the valve rocker arm covers and disconnect the two oil lines. Remove the nuts which hold the rocker arm assemblies to the cylinder head and remove the rocker arm assemblies.

(b) After the rocker arm assembly has been lifted off the head, the rocker arms can be removed.

(2) ***Disassembly.***

(a) Pull the cotter pin ((9), fig. 3-17) and slide off the washers, spring and outer rocker arm (4).

(b) Remove the nut (2) and tap. the lock bolt (7) down far enough to release the shaft. It is not necessary to remove the lock bolt.

(c) Slide the bracket off the shaft and remove the other rocker arm (6).

(d) To remove the center bracket and rocker arms, take out the steel fitting (5) and slide off the spring (1). Then the rocker arms and bracket can be removed like the outer ones.

(3) ***Inspection.***

(a) Inspect bearings in rocker arms and replace if necessary.

(b) Check clearance between sleeve (3) and bore in bracket (table 1-1).

(4) ***Assembly.***

(a) In order to install new rocker arm bearings properly, a tool similar to one shown in figure 3-18, should be used. Carefully align the oil holes before the bearing is pressed into place.

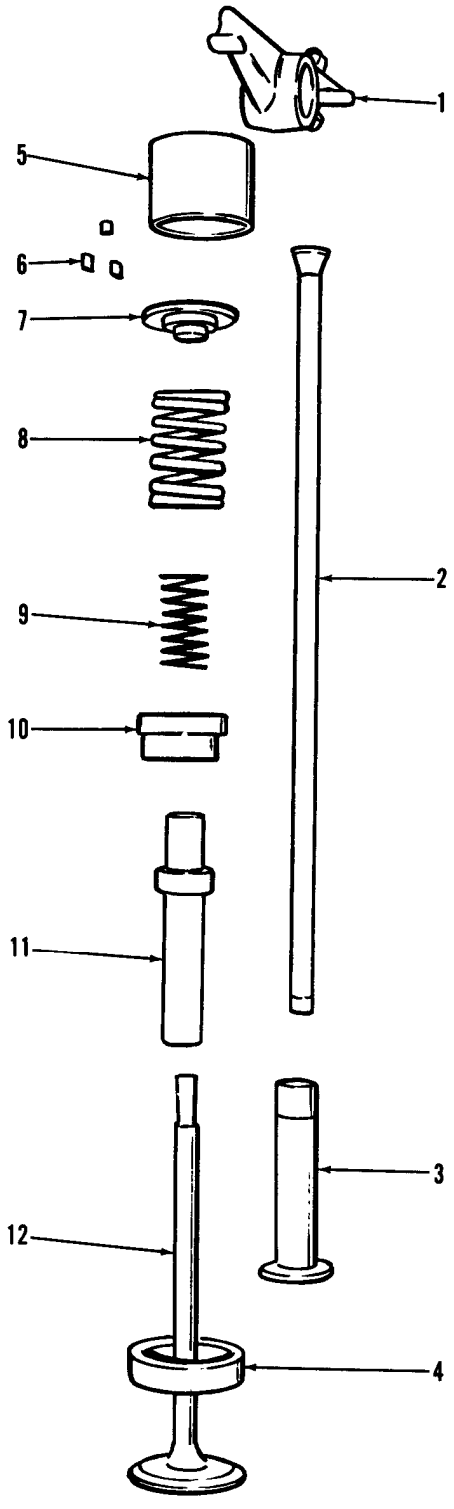
(b) Assemble the rocker arm assembly in reverse order of disassembly.

c. ***Valves.***

(1) ***Removal.*** Compress the valve springs and remove the locks. Release the compressor and remove the retainers, springs, and the valve rotators. The valves can now be removed. See figure 3-19 for use of valve spring compression tools. The adapter (1) threads onto a rocker arm stud (2). Also shown in figure 3-20 is a simple tool which can be made to hold the valves in place while installing the valve springs. The threaded end of this tool which can also be used on other models of heads, is shown ((3), fig. 3-19).

(2) ***Cleaning.*** After removing the cylinder head from the diesel engine and the valve assemblies from the head, carefully scrape all carbon accumulations from the ports. Be sure to clean the valves and valve guides thoroughly.

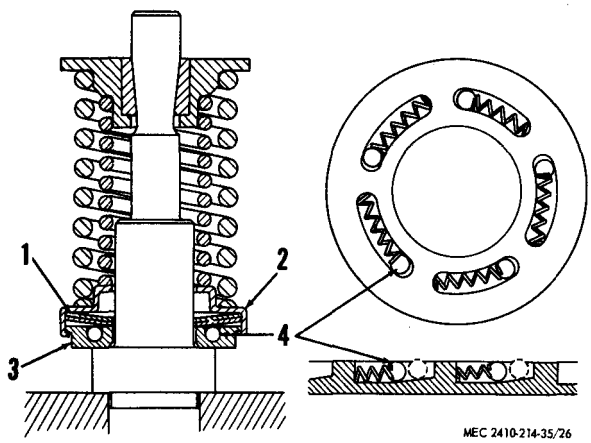
(3) ***Valve inspection and reconditioning.*** If the valve faces are pitted or are making poor contact with the valve seat, reface in a valve refacing machine. If the valves are deeply pitted, badly warped or worn, they should be replaced. In refacing, be sure there is sufficient metal left



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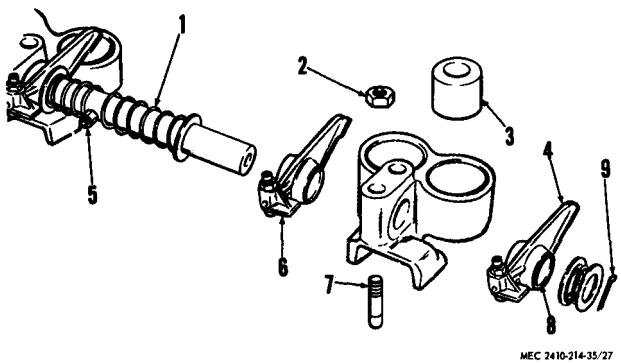
1	Rocker arm	7	Retainer
2	Push rod	8	Large spring
3	Lifter	9	Small spring
4	Insert	10	Valve rotator
5	Sleeve	11	Valve stem guide
6	Locks	12	Valve

Figure 3–15. Valve train.



1 Spring washers
2 Spring seating collar
3 Retainer body
4 Steel ball

Figure 3-16. Valve rotator.



1 Spring
2 Nut
3 Sleeve
4 Rocker arm
5 Fitting
6 Rocker arm
7 Lock bolt
8 Bearing
9 Cotter pin

Figure 3-17. Valve rotator.

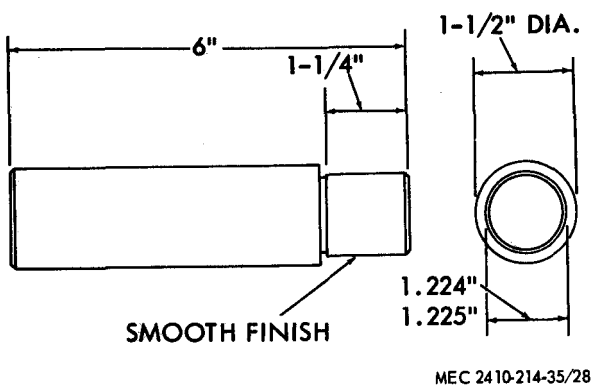
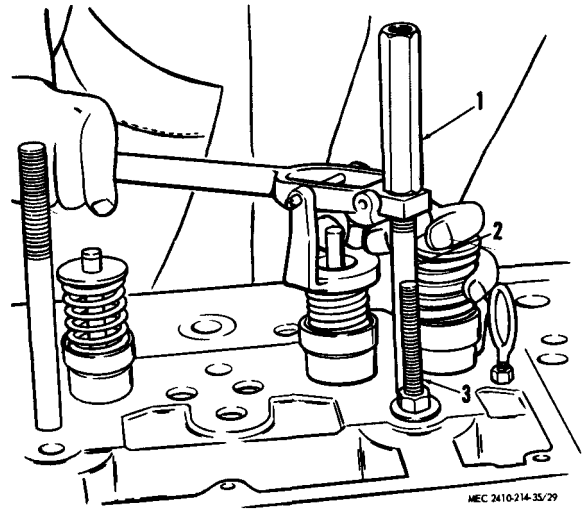


Figure 3-18. Tool for installing rocker arm bearings.

on the head of the valve to prevent "dishing" of the valve in service. The wear of the valve stems can be checked by the use of a 0" to 1" micrometer. The valve stem should be measured in three places. Use the measurement near the top of the valve stem, where the valve stem does not touch the guide, as the original valve stem diameter.



1 Adapter
2 Rocker arm stud
3 Threaded end of valve holding tool

Figure 3–19. Compressing Valve spring.

Caution: **In handling valves, caution should be exercised to prevent nicking or scratching the radius between the valve face and stem. A very small nick can cause the valve head to break off during service.**

(4) ***Check valve guides. See d*** below.

(5) ***Checking valve seats.*** Coat the valve face with Prussian blue and rotate the valve in the valve seat. Remove the valve and examine the contact pattern on both valve and seat. A line of contact near the top and around the entire circumference of the valve seat should indicate line contact with the valve. After the valve seats have been ground until they are smooth and concentric with the valve guides, clean all parts thoroughly.

(6) ***Valve installation.*** Inlet valves have a small groove around the top of the stem for identification after the head has been installed. Lubricate the stems and guides for initial starting. Insert the valve through the valve stem guide and install the springs and the spring retainer. Compress the springs with a compressor. Insert the locks, large end down, and tap the retainer lightly as the spring compressor is removed, to make sure the locks are seated properly in the retainer.

d. Valve Guides.

(1) The inlet and exhaust valves operate in replaceable valve guides. After the valves have been removed, clean the valve stems and guides.

(2) Check valve guide wear with a gage or by the pilots furnished with some makes of valve seat regrinding equipment. Generally the pilots are supplied in graduated sizes. Use a micrometer to measure the diameter of the largest pilot that will pass through the guide. This dimension will

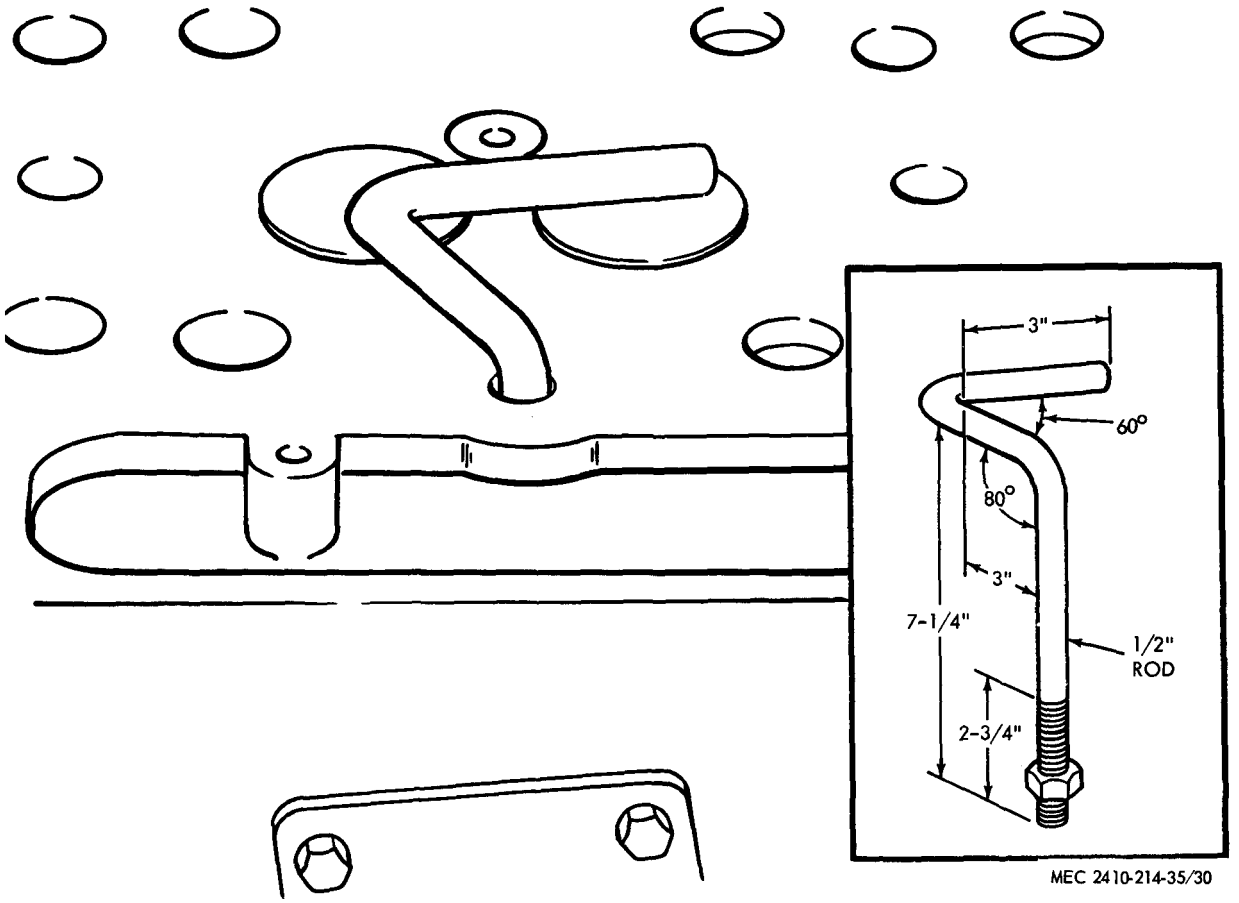


Figure 3–20. Valve holding tool.

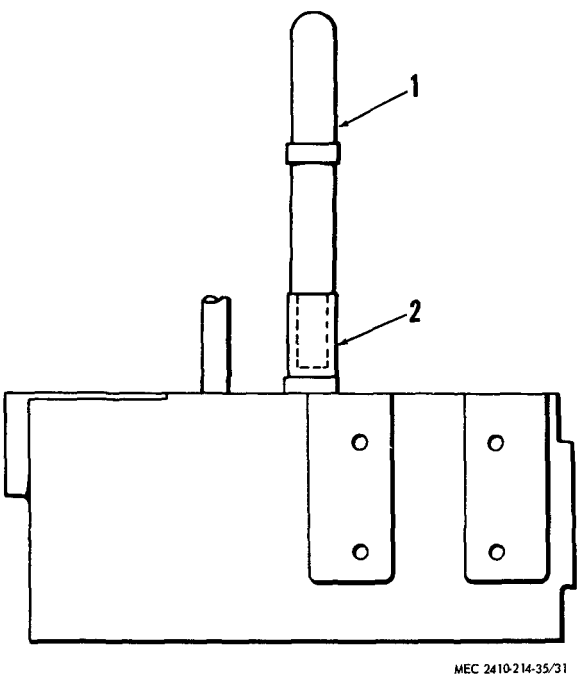


Figure 3–21. Installing valve guide.

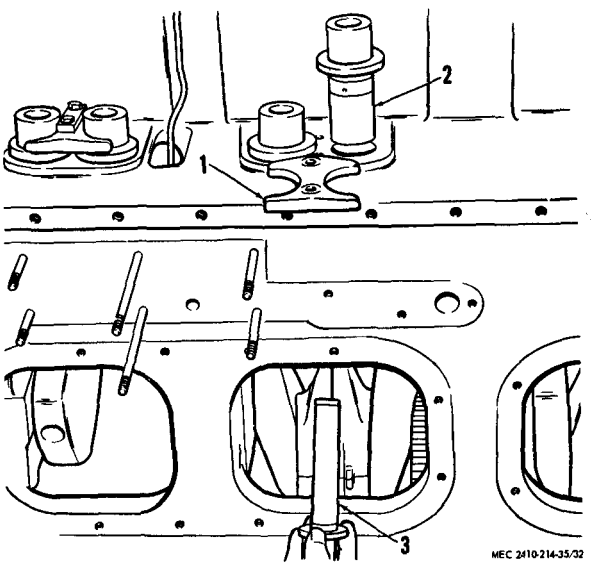


Figure 3–22. Valve lifters and guides.

indicate the wear in the guide excluding possible out-of-roundness. The valve guide ((2), fig. 3–21) can be pressed or driven in or out of the head with

the driver (1). Press into place carefully with the type of driver or inserting tool shown to prevent damage to the guide. A .499 -inch-.500-inch reamer run through the guides after they are installed will insure correct valve stem clearance.

e. ***Valve Lifters. The*** valve lifters operate in guides, which are located on the right side of the cylinder block and can be removed in the following manner:

(1) Remove the valve rocker arm assemblies.

(2) Remove the push rods.

(3) Remove the push rod cover from the side of the cylinder block.

(4) Remove the connecting rod inspection cover from the right side of the engine.

(5) Remove the retainer ((1), fig. 3-22) and raise the guide (2) sufficiently to permit the lifter (3) to clear the side of the camshaft and be removed through the inspection opening.

f. Compression ***Release Mechanism. The*** compression release is used to release engine compression by opening the inlet valve on each cylinder, thereby allowing the engine to be more easily barred over for repair and adjustment.

(1) Install a wrench on the compression release nut through the hole in the dash as shown in figure 3-23 and rotate 90° counterclockwise to relieve compression.

(2) Remove floor plate, cover on flywheel housing and pray against flywheel ring gear teeth as shown in figure 3-23 to bar engine over.

(3) Replace cover on flywheel housing, replace floor plate and rotate compression release shaft 900 clockwise to restore compression before attempting to start the engine.

Note. When rotating compression release to relieve compression the wrench will turn hard when valves have been opened and when restoring compression the wrench will turn easy when the valves have returned to their normal positions.

(4) Remove the compression release shaft ((1), fig. 3-24) if necessary, by removing screw (3) at front of block. Slide shaft out through guides (2) taking care not to damage the seal in the rear of the block.

(5) Install in reverse order of removal.

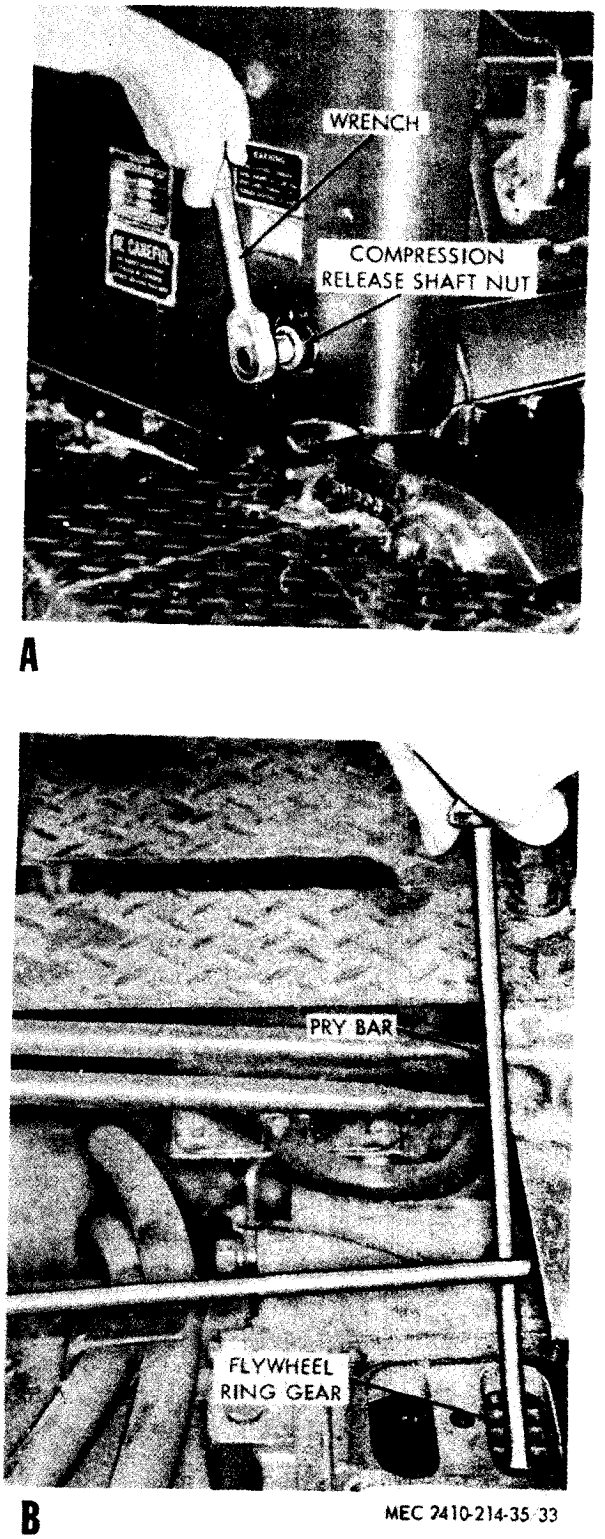


Figure 3–23. Releasing compression and barring.

3-6. Engine Cylinder liners

a. General. Cylinder liner surfaces are machined, hardened, ground, honed, and chemically treated to assure proper break-in. The resultant surf ace is so hard that ordinary boring tools will not machine it. Liners, pistons, and rings are available from the factory in standard sizes only and require no fitting when they are installed.

b. ***Removal and Installation.***

(1) Drain the cooling system.

(2) Remove the cylinder heads, the connecting rods and the pistons.

Note. Replace cylinder liners when they are worn at the top of ring travel more than .008 inch or when they are scratched or scored. Using inside micrometers, check cylinder wear at several positions to determine the greatest amount of wear.

,) Place a piece of cardboard or heavy gasket material through the inspection openings to protect the inside of the engine.

(4) Install a puller as shown in figure 3-25.

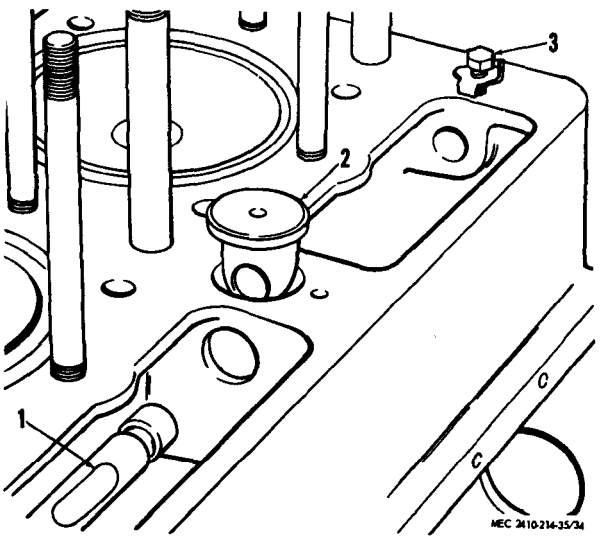
(5) Remove the cylinder liner and clean the water jacket sediment from the cylinder block.

Note. Three preformed packings fit in grooves on the lower end of each liner. The top packing ((1), fig. 3-26) protects the cylinder bore chamfer (3) from rust and scale. The cylinder bore chamfer is machined to permit the lower edge of the chamfer to align with the center line (2) of the top packing ring groove as illustrated.

(6) When installing the cylinder liner, always use new rubber packings. Coat the rubber packings with liquid soap to ease installation.

(7) Lower the cylinder liner carefully into the block. The liners can be driven into place by using a suitable driver, or by placing the puller adapter on the top of the liner. A block of hard wood, to be used as a driving block, is then placed on the puller adapter.

Note. Properly installed liners should extend slightly above the face of the cylinder block. This insures proper holding and sealing of the cylinder liner against the cylinder head gasket when the cylinder head is drawn down. Some liners may feel slightly loose in the cylinder block, yet serve satisfactorily without water or antifreeze leaking past the rubber seals.



1 Shaft
2 Guides
3 Screw

Figure 3–24. Compression release mechanism.

(8) Drive the liner into the cylinder block until it bottoms. Then hit the block of wood several light taps, to assure that the liner is in. If the last blow bottoms the liner too hard, the liner may bounce back out a trifle.

(9) Remove the cardboard and assemble the parts in the reverse order of removal.

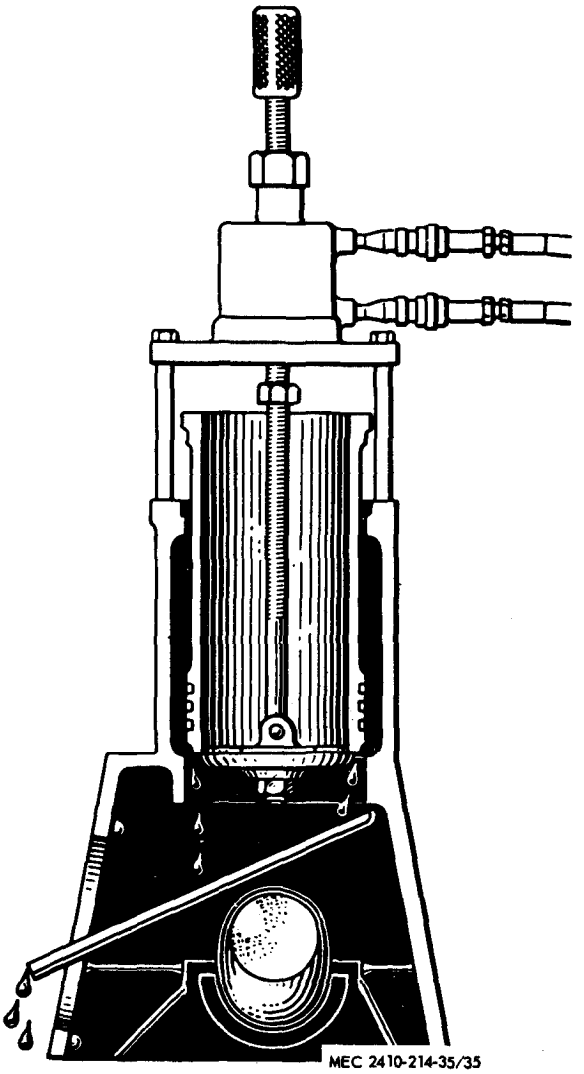
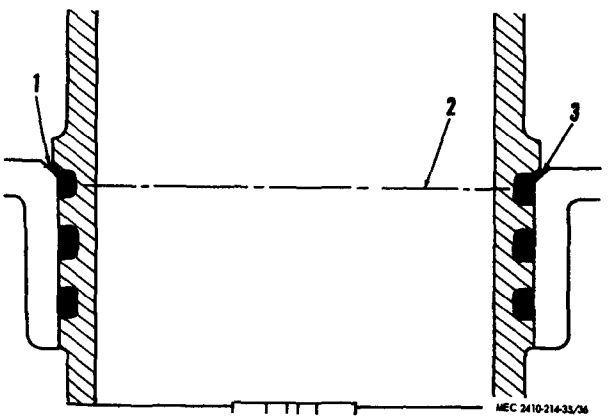


Figure 3–25. Pulling cylinder liner.



1 Top liner seal
2 Center line of the top seal ring groove
3 Cylinder bore chamfer

Figure 3–26. Liner packings.

c. Reconditioning Cylinder Liners. When new piston rings are to be used in worn cylinder liners, the ridge in the liner at the top of the ring travel must be raised to provide clearance for the new top ring. Since the liners are too hard for ordinary tools, use a liner ridge boring tool.

Caution: Be careful not to rotate the tool counterclockwise when the tool bit is against the liner wall. Doing so will break the cutting edge.

3-7. Main Bearings

a. General.

(1) The main bearings are precision-type of aluminum alloy. The lower halves are held in position by dowels in the bearing caps and the upper halves are doweled to the lower halves. This construction makes it possible to remove and replace the main bearings without removing the crankshaft from the engine.

(2) Oil enters the drilled passages in the cylinder block from the oil manifold. The main bearings are lubricated by this supply of oil. The oil is then carried through the drilled passages in the crankshaft to lubricate the connecting rod bearings.

b. Removal.

Note. **If crankshaft is not to be removed, remove only one bearing at a time. The bearing caps are identified by numbers stamped on the sides of the caps and block.**

The main bearings can be removed in the following manner:

(1) Remove the oil pan and main bearing cap nuts.

(2) Using either a pry bar or a puller, all bearing caps (except the rear) can be pulled. The recesses (fig. 3-27) can be used as a location for attaching the puller.

(3) Use a puller as shown in figure 3-28 to remove the rear main ‘bearing.

(4) The upper main bearing halves can be removed by use of the tool shown in figure 3-29. Place the tool in the drilled oil hole in the crankshaft and roll the bearing half out by rotating the crankshaft.

Note. **The flywheel end of the rear main bearing ((1), fig. 3-30) is bored .005 inch larger in diameter and consequently, the crankshaft will not touch this part of the bearing. This counterbore provides for oil control by permitting the oil return threads on the crankshaft to pump oil back to the oil groove from which a passage in the bearing and cap returns the oil to the oil pan. The rear main bearing (1) and the oil seal (3) eliminate the possibility of oil leaking into the flywheel clutch compartment. The rear main bearing halves have an annular *groove* (2) on the outside of the bearing at the rear. The seal is made to fit on the bearing with a rubber encased steel section of the seal fitting in this annular groove The seal contacts the crankshaft surface behind the oil return threads. A special adhesive material on the mating ends of the seal havles form a tight, leak-resistant joint comparable to a one-piece seal when the bearing cap is installed.**

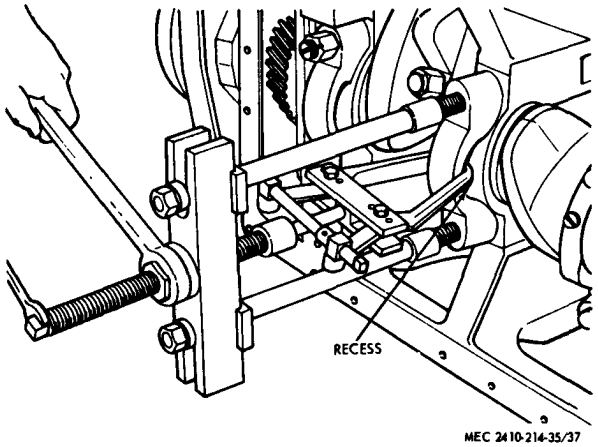


Figure 3–27. Removing main bearings.

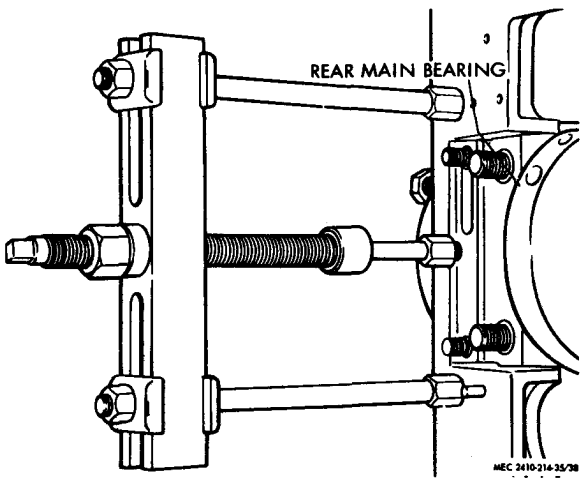


Figure 3–28. Removing rear main bearing.

c. Cleaning, Inspection, and Repair.

(1) Abrasive material may roll around between the bearing and crankshaft journal causing scratches in the aluminum bearing without actually becoming embedded in the aluminum. Such scratches are not necessarily harmful and do not indicate that the bearings should be replaced. If there is any question about the surface of a bearing, wash it with cleaning solvent to remove oil. If the surface feels rough and abrasive, install a new bearing. Another indication of dirt in the bearing is excessive crankshaft wear.

(2) The center main bearing (fig. 3-31) takes the end thrusts of the crankshaft. For normal end clearance and permissible end clearance (table 1-1). End clearance can be checked by pushing the crankshaft as far as will go to one end of the cylinder block and using a thickness gage to measure the clearance between the ma-

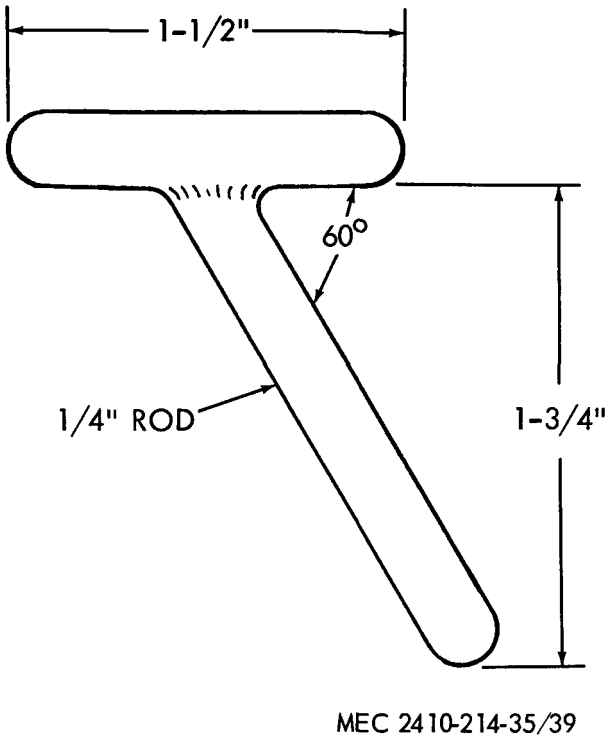
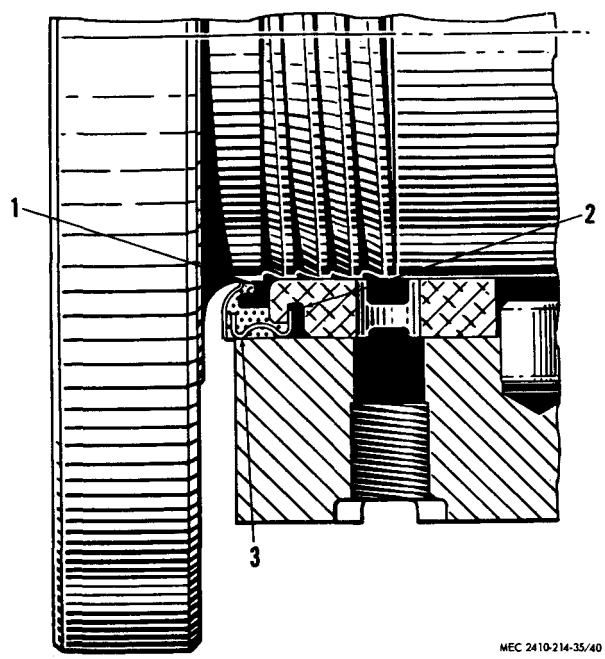


Figure 3–29. Tool for removing and installing main bearings.



1 Rear main bearing
2 Annular groove
3 Oil seal

Figure 3–30. Rear main bearing.

chined face of the crankshaft flange and the flange of the lower half of the center main bearing.

(3) Make certain that the cylinder block and bearing caps are perfectly clean and free from burrs and high spots. Handle the bearings carefully to avoid marring them. Leave them dry except for the grease holding the lead wire when checking clearances, and lubricate them generously for final installation.

Note. See table 1-1 for bearing clearances and wear limits on bearings and crankshaft. The clearances of the main bearings can be measured without removing the crankshaft if the engine is in an upright position. However, the crankshaft must be held against the upper halves of the main bearings; otherwise, the weight of the crankshaft will compress the lead wire slightly and indicate a lesser clearance than really exists.

(4) The bearing clearance can be checked by placing soft lead wire between the lower bearing half and the crankshaft. Coat two 1-inch lengths of the wire with soft grease and place them diagonally on the bearing as shown. The soft grease will keep the wires in position while installing and tightening the cap. Turn the crankshaft one complete revolution. Remove the cap and measure the thickness of the compressed wire with a 0-inch to l-inch micrometer to determine the bearing clearance (fig. 3-32).

Note. Precision main bearing valves, machined to provide proper clearance, are obtainable in complete sets and are to be installed without further machining or hand fitting. Single replacement bearings (both upper and lower half) can also be obtained and installed without special fitting. As a rule, however, it is good practice to replace the complete set if any one of the bearings needs to be replaced. If only one new bearing is installed and the other bearings are worn to any extent, the new bearing will carry more than its normal share of the load and might be damaged as a result.

d. Installation.

(1) Replace the seal when the rear main bearing assembly is removed or replaced. This is necessary because the adhesive material which seals the two halves of the split seal may be damaged when the seal is separated and the seal may leak if reinstalled.

(2) Before installing a bearing, wash it thoroughly and wipe the outer surface dry. Rotate the upper half into position in the same manner in which it was removed. Remove the tool, if used, from the oil hole in the crankshaft. Place the lower half in the cap, lubricate thoroughly and install the cap. The front and rear main bearing caps should be flush with the end faces of the cylinder block before tightening. See paragraph 1-4 for the proper torque values to use on the stud nuts. It is permissible to exceed the value by the amount necessary to turn to the next slot for alignment with the cotter pin hole.

(3) After the rear main bearing has been installed and the hollow-head screws and nuts

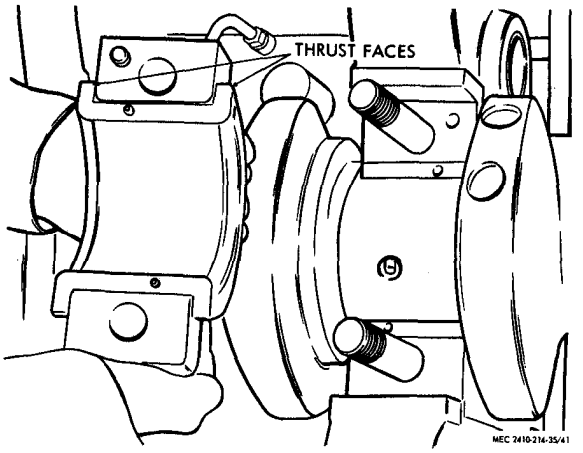


Figure 3–31. Center main bearing.

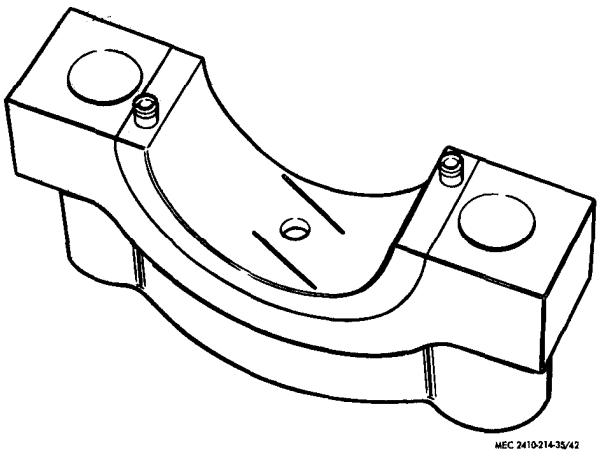


Figure 3–32. Checking main bearing clearance.

tightened. seal the bearing with 2B2414 packing as shown in figure 3-33.

(4) Feed the packing into the grooves on each side of the cap, tamping it tightly with a hammer and a long thin punch, in progressive folds until the grooves are filled.

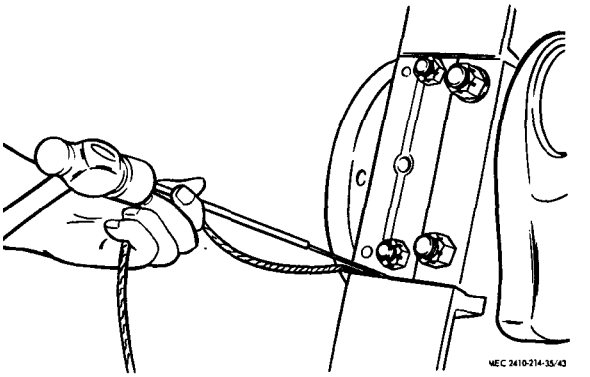


Figure 3–33. Rear main bearing packing seal.

(5) Complete the assembly in the reverse order of disassembly.

3-8. Crankshaft

a. Removal.

(1) Remove the diesel engine from the tractor (para 2-5).

(2) Mount the engine on a suitable engine positioning stand, if available, and remove the following: oil pan, oil pump, gear-type balancer, crankshaft pulley, engine front support flywheel housing, and timing gear housing.

(3) Support the engine on its side. as shown (fig. 3-34) and remove the connecting rod bolts and caps. Push the rods into the cylinders far enough to clear the crankshaft.

(4) Attach a sling and a suitable hoist and tighten the sling just enough to prevent the crankshaft from moving when the main bearing caps are removed. Remove the main bearing caps.

(5) Carefully remove the crankshaft. Protect the bearing surfaces from dirt and damage.

b. Cleaning, Inspection, and Repair.

(1) Clean the crankshaft in an approved solvent and dry thoroughly.

(2) The crankshaft should be replaced if the wear or out-of-roundness exceeds the maximum value given in table 1-1.

c. ***Installation.***

(1) Refer to paragraph 3-14 for proper timing of the crankshaft gear.

(2) Lubricate the bearings and position the crankshaft into the cylinder block.

(3) Install bearing caps. Tighten the center main bearing cap with the crankshaft in the extreme forward position. Refer to paragraph 1-4 for the proper torque on the bearing cap stud nuts.

(4) Check the crankshaft end thrust as indicated in paragraph 3-7.

3-9. Flywheel and Ring Gear

a. Remove the engine from the tractor (para 2-5) .

Note. The following sequence is with the engine removed. The operation can be performed with the engine in the tractor if the torque divider is removed (para 3-40). Before removing the flywheel, make certain that the alignment marks are visible on the flywheel and on the crankshaft flange.

b. Remove the torque divider.

c. Remove the torque divider sun gear ((1), fig. 3-35).

d. Remove cover (2), pointer (3), and bolts and locks (4).

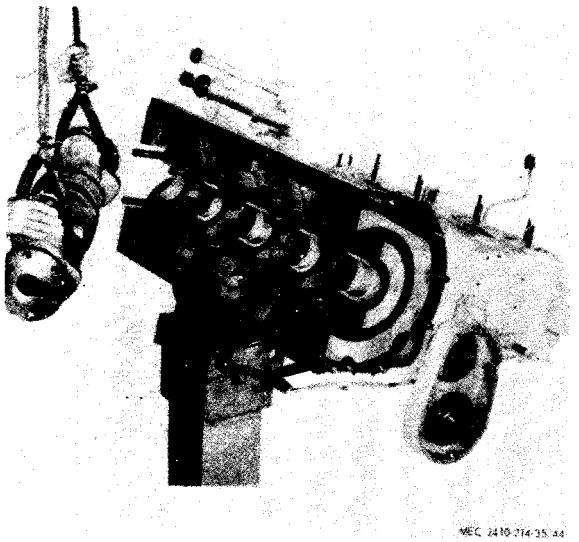
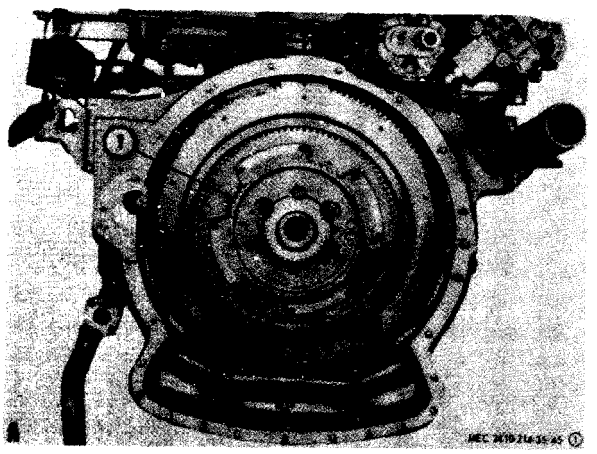


Figure 3–34. Removing crankshaft.



1 Torque divider sun gear
Figure 3–35. Preparing to remove flywheel.

e. Install a 3/8-inch-16 NC lifting eye in one of the threaded holes in the flywheel and attach a hoist.

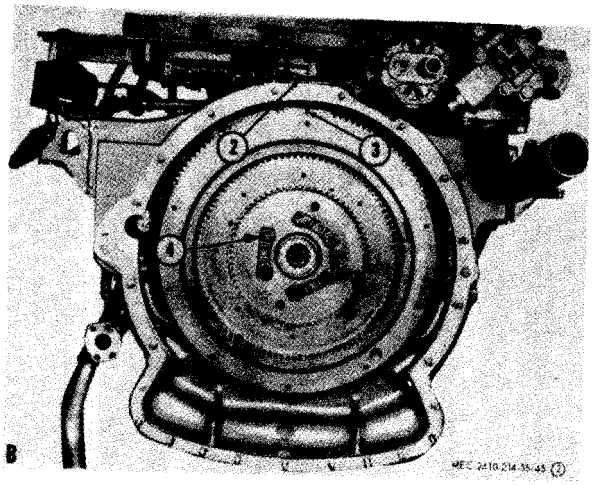
f. Remove the flywheel as shown in figure 3-36.

g. Remove the bolts and locks holding the ring gear on the flywheel.

h. Press the ring gear off the flywheel.

i. Before installing the ring gear, clean both the ring gear and flywheel and remove all burrs.

j. Heat the ring gear in oil, to a temperature not to exceed 600° F, and install it on the flywheel. Make certain the chamfered portion of the teeth on the ring gear is toward the cylinder block.



2 Cover
3 Pointer
4 Bolts and locks
Figure 3–35.—Continued

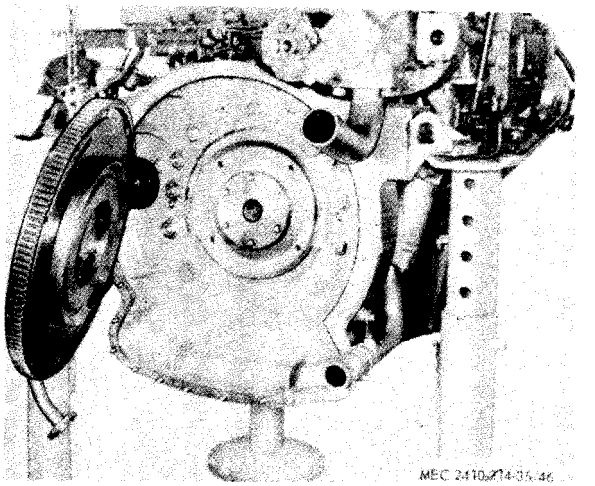


Figure 3–36. Flywheel removal.

k. When installing the flywheel, use guide studs in the crankshaft flange.

Caution: **Align the marks on the flywheel and crankshaft flange and install the flywheel.**

l. Tighten the flywheel bolts evenly and diametrically to the torque value given in paragraph 1-4g.

3-10. Gear-Type Balancer

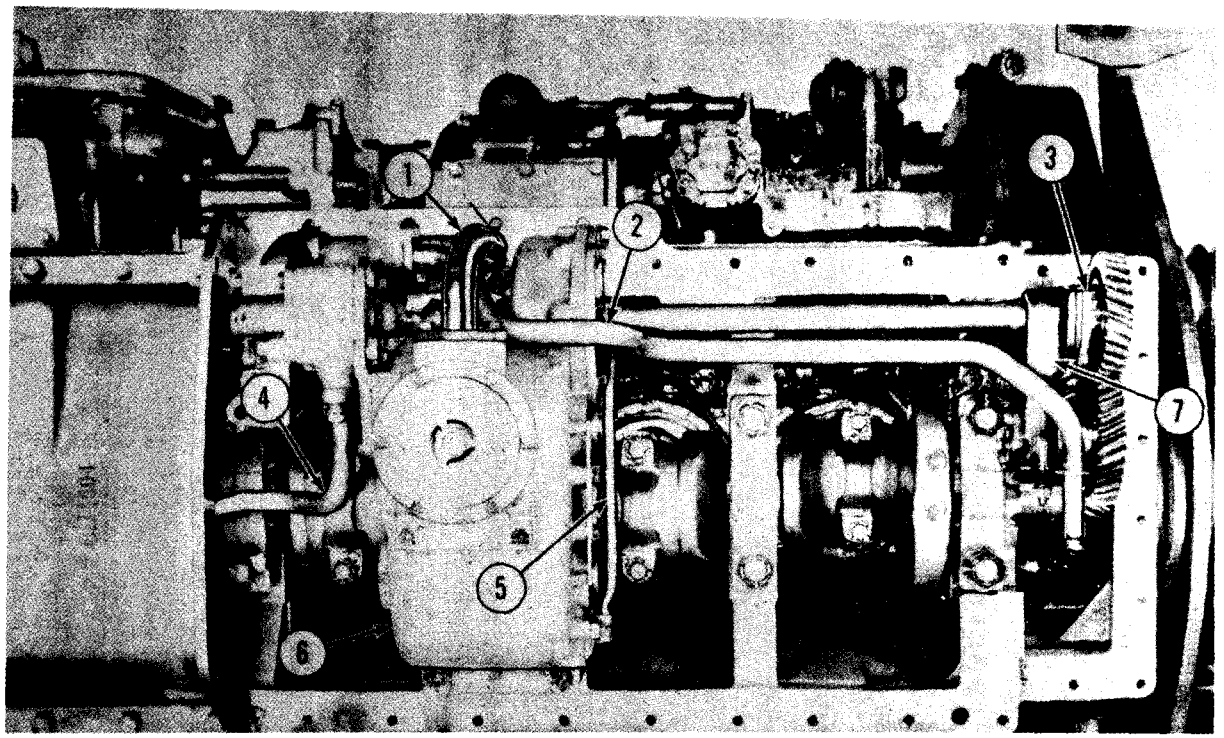
a. General. The balancer is positioned in a housing fastened to the underside of the block at the center of the engine. The balancer has two balance weights timed to each other and to the crankshaft. The balancer is driven from the crankshaft through an idler. The balance weights ro-

tate in opposite directions at twice engine speed and counteract vertical enertia forces of the connecting rods and pistons.

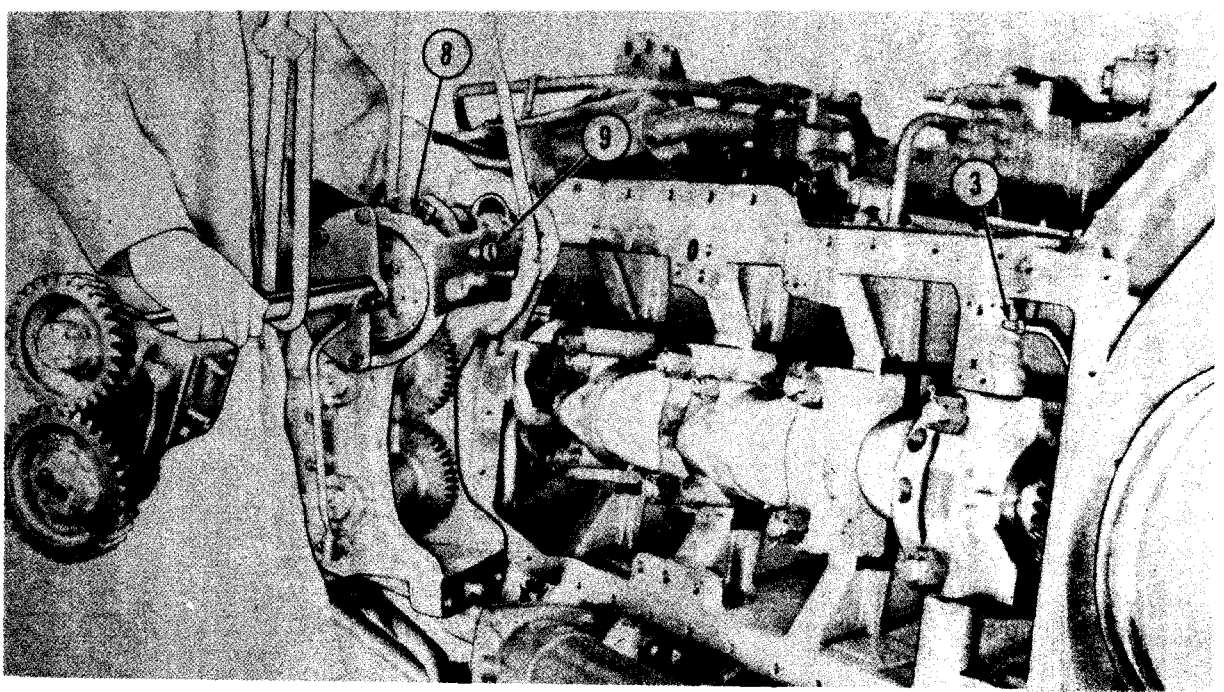
b. Balancer Drive.

(1) *Removal and installation.*

(*a*) Refer to paragraph 3–34 and remove oil pan.



A



B

MEC 2410-214-35. 47

1 Main oil pick up tube
2 Front scavenge tube
3 Oil line (hidden)
4 Rear scavenge tube
5 Oil line
6 Balancer bracket assembly
7 Shaft support bracket
8 Drive gear
9 Preformed packing

Figure 3–37. Removing balancer.

(b) Remove main oil pickup tube ((1), fig. 3-37) from scavenge tube (2) and oil line (3) from engine.

(c) With No. 1 piston on top center, insert the drive gear (8) to lock the balancer drive gear.

Note. If complete disassembly of the balancer is necessary, this step may be omitted.

(d) Remove the locks and bolts securing the shaft support bracket (7) and the balancer bracket assembly (6) to the cylinder block. Lift the brackets from the locating dowels on the cylinder block.

(e) Inspect preformed packing.

(f) With all timing marks in correct position and No. 1 piston on top center, install the balancer to the block. The balancer must be correctly timed within itself and to the engine (para 3-14).

Note. The crankshaft gear teeth are center punched to indicate the position of the timing mark. This makes it possible to align the balancer drive idler gear to the crankshaft gear without removing the timing gear cover.

(g) Tighten the bracket bolts (fig. 3-38). Torque bolts (1), (2), and (5) to 42-50 lb-ft and bolt (4) to 115-125 lb-ft. Install wire locks (3) as shown.

Caution: **Remove the positioning bolt before installing the oil pan or rotating the crankshaft.**

(2) *Disassembly and assembly.*

(a) Disconnect drive gear cover ((4), fig. 3-39) and remove balancer bracket assembly.

(b) Remove thrust washer (7) from shaft support bracket (9).

(c) Pull drive gear (8).

(d) Remove the bolts securing front plate (13) to the rear plate (10) and remove the plates, gear (5), spring plate (11), and key (14) from the hub (12).

(e) If the hub is moved or removed from the shaft, position the hub so the distance from the threaded end of the shaft to the front of the hub is 20.422 inches.

(f) Install two 5/16-inch-18 (NC) guide studs ((1), 3-40) in the rear plate ((10), fig. 3-39).

(g) Install gear and hub. Install a spring ((2), fig. 3-40) a spacer (3), two springs, a spacer and a spring in that order.

(h) Install front plate, remove the guide studs and install the bolts.

(i) With the timing marks aligned (weights down with the flat top sides in a horizontal plane) install the balancer drive gear and align the timing marks (fig. 3-41).

(j) Install the positioning bolt (2) to lock gears in correct position. Assemble drive gear cover to bracket.

(k) Refer to table 1-1 for proper bearing clearance and end clearance.

(l) Assemble the shaft support bracket and idler gear, and drive gear to the balancer drive shaft.

c. Balancer Weight and Bracket, Disassembly and Assembly.

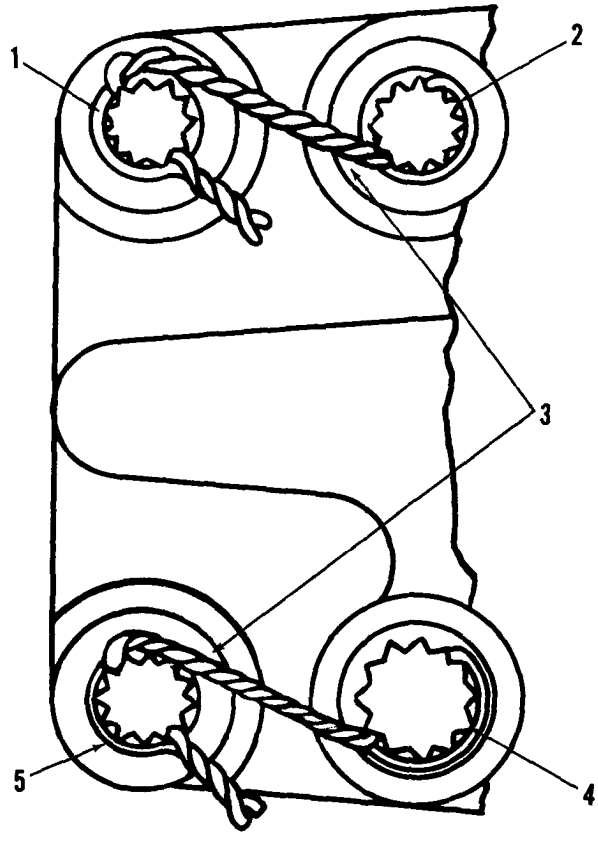
(1) Remove the shafts ((4), fig. 3-42) and (6) from front of bracket.

(2) Check the oil inlet hole (7) tol obstructions.

(3) A suitable press or driver can be used to remove and install bearings ((1), fig. 3-43) and (3) and spacers (2) in the weights.

(4) With the large gear end of the weights turned up, press the bearings (1) into the bore of the weights .031 -inch past the face of the large end of the gear at (A).

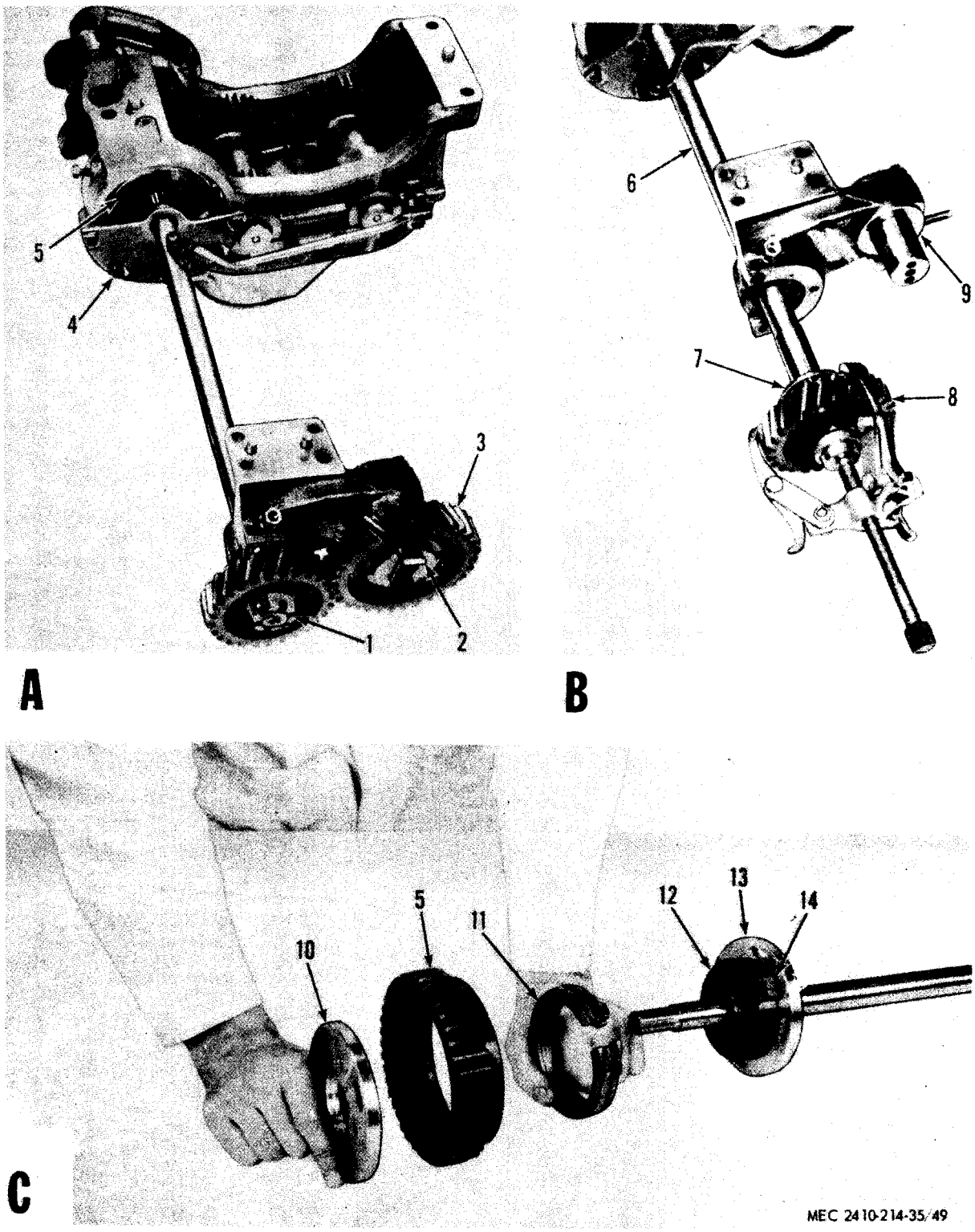
Caution: **The bearings must be installed with the split joint toward the heavily weighted portion of the weight assembly.**



1 Bolt
2 Bolt
3 Wire locks
4 Bolt
5 Bolt

Figure 3–38. Shaft support bracket mounting detail.

(5) Install the spacers and then press the



1 Nut
2 Retainer plate
3 Idler gear
4 Drive gear cover
5 Drive gear
6 Balancer drive shaft
7 Washer
8 Drive gear
9 Shaft support bracket
10 Drive gear rear plate
11 Spring plate
12 Hub
13 Drive gear front plate
14 Key

Figure 3–39. Balancer drive disassembly.

remaining bearings into the weights until they bottom against the spacers.

(6) Place the balance weights in the bracket, aligning the timing marks ((2), fig. 3–42) on the weight gears.

(7) Align the bores and press the shafts into the bracket and weights. Install the bar (5), bolts and lock.

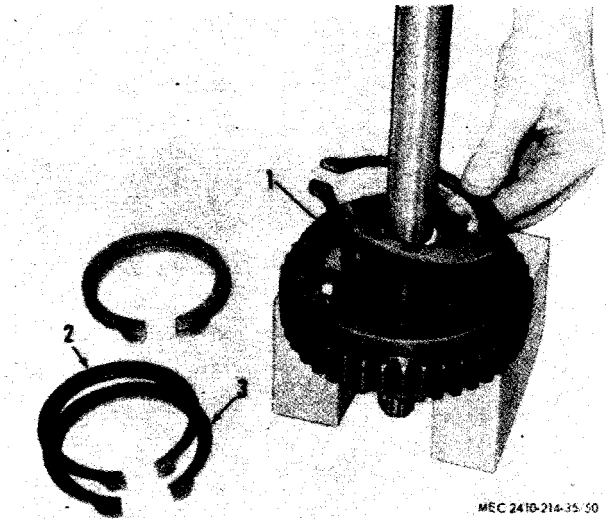
3-11. Flywheel Housing and Slinger

a. Remove the flywheel (para 3-9).

Note. The following sequence is with the engine removed. The operation can be performed with the engine in the tractor if the engine is securely blocked to remove the weight from the flywheel housing.

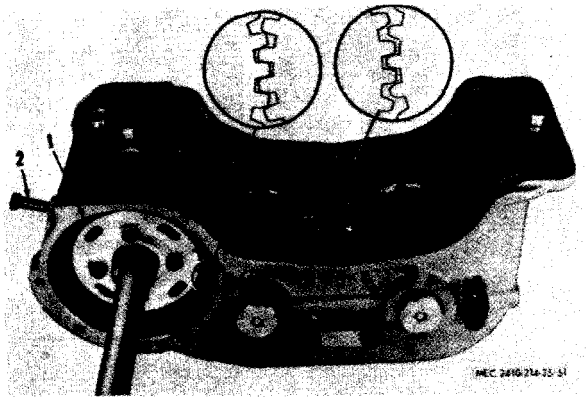
b. Install two 3/8-inch eyebolts in the top of the flywheel housing and attach a suitable hoist.

c. Remove bolts and lock (1), fig. 3-44) nuts and locks (2), and slinger (3).



1 Guide stud, 5/16 inch-18
2 Spring
3 Spacer

Figure 3–40. Balancer gear assembly.

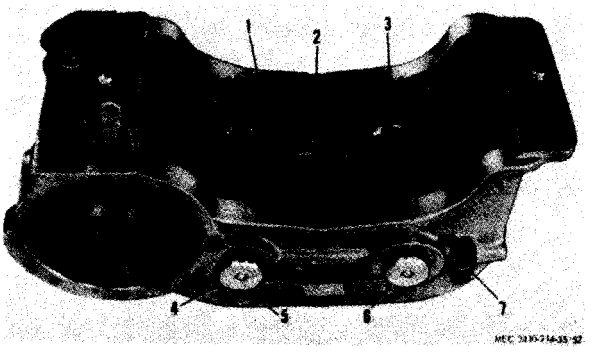


1 Drive gear
2 Bolt, positioning, 3/8 in.-16

Figure 3–41. Assembly of balancer drive to balancer.

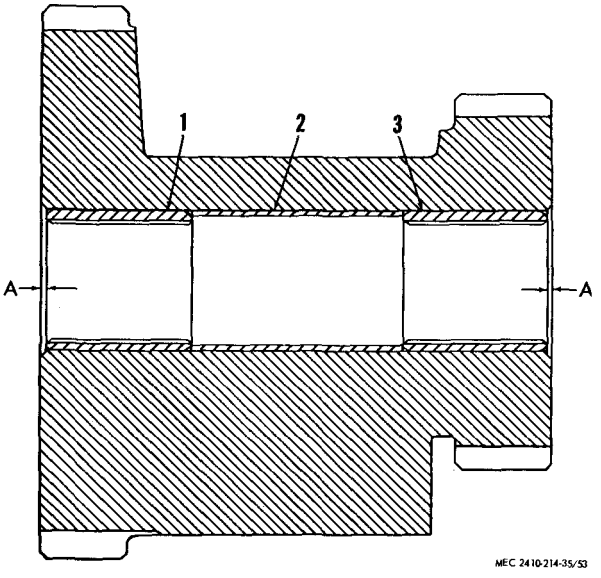
d. Remove the four bolts which hold the flywheel housing to the pan, and remove the housing.

e. Check and replace gaskets, if necessary, before installation.



1 Balancer weight
2 Timing marks
3 Balancer weight
4 Shaft
5 Bar
6 Shaft
7 Oil inlet hole

Figure 3–42. Balancer weight removal.



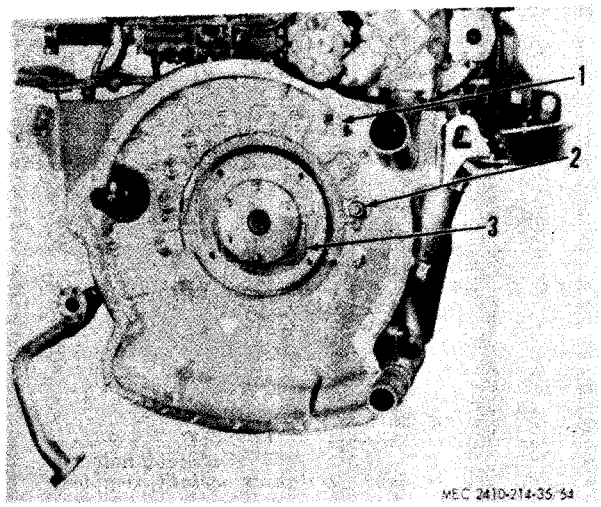
A—.031 dimension
1 Bearing
2 Spacer
3 Bearing

Figure 3–43. Installing bearing and spacers in balance weights.

f. Tighten the flywheel housing nuts and bolts evenly to the torque valve given in paragraph 1-4g.

3-12. Pistons and Connecting Rods (fig. 3-45)

a. General. The aluminum alloy piston has three rings, consisting of two compression rings and one oil ring. All rings are located above the piston pin bore. The two compression rings seat in integral cast iron bands and the single oil ring is springloaded. Holes in the groove for the oil ring provide for the return of oil to the crankcase. The piston pins are full floating and are held in place by retainers fitting into recesses in the pin



1 Bolts and lock
2 Nuts and locks
3 Slinger

Figure 3–44. Flywheel housing removal.

bore. The stainless steel plug in the crater of the piston prolongs piston life by providing a more heat resistant surface at the point of highest combustion temperature.

b. Removal and Disassembly.

(1) Drain the lubricating oil and the engine coolant.

(2) Remove the cylinder heads as described in paragraph 3-4.

(3) Remove the carbon from the inside top surface of the cylinder liner.

(4) Remove the cylinder block inspection covers or the oil pan.

(5) Remove the cotter pins and nuts from the connecting rod bolts. Remove the cap and bearing lower half as shown in figure 3-46.

Caution: **Connecting rod bearing caps and connecting rods are numbered to insure installation in their original positions.**

(6) Remove the bearing upper half by turning the crankshaft or pushing the rod up slightly.

(7) Rotate the crankshaft until the piston to be removed is at top dead center. Carefully push the connecting rod upward until the piston rings are out of the cylinder.

(8) Lift out the piston and connecting rod assembly.

(9) Remove piston rings with a ring expander.

(10) Remove piston pin retainers at each end of piston pin and remove piston pin.

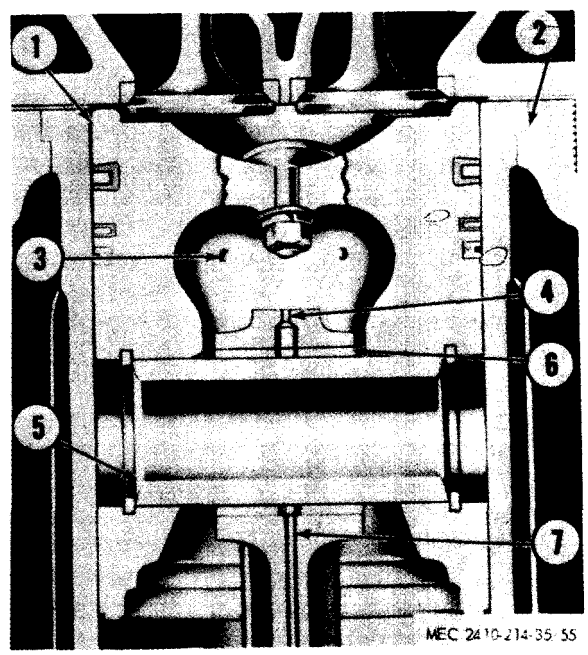
c. *Cleaning, Inspection, and Repair.*

(1) Remove all carbon and gummy deposits from the piston by cleaning with an approved solvent. Dry thoroughly.

Caution: **Do not use carbon scrapers 01 broken piston rings to remove carbon from the piston grooves. Use a stick of hardwood for this purpose.**

(2) The gap between the ends of the piston ring should be measured before the rings are installed on the pistons. Insufficient ring gap may caused scored cylinder sleeves or other serious damage. Select the rings to be used on each piston and push them one at a time into the cylinder sleeve in which they are to operate. Use a piston to push the ring squarely into the cylinder sleeve so that it is parallel with the top and in the ring travel area and measure the gap with a feeler gage.

Note. Prior to reassembly ensure that the piston and piston parts are within limits given in table 1-1. Check cylinder liners.



1 Piston
2 Cylinder liner
3 Oil return hole
4 Oil discharge hole
5 Piston pin
6 Bearing
7 Drilled oil passage in connecting rod

Figure 3–45. Piston and ring lubrication.

d. Reassembly and Installation.

(1) If a new piston pin bearing is required, it must be pressed into place and then machined accurately on a rod boring machine.

(2) Reassemble piston, connecting rod and piston pin and secure with piston pin retainers. Number on connecting rod must be opposite V-mark on piston.

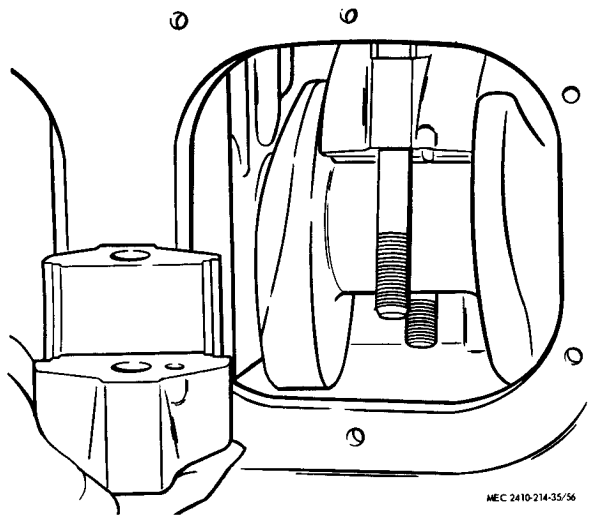


Figure 3–46. Removing connecting rod bearing cap.

Caution: **The intermediate compression ring has the TOP marked. Be sure to install this ring correctly.**

(3) Install the piston rings on the piston using a piston ring expander. New rings must be used on new pistons. If old pistons are reused, the use of new rings is recommended to ensure proper seating.

(4) Place a piston ring compressor tool over the cylinder into which the piston is to be installed.

(5) Oil the piston and rings and place the piston and connecting rod assembly into the cylinder liner until the ring rests on the compressor tool. Position the V-mark on top of the piston in alignment with the V-mark on top of the cylinder block. This will place the recess for the valves and the heat plug in the piston in the correct relationship to the valves and precombustion chamber in the cylinder head. Push the piston through the compressor and into the cylinder liner.

(6) Oil and reinstall the bearing upper half and push the piston down to hold it in place.

(7) Oil and install the bearing lower half and the bearing cap and secure with the proper nuts. Torque the nuts to the value listed in paragraph 1-4b.

(8) Install cotter pins to secure the nuts.

(9) Replace the cylinder block inspection covers or the oil pan (whichever was removed).

(10) Replace the cylinder head, lubricating oil, and engine coolant.

(11) Whenever new rings, piston assemblies or piston and liner groups are installed, be sure to run-in the engine on a conditioning schedule before operating at normal load and speed. Do not run the engine idle for a long period after installing new rings.

3-13. Camshaft and Camshaft Bearings

a. Removal.

(1) Remove the valve rocker arms and push rods. Remove the timing gear housing, as covered in paragraph 3-14.

(2) Remove the accessory drive housing and the push rod cover.

(3) Raise the valve lifters (fig. 3-47) and secure them in this position with a piece of wire around the groove in the top.

(4) Remove the camshaft and gear assembly. Be careful not to damage the bearing bores as the cams pass through them.

(5) Check the bearing clearance. For the permissible bearing clearance, (table 1-1).

(6) Press the bearings out of the cylinder block if replacement is necessary.

b. Cleaning, Inspection, and Repair.

(1) Clean all parts in an approved solvent.

(2) Replace all parts exceeding limits given in table 1-1.

c. Installation.

(1) Install the camshaft f rent bearings and spacer with the split toward the top and center of the block, and so there is .03-inch clearance from the face of the cylinder block to the bearing edge.

(2) Install the center and rear bearings with split toward top and center of block.

(3) Complete the installation in the reverse order of removal.

d. Checking Camshaft End Clearance.

(1) The end thrust of the camshaft is taken by two thrust washers. These thrust washers are identical and interchangeable. One thrust washer is located on the cylinder block and held by two dowels. The other thrust washer (fig. 3-48) is located inside the timing gear housing and held in position by two dowels. The thrust washers take the thrust from the machined face on both sides

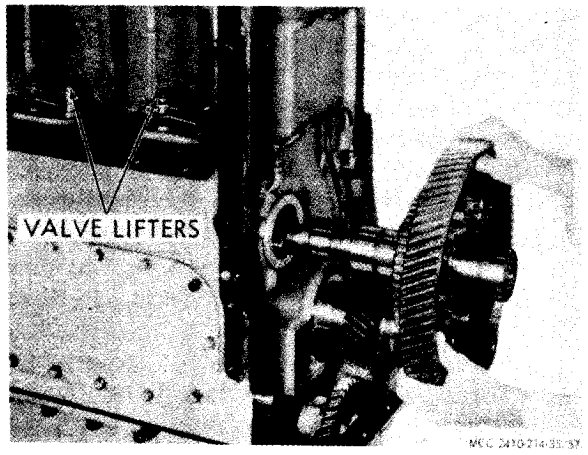


Figure 3–47. Removing camshaft.

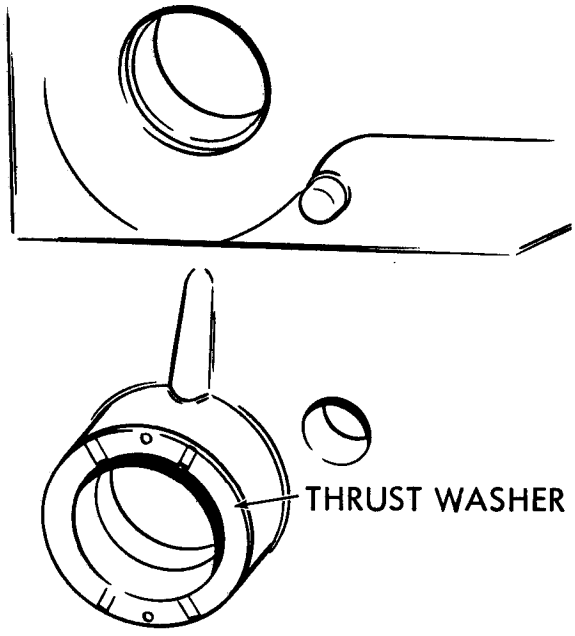


Figure 3–48. Camshaft thrust washer.

of the small camshaft gear, which is integral with the camshaft.

(2) The end clearance can be checked only with the timing gear housing in place.

(3) To check end clearance, remove the camshaft bearing cover and install a dial indicator on the housing so that the anvil is against the end of the camshaft.

(4) Remove the rear connecting rod inspection cover and use a bar to move the camshaft forward and back as far as it will move. See table 1–1 for the correct end clearance and permissible clearance. When excessive clearance is noted, remove the timing gear housing and the camshaft and install new thrust washers.

3-14. Timing Gears and Timing Gear Housing

a. Timing Gear Housing.

(1) Removal.

Note. The engine is removed from the tractor for the following removal sequence. The operation can be accomplished with the engine in the tractor if the radiator and guard are removed (para 3-29). The engine must be securely blocked up in the front after the spacers are inserted between the oil pan and cylinder block, but before the front support is removed.

(a) Remove the governor control mechanism ((1), fig. 3-49).

(b) Remove water pump (2). Refer to TM 5-2410-214-12.

(c) Refer to paragraph 3-2 and remove the crankshaft pulley ((3), fig. 3-49).

(d) Refer to paragraph 3-15 and the rear power takeoff shaft.

(e) Remove the bolts that secure the oil pan to the timing gear housing.

(f) Loosen the bolts along both sides of the oil pan so that the spacers (fig. 3-50) can be placed, one on each side, between the oil pan and the cylinder block to prevent damaging the gasket when removing the timing gear housing.

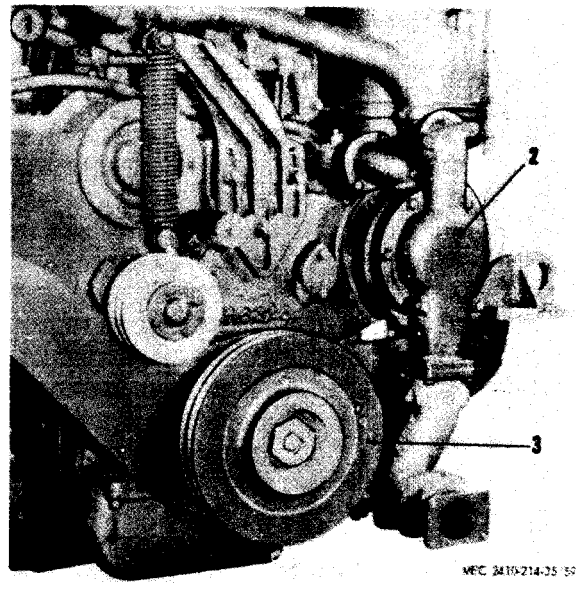
Note. Use care, when installing the spacers, not to damage the oil pan gasket.

(g) Remove the front support (para 3-2).

(h) Remove all bolts securing the timing gear housing to the cylinder block.

(i) Using a hoist for support, move the timing gear housing straight forward until it clears the dowels and the end of the crankshaft.

Note. The timing gears are driven by the crankshaft. These gears have timing marks which must be aligned as shown for proper engine operation. The rear power takeoff is driven by the large helical gear of the camshaft gear assembly ((2), fig. 3-51). This gear also meshes with an idler gear, located in the timing gear housing, which drives the water pump. There is a small cover on the front of the timing gear housing which can be removed for checking the timing marks of gears (1) and (2).



1 Governor control mechanism
2 Water pump
3 Crankshaft pulley

Figure 3–49. Preparing to remove timing gear housing.

(2) Inspection.

(a) Inspect the timing gear housing for cracks or damage.

(b) Inspect the mounting gasket and replace if damaged.

(3) Installation.

(a) Install the timing gear housing cover in the reverse order of removal.

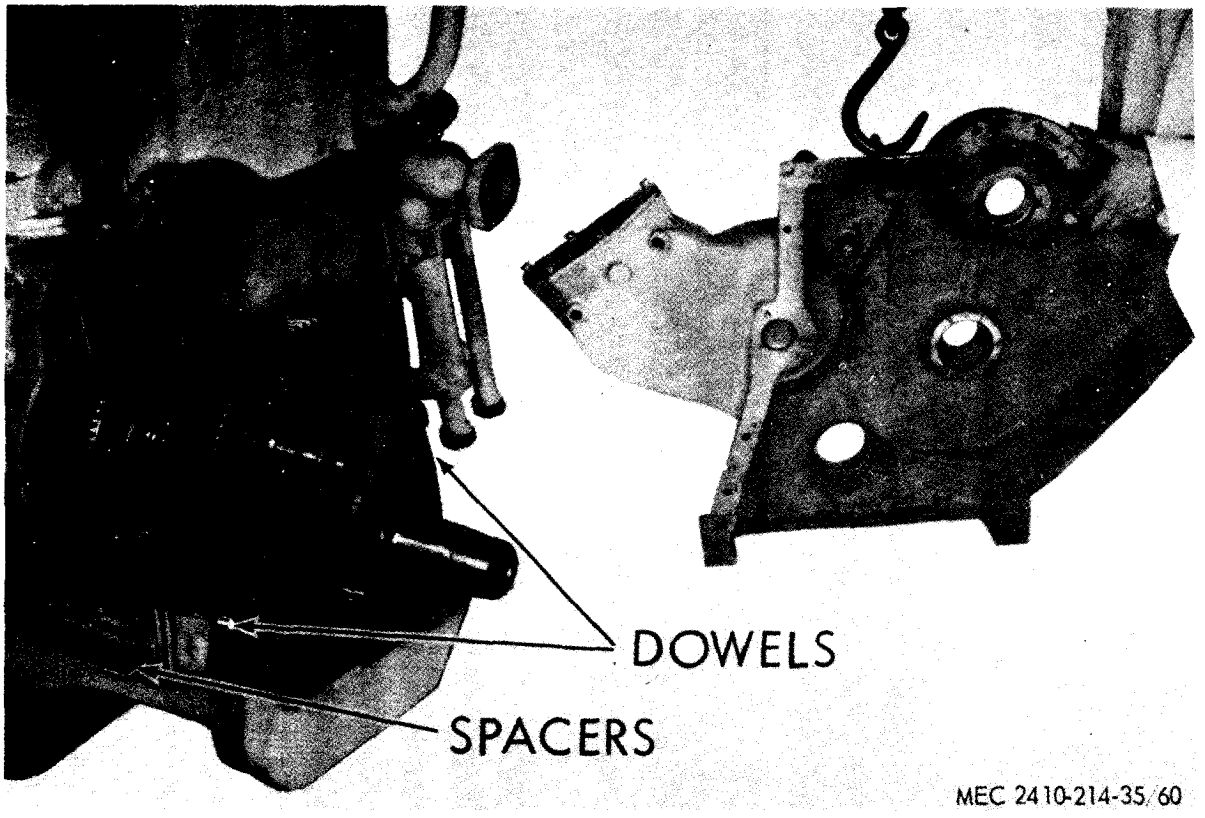


Figure 3–50. Timing gear housing removed.

(b) Tighten the timing gear housing bolts evenly to the torque valve given in paragraph 1-**4g.**

b. Idler Gear.

(1) Removal.

(a) Remove the timing gear housing.

(b) The water pump idler gear ((1), fig. 3-52) can be removed in the following manner: Remove the cover from the timing gear housing (2) and pull the shaft (3) from its bore in the housing as shown. Use a puller, an adapter, and a box wrench.

(c) Remove the idler gear.

(2) ***Inspection.***

(a) Clean idler gear and shaft in an approved solvent.

(b) Check the shaft and bearings (table 1-1).

(c) Inspect the oil line to be sure it is not damaged.

(3) ***Installation.***

(a) When installing the water pump idler gear, place the gear in the housing so the side of the gear with the longest hub ((1), fig. 3-53) is facing the rear of the engine.

(b) Press the shaft (2) through the bore in the housing and through the gear to a depth of 3/16 inch (A) as illustrated.

c. Camshaft Gear.

(1) ***Removal.***

(a) Remove the timing gear housing.

(b) Remove the nuts and locks from the bolts ((1), fig. 3-54) and remove the gear (2).

(2) Cleaning, ***inspection, and repair.***

(a) Clean the gear in an approved solvent and dry thoroughly.

(b) Inspect the gear for cracks and missing or worn teeth. Replace if necessary.

(3) ***Installation.***

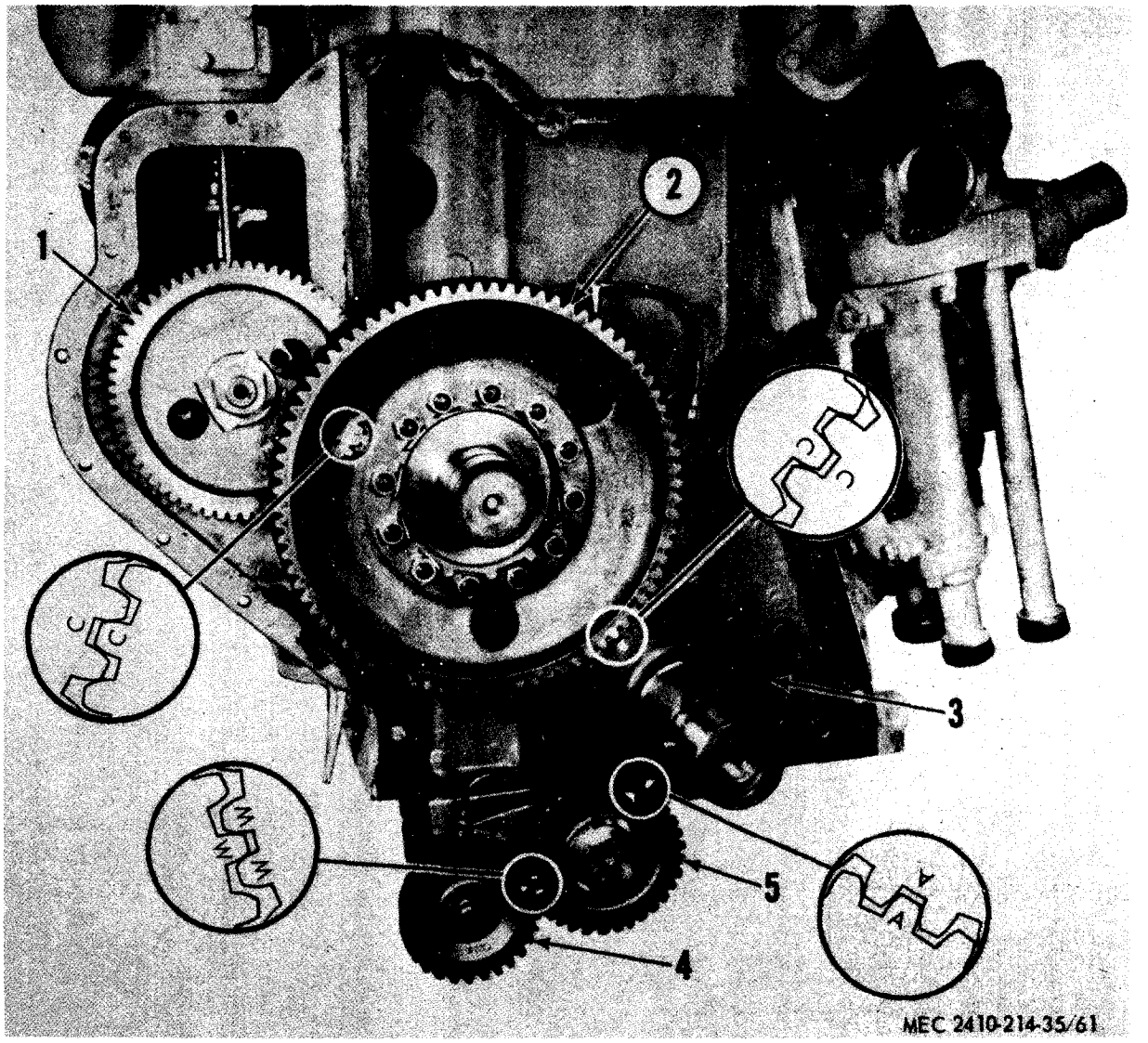
Caution: **Do not drive the gear on the camshaft, as this may dislodge the plug in the camshaft rear bearing bore and allow oil to leak into the flywheel housing.**

(a) Align the camshaft timing mark with the crankshaft timing mark and install the camshaft gear.

(b) Install the locks and nuts and tighten evenly and diametrically to the torque valve given in paragraph 1-4g.

(4) ***Checking camshaft gear backlash.***

(a) The backlash between the camshaft gear and the crankshaft gear can be checked by a dial indicator. The backlash between the camshaft gear and the crankshaft gear is listed in table 1-1.



1 Accessory drive gear
2 Camshaft gear
3 Crankshaft gear
4 Balancer drive gear
5 Balancer drive idler gear

Figure 3–51. Timing gears and marks.

(b) When a dial indicator reading of a value greater than the permissible backlash is shown, a further check must be made to determine the cause. Excessive backlash indicates that either the timing gears, the main bearings or the camshaft bearings are badly worn.

(c) Timing gear wear can be compensated for by adjusting the fuel injection pump lifters (para 3-22).

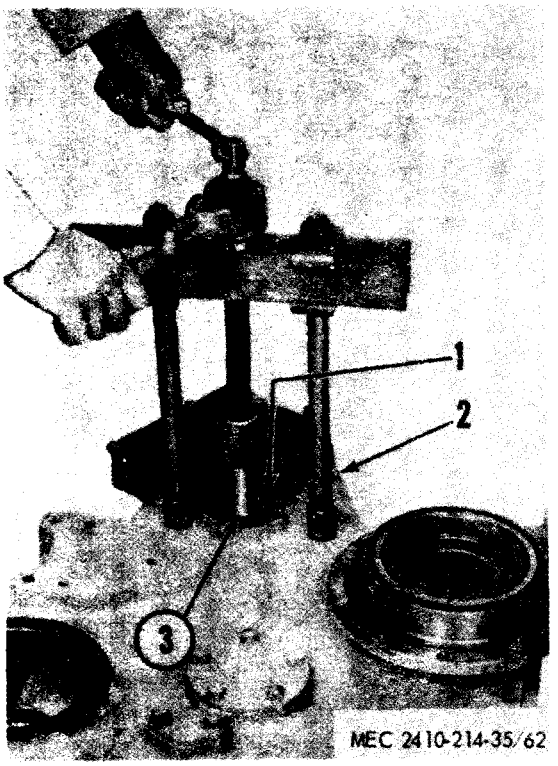
(d) If either the main bearings or the camshaft bearings are badly worn, they should be replaced with new ones.

(e) If a reading of less than the minimum backlash is shown, it is an indication of incorrect assembly, or burr or rough spot on one of the gears. In this case, take readings every 90° around the camshaft gear to determine the cause. A burr can be removed from a gear tooth, by using a gear file or fine stone, without removing the gear from the camshaft. When removing a burr, cover the remaining exposed parts to keep them clean.

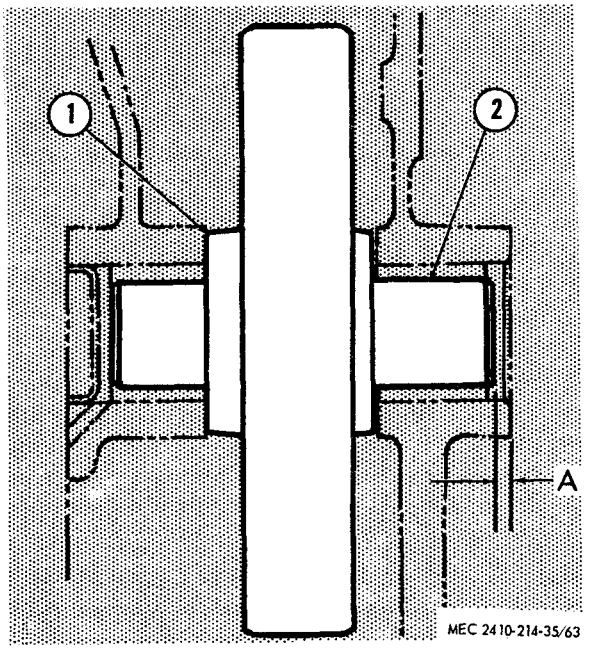
3-15. Rear Power Takeoff and Transmission Oil Pump Driver

a. Rear Power Takeoff Drive.

(1) General. The rear power takeoff drive shaft is located on the right side of the engine and is driven by the camshaft gear. The drive gear is a shrink fit on the shaft, and is carried by a bearing **in the cover on** the **timing gear housing** and bearing at the front and the rear of the cylinder block. Thrust washers in the timing gear



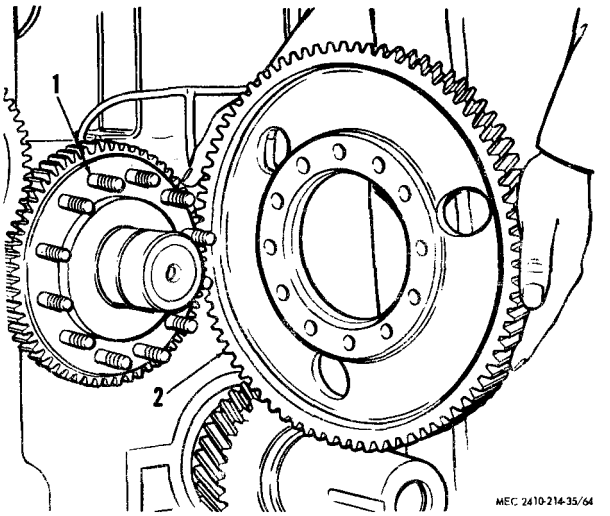
1 Gear
2 Housing
3 Shaft
Figure 3–52. Idler gear removal.



A—3/16 in.
1 Hub
2 Shaft
Figure 3–53. Installing the water pump idler gear

housing take the thrust loads on the machined faces of the drive gear.

(2) ***Removal and disassembly.***



1 Bolt
2 Gear
Figure 3–54. Camshaft gear removal.

(a) Remove hydraulic and winch pumps.

(b) Remove the cover from the power takeoff housing ((1), fig. 3-55).

(c) Remove snapring (2) and gear (3).

(d) Remove snapring (5) and bolts securing cage assembly (6) to the housing.

(e) Use two 3/8-inch-16 (NC) bolts in the holes (6) to remove the cage assembly.

Caution: **The cage assembly must be removed to prevent damage to the bearings inside of the cage when removing and installing the rear power takeoff shaft.**

(f) After the bolts which hold the cover assembly ((1), fig. 3-56) in place have been removed, use three 3/8-inch–16 (NC) forcing bolts (2) in the holes provided to remove the cover assembly from the timing gear housing as shown.

(g) Remove the shaft as shown in figure 3-57.

(3) *Cleaning, inspection, and repair.*

(a) Clean all parts in an approved solvent.

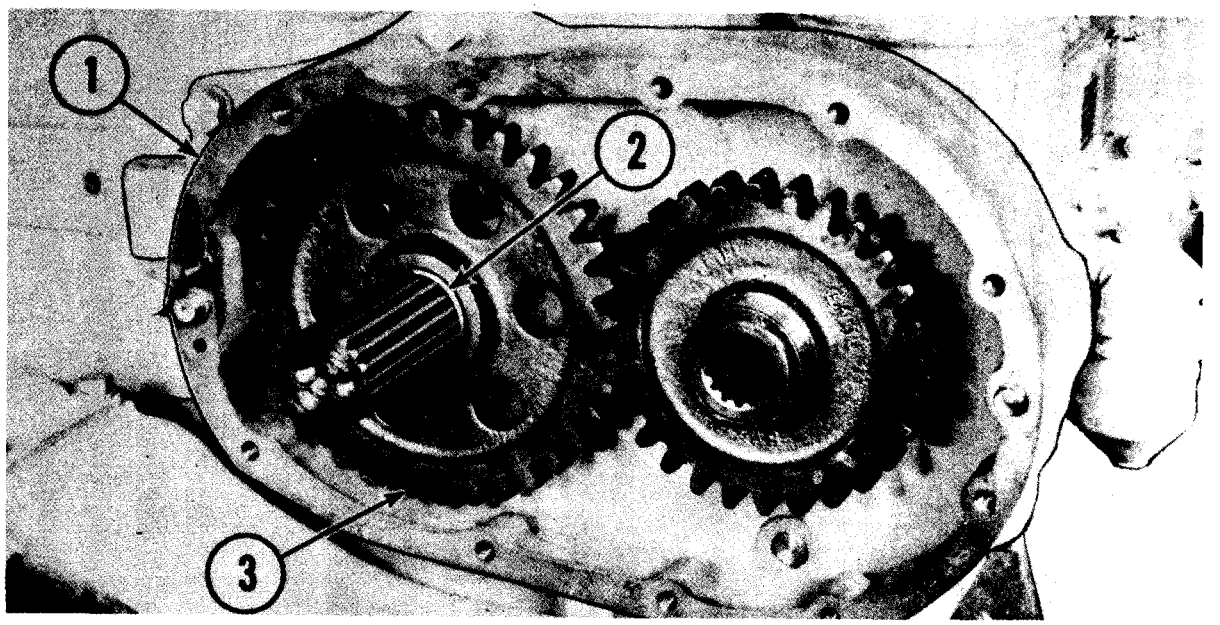
(b) Remove burrs and rough surfaces from the gear teeth with a gear file or fine stone.

(4) ***Reassembly and installation.*** Reassemble and install in the reverse order of removal and disassembly.

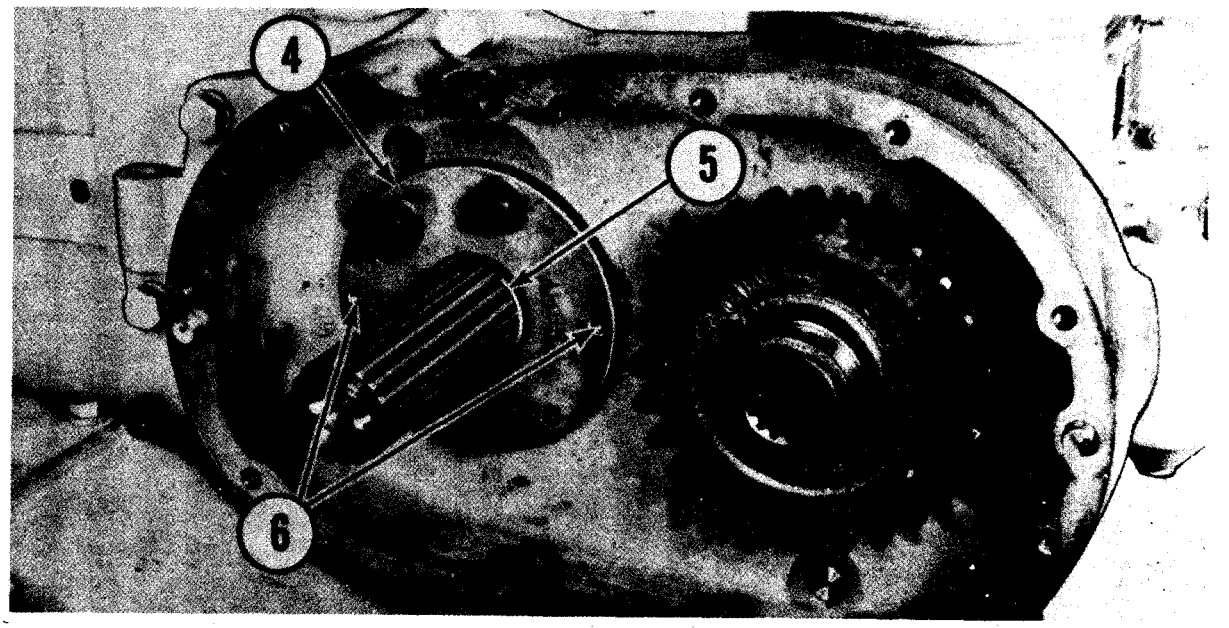
(5) Checking ***end clearance.***

(a) The end clearance is controlled by two thrust washers similar to the camshaft thrust washers. The distance between the thrust washers is greater than the distance between the machined faces of the drive gear, thus permitting the shaft to move forward and back in the bearings.

(b) The end clearance can be checked by removing the power takeoff housing cover, mounting a dial indicator against the rear end of the



A



B

MEC 2410-214-35/65

1 Power takeoff housing
2 Snapring
3 Gear
4 Cage assembly
5 Snapring
6 Forcing bolt holes

Figure 3–55. Rear drive assembly.

rear power takeoff drive shaft and moving the shaft forward and backward to its limits.

(c) See table 1-1 for the correct end clearance and permissible clearance.

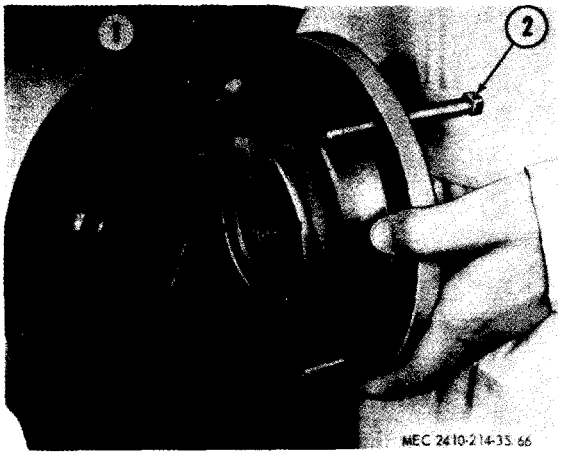
(d) When excessive clearance is shown, remove the drive shaft and install new thrust washers.

b. Transmission Oil Pump Drive.

(1) Removal and disassembly.

(*a*) Remove the cover of the power takeoff housing.

(b) Inspect the bearings (fig. 3-58) and replace if damaged. To remove the inner races (1) and (3) fracture will probably be necessary. The outer race (4) can be driven out of the housing (5) through an opening in the front of the housing. The outer race (7) can be driven from the cage (6) after the cage has been removed from the cover.



1 Cover assembly
2 Forcing bolts
Figure 3-56. Cover assembly removal.

(2) *Cleaning, inspection, and repair.*

(a) Clean all parts in an approved solvent.

(b) Remove burrs or rough spots from pump drive gear with a gear file or fine stone.

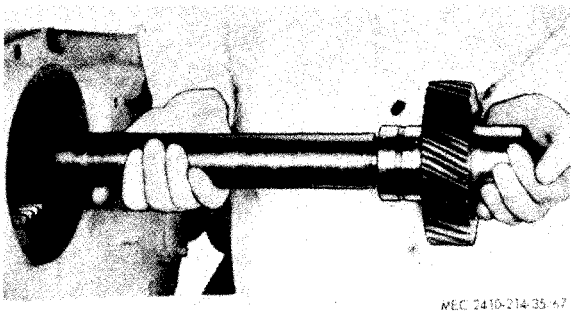
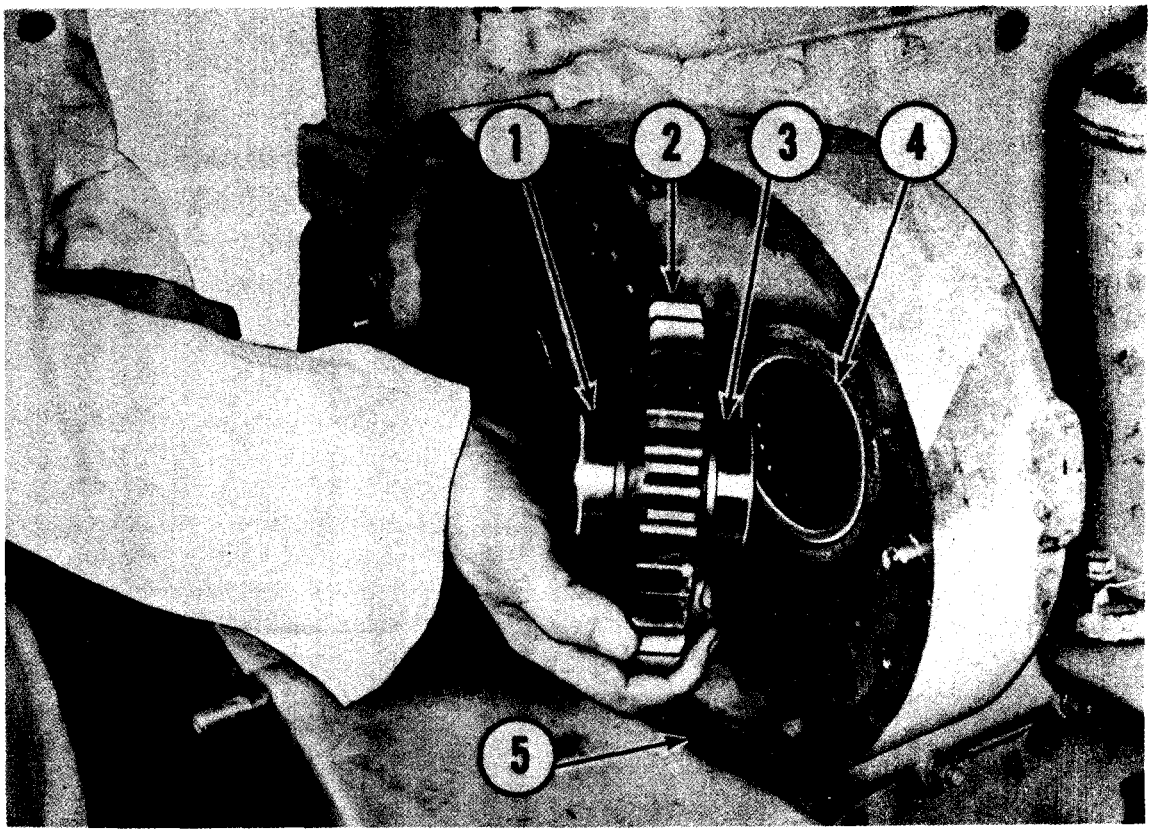


Figure 3–57. Shaft removal.

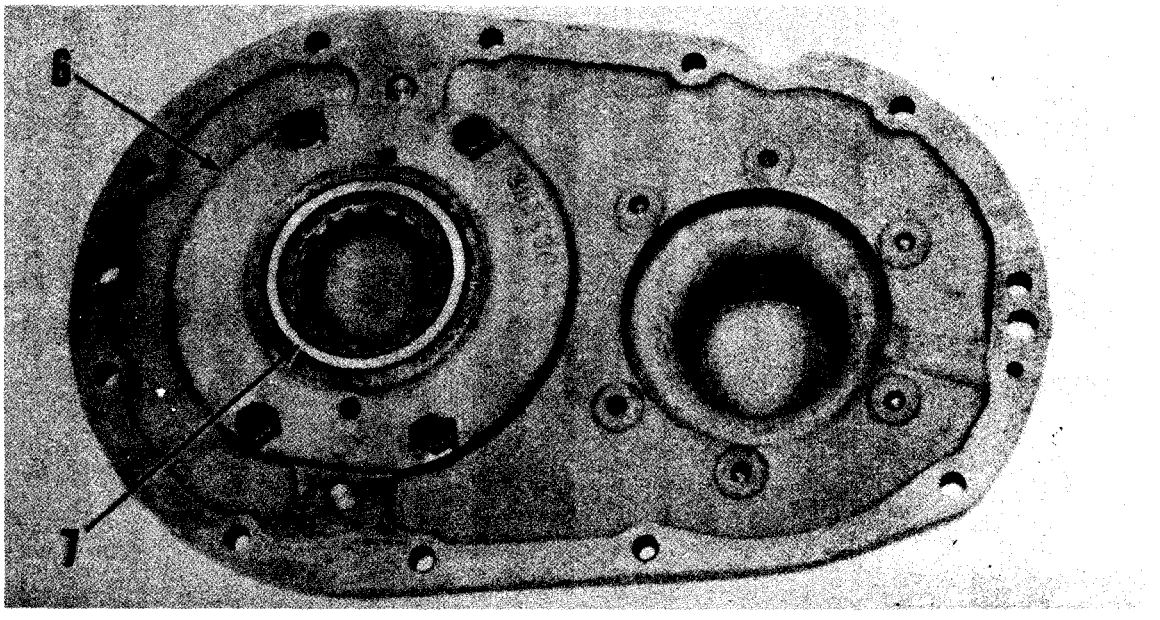
(*c*) Heat the inner races (1) and (3) in oil to a temperature not to exceed 600° F and install if replacement was necessary.

(d) Outer races (4) and (7) can be pressed into position in their respective cages.

(3) *Reassembly and installation.* Reassemble and install in the reverse order of removal and disassembly.



A



B

MEC 2410-214-35 68

1 Inner race
2 Transmission oil pump drive gear
3 Inner race
4 Outer race
5 Housing
6 Cage
7 Outer race

Figure 3–58. Pump drive gear and bearing.

3-16. Governor Housing Removal and Installation

a. Removal.

(1) Remove the fuel injection pump housing (para 3-22).

(2) Disconnect bleed line ((1), fig. 3-59).

(3) Remove linkage (2).

(4) Attach a hoist to support the weight of the governor housing.

(5) Remove the nuts and blots (3).

(6) Slide the housing off dowels ((1) and (4), fig. 3-60) and ferrule and seal (5), and move it away from the timing gear housing.

b. Installation.

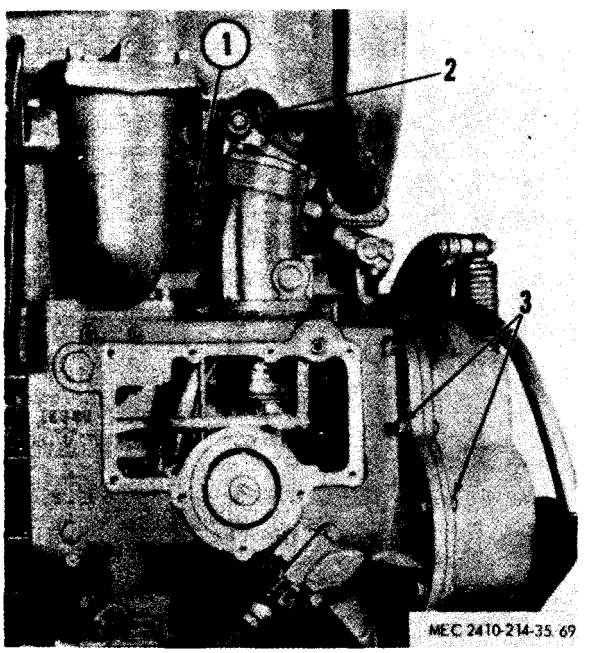
(1) Use a new seal and gasket when installing the governor housing.

(2) Accessory drive gear (6) must be timed to small camshaft gear (3). Proceed as follows:

(a) Remove cover ((3), fig. 3-61) and the cover at the top of the flywheel housing.

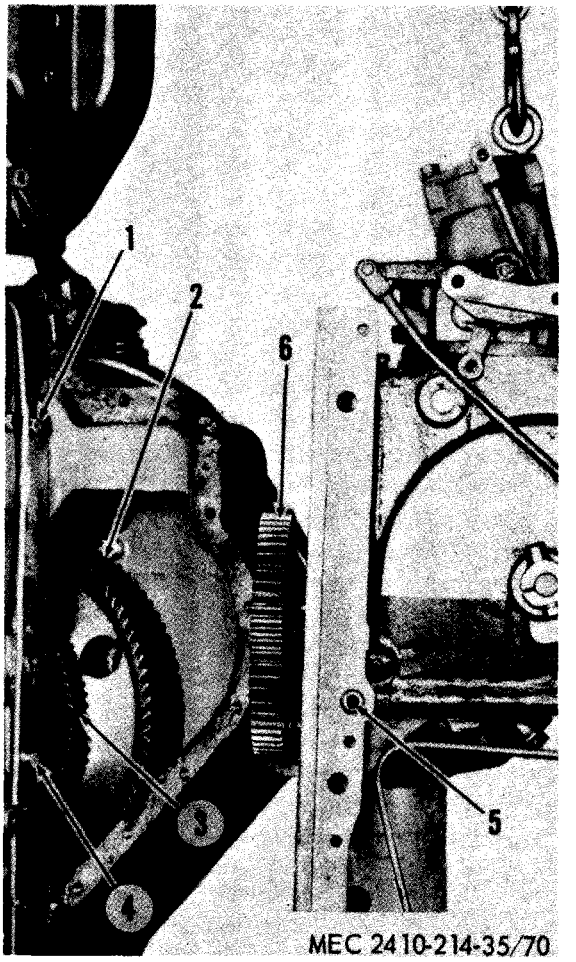
(b) Rotate the crankshaft in the direction of normal rotation until No. 1 piston is at the top of the compression stroke and the TC1 and 4 mark on the flywheel aligns with the pointer on the flywheel housing.

(c) Look through the hole in the timing gear housing and the hole in the large camshaft gear. Align the marks on the small camshaft gear (1), and the accessory drive gear (2).



1 Bleed line
2 Linkage
3 Nuts and bolt

Figure 3–59. Preparing to remove governor housing.



1 Dowel
2 Camshaft gear (large)
3 Camshaft gear (small)
4 Dowel
5 Ferrule and seal
6 Accessory drive gear

Figure 3–60. Remove governor housing.

3-17. Governor

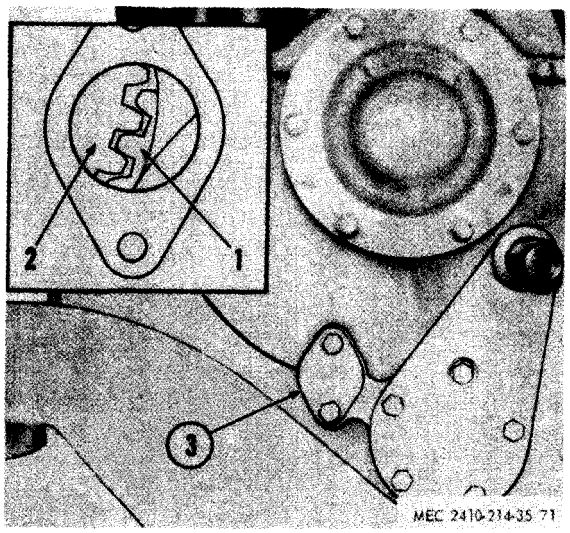
a. Operation and Lubrication.

(1) The governor is located in the accessory drive and governor housing. It is connected to the fuel rack through levers and linkage. The governor regulates the amount of fuel supplied to the engine during engine operation.

(2) Governor weight force varies with engine speed and spring force is varied according to the governor hand control lever setting.

(3) The operator selects a desired engine speed by moving the governor control lever, thus increasing tension on spring ((2), fig. 3-62). The governor maintains this speed nearly constant even though the load varies.

(4) The centrifugal force of governor weights (8) acting through retainer (3), thrust



1 Camshaft gear
2 Accessory drive
3 Cover

Figure 3–61. Aligning timing marks.

bearing (7), and crank (6), opposes the force created by the tension on governor spring (2). These forces always tend to balance. The balanced forces hold rack (1) which controls the amount of fuel delivered to the engine in such a position to make the engine operate at a constant speed.

(5) The governor is lubricated by oil from the engine lubricating system. Oil under pressure reaches the accessory shaft bearing assembly and is conducted to cover (5) by tube (9). A drilled passage in the cover conducts the oil to upper bearing (4) in the cover. The shaft is drilled to lubricate the bearing in retainer (3). Other parts of the governor are lubricated by the oil thrown off the rotating retainer and the oil which escapes past the upper bearing. The oil drains through a hole in the front of the housing into the timing gear housing.

b. Speed Limiter Operation.

(1) The speed limiter limits engine speed to approximately low idle until sufficient oil pressure is attained. It is accessible from the left side of the accessory drive housing and has a plunger which extends into the governor mechanism.

(2) With no oil pressure in the engine lubrication system, the spring forces the plunger to extend in front of the arm on the governor control lever. This prevents the rack from being moved in the direction of more fuel. Engine oil, directed to a passage in the housing, pushes the plunger back when the desired oil pressure is attained. With the plunger forced back, the fuel rack can be moved in the direction of more fuel.

c. Governor *Seals.*

(1) The governor high and low idle adjustment cover and the accessory drive cover are sealed by seal ((2), fig. 3-63). The rack adjustment cover at the rear of the fuel pump housing is sealed by seal (1). The wire and aluminum seals are installed through holes drilled in the bolt heads. To adjust the governor, remove the fuel injection pump housing, or adjust the fuel rack, it is necessary to break the seals.

(2) Rack settings are carefully set at the factory and should not be changed without specific instructions. An incorrectly adjusted fuel rack affects the operation of the turbocharger (g below).

d. Governor *disassembly and assembly.*

(1) Remove the decelerator spring ((2), fig. 3-64) and deceleration housing (1).

(2) Remove cover from side of governor housing.

(3) Remove pin which attaches governor spring to crank arm (6) and the crank arm's corresponding lever.

(4) Remove pin which connects rack control rod to other end of crank arm.

(5) Install a 5/16-inch-18 (NC) bolt into the tapped hole in shaft (7).

(6) Pull shaft (7) toward outside of housing.

(7) As shaft is withdrawn, remove lever, spacer and crank arm (6).

(8) The shaft is supported by bearings at each end. If it is necessary to replace bearings, they can be pushed out after shaft is removed.

(9) The bearing (3) in the decelerator housing should be replaced if worn or damaged.

(10) To replace rollers (5) on the lever and crank arm, remove the cotter pins and drive out the pins on which the rollers are mounted.

(11) The governor shaft and weights can be lifted out the top of the housing after unlocking and removing the bolts which hold the bearing retainer to pad ((2), fig. 3-65) in the housing.

(12) Shims (1) are provided for adjusting the backlash between the bevel gears.

(13) Slide the thrust bearing assembly consisting of races ((6), fig. 3-66) and (7) and bearing (2) off retainer (4). Remove shims (3) from retainer.

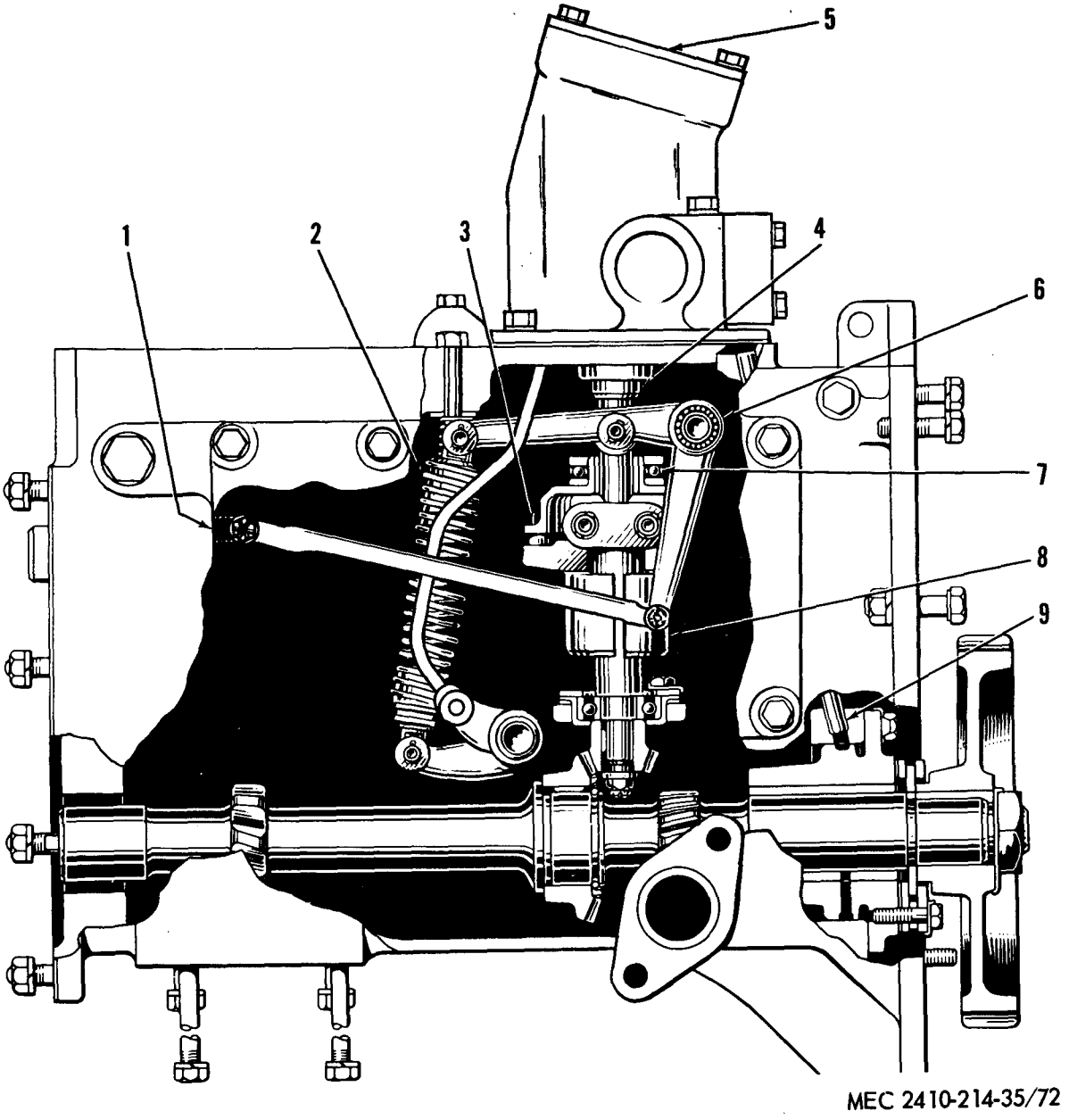
(14) Slide the retainer off governor shaft (9).

(15) Press the bearing out of the retainer if the clearance exceeds .005-inch.

(16) Remove the cotter pins and press out the pins to remove weights (5) from the shaft.

(17) Bearings (8) should be pressed out of the shaft arms, if worn.

(18) Remove the cotter pin and nut from the



1 Rack
2 Governor spring
3 Retainer
4 Upper bearing
5 Cover
6 Crank
7 Thrust bearing
8 Governor weight
9 Tube

Figure 3–62. Governor.

lower end of the shaft and pull the gear (11), using a puller.

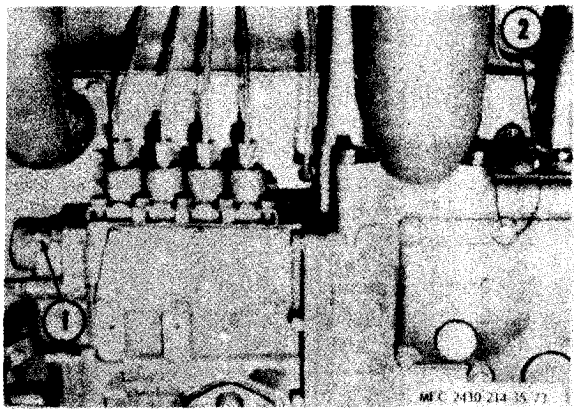
Caution: **When pulling the gear, it is advisable to install a nut flush with the** end of **the** shaft.

(19) Pull shims (3), fig. 3-66) and bearing (10) in the same manner as the gear was pulled. Press the bearing from the retainer.

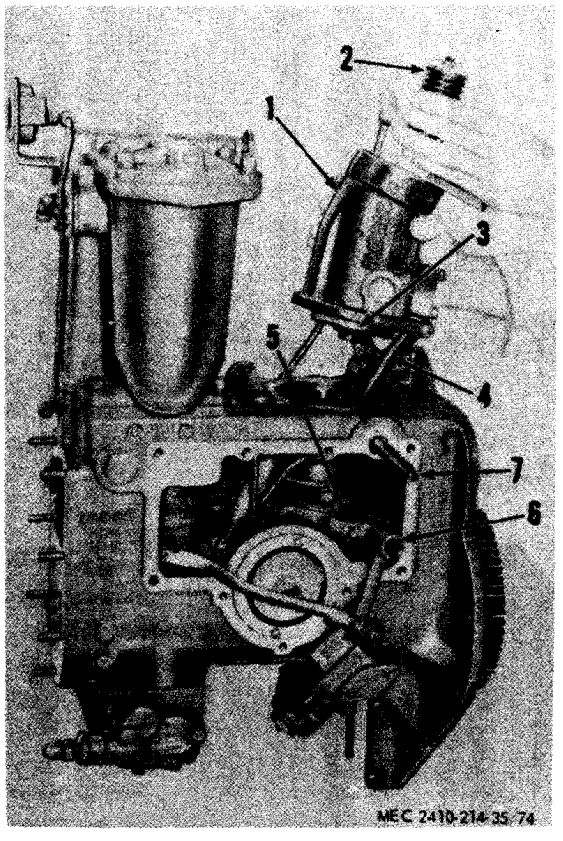
(20) Replace any parts worn enough to cause sloppy action of the governor and linkage.

(21) When installing the shaft assembly in the housing, use the proper number of shims **((1**), fig. **3-65)** between the bearing retainer and the pad to align the heels of the bevel gears and allow .006-inch backlash.

(22) If new parts have been installed in the governor, check the distance ((X), fig. 3-67) between the top of the housing and the upper bearing race as shown. The weights must be tight against the shaft when the measurement is taken.



1 Rack adjustment cover seal
2 Governor seal
Figure 3–63. Governor seals.

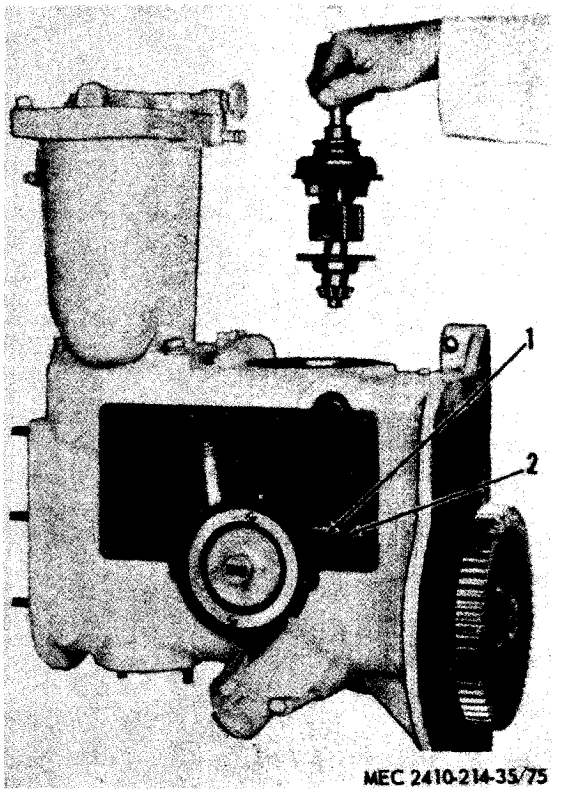


1 Decelerator housing
2 Spring
3 Bearing
4 Decelerator rod
5 Roller
6 Crank arm
7 Shaft
Figure 3–64. Disassembly governor.

Use shims (1) between the lower bearing race and the retainer to obtain the correct dimensions (X) listed in table 1-1. This setting insures that full rack travel can be achieved with the governor weights in the fully closed position.

(23) Make sure that all parts operate freely without binding as the governor is assembled.

e. *Speed Limiter Disassembly and Assembly.*



1 Shims
2 Pad in housing
Figure 3–65. Shaft and weight removal.

(1) Remove the governor housing from the side of the engine (para 3-16).

(2) Tighten plug ((3), fig. 3-68) to torque valve given in paragraph 1-4g .

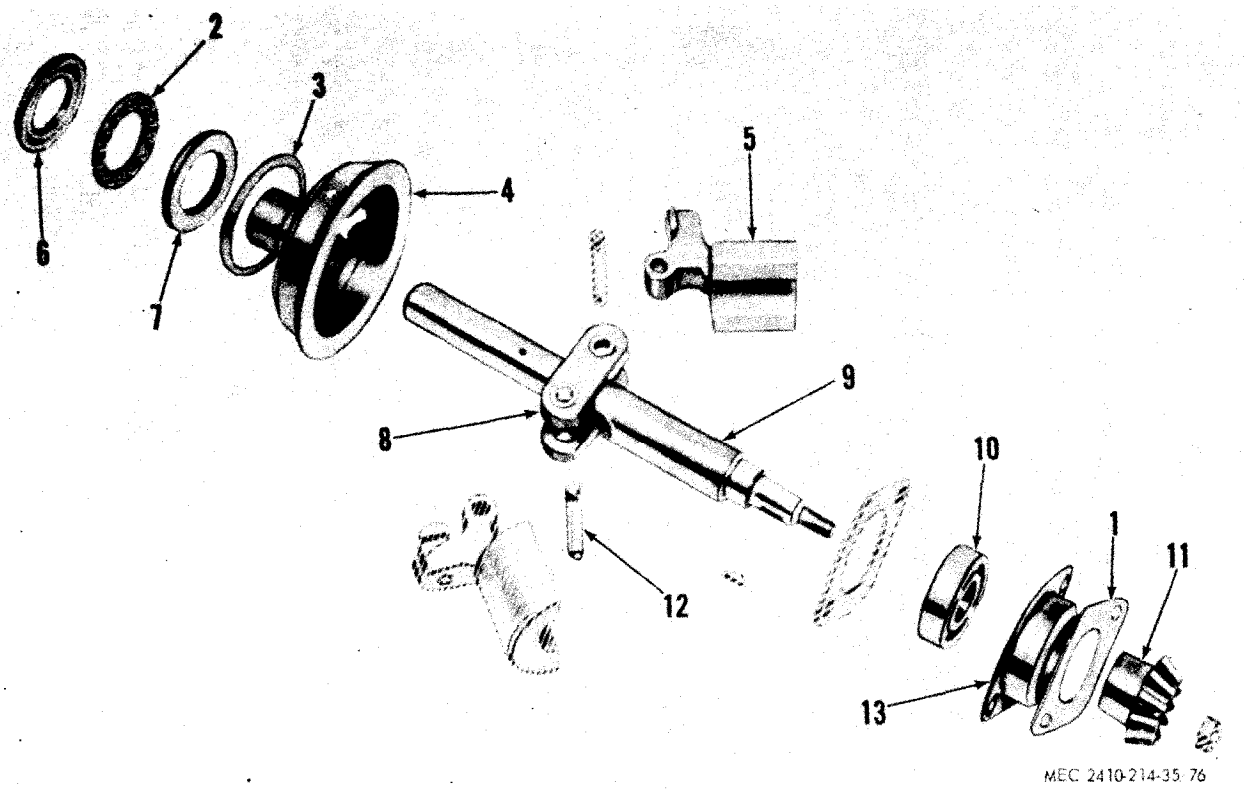
f. Low and High Idle Speed Adjustments.

(1) The engine speed can be checked at the tachometer drive connection on the service meter after removing the cover. The reading observed will be one-half actual engine speed (fig. 3-69) .

(2) The low idle and high idle engine speeds can be adjusted by removing cover ((3), fig. 3-70) over the governor and turning adjusting screws (2) (4). Screw (2) nearest the engine adjusts the low idle speed and screw (4) adjusts the high idle speed. Holes (1) are shaped to act as retainers to prevent the screws from turning after the adjustment is made.

(3) To adjust low idle speed, turn adjusting screw (2) clockwise to decrease, or counterclockwise to increase the low idle speed. Push the governor control lever to the LOW IDLE position (with the engine running) and check the speed as shown.

(4) To increase the low idle speed, pull the governor control lever back to the point where the engine operates at the desired speed. Then



1	Shims	8	Bearing
2	Bearing	9	Shaft
3	Shims	10	Bearing
4	Retainer	11	Gear
5	Weights	12	Pin
6	Race	13	Retainer
7	Race		

Figure 3–66. Governor components.

turn the screw counterclockwise until resistance is felt. Pull the governor control lever back; then push it forward and recheck the speed.

(5) Move the governor control lever to the HIGH IDLE speed position and check the engine speed. Turn the high idle speed adjusting bolt clockwise to decrease the speed or counterclockwise to increase the speed. Move the governor control lever to a lower speed, then back to the high idle and recheck the engine speed after each adjustment until the specified high idle speed is obtained.

g. ***Fuel Rack Setting.***

(1) The fuel rack setting can be checked or adjusted with the fuel injection pump housing either removed from or installed on the engine.

(2) Remove the fuel injection pump and plunger nearest the governor and wrap the pump and plunger in clean, lint-free material. Place a plug in the fuel injection line.

Note. For easier adjustment, remove cover ((2), fig. 3-71) and disconnect the governor linkage from rack (3). This will eliminate governor spring tension on the rack.

(3) Install a fuel rack setting gage (1) in the opening left by the previously removed fuel injection pump and align the mark on the gear of the gage with the mark on the fuel rack.

(4) Remove the housing on the rear of the fuel pump housing to gain access to torque spring (4) and shims (5).

(5) Move fuel rack (3) forward until the collar on the rack touches, but does not move, torque spring (4).

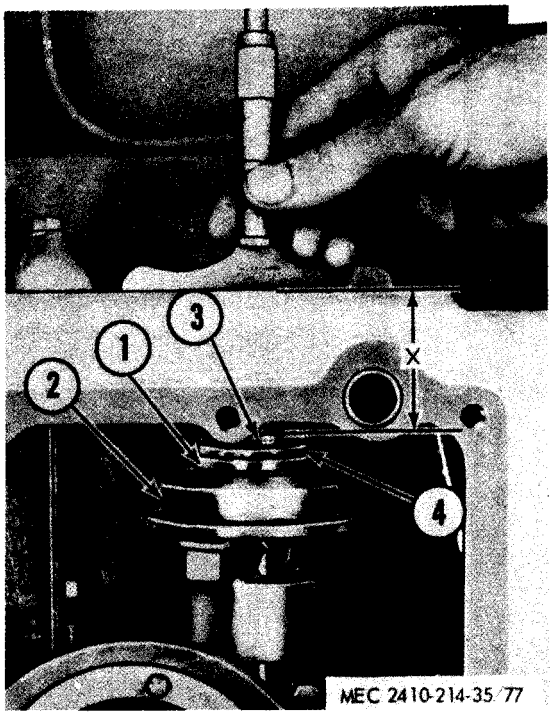
(6) Add or remove shims (5) to obtain the proper rack setting on the rack setting gage with the rack in this position.

(7) If shims are added or removed, be sure clamp ((4), fig. 3-72) torque spring (2), spacers (5), stop (6), and spacers (7) are reinstalled in the proper location.

3-18. Decelerator

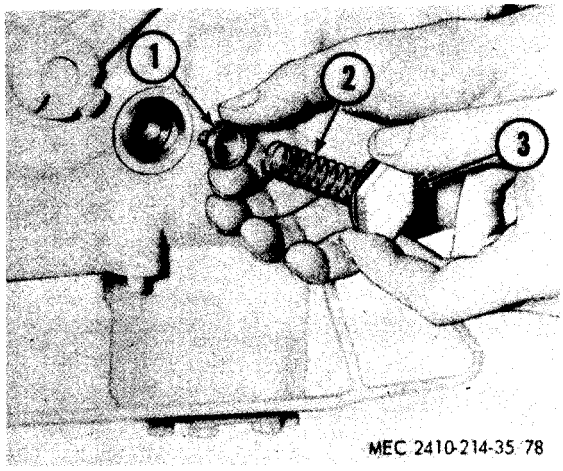
a. Operation.

(1) The decelerator is a mechanical device that reduces the engine speed for short periods of time without distrubing the governor control



1 Shims
2 Retainer
3 Upper race of bearing
4 Lower race of bearing
X—Distance between top of housing and upper bearing race

Figure 3–67. Adjusting governor.



1 Plunger
2 Spring
3 Plug

Figure 3–68. Disassembling speed limiter.

lever. Pedal ((5), fig. 3-73) allows the operator to reduce the tractor speed without using the steering clutches or brakes and leaves the operator's hands free to operate various control levers.

(2) The decelerator group consists of a pedal, similar to the accelerator pedal used on wheel tractors, a linkage system and decelerator housing (1), which is mounted on top of the governor housing (3).

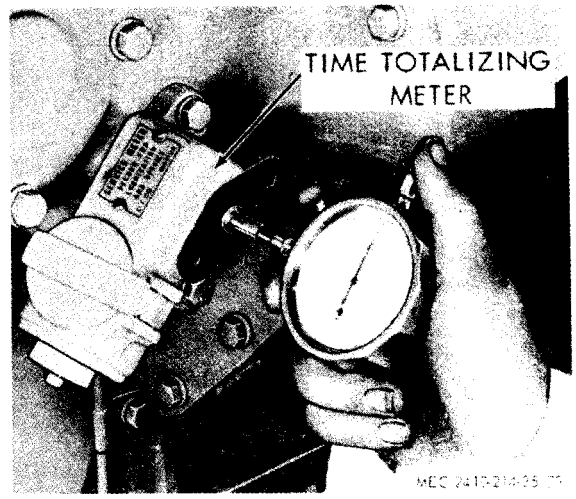
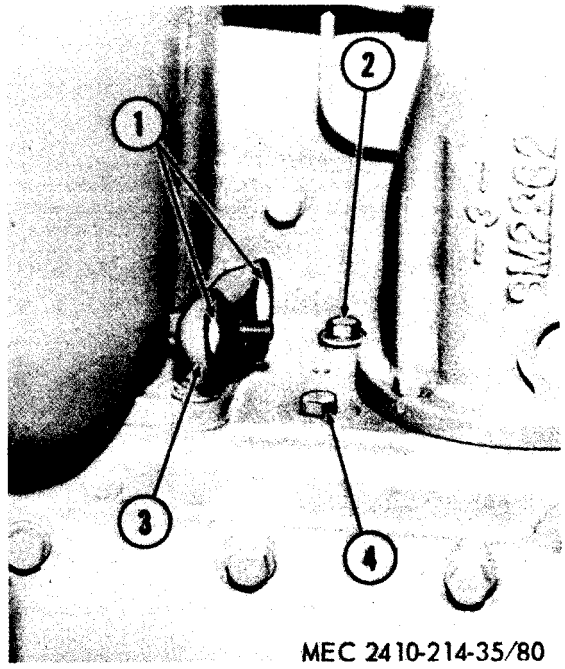


Figure 3–69. Checking engine speed.

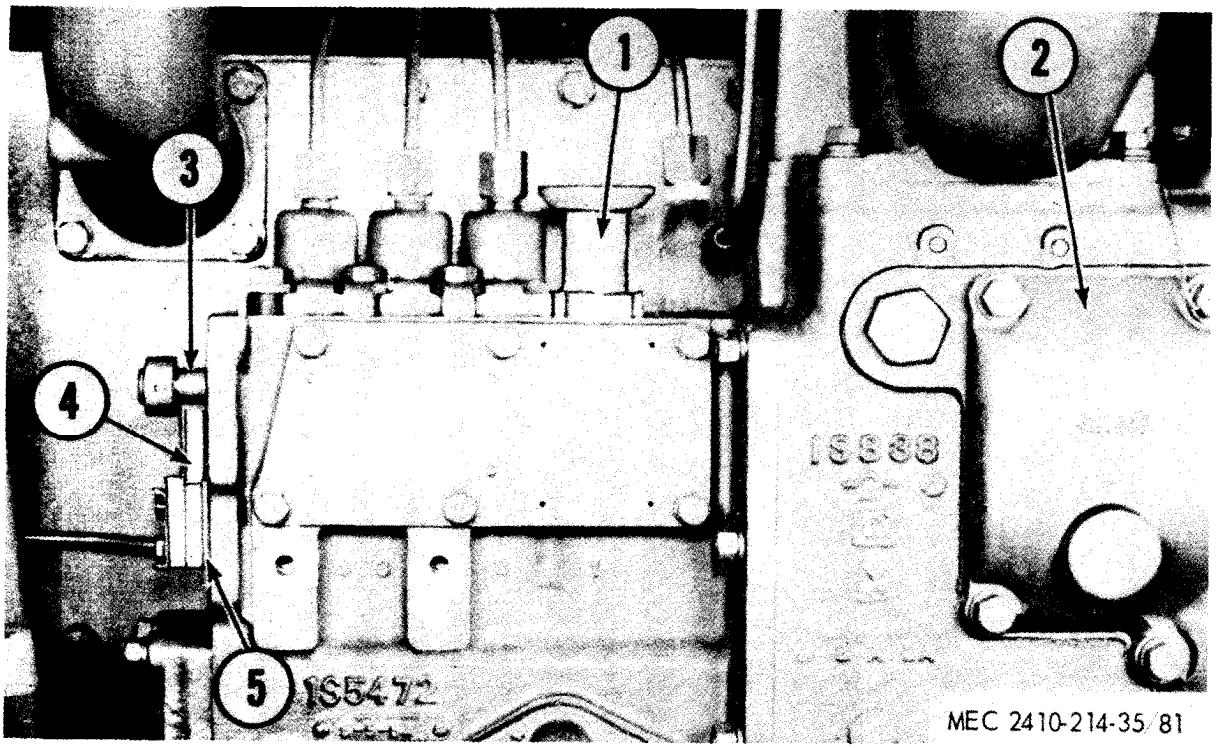


1 Retainer holes
2 Screw
3 Cover
4 Screw

Figure 3–70. Governor adjustments.

(3) In normal operation, the diesel engine governor function is not limited or reduced by the decelerator. The decelerator only reduces engine speed when the pedal is depressed and returns the engine to the original speed as set on the governor hand control lever (7) when the pedal is released.

(4) The decelerator is connected to one of the two arms on governor control lever (9) by



1 Fuel rack setting gage
2 Cover
3 Rack
4 Torque spring
5 Shims

Figure 3–71. Installing gage.

rod (4). Governor spring (6) is hooked to the other arm on the lever. In the full load position, decelerator spring (2), acting against the rod, keeps lugs ((3), fig. 3-74) on the control lever in contact with hub (1).

(5) Hub (1) is secured to the governor lever control shaft, while governor lever (2) is free on the control shaft. The hub stays in the position determined by governor control lever setting.

(6) When pedal ((5), fig. 3-73) is depressed, decelerator spring (2) is compressed which relieves the pressure on rod (4). This relieves the tension on the governor spring and allows control lever ((2), fig. 3-74) to rotate clockwise. The rack is moved in the direction of less fuel. Figure 3-75 illustrates the position of the lugs when deceleration pedal is depressed.

(7) The engine speed slows to near low idle speed. Control lever (2) has rotated clockwise and lugs (3) on the lever are no longer in contact with those on the hub. The position of the hub has not changed.

(8) When the decelerator pedal is released, the decelerator spring expands and forces the rod down to rotate the control lever counterclockwise until the lugs are against the hub again in the original position.

b. Removal and Installation.

(1) Remove the governor side cover.

(2) Loosen one bolt and remove the other bolt holding cover ((5), fig. 3-76) to the decelerator housing. A warning plate attached to the cover states: BE CAREFUL, COVER IS SPRING LOADED.

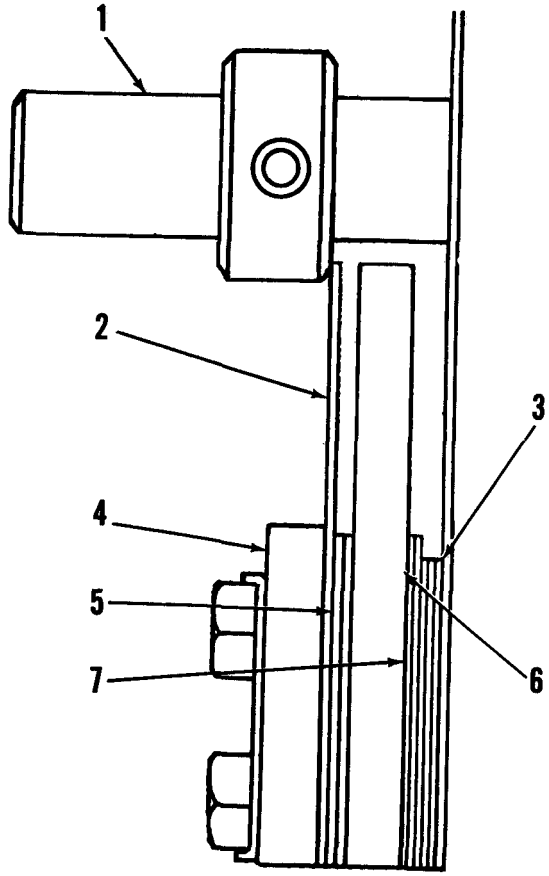
Warning: **Do not** rotate **the cover to completely uncover the spring and guide until a bolt (4) below, is installed to compress the spring. The spring may eject wit h considerable force if uncovered before installing the bolt.**

(3) Rotate the decelerator cover enough to permit access to the hole in the top of spring seat (4) of the decelerator, but still hold spring (3) in the housing.

(4) Insert a 1/4-inch-20NC bolt (1), 2 inches long, with a suitable washer, into the hole and tighten to compress the decelerator spring.

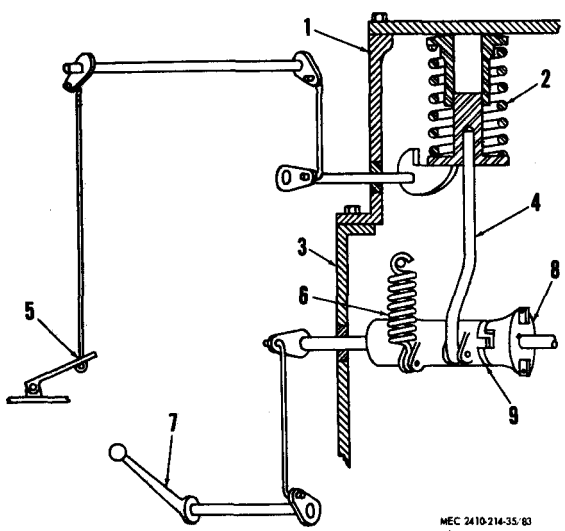
(5) Rotate the cover out of the way and remove the decelerator spring, guide, and seat as a unit.

(6) Remove the pin in the lever attached to the decelerator lever.



1 Rack
2 Torque spring
3 Shims
4 Clamp
5 Spacer
6 Stop
7 Spacer

Figure 3-72. Adjusting rack setting.



1 Decelerator housing
2 Decelerator spring
3 Governor housing
4 Decelerator rod
5 Pedal
6 Governor spring
7 Governor hand control lever
8 Hub
9 Governor control lever

Figure 3-73. Decelerator control.

(7) Remove the bolts holding the decelerator housing and remove the housing.

(8) Remove the pins securing decelerator rod ((1), fig. 3-77) and governor spring to governor control lever (2). Also remove the rod to the fuel rack.

(9) Remove the clamping bolt from the lever on the governor control shaft. This lever is located between the diesel engine block and governor housing. Slide lever off the shaft.

(10) Slide the governor control shaft, hub, pawls and inner hub from the housing as an assembly. Exercise care when removing the unit from the housing to avoid losing the plunger springs.

(11) The hub, pawls, springs and inner hub may be removed from the governor shaft, if necessary, by pulling the outer hub from the shaft.

(12) Figure 3-78 shows the position of the decelerator parts assembled with the governor parts. The parts are shown assembled out of the housing, but the parts must be disassembled before installing in the housing.

(13) Inspect the governor control shaft seal.

(14) Install the parts in the governor housing in the reverse order of removal. Use the reverse procedure in installing the decelerator spring. Turn the decelerator cover over the edge of the spring guide to hold the spring when the retaining bolt is removed.

(15) Check the governor low and high idle speed settings after the parts have been installed.

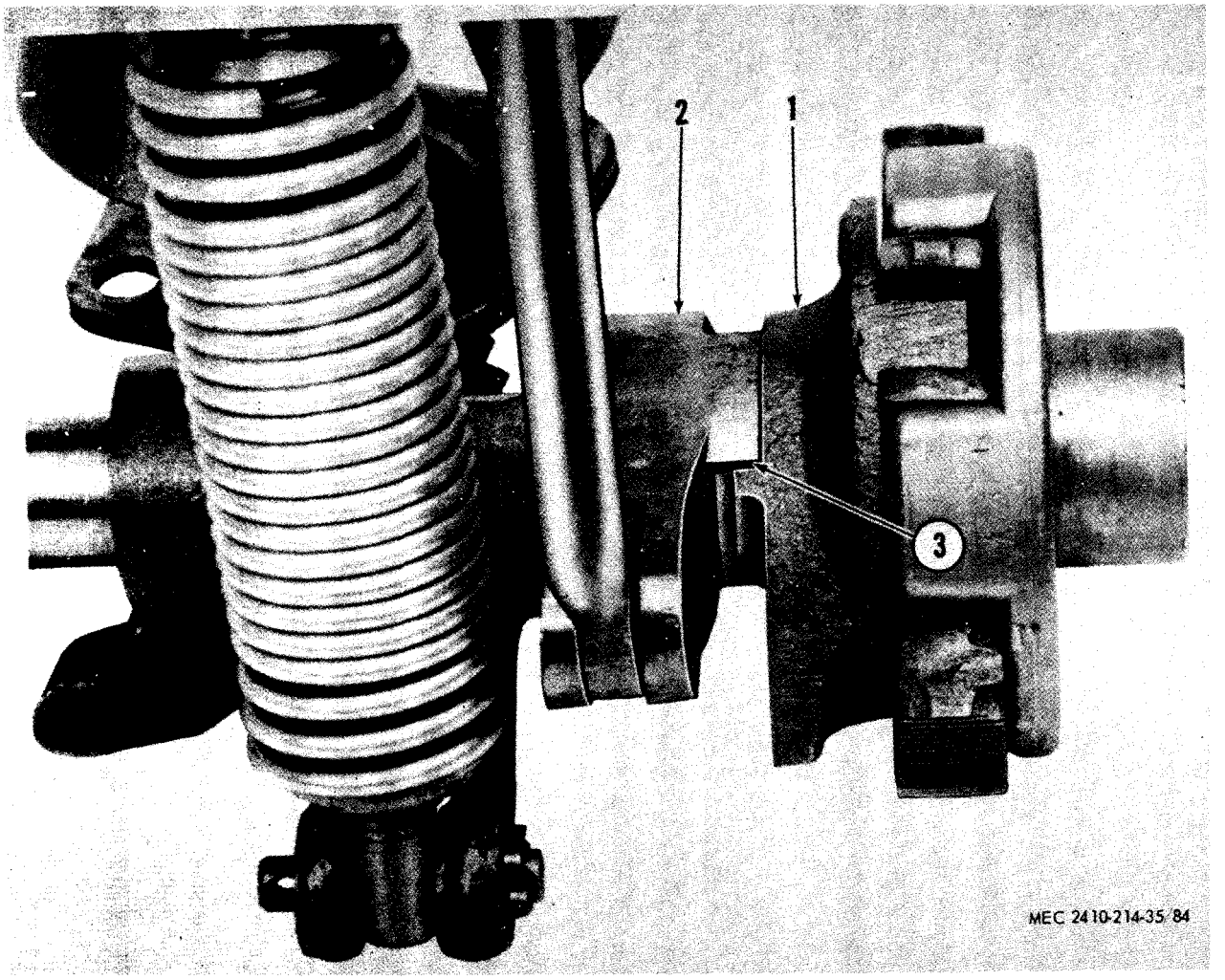
(16) Remove the cover ((1), fig. 3-79) for access to the low idle adjusting screw (2) for the decelerator. The decelerator low idle speed should be set at approximately 200 rpm above engine low idle speed.

3-19. Governor Locking Control Mechanism

a. *Operation.*

(1) When the operator moves the governor control lever, the motion is transmitted through linkage to shaft ((2), fig. 3-80) which in turn rotates hub (3). The bosses on the hub apply pressure on pawls (5) which compress springs (6), reducing the contact pressure between the serrated ends of the paws and the serrated inner face of ring (4) permitting the pawls to move. The rotating motion of the pawls is transmitted to the governor mechanism through tangs (8) on lever (1).

(2) When the control has been moved to the desired position and the hub is no longer being moved, springs (6) force the pawls outward against ring (4) with sufficient pressure to hold the hub from turning. Governor action at-



1 Hub
2 Governor control lever
3 Lug

Figure 3-74. Position of lugs—Normal operation.

tempting to work through the control causes the pawls to be forced tighter against the ring, providing a more positive lock.

(3) If the governor control lever is moved to a desired position and fails to stay at that position, it is advisable to inspect the serrated surfaces of the pawls and ring for wear.

b. Disassembly.

(1) Remove the control lever from shaft ((2), fig. 3-81).

(2) Remove the governor side cover. It positioned by dowels (3) and held in place bolts.

(3) Remove hub (4).

(4) Move shaft (2) out of the housing far enough to remove pawls (5).

(5) Remove oil seal (1).

(6) Remove ring (7) which is located by dowels (3).

(7) Lever (6) can be removed after disc netting the governor linkage.

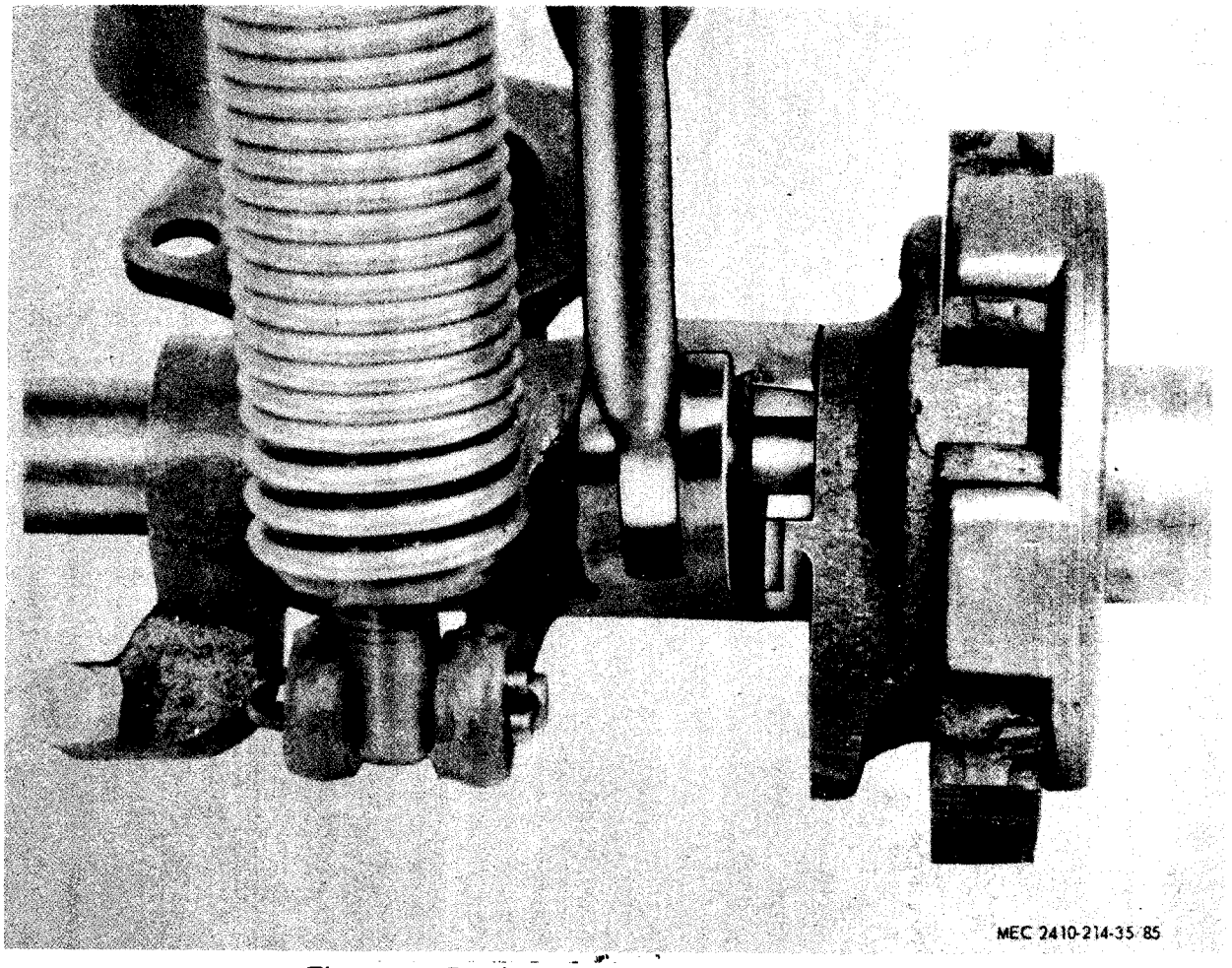


Figure 3–75. Position of lugs—decelerator pedal depressed.

3-20. Accessory Drive Gear and Shaft

a. *General.* The accessory drive shaft can be removed by removing the timing gear cover and camshaft gear or by removing the accessory drive and governor housing. Unless the timing gear cover is to be removed for other reasons, it is preferable to remove the accessory drive and governor housing.

b. Removal. Remove the governor shaft assembly (para 3-17). Remove the time totalizing meter. Remove the bolts (fig. 3-82) holding bearing assembly ((1), fig. 3-83) to the housing by using a socket wrench through the holes in the accessory drive gear. The accessory drive gear and shaft can then be removed from the housing as shown.

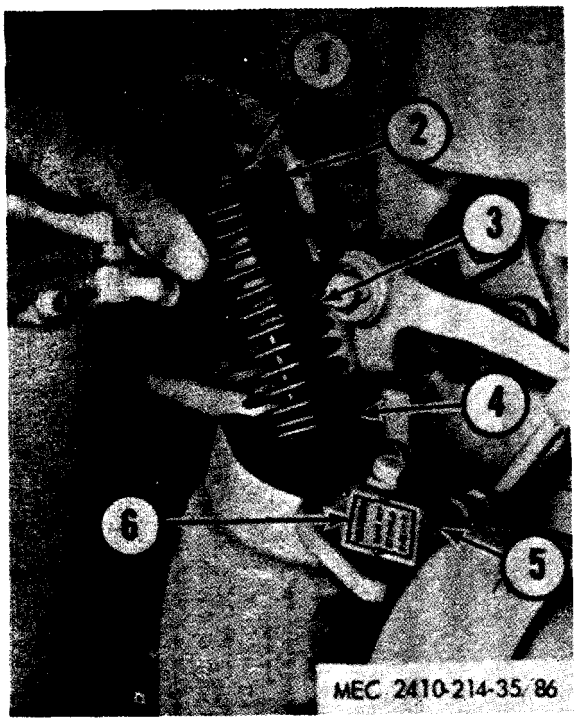
c. *Disassembly and Assembly.*

(1) Unlock and remove the retainer nut and pull gear ((4), fig. 3-84) from the shaft using a puller. Take out the bolts and remove thrust plate (8). Slide off thrust washer (3) and remove plate (7) and shims (2). Remove the key from the shaft and slide off bearing assembly (1). Replace the bearing if the clearance exceeds the permissible clearance as listed in table 1-1.

(2) Press the new bearing into bearing assembly ((1), fig. 3-84) after carefully aligning the oil holes. Slide the bearing assembly on shaft (6). If the end clearance of the shaft exceeds the permissible clearance as listed in table 1-1 install a new thrust washer (3). Thrust plates (7) and (8) can be turned around once to present a new wearing surface. Tighten the bolts through the thrust plates but do not lock them. Press the gear on the shaft until it clamps the thrust washer (3) tightly against the shoulder or heat the gear to 350°F and shrink in place. Refer to paragraph 1-4 for correct retainer nut torque value.

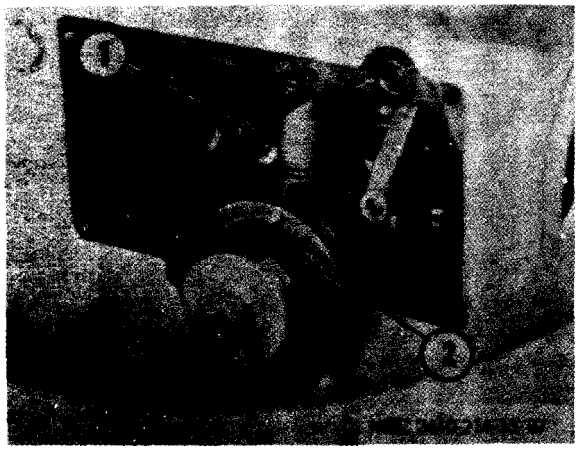
d. Installation and Adjustment (fig. 3-85).

(1) Install the accessory drive gear and shaft in the housing and tighten the bolts which



1 Bolt
2 Guide
3 Spring
4 Seat
5 Cover
6 Warning plate

Figure 3–76. Removing decelerator spring.



1 Rod
2 Control lever

Figure 3–77. Removing rod and control lever shaft.

secure the bearing assembly. Bend the locks securely against the bolt heads.

(2) Install the governor shaft assembly with sufficient shims to align the heels of the bevel gear teeth. Then use shims (2) between the thrust plate and bearing assembly to adjust the backlash between the bevel gear teeth when the accessory drive shaft is held toward the rear of the

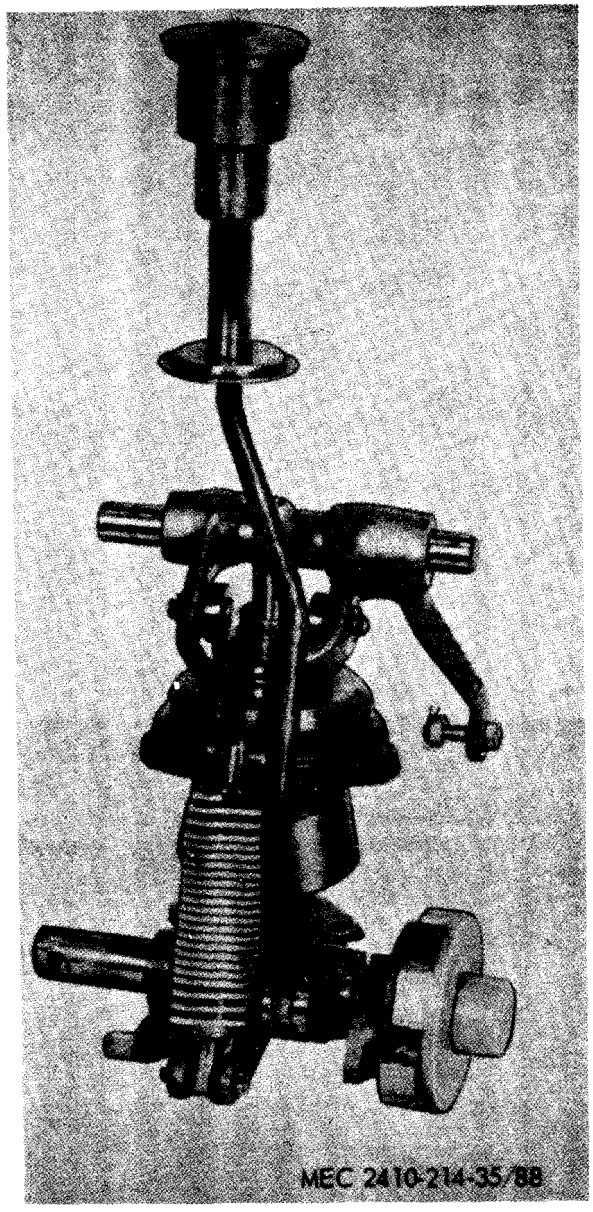


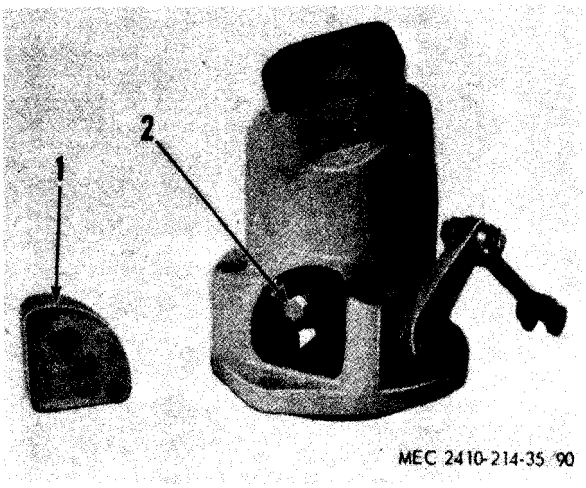
Figure 3–78. Decelerator parts assembled (outside of housing).

engine as far as the thrust washer will permit. Refer to table 1-1 for the correct adjustment. Lock the bolts through the thrust plates when the correct backlash has been established. Install the Service Meter and complete the assembly of the governor.

(3) Refer to paragraph 3-17 and figure 3-67 and follow the procedure outlined to obtain dimension (X) described.

e. Accessory Drive Shaft Bearing.

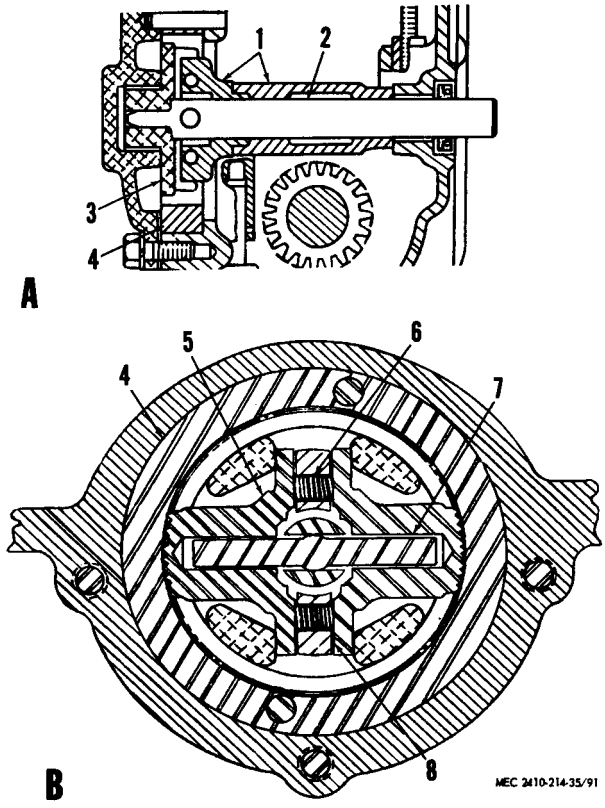
(1) The accessory drive shaft bearing is located at the rear of the accessory drive and governor housing.



1 Cover
2 Adjusting screw

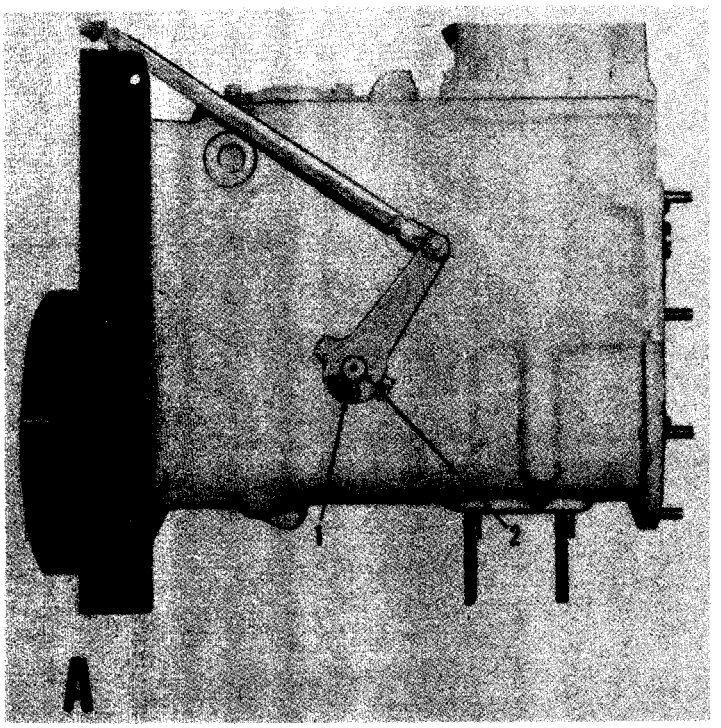
Figure 3–79. Decelerator adjusting screw.

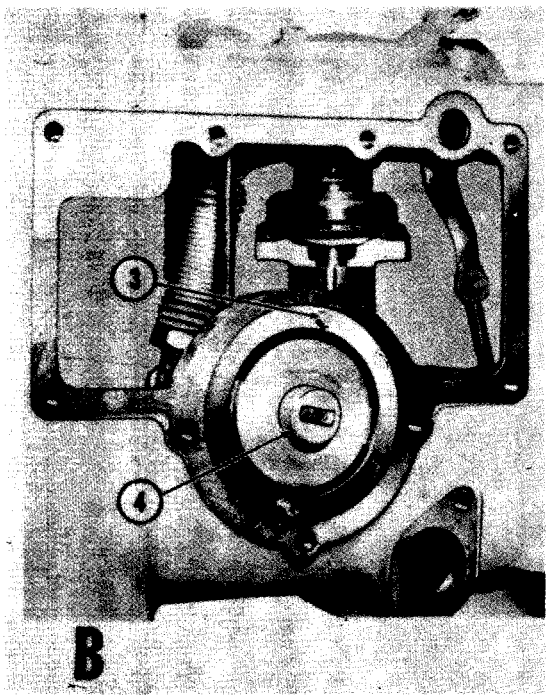
(2) Removal and installation.
(a) Remove the fuel injection pump housing.
(b) Pull bearing with a suitable puller.
(c) Install in reverse order of removal.
(d) Install a new cork gasket.

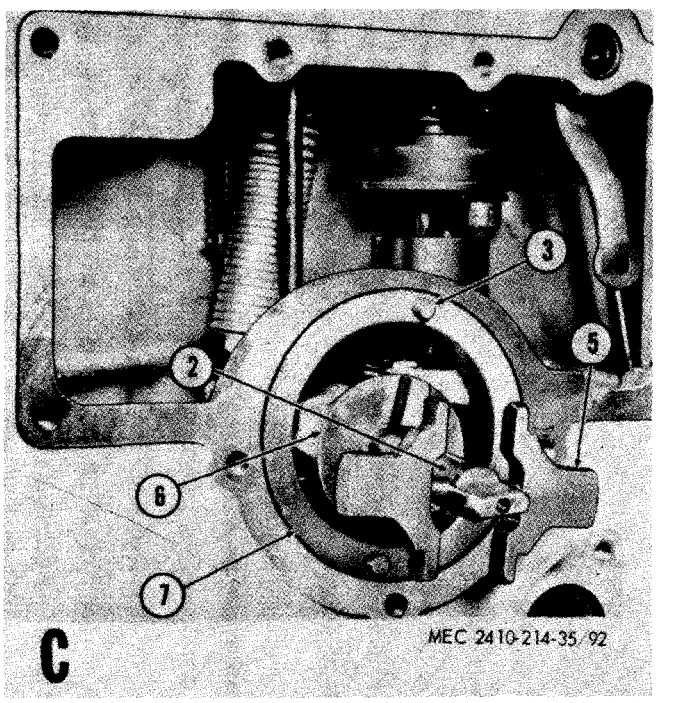


1 Lever
2 Shaft
3 Hub
4 Ring
5 Pawl
6 Spring
7 Guide
8 Tang

Figure 3–80. Governor locking control.







1 Seal
2 Shaft
3 Dowel
4 Hub
5 Pawl
6 Lever
7 Ring

Figure 3–81. Governor locking control disassembly, side view.

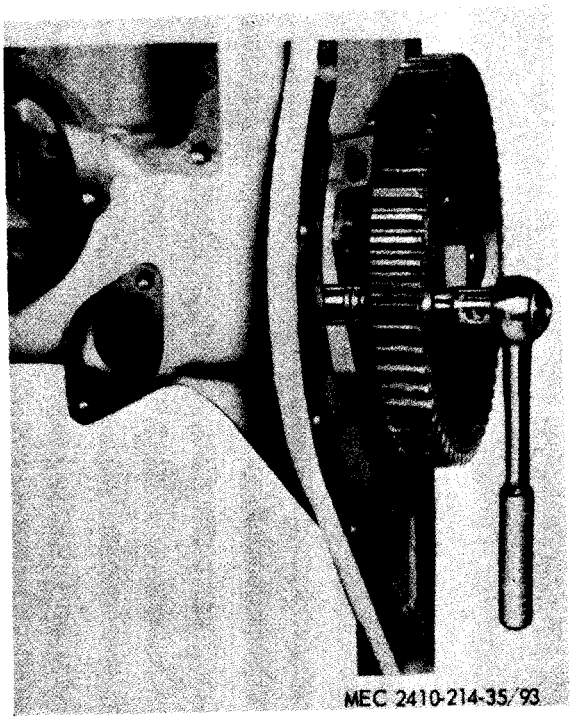
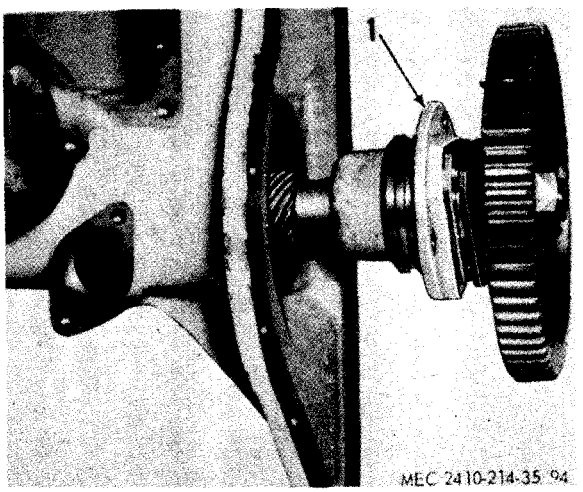
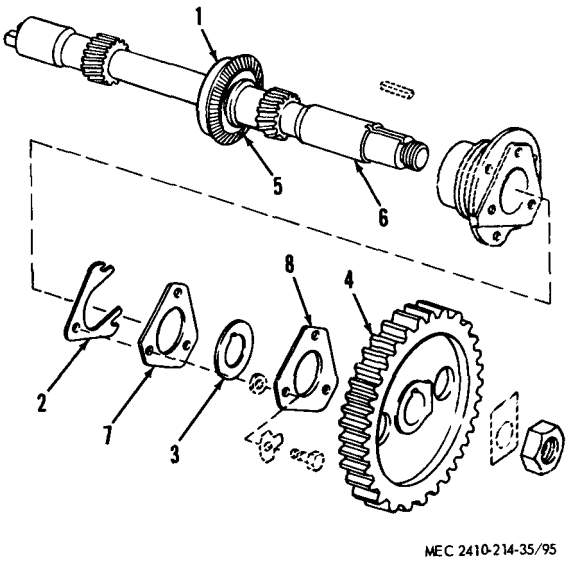


Figure 3–82. Removing bolts from bearing assembly.



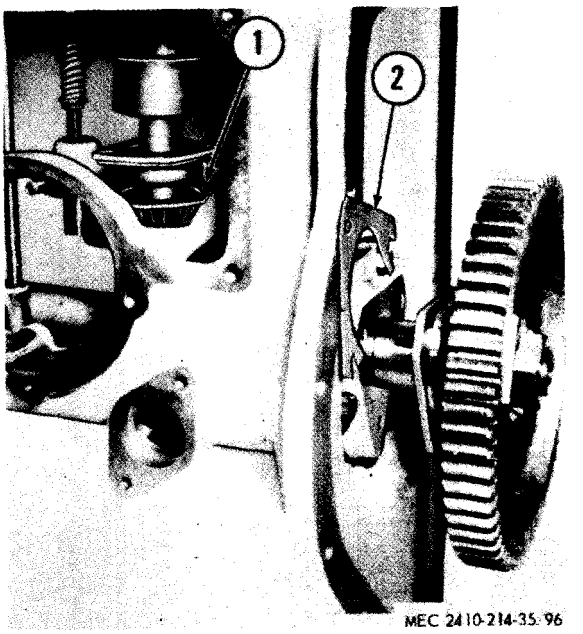
1 Bearing assembly

Figure 3–83. Removing accessory drive shaft and gear.



1	Bearing assembly	5	Governor drive gear
2	Shims	6	Shaft
3	Thrust washer	7	Plate
4	Gear	8	Thrust plate

Figure 3–84. Accessory drive shaft group disassembled.



1 Shims
2 Shims

Figure 3–85. Shims for adjusting bevel gear backlash.

Section III. FUEL SYSTEM

3-21. General

Refer to TM 5-2410-214-12 for a description of the tractor fuel system.

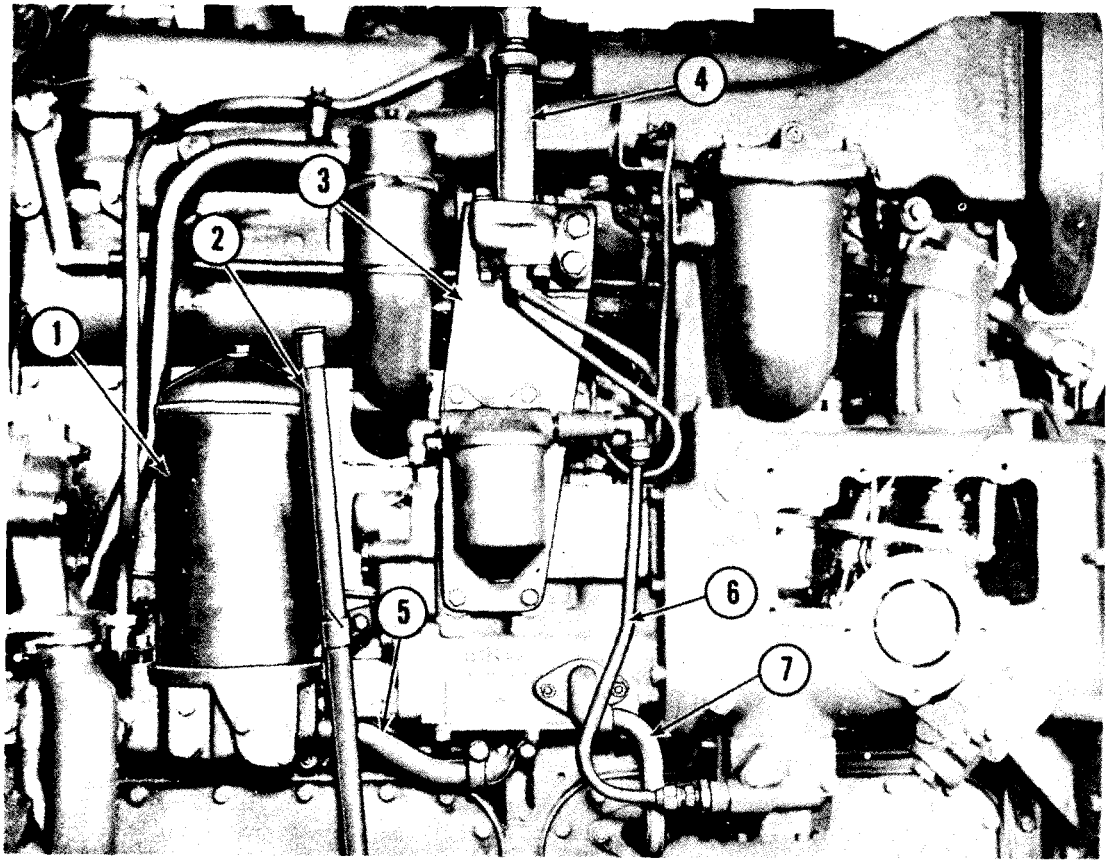
3-22. Fuel Injection Pump Housing

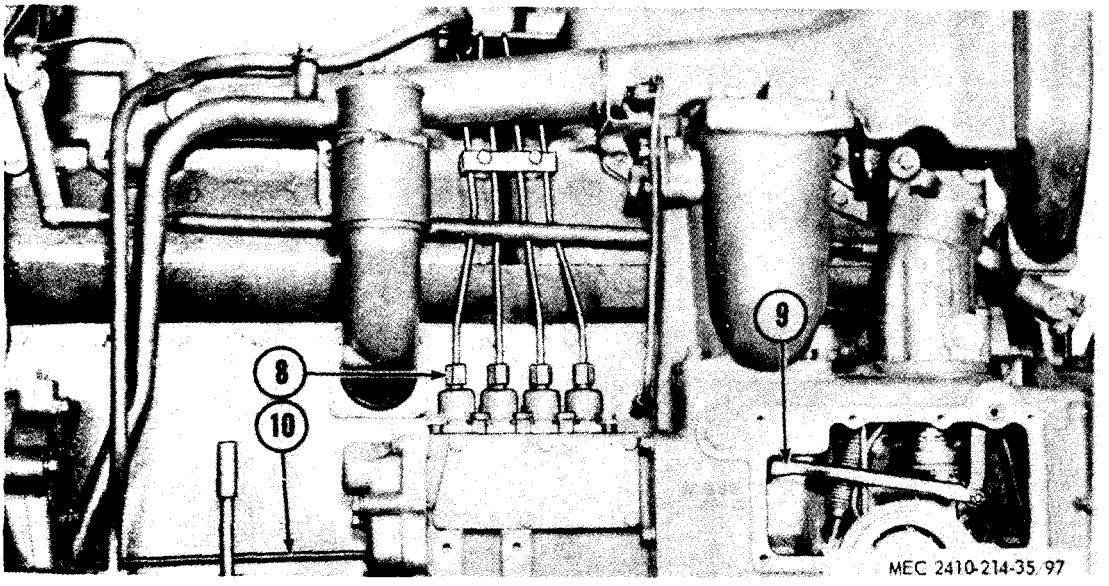
Refer to TM 5-2410-214-12 for fuel injection pump service.

a. Removal and Installation.

(1) Close the fuel shutoff valve at the fuel tank. Disconnect the fuel supply line at the primary fuel filter.

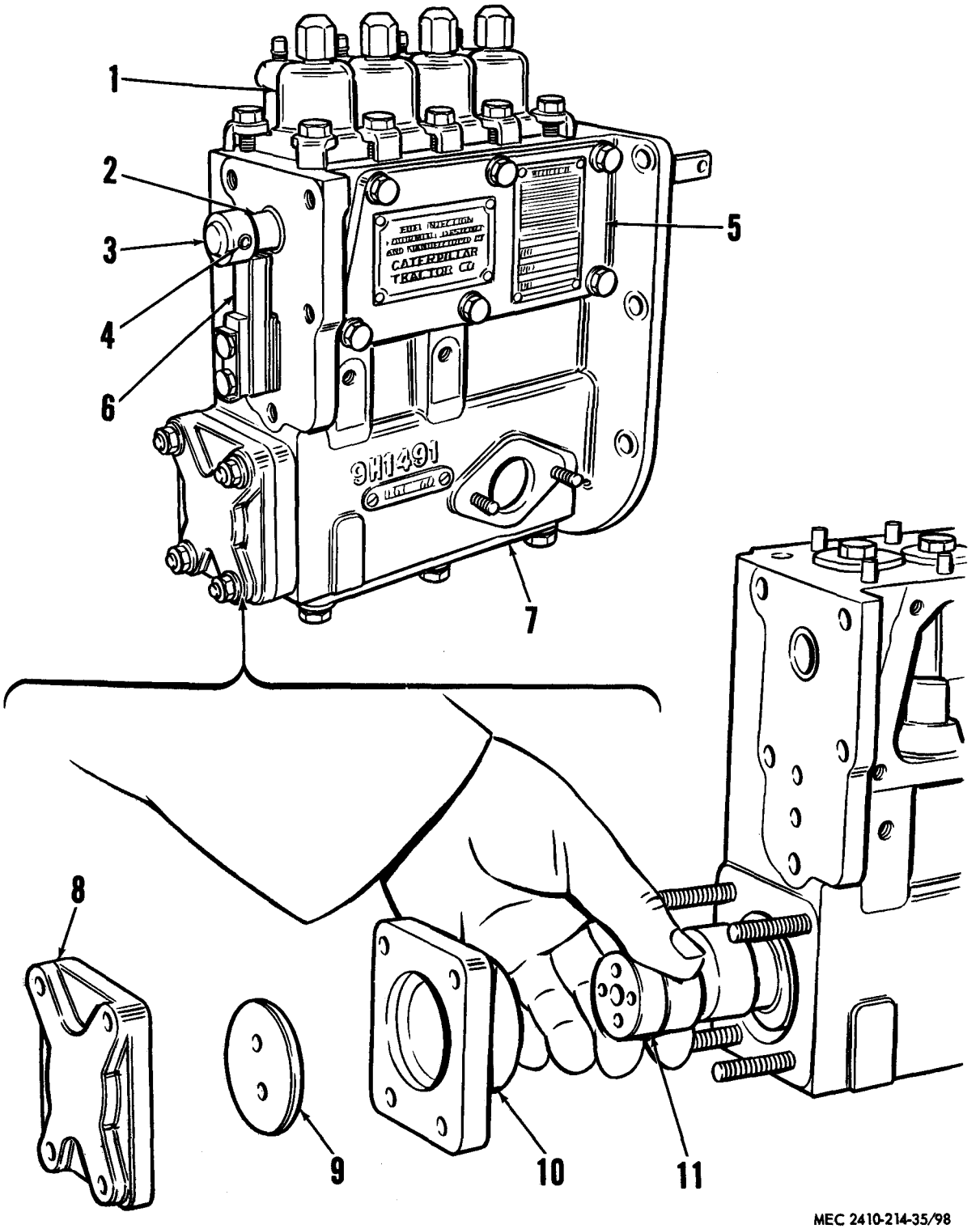
(2) Drain the oil from the fuel injection pump housing and the oil filter.





1 Oil filter case assembly
2 Oil level gage
3 Bracket
4 Priming pump
5 Oil line
6 Fuel supply line
7 Oil drain line
8 Fuel injection lines
9 Control linkage
10 Oil line

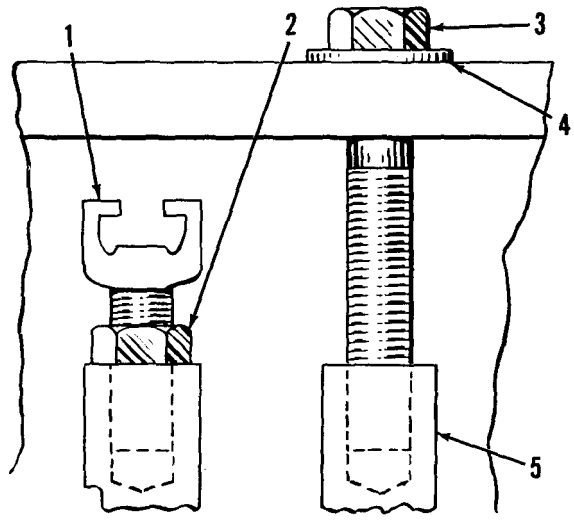
Figure 3–86. Preparing to move fuel injection pump housing.



MEC 2410-214-35/98

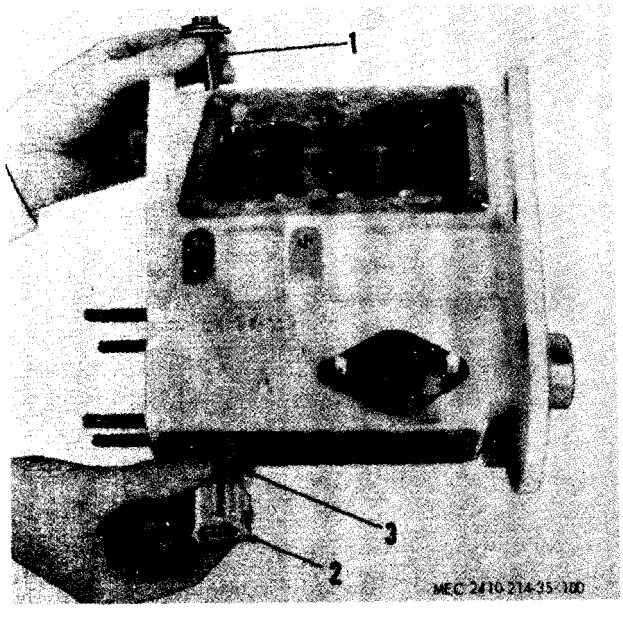
1 Fuel pumps (4)
2 Fuel rack
3 Collar
4 Pin
5 Side cover
6 Torque spring
7 Bottom cover
8 Cover
9 Thrust plate
10 Bearing assembly
11 Camshaft

Figure 3–87. Disassembling fuel injection pump housing.



1 Lifter yoke
2 Locknut
3 Bolt
4 Washer
5 Threaded end of lifter

Figure 3–88. Removing lifter yokes and raising lifters.



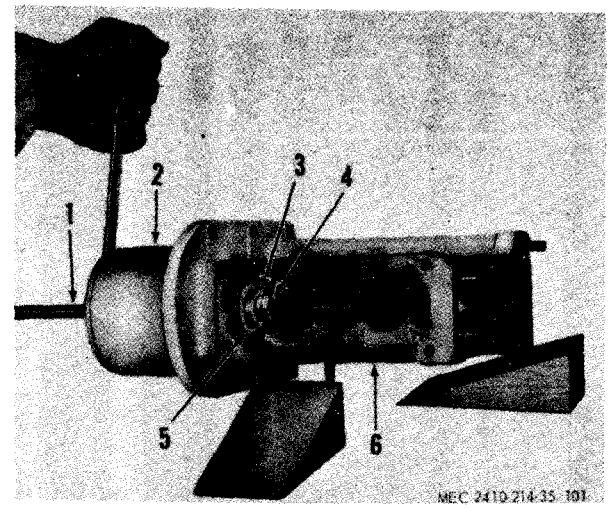
1 Bolt
2 Lifter
3 Spring

Figure 3–89. Removing lifter.

(3) Remove the oil filter case assembly ((1), fig. 3-86) and filter element.

(4) Remove the cover from the side of the accessory drive housing and disconnect rack control linkage (9).

(5) Remove oil level gage (2), bracket (3), priming pump (4), oil line (5), fuel supply line (6), and drain line (7).



1 Puller stud
2 Adapter assembly
3 Washer (only one shown)
4 Nuts (only one shown)
5 Bearing puller
6 Pump housing

Figure 3–90. Removing front bearing.

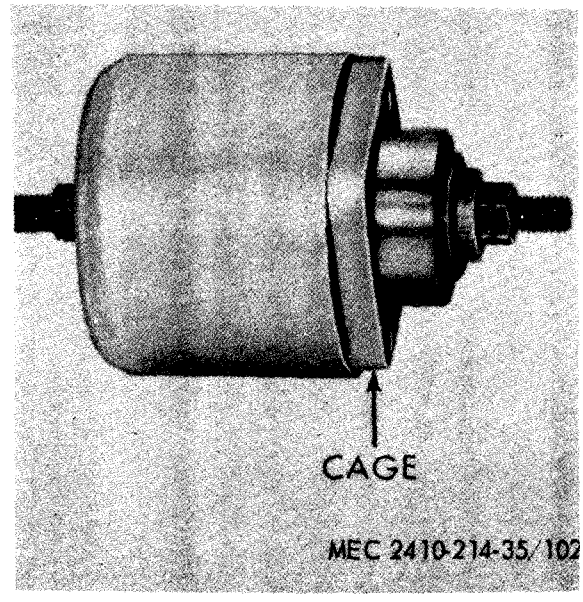


Figure 3–91. Removing rear bearing.

(6) Disconnect fuel injection lines (8) and remove oil line (10).

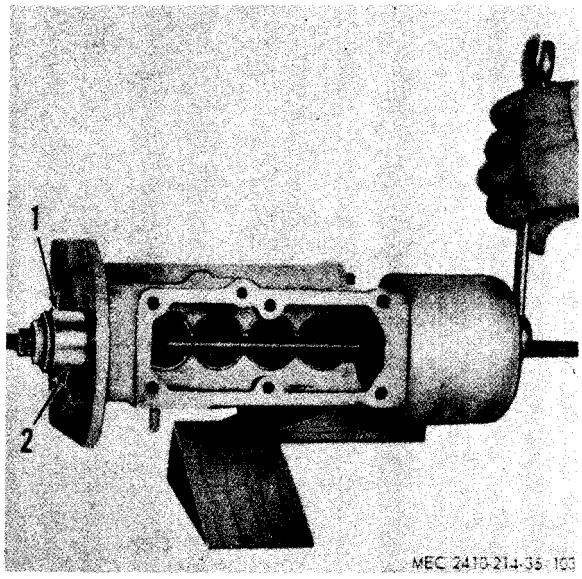
(7) Attach a sling to the fuel injection pump housing and support the weight of the housing.

(8) Remove the nuts securing the pump housing to the accessory drive housing and remove the pump housing.

b. Disassembly.

(1) Remove the four fuel pumps ((1), fig. 3-87) fuel rack (2), collar (3), pin (4), side cover (5), torque spring (6), and bottom cover (7).

(2) Loosen the locknuts ((2), fig. 3-88) and remove the lifter yokes (1).



1 Front bearing
2 Oil hole

Figure 3–92. Installing front bearing.

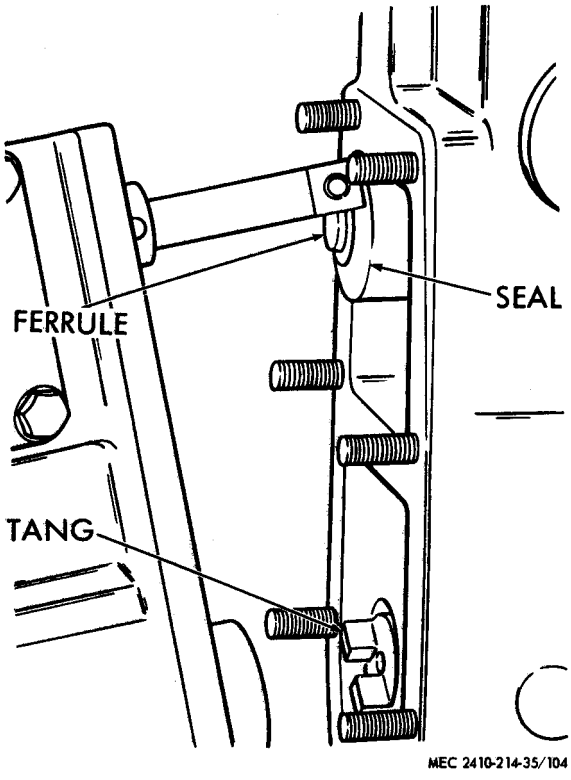


Figure 3–93. Preparing to install pump housing.

(3) Install the washers (4) and the bolts (3) into the threaded end (5) of the lifters. Use 3/8-inch-24 (NF) 3-inch long bolts.

(4) Thread the bolts into the lifters enough to raise the lifters free from the camshaft ((11), fig. 3-87).

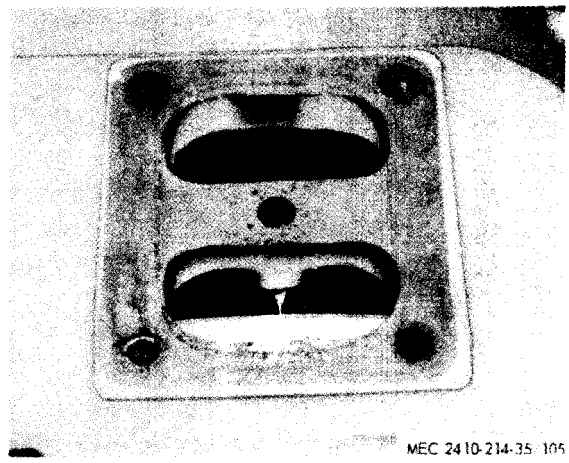
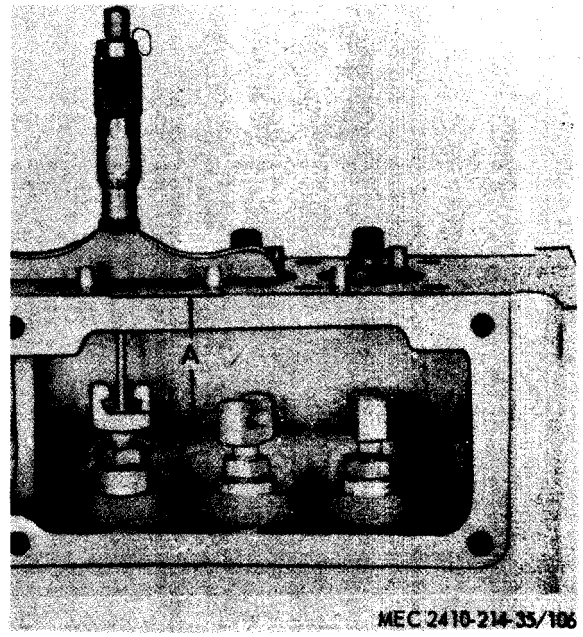


Figure 3–94. Locating top center flywheel mark.



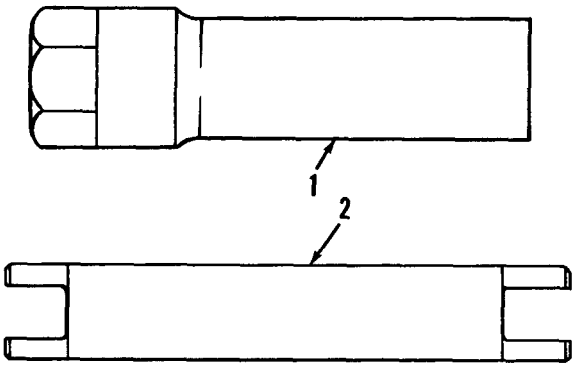
A—Distance to be measured
Figure 3–95. Measuring lifter setting.

(5) Remove the cover (8) thrust plate (9), bearing assembly (10) and camshaft (11).

(6) Remove the bolt ((1), fig. 3-89) and then remove the lifter (2) and the spring (3) through the bottom of the pump housing as shown.

(7) Refer to table 1-1 for pump camshaft bearing clearance and permissible clearance. Replace the bearings and/or camshaft if clearance exceeds the permissible limit.

Caution: The correct tools should be used to replace the bearings since bearing clearances are held to very close limits and a slight amount of distortion will cause the camshaft to bind in its bearings.



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1 Lifter adjustment wrench
2 Lifter adjustment wrench

Figure 3–96. Pump lifter setting tools.

(8) Assemble an adapter assembly ((2), fig. 3-90), puller stud (1), bearing puller (5), nuts (4), and washers (3), and force the f rent bearing out of the pump housing (6) as shown. The other washer (3) and nut (4) bear against the adapter assembly.

(9) The rear bearing and its cage (fig. 3-91) can be removed from the housing as a unit prior to pulling the bearing from the cage. Then pull the bearing as illustrated using the same tools in the same manner as used for removing the front bearing.

c. Cleaning and Inspection.

(1) Clean all parts in an approved solvent.

(2) Check bearing clearances as given in table 1-1.

(3) Inspect pump plunger for proper length with a micrometer. Permissible wear is listed in table 1-1.

Note. When pump plunger wear becomes excessive, the lifter yoke may also be worn in such a manner that it will not make full contact with the end of a new pluger. To avoid rapid wear on the end of the new plunger lifter yokes showing visible wear should always be replaced.

d. Reassembly and Installation.

(1) Install the bearings in reverse order of removal.

Note. The front bearing ((1), fig. 3-92) is installed with the oil hole (2) facing down as shown (with the housing on its side), or facing away from the engine when the housing is in the installed position. It is pressed into the pump housing until 7/8-inch of the end nearest the oil hole is protruding beyond the face of the pump housing.

(2) Reassemble the pump housing in the reverse order of disassembly.

(3) Install the pump housing in the reverse order of removal.

Note. When installing the pump housing be sure the seal (fig. 3-93) is in place on the ferrule and align the off center tang with the *off-center groove* in the fuel injection pump camshaft.

e. Fuel Pump Lifter Adjustment (On Engine).

(1) Turn the crankshaft (para 3-8) in the direction of the engine rotation to top center (TC) on the compression stroke of the cylinder for which lifter is to be set as illustrated in figure 3-94.

(2) If the top center mark on the flywheel is turned past the pointer, turn the flywheel backward approximately 600. Then turn the crankshaft again in the directio of cranshaft rotation until the top center mark aligns with the pointer.

(3) Check the pump lifter at this crankshaft position (top center of the cylinder for which the lifter is being set).

(4) Using a micrometer depth gage, check the distance ((A), fig. 3-95) and reset if necessary, using the wrenches (1) and (2) shown in figure 3-96. Refer to table 1-1 for correct lifter setting.

(5) If all the lifters are to be checked or reset, continue the procedure in the firing order of the engine.

Note. It is important when checking and setting the lifters that the engine be turned in the direction of the engine rotation. After a lifter has been checked or set according to specifications, turn the crankshaft a few degrees in the direction of engine rotation. Again measure the distance. This distance should be less than the measurement when checked with the crankshaft at top center, thus indicating the lifter is rising and was checked at the correct position.

3-23. Fuel Transfer Pump

a. *General.* The gear-type fuel transfer pump is mounted on the bottom of the accessory drive housing and is driven by the accessory drive shaft.

b. Removal.

(1) Remove crankcase guards.

(2) Shut off the fuel at the fuel tank and disconnect the fuel line (2) and drain line (1) from the fuel transfer pump (fig. 3-97).

Note. Four bolts ((3), fig. 3-97) secure the transfer pump to the accessory drive housing. These bolts have 9/16-inch hexagonal heads.

(3) Lower pump carefully to prevent loss of the rubber seals.

(4) Replace all damaged seals and gaskets.

c. *Disassembly.*

(1) Using a puller and a suitable step plate, remove gear ((1), fig. 3-98) from shaft assembly (4).

(2) Disassemble the fuel transfer pump (fig. 3-98).

d. Cleaning, Inspection, and Repair.

(1) Clean all parts in an approved solvent.

(2) Inspect all seals and gaskets and replace if damaged.

(3) Check bearing clearances as given in table 1-1.

(4) Bearings (7) and (21) can be pressed out and replaced if necessary.

Note. If the bearings (7) and (21) are replaced, the chamfer on the bearing (21) must be flush with the chamfer in the body (17) and the chamfer on the bearing (7) must be flush with the chamfer in the seat assembly (6).

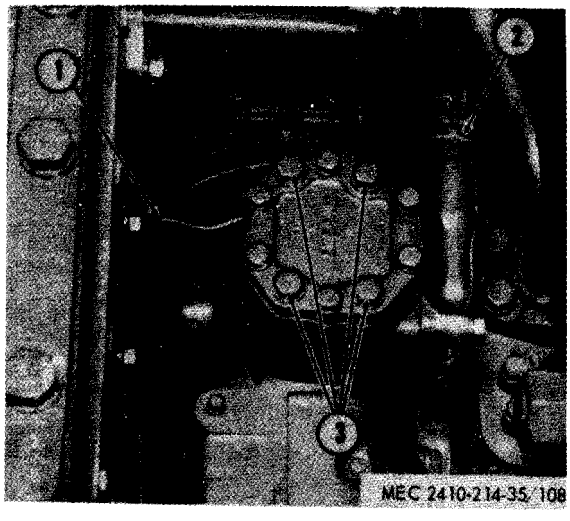
(5) Ensure that the bypass valve assembly plunger is in good condition and that the plunger seat is smooth and flat.

e. ***Reassembly and Installation.*** Prior to installation, soak seals (8), in a solution of 1/2 SAE 30 oil and 1/2 diesel fuel long enough to soften them. Tamp seals firmly into pump body bore and around shaft with a tamping tool (fig. 3-99). Use a guide over the end of pump shaft to guide seals over the threads and sharp corners of shaft. Guide should remain in place when using tamping tool.

(1) Assemble the pump in the reverse order of disassembly.

(2) Install the transfer pump (fig. 3-97) connect the fuel and drain lines and open the shutoff valve at the fuel tank.

(3) Check for fuel leaks.

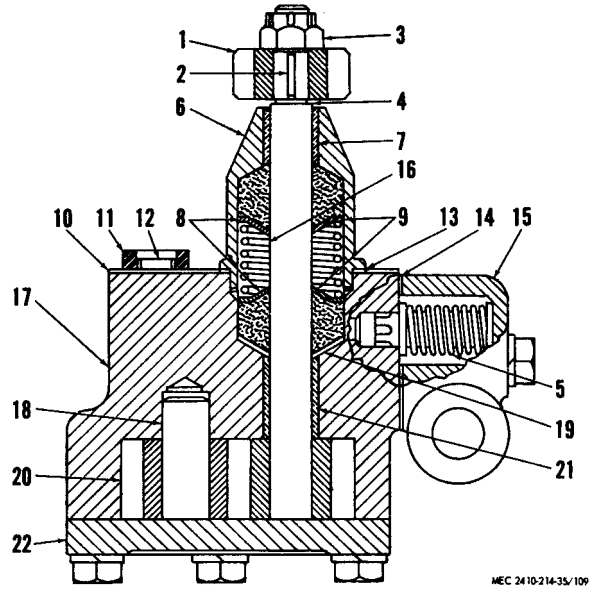


1 Fuel line
2 Fuel line
3 Bolt

Figure 3–97. Fuel transfer pump removal.

3-24. Fuel Tank

a. General. Refer to TM 5-2410-214-12 for fuel tank service instructions.



1	Gear	12	Ferrule
2	Key	13	Gasket
3	Nut	14	Gasket
4	Shaft assembly	15	Adapter
5	Bypass valve assembly	16	Spring
6	Seat assembly	17	Body
7	Bearing	18	Shaft assembly
8	Seals	19	Gasket
9	Retainer	20	Idler Gear
10	Gasket	21	Bearing
11	Seal	22	Cover

Figure 3–98. Fuel transfer pump.

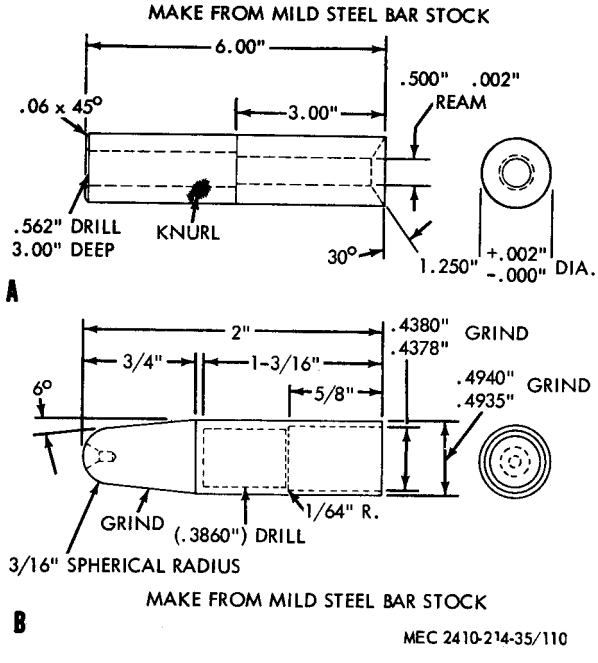
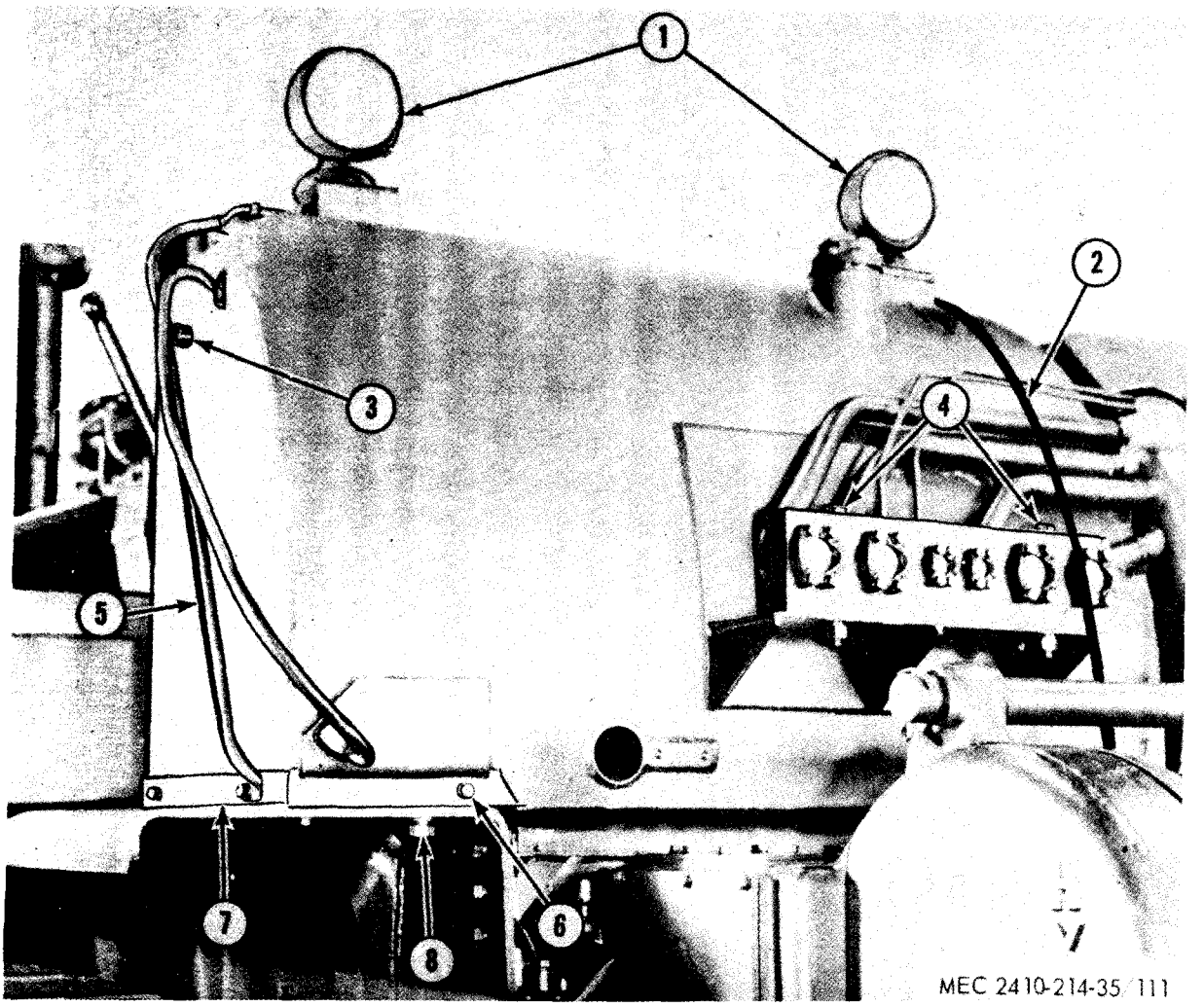


Figure 3–99. Seal tamping tool and guide.

b. Removal and Installation.

(1) Remove the rear guard and shut off the fuel supply at the tank.

(2) Disconnect the fuel supply and drain lines at the tank.



1	Lights	5	Conduit
2	Grab iron	6	Bolt
3	Clip	7	Guard
4	Bolts	8	Bolts

Figure 3–100. Fuel tank removal.

(3) Remove the seat and seat frame.

(4) Disconnect wiring and remove lights ((1), fig. 3-100).

(5) Remove grab iron (2).

(6) Remove guard (7).

Note. Be sure to reinstall ground wire on bolt (6) when installing guard (7).

(7) Pull wiring back into conduit (5), loosen clip (3) and move conduit aside.

(8) Remove wires from clip mounted on front lower left corner of fuel tank.

(9) Remove bolts (4) and mounting bolts (8).

(10) Install two eyebolts in light brackets, attach a hoist and remove the fuel tank by moving it forward and to the left.

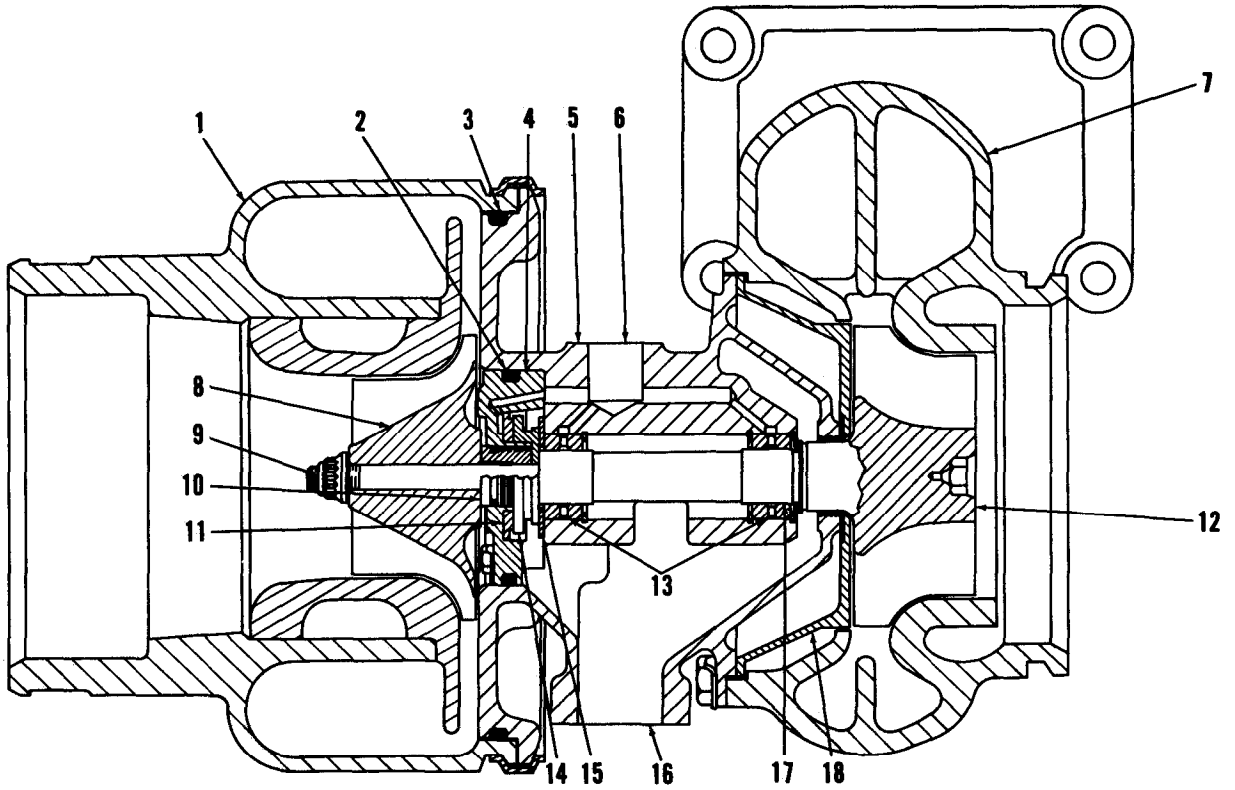
(11) Install in reverse order of removal,

3-25. Turbocharger

a. General.

(1) The turbocharger consists of four main parts: the compressor housing ((1), fig. 3-101), the center housing (5), the turbine housing (7) and the rotating assembly. Two free flaoting bearings (13) support the rotating assembly which consists of the turbine wheel (12), shaft (17), impeller (8), impeller nut (9), spacer (10) and thrust collar (14). Exhaust gas enters the turbocharger at the outer circumference of the turbine wheel. It forces the turbine wheel to rotate and leaves through the center of the turbine housing (7).

(2) Since the impeller (8) is directly connected to the turbine wheel, it rotates at the same speed. This causes air to flow into the com-



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1	Compressor housing	10	Spacer
2	O-ring seal	11	Thrust bearing
3	O-ring seal	12	Turbine wheel assembly
4	Thrust plate assembly	13	Bearings
5	Center housing	14	Thrust collar
6	Lubrication oil inlet	15	Thrust bearing
7	Turbine housing	16	Lubrication oil outlet
8	Impeller	17	Shaft
9	Impeller nut	18	Shroud

Figure 3–101. Turbocharger.

pressor housing center, pass through the impeller and then radially outward through the vortex and into the diesel engine manifold system.

(3) The turbocharger shaft bearings (13) are pressure lubricated by the diesel engine lubrication system. Oil enters through an inlet hole (6) and is directed by passages to the bearings. After passing through the bearings, the oil is allowed to return to the diesel engine pump through the lubrication outlet (16).

(4) On the turbine end of the shaft, a slinger is used to prevent oil leakage while a piston ring-type seal and sprial groove are used on the compressor end. Also the thrust collar has radial holes in it which allow oil to flow back into the bearinghousing because of centrifugal action.

b. Removal.

(1) Remove the exhaust extension, the air cleaner cap and the hood.

(2) Remove the No. 1 fuel injection line and exhaust pipe ((1), fig. 3-102).

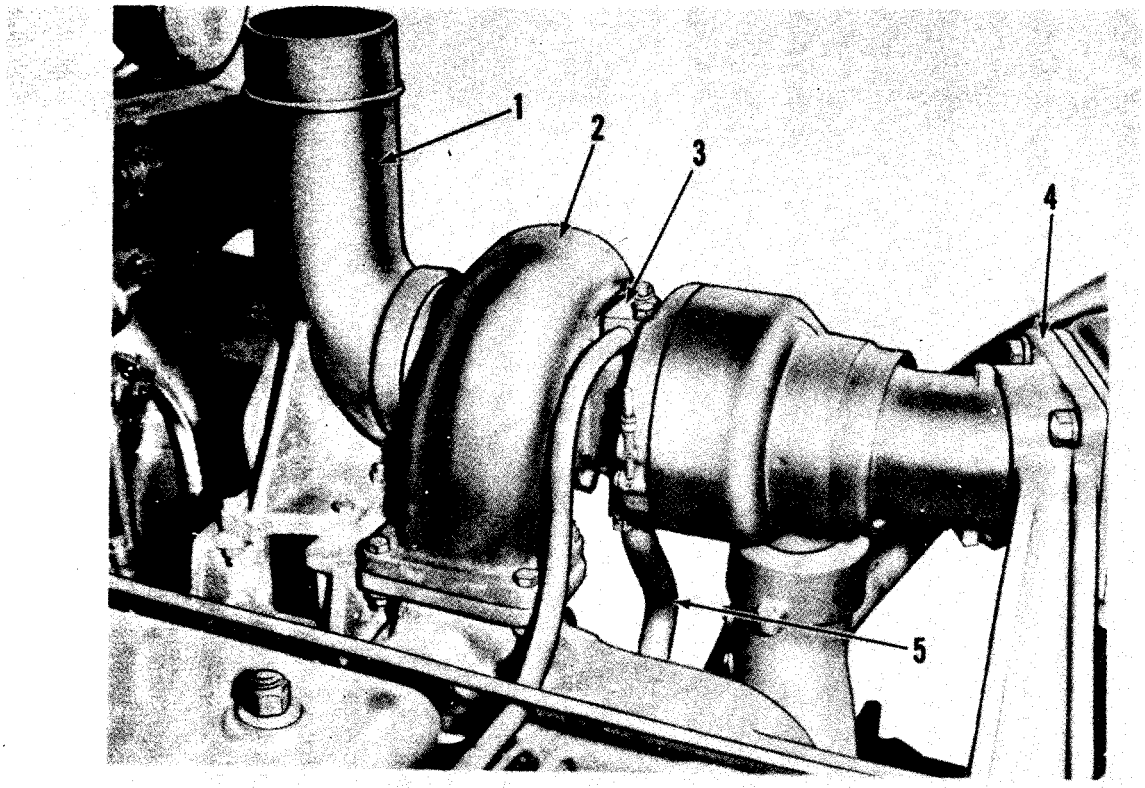
(3) Disconnect the turbocharger oil lines (3) and (5).

(4) Remove the bolts that hold the bracket (4) to the air cleaner and to the engine block.

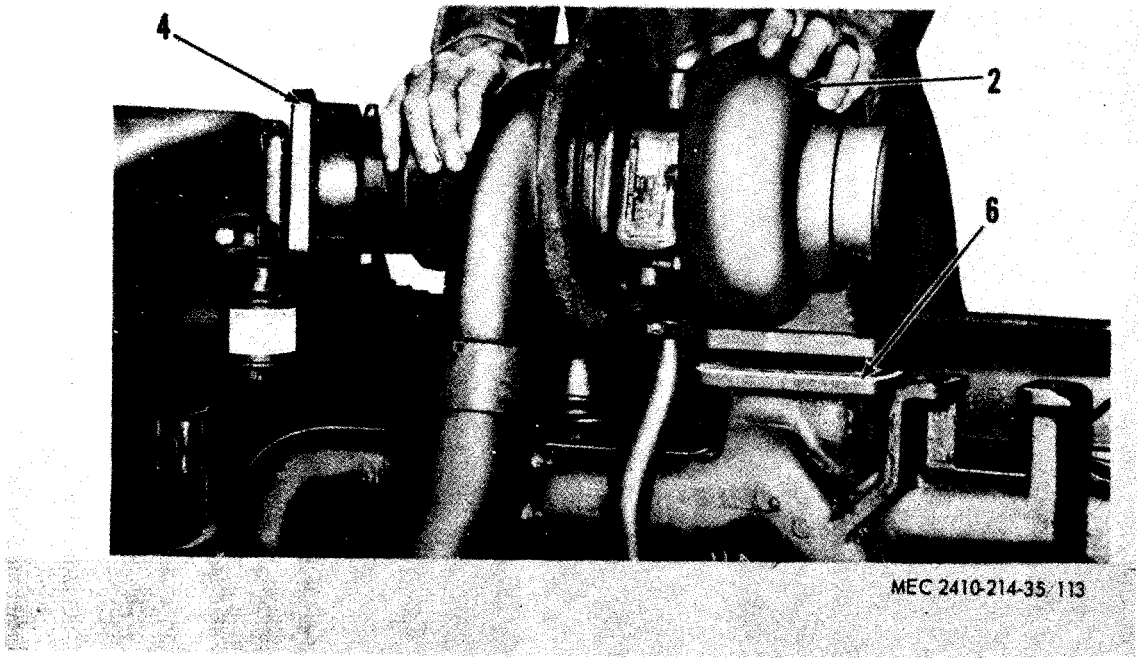
(5) Remove the bolts which hold the turbocharger (2) in place on the exhaust manifold (6) and, using a suitable hoist, remove the turbocharger and the support bracket (4) as a unit as shown.

Note. Cover all oil line opening and air openings immediately after removing the turbocharger: Put the turbocharger in a safe, clean place.

(6) Refer to table 1-1 for normal and permissible shaft end clearance (axial movement). End clearance is checked with a dial indicator, either on or off the engine. If the permissible clearance is exceeded, recondition the turcharger.



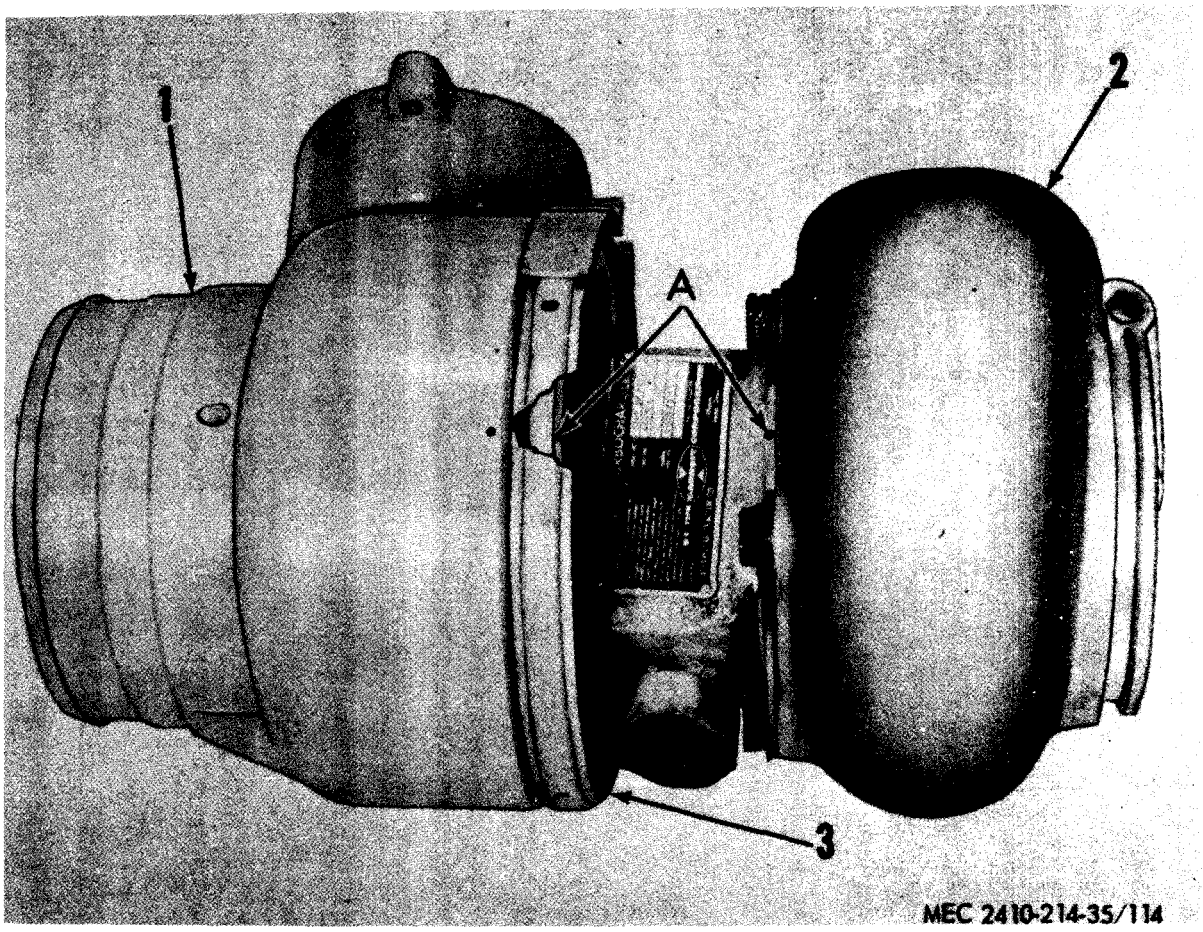
A



B

1	Exhaust pipe	4	Support bracket
2	Turbocharger	5	Oil drain line
3	Oil supply line	6	Exhaust manifold

Figure 3–102. Turbocharger removal.



1 Compressor housing
2 Turbine housing
3 Clamp
A—Punch marks

Figure 3–103. Preparing to disassemble turbocharger.

c. **Disassembly.**

(1) Before disassembling the turbocharger, **punch** mark ((A), fig. 3-103) the compressor housing (1), center housing and turbine housing (2) to assure correct positioning of the turbocharger parts upon reassembly.

Note. In some cases, it may be necessary to loosen the compressor and turbine housings by carefully striking them with a soft hammer.

(2) Fabricate a fixture and an adapter plates as shown in figure 3-104. Bolt the adapter to the fixture.

Note. It may be possible to modify adapter made for other turbochargers to suit the dimensions given in the illustration. Check available adapters.

(3) Remove the impeller nut and place the compressor end of the center housing in an oil bath so only the impeller is immersed. Heat to a maximum of 325° –375° F for not more than 10 minutes.

(4) When the impeller is heated, place the center housing in the fixture and press the shaft and turbine wheel as a unit from the impeller. Approximately 1/2-inch of shaft and turbine wheel ((3), fig. 3-105) movement is required to free them from impeller.

(5) Remove center housing from fixture to allow removal of shaft and turbine wheel (3) and shroud (2).

Caution: **Shroud (2) is not retained on the center housing. Prevent it from falling when the shaft and wheel is removed.**

(6) Measure the shaft journal diameters and inspect the journals for roughness. If the journal diameters are less than specified, replace the rotating assembly. Refer to table 1-1 for correct dimensions.

(7) Check the runout of the shaft (fig. 3-106). This can be done by one of two methods. Use the standard bearings and place the shaft in vee blocks or use a partially open vise.

(8) To prepare center housing for disassembly remove three bolts (1, fig. 3-107) and locks (2).

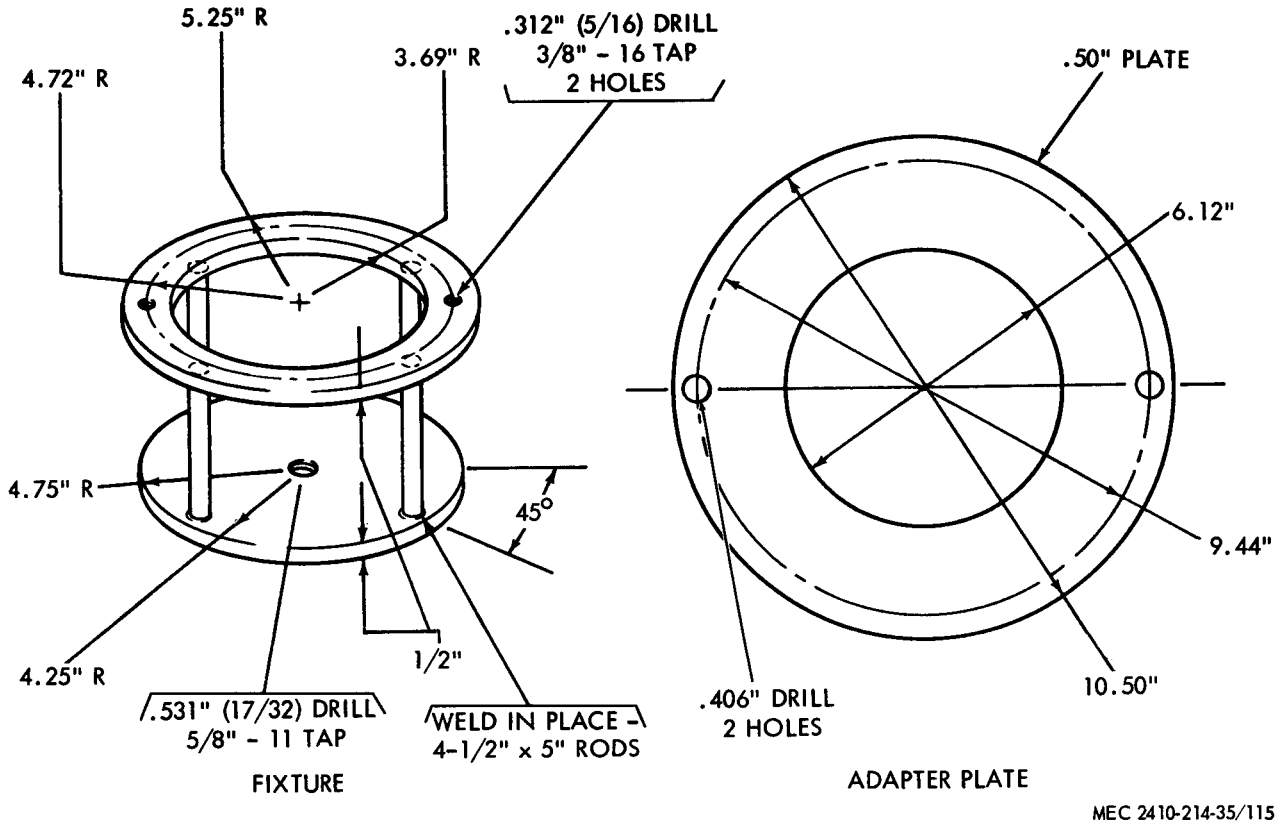


Figure 3-104. Fixture and adapter plate.

(9) Fabricate a wood dowel as illustrated in figure 3-108.

(10) Using a wood dowel ((3), fig. 3-109) remove thrust plate assembly (1) from center housing (2).

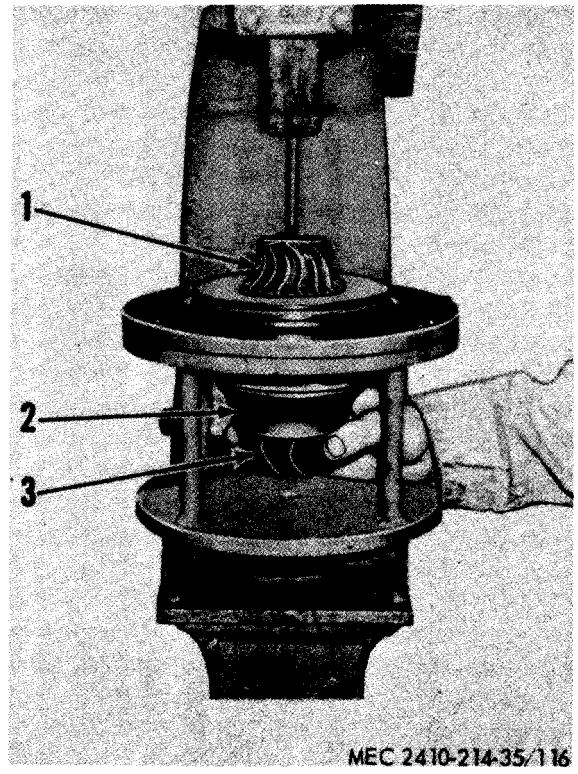
(11) Measure the thickness of thrust collar ((5). fig. 3-110) and thrust bearing (6). If the thickness is less than the required value listed in table 1-1 replace the worn parts to correct excessive end clearance.

(12) Thrust bearing (2) is riveted to thrust plate (1) and the two parts are serviced as a plate assembly. Using a depth micrometer, measure depth from mounting face of thrust bearing (1) to surface of thrust bearing (2) to check for excessive wear. If the maximum depth listed in table 1-1 is exceeded, replace the plate assembly.

(13) Replace thrust plate assembly (1) if its bore is grooved. Check the gap of oil seal ring (3) using the bore in a new thrust plate as a ring gage.

(14) Inspect preformed packing (7) and oil holes (8) and (9).

Note. Rings ((1), fig. 3-112) and (3) and bearing (2) must be removed from the compressor end of the center section.



1 Impeller
2 Shroud
3 Shaft and turbine wheel

Figure 3-105. Pressing shaft and turbine wheel from impeller.

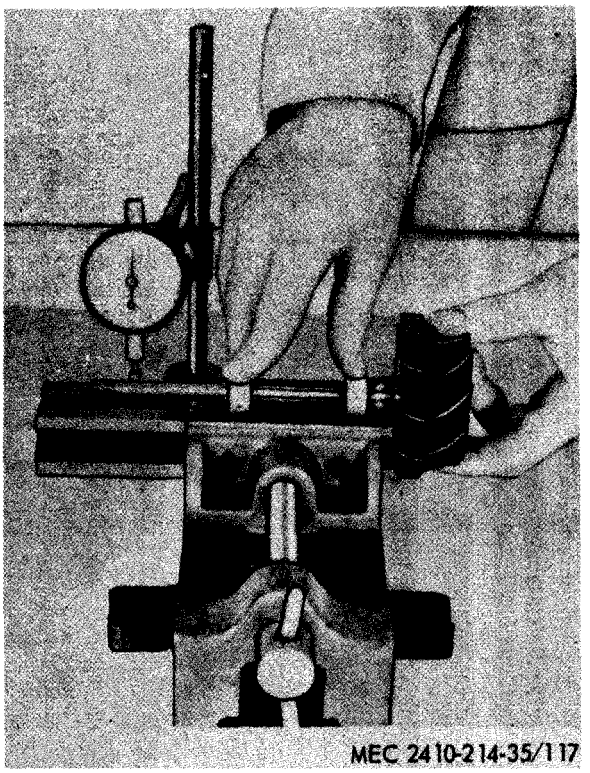
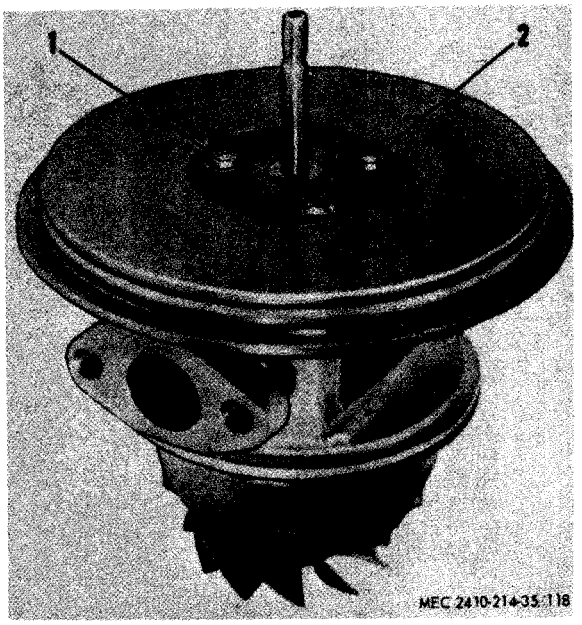


Figure 3–106. Checking shaft runout.



1 Bolts
2 Locks

Figure 3–107. Preparing to disassemble housing.

(15) Check the inside and outside diameters of bearings ((1), fig. 3–111) and ((2), fig. 3–102). Inspect the bores in the center housing ((2), fig. 3–109) for roughness and measure the bores. If these measurements do not fall within the limits listed in table 1–1 replace the bearings

Note. The bearing ((1), fig. 3–111) and ((2), fig. 3–112) are interchangeable and can be installed with either end in the housing.

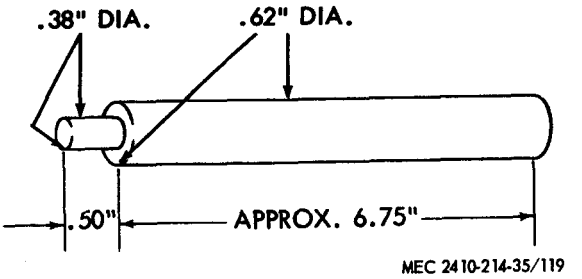
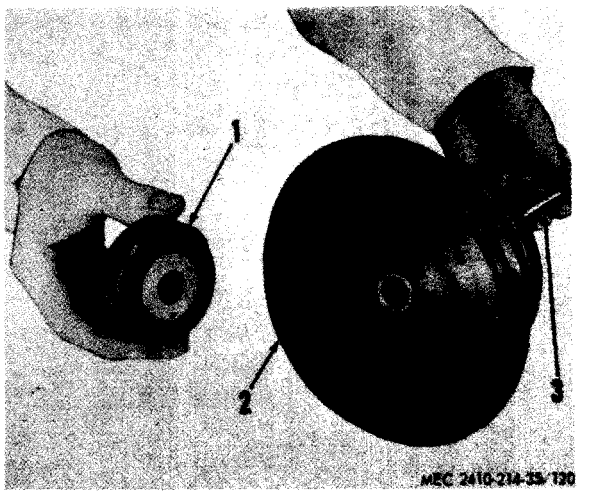
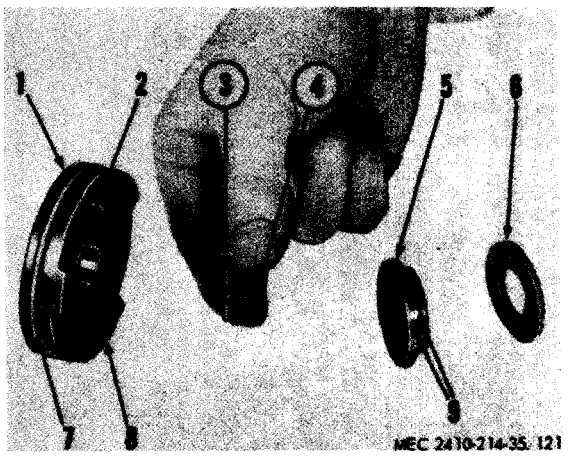


Figure 3–108. Wood dowel.



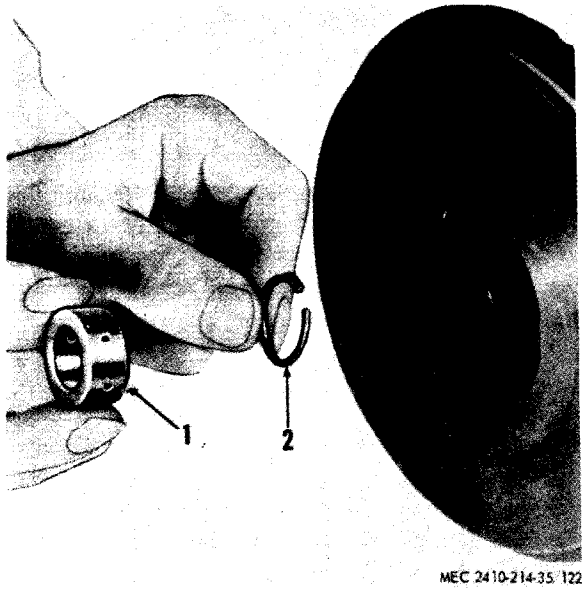
1 Thrust plate assembly
2 Center housing
3 Dowel

Figure 3–109. Thrust plate removal.



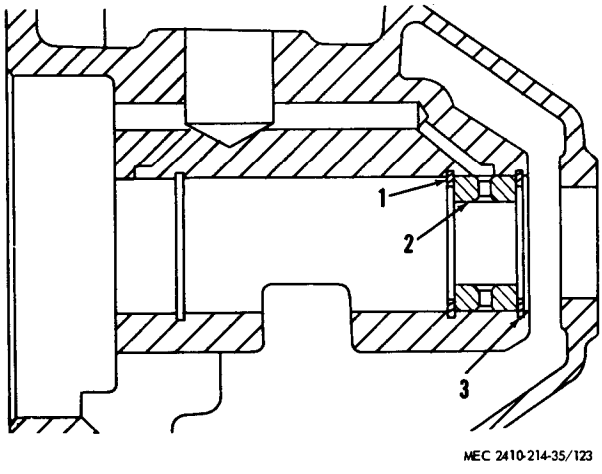
1 Thrust plate assembly
2 Thrust bearing
3 Oil seal ring
4 Spacer
5 Thrust collar
6 Thrust bearing
7 Packing
8 Oil hole
9 Oil holes

Figure 3–110. Thrust spacer, plate and washer removal.



1 Bearing
2 Ring

Figure 3–111. Bearing removal (compressor end).



1 Ring
2 Bearing
3 Ring

Figure 3–112. Bearing removal (turbine end).

d. Cleaning and Inspection.

(1) Inspect all rotating parts for binding, damage, or evidence of rubbing on adjacent parts. Replace any damaged parts.

(2) Wash all parts (except the impeller and turbine wheel) with an approved cleaning solvent and dry thoroughly. Use a wire brush to clean the carbon and deposits from ONLY the turbine housing.

(3) Neither the impeller nor turbine wheel need be cleaned unless the build-up of dirt or carbon is so excessive that portions of the build-up are breaking off. The impeller and turbine wheel remain in balance if the deposits of dirt or carbon have not been disturbed. However, large carbon deposits on the turbine wheel, if allowed to remain, will flake or burn off and cause the assembly to be out of balance.

Caution: If the unit has been completely disassembled and the impeller removed, it is quite likely some carbon deposits have been disturbed from the turbine wheel, even though the build-up may not be excessive. This might not be visible and may necessitate thoroughly cleaning the turbine wheel.

(4) The turbine wheel must be cleaned with a strong cleaning solvent in order to dissolve the carbon. The amount of soaking depends on the amount and type of deposits on the wheel. When hard carbon deposits are formed, soaking in a solvent-type cleaner for an hour or more is required. The loosened particles must all be scraped off with a stiff brush or a specially shaped piece of wood and, if necessary, the whole process repreated. If the wheel is covered with soot only, washing with a stiff brush and cleaning solvent and then rinsing with clean water will be sufficient.

Caution: **A strong solvent will attack preformed packings; use only on the turbine wheel. The wheel must be thoroughly cleaned in order to maintain the critical balance of the unit. Protective clothing must be worn when handling a strong solvent.**

(5) If the tips of the turbine blades are very slightly bent, they can be straightened, using a cloth and pliers. Badly bent turbine wheel blades necessitate the use of a new rotating assembly since such blades could provide a source of failure.

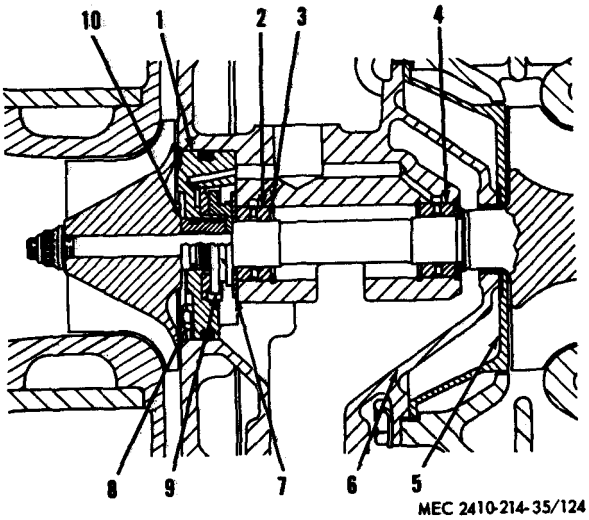
(6) If cleaning of the impeller is required, use a small bristle brush or, if found necessary, a piece of soft wood to loosen the heavy deposits. Then use a clean, lint-free cloth with a cleaning solvent in order to remove all deposits from the impeller blades. Laundry soap and warm water may also be used. Never use a stiff brush. It is important that the impeller be thoroughly cleaned to prevent bearing damage.

e. Assembly.

(1) Before assembling, be certain all parts are thoroughly clean. Take extreme care to keep out dirt and foreign material.

(2) Lubricate all rotating parts and housing bores with clean oil before assembling.

(3) Install bearing ((4), fig. 3-113) and snap rings. Install snap ring (3).



1 Thrust plate assembly
2 Bearing
3 Snapring
4 Bearing
5 Shroud
6 Center housing
7 Thrust bearing
8 Bolt (3)
9 Thrust collar
10 Spacer

Figure 3–113. Turbocharger assembly.

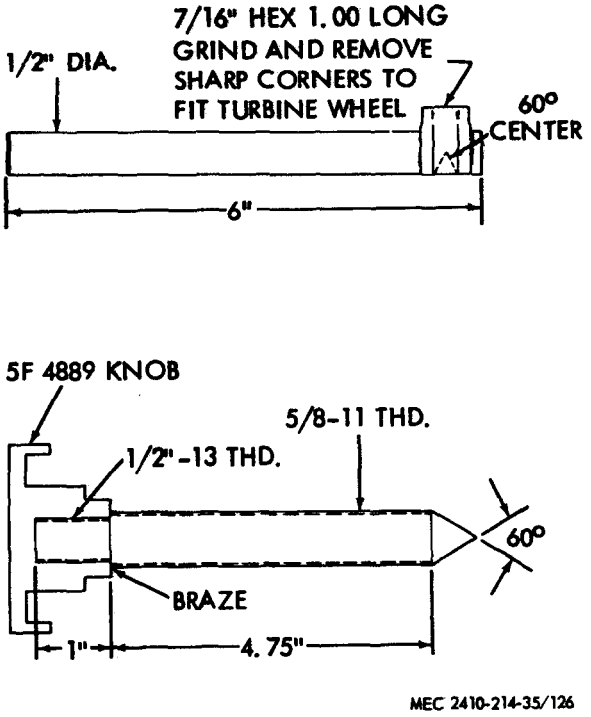
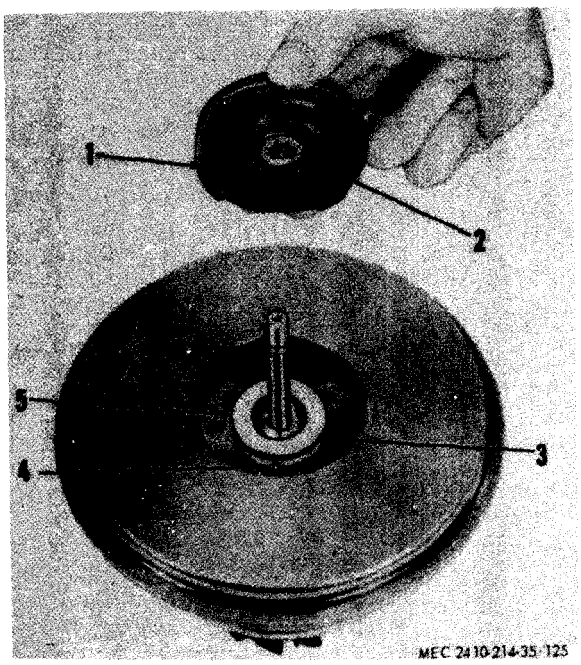
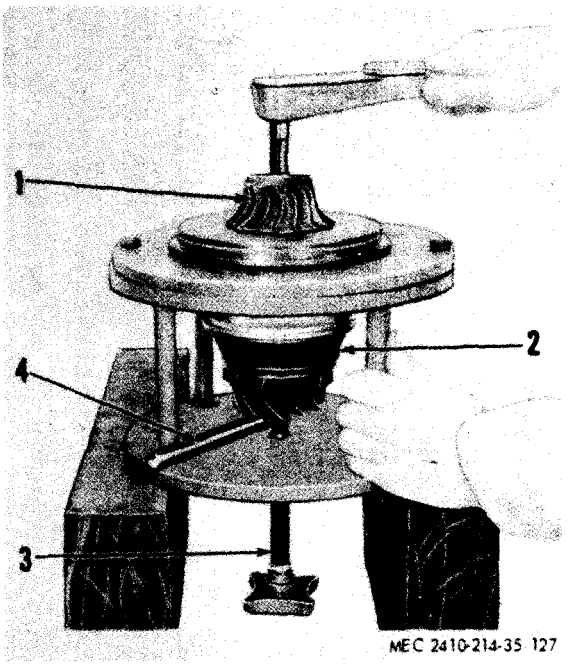


Figure 3–115. Turbine wheel holding tool.



1 Thrust plate assembly
2 Spacer
3 Thrust bearing
4 Pins (2)
5 Thrust collar

Figure 3–114. Installing thrust plate assembly.



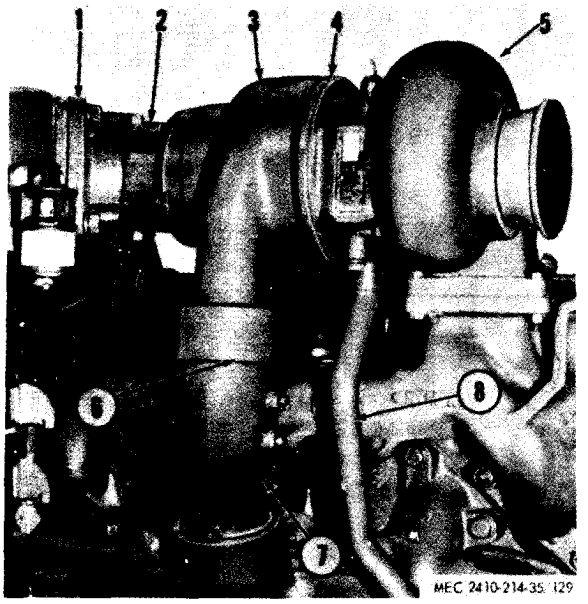
1 Impeller
2 Shroud
3 Screw
4 Holding tool

Figure 3–116. Installing nut on shaft.

(4) Place turbine wheel and shaft upright. Guide shaft through shroud (5), center housing (6) and bearing (4). Lubricate and install bearing (2) and thrust bearing (7). Be sure thrust bearing (7) engages pins ((4), fig. 3–114) properly and is seated flat against housing.

(5) Install thrust collar ((9), fig. 3-113) (with large od toward impeller end) over shaft and flat against thrust bearing (7).

(6) Install piston ring on spacer (10). Install spacer in thrust plate assembly (1) so, when assembled, piston ring will be toward impeller



1 Support bracket
2 Inlet pipe
3 Cover
4 Cover clamp
5 Housing
6 Positioning marks
7 Outlet pipe
8 Drain line

Figure 3–117. Turbocharger installation.

(7) Install thrust plate assembly preformed packing.

(8) Align oil hole in center housing and thrust plate assembly and install in center housing. Maintain thrust pressure against spacer (10) to keep in place while installing thrust plate.

(9) Install locks and bolts (8) and tighten to torque valve given in paragraph 1-4g.

(10) Fabricate a turbine wheel holding tool (fig. 3-115) and a support screw.

(11) Place the tool in the turbine wheel and move screw (3, fig. 3-116) upward until the wheel and shaft assembly is seated against the center housing.

(12) Heat impeller (1) at 325° –375° F for not longer than 10 minutes and immediately install on the shaft. Tighten nut, while the impeller is still hot, to torque valve given in paragraph 1-4g.

(13) After impeller has cooled sufficiently (150° F max), remove the nut. The washer face of the nut must be smooth and clean.

(14) Lightly oil threads of the turbine shaft and nut. Install nut and tighten to torque value given in paragraph 1-4g.

(15) Mark the nut location to the shaft. Tighten the nut an additional portion of a turn (para 1-4g). Turn nut in such a manner as not to impose any bending load on shaft.

(16) Check shaft end clearance (table 1-1).

(17) Align punch marks on compressor housing and center housing. Install band clamp and tighten to torque value given in paragraph 1-4g.

(18) Align marks on turbine housing and center housing. Coat threads of bolts with antiseize compound. Install bolts, clamps and locks. Tighten bolts to torque value given in paragraph 1-4g.

(19) After assembly, push the rotating assembly as far as possible toward either end and check for binding. Lubricate internally.

f. Installation.

(1) Clean all mating surfaces and replace any worn or damaged gaskets.

(2) Install the support bracket ((1), fig. 3-117) and the turbocharger without the preformed packings.

(3) Make sure that the band-type clamp (4) is loose so that the compressor cover may rotate. Bolt the support bracket (1), the turbocharger and the oil drain line (8) in their proper positions as shown.

(4) Lubricate the threads on the band-type clamp.

(5) Rotate the compressor cover to determine the free-play between the cover and inlet and outlet pipes. Position for equal free-play and tighten the compressor cover clamp (4).

(6) Rotate the compressor inlet pipe, *(2)* and the outlet pipe (7) to determine their extremes of free-play. Position for equal free-play and draw the marks (6) as shown.

(7) Remove the turbocharger and support bracket.

(8) Check and replace, if necessary, all preformed packings. Install the seals.

Note. Lubricate the preformed packings with oil to aid installation. Do not use soap as its somewhat adhesive properties will make future removal difficult.

(9) Assemble the compressor inlet and outlet pipes and the support bracket to the turbocharger and align the positioning marks (6).

(10) Before final installation, lubricate the turbocharger shaft with clean crankcase lubricating oil and turn the shaft a few times by hand.

Note. Install the gasket on the exhaust manifold with the rolled edge up. The use of antisieze thread compound is recommended on bolts subject to heat to ease future removal.

(11) Install the turbocharger and support bracket as a unit, being certain that all oil and manifold connections are tight.

(12) Loosen the compressor cover clamp and position the cover for equal freeplay. Tighten the clamp to the torque value listed in paragraph 1-4g.

Note. The turbocharger requires no special test procedure. However, observe the turbocharger for the initial one-half hour of operation to determine that the unit is secure and that no lubrication leaks develop. Thereafter frequency periodic checks should be made.

Section IV. ELECTRICAL SYSTEM

3-26. Generator

a. General. The generator is a 24-volt, 40-ampere type mounted on the right front of the engine compartment. It is fungus-and corrosion-resistant and is arranged for B-type circuit with the field grounded inside the generator.

b. Removal and Installation. Refer to TM 5-2410-214-12 for removal and installation instructions.

c. Disassembly.

(1) Remove nut ((29), fig. 3-118) 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 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 andinsulators (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 a safety type petroleum solvent such as MIL-T-6003, with brush. Wipe clean, then use compressed air to remove any remaining dirt film. Do not use any decreasing compounds or submerge the armature

1	Lockwasher	24	Elbow
2	Nut	25	Gasket
3	Screw	26	Spacer
4	Plate	27	Lead assembly
5	Bearing	28	Lead assembly
6	Bolt	29	Nut
7	Lockwasher	30	Washer
8	Frame	31	Screw
9	Dowel	32	Lockwasher
10	Plate assembly	33	Plate
11	Washer	34	Frame
12	Arm	35	Collar
13	Spring	36	Bearing
14	Brush	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	Not used
23	Screw	46	Screw

Figure 3-118—Continued

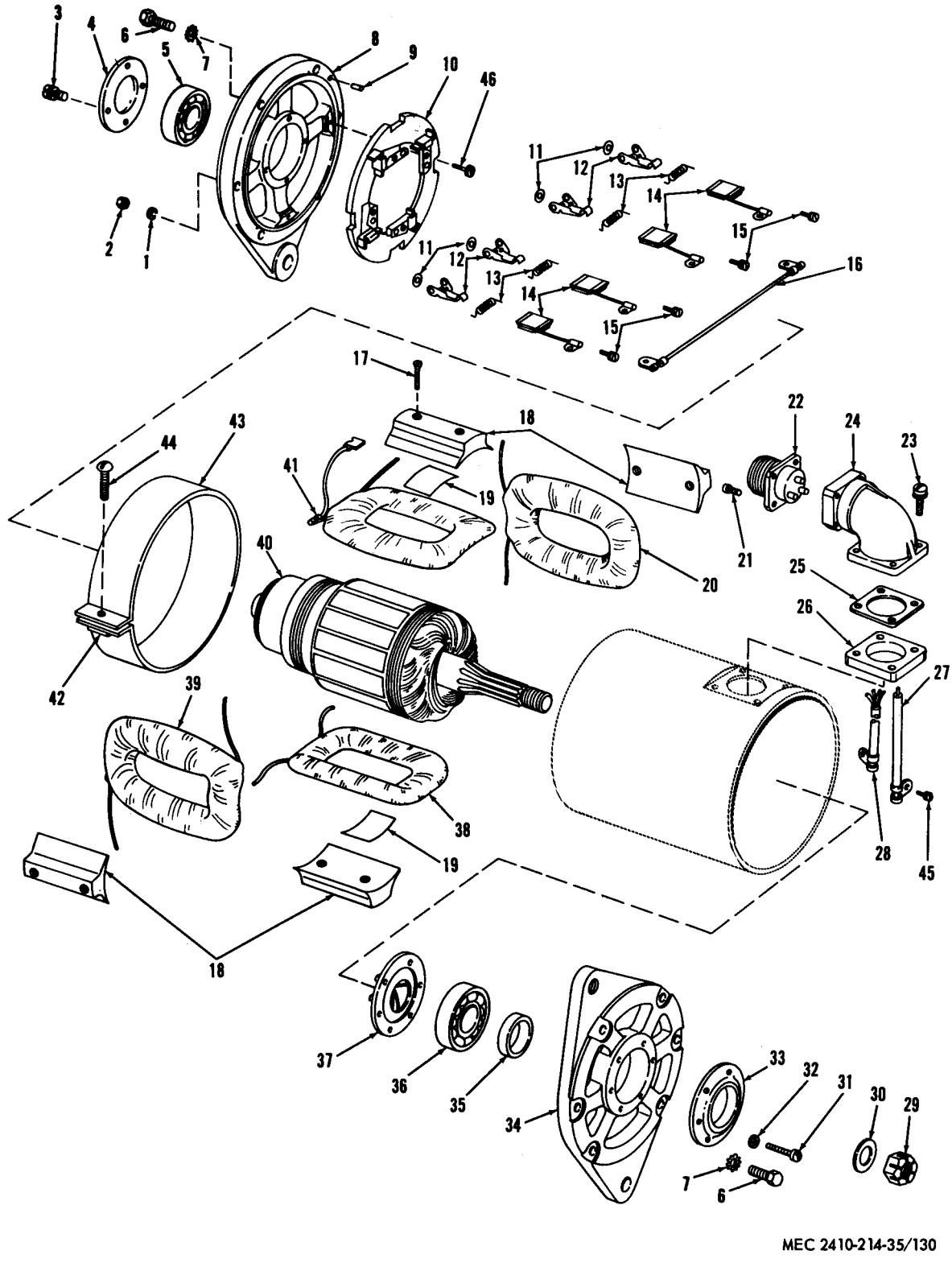


Figure 3–118. Generator disassembly.

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 an approved solvent and dry thoroughly.

Caution: **Do not soak insulators.**

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 op. eration. 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.

3-27. 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 5-2410-214-12.

c. *Starter Disassembly.*

(1) Scribe marks across drive housing ((104), fig. 3-119), 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

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 Bushing
42 Seal
43 Plug
44 Bushing
45 Frame assembly
46 Plug
47 Felt
48 Packing
49 Washer
50 Insulator

Figure 3-119①—Continued

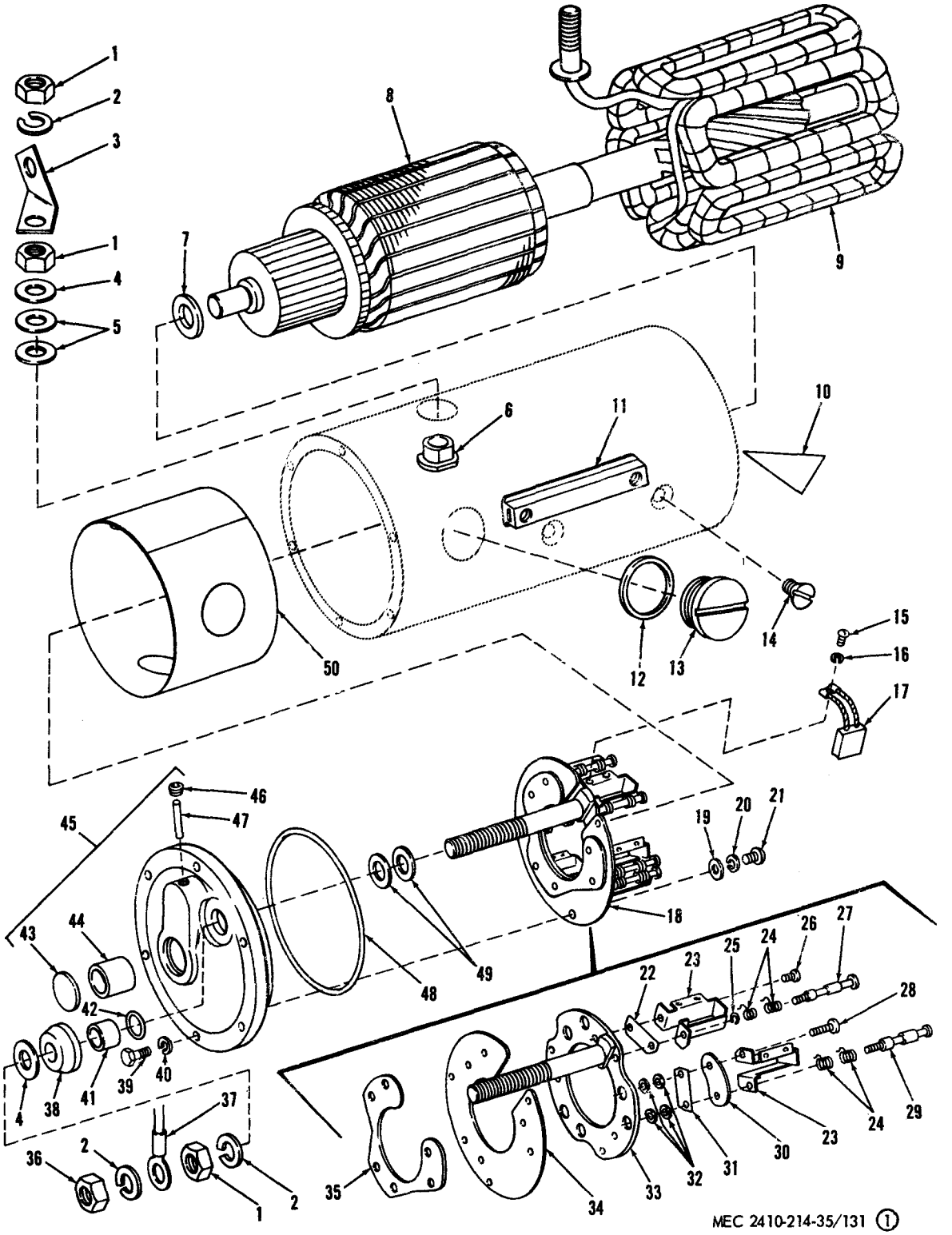


Figure 3–119①. Starter motor, exploded view.

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 attaching

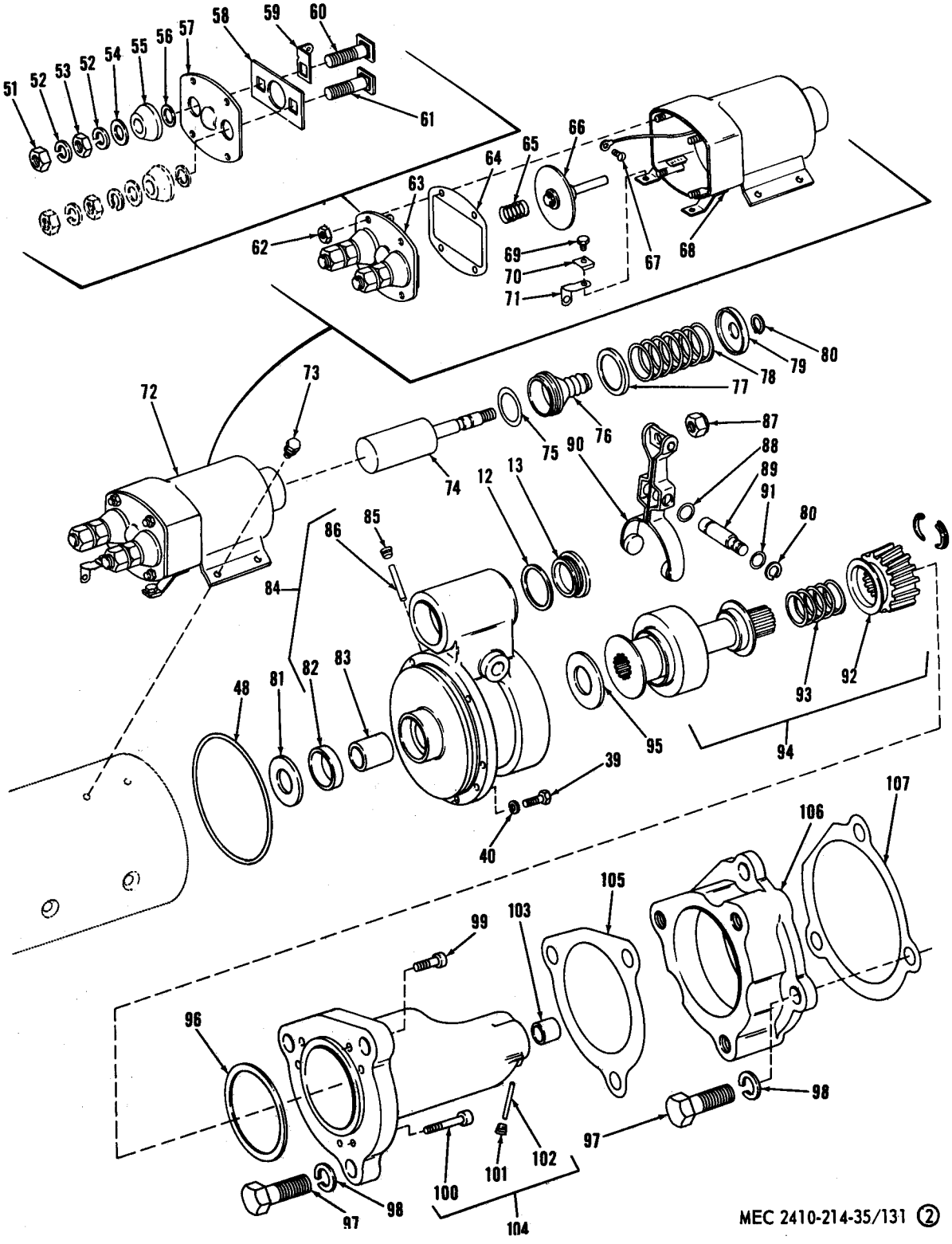


Figure 3–119②. Starter motor, exploded view.

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 Felt
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

Figure 3-119②—Continued

screws from each of the holes. Mark screw holes to identify them during assembly of brushes.

(6) Remove six hex-head bolts (39) and lockwasher (40) securing commutator end bell assembly to frame. Using a screw driver, 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 o! 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 expansion plug and plug. Remove pipe plug and wick.

(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 shoe 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, expansion plug, wick, and plug from end frame and bearing assembly.

(4) If sleeve bearing is worn, remove expansion plug and press sleeve bearing from end frame.

(5) Remove screws (15) and lockwashers (16) securing brush leads to brush holders. Lift each srping 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 nonmetallic 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 grounds with a test light by touching one probe to armature core and other to commutator risers. If test light glows, the armature is grunded and must be replaced.

(5) Inspect armature for short circuits using a growler fixture and a steel grip. Grip 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 (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 plugnger 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 ((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. In. stall 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 $\pm 1/32$ inch.

Section V. ENGINE COOLING SYSTEM

3-28. General

Refer to TM 5-2410-214-12 for description and servicing of engine cooling system.

3-29. Radiator

a. Removal and Installation.

(1) Drain the coolant from the radiator, and remove engine upper guard assemblies (serial nos. 75E1301–UP). Refer to TM 5-2410-214-12.

(2) Remove the hood, head light brackets and radiator top guard.

(3) Disconnect tube ((1), fig. 3-120) and elbow (2).

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

(5) Remove the radiator" guard lower plate and lower baffle plate.

(6) Remove bolts (6).

(7) Rotate bracket (7) away from the radiator core after loosening bolt (5).

Note. Be sure the seal strip ends are moved on both sides of the radiator core or damage to the strips and/or core may result as the radiator is lifted out.

(8) Disconnect elbow (8).

(9) Remove bolts (9) and retain shims (11) if so equipped.

(l0) Loosen bolts (10).

(11) Attach a hoist (fig. 3-121) and remove the radiator (approx. weight 425 lb).

(12) Pull the radiator forward, so the bottom tank does not catch on the shroud braces as the radiator is removed.

(13) Tilt radiator sideways so the bottom tank will pass the top tank mounting pads.

Note. Be sure to replace shims ((1), fig. 3-120) if so equipped.

b. Disassembly and Reassembly. With the radiator removed drom the engine, the radiator can be disassembled in the following manner:

(1) Remove top tank ((1), fig. 3-122) by removing the bolts holding reinforcing strips (2) and radiator core (3) to the top tank.

(2) Remove bottom tank (4) in the same manner.

(3) Clean the radiator core of all accumulations of debris between the fins and tubes with water or compressed air. Such accumulations decrease the efficiency of the cooling system and may cause the engine to overheat.

(4) Clean the inside of the radiator cores, bottom tank, and top tank with commerical radiator cleaner.

(5) When assembling the radiator, be sure there is a perfect seal between the radiator core and the top and bottom tanks.

c. ***Radiator and Radiator Guard Removal.***

(1) Drain the cooling system. Remove engine upper guard assemblies (serial nos. 75E-1301–UP). Refer to TM 5-2410-214-12.

(2) Remove the hood, radiator bottom guard, and the front section of the crankcase guard,

(3) Disconnect the generator wires.

(4) Disconnect the upper elbow ((2), fig. 3-120) from the radiator top tank.

(5) Disconnect the lower elbow (8) from the radiator.

(6) Remove the fan belts.

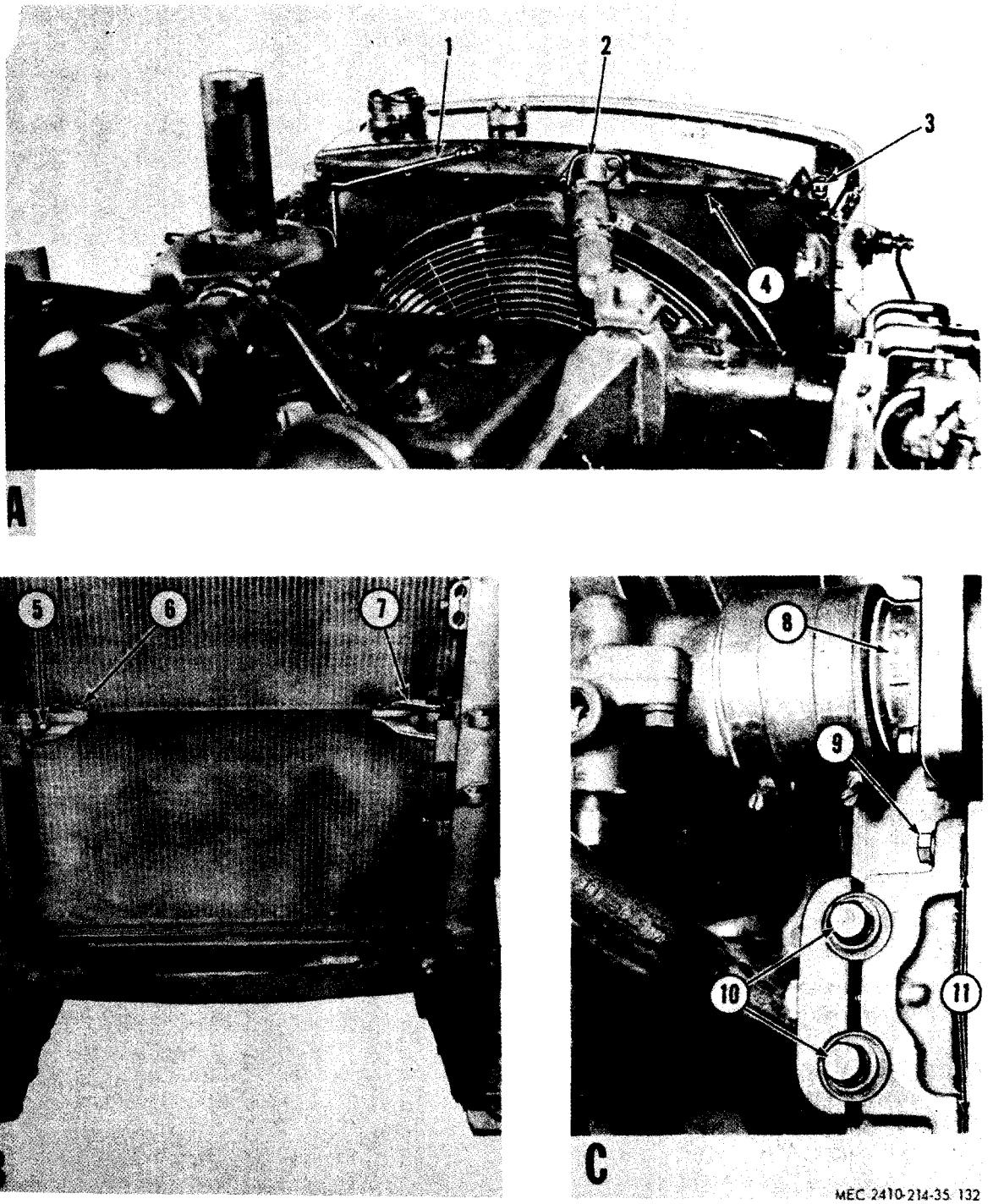
(7) Disconnect and loop the bulldozer lift cylinder hydraulic lines.

(8) Remove the bolts securing bracket ((1), fig. 3-123) to the main frame.

(9) Attach a hoist for support and remove the bolts that secure the radiator guard (approx. weight 2,550 lb) to the tractor.

(10) Remove the radiator guard and radiator from the tractor as shown in figure 3-123.

(11) Check the pulley alignment prior to installing fan belts.



1 Tube
2 Elbow
3 Bolts
4 Bolts
5 Bolt
6 Bolt
7 Bracket
8 Elbow
9 Bolts
10 Bolts
11 Shims

Figure 3–120. Preparing to remove radiator.

3–30. Water Pump

a. General. The gear driven centrifugal type water pump is mounted on the left front of the timing gear housing. Figure 3–124 shows a cutaway view of the water pump.

b. Removal and Installation. Refer to TM 5–2410–214–12 for removal and installation of the water pump.

c. Disassembly and Assembly.

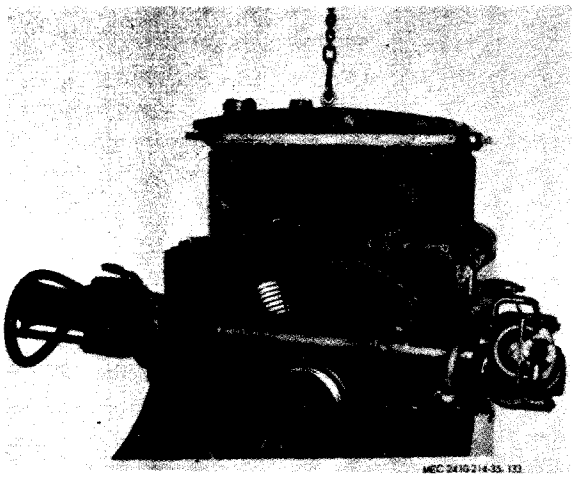
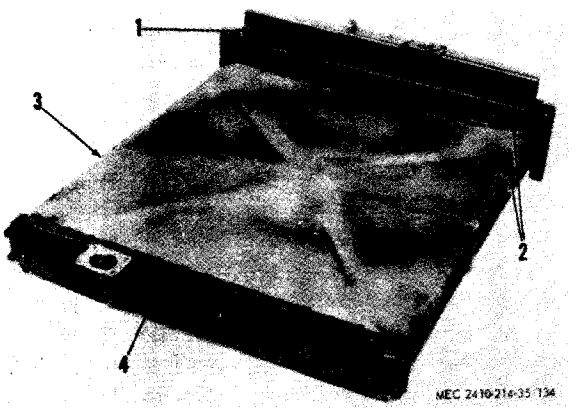


Figure 3–121. Lifting radiator from guard.



1 Top tank	3 Core
2 Strips	4 Bottom tank

Figure 3–122. Radiator disassembly.

(1) Remove washer ((1), fig. 3-125) cotter pin (2) and nut (3).

(2) Use a puller with a step plate and two 5/16-inch-18 (NC) bolts, 5 inches long, to pull the impeller ((1), fig. 3-126) from the shaft.

(3) Remove the carbon face seal, the bellows under the seal, and the brass case *(d* below) .

(4) Remove the locks and bolts ((2), fig. 3-127) and the gear and shaft assembly (1).

(5) Remove the oil seal ((3), fig. 3-124) from the pump housing (d below).

(6) Remove the lock and bolt ((4), fig. 3-128) washer (3), locks and bolts (1), and cover (2).

(7) Use three 3/8-inch-16 (NC) bolts, 4 inches long, to force the cage ((1), fig. 3-129) and bearing (2) from the shaft. The bearing is a slip fit in the cage and can be removed for inspection.

(8) Press the pump shaft ((2), fig. 3-130) out of the gear (1) and remove the key.

(9) Press the pump shaft out of the bearing as shown in figure 3-131.

(10) Reassemble water pump in reverse order of disassembly (para 1-4) for the impeller retaining nut torque.

d. Water Pump Seal and Inner Oil Seal Replacement.

(1) Water leaking from the drain opening in the under side of the pump indicates that the water seal should be replaced.

(2) The seal consists of a carbon thrust washer ((3), fig. 3-132) and a spring enclosed by a bellows (2). These two parts, which make up the replaceable unit, are contained in a brass case (1) which is pressed into the water pump housing.

(3) Inspect the bearing surface of the impeller seal assembly (fig. 3-135). The contact surface must be smooth and free of roughness, nicks or burrs. Replace the seal assembly, if necessary.

(4) It is not necessary to remove the brass case from the water pump housing, for water seal replacement. The carbon thrust washer ((3), fig. 3-132) and the bellows seal (2) can be removed from the brass case (1) by bending back the three ears holding them in place.

(5) When replacing the carbon thrust washer, be careful not to crack or scratch it. After the bellows seal and thrust washer are installed, see that the washer moves freely under finger pressure.

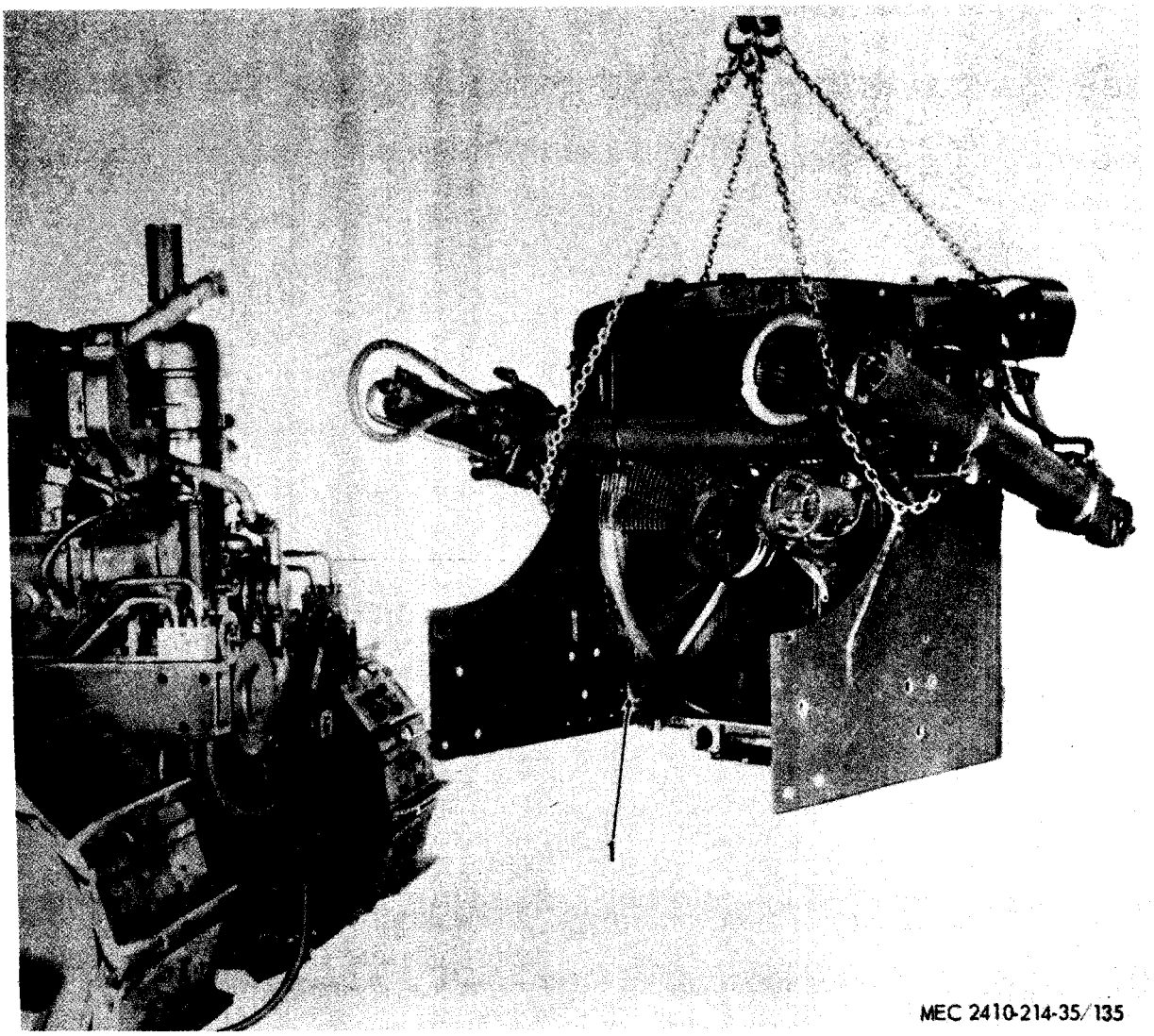
(6) If the brass case is damaged, a tool such as the one shown (fig. 3-133) can be made for removing it as shown in figure 3-134. If a tool is not used, it is necessary to completely disassemble the pump to replace the brass case.

(7) When installing a new brass case, coat the case and housing bore with a lubricant to avoid shearing the brass case, and also to provide a positive seal against water leakage.

(8) Make sure the case bottoms squarely in the bore so the carbon washer will bear evenly against the impeller contact surface.

Caution: **The flange on the case can be bent, if excessive pressure is applied after the case bottoms.**

(9) If it becomes necessary to replace the inner oil seal ((3), fig. 3-124) the pump must be disassembled. Press the oil seal out and install a new one, with the lip of the seal toward the bearing.



1 Bracket

Figure 3–123. Radiator guard and radiator removal.

e. Impeller Seal Assembly Replacement.

(1) The impeller seal assembly consists of a ring ((1), fig. 3-135) mounted in the rubber seal (2), which bears against the impeller. The impeller seal assembly can be removed after the impeller is removed.

(2) Install the impeller seal assembly with the ring (1) toward the carbon washer of the bellows seal assembly. The grooved side or the unpolished side of the ring should be against the face of the rubber seal (2).

Caution: Handle the impeller seal assembly with care to avoid damaging the contact surface.

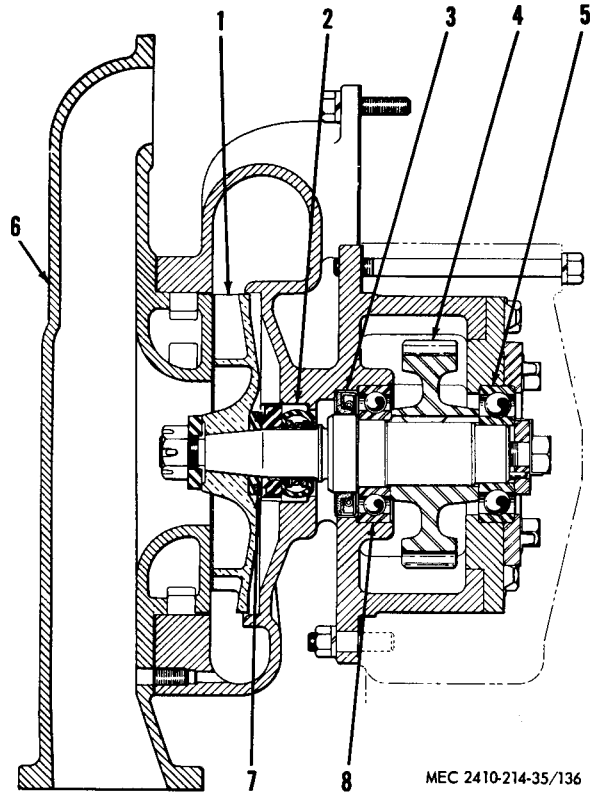
f. Oil Seal Replacement. If it becomes necessary to replace the inner oil seal ((3), fig. 3-124) the pump must be disassembled. Press the old seal out and install a new one, with the lip of the seal toward the bearing.

3-31. Belt Tightener

a. Removal and Installation

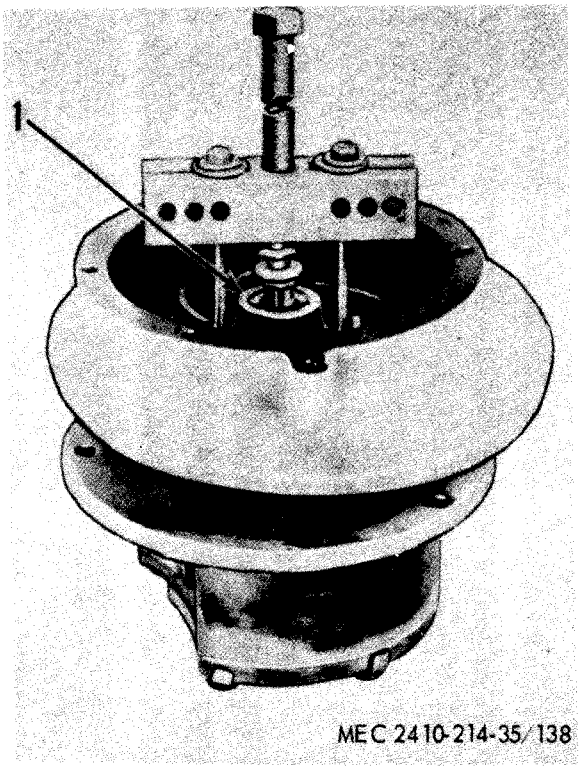
(1) Remove the fan belts as described in TM 5-2410-214-12.

(2) Disconnect shock absorber spring ((1), fig. 3-136) by removing pin and cotter pin (6).



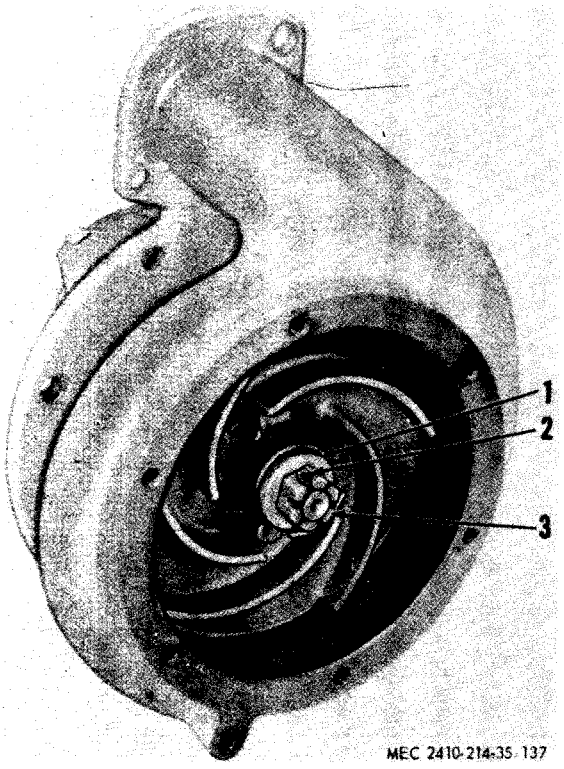
1 Impeller
2 Bellows seal assembly
3 Oil seal
4 Drive gear
5 Bearing
6 Cover
7 Impeller seal assembly
8 Bearing

Figure 3–124. Water pump.



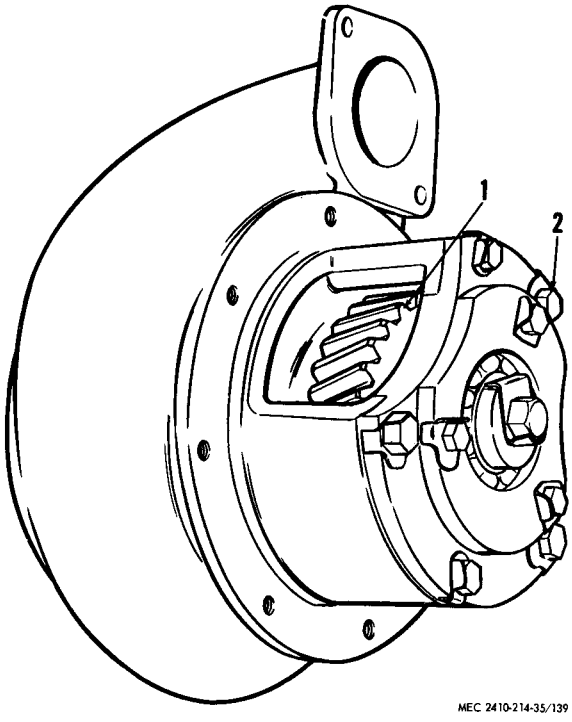
1 Impeller

Figure 3–126. Pulling Impeller.



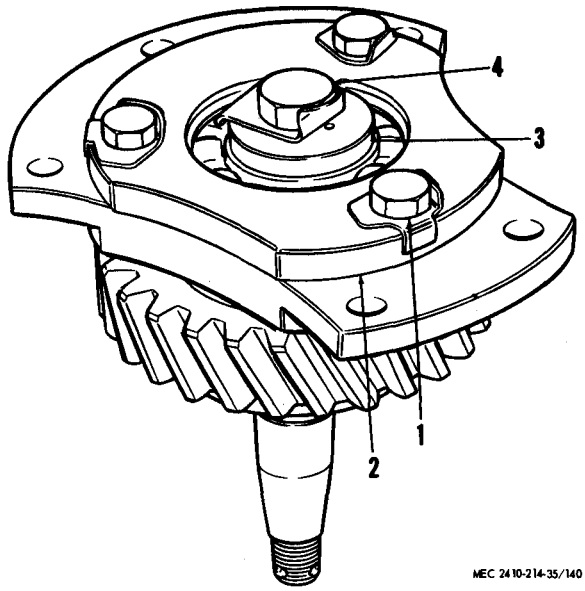
1 Water 2 Cotter pin 3 Nut

Figure 3–125. Preparing to remove impeller.



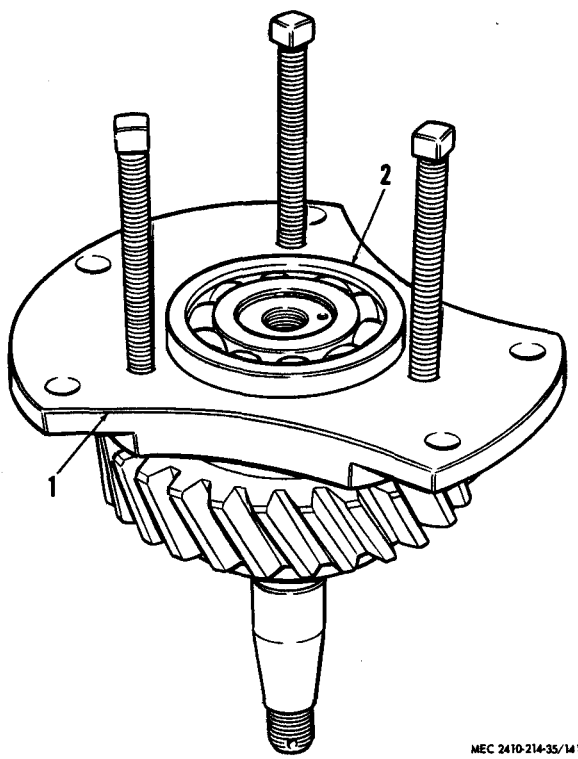
1 Shaft assembly 2 Locks and bolts

Figure 3–127. Preparing to remove drive gear and shaft assembly.



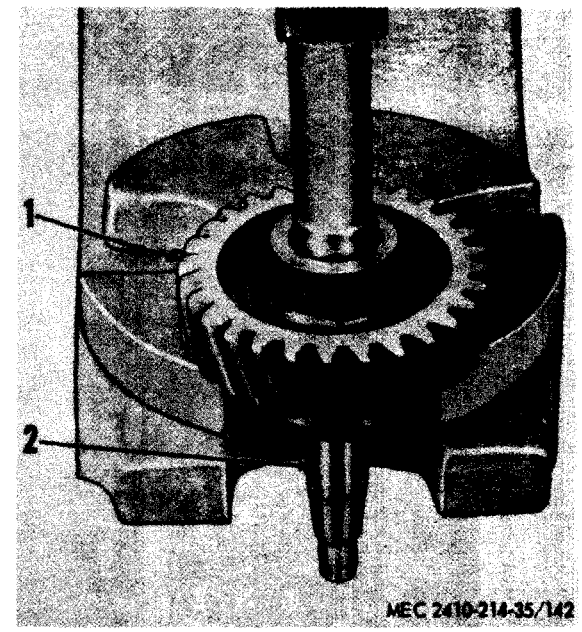
1 Locks and bolts
2 Cover
3 Washer
4 Lock and bolt

Figure 3–128. Disassembling drive gear and shaft assembly.



1 Cage
2 Bearing

Figure 3–129. Cage and bearing removal.



1 Gear
2 Shaft

Figure 3–130. Gear removal.

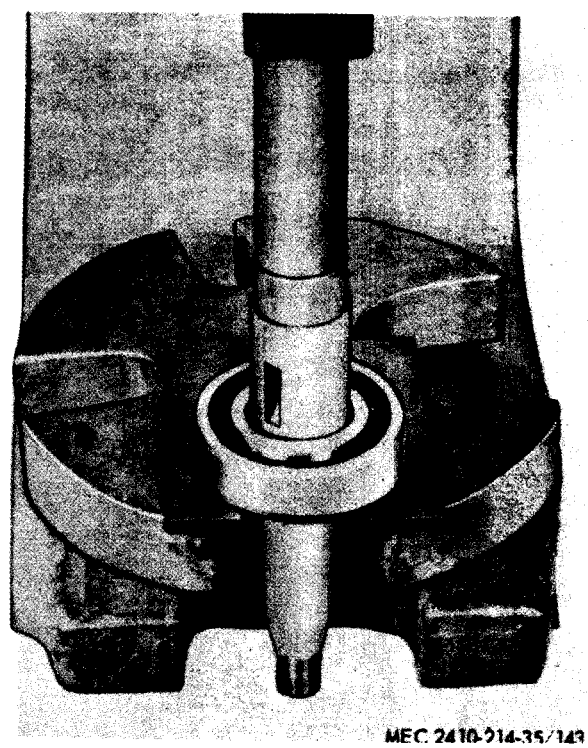
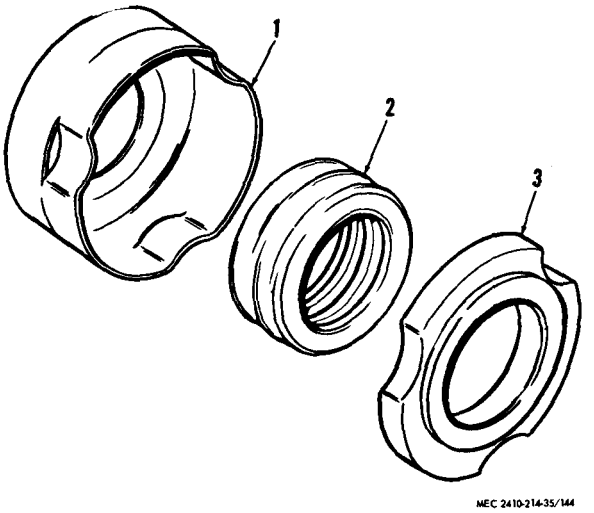


Figure 3–131. Bearing removal.



1 Case
2 Bellows
3 Carbon thrust washer

Figure 3–132. Seal assembly.

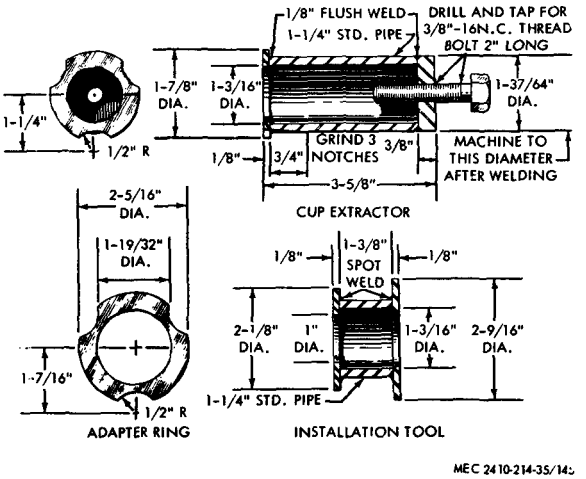


Figure 3–133. Water seal case removal tool.

(3) Remove nuts (3) securing the tension adjusting bracket (2) to the timing gear cover.

(4) Remove bolts (4) securing belt tightener arm (5) to the timing gear cover.

(5) Install in reverse of removal. Turn belt tightener jack screw clockwise until studs are bottomed in bracket slots, then tighten nuts and screws.

b. Disassembly and Reassembly.

(1) Remove bolt and lockwasher ((5), fig. 3-137) plate (4), seal (3), and bearing (2) from arm assembly (1).

(2) Remove bracket assembly (16).

(3) Remove bolts and lockwashers (8) securing cover (9) to pulley (6), being careful not to damage gasket (7).

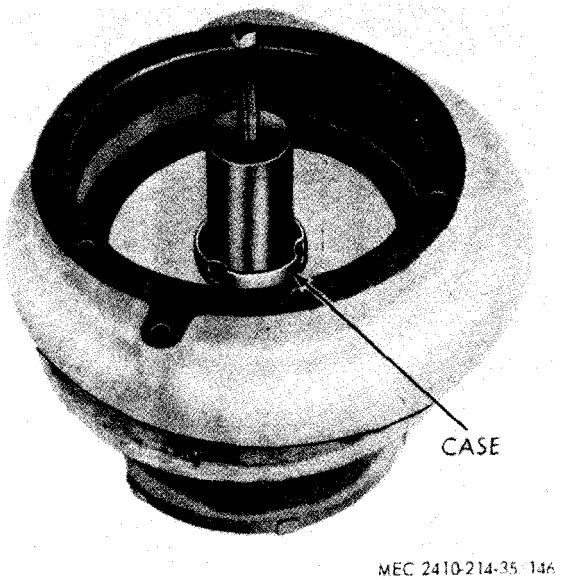


Figure 3–134. Water seal case removal.

(4) Remove bolt and lockwasher (10) and washer (11) securing pulley (6) to arm assembly (1).

(5) Remove seal (15), bearings (12), spacer (14), and retaining ring (13) from pulley (6).

(6) Inspect seals (3) and (15), and bearings (2) and (12), and replace if necessary.

(7) Reassemble in reverse order of disassembly.

3-32. Fan and Fan Pulley

a. Removal and Installation.

(1) Remove the radiator and radiator guard from the machine as an assembly (para 3-29).

(2) Loosen the bolts securing the generator ((1), fig. 3-138) in place and rotate the generator (1) toward the fan pulley to relieve the belt tension.

(3) Remove the generator belt (2).

(4) Remove fan guard (4).

(5) Attach a hoist to the fan and pulley assembly (5). (Fan assembly weight -90 lb).

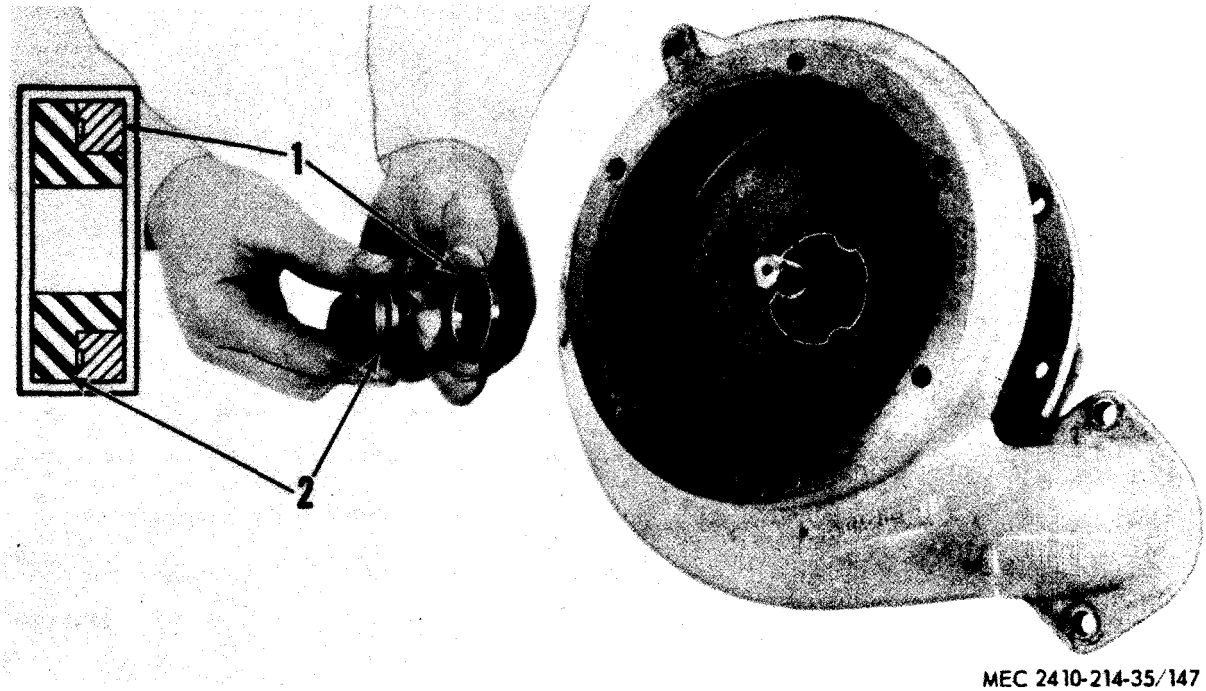
(6) Remove bolts (3) securing the fan shaft assembly to the shroud and remove the fan and pulley assembly (5).

(7) Install in reverse order of removal.

b. Disassembly.

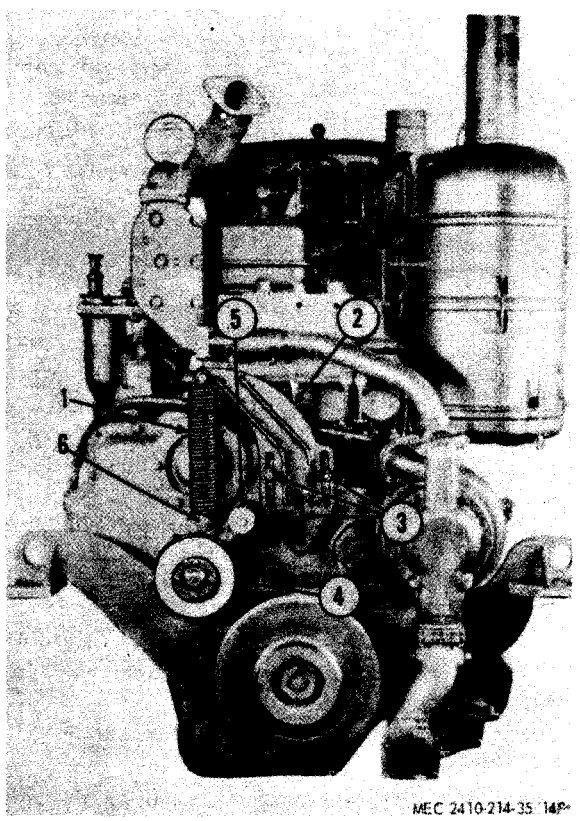
(1) Remove bolts and lockwashers ((1) fig. 3-139) securing the pulley (2) to the hub (16). Remove the pulley.

(2) Remove any shims (3) located between the fan pulley (2) and hub (16).



1 Ring 2 Rubber seal

Figure 3–135. Impeller seal assembly.



1 Shock absorber spring
2 Abjusting bracket
3 Nuts
4 Bolts (5)
5 Belt tightener arm
6 Pin and cotter pin

Figure 3–136. Belt tightener removal.

(3) Mark the fan spider (17) so it can be installed in the same position.

(4) Remove bolts and lockwashers (18) securing the fan spider (17) to the fan hub (16), and remove the spider.

(5) Remove bolts and lockwashers (4) securing cover (5) to the fan hub (16), and remove cover (5) and preformed packing (6).

(6) Remove bolts (7), locking plate (8), and retainer (9).

(7) Pull the hub (16) with bearing (10) from the fan shaft (12), as shown in figure 3-140.

(8) Remove retaining ring ((11), fig. 3-139) and bearing (10) from hub (16).

(9) Remove spacer (15).

(10) Pull the inner bearing (14) from fan shaft (12) as shown in figure 3-141.

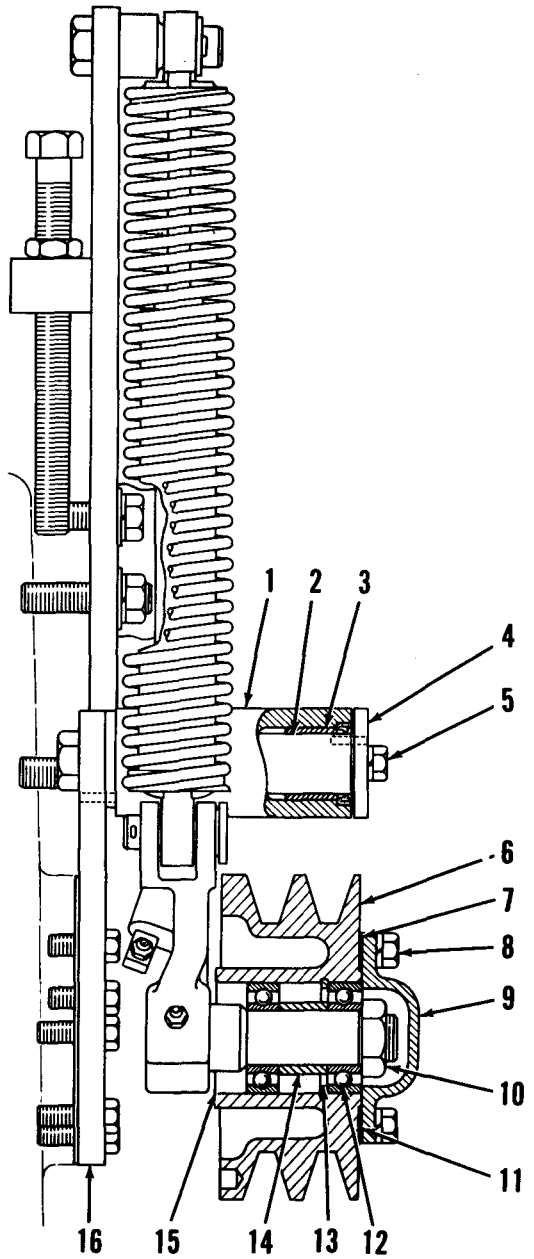
(11) Remove the hub seal ((13), fig. 3-139).

(12) Inspect seals (6) and (13), and bearing (10) and (14). Replace as necessary.

c. *Reassembly.*

Note. The reversible fan has movable fan blades which can be positioned to provide either suction or blower fan arrangement.

(1) Reassemble and install the fan assembly in reverse order of disassembly and removal. Push fan blade inward to disengage tongue on thrust washer from locking slot in hub. Turn blade until tongue on thrust washer locks in place in the al-



1	Arm assembly	9	Cover
2	Bearing	10	Bolt and lockwasher
3	Seal	11	Washer
4	Plate	12	Bearing
5	Bolt and lockwasher	13	Retaining ring
6	Pulley	14	Spacer
7	Gasket	15	Seal
8	Bolt and lockwasher	16	Bracket assembly

Figure 3–137. Belt tightener disassembly.

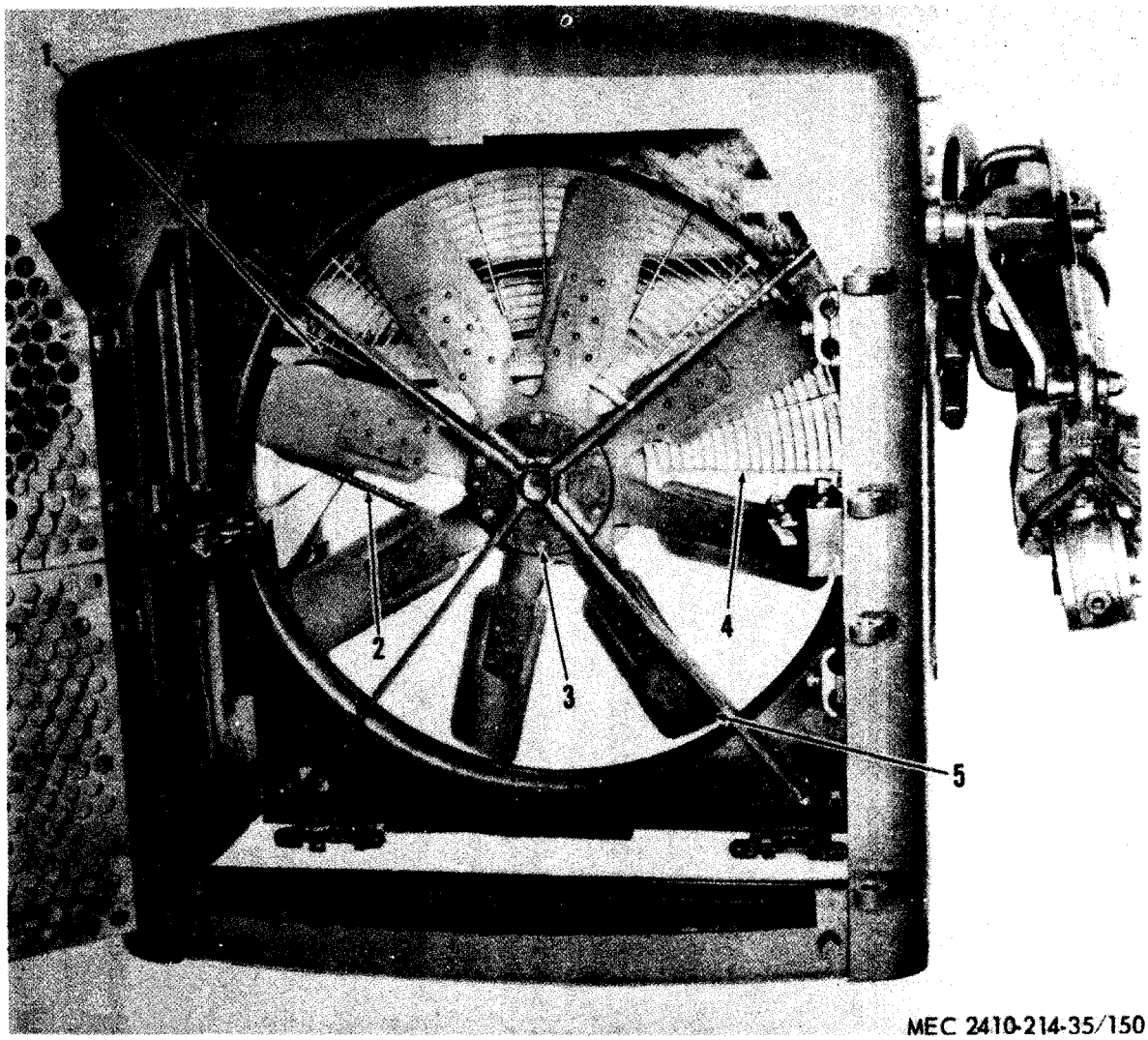
ternate position desired. Be sure all blades are turned to the same position.

(2) With a grease gun, lubricate the hub with ball and roller bearing lubricant.

d. Alignment.

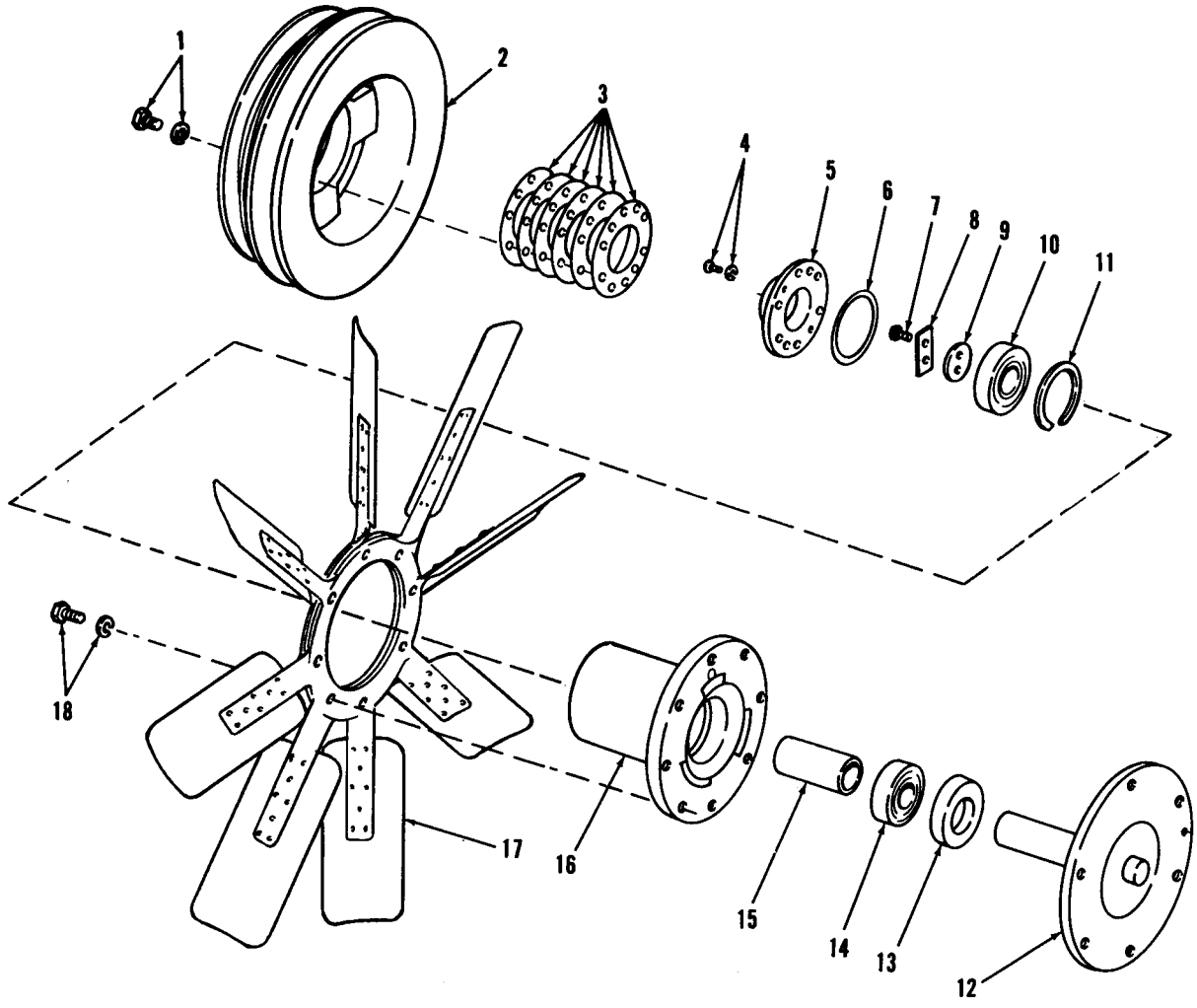
(1) Check alignment of the fan pulley ((1), fig. 3–142) with the crankshaft pulley (2) by holding a straight edge against the rear faces of the fan and crankshaft pulleys as shown. The straight edge should be flat against both pulleys.

(2) Add or remove shims ((3), fig. 3–139) as required for proper alignment.



1 Generator
2 Generator belt
3 Bolts (6)
4 Fan guard
5 Fan and pulley assembly

Figure 3–138. Preparing to remove fan and fan pulley.



MEC 2410-214-35/151

1 Bolts and lockwashers
2 Fan pulley
3 Shims
4 Bolts and lockwashers
5 Cover
6 Preformed packing
7 Bolt
8 Locking plate
9 Retainer
10 Bearing
11 Retaining ring
12 Fan shaft
13 Seal
14 Bearing
15 Spacer
16 Hub
17 Spider
18 Bolt and lockwasher

Figure 3–139. Fan and fan hub disassembly.

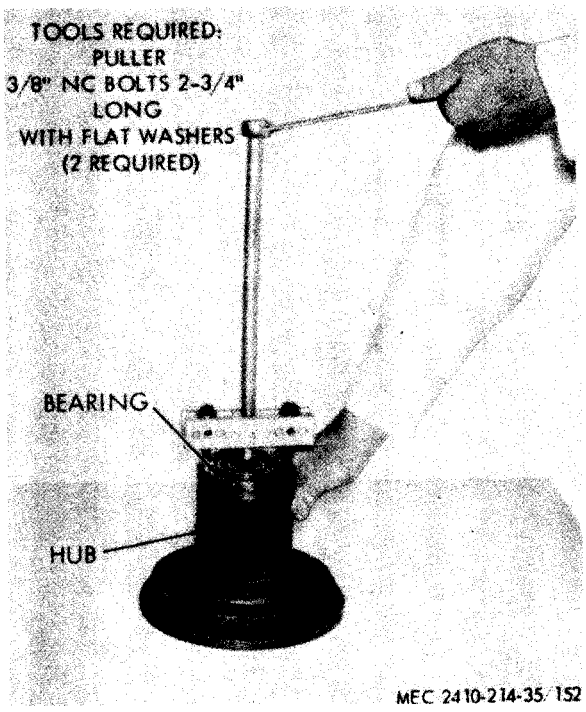


Figure 3–140. Pulling hub with bearing.

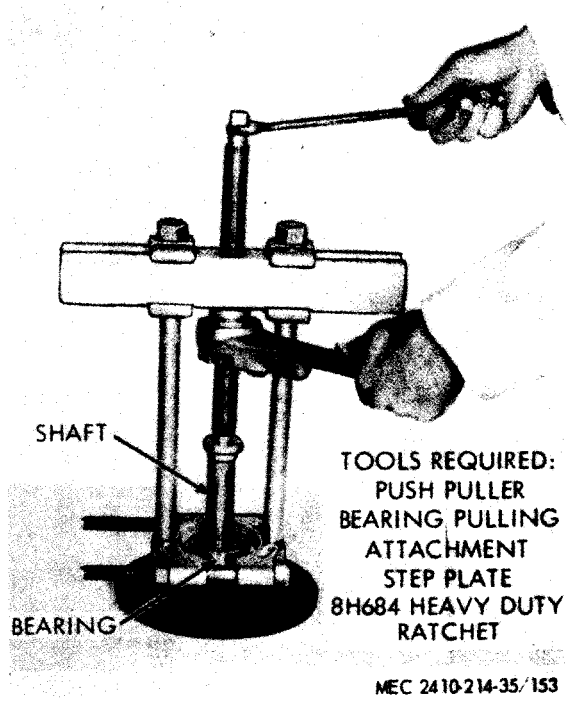
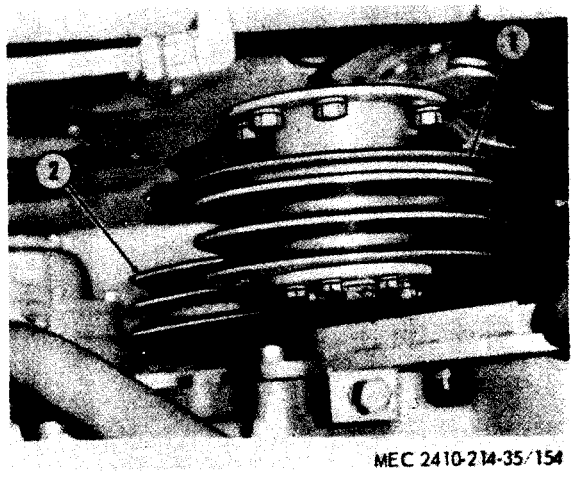


Figure 3–141. Pulling inner bearing.



1 Fan pulley **2 Crankshaft**

Figure 3–142. Pulley alignment.

3-33. General

Refer to TM 5-2410-214-12 for description and servicing of the engine lubrication system.

3-34. Engine Oil Pan

Removal and Installation.

(1) Drain the lubricant from the oil pan.

(2) Remove the crankcase guard.

(3) Remove oil line ((1), fig. 3-143).

(4) Remove oil gage tube assembly ((2), fig. 3-144)

(5) Support oil pan front section (3) and remove the bolts that secure it to the oil pan rear section (1).

(6) Remove the bolts which secure the oil pan front section to the cylinder block and timing gear housing.

(7) Remove the oil pan front section (approx weight 150 lb).

(8) Remove the bolts that secure the oil pan rear section to cylinder block and flywheel housing.

Caution: **Remove the oil pan rear section carefully to prevent damage to the gasket between the pan and flywheel housing. A thin piece of shim stock can be used to separate the gasket from the oil pan.**

(9) Install in the reverse order of removal.

3-35. Oil Pressure Regulating Valve

a. General. The oil pump contains a pressure regulating valve which is not adjustable. The lubricating oil pressure is regulated by pressure of the spring ((2), fig. 3-145) against the plunger (3). The cover (1) holds the spring and plunger in the pump body.

Caution: **When the engine is warm and running at rated engine speed, the indicator on the lubricating oil pressure gage should register in the Operating Range. A lower pressure reading is normal at low idling speeds. If no pressure is indicated, investigate at once.**

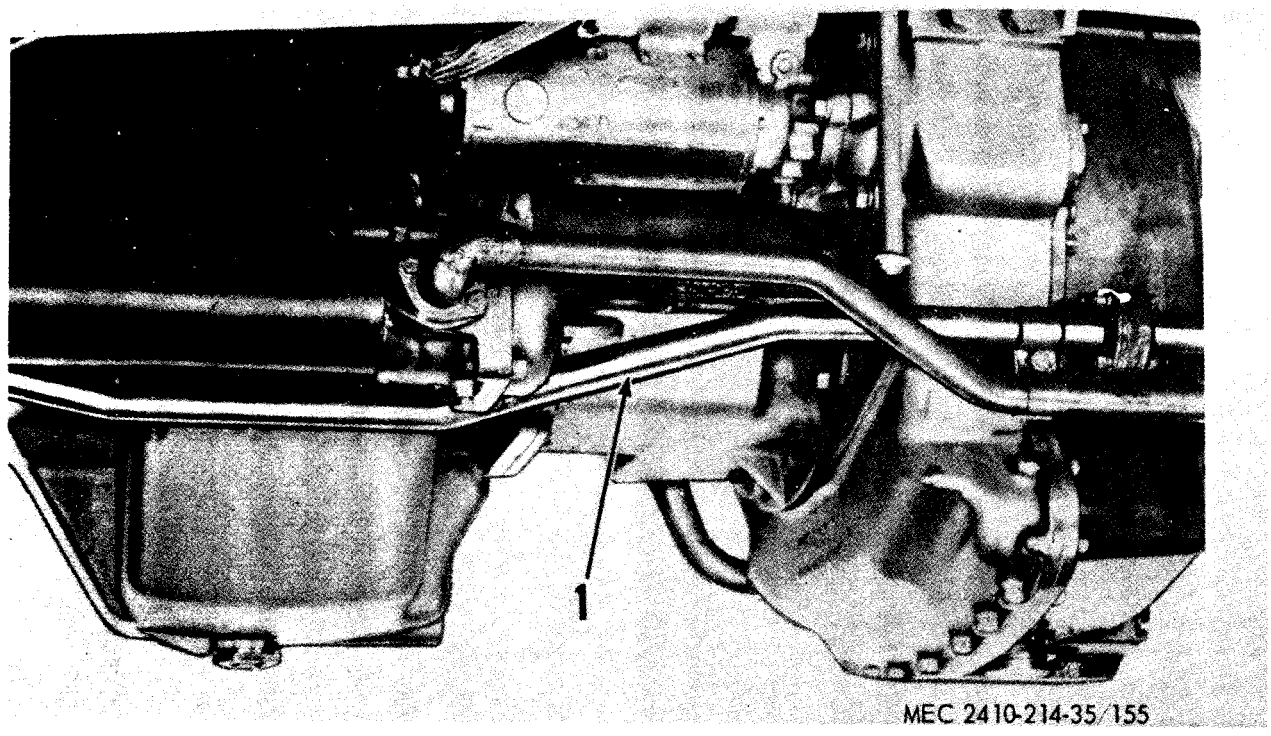
b. Disassembly.

Note. The pressure regulating valve can be removed through the inspection opening on the right side of the engine.

(1) Remove cover (1).

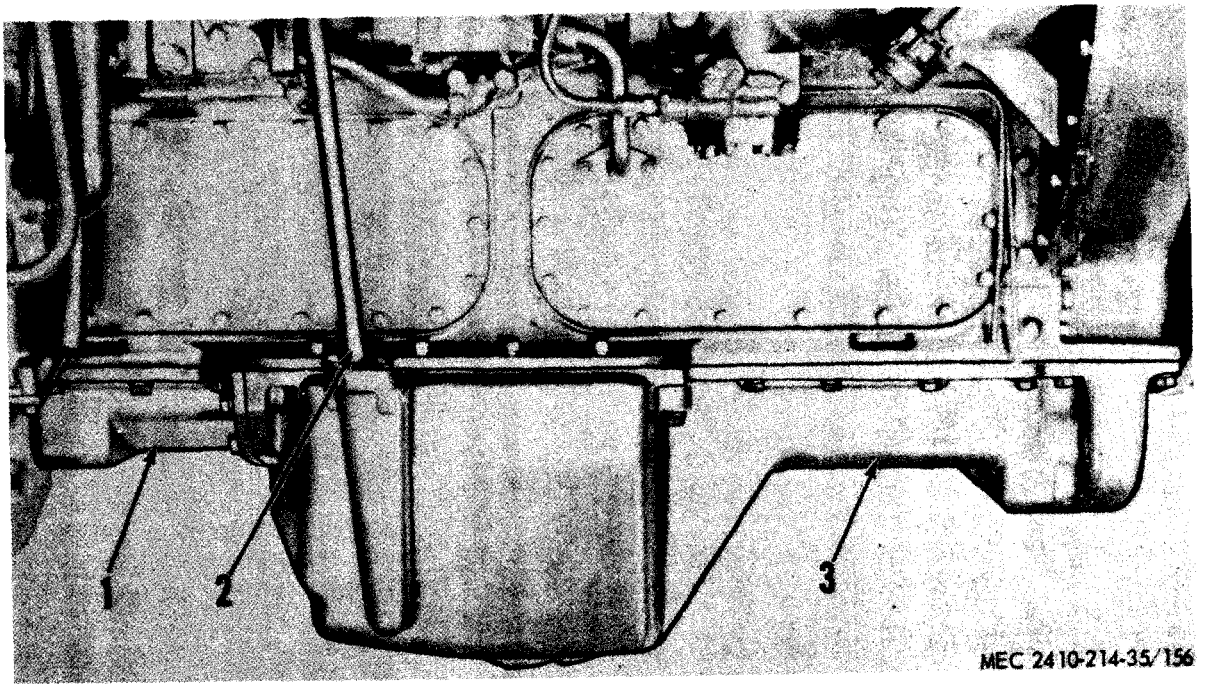
(2) Withdraw spring (2) and plunger (3) from their housing.

c. ***Cleaning Inspection, and Repair.*** Inspect the parts for damage or wear. Check the valve seat



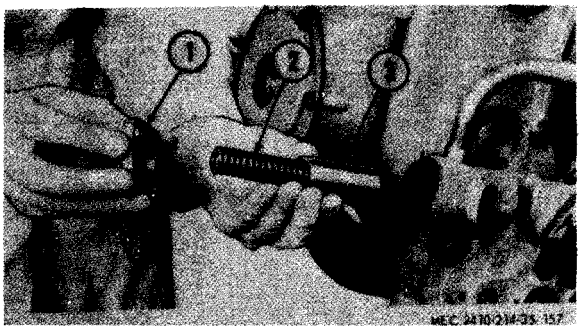
1 Oil line

Figure 3–143. Preparing to remove oil pan.



1 Oil pan rear section
2 Oil gage tube assembly
3 Oil pan front section

Figure 3–144. Removing oil pan.



1 Cover
2 Spring
3 Plunger

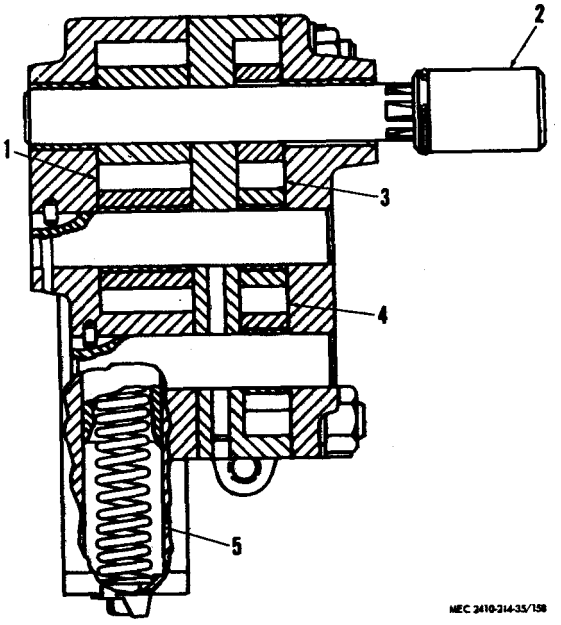
Figure 3–145. Pressure regulating valve.

and contact surfaces, making certain they are clean and smooth.

d. Reassembly. Reassemble in the reverse order of disassembly.

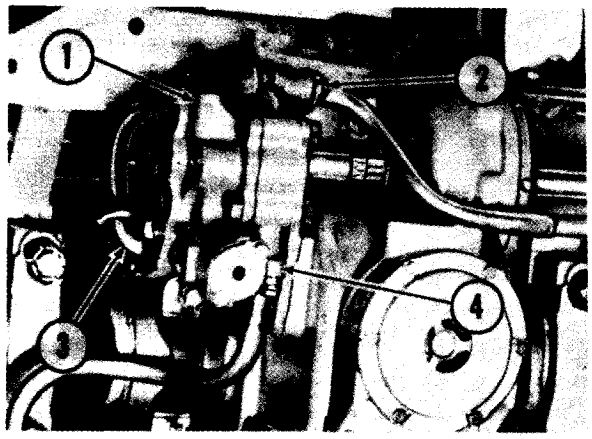
3-36. Oil Pressure and Scavenging Pump

a. ***General.*** The oil pump is driven by the gear-type balancer drive shaft through the coupling ((2), fig. 3-146). This is a two-section, gear-type pump. The rear section (1) is the main pump, which pumps oil through the engine. The front section consists of three gears, which function as the two scavenge pumps. The top pump (3) returns oil from the front suction bell to the main sump. The bottom pump (4) returns oil from the rear suction bell to the main sump. A nonadjustable pressure regulating valve (para 3-35) main-



1 Rear section
2 Coupling
3 Top pump
4 Bottom pump
5 Pressure regulating valve

Figure 3–146. Oil pump cross-section.



MEC 2410-214-35/159

1 Oil pump
2 Front suction bell tube
3 Pump discharge tube
4 Rear suction bell tube

Figure 3–147. Removing oil pump.

tains oil pressure of approximately 35 pounds per square inch at the gage.

b. Removal and Disassembly.

(1) Refer to paragraph 3-34 and remove the oil pan.

(2) Disconnect the front suction bell tube ((2), fig. 3-147) pump discharge tube, and rear suction bell tube (4).

(3) Remove the drive shaft coupling ((3), fig. 3-148) ring (2), and pump cover (1).

(4) Remove gear ((7), fig. 3-148) gear (8, body (6), and gear (5) from the main pump body (4).

(5) Pull the scavenger pump drive gear ((2), fig. 3-149) from the drive shaft assembly (4) using a puller, step plate, flat washer (3) with two 1/4-inch holes drilled to align with the puller holes in the gear, and two machine screws as shown.

(6) Remove the key.

(7) Remove the drive shaft assembly (4) from the scavenger pump body (1).

Caution: **Do not press the drive shaft assembly (4) from the drive gear (2) as the key will damage the pump body.**

(8) Remove the cover ((1), fig. 3-150) and screen assembly (2) from the suction bell (3).

c. *Cleaning, Inspection, and Repair.*

(1) Clean the screen assembly (2) and suction bell (3) in a suitable cleaning fluid, and replace the gaskets, if necessary, before assembling.

(2) Clean pump parts in an approved SOL vent.

(3) Inspect all gears for damage or wear and replace as required.

Note. Ordinarily, oil pump gears should not have to be replaced, unless they have worn sufficiently to cause a considerable drop in oil pressure, or unless they have been damaged.

(4) Inspect the bearings in the gears, and in the body assemblies. If the bearings are worn excessively, they should be pressed out and replaced.

d. Reassembly and Installation.

(1) Reassemble and install in the reverse order of removal and disassembly.

Note. Check that the shaft turns freely with no binding or drag on the gears.

(2) If the gears bind, loosen the bolts, slightly and relocate the pump bodies by tapping them lightly until the shafts turn freely. Retighten the bolts.

3-37. Oil Manifold

a. General. The oil manifold is mounted in the cylinder block and receives a constant supply of oil from the oil pump. Refer to TM 5-2410-214-12 for a more complete description of the oil flow to and from the oil manifold.

b. Removal and Installation.

(1) Remove the crankshaft (para (38).

(2) Disconnect the main bearing oil tubes ((1), fig. 3-151) and rocker arm tubes (4) from the oil manifold (3).

(3) Remove the oil filter base. Refer to TM 5-2410-214-12.

(4) Remove hollow nut (6) holding the rear of the oil mainfold to the cylinder block.

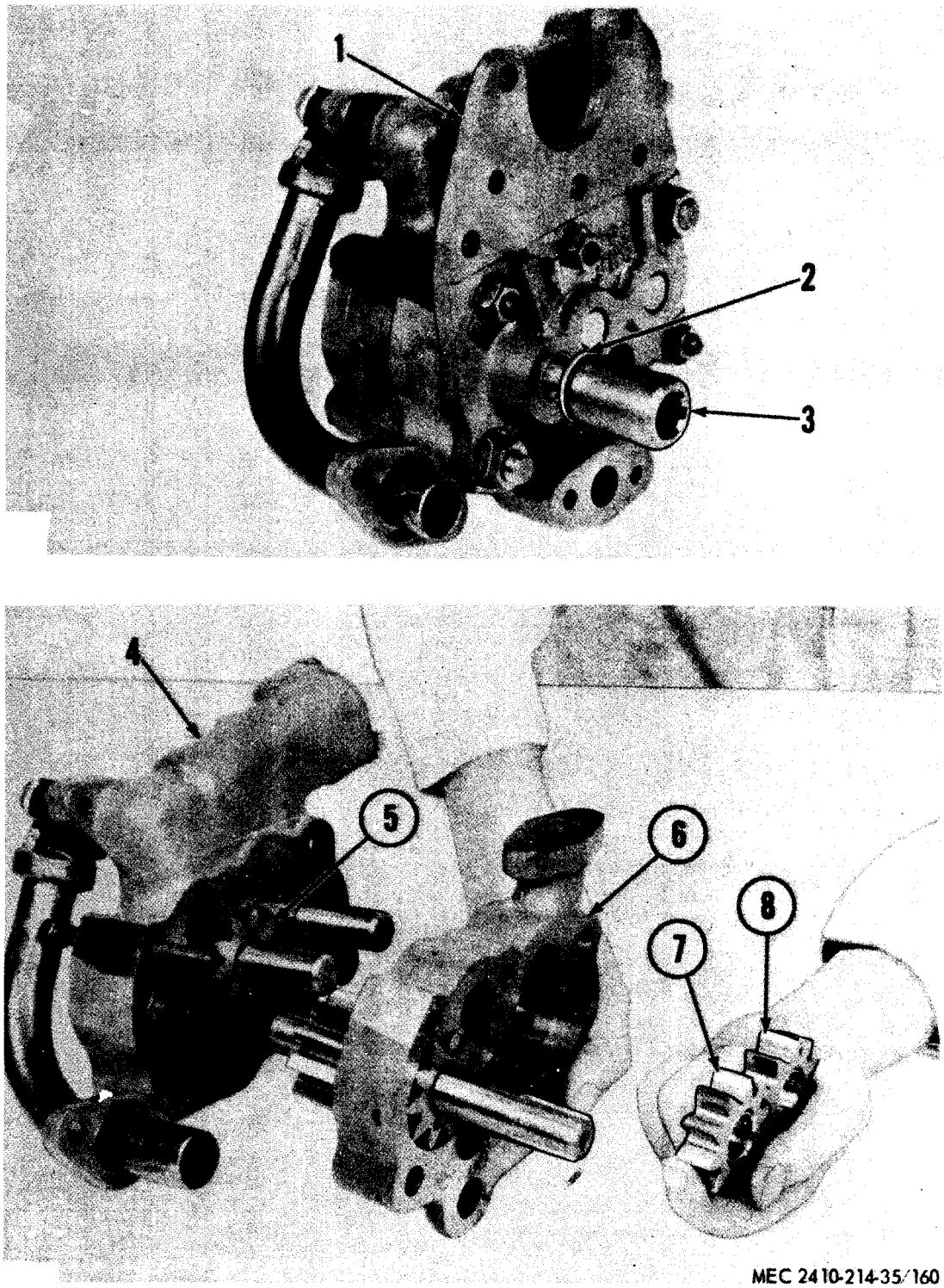
(5) Remove nuts (2) and (5) securing the oil manifold to the cylinder block.

(6) Rotate the oil manifold approximately 1/4 turn so the fittings will pass through the front opening on the cylinder block.

(7) Withdraw the manifold.

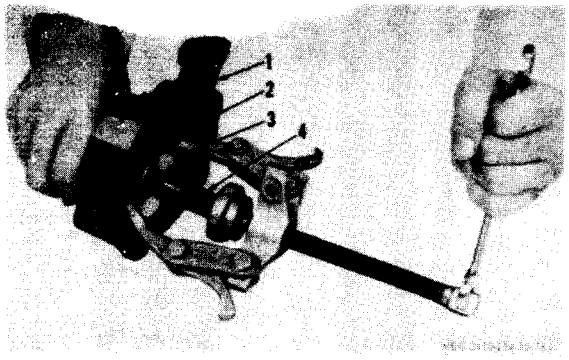
(8) Inspect seals and component parts.

(9) Install in the reverse order of removal.



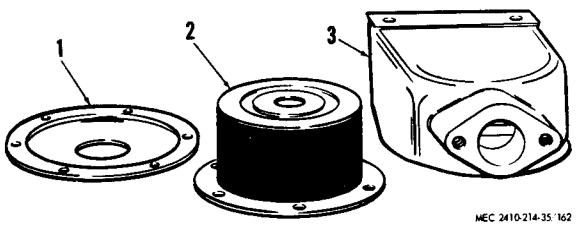
1 Pump cover
2 Ring
3 Drive shaft coupling
4 Main pump body
5 Main pump idler gear
6 Scavenger pump body
7 Scavenger pump idler gear
8 Scavenger pump idler gear

Figure 3–148. Pump disassembly.



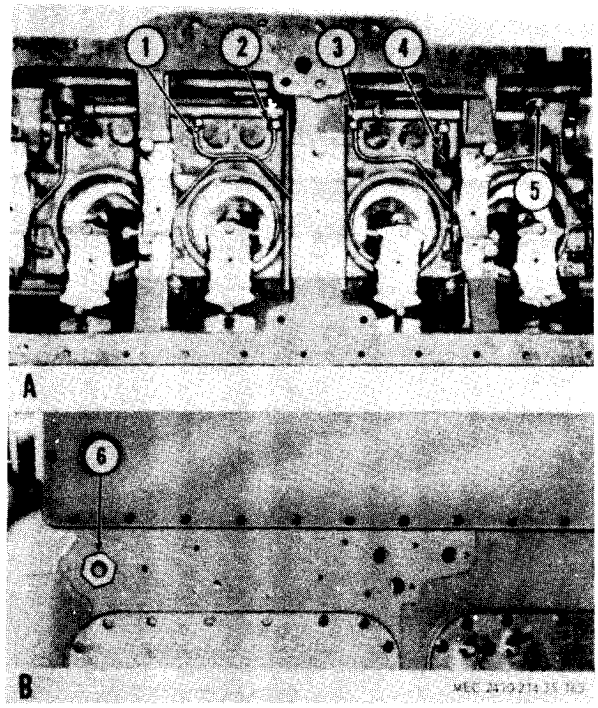
1 Scavenger pump body
2 Scavenger pump drive gear
3 Flat washer
4 Drive shaft assembly

Figure 3-149. Drive shaft disassembly.



1 Cover
2 Screen assembly
3 Suction bell

Figure 3-150. Disassembly of main suction bell.



1 Tube
2 Nut
3 Manifold
4 Tube
5 Nut
6 Nut

Figure 3-151. Oil manifold removal.

Section VII. TORQUE DIVIDER AND TRANSMISSION

3-38. General

a. Power from the diesel engine is transmitted by the flywheel ((7), fig. 3-152) to the torque divider (5) where it travels through two separate paths. An internal coupling gear on the engine flywheel drives the rotating housing (12), which delivers a larger portion of the diesel engine torque through torque converter. Another coupling gear drives the sun gear (14) on a planetary gear set to mechanically transmit a lesser portion of the torque to the plant carrier (13), which is splined to the torque divider output shaft (10). Since the ring gear (6) is driven by the turbine of the torque converter, this torque is also applied to the output shaft through the planet carrier (13).

b. From the torque divider output shaft (10), torque is transmitted through the universal joint (4) to the transmission input shaft (3). 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 (11) 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.

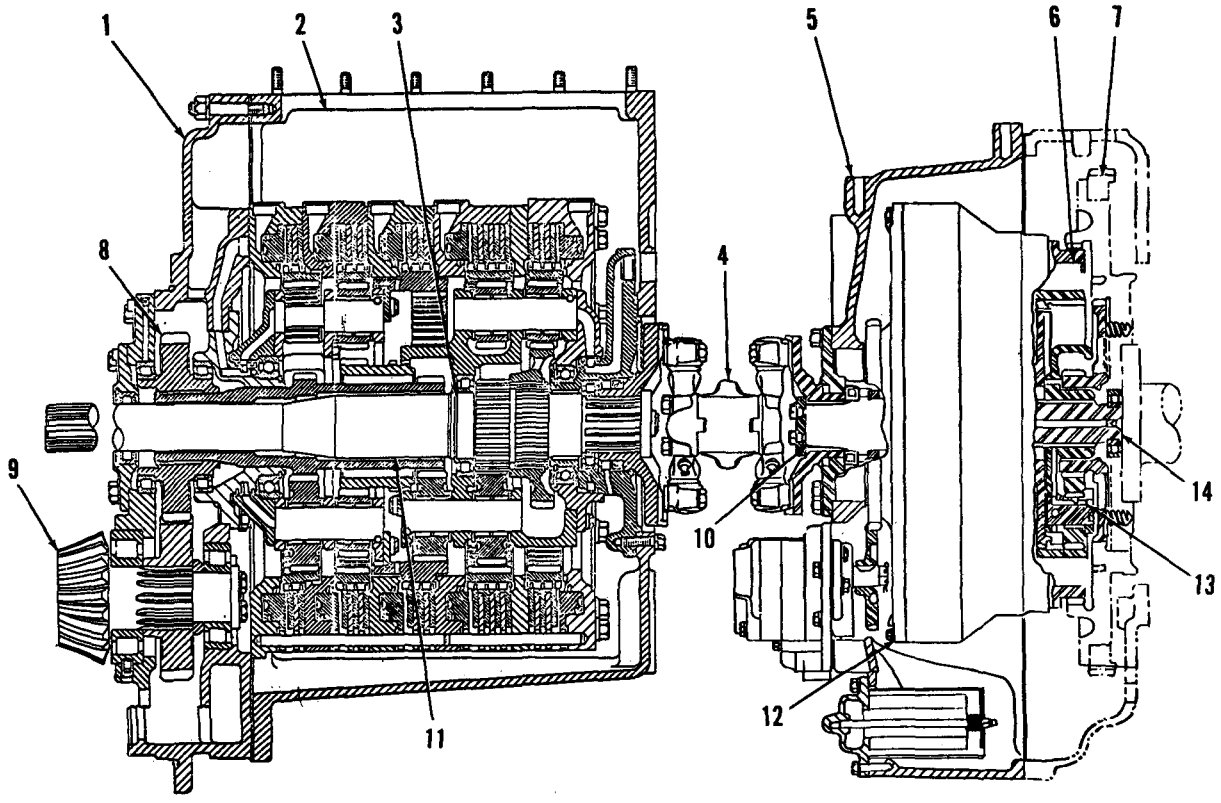
c. The transmission output shaft (11) is splined to a transfer gear (8), within the transfer case (1). This transfer gear drives the bevel pinion (9). From the bevel pinion the power is transmitted through the bevel gear, to the steering clutches, then through the final drives to the tracks.

3-39. Universal Joint

a. Removal.

(1) Remove the floor plates and the brake pedals and support.

(2) Remove oil supply line ((1), fig. 3-153) and oil pressure line (2).



1	Transfer case	8	Transfer gear
2	Upper compartment of transmission case	9	Bevel pinion
3	Transmission input shaft	10	Torque divider output shaft
4	Universal joint	11	Transmission output shaft
5	Torque divider	12	Rotating housing
6	Ring gear	13	Planet carrier
7	Flywheel	14	Sun gear

Figure 3–152. Power flow.

(3) Rotate the universal joint as necessary and remove the bolts (4) securing the bearing caps (3) to the transmission input shaft flange (6) arid torque divider output shaft flange (5).

(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.

(5) Install the universal joint in the reverse order of removal.

b. Disassembly **(fig. 3-154).**

(1) Remove the bolts which secure the bearings to the center plate.

(2) Remove the strap (4) from both of the bearings (1) with a small chisel.

Note. The small straps connecting the bearing caps on each of the spider and bearing assemblies prevent the bearing caps from falling off the spider during installation and removal from the tractor. These straps should not be welded to the bearing caps after the unit has been assembled.

(3) Remove the bearing (1), seal (2) and retainer (3) from the spider (5).

c. ***Cleaning and Inspection.***

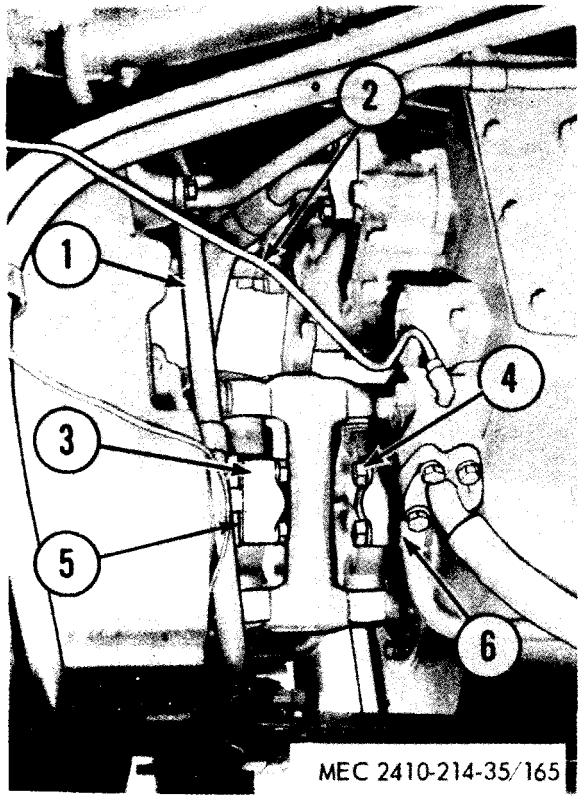
(1) Inspect the spider journal bearing surfaces for roughness or needle bearing grooves,

(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.

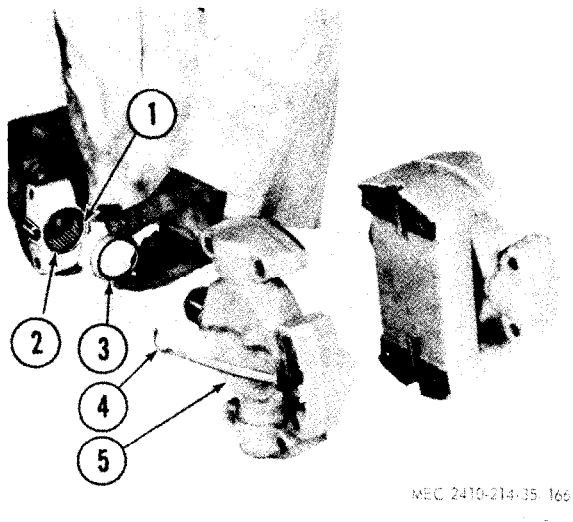
(4) Light brineling of the spider bearing area is not harmful.

d. Reassembly and Installation. Reassemble the universal joint in the reverse order of disassembly.



1 Oil supply line
2 Oil pressure line
3 Bearing cap
4 Bolt
5 Torque divider output shaft flange
6 Transmission input shaft flange

Figure 3–153. Preparing to remove universal joint.



1 Bearing
2 Seal
3 Retainer
4 Strap
5 Spider

Figure 3–154. Universal joint disassembly.

3-40. Torque Divider

a. General (fig. 3-155). 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.

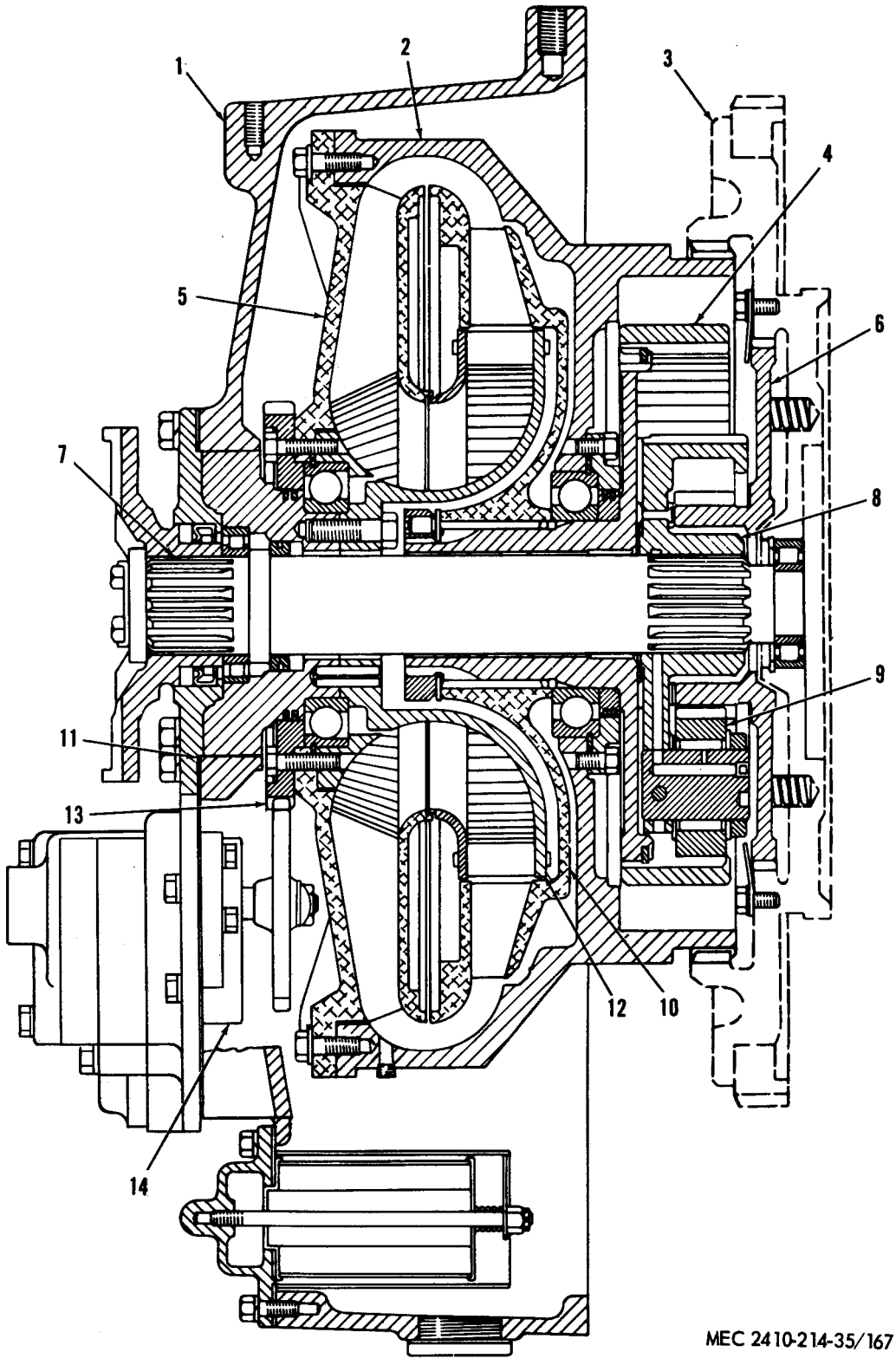
(1) The torque divider is driven by the diesel engine through a rotating housing ((2), fig. 3-156) and sun gear (6) to direct the torque output of the engine through two separate paths. Most of the torque is transmitted by the rotating housing (2) and impeller (5) through a medium of oil to the stator or reactionary member (14) which directs the oil to rotate the turbine (8). Since the turbine is splined to the same hub as the ring gear (4), the torque is transferred through the planet carrier (10) to the output shaft (9). A lesser amount of torque is transmitted from the engine flywheel (3) through the sun gear (6) and planet carrier (10) to the output shaft (9).

(2) The planetary system is composed of a sun gear (6) that turns with the diesel engine flywheel (3), a planet carrier (10) which is splined to the output shaft (9) and supports the planet gears (12) that mesh with the ring gear (4).

(3) The major components of the torque converter are the rotating housing (2), impeller (5), turbine (8), and stator (14).

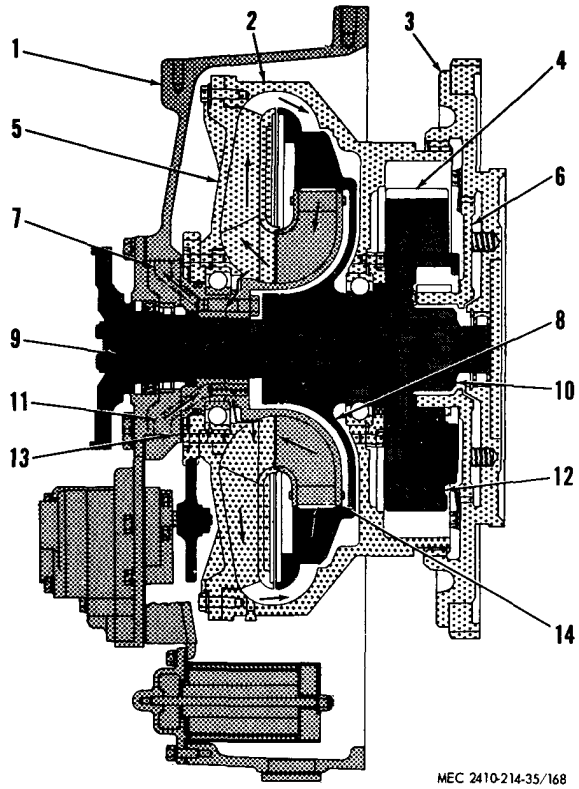
(4) Oil for operation of the torque converter is supplied by the transmission and steering clutch control oil pump and enters the housing (1), passes through the inlet port (11) in the carrier (13) to the torque converter. The pressure of this oil is held to 40–44 psi at stall speed by a torque converter outlet relief valve. Refer to paragraph 3-48 for the correct testing and adjusting procedure. Oil leaves the torque converter through. outlet port (7) 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 (8) and con-



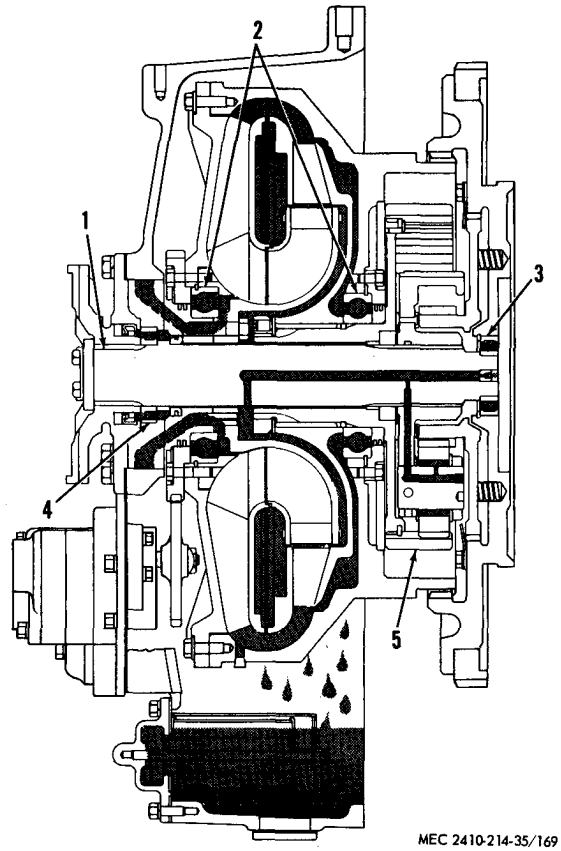
1 Torque divider housing
2 Rotating housing
3 Diesel engine flywheel
4 Ring gear
5 Impeller
6 Sun gear
7 Output shaft
8 Planet carrier
9 Planet gear
10 Turbine
11 Carrier
12 Stator
13 Torque converter gear
14 Scavenge pump

Figure 3–155. Torque divider.



1	Torque divider housing	8	Turbinc
2	Rotating housing	9	Output shaft
3	Diesel engine flywheel	10	Planet carrier
4	Ring gear	11	Inlet port
5	Impeller	12	Planet gears
6	Sun gear	13	Carrier
7	Outlet port	14	Stator

Figure 3–156. Torque divider operation.



1	Output shaft	4	Output shaft rear bearing
2	Bearings	5	Planetary system
3	Pilot bearing		

Figure 3–157. Torque divider lubrication.

sequently the output shaft (9). 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*** **(fig. 3-157).**

(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 (2) are constantly running in oil. The bearings and gears in the planetary system (5) and the pilot bearing (3) receive lubrication through drilled passages in the output shaft (1). The output shaft rear bearing (4) 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.

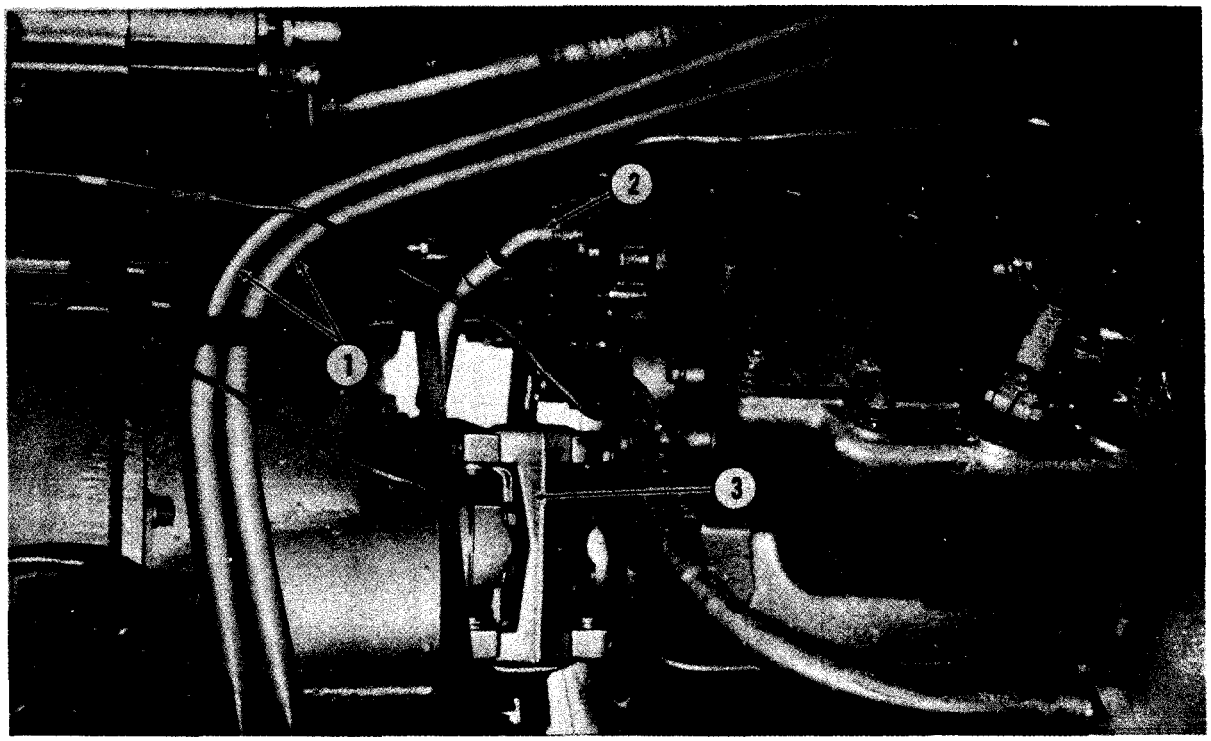
d. Torque Divider Reconditioning.

(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.

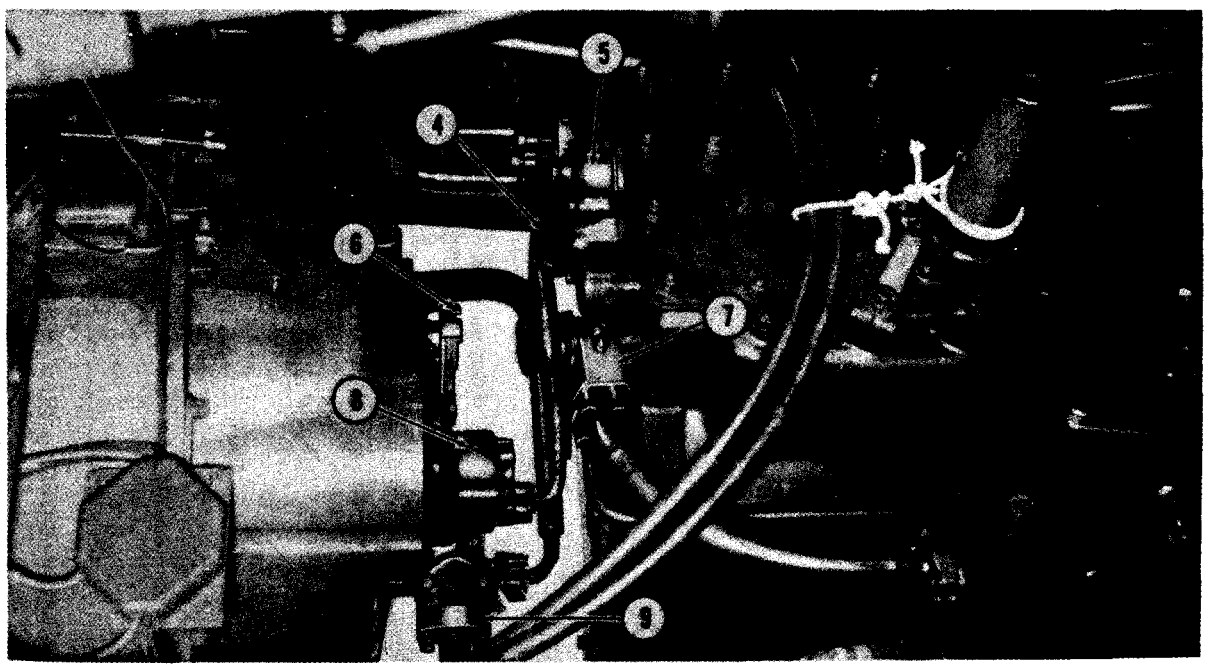
(2) Protect all internal parts of the torque divider during reconditioning to avoid bumping, burring, scratching, or damaging.

(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**



A



B

MEC 2410-214-35/170

1 Hydraulic lines
2 Oil line
3 Universal joint
4 Transmission lubrication junction block
5 Torque divider inlet relief valve
6 Output flange
7 Junction block
8 Scavenge pump
9 Torque divider outlet relief valve

Figure 3–158. Preparing to remove torque divider.

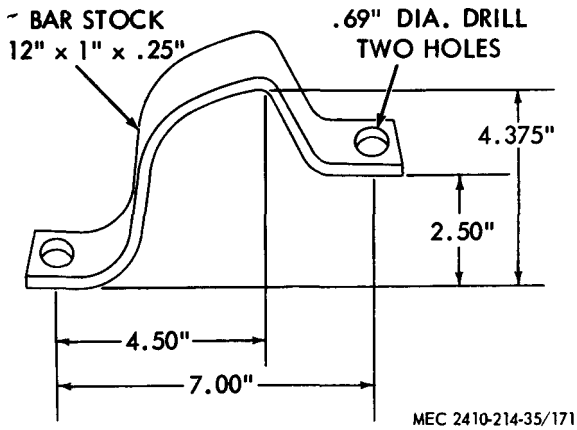


Figure 3–159. Lifting bracket.

e. *Removal and Installation.*

(1) Drain the oil from the transmission and torque divider.

(2) Remove the floor plates, seat, fuel tank, fenders, and brake pedals together with the brake pedal support.

(3) Remove the universal joint para 3-39.

(4) Remove oil line ((2), fig. 3-158) and move lines (1) aside as shown.

(5) Remove output flange (6), scavenge pump (8) and outlet relief valve (9) from torque divider and inlet relief valve (5), junction block (4) and junction block (7) from transmission.

Note. A lifting bracket as shown can be fabricated to facilitate removal of the torque divider.

(6) Install the lifting bracket (fig. 3-159) using two 5/8-inch–11 (NC) bolts, and attach a suitable hoist to support the weight of the torque divider.

system will be circulated through the transmission lubrication valve and into the transmission lubricant circuit.

Note. The torque divider unit weighs approximately 550 pounds.

(7) Remove the nuts and lock washers securing the torque divider to the flywheel housing.

(8) Install 1/2-inch-13 (NC) forcing screws in the tapped holes provided to facilitate separating the torque divider housing from the bore of the flywheel housing.

(9) Remove the torque divider as shown in figure 3-160.

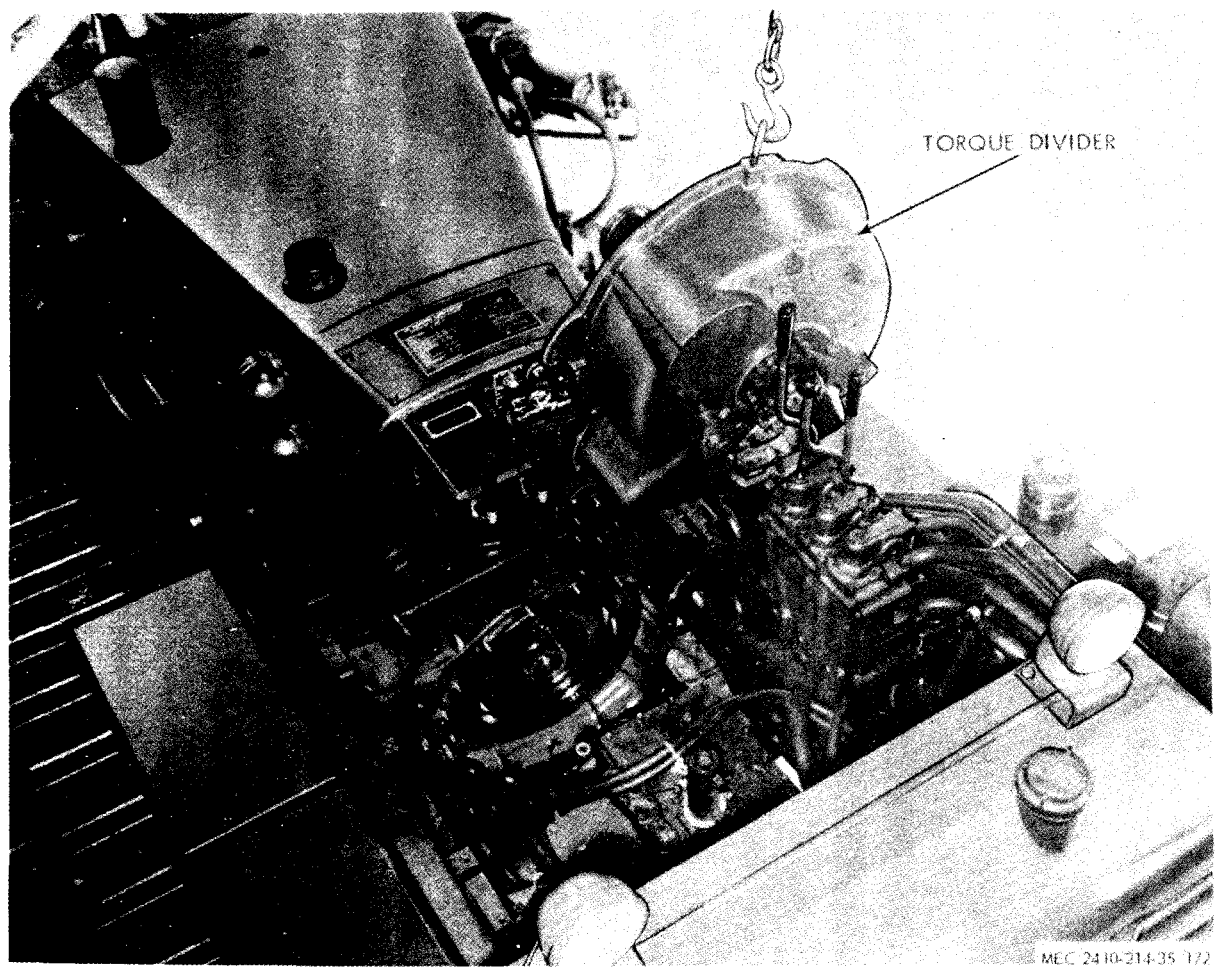


Figure 3–160. Removing torque divider.



Figure 3–161. Removing planet carrier.

Warning: **Secure the planet carrier to the torque divider housing with a wire as shown to prevent possible serious personal injury as a Result of the carrier sliding out of location and falling from the torque divider output shaft.**

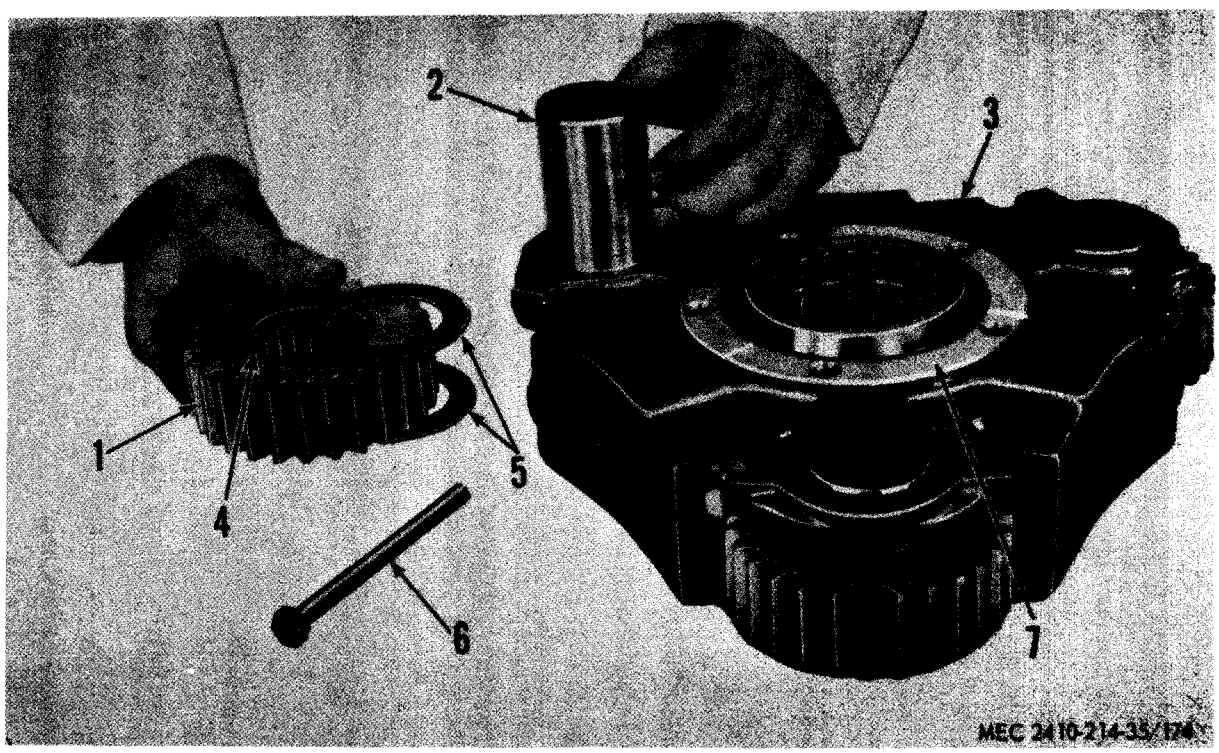
Note. To facilitate installation of the torque divider, remove three studs from the flywheel housing, two at the top and one at the bottom and install three 1/2-inch -13 (NC) guide pins. As the torque divider is moved slowly and evenly into position, check for ring gear and sun gear and sun gear alignment. Gear alignment can be accomplished by either rotating the torque divider output flange, or by reaching through the opening for the transmission oil pump and rotating the torque converter impeller. Do not force the torque divider into position.

(10) Complete the installation in the reverse order or removal.

Caution: **Install the universal joint before starting the diesel engine to prevent hydraulic pressure from forcing the torque divider output shaft to the rear and causing a rapid loss of oil.**

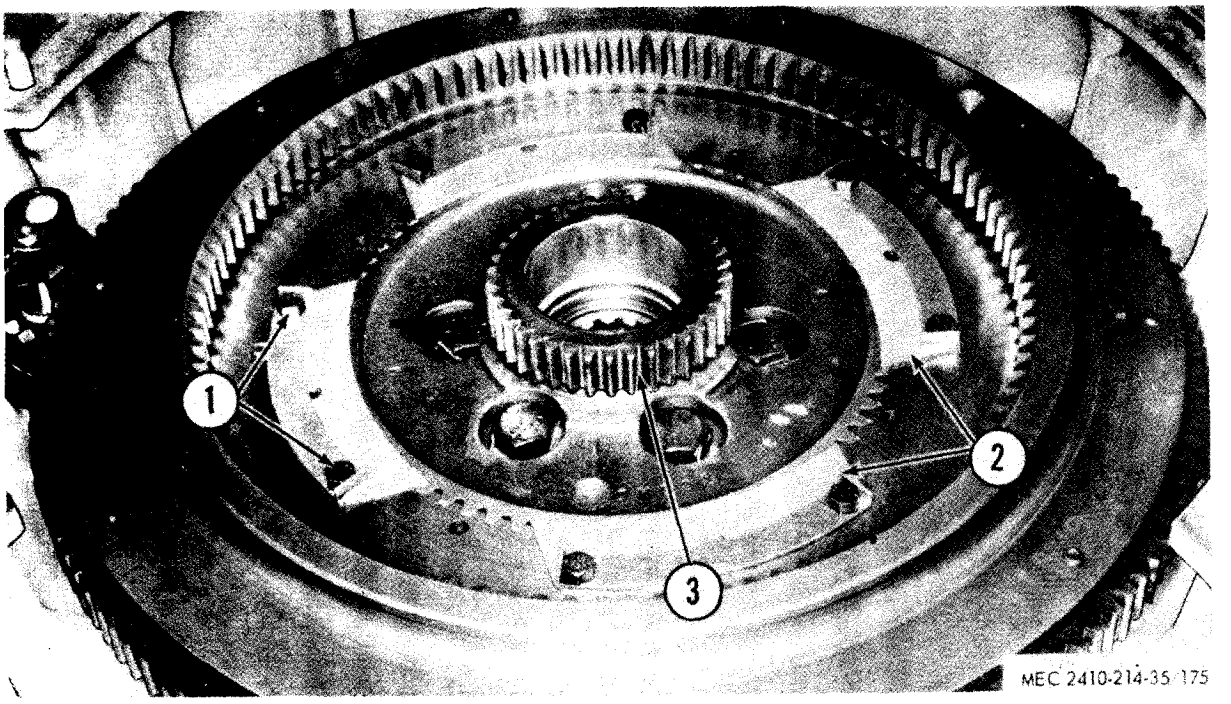
f. Torque Divider Disassembly and Assembly.

(1) Planet carrier, sun gear and pilot bearing.



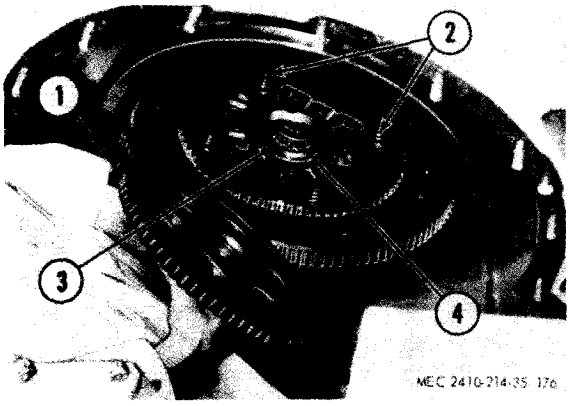
1 Planet gears (3)
2 Planet gear shafts (3)
3 Planet carrier
4 Planet gear bearings (3)
5 Washers (6)
6 Bolts (3)
7 Thrust washer

Figure 3–162. Planet carrier disassembly.



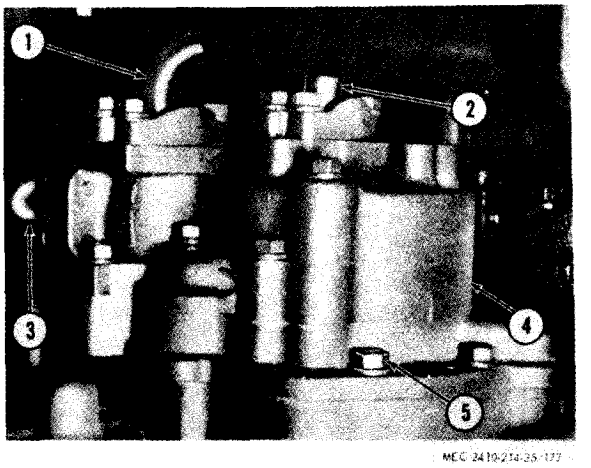
1 Bolts and locks 2 Retainers 3 Sun gear

Figure 3–163. Preparing to remove sun gear.



1 Sun gear
2 Springs (4)
3 Retainer ring
4 Pilot bearing

Figure 3–164. Removing sun gear.



1 Oil line
2 Oil line
3 Oil line
4 Scavenge pump
5 Bolts

Figure 3–165. Scavenge pump removal.

(a) Remove the torque divider (e above).

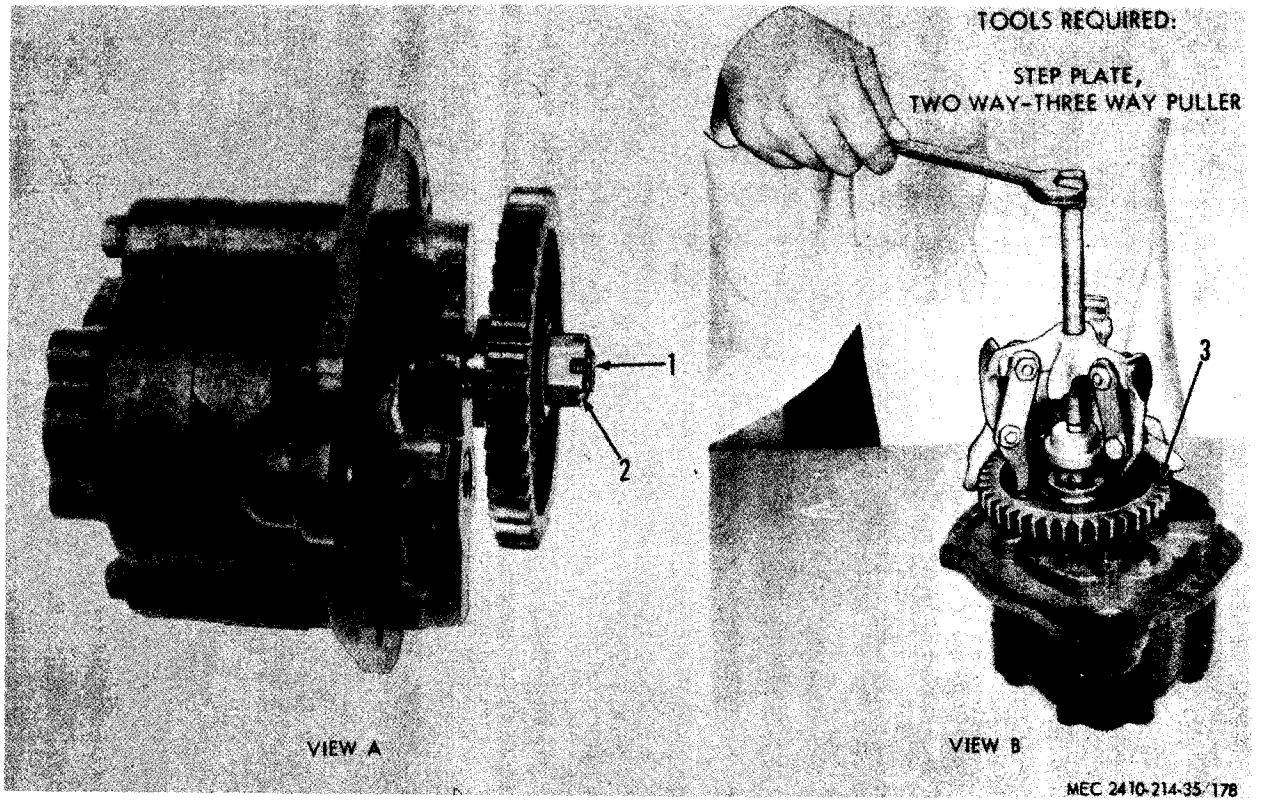
(b) Remove the wire used to prevent the planet carrier from sliding out during removal of the torque divider.

(c) Remove the planet carrier (fig. 3-161) from the torque divider.

(d) Remove the planet gears ((1), (fig. 3-162) shafts (2), washers (5), and bolts (6).

(e) Inspect the bearings (4) in each planet gear (1) and replace them if worn or damaged.

(f) Install the planet gear (1) into carrier (3) with a washer (5) on each side of the gear. Secure the shaft (2) in the carrier with the bolt (6). Tighten the nut on the bolt securely and bend the lock into place against the nut.



1 Cotter pin **2 Nut** **3 Gear**

Figure 3–166. Gear removal view.

Note. Install bolts (6) with all nuts either clockwise or counterclockwise to maintain balance.

(g) Remove bolts and locks ((1), fig. 3-163 and retainers (2).

(h) Inspect the thrust washer ((1), fig. 3-162) on either side of carrier (3) and replace them if worn or damaged. Use new rivets when installing new thrust washers.

(i) Remove the sun gear ((1), fig. 3-164).

(j) The springs (2), can be removed for inspection or replacement.

(k) Inspect the pilot bearing (4) for wear or damage,

(l) The pilot bearing can be removed, if necessary, after removing the retainer ring (3).

(m) Chill the pilot bearing (4) to facilitate installation.

(n) Install the sun gear (1) in the reverse order of removal making certain the springs (2) are in place and that locks on the flywheel bolts are bent so-there is no interference with the gear.

(2) Scavenge *pump removed and* ***install tion.*** The scavenge pump is a two section pump and must be removed from the bottom of the tractor.

(a) Remove the guard from beneath the torque divider.

(b) Disconnect oil lines ((1), fig. 3-165 (2) and (3).

(c) Remove mounting bolts (5) and remove scavenge pump (4) from torque divider.

(d) Replace gaskets and seals before installation.

(3) Scavenge *pump disassembly and assembly.*

(a) Remove cotter pin ((1), fig. 3-166) and nut (2).

(b) Invert nut and install flush with shaft threads to make a flat surface.

(c) Pull gear (3) as shown.

(d) Remove woodruff key ((1, fig. 3-167) and bolts (2).

(e) Remove end cover (3) and inspect preformed packing (4).

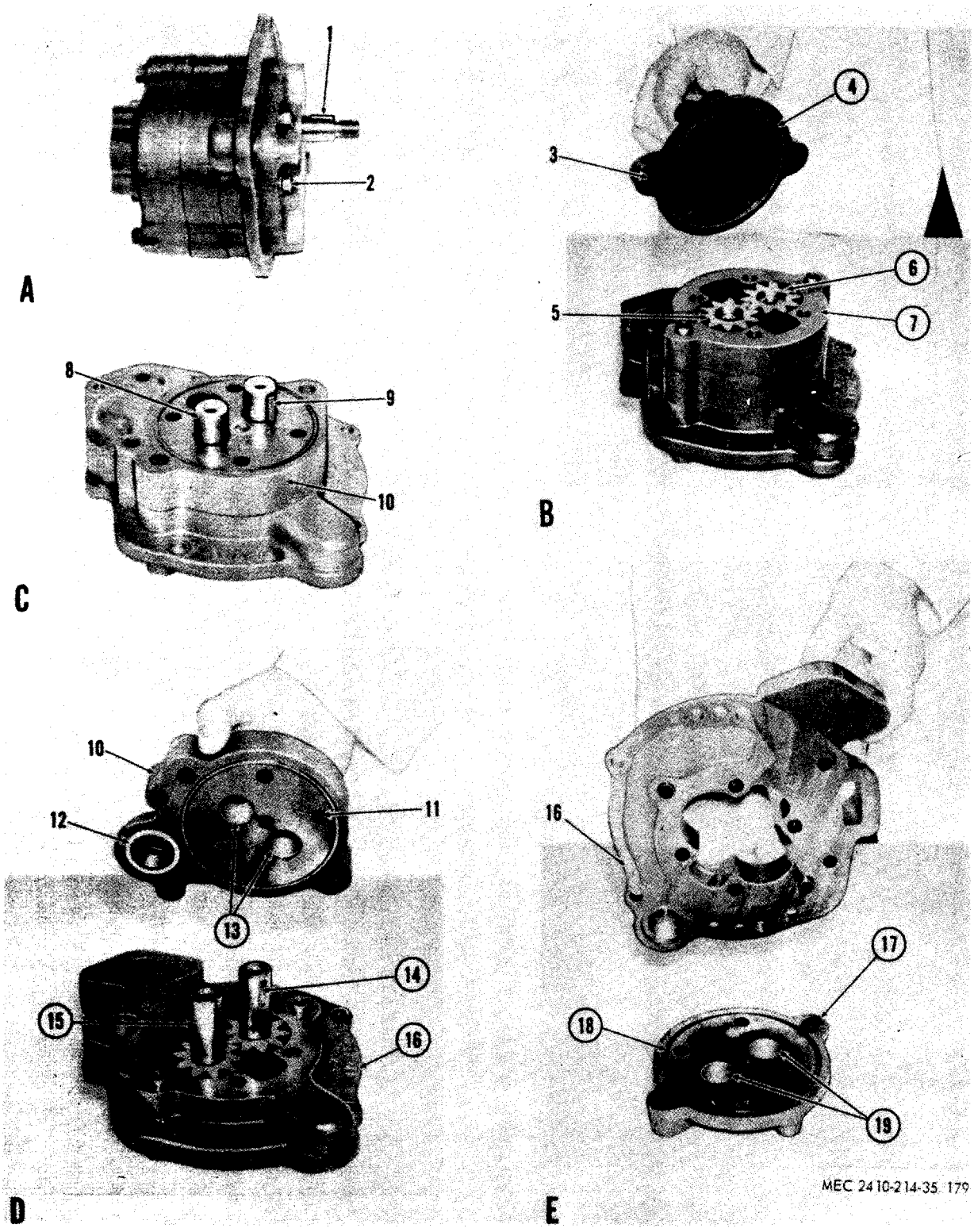
(f) Remove gears (5) and (6) and spacer (7).

(g) Remove woodruff key (9).

(h) Remove spacer (10 and inspect preformed packings (8), (11) and (12).

(i) Replace bearings (13) if necessary.

(j) Remove gears (14) and (15).



1	Woodruff key	8	Packing	15	Gear
2	Bolt	9	Woodruff key	16	Manifold
3	End cover	10	Spacer	17	End cover
4	Packing	11	Packing	18	Packing
5	Gear	12	Packing	19	Bearing
6	Gear	13	Bearing		
7	Spacer	14	Gear		

Figure 3–167. Pump disassembly.

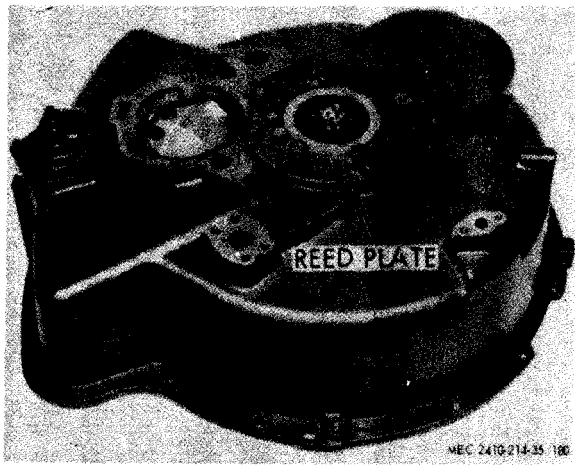
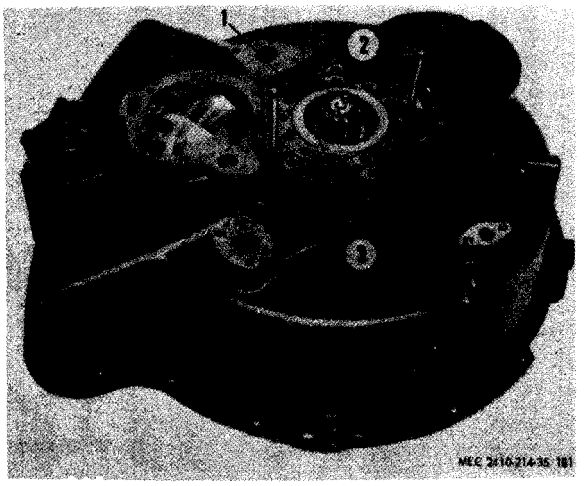


Figure 3–168. Preparing to remove rear seal.



1 End plate
2 Forcing screws
3 Rear seal

Figure 3–169. Rear seal removal.

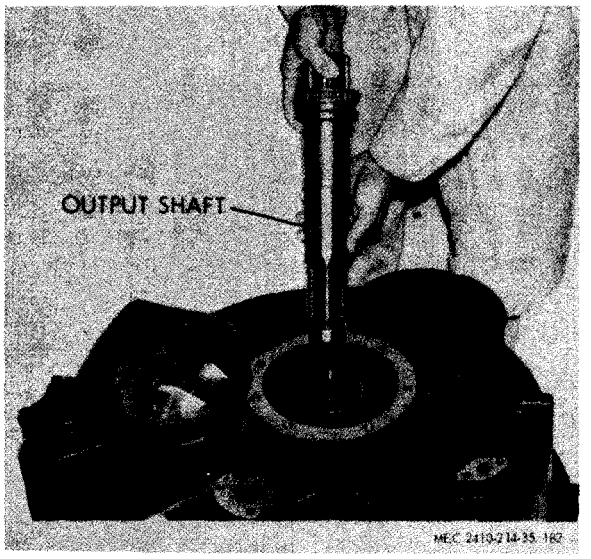


Figure 3–170. Preparing to remove torque divider housing.

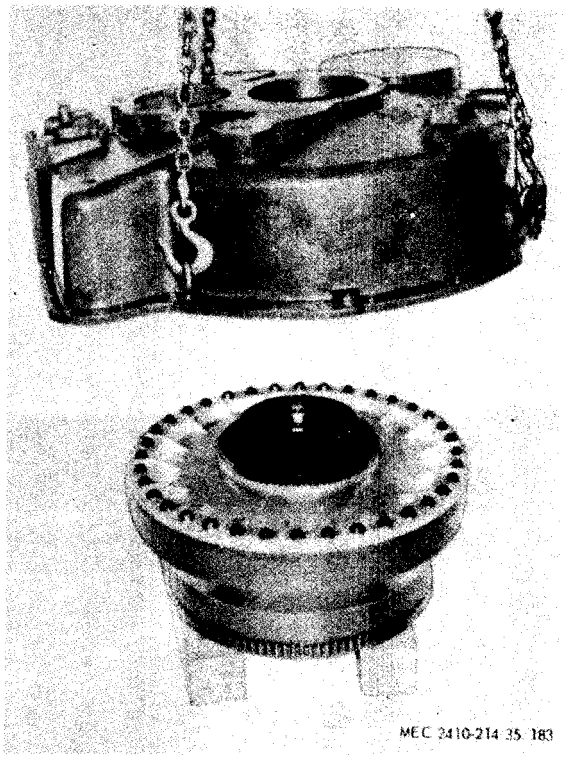
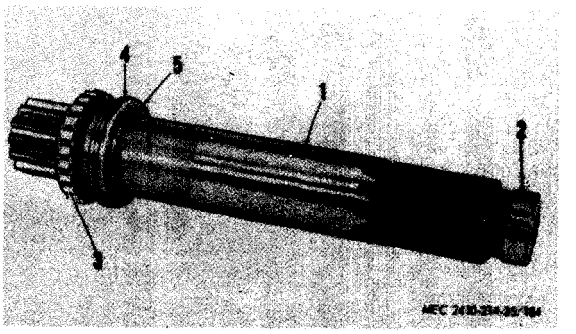


Figure 3–171. Removing torque divider housing.



1 Output shaft
2 Inner race
3 Bearing
4 Piston ring-type seal
5 Bearing

Figure 3–172. Output shaft.

(k) Remove manifold (16) and inspect preformed packing (18).

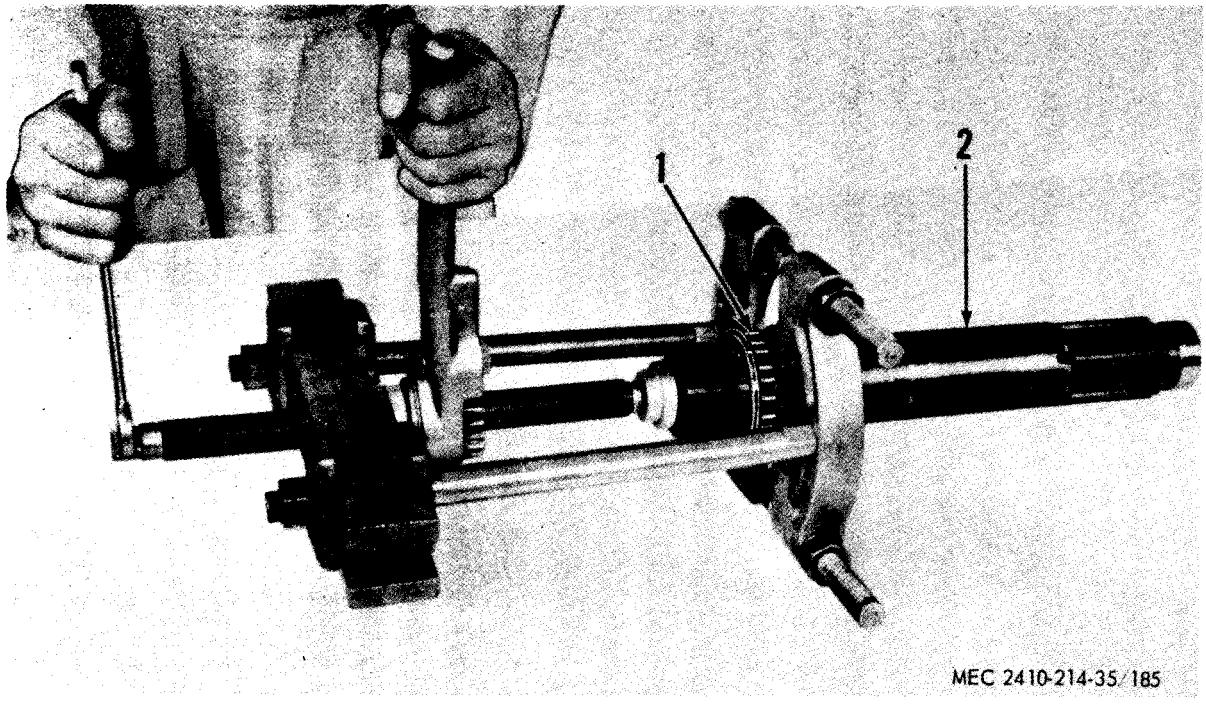
(l) Replace bearing (19) if damaged.

(m) Install in reverse order of removal replacing damaged preformed packings.

(4) *Rear seal removal and installation.* The torque divider rear seal can be serviced without removing the divider from the tractor, The torque divider is shown removed for better illustration.

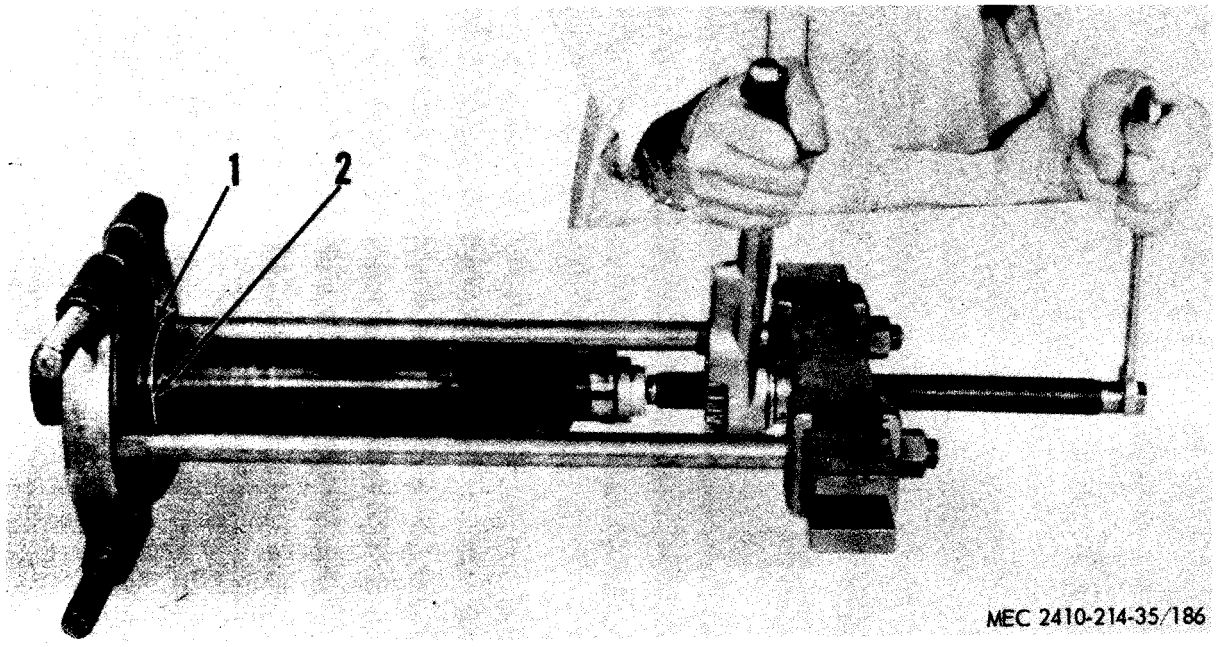
(a) Remove the universal joint (para 3-39).

(b) Remove the output shaft flange.



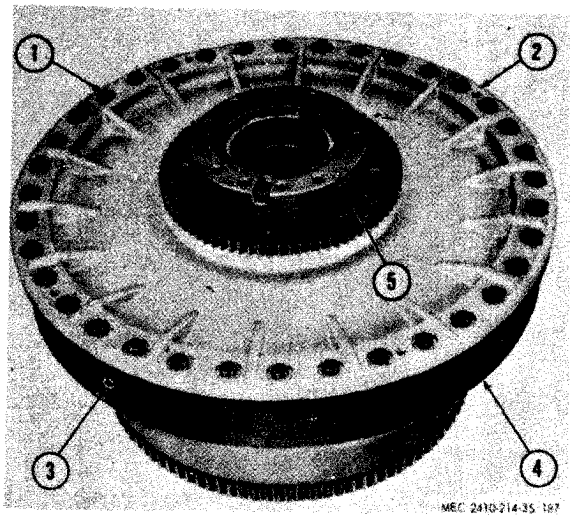
1 Bearing 2 Output shaft

Figure 3–173. Removing bearing.



1 Piston ring-type seal 2 Sleeve

Figure 3–174. Removing sleeve.



1 Bolts and washers
2 Impeller
3 Plug
4 Rotating housing
5 Carrier

Figure 3–175. Preparing to remove impeller.

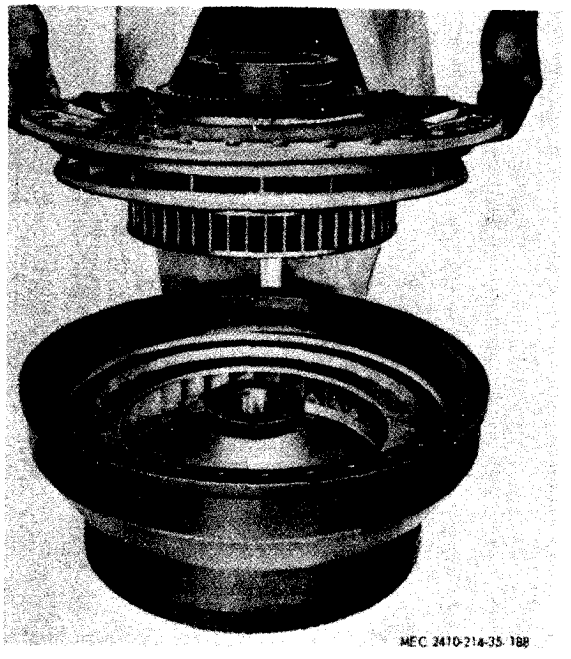


Figure 3–176. Impeller removal.

Caution: **If this operation is being performed with the torque divider removed from the tractor as illustrated, it is important that blocking is placed under both the torque divider housing and the rotating housing.**

(c) Remove both the inner and outer circle of bolts from the end plate (fig. 3-168).

(d) Install two 3/8-inch-16 (NC) forcing screws ((2) fig. 3-169) into the tapped holes provided to facilitate removal of the end plate.

(e) Remove the seal ((3), fig. 3-169 from the end plate (1).

(f) Install the seal (3) with the lip facing the torque divider.

(9) *Use new* gaskets, if necessary, when installing the end plate (l).

(5) ***Torque divider housing removal and installation.***

(a) Lay the torque divider face down. Securely block under both the torque divider housing and rotating housing.

(b) Remove end plate.

(c) Remove the torque divider output shaft (fig. 3-170).

(d) Install two 1/2-inch-13 (NC) eyebolts, one 3/8-inch-16 (NC) eyebolt and using a hoist as illustrated in figure 3-17 lift the housing from the torque divider.

(e) Install the torque divider housing in the reverse order of removal.

(6) ***Output shaft disassembly and assembly.***

(a) Inspect the condition of the inner race ((2 ***), fig. 3-172)*** for the pilot bearing, and replace if necessary.

Note. At the time of assembly, the output shaft (1) should be installed into the torque divider prior to installation of the rear oil seal. Refer to (4) above to install the rear seal.

(b) Remove the bearing ((1), fig. 3-173) from the output shaft (2) using a puller, a bearing pulling attachment, a step plate, and a wrench.

(c) Heat the bearing (1) in oil to facilitate installation on the output shaft (2).

(d) Remove the sleeve ((2), fig. 3-174) containing the piston ring-type seal (1) using a puller, a bearing pulling attachment, a step plate and a wrench.

(e) Installation of the sleeve (2) can be facilitated by heating it in oil.

(t) Inspect *the* condition of the piston ring-type seal (1), and replace if necessary.

(7) *Impeller removal and installation.*

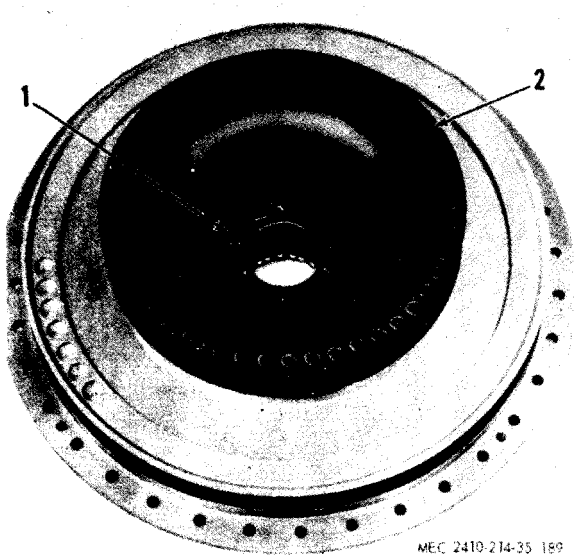
(a) Remove the plug ((3), fig. 3-175) and drain the oil from the rotating housing (4).

(b) Remove the bolts and washers (1) that secure the impeller (2) to the rotating housing (4).

(c) Install 3/8-inch-16 (NC) forcing ***screws*** into the tapped holes in the impeller and separate the impeller from the rotating housing. Remove the impeller together with the stator and carrier as illustrated in figure 3-176.

(d) Check the clearance between the stator and impeller ((11) below).

(e) Install the impeller in the reverse order of removal and tighten the bolts securely.



1 Bolts 2 Stator

Figure 3–177. Preparing to remove stator and carrier.

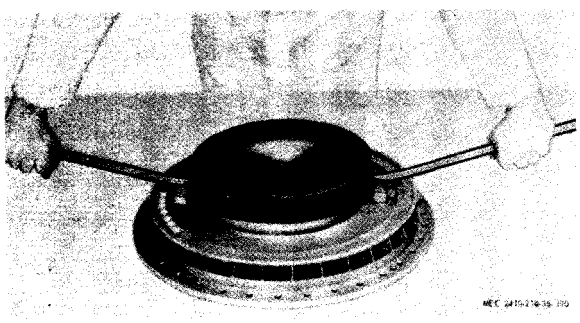


Figure 3–178. Removing stator.

(8) Stator and carrier removal and installation.

(a) Remove the bolts ((1), fig. 3-177) that secure the stator *(2)* to the carrier.

(b) Remove the stator as shown in figure 3-178 by placing two wood blocks on the impeller and prying upward.

(c) Turn the impeller over and remove the carrier by using 3/8-inch–16 (NC) forcing screws in the tapped holes provided in the carrier.

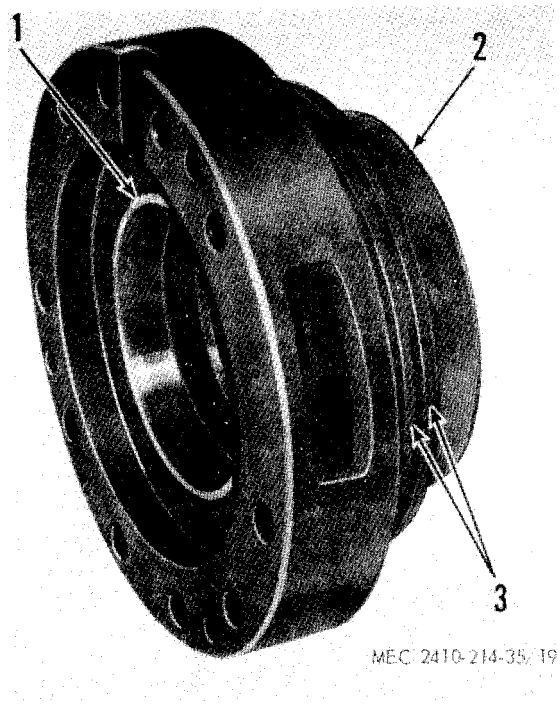
(d) The piston rings ((3), fig. 3-179) can be removed from the carrier (2) if worn or damaged.

(e) Remove the bearing outer race (1).

(t) Chill the bearing outer race (1) to facilitate installation.

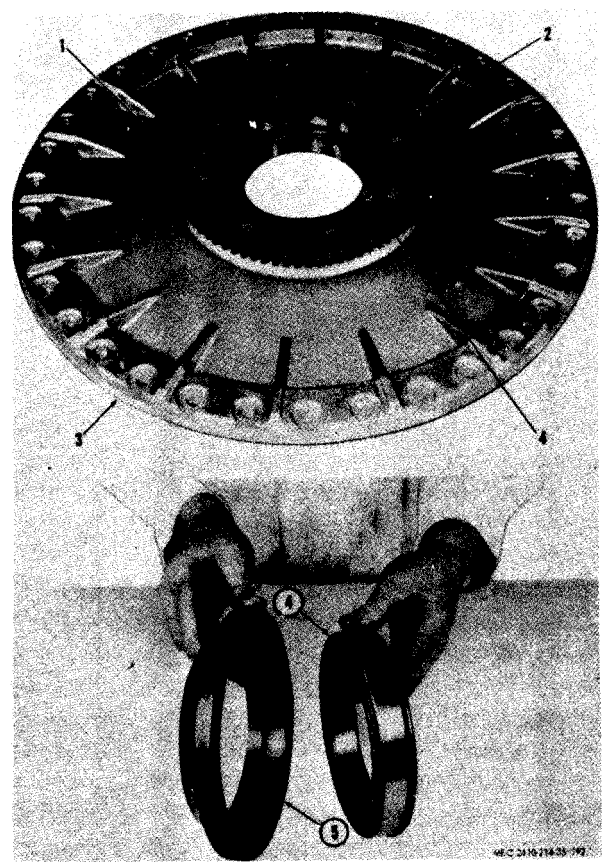
(9) *Impeller Disassembly.*

(a) Remove the bolts ((l), fig. 3-180) that secure the gear (2), bearing (4) and carrier (5) to the impeller (3).



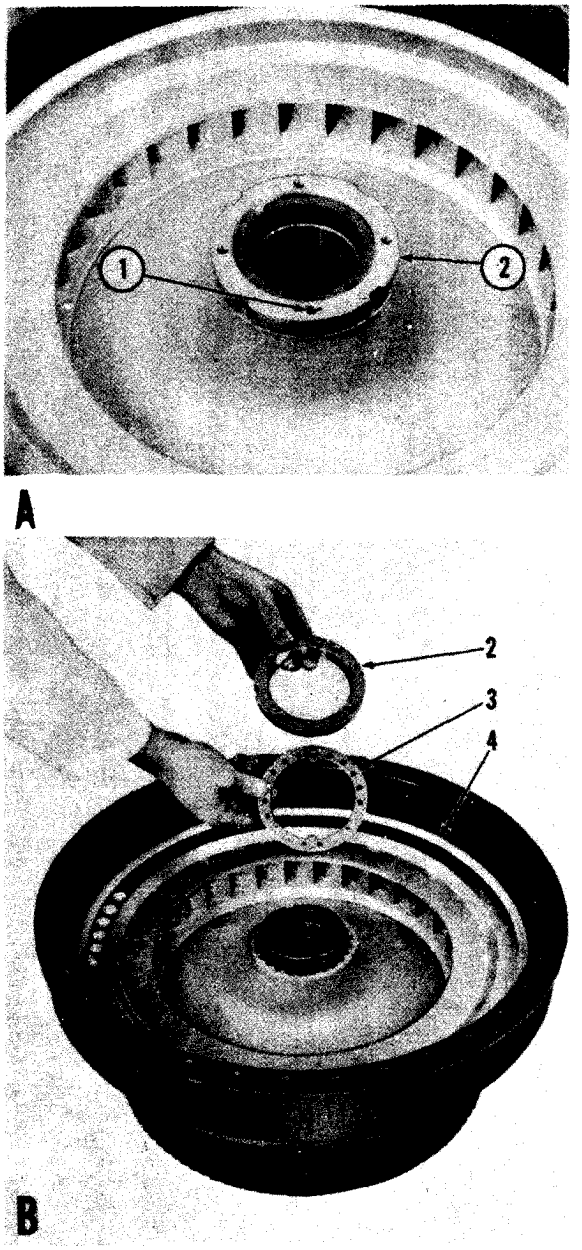
1 Bearing outer race
2 Carrier
3 Piston ring-type seals

Figure 3–179. Carrier disassembly.



1 Bolts
2 Gear
3 Impeller
4 Bearing
5 Carrier

Figure 3–180. Impeller disassembly.



1 Lockscrew
2 Retaining nut
3 Washer
4 Turbine

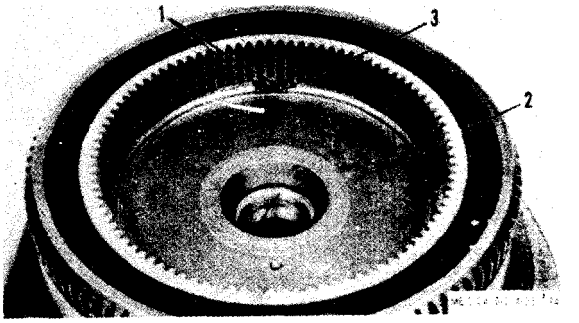
Figure 3–181. Turbine removal.

(b) Use 3/8-inch-16 (NC) forcing screws in the tapped holes provided to facilitate removal of the gear (2). Remove gear (2).

(c) The bearing (4) and carrier (5) will fall free of the impeller after all the bolts have "been removed.

(d) Remove the bearing (4) from the carrier (5).

Note. The bearing (4) is a thrust bearing. The inner race and outer race of the bearing each have the words "thrust here" marked on one side. At the time of assembly, the side of the inner race having this inscription should enter the carrier first and the side of the outer race having this inscription should face the impeller.



1 Spring pins
2 Ring gear
3 Retaining ring

Figure 3–182. Ring gear removal.

(e) Complete the assembly in the reverse order of disassembly.

(10) ***Rotating Housing Disassembly and Assembly.***

(a) Place the rotating housing, turbine side up, on a flat surface as illustrated in figure 3-181.

(b) Remove the lockscrew (1) from the retaining nut (2).

(c) Remove the nut (2) and washer (3).

(d) Remove the turbine (4).

Note. At the time of installation, place the turbine (4) down on the splines of the flange assembly, tap with a soft hammer, and install the washer (3) and nut (2), flange side toward the washer. Tighten the nut by hand. Observe the position of the holes provided for the lockscrew. One of the holes in the nut (2) should be in alignment with a hole in the washer (3). Tighten the nut one hole tighter, install the lockscrew (1) and stake in two places.

(e) Invert the rotating housing so the ring gear ((2), figure 3-182) is facing upward.

(f) Remove the spring pins (1) and pull the two ends of the retainer ring (3) together. Install 3/8-inch-16 (NC) forcing screws into the tapped holes provided in the ring gear (2) and remove it.

(g) Install 3/8-inch-~6 (NC) forcing screws into the tapped holes in the flange assembly (fig. 3-183) and remove it. Figure 3-184 shows flange assembly removed.

(h) Remove the bolts ((1), fig. 3-185).

Note. Use 3/8-inch-16 (NC) forcing screws in the tapped holes provided to facilitate removal of the retainer (2).

(i) Inspect and replace the bearing (3) if necessary.

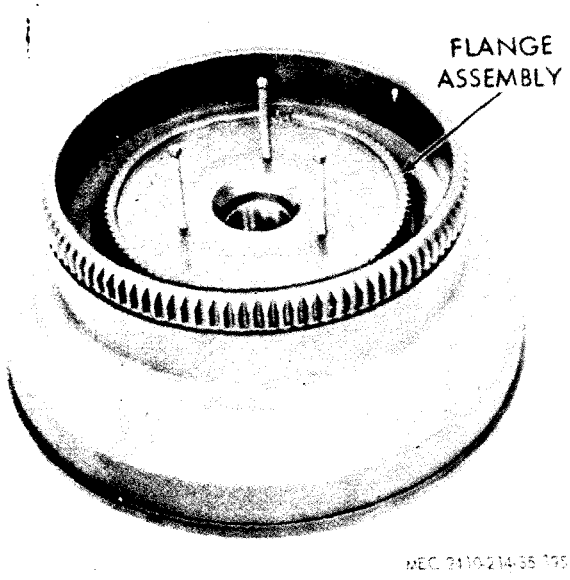
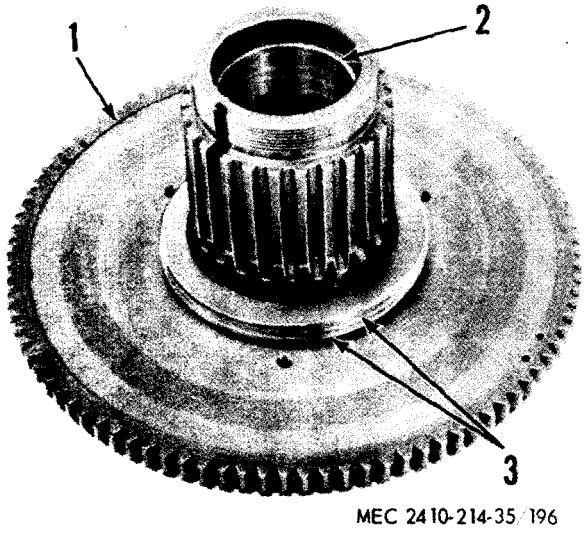


Figure 3–183. Preparing to remove flange assembly.



1 Flange assembly
2 Bearings
3 Piston rings

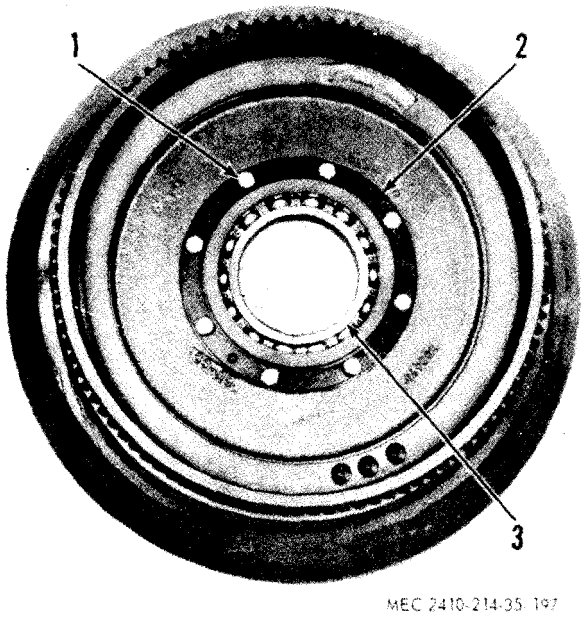
Figure 3–184. Flange assembly removed.

(j) Check the clearance between the stator and turbine. Refer to step (11) below.

(11) *Checking Torque Converter Clearances (fig. 3-186).*

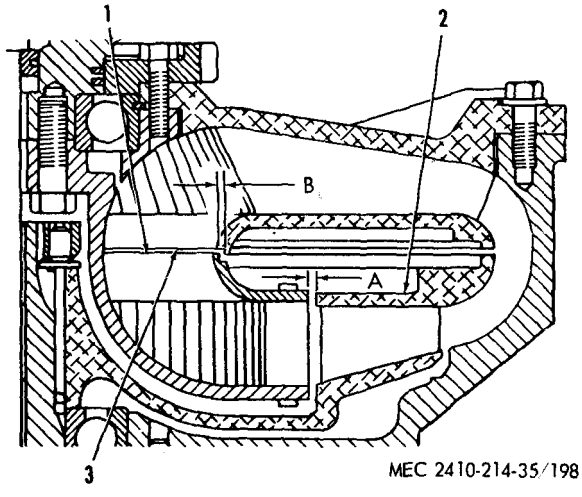
Note. To maintain efficiency of the torque converter, it is necessary that minimum wear limits between certain components be observed and used as a guide when deciding if parts should be replaced. At the time of assembly use the following procedure to check the clearances. See table 1-2 for correct running clearances.

(a) Equally space steel balls ((4), fig. 3-187) between blade ends in turbine flange as illustrated.



1 Bolts
2 Retainer
3 Bearing

Figure 3–185. Preparing to remove retainer.



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 on impeller)

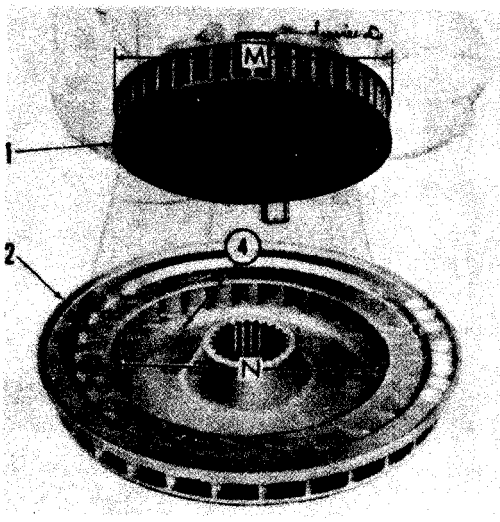
Figure 3–186. Torque converter clearances.

(b) Position stator (1) in turbine *(2)* being careful not to move steel balls (4).

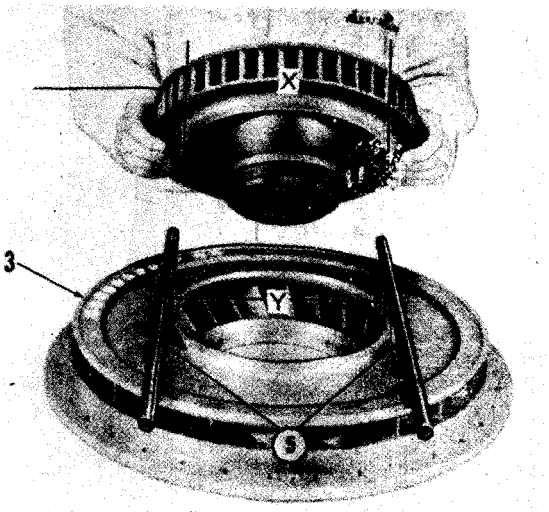
(c) Rotate stator (1) slightly until the smooth surface of the turbine is resting on steel balls (4).

(d) Clamp dia lindicator to turbine (2).

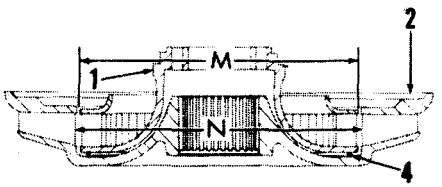
(e) Move the stator (1) from side-to-side (in line with the dial indicator stem) and record the total movement reading on the dial indicator. This reading is the total diametral clearance which is twice the running clearance (A).



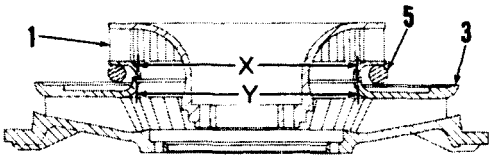
POSITIONING STATOR INTO TURBINE



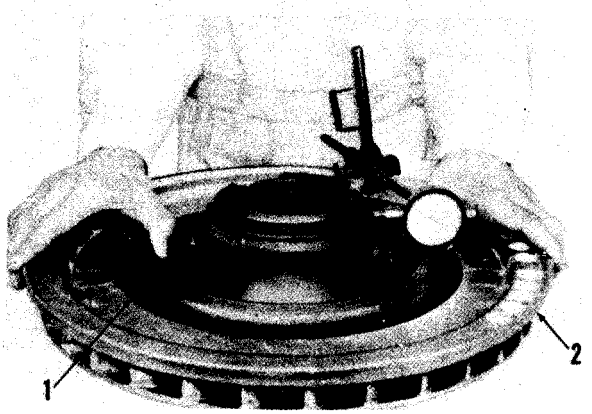
POSITIONING STATOR INTO IMPELLER



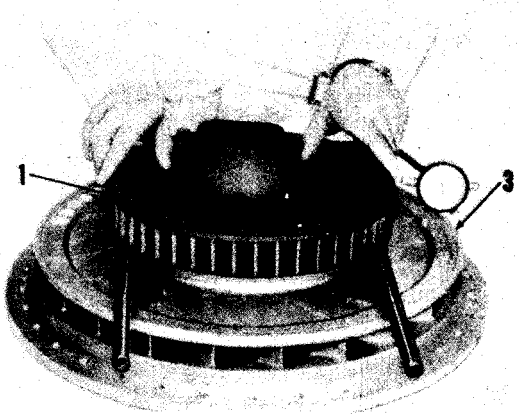
STATOR POSITIONED IN TURBINE



STATOR POSITIONED IN IMPELLER



MEASURING DIAMETRAL CLEARANCE BETWEEN STATOR AND TURBINE



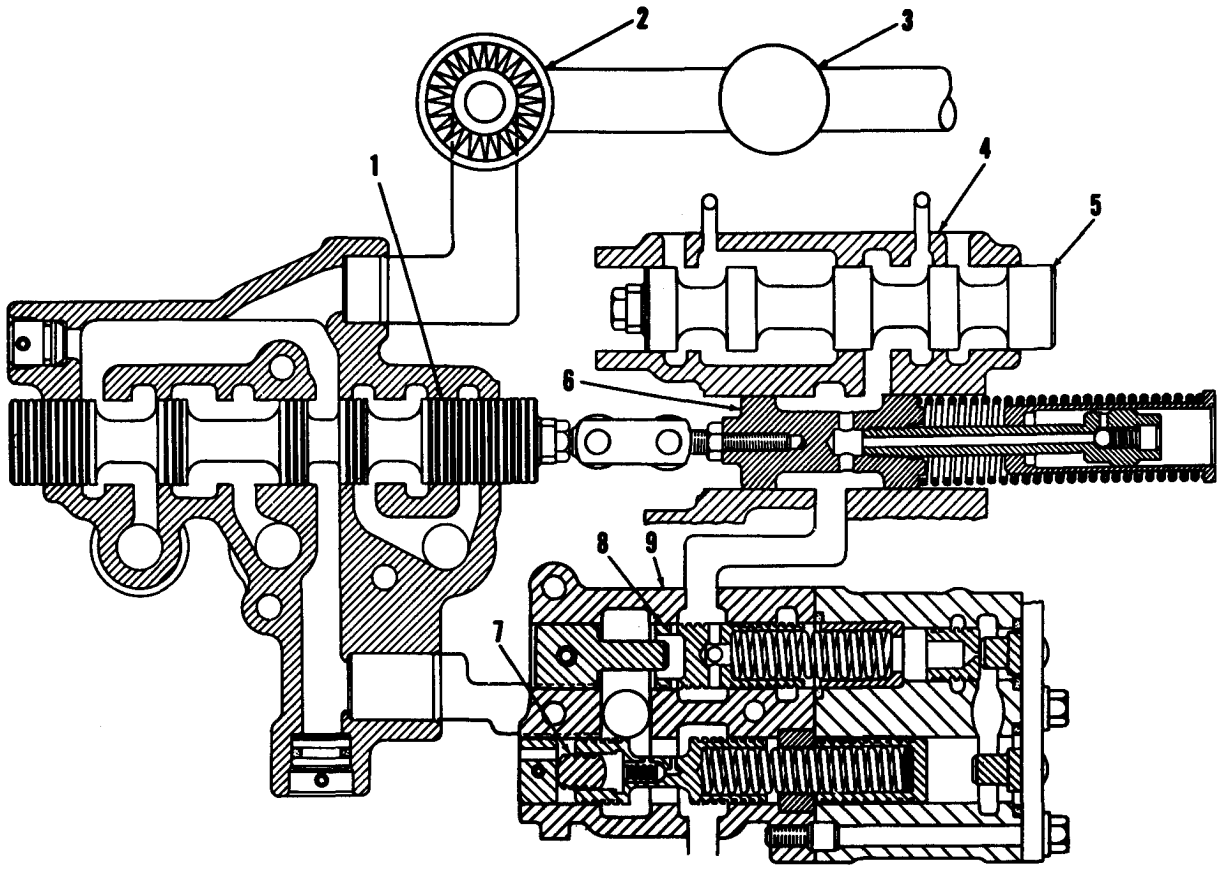
MEASURING DIAMETRAL CLEARANCE BETWEEN STATOR AND IMPELLER

MEC 2410-214-35 199

1 Stator
2 Turbine
3 Impeller
4 Steel balls (4, 1/16 in. dia)
5 Steel rods (2 5/8 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 3–187. Checking torque converter clearances.



MEC 2410-214-35/200

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 3–188. Hydraulic controls (schematic).

(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 impeller (3).

(h) Position stator (1) into impeller (3) and on rods (5).

(i) Clamp 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 total diametral clearance which is twice the running clearance (B).

(k) Measure diametral clearance at four equidistant points using the highest clearance when determining if the components are within allowable limits.

Note. These measured distances are total diametral clearances which are twice the actual running clearances (A) and (B). See table 1-2 for correct running clearances.

3-41. Transmission Hydraulic Controls

a. General (fig. 3-188).

(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 thee 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.

(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 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 seelector lever to the left or right.

b. Hydraulic Control Removal and Installation. 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, floor plates, floor plate framework and the corner panel from the seat frame.

(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 3-46).

(4) Remove spring ((4), fig. 3-189).

(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.

(16). Lubricate the preformed packings with liquid soap to facilitate installation.

(17) Adjust control linkage (d below).

Note. Tubes (10) and (16) can be installed through openings in front of transmission case.

(18) Tighten bolts holding valve housing. Refer to paragraph 1-4 for torque data.

c. ***Hydraulic Control Disassembly and Assembly.***

(1) Pressure control valve disassembly.

(a) Remove bolts ((1), fig. 3-190) and cover (2).

(b) Separate housing (3) from housing (10).

(c) Remove springs (4) and (7).

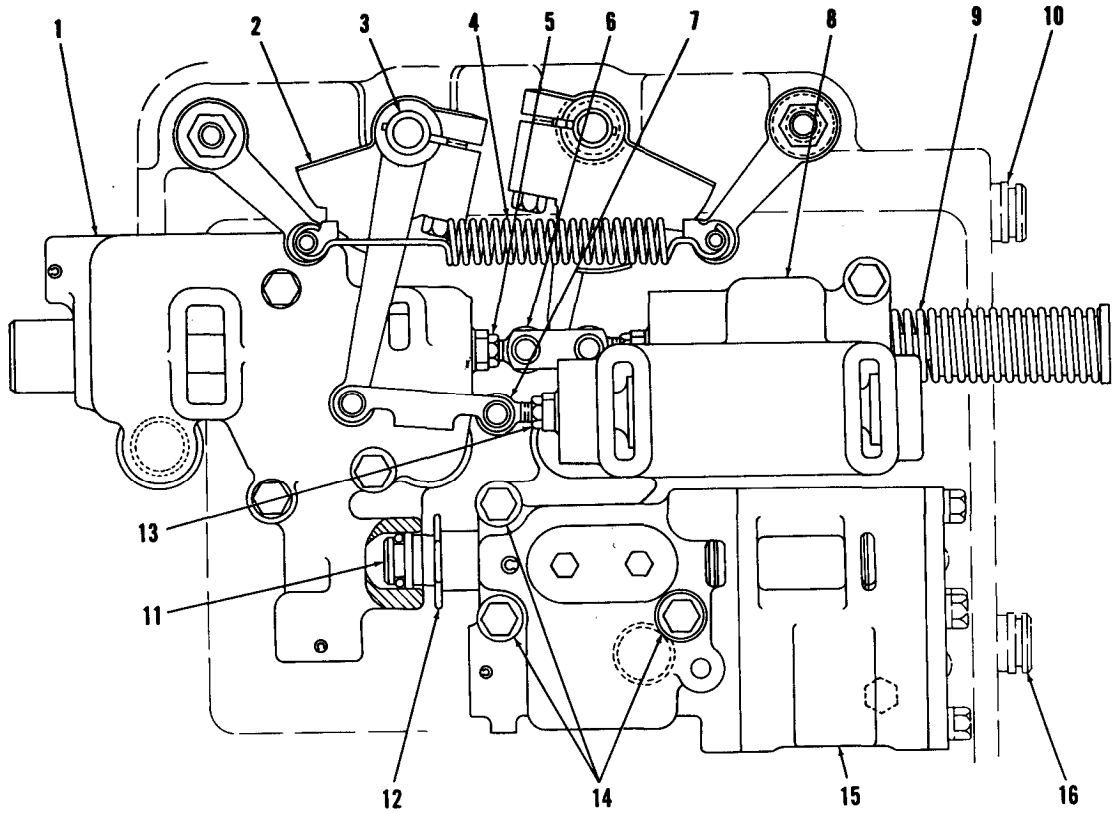
(d) Remove retainer (5).

(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. 3-191), stop (2) and piston (3).

(g) Remove pin ((1), fig. 3-192) stop (2), slug (3), relief valve piston (4) and stop (5).



1	Speed selector valve housing	9	Safety valve
2	Lever	10	Tube
3	Shaft	11	Tube
4	Spring	12	Clip
5	Locknut	13	Locknut
6	Eyebolt	14	Bolts
7	Eyebolt	15	Pressure control valve housing
8	Safety and directional valve housing	16	Tube

Figure 3–189. Hydraulic control removal.

(h) Remove slug (3) from end of relief valve piston (4).

(i) Remove retainer ring ((2), fig. 3-193) retainer (3), spring (4), and plunger (5) from relief valve piston (1).

(2)Pressure control valve inspection. Inspect valve housings and pistons for nicks, burrs, or pitting. Inspect the valve body land edges for wear caused by recirculating abrasive particles. The valves are very hard and are seldom damaged. Light scratches and light grey wear appearance are not detrimental to valve. Always replace all springs when reconditioning a valve with appreciable service hours. Valves must move freely in housings. Be sure slug ((10), fig. 3-194) 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. Always install new preformed packings when assembling control valve.

(3) Pressure control valve reassembly.

(a) Install plunger ((14), fig. 3-194) 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 (8) into housing (7).

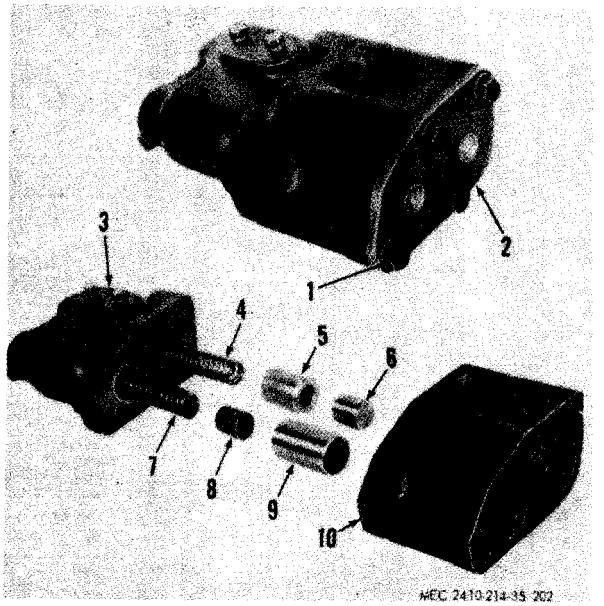
Note. Install spacers (19) inside piston (18).

(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.*

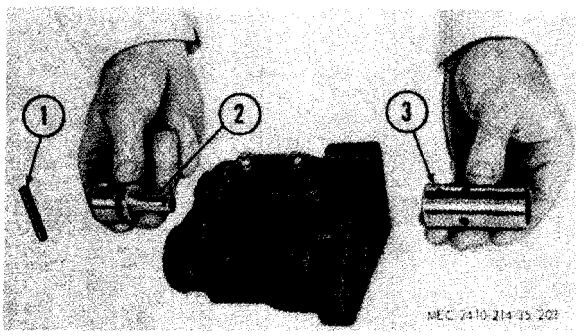
(a) Safety valve ((4), fig. 3-195) and directional valve (1) can be removed from valve housing (2) for inspection.

(b) Screw center stem out of valve (4) to remove spring (3).



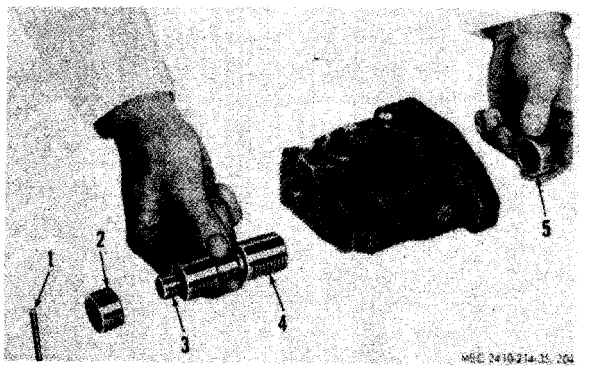
1 Bolts
2 Cover assembly
3 Housing
4 Spring
5 Retainer
6 Piston
7 Spring
8 Spacers
9 Piston
10 Housing

Figure 3–190. Disassembly of pressure control valve.



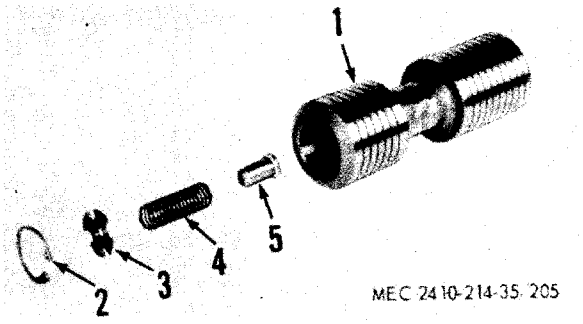
1 Pin
2 Stop
3 Differential valve piston

Figre 3–191. Differential valve removal.



1 Pin
2 Stop
3 Slug
4 Relief valve piston
5 Stop

Figure 3–192. Pressure relief valve removal.



1 Relief valve piston
2 Retainer ring
3 Retainer
4 Spring
5 Plunger

Figure 3–193. Pressure relief 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 valve listed in paragraph 1-4. Do not hold valve (4) by finished lands.

(5) Speed ***selector valve.*** Speed selector valve stem ((1), fig. 3-196) can be removed from valve housing (2) if necessary.

d. Linkage Adjustment.

(1) Internal adjustment.

(a) When hydraulic controls are installed in transmission, control linkage should be adjusted to position directional valve stem ((5), fig. 3-197, 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; that is, the end of first land of valve stem (2) must be flush with surface (A), (3) with surface (B), and (5) with surface (C).

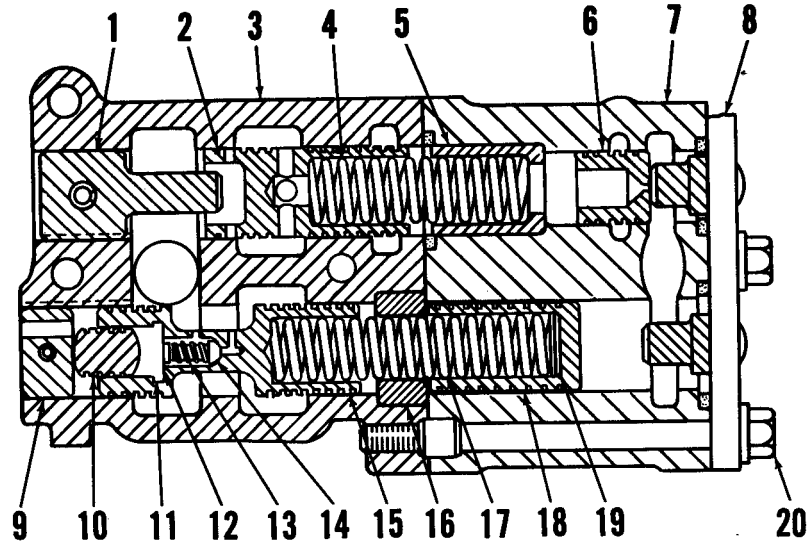
(2) ***External adjustment.***

Warning: **Do not adjust linkage with engine running.**

(a) Loosen clamp bolt in lever ((6), fig. 3-198) on selector lever control shaft and, using a thickness gage between washer (5) and lever, position lever to obtain dimension given in table 1-2. Tighten clamp bolt.

(b) Loosen bolts in clamps (2) and (4) and position support (3) to obtain dimension (A) listed in table 1-2.

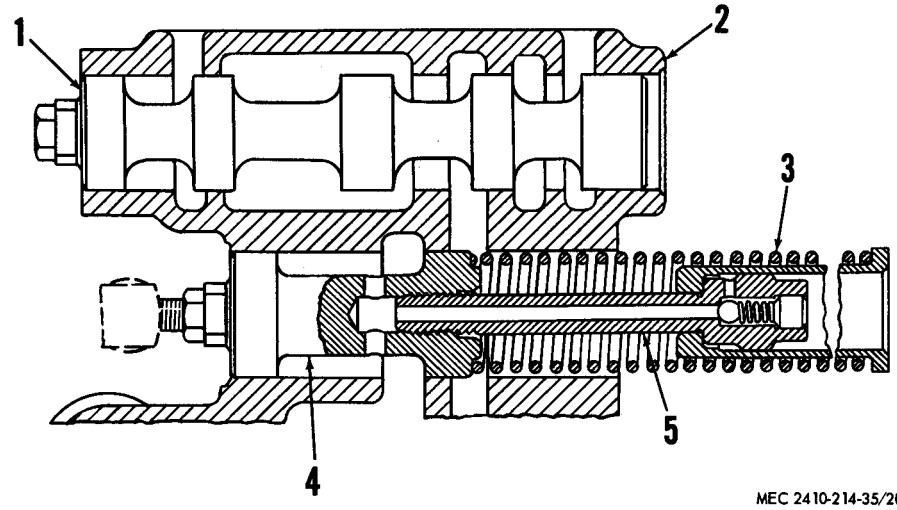
(c) With the connecting link disconnected, position lever (8) in forward detent.



MEC 2410-214-35/206

1	Stop	8	Cover	15	Relief valve piston
2	Differential valve piston	9	Stop	16	Stop
3	Housing	10	Slug	17	Spring
4	Spring	11	Retainer ring	18	Piston
5	Retainer	12	Retainer	19	Spacers
6	Piston	13	Spring	20	Bolts
7	Housing	14	Pluger		

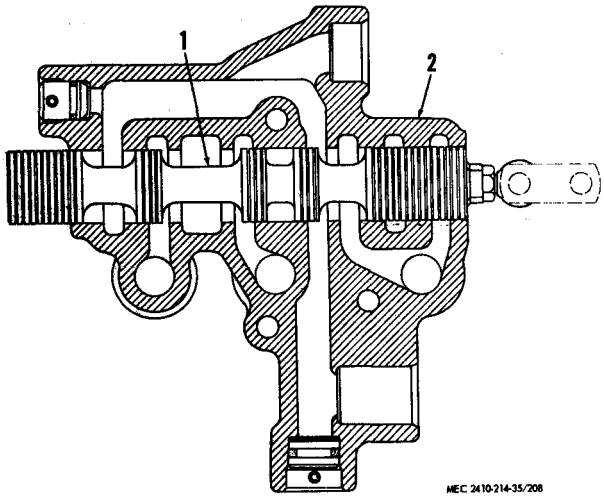
Figure 3–194. Pressure control valve assembly.



MEC 2410-214-35/207

1	Directional valve	3	Spring	5	Stem
2	Valve housing	4	Safety valve		

Figure 3–195. Safety and directional valve disassembly.



1 Valve stem 2 Valve housing

Figure 3–196. Speed selector valve.

(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).

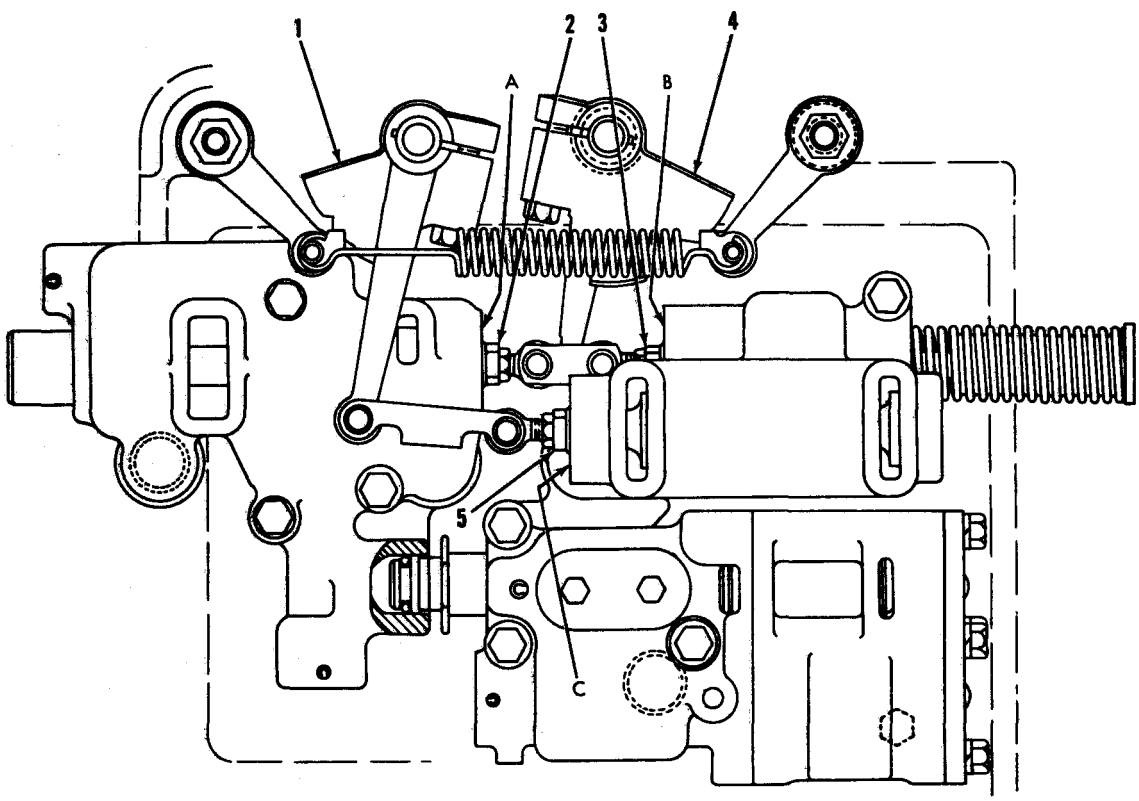
(g) Place selector lever (1) in NEUTRAL position of forward slot.

(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.

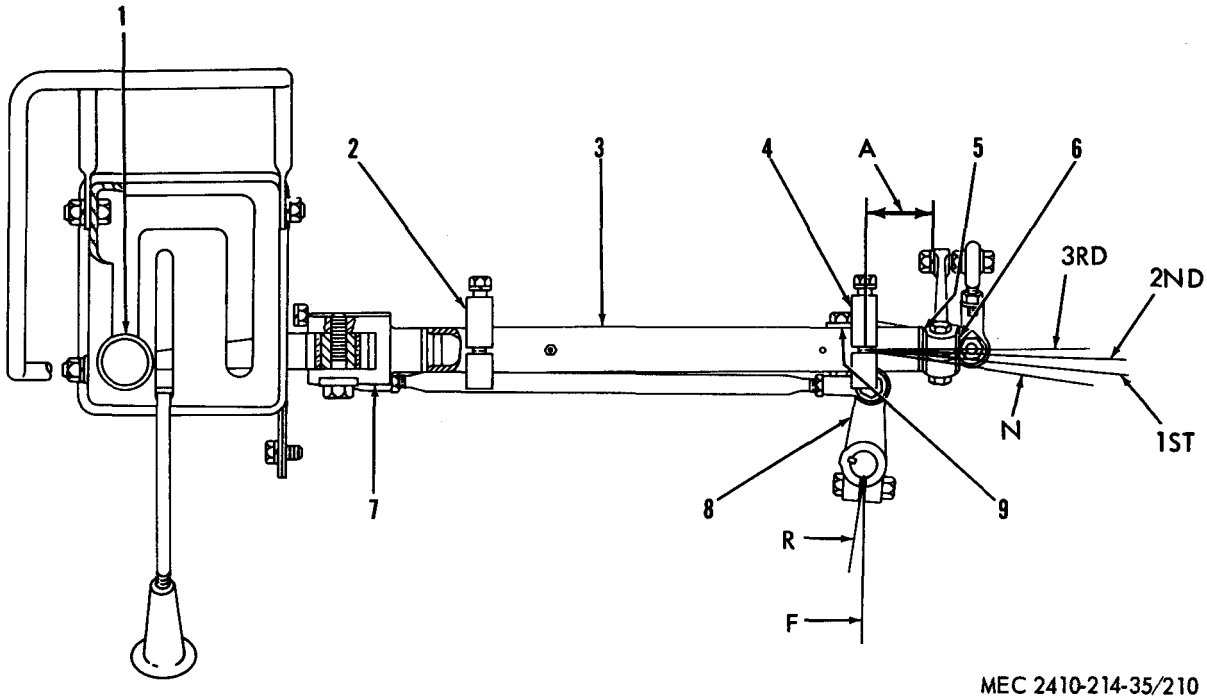
3-42. Hydraulic Pump

a. General The steering clutch and transmission hydraulic pump is a single section gear type



1 Lever
2 Speed selector valve stem
3 Safety valve stem
4 Lever
5 Directional valve stem
A,B C-Surfaces of valve housings

Figure 3–197. Linkage adjustment.



1 Selector lever	4 Clamp	7 Shaft assembly
2 Clamp	5 Washer	8 Lever
3 Support	6 Lever	9 Lever

A—Dimension between centerline of transmission control shafts and left face of lever (6)

Figure 3–198. Linkage adjustment (top view).

pump which is bolted to the front of the rear power takeoff housing.

b. Removal and Installation.

(1) Remove the toolbox and support bracket from the right side of the diesel engine.

(2) Drain the steering clutch and transmission hydraulic system. Refer to TM 5-2410-214-12.

(3) Disconnect the hydraulic lines ((3), fig. 3-199) and cover the ends of the oil lines to prevent the entry of dirt or other foreign material.

(4) Remove bolts (1) and pump (2).

(5) Install the pump in the reverse order of removal.

c. *Disassembyl and Assembly.*

(1) Refer to figure 3-200 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.

3-43. Torque Converter Inlet Relief Valve

a. Removal and Installation.

(1) Remove the right front and center floor plates.

(2) Refer to TM 5-2410-214-12 and drain the transmission and steering clutch hydraulic system.

(3) Disconnect oil line ((1), fig. 3-201).

(4) Remove nuts (3), bolts (4), and valve body (2).

b. Disassembly and Reassembly.

(1) Refer to figure 3-202 and disassemble the inlet relief valve.

(2) Replace any damaged or worn parts.

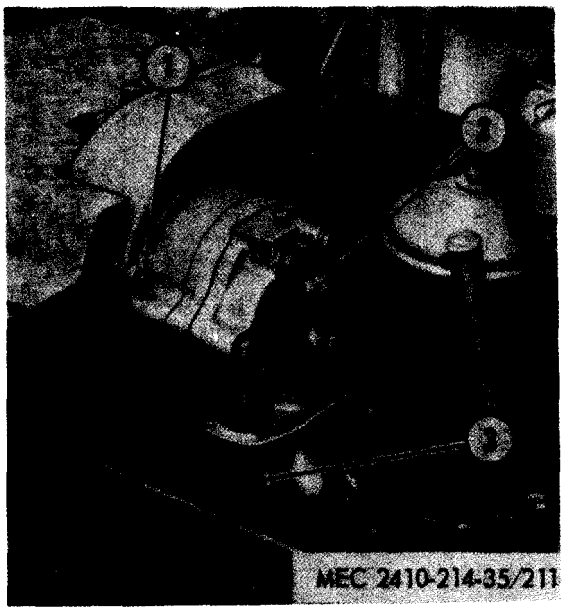
(3) Reassemble the inlet relief valve in the reverse order of disassembly.

3-44. Torque Converter Outlet Relief Valve

a. Removal and Installation.

(1) Remove the left front and center floor plates.

(2) Refer to TM 5-2410-214-12 and drain the torque converter hydraulic system.



1 Bolts
2 Oil pump
3 Hydraulic lines

Figure 3–199. Hydraulic pump removal.

(3) Disconnect oil lines ((3), (4), fig. 203) .

(4) Remove bolts (1) and outlet relief valve (2).

b. Disassembly and Reassembly.

(1) Refer to figure 3-204 and disassembly 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.

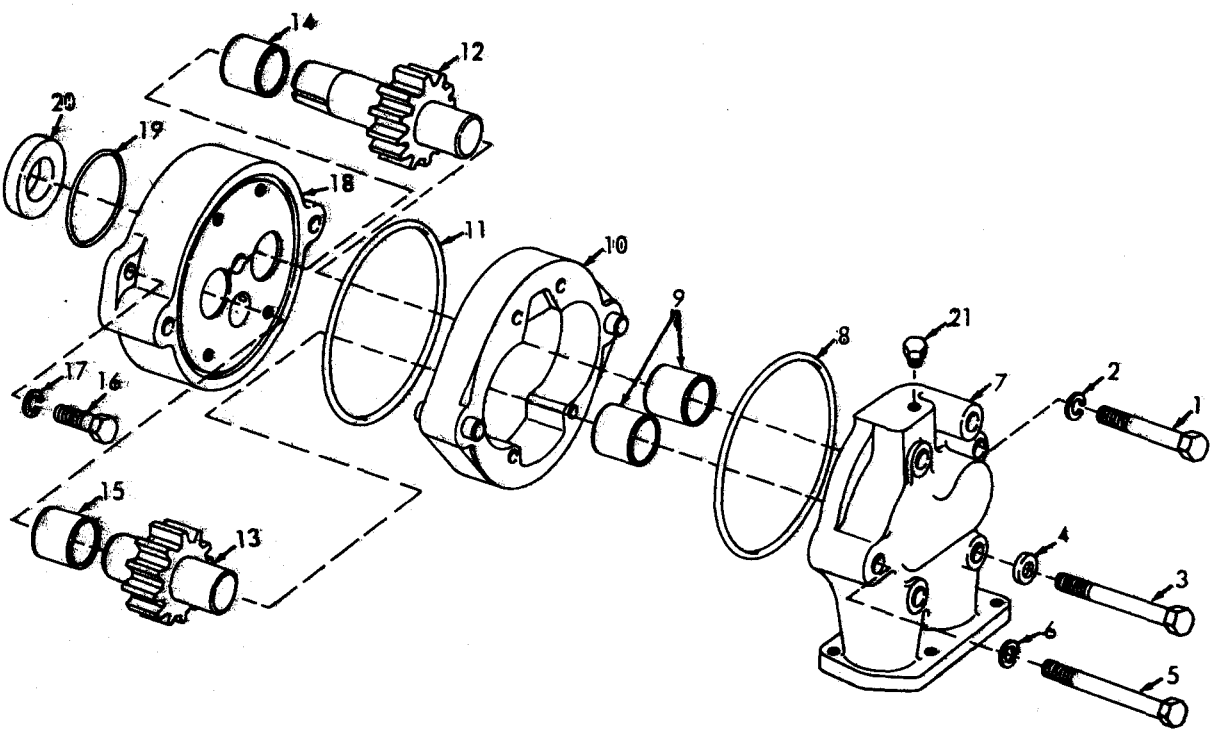
3-45. Transmission and Steering Clutch Control Check Valve

a. Removal and Installation.

(1) Refer to TM 5-2410-214-12 and drain the transmission and steering clutch hydraulic system.

(2) Disconnect oil supply line ((3), fig. 3-205) .

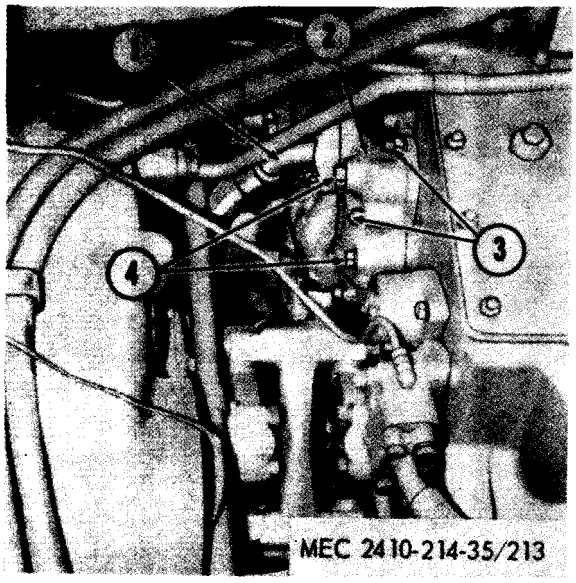
(3) Remove bolts (2) and check valve (1).



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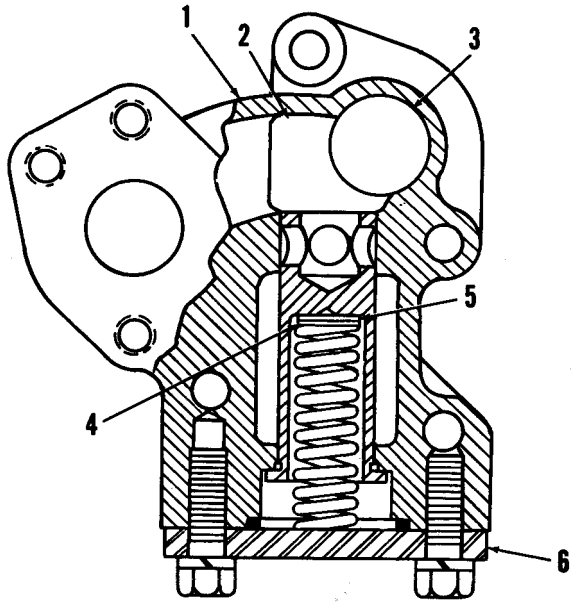
1	Bolt	8	Packing	15	Bearing
2	Washer	9	Bearing	16	Bolt
3	Screw	10	Body assembly	17	Washer
4	Washer	11	Packing	18	Cover assembly
5	Bolt	12	Gear	19	Packing
6	Washer	13	Gear	20	Seal
7	Manifold assembly	14	Bearing	21	Plug

Figure 3–200. Hydraulic pump disassembly.



1 Torque converter oil inlet line
2 Valve body
3 Nuts
4 Bolts

Figure 3–201. Removing torque converter inlet relief valve.



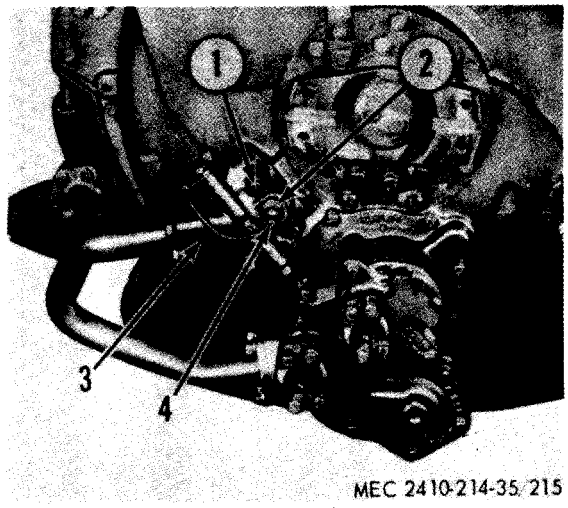
1 Valve body
2 Opening
3 Valve plunger
4 Spacer
5 Spring
6 Cover

Figure 3–202. Torque converter inlet relief valve.

(4) Install the relief valve in the reverse order of removal using new preformed packings.

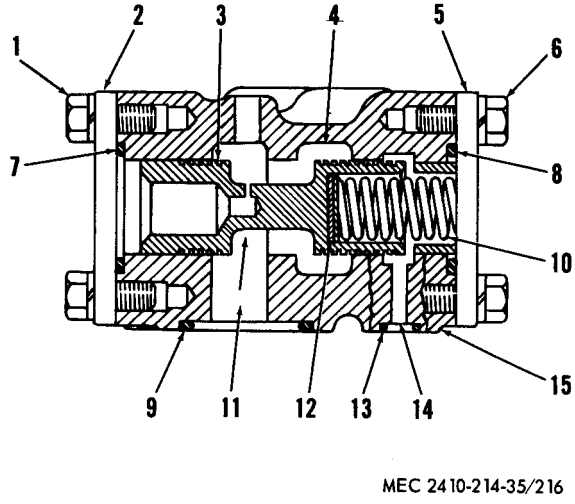
b. Disassembly and Reassembly.

(1) Refer to figure 3-206 to disassemble and reassemble check valve.



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 3–203. Torque converter outlet relief valve removal.



1 Bolts
2 Cover
3 Valve
4 Vavity
5 Cover
6 Bolt
7 O-ring seals
8 O-ring seals
9 O-ring seals
10 Spring
11 Cavity
12 Washers
13 O-ring seal
14 Bleed passage
15 Valve housing

Figure 3–204. Outlet relief valve assembly.

(2) Replace any worn or damaged parts,

3-46. Transmission

a. General.

(1) The power shift transmission utilizes planetary gearing and five hydraulically actuated clutches to provide three forward and three reverse speeds.



1 Check valve
2 Bolts
3 Oil supply line

Figure 3–205. Check valve removal.

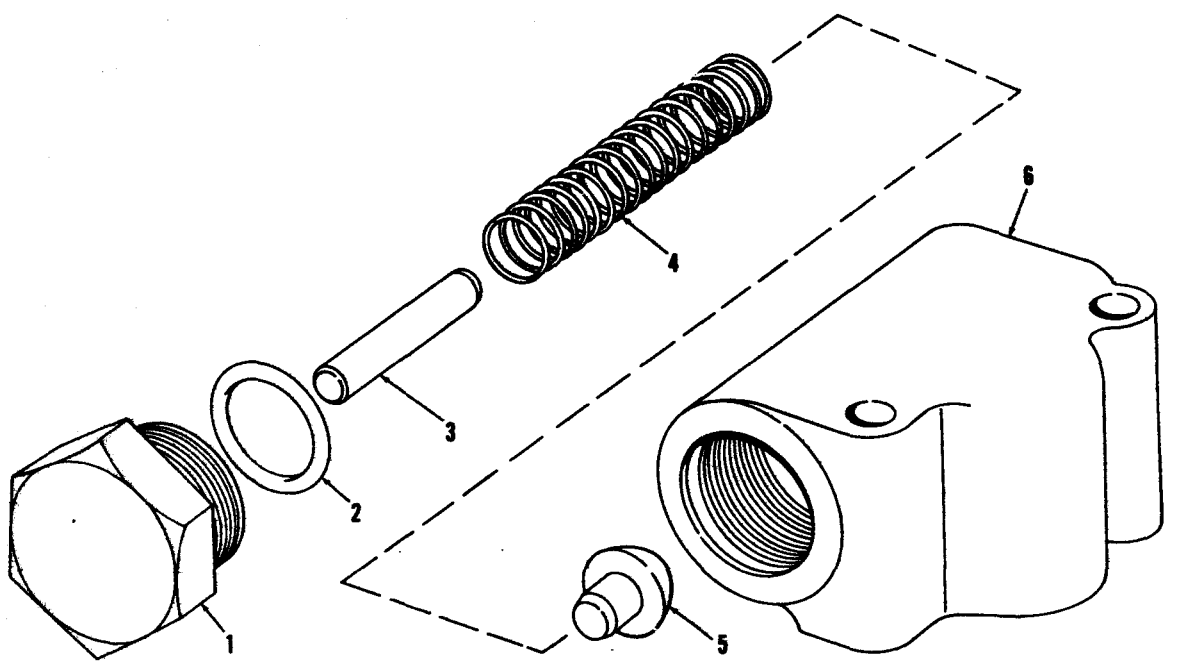
(2) The five transmission clutches are of the multiple disc type, and are contained in separate housings surrounding the ring gears of the transmission. The clutches have alternate discs ((5), fig. 3–207) and plates (3). The discs (5) have internal teeth which mesh with external teeth on the ring gear (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 f rent clutches (No. 1 and No. 2, fig. 3-208) 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.

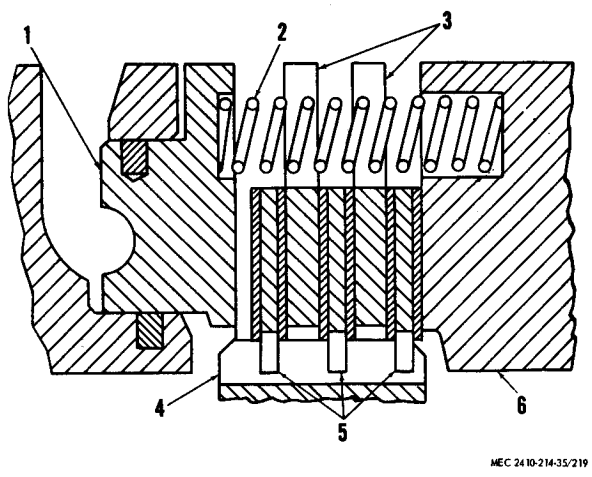
(5) Two clutches must be engaged in order to transmit power through the transmission. The following chart shows the combination of clutches engaged for each forward or reverse speed.

Speed	*Cluches 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 Plug
2 Packing
3 Pin
4 Spring
5 Valve
6 Housing

Figure 3–206. Check valve disassembly.



1 Piston
2 Spring
3 Plates
4 Clutch housing
5 Discs
6 Ring gear

Figure 3–207. Clutch operation.

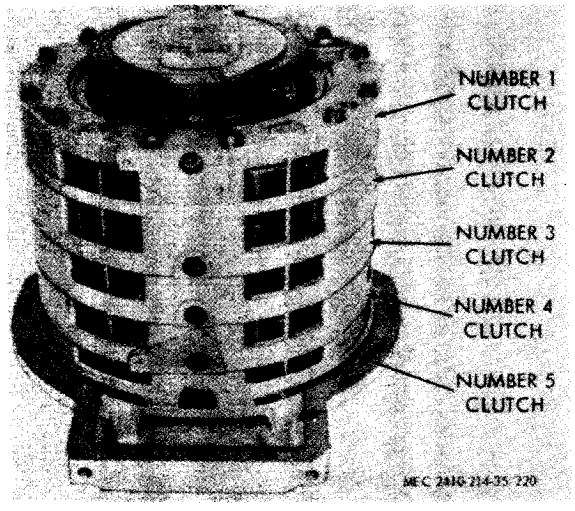


Figure 3–208. Clutch designation.

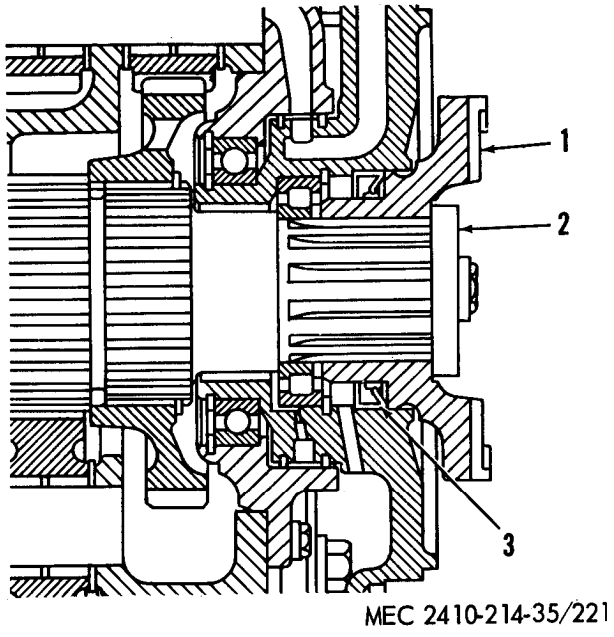
b. Transmission Reconditioning.

(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 3-39).

(b) Remove the bolts, lock and retainer (*(2)*, fig. 3-209) and the flange (1) from the input shaft.



1 Flange
2 Bolts, lock, and retainer
3 Oil seal

Figure 3–209. Preparing to remove imput shaft front oil seal.

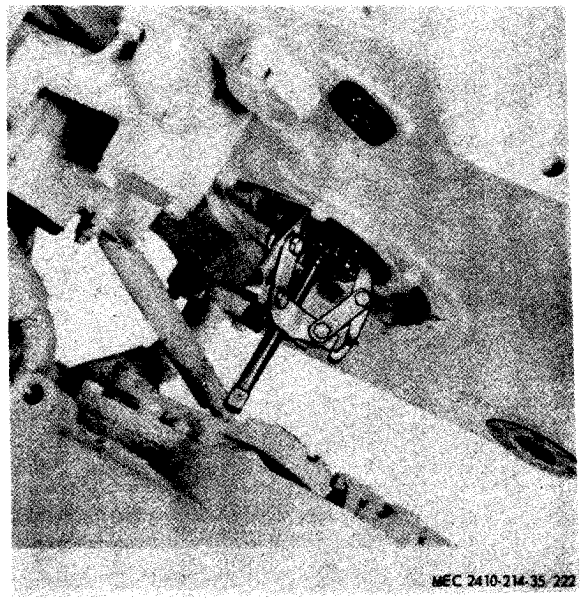


Figure 3–210. Removing input shaft front oil seal.

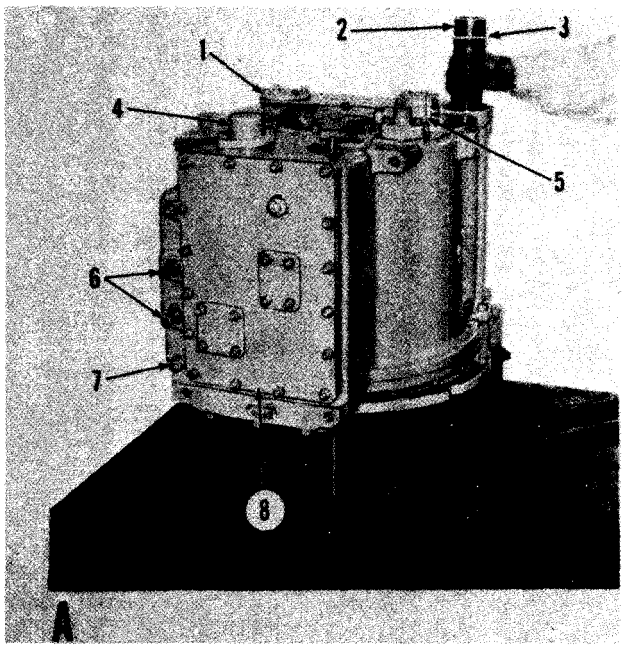
(c) Remove the oil seal (fig. 3-210) using a puller, screw, and step plate.

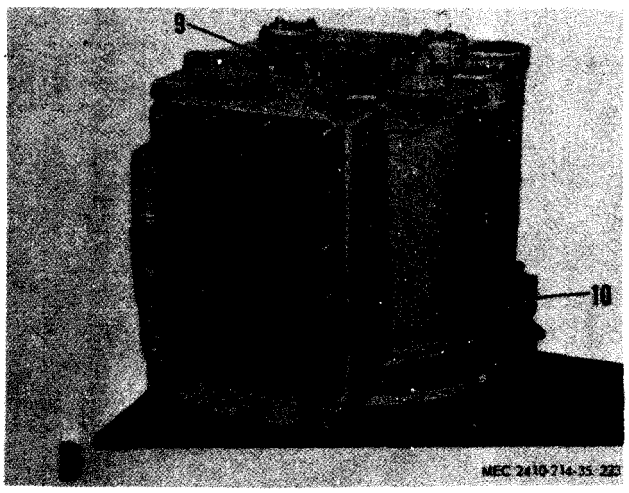
(d) Install the new oil seal with the spring-loaded lip toward the transmission.

(e) Replace the flange, bolts, lock, and retainer in the reverse order of removal.

c. *Transmission Case Removal.*

(1) Position the transmission assembly on end, input end up.





1	Cover	6	Control shafts
2	Tube	7	Nuts and lockwashers
3	O-ring seal	8	Transmission cover
4	Cover	9	Bolts
5	Lubrication valve	10	Nuts and bolts

Figure 3–211. Preparing to remove transmission case.

(2) Remove control levers from shafts ((6), fig. 3–211).

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 preformed packings (3) and preformed packing at. other end of tubes. Replace if damaged

(6) Remove lubrication valve (5) and nuts and lockwashers (7).

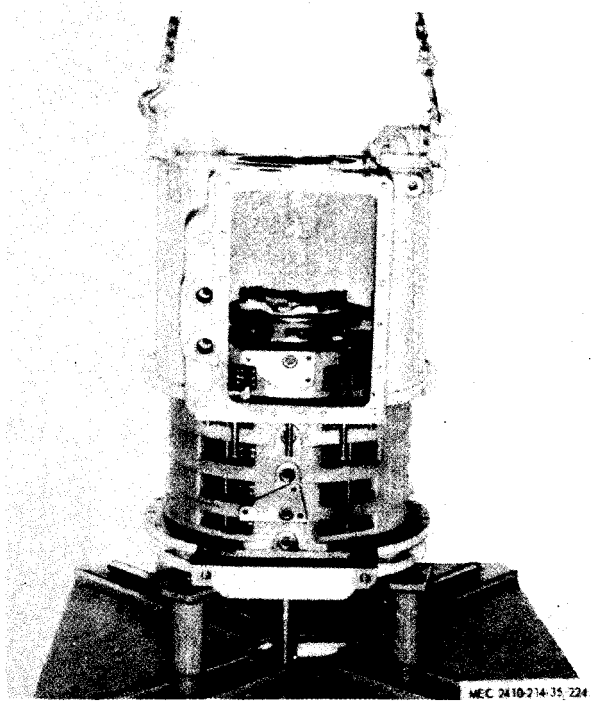


Figure 3–212. Removing transmission case.

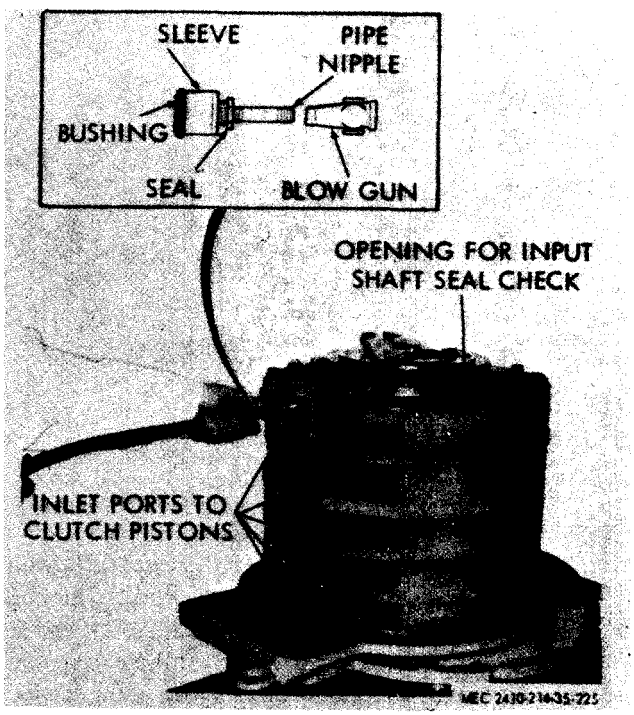
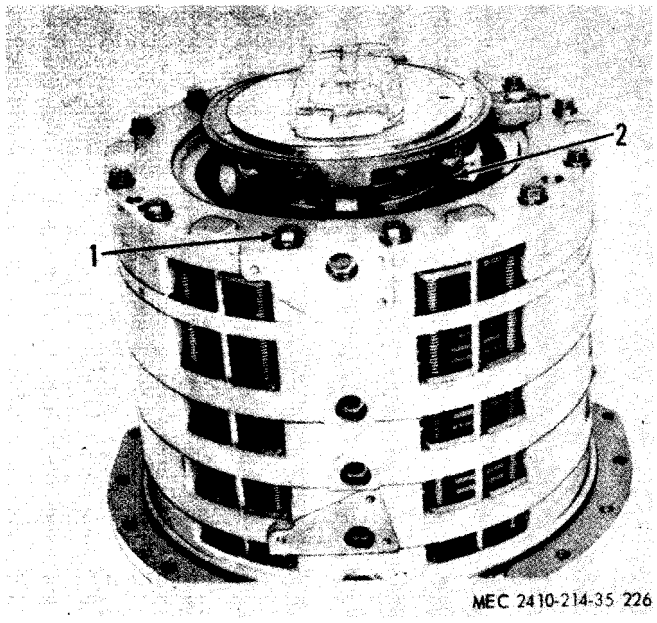


Figure 3–213. Checking clutch operation.

(7) Remove transmission cover (8).

(8) Remove the transmission hydraulic trols (para 3-41).

(9) Remove bolts (9) and nuts and bolts (10).



1 Bolts 2 Cage

Figure 3–214. Preparing to remove input shaft.

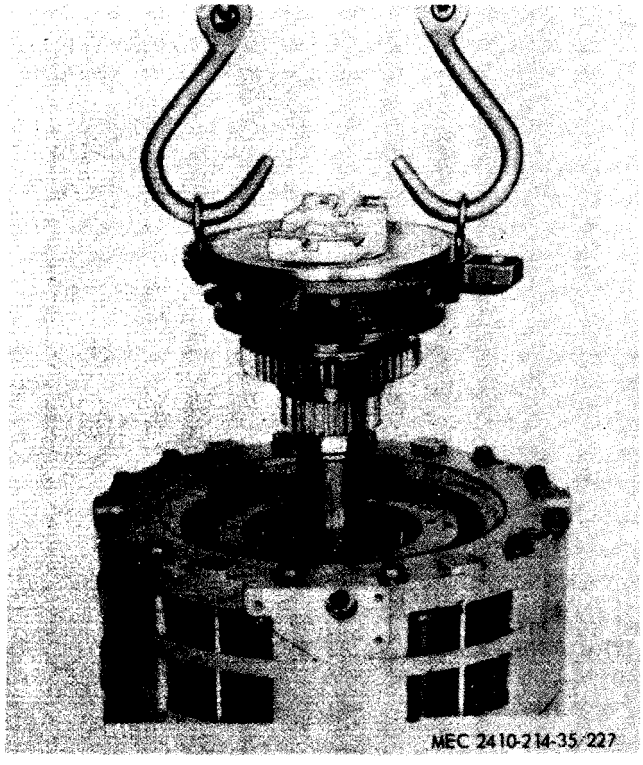
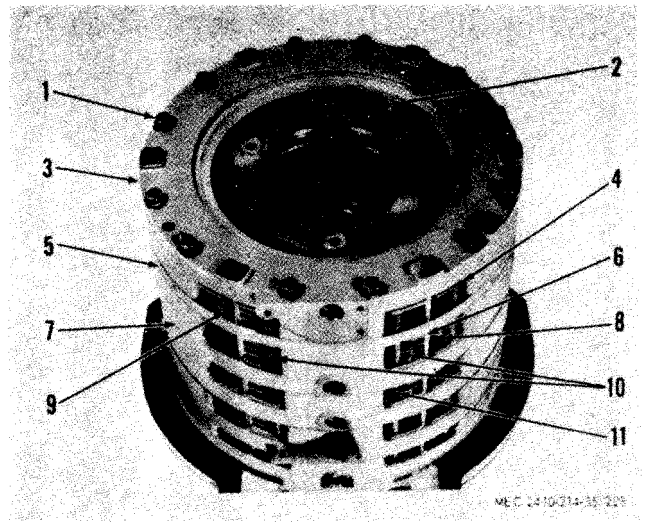


Figure 3–215. Removing input shaft.

(10) Install two 3/4-inch (NC) eyebolts and lift off the transmission case (fig. 3-212).

(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. 3-211) to the torque value given in paragraph **4–4.**



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 3–216. Removal of No. 1 and No. 2 clutch.

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.

(3) The clutch packs can be checked, one at a time, by inserting the tool sleeve into the inlet port as shown in figure 3-213 and injecting air under pressure. If the clutch pistons are operating properly, there should be approximately l/8-inch–1/4-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 3-213 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.

e. Input Shaft Removal and Installation.

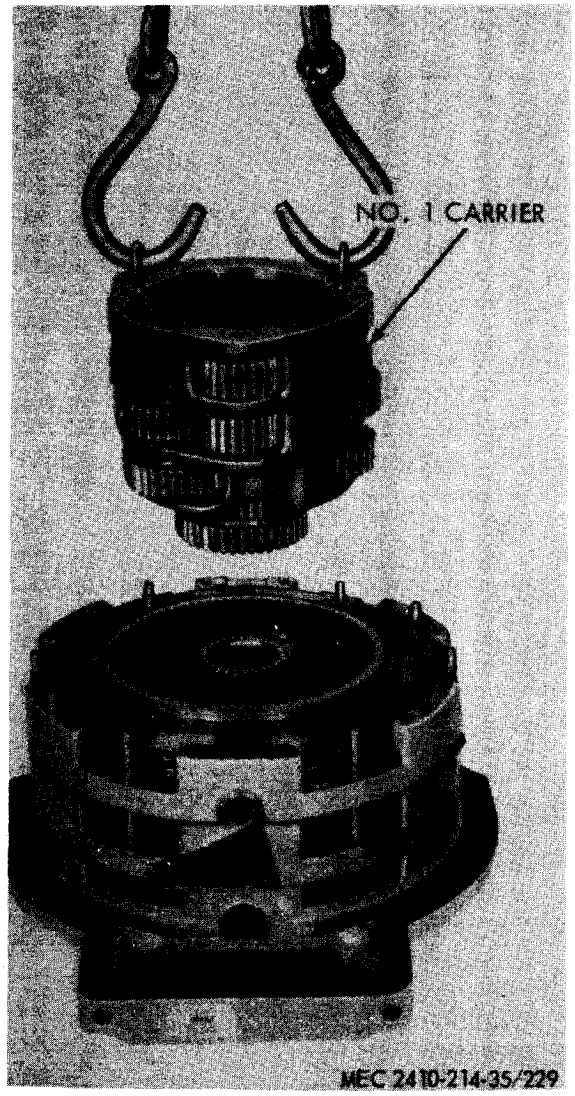


Figure 3–217. Removing No. 1 carrier.

(1) Remove bolts ((1), fig. 3-214) that secure the cage (2) to the No. 1 carrier.

(2) Install two 3/8-inch-16 (NC) eyebolts and lift the input shaft from the transmission (fig. 3-215).

(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 paragraph 1-4.

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.

(l) Remove bolts ((1), fig. 3-216).

Caution: During removal **and installation of the No. 1 clutch housing (3) and piston (4), hold the piston securely inside the clutch housing to prevent if 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 1/2-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.

(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 3/8-inch-16 (NC) eyebolts and remove the No. 1 carrier (fig. 3-217).

(6) Remove bolts, locks, and plates ((1), fig. 3-218) and No. 2 clutch ring gear (2).

(7) Install 1/2-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).

(8) Remove the No. 2 carrier ((1), fig. 3-219 bolts (2), and bolts and locks (3).

(9) Remove bolts and locks ((l), fig. 3-220).

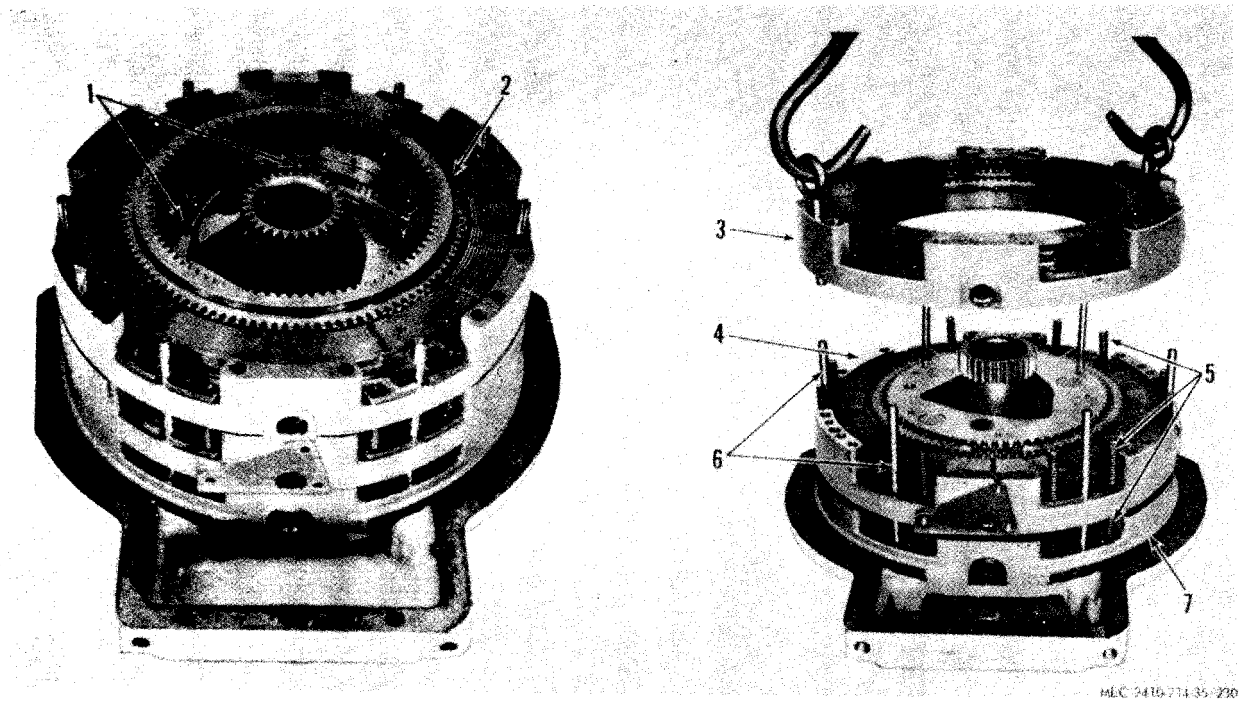
(10) Install 3/8-inch–16 (NC) eyebolts in the tapped holes provided and remove the output shaft (2).

Note. Cover the openings (3) when installing the carriers and clutches to prevent the loss of parts into the transfer gear case.

(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. 3-219) to the torque value listed in paragraph 1-4.

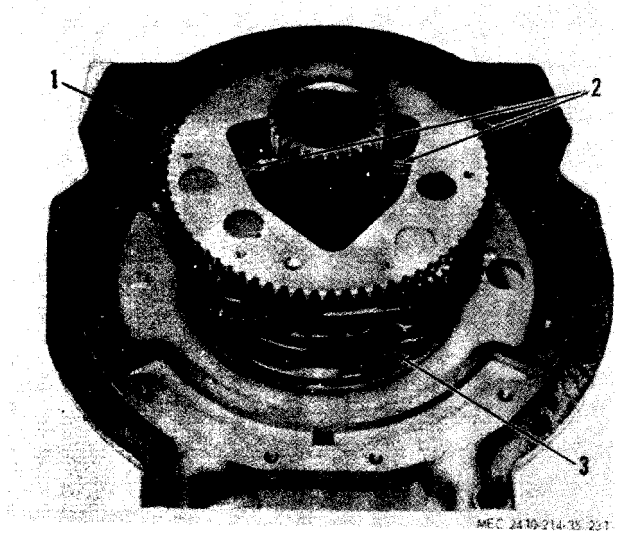
(12) All worn, damaged, or warped clutch plates and disc assemblies should be replaced when installing the clutches.

Caution: **When installing the clutches, install the clutch housing first, then install the ring gear followed by a disc assembly and plate alternately (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**



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 3–218. Removing No. 3 clutch housing



1 No. 2 carrier
2 Bolts
3 Bolts and locks

Figure 3–219. No. 2 carrier removal.

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.

Complete the installation in the reverse order of removal and tighten the clutch housing retaining bolts ((1), fig. 3-216) to the value given in paragraph 1-4.

g. ***Input Shaft Disassembly and Assembly.***

(1) Remove bolts, lock, and retainer ((1), fig. 3-221), and input flange (2).

(2) Slide the bearing cage ((2), fig. 3-222) and bearing cage and oil manifold (3) from the input shaft (1) while removing the ring (4) at the same time.

(3) Remove the oil seal (fig. 3-223) by tapping it from the rear with a small block of wood.

(4) Remove the retainer ring (fig. 3-224).

Note. The oil seal is correctly installed with the spring-loaded lip toward the rear of the transmission.

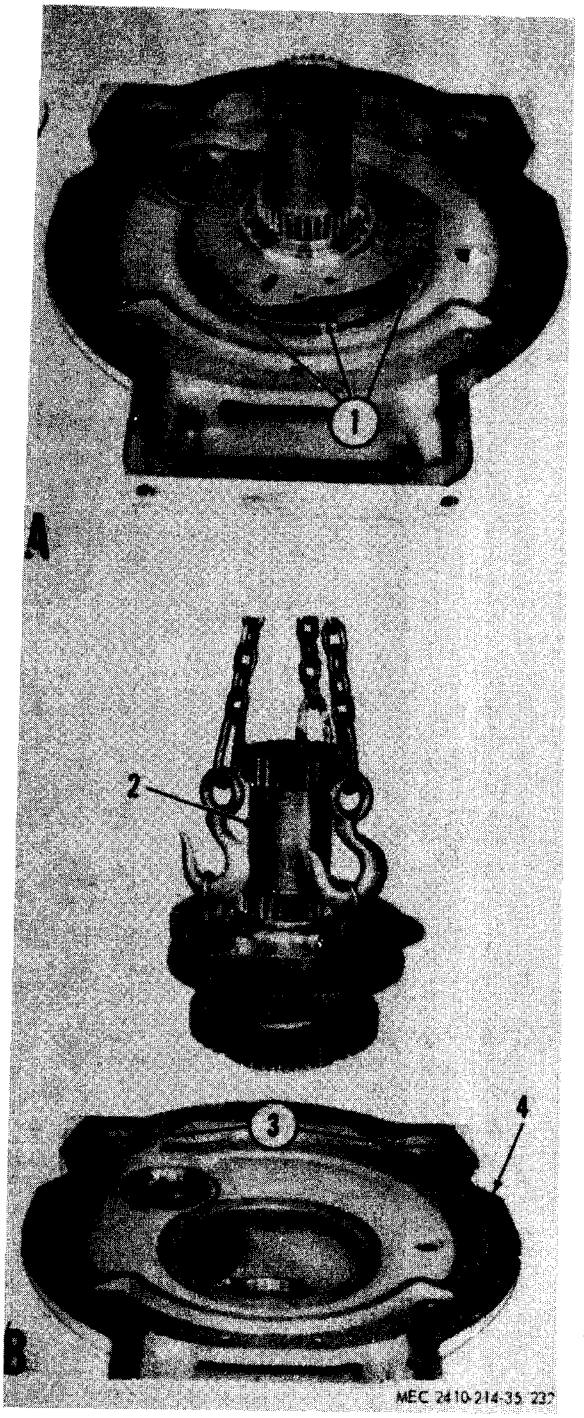
(5) Separate the bearing cage ((1), fig. 3-225) from the bearing cage and oil manifold (2).

(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.

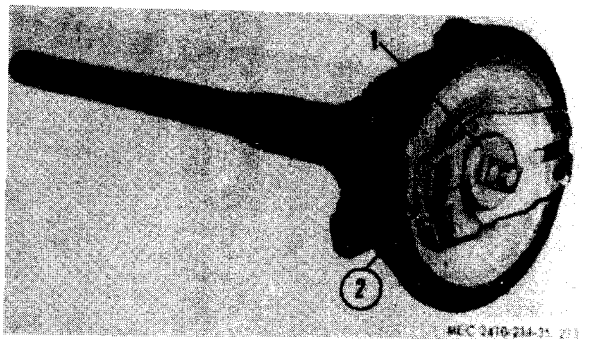
Note. Be sure the seal drain hole (6) is not plugged.

(8) Inspect the bearing (8) for wear or



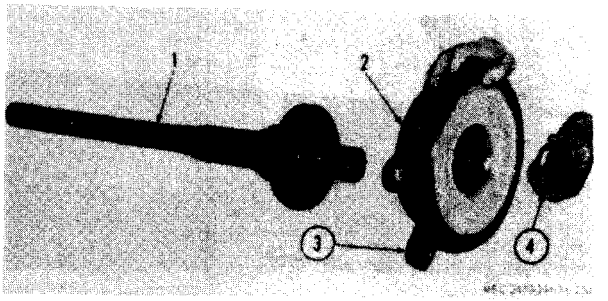
1 Bolts and locks
2 Output shaft
3 Openings
4 Transfer gearcase

Figure 3–220. Removing output shaft.



1 Bolts, lock, and retainer
2 Input flange

Figure 3–221. Preparing to disassembly input shaft.



1 Input shaft
2 Bearing cage
3 Bearing cage and oil manifold
4 Ring

Figure 3–222. Bearing cage removal.



Figure 3–223. Oil seal removal.

damage. If replacement is necessary, remove the Iockring (7) and press out the bearing.

(9) Remove No. 1 sun gear ((1), fig. 3-226) Iockrings (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 bear. ing race using a bearing pulling attachment, a puller and a hydraulic puller.

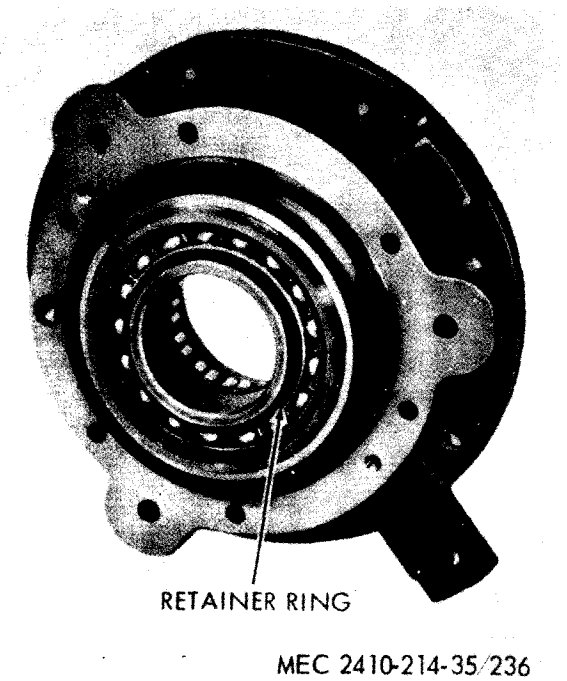


Figure 3–224. Retainer ring removal.

Note. Heat the bearing races (4) and (5) in oil to facilitate their installation. Chilling the bearings ((3) and (8), fig. 3-225) will permit easier installation into the bearing cages.

(12) Assemble the input shaft in the reverse order of disassembly.

h. No. 1 Carrier Disassembly and Assembly.

(1) Position the No. 1 carrier ((4), fig. 3-227) 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 ((l), fig. 3-228) 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.

i. No. 2 *Carrier Disassembly and Assembly.*

(1) Position the No. 2 carrier ((1), fig. 3-229) 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, and 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.

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 as 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. 3-230).

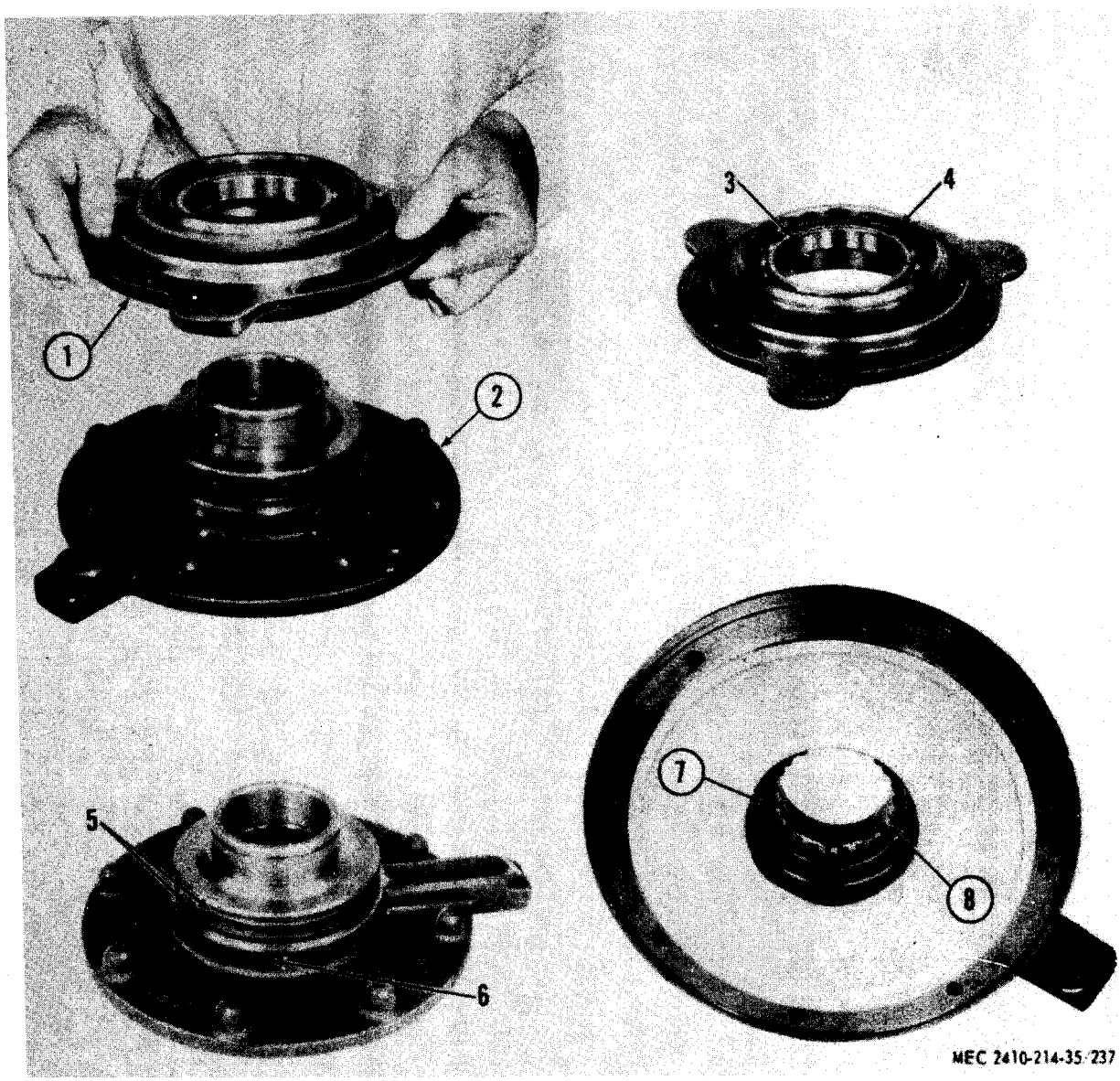
(2) Remove the clutch disc assemblies (2) and plates (3).

(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.**



1 Bearing cage
2 Bearing cage and oil manifold
3 Bearing
4 Lockring
5 Piston ring-type seals
6 Seal drain hold
7 Lockring
8 Bearing

Figure 3–225. Bearing cage disassembly.

k. ***Output*** *Shaft* ***Disassembly and Assembly.***

(1) Remove the retainer ring ((1), fig. 3-**231)** and transfer gear (2).

(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 3-232.

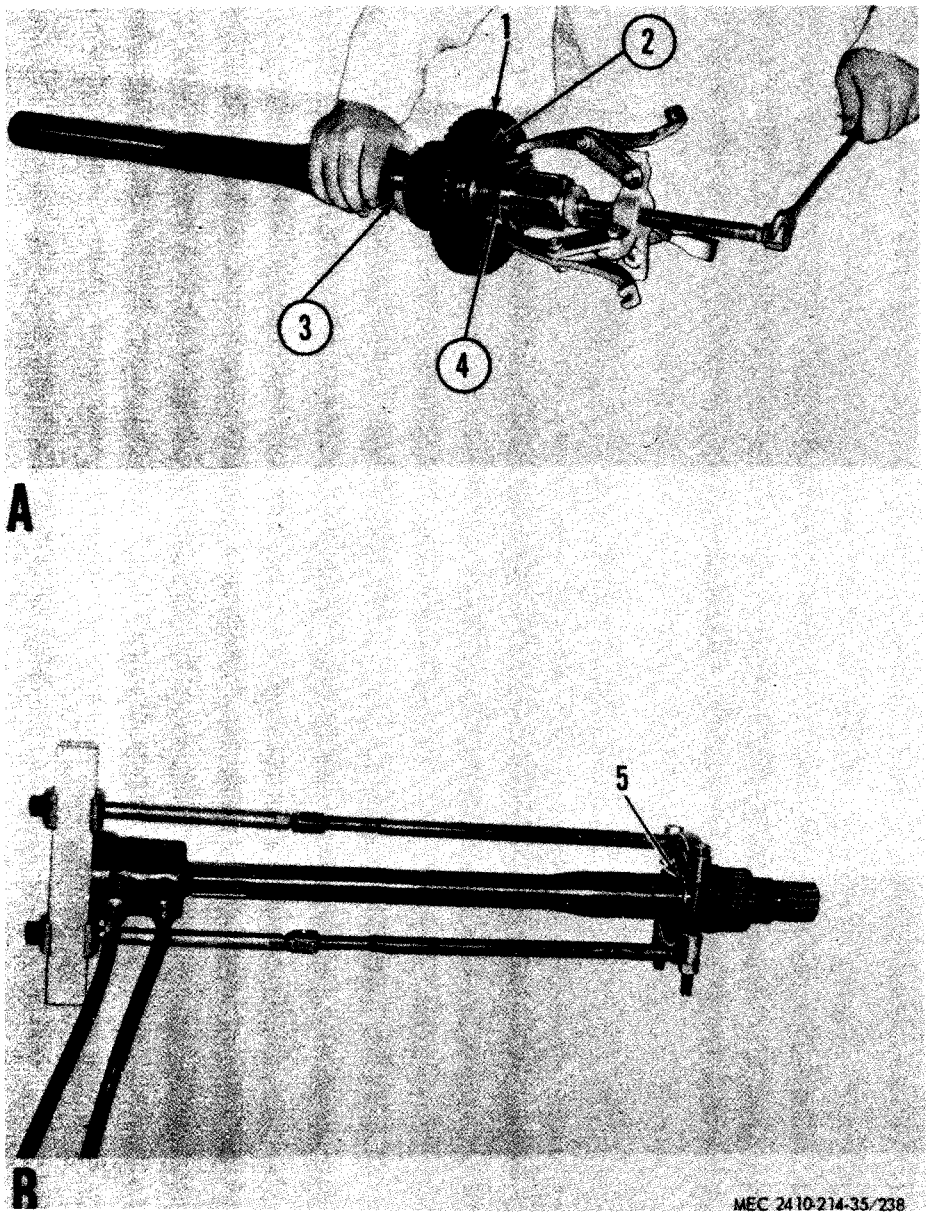
Note. The bearing cage assembly ((3), fig. 3-233) and bearing cage (4) are removed as a unit from the output shaft.

(4) Remove lockring (l).

(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.



1 No. 1 sun gear
2 Lockring
3 Lockring
4 Bearing race
5 Bearing race

Figure 3-226. Bearing race and sun gear removal.

(8) The bearing outer race ((5), fig. 3-231) in the bearing cage assembly (3) can be removed if necessary, after removing the plug ((6), fig. 3-233) and the dowel under the plug.

(9) Assemble the output shaft in the reverse order of disassembly.

1. 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 2-6).

(2) Remove bolts ((1), fig. 3-234) 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).

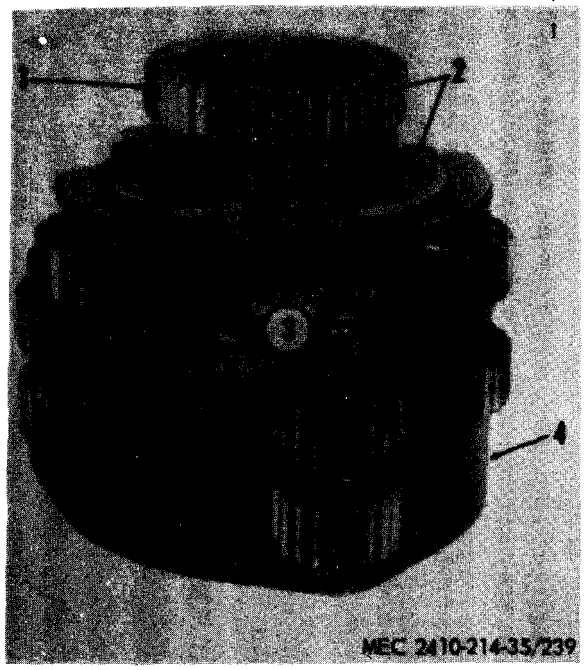
(4) Refer to figure **3-234** and remove the transfer gear case cover with a hoist as shown.

(5) Remove plate ((1), fig. 3-235) bolts (2), and lock (3).

(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).



1 No. 4 sun gear
2 Bolts and locks
3 Plates
4 No. 1 carrier

Figure 3-227. No. 4 sun gear removal.

(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. 3-236), and the dowels beneath the plugs, then remove the bearing outer races (1) and (2).

3-47. 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.

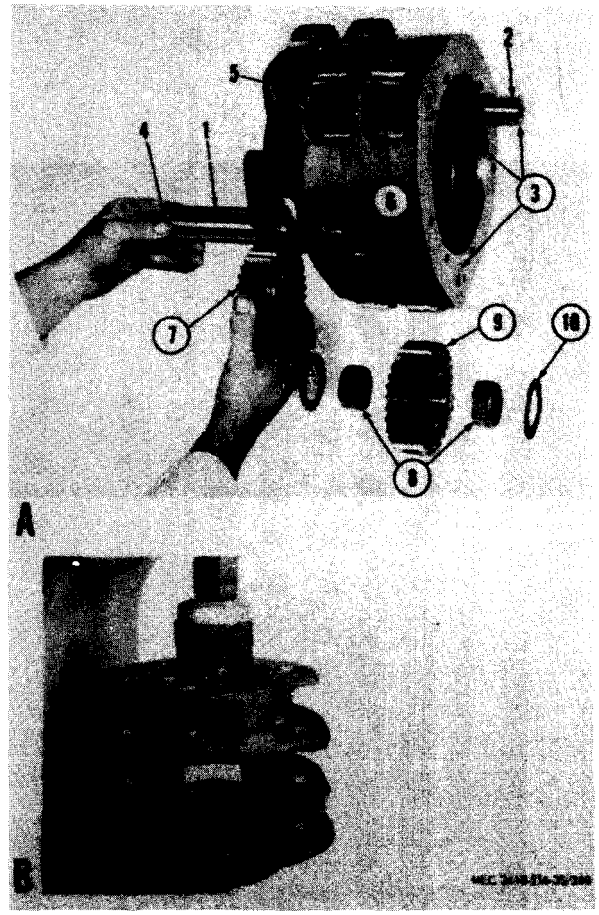
(2) Refer to TM 5-2410-214-12 and drain the transmission lubrication system.

(3) Disconnect the junction block outlet line (fig. 3-237) 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.



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

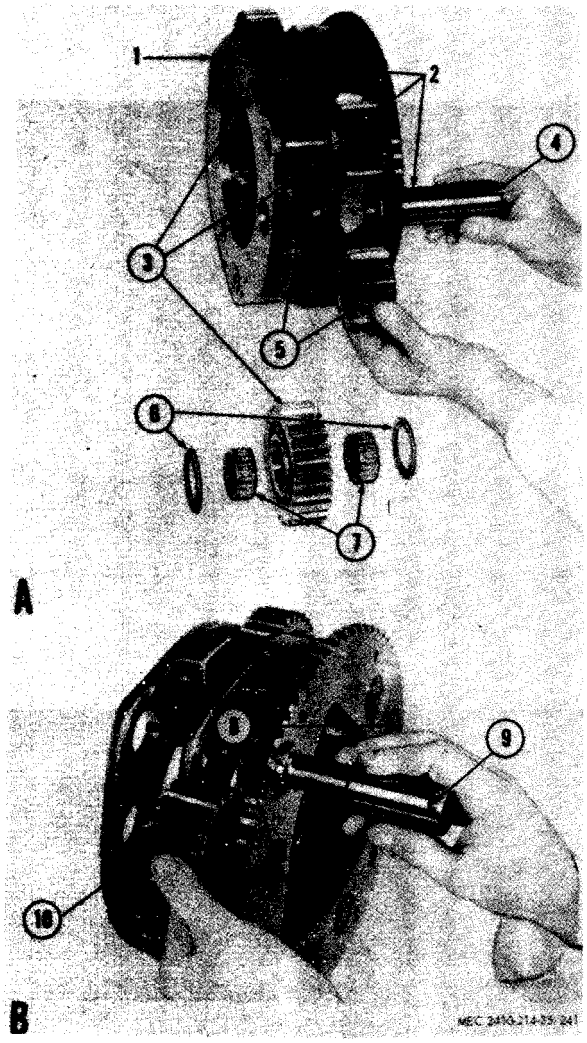
Figure 3-228. No. 1 carrier disassembly.

(6) Install in the reverse order of removal.

3-48. Transmission Hydraulic System Testing and Adjustment

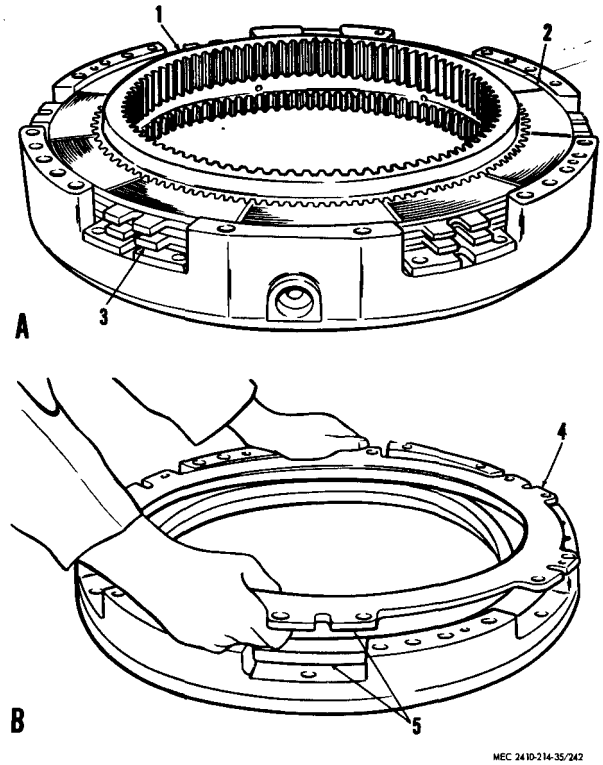
a. General. The hydraulic control system oil supply (fig. 3-238 is common to the entire system. Tests and adjustments can be performed using individual pressure gages or a hydraulic test box. All pressure taps use ⅛-inch—27 NPT plugs except tap (I) on the junction block. Use an adapter when making connections to the pressure tap (1).

***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 625 rpm and 1315 rpm respectively. It is important that the transmission hydraulic control linkage is properly adjusted before making any**



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

Figure 3-229. No. 2 carrier disassembly.



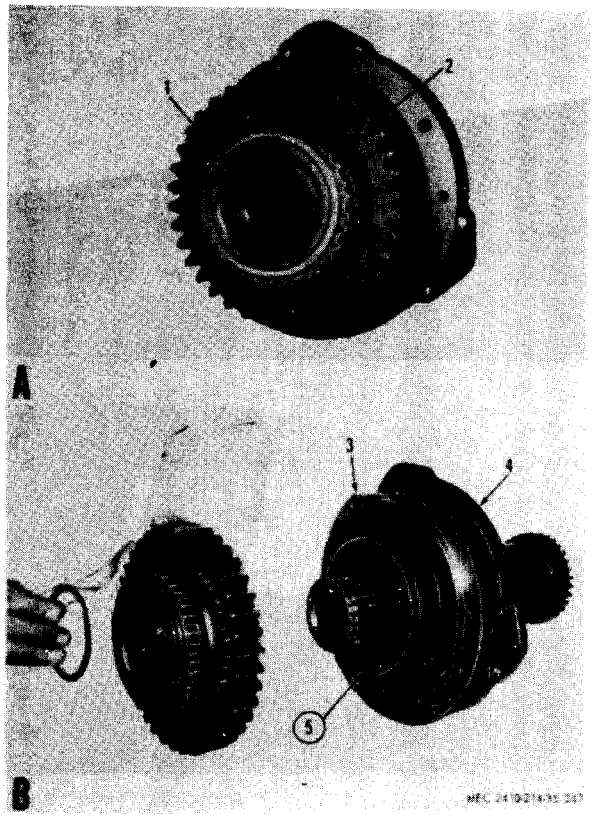
1 Ring gear
2 Disc assembly
3 Plate
4 Piston
5 Piston rings

Figure 3-230. Clutch disassembly.

tests. Refer to paragraph 3-41 for linkage adjustments.

b. Steering Clutch Control Tests. Refer to table 3-1 and figure 3-238 to make necessary tests.

c. Transmission and Torque Converter Hydraulic Controls Tests. Refer to table 3-2 and figure 3-238 to make necessary tests.



1 Retainer ring
2 Transfer gear
3 Bearing cage assembly
4 Bearing cage
5 Bearing outer race

Figure 3-231. Transfer gear removal.

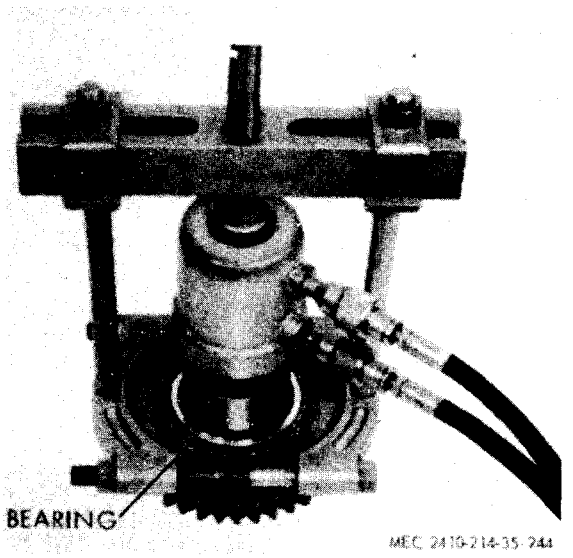
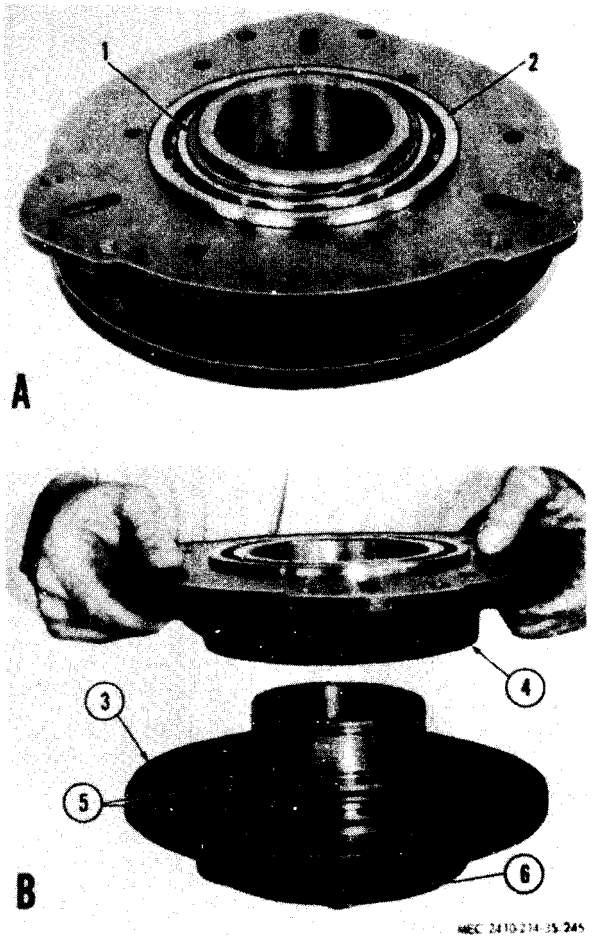


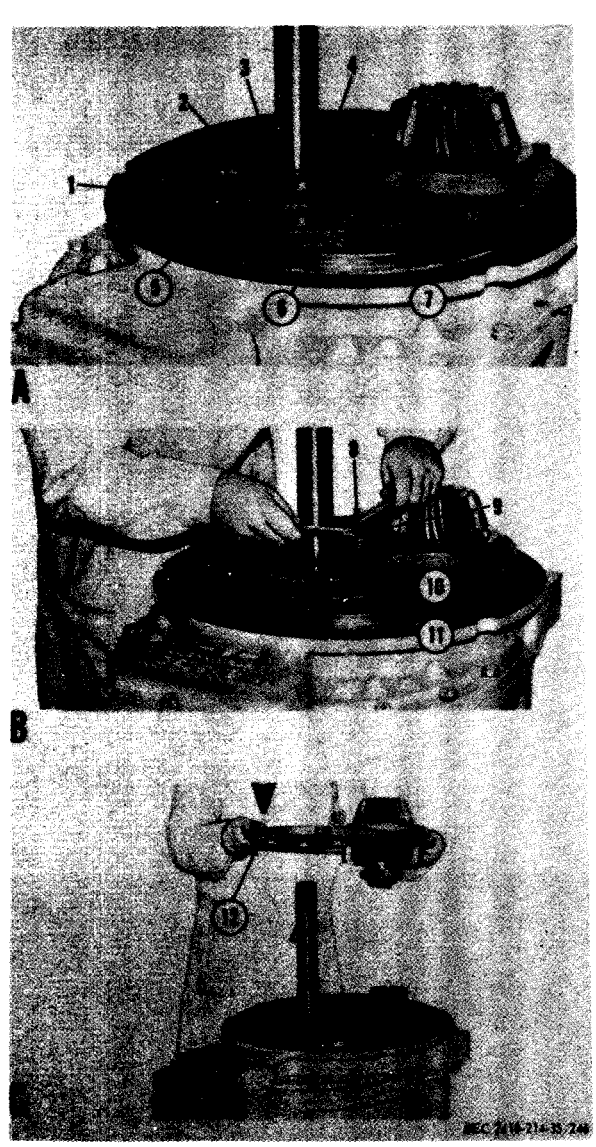
Figure 3-232. Removing transfer gear outer bearings.



1 Lockring
2 Bearing
3 Bearing cage assembly
4 Bearing cage
5 Piston ring-type seals
6 Plug

Figure 3-233. Separating cages.

Note. For tractors with serial numbers 75E1301 and up, refer to tables 3-3 and 3-4 for steering clutch control tests, and transmission and torque converter hydraulic control tests.

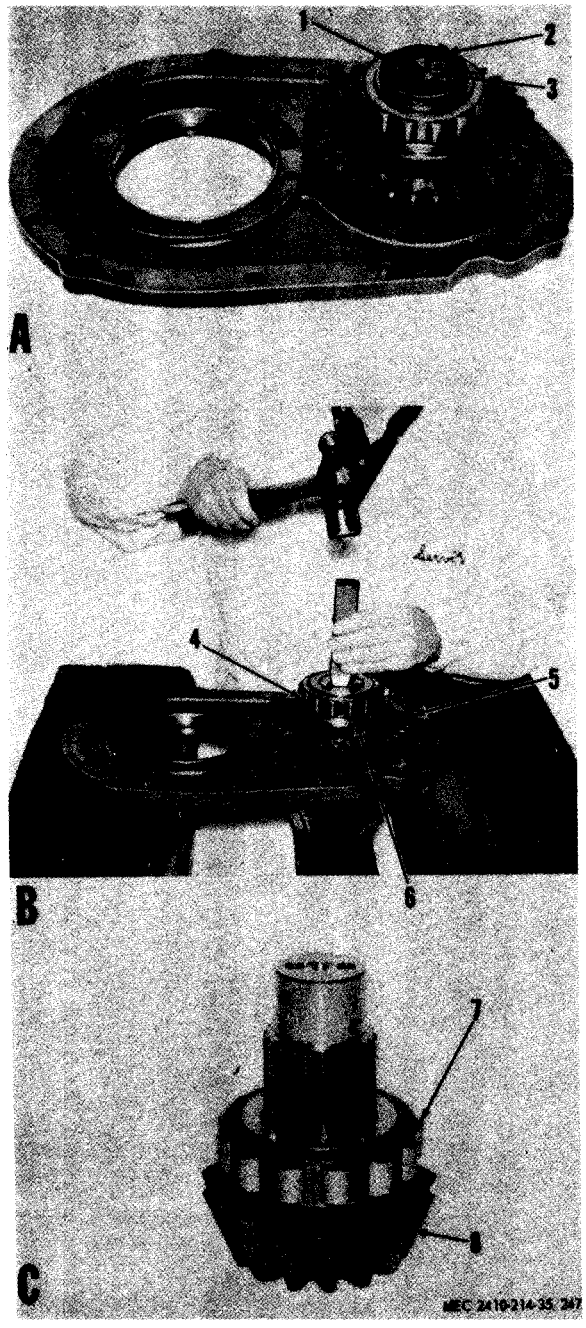


1 Bolts
2 Bolts and locks
3 Lockring
4 Bearing
5 Cage
6 Dowels
7 Locks
8 3/8 in–16 NC forcing screws
9 Nut
10 Washer
11 2 in. length of 3/4 in. id pipe
12 Transfer gear case cover

Figure 3–234. Removing cover.

Table 3–1. Steering Clutch Control Tests

Pressure	*Location*	*Value*
Steering clutch pistons (steering clutches disengaged and engine at low idle).	A–F	265–300 psi
Hydraulic pump (steering clutches disengaged and engine at low idle).	J	285–315 psi



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

Figure 3–235. Removing bevel pinion.



1 Transfer gear bearing outer race
2 Bevel pinion shaft bearing outer race
3 Plug
4 Plug

Figure 3–236. Bearing outer race removal.

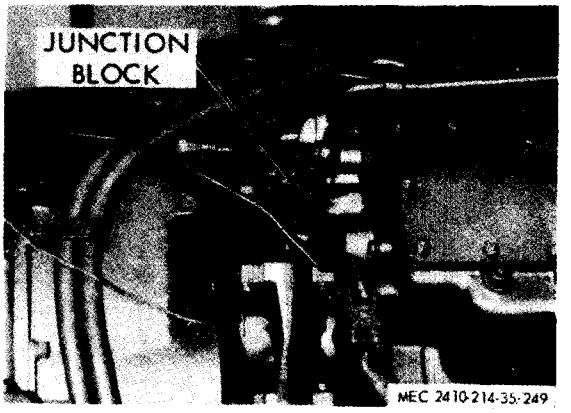


Figure 3–237. Junction block removal.

A
1 Left steering clutch oil pressure tap
2 Steering clutch hydraulic control
3 Right steering clutch oil pressure tap

B
1 Oil pump (transmission and steering clutch)
2 Oil pump pressure tap

C
1 Transmission pressure control valve
2 Speed clutch pressure tap
3 Direction clutch high and low pressure tap
4 Transmission case
5 Transmission oil pump pressure tap
6 Transmission lubricating oil pressure tap
7 Check valve dump port tap
8 Torque converter inlet relief valve pressure tap
9 Torque converter inlet relief valve

D
1 Torque converter inlet relief valve
2 Pressure tap

***Figure 3–238*—Continued.**

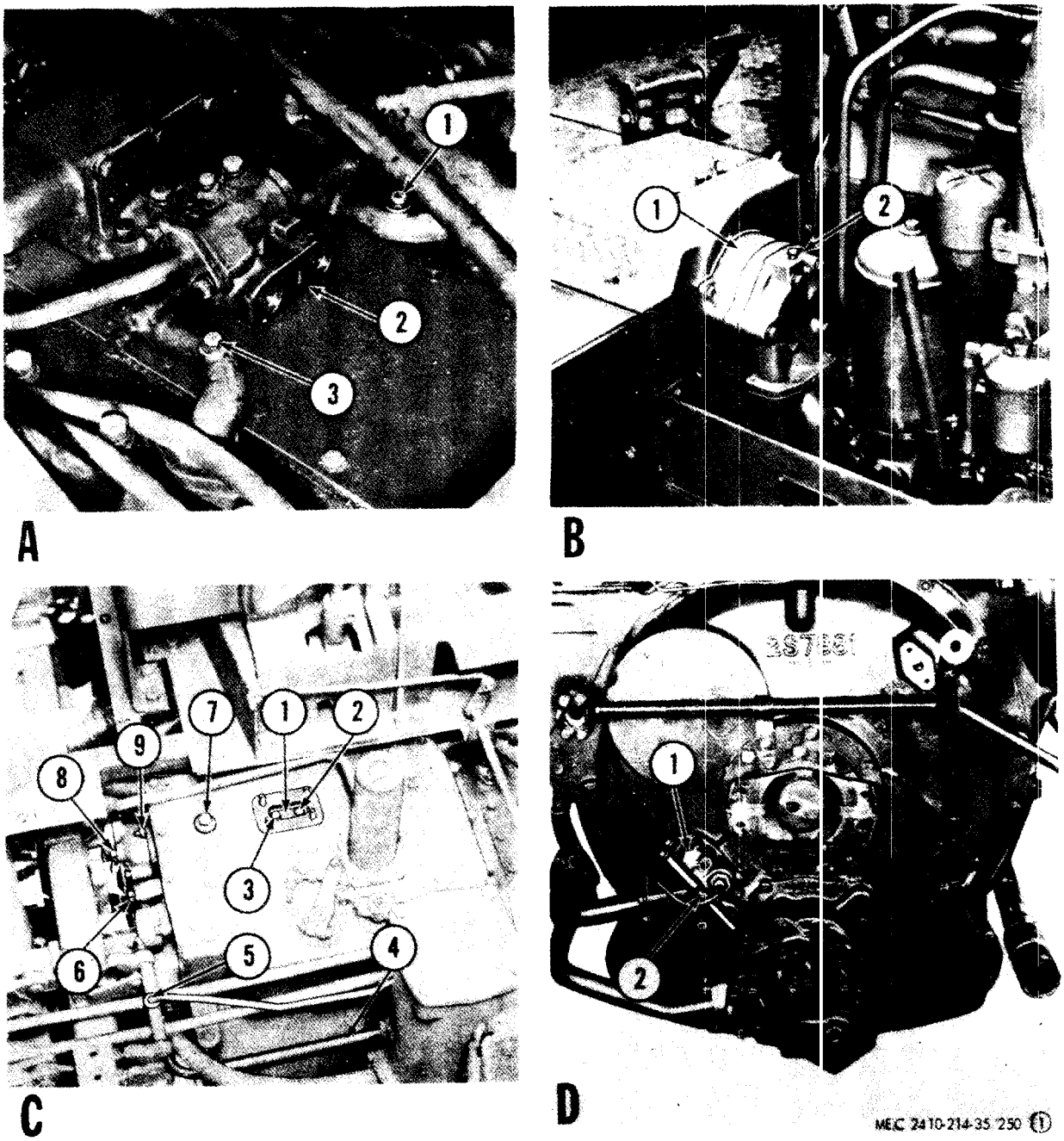
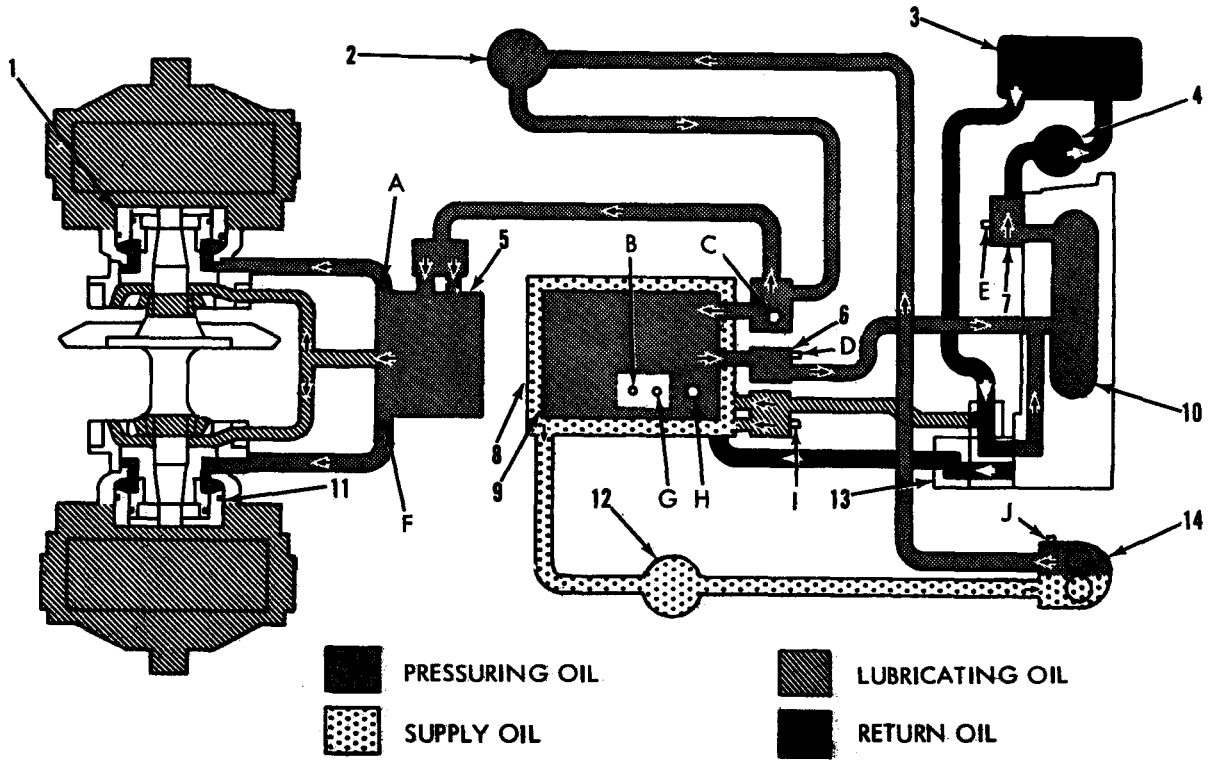


Figure 3-238. Hydraulic control system.



MEC 2410-214-35/250 (2)

1 Left steering clutch piston
2 Oil filter
3 Oil cooler
4 Magnetic strainer
5 Steering clutch hydraulic control
6 Torque converter inlet relief valve
7 Torque converter outlet relief valve
8 Transmission case
9 Transmission pressure control valve
10 Torque converter
11 Right steering clutch piston
12 Magnetic strainer
13 Scavenge and circulating pump
14 Oil pump (transmission and steering clutch)
A—Left steering clutch oil pressure tap
B—Speed clutch pressure tap
C—Transmission oil pump pressure tap
D—Torque converter inlet relief valve pressure tap
E—Torque converter outlet relief valve pressure tap
F—Right steering clutch oil pressure tap
G—Directional clutch high and low pressure tap
H—Check valve dump poet tap
I—Transmission lubricating oil pressure tap
J—Oil pump pressure tap

Figure 3–238—**Continued.**

Table 3-2. Transmission and Torque Converter Hydraulic Control Tests

Pressure	Location	Value	Adjustment
transmission oil pump (engine at high idle and transmission selector lever in neutral).	B	285-315 psi	Established by initial relief valve setting.
Directional clutch (engine at low idle speed and clutch engaged).	G	Initial setting, 30-36 psi (to be made with check valve blocked using brass rod through dump port and hole for plug D).	Add or remove spacers from pressure modulating relief valve. Adding 5M9622 Spacer adds 15psi.5M9623 Spacer adds 8.5 psi. 5M9624 Spacer adds 2.5 psi.
Speed clutch (engine at high idle speed and clutch engaged).	B	285–315 psi	Established by initial relief valve setting.
Directional clutch (engine at high idle speed and clutch engaged).	G	50–60 psi less than speed clutch pressure reading.	None.
Transmission lubrication junction block (at engine high idle speed).	I	14–16 psi	None.
Torque converter outlet relief valve (with engine at high idle speed and brakes locked, move transmission selector lever to third range. When converter is at stall speed take reading. Engine speed at torque converter stall is 930–1060 rpm.	E	37–47 psi .	Add or remove washers from valve. Adding 4B5270 Washers adds 6 psi.
Torque converter inlet relief valve (to be only bench tested and set).	----	110–120 psi _____	Add or remove spacers. Adding 7M1397 Spacer adds 9 psi. Adding 7M1396 Spacer adds 5 psi.

Table 3-3. Steering Clutch Control Tests
(Serial Nos. 7'5E1301-UP)

Pressure	Location	Value
Steering clutch pistons (steering clutches disengaged and engine at low idle).	A-F	250–280 psi
Hydraulic oil pump (engine at high idle).	J	310-330 psi
Hydraulic pump (steering clutches disengaged and engine at low idle).	J	275-psi min

Table 3–4. Transmission and Torque Converter Hydraulic Control Test (Serial Nos. 75E1301–UP)

Pressure	Location	Value	Adjustment
Transmission oil pump (engine at high idle and transmission selector lever in neutral).	J	310–330 psi	None.
Speed clutch (engine at high idle speed and clutch engaged).	B	300–330 psi	Add or remove spacers (5M9622, 5M9623, 5M9624) located inside piston in the pressure control valve assembly. Spacer — Change in psi 5M9622 — 15.0 5M9623 — 8.5 5M9624 — 2.5
Directional clutch (engine at high idle speed and clutch engaged).	G	50–60 psi less than speed clutch pressure reading.	None.
Transmission lubrication junction block (at engine high idle speed).	I	9–15 psi	None.
Torque converter 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.	E	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 converter may have to be disassembled and the causes for loss of efficiency determined.
Torque converter inlet relief valve (to be only bench tested and set).	D	109–121 psi	Attach pressure gage at top (E) and a pressure oil line to inlet port. Supply oil at a rate of 4–6 GPM to the inlet port. Add or remove spacers located inside valve spool to maintain correct pressure while bypassing the 4–6 GPM through the outlet port. Adding spacer (7M-1397) adds 9 psi, and spacer (5M-3492) adds 5 psi.

Section VIII. STEERING CLUTCHES, BRAKES AND BEVEL GEAR

3-49. General

This section contains. information on the brakes, steering clutches, steering clutch hydraulic controls, and bevel gear.

3-50. 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. 3-239). 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 brake This will prevent damage to the ratchet teeth or the pawl.**

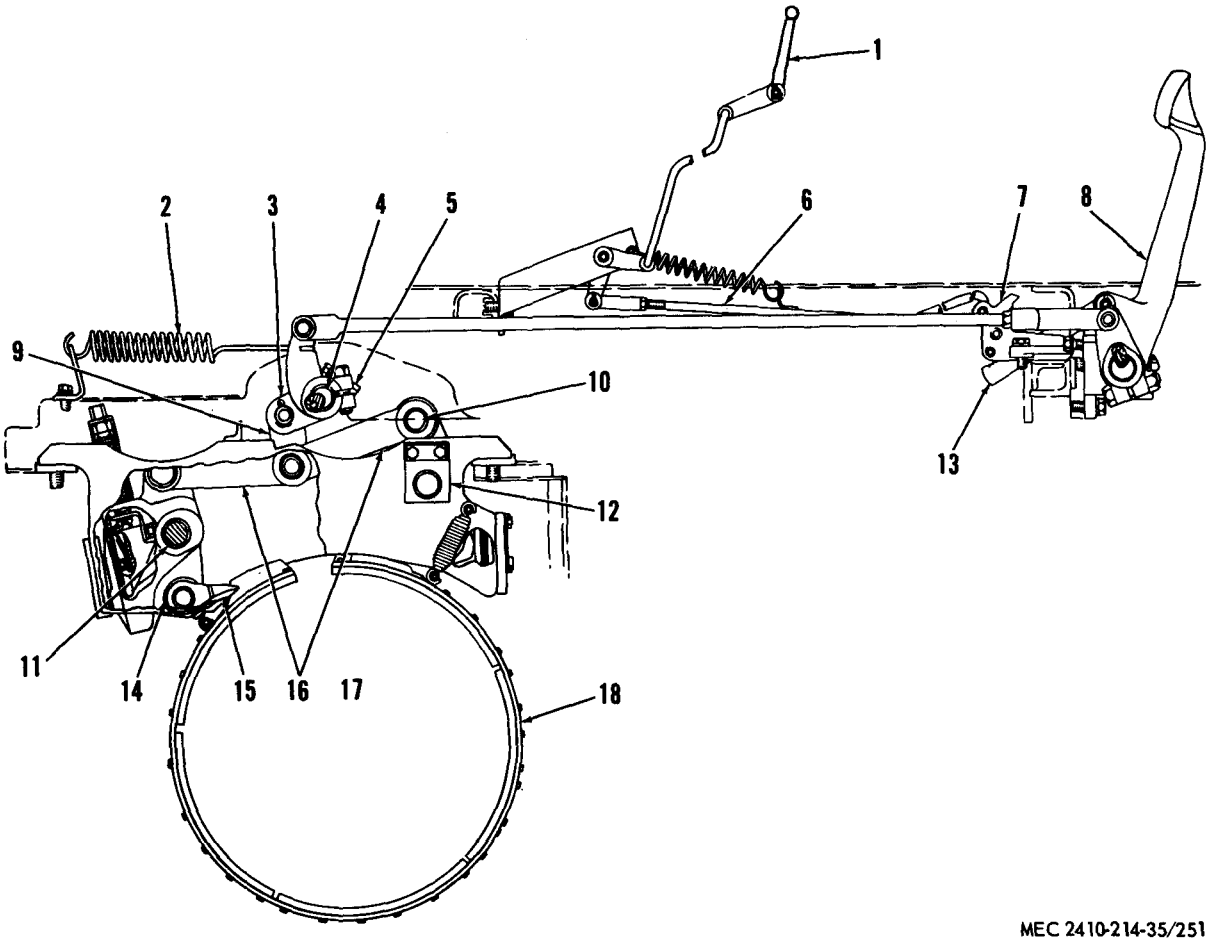
b. Removal and Installation.

(1) Remove the fuel tank (para 3-24).

(2) Remove -rear support (1), fig. 3-240).

(3) Remove bolts (3) and cover (2).

(4) Disconnect the brake rod attached to the brake control lever (4).



1	Parking brake lever	10	Brake lever assembly
2	Spring	11	Brake lever shaft
3	Brake lever	12	Brake lever shaft
4	Brake shaft	13	Ratchet
5	Brake control lever	14	Brake strut support lever assembly
6	Parking brake linkage	15	Brake band strut
7	Brake lock pawl	16	Brake toggle link
8	Brake pedal	17	Brake band strut
9	Brake link	18	Brake band

Figure 3–239. Brake operation.

(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. 3-241 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 d below.

(10) Tighten bolts ((9), fig. 3-240) securing steering clutch cover (5) to the bevel gear case, to 100 ± 5 lb-ft.

c. ***Disassembly and Reassembly.***

(1) Remove the adjusting screw socket assembly ((2), fig. 3-242).

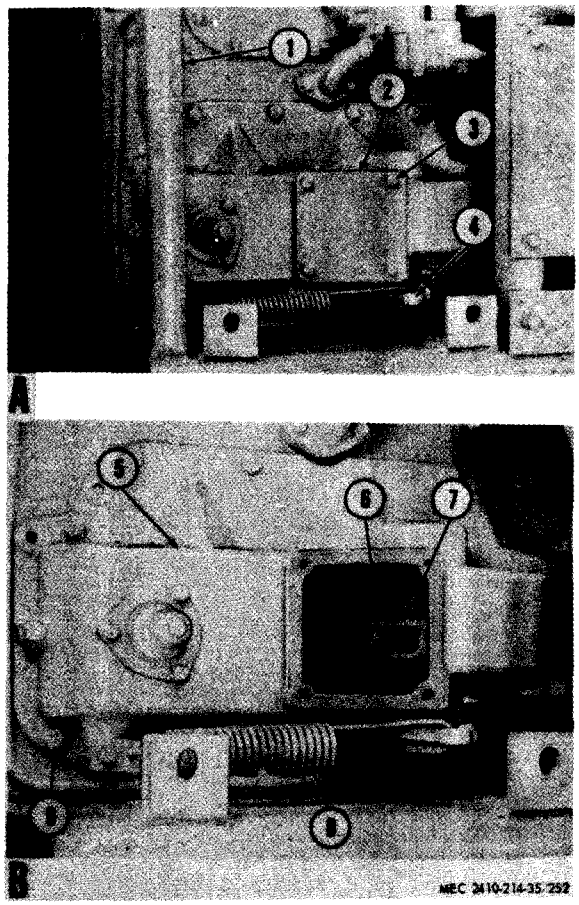
(1) Remove brake lever 8haft (1) which joins the brake lever (17) and the brake strut support assembly (13) and secures them to the brake linkage support assembly (3).

(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).

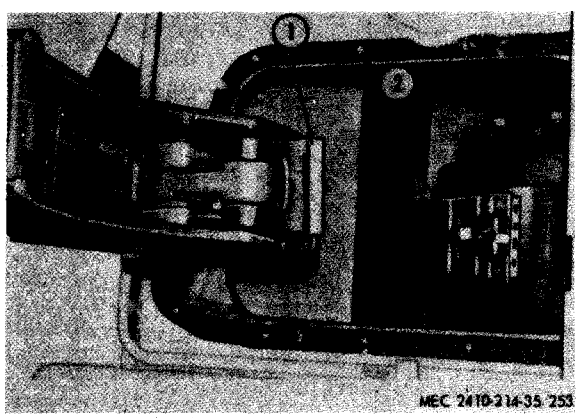
(5) Remove brake toggle link (9) and front brake lever assembly (12) as a unit.

(6) Guide the links (8) between the two



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 3-240. Preparing to remove brake engaging mechanism.



1 Strut
2 Lug

Figure 3-241. Brake engaging mechanism removed.

support assembly braces, and lift off the support assembly (3).

(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. 3-243 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 to facilitate all bearing removal and installation.

(11) Place adjusting screw ((1), fig. 3-244) in as low a position as is necessary to remove wedge support (4) and brake adjustment wedge (5).

(15) 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. 3-245 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.

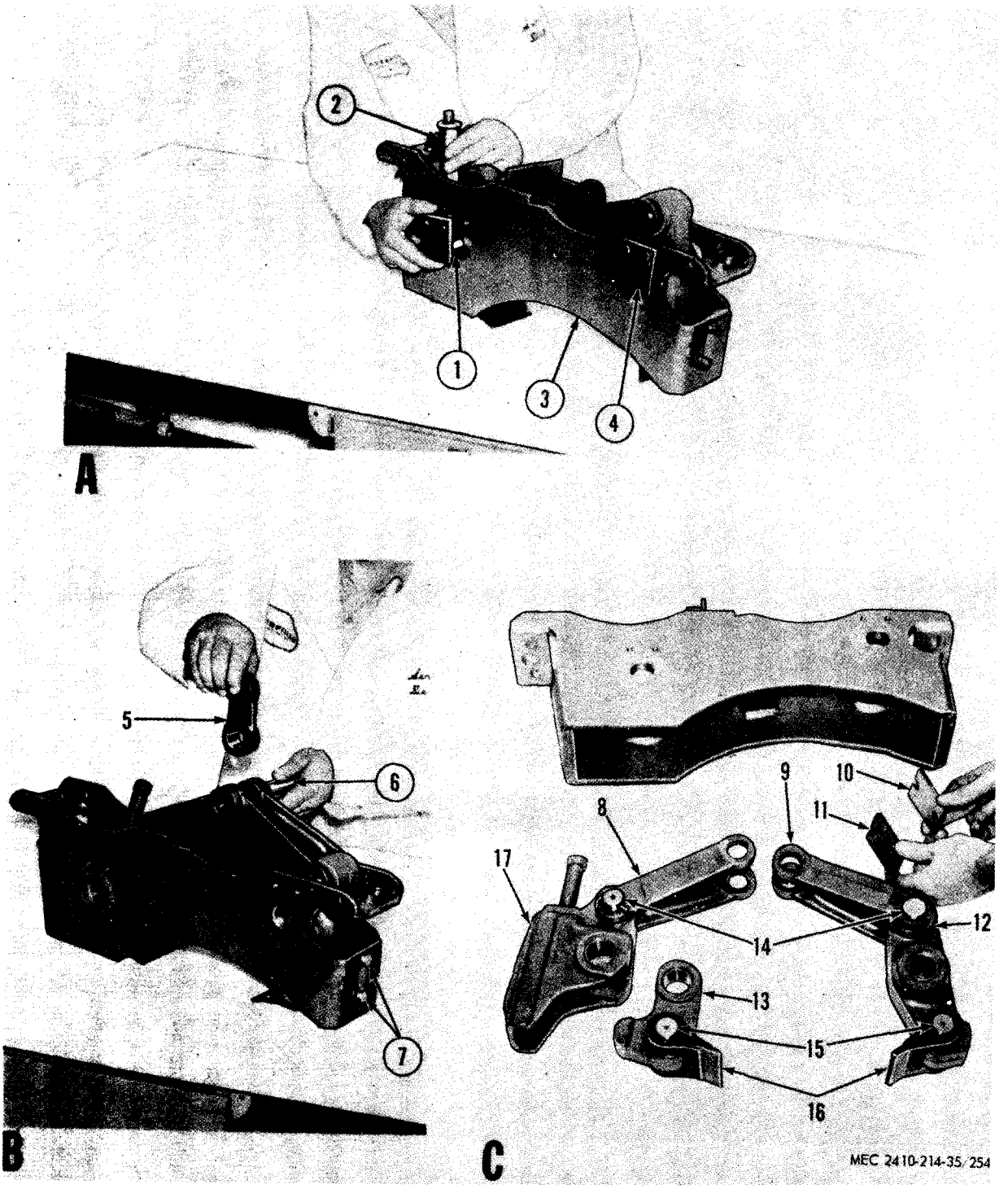
Note. A suitable drift pin can be used to facilitate needle bearing removal and installation, after removing the plug (9). Drive in the new needle bearings from the stamped end to the dimensions show. Fill the needle bearing compartments with an approved ball and roller bearing lubricant. Stake the plug (9) in three places to secure it to the steering clutch cover at assembly.

(17) Inspect the oil seal (4) for damage. Replace if necessary.

Note. Install the seal with the lip away from the needle bearing (12). Before installation, lubricate the lip with an approved ball and roller bearing lubricant. Assemble seal to the shoulder at the bottom of the counterbore.

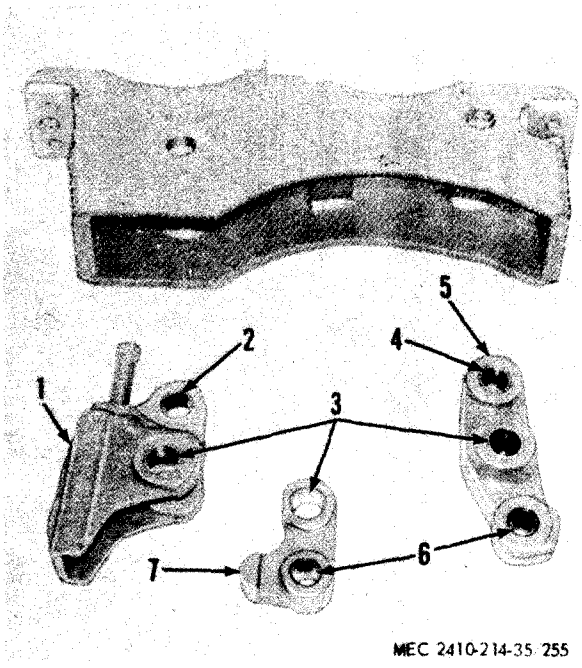
Inspect the Washers (3) and (11) for damage **or** excessive wear. Replace if necessary.

(18) Reassemble in reverse order of disassembly.



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 3–242. Brake engaging mechanism disassembly.



1 Brake lever
2 Bearing
3 Bearings (5)
4 Bearings (2)
5 Brake lever
6 Bearings (2)
7 Strut support

Figure 3–243. Brake lever bearings.

Note. Refer to ***d*** below for adjustment of brake engaging mechanism prior to installation in the steering clutch and bevel gear case.

d. ***Adjustment.***

(1) Install a wood block as shown in figure 3-246 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.

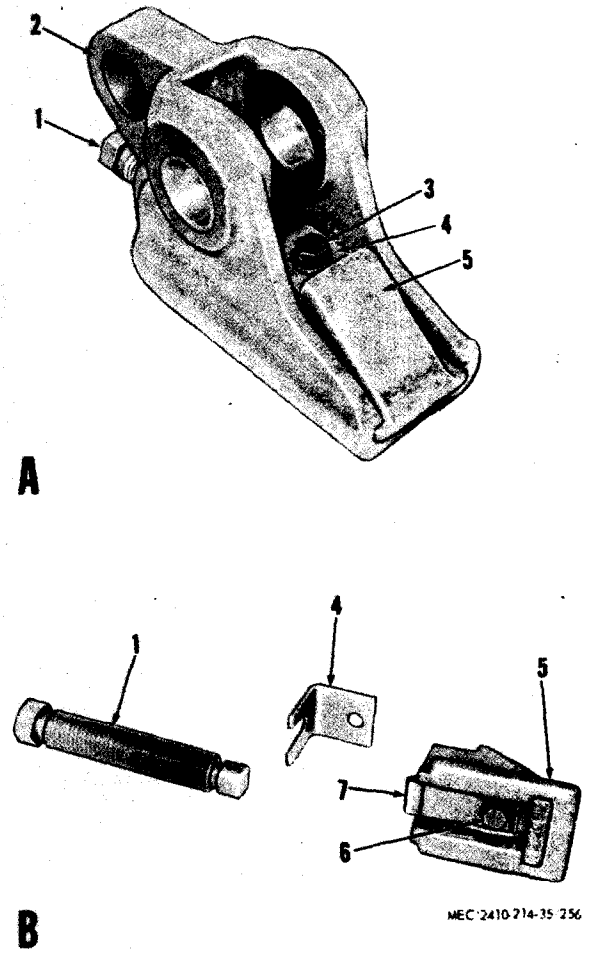
(4) Add or remove shims behind the stop to obtain a distance "A" of 0.71-inch to 0.75-inch.

(5) Install the support assembly in the steering clutch and bevel gear case (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 the number of turns given in paragraph 1-4.

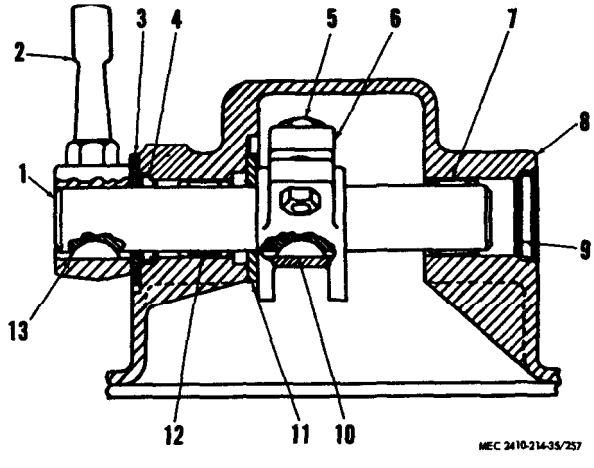
(7) Install the remaining brake linkage.

(8) The parking brake lever ((1), fig. 3-247) 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



1 Adjusting screw
2 Brake lever
3 Bolt
4 Wedge support
5 Adjusting wedge
6 Bolt
7 Adjusting wedge spring

Figure 3–244. 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 3–245. Disassembling clutch cover brake linkage.

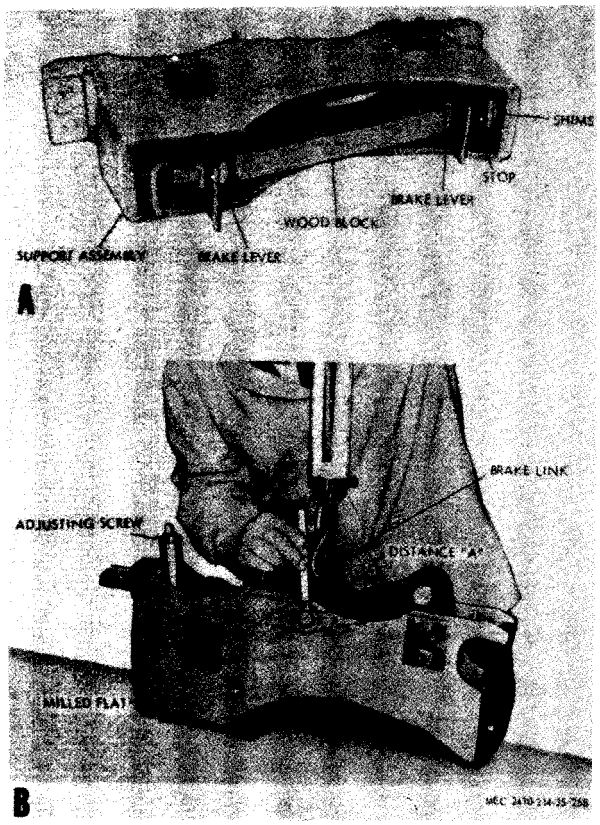
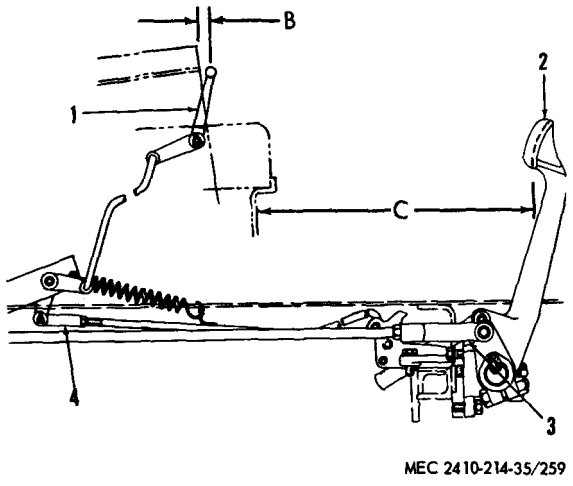


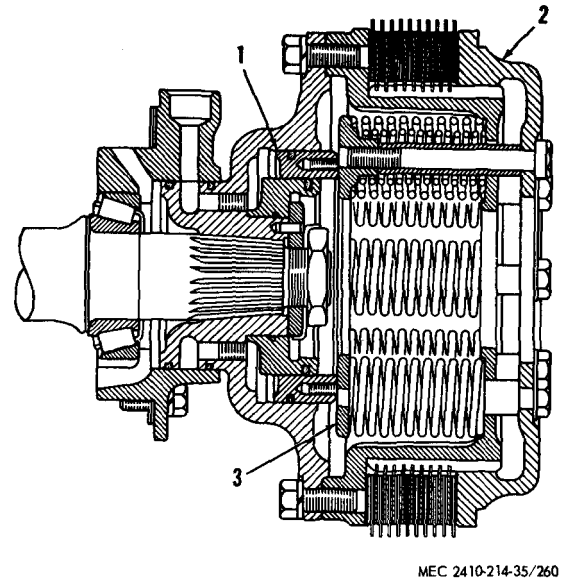
Figure 3–246. Adjusting brake engaging mechanism.



1 Parking brake lever
2 Brake pedal
3 Brake linkage
4 Parking brake linkage

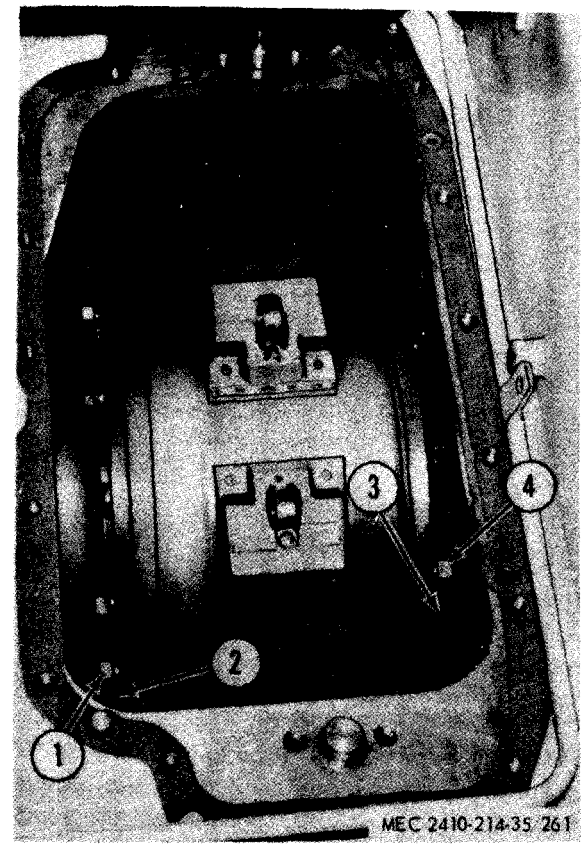
Figure 3–247. Adjusting brake linkage.

support and centerline of parking brake lever (para 1-4). The brake pedal (2) can readjusted 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. (para 1-4).



1 Steering clutch piston
2 Steering clutch pressure plate
3 Steering clutch spring retainer

Figure 3–248. Steering clutch operation.

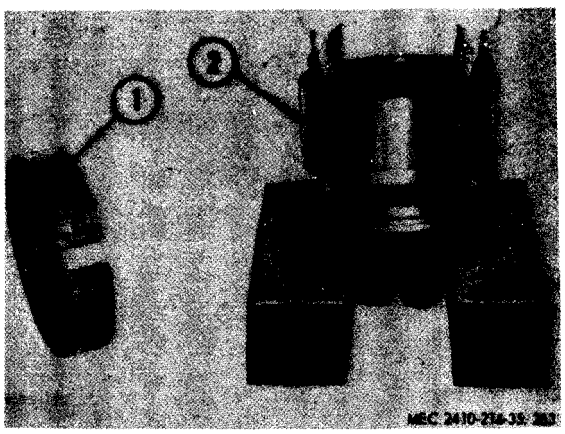


1 Bolts
2 Steering clutch driving hub
3 Steering clutch driven drum flange
4 Bolts

Figure 3–249. Preparing to remove steering clutch assembly.

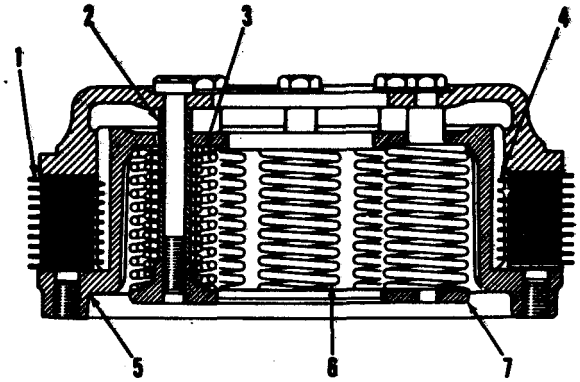


Figure 3–250. Removing steering clutch assembly.



1 Brake band
2 Steering clutch driven drum (outer drum)

Figure 3–251. Removing outer drum.



MEC 2410-214-35/264

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 3–252. Cross—section of clutch assembly.



1 Steering clutch pressure plate
2 Plate

Figure 3–253. Holding steering clutch spring in compression.

3-51. Steering Clutches

a. General.

(1) The multiple disc, oil-type steering clutches are held in engagement by springs, and are disengaged hydraulicalIy.

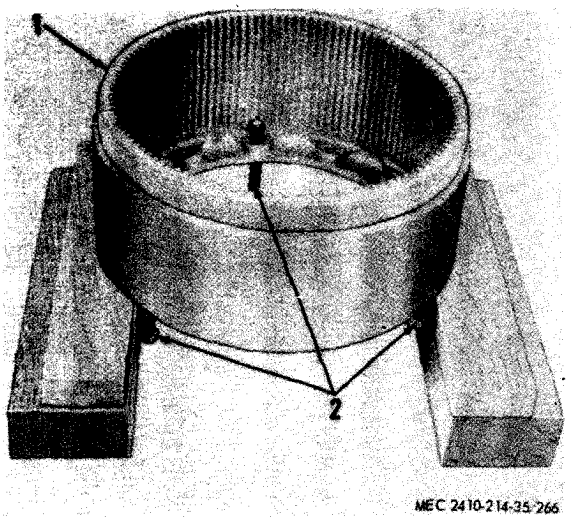
(2) The steering clutch disc assemblies have teeth on the outer diameter which mesh with splines in the outer drum. The steering clutch driving discs have lugs on the inside diameter which interlock with the tapered recesses of the inner drum.

(3) The steering clutches are disengaged by oil pressure acting behind the steering clutch piston ((1), fig. 3-248) 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.

b. Removal and Installasion.

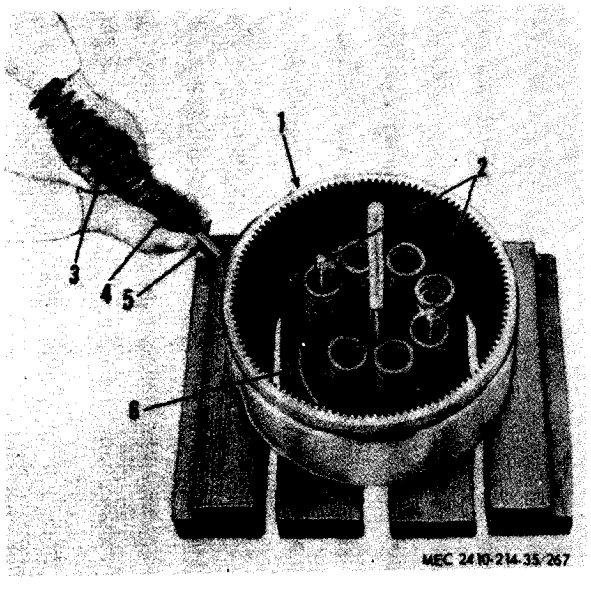
(1) Remove the fuel tank, (para 3-24) the rear crossmember, and brake engaging mechanism (para 3-50).

(2) Rotate the track by placing a hydraulic jack under track grouser and remove the bolts ((1), fig. 3-249) by bolts (4).



1 Steering clutch driven drum (outer drum)
2 Forcing screws

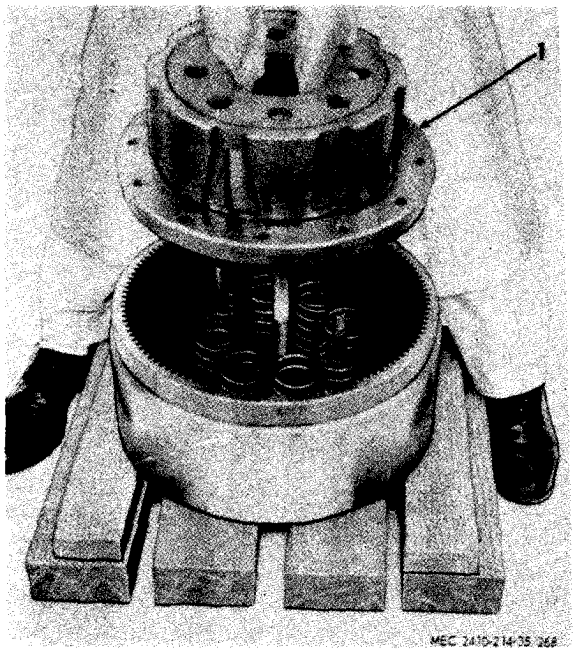
Figure 3–254. Preparing to assemble clutch assembly.



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

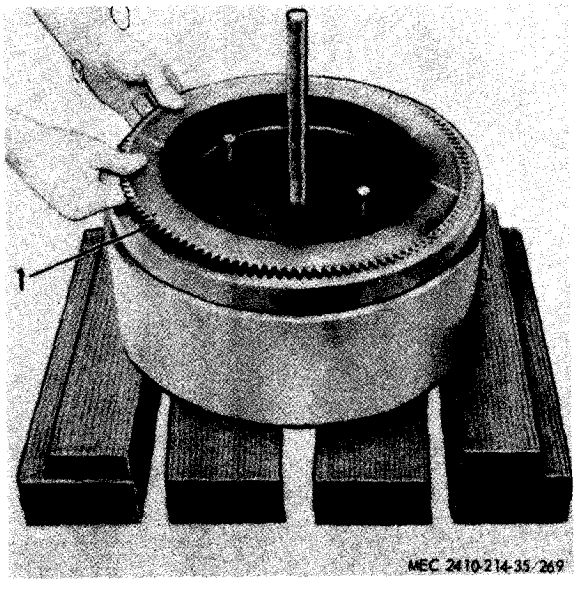
Figure 3–255. Assembling springs and sleeves to retainer.

Note. To prevent the possibility of the outer drum slipping off the steering clutch driven drum flange ((3), fig. 3-249) 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 Steering clutch inner drum

Figure 3–256. Installing inner drum.



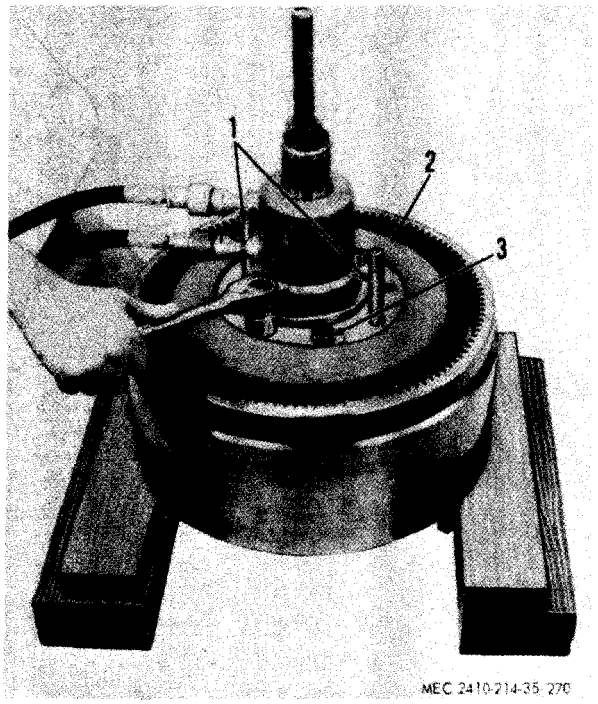
1 Installing clutch disc assemblies

Figure 3–257. Installing clutch disc assemblies.

(3) Attach a suitable hoist and sling to the brake band and pry the outer drum away from the flange.

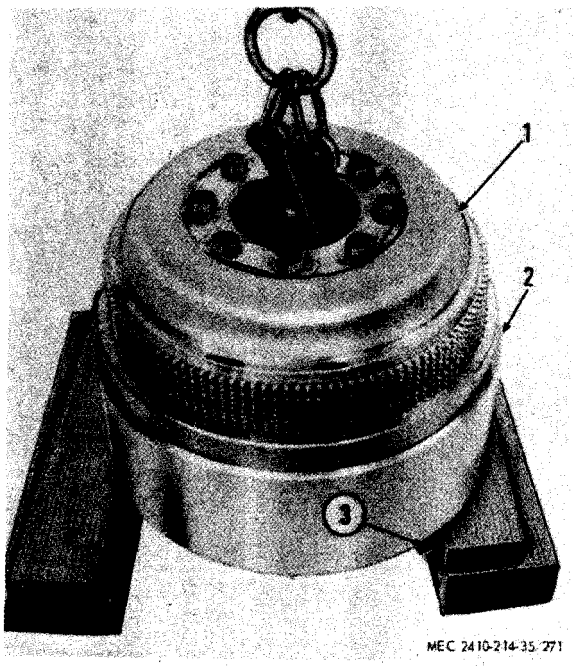
(4) Remove the two bolts securing the inner drum to the hub pry the drum away from the hub, and remove the steering clutch assembly as shown in figure 3-250.

Caution: Keep the steering clutch assembly level since the clutch is free to slide out of the outer drum.



1 Guide pins
2 Steering clutch pressure plate
3 Bolts

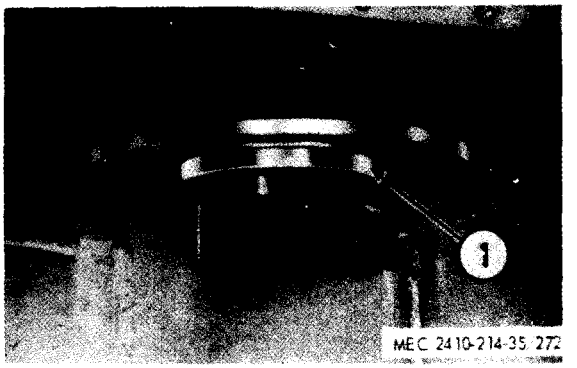
Figure 3–258. Compressing steering clutch springs.



1 Steering clutch assembly
2 Steering clutch driven drum (outer drum)
3 Forcing screws

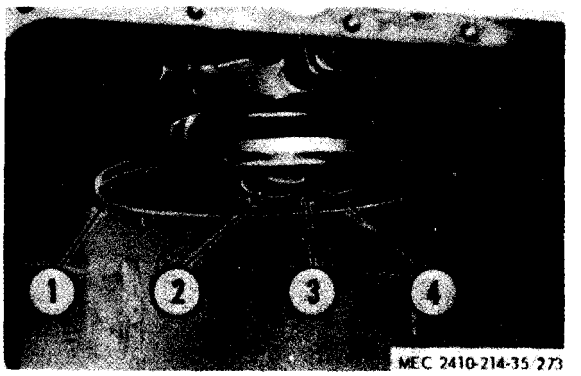
Figure 3–259. Removing steering clutch assembly from outer drum.

(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.



1 Steering clutch piston

Figure 3–260. Removing steering clutch piston.



1 Steering clutch driving hub
2 Steering clutch shaft
3 Retaining nut
4 Retaining washer

Figure 3–261. Preparing to remove hub retaining hub.



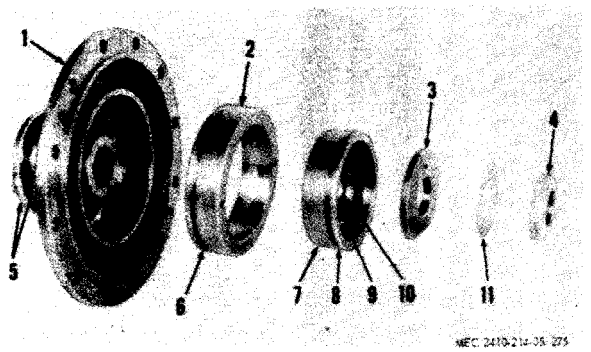
1 Bolts
2 Wrench socket

Figure 3–262. Removing hub retaining nut.

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.**

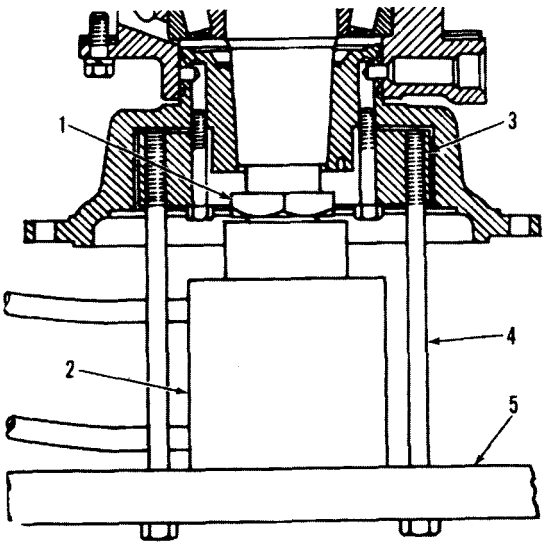
(6) Install one bolt that secures the outer drum to the flange, but do not tighten the bolt too tight.

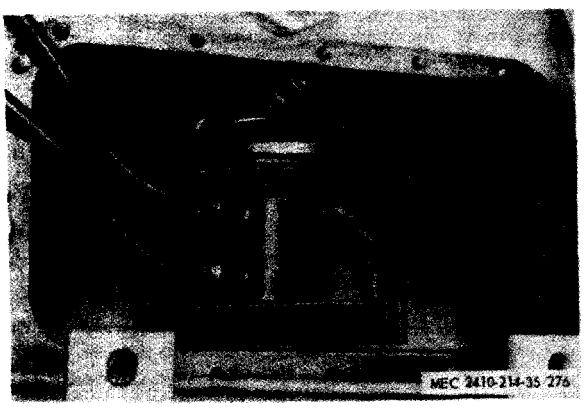
(7) Rotate the steering clutch 180° by moving the machine or the sprocket.



1 Steering clutch driving hub
2 Steering clutch piston
3 Retainer washer
4 Retaining nut
5 Seal ring
6 Seal ring
7 Steering clutch piston pilot
8 Seal ring
9 Preformed packing
10 Groove
11 Lock

Figure 3–263. Steering clutch hub assembly (exploded view).





1 Retaining nut
2 Puller
3 Hydraulic puller
4 Bolt
5 Push puller

Figure 3–264. Pulling hub.

(8) Install a second bolt that secures the outer drum to flange tighten this bolt securely.

(9) Complete the installation m revers e order of removal. Torque the bolts ((1), fig. 3-249) and (4) to the value given in paragraph 14.

(10) Refer to paragraph 3-50 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. 3-251) 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 1–2. If the overall thickness is less than the minimum overall width, they should be replaced.

(3) Place the plate on the bolt, insert the bolt through the center of the steering clutch assembly and place the plate ((2), fig. 3-253), 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. 3-253).

(8) Remove the clutch disc assemblies ((1), fig. 3-252) 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.

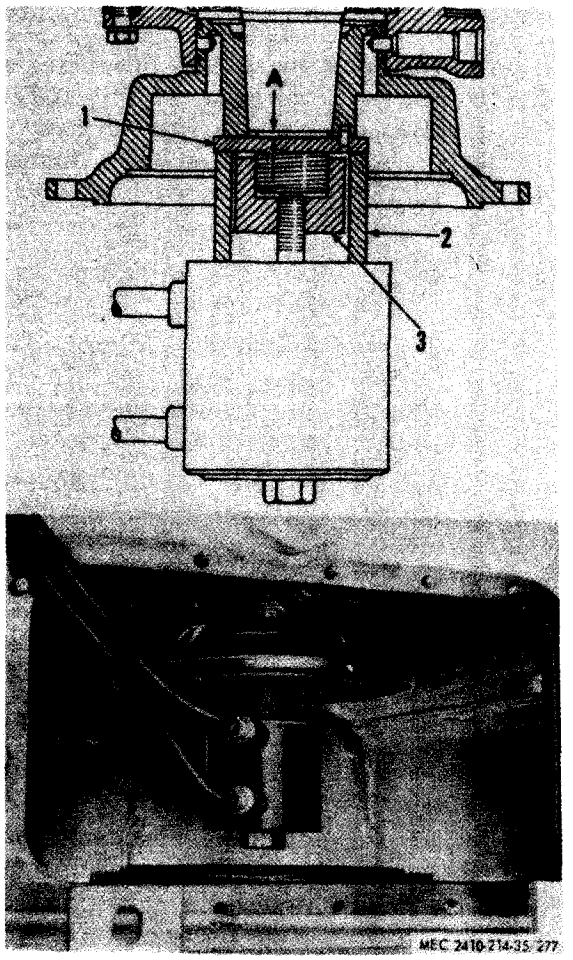
(9) Remove the clutch springs (3) and (6) and the clutch spring sleeves (2).

(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.

d. ***Assembly.***

Note. To prevent the first clutch disc assembly from dropping below the end of the splines on the outer drum



1 Retainer washer
2 Spacer
3 Adapter
A—Dimension to be checked

Figure 3-265. Installing hub.

((1), fig. 3-254) insert three 5/8-inch-11 (NC) forcing screws (Z) in the bolting flange of the outer drum, until they touch the splines.

(1) Place the outer drum ((1), fig. 3-254) on blocks as a guide to assemble the disc assemblies and discs onto the inner drum ((1), fig. 3-256).

(2) Install two 5/8-inch-11 (NC) guide pins ((2), fig. 3-255) 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.

(6) Place the inner drum ((1), fig. 3-256) 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. 3-257) 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. 3-258) 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. 3-259) 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.

3-52. Steering Clutch Driving Hub

a. Removal and Installation.

(1) Install two 5/16-inch-18 (NC) bolts approximately 3-inches long in the steering clutch piston ((1), fig. 3-260). Remove the piston by pulling toward the outside of the tractor.

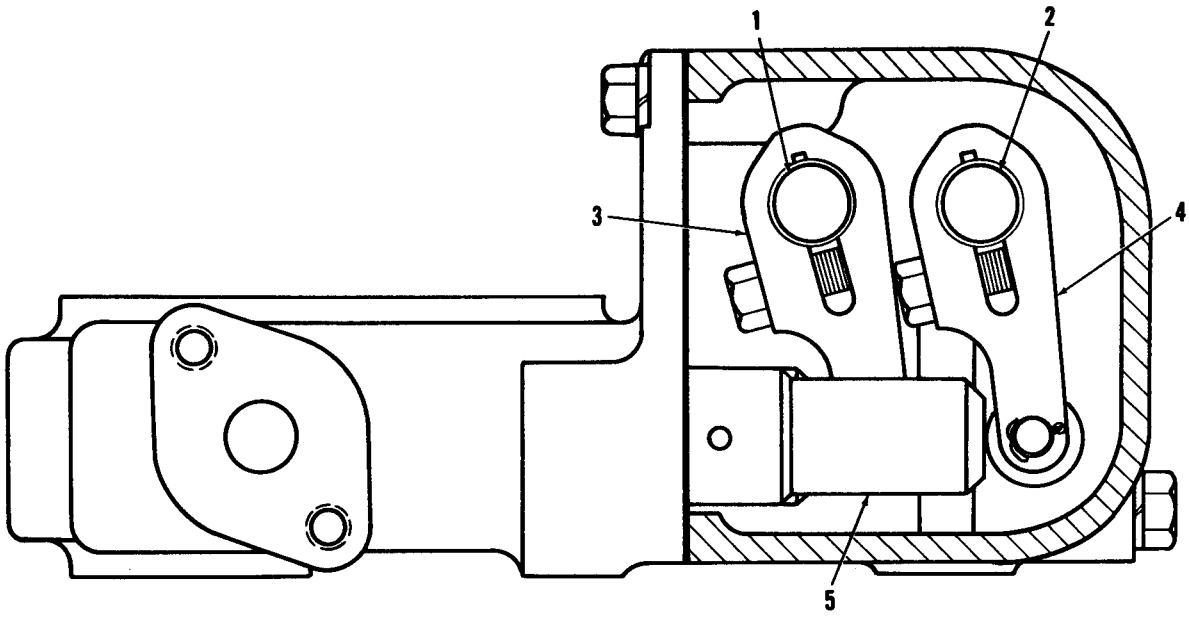
(2) Straighten the lock (11) figure 3-263) securing the hub retaining nut ((3), fig. 3-261).

(3) Remove the retaining nut (3).

Note. To facilitate nut removal, with both steering clutches removed, install two 5/8-inch-11 (NC) bolts ((1), fig. 3-262) approximately 3 inches long, into the opposite clutch hub clearance holes and insert a bar to retain the steering clutch shaft. ((2), fig. 3-261). Using the wrench ((2), fig 3-262) 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.

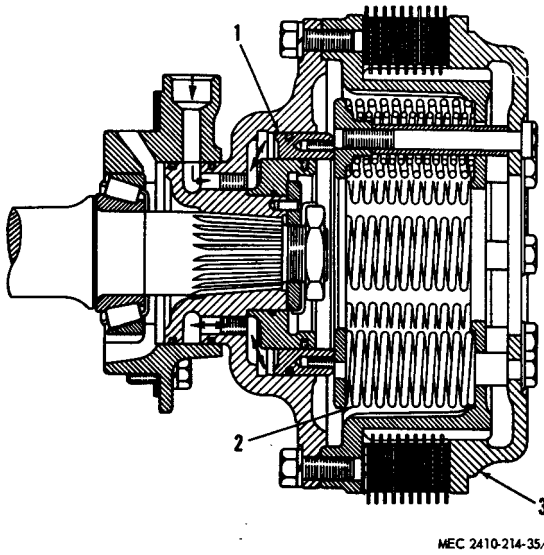
(4) Remove the lock and retainer washer ((4), fig. 3-261).

(5) Remove the steering clutch piston pilot ((7), fig. 3-263) by inserting a screw driver in



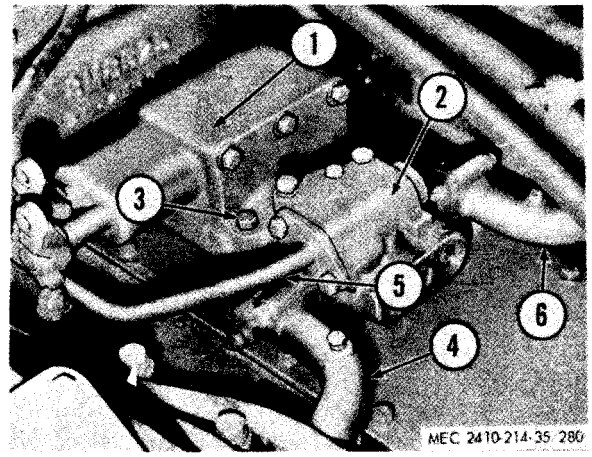
1 Shaft
2 Shaft
3 Lever
4 Lever
5 Olunger

Figure 3–266. Steering clutch hydraulic control (side view).



1 Piston
2 Spring
3 Pressure plate

Figure 3–267. Control piston operation.



1 Control valve
2 Check valve
3 Bolt
4 Elbow
5 Supply tube
6 Elbow

Figure 3–268. Control valve removal.

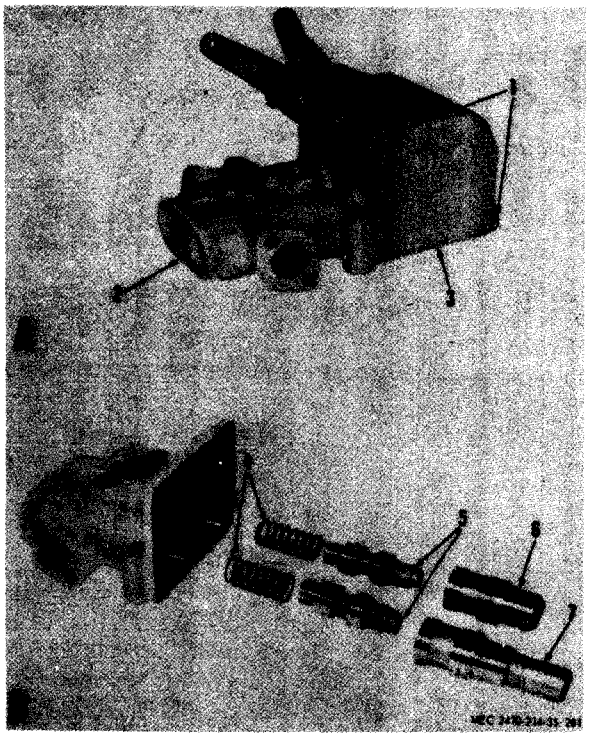
the machined groove (10) and prying against the end of the clutch shaft.

(6) Install the retaining nut ((l), fig. 3-264) on the clutch shaft so that there is approximately 3/8-inch clearance between the nut and the clutch hub. The nut is installed to decrease the possibility of personal injury or damage when the clutch hub is pulled loose from the shaft.

(7) Fasten the puller (2) to the clutch hub using four 5/8-inch-11 (NC) bolts approximately 3-inches long.

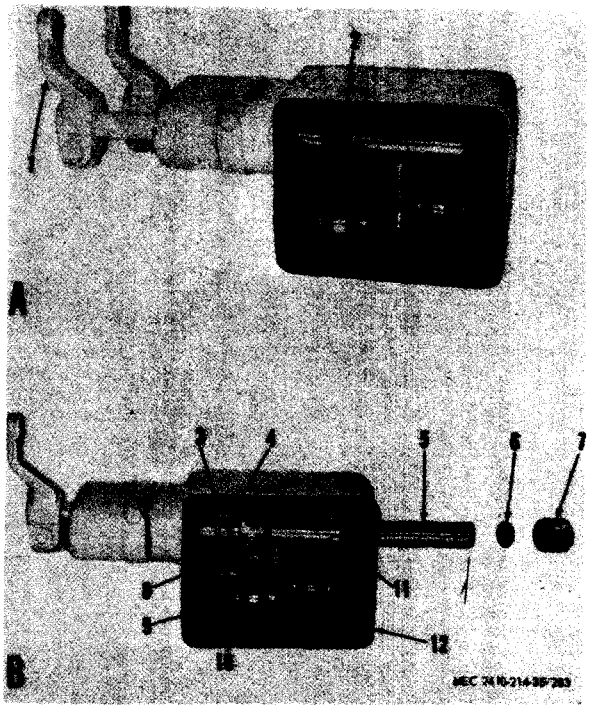
(8) Using hydraulic puller (3), a puller (5) with two 3/4-inch–10 (NC) bolts (4), 9-inches long, pull the hub loose from the shaft.

(9) Remove the puller tools and the nut and remove the hub.



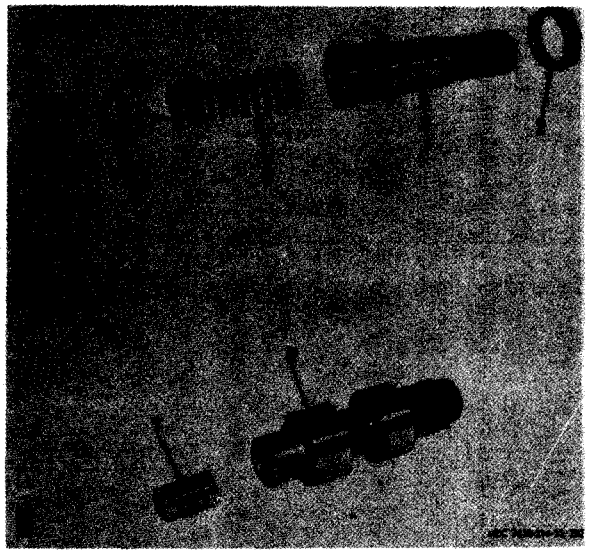
1 Bolts
2 Control valve housing
3 Control lever housing
4 Spring (2)
5 Valve (2)
6 Plunger
7 Plunger

Figure 3-269. Control valve housing disassembly.



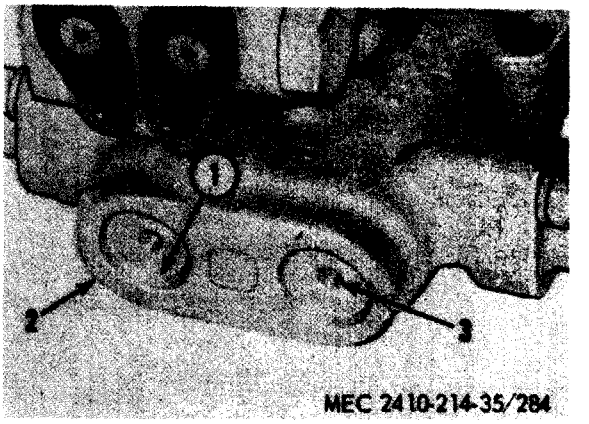
1 Lever and key
2 Bolt
3 Washer
4 Snapring
5 Shaft
6 Spacer
7 Bearing
8 Lever
9 Pin
10 Roller
11 Key
12 Control lever housing

Figure 3-271. Control lever housing disassembly.



1 Plunger
2 Bushing
3 Locking
4 Washer
5 Spring
6 Valve
7 Slug

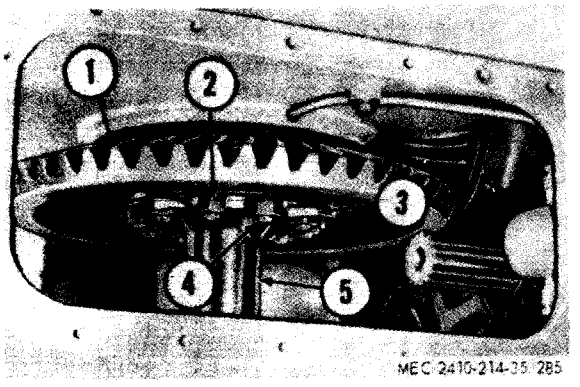
Figure 3-270. Plunger and valve disassembly.



1 Rings
2 Control valve housing
3 Plugs

Figure 3-272. Plug removal.

(10) Inspect the seal rings ((6), fig. 3-263) and the seal rings (8) for damage or excessive wear. Replace if necessary.



1 Bevel gear
2 Nuts
3 Locks
4 Bolts
Bevel gear shaft

Figure 3–273. Preparing to remove bevel gear and bevel gear shaft.

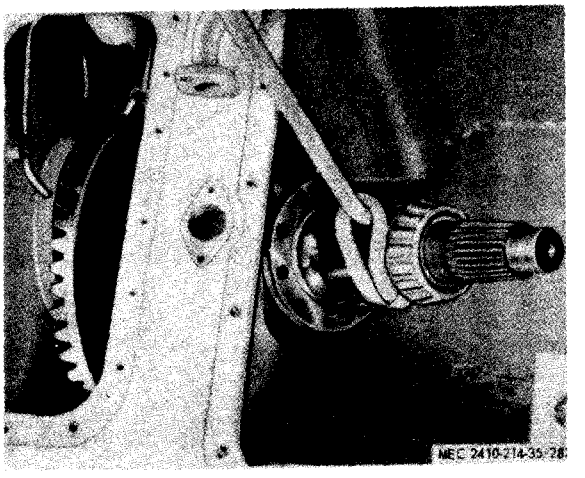
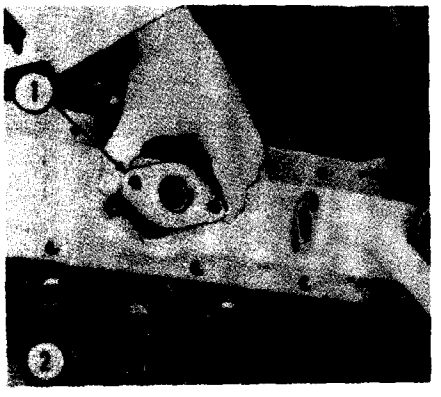
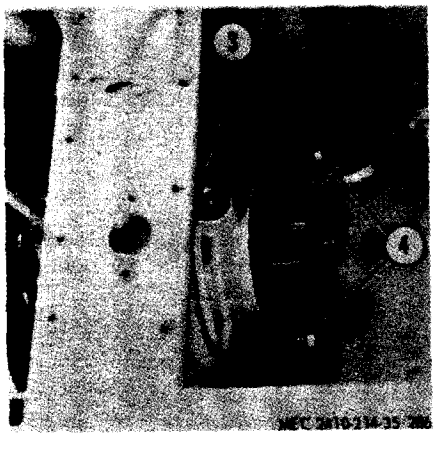


Figure 3–275. Removing bevel gear shaft.



A



1 Oil tube
2 Bolts
3 Bearing cage
4 Forcing screws

Figure 3–274. Removing bearing cage.



Figure 3–276. Measuring clearance.

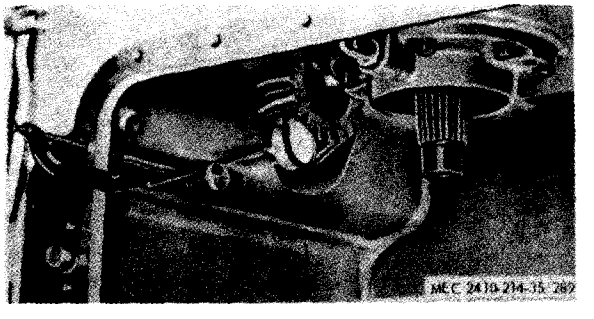


Figure 3–277. Measuring backlash.

(11) Inspect the preformed packing (9) for damage. Replace if necessary.

(12) Inspect the seal rings (5) for damage or excessive wear. Replace if necessary.

(13) Place the hub on the clutch shaft.

(14) Align the locating dowel in the retainer washer ((1), fig. 3-265) with the dowel hole in the hub. Install the washer.

(15) Bolt adapter (3) to the hydraulic puller and install the adapter (3) on the clutch shaft.

(16) Place the spacer (2) over the adapter as shown.

(17) Press the huh onto the shaft to the pressure given in table 1-2. Measure the distance (A), from the shoulder on the clutch shaft to the

face of the clutch hub. Refer to table 1-2 for the correct dimension.

(18) Install the pilot ((7), fig. 3-263) lock (11), nut (4) and piston (2) inreverse order of removal.

3-53. 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. 3-266). 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. 3-267) 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.

b. Removal and Installation.

(1) Remove the fuel tank (para 3-24).

(2) Disconnect steering clutch control rods.

(3) Disconnect oil supply tube ((5), fig. 3-268) 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. ***Disassemble and Assembly.***

(1) Remove five bolts ((1), fig. 3-269) 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. 3-270) 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. 3-269) except for length. Disassembly is the same since all parts are the same.

(4) Remove slugs ((7), fig. 3-270) 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. 3-271) 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.

(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. 3-272) by removing rings (1) and plugs (3).

(14) Inspect preformed packings on plugs before assembly.

3-54. Bevel Gear

a. Removal and Installation.

(1) Drain the oil from the transmission, steering clutch compartment, and bevel gear compartment. Refer to TM-5-2410-214-12.

(2) Remove the seat frame (para 3-77) and the fuel tank (para 3-24).

(3) Remove the steering clutch hydraulic control (para 3-53) steering clutches (para 3-51) and the steering clutch driving hubs, (para 3-52) .

(4) Remove bevel gear compartment plate. At installation, apply liquid gasket to bevel **gear** case and tighten bolts securing plate to 45 ± 3 lb-ft.

(5) Remove nuts ((2), fig. 3-273) and locks (3).

(6) Remove oil tube ((1), fig. 3-274). At installation apply liquid gasket to bevel gear case under tube flange.

(7) Attach a suitable hoist to support the bevel gear shaft.

(8) Remove bolts (2), and remove bearing cage (3) using two 1/2-inch-13 (NC) forcing screws as shown.

(9) Slide the bevel gear ((1, fig. 3-273) 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 3-275.

(11) Lift out the bevel gear.

(12) Install the bevel gear and shaft in the reverse order of removal. Adjust the bevel gear and pinion backlash as described in c 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.

(5) Inspect bearing cones and cups and replace if necessary.

c. Bevel Gear and Pinion Setting.

(1) 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 ((2) and (3) below), and the backlash ((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 1-2. 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 1-2 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 3-276 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.

(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 blacklash 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 1-2.

(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 .002-inch end clearance as 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 (4) less .015-inch to give the required preload to the bevel gear shaft bearings.

Note. The .015-inch shim removal includes .002-inch end clearance as left in (c) above, plus the .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 3-277.

(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

If be the be the difference in readings on the dial indicator. --

(d) Check the backlash at four points ound the bevel gear to determine the point of east backlash. Be sure the pinion is held forward while rocking it back and forth to take the backlash readings.

Note. The correct amount of blacklash 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 1-2.

(e) If the reading is too great at the point of least backlash, remove shims from the bearing cage on the right side arid 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.

Section IX. FINAL DRIVE

3-55. General
(fig. 3-278)

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 finaI drive case, which is mounted to the steering clutch case.

b. The final drives are splash lubricated. Each find 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.

3-56. Track Roller Frame Outer Bearing

a. Removal.

(1) Drain the final drive compartment.

(2) Remove the track roller frame (para 3-76).

(3) Remove the outer bearing cap ((1), fig. 3-279.

(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. 3-280) from bearing cage holder (10), hold bearing assembly (7) level to prevent damage to seal (8) contained in the bearing assemblies (7).

b. Installation.

(1) Inspect seal ((8), fig. 3-280) in bearing assembly (7). Install seal (8) with the lip facing the outside of bearing assembly (7).

Note. Lubricate seal (8) with an approved ball and roller bearing lubricant. Install seal (8) with lip facing out.

(2) Inspect bearing (9).

(3) Using an approved ball and roller bearing lubrication, lubricate mating surfaces of holder (10) and bearing (9). Install bearing assembly (7).

(4) Place shims (5) and retainer (2) on locating dowels (6).

(5) 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 3-65).

(6) Install lock (3) on locating dowels (11). Six lock positions can be obtained by reversing the lock.

(7) Using an approved ball and roller bearing lubricant, hand pack the bearing and install cap (1).

3-57. Bearing Cage Holder Assembly

a. Removal and Installation.

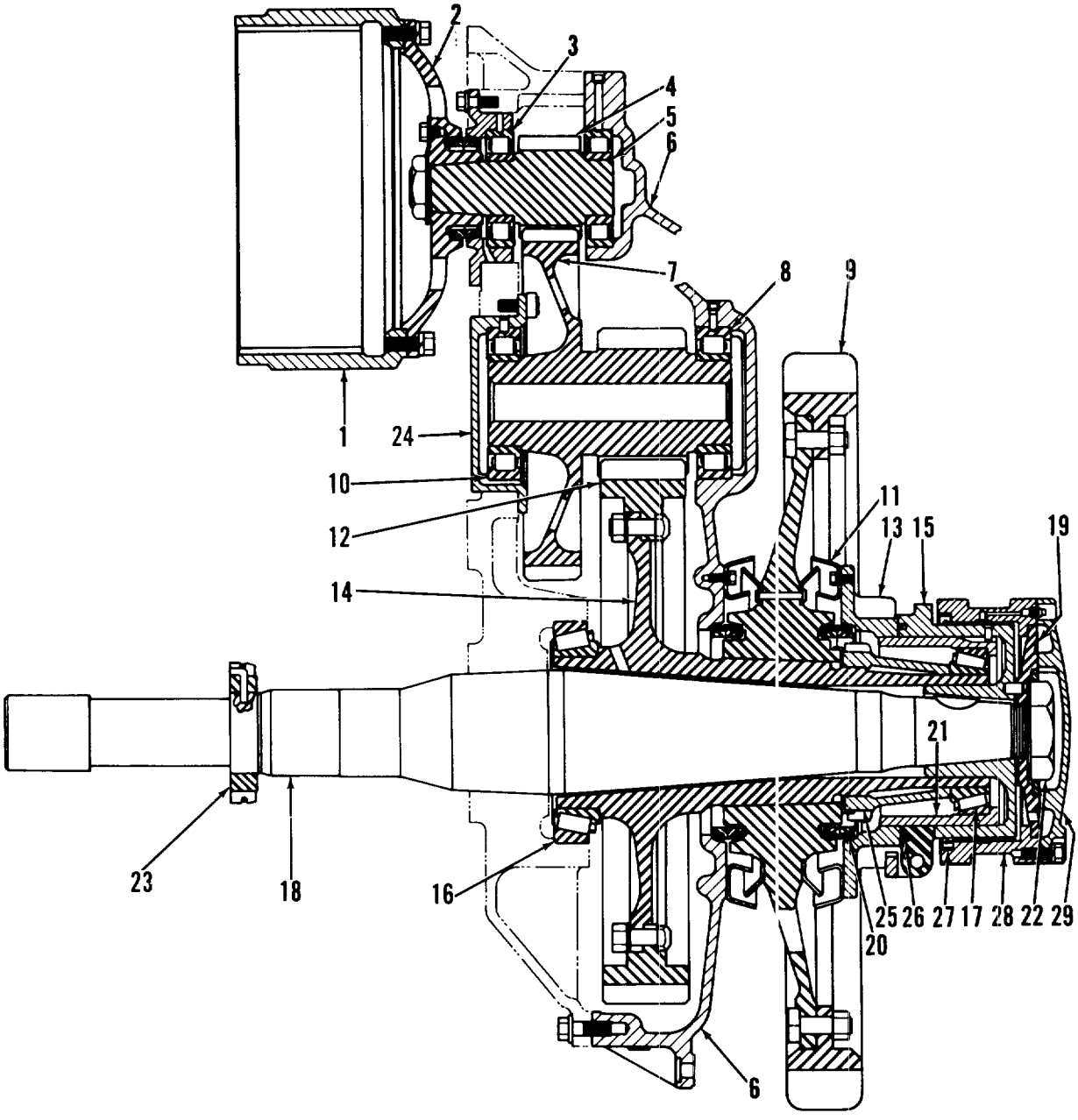
Note. Replace nut ((3), fig 3-281) on the sprocket shaft (5) to retain bearing cage holder assembly (2) during removal. Leave approximately 1/2-inch clearance between the nut and holder assembly.

(1) Remove the clamping bolt and lock securing bearing cage holder assembly (2) to outer bearing adjustment nut (1).

(2) Using a puller and a step plate, force holder assembly (2) from taper on sprocket shaft (5).

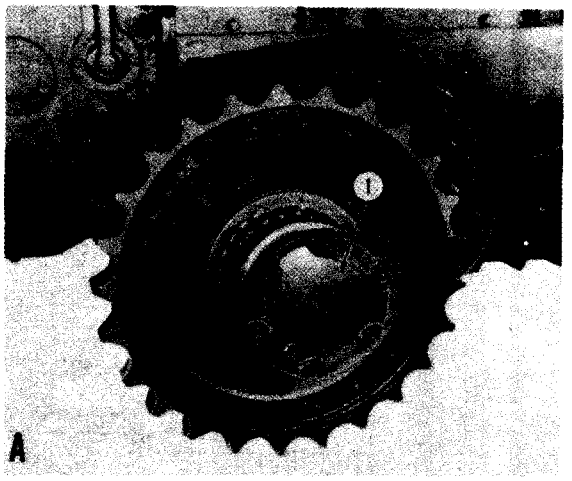
Note. It may be necessary to strike the holder assembly with a soft hammer to free it from the taper on the shaft.

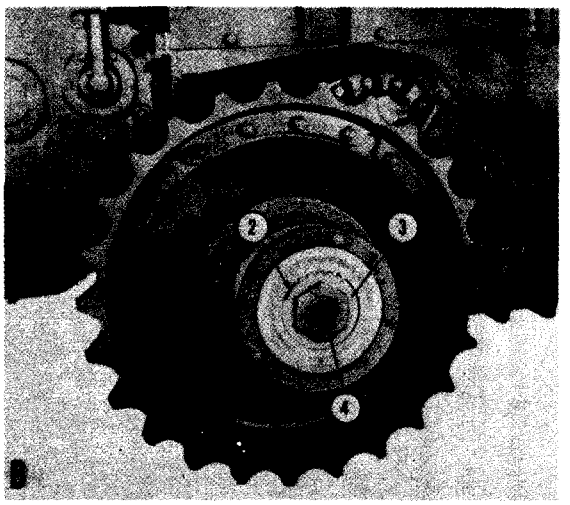
(3) Attach a hoist to support holder assembly (2). Remove retaining nut (3), and the holder assembly. Remove adjusting nut (1), metal floating ring seal (9), holder assembly (2), and

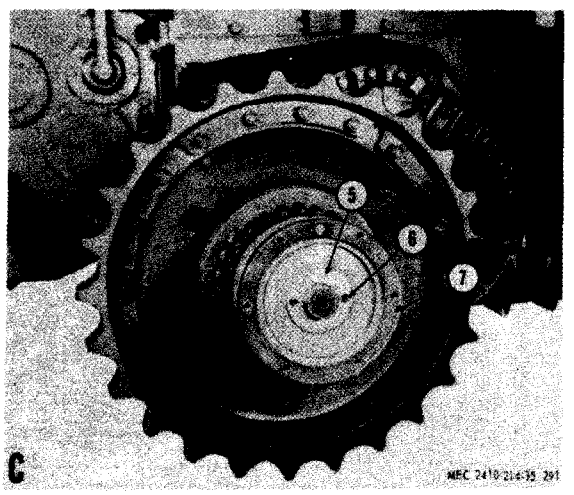


1 Brake drum
2 Final drive pinoin flange
3 Final drive pinion inner bearing
4 Final drive pinion
5 Final drive pinion outer bearing
6 Case
7 Idler pinion
8 Idler pinion outer bearing
9 Sprocket
10 Idler pinion inner bearing
11 Dirt guard
12 Final drive gear
13 Outer bearing adjusting nut
14 Final drive 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 3-278. Final drive.

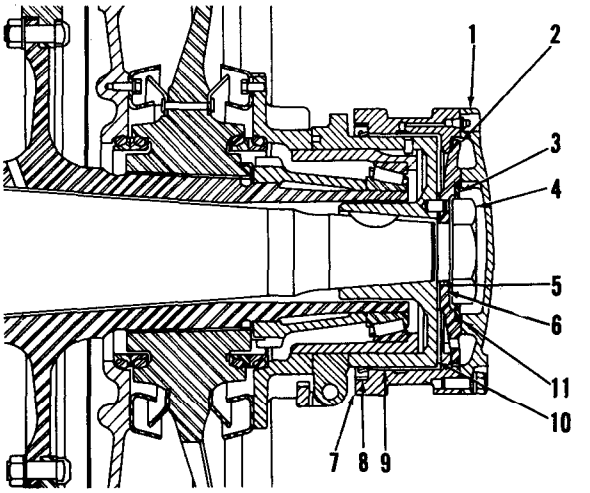






1 Cap
2 Retainer
3 Lock
4 Nut
5 Shims
6 Dowels
7 Track roller frame outer bearing assembly

Figure 3–279. 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 3–280. Outer bearing installation.

gasket (10), bearing cage (7), and bearing cup (6) as a unit.

(4) Inspect the mating surfaces of metal floating ring seals ((9) and (10), fig. 3-282) for damage or excessive wear (para 3-58).

(5) 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 3-64.

b. Disassembly and Assembly.

(1) Remove the dust guard.

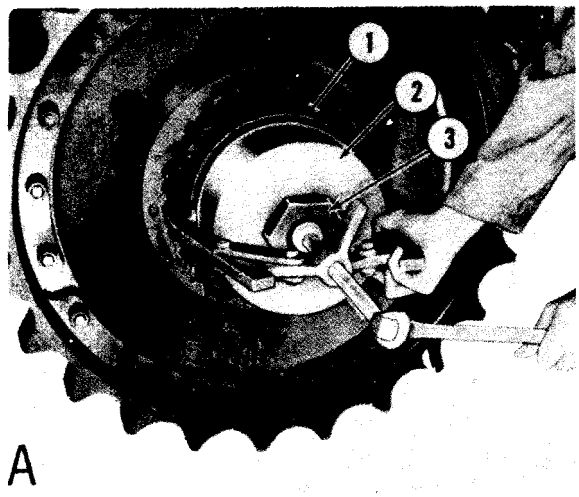
(2) Inspect metal floating ring seal ((2), fig. 3-283). Replace if necessary (para 3-58).

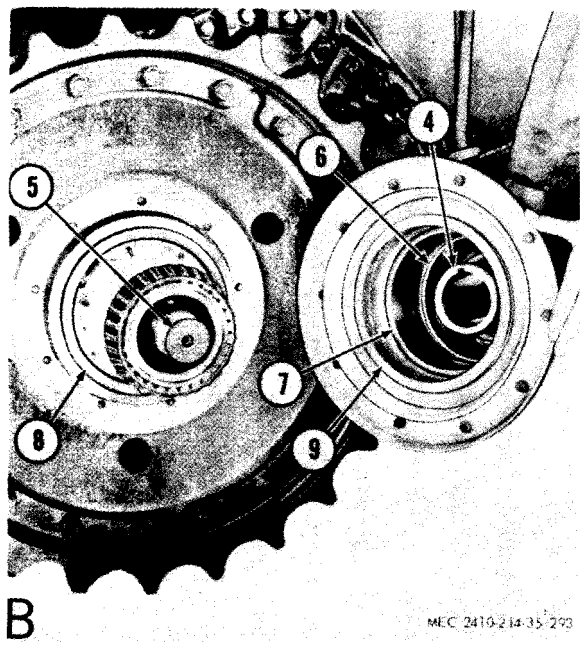
(3) Remove outer bearing adjusting nut (1) from bearing cage holder assembly (3).

(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. 3-284) and cup (3) as a unit.

(5) Inspect bearing cage holder gasket (4) and seal (5). Replace if necessary.

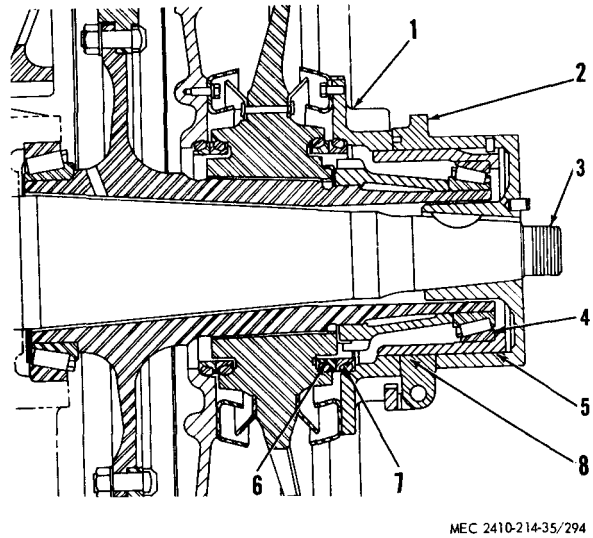
(6) Inspect bearing cup ***(3)*** and replace if necessary. Using a puller, an adapter and a bearing cup pulling attachment, remove the cup from the bearing cage.





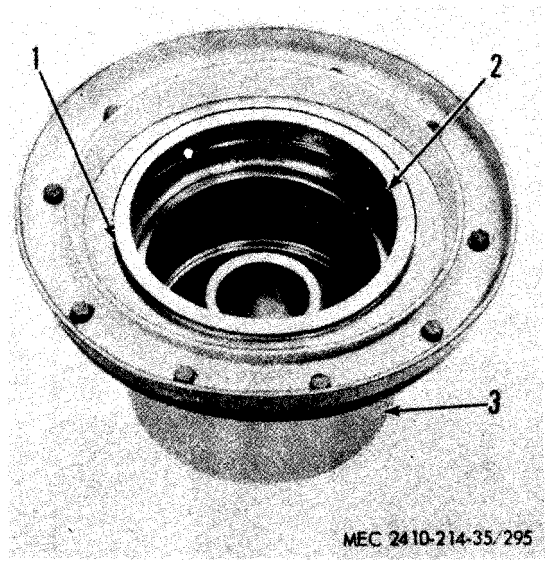
1 Nut
2 Holder assembly
3 Nut
4 Keyway
5 Shaft
6 Cup
7 Cage
8 Metal floating ring seal
9 Metal floating ring seal

Figure 3–281. Bearing cage holder removal.



1 Nut
2 Holder assembly
3 Shaft
4 Cup
5 Cage
6 Metal floating ring seal
7 Metal floating ring seal
8 Gasket

Figure 3–282. Bearing cage holder installation.



1 Nut
2 Metal floating ring seal
3 Holder assembly

Figure 3–283. Bearing cage holder assembly.

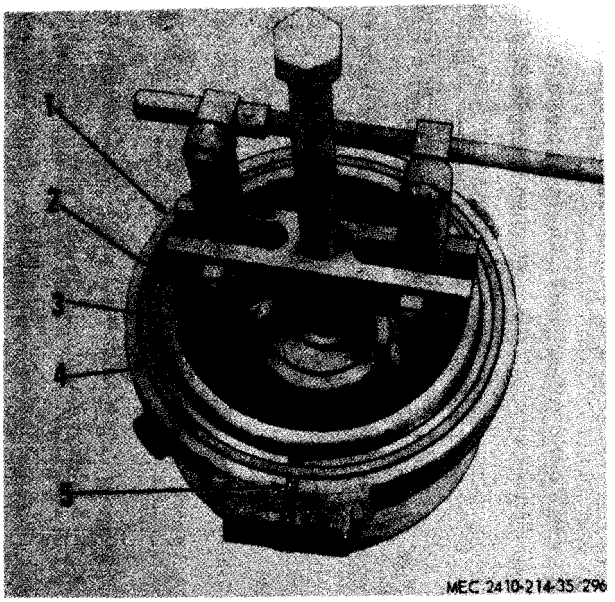
Caution: **At assembly, align the milled slot in bearing cage with the dowel in bearing cage holder assembly ((1), fig. 3–284). This is not a press fit and can be assembled by using a soft hammer. Invert the assembly to see that bearing cage (2) has bottomed in the bearing cage holder.**

3–58. Floating Duo-Cone Seals

a. Removal.

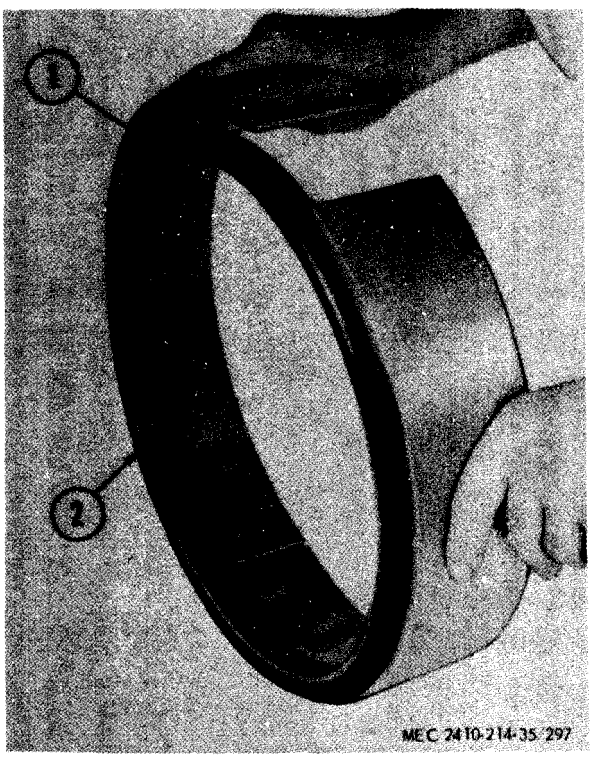
(1) To remove the outer metal floating ring seal, it is necessary to remove the track roller frame outer bearing, holder and outer bearing adjusting hub outer bearing cage holder and outer bearing adjusting nut. The sprocket must be removed to service or replace the inner metal floating ring seal.

(2) Inspect the metal floating ring seals 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.



1 Holder assembly
2 Cage
3 Cup
4 Gasket
5 Seal

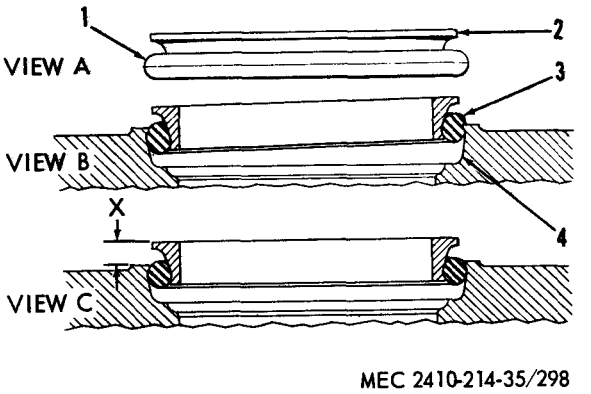
Figure 3–284. Removing bearing cage.



1 Rubber toric sealing ring
2 Metal floating ring seal

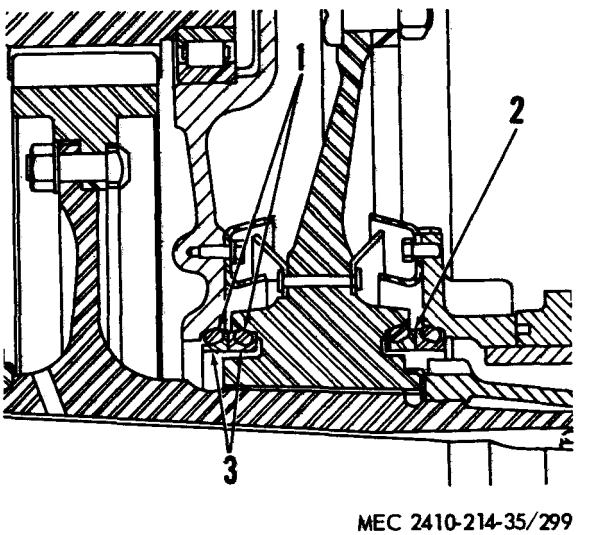
Figure 3–285. Metal floating ring seal installer tool.

Caution: To obtain maximum service, cleanliness must be the rule. Avoid introducing dirt into the parts during installation or filling with oil.



1 Rubber toric sealing ring
2 Metal floating ring seal
3 Location to press toric sealing ring
4 Toric sealing ring groove
X—Dimension to be checked

Figure 3–286. Installing metal floating ring seal and toric sealing ring.



1 Toric sealing rings
2 Metal floating ring seal
3 Toric sealing ring grooves

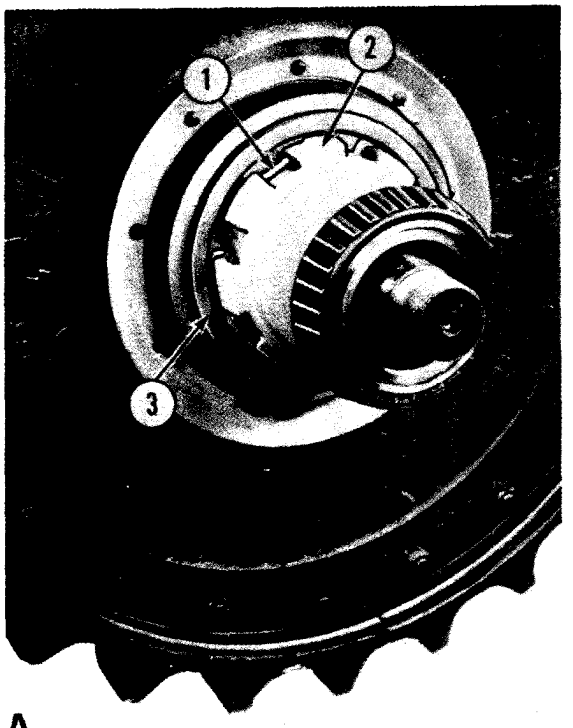
Figure 3–287. Floating duo-cone seals correctly installed.

b. Installation.

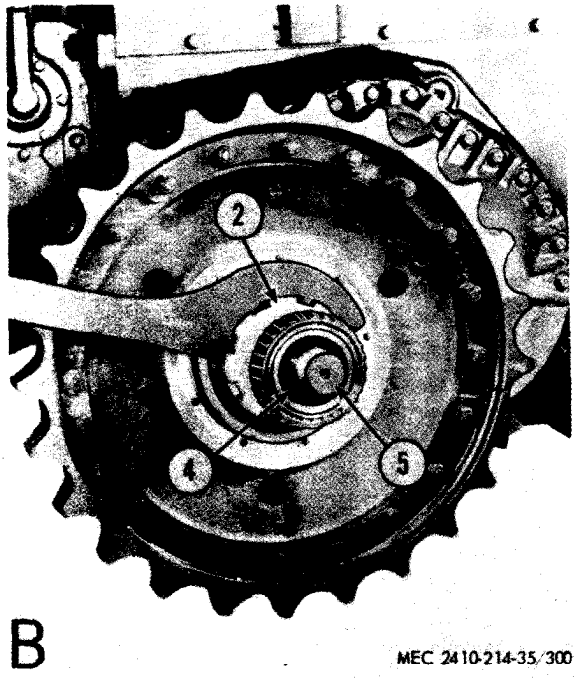
(1) Handle all parts with care to avoid nicking critical areas. File smooth any parts, other than the sealing faces, that have nicks that may make assembly difficult or questionable.

(2) Wash off all dirt accumulation from used parts. 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.

(3) Remove all oil or the protective coating from the flaoting ring seals ((2), fig. 3-285) with a nonflammable cleaning solvent and dry.



A



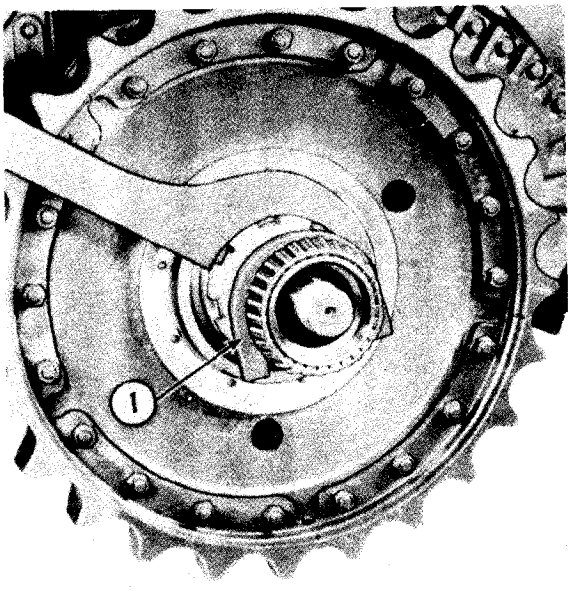
B

MEC 2410-214-35/300

1 Lock
2 Retaining nut
3 Metal floating ring seal
4 Bearing cone
5 Final drive hub

Figure 3–288. Removing outer bearing cone.

(4) 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 too' marks and nicks. On used parts, removed all dirt or rust deposits from the ramps with a scraper or wire brush and smooth the surface with emery cloth.



MEC 2410-214-35/301

1 Yoke

Figure 3–289. Removing nut with yoke installed.

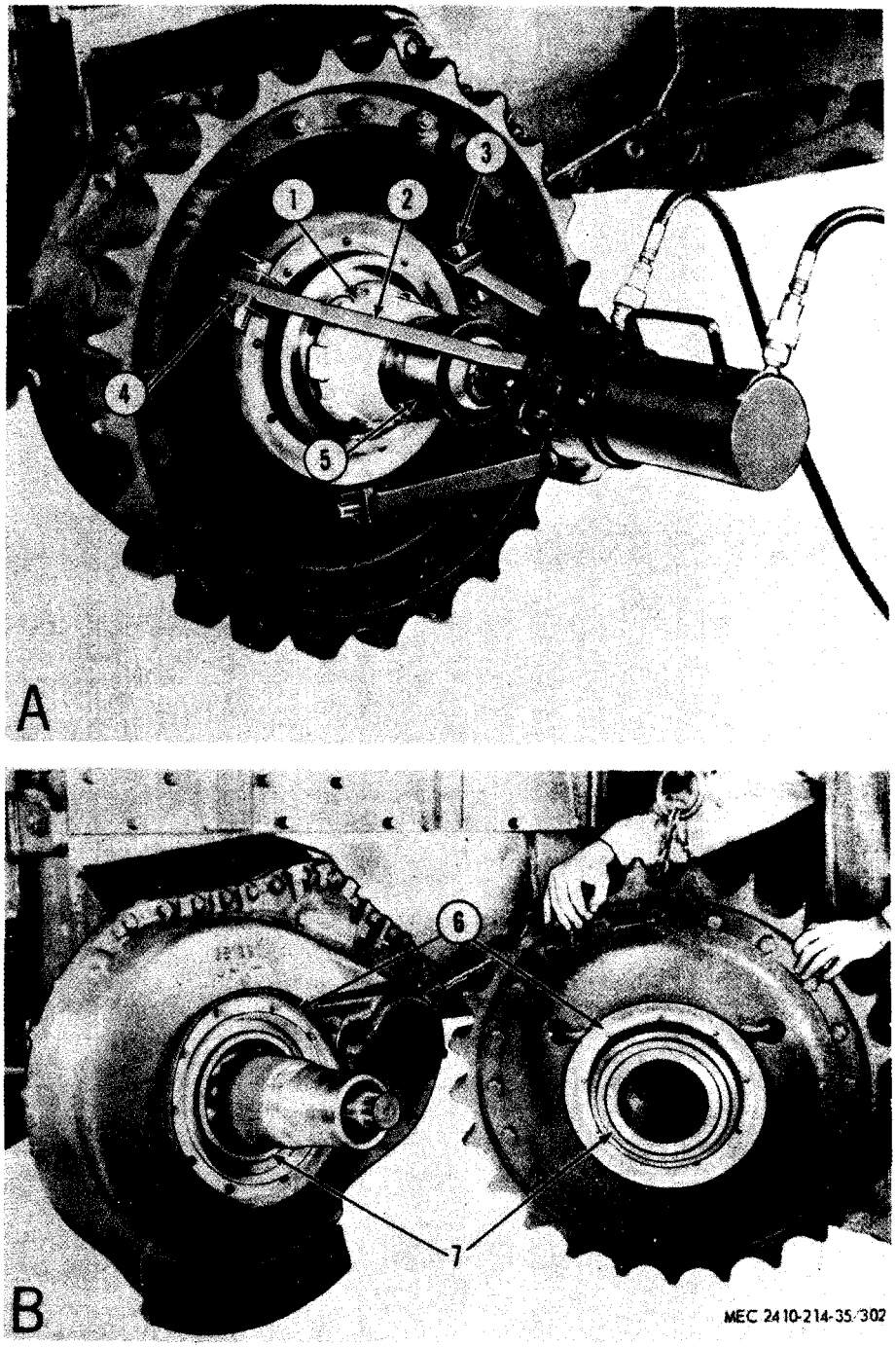
(5) Always install new rubber toric sealing rings (1) on floating ring seals (2). Never install a used toric sealing ring on a new or used floating ring seal.

Note. Use seal installer tool (fig. 3-285) to install metal floating ring seal (2) and toric sealing ring (1) into seal mounting groove (4), fig. 3-286. Be sure not to bump the floating ring seal when removing the installer tool.

(6) Install toric sealing ring (1) 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 as illustrated in views A and C.

(7) If the installer tool is not used, install the toric sealing ring (1) and floating ring seal (2) as an assembly into groove (4) by pressing on the toric sealing ring at location (3), view B. 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, view C.

Caution: **If installer tool is not used, do not use a screw driver or stick to assemble the toric sealing ring in the groove. Use finger pressure only.**



1 Retaining nut
2 Arms
3 Pins
4 Adapters and nuts
5 Sleeve assembly
6 Guards
7 Metal floating ring seal

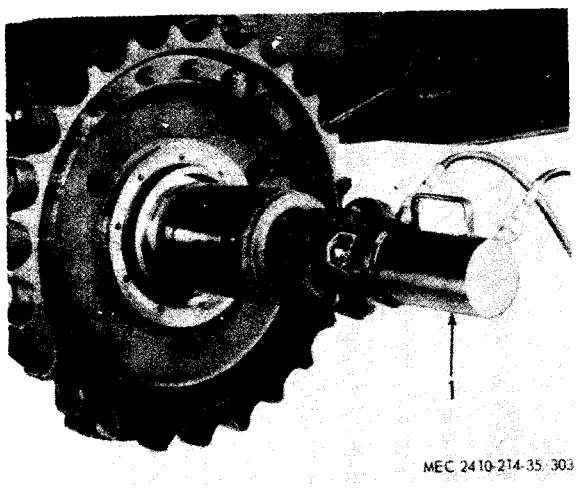
Figure 3–290. Sprocket removal.

(8) Install the floating ring seal to a uniform depth in the groove. The dimension (X) must be uniform around the entire circumference of the floating ring seal.

(9) Always install the floating ring seals (fig. 3-287) 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.

(10) Before assembling floating ring seals together, wipe faces of seals with lint-free tissue to remove any foreign material and finger prints.

(11) Place one drop of light oil on the clean-



1 Cylinder group

Figure 3–291. Installing sprocket.

ing 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.

3-59. Sprocket and Sprocket Segments

a. Sprocket.

(1) *Removal.*

(a) Remove floating ring seal ((3), fig. 3-288) as described in paragraph 3-58.

(b) Bend lock (1) securing retaining nut (2).

(c) Using a spanner wrench, back off retaining nut (2) approximately 7/8-inch. Turn the nut back toward the sprocket and install yoke (fig. 3-289) between the nut and bearing cone as shown. Remove bearing cone by unscrewing nut (2) witk 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.

(d) Attach the Cylinder Group to the Pump Group. Place sleeve assembly ((5), fig. 3-290) 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. 3-288) and lock (1).

(g) Remove sprocket (weighs approx 300 lb).

Note. Inspect the splines on hub (5) and splines in the sprocket for wear, if the sprocket pulls off or easily.

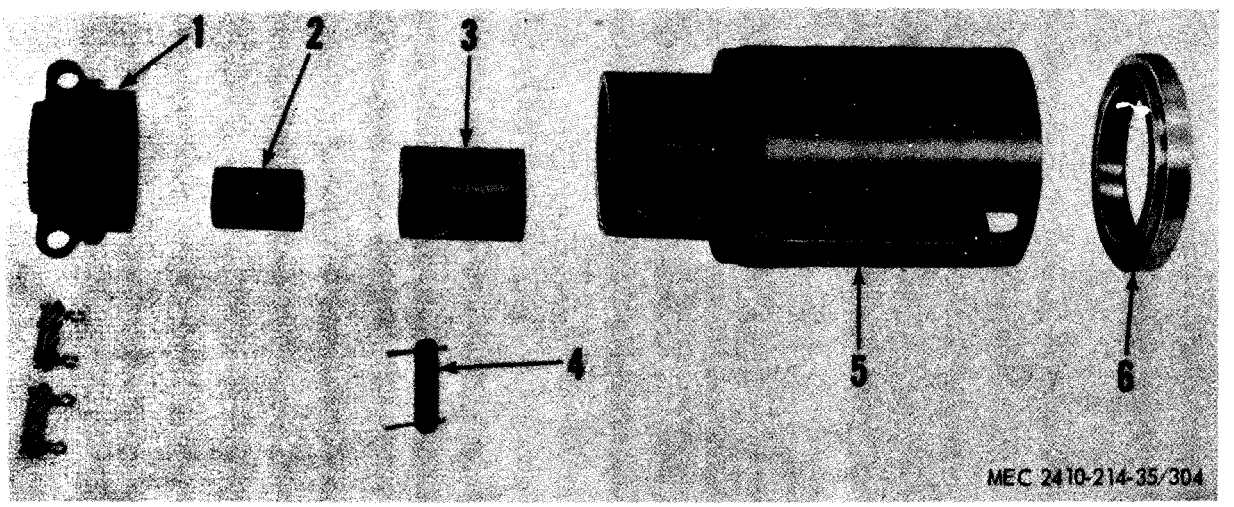
(h) Remove metal floating ring seals ((7), fig. 3-290) as soon as the sprocket has been removed. Tie the mating seals together to assure installation of the same mating seal surfaces.

(i) Inspect guards (6).

(2) *Installation.*

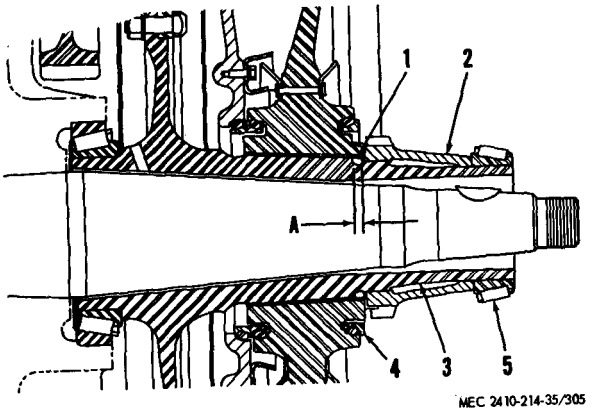
(a) Install the metal floating ring seals (para 3-58).

(b) Before installing the sprocket (fig. 3-291), make sure the splines are clean, dry, and



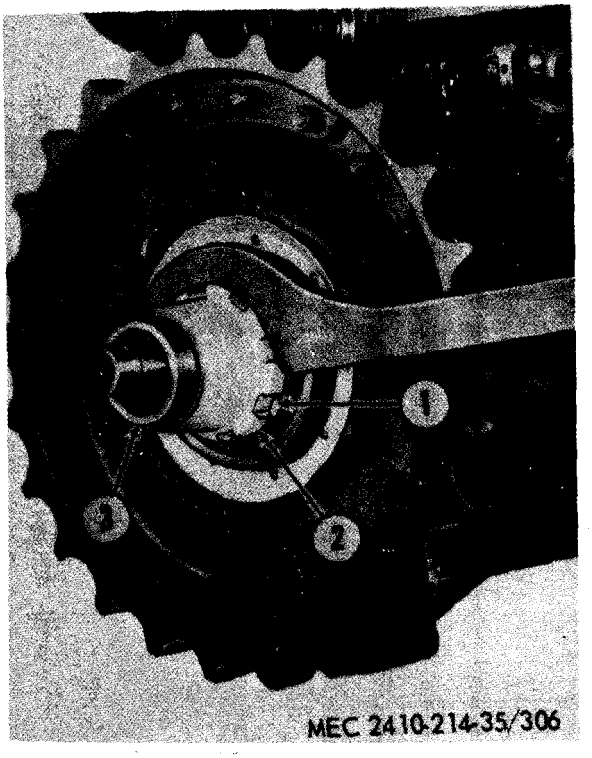
1 Head
2 Adapter
3 Adapter
4 Coupling pin
5 Sleeve
6 Ring

Figure 3–292. Sprocket installing tools.



1 Lock
2 Nut
3 Hub
4 Bearing cone
A—Dimension to be checked

Figure 3–293. Checking sprocket location.



1 Lock
2 Nut
3 Hub

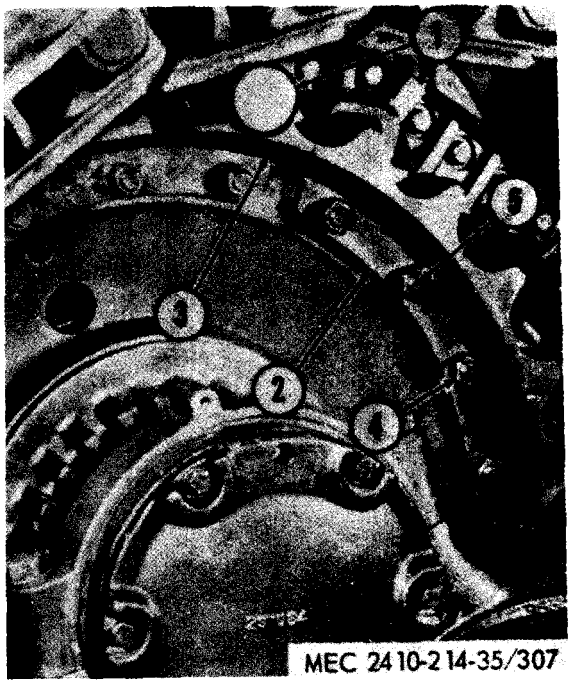
Figure 3–294. Installing retaining nut.

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.

(c) Install adapter ((2), fig. 3-292) on cylinder group and extend the ram to its limit with the pump group.

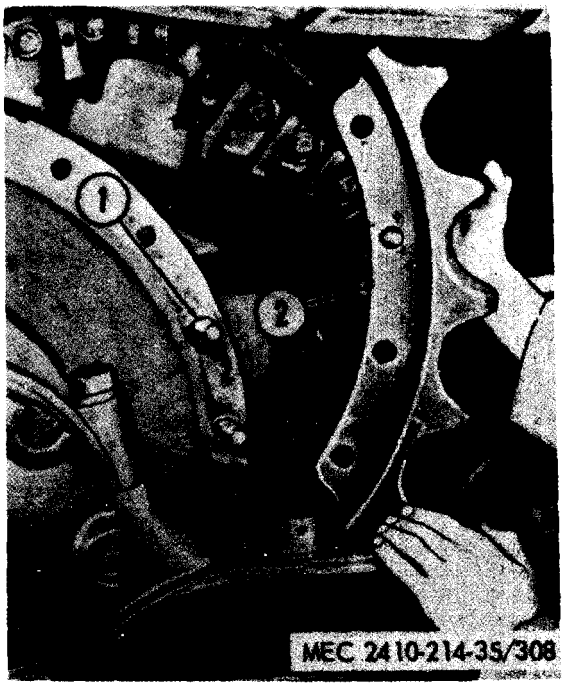
(d) Assemble head (1) to cylinder group.

(e) Install adapter (3) onto the sprocket shaft.



1 Pin
2 Segment
3 Segment
4 Nuts (4)
5 Bolts

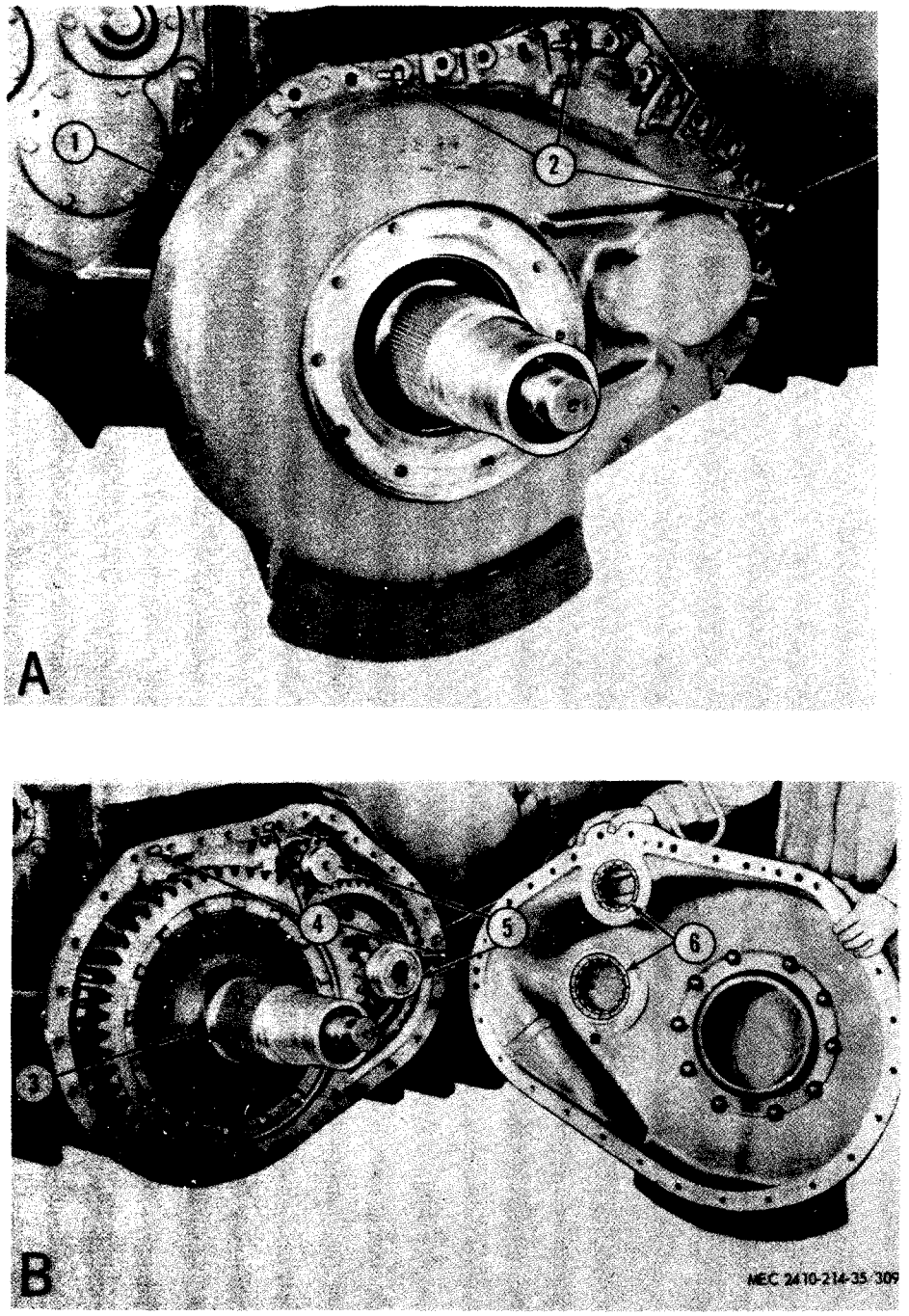
Figure 3–295. Preparing to remove segment.



1 Bolt
2 Segment

Figure 3–296. Removing segment.

(f) Place ring (6) and sleeve (5) *over* adapter (3) and hub ((3, fig. 3-293) and connect adapter ((2), fig. 3-292) and adapter (3) with pin (4).



1 Final drive case
2 Forcing screws
3 Final drive gear hub
4 Dowels
5 Inner races
6 Outer race and roller assemblies

Figure 3–297. Final drive case removdl.

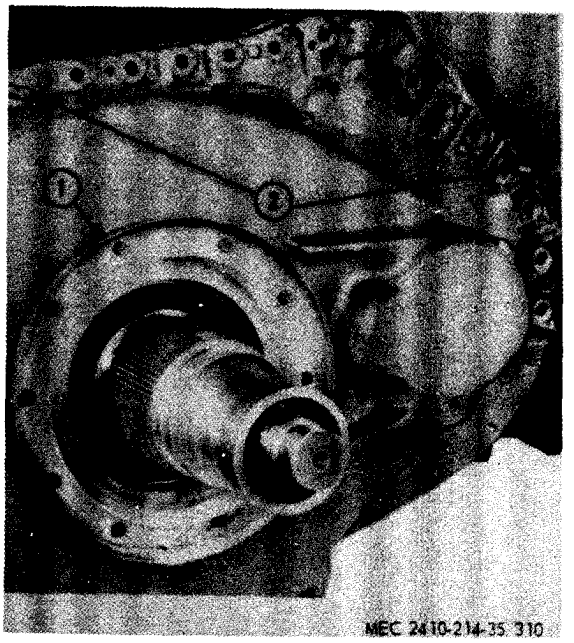
(g) Place the pump control in the pulling position and apply a slight press to the sprocket. Rock the sprocket back and forth to equalize the load.

(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. 3-293) between the end of the sprocket and the end of the splines on the final drive hub. Distance (A) should be .44-.56 inches.

(j) Install lock ((1), fig. 3-294) 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 Dirt guard 2 Guide pins

Figure 3–298. Final drive case installation.

(l) Remove the installation tools and install the metal floating ring seals (para 3-58).

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 sprockets.

(b) Loosen track adjustment and insert pin (1, fig. 3-295) in the last slot of the segment (3) just behind the segment (2) to be replaced.

Warning: **Refer to paragraph 3-66 for correct procedure on releasing pressure in the hydraulic track adjuster cyIinder.**

(c) Move the machine backward until pin lifts track and all of segment (2) is visible.

(d) Remove nuts ((4), fig. 3-295) and lift segment (2) away as shown in figure 3-296.

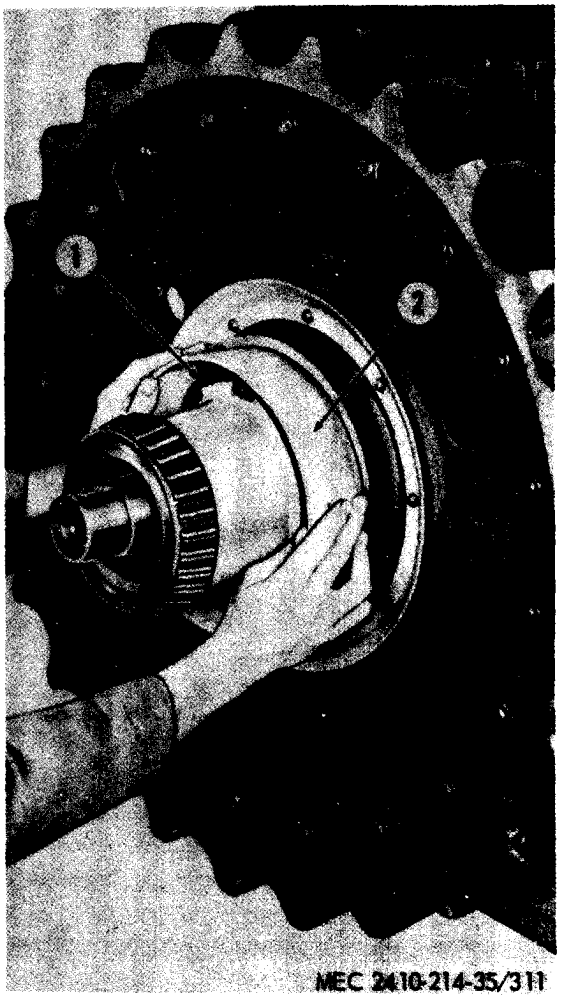
(e) Bolts ((1), fig. 3-296) can be removed if hub is rotated backward far enough so the. bolts will not interfere with the final drive cover.

(3) ***Installation.*** Install in reverse order of removal.

3-60. Final Drive Gear Case

a. Removal.

(1) Remove the final drive ease metal floating ring seal (para 3-58).



1 Metal floating ring seal 2 Seal installer

Figure 3–299. Installing metal floating ring seal.

(2) Remove the bolts securing final drive case ((1), fig. 3-297) to the steering clutch and bevel gear case.

(3) Install three 1/2-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 1/2/-inch-13 NC forged eyebolt. Attach a hoist to the final drive case (weighs approx 350 lb).

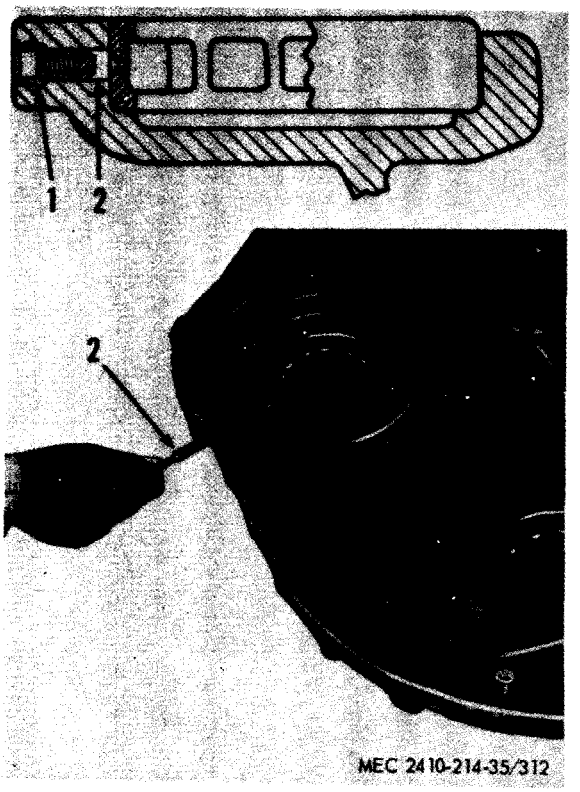
(5) Guide final drive case (1) off dowels (4). Take care not to damage splines of final drive gear hub (3).

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.

(6) Inspect the final drive case-to-steering clutch and bevel gear case gasket for damage.

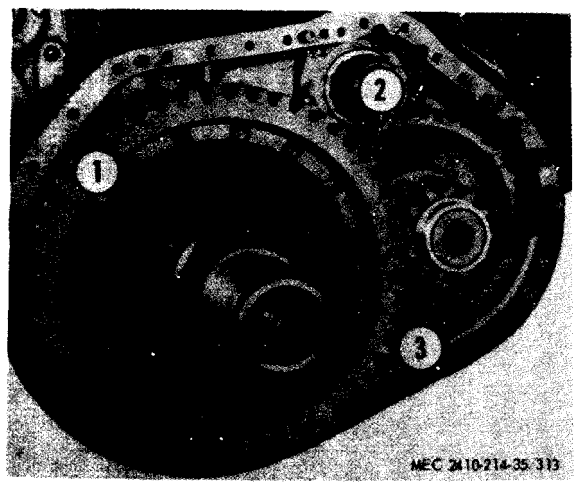
b. Installation.

(1) Install two 5/8-inch-inch-11 NC guide pins



1 Plug
2 Dowel

Figure 3–300. Removing outer race and roller assemblies.

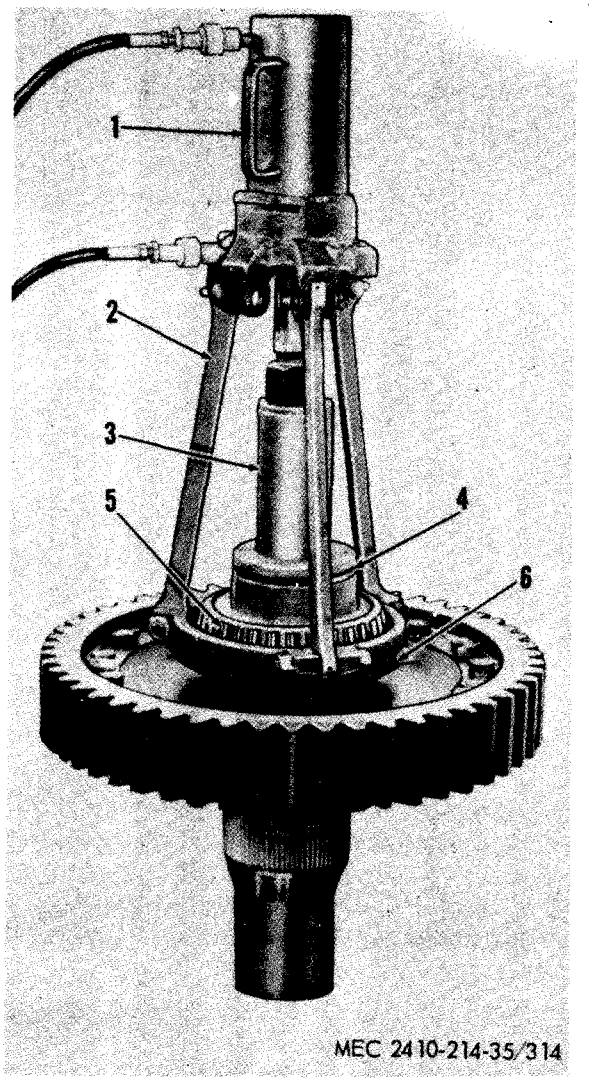


1 Hub
2 Final drive gear
3 Idler pinion

Figure 3–301. Removing final drive gear and hub.

((2), fig. 3-298) attach a hoist, align pinion outer bearing inner races ((5), fig. 3-297) 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.



1 Cylinder group
2 Arm
3 Spacer
4 Spaced (5.75 in. diameter)
5 Bearing cone
6 Puller assembly

Figure 3-302. Hub inner bearing cone removal.

(3) Remove dirt guard ((1), fig. 3-298) 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. 3-299) using installer tool (2) as shown (para 3-58).

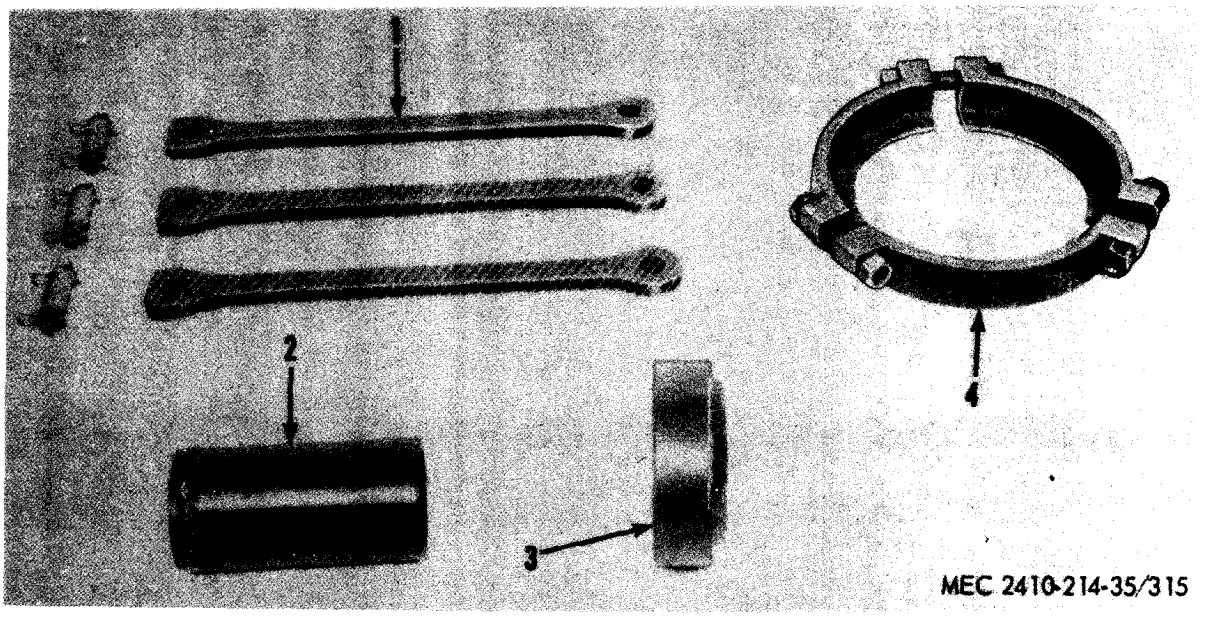
3-61. Final Drive Gear, Idler Pinion, and Bearings

a. Removal.

(1) Remove the final drive gear case as described in paragraph (3-60).

(2) Inspect drive pinion and idler pinion outer race and roller assemblies((6) fig. 3-297) for excessive wear.

(3) Remove both pinion outer race and



1 Arm
2 Spacer
3 Spacer (5.75 in. diameter)
4 Pulley assembly

Figure 3–303. Bearing cone removal tools.

roller assemblies from the final drive case after removing plugs ((1), fig. 3-300) 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.

(5) Attach a hoist to support final drive gear ((2), fig. 3-301) and final drive gear and hub off the sprocket shaft.

Warning: Support idler pinion (3) during removal of final drive gear (2) and The (1). The idler pinion is supported only by the idler pinion inner bearing and is free to fall.

(6) Separate gear (2) from hub (1) after removing the bolts which hold the two together.

(7) Inspect huh inner bearing cone ((5), fig. 3-302) .

(8) Using puller assembly ((4), fig. 3-303), two. arms (1) spacer (3), cylinder group ((1), fig (3-302) 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.

(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. 3-304) .

(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.

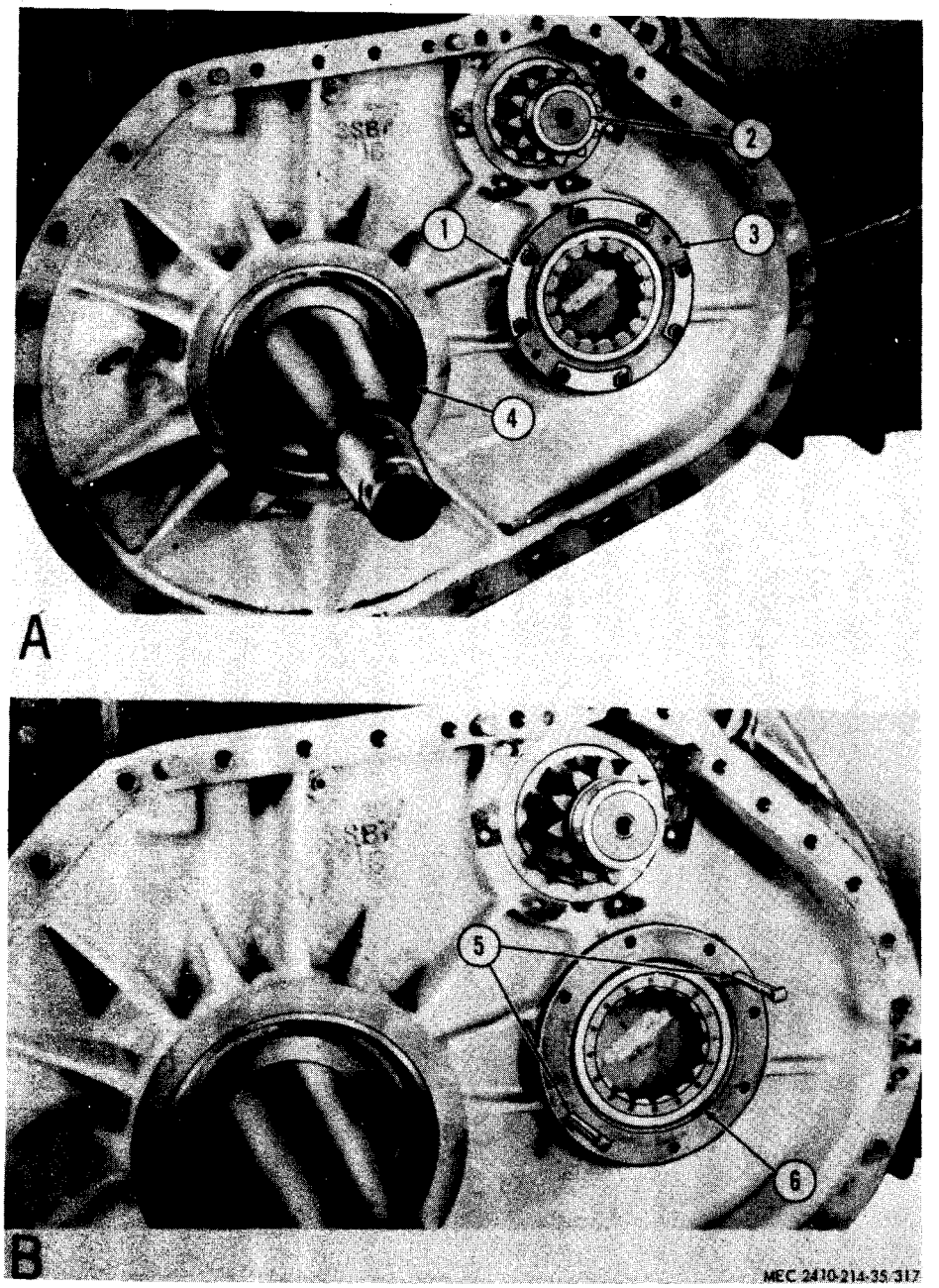
(15) Using a 1/4-inch-20 NC bolt, remove dowel ((2), fig. 3-305) and remove outer race and roller assembly (1).

Note. When installing bearing cage ((3), fig. 3-304) 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.

(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 machine to the other. This will provide a longer service life for the gears and pinions, by wearing both faces of the teeth. Sprocket segments can also be switched from



1 Bolts and locks
2 Pinion gear
3 Cage
4 Cup
5 Forcing screws
6 Oil drain passage

Figure 3-304. Removing bearing cage.

one side to the other. Before assembling final drive, inspect and thoroughly clean all components.

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.

3-62. Sprocket Shaft

a. ***Removal.***

(1) Remove the lockring ((1), fig. 3-306).

(2) Remove the pin securing sprocket retaining nut (2) to the sprocket shaft.

(3) Using a spanner wrench, remove the retaining nut (2).

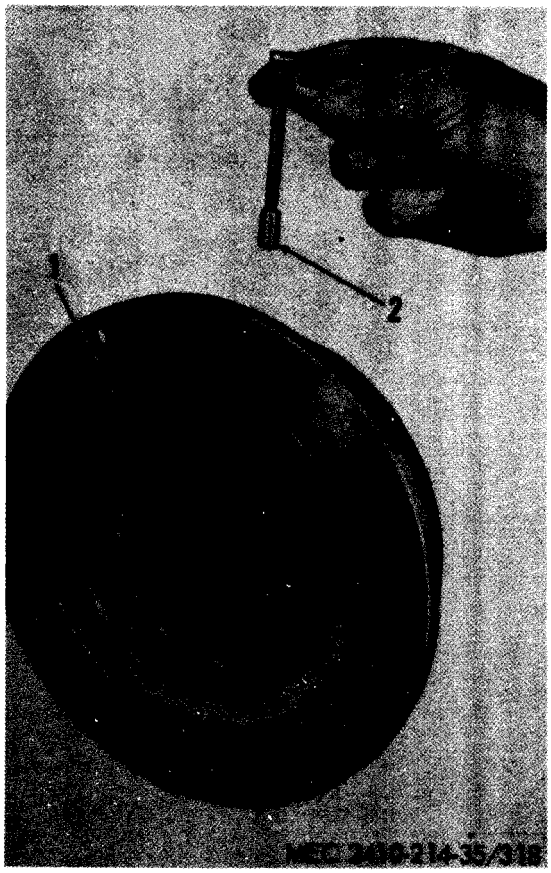
(4) Remove sprocket shaft.

b. ***Installation.***

(1) Attach a hoist to sprocket shaft and position it for installation.

(2) Position sprocket shaft retaining nut and lockring.

(3) insert sprocket shaft in the steering



1 Roller assembly 2 Dowel

Figure 3–305. Removing outer race and roller assembly.



1 Lockring 2 Retaining nut and winch removed

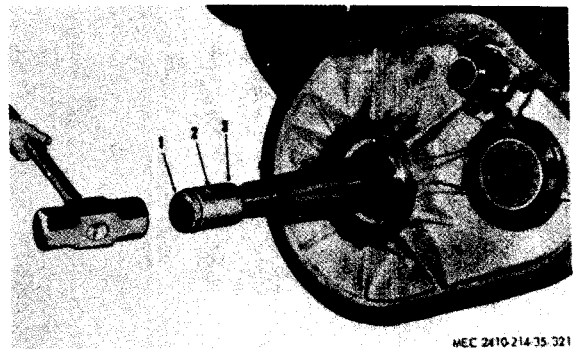
Figure 3–306. Removing retaining nut.

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.

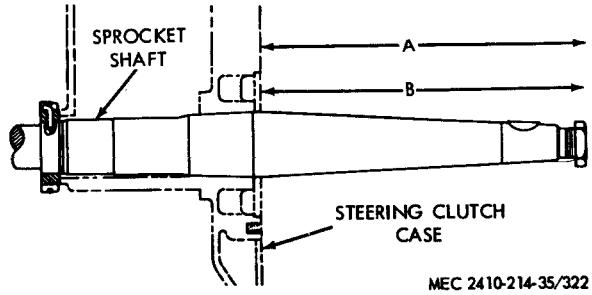
(5) Install adapter ((3), fig. 3-307) plug (1), and coupling pin (2) as shown.

(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. 3-308) is attained.



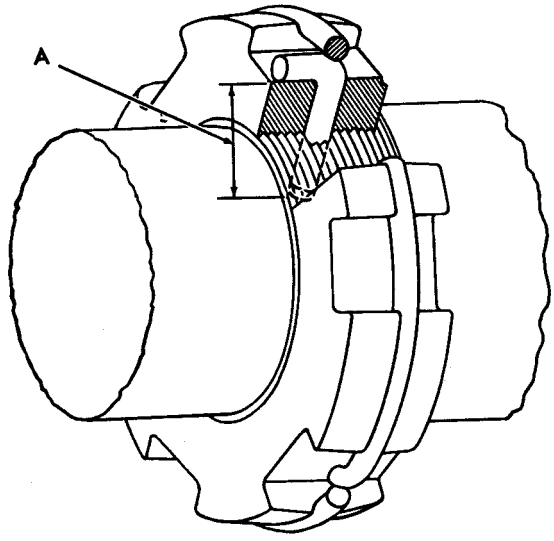
1 Plug
2 Coupling pin 3 Adapter

Figure 3–307. Installing sprocket shaft.



A—22.938 in.–23.062 in. dimension
B—23.485 in.–23.609 in. dimension

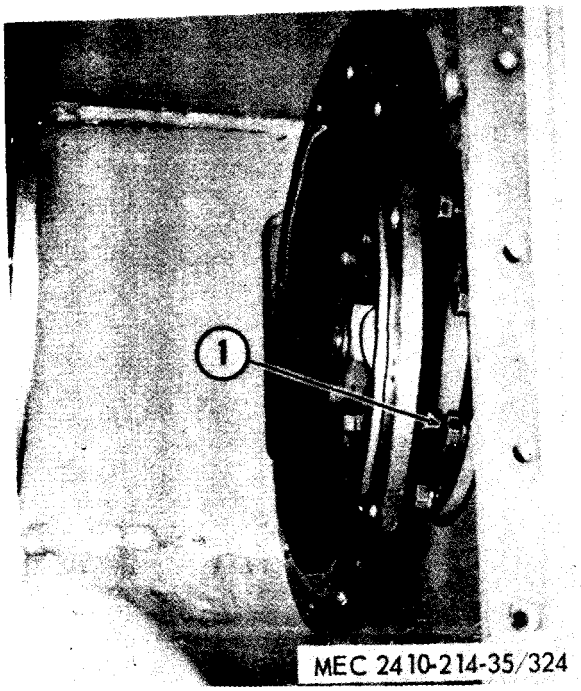
Figure 3–308. Dimensions with sprocket shaft properly installed.



A—.368 in. drill, .56 in. deep in shaft

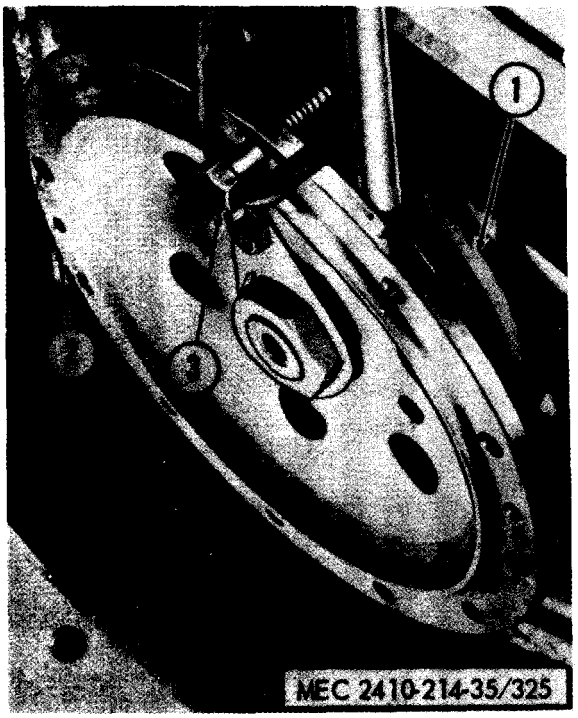
Figure 3–309. Installing retaining nut lockpins.

(7) Maintaining the 55-60 tons pressure on the shaft, tighten retaining nut with a spanner wrench.



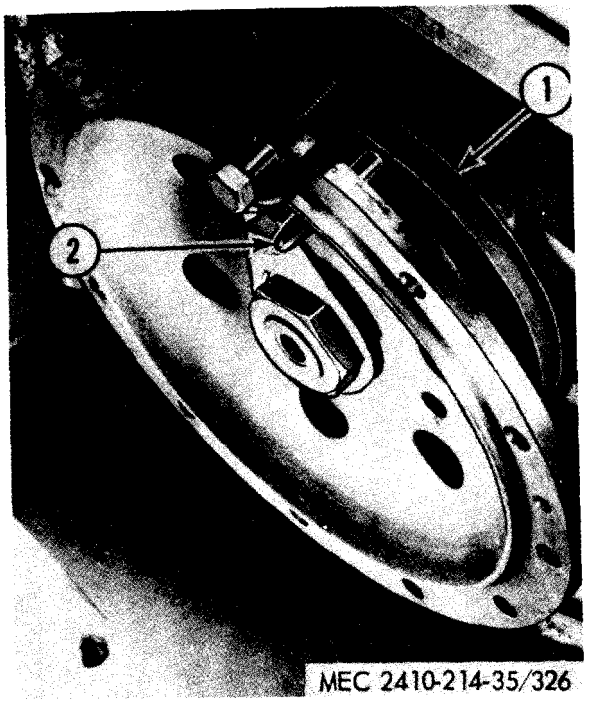
1 Bolts (7)

Figure 3–310. Preparing to remove final drive pinion.



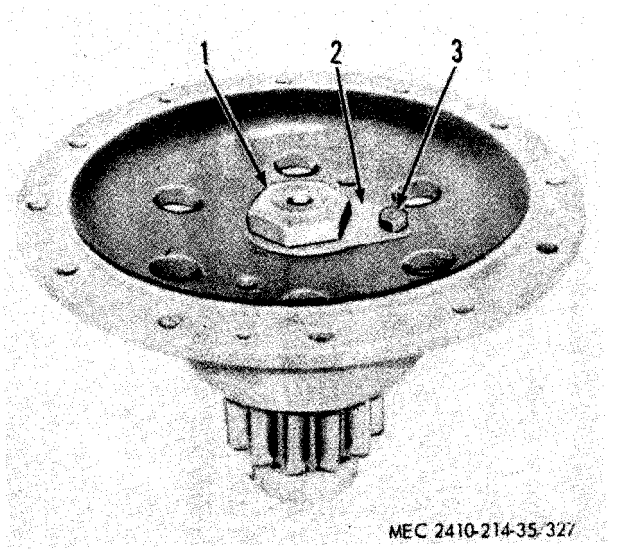
1 Cage
2 Flange
3 Bolt

Figure 3–311. Removing final drive pinion gear.



1 Gasket 2 Guide pin

Figure 3–312. Installing final drive pinion gear.



1 Nut 2 Lock 3 Bolt

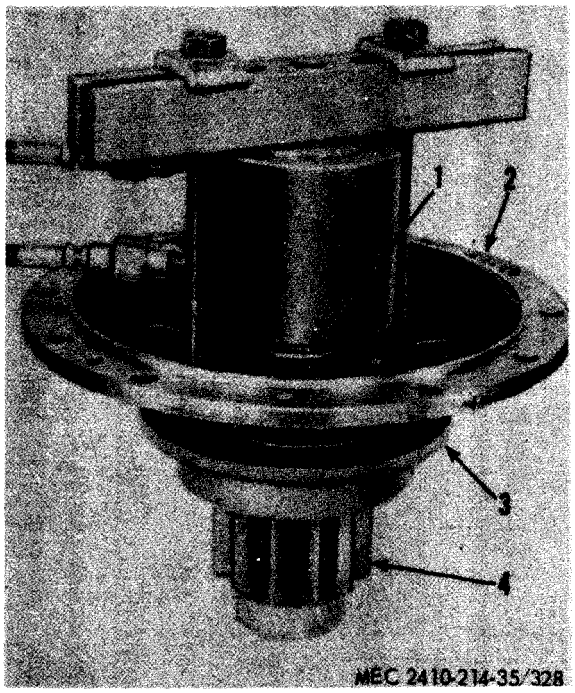
Figure 3–313. Preparing to remove pinion flange.

(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 .368" diameter hole through the nut and .56-inches deep into the sprocket shaft ((A) fig. (3-309). Place the lockpin in the hole and install the lockring to hold it in place.

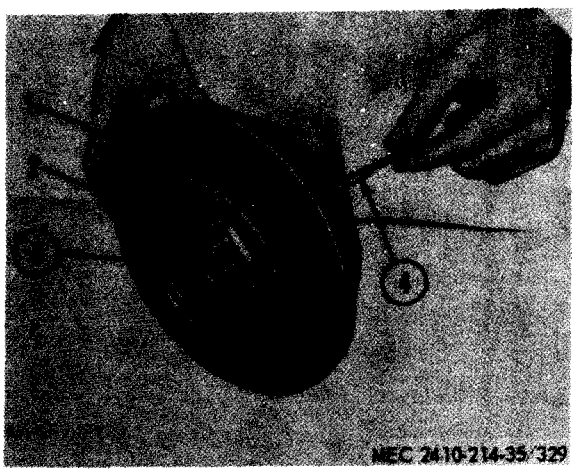
c. *Checking Sprocket Shaft.* Check the final drive sprocket shaft to determine if it is straight.

Note. If the sprocket shaft is bent more than the allowable tolerance, the shaft should be removed and a new shaft installed.



1 Nut
2 Flange
3 Cage
4 Pinion gear shaft

Figure 3–314. Removing pinion flange.



1 Cage
2 Metal floating ring seal
3 Outer race and roller assembly
4 Dowel

Figure 3–315. Removing outer race and roller assembly.

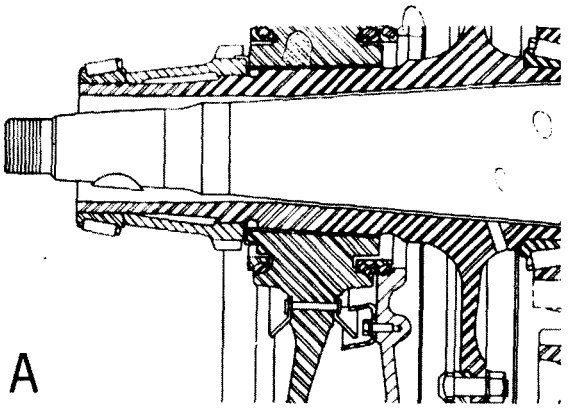
3-63. Final Drive Pinion Group

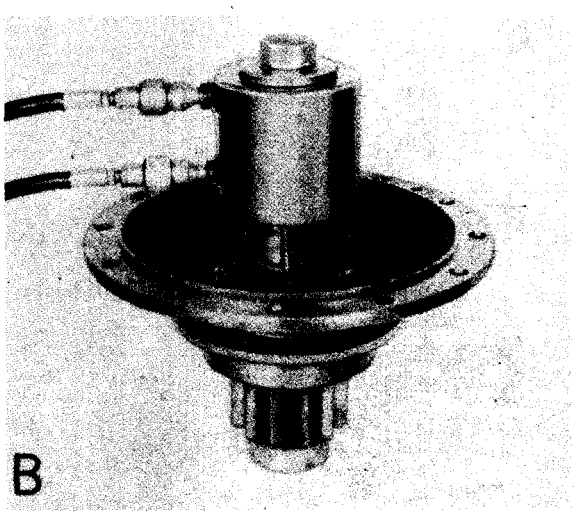
a. Removal and Installation.

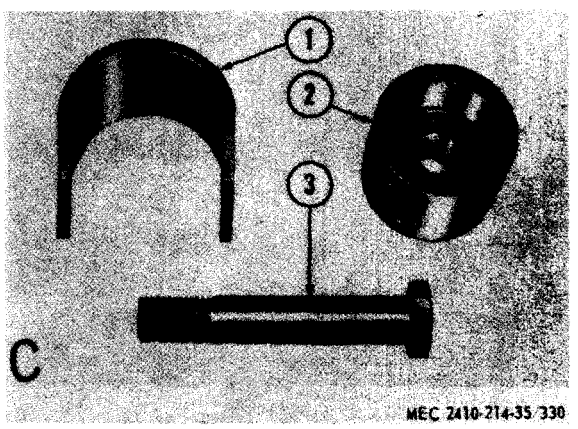
(i) Remove the steering clutch as outlined in paragraph 3-51.

(2) Remove bolts ((1), fig. 3-310).

(3) Insert a bolt ((3), **fig.** (3-311) in one of the steering clutch to pinion flange clearance holes and attach a hoist for support.





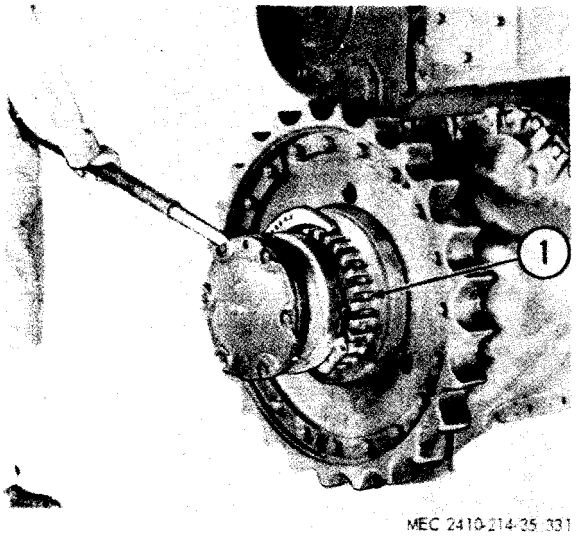


1 Sleeve 2 Adapter 3 Bolt
D—Dimension to be checked = .094 in. – .154 in.

Figure 3–316. Installing pinion flange.

(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. 3-312) to position the bearing cage.



1 Retaining nut

Figure 3–317. Adjusting final drive bearings.

(6) Inspect 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. (3-311) with oil\ drain hole at bottom.

b. Disassembly and Assembly.

(1) Position the final drive pinion assembly as shown in figure 3-313.

(2) Remove the nut (1), bolt (3) and lock (2).

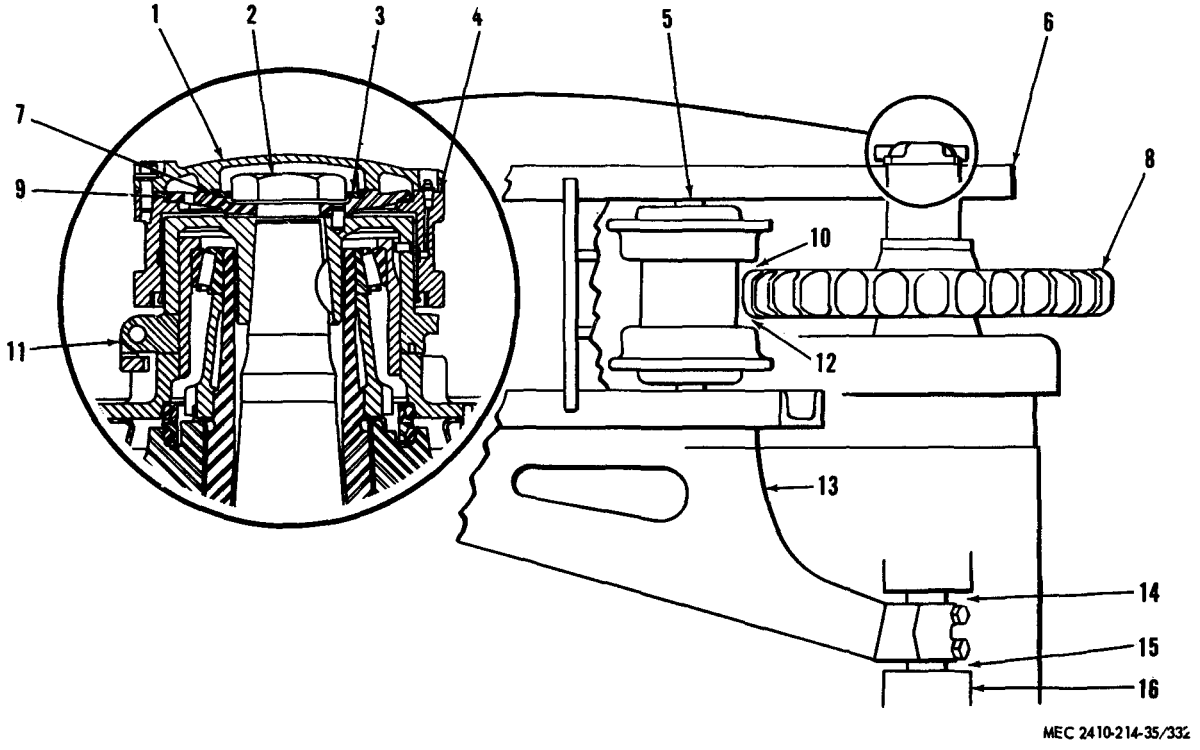
Caution: **Before attempting to remove flange ((2), fig. 3-314) install nut (1) flush with the end of the pinion gear shaft (4) to prevent the pinion flange from becoming damaged while being removed under hydraulic pressure.**

(3) Using a hydraulic puller and a puller (with two 3/4-inch-10 NC bolts approximately 7 ½-inches long), remove flange ((2) fig. 3-314).

Note. The final drive pinion flange can be removed with the pinion installed, using the same tool group.

(4) Remove bearing cage ((1), fig. 3-315) outer race and roller assembly (2) and seal (3) as a unit.

(5) Inspect outer race and roller assembly (2). Using a ¼-inch (20) NC bolt, remove dowel (4) and remove outer race and roller assembly.



1 Cap
2 Nut
3 Shims
4 Outer bearing assembly
5 Rear track roller
6 Track roller frame
7 Lockring
8 Final drive sprocket
9 Retainer assembly
10 Clearance
11 Holder assembly
12 Clearance
13 Diagonal brace
14 Clearance
15 Clearance
16 Steering clutch case

Figure 3–318. Aligning track roller frame with sprocket.

Note. Chill the outer race and roller assembly ore installation. When installing, align the hole in the outer race and replace dowel (4).

(6) Inspect seal (3) and mating seal in pinion flange. To remove and install, (para 3-58) and use a seal installer tool.

(7) Inspect the final drive pinion bearing races and replace if necessary (para 3-61).

(8) When installing the final drive pinion flange (fig. 3-316) 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.

(9) Install adapter ((2), fig. (3-316) 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.

3-64. 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. 3-317) 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.

3-65. Aligning Track Roller Frame With Sprocket

a. When installing track roller frame ((6), fig. 3-318) 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 im are equal.

c. When this is 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).

Section X. TRACK ROLLER FRAME AND TRACKS

3-66. General

The track roller frame assembly ((11), fig. 3-319) 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 3-320 shows a cut away view of track pin and bushing.

3-67. Track Assembly

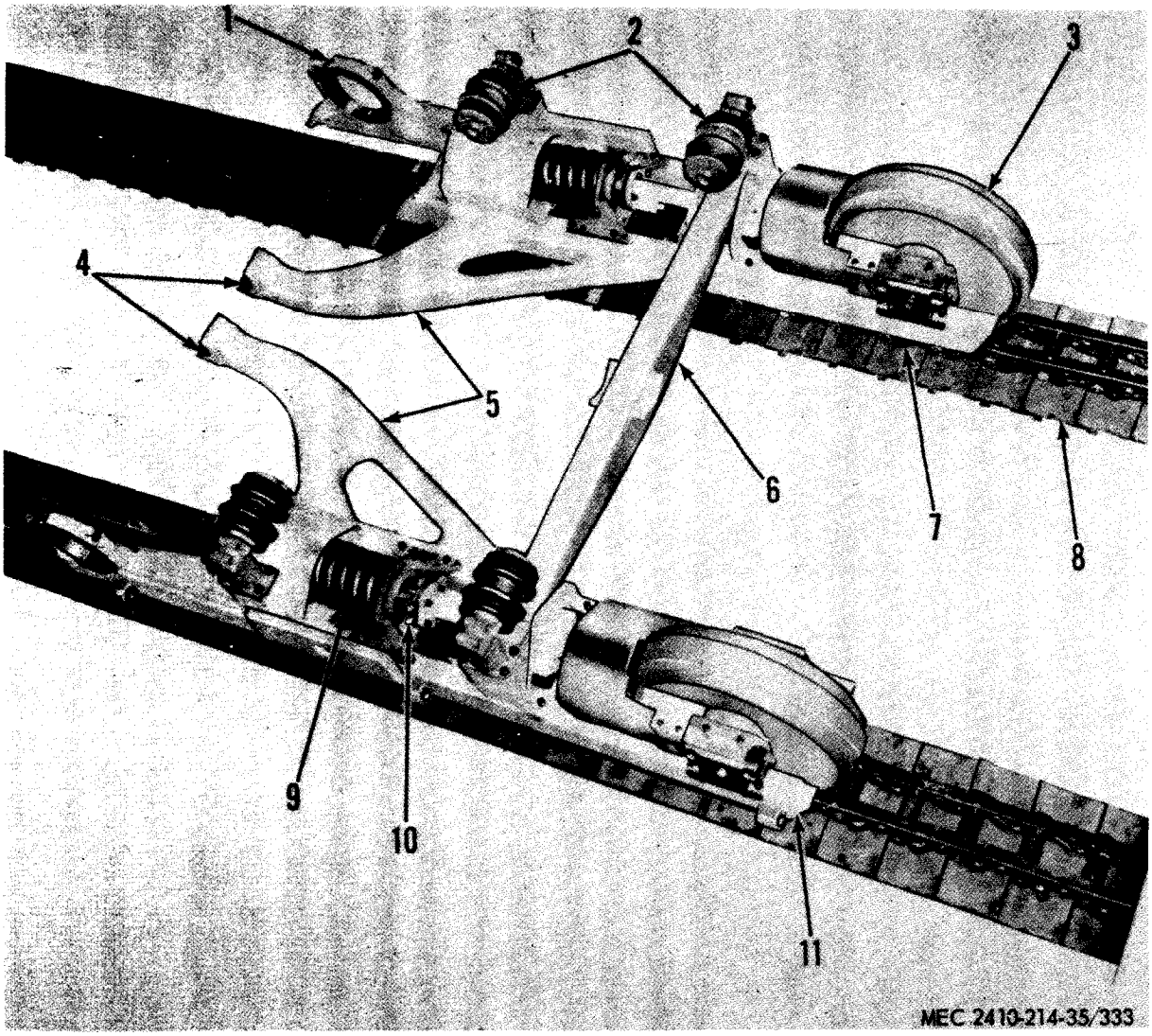
a. Removal and Disassembly.

(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 possibIe 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. 3-321) thoroughly.

(3) Release the pressure in the hydraulic track adjuster cylinder, with CAUTION, as given in the following steps.



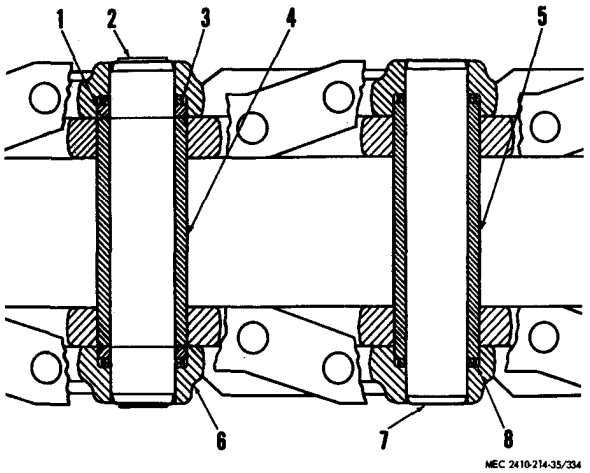
1 Outer bearing cup
2 Track carrier rollers
3 Front idler
4 Diagonal brace bearings
5 Diagonal braces
6 Equalizer bar
7 Track roller
8 Track
9 Recoil spring
10 Hydraulic track adjusting mechanism
11 Track roller frame

Figure 3-319. Tractor roller frame group.

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 is 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 f rent 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. 3-322) is exposed above the flange of the hydraulic cylinder. The lower hexagonal shoulder of the



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 3-320. Track pin and bushing cutaway.

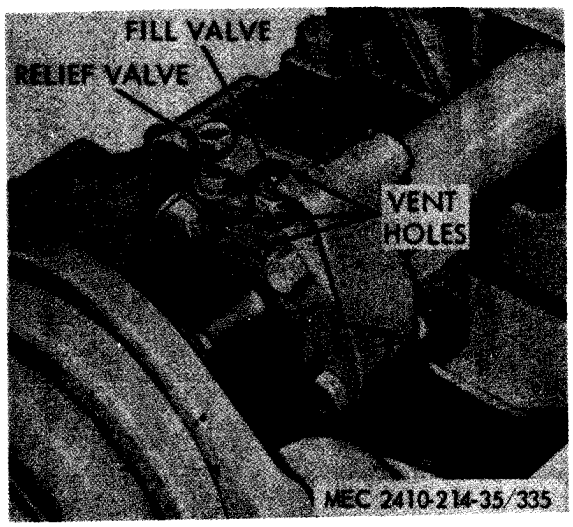
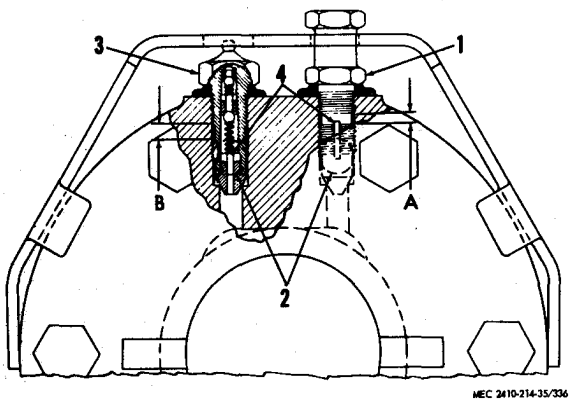


Figure 3-321. *Preparing to separate tracks.*



1 Relief valve
2 Vent holes
3 Fill valve
4 Slots

A and B—Unthreaded sections

Figure 3-322. Relief valve and *fill valve.*

relief valve will contact the underneath side of the guard. Grease should then escape through slot (4) in the lower section of threads.

(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 3-73.

(7) Position the master pin above and slightly behind the front carrier roller.

(8) Install the tools (fig. 3-323) 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.

(9) Separate the track and remove spacers (fig. 3-324) 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.

b. Cleaning, Inspection, and Repair. To obtain maximum life of track pins and bushings, turn the pins and bushings when either the external wear on the bushing or the track pitch increase is .120-inch per link. This dimension is good for average operating conditions. However, if a machine is operating in very sandy and abrasive conditions with little or no shock loading, this demension could be extend to .190-inch.

Caution: **When operating under *shock loading* conditions such as over rough *terrain, do* not exceed the .120-inch dimension.**

c. *Reassembly and Installation.*

(1) Back the machine 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 machine 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. 3-325) and links (5) are

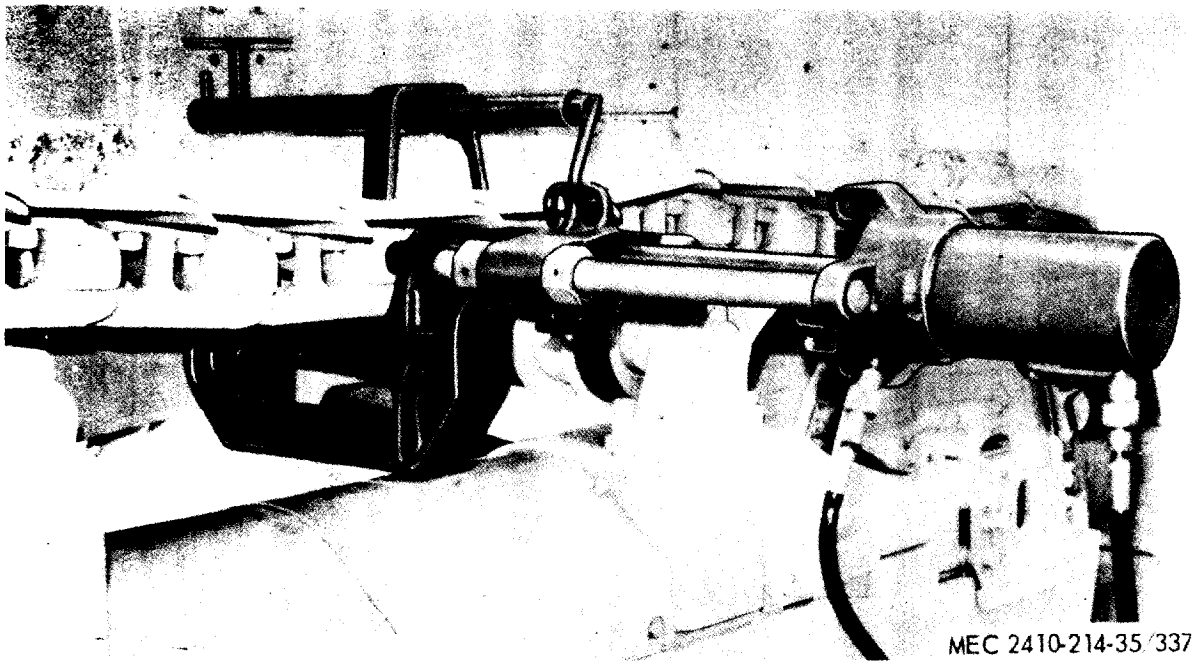


Figure 3–323. Master pin removal group.

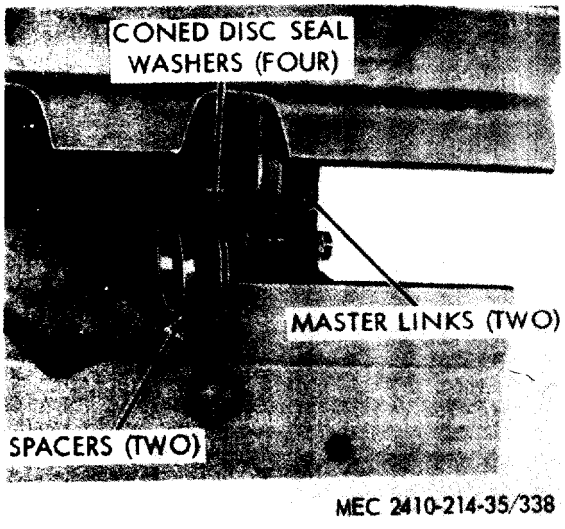


Figure 3-324. Track seal washers and spacers.

approximately l-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. 3–325) and links (5) are approximately 1“ apart and install coned disc seal washers (2) and (3) and spacers (1) in master links (4).

(5) Install each set of coned disc seal washers with one outside diameter facing the counterbore n 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 sel 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 3–325.

(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 paragraph 1–4 for track shoe bolt torque.

Note. Install the track shoe bolt nut with end having the .156-inch corner radii against the track link.

(10) Adjust the track (para 3-73).

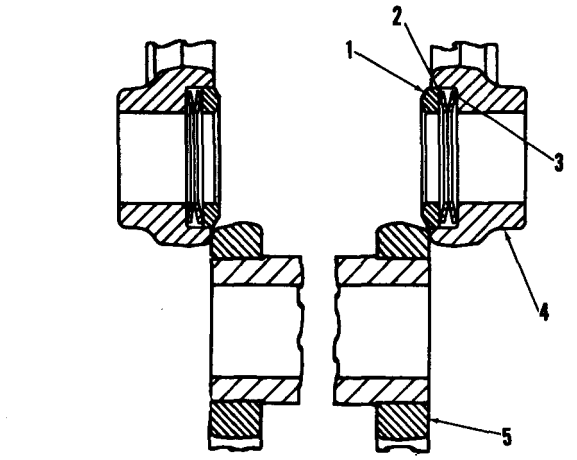
3-68. Track Carrier Rollers

a. Removal.

(1) Loosen the track as outlined in paragraph 3–67.

(2) Lift the track to provide clearance for removal.

(3) Remove the bracket (fig. 3-326) and roller as an assembly.



1 Spacers (2)
2 and 3. Coned disc seal washers (4)
4 Master link
5 Track link

Figure 3-325. Installing seal washers and spacers.

b. Disassembly.

(1) Remove the cover ((6), fig. 3-327) 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. 3-328) 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**

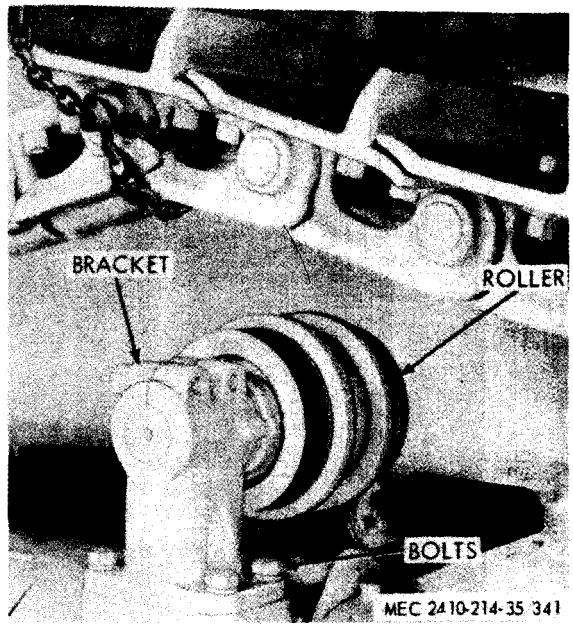
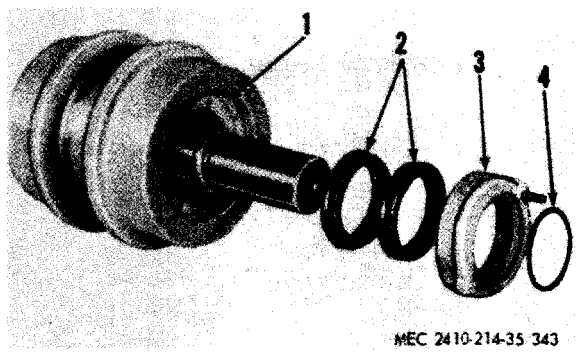
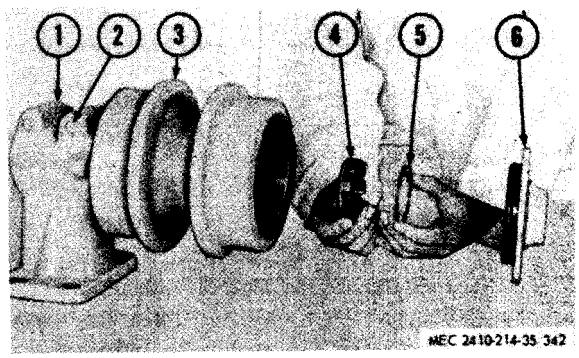


Figure 3-326. Preparing to remove carrier rollers.



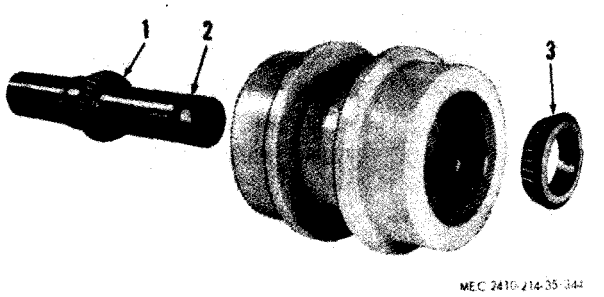
1 Bracket
2 Bolt
3 Roller
4 Nut
5 Lockring
6 Cover

Figure 3-327. Removing nut.



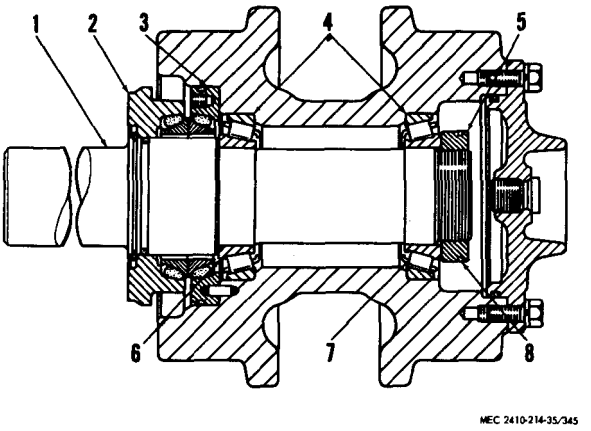
1 Seal support
2 Metal floating ring seals
3 End collar
4 Lock ring

Figure 3-328. Removing metal floating ring seals.



1 Bearing 2 Shaft 3 Bearing

Figure 3-329. Removing bearings.



1 Shaft
2 End collar
3 Seal support
4 Outer races
5 Nut
6 Bearing cone
7 Bearing cone
8 Lockring

Figure 3-330. *Assembling carrier roller.*

that have previously run together. Never assemble one new seal and one used seal together or two seals that have not previously run together.

(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. 3-329) 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.

c. Reassembly and Installation.

(1) Heat the bearing cone ((6), fig. 3-330) 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.**

(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 f acilitate 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 3-58.

(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.

3-69. Track Rollers

a. Removal.

(1) Loosen the tracks as outlined in paragraph 3-67.

(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 untill 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. 3-331) 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.

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. 3-332) 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.

(6) The bearing (fig. 3-333) can be pressed out and replaced provided the bushing is not damaged.

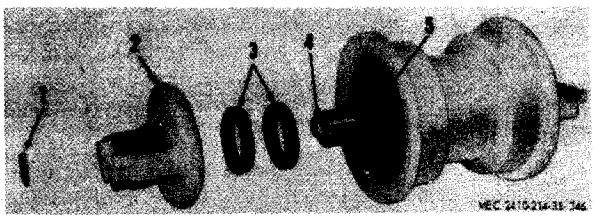
Note. Install new bearings if the shaft clearance exceeds that *given* in table 1-3.

(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 9/3-inch holes 13/16-inch deep through the flange of the bearing and into the wall of the cast iron bushing.



1 Ring
2 Collar
3 Metal floating ring seals
4 Plug
5 Preformed packing

Figure 3-331. Track roller disassembly.

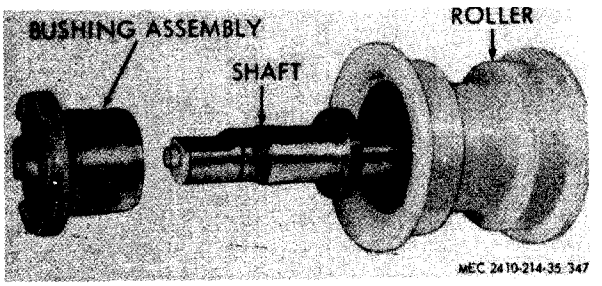


Figure 3-332. Bushing assembly removal.

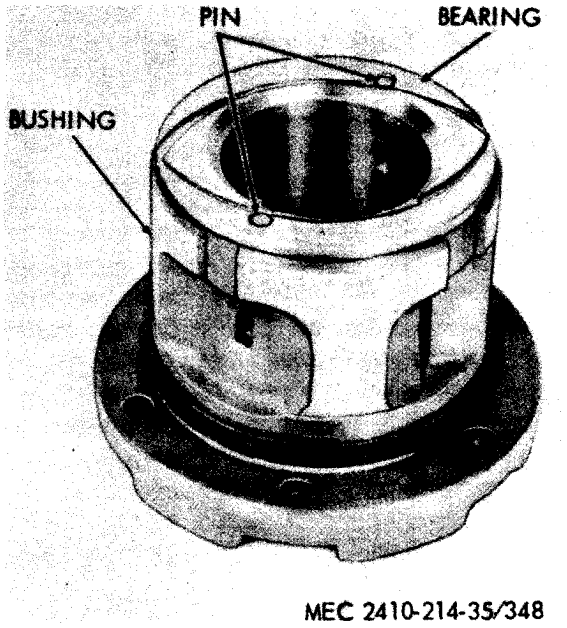


Figure 3-333. Bushing assembly.

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.

c. Assembly.

Note. Care should be taken when pressing the bushing assembly (1, fig. 3-334) 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 1200 apart into the roller hub to act as guides.

(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 3-58.

(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.

d. 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 securey against the track roller frame.

3-70. Front Idler

a. Removal.

(1) Separate the track and lay it out flat (para 3-67).

(2) Remove the guard ((1), fig. 3-335), bolts (2), and guide plate (3).

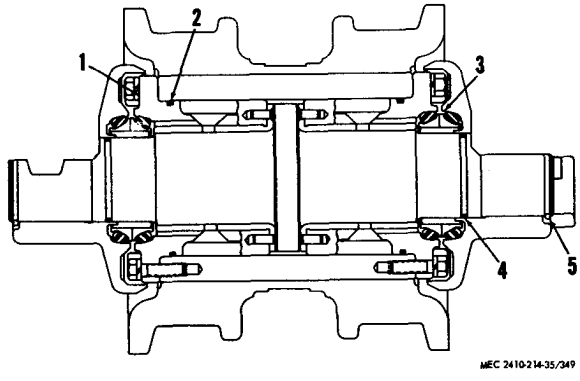
Note. Keep the shims from beneath guide plate (3) together. The same shims will be used for assembly. The following removal procedure is applicable to both sides of the idler.

(3) Remove bolts ((1), fig. 3-336) 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.

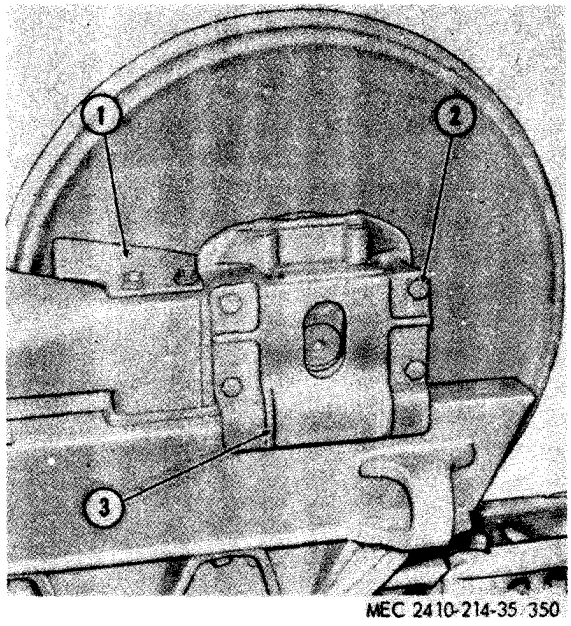
b. Disassembly.

(1) Remove the nuts and washers and drive out the tapered pins that secure bearings ((1), fig. 3-337) and (4) to shaft (5).



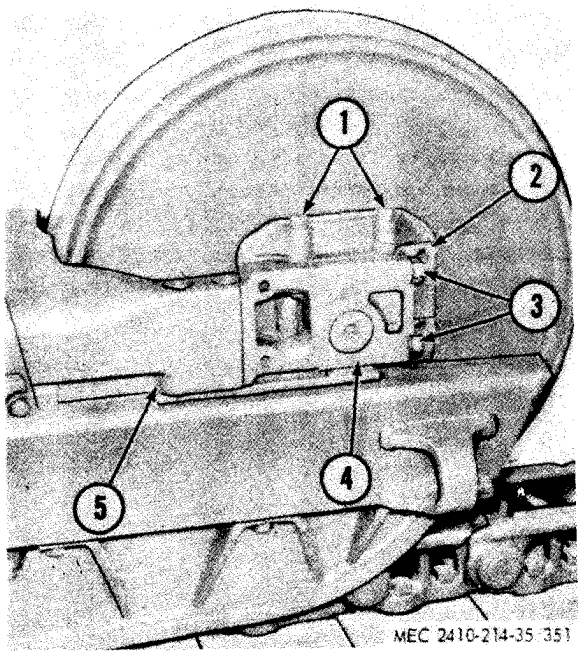
1 Bushing assembly
2 Preformed packing
3 Metal floating ring seal
4 Preformed packing
5 Retaining ring

Figure 3-334. Assembling track roller.



1 Guard
2 Bolts
3 Guide plate

Figure 3-335. Preparing to remove guide plate.

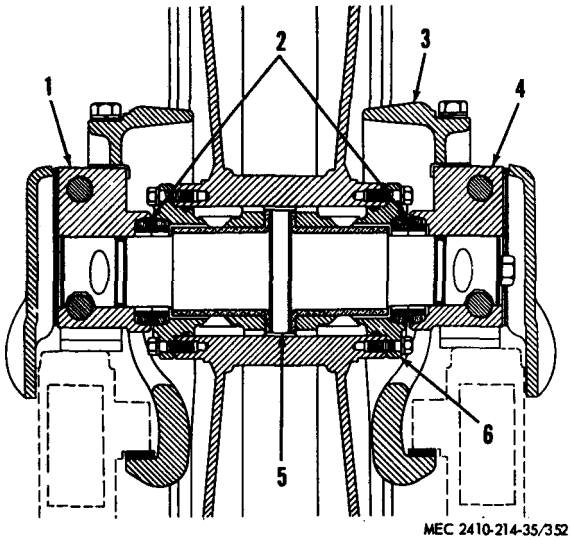


1 Bolts
2 Collar
3 Bolts
4 Bearing
5 Yoke

Figure 3-336. Preparing to remove idler.

(2) Remove bearings (1) and (4) from shaft (5).

(3) Remove floating due-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.



1	Bearing	4	Bearing
2	Floating duo-cone seals	5	Shaft
3	Collars (2)	6	Bushing assemblies (2)

Figure 3-337. Front idler dissassembly.

(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.

c. *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 3-58.

Note. At assembly tighten the nuts on the tapered pins to the initial torque given in paragraph 1-4. Use a hammer and punch to seat the tapered pins and then tighten the nuts to the final torque value.

(3) Lubricate the idler.

d. Installation.

(1) Install the idler in the reverse order of removal.

(2) Align the idler with the track rollers (para 3-71).

e. 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. 3-338).

(2) Remove the bolts, raise collars and revolve bearings and shaft 180 ° so recesses are toward the rear of the machine (fig. 3-339). 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.

3-71. Front Idler Yoke Assembly

a. Removal and Installation.

(1) Separate the track and lay it out flat (para 3-67).

(2) Remove front idler (para 3-70).

(3) Remove recoil rod ((2), fig. 3-340) 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 machine. Align the ear on washer ((4), fig. 3-341) in notch (1) in yoke for use on the right side of the machine. Align ear on washer with notch (2) for tha-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.

b. Front Idler Adjustment.

(1) Install shims ((1), fig. 3-342) 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 within tolerances given in table 1-3.

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.

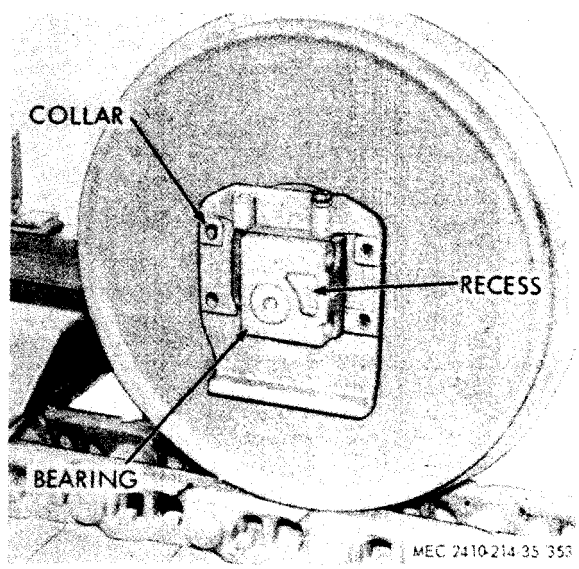


Figure 3-338. Idler bearing in low position.

(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 1-3 for correct clearance.

(3) Shims (4) and (5) areusedto shift the idler from side to side to align idler and track properly.

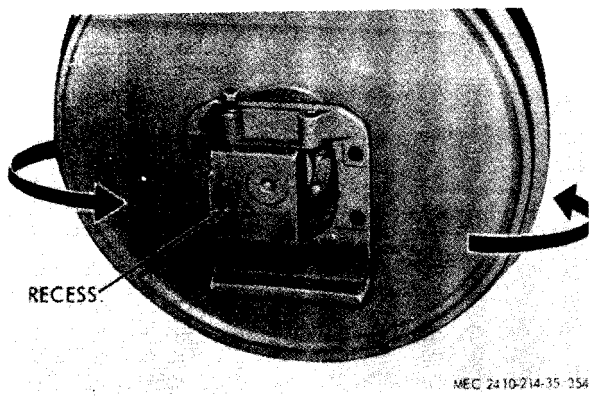
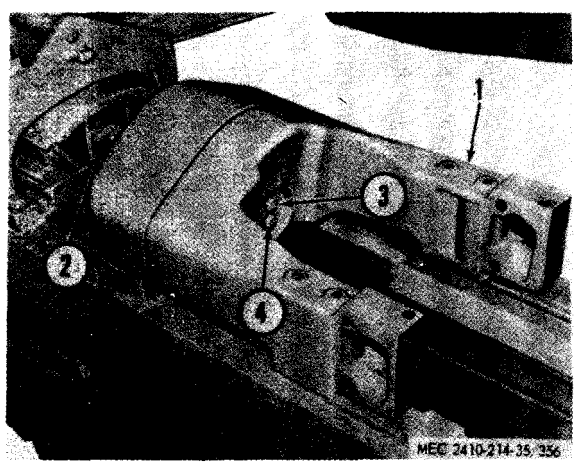
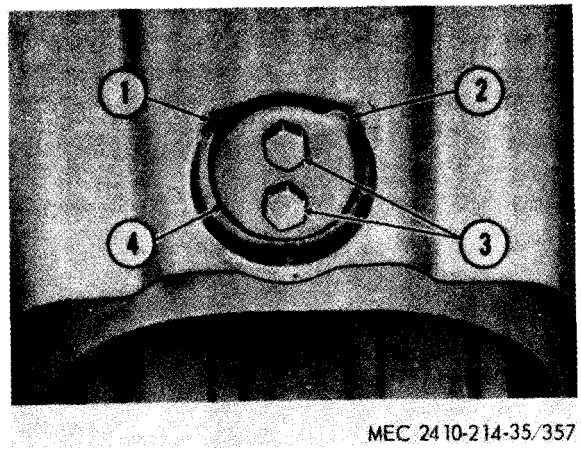


Figure 3-339. Repositioning bearings.



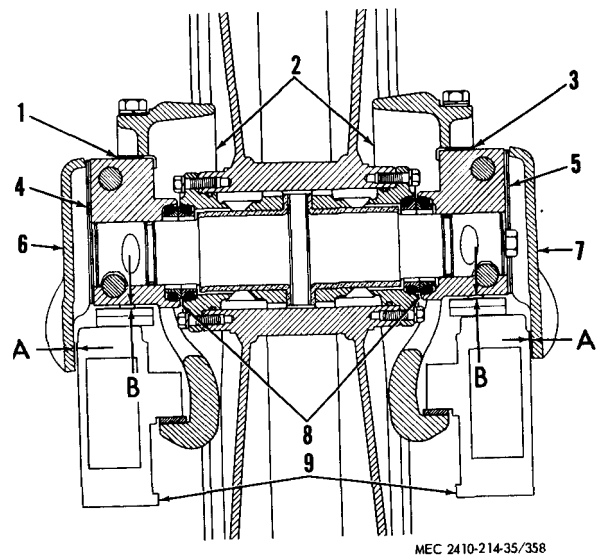
1 **Front idler yoke assembly**
2 **Idler recoil rod**
3 **Washer**
4 **Bolts**

Figure 3-340. Preparing to remove yoke assembly.



1 **Notch for right side use**
2 **Notch for left side use**
3 **Bolts (2)**
4 **Washer**

Figure 3-341. Idler recoil rod alignment.



1 **Shims**
2 **Collars**
3 **Shims**
4 **Shims**
5 **Shims**
6 **Guide plate**
7 **Guide plate**
8 **End bearings**
9 **Frame**
B—Dimension to be checked
A—Dimension to be checked

Figure 3-342. *Aligning idler with track rollers.*

3-72. 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. 3-343). 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 tops, remove locking bolt and washer ((4), fig. 3-344) 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 (para 3-67).

(8) Move cylinder ((5), fig. 3-345) 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. 3-349) and seal (1).

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. 3-346) 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 a hoist to and remove outer recoil spring (4). Remove inner recoil spring (5).

c. *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. 3-347) in inner recoil spring (3) and install front pilot (1).

(4) Fabricate guide pin (5), as illustrated in figure 3-348 and screw it into the recoil spring bolt (4).

(5) Insert bolt ((4), fig. 3-347) 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 1-3).

(7) Remove guide pin (5). Install retaining nut ((6), fig. 3-346).

Note. Install bolt (1) and washer (2) to lock

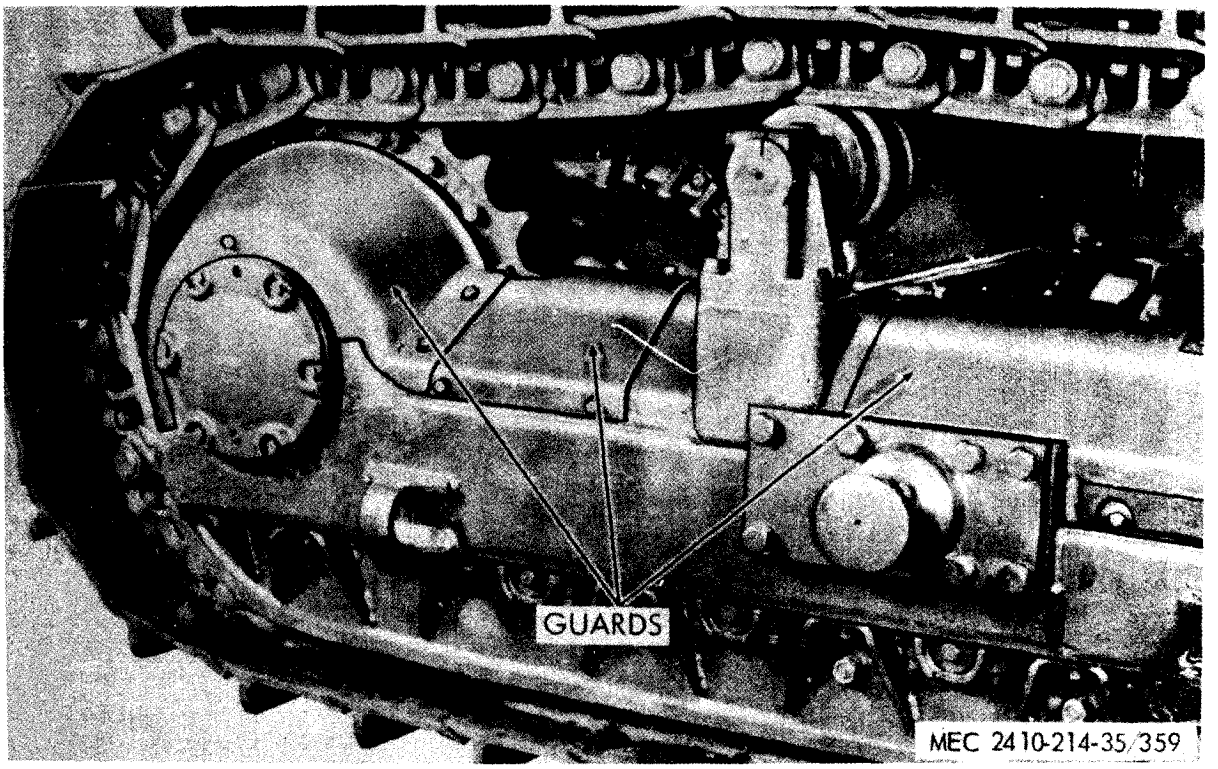
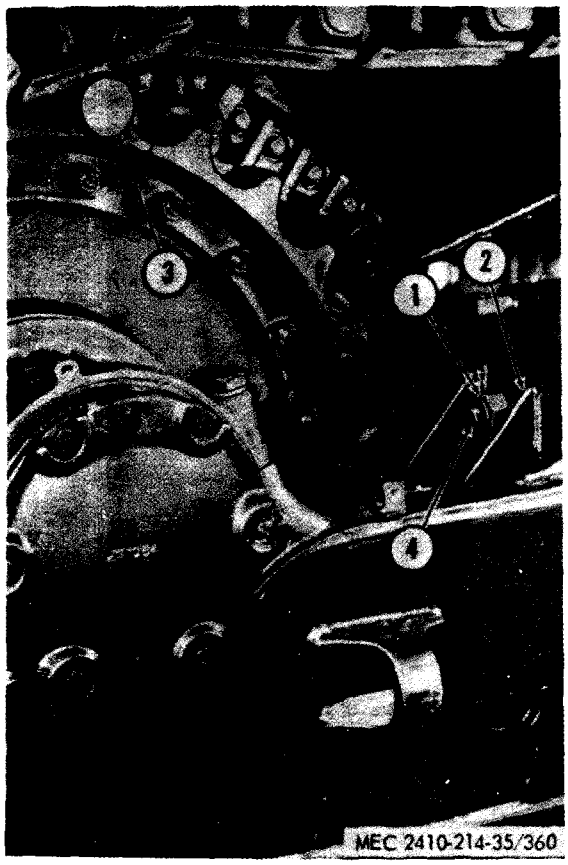
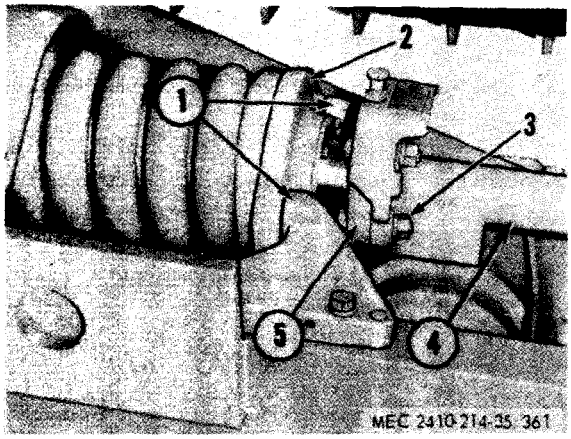


Figure 3-343. Removing guards.



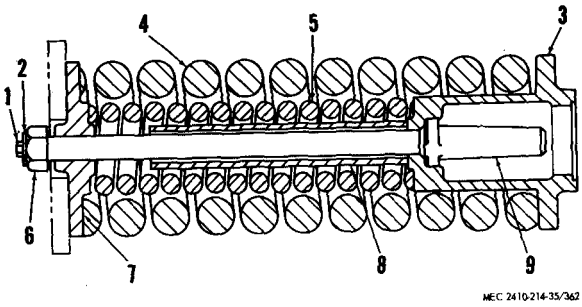
1 Recoil spring bolt nut
2 Recoil spring rear pilot
3 Drawbar pin
4 Locking bolt and washer

Figure 3-344. Removing tension from recoil spring stops.



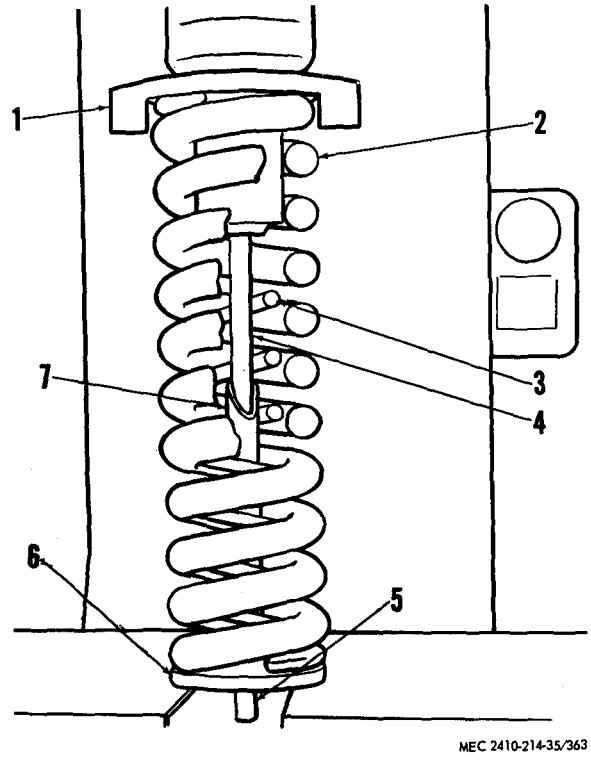
1 Recoil spring stops
2 Recoil spring front pilot
3 Nuts
4 Idler recoil rod
5 Cylinder

Figure 3-345. Removing recoil spring stops.



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 3-346. Recoil spring assembly.



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 3-347. Assembling recoil spring assembly.

retaining nut (6), after the recoil spring assembly has been installed in the machine (a above).

d. Installation.

(1) Install the recoil spring assembly in reverse order of removal.

Note. When installing ((2) fig. 3-349), 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.

(2) After recoil spring stops ((1), fig.

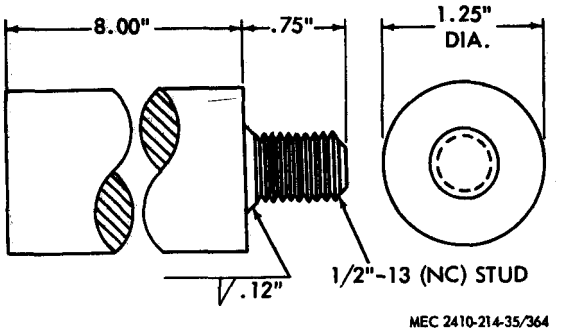
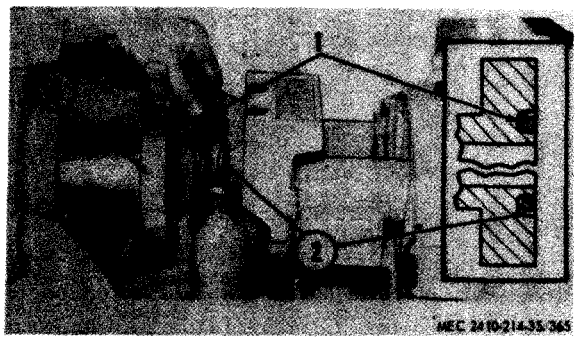


Figure 3-348. Spring bolt guide pin.



1 Seal
2 Antiextrusion ring
3 Cylinder

Figure 3-349. Installing seal and ring.

3-345) have been installed, loosen recoil spring bolt nut ((6), fig. 3-346) 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.

3-73. 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 machines 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 3-67).

(2) Remove guards (fig. 3-343).

(3) Remove either carrier roller support assembly or recoil spring assembly.

(4) Remove bolts and nuts (fig. 3-350).

(5) Remove the seal ((3), fig. 3-351) and antiextrusion ring (4).

Note. When installing antiextrusion ring (4), place the beveled edge toward the cylinder.

(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. 3-352) out of cylinder (1).

(2) Inspect packing (3) and rings (2).

(3) Remove packing (3) and washer (6) after removing snapring (7).

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 l-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. 3-353) opened one turn counterclockwise, force GAA lubricant through fitting in fill valve (3) machines.

(3) When the grease coming out vent hole (2) from the opened relief valve (1) is thick

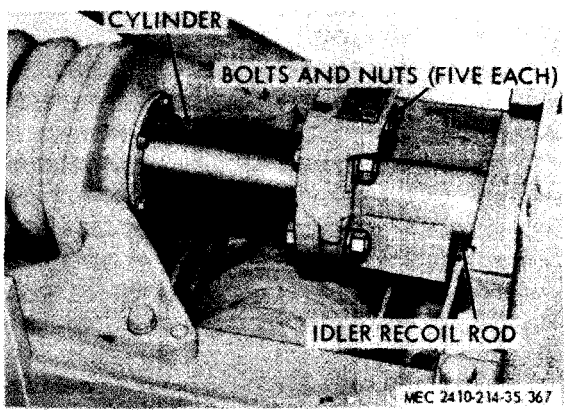
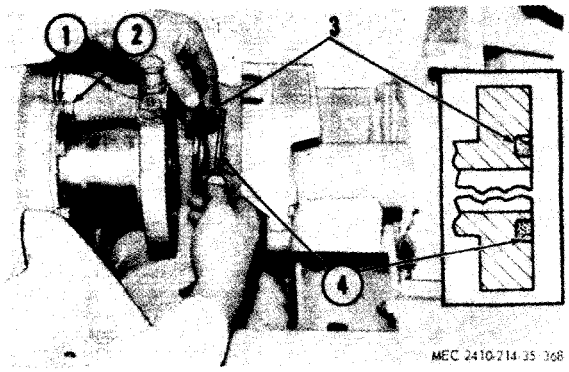
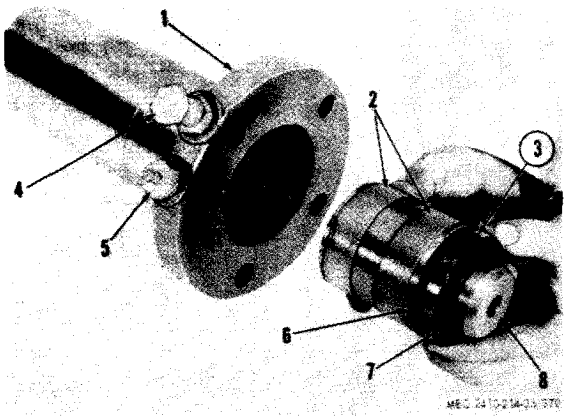


Figure 3-350. Preparing to remove cylinder.



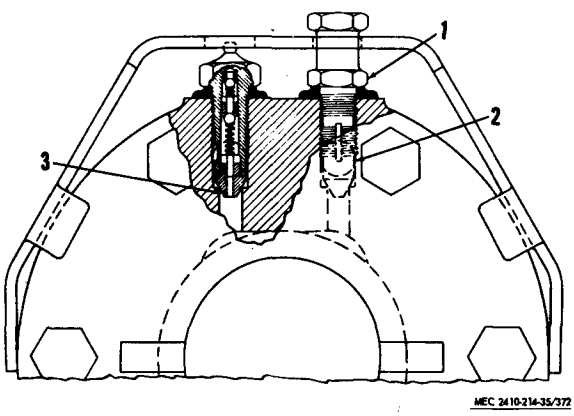
1 Cover
2 Bolt (5)
3 Seal
4 Antiextrusion ring

Figure 3-351. Removing seal and ring.



1 Cylinder
2 Rings
3 Packing
4 Relief valve
5 Fill valve
6 Washer
7 Snapring
8 Piston

Figure 3-352. Cylinder disassembly.



1 Relief valve
2 Vent hole
3 Fill valve

Figure 3-353. Relief valve and fill valve.

close the relief valve and continue filling with lubricant until the track has l-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 1-4.

(5) Make subsequent track adjustments as outlined in TM 5-2410-214-12.

3-74. 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 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. (3-343).

(2) Separate the track and lay it out flat (para 3-67).

(3) Raise the front of the machine until equalizer bar ((3), fig. 3-354) is against roll bar (2). Use blocking to support the front of the machine.

(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.

b. Installation. Install in reverse order of removal.

3-75. Equalizer Bar

a. Removal.

(1) Separate the track and lay it out flat (para (3-67).

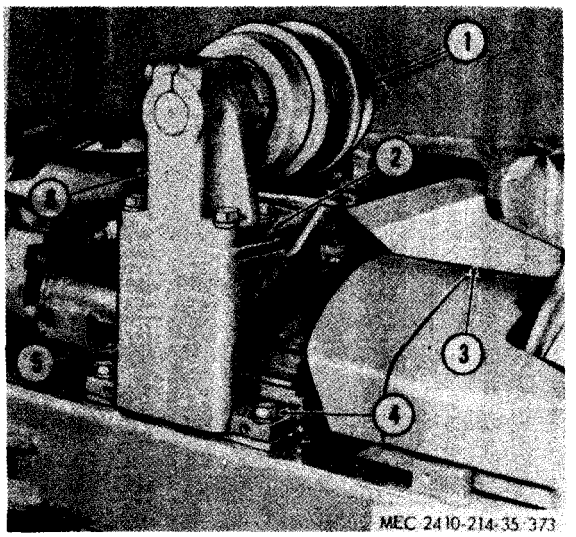
(2) Remove the track carrier roller, bracket and support assembly on one side of the tractor (para 3-74).

(3) From the same side of the tractor, attach a suitable hoist and support the equalizer bar.

(4) Remove plates and pads (fig. 3-355).

(5) Raise the front of the tractor until the plates (fig. 3-356) on the equalizer bar are below the ribs of the support and block the tractor in this position.

(6) Remove the equalizer bar from the tractor.



1 Track carrier roller
2 Roll bar
3 Equalizer bar
4 Bolts
5 Support assembly
6 Track carrier roller bracket

Figure 3-354. Preparing to remove support assembly.

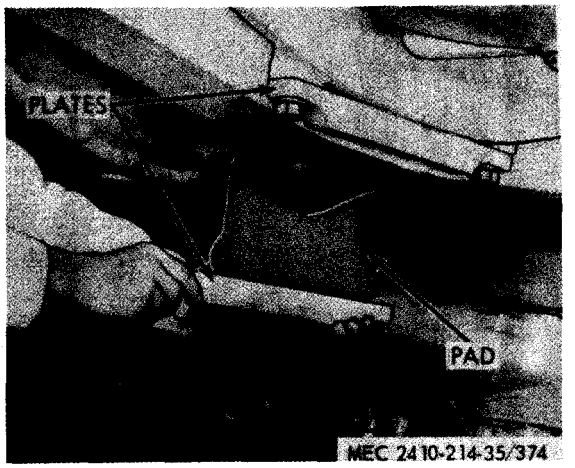


Figure 3-355. Removing plates and pads.

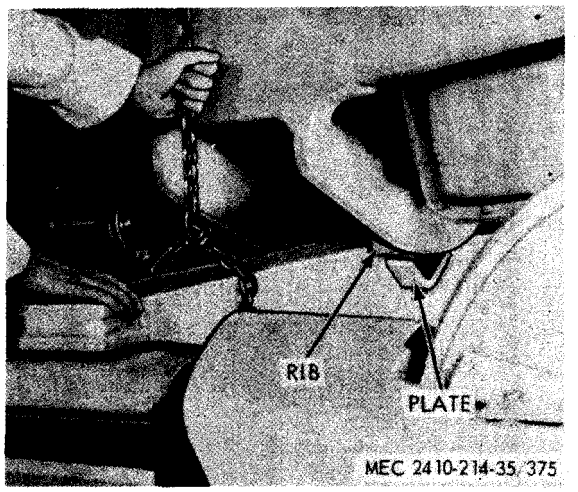


Figure 3-356. Removing equalizer bar.

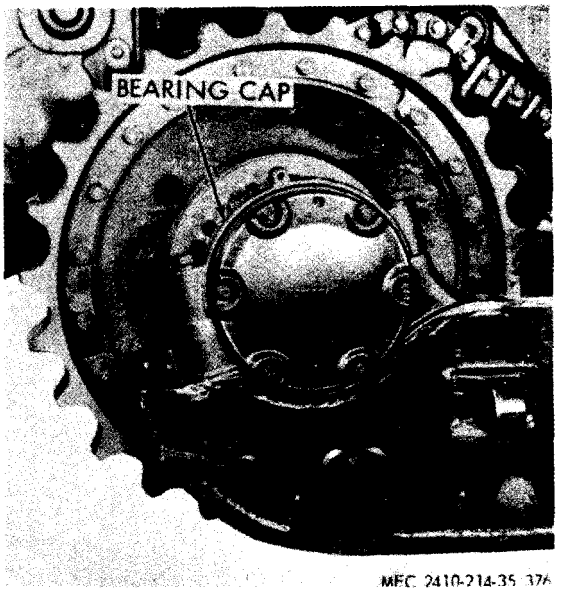
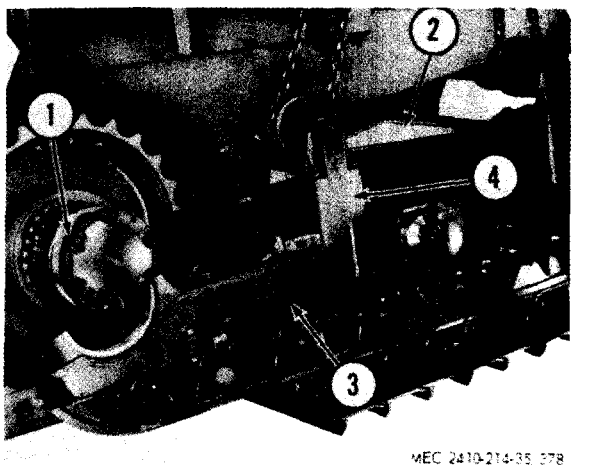


Figure 3-357. Removing outer bearing cap.



Figure 3-358. Removing diagonal brace bearing cap.



1 Track roller frame outer bearing
2 Equalizer bar
3 Track roller frame
4 Track carrier roller support

Figure 3-359. Removing track roller frame.

b. Installation. Install in reverse order of removal.

3-76. Track Roller Frame

a. Removal.

(1) Separate the track and lay it out flat (para 3-67).

(2) Remove sprocket guard and rear track roller frame guard.

(3) Remove outer bearing cap (fig. 3-357), and brace bearing cap (fig. 3-358).

(4) Raise andsupport 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 asuitable sling and hoist around the track carrier rollers, to support the track roller frame ((3), fig. (3-359). The track roller frame weighs approximately 4350 pounds.

Note. Adjust the hoist sling to position the from of the track roller frame slightly higher than the rear.

(6) Raise the track roller frame to tran fer the weight of the track roller frome, 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. 3-360) 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. Installation.

(1) Install the track roller frame in the reverse order of removal.

(2) Install and adjust the track.

Section XI. CHASSIS AND MAIN FRAME

3-77. Seat and Seat Frame

a. Removal.

(1) Remove seat ((3), fig. 3-361). Refer to TM 5-2410-214-12.

(2) Remove left arm rest (2).

(3) Remove winch control levers and bracket (1).

(4) Disconnect brake lock linkage (4).

(5) Disconnect transmission linkage ((1), fig. 3-362) and (2).

(6) Disconnect electric cable (3).

(7) Disconnect electrical cables (4) at the battery and pull from battery box through seat frame opening into the seat frame.

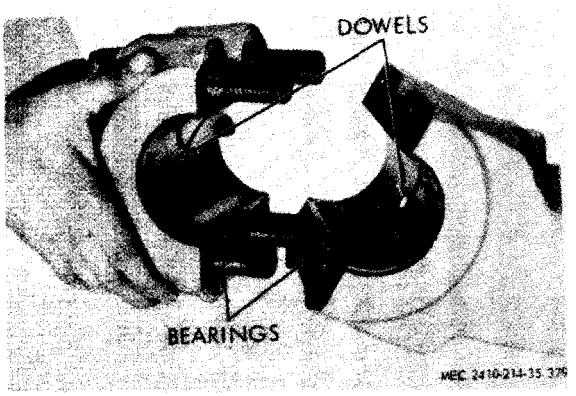
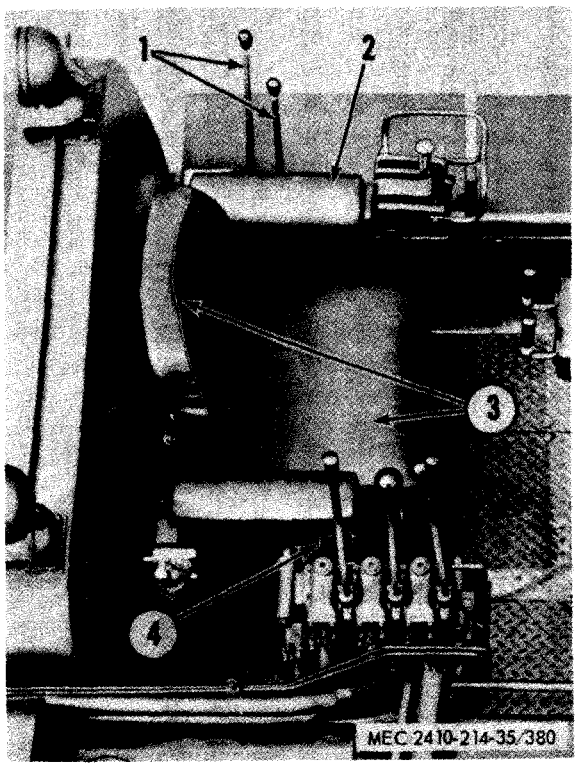


Figure 3-360. Bearing cap assembly.



1 Winch control levers and bracket
2 Left arm rest
3 Seat
4 Brake lock linkage

Figure 3-361. Preparing to remove seat frame.

(8) Disconnect rod (5) from linkage assembly (7).

(9) Remove mounting bolts (6), turn linkage assembly (7) so seat frame can be moved to left.

(10) Attach a hoist, move seat frame to the left and raise to remove.

b. Installation. Install in reverse order.

3-78. Brake Pedal and Support Assembly Removal and Installation

a. Removal.

(1) Remove the seat, seat frame and floor plates.

(2) Remove dozer lift and tilt control lever ((2), fig. 3-363) and scraper valve support bracket (1).

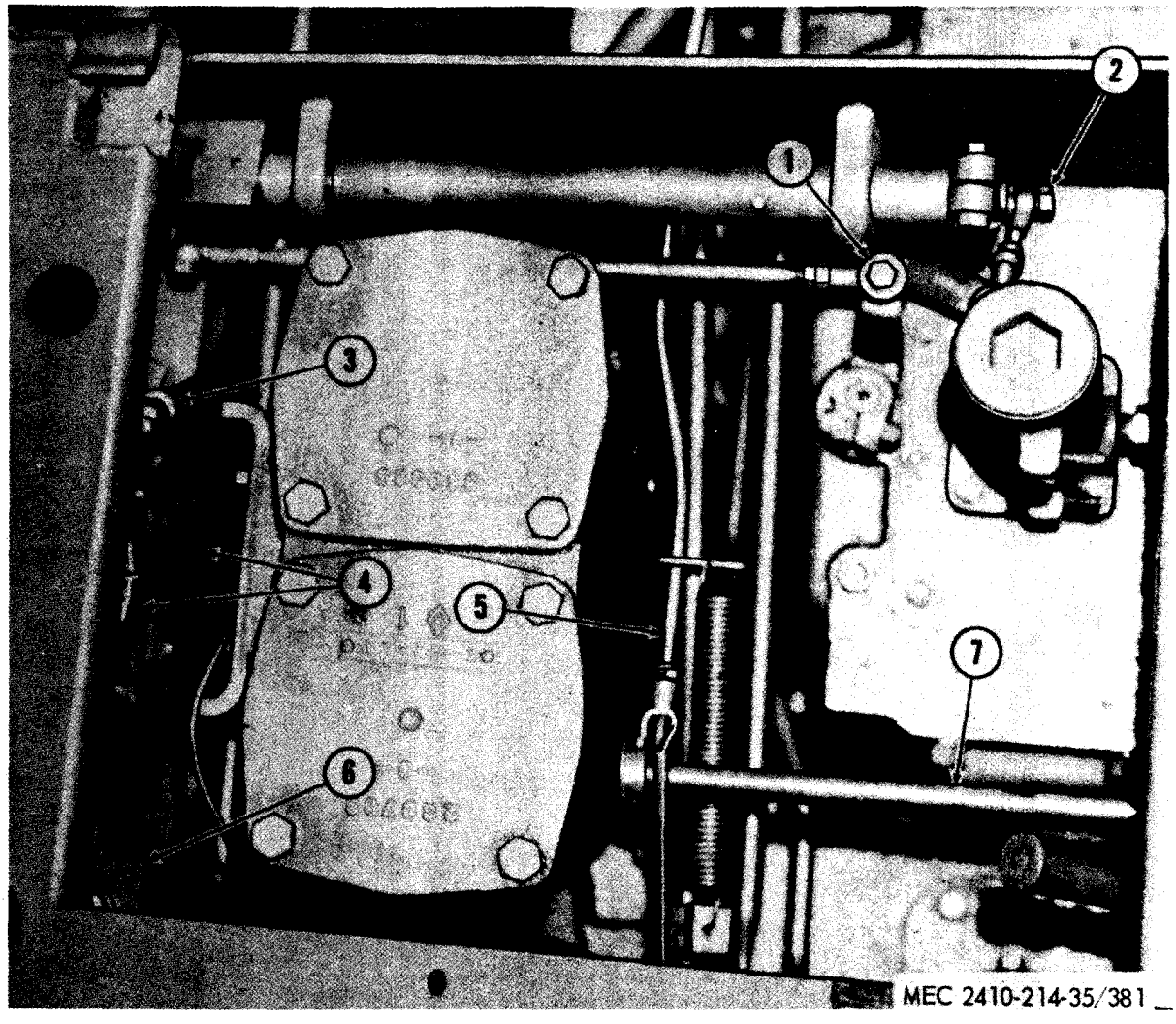
(3) Disconnect dozer tilt valve linkage at hydraulic tank and lift valve linkage rod (8) from bottom of control lever linkage (3).

(4) Remove lug (7), plate (4) and control lever linkage (3).

(5) Disconnect brake lock rod (17) at foot pedal end.

(6) Remove bolts securing brackets (11) and (13) and remove brackets with brake lock linkage (12) in place.

(7) Disconnect steering clutch control rods (15) at both ends and slide forward to clear support assembly (14).



1 Transmission linkage
2 Transmission linkage
3 Electric cable
4 Electric cables (2)
5 Rod
6 Mounting bolts
7 Linkage assembly

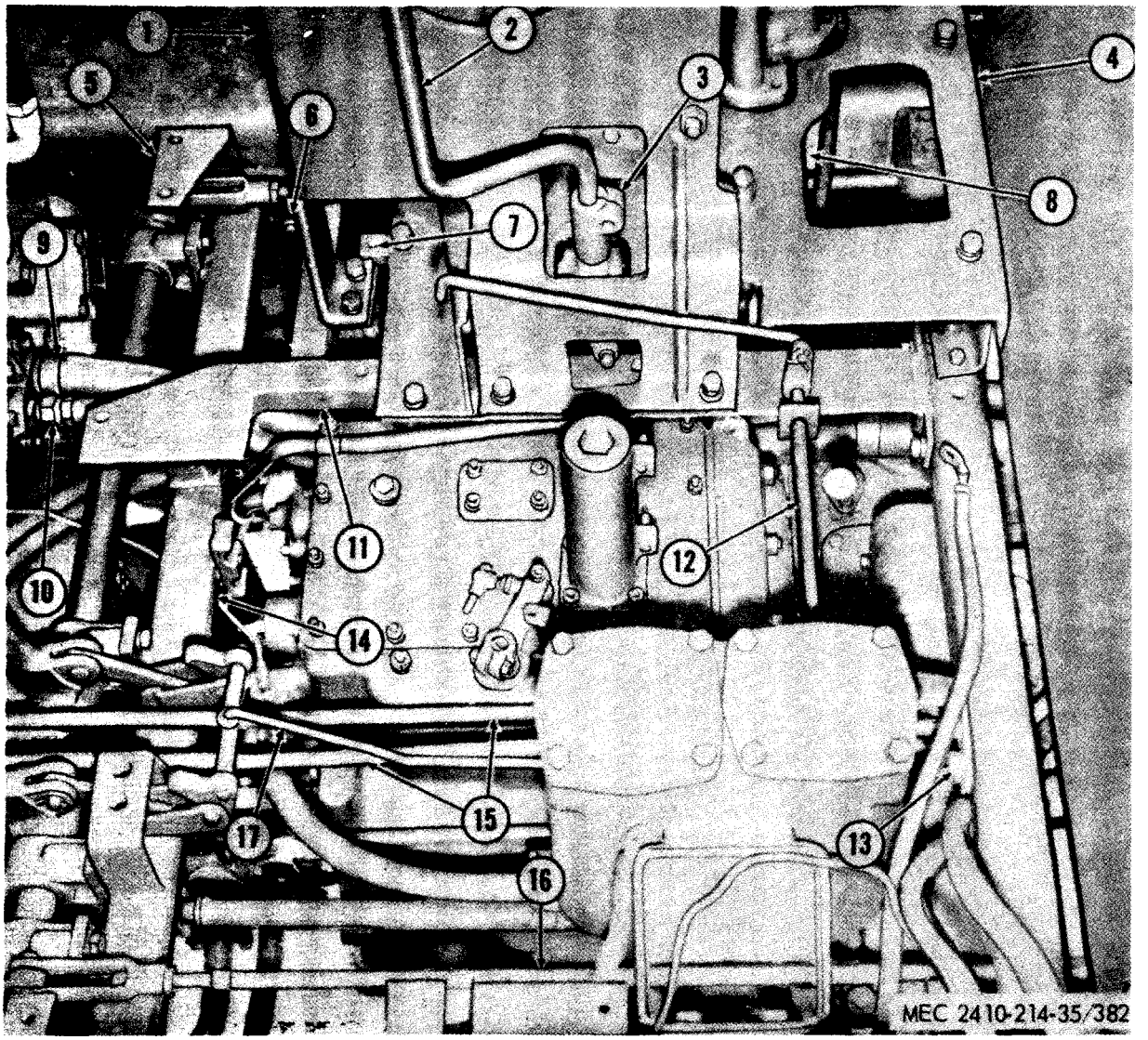
Figure 3-362. Preparing to remove seat frame.

(8) Remove brake control rods (6) and 16) .

(9) Remove bracket (5) and disconnect hoses (9) and (10).

(10) Remove eight bolts and remove brake pedal and support assembly (14).

b. Installation. Install in reverse order.



1 Support bracket
2 Lever
3 Control lever linkage
4 Plate
5 Bracket
6 Brake control rod
7 Lug
8 Valve linkage rod
9 Hose
10 Hose
11 Bracket
12 Brakelock linkage
13 Bracket
14 Support assembly
15 Clutch control rods
16 Brake control rod
17 Brakelock rod

Figure 3-363. Brake pedal and support removal.

3-79. 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 operation of a rear mounted attachment such as a scraper.

3-80. Hydraulic Tank

a. Removal and Installation.

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

(2) Drain the hydraulic tank. Refer to TM 5-2410-214-12.

(3) Disconnect hydraulic lines ((1), fig. 3-364) and (3) below tank.

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

(5) Refer to paragraph 3-78 and follow (1) through (4).

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

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

(8) Disconnect bulldozer control linkage (15).

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), (13), and (14) and remove the hydraulic tank.

(11) Install in reverse order of removal replacing all damaged gaskets and seals.

b. Disassembly and Reassembly.

(1) Remove bolts ((2), fig. 3-365) and remove mounting plate (3) and manifold (6) as a unit (weighs approx 70 lb).

(2) See paragraph 3-82 for the removal of pressure relief valve (5).

3) Remove bolts ((2), fig. 3-366) 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. 3-365) 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 assemby (1) which weighs approximately 300 pounds.

(6) Refer to TM 5-2410-214-12 for filter cap and filter removal.

(7) Assemble in the reverse order.

3-81. Bulldozer Control Valve

a. Removal and Installation.

(1) Remove the hydraulic control tank from the machine (para 3-80).

(2) Remove the tank assembly from bottom plate ((6), fig. 3-367).

(3) Remove bolts (3) and (13) 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.

(8) At installation, tighten bolts (3), (7), (8), and (12) to 60 ±2 lb-ft.

(9) Install in reverse order of removal.

b. Valve Spool Removal.

(1) Remove and inspect plug assemblies ((2), fig. 3-368) and inspect them for broken springs. The balls encased in the end of the plugs engage detent ((1), fig. 3-369) to hold valve spool ((4), fig. 3-368) in the FLOAT position.

(2) Remove bolt and lockwasher (5).

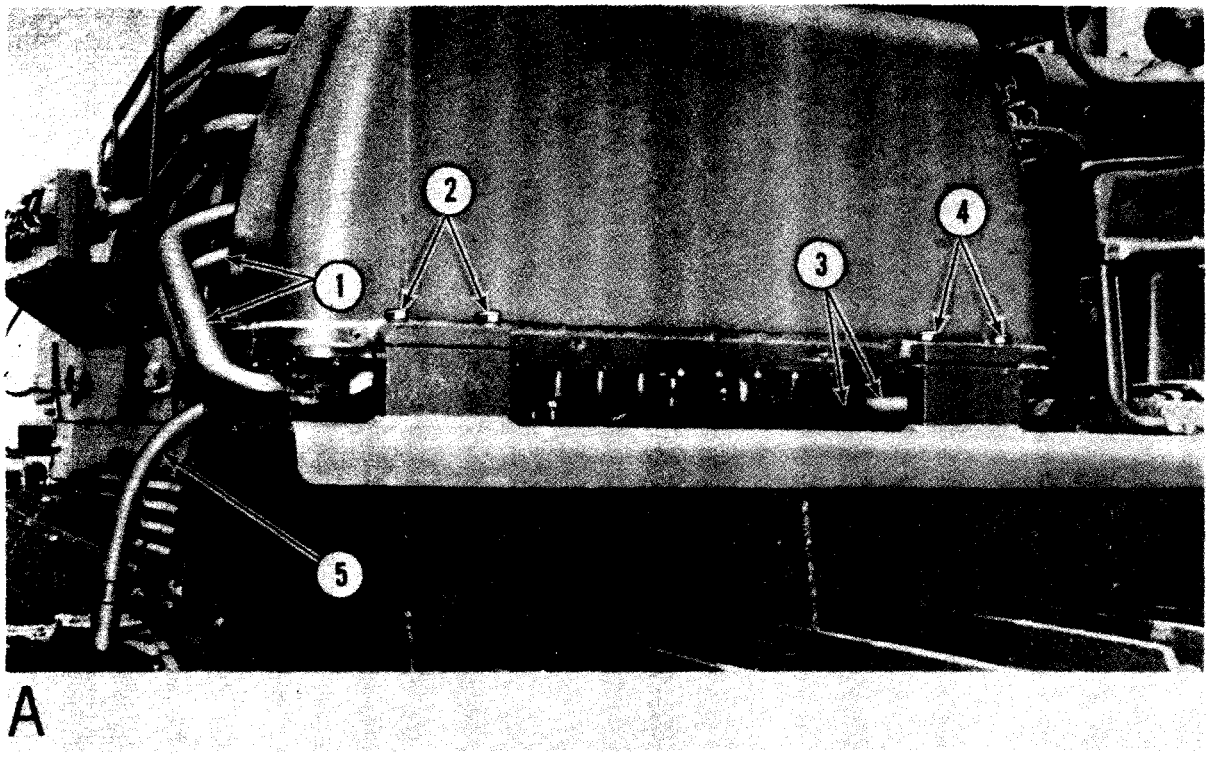
Caution: **Valve body (3) and spool (4) are machined to close tolerances. To avoid distortion of spool (4), leave spool in valve body when loosening or tightening bolt (5).**

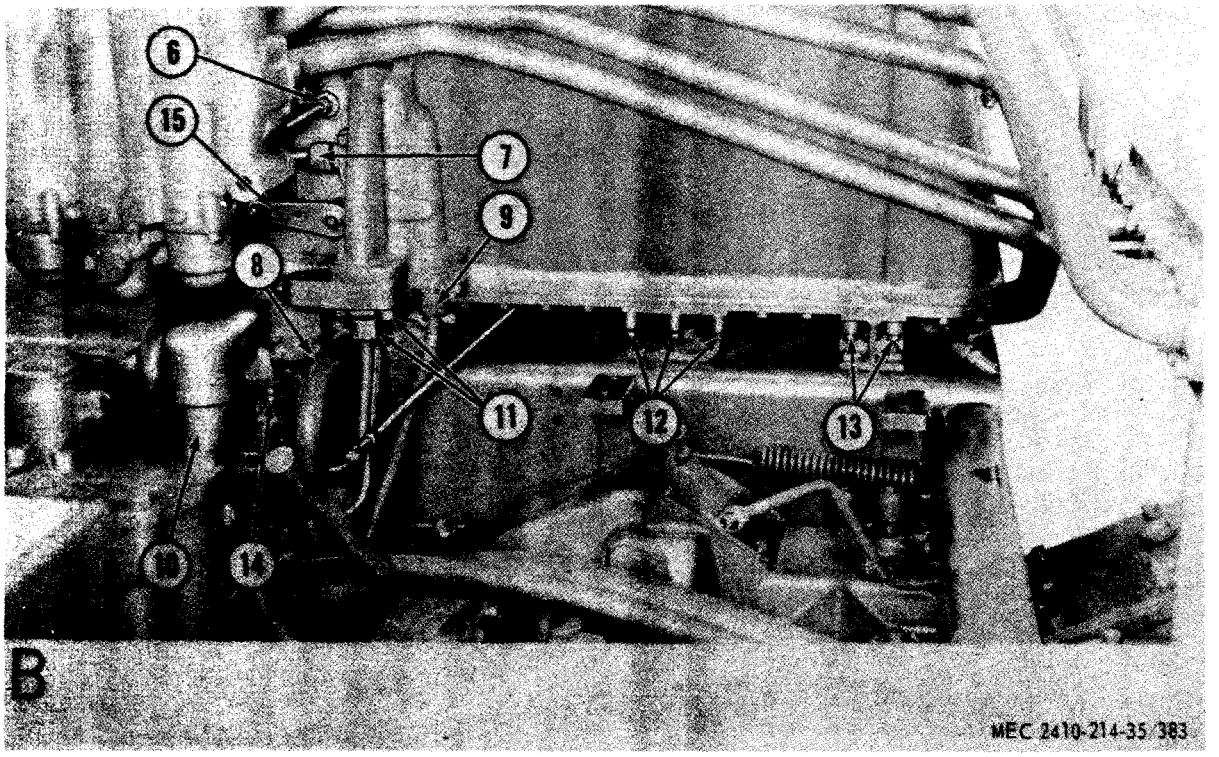
(4) Disassemble spool as shown in figure 3-369.

(5) Shims ((4), fig, 3-370) are used between housing (2) and spacer (3) to minimize the free travel of the valve spool (1). To obtain the correct thickness of shims required, assemble and install the valve spool. Install housing without shims. Tighten bolts (5) until the shoulder in the housing just contacts retainer ((2), fig. 3-369) and starts to compress the spring. Hold spacer ((3), fig. 3-370) tight against the valve body and measure clearance (A) between housing (2) and spacer (3) with a thickness gage. Install shims (4) with a total thickness equal to this measurement.

c. Check Valve Removal.

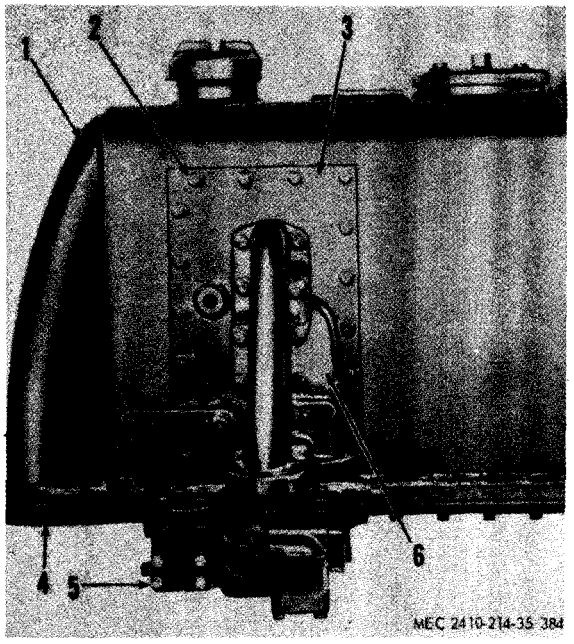
(1) Remove the bulldozer control valve and remove the valve spool.





1 Hydraulic lines
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
14 Bolts (2)
15 Bulldozer control linkage

Figure 3-364. Hydraulic tank removal.



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

Figure 3-365. Preparing to disassemble tank.

(2) Remove bolts, (1, fig. 3-371) 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).

(5) Check valve (6) must slide freely in its bore in valve body (7). Inspect chamfered seating surface of check valve (6) and mating seat in valve body for nicks or burrs.

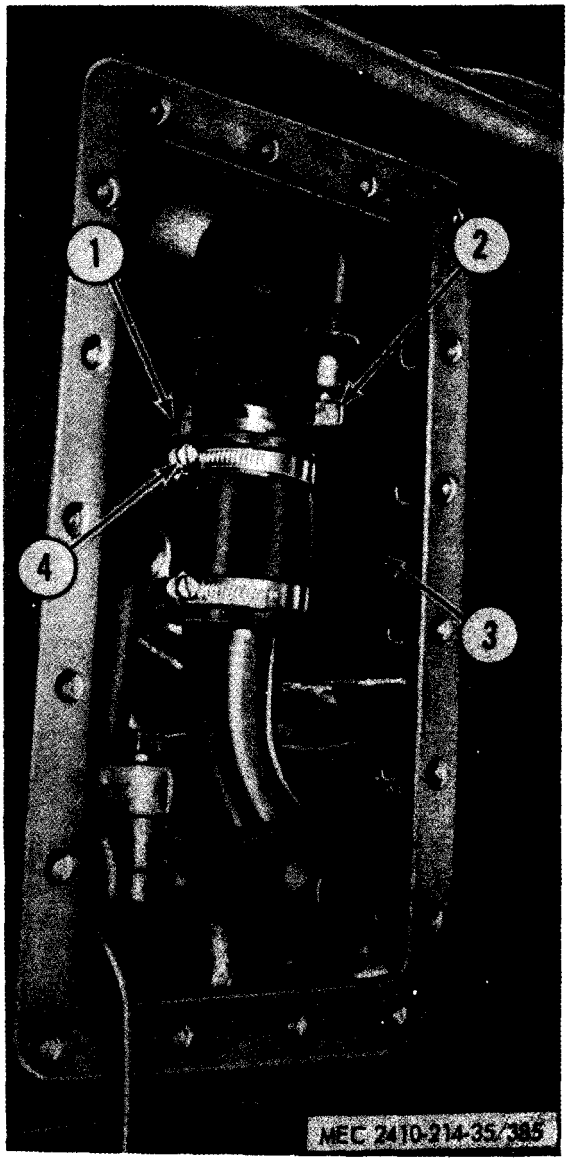
(6) Install in reverse order.

d. Makeup Valves - Removal and Installation. 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.

(1) Remove the hydraulic tank from machine and remove the tank assembly from bottom plate (para 3-80).

(2) Remove bolts ((4), fig. 3-372) and remove makeup valve body (3). At installation, tighten bolts (4) to 60 ± 2 lb-ft.

(3) Remove bolts (1) and (6) and remove



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

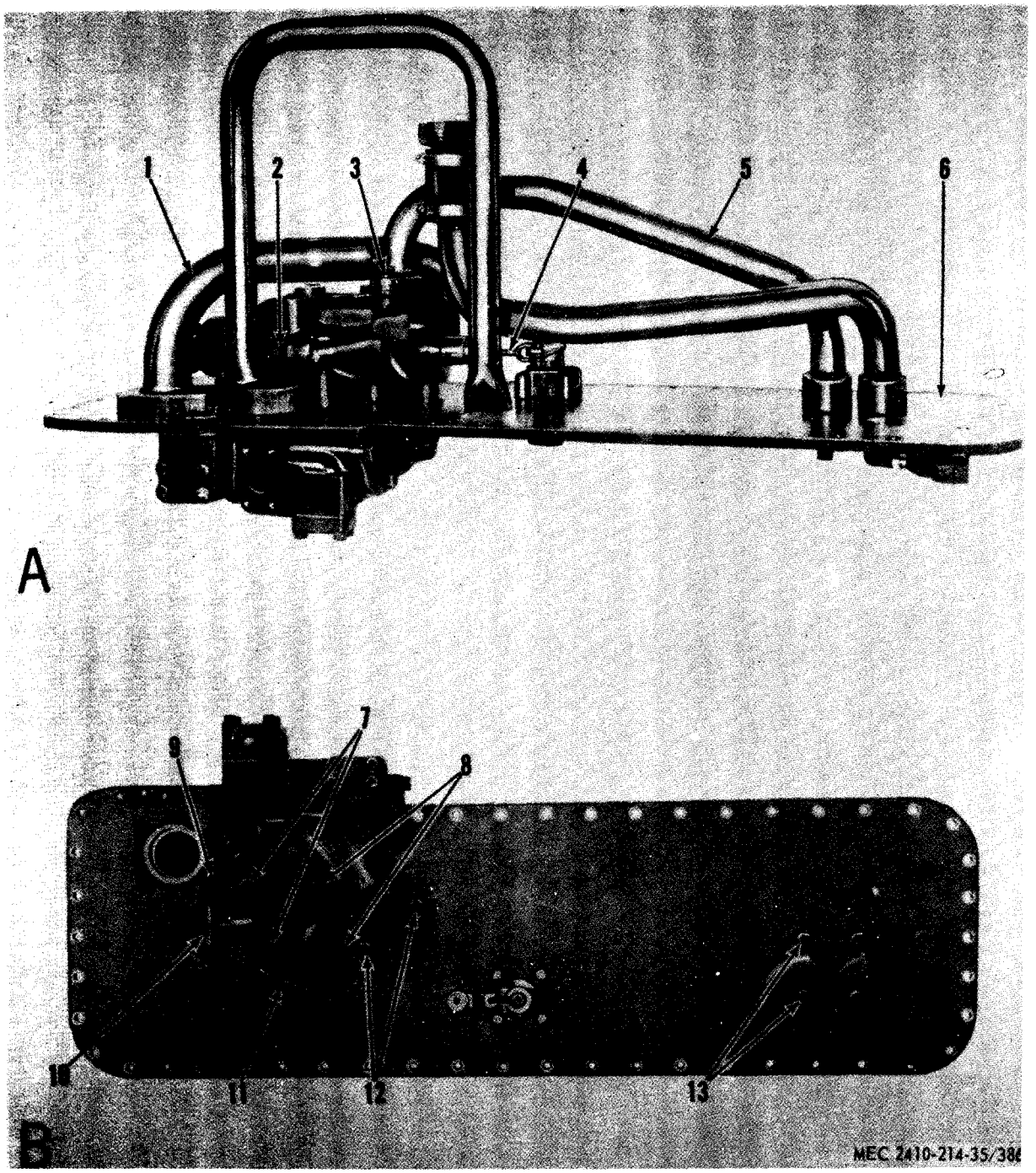
Figure 3-366. Filter inlet line disconnect.

covers (2) and (5). At installation, tighten bolts (1) and (6) to 60 ± 2 lb-ft.

(4) Remove springs ((3), fig. 3-373) and valves (4).

(5) Check to see that valves (4) move freely in their bores. Finger pressure against the faces of the valves should move them and springs (3) should return them to the CLOSED position.

(6) The chamfered contact seat of valves (4) must make a 100 percent contact (on circumference) with their mating seats in valve body (5). This can be checked by cleaning the seating surfaces thoroughly and brushing a light coating of Prussian blue on the chamfered seating surface of valves (4). Insert the valves in their respective bores and rotate each valve slightly



1 Pump suction line
2 Bulldozer control valve
3 Bolts
4 Rod
5 Pressure oil line from bulldozer control valve to scraper control valve
6 Bottom Plate
7 Bolts
8 Bolts
9 Bolt
10 Elbow
11 Elbow
12 Bolts
13 Bolts

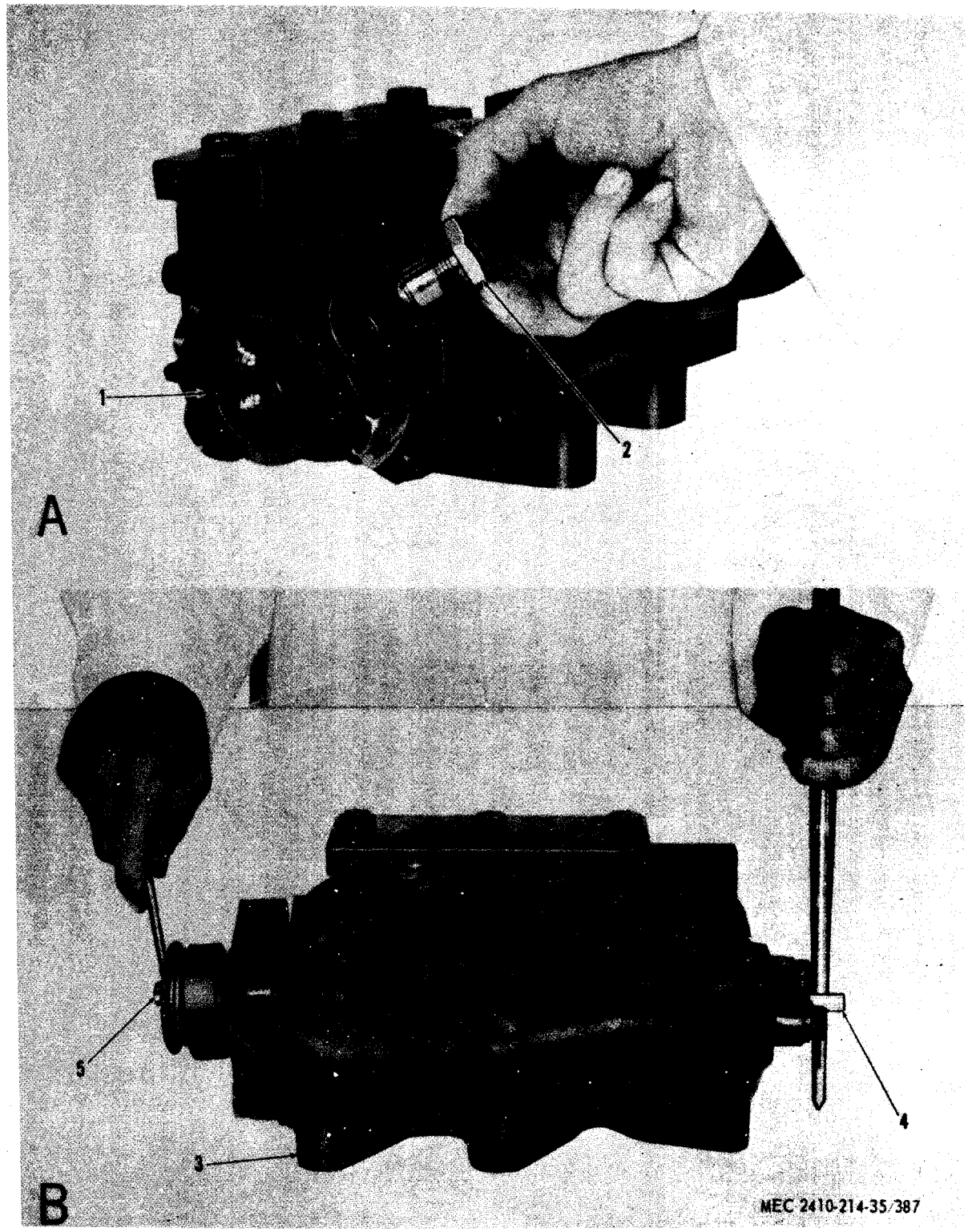
Figure 3-367. Bulldozer *control valve remval.*

while holding the valve against its seat. A portion of the blue will be transfered to the seat in the valve body. This will show the degree of valve contact.

(7) Inspect preformed packings (1) and replace if necessary.

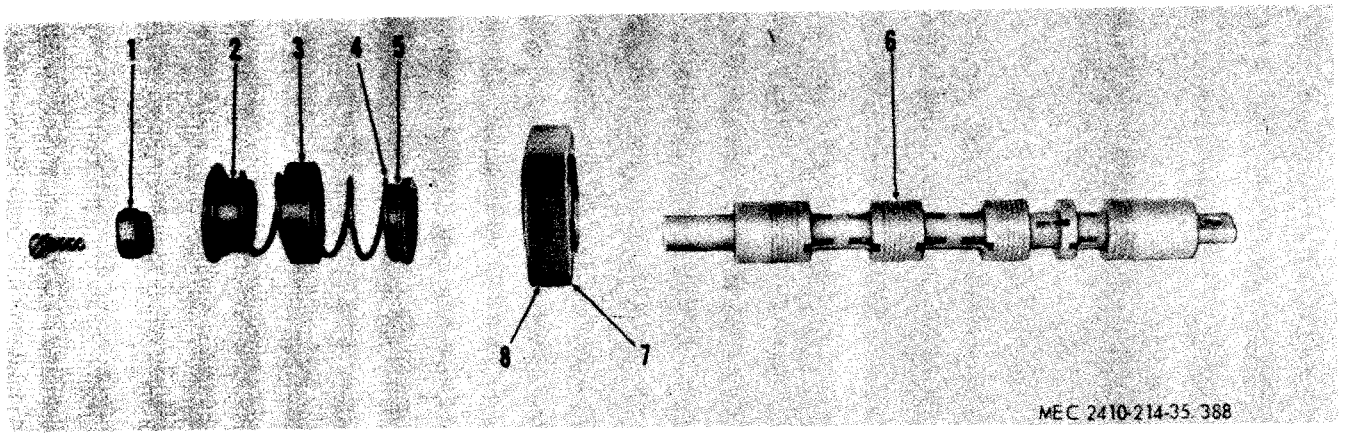
e. ***Control Level Removal and Disassembly.***

(1) Remove the hydraulic tank from the



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

Figure 3-368. Valve spool removal.



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

Figure 3-369. Valve spool disassembled.



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

Figure 3-370. Measuring clearance.

machine and remove the tank assembly from bottom plate (para 3-80).

(2) Remove and inspect pin ((1), fig. 3-374).

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

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

(5) Remove key ((2), fig. 3-375) and washer (1).

(6) Remove lever (3) andadapter (4).

(7) Inspect bearing (8).

(8) Inspect seal (7) and seal contact surface on shaft of lever (3). The seal is installed with spring-loaded lip toward bearings (6). The outer metal shell of the seal must be flush with outside face of housing (5).

(9) Inspect bearings (6) and bearing contact surface on shaft of lever (3).

(10) Replace parts as necessary.

(11) At assembly, position lever ((4), fig. 3-374) on shaft of lever ((3), fig. 3-375) until it is snug, not tight, against washer (1) and tighten bolt (3), fig. 3-374. Check for binding.

3-82. Bulldozer Relief Valve

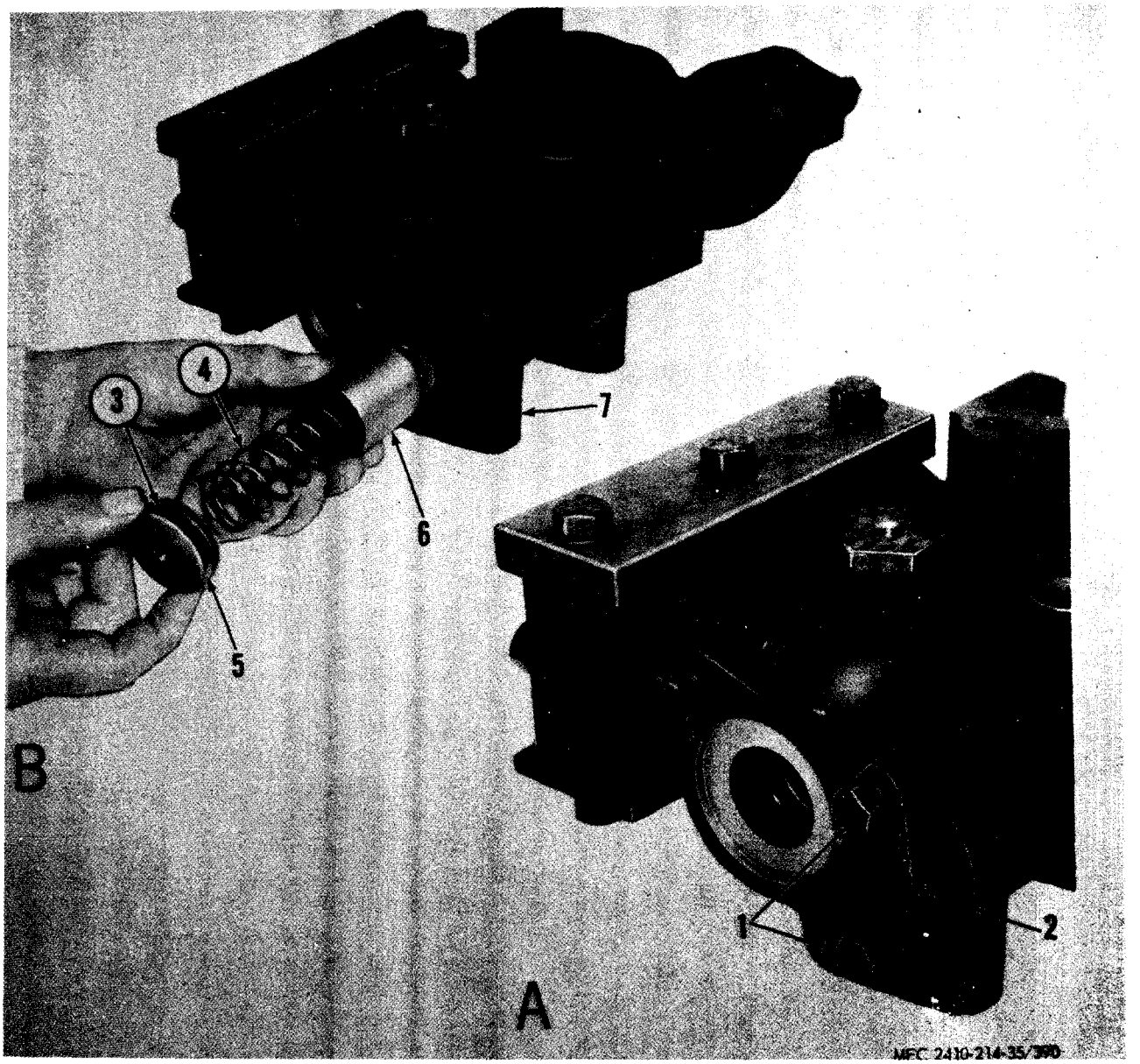
The bulldozer relief valve ((1), fig. 3-376) mounted on the bottom plate of the hydraulic tank, prevents excessive pressures from being imposed on the large section of the two-section pump and other components of the bulldozer circuit.

a. *Removal and Installation.*

(1) Remove the hydraulic tank from the machine (para 3-80).

(2) Remove the blade tilt control valve, mounting plate and manifold (2) (para 3-80).

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



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

Figure 3-371. Check valve removal.

Note. Bolts (3) secure the relief valve discharge tube (on inside of tank) to the tank bottom plate making (2) necessary.

(4) Install in reverse order. At installation, tighten bolts (3) to 43 ± 2 lb.ft. Tighten bolts (4) to 60 ± 2 lb-ft.

b. Disassembly and Assembly.

(1) Remove bolts and lockwashers ((6), fig. 3-377) and cover (7).

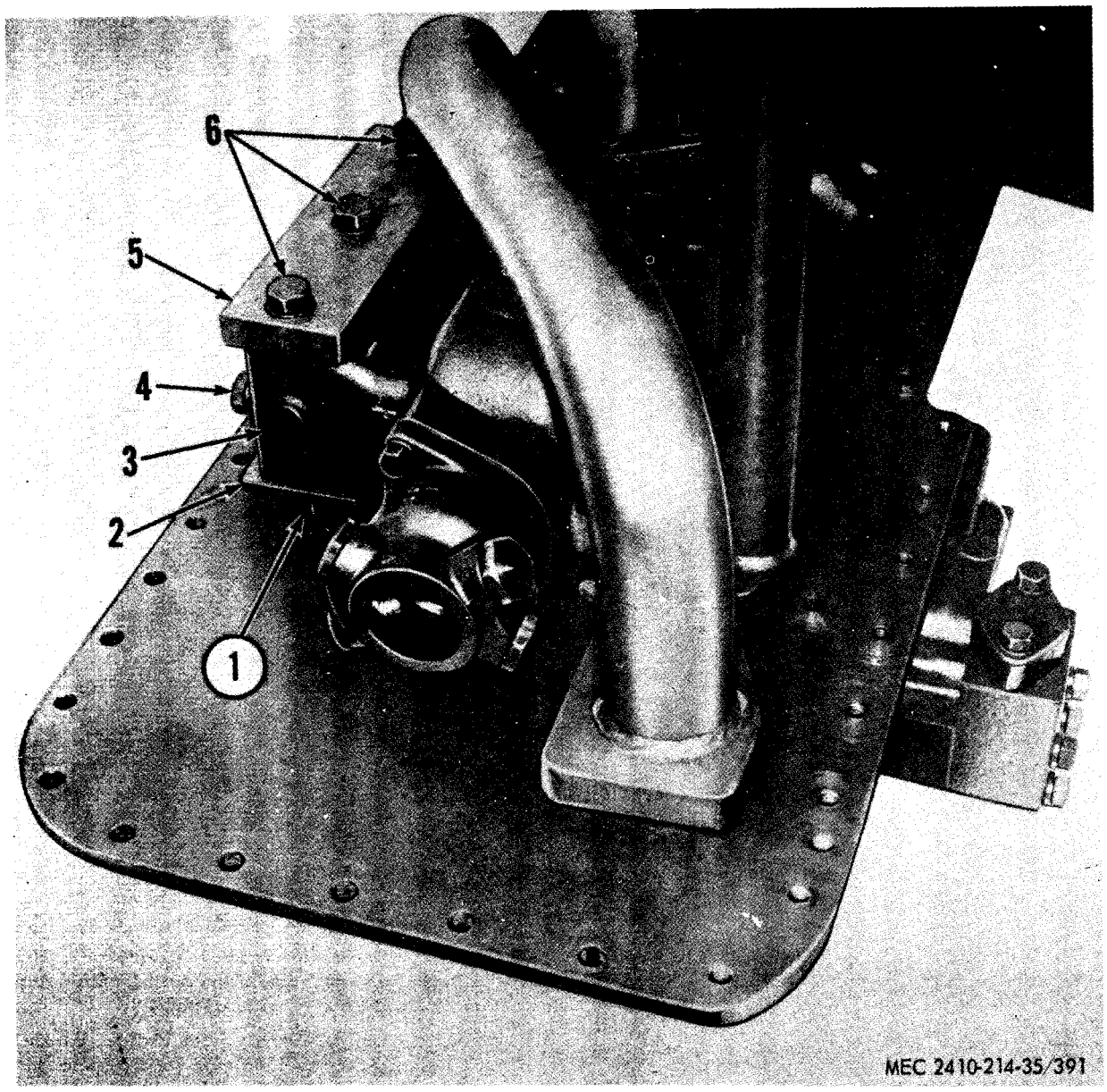
(2) Remove bolts and lockwashers (13) to remove pilot valve body (14). At installation, tighten bolts (13) to 24 ± 2 lbs-ft.

(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.

(5) Inspect preformed packings (8) and (9). Replace as necessary.

(6) Inspect the contact surface of pilot valve (12) and its seat in body (14). Any nicks, burrs, or grooves worn on the valve or seat can cause the relief valve to remain open.



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

Figure 3-372. Makeup valve body removal.

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).

(7) Inspect preformed packing (16) and replace if necessary.

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

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

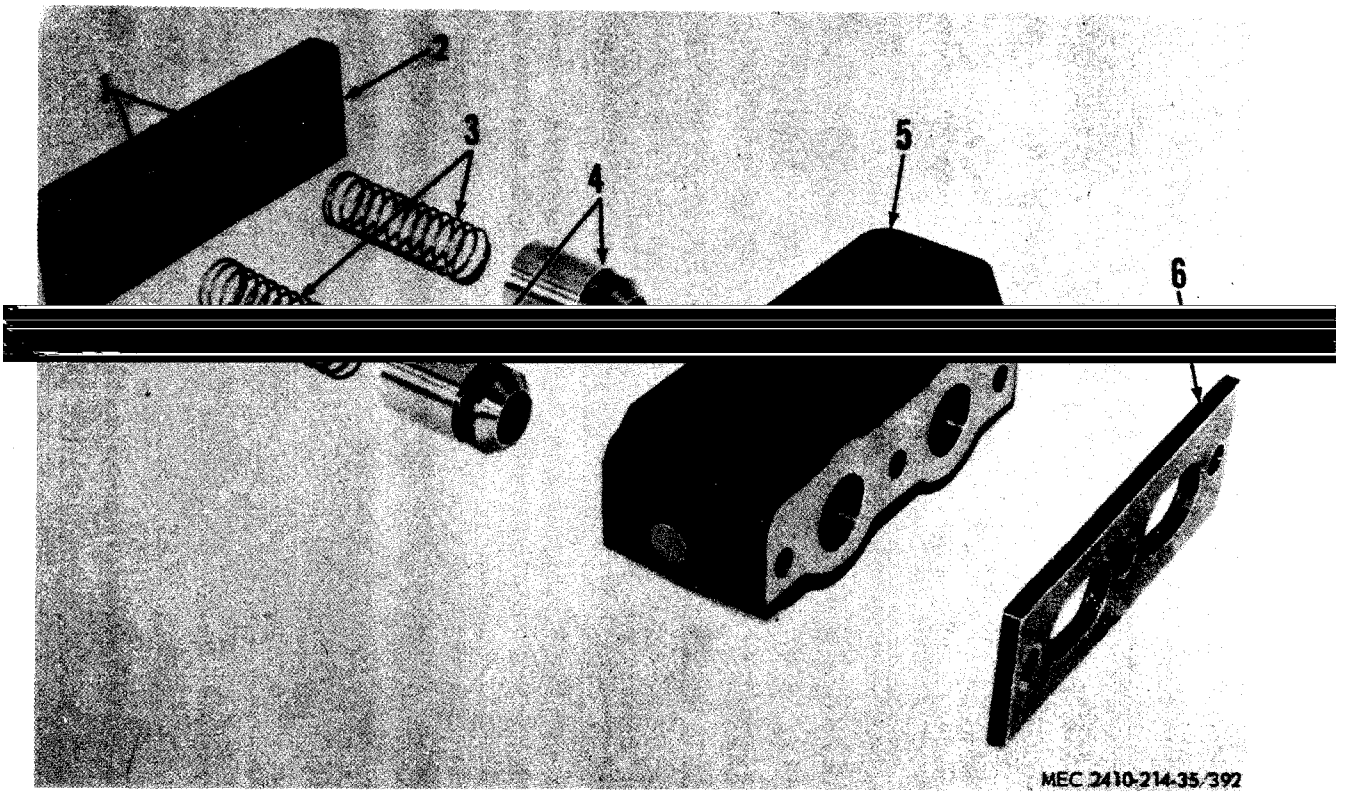
(10) Insert a ½-inch diameter rod 10-inches long into the plug opening until the rod contacts dump valve (23). Push against rod, compressing spring (22), until dump valve contacts plug (20). Tap on end of rod, forcing plug (20) out of body (5).

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

(12) Inspect dump valve (23) for nicks or burrs. The valve must slide freely in its bore in body (5).

(13) Inspect preformed packings (21) and (3). Replace as necessary.

(14) Assemble relief valve in reverse order.



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

Figure 3-373. Makeup valves disassembled.

3-83. Tilt Control Valve

a. Removal and Installation.

(1) Drain the hydraulic tank. Refer to TM 5–2410–214–12.

(2) Remove the blade tilt control valve mounting plate and manifold from the tank (para 3-80).

(3) Remove bolts ((1), fig. 3-378) securing manifold (3) to plate (2). At installation tighten bolts (1) to 60 ± 2 lb-ft.

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 huoles in plate to receive bolts (1).

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

(6) At installation, position machined flat (6) on valve spool within lever (8) as shown.

b. Disassembly and Reassembly.

(1) Remove bolts and lockwashers ((9), fig. 3-379) securing housing (12) to valve body (5). At assembly tighten bolts (9) to 25 ± 1 lb-ft.

(2) Remove plug (1) with a 3/8-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 preformed packings (2) and replace if necessary.

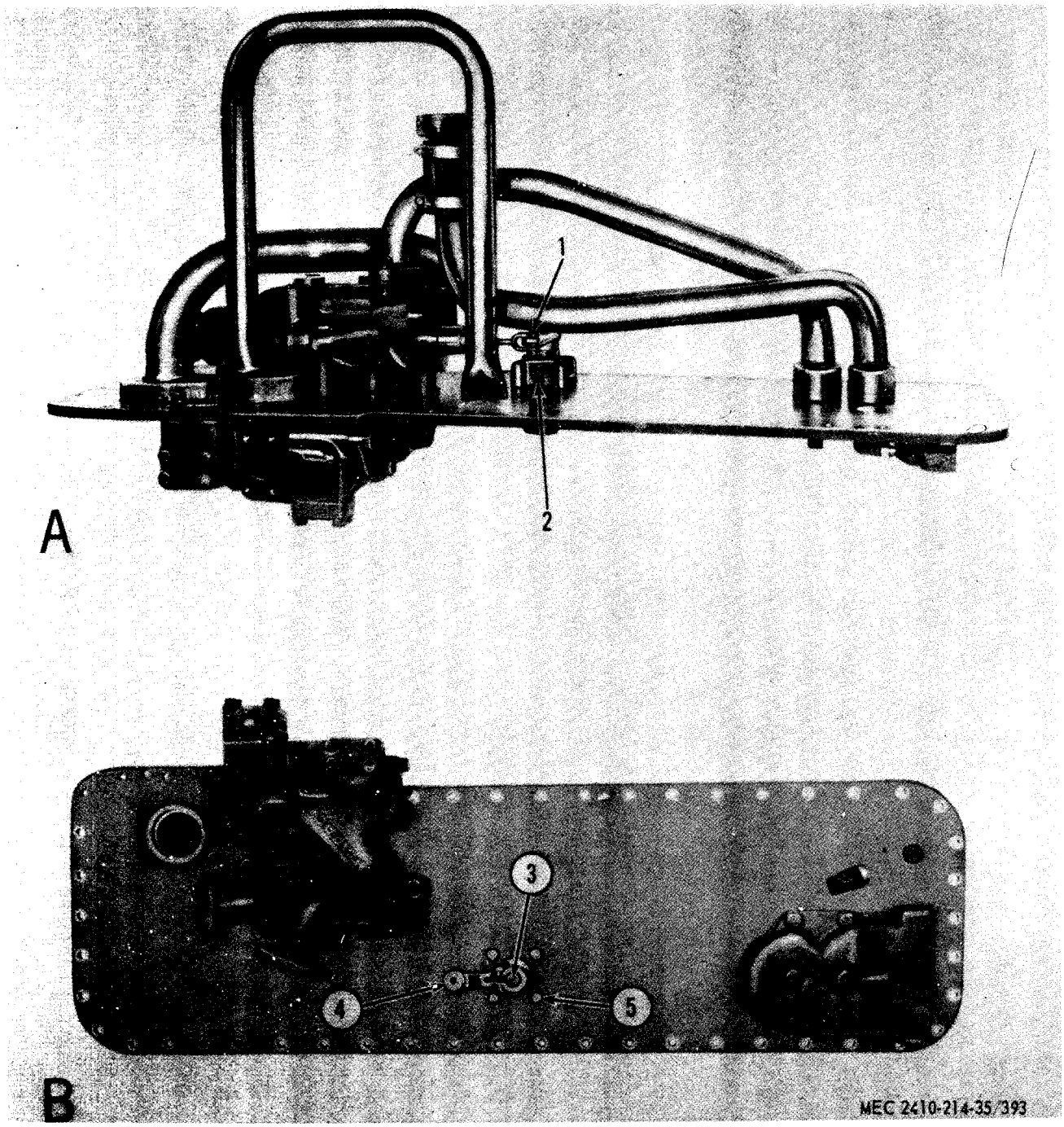
(6) Remove bolt and lock washer (10), washer (11), spacer (13), spring (14) and spacer (15) from spool (16).

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 preformed packing (24). To remove,



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

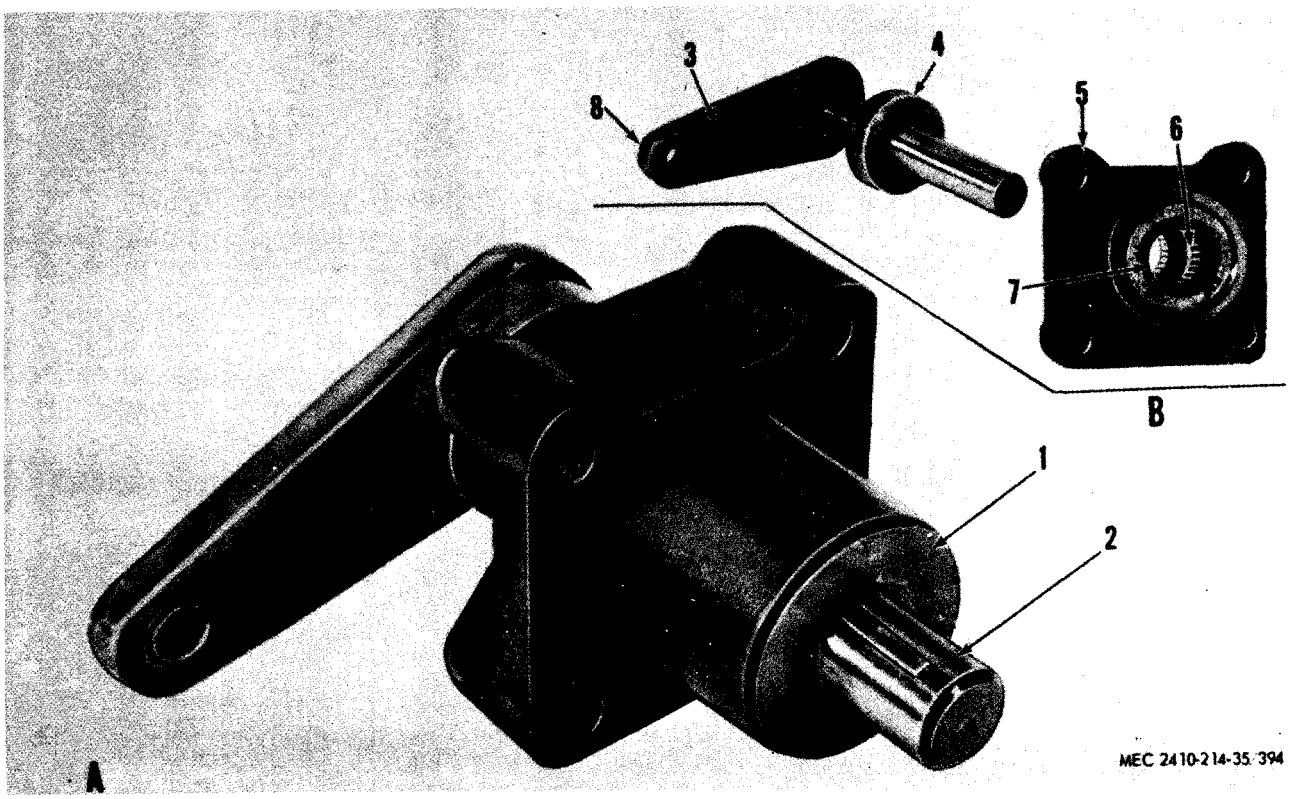
Figure 3-374. Control lever assembly.

insert a 1/2-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.

(10) Inspect dump valve (26) for nicks or burrs. The valve must slide freely in its bore in valve body (5). Inspect contact surface on pilot valve (22) and its seat (23). Nicks, burrs or grooves on valve or seat can cause the relief valve to remain open.

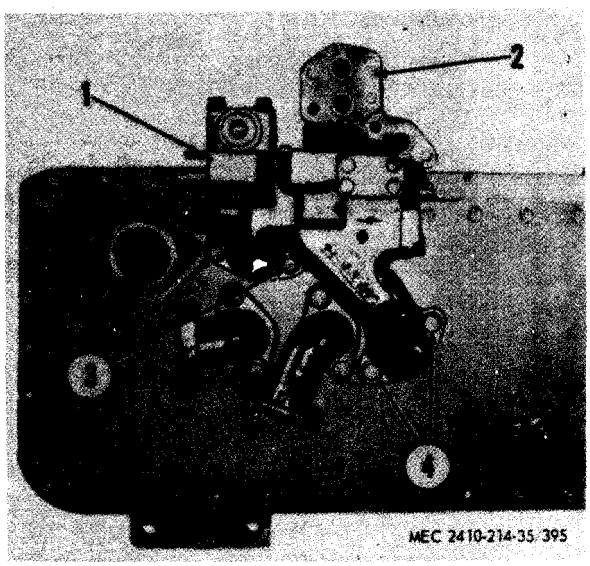
(11) Inspect preformed packings (7) and (8) and replace if necessary.

(12) Assemble in the reverse order. Be sure



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

Figure 3-375. Control lever disassembly.



1	Relief valve assembly	3	Bolts
2	Manifold	4	Bolts

Figure 3-376. Bulldozer relief valve removal.

pilot valve seat (23) is bottomed square against the shoulder in control valve body (5), and spring (25) is in its recess in seat (23).

c. Tilt Control Lever Removal and Disassembly.

(1) Loosen bolt ((2) fig. 3-380) and remove lever (1).

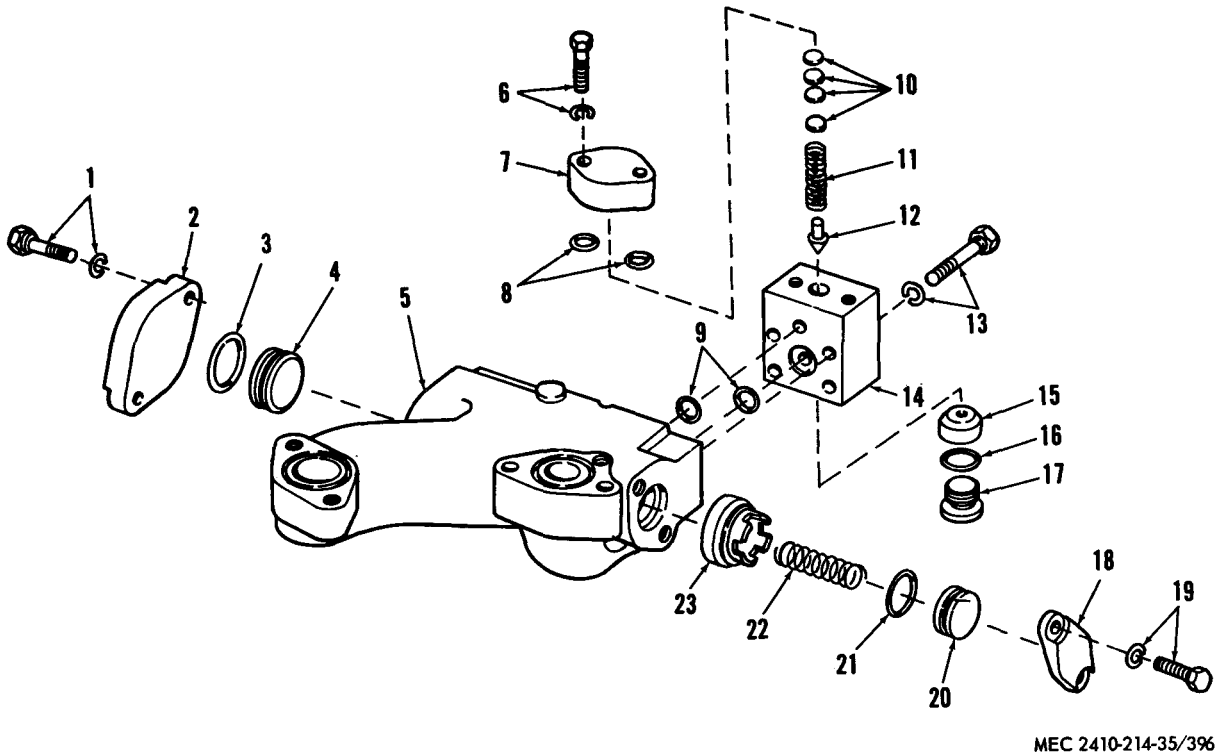
(2) Remove key (3).

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

(4) Inspect seal (5) and seal contact surface on shaft of lever (6). The seal is installed with spring-loaded lip toward bearings (8). The outer metal shell of the seal must be flush with outside surface of plate (4).

(5) Inspect bearings (8) and bearing contact surface on shaft of lever (6).

(6) At assembly, position lever (1) on shaft of lever (6) until it is just snug, not tight, against shoulder of plate. Tighten bolt (2). Rotate lever (6) to check for binding.



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

Figure 3-377. Relief valve disassembly.

3-84. 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 and Installation. For removal and installation, refer to TM 5-2410-214-12.

c. Disassembly and Assembly.

(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.

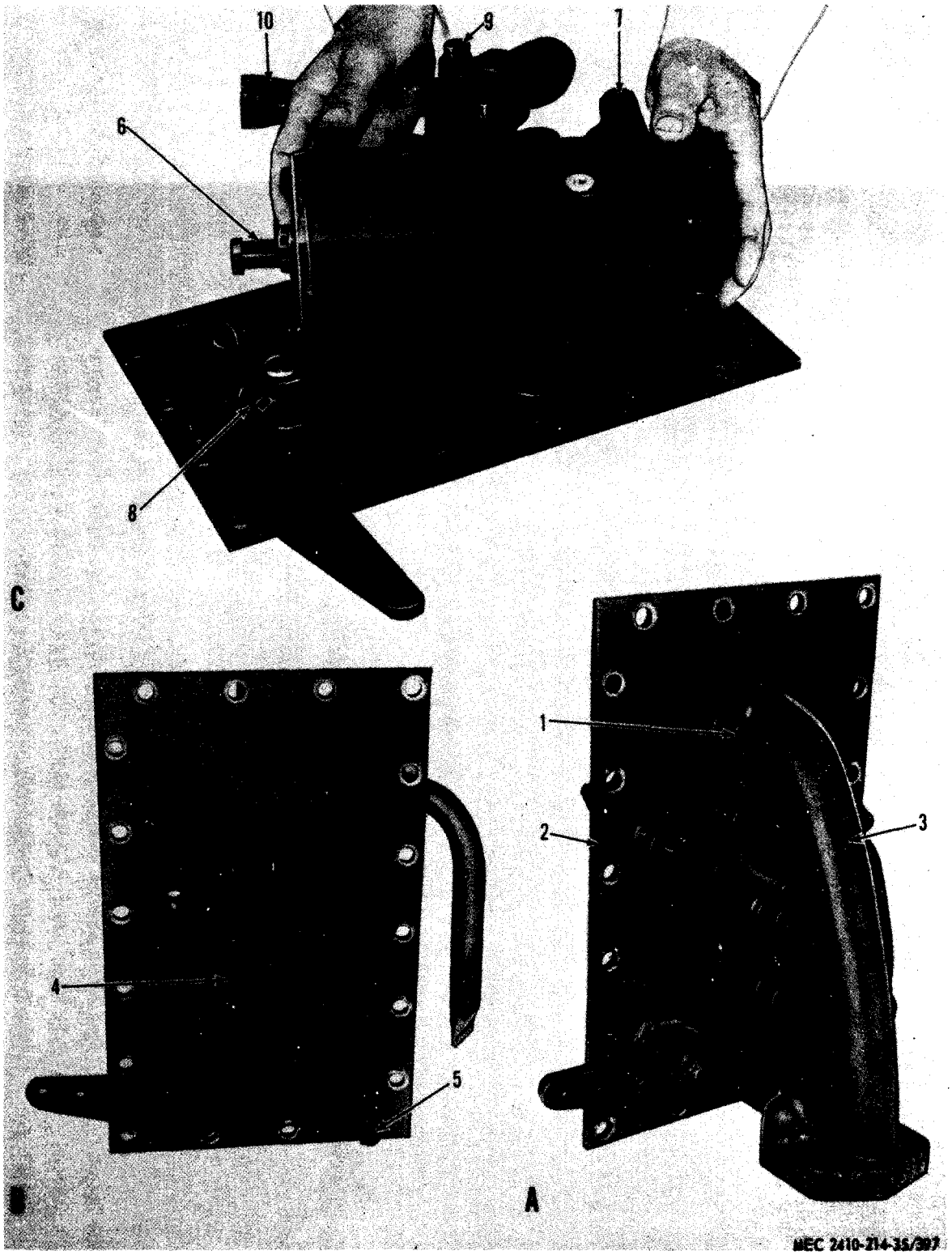
(3) During assembly, immerse each pump part in clean hydraulic oil. This will facilitate assembly and provide initial lubrication for the pump.

(4) *Small pump section.*

(a) Remove bolts ((1), fig. 3-381) and cover (2).

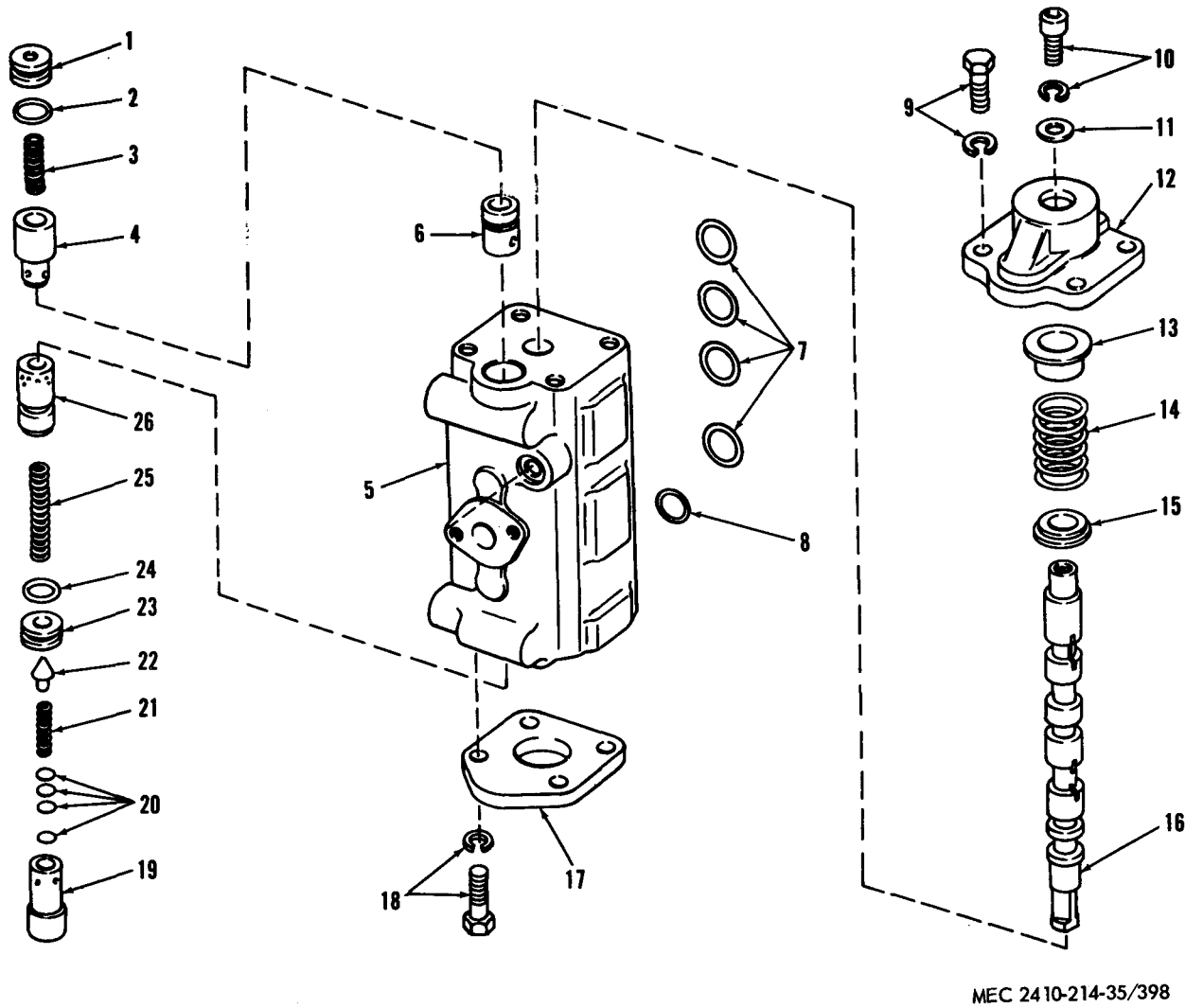
(b) Remove preformed packing (3), wave washer (4), and cartridge (5).

Caution: **Vanes ((11), fig. 3-382) and insert vanes (12) are free to slide out of the rotor and ring, and may be damaged if dropped.**



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

Figure 3-378. Blade tilt manifold and valve removal.



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

Figure 3-379. Tilt control valve disassembly.

(c) Refer to figure 3-382 and disassemble the cartridge.

Pump rotation is counterclockwise when viewed from the drive spline end. Correct pump assembly requires that the leading chamgered edge of vanes (11), arrow (6) on ring (5) and the arrow on rotor (13) all point in the direction of pump rotation.

At assembly, tighten bolts ((1), fig. 3-381) to torque value given in paragraph 1-4.

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

(5) *Large pump section.*

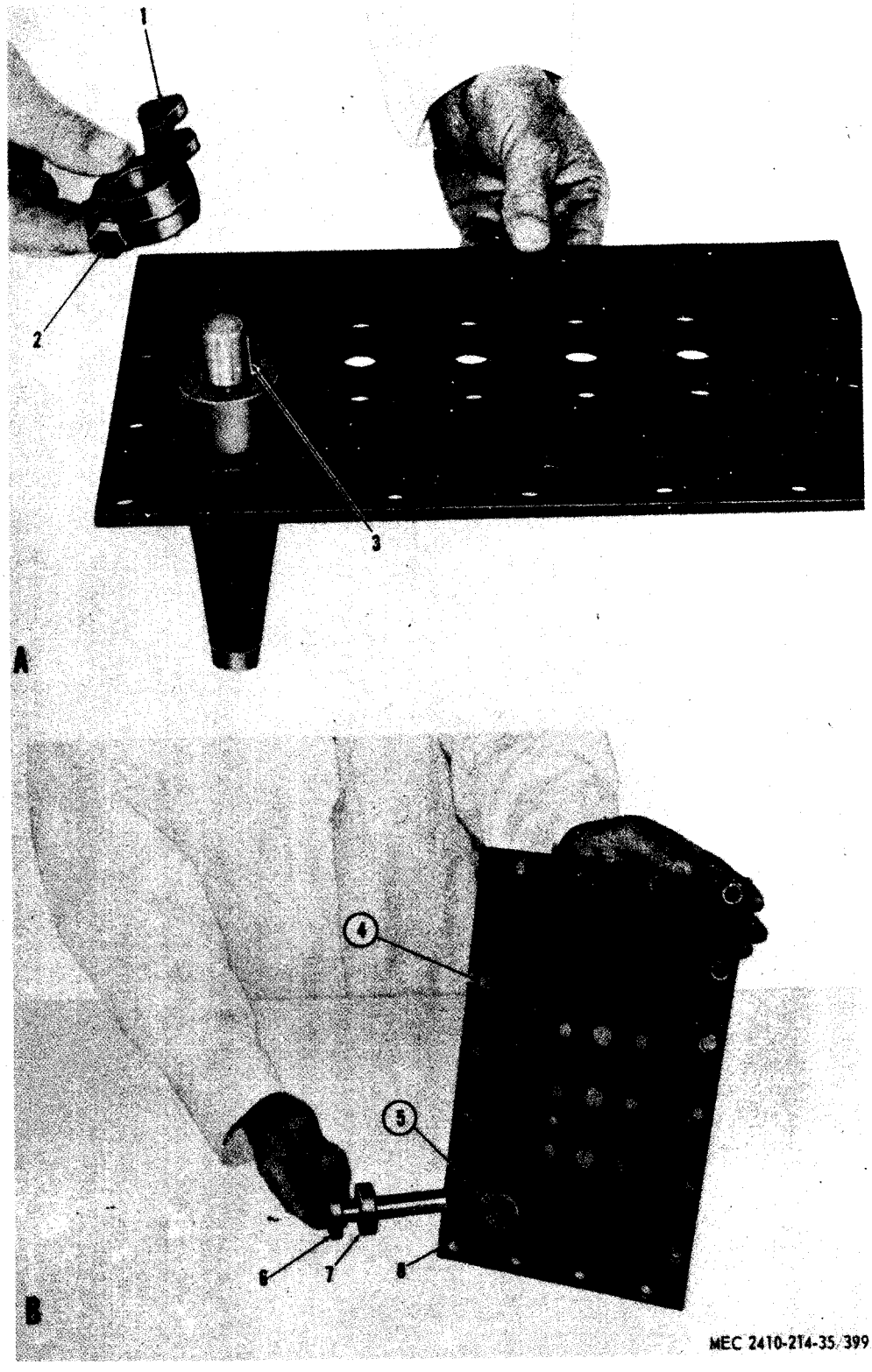
(a) Remove bolts ((1, fig. 3-383) and cover (2).

(b) 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. 3-384) and insert vanes (10) are free to slide out of the rotor and ring, and may be damaged if dropped.**

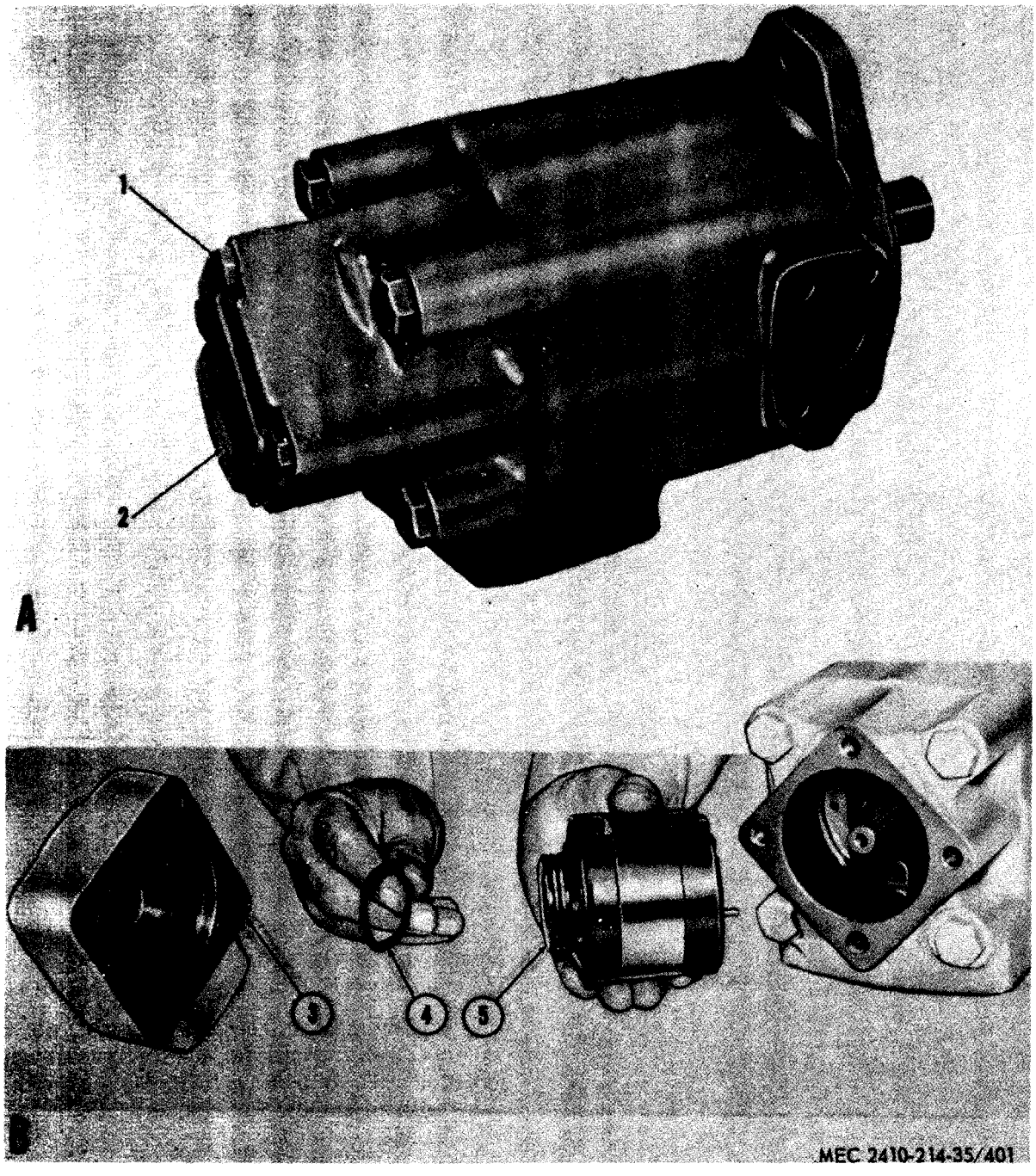
(c) Refer to figure 3-384 and disassemble the cartridge.

(d) At assembly, the leading chamfered



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 3-380. Tilt control lever removal.



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

Figure 3-381. Cover and cartridge removal, small pump section.

edge of vanes (11), arrow (4) on ring (3) and the arrow on rotor (9) must all point in a counterclockwise direction when viewed from the drive spline end of the pump.

(e) Tighten bolts ((1), fig. 3-383) to torque valve given in paragraph 1-4.

(6) *Pump shaft removal.*

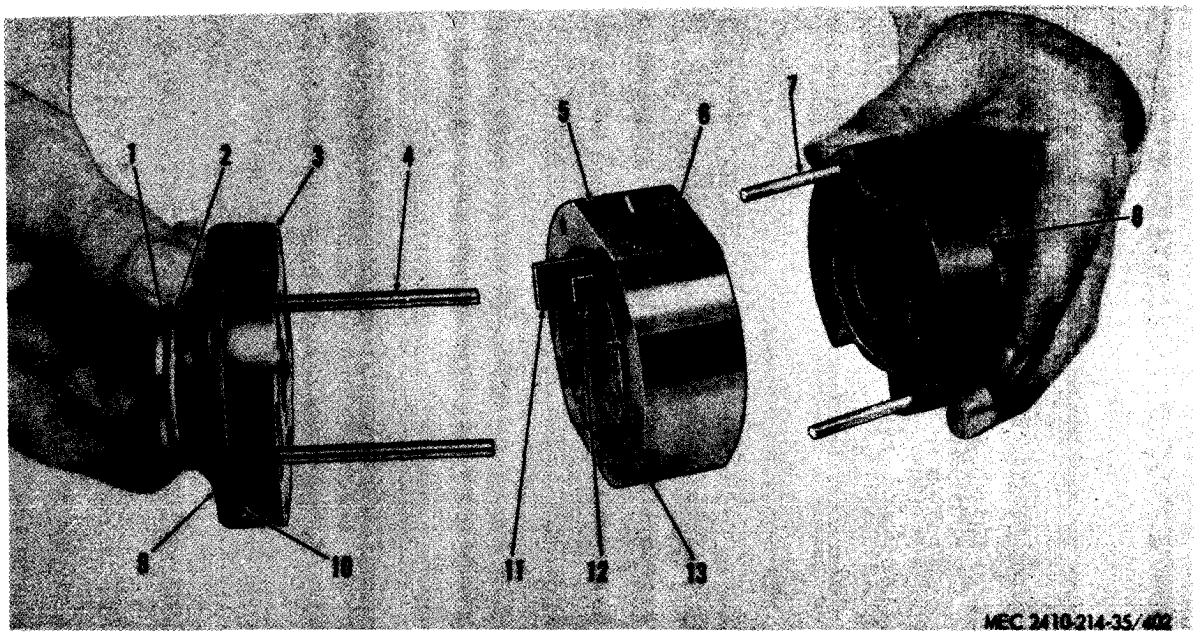
(a) Refer to figure 3-385 and remove the shaft, seal and bearing.

(b) Inspect bearing (8), seal (4), and wiper (5) for wear or damage. Inspect seal and wiper contact surf ace on shaft (3).

(c) Install seal (4) with spring-loaded lip toward pump cartridge.

3-85. Hydraulic Lift Cylinders

a. General. Both blade lift cylinders are re-



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

Figure 3-382. Cartridge disassembly, small pump section.

moved 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 and Installation.

(1) Lower the bulldozer blade to the ground.

(2) Remove bolt ((3), fig. 3-386) 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. 3-387).

(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.

(9) Install the cylinder in the reverse order of removal using new preformed packings on the cylinder oil line connections.

c. Disassembly.

(1) Drain both ends of the cylinder.

(2) Remove tube assemblies ((1) and (2), fig. 3-388).

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

(4) Remove bolts (3) securing the head (5) to the 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. 3-389) and washer (2).

(7) Remove piston (10).

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

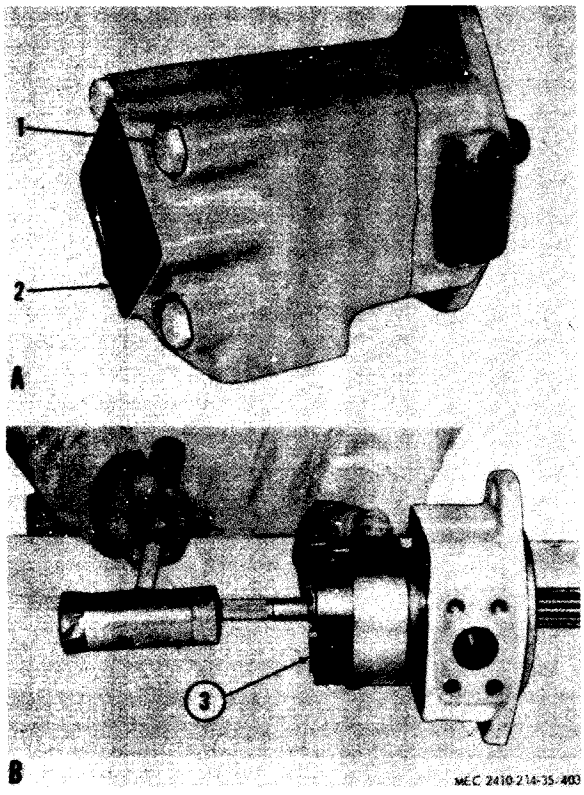
(9) Expand the outer ring of seal assembly (9) and remove the outer and inner rings.

(10) Press plungers ((1), lg. 3-390) inserts (2) and (3) from piston (4), using a driver fabricated as shown in figure 3-391.

(11) Remove preformed packing ((8), fig. 3-389) and backup ring (7).

(12) Remove head (6).

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



1 Bolts 2 Cover 3 Cartridge

Figure 3-383. Cover and cartridge removal, large pump section.

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

(15) Remove bolts ((4), fig. 3-392) securing bearings (1) and (2) and shims (3) to piston rod. (6)

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

(17) Inspect all parts and replace parts as required.

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

(19) 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 bore shrinkage to cause interference between piston and cylinder wall and may result in severe scoring of cylinder walls.**

d. 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. 3-389) 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. 3-393) 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 .010-inch to .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.**

(9) Install new backup ring ((7), fig. 3-389) and preformed packing (8) on the head.

(10) Install inserts ((3), and (4), fig. 3-394) 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.

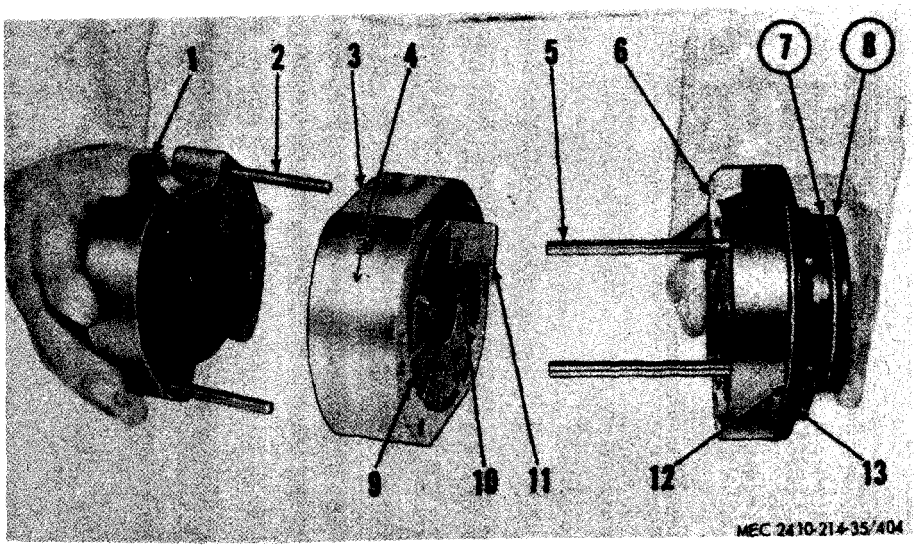
(12) Assemble wear ring ((3), fig. 3-389) to piston (10).

(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. 3-395).

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



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

Figure 3-384. Cartridge disassembly, large pump section.

(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 paragraph 1-4 for correct torque values.

e. 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. 3-396) 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 .010 inch thickness. The thicker shim should not be removed to adjust the packing.

3-86. 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 and Installation.

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

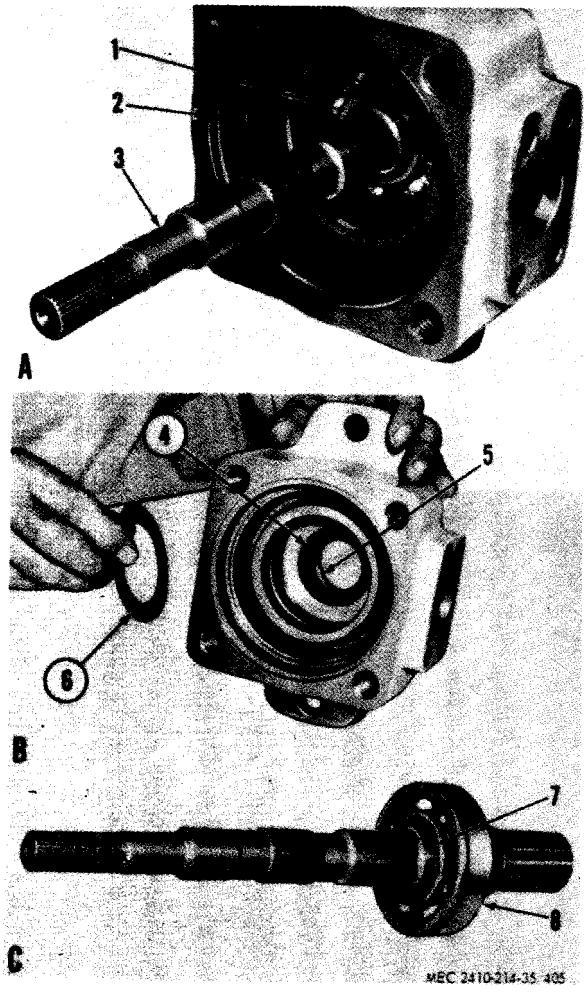
(2) Attach a hoist to cylinder ((1), fig. 3-397) and remove the bolts (2) securing cap (3) to the blade.

(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.

(5) Install in reverse order of removal.

Note. Shims (4) are used to obtain a free fit between cap (3) and the ball joint. To obtain proper clearance, install the cap without shims and tighten bolts evenly until the cap is snug on ball joint. Measure existing space with shims (4). Remove cap (3), and add one shim for clearance.



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

Figure 3-385. Shaft, seal, and bearing removal.

c. Disassembly.

(1) Drain both ends of the cylinder.

(2) Remove bolts ((3), fig. 3-398) 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.

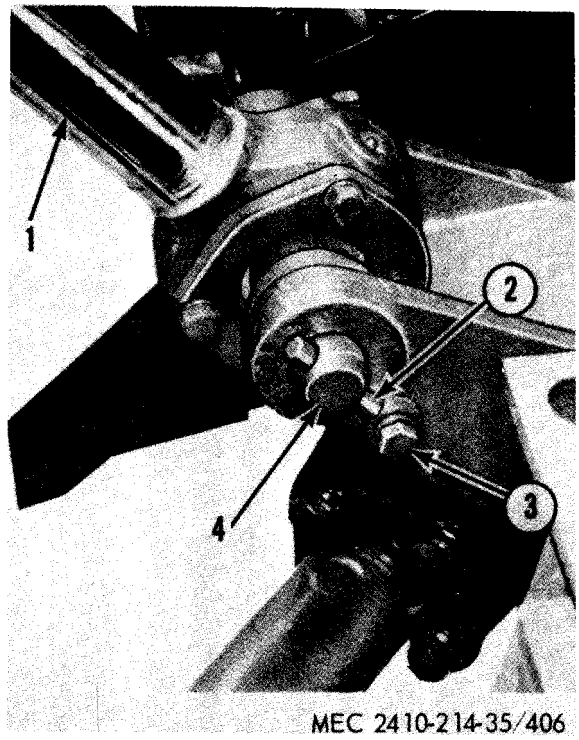
(5) Remove retaining ring and pin securing nut ((1), fig. 3-399) to the piston rod (2).

(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.

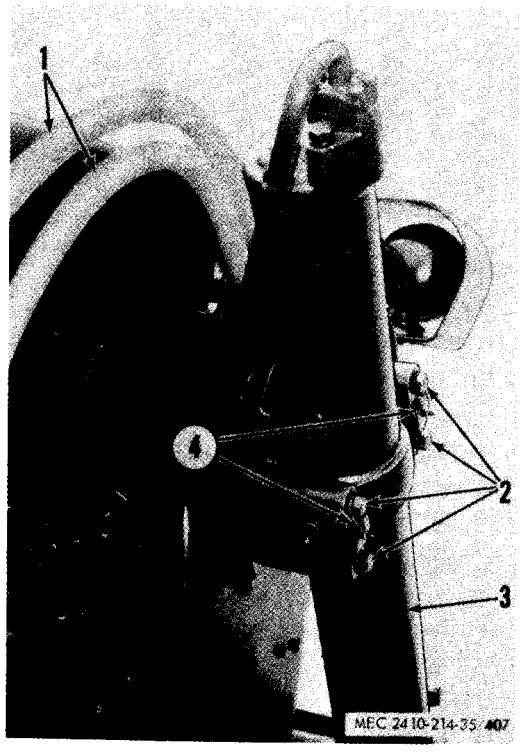
(7) Remove piston ((1), fig. 3-400).

(8) Remove wear ring (8).



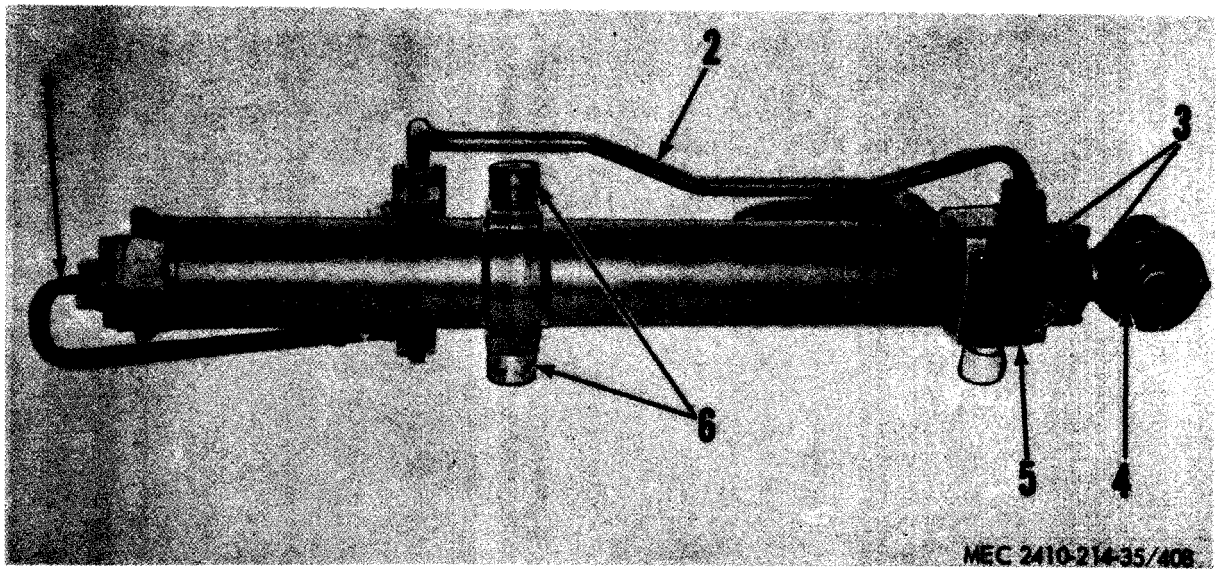
1 Piston rod
2 Lockpin
3 Bolt
4 Pin

Figure 3-386. Disconnecting piston rod.



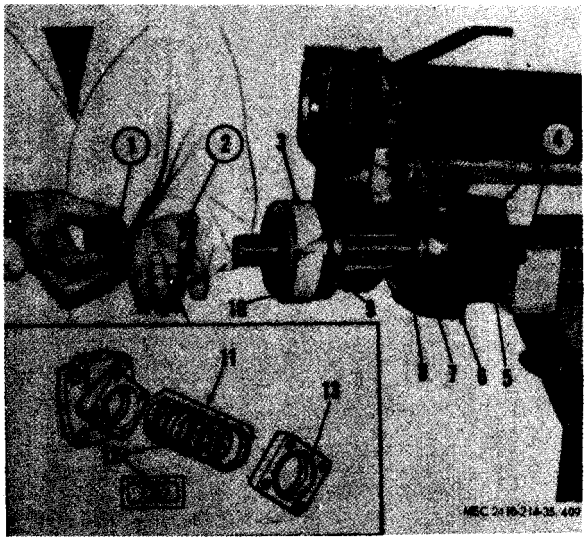
1 Hydraulic oil lines
2 Bolts
3 Cylinder
4 Trunnion caps

Figure 3-387. Lift cylinder removal.



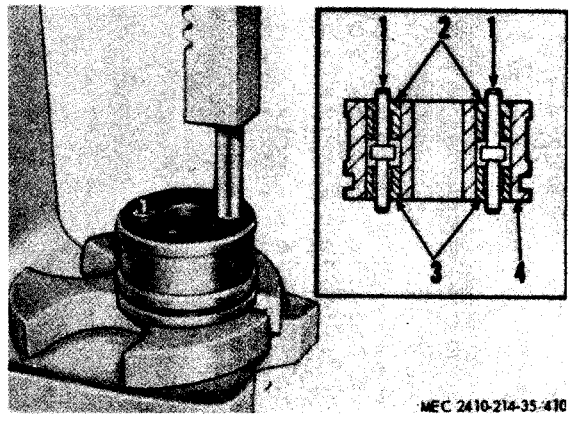
1 Tube assembly
2 Tube assembly
3 Bolts
4 Piston rod
5 Head
6 Bearings

Figure 3-388. Preparing to disassemble cylinder.



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 3-389. Disassembling piston and head.



1 Plunger
2 Insert
3 Insert
4 Piston

Figure 3-390. Relief valve removal.

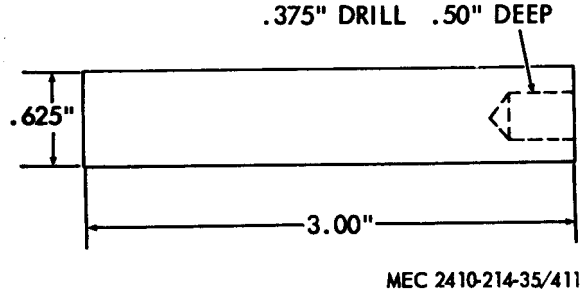


Figure 3-391. Driver dimensions.

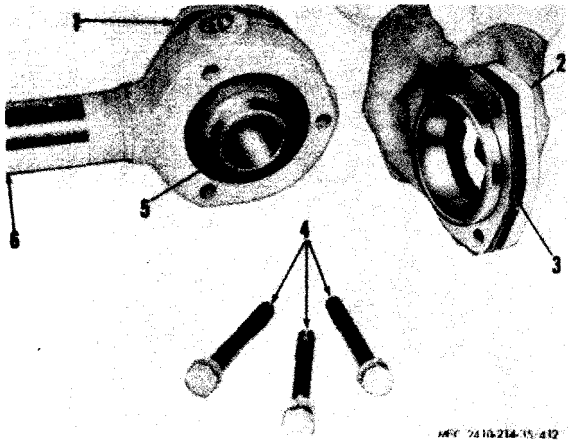
(9) Expand the outer ring of seal assemblies (7) and remove the outer and inner rings.

(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).



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

Figure 3-392. Piston rod bearing disassembly.

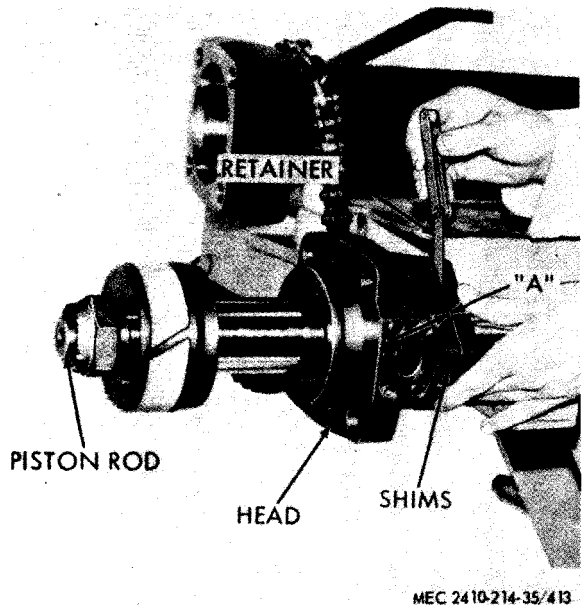
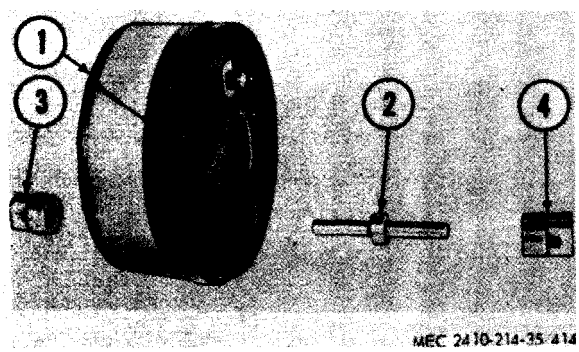
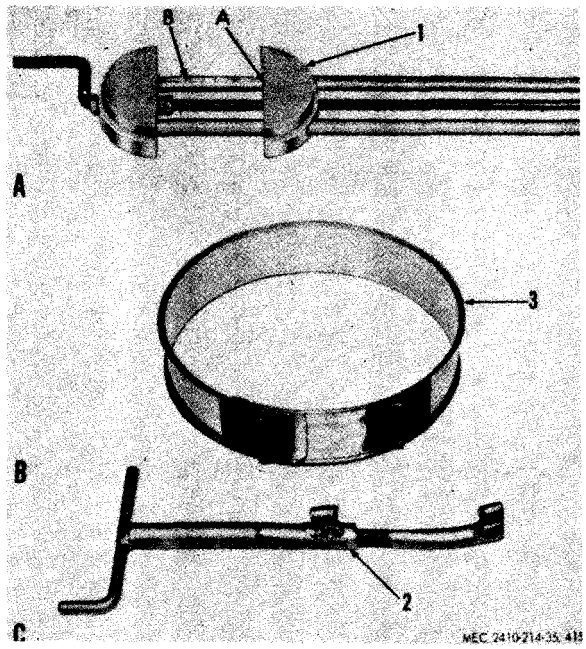


Figure 3-393. Measuring clearance.



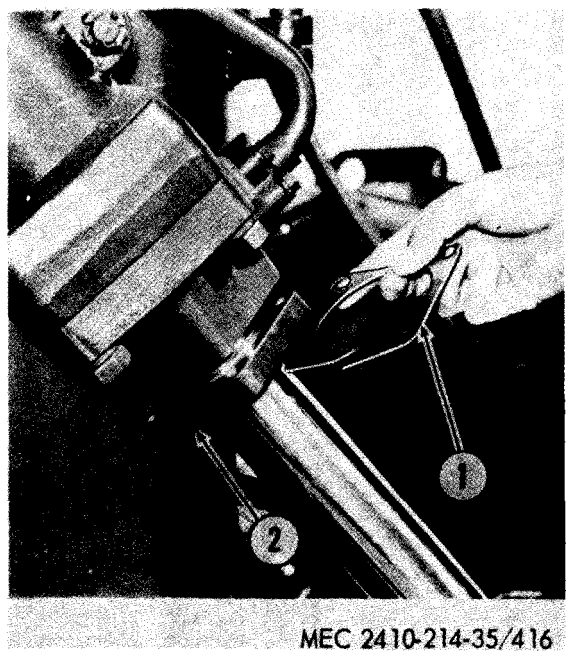
1 Piston
2 Plunger
3 Insert
4 Insert

Figure 3-394. Piston reassembly.



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

Figure 3-395. Seal assembly Installation tools.



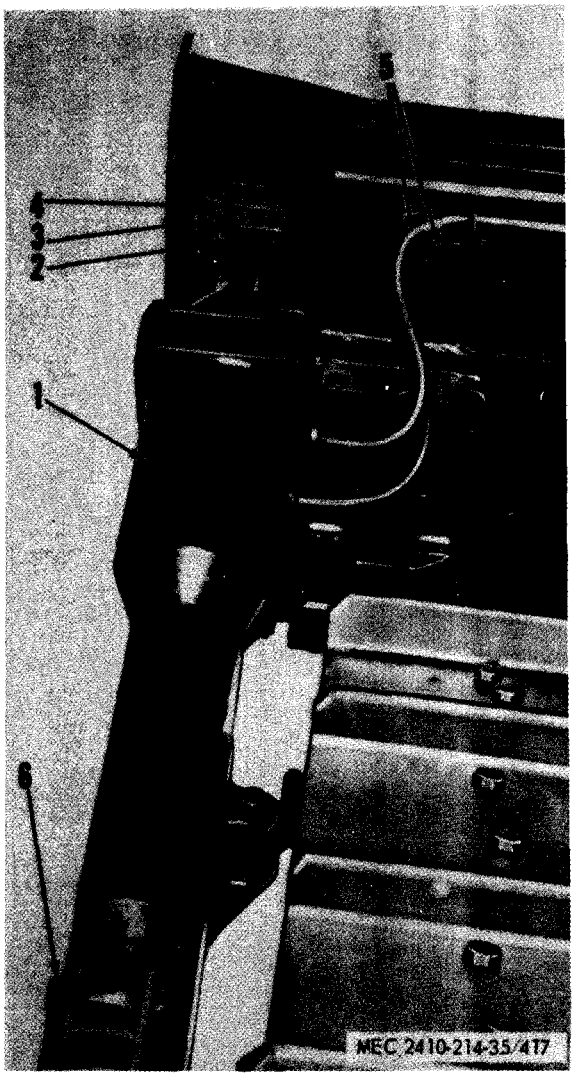
1 Shims
2 Retainer

Figure 3-396. Removing shims.

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

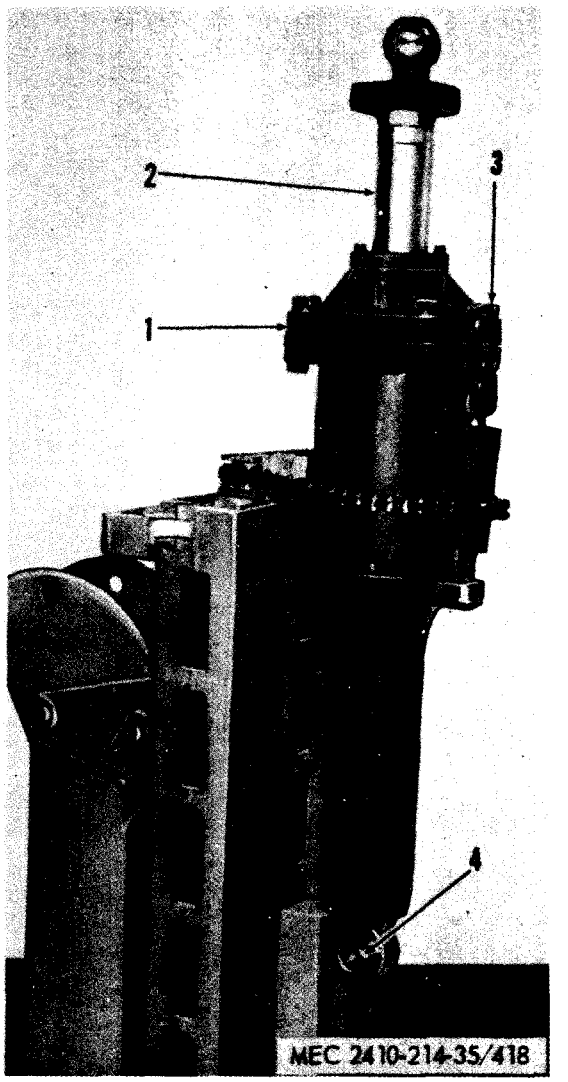
(15) Remove marks or rough spots on the piston rod with crocus or fine emery cloth to prevent seal and packing damage.

(16) Inspect walls of cylinder bore for scor-



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

Figure 3-397. Tilt cylinder removal.



1 Cylinder head
2 Piston rod
3 Bolts
4 Bearings

Figure 3-398. Preparing to disassemble cylinder.

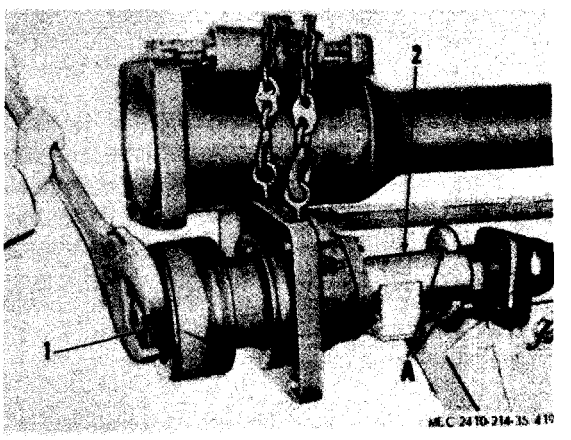
ing marks. Any scoring marks which cannot be removed with a minimum of light honing will require replacement of cylinder assembly.

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

d. Reassembly.

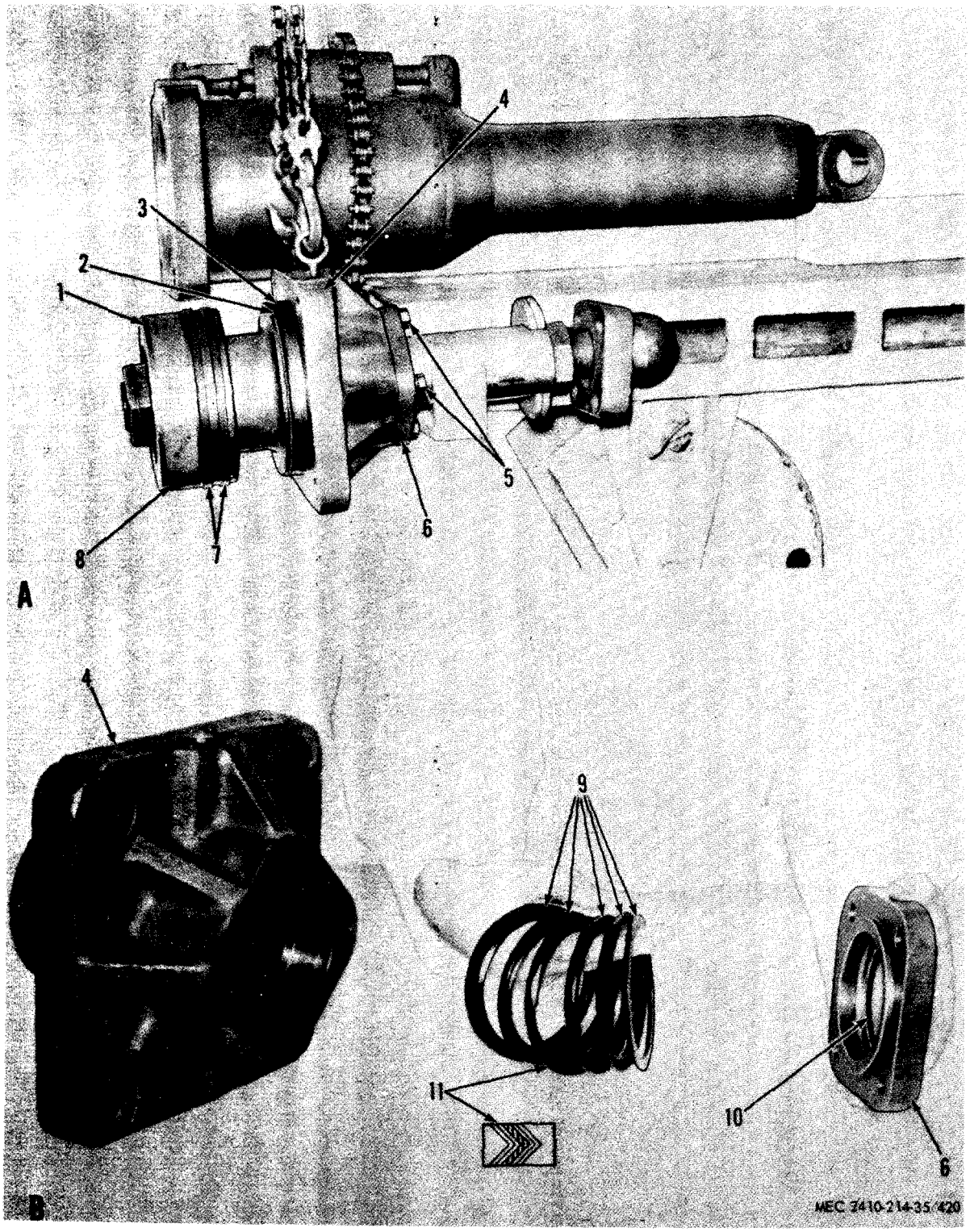
(1) Place retainer (6) packing rings (9) and head (4) on the piston rod.

(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.



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

Figure 3-399. Removing nut.



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 3-400. Disassembling piston head.

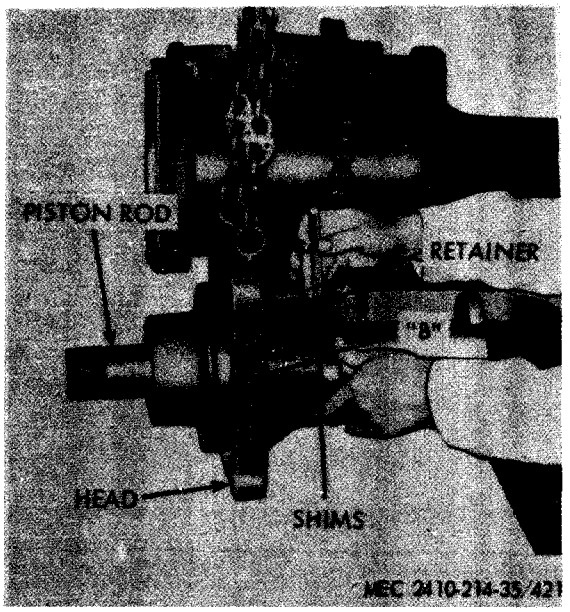
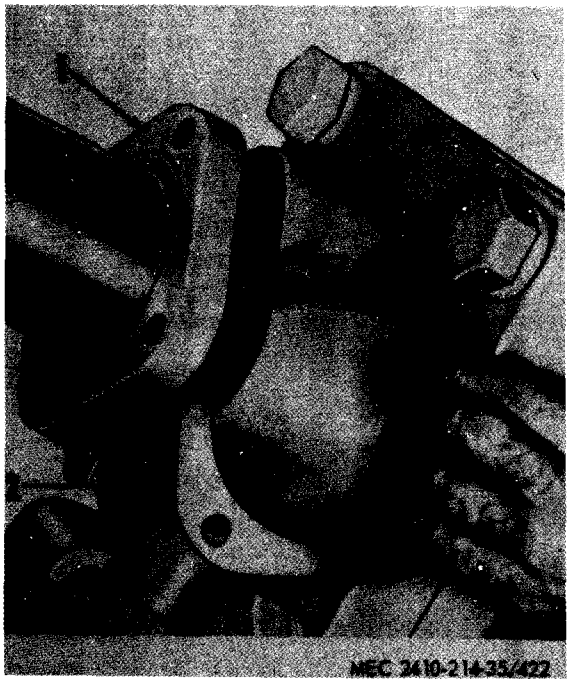


Figure 3-401. Measuring clearance.



Retainer **2 Shims**

Figure 3-402. Removing shims.

(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. 3-401) 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 .010-inch to .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. 3-400) 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 paragraph 1-4.

(10) Install seal assemblies (7) to the piston (1). Refer to paragraph 3-85d (14) through (20) for installation procedures.

Note. Point "B" (fig. 3-395) will be at tbe 8.25-inch mark on the expander assembly for this cylinder.

e. 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. 3-402) 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.

3-87. Ripper Hydraulic lift Cylinder (Serial Nos 75E1301-UP)

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.

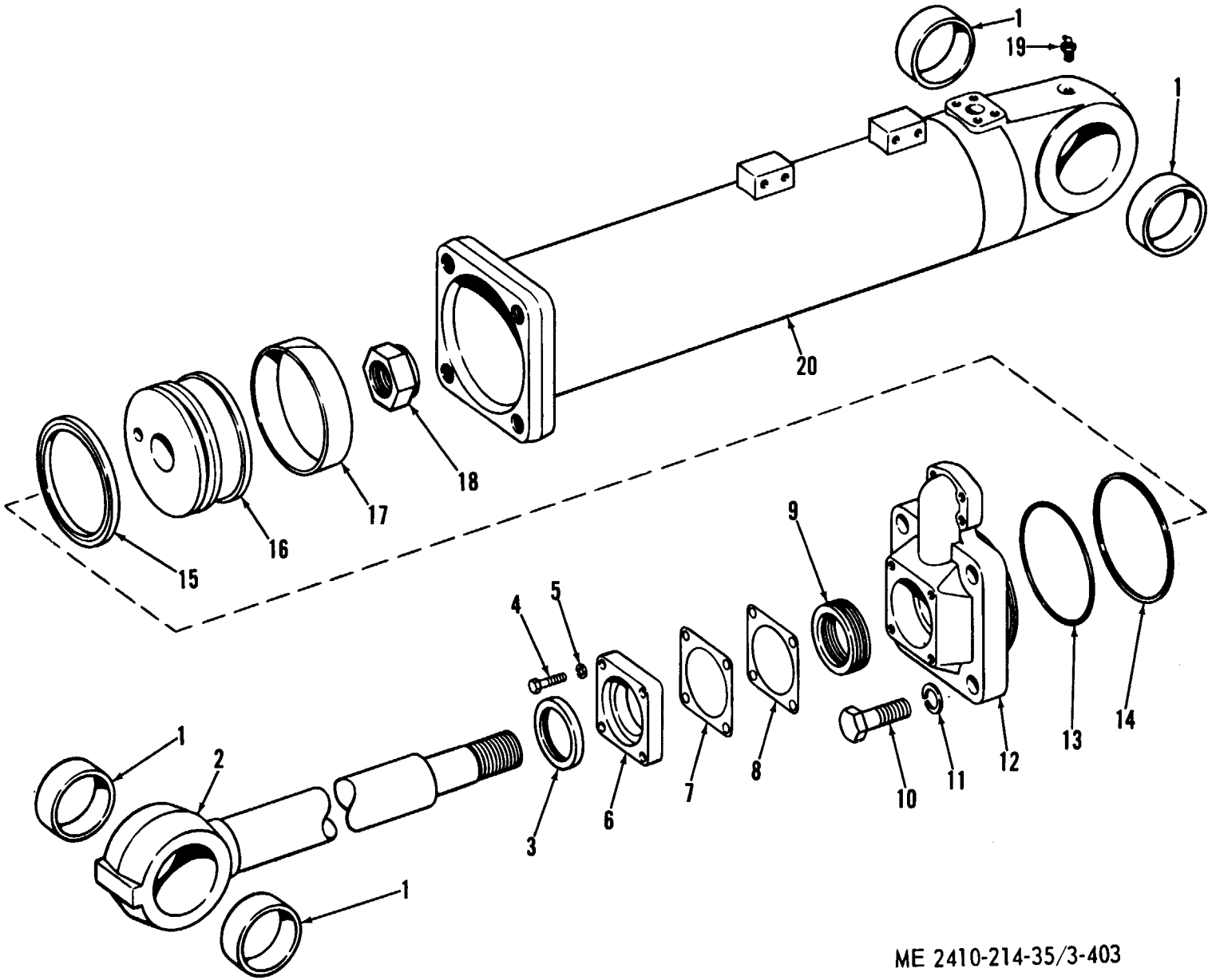
b. Removal and Installation. Refer to TM 5-2410-214-12 to remove and install the cylinders.

c. Disassembly and Reassembly. Disassemble and reassemble the ripper lift cylinders as illustrated in figure 3-403.

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, Inspection and Repair.

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



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 3-403. Ripper lift cylinder (serial number 75E1301-UP).

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

(3) Inspect walls if 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 the cylinder.**

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

Section XIII. WINCH

3-88. General

Refer to TM 5-2410-214-35 for removal, installation, and servicing of the winch, winch pump, and winch controls.

3-89. Winch Pump

a. General. The pump contains two steel gears, a drive and driven shaft, and four bearing assemblies. The machined housings 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 3-404 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 suitable cleaning solvent 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 housings. If bearings wedge in the housings 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 housing until the bearings slide into place freely. The clearance between the flats, when assembled in their housing, should not exceed .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.

3-90. Winch Control Valve

a. Removal.

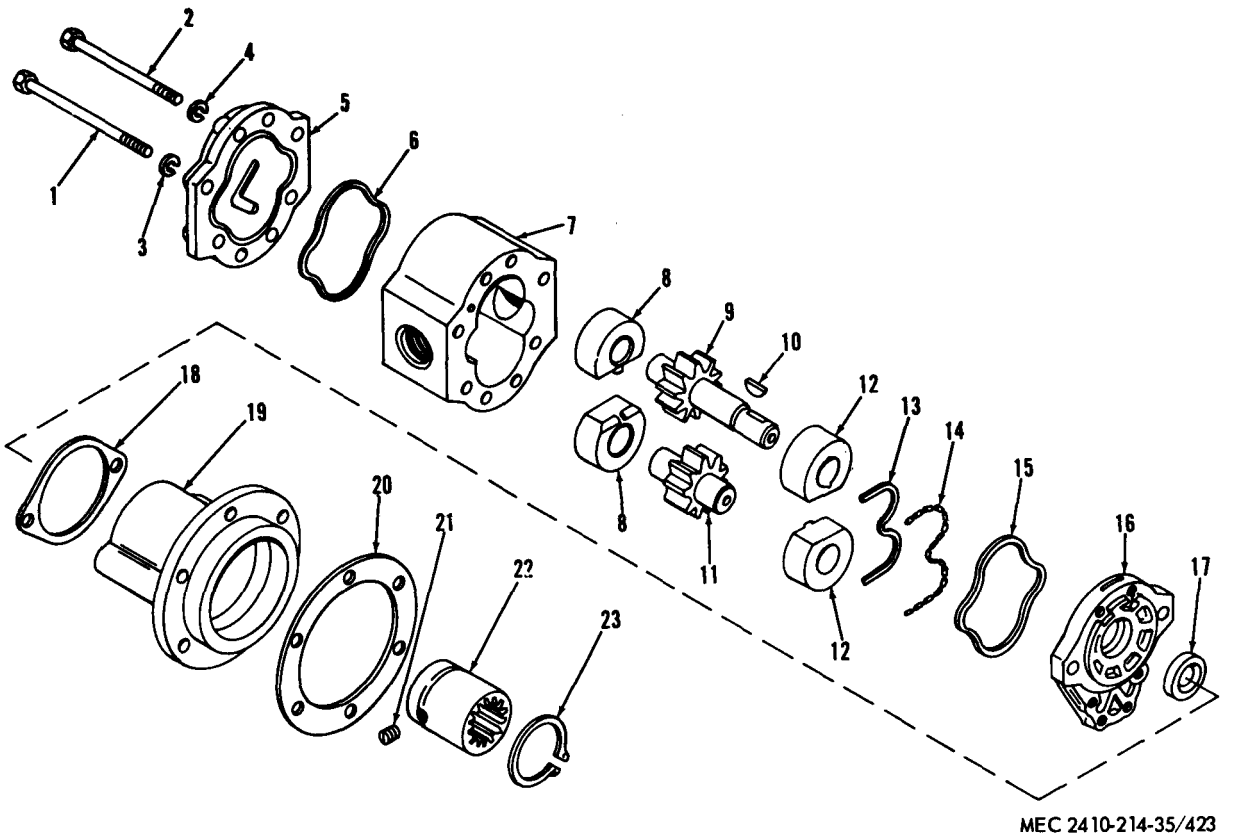
(1) Remove valve housing cover setscrews ((1), fig. 3-405) and loosen push-pull cable locknuts on the valve spools.

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

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

(4) Remove the valve housing.

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



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 3-404. Winch hydraulic pump, exploded view.

(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.

b. Disassembly and Reassembly.

(1) Selector Spool Removal.

Note. This maybe accomplished without removing the valve body ((29), fig. 3-406) 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) with new parts.

(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.

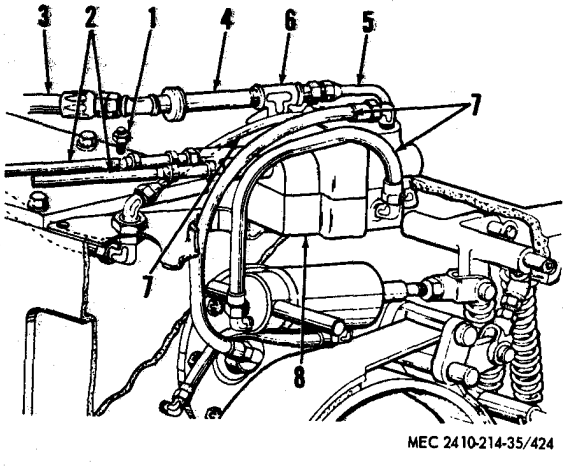
(d) Remove the spool and return spring (14).

(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.

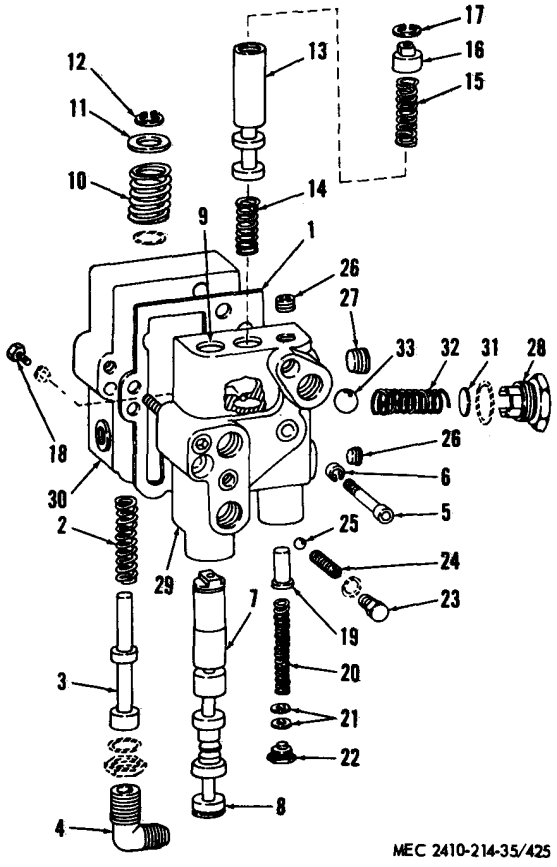
(b) Oil all parts generously. Place new preformed packing firmly in groove and install spring (14) and spool. Tap spool gently to pass over preformed packing and while holding in position, replace spool stop capscrew (18).

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



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

Figure 3-405. Control valve removal.



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 3-406. Winch control valve, exploded view.

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

(a) Remove retainer (22), wahsers (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 61/2 gpm—1,000 rpm—Oil Temperature 70.0

(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.

(6) *Servicing filter.* After cleaning filter screen, care should be taken when reassembling filter to prevent stripping threads of capscrews holding cap to body. Only slight pressure will give a good oil seal.

3-91. Winch Disassembly

a. Power Takeoff Assembly Removal. Unbolt the power takeoff bearing carrier and remove the complete power takeoff assembly. Be careful not to damage shims behind bearing carrier.

b. Brake Band Removal.

(1) Remove both covers on lh side of winch.

(2) Release brake by moving the selector lever to "Brake Release".

(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 3-407.

(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 1/2 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. 3-408).

(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.

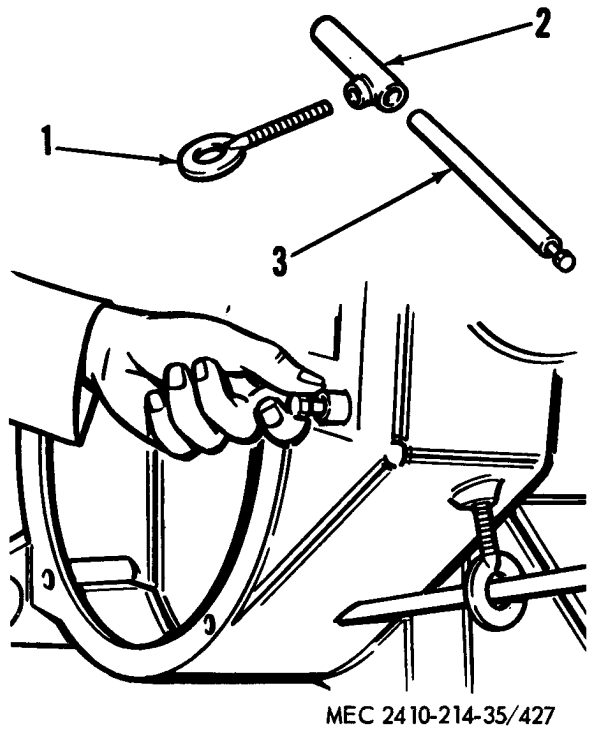
(8) Remove bearing nut ((2), fig. 3-408).

(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 3-409.

(11) Insert a 5/8-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 3-410.



1 Eyebolt 2 Sleeve 3 Pin

Figure 3-407. Brake 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 3-411.

f. Drum Shaft Removal.

(1) Unscrew drum shaft nut.

(2) Remove bearing retainer shown in figure 3-412.

(3) Remove place bolts in drum gear.

(4) Rethread nut on shaft.

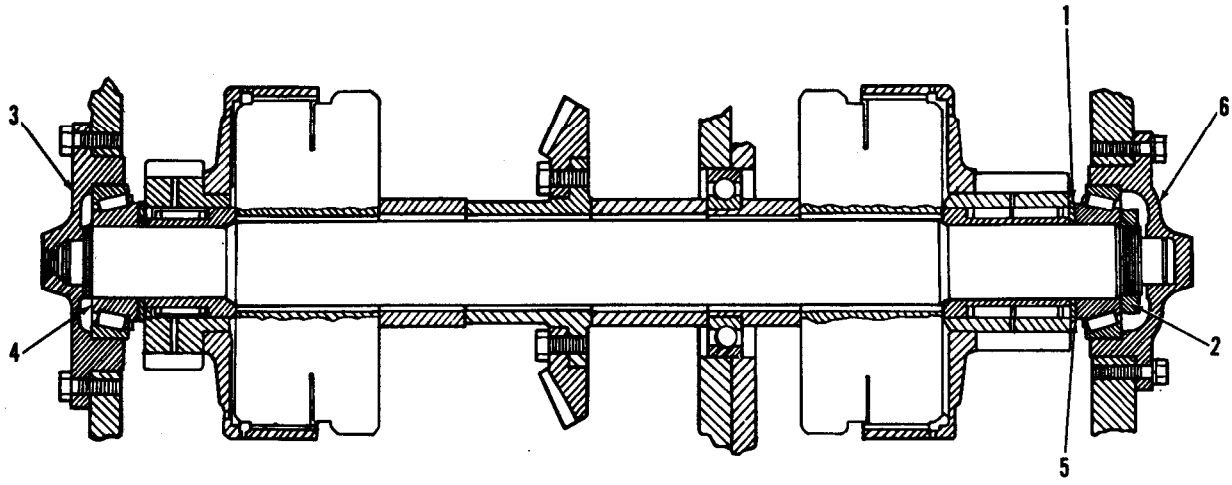
(5) Sling shaft using nut.

(6) Pull shaft straight up as shown in figure 3-413.

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.

g. Clutch Disassembly.

(1) It is unlikely that the clutch discs and separator plates will have to be replaced because of wear. 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



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

Figure 3-408. Bevel gear shaft, cross sectional view.



Figure 3-409. Bearing and clutch drive gear removal.

steel with a slight dish built into them as shown in figure 3-414.

Note. THE HYDRAULIC CLUTCH MUST BE SERVICED IN A CLEAN AREA. The clutch pack contains two parts: The clutch ((1), fig. 3-415) 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.

(2) Remove the setscrews ((12), fig. 3-416).

(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.

3-92. 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. 3-416) must be in line.

(8) Assembled clearance to be from .040-inch to .070 -inch. Use shims as required.

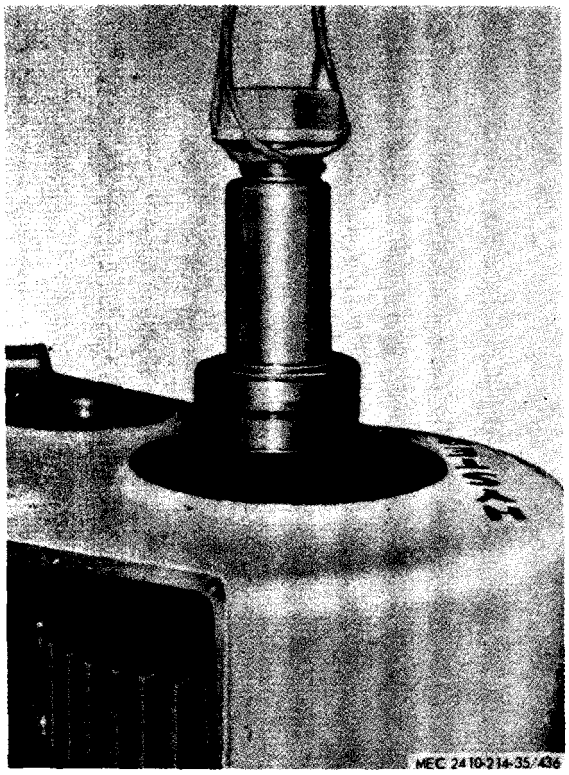


Figure 3-410. Bevel gear shaft removal.

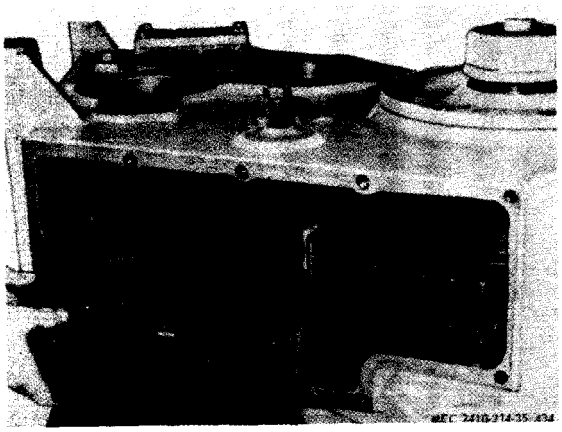


Figure 3-411. Intermediate gear and drum pinion removal.

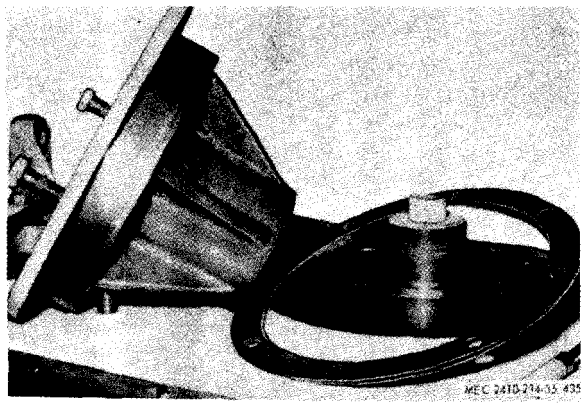


Figure 3-412. Bearing retainer removal.

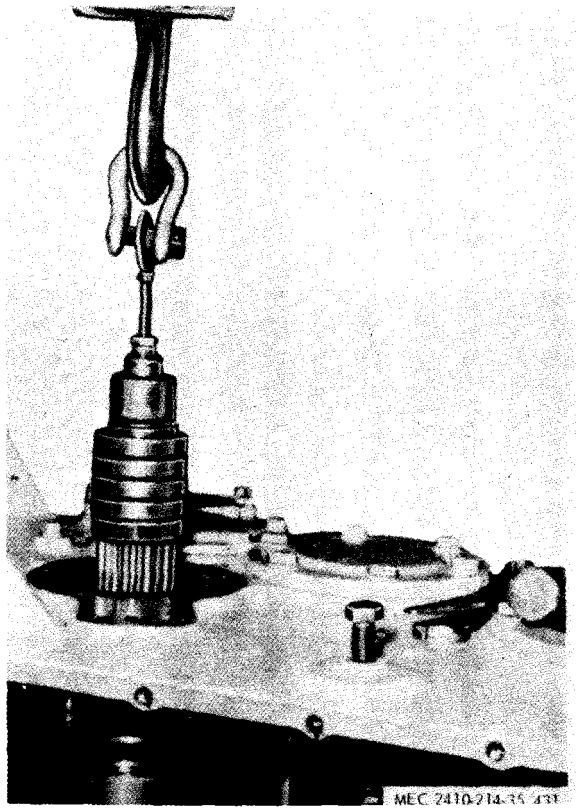


Figure 3-413. Drum shaft removal.

(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 .004 -inch to .007-inch end play in 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.

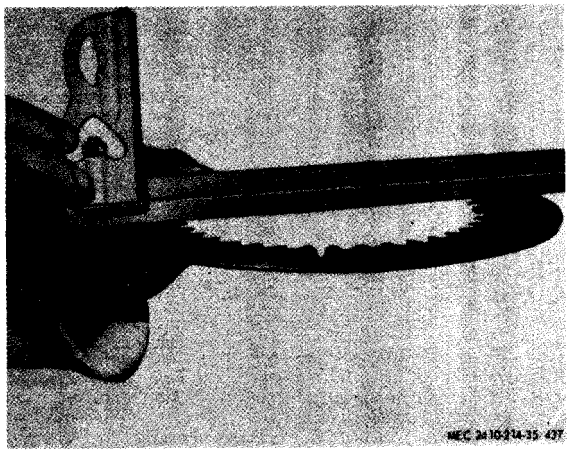
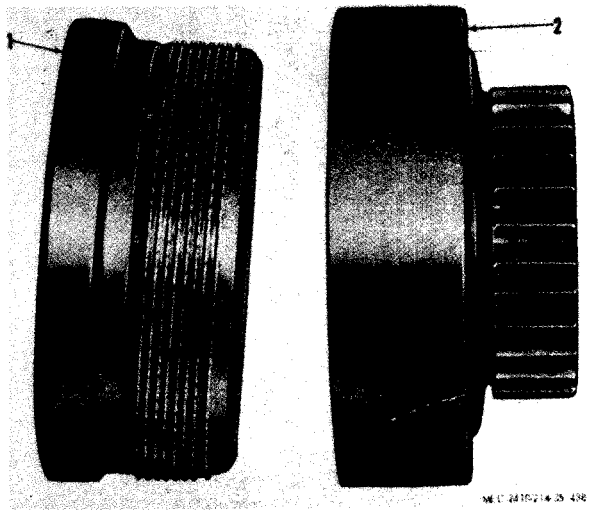
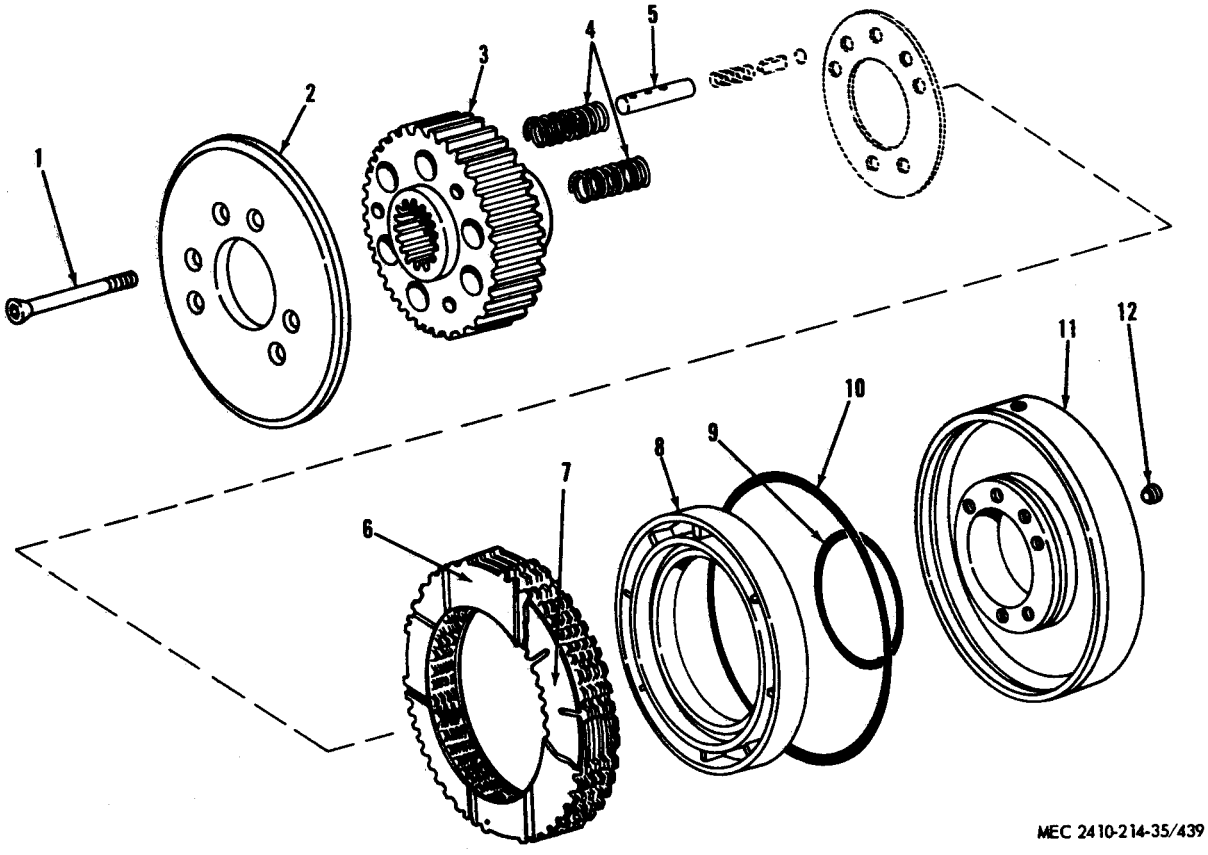


Figure 3-414. Clutch separator plates.



1 Clutch 2 Spider

Figure 3–415. Hydraulic clutch.



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

Figure 3-416. Hydraulic clutch, exploded view.

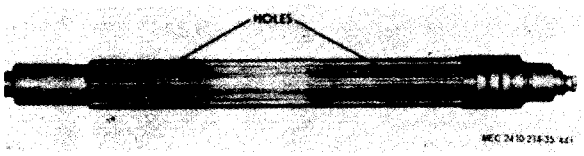


Figure 3-417. Bevel gear shaft.





MEC 2410-214-35/442

Figure 3-418. Pinion depth.

(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 3-417 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.

(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 .000-.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 .006-inch to .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 snaping 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 3-418.

(3) After the correct gear pattern is obtained, move the bevel ring gear away from the pinion to obtain .006-.014 backlash.

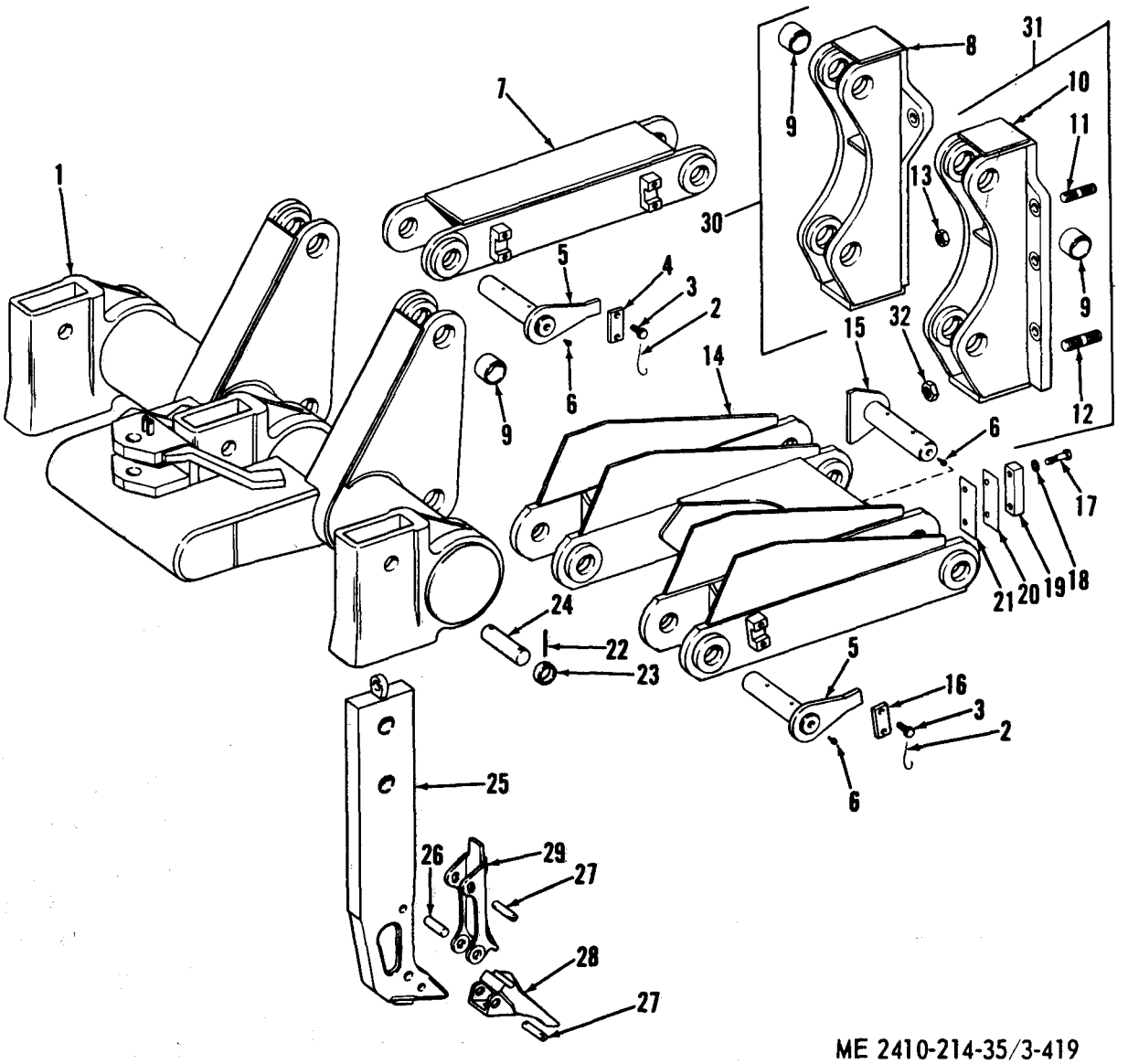
Section XIV. RIPPER

3-93. General

Refer to TM 5-2410-214-12 for removal and installation of the ripper, ripper shank protectors, tips, and ripper shank adjustment.

3-94. Disassembly and Reassembly

Disassemble and reassemble ripper as illustrated in figure 3-419. Repair or replace damaged or worn parts.



1	Beam assembly	12	Stud	23	Retainer
2	Lock wire	13	Nut	24	Pin
3	Bolt	14	Frame assembly	25	Shank assembly
4	Plate	15	Pin assembly	26	Pin
5	Pin assembly	16	Plate	27	Pin
6	Fitting	17	Bolt	28	Tip assembly
7	Link assembly	18	Lockwasher	29	Protector
8	Bracket, LH	19	Plate	30	Bracket assembly, LH
9	Bearing	20	Shim	31	Bracket assembly, RH
10	Bracket, RH	21	Shim	32	Nut
11	Stud	22	Cotter pin		

Figure 3-419. Ripper (serial nos. 75E1301-UP).

APPENDIX

REFERENCES

1. **Fire Protection**

TB 5-4200-200-10	Hand Portable Fire Extinguishers For Army Users

2. **Lubrication**

C9100IL LO 5-2410-214-12-1 and 2	Fuels, Lubricants, Oils and Waxes Lubrication Order

3. **Painting**

TM 9-213	Painting Instructions for Field Use

4. **Radio suppression**

TM 11-483	Radio Interference Suppression

5. **Maintenance**

TB ORD 651	Use of Antifreeze Solutions and Cleaning Compounds in Engine Cooling Systems
TM 38-750	Army Equipment Record Procedures
TM 5-2410-214-2	Organizational Maintenance Manual
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By Order of the Secretary of the Army:

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

OFFICIAL:

KENNETH G. WICKHAM,
Major *General, United States Army,*
The Adjutant General.

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 dekagram = 10 grams = .35 ounce
1 hectogram = 10 dekagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

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