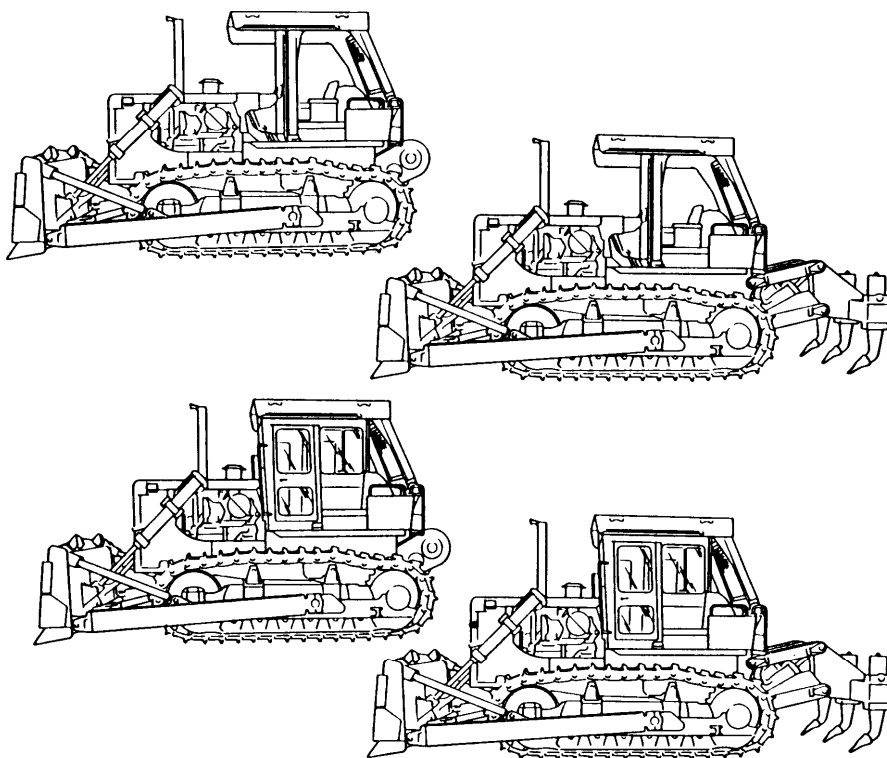


**TECHNICAL MANUAL**

**DIRECT SUPPORT AND GENERAL SUPPORT  
MAINTENANCE  
FOR**

**TRACTOR, FULL TRACKED, LOW SPEED: DED,  
MEDIUM DRAWBAR PULL, SSN M061**



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**TRACTOR WITH RIPPER,  
NSN 2410-01-223-0350  
TRACTOR WITH WINCH,  
NSN 2410-01-223-7261**

**TRACTOR WITH RIPPER AND WINTERIZED CAB,  
NSN 2410-01-253-2118  
TRACTOR WITH WINCH AND WINTERIZED CAB,  
NSN 2410-01-253-2117**

A rectangular box with a thick black border and a slight 3D effect, containing the word "WARNING" in bold, uppercase letters.

## FLAMMABLE LIQUIDS

Dry cleaning fluid, mineral spirits paint thinner, alcohol, acetone, methylethyl ketone and trichloroethylene are flammable solvents. Use these materials only in well-ventilated areas away from open flames and other heat sources that could cause ignition. The minimum safety measures described below must be observed in the handling and use of solvents:

- Fire extinguishers should be nearby when these materials are used.
- Cloths or rags saturated with cleaning solvents must be disposed of in accordance with authorized facilities procedures.
- The use of diesel fuel, oil, gasoline or benzene (benzol) is PROHIBITED for cleaning purposes.
- Fuel vapors can ignite and cause an explosion. Do not allow smoking or an open flame within 50 feet (16 meters).

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## PROPER MACHINE OPERATION

This equipment must be operated only by authorized personnel who have satisfactorily completed a program of training which must include familiarity with safe operating procedures, characteristics, and a knowledge of applicable codes, regulations, and facilities directives. Untrained personnel subject themselves and others to the possibility of DEATH or SERIOUS INJURY from the improper operation of this machine. Understand the equipment, its function, and the controls before operations are begun.

A rectangular box with a thick black border and a slight 3D effect, containing the word "WARNING" in bold, uppercase letters.

Hot oil or metal parts can cause severe burns. Wear insulated gloves, long sleeves, and eye protection when working with heated parts.

## WARNING

### **HANDLING CLEANING AGENTS (SOLVENTS)**

Toxic solvents are used in cleaning the equipment. Methyl-ethyl ketone TT-M-261 is a highly flammable solvent containing toxic characteristics that may irritate the skin and cause burns or internal disorders if fumes are repeatedly inhaled.

Trichloroethylene is a flammable solvent that has a chloroform odor. Inhaling concentrated fumes can cause unconsciousness. Inhaling fumes for a prolonged time can cause headache and drowsiness. Solvent absorbed by the skin can also result in internal disorders.

P-D-680 (Type II) is a flammable solvent that is potentially dangerous to personnel, Inhaling fumes for a prolonged time can cause headache and drowsiness. Solvent absorbed through the skin can also result in internal disorders.

The safety measures described below should be observed in the handling and use of solvents.

- Avoid prolonged or repeated breathing of vapors.
- Use only in a well-ventilated area.
- Keep away from heat, sparks, or open flames.
- Avoid contact with skin, eyes and clothing. The use of gloves is advised to prevent irritation or inflammation of the skin. If contact with the skin or eyes does occur, quickly wash the affected area with water for at least 15 minutes. For eyes, seek medical attention immediately after flushing eyes with water,

### **FIRST AID**

Refer to FM21-11 for applicable first aid information,

A rectangular box with a thick black border and a slight 3D effect, containing the word "WARNING" in bold, uppercase letters.

## **CARBON MONOXIDE**

Carbon monoxide is colorless, odorless, DEADLY POISONOUS gas which, when breathed, deprives the body of oxygen and causes SUFFOCATION. Exposure to air contaminated with carbon monoxide produces symptoms of headache, dizziness, loss of muscular control, apparent drowsiness, or coma. Permanent BRAIN DAMAGE or DEATH can result from severe exposure.

Carbon monoxide occurs in the exhaust fumes of fuel-burning heaters and internal-combustion engines and becomes DANGEROUSLY CONCENTRATED under conditions of INADEQUATE VENTILATION. The following precautions MUST be observed to insure the safety of personnel whenever the engine is operated for maintenance purposes.

- DO NOT operate the engine in an enclosed area unless it is ADEQUATELY VENTILATED.
- DO NOT operate the engine in an enclosed area such as a test cell without properly fitted and functioning exhaust ducts.
- BE ALERT at all times during engine operation for exhaust odors and exposure symptoms. If either are present, IMMEDIATELY VENTILATE the work area. If symptoms persist, remove affected personnel from the work area and treat as follows: expose to fresh air; keep warm; DO NOT PERMIT PHYSICAL EXERCISE; if necessary, administer artificial respiration as described in FM 21-11.

A rectangular box with a thick black border and a slight 3D effect, containing the word "WARNING" in bold, uppercase letters.

## **HANDLING WEIGHTS**

This manual considers short-term, non-repetitive lifts of equipment weighting up to 190 pounds to heights of about 3 feet. Under these conditions, this manual assigns one man for each 47-pound increment of weight up to a total of four men to accomplish the required lifts. If local conditions mandate higher lifts, repetitive lifts, or carries greater than 9 feet, refer to MIL-STD-1472 for a guideline on the number of personnel needed.





### **MECHANICAL HAZARDS**

Mechanical systems and components used on this equipment are energized, under pressure, or have sharp edges.

Use all precautions to de-energize a system, bleed pressure and to protect yourself from sharp edges when working on the equipment. Failure to do so may cause serious PERSONAL INJURY or DEATH.



### **HIGH NOISE DANGER**

Your hearing can be PERMANENTLY DAMAGED if you are exposed to constant high noise levels of 85 dB(A) or greater. Wear approved hearing protection devices when working in high noise level areas. Personnel exposed to high noise levels shall participate in a hearing conservation program in accordance with TB MED 501.



### **USE OF COMPRESSED AIR TO DRY PARTS**

DO NOT exceed 15 psig nozzle pressure when drying parts with compressed air, DO NOT direct compressed air against human skin. Failure to do so may result in SERIOUS INJURY or DEATH.



Eye shields must be worn when cleaning with a wire brush. Flying rust and metal particles may cause injury to personnel.

\* TECHNICAL MANUAL  
NO. 5-2410-237-34

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
Washington D.C., 30 March 1993

Direct Support and General Support  
Maintenance Manual  
for

# TRACTOR, FULL TRACKED, LOW SPEED: DED, MEDIUM DRAWBAR PULL, SSN M061

TRACTOR WITH RIPPER,  
NSN 2410-01-223-0350

TRACTOR WITH WINCH,  
NSN 2410-01-223-7261

TRACTOR WITH RIPPER AND WINTERIZED CAB,  
NSN 2410-01-253-2118

TRACTOR WITH WINCH AND WINTERIZED CAB,  
NSN 2410-01-253-2117

## REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know, Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, US Army Tank-Automotive Command, ATTN: AMSTA-MB, Warren, MI 48397-5000. A reply will be furnished to you.

Approved For Public Release; Distribution is Unlimited

\*This publication along with TM5-2410-237-20 supersedes TM5-2410-237-24

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## SAFETY SUMMARY

The following warnings appear in the text in the manual and are repeated here for emphasis.

**WARNING**

If the valve spring lock is not correctly installed on the valve stem, it will unseat and be thrown with force when the spring compressor is released. The thrown lock could cause serious personal injury. (page 3-38)

**WARNING**

Reinstall large nut on pinion shaft after capscrew and lock have been removed. Because the flange is installed on pinion shaft with force of 35 to 40 tons, nut will prevent flange from coming off and causing personal injury. (page 8-13)

**WARNING**

Be certain that the crankshaft is secured properly to a floor jack before removal of the last two bearing caps. Failure to follow these instructions could cause personal injury. (page 3-44)

**WARNING**

The adjuster cylinder for the track is under high hydraulic pressure. Do not visually inspect the relief valve to see if grease is released when it is open. Look to see that the track has loosened. Use this warning any time the tracks are loosened or tightened. (page 8-28)

**WARNING**

The oil pump idler gear is free to fall when the oil pump is removed. (page 3-112)

**WARNING**

When removing the equalizer bar, make sure all jacks and blocking are properly placed and secure to prevent movement of tractor before starting removal procedure. Failure to follow this precaution could result in serious or even fatal injuries. (page 9-6)

**WARNING**

Fuel transfer pump cover is under spring tension. Use caution when removing. (page 4-11)

**WARNING**

Put wood blocks behind tracks at rear of machine and engage parking brake to prevent movement of machine when it is being raised on hydraulic jack stands. Failure to follow these precautions could result in serious or even fatal injuries. (page 9-8)

**WARNING**

Equalizer bar weighs 300 lbs. Use caution and proper handling equipment to prevent personal injury or damage to machine. (page 9-10)

**WARNING**

Make sure there is no spring pressure on the two front stops. Do not remove the recoil spring from the track roller frame until the pressure is released from the two front stops. (page 9-30)

**WARNING**

Make sure the press is equipped with guards to hold the recoil spring assembly in position while it is under compression. (page 9-31)

**WARNING**

Front idler weighs 500 lb. Use caution and proper handling equipment to avoid personal injury or damage to machine. (page 9-39)

**WARNING**

Yoke weighs 110 lbs. Use proper handling equipment to prevent personal injury or damage to machine. (page 9-48)

**WARNING**

Make sure the hydraulic pressure in the track adjusting mechanism is completely released and the cylinder can be moved to the rear into the front pilot of the recoil spring before removing the hydraulic track adjuster. (page 9-50)

**WARNING**

Sprocket has been installed with 60 to 65 tons force and requires considerable force to loosen. Stand clear of sprocket during loosening procedure to avoid personal injury. (page 9-58)

**WARNING**

Sprocket weighs 400 lbs. Use caution and proper handling equipment to prevent personal injury or damage to machine. (page 9-60)

**WARNING**

Make sure pressure is off cylinder before trying to remove it from sprocket shaft. Failure to follow this precaution could result in serious personal injury. (page 9-61)

**WARNING**

Use insulated gloves for handling hot and cold parts to avoid personal injury. (page 9-62)

**WARNING**

Plunger assembly, lever arm, and cover are under spring pressure. Use caution when removing these parts to prevent personal injury or damaged or lost parts. (page 10-18)

**WARNING**

Do not disturb capscrew holding plunger assembly until lever and cover assemblies are in place. Spring pressure behind plunger could cause injury or lost parts. (page 10-22)

**WARNING**

Turn battery disconnect switch to OFF before working inside dash assembly. Failure to follow this precaution could result in personal injury and damage to equipment. (page 10-30)

**WARNING**

Hydraulic oil in the system can be under pressures over 2500 psi with the engine and pump OFF. ALWAYS relieve pressure in hydraulic lines before attempting to remove any component in the hydraulic system. With engine OFF and hydraulic attachments on the ground, move control levers through all operating position several times to relieve line pressure. Relieve pressure in hydraulic oil tank, by loosening filler cap very slowly. Failure to follow these precautions could result in serious personal injury. (page 10-60)

**WARNING**

Spool and lever housings are spring loaded. Separate housings carefully to prevent personal injury or parts damage. (page 10-62)

**WARNING**

Capscrew and washers are under spring pressure. Remove carefully to prevent personal injury or parts damage. (page 10-63)

**WARNING**

Take necessary precautions to insure adequate personal safety while welding on or around the frame. Use caution while welding near hydraulic and fuel lines; personal injury or death could result. See TM9-273 for proper welding procedures. (page 11-2)

**WARNING**

When disconnecting electrical wiring, make sure the battery disconnect switch is in the off position. Failure to do so could result in personal injury. (page 11-8)

**WARNING**

Immediately after adjustment, check to see that the operator can fully depress the tractor brake pedals. All controls must be in proper operating distance from the operator. An unsafe condition exists when control cannot be reached. Failure to make proper adjustments may result in serious personal injury or death. (page 11-21)

**WARNING**

There is spring tension on the bolts in the following step. Spring throw can cause personal injury. Unscrew each capscrew a little at a time in rotation. Do not remove the capscrews too fast. (page 12-20)

**WARNING**

Capscrews on clutch cover plate are under spring tension. Remove slowly to avoid injury. (page 12-15)

**WARNING**

Bracket is under spring pressure. Remove carefully so as not to lose parts or cause personal injury. (page 12-55)

**WARNING**

There is spring pressure behind cover. Remove cover slowly to prevent personal injury. (page 12-58)

**WARNING**

Relieve pressure in hydraulic oil tank by loosening filler cap very slowly. Failure to follow these precautions could result in serious personal injury. (page 13-17)

**WARNING**

Cover holds springs under compression. Remove bolts slowly and evenly to prevent possible personal injury. (page 13-35)

**WARNING**

Relieve pressure in hydraulic lines by moving ripper control handle back and forth and side to side several times before starting removal. Failure to do so could result in injury or damage to equipment. (page 13-60)

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**WARNING**

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Hydraulic oil, under pressure that can be higher than 2500 psi, can remain in the hydraulic system on this tractor after the engine and pump have been stopped. Serious injury can be caused if this pressure is not released before any service or test is done on the hydraulic system. To prevent possible injury, be sure that the pressure in the system is released before any fitting, hose, or component is loosened, tightened, removed, or adjusted. When possible, the blade and ripper must always be completely lowered to the ground before service is started. When it is necessary for the blade and/or ripper to be raised while tests or adjustments are done, be sure that it has the correct support. Always move the tractor to a location away from the travel of other machines. Be sure that other personnel are not near the tractor when the engine is running and tests or adjustments are being made. (page 13-113)

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**WARNING**

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Do not install hydraulic circuit tester to the pump supply line with the engine running. Oil could be hot and under pressure, and cause serious personal injury. (page 13-114)

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**WARNING**

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Personal injury and equipment damage can result when disconnecting lines to install flow blocking devices, caps, or plugs. The blade and ripper can move and pressure oil can be released. (page 13-118)

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**WARNING**

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To prevent personal injury while checking pressures, disconnect and remove cable from drum. (page 13-126)



## HOW TO USE THIS MANUAL

## 1. ABOUT YOUR MANUAL

Spend some time looking through this manual. You'll find that it has a new look, different than most of the TMs you've been using.

New features added to make this manual easier for you to use are:

- a. **Finding Information** - These include entry features such as the thumb indexing indicators on the cover and edge of the manual. Extensive troubleshooting guides for specific systems lead directly to step-by-step directions for problem solving and maintenance tasks.
- b. **Illustrations** - Many methods are used to make finding and fixing parts much easier. Locator illustrations with keyed text, exploded views, and cut-away diagrams make the information in this manual easier to understand and follow.
- c. **Keying Text With Illustrations** - Instructions/text are located together with figures that illustrate the specific task you are working on. In most cases, the task steps and figures are located side by side.

This TM is organized so that the information and procedures, needed to perform maintenance tasks, are easily located. Take a few minutes to read through this How To Use part of the manual to learn how it is put together and how to find the information you need.

## 2. BEFORE YOU START

- a. Read and understand all WARNING, SAFETY AND FIRST AID DATA in the front of this manual. This data contains general shop safety practices not included in maintenance tasks.
- b. Read Chapter 1 to learn more about the tractor and its purpose, capabilities and features.

## 3. CONTENTS OF MANUAL

- a. This TM contains maintenance instructions at the direct support and general support levels for the D7G Tractor. Included are principles of operation, fault isolation troubleshooting, and corrective maintenance tasks as authorized by the Maintenance Allocation Chart (MAC).

- b. This TM is made up of:

(1) Chapters. There are 14 chapters.

- (a) Chapter 1, Introduction. This chapter contains general tractor information of interest to direct support and general support maintenance technicians.
- (b) Chapter 2, Direct Support and General Support Maintenance Instructions. This chapter contains instructions of interest to direct support and general support level maintenance technicians on tools, equipment, and troubleshooting.

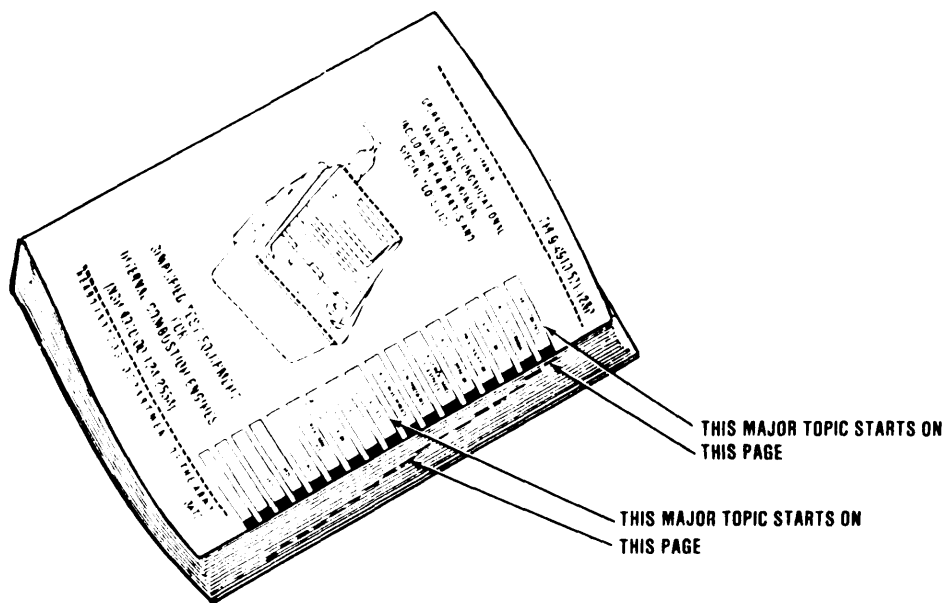
## HOW TO USE THIS MANUAL (Cont'd)

- (c) Chapter 3, Engine Maintenance. This chapter contains maintenance of engine components.
  - (d) Chapter 4, Fuel System Maintenance. This chapter contains maintenance of fuel system components.
  - (e) Chapter 5, Cooling System Maintenance. This chapter contains maintenance of cooling system components.
  - (f) Chapter 6, Electrical System Maintenance. This chapter contains maintenance of electrical system components.
  - (g) Chapter 7, Transmission Maintenance. This chapter contains maintenance of transmission components.
  - (h) Chapter 8, Transfer and Final Drive Maintenance. This chapter contains maintenance of transfer and final drive components.
  - (i) Chapter 9, Track Maintenance. This chapter contains maintenance of track and carrier components.
  - (j) Chapter 10, Steering and Brake Maintenance. This chapter contains maintenance of steering, brake and clutch components.
  - (k) Chapter 11, Frame, Body, Cab, Hood, and Hull Maintenance. This chapter contains maintenance of frame components.
  - (l) Chapter 12, Winch Maintenance. This chapter contains maintenance of winch components.
  - (m) Chapter 13, Hydraulic System Maintenance. This chapter contains maintenance of hydraulic components and controls.
  - (n) Chapter 14, Earth Moving Equipment Maintenance. This chapter contains maintenance of blade and ripper components.
- (2) Sections. Some chapters are further subdivided into sections. Sections allow for easier break-up of material. They are:
- (a) Chapter 1 has two sections: General Information and Equipment Description.
  - (b) Chapter 2 has three sections: Repair Parts, Special Tools, TMDE and Support Equipment; Troubleshooting Procedures; and Pre-embarkation of Material for Overseas Movement.
- (3) Paragraphs. Paragraphs make up chapters. The paragraphs have the information needed to do the job properly. Each paragraph is the start of a major topic within the chapter.
- (4) Pages. Pages are numbered consecutively within each chapter. The first part is the chapter number followed by a dash and the consecutive page number. For example, page 3 of Chapter 2 is numbered 2-3.

## HOW TO USE THIS MANUAL (Cont'd)

- (5) Appendices. Appendices are found in the back of the manual.
- (a) Appendix A, References. This appendix contains references to other information you may need to do your job.
  - (b) Appendix B, Expendable Supplies and Materials List. This appendix contains procurement information on expendable items you need for maintenance.
  - (c) Appendix C, Illustrated List of Manufactured Items. This appendix contains information you need to make parts that are not procured.
  - (d) Appendix D, Torque Limits. This appendix contains torquing information for normal hardware on components without specific torques.
- (6) Glossary. The glossary is located in the back of the manual. It contains a listing of unusual terms and abbreviations used in this manual and their explanation.
- (7) Index. The index is located in the back of the manual. It lists topics in alphabetical order and references the paragraph numbers where information on the topic can be found.

## 4. HOW TO FIND INFORMATION QUICKLY



- a. Using the Front Cover. The front cover of the manual has boxed titles for major topics you use the most. At the right side of each box is a blackened area. The blackened area matches black markings on the first page of that major topic in the manual. Fan the outer edge of the manual with your thumb to find the topic material marked.

HOW TO USE THIS MANUAL (Cont'd)

- b. Using the Table of Contents. The table of contents lists all chapters, appendices, sections and other important information in this manual and the page number where each starts.

**CHAPTER NUMBER**

**PARAGRAPH NUMBER**

**PARAGRAPH TITLE CONTINUED**

TM 9-4910-571-128P

2-3-31. DC VOLTAGE TO HV: TEST 189 (cont)

2-3-31

<p><b>Description:</b></p> <p>This procedure measures voltage in the range of -45 to +45 volts. The VM is used as a DC voltmeter with the scales printed in the correct direction. This test must be done with the component being tested turned on.</p> <p><b>Typical Applications:</b></p> <p>Battery: Coil Primary Fuel Solenoid Starter Motor Starter Solenoid Starter Cable Drop Interior Output Alternator Weather-Cable Drop Any DC voltage within -45 to +45</p> <p><b>References:</b></p> <p>Vehicle/Equipment: TM</p> <p><b>Pre-Test Procedures:</b></p> <p>Procedure: Ref Amplification Test: 2-3-3</p> <p><b>Possible Error Passages:</b></p> <p>EMF Offset not performing</p> <p><b>Control Functions:</b></p> <p>CI, O2, O1, O5</p>	<p>1. Set TEST SELECT switch to 189.</p> <p>2. Press and hold TEST button until EAL appears on display.</p> <p>3. Release TEST button and note color offset value to appear on display. If offset is within +0.6 to +6.1, proceed to step 3. If offset is more than +5.9 to +6.0, refer to Offset Fault Isolation paragraph 3-2-2.</p> <p style="text-align: center;"><b>CAUTION:</b></p> <p>Electrical shock hazard. Ensure circuit is off before attaching leads. Failure to heed warnings could cause shock, injury or death. If electrical shock occurs, administer first aid and seek medical assistance immediately.</p> <p style="text-align: center;"><b>NOTE:</b></p> <p>Always attach red clip E1 to positive (+) side and black clip E2 to negative (-) side of item being measured, or a negative number may be displayed.</p> <p>3. Connect leads. Attach clips E1 and E2 across circuit where voltage is to be measured.</p> <p>4. Measure voltage:</p> <p>a. Turn on circuit to be tested.</p> <p>b. Press TEST button.</p> <p style="text-align: center;"><b>NOTE:</b></p> <p>If -0.9, 0.5 to display, voltage is not in this -45 to +45 volt range. Circuit to be measured on VM. If negative (-) number is displayed then a negative voltage is being measured.</p> <p>c. Measure displayed value (unit)</p> <p>PC 2 1AS</p>
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2-3

**PAGE NUMBER**

- c. Using Chapter Indexes. On the first page of each chapter is an alphabetical summary listing of all paragraphs in that chapter and the page number where each can be found. In cases where the chapter has been divided into sections, a table of contents is located at the beginning of each section. If you are still having trouble finding a task, refer to the manual index at the end of the manual.
- d. Using Paragraph Numbers and Titles. Paragraph numbers include the chapter number. The paragraph number appears before the title of the paragraph title line. Paragraphs that are longer than one page will have the paragraph number and title continued at the top of each following page.

HOW TO USE THIS MANUAL (Cont'd)

**DESCRIPTION**

TM 9-4910-571-10-10

2-3-32. DC CURRENT 0 TO 1500 AMPS DC TEST #90 2-3-31

<p><b>Description:</b></p> <p>This procedure measures DC current in the range of 0 to 1500 amps. The YIM is used as an ammeter with the decimal point in the correct position. This test may be done with the vehicle/equipment operating.</p> <p><b>Typical Applications:</b></p> <p>Alternator output Generator output Average starter current Field winding current Accessory current Battery charging current Any current from 0 to 1500 Amps DC Locating shorts</p>	<p><b>References:</b></p> <p>Vehicle/Equipment IM</p> <p><b>Pre-Test Procedures:</b></p> <p><u>Procedure</u> <span style="float: right;">2-2-3</span></p> <p>Run confidence test</p> <p><b>Possible Error Messages:</b></p> <p>E002 Transducer not connected E005 Offset not performed</p> <p><b>Control Functions:</b></p> <p>01, 02, 03, 04, 05</p>
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WARNING

On vehicles with a master switch in the negative (-) battery cable, sparking may occur if the YIM case touches the vehicle while master switch is off and YIM is on. Sparking in the presence of fuel or fuel vapors presents a potential hazard. Avoid hazard by doing all testing with the vehicle master switch on.

**1. Connect current probe.**

- a. Attach connector P1 of cable W4 to J2 T4 or J3 T4.
- b. Attach connector P2 of cable W4 to current probe, T4 item 11.

GO TO NEXT PAGE  
2-34

APPLICATIONS

REFERENCES

PRE-TEST PROCEDURES

WARNINGS, CAUTIONS AND NOTES

MAJOR STEPS

ILLUSTRATIONS

5. HOW TO USE THE TROUBLESHOOTING CHARTS

Troubleshooting is divided into two parts, electrical and mechanical. At the start of the section is an alphabetical summary listing of the paragraphs in that section and the page number where each can be found. Two of the paragraphs contain a symptom index, one for electrical and one for mechanical.

The symptom index lists common problems that you may have with the tractor and the page number where each can be found.

Each problem is followed by several tests or inspections that may indicate the cause of the problem. The tests or inspections are arranged from the most likely (1) to the least likely.

Each test or inspection is followed by step-by-step instructions needed to find the problem and the page number needed in the maintenance chapter to correct the problem.

6. HOW TO USE A PROCEDURE

Each procedure consists of two parts, an initial setup table and a task section. You must familiarize yourself with the entire maintenance procedures before beginning the maintenance task.

## HOW TO USE THIS MANUAL (Cont'd)

The initial setup table contains the following parts:

Description - Describes the procedure.

Applications - Gives examples of how/where the procedure is used.

References - Shows where reference material can be found.

Equipment Conditions - Refers to procedures that must be done before attempting this procedure.

## CHAPTER 1

## INTRODUCTION

## Section I. GENERAL INFORMATION

## 1-1. SCOPE

- a. Type of Manual. This manual contains maintenance instructions, at the direct support and general support levels, for the D7G Tractor.
- b. Model Numbers and Equipment Names. D7G Tractor, Full Tracked, Low speed: Diesel Engine-Driven, Medium-Drawbar Pull. Equipped with rollover protective structure (ROPS) and Semi-U (straight) tilt type blade. Available in four versions:
  - Tractor with rear-mounted ripper
  - Tractor with rear-mounted winch
  - Tractor with rear-mounted ripper and winterized cab
  - Tractor with rear-mounted winch and winterized cab
- c. Purpose of Equipment.  
and for clearing land of small trees and brush.
  - (1) Tractors equipped with ripper are designed for dozing and also for ripping soil, rocks, asphalt, and concrete.
  - (2) Tractors equipped with winch are designed for dozing and also for all types of winching operations.

## 1-2. MAINTENANCE FORMS AND RECORDS

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA PAM 738-750, The Army Maintenance Management System (TAMMS).

## 1-3. EQUIPMENT IMPROVEMENT REPORT AND MAINTENANCE DIGEST (EIR MD)

The quarterly Equipment Improvement Report and Maintenance Digest, TB 43-0001-39 series, contains valuable information on the equipment covered in this manual. The information in the TB 43-0001-39 series is compiled from some of the Equipment Improvement Reports that you prepared on the vehicles covered in this manual. Many of these articles result from comments, suggestions, and improvement recommendations that you submitted to the EIR program. The TB 43-0001-39 series contains information on equipment improvements, minor alterations, proposed Modification Work Orders (MWO's), warranties (if applicable), actions taken on some of your DA Forms 2028-2 (Recommended Changes to Publications), and advance information on proposed changes that may affect this manual. The information will help you in doing your job better and will help in keeping you advised of the latest changes to this manual. Also refer to DA PAM 25-30 Consolidated Index of Army Publications and Blank Forms, and Appendix A, References of this manual.

#### 1-4. DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

Demolition of materiel to prevent enemy use shall be in accordance with the requirement of TM 750-244-3 (procedures for Destruction of Equipment to Prevent Enemy Use for U.S. Army).

#### 1-5. REPORTING EQUIPMENT IMPROVEMENT RECOMENDATIONS (EIR'S)

If your D7G tractor needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 (Quality Deficiency Report). Mail it to: Commander, US Army Tank-Automotive Command, ATTN: AMSTA-QRD, Warren, MI 48397-5000. We'll send you a reply.

#### 1-6. WARRANTY INFORMATION

Refer to warranty TB, Technical Bulletin 5-2410-237-1.

### Section II. EQUIPMENT DESCRIPTION AND DATA

#### 1-7. EQUIPMENT CHARACTERISTICS, CAPABILITIES AND FEATURES

Detailed descriptions of the D7G Tractor can be found in TM5-2410-237-20.

#### 1-8. EQUIPMENT DATA

TM5-2410-237-20 contains the tabulated data for the D7G Tractor.



CHAPTER 2

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section 1. REPAIR PARTS, SPECIAL TOOLS, TMDE AND SUPPORT EQUIPMENT

	Page
Common Tools and Equipment .....	2-1
Special Tools, TMDE and Support Equipment .....	2-1
Repair Parts .....	2-1

2-1. COMMON TOOLS AND EQUIPMENT

For authorized common tools and equipment, refer to the Modified Table of Organization and Equipment (MTOE) applicable to your unit.

2-2. SPECIAL TOOLS, TMDE AND SUPPORT EQUIPMENT

Refer to TM5-2410-237-24P for special tools and TMDE you will need in maintaining the vehicle. No support equipment is required.

2-3. REPAIR PARTS

Repair parts are listed and illustrated in the repair parts and special tools list (TM5-2410-237-24P) covering direct support and general support maintenance for this equipment.

Section II. TROUBLESHOOTING

	Page
Explanation of Columns .....	2-2
General Troubleshooting Instructions .....	2-1
Symptom Index .....	2-3
Troubleshooting .....	2-5

2-4. GENERAL TROUBLESHOOTING INSTRUCTIONS

- a. Troubleshooting procedures in this section cannot give all the answers or correct all vehicle malfunctions encountered. However, these procedures are an organized step-by-step approach to a problem that directs tests and inspections toward the source of a problem and successful solution. Information in this section is for use by support maintenance personnel in conjunction with, and as a supplement to, the troubleshooting procedures in TM5-2410-237-20.

WARNING

Operation of a deadlined vehicle without preliminary inspection may cause further damage to a disabled component and possible injury to personnel.

- b. Do the easiest things first. Most problems are easily corrected. For example:

- (1) Low power problems are generally caused by loose governor linkage or dirty fuel filters.
  - (2) Excessive oil consumption is generally caused by leaky gaskets or loose line connections.
  - (3) Always check the easiest and most obvious things first. This simple rule saves time and trouble.
- c. Double check before disassembly. The source of most engine problems can be traced to more than one part in a system. For example:
- (1) Excessive fuel consumption may not be caused by the fuel pump alone. Instead, the trouble could be a clogged air cleaner reducing air inflow or a restricted exhaust passage, causing abnormally high back pressure.
  - (2) Engines very often are disassembled in search of a complaint and the real evidence of the problem is destroyed. Check again to be sure an easier solution to the problem has not been overlooked.
  - (3) Check all tags, service request forms, and vehicle logbook for repair history. This may help lead to the source of problems.
- d. Before attempting to correct a problem, diagnose the cause of the problem. Do not allow the same failure to occur again.

2-5. EXPLANATION OF COLUMNS

MALFUNCTION	Visual or operational indication that something is wrong with the D7G tractor.
TEST/INSPECTION	Procedure to isolate the problem to a component or system.
CORRECTIVE ACTION	Procedure to correct problem.

## 2-6. SYMPTOM INDEX

This symptom index is provided as a quick way to get you to the troubleshooting procedure that will help you solve the problem you are having.

## MECHANICAL TROUBLESHOOTING SYMPTOM INDEX

MALFUNCTION NO.	MALFUNCTION	PAGE
<b>ENGINE</b>		
1	Engine will not crank .....	2-5
2	Engine cranks, fails to start .....	2-5
3	Engine starting motor operates, does not engage flywheel ring gear .....	2-6
4	Engine stalls at low rpm .....	2-6
5	Low oil pressure .....	2-7
6	Engine knocks (mechanical noise) .....	2-7
7	Abnormal noise from valve mechanism (clicking sound) .....	2-8
8	Excessive oil consumption .....	2-8
9	Engine misses or runs rough .....	2-9
10	Excessive engine vibration .....	2-10
11	Coolant in engine lubricating oil .....	2-11
12	Engine lubricating oil in cooling system .....	2-11
13	Engine lubricating oil at exhaust .....	2-12
14	Excessive exhaust smoke (black or gray smoke) .....	2-12
15	Excessive exhaust smoke (white or blue smoke) .....	2-12
<b>FUEL SYSTEM</b>		
16	Sudden changes in engine speed (rpm) .....	2-13
17	Low power - loss of power .....	2-13
18	Engine fuel knocks .....	2-14
19	Excessive fuel consumption .....	2-14
<b>COOLING SYSTEM</b>		
20	Engine overheats .....	2-15
21	Loss of coolant .....	2-15
<b>TRANSMISSION AND TORQUE DIVIDER</b>		
22	Transmission does not operate in any speed or slips in all speeds .....	2-15
23	Transmission does not shift .....	2-16
24	Slow shifting .....	2-16
25	Transmission downshifts during operation (no transmission selector lever movement) .....	2-16
26	Rough shifting .....	2-17
27	Tractor moves in forward speeds only .....	2-17
28	Tractor moves in reverse speeds only .....	2-17
29	Tractor does not move in FIRST speed forward or reverse .....	2-17
30	Tractor does not move in SECOND speed forward or reverse .....	2-18

MECHANICAL TROUBLESHOOTING SYMPTOM INDEX (Cont'd)

MALFUNCTION NO.	MALFUNCTION	PAGE
31	Tractor does not move in THIRD speed forward or reverse . . . . .	2-18
32	Tractor moves in neutral . . . . .	2-18
33	Transmission engages, but the tractor does not move and the engine stops . . . . .	2-18
34	Transmission overheating in all ranges . . . . .	2-19
35	Abnormal transmission oil pump noise . . . . .	2-19
36	Transmission oil dirty . . . . .	2-19
37	Torque divider overheats . . . . .	2-20
38	Loss of torque divider oil . . . . .	2-20
39	Excessive torque divider noise . . . . .	2-21
 <b>STEERING</b>		
40	Tractor will not turn in one direction . . . . .	2-21
41	Tractor will not turn in either direction . . . . .	2-21
42	Tractor moves in either direction when both steering control levers are operated simultaneously . . . . .	2-22
43	Slow response to steering control lever operation . . . . .	2-22
 <b>HYDRAULIC SYSTEM (BULLDOZER AND RIPPER)</b>		
44	Erratic cylinder movement/noisy hydraulic pump accompanied by oil foaming in the hydraulic tank . . . . .	2-23
45	Slow cylinder movement (all cylinders)/loss of pressure (inefficient implement circuits) . . . . .	2-23
46	Lift cylinder drifts . . . . .	2-24
47	Tilt cylinder or ripper lift cylinder drifts . . . . .	2-24
48	Both dozer tilt and ripper lift cylinders drift . . . . .	2-24
49	Dozer tilt or ripper lift circuit is slow or does not move . . . . .	2-24
50	Ripper moves very slowly/no down pressure in lift circuit (dozer tilt circuit OK) . . . . .	2-25
51	Hydraulic oil is overheating . . . . .	2-25
 <b>WINCH</b>		
52	Winch does not operate . . . . .	2-25
53	Winch operates in one direction only . . . . .	2-26
54	Winch does not hold load with control lever in "BRAKE ON" position . . . . .	2-26
55	Torque divider stalls . . . . .	2-27
56	Oil leak at both ends or at one end of drum . . . . .	2-27

Table 2-1. Direct Support and General Support Troubleshooting Table

## MALFUNCTION

## TEST OR INSPECTION

## CORRECTIVE ACTION

## ENGINE

## 1. ENGINE WILL NOT CRANK

Step 1. Perform electrical system troubleshooting (TM5-2410-237-20).

Step 2. Check for engine seizure.

a. Remove fuel injection nozzles (TM5-2410-237-20).

b. Try to turn crankshaft manually.

c. If crankshaft will not rotate, go to step 3.

d. If crankshaft turns and liquid is discharged from nozzle holes, check if liquid is coolant or fuel.

e. If liquid is coolant, replace cylinder head (page 3-30).

f. If liquid is fuel, test fuel injection nozzles (page 4-8).

Replace defective nozzle(s) (TM5-2410-237-20).

Step 3. If crankshaft will not turn, engine has internal damage and may require complete overhaul.

Remove engine (page 3-3). Disassemble and check for bearing seizure (page 3-51) or piston seizure (page 3-77). Replace components as required.

## END OF TESTING!

## 2. ENGINE CRANKS, FAILS TO START

Step 1. Check fuel injection timing (page 4-26).

Adjust fuel injection timing (page 4-26).

Step 2. Check governor setting (page 4-33).

Adjust governor low and high idle, if necessary (page 4-33).

Step 3. Check for possible dirty or damaged fuel injection nozzles.

Remove (TM5-2410-237-20), test, and repair or replace fuel injection nozzles, if necessary (page 4-8).

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

## MALFUNCTION

## TEST OR INSPECTION

## CORRECTIVE ACTION

Step 4. Check for slipping fuel injection pump drive. Remove fuel transfer pump (page 4-10). Crank the engine and look through the fuel transfer pump mounting openings to see if the shaft rotates.

If the shaft does not rotate, remove the small cover from the timing gear cover and tighten the accessory drive gear retaining nut (see page 3-04). If tightening corrects the slipping, time the fuel injection pump (page 4-26).

END OF TESTING!

## 3. ENGINE STARTING MOTOR OPERATES, DOES NOT ENGAGE FLYWHEEL RING GEAR

Step 1. Check for broken or damaged flywheel ring gear teeth.

- a. Remove starting motor (TM5-2410-237-20).
- b. Use engine barring tool to turn engine and inspect flywheel ring gear teeth through starting motor opening in flywheel housing.
- c. Repair or replace defective flywheel ring gear (page 3-71).

END OF TESTING!

## 4. ENGINE STALLS AT LOW RPM

Step 1. Check fuel pressure at the gage on the filter base. The fuel transfer pump should supply enough pressure so that gage reads in green zone at high. If not, replace gage and check for:

25 psi minimum at full load  
30 psi minimum at high idle

Repair or replace transfer pump, if necessary (page 4-10).

Step 2. Measure engine low idle speed (page 4-33).

Adjust governor low idle rpm if necessary (page 4-33).

Step 3. Check for defective fuel injection nozzle.

Repair or replace nozzle (TM5-2410-237-20).

Step 4. Check for defective fuel injection pump(s) (page 4-14).  
Repair or replace pumps, if necessary (page 4-14).

END OF TESTING!

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
<b>5. LOW OIL PRESSURE</b>		
	Step 1. Check for fuel in engine lubrication system.	Find the place where fuel is entering. Repair is required.
	Step 2. Check for restriction at oil pump inlet. Clean inlet screen, or replace inlet pipe or strainer assembly (page 3-111).	
	Step 3. Inspect piston rings (page 3-77).	Replace piston rings, if necessary (page 3-77).
	Step 4. Check rocker arm-to-rocker arm shaft clearance (page 3-95).	Repair or replace valve mechanism (page 3-95).
	Step 5. Check camshaft-to-camshaft bearings clearance (page 3-104).	Replace camshaft and/or camshaft bearings (page 3-104).
	Step 6. Check crankshaft journal-to-crankshaft bearing clearance (page 3-51).	Replace crankshaft bearings (3-51) or connecting rod bearing (page 3-77) and repair or replace crankshaft (page 3-43).
	Step 7. Check oil pump idler gear bearing clearance.	Replace bearing (page 3-111).
	Step 8. Inspect engine oil pump.	Repair or replace pump (page 3-111).
<b>END OF TESTING!</b>		
<b>6. ENGINE KNOCKS (MECHANICAL NOISE)</b>		
	Step 1. Inspect timing gears (page 3-108).	Replace timing gear(s), if necessary (page 3-108).
	Step 2. Inspect connecting rod bearings (page 3-85).	Replace bearings, if necessary (page 3-85).

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

Step 3. Inspect crankshaft bearing surfaces (journals) for connecting rods (page 3-43 and 3-51).

Repair or replace crankshaft, if necessary (page 3-44).

Step 4. Inspect crankshaft (page 3-43).

Repair or replace crankshaft, if necessary (page 3-43).

END OF TESTING!

7. ABNORMAL NOISE FROM VALVE MECHANISM (CLICKING SOUND)

Step 1. Check valve clearance (TM5-2410-237-20).

Adjust valves, if necessary (TM5-2410-237-20).

Step 2. Inspect valve mechanism (page 3-95).

Replace damaged components, if necessary (page 3-95).

Step 3. Check lubrication flow at valve mechanism. There must be a strong flow of oil at high engine rpm and a small flow at low rpm.

If there is a low flow of oil, clean oil passages in the cylinder block.

Step 4. Check valve springs and locks (page 3-30). Damaged or worn locks can cause valve to fall into cylinder resulting in serious engine damage.

Replace damaged or worn valve spring and/or locks (page 3-30).

Step 5. Inspect valves (page 3-30).

Replace defective valve(s), if necessary (page 3-30).

Step 6. Inspect camshaft (page 3-104).

Replace camshaft, if necessary (page 3-104).

END OF TESTING!

8. EXCESSIVE OIL CONSUMPTION

Step 1. Check for oil at inlet manifold-to-turbocharger connection.

If oil is present, repair (page 4-18) or replace turbocharger (TM5-2410-237-20).



Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Step 2.	Check for too much oil in valve mechanism compartment.	Check if there is a plug in each end of rocker shaft. Install plug(s), if necessary (page 3-95).
Step 3.	Replace valve guides (page 3-30).	
Step 4.	Inspect piston rings (page 3-77), cylinder liners (3-24), and cylinder liner projection (page 3-24).	Replace piston rings (page 3-77) and/or cylinder liners (page 3-24), if necessary.
END OF TESTING!		
9. ENGINE MISSES OR RUNS ROUGH		
Step 1.	Check fuel injection timing (page 4-26).	Adjust timing, if necessary (page 4-26).
Step 2.	Operate engine at rpm where misfiring or rough operation occurs. Loosen the fuel line nut at a fuel injection pump. This will stop fuel flow to that cylinder. Do this for each cylinder until a loosened fuel line is found that makes no difference in engine performance. Be sure to tighten each fuel line nut after the test before the next fuel line nut is loosened.	When a cylinder is found where the loosened line does not make a difference in engine performance, test the fuel injection nozzle for that cylinder (page 4-8).
	a. Repair (4-8) or replace defective nozzle (TM5-2410-237-20).	
	b. If nozzle is operating properly, replace the fuel injection pump for that cylinder (page 4-14).	
Step 3.	Check valve clearance (TM5-2410-237-20).	Adjust valves, if necessary (TM5-2410-237-20).
Step 4.	Check for worn, bent or broken push rod.	Replace push rod, if necessary (page 3-95).

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

## MALFUNCTION

## TEST OR INSPECTION

## CORRECTIVE ACTION

- 
- Step 5. Check cylinder head.
- a. Replace valves that have worn stems or burned valves (page 3-30).
  - b. If a valve is replaced, replace corresponding valve seat insert and valve guide (page 3-30).
  - c. Replace a warped cylinder head (page 3-30).
- Step 6. Inspect valve lifters (page 3-101).
- a. Replace damaged valve lifters.
  - b. Replace valve lifters that do not meet specifications.

END OF TESTING!

## 10. EXCESSIVE ENGINE VIBRATION

- Step 1. Operate engine at rpm where vibration begins. Loosen the fuel line nut at a fuel injection pump. This will stop fuel flow to that cylinder. Do this for each cylinder until a loosened fuel line is found that makes no difference in engine operation. Be sure to tighten each fuel line nut after the test before the next fuel line nut is loosened.

When a cylinder is found where the loosened line does not make a difference in engine performance, test the fuel injection nozzle for that cylinder (page 4-8).

- a. Repair (page 4-8) or replace defective nozzle (TM5-2410-237-20).
  - b. If nozzle is operating properly, replace the fuel injection pump for that cylinder (page 4-14).
- Step 2. Check for loose or damaged vibration damper.
- a. Tighten vibration damper capscrews to  $75 \pm 10$  lb. ft.
  - b. Replace damaged vibration damper (page 3-67).
- Step 3. Check for loose or damaged crankshaft pulley.
- a. Tighten pulley capscrew to  $230 \pm 20$  lb. ft.
  - b. Replace damaged crankshaft pulley (page 3-65).

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
	Step 4.	Check fan blade balance. <ol style="list-style-type: none"> <li>Loosen or remove vee belts (TM5-2410-237-20).</li> <li>Operate engine at rpm where vibration occurred.</li> <li>If vibration is not noticeable, replace fan assembly (TM5-2410-237-20).</li> <li>If vibration is noticeable, go to step 5.</li> </ol>
	Step 5.	Inspect for loose engine mounting supports. <ol style="list-style-type: none"> <li>If supports are loose because of wear or damage, replace support(s) (pages 3-18 and 3-21).</li> <li>If mounting supports are not damaged or worn, but are loose, tighten mounting supports-to-frame capscrews to 325±25 lb. ft. torque. Securely tighten front supports-to-engine and rear supports-to-flywheel housing capscrews.</li> </ol>

END OF TESTING!

#### 11. COOLANT IN ENGINE LUBRICATING OIL

Step 1. Replace engine oil cooler (TM5-2410-237-20).

Step 2. Inspect cylinder head (page 3-30).

- Replace a damaged or warped cylinder head (page 3-30).
- If cylinder head is not defective, install new cylinder head gasket and spacer plate gasket (page 3-30).

Step 3. Replace cylinder liners seals and filler bands (page 3-24).

Step 4. Check for a cracked cylinder block.

If necessary, replace engine (page 3-3).

END OF TESTING!

#### 12. ENGINE LUBRICATING OIL IN COOLING SYSTEM

Step 1. Replace engine oil cooler (TM5-2410-237-20).

Step 2. Replace cylinder head gasket and spacer plate gasket (page 3-30).

END OF TESTING!

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

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MALFUNCTION		
TEST OR INSPECTION		
		CORRECTIVE ACTION

---

13. ENGINE LUBRICATING OIL AT EXHAUST

Step 1. Check for too much oil in valve mechanism compartment.

Check if there is a plug in each end of rocker shaft. Install plug(s), if necessary (page 3-95).

Step 2. Inspect valve guides (page 3-30).

Replace valve guide that does not meet specifications (page 3-30).

Step 3. Inspect piston rings (page 3-77).

Replace piston rings, if necessary (page 3-77).

END OF TESTING!

14. EXCESSIVE EXHAUST SMOKE (BLACK OR GRAY SMOKE )

Step 1. Check turbocharger for proper operation.

Repair turbocharger, if necessary (page 4-18).

Step 2. Check for fuel in engine lubricating oil.

a. If fuel is present, test fuel injection nozzles (page 4-8). Reinstall original, good nozzle and replace defective nozzle (TM5-2410-237-20).

b. Drain engine lubricating oil, install new oil filter, and refill crankcase (TM5-2410-237-20).

Step 3. Check fuel injection timing (page 4-26).

Adjust timing, if necessary (page 4-26).

15. EXCESSIVE EXHAUST SMOKE (WHITE OR BLUE SMOKE)

Step 1. Check fuel injection timing (page 4-26).

Adjust timing, if necessary (page 4-26).

Step 2. Inspect piston rings (page 3-77). Replace piston rings, if necessary (page 3-77).

Step 3. Inspect the cylinder head for worn valve guides (page 3-30).

Repair cylinder head, if necessary (page 3-30).

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

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MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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Step 4. Inspect air inlet manifold for oil.

If oil is present, repair turbocharger (page 4-18).

END OF TESTING!

FUEL SYSTEM

#### 16. SUDDEN CHANGES IN ENGINE SPEED (RPM)

Replace fuel injection pump housing and governor (page 4-26).

END OF TESTING!

#### 17. LOW POWER - LOSS OF POWER

Step 1. Operate engine at rpm where misfiring or rough operation occurs. Loosen the fuel line nut at a fuel injection pump. This will stop fuel flow to that cylinder. Do this for each cylinder until a loosened fuel line is found that makes no difference in engine performance. Be sure to tighten each fuel line nut after the test before the next fuel line nut is loosened.

When a cylinder is found where the loosened line does not make a difference in engine performance, test the fuel injection nozzle for that cylinder (page 4-8).

- a. Repair (page 4-8) or replace defective nozzle (TM5-2410-237-20).
- b. If nozzle is operating properly, replace the fuel injection pump for that cylinder (page 4-14).

Step 2. Check fuel pressure at the fuel injection housing inlet. Pressure must be at least 15 psi.

- a. If pressure is below 15 psi, service primary fuel filter (TM5-2410-237-20).
- b. If fuel pressure is still below 15 psi, repair or replace fuel transfer pump (page 4-10).

Step 3. Check fuel injection timing (page 4-26).

If necessary, adjust fuel injection timing (page 4-26).

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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Step 4. Check fuel setting (page 4-33).  
 If necessary, adjust fuel setting (page 4-33).

Step 5. Disassemble turbocharger and check for carbon deposits and other causes of friction (page 4-18).

END OF TESTING!

18. ENGINE FUEL KNOCKS

Step 1. Operate engine at rpm where maximum combustion noise occurs. Loosen the fuel line nut at a fuel injection pump. This will stop fuel flow to that cylinder. Do this for each cylinder until a loosened fuel line stops the combustion noise. Be sure to tighten each fuel line nut after the test before the next fuel line nut is loosened.

When a cylinder is found where the loosened line stops the knock, test the fuel injection nozzle for that cylinder (page 4-8).

- a. Repair (page 4-8) or replace defective nozzle (TM5-2410-237-20).
- b. If nozzle is operating properly, replace the fuel injection pump for that cylinder (page 4-14).

Step 2. Check fuel injection timing (page 4-26).  
 Adjust timing if necessary (page 4-26).

END OF TESTING!

19. EXCESSIVE FUEL CONSUMPTION

- Step 1. Check for fuel in engine lubricating oil.
- a. If fuel is present, test fuel injection nozzles (page 4-8).
  - b. Drain engine lubricating oil, install new oil filter, and refill crankcase (TM5-2410-237-20).

Step 2. Check fuel injection timing (page 4-26).  
 Adjust timing if necessary (page 4-26).

END OF TESTING!

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
COOLING SYSTEM		
20. ENGINE OVERHEATS		
Step 1.	Check radiator for leaks.	Repair or replace radiator (page 5-4).
Step 2.	Check for broken or damaged fan blades.	Replace fan, if necessary (TM5-2410-237-20).
Step 3.	Verify that fan drive is turning properly.	Repair or replace fan drive, if necessary (TM5-2410-237-20).
Step 4.	Check water pump for wear or damage.	Repair (page 5-17) or replace water pump (TM5-2410-237-20).
END OF TESTING!		
21. LOSS OF COOLANT		
Step 1.	Check cylinder head and spacer plate for defective gaskets. Also inspect cylinder head and spacer plate (page 3-30).	<ul style="list-style-type: none"> <li>a. Repair or replace cylinder head and/or spacer plate, if necessary (page 3-30).</li> <li>b. Replace cylinder head and spacer plate gaskets (page 3-30).</li> </ul>
Step 2.	Check for a cracked cylinder block.	If necessary, replace engine (page 3-3).
END OF TESTING!		
TRANSMISSION AND TORQUE DIVIDER		
22. TRANSMISSION DOES NOT OPERATE IN ANY SPEED OR SLIPS IN ALL SPEEDS		
Step 1.	Check speed clutch pressure (page 7-98).	<ul style="list-style-type: none"> <li>a. If low pressure is indicated, check for air leaks at transmission oil pump inlet. If necessary, refer to TM5-2410-237-20 and replace seal, flange, and/or hose assembly.</li> </ul>

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

b. If pump inlet is okay, repair transmission relief valve (page 7-79).

Step 2. Check transmission oil pump outlet pressure (page 7-98).

If pressure is low, repair sequence relief valve (page 7-79) or repair or replace transmission oil pump (page 7-73).

If correct pressure still cannot be obtained, repair or replace pressure control valve (page 7-64) or selector valve (page 7-64).

Step 3. Check if universal joint is trying to turn.

a. If there is no shaft rotation or attempted shaft rotation, check torque diverter outlet pressure (page 7-98). If pressure is low, repair converter outlet relief valve (page 7-86) or repair or replace torque divider (page 7-8).

b. If there is shaft rotation or if shaft is trying to turn, repair or replace transmission (page 7-26).

END OF TESTING!

23. TRANSMISSION DOES NOT SHIFT

Step 1. Check direction clutch pressure (page 7-98).

If pressure is low, repair pressure control valve (page 7-64).

Step 2. Inspect transmission clutches and replace defective parts (page 7-26).

24. SLOW SHIFTING

Step 1. Check direction clutch pressure (page 7-98).

If pressure is not within the specified limits, repair or replace pressure control valve (page 7-64).

Step 2. Repair or replace transmission oil pump (page 7-73).

END OF TESTING!

25. TRANSMISSION DOWNSHIFTS DURING OPERATION (NO TRANSMISSION SELECTOR LEVER MOVEMENT)

Step 1. Repair or replace transmission oil pump (page 7-73).



Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
	Step 2.	Repair or replace selector valve (page 7-64).
		END OF TESTING!
26. ROUGH SHIFTING		Repair or replace pressure control valve (page 7-64).
		END OF TESTING!
27. TRACTOR MOVES IN FORWARD SPEEDS ONLY		
	Step 1.	Verify that transmission lever control linkage adjustment is correct (TM5-2410-237-20).
	Step 2.	No. 2 clutch does not engage.
		a. Repair or replace transmission oil pump (page 7-73).
		b. Repair or replace transmission No. 1 clutch components (page 7-26).
		END OF TESTING!
28. TRACTOR MOVES IN REVERSE SPEEDS ONLY		
	Step 1.	Verify that transmission control lever linkage adjustment is correct (TM5-2410-237-20).
	Step 2.	No. 1 clutch does not engage.
		a. Repair or replace transmission oil pump (page 7-73).
		b. Repair or replace transmission No. 5 clutch components (page 7-26).
		END OF TESTING!
29. TRACTOR DOES NOT MOVE IN FIRST SPEED FORWARD OR REVERSE		
	Step 1.	Verify that transmission control lever linkage adjustment is correct (TM5-2410-237-20).
	Step 2.	No. 5 clutch does not engage.
		a. Repair or replace transmission oil pump (page 7-73).
		b. Repair or replace transmission No. 3 clutch components (page 7-26).
		END OF TESTING!

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

## MALFUNCTION

## TEST OR INSPECTION

## CORRECTIVE ACTION

## 30. TRACTOR DOES NOT MOVE IN SECOND SPEED FORWARD OR REVERSE

Step 1. Verify that transmission control lever linkage adjustment is correct (TM5-2410-237-20).

Step 2. No. 3 clutch does not engage.

a. Repair or replace transmission oil pump (page 7-73).

b. Repair or replace transmission No. 4 clutch components (page 7-26).

END OF TESTING!

## 31. TRACTOR DOES NOT MOVE IN THIRD SPEED FORWARD OR REVERSE

Step 1. Verify that transmission control lever linkage adjustment is correct (TM5-2410-237-20).

Step 2. No. 4 clutch does not engage.

a. Repair or replace transmission oil pump (page 7-73).

b. Repair or replace transmission (page 7-26).

END OF TESTING!

## 32. TRACTOR MOVES IN NEUTRAL

Step 1. Verify that transmission control lever linkage adjustment is correct and that the linkage is not loose (TM5-2410-237-20).

Step 2. Inspect no. 1 and no. 2 clutches (page 7-26).

Replace damaged parts (page 7-26).

## 33. TRANSMISSION ENGAGES, BUT THE TRACTOR DOES NOT MOVE AND THE ENGINE STOPS

There is no operation process for determining the exact cause of this problem. Use the following procedure to locate and correct the problem.

a. Repair steering clutches (page 10-40).

b. Repair bevel gear and shaft (page 8-18).

c. Repair transmission (page 7-26).

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
		d. Repair torque divider (page 7-8).
		e. Repair final drives (page 8-4).
		END OF TESTING!
34.	TRANSMISSION OVERHEATING IN ALL RANGES	
	Step 1.	Repair or replace transmission oil pump (page 7-73).
	Step 2.	Inspect clutch discs and plates (page 7-26). Replace damaged or worn discs and/or plates (page 7-26).
35.	ABNORMAL TRANSMISSION OIL PUMP NOISE	
		Repair or replace transmission oil pump (page 7-73).
		END OF TESTING!
36.	TRANSMISSION OIL DIRTY	
	Step 1.	Locate defective component.
		NOTE
		If any of the following type particles are found, it should be considered a preliminary analysis. Before replacing any components, oil samples should be processed through AOAP (Army Oil Analysis Program).
		a. If oil contains bronze-colored particles, repair transmission (page 7-26).
		b. If oil contains shiny steel particles, repair transmission oil pump (page 7-73).
		c. If oil contains rubber particles, check for seal or hose failure and replace defective part.
		d. If oil contains aluminum particles, repair torque divider (page 7-8).
	Step 2.	Clean hydraulic system. Drain oil and flush with new oil (L05-2410-237-12).
		END OF TESTING!

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

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MALFUNCTION		
TEST OR INSPECTION		
	CORRECTIVE ACTION	

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37. TORQUE DIVIDER OVERHEATS

Step 1. Replace relief valve for torque divider input (page 7-79).

This valve is located in the sequence relief valve.

Step 2. Test outlet pressure from torque divider (page 7-98).

If necessary, repair or replace relief valve for torque divider output (page 7-86).

Step 3. The problem could be that there is excessive oil in the engine flywheel housing and torque divider cover.

a. Clean torque divider screen assembly (TM5-2410-237-20).

b. Repair torque divider (page 7-8).

c. Repair or replace torque divider scavenge pump (page 7-92).

END OF TESTING!

38. LOSS OF TORQUE DIVIDER OIL

Step 1. Check for oil around torque divider scavenge pump cover gasket.

Replace cover gasket, if necessary (page 7-92).

Step 2. Check for oil around flywheel housing-to-torque divider cover area.

Replace flywheel housing-to-torque divider housing cover gasket, if necessary (page 7-8).

Step 3. Check for oil around torque divider output shaft. Replace output shaft seal, if necessary, or repair torque divider (page 7-8).

Step 4. Check for oil around flywheel housing-to-engine block area.

If necessary, replace flywheel housing-to-engine block gasket (page 3-72).

END OF TESTING!

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

## MALFUNCTION

## TEST OR INSPECTION

## CORRECTIVE ACTION

## 39. EXCESSIVE TORQUE DIVIDER NOISE

Disassemble torque divider and inspect components (page 7-8).

Replace defective components as necessary (page 7-8).

END OF TESTING!

## STEERING

## 40. TRACTOR WILL NOT TURN IN ONE DIRECTION

Step 1. Operate steering control lever for direction with problem, and observe steering clutch control valve shaft operation.

- a. If valve shaft does not move, check for broken or damaged control lever linkage.
- b. If linkage is broken or damaged, replace damaged parts (page 10-48).
- c. If shaft moves, repair or replace steering clutch control valve (page 10-59).

Step 2. If problem still exists after step 1, check steering clutch piston (page 10-40). Repair steering clutch (page 10-40) if necessary.

END OF TESTING!

## 41• TRACTOR WILL NOT TURN IN EITHER DIRECTION

Step 1. Verify that steering and brake control linkage adjustments are correct (TM5-2410-237-20).

Step 2. Check steering clutch oil lines for leaks.

Replace damaged oil lines and/or seals, if necessary (page 13-76).

Step 3. Check transmission oil pump pressure (page 7-98). If necessary, repair or replace transmission oil pump (page 7-73).

Step 4. Perform steering clutch piston and brake boosters pressure checks (page 7-98).

Repair or replace steering clutch control valve, if necessary (page 10-59).

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

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MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

---

Step 5. If the problem still exists after performing the above steps, repair steering clutches (page 10-40).

END OF TESTING!

42. TRACTOR MOVES IN EITHER DIRECTION WHEN BOTH STEERING CONTROL LEVERS ARE OPERATED SIMULTANEOUSLY

Step 1. Check steering clutch control and brake control linkages for damage.

Repair or replace linkage components, if necessary (pages 10-30 and 10-48).

Step 2. Verify that steering control and brake control linkages adjustments are correct (TM5-2410-237-20).

Step 3. Perform steering clutch piston and brake boosters pressure checks (page 7-98).

Repair or replace steering clutch control valve, if necessary (page 10-59).

Step 4. If the problem still exists after performing the above steps, repair steering clutches and/or clutch hubs (pages 10-40 and 10-71).

END OF TESTING!

43. SLOW RESPONSE TO STEERING CONTROL LEVER OPERATION

Step 1. Verify that steering control and brake control linkages adjustments are correct (TM5-2410-237-20).

Step 2. Check for steering clutch oil lines leaks.

Replace damaged oil lines and/or seals, if necessary (page 13-70).

Step 3. Check transmission oil pump pressure (page 7-98).

If necessary, repair or replace transmission oil pump (page 7-73).

Step 4. Perform steering clutch piston and brake boosters pressure checks (page 7-98).

Repair or replace steering clutch control valve, if necessary (page 10-59).

Step 5. If the problem still exists after performing the above steps, repair steering clutch hubs (page 10-71).

END OF TESTING!

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
HYDRAULIC SYSTEM (BULLDOZER AND RIPPER)		
44.	ERRATIC CYLINDER MOVEMENT/NOISY HYDRAULIC PUMP ACCOMPANIED BY OIL FOAMING IN THE HYDRAULIC TANK	<p>Step 1. Check the hose and connections between the tank and pump for leaks. Repair or replace line or fitting (page 13-70 and TM5-2410-237-20).</p> <p>Step 2. Check oil level in the hydraulic tank. Add oil to maintain level above the return line to prevent air from entering the system (L05-2410-237-12).</p> <p>Step 3. Ensure tank is filled with correct viscosity hydraulic fluid. Drain and refill system with correct fluid (L05-2410-237-12).</p> <p style="text-align: center;">END OF TESTING!</p>
45.	SLOW CYLINDER MOVEMENT (ALL CYLINDERS)/LOSS OF PRESSURE (INEFFICIENT IMPLEMENT CIRCUITS)	<p>Step 1. Check hydraulic tank for correct oil level. Ensure tank is filled with correct viscosity hydraulic fluid. Add or replace oil as required (L05-2410-237-12).</p> <p>Step 2. Check the supply line to the pump for restrictions. Repair or replace supply line (TM5-2410-237-20).</p> <p>Step 3. Carefully check the system for leakage. Repair or replace leaking component.</p> <p>Step 4. Check control linkages for free movement and full travel of control valve spools. Repair or adjust control linkage (page 13-59, blade control; page 13-67, ripper control), or repair or replace bulldozer control valve (page 13-15) or ripper control valve (page 13-51).</p> <p>Step 5. Check for low relief valve setting and low hydraulic pump output. Perform hydraulic system flow test d (page 13-111). Adjust relief valve (page 13-111). Repair or replace hydraulic pump or control valve as indicated by test results.</p>

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

## MALFUNCTION

## TEST OR INSPECTION

## CORRECTIVE ACTION

## 46. LIFT CYLINDER DRIFTS

Perform cylinder drift test c (page 13-111) for the lift cylinders.

- If drift occurs only with the blade control lever in the LOWER or RAISE position, repair the bulldozer control valve (page 13-15).
- If drift occurs only with the blade lowered or only with the blade raised (control lever in any position), repair the bulldozer control valve (page 13-15).
- If drift occurs with blade lowered (control in LOWER) and with blade raised (control in any position), replace (TM5-2410-237-20) or repair (page 13-93) the blade lift cylinder.

## 47. TILT CYLINDER OR RIPPER LIFT CYLINDER DRIFTS

Perform cylinder drift test c (page 13-111).

If drift exceeds maximum limits, repair cylinder (page 13-71) or repair control valve (page 13-15).

## 48. BOTH DOZER TILT AND RIPPER LIFT CYLINDERS DRIFT

Perform cylinder drift test (page 13-111).

If drift exceeds maximum limits, repair or replace pressure control valve (page 13-35).

## 49. DOZER TILT OR RIPPER LIFT CIRCUIT IS SLOW OR DOES NOT MOVE

Step 1. Check hydraulic tank for correct oil level. Ensure tank is filled with correct viscosity hydraulic fluid.

Add or replace oil as required (L05-2410-237-12).

Step 2. Carefully check the system for leakage.

Repair or replace leaking component.

Step 3. Check pilot lines for restrictions.

Repair or replace pilot line (TM5-2410-237-20).



Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
Step 4.	Perform hydraulic system flow tests (page 13-111) for circuit.	Repair or replace hydraulic pump or control valve as indicated by flow test results.
50. RIPPER MOVES VERY SLOWLY/NO DOWN PRESSURE IN LIFT CIRCUIT (DOZER TILT CIRCUIT OK)	Step 1. Inspect the pilot line between the pilot valves and the bulldozer control valve shuttle valve for restriction.	Repair or replace line (TM5-2410-237-20 or page 13-67).
Step 2.	Check the shuttle valve for damage. Remove bulldozer control valve (page 13-15) and remove shuttle valve components.	Replace worn or damaged parts.
51. HYDRAULIC OIL IS OVERHEATING (INDICATED BY BLOWN OIL SEALS, DECREASED LIFE OF COMPONENTS)	Step 1. Check oil level in the hydraulic tank.	Add oil as required to fill (L05-2410-237-12).
Step 2.	Check lines, hoses, connections, valves and cylinders for leaks.	Repair or replace as required.
Step 3.	Check pressure relief valve setting. Perform hydraulic system flow tests (page 13-111).	Adjust relief valve setting or repair bulldozer control valve (page 13-15).
END OF TESTING!		
WINCH		
52. WINCH DOES NOT OPERATE	Step 1. Verify that winch control linkage adjustment is correct (TM5-2410-237-20).	
Step 2.	Inspect winch control lever and linkage for damage.	Replace lever and/or linkage, if necessary (page 12-48).

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

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MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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- Step 3. Perform winch system test (page 12-7).
- a. If necessary, repair (page 12-54) or replace (TM5-2410-237-20) winch control valve.
  - b. Repair (page 12-64) or replace (TM5-2410-237-20) winch gear pump.

Step 4. If winch still does not operate, repair winch assembly (page 12-7).

END OF TESTING!

**53. WINCH OPERATES IN ONE DIRECTION ONLY**

- Step 1. Perform winch system test (page 12-7).
- a. If necessary, repair (page 12-64) or replace (TM5-2410-237-20) winch gear pump.
  - b. If necessary, repair (page 12-54) or replace (TM5-2410-237-20) winch control valve.

Step 2. Repair winch assembly (page 12-7).  
 Repair or replace directional clutch (page 12-7).

END OF TESTING!

**54. WINCH DOES NOT HOLD LOAD WITH CONTROL LEVER IN "BRAKE ON" POSITION**

- Step 1. Perform winch system test (page 12-7).
- a. If necessary, repair (page 12-64) or replace (TM5-2410-237-20) winch gear pump.
  - b. If necessary, repair (page 12-54) or replace (TM5-2410-237-20) winch control valve.

Step 2. Repair winch assembly (page 12-7).  
 Repair or replace directional clutches.

END OF TESTING!

Table 2-1. Direct Support and General Support Troubleshooting Table (Cont'd)

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
55. TORQUE DIVIDER STALLS	<p>Step 1. Check for correct adjustment of winch control linkage (TM5-2410-237-20).</p> <p>Step 2. Perform winch system test (page 12-7).</p> <p>a. If necessary, repair (page 12-54) or replace (TM5-2410-237-20) winch control valve.</p> <p>b. Repair (page 12-64) or replace (TM5-2410-237-20) winch gear pump.</p> <p>Step 3. Repair winch assembly (page 12-7).</p> <p>Repair or replace input clutch.</p> <p style="text-align: center;">END OF TESTING!</p>	
56. OIL LEAK AT BOTH ENDS OR AT ONE END OF DRUM	<p>Repair winch assembly (page 12-7).</p> <p>Replace case and shaft seals.</p> <p style="text-align: center;">END OF TESTING!</p>	

Section III. PRE-EMBARKATION INSPECTION OF MATERIEL IN  
UNITS ALERTED FOR OVERSEAS MOVEMENT

2-7. INFORMATION TO BE PROVIDED BY TACOM

Section IV. GENERAL MAINTENANCE INSTRUCTIONS

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2-8. SCOPE

These general maintenance instructions contain general shop practices and specific methods you must be familiar with to properly maintain the D7G tractor. You should read and understand these practices and methods before starting maintenance tasks on the D7G tractor.

2-9. WORK SAFETY

- a. Before starting a task, think about the risks and hazards to your safety as well as others. Wear protective gear such as safety goggles or lenses, safety shoes, rubber apron, or gloves. Protect yourself against injury.
- b. When lifting heavy parts, have someone help you. Make sure that lifting equipment is working properly, that it is suitable for the task assigned, and is secured against slipping.
- c. Always use power tools carefully.

2-10. GENERAL INFORMATION

- a. Before beginning a task, find out how much repair, modification, or replacement is needed to fix the equipment as described in this manual. Sometimes the reason for equipment failure can be seen right away and complete teardown is not necessary. Disassemble the equipment only as far as necessary to repair or replace damaged or broken parts.
- b. All tags and forms attached to the equipment must be checked to learn the reason for removal from service. Check all Modification Work Orders (MWO) and Technical Bulletins (TB) for equipment changes and updates.
- c. In some cases a part may be damaged by removal. If the part appears to be good, and other parts behind it are not defective, leave it on and continue the procedure. Here are a few simple rules:
  - (1) Do not take out dowel pins or studs unless loose, bent, broken or otherwise damaged.

- (2) Do not pull bearings or bushings unless damaged. If you must get at parts behind them, pull out bearings or bushings carefully.
- (3) Replace all gaskets, seals, and preformed packings.

## 2-11. CLEANING INSTRUCTIONS

### a. General.

- (1) The cleaning instructions will be the same for the majority of parts and components that make up the D7G tractor.
- (2) The importance of cleaning must be thoroughly understood by maintenance personnel. Great care and effort are required in cleaning. Dirt and foreign material are a constant threat to satisfactory maintenance. The following should apply to all cleaning, inspection, repair and assembly operations.
  - (a) Clean all parts before inspection, after repair and before assembly.
  - (b) Hands should be kept free of any accumulation of grease, which can collect dust, dirt or grit.
  - (c) After cleaning, all parts should be covered or wrapped to protect them from dust and dirt. Parts that are subject to rust should be lightly oiled.
- (3) Observe the following precautions during all cleaning operations:

### WARNING

P-D-680 (Type II) is a flammable solvent that is potentially dangerous to personnel. Keep away from heat, sparks or open flame. Flashpoint of solvent is 138°F (59°C). Use only in a well ventilated area. Inhaling vapors over a period of time can cause headache and drowsiness. Use gloves to prevent irritation or inflammation of the skin. Solvent absorbed through the skin can result in internal disorders. If contact occurs, wash the affected area with water for 15 minutes. For eyes, flush with water and then seek immediate medical attention.

### WARNING

Improper cleaning methods and use of unauthorized cleaning solvents may injure personnel and damage equipment. Refer to TM9-247 for correct information.

**WARNING**

Eye shields must be worn when cleaning with a wire brush. Flying rust and metal particles may cause injury to personnel.

**WARNING**

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

b. External Engine Cleaning.

- (1) Protect all electrical equipment that could be damaged by the steamer moisture before steam cleaning.
- (2) Cover all openings before steam cleaning.
- (3) After cleaning, dry and apply a light coat of oil to all parts subject to rust.
- (4) Blowout all tapped (threaded) holes with compressed air to remove dirt and cleaning fluids.

c. Disassembled Parts Cleaning.

- (1) Place all disassembled parts in wire baskets for cleaning.
- (2) Dry and cover all cleaned parts.
- (3) Place parts on or in "racks" and hold for inspection or repair.
- (4) All parts subject to rusting must be lightly oiled and wrapped.
- (5) Keep all related parts and components together. Do not mix parts.

d. Castings.

- (1) Clean inner and outer surfaces of castings and all areas subject to grease and oil with cleaning solvents. Refer to TM9-247.
- (2) Use a stiff brush to remove sludge and gum deposits.
- (3) Blowout all tapped (threaded) holes with compressed air to remove dirt and cleaning fluids.

- e. Oil Passages. Particular attention must be given to all oil passages in castings and machined parts. Oil passages must be clean and free of any obstructions.
- (1) Clean passages with wire probes to break up any sludge or gum deposits.
  - (2) Wash passages by flushing with solvents. Refer to TM9-247.
  - (3) Dry passages with compressed air.

f. Oil Seals, Electrical Cables, and Flexible Hoses.

CAUTION

Washing oil seals, electrical cables and flexible hoses with dry cleaning solvents or mineral spirits will cause serious damage or destroy the material.

- (1) Wash electrical cables and flexible hose with water and mild soap solution and wipe dry.
- (2) Oil seals are generally damaged during removal, so cleaning will not be necessary since new seals will be used in assembly.

g. Bearings.

- (1) Bearings require special cleaning. After removing surface oil and gum deposits, place bearings in hot oil (140°F (60°C)) to loosen congealed oil and grease. Wipe bearings dry. Do not use compressed air. After cleaning, coat bearings with oil, wrap in paper, and hold for inspection.
- (2) Refer to TM9-214 for information and care of bearings.

h. Machine Tool ed Parts.

- (1) Clean machine tool ed parts with dry cleaning solvent (P-D-680).
- (2) Dry parts with compressed air.

i. Machined Surfaces.

- (1) Clean machined surfaces with dry cleaning solvent (P-D-680).
- (2) Dry surfaces with compressed air.

j. Mated Surfaces.

- (1) Remove old gasket and/or sealing compound using wire brush and dry cleaning solvent (P-D-680).
- (2) Lightly oil and wrap all parts subject to rust before storing.

k. Rusted Surfaces. Clean all rusted surfaces using wire brush and crocus cloth.

- l. Oil Bathed Internal Parts. Wipe oil bathed internal parts clean with lint free cloth.
- m. Air Actuated Internal Parts. Wipe air actuated internal parts clean with lint free cloth.
- n. Externally Exposed Parts. Wash externally exposed parts with soap and water. Rinse thoroughly and air dry.

2-12. INSPECTION INSTRUCTIONS

- a. General. All components and parts must be carefully checked to determine if they are serviceable for reuse, if they can be repaired, or if they must be scrapped.
- b. Drilled and Tapped (Threaded) Holes.
  - (1) Inspect for wear, distortion (stretching), cracks or any other damage in or around holes.
  - (2) Inspect threaded areas for wear, distortion or evidence of cross-threading.
  - (3) Mark all damaged areas for repair or replacement.
- c. Metal Lines, Flexible Lines (Hoses) and Fittings.
  - (1) Inspect lines for sharp kinks, cracks, bends or dents.
  - (2) Inspect flexible lines for fraying, evidence of leakage or loose fittings or connectors.
  - (3) Check all fittings and connectors for thread damage. Check for hex heads that are worn or rounded by poorly fitting wrenches.
  - (4) Mark all damaged material for repair or replacement.
- d. Castings.
  - (1) Inspect all ferrous and nonferrous castings for cracks using a magnifying glass and strong light.
  - (2) Refer to MIL-I-6866, Inspection, Liquid Penetrant Methods, and MIL-I-6868, Inspection Process, Magnetic Particles.
  - (3) Particularly check areas around studs, pipe plugs, threaded inserts, and sharp corners. Replace all cracked castings.
  - (4) Inspect machined surfaces for nicks, burrs, or raised metal. Mark damaged areas for repair or replacement.
  - (5) Inspect all pipe plugs, pipe plug openings, screws, and screw openings for damaged or stripped threads.



- (6) Check all gasket mating surfaces, flanges on housings, and supports for warpage with a straightedge or surface plate. Inspect mating flanges for discolorations that may indicate persistent oil leakage
- (7) Check all castings for conformance to applicable repair standards.
- e. Bearings. Refer to TM9-214 for inspection of bearings. Check all bearings for conformance to applicable repair standards.
- f. Studs, Bolts, and Screws. Replace if missing, threads are damaged, bent, loose or stretched.
- g. Gears.

#### NOTE

When gear teeth wear limits are not established, good judgement is required to determine if gear replacement is necessary.

- (1) Inspect all gears for cracks using a magnifying glass and strong light. No cracks are permissible.
- (2) Inspect gear teeth for wear, sharp fins, burrs, and galled or pitted surfaces.
- (3) Check keyway slots for wear or damage.
- h. Bushings and Bushing Type Bearings.
  - (1) Check all bushings and bushing type bearings for secure fit, evidence of overheating, wear, burrs, nicks and out-of-round condition. Replace as necessary.
  - (2) Check for dirt in lubrication holes or grooves. Holes and grooves must be clean and free from damage.
- i. Oil Seals. Oil seals are mandatory replacement items.
- j. Core Hole Expansion Plugs. Inspect for leakage. Replace plugs when leakage is present.
- k. Machine Tool ed Parts. Inspect for cracks, breaks, elongated holes, wear and chips. Replace any damaged parts.
- l. Machined Surfaces. Inspect for cracks, evidence of wear, galled or pitted surface, burrs, nicks, and scratches.
- m. Mated Surfaces. Inspect for remains of old gasket, seal, secure fit, pitting and evidence of leakage.
- n. Rusted Surfaces. Inspect for pitting, holes and severe damage.
- o. Oil Bathed Internal Parts. Inspect for cracks, nicks, burrs, evidence of overheating and wear.

- p. Air Actuated Internal Parts. Inspect for cracks, nicks, burrs, evidence of overheating and wear.
- q. Externally Exposed Parts. Inspect for breaks, cracks, rust damage and wear.
- r. Springs. Inspect for broken, collapsed and twisted coils.

## 2-13. REPAIR INSTRUCTIONS

- a. General. Any repair procedure peculiar to a specific part or component is covered in the section or paragraph relating to that item. After repair, clean all parts thoroughly to prevent dirt, metal chips or other foreign material from entering any working parts.

### CAUTION

Repaired items must be thoroughly cleaned to remove metal chips and abrasives to prevent them from entering working parts of the D7G tractor.

- b. Castings.
  - (1) All cracked castings will be replaced.
  - (2) Only minor repairs to machined surfaces, flanges and gasket mating surfaces are permitted. Remove minor nicks, burrs and scratches with:
    - (a) Fine mill file.
    - (b) Crocus cloth dipped in cleaning solvent.
    - (c) Lapping across a surface plate.
  - (3) Remachining of machined surfaces to repair damage, warpage or uneven surfaces is not permitted. Replace castings.
  - (4) Repair damaged threaded pipe plug or screw threads with a tap. Repair oversize holes with threaded inserts.
- c. Bearings. Refer to TM9-214 for repair of bearings.
- d. Studs. Replace all bent and stretched studs. Repair minor thread damage with a thread die. Replace studs having stripped or damaged threads as outlined below:
  - (1) Remove using a stud remover. Back studs out slowly to avoid heat buildup and seizure that can cause stud to break off.
  - (2) If studs break off too short to use a stud remover, use a stud extractor to remove or use "welding method".

### CAUTION

Refer to TM9-237, Welding Instructions, to avoid damage to castings if welding method is used.

- (3) Broken studs can be removed by welding bar stock or a nut to stud and removing with wrench.
- (4) Install replacement stud slowly to prevent heat buildup and snapping off.

e. Gears.

- (1) Remove gears using pullers.
- (2) Only minor repairs to gears are permitted. Remove minor nicks, burrs or scratches on gear teeth with:
  - (a) Fine mill file.
  - (b) Crocus cloth dipped in cleaning solvent.
- (3) If keyways are worn or enlarged, replace gear.

f. Bushings and Bushing Type Bearings. When bushings and bushing type bearings seize to a shaft and spin in the bore, the associated part must also be replaced.

g. Oil Seals.

- (1) Remove oil seals by pressing or prying out, being careful not to damage casting or adapter bore.
- (2) Always install new seal in bore using proper seal replacing tool.

## 2-14. PAINTING

Upon installation, restored parts must be painted per TB 43-0209.

## CHAPTER 3

## ENGINE MAINTENANCE

## Section I. DESCRIPTION AND DATA

## 3-1. GENERAL

Engine maintenance procedures not covered in this chapter can be found in TM5-2410-237-20.

## 3-2. PRINCIPLES OF OPERATION

The engine is a six cylinder, inline, four-stroke-cycle, turbocharged, fuel injected, liquid cooled diesel.

A 4.75 in. bore and 6 in. stroke produces 638 cu. in. and 200 flywheel horsepower at 2000 rpm. Firing order is 1, 5, 3, 6, 2, 4 and the engine rotates C.C.W. as viewed from the flywheel end, with cylinder #1 furthest from the flywheel.

Two stellite-faced overhead valves per cylinder with valve rotators. Cam-ground and tapered aluminum alloy pistons with three ring design, cooled by oil spray. Steel-backed aluminum bearings and through-hardened crankshaft. Pressure lubrication with full-flow, spin-on filters and integral oil cooler.

## Section II. ENGINE MAINTENANCE PROCEDURES

## 3-3. ENGINE MAINTENANCE TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
3-4	Engine Assembly - Replace	3-4
3-5	Front Engine Support - Replace	3-18
3-6	Rear Engine Mounts and Lifting Eyes - Replace	3-21
3-7	Engine Trunnion - Replace	3-22
3-8	Cylinder Liners - Replace	3-24
3-9	Cylinder Head Assembly and Spacer Plate - Replace/Repair	3-30
3-10	Crankshaft Assembly - Replace/Repair	3-43
3-11	Crankshaft Bearings - Replace	3-51
3-12	Crankshaft Front Seal and Wear Sleeve - Replace	3-59
3-13	Crankshaft Rear Seal and Wear Sleeve - Replace	3-62
3-14	Crankshaft Pulley - Replace	3-65
3-15	Crankshaft Vibration Damper - Replace	3-67
3-16	Flywheel - Replace/Repair	3-71
3-17	Flywheel Housing - Replace/Repair	3-73
3-18	Pistons, Connecting Rods, Piston Pins and Rings - Replace/Repair	3-77
3-19	Connecting Rod Bearings - Replace	3-85
3-20	Front Housing Covers - Replace/Repair	3-89
3-21	Valve Mechanism - Replace	3-95
3-22	Valve Lifters - Replace	3-101
3-23	Camshaft and Camshaft Bearings - Replace	3-104
3-24	Timing Gears, Bearings and Timing Gear Plate - Replace	3-108
3-25	Engine Oil Pump - Replace/Repair	3-111
3-26	Oil Pan - Replace	3-117
3-27	Oil Pan Plate - Replace/Repair	3-119
3-28	Exhaust Manifold - Replace	3-122
3-29	Rear Accessory Drive Gears - Replace	3-124
3-30	Accessory Drive Cover Assembly - Replace	3-126

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 3-4. ENGINE ASSEMBLY - REPLACE
 

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This task covers:

- a. Removal
- b. Installation
- c. Place in Service

---

INITIAL SETUP
Applicable Configurations

All

Personnel Required

MOS62B

Common Tools

Shop Equipment General Purpose Repair; Semi-Trailer Mounted NSN 4940-00-287-4894  
 Lifting Equipment (capacity 3000 lb.)  
 Spreader Bar (length approx. 43" capacity 3000 lb.)  
 Engine Stand (capacity 3000 lb.)

Materials/Parts

Gasket (29)  
 Seal (25, 33)  
 Lubricating Oil OE/HDO-30 (See L05-2410-237-12)  
 Wire I.D. Tags  
 Oil pan  
 Cotter Pin (12)  
 Preformed Packing (52)

Equipment Condition

Fuel supply valve turned "OFF".  
 Hood removed. See TM5-2410-237-20.  
 Radiator guard removed. See page 11-4.  
 Fan guard removed. See page 5-21.  
 Dash removed. See page 11-8.  
 Floor plates removed. See TM5-2410-237-20.  
 Crankcase guards removed. See TM5-2410-237-20.  
 Transmission oil drained. See TM5-2410-237-20.  
 Transmission oil filter assembly removed. See TM5-2410-237-20.

Engine oil drained. See TM5-2410-237-20.  
 Drive shaft removed. See TM5-2410-237-20.  
 Air cleaner dust ejector removed. See TM5-2410-237-20.  
 Start receptacle removed. See TM5-2410-237-20.  
 Winch pump removed (if equipped). See TM5-2410-237-20.  
 Hydraulic tank drained. See TM5-2410-237-20.  
 Hydraulic oil pump removed. See TM5-2410-237-20.

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 a. Removal

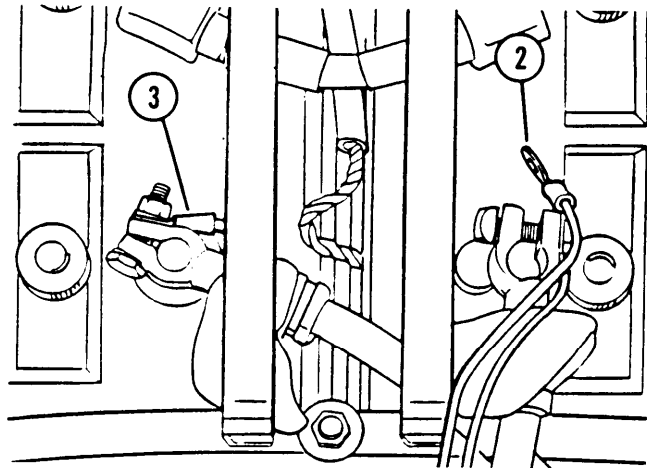
**NOTE**

Tag wires and cables for installation.

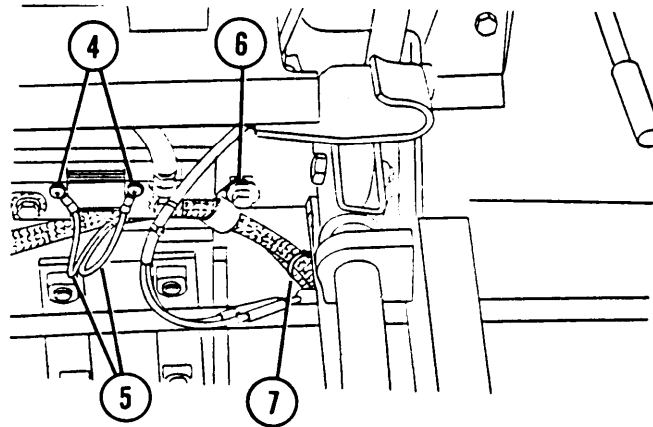
- (1) Tilt operator's seat forward and disconnect STE/ICE wire (1) from battery disconnect switch using a wrench.

3-4. ENGINE ASSEMBLY - REPLACE

- (2) Remove battery cover and use a wrench to disconnect two cables (2) from positive post of battery and one cable (3) from negative post of battery.



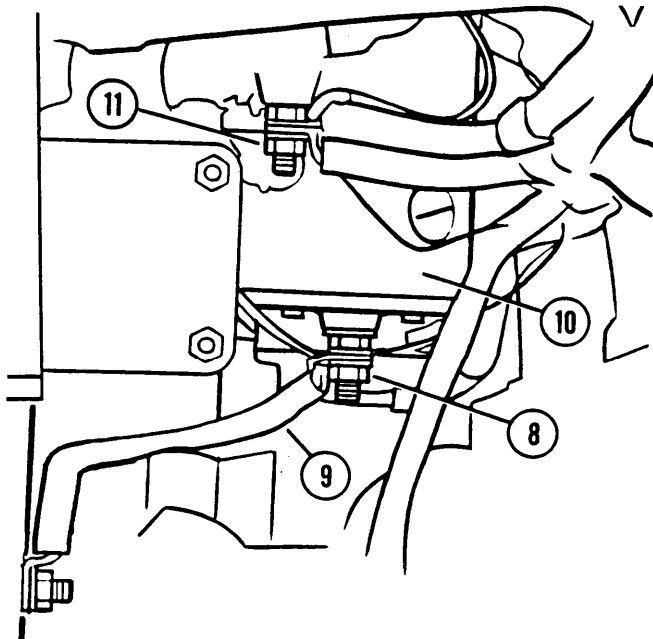
- (3) Use a phillips screwdriver to remove two screws (4) that hold wires (5) to shunt and remove wires.



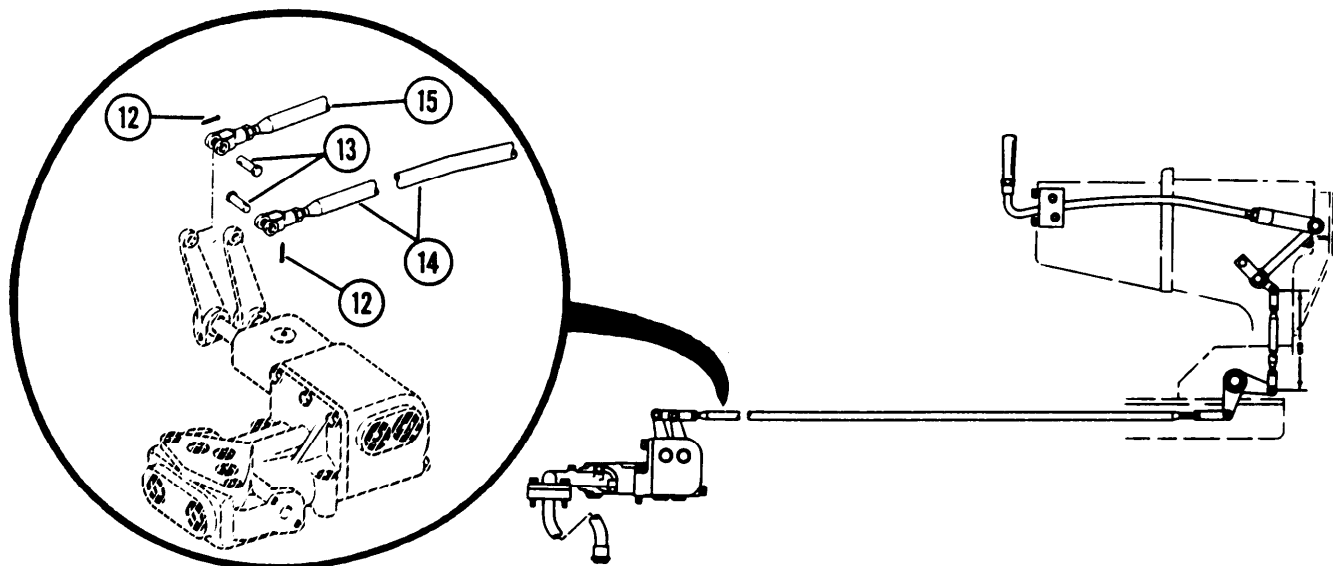
- (4) Use a wrench to remove one clip (6) and three plastic ties (7) that hold STE/ICE wiring harness to the tractor. Pull the STE/ICE wiring harness through the frame and drape over the engine.

- (5) Use a wrench to remove nut (8) that holds ground wire (9) to the starter (10).

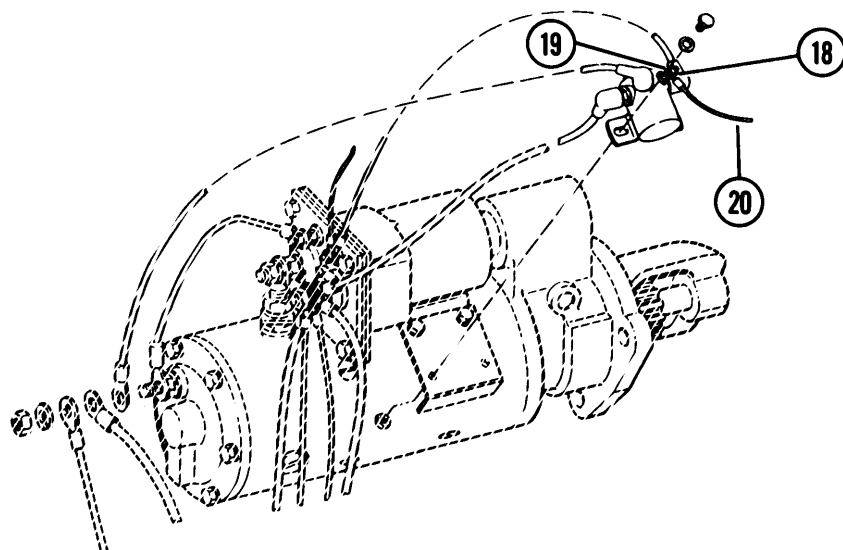
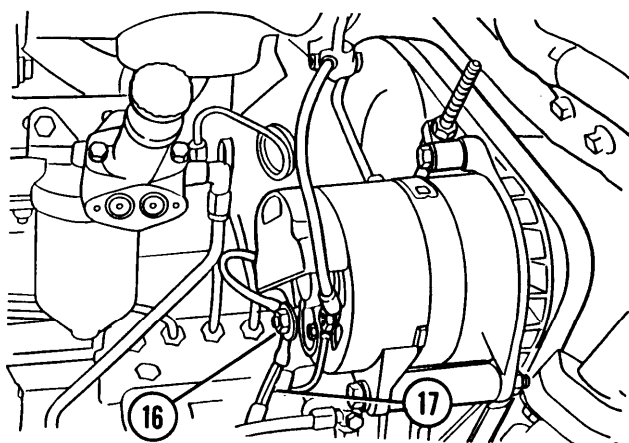
- (6) Use a wrench to remove nut (11) that holds power cable to positive post of starter (10).



3-4. ENGINE ASSEMBLY - REPLACE (Cont'd)



- (7) Remove two cotter pins (12) and pins (13) to remove right (14) and left (15) steering rods. Discard cotter pins (12).
- (8) Use a wrench to remove nut (16) that holds wire harness (17) to alternator terminal.
- (9) Slide rubber boot from start relay terminal. Use a wrench to remove nut (18) and washer (19) holding wire (20) to relay.





3-4. ENGINE ASSEMBLY - REPLACE (Cont'd)

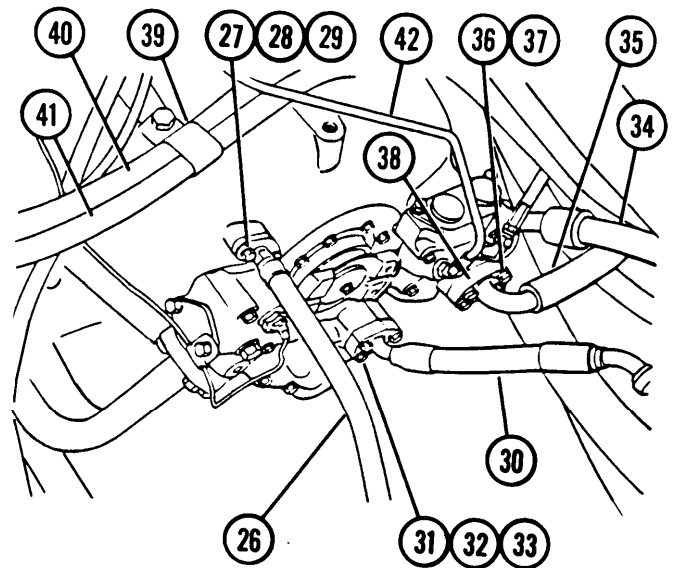
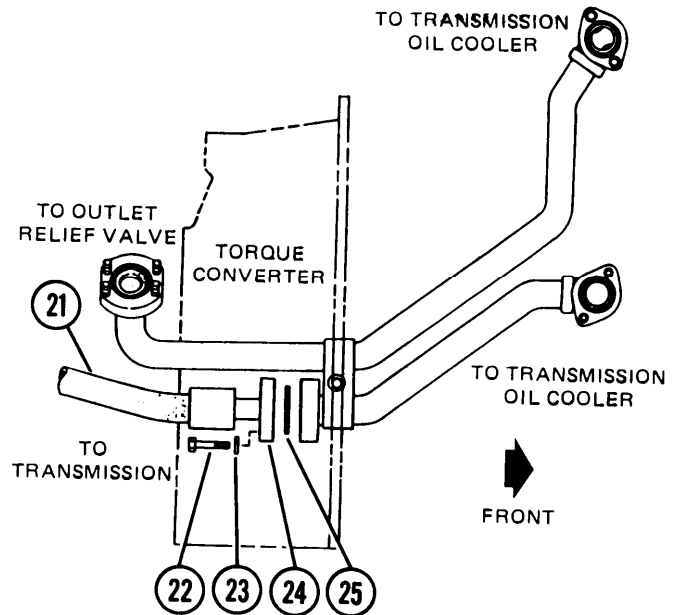
NOTE

If more than one hydraulic line is to be removed, identify lines to assure proper installation. Use suitable container to catch any hydraulic oil that may drain from the system.

CAUTION

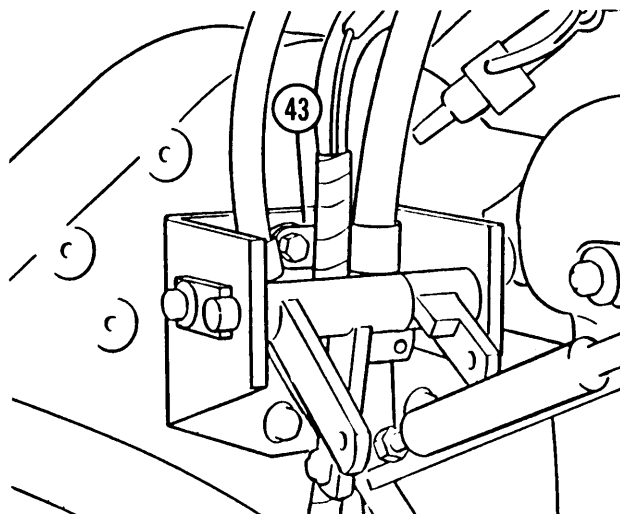
Wipe the area clean around all hydraulic connections to be opened during removal and disassembly. Cap oil lines and plug holes after removing lines. Contamination of the hydraulic system could result in premature failure!

- (10) Use a wrench to remove four capscrews (22), four washers (23), and two flange halves (24) holding hose assembly (21) to oil cooler tube assembly. Remove and discard seal (25).
- (11) Disconnect vent line (26) from the torque divider by using a wrench to remove two capscrews (27), two flat washers (28), and gasket (29). Discard gasket (29).
- (12) Disconnect oil supply line (30) for the transmission using a wrench to remove two capscrews (31), flat washer (32), and seal (33). Discard seal (33).
- (13) Disconnect two lines (34 and 35) from sequence relief valve using a wrench to remove eight capscrews (36), washers (37), and four split flanges (38).
- (14) Use a wrench to remove two clamps (39) that attach two lines (40 and 41) to torque divider.
- (15) Use a wrench to remove line (42) from sequence relief valve.

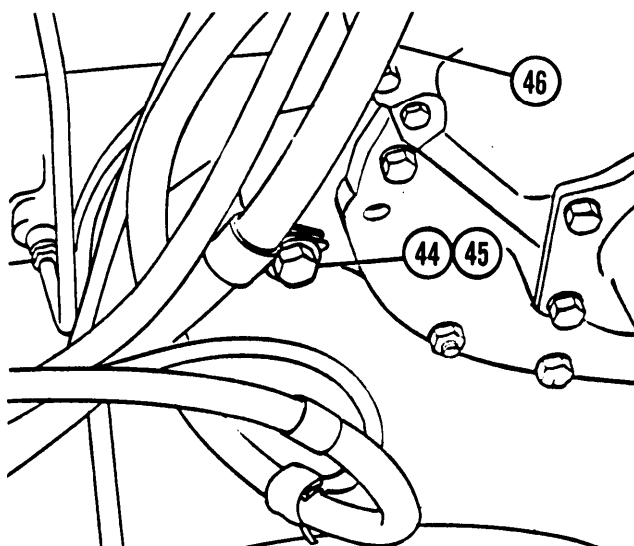


## 3-4. ENGINE ASSEMBLY - REPLACE (Cont'd)

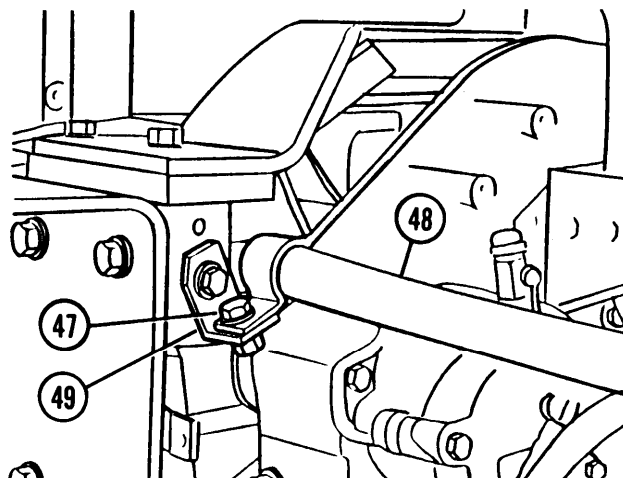
- (16) Use a wrench to remove clip (43) that holds the power cable to governor control linkage bracket. Cut plastic ties and pull wire harness from engine and lay harness over transmission.



- (17) Use a wrench to remove capscrew (44) and flat washer (45). Disconnect clamp that holds the battery cable (46) to the flywheel housing. Move the battery cable out of the way of the engine.

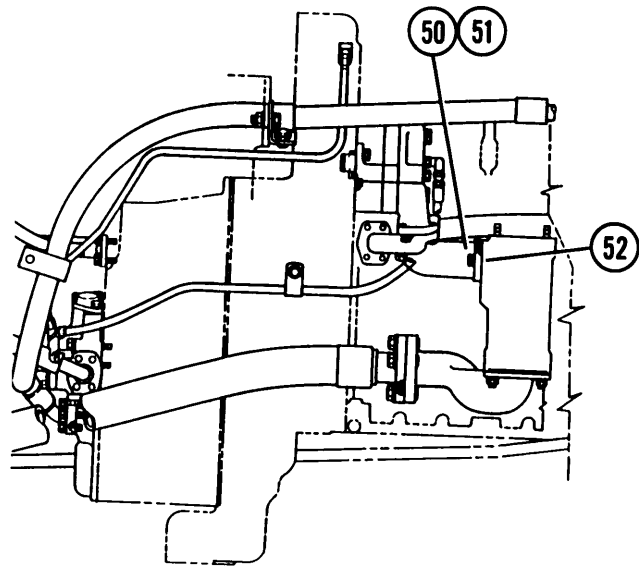


- (18) Use two wrenches to disconnect clamp (47) that holds the transmission oil supply line to the fender. Move line (48) and bracket (49) out of the way.



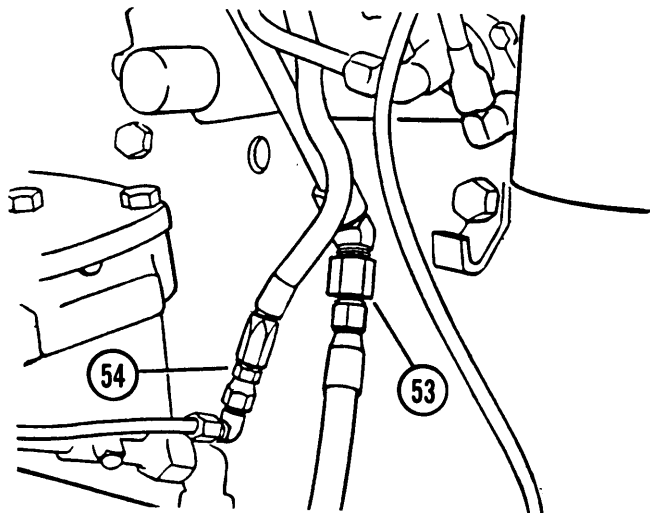
3-4. ENGINE ASSEMBLY - REPLACE (Cont' d)

- (19) Use a wrench to remove two capscrews (50) and lock washers (51). Discard preformed packing (52). Lower magnetic screen assembly out of the way of the engine.



- (20) Use two wrenches to disconnect fuel supply line (53) from primary fuel filter.

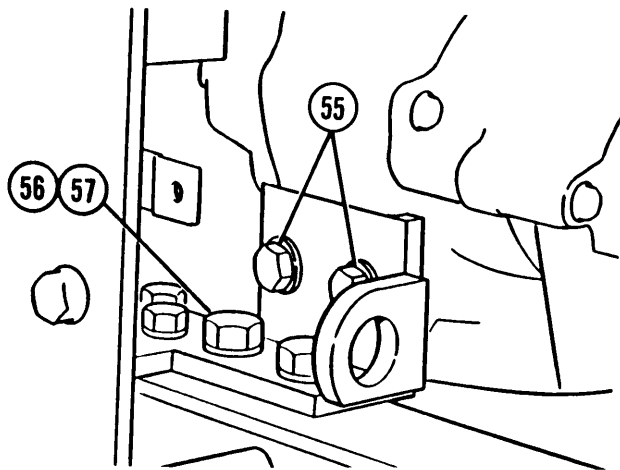
- (21) Use a wrench to remove fuel return line (54) from fuel injection pump.



**WARNING**

DO NOT remove capscrews (55) on either side of the engine.

- (22) Use a wrench to remove four capscrews (56) and four washers (57) from rear engine mounting brackets.

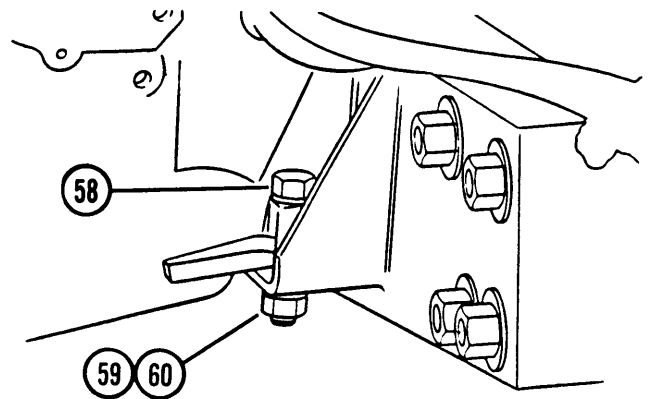


3-4. ENGINE ASSEMBLY - REPLACE (Cont'd)

- (23) Use two wrenches to remove two capscrews (58), two nuts (59), and two flat washers (60) from the engine front support.

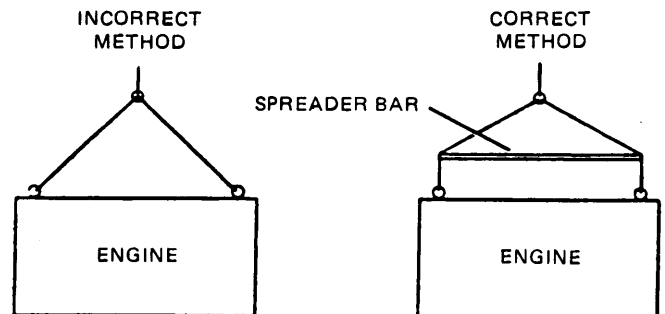
CAUTION

Always use a spreader bar while lifting the engine assembly. This will keep the lifting force vertical at all times, avoiding damage to the lifting brackets.

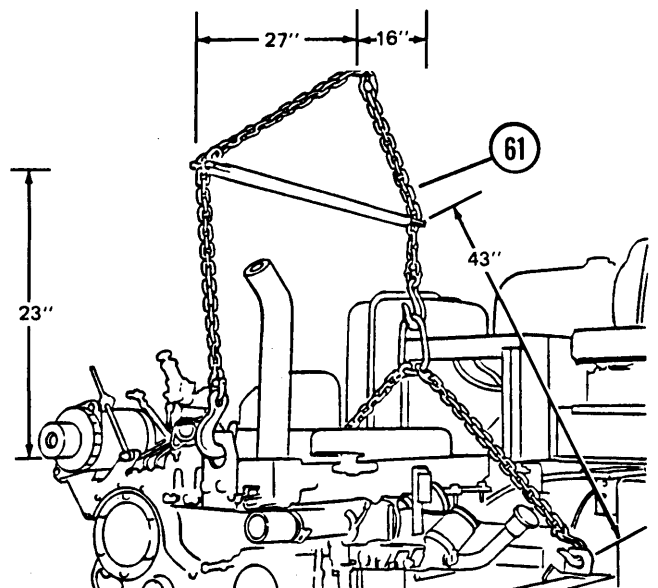


CAUTION

Engine assembly must be lifted so crankshaft centerline is horizontal. This will prevent binding on rear engine mounts locating pins.



- (24) Attach lifting equipment (61) to engine lifting brackets according to the approximate dimensions shown in diagram. Lift engine from the machine. The weight of the engine and torque divider is 3000 lbs.
- (25) Lower the engine to a suitable repair stand.



3-4. ENGINE ASSEMBLY - REPLACE (Cont'd)

**WARNING**

Be sure engine is clear before remove shims (62), to avoid pinching hands or fingers.

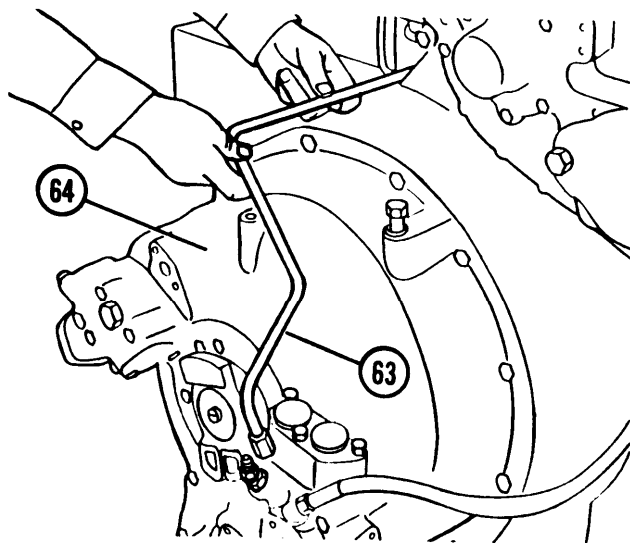
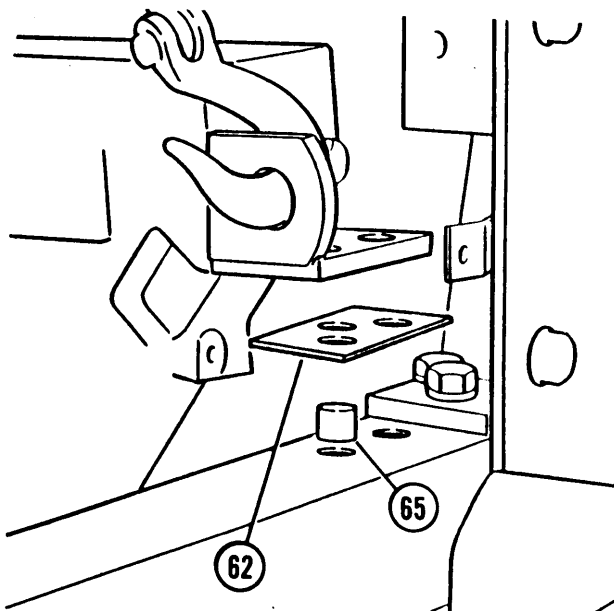
- (26) Remove the shims (62) from locating pins (65) and rear mounting surface on the main frame.

b. Installation

**CAUTION**

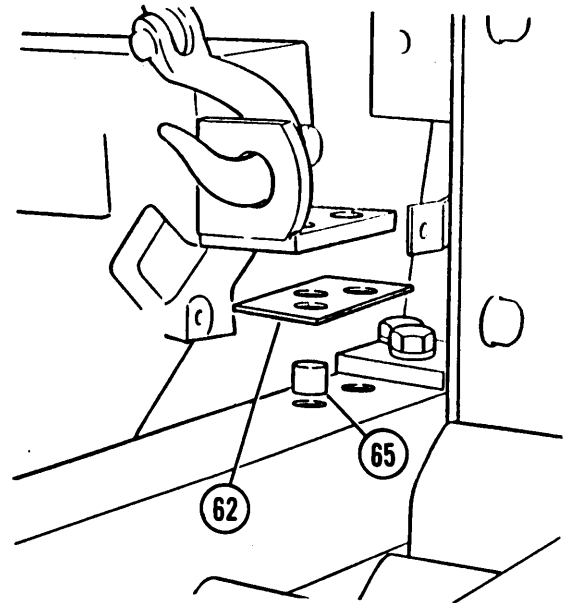
Remove caps from lines and remove plugs from holes as installations are made. Wipe all line ends, line fittings, and mounting surfaces clean. Apply light film of clean hydraulic oil to all seals as they are installed. Contamination of hydraulic system could result in premature failure.

- (1) Place replacement engine in an engine stand suitable for transferring the following accessories from the damaged engine.
- (2) Remove transmission oil line (63) from damaged engine.
- (3) Remove torque divider (64) from damaged engine. See page 7-8.
- (4) Install torque divider (64) onto replacement engine. See page 7-8.
- (5) Install transmission oil line (63) onto replacement engine.

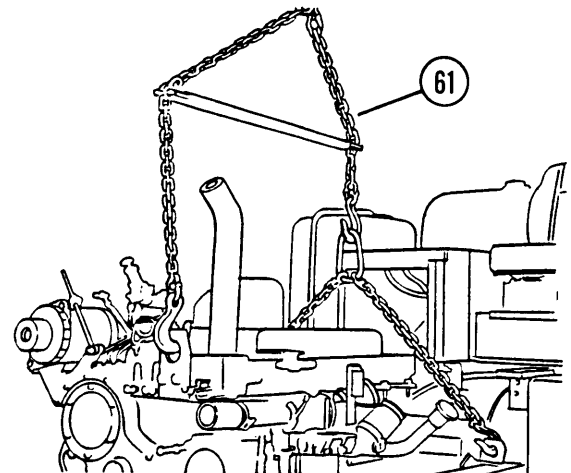


## 3-4. ENGINE ASSEMBLY - REPLACE (Cont'd)

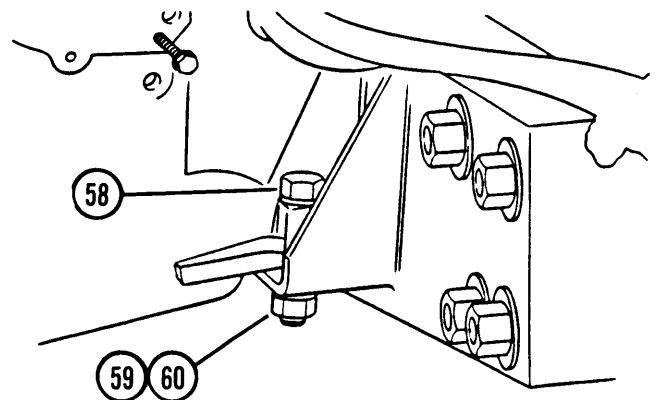
- (6) Remove all clamps or ties that attach STE/ICE harness to engine and remove harness from starter, alternator, and tach drive. Tag all cables as to their location and remove STE/ICE harness from engine.
- (7) Install STE/ICE wiring harness and ties that secure harness to the replacement engine and connect wires to starter, alternator, and tach drive on replacement engine.
- (8) Position shims (62) in place on rear mount surface on the main frame. Be sure locating pins (65) are in position on main frame.



- (9) Attach lifting equipment (61) to three lifting brackets on replacement engine. Install engine in machine, keep crankshaft centerline horizontal. Make sure rear engine mounts fit onto locating pins in frame.

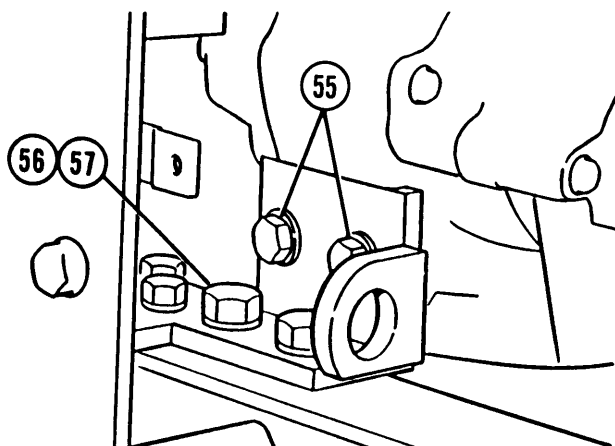


- (10) Install two capscrews (58), washers (60), and nuts (59) into front engine mounting bracket. Tighten capscrews to 325+25 lb. ft.

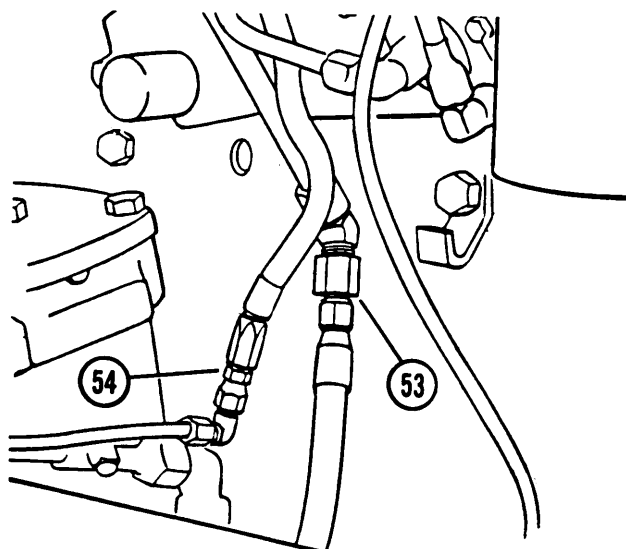


3-4. ENGINE ASSEMBLY - REPLACE (Cont'd)

- (11) Install four capscrews (56) and four washers (57) in rear engine mounting brackets. Tighten capscrews to 325+25 l.b. ft.

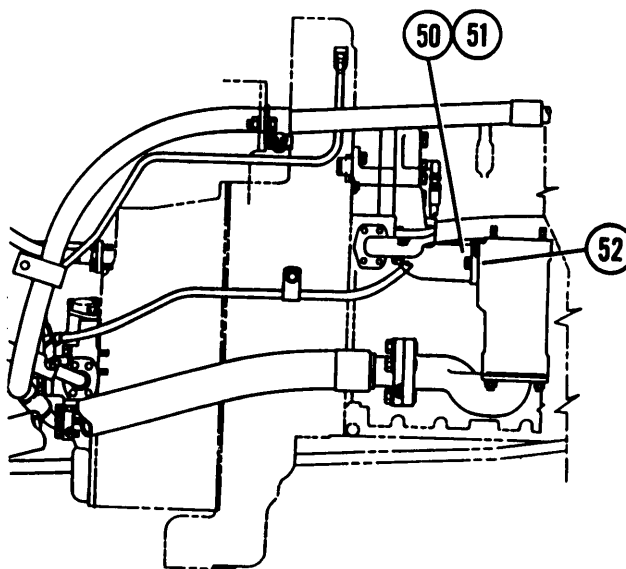


- (12) Connect fuel return line (54) to fuel injection pump.



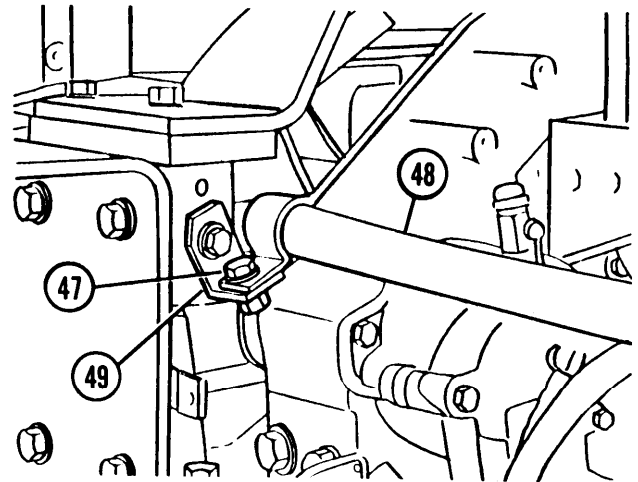
- (13) Use two wrenches to connect fuel supply line (53) to primary fuel filter.

- (14) Lift magnetic screen assembly into position and install new preformed packing (52). Use a wrench to install two capscrews (50) and lock washers (51).

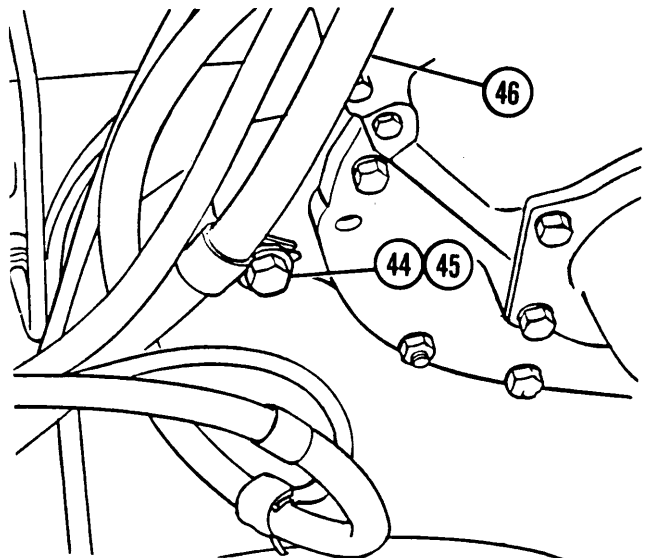


## 3-4. ENGINE ASSEMBLY - REPLACE (Cont'd)

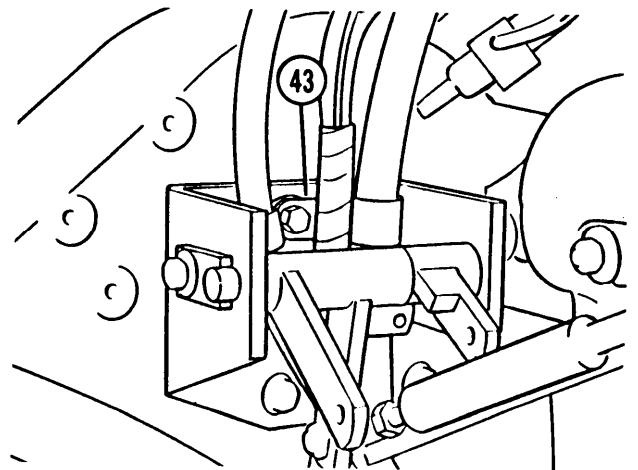
- (15) Put transmission oil supply line (48) and bracket (49) into position. Use two wrenches to connect clamp (47) that holds line to the fender.



- (16) Position the battery cable (46) over the flywheel housing and use a wrench to attach the clamp, that holds the battery cable to the flywheel housing, with capscrew (44) and washer (45).



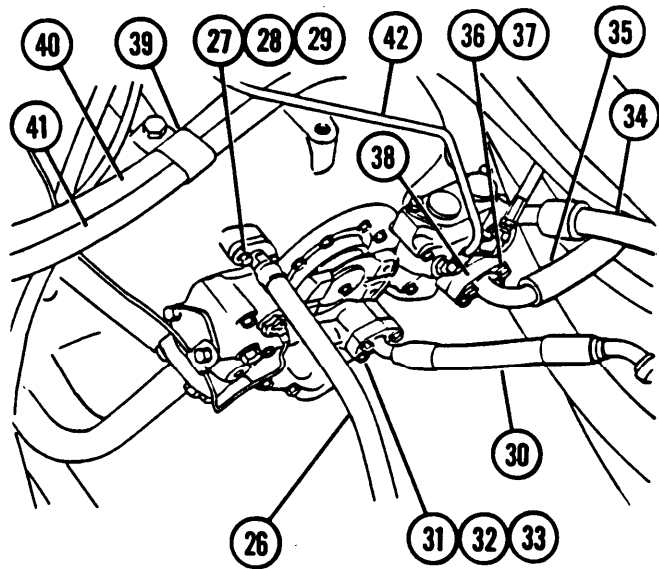
- (17) Put power cable through governor control linkage bracket and attach clip (43) holding cable to bracket.



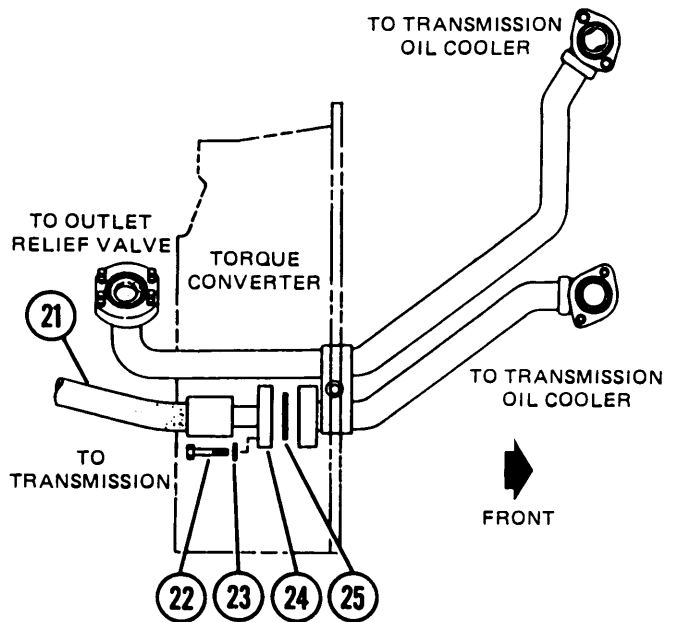


3-4. ENGINE ASSEMBLY - REPLACE (Cont'd)

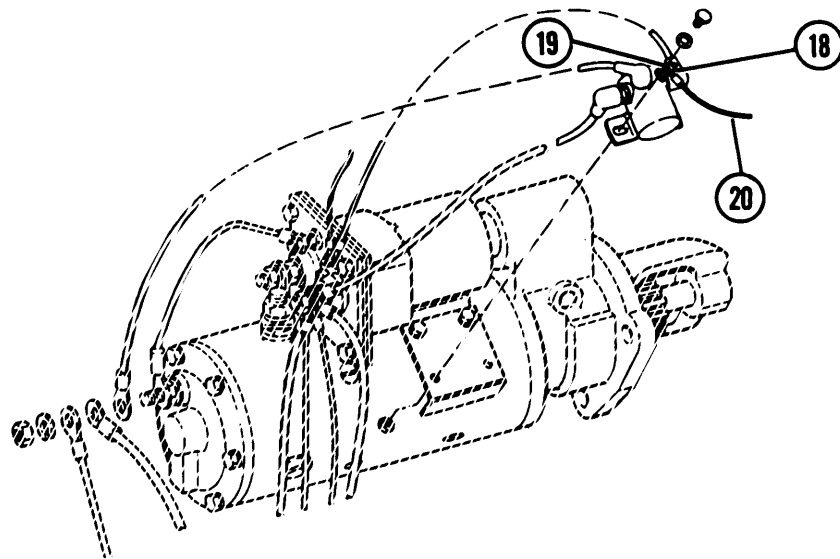
- (18) Install line (42) on sequence relief valve using a wrench.
- (19) Install two clamps (39) that attach two lines (40 and 41) to torque divider.
- (20) Connect two lines (34 and 35) to sequence relief valve using a wrench to install eight capscrews (36), washers (37), and four split flanges (38).
- (21) Connect transmission oil supply line (30) using a wrench to install two capscrews (31), washers (32), and new seal (33).
- (22) Connect vent line (26) using a wrench to install two capscrews (27), two flat washers (28), and new gasket (29).



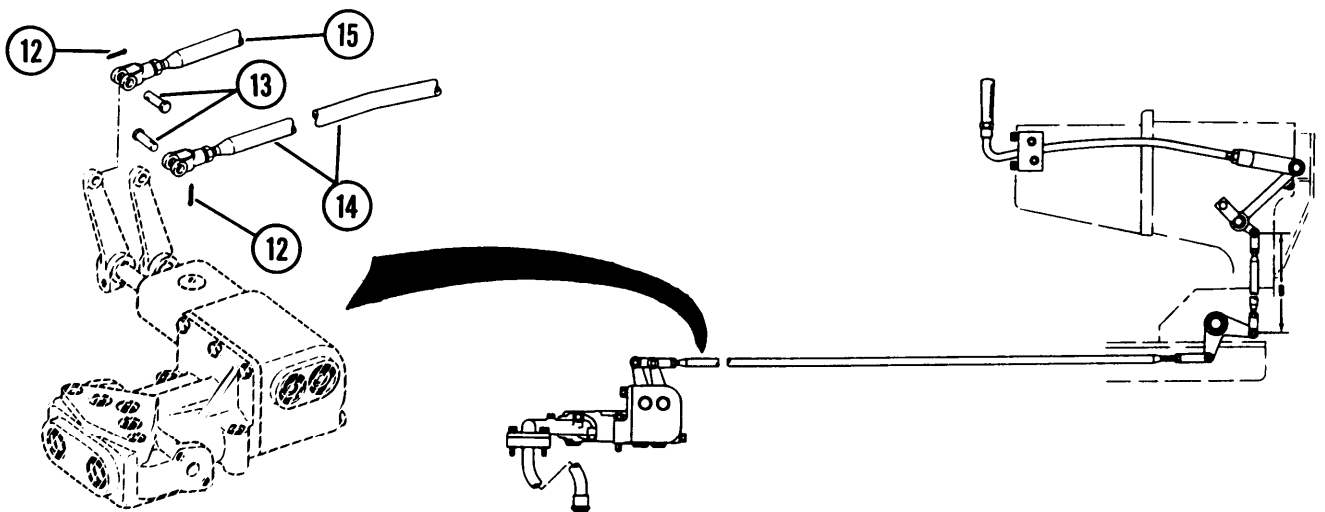
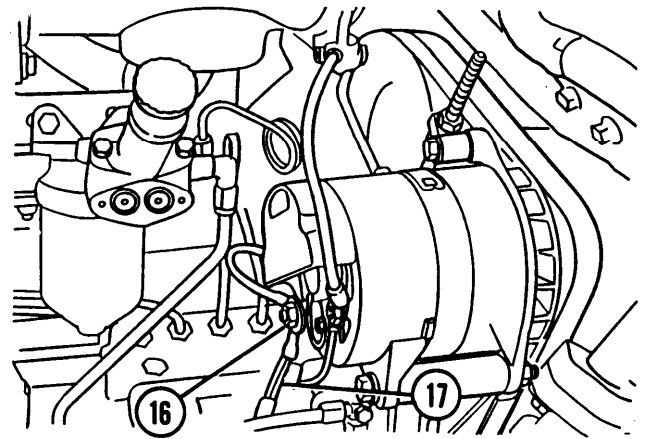
- (23) Install new seal (25). Connect hose assembly (21) to oil cooler tube assembly using four capscrews (22), four washers (23), and two flange halves (24).



3-4. ENGINE ASSEMBLY - REPLACE (Cont'd)

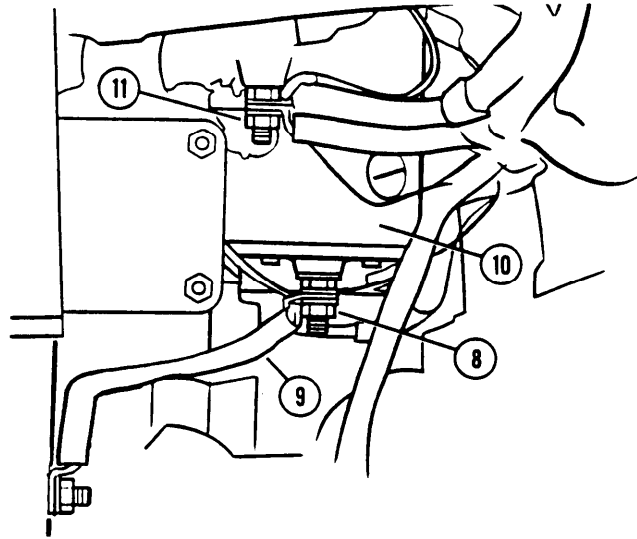


- (24) Connect wire (20) to start relay terminal using washer (19) and nut (18). Slide rubber boot over terminal.
- (25) Connect wire harness (17) to alternator terminal using nut (16).
- (26) Connect right (14) and left (15) steering rods to control valve using pins (13) and cotter pins (12).

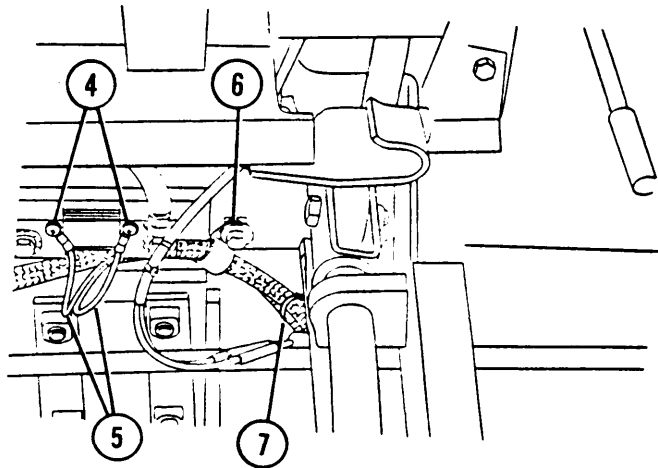


3-4. ENGINE ASSEMBLY - REPLACE (Cont' d)

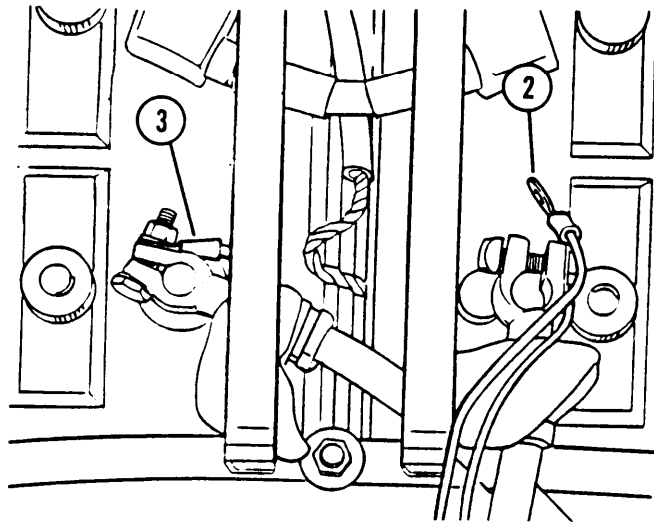
- (27) Use a wrench to install nut (11) that holds power cable to positive post of starter (10).
- (28) Use a wrench to install nut (8) that holds ground wire (9) to the starter (10).



- (29) Pull STE/ICE wiring harness through the frame. Install one clip (6), using a wrench, and three plastic ties to hold STE/ICE wiring harness to the tractor.
- (30) Place two wires (5) into position on shunt and attach with two phillip screws (4).



- (31) Use a wrench to connect two wires (2) to positive post of battery and one wire (3) to negative post of battery. Install battery cover.

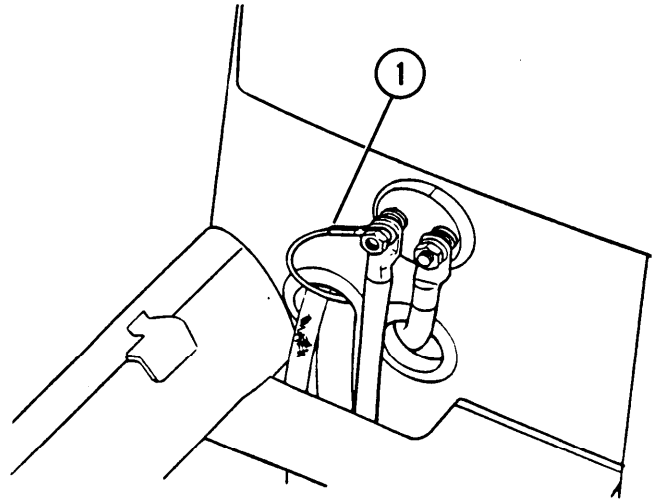


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 3-4. ENGINE ASSEMBLY - REPLACE (Cont'd)
 

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- (32) Connect STE/ICE wire (1) to battery disconnect switch using a wrench.
- (33) Install hydraulic oil pump on flywheel housing. See TM5-2410-237-20.
- (34) Install winch pump (if equipped). See TM5-2410-237-20.
- (35) Install start receptacle. See TM5-2410-237-20.
- (36) Install air cleaner dust ejector. See TM5-2410-237-20.
- (37) Install drive shaft. See TM5-2410-237-20.
- (38) Install transmission oil filter assembly. See TM5-2410-237-20.
- (39) Install radiator guard. See page 11-4.
- (40) Install floor plates. See TM5-2410-237-20.
- (41) Install dash. See page 11-8.
- (42) Install fan guard. See page 5-21.
- (43) Install hood. See TM5-2410-237-20.
- (44) Service the transmission with transmission oil. See TM5-2410-237-20.
- (45) Service engine with engine oil. See TM5-2410-237-20.
- (46) Turn fuel supply valve "ON".


 c. Place In Service

Run engine and check for leaks and proper operation.

Install crankcase guards.  
See TM5-2410-237-20.

---

### 3-5. FRONT ENGINE SUPPORT - REPLACE

---

This task covers:

- a. Removal
  - b. Installation
  - c. Place In Service
- 

#### INITIAL SETUP

##### Applicable Configurations

**ALL**

##### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

##### Materials/Parts

Wood support 2' Long x 2' x 8'  
Drain pan

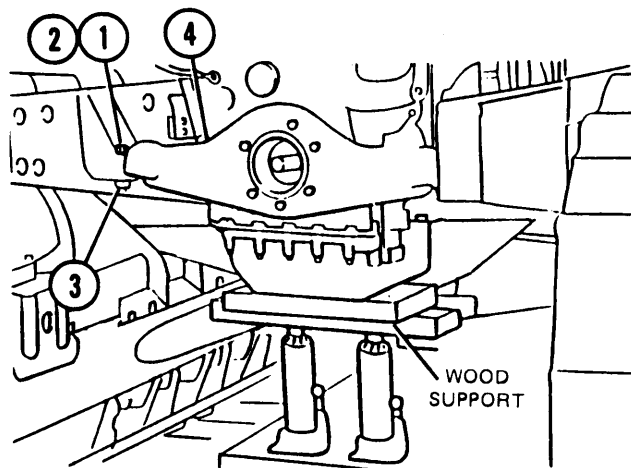
##### Equipment Condition

Crankshaft pulley removed. See page 3-65.

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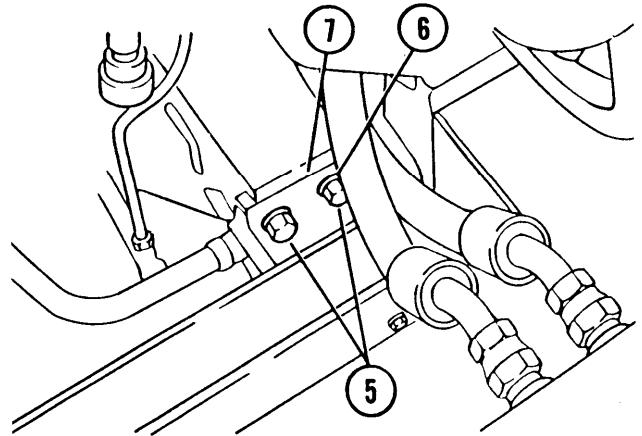
#### a. Removal

- (1) place two hydraulic hand jack (8-ton or greater capacity) and suitable wood support under the oil pan. The wood support is necessary, and should be slightly larger than the width of the pan, to prevent damage to the oil pan.
- (2) Raise the jacks until wood support is firmly against the oil pan.
- (3) Place two hydraulic hand jack (8-ton or greater capacity) and suitable wood support under the flywheel housing. The wood support will prevent damage to the housing when engine rear support-to-flywheel housing mounting hardware is removed.
- (4) Raise the jacks until wood support is firmly against the flywheel housing.
- (5) Use a wrench to remove two nuts (1) washers (2) and capscrews (3) from engine front support (4).



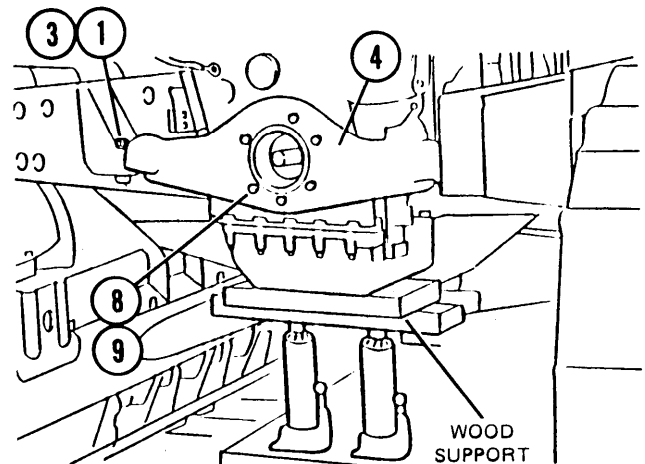
## 3-5. FRONT ENGINE SUPPORT - REPLACE (Cont'd)

- (6) Use a wrench to remove two capscrews (5) and washers (6) that attach the engine rear supports (7) at each side of the flywheel housing.
- (7) Check that the front hydraulic jacks are firmly positioned against the oil pan.
- (8) Use a wrench to remove capscrews (8) and washers (9) to attach the engine front support (4) to the trunnion.
- (9) Turn the engine front support clockwise (as seen from the front of the engine) and remove it from the engine.



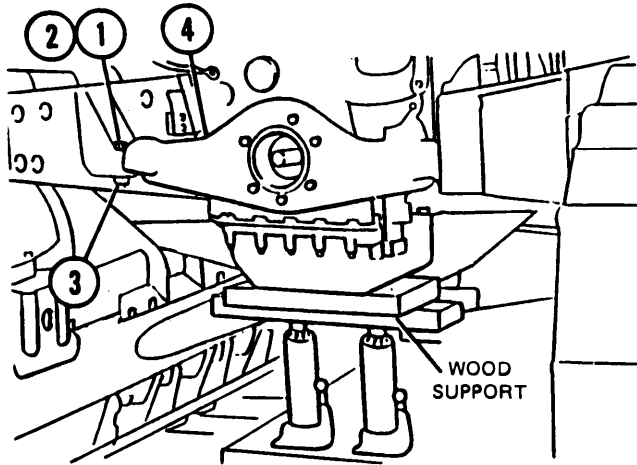
## b. Installation

- (1) Install engine front support (4) in position on the trunnion.
- (2) Install capscrews (8) and washer (9).
- (3) Use a torque wrench to tighten capscrews (8) to a torque of 75+10 lb. ft.
- (4) Slowly lower jacks under the oil pan until engine front support (4) is resting on the frame.

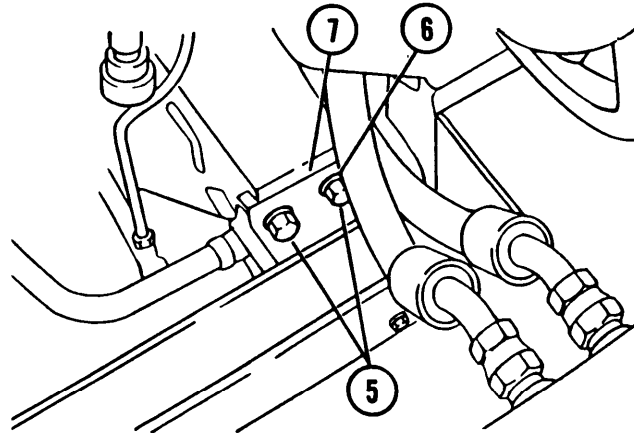


3-51 FRONT ENGINE SUPPORT - REPLACE (Cont'd)

- (5) Install capscrews (3), washers (2), and nuts (1) on engine front support (4).
- (6) Use a torque wrench to tighten capscrews (3) to a torque of 325+25 lb. ft.
- (7) Lower and remove hydraulic hand jack and wood support from front of engine.



- (8) Install capscrews (5) and washers (6) that attach the engine rear supports (7) at each side of the flywheel housing.
- (9) Use a torque wrench to tighten capscrews (5) to a torque of 150+20 lb. ft.
- (10) Lower and remove hydraulic hand jacks and wood support from rear of engine.
- (11) Install crankshaft pulley and vibration damper. Refer-to page 3-65 and 3-67.



c. Place In Service

Run engine and check for leaks and proper operation.

---

### 3-6. REAR ENGINE MOUNTS AND LIFTING EYES - REPLACE

---

This task covers:

- a. Removal
  - b. Installation
  - c. Place In Service
- 

#### INITIAL SETUP

##### Applicable Configurations

All

##### Equipment Condition

Engine removed. See page 3-3.

##### Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-287-4894

---

#### a. Removal

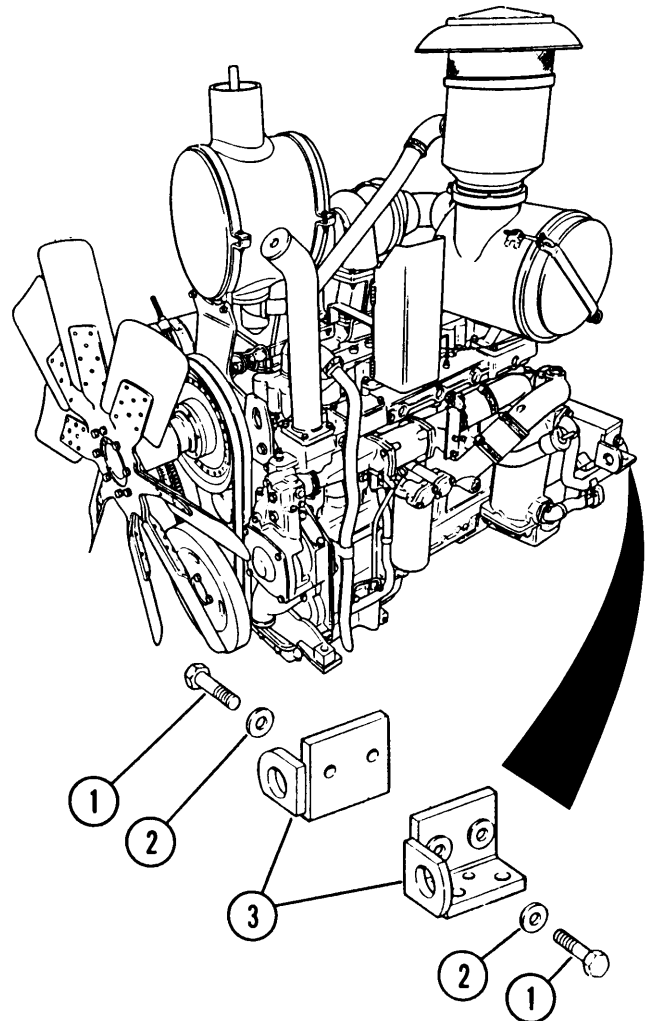
- (1) Use a wrench to remove two capscrews (1) and washers (2) from each engine rear support (3).
- (2) Remove engine rear supports (3).

#### b. Installation

- (1) Position engine rear supports (3) on flywheel housing.
- (2) Install capscrews (1) and washers (2). Use a torque wrench to tighten capscrews to a torque of  $150 \pm 20$  lb. ft.
- (3) Install engine. See page 3-3.

#### c. Place In Service

Run engine and check for proper operation.





---

### 3-7. ENGINE TRUNNION - REPLACE

---

This task covers:

- a. Removal
- b. Installation
- c. Place In Service

---

#### INITIAL SETUP

##### Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

##### Materials/Parts

Liquid Soap (App. B, Item 16)  
Packing (7)  
Ring (4)

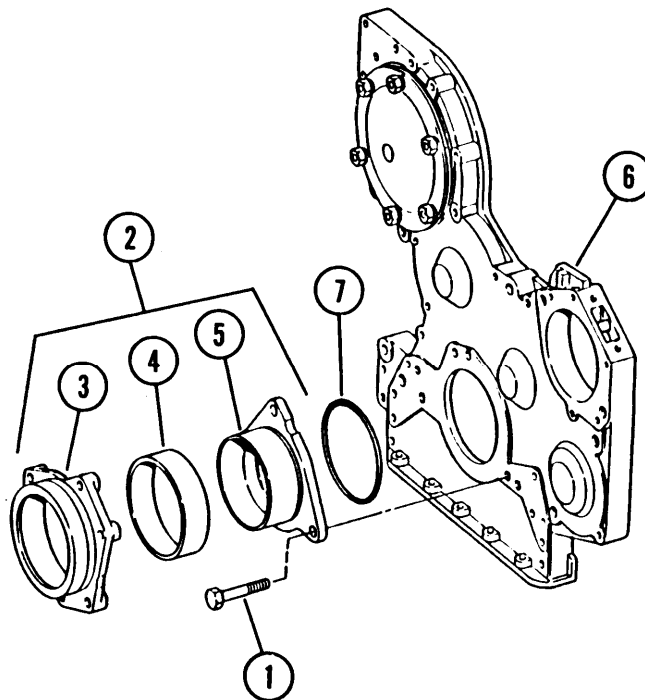
##### Equipment Condition

Crankshaft pulley removed. See  
page 3-65.  
Engine front support removed. See  
page 3-18.

---

#### a. Removal

- (1) Use a wrench to remove three  
capscrews (1) and trunnion  
assembly (2) from front housing  
(6).
- (2) Remove and discard packing (7).
- (3) Separate trunnion supports (3  
and 5) and ring (4). Discard  
ring (4).



---

### 3-71 ENGINE TRUNNION - REPLACE (Cont' d)

---

#### b. Installation

- (1) Install new packing (7) into front housing (6).
- (2) Install new ring (4) into bore of support (3) dry. Install trunnion support (5) into support (3) and ring (4).
- (3) Lubricate inside diameter of ring (4) with 3% soap solution.
- (4) Position trunnion assembly (2) on front housing (6) and install capscrews (1).
- (5) Use a wrench to tighten capscrews (1) to  $75 \pm 10$  lb. ft.
- (6) Install engine front support. See page 3-18.
- (7) Install crankshaft pulley. See page 3-65.
- (8) Install engine. See page 3-10.

#### c. Place In Service

Run engine and check for proper operation.

---

3-8. CYLINDER LINERS - REPLACE

---

This task covers:

- a. Removal
- b. Cleaning
- c. Inspection
- d. Projection Check
- e. Installation
- f. Place In Service

---

INITIAL SETUP

Common Tools:

Shop Equipment, General Purpose  
 Repair Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Shop Equipment, Machine  
 Shop: Field Maintenance, Basic  
 NSN 3470-00-754-0708  
 Cylinder Liner Puller tool  
 NSN 5120-01-189-9632  
 Puller Crossbar  
 NSN 5120-00-633-5085  
 Adapter Plate  
 NSN 5120-00-036-6350  
 Plate NSN 5120-01-124-1738  
 Cylinder Liner Installation Tool  
 NSN 4910-097-6946

Materials/Parts:

**Bolt 5/8-11NC-1.75" long**  
 NSN 5305-00-010-0185  
 Washer (copper) NSN 5330-00-725-3333  
 Bolt 5/8-11NC-6° Long  
 NSN 5306-00-814-6559  
 Washer NSN 5310-00-432-4324  
 Liquid Soap  
 Lubricating Oil, OE/HDO-30 (See  
 L05-2410-237-12)  
 Suitable container (2 gallon)  
 Cleaning solvent (App. B, Item 19)  
 Lint-free cloth (App. B, Item 12)

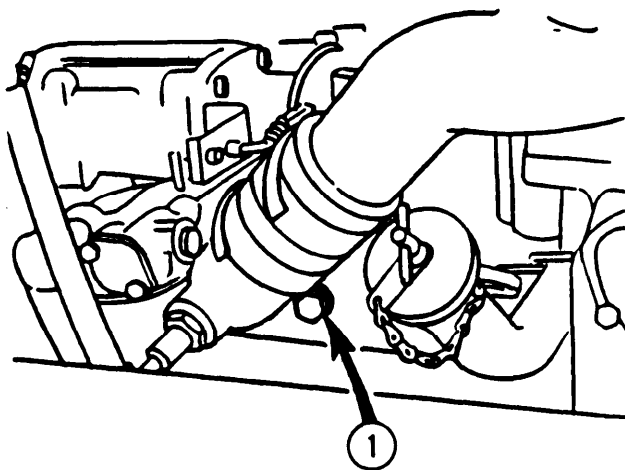
Equipment Condition

Engine removed. See page 3-4.  
 Pistons removed. See page 3-78.

---

a. Removal

- (1) Cover the crankshaft bearing journals for protection from dirt, water, and cleaning solvent.
- (2) Remove the block coolant drain plug (1) and drain coolant from block. Use a suitable container to catch coolant.



---

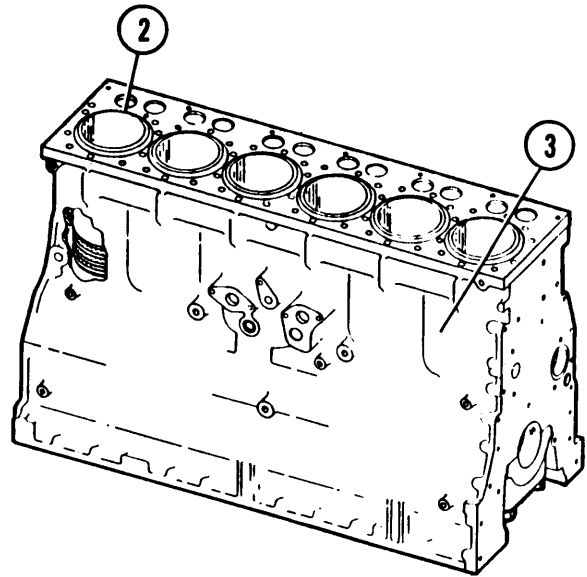
### 3-8. CYLINDER LINERS - REPLACE (Cont'd)

---

- (3) Use a suitable puller tool to remove cylinder liners (2) from the block (3).

#### b. Cleaning

- (1) Check that the crankshaft bearing journals are adequately covered.
- (2) Clean cylinder liners and cylinder bores in block with an approved cleaning solvent and dry thoroughly with a lint-free cloth. See page 2-29.



#### NOTE

Cylinder liners, with light rust on the inside surface that is not opposite pits on the outside surface, and liners with shiny areas on the inside surface, can be used again if honing removes all of the rust and shiny areas. Honing must be done by higher echelon maintenance.

#### c. Inspection

- (1) Visually inspect the cylinder liners. Do not reuse cylinder liner if any of the following defects or abnormal conditions are observed:
  - (a) Grooves on the inside surface of the liner.
  - (b) Pitting on the inside surface.
  - (c) Cracks on the inside surface.
  - (d) Rust on the inside surface.
  - (e) Shiny areas on the inside surface.

3-8. CYLINDER LINERS - REPLACE (Cont'd)

- (2) Refer to Table 3-1. Measure cylinder liner as indicated. If liner is equal to or within the specifications given, use the liner again. If measurements are not within the specified tolerances, replace the liner.

d. Projection Check

NOTE

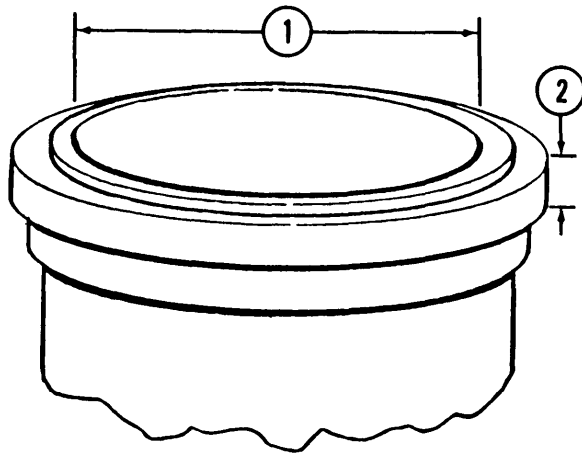
Correct cylinder liner projection is very important to prevent leaks between the liner, cylinder head, and cylinder block.

CAUTION

Do not use hard gasket scrapers or files to remove gasket material, grease or other particles from the block or spacer plate surfaces. These tools could cause nicks or scratches which, in turn, could cause leaks or incorrect seat between the cylinder head and spacer plate, and/or block and spacer plate.

- (1) Check that the surfaces of the cylinder block, cylinder liner, and spacer plate are clean.
- (2) Place spacer plate gasket and spacer plate on the cylinder block.
- (3) Place a copper gasket (4) on each 5/8-11 X 1-3/4" capscrew (5), and install capscrews and copper gaskets. Put two capscrews (5) and gaskets (4) on each side of the cylinder liner (2) as shown. Tighten the 14 capscrews evenly, in four steps, as follows:

Table 3-1. Cylinder Liner Specifications



(1) Bore in liner (new)	4.751 ± 0.001 in.
Use again maximum bore when measured near upper end of the wear surface of the cylinder liner	4.755 in.
(2) Thickness of flange on liner	0.4048 ± 0.0008 in.
(3) Filler band.	

## 3-8. CYLINDER LINERS - REPLACE (Cont'd)

**Step 1:** 10 lb. ft.

**Step 2:** 25 lb. ft.

**Step 3:** 50 lb. ft.

**Step 4:** 70 lb. ft.

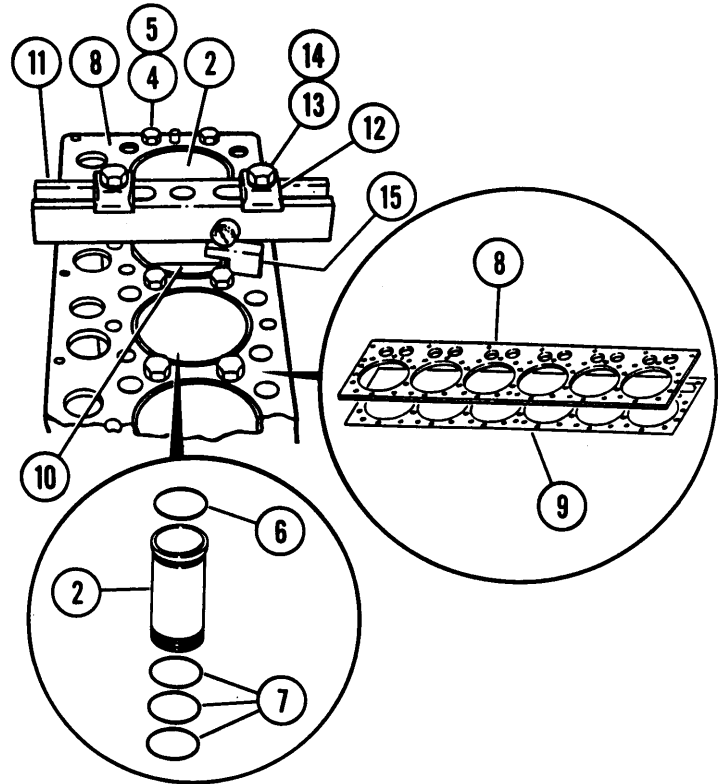
- (4) Install cylinder liners (2), without packings (6) and filler bands (7), through the spacer plate (8) and gasket (9) and into the block.
- (5) Put adapter plate (10) on the cylinder, then install puller crossbar (11), plates (12), and 5/8-11 X 6" capscrews (13) and 21/32 ID flat washers (14).
- (6) Tighten capscrews (13) evenly, in four steps, as follows:

**Step 1:** 5 lb. ft.

**Step 2:** 15 lb. ft.

**Step 3:** 25 lb. ft.

**Step 4:** 50 lb. ft.

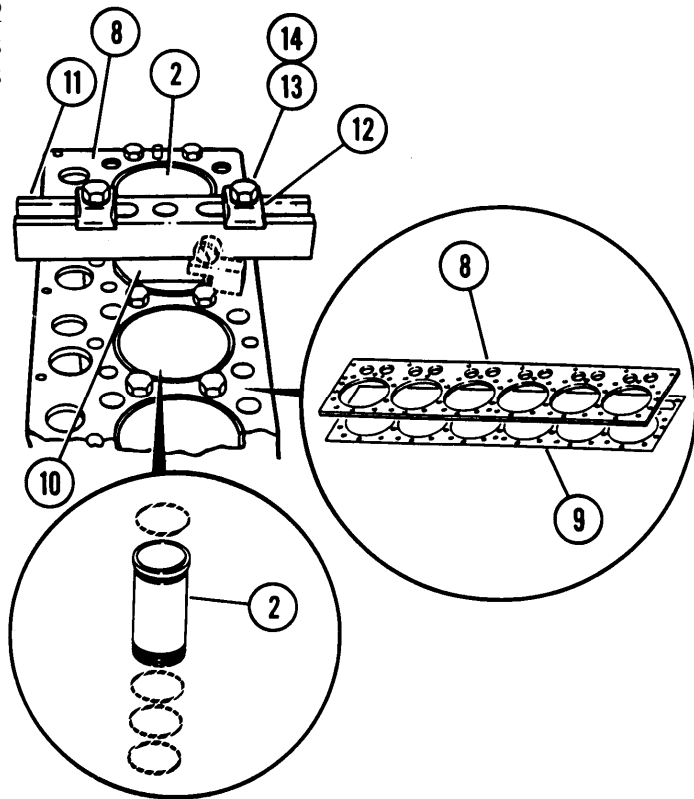


The measurement, from the bottom of the crossbar-(n) to the spacer plate (8), must be the same on both sides of the cylinder liner (2).

- (7) Check cylinder liner projection with a Liner Projection Tool (15). Measure as close as possible to the four corners of the adapter plate (10).
- (8) Record the four measurements as they will be needed as reference data later.
- (9) Liner projection must be 0.0012 to 0.0069 inches. Measurements on the same liner must not be different by more than 0.002 inches. The difference in the average cylinder liner projection between adjacent liners must not be more than 0.002 inches.

3-8. CYLINDER LINERS - REPLACE (Cont' d)

- (10) If liner projection is not 0.0012 to 0.0069 inches, check thickness of the spacer plate (8). Thickness must be  $0.3925 \pm 0.0010$  inches.
- (11) Check thickness of gasket (9). Thickness must be  $0.0082 \pm 0.0010$  inches.
- (12) Recheck thickness of cylinder liner flange (2). Thickness must be  $0.4048 \pm 0.0008$  inches.
- (13) If the measurements taken in STEPS 8 through 12 agree with the specifications (refer to Table 3-1, page 3-26) and liner projection changes from point to point around the liner, or if any of the mentioned parts are replaced and liner projection is still not correct, turn the liner to a new position within the bore. If correct projection is achieved this way, put an alignment mark on the liner and the block. This will ensure correct liner placement at installation. If projection cannot be corrected this way, move the liner to a different bore and repeat previous STEPS 4 through 7 and STEP 13. If correct projection is accomplished, put a liner-to-block alignment mark on both parts to ensure correct liner position at installation.
- (14) If correct cylinder liner projection cannot be accomplished using the preceding procedure, adjustment will have to be done by machining the contact face of the cylinder block.
- (15) Remove liner projection tool puller crossbar (11), and adapter plate (10).
- (16) Remove cylinder liner (2), spacer plate (8) and gasket (9).



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 3-8. CYLINDER LINERS - REPLACE (Cont'd)
 

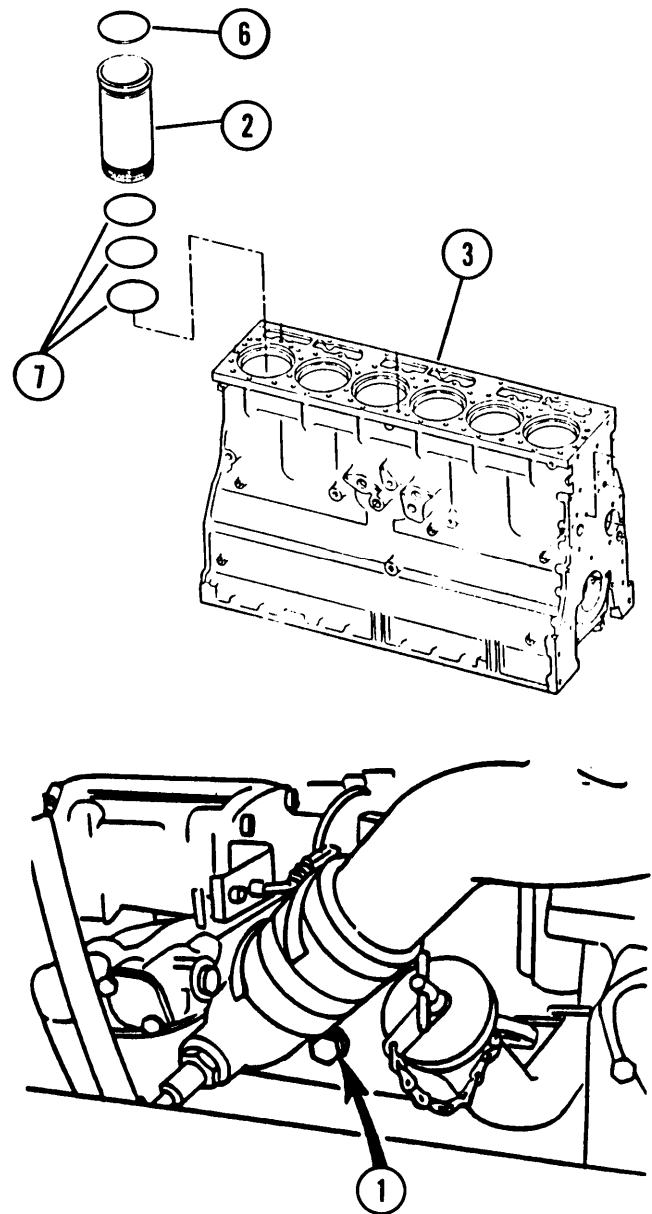
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## e. Installation

- (1) Put liquid soap on bottom liner bore in cylinder block (3), on grooves in lower liner, and on the preformed packing (7).
- (2) Put filler band (6) in clean OE/HDO-30 lubricating oil for a very brief time and install on liner (2).
- (3) Install cylinder liner (2) immediately in the block (3) before filler band expands. Be sure mark on liner is aligned with mark on the cylinder block.
- (4) Press cylinder liner (2) into block (3) with cylinder liner installation tool.
- (5) Perform STEPS 1 through 4 above for the remaining cylinder **liners.**
- (6) Install the cylinder block drain plug (1)
- (7) Install engine. See page 3-4.
- (8) Install pistons. See page 3-77.

## f. Place In Service

Run engine and check for proper operation





3-9. CYLINDER HEAD ASSEMBLY AND SPACER PLATE - REPLACE/REPAIR

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning
- d. Inspection
- e. Assembly
- f. Installation
- g. Place In Service

INITIAL SETUP

Applicable Configurations

ATT

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Shop Equipment, Machine Shop: Field Maintenance, Basic  
 NSN 3470-00-754-0708  
 Lifting Equipment  
 (Capacity 400 lbs. )

Special Tools

**Fan drive support**  
 bracket, 5P1762 (Required if engine is installed in vehicle)

Materials/Parts

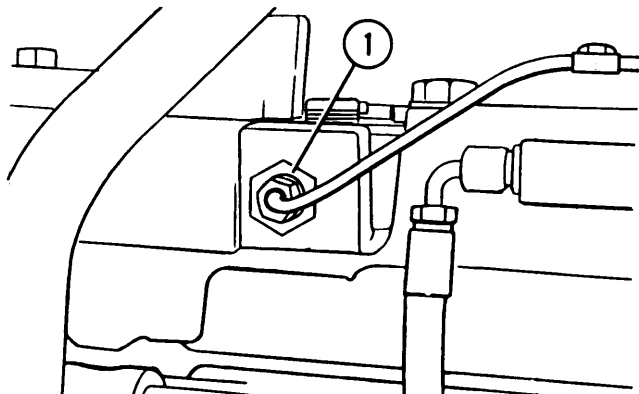
Gasket (6), (12) 3/4" -10NC  
 Forged Eyebolt  
 Seal (7), (8)  
 Cleaning Solvent (App. B, Item 18)  
 Preformed Packing (10), (11)  
 Anti-seize Compound (App. B, Item 2)  
 Lubricating Oil (Refer to L05-2410-237-121)  
 Fuel Oil (Refer to L05-2410-237-12)

Equipment Condition

Water temperature regulator removed. See TM5-2410-237-20.  
 Valve mechanism removed. See page 3-95.  
 Exhaust manifold removed. See page 3-122.  
 Fuel lines removed. See TM5-2410-237-20.  
 Water pump lines removed. See TM5-2410-237-20.

a. Removal

- (1) Use a wrench to remove clamp near water temperature sending unit (1).
- (2) Use a wrench to remove water temperature sending unit (1) from intake manifold.



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 3-9. CYLINDER HEAD ASSEMBLY AND SPACER PLATE - REPLACE/REPAIR (Cont'd)
 

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- (3) If engine is removed from vehicle, remove fan drive (TM5-2410-237-20).
- (4) If engine is installed in vehicle, remove fan drive support (TM5-2410-237-20) bracket and spacer.
- (5) Fasten lifting equipment to the fan drive.
- (6) Remove front engine lifting bracket.

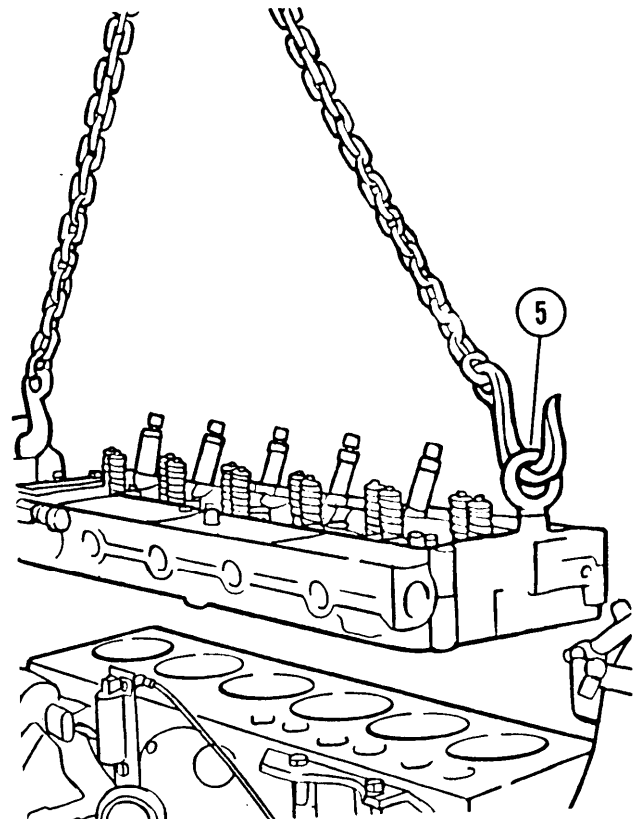
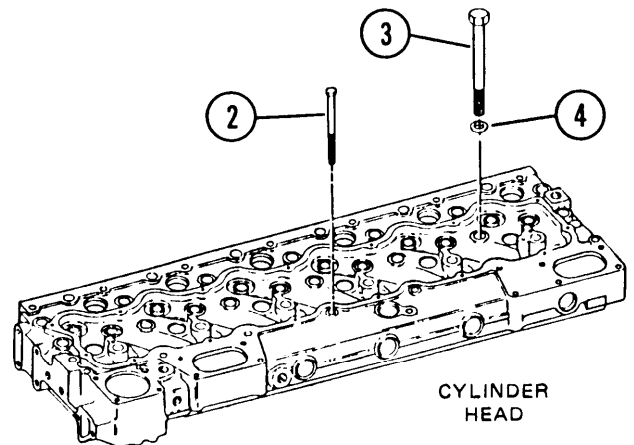
CAUTION

Make sure that fan does not damage the radiator when installing the fan drive support bracket.

- (7) Install fan drive support bracket (TM5-2410-237-20) to secure fan drive to engine. Remove lifting equipment.
- (8) Remove six capscrews (2), 20 capscrews (3) and washers (4) from cylinder head.
- (9) Install a 3/4" lifting eyebolt (5) at the rear of cylinder head. If engine is removed from vehicle, also install a 3/4" lifting eyebolt at front of cylinder head.
- (10) Attach lifting equipment to engine lifting plate or eyebolt at front of cylinder head and the lifting eyebolt at rear of cylinder head. The cylinder head weighs approximately 220 lbs.

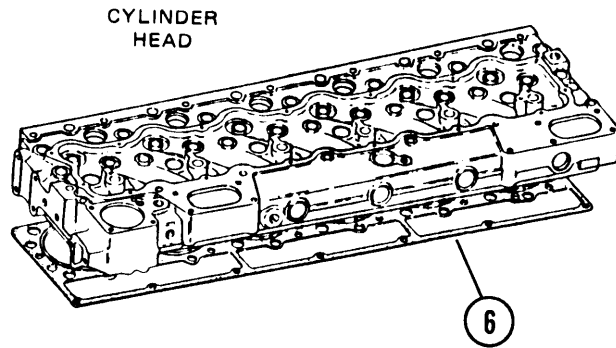
CAUTION

Do not lower the cylinder head onto a flat surface as this could damage the valves.

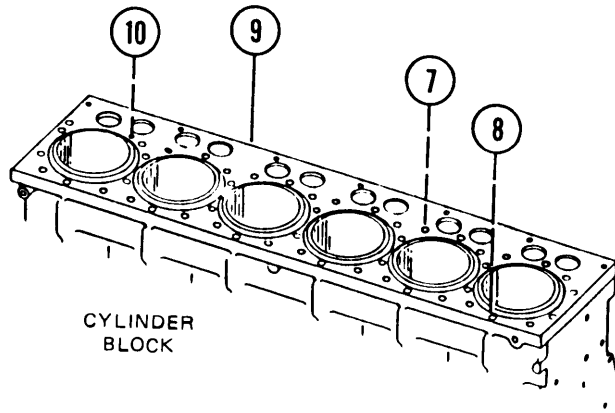


3-9. CYLINDER HEAD ASSEMBLY AND SPACER PLATE - REPLACE/REPAIR (Cont' d)

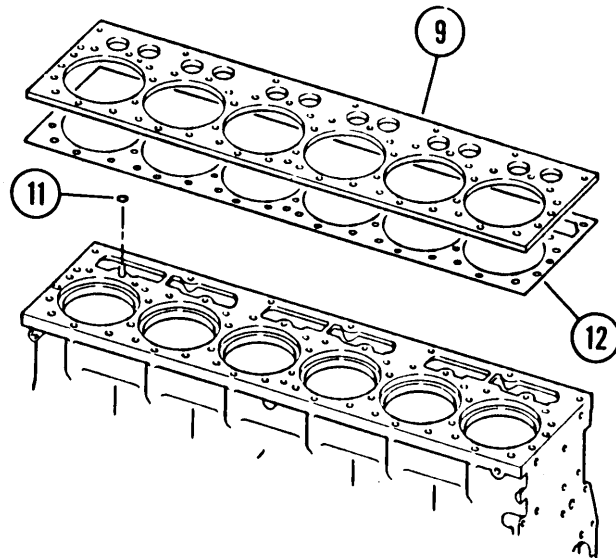
- (11) Slowly and carefully lift the cylinder head from the cylinder block, and place it on a suitable stand or platform which will support the bottom perimeter of the cylinder head.
- (12) Remove and discard cylinder head gasket (6).



- (13) Use a snap ring pliers to remove eighteen water seals (7) and six water seals (8) from spacer plate (9). Discard water seals.
- (14) Remove preformed packing (10) from dowel and discard.
- (15) Remove spacer plate (9) from cylinder block.



- (16) Remove and discard preformed packing (11) from hollow dowel in cylinder block.
- (17) Remove and discard spacer plate gasket (12) from cylinder block.



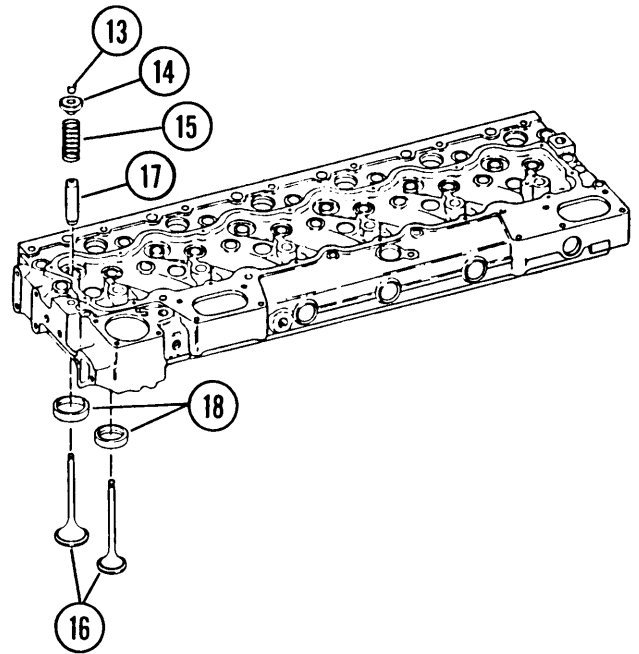
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 3-9. CYLINDER HEAD ASSEMBLY AND SPACER PLATE - REPLACE/REPAIR (Cont'd)
 

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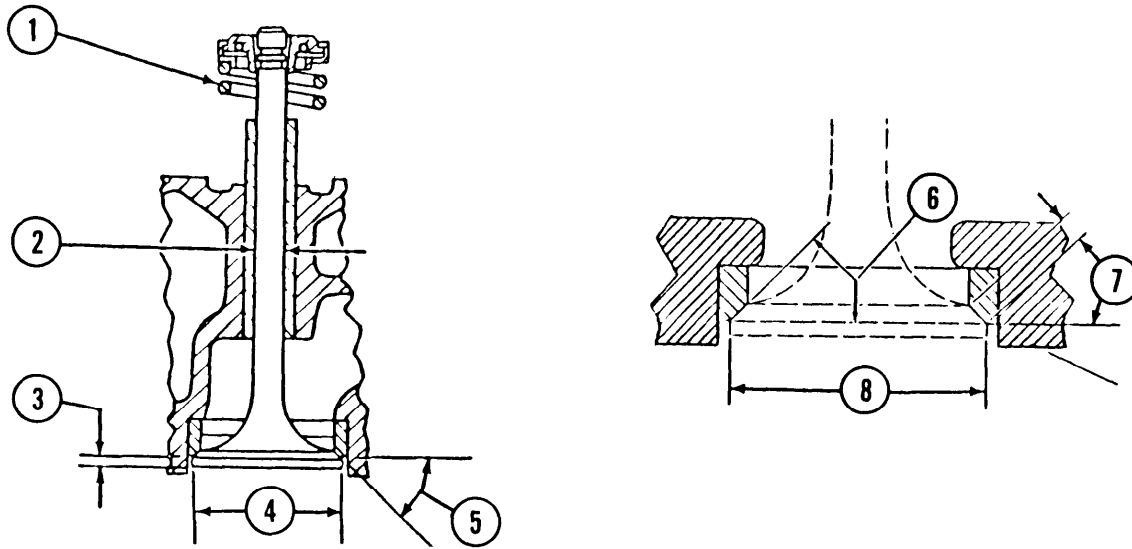
## b. Disassemble

- (1) Use a valve spring compressor to compress valve spring (15) and remove locks (13).
- (2) Remove the valve spring compressor, rotocoil (14), valve spring (15), and valve (16).
- (3) Inspect valves, valve springs, rotocoils, and locks as described in Section C, Cleaning, Inspection, and Repair.
- (4) Repeat STEPS 1 through 3 for all of the remaining valves.
- (5) Inspect valve guides (17) as described in Section C, Cleaning, Inspection, and Repair. Do not remove valve guide if there is no indication of visible damage or if measurements are within wear limits. If required, remove valve guide.
- (6) Inspect valve seat inserts (18) as described in Section C and D, Cleaning, Inspection, and Repair. If valve seat insert must be replaced, proceed as follows.
  - (a) Remove valve seat insert (18).
  - (b) Clean and remove burrs from the valve seat bore.
  - (c) Refer to Table 3-2 for all wear limits and specifications applicable to the valve seat insert. If measurements are not within the specified limits, send cylinder head to higher echelon maintenance for repair, or replace cylinder head.



3-9. CYLINDER HEAD ASSEMBLY AND SPACER PLATE - REPLACE/REPAIR (Cont'd)

Table 3-2. Valve Specifications



Ref. No.	Description	Specification
1	Valve spring:	
	Test force.....	58+6 lb.
	Length under test force.....	1.756 in.
	Free length after test.....	2.05 in.
	Outside diameter.....	1.386 in.
	Spring MUST not be bent more than.....	0.072 in.
	Valves:	
2	Stem diameter (minimum allowable).....	0.3704 in.
3	Lip thickness (minimum allowable):	
	Exhaust valve.....	0.106 in.
	Intake valve.....	0.106 in.
4	Diameter of valve head:	
	Exhaust valve.....	0.005 in.
	Intake valve.....	0.005 in.
5	Angle of valve face.....	29-1/4
	Valve seat insert:	
6	Angle of face.....	30°
7	Width, intake and exhaust:	
	Minimum.....	0.045 in.
	Maximum.....	0.076 in.
8	Face O.D.:	
	Exhaust seat.....	1.812 - 1.862 in.
	Intake seat.....	1.1940 - 1.990 in.

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 3-9. CYLINDER HEAD ASSEMBLY AND SPACER PLATE - REPLACE/REPAIR (Cont'd)
 

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## NOTE

Refer to page 2-29 for additional cleaning instructions and warnings.

c. Cleaning

- (1) Thoroughly clean cylinder head with an approved solvent or other approved method of carbon removal.
- (2) Thoroughly clean both surfaces of the spacer plate, using an approved cleaning method.
- (3) Clean carbon from the valve stems and wash the valve with fuel oil.
- (4) Clean valve springs with an approved solvent and dry thoroughly.

CAUTION

Be very careful when cleaning the rotocoil. Do not disassemble rotocoil as it can be easily damaged. Be sure to keep the solvent clean as foreign material entering the rotocoil will cause internal damage.

- (5) Use a clean, approved cleaning solvent to clean the rotocoils and locks, and dry them thoroughly.
  - (6) Clean the inside diameter of the valve guides with a brush and approved cleaning solvent. Remove all gum and carbon deposits.
- d. Inspection

- (1) Visually inspect the cylinder head and spacer plate for cracks, heat deterioration, or other damage. Replace a damaged cylinder head and/or spacer plate.

- (2) Check cylinder head for warpage using a straightedge and feeler gage. Replace a warped cylinder head.

- (3) Check cylinder head for cracks, using liquid dye and/or magnetic particle inspection methods. Replace a cracked cylinder head.

## NOTE

Carbon on the face of a valve indicates blow-by due to a faulty seat. Black carbon deposits, extending from the valve seats to the valve guides may result from cold operation due to light loads or the use of too light a grade of fuel. Rusty brown valve heads, with carbon deposits forming narrow collars near the valve guides, is evidence of high operating temperatures. High operating temperatures are normally due to overloads, inadequate cooling, or improper timing which results in carbonization of the lubricating oil.

- (4) Inspect the valves stems for scratches or scuff marks. Inspect the valve faces for ridges, cracks, or pitting. If any of these defects occur, replace the valve.
- (5) If valves can be used again, grind the valves and reinspect. Refer to Table for valve specifications. Replace valve if distortion is more than the dimensions, given in Table 3-2.

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### 3-9. CYLINDER HEAD ASSEMBLY AND SPACER PLATE - REPLACE/REPAIR (Cont' d)

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- (6) Visually inspect valve springs for nicks, deep scratches, rust deposits, notches at the end of the spring, and for wear between coils, on the spring sides, and on the end. Replace valve spring if any of these conditions exist.
- (7) Check spring force using a valve spring tester. See Table 3-2 for valve spring specifications and measurements.
- (8) Inspect rotocoil for deep grooves or notches. Also check that the inner part of the rotocoil turns smoothly. Replace rotocoil assembly if any damage or defect is noted.
- (9) Inspect locks for heavy wear, cracks, and/or gouges. Replace damaged locks.
- (10) Visually inspect valve guides for looseness and for any signs of damage. Replace a loose or damaged valve guide.
- (11) Measure both ends of each valve guide. If valve guide bore exceeds 0.3772 in., replace valve guide.
- (12) Visually inspect valve seat insert for any signs of excessive wear, burned condition, or other damage. Replace a damaged valve seat insert.
- (13) Refer to Table 3-2 and measure angle of face of valve seat insert, maximum permissible width of valve seat, and outside diameter of the face of the valve seat insert. If measurements are not within the limits specified, replace the valve seat insert.

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 3-9. CYLINDER HEAD ASSEMBLY AND SPACER PLATE - REPLACE/REPAIR (Cont' d)
 

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e. Assembly

- (1) Install new valve seat insert as follows:
- (a) Temporarily shrink the size of the insert by cooling to ease installation.
  - (b) Install valve seat insert (18) to the bottom of the counterbore.

CAUTION

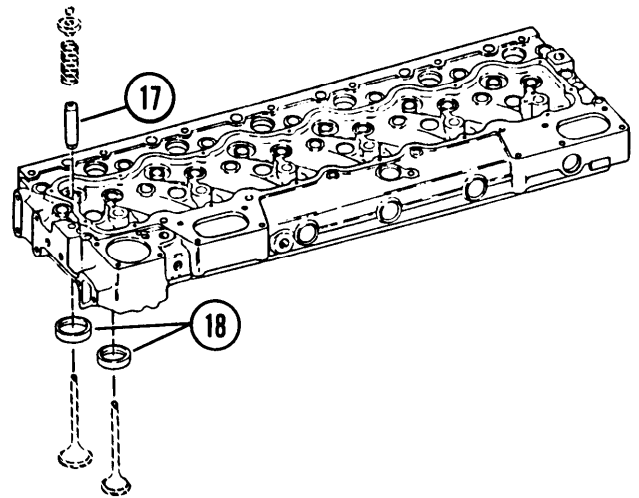
Do not increase diameter of extractor in valve seat insert when the insert is installed in the cylinder head. Damage to insert may occur.

NOTE

If necessary, temporarily shrink the size of the valve guide by cooling to ease installation.

- (2) Put clean lubricating oil on the outside diameter of the new valve guide (17). Install valve guide into the cylinder head to the dimension specified in Table 3-9.

The inside diameter of the valve guides, at room temperature after installation, must be  $0.373 \pm 0.0010$  in.





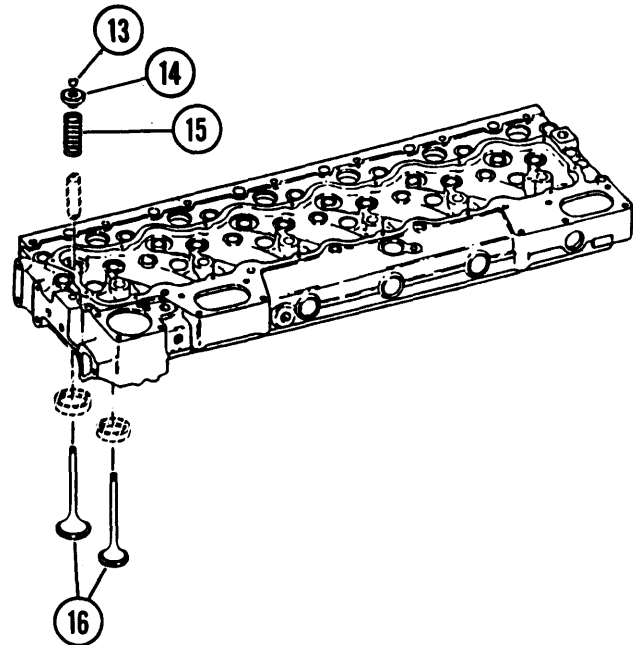
3-9. CYLINDER HEAD ASSEMBLY AND SPACER PLATE - REPLACE/REPAIR (Cont' d)

- (3) Put clean lubricating oil on the valve stem.
- (4) Install valve (16), spring (15), and rotocoil (14) in the cylinder head.

**WARNING**

If the lock is not correctly installed on the valve stem, it will unseat and be thrown with force when the spring compressor is released. The thrown lock could cause serious personal injury.

- (5) Compress the valve spring (15) and correctly install the locks (13).
- (6) Slowly release the valve spring compressor and remove it from the valve.
- (7) Lightly tap the top of the valve with a soft head hammer to be sure the locks (13) are installed correctly.
- (8) Perform STEPS 3 through 7 for the remainder of the valves.



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 3-9. CYLINDER HEAD ASSEMBLY AND SPACER PLATE - REPLACE/REPAIR (Cont'd)
 

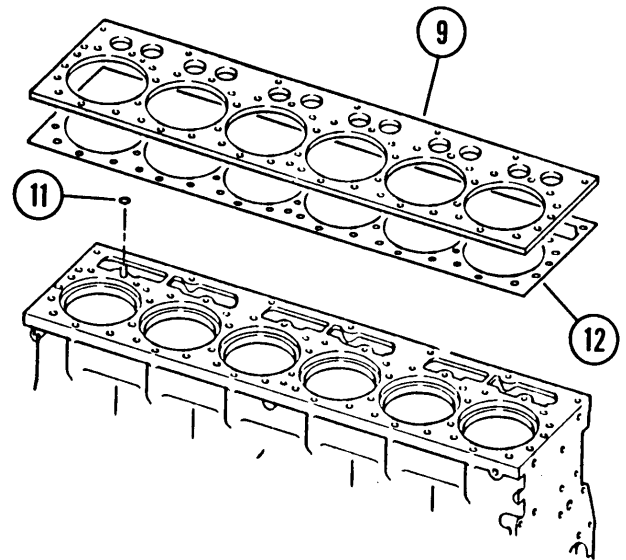
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## f. Installation

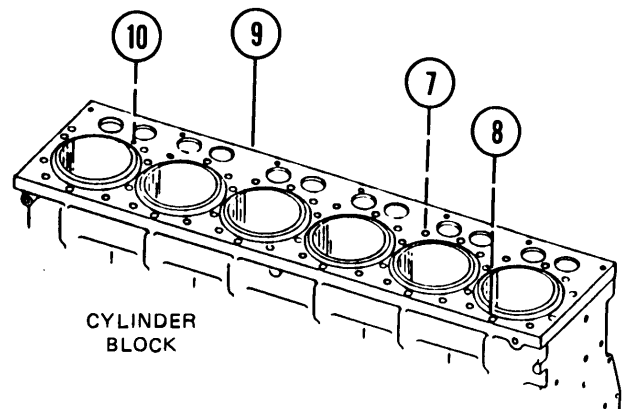
CAUTION

Both surfaces of the spacer plate, both sides of the spacer plate gasket, bottom surface of the cylinder head, and top of cylinder block MUST be clean and dry. Do not use hard gasket scrapers or files to remove gasket material, grease or other particles from the cylinder head, block, or spacer plate surfaces. These tools could cause nicks or scratches which, in turn, could cause leaks or incorrect seat between the cylinder head and spacer plate, and/or block and spacer plate.

- (1) Install new spacer plate gasket (12) on the cylinder block.
- (2) Install new packing (11) on the hollow dowel in the cylinder block.
- (3) Install spacer plate (9) on the cylinder block.
- (4) Check cylinder liner projection. Refer to page 3-24.

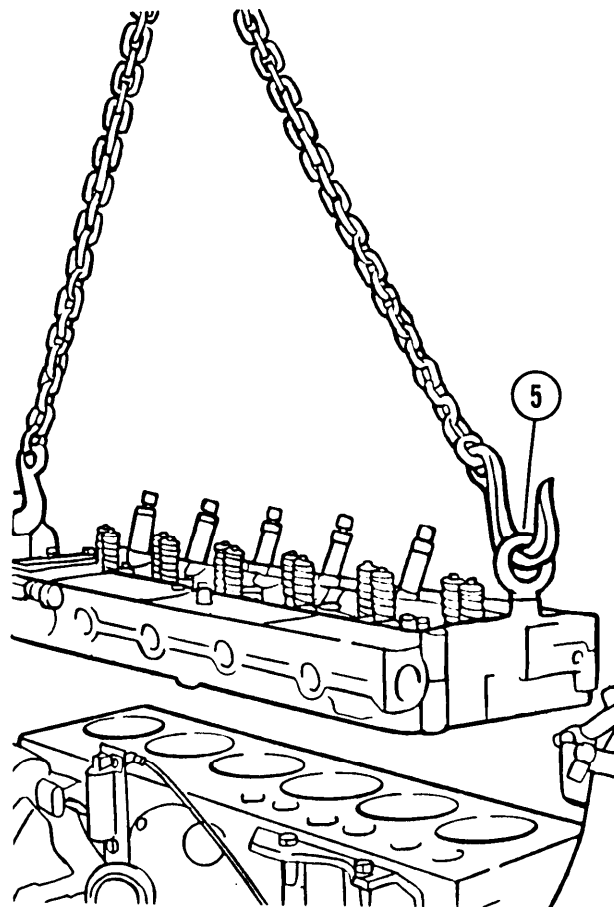
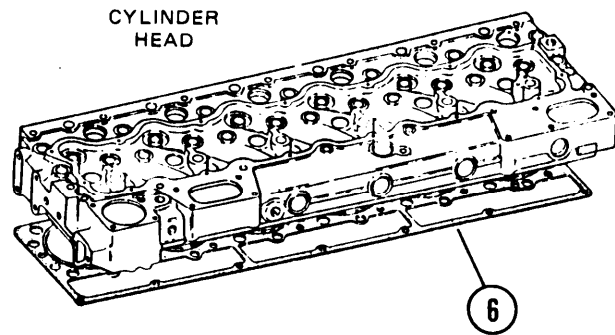


- (5) Install new packing (10) over dowel on spacer plate (9).
- (6) Install six new water seals (8) and 18 new water seals (7) in spacer plate (9).



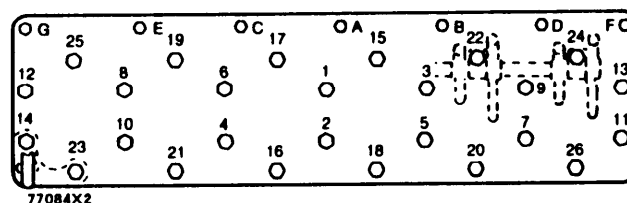
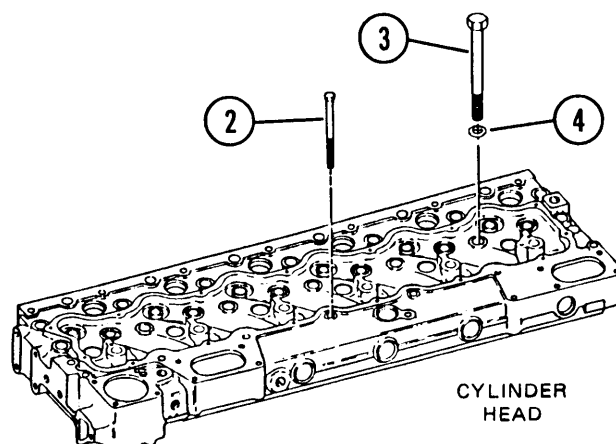
3-9. CYLINDER HEAD ASSEMBLY AND SPACER PLATE - REPLACE/REPAIR (Cont'd)

- (7) Install new cylinder head gasket (6) on spacer plate.
- (8) Install 3/4" eyebolt (5) at rear of cylinder head. If engine is removed from vehicle, also install a 3/4" eyebolt at front of cylinder head.
- (9) Attach lifting equipment, capable of lifting 300 lbs., to the eyebolt and engine front lifting plate or eyebolt.
- (10) Carefully place the cylinder head in the correct position on the cylinder block.
- (11) Remove lifting device and eyebolt(s).
- (12) If engine is installed in vehicle:
  - (a) Support the fan drive with lifting equipment.
  - (b) Remove the fan drive support bracket (TM5-2410-237-20).
  - (c) Install the front engine lifting bracket.
  - (d) Install the fan drive support bracket (TM5-2410-237-20) and spacer.
- (13) Install valve mechanism, but do not torque tighten capscrews at this time. Refer to page 3-95.
- (14) Put anti-seize compound on the threads of the cylinder head capscrews.



## 3-9. CYLINDER HEAD ASSEMBLY AND SPACER PLATE - REPLACE/REPAIR (Cont'd)

- (15) Install 20 capscrews (3) and washers (4), and six capscrews (2).
- (16) Tighten capscrews (2 and 3) in the following sequences:
- Tighten all capscrews in number sequence with a wrench. Tighten to 115 lb. ft. torque.
  - Tighten all capscrews in number sequence to  $185 \pm 13$  lb. ft. torque.
  - Again tighten all capscrews in number sequence to  $185 \pm 13$  lb. ft. torque.
  - Tighten all capscrews in letter sequence with a wrench. Tighten to 22 lb. ft. torque.
  - Tighten all capscrews in letter sequence to  $32 \pm 5$  lb. ft. torque.
  - Again hand tighten all capscrews in letter sequence to  $32 \pm 5$  lb. ft. torque.



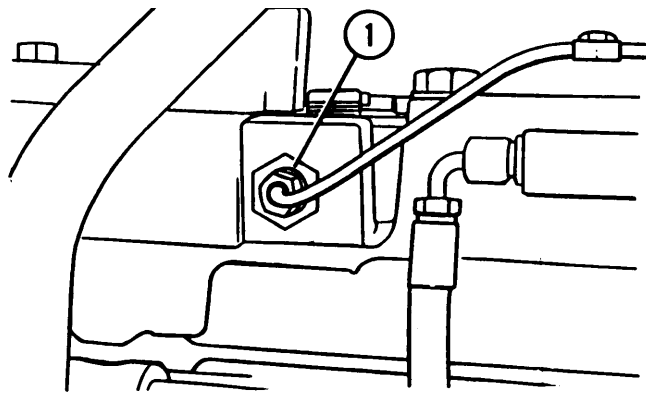
- (17) Adjust valves. Refer to TM5-2410-237-20.
- (18) Install valve mechanism cover. Refer to TM5-2410-237-20.
- (19) Install water pump lines. Refer to TM5-2410-237-20.
- (20) Install exhaust manifold. Refer to page 3-122.

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3-9. CYLINDER HEAD ASSEMBLY AND SPACER PLATE - REPLACE/REPAIR (Cont' d)

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- (21) Install water temperature sending unit (1) into cylinder head and tighten with a wrench. Be careful not to overtighten.
- (22) Attach water temperature sending unit tube to cylinder head with clamp and capscrew. Use a wrench to tighten capscrew.
- (23) If engine is not installed in the vehicle, install fan drive. Refer to TM5-2410-237-20.
- (24) Install fuel lines. Refer to TM5-2410-237-20.
- (25) Install water temperature regulator. Refer to TM5-2410-237-20.



g. place In Service

Run engine and check for proper operation.

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### 3-10. CRANKSHAFT ASSEMBLY - REPAIR/REPLACE

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This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning
- d. Inspection
- e. Assembly
- f. Installation
- g. Place In Service

---

#### INITIAL SETUP

##### Applicable Configuration

All

##### Common Tools

Shop Equipment, General Purpose  
Repair; Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Shop Equipment, Machine Shop:  
Field Maintenance, Basic  
NSN 3470-00-754-0708  
Nylon Straps

##### Materials/Parts

Oil, Lubricating, OE/HDO-30 (See  
L05-2410-237-12)  
Quick Cure Primer (App. B, Item 9b)  
Loctite 262 (App. B, Item 13)  
Seal (13), (18)  
Wear sleeve (14)  
Cleaning Solvent (App. B, Item 19)

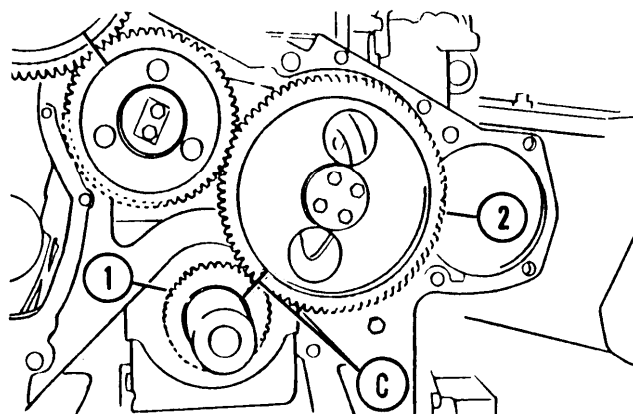
##### Equipment Condition

Flywheel housing removed. See  
page 3-73.  
Front housing covers removed.  
See page 3-89. Do not remove  
timing gears.  
Pistons removed. See page 3-77.

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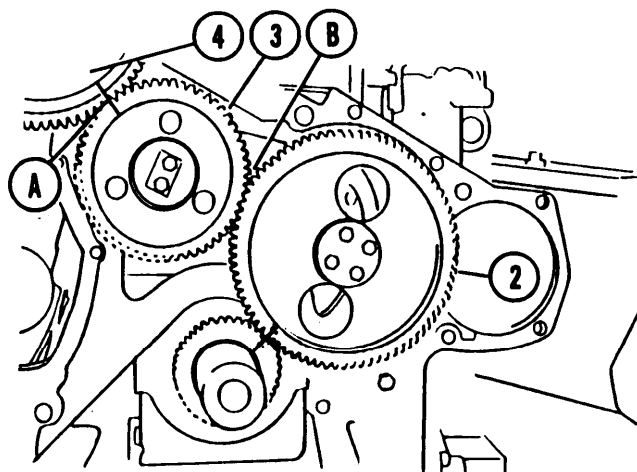
#### a. Removal

- (1) Turn the crankshaft until the timing mark "C" on the crankshaft gear (1) is aligned with timing mark "C" on the camshaft gear (2).



3-10. CRANKSHAFT ASSEMBLY - REPAIR/REPLACE (Cont'd)

- (2) Make a mark on the teeth of the fuel pump idler gear (3) and the fuel pump drive gear (4), in their engaged location, at location "A". Make a mark on the engaged teeth of the fuel pump idler gear and the camshaft gear (2) at location "B". This will help in the correct timing of the camshaft, for the fuel injection pump, during crankshaft installation.



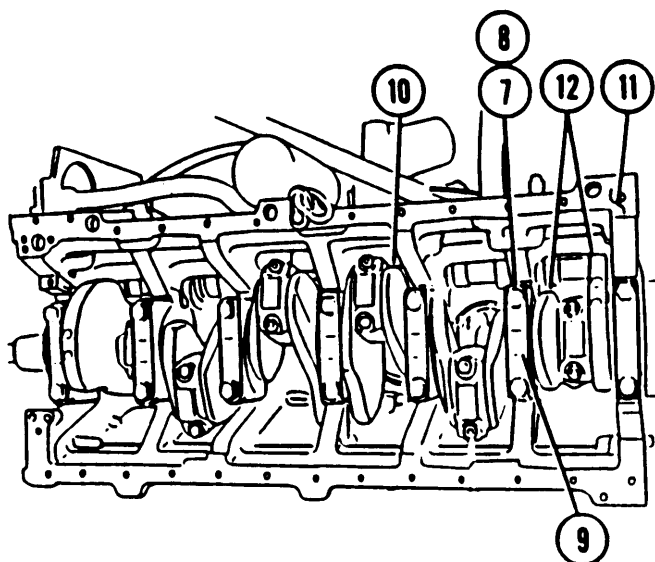
WARNING

Be certain that the crankshaft is secured properly to a floor jack before removal of the last two bearing caps. Failure to follow these instructions could cause personal injury.

CAUTION

It is recommended that nylon straps, or equivalent, be used to secure the crankshaft on floor jack to prevent damage to the machined surfaces of the crankshaft. Be sure that nothing metallic comes in contact with the machined surfaces.

- (3) Use a wrench to remove fourteen capscrews (7) and fourteen washers (8), then remove seven bearing caps (9) from crankshaft (10) in cylinder block (11).
- (4) Remove two thrust plates (12) from the No. 7 main bearing.
- (5) Use a floor jack to lower crankshaft (10) from the cylinder block (11) and place it in a clean work area.
- (6) Remove the main bearings. See page 3-51.



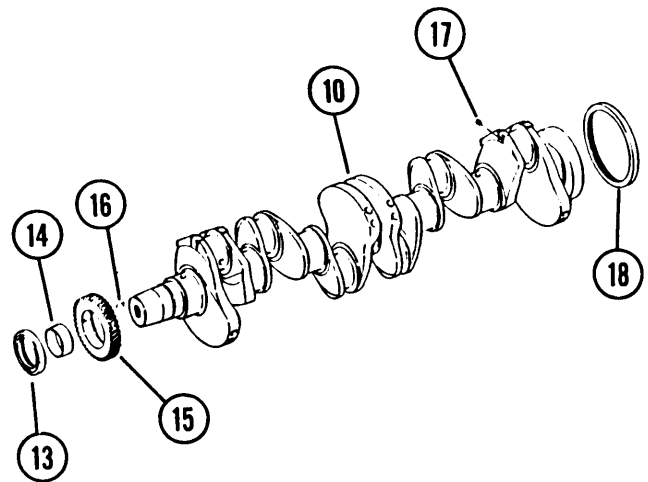
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 3-10. CRANKSHAFT ASSEMBLY - REPAIR/REPLACE (Cont'd)
 

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b. Disassembly

- (1) Remove and discard front seal (13) and wear sleeve (14) from crankshaft (10).
- (2) Use a suitable gear puller to remove the crankshaft gear (15) from the crankshaft (10). Remove key (16) from shaft. DO NOT REMOVE any of the six plugs (17) at this time.
- (3) Remove and discard rear seal and wear sleeve (18) as a unit from the crankshaft (10).

c. Cleaning


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 WARNING
 

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Compressed air used for cleaning purposes will not exceed 30 psi. Use only with effective chip guarding and personal protective equipment.

- (1) Clean the outside of the crankshaft with an approved cleaning solvent (See page 2-29) and dry thoroughly with low pressure air (30 psi or less).

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 CAUTION
 

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If the crankshaft is not to be inspected immediately (less than one hour after it is cleaned), lubricating oil must be put on the bearing journals to prevent corrosion.

- (2) Put lubricating oil on the bearing journals if crankshaft is not going to be inspected within one hour after cleaning.



3-10. CRANKSHAFT ASSEMBLY - REPAIR/REPLACE (Cont'd)

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d. Inspection

- (1) Visually inspect crankshaft for:
  - (a) Large, deep cracks or broken material throughout the crankshaft, especially in the fillet and journal areas.
  - (b) A high concentration of depressions or pitting.
  - (c) Burning or scoring in the journal areas.
  - (d) Cracks in the oil holes.
  - (e) Damage to the tapered end of shaft, keyway, and gear that cannot be corrected by simple filing or polishing.
  - (f) If any of the above conditions (a through e) exist, replace the crankshaft.
- (2) See page 2-32 for general Inspection Instructions.

e. Assembly

- (1) Apply lubricating oil on the rear seal lip (18).
- (2) Clean the crankshaft flange and inside diameter of the wear sleeve (18) with quick cure primer.
- (3) Apply Loctite 262 on the crankshaft flange and on the inside diameter of the wear sleeve (18).

CAUTION

Do not separate rear seal and wear sleeve. If this assembly is separated, it will not function.

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 3-10. CRANKSHAFT ASSEMBLY - REPAIR/REPLACE (Cont' d)
 

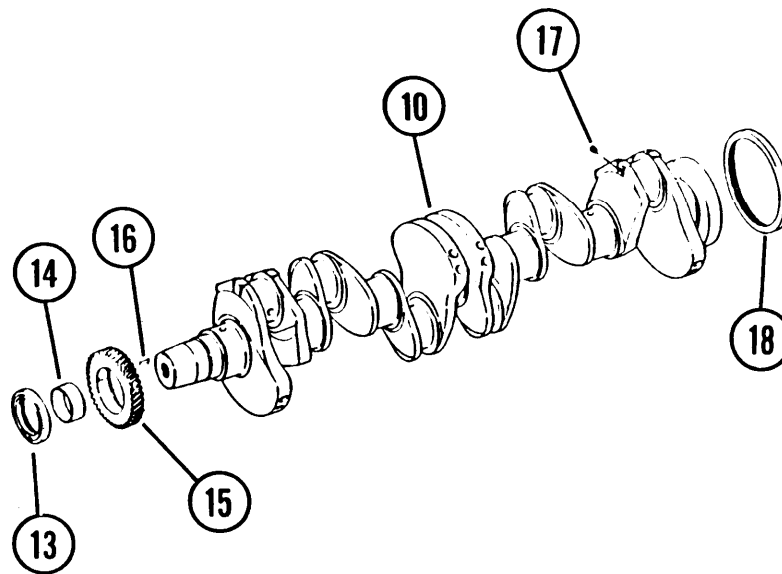
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- (4) Install new rear seal and wear sleeve (18) as a unit on the crankshaft (10).

WARNING

Hot oil or metal parts can cause severe burns. Wear insulated gloves, long sleeves, and eye protection when working with heated parts.

- (5) Raise the temperature of the crankshaft gear (15) 600°F maximum. Install key (16) and gear on the crankshaft (10).
- (6) Apply clean lubricating oil on the seal lip of a new front seal (13) and on the outside diameter of a new wear sleeve (14).
- (7) Install a front seal (13) on wear sleeve (14) with the lip of the seal toward the side of the wear sleeve that has chamfer on the inside diameter.
- (8) Clean the inside diameter of the wear sleeve (14) and the tapered surface of the crankshaft (10) with quick cure primer.
- (9) Apply Loctite 262 to the inside diameter of the wear sleeve (14) and its contact surface on the crankshaft (10).
- (10) Install the wear sleeve (14) and front seal (13), as a unit, onto the crankshaft (10), with the lip of the seal toward the engine.



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### 3-10. CRANKSHAFT ASSEMBLY - REPAIR/REPLACE (Cont'd)

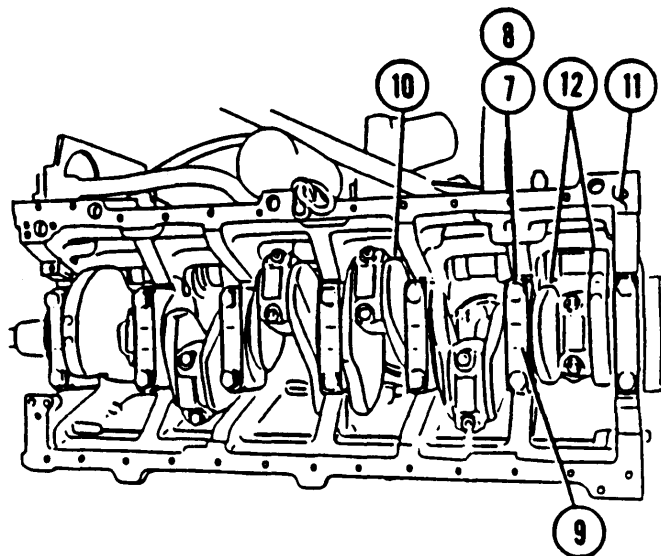
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#### f. Installation

#### **WARNING**

Compressed air used for cleaning purposes will not exceed 30 psi. Use only with effective chip guarding and personal protective equipment.

- (1) Clean main bearing surfaces in the cylinder block (11) and the bearing caps (9) with an approved cleaning solvent (See page 2-29). Dry surfaces thoroughly with low pressure air (30 psi or less).
- (2) If a new or altered crankshaft (10) is installed, new main bearings must be installed. If crankshaft was ground to a smaller size, the correct new smaller size bearings must be used. If a crankshaft journal was polished, new bearings must be installed for that journal. If all journals were polished, install all new bearings. See page 3-51.



#### **CAUTION**

It is recommended that nylon straps, or equivalent, be used to secure the crankshaft on the floor jack to prevent damage to the machined surfaces of the crankshaft. Be sure that nothing metallic comes in contact with the machined surfaces.

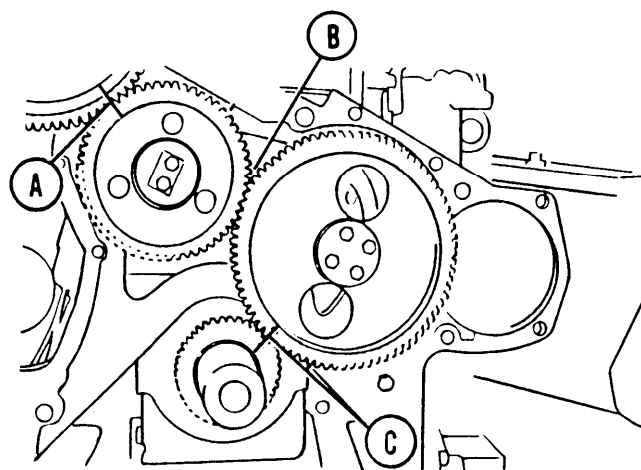
- (3) Raise the floor jack to install the crankshaft (10) into correct location in cylinder block (11). Check that timing marks (A, B, and C) are aligned as shown. Position the crankshaft main bearing journals firmly against the upper main bearing halves.

## 3-10. CRANKSHAFT ASSEMBLY - REPAIR/REPLACE (Cont'd)

**NOTE**

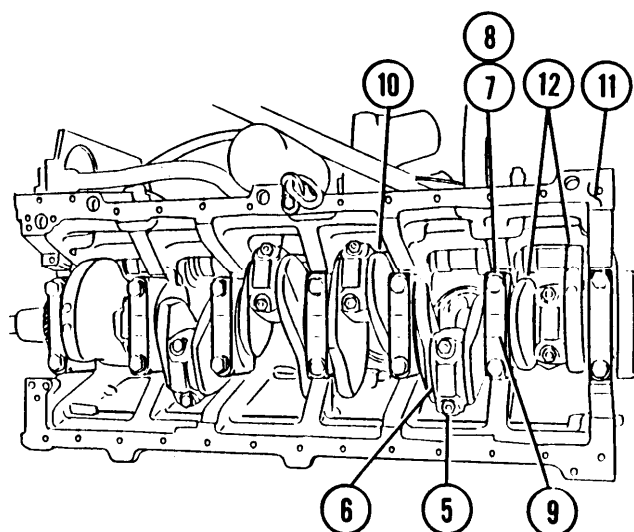
Install bearing caps (9) with the part number toward the front of the engine. Be sure that the mark (number) on the bearing cap corresponds with the mark in the cylinder block.

- (4) Place main bearing caps (9) in position. Put clean lubricating oil on the threads of capscrews (7) and on the face of washers (8). Use a wrench to install capscrews and washers. Tighten capscrews to a torque of 27 to 33 lb. ft. Do not remove floor jack from crankshaft at this time.

**CAUTION**

Do not use an impact wrench to tighten main bearing cap capscrews the additional 90 degrees.

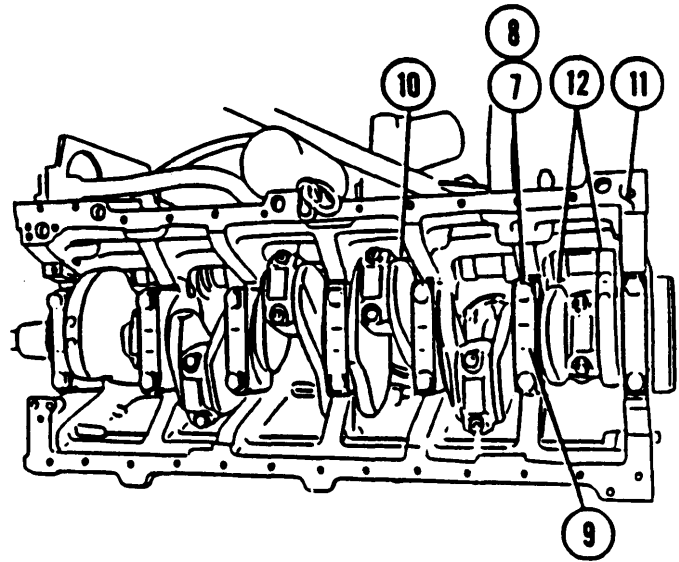
- (5) Put a mark on each bearing cap (9) and capscrew (7). Tighten capscrews 90 degrees more.
- (6) Use a wrench to remove all of the capscrews (7) and washers (8), then remove bearing caps (9).
- (7) Put clean lubricating oil on thrust plates (12). Install thrust plates for the No. 7 bearing, with the words "BLOCK SIDE" toward the cylinder block (11). The thrust plates have tabs which must be inserted into the machined area in the block. The tabs prevent incorrect installation.
- (8) Perform STEPS 4 and 5 above.



3-10. CRANKSHAFT ASSEMBLY - REPAIR/REPLACE (Cont'd)

CAUTION

When the connecting rod caps are installed, make sure the number on the side of the cap is next to, and respective with, the number on the side of the connecting rod.



(9) Check crankshaft end play with a dial indicator. End play is controlled by the thrust plates on the No. 7 main bearing.

(a) End play with new thrust plates is 0.0025 to 0.0145 inches.

(b) Maximum permissible end play with used thrust plates is 0.025 inches.

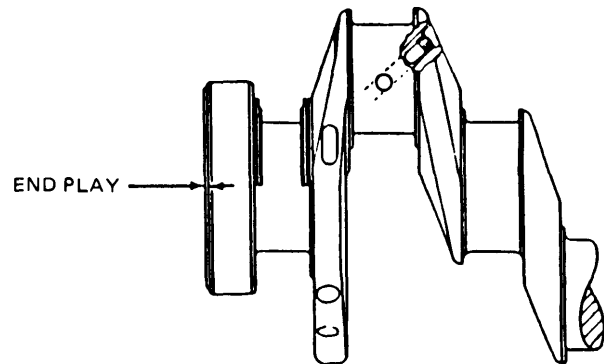
(10) Install front housing covers. See page 3-89.

(11) Install flywheel housing. See page 3-73.

(12) Install pistons. See page 3-77.

g. Place In Service

Run engine and check for proper crankshaft operation.



3-11. CRANKSHAFT BEARINGS - REPLACE

This task covers:

- a. Removal
- b. Cleaning
- c. Inspection
- d. Installation
- e. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted NSN 4940-00-287-4894  
 Shop Equipment, Machine Shop: Field Maintenance, Basic NSN 3470-00-754-0708  
 Bearing Removal/Installation Tool NSN 5120-01-124-1906

Materials

Plastigage  
 Lubricating Oil OE/HDO-30 (Refer to L05-2410-237-12)  
 Cleaning Solvent (App. B, Item 18)  
 Lint-free Rags

Equipment Condition

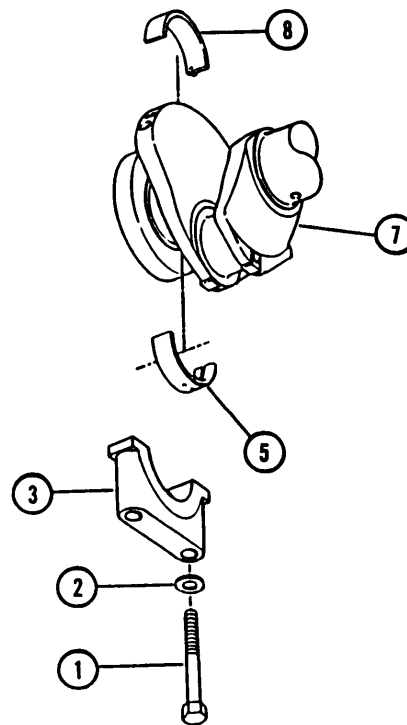
Engine oil-pan plate removed. See page 3-119.  
 Engine oil pump removed. See page 3-111.

a. Removal

NOTE

Identify main bearings with the same number that is on the bearing cap. When used bearings are reinstalled, each bearing must be installed in its original location because the bearing surfaces have worn to the crankshaft journals.

- (1) Use a wrench to remove capscrews (1) and washers (2). Remove bearing caps (3) from cylinder block (4) for main bearings 1, 3, 5, and 7 ONLY. DO NOT REMOVE BEARING CAPS FROM POSITIONS 2, 4, AND 6 MAIN BEARINGS AT THIS TIME. Remove lower half of main bearings (5) from bearing caps (3).



3-11. CRANKSHAFT BEARINGS - REPLACE (Cont' d)

- (2) Remove two thrust plates (6) from No. 7 main bearing.

CAUTION

If the crankshaft is turned in the wrong direction, the tab on the upper half of the bearing will be pushed between the crankshaft and bearing area in the block. This could cause damage to the block and the crankshaft.

- (3) Slowly turn crankshaft in the correct direction until the bearing journal oil holes are accessible to insert bearing removal tool. Insert bearing removal tool through the oil hole in the bearing journal. Slowly turn the crankshaft (7) until upper bearing half (8) is out of the cylinder block.

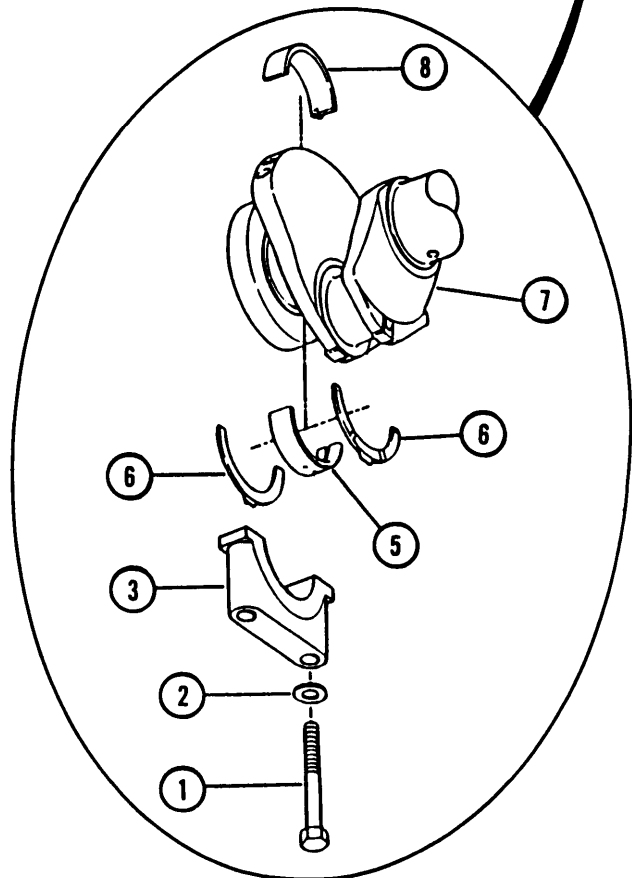
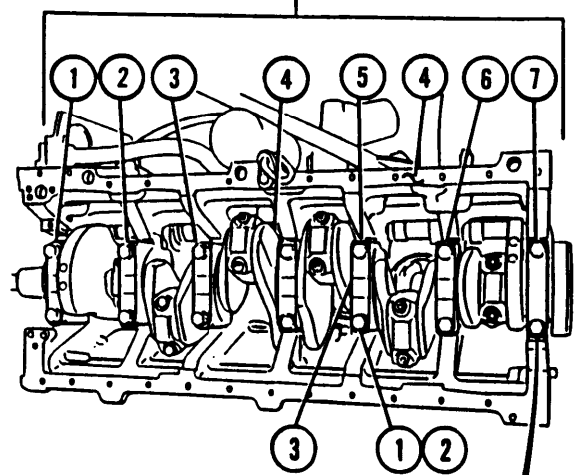
b. Cleaning

CAUTION

Never use any type of rough material or tools such as sandpaper, emery or crocus cloth, files, or glassbead cleaning equipment to clean bearings.

Clean removed parts with an approved cleaning solvent and dry thoroughly with lint-free wiping rags (See page 2-29). If bearings, bearing caps, and thrust plates are not to be installed within one hour after cleaning, apply a thin film of lubricating oil over them.

MAIN BEARING POSITIONS



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### 3-11. CRANKSHAFT BEARINGS - REPLACE (Cont'd)

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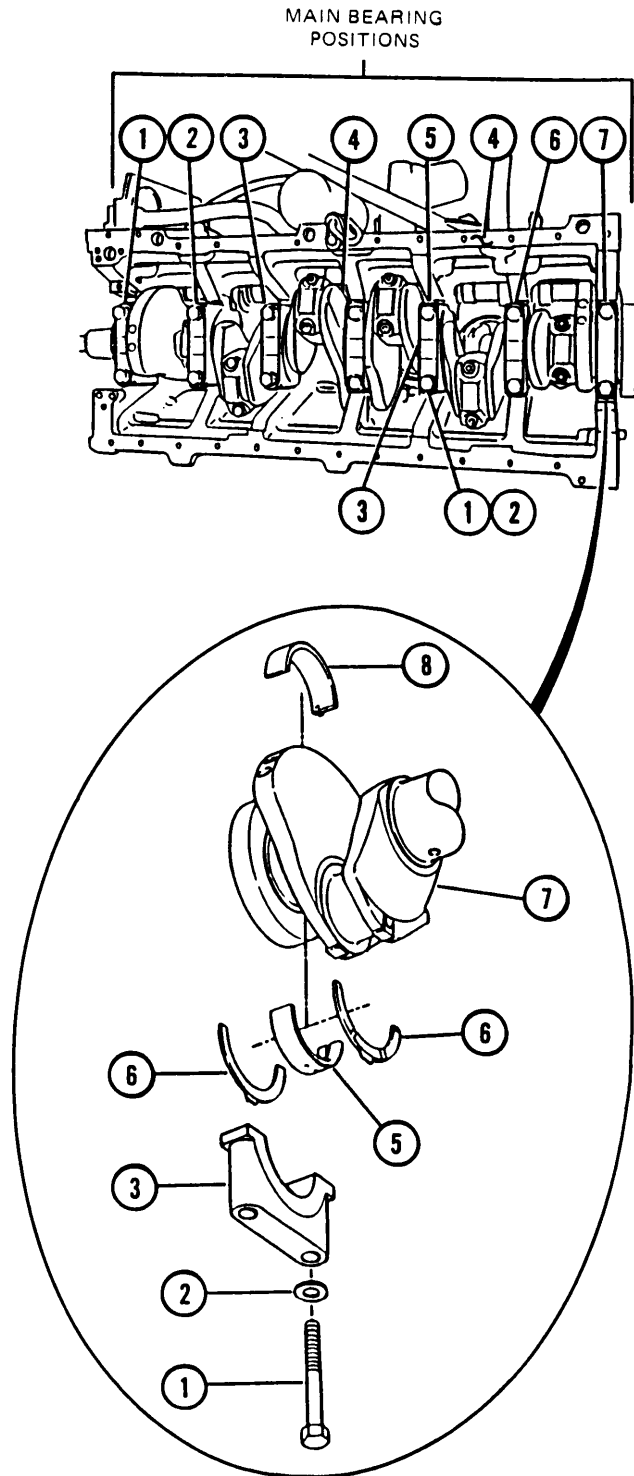
#### c. Inspection

- (1) Inspect bearings for signs of excessive wear and other damage. Replace bearing if:
  - back of bearing shows that fretting has taken place.
  - back of bearing has a mirror-like (shiny) finish. This condition is caused by a loose fit of the bearing in the bore.
  - it has scratches in the bearing surface which do not disappear after cleaning.
  - bearing surface has material damage such as cracks or flaking.
  - there is a hole in the bearing surface.
  - bearing shows wear on the mating face.
  - bearing oil hole is distorted.
  - there are hot spots in bearing surface.
  - bearing has damage to the tab.
- (2) Inspect thrust plates for flange and bearing surface material damage. Replace damaged thrust plates.
- (3) Check thickness of thrust plates. If thickness is less than  $0.2150 \pm 0.0015$  inches, replace both thrust plates.



3-11. CRANKSHAFT BEARINGS - REPLACE (Cont'd)

- (4) Inspect main bearing bores in the block for cracks, chips, distortion, thread damage, or other damage. Replace a damaged block.
- (5) Inspect main bearing caps for cracks, chipping or fretting mating surfaces, and distortion around the threaded bores. Replace bearing cap if any of these conditions exist.
- (6) Install bearing caps (3), without lower bearing halves, and capscrews (1). Use a wrench to tighten capscrews to a torque of 27 to 33 lb. ft., and take measurements as shown in Table 3-3. If any of the measurements are not as shown in Table 3-3, replace the bearing cap. If bearing cap replacement does not alleviate the problem, see page 3-44 for repair of crankshaft assembly. Remove capscrews and bearing caps.
- (7) Inspect crankshaft and measure crankshaft main bearing journals. See page 3-47 for crankshaft inspection instructions.
- (8) See page 3-32 for general Inspection Instructions.



3-11. CRANKSHAFT BEARINGS - REPLACE (Cont'd)

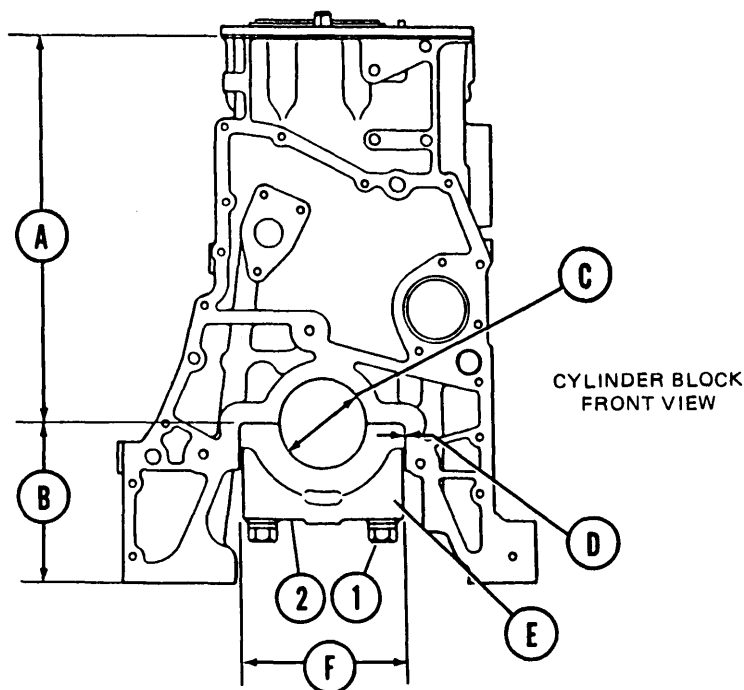


Table 3-3. Main Bearing Dimension Data

Reference	Location	Dimension
A	Dimension from center of main bearing bore to top of cylinder block (new) . . . . .	15.099±0.006 in.
B	Dimension from center of main bearing bore to bottom of cylinder block (new) . . . . .	6.063±0.004 in.
C	Bore in block for main bearings (standard size) . . . . .	3.8160±0.0005 in.
C	Bore in block for main bearings. Oversize . . . . .	0.020 in. 3.8360±0.005 in.
D	Clearance between main bearing cap and cylinder block . . . . .	0.0013 in.
E	Main bearing cap width . . . . .	6.4998±0.0008 in.
F	Width of cylinder block for main bearing cap . . . . .	6.500±0.0007 in.

3-11. CRANKSHAFT BEARINGS - REPLACE (Cont'd)

d. Installation

- (1) If main bearings were coated with lubricating oil subsequent to bearing cleaning, remove oil with a clean lint free rag.

WARNING

Compressed air used for cleaning purposes will not exceed 30 psi. Use only with effective chip guarding and personal protective equipment.

- (2) Clean main bearing surfaces in the cylinder block with an approved cleaning solvent (See page 2-29). Dry surfaces thoroughly with low pressure air (30 psi or less).
- (3) If a new crankshaft is being installed, new main bearings must be installed. If crankshaft was ground to a smaller size, the correct new smaller size bearings must be used. If a crankshaft journal was polished, new bearings must be installed for that journal. If all journals were polished, install all new bearings.

NOTE

Install upper bearing halves dry for the following clearance checks. Be sure cylinder block bearing bores and backsides of upper bearings are clean and dry.

- (4) Position upper bearing half (8) over the crankshaft journal such that the bearing tab will fit into the notch in cylinder block.

- (5) Insert bearing installation tool into the bearing journal oil hole until it engages the upper bearing hole.

CAUTION

If the crankshaft is turned in the wrong direction, the tab on the upper half of the bearing will be pushed between the crankshaft and bearing area in the block. This could cause damage to the block and the crankshaft.

- (6) Slowly turn the crankshaft in the correct direction until upper bearing tab is in the notch in cylinder block. Remove bearing installation tool.
- (7) Put clean lubricating oil on the thrust plates and install two thrust plates (6), for the No. 7 bearing, with the words "BLOCK SIDE" toward the cylinder block. The thrust plates have tabs which must be inserted into the machined area in the block. The tabs prevent incorrect installation.

NOTE

Install bearing halves dry for the following clearance checks. Clean lubricating oil will be applied later at final assembly.

- (8) Place lower half of main bearing (5) in the bearing cap (3). Tab on bearing must be in the notch in bearing cap.

3-11. CRANKSHAFT BEARINGS - REPLACE (Cont' d)

NOTE

Do not turn the crankshaft when the plastigage is installed for clearance checks.

- (9) Place a piece of plastigage on the surface of the lower half of main bearing (5).

NOTE

Install bearing caps with the part number towards the front of the engine. Be sure that the mark (number) on the bearing cap corresponds with the mark in the cylinder block.

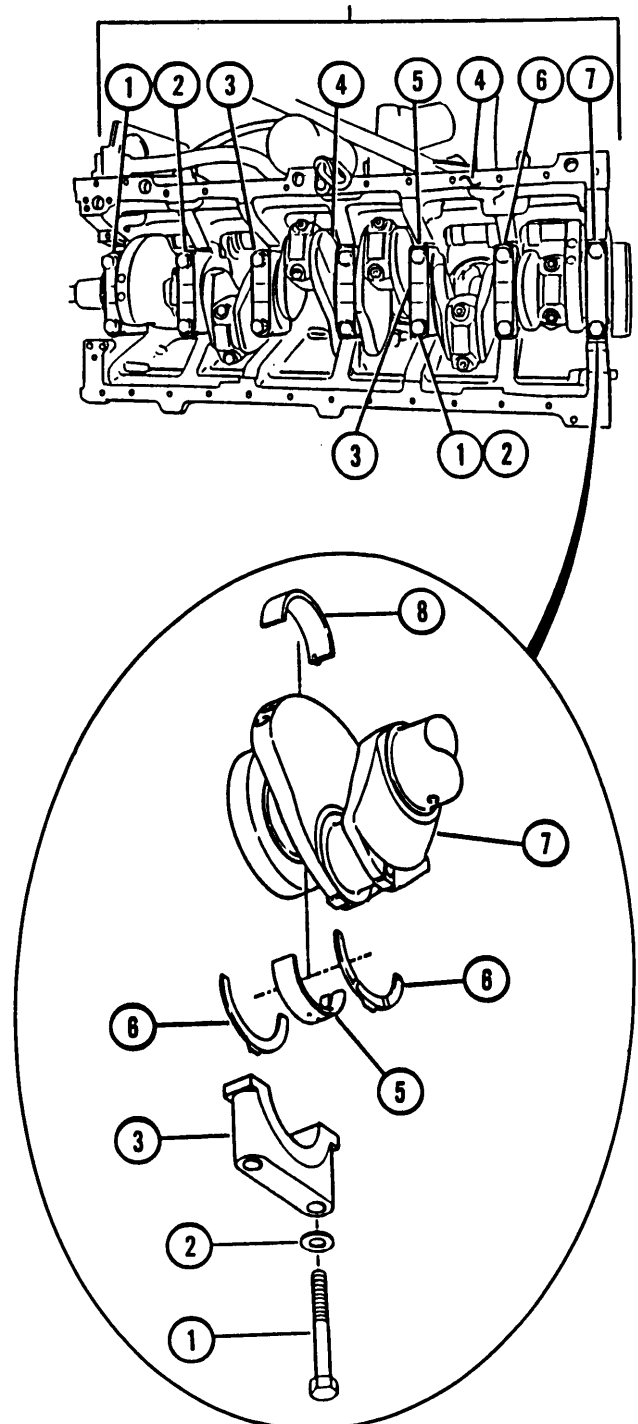
- (10) Place main bearing cap (3) in position in the cylinder block (4). Put clean lubricating oil on the threads of capscrews (1) and on the face of washers (2), and install capscrews and washers. Use a wrench to tighten capscrews to 27 to 33 lb. ft.

CAUTION

Do not use an impact wrench to tighten main bearing cap capscrews the additional 90 degrees.

- (11) Put a mark on each bearing cap and capscrew. Use a wrench to tighten capscrews (1) 90 degrees more.
- (12) Remove all of the capscrews (1) and washers (2); then remove bearing caps (3).

MAIN BEARING POSITIONS



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3-11. CRANKSHAFT BEARINGS - REPLACE (Cont'd)

---

- (13) Remove plastigage and measure for new bearings; the main bearing clearance must be 0.0030 to 0.0065 inches. Maximum possible clearance with used bearings is 0.010 inches. Replace the upper and the lower bearing halves if measurement is less than 0.010 inches. Line bore bearing cap if new bearing clearance is under the specified measurements.

CAUTION

Be sure cylinder block bearing bores and backsides of bearings are clean and dry. Oil on these areas could cause less heat transfer between the bearings and the block which, in turn, could cause overheated bearings.

- (14) Put clean lubricating oil on upper and lower bearing halves inside surfaces.
- (15) Perform STEPS 10 and 11 above for the other bearing caps.
- (16) See page 3-51 and use the same removal procedures for main bearings 2, 4, and 6. DO NOT REMOVE bearing caps for 1, 3, 5, and 7 bearings, and disregard STEP 2 for thrust plates removal.
- (17) Perform cleaning and inspection procedure outlined on pages 3-52 through 3-55 for main bearings 2, 4, and 6. Disregard STEPS 3 and 4.
- (18) Install main bearings 2, 4, and 6 as described above in STEPS 1 through 4, and 8 through 15.
- (19) Check crankshaft end play with a dial indicator. End play is controlled by the thrust plates on the No. 7 main bearing.
- (20) End play with new thrust plates must be 0.0025 to 0.0145 inches.
- (21) Maximum permissible end play with used thrust plates is 0.025 inches. Replace both thrust plates if measurement is more than 0.025 inches.
- (22) Install engine oil pan plate. See page 3-119.
- (23) Install engine lube oil pump. See page 3-111.

e. Place In Service

Run engine and check for proper operation.

---

### 3-12. CRANKSHAFT FRONT SEAL AND WEAR SLEEVE - REPLACE

---

This task covers:

- a. Removal
  - b. Installation
  - c. Place In Service
- 

#### INITIAL SETUP

##### Applicable Configurations

All

##### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

##### Materials/Parts

Loctite 262 (App. B, Item 13)  
Quick Cure Primer (App. B, Item 9b)  
Lubricating Oil OE/HDO-30 (See L05-2410-237-12)  
Lint-free Rag (App. B, Item 12)  
Wear Sleeve (4)

##### Equipment Condition

Crankshaft pulley removed. See page 3-65.

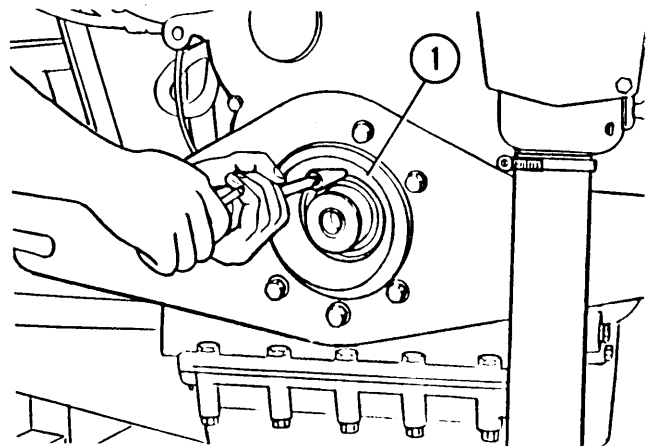
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#### a. Removal

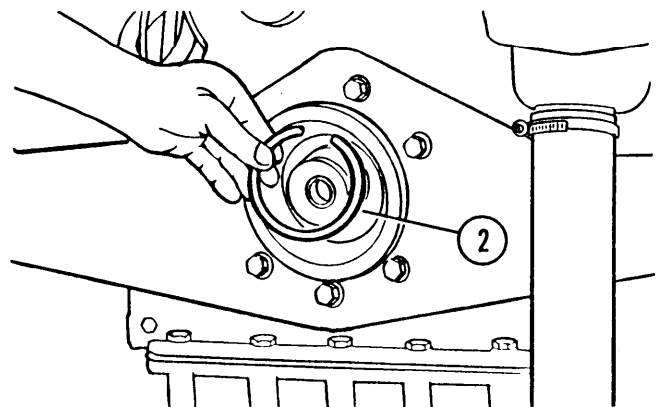
##### NOTE

When replacing the front crankshaft seal, the front wear sleeve must also be replaced.

- (1) Remove the crankshaft front seal (1) with seal puller.

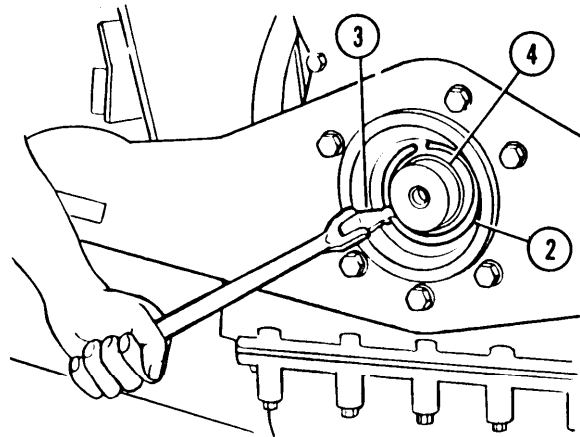


- (2) Install distorter ring (2) into the seal bore.



3-12. CRANKSHAFT FRONT SEAL AND WEAR SLEEVE - REPLACE (Cont'd)

- (3) Put wear sleeve distorter (3) between the distorter ring (2) and the wear sleeve (4). Turn until the edge of the distorter makes a crease in the wear sleeve. Make additional creases in the wear sleeve until the wear sleeve is loose. Remove distorter ring and the wear sleeve. Discard wear sleeve.

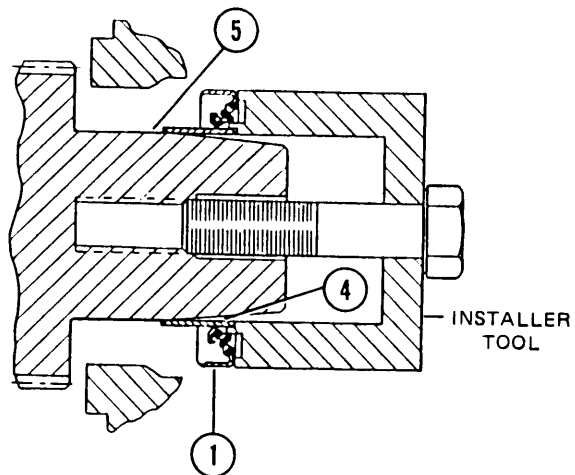
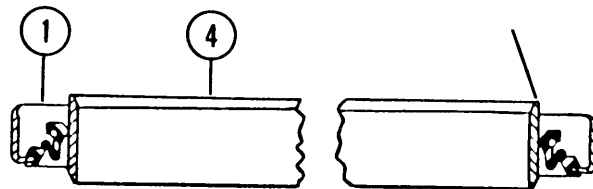


b. Installation

NOTE

The wear sleeve and crankshaft front seal must be installed together.

- (1) Apply clean lubricating oil on the seal lip of seal (1) and on the outside diameter of the wear sleeve (4).
- (2) Install seal (1) on the wear sleeve (4) as shown, with the lip of the seal towards the side of the wear sleeve that has the chamfer on the inside diameter.
- (3) Clean the inside diameter of the wear sleeve (4) and the tapered surface of the crankshaft (5) with quick cure primer.
- (4) Apply Loctite 262 to surfaces on the inside diameter of the wear sleeve (4) and on the crankshaft (5).
- (5) Put wear sleeve (4) and seal (1) on the crankshaft, with the lip of the seal towards the engine.
- (6) Install the wear sleeve and seal installer tool. Apply a small amount of lubricating oil between capscrew and installer tool.



---

### 3-12. CRANKSHAFT FRONT SEAL AND WEAR SLEEVE - REPLACE (Cont'd)

---

(7) Tighten capscrew until the inside surface of the installer tool contacts the end of the crankshaft (5). The wear sleeve and seal will be in the correct location.

(8) Install the crankshaft pulley.  
See page 3-65.

c. Place In Service

Run engine and check for proper operation.



3-13. CRANKSHAFT REAR SEAL AND WEAR SLEEVE - REPLACE

This task covers:

- a. Removal
- b. Installation
- c. Place In Service

INITIAL SETUP

Applicable Configurations

AIT

Common Tools

Shop Equipment, General Purpose  
 Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894

Materials/Parts

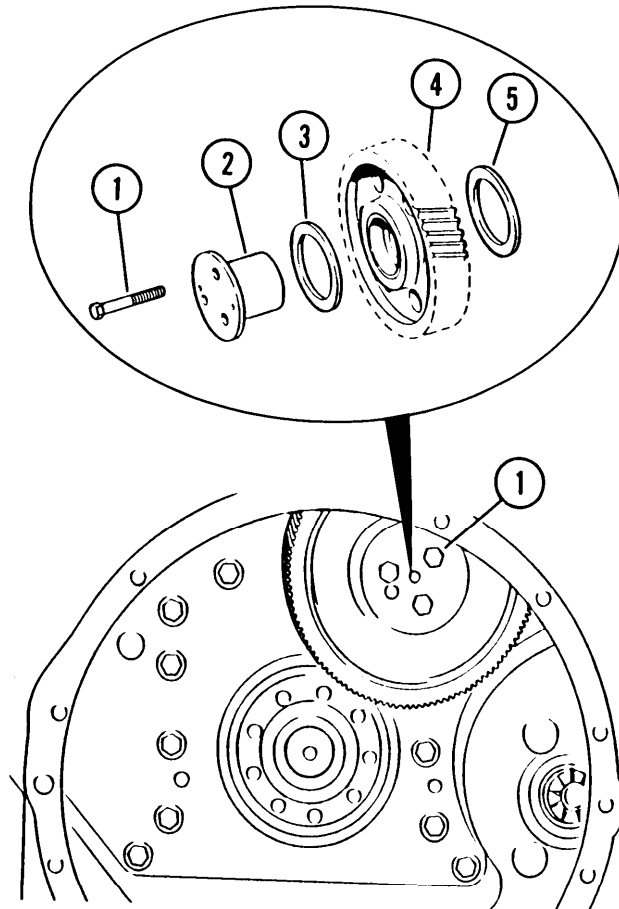
Seal (6)  
 Wear Sleeve (9)  
 Grease (App. B, Item 6)  
 Loctite 262 (App. B, Item 13)  
 Lubricating Oil OE/HDO-30  
 (See L05-2410-237-12)

Equipment Condition

Flywheel removed. See page 3-71.

a. Removal

- (1) Use a wrench to remove three capscrews (1), shaft (2), washer (3), and gear (4).
- (2) Remove washer (5).

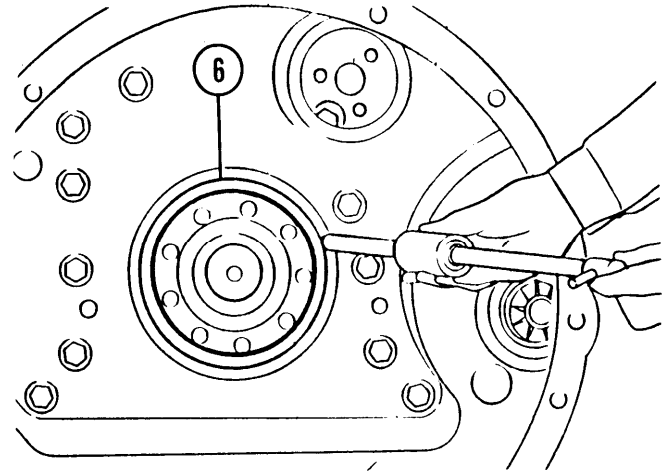


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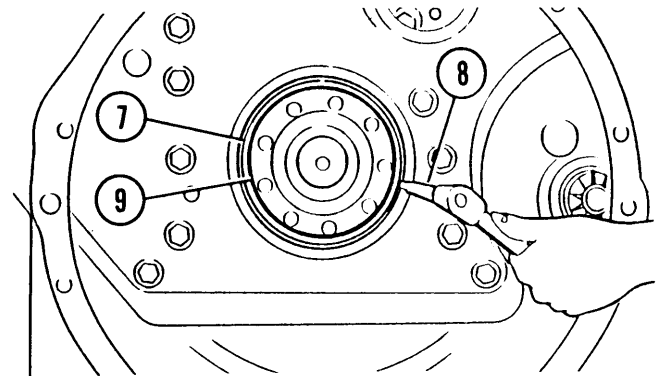
 3-13. CRANKSHAFT REAR SEAL AND WEAR SLEEVE - REPLACE (Cont' d)
 

---

- (3) Remove crankshaft rear seal (6) using seal puller. Discard rear seal.



- (4) Insert distorter ring (7) in the rear seal bore.
- (5) Insert wear sleeve distorter (8) between the distorter ring (7) and wear sleeve (9).
- (6) Turn distorter (8) until it makes a crease in the wear sleeve (9). Make additional creases in the wear sleeve until the wear sleeve is loose.
- (7) Remove wear sleeve distorter (8) and wear sleeve (9). Discard wear sleeve.

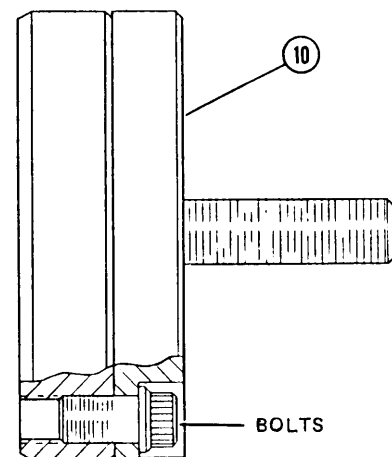


b. Installation

- (1) Fasten locator (10) to the rear of the crankshaft with three bolts.

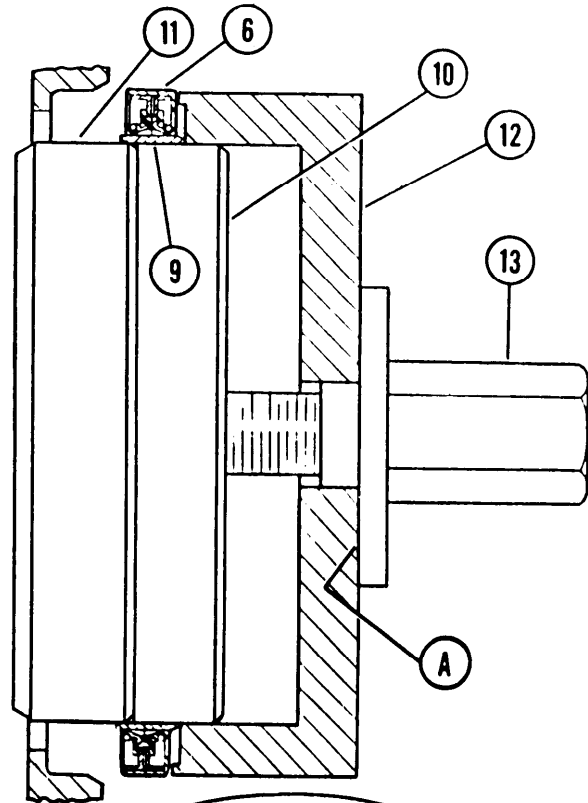
**CAUTION**

Do not separate rear seal and wear sleeve assembly.

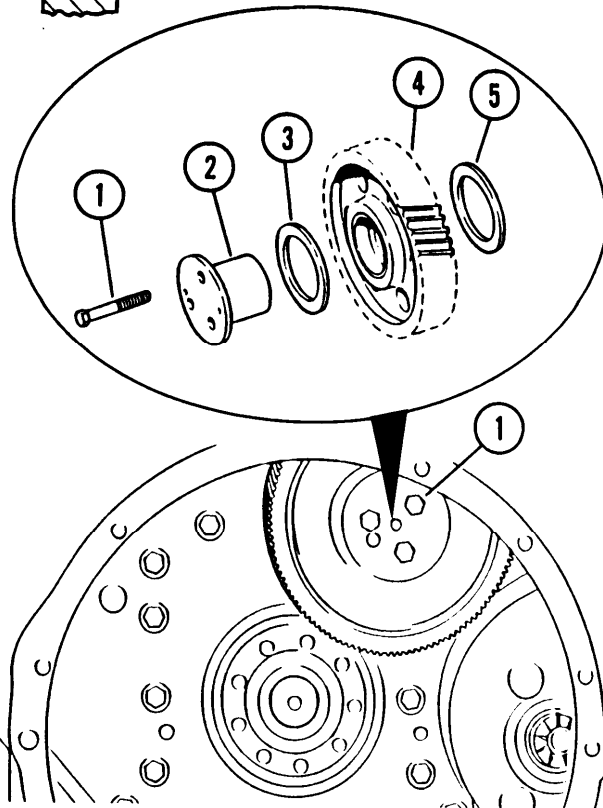


3-13. CRANKSHAFT REAR SEAL AND WEAR SLEEVE - REPLACE (Cont'd)

- (2) Clean outer diameter of crankshaft flange (11) and inside diameter of wear sleeve (9) |
- (3) Apply Loctite 262 on the outer diameter of crankshaft flange (11) and on the inside diameter of the wear sleeve (9).
- (4) Put seal (6) and wear sleeve (9) assembly on locator (10) with part number on seal facing out.
- (5) Apply clean lubricating oil on washer face (A) of nut (13). Place installer (12) on locator (10), then install nut (13).
- (6) Turn nut (13) until inside surface of installer (12) comes in contact with the locator (10). The rear seal and wear sleeve will be in the correct location.



- (7) Remove nut, installer (12), and locator (10).
- (8) Coat outside surface of washer (5) with multi purpose grease, and install washer (5) on stub shaft.
- (9) Install washer (3) on shaft (2).
- (10) Put gear (4) on shaft (2); then install gear and shaft. Use a wrench to install capscrews (1) and tighten to a torque of 75±10 lb. ft.
- (11) Install flywheel. See page 3-71.



co Place In Service

Run engine and check for proper operation.

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### 3-14. CRANKSHAFT PULLEY - REPLACE

---

This task covers:

- a. Removal
- b. Inspection
- c. Installation
- d. Place In Service

---

#### INITIAL SETUP

##### Applicable Configurations

All

##### Equipment Condition

Crankshaft vibration damper removed. See page 3-67.

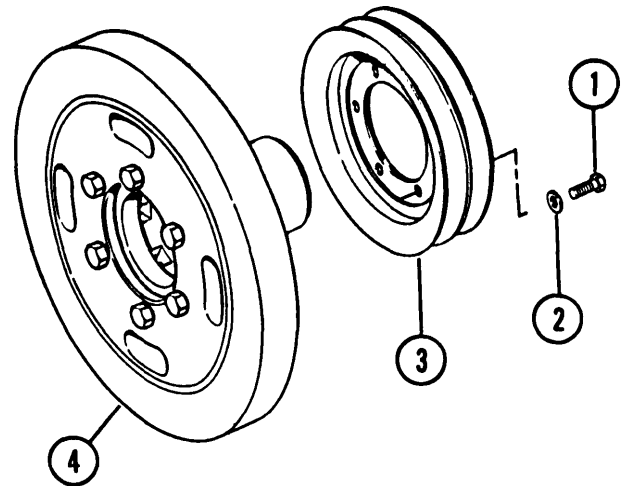
##### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

---

#### a. Removal

- (1) Use a wrench to remove six capscrews (1), and six flat washers (2) from crankshaft pulley (3);
- (2) Remove crankshaft pulley (3) from hub (4).



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### 3-14. CRANKSHAFT PULLEY - REPLACE (Cont'd)

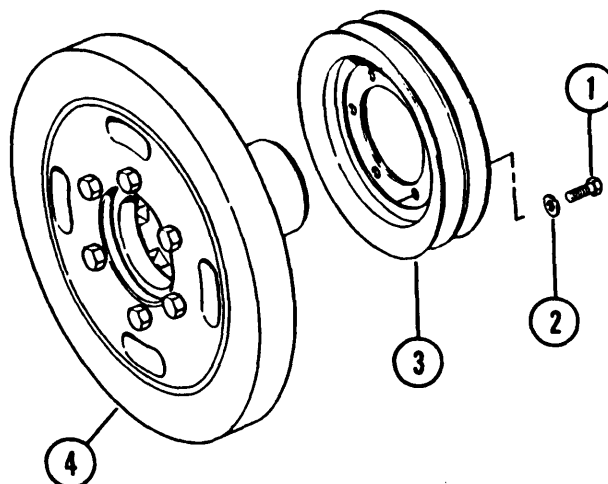
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#### b. Inspection

- (1) Inspect the crankshaft pulley for cracks, chipped condition, or other damage. Replace if necessary.
- (2) Inspect crankshaft pulley groove wear. Measure the distance the V-belt runs above or below the top of the groove. If the V-belt runs more than 1/16 in. below the top of the groove, replace the pulley.
- (3) See page 2-32 for general Inspection Instructions.

#### c. Installation

- (1) Install the crankshaft pulley (3) onto the hub (4). Use a wrench to install six capscrews (1) and six washers (2) which secure the crankshaft pulley to the crankshaft vibration damper. Tighten capscrews to a torque of  $32 \pm 5$  lb. ft.
- (2) Install the crankshaft vibration damper. See page 3-67.



#### d. Place In Service

Run engine and check for proper operation.

3-15. CRANKSHAFT VIBRATION DAMPER - REPLACE

This task covers:

- a. Removal
- b. Cleaning
- c. Inspection
- d. Installation
- e. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Materials/Parts

Vee Belt Set (7M4710)  
Lubricating Oil OE/HDO-30 (See L05-2410-237-12)  
Cleaning Solvent (App. B, Item 19)

Equipment Condition

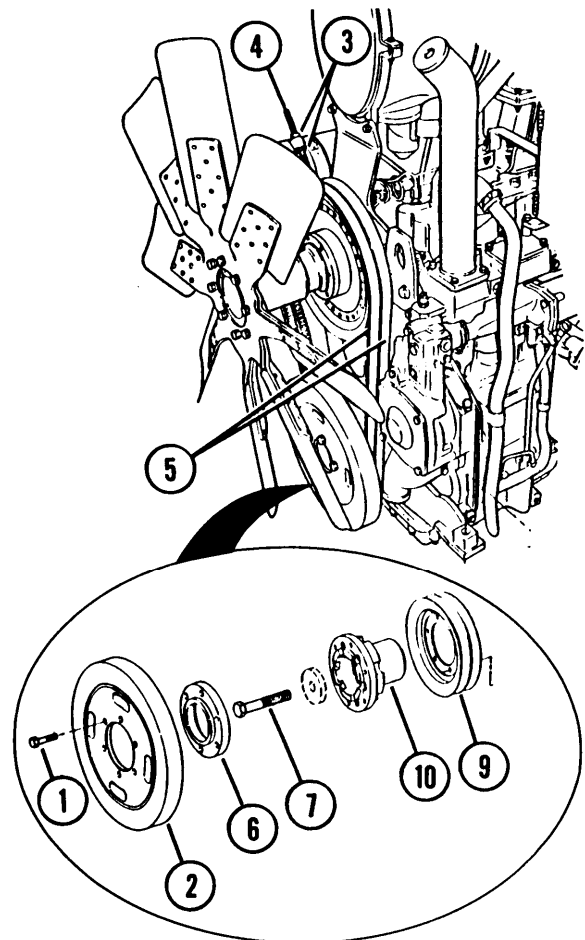
Radiator removed. See page 5-4.

a. Removal

- (1) Use a wrench to remove six capscrews (1) and vibration damper (2).
- (2) Use a wrench to loosen two nuts (3) on adjustment rod (4), and remove the two Vee belts (5). Discard Vee-belts (5), if necessary.
- (3) If necessary remove adapter (6).
- (4) Loosen capscrew (7).
- (5) Loosen hub (10) and pulley assembly (9) with a suitable puller tool.

NOTE

Use an impact wrench on puller tool so crankshaft does not turn.



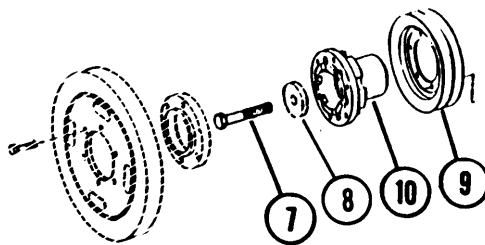
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**3-15. CRANKSHAFT VIBRATION DAMPER - REPLACE (Cont' d)**

---

(6) Remove puller tool. Use a wrench to remove capscrew (7) and washer (8). Remove crankshaft pulley (9) and hub (10) from crankshaft.

(7) Remove crankshaft pulley. See page 3-65.

**b. Cleaning**

---

**WARNING**

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Compressed air used for cleaning purposes will not exceed 30 psi. Use only with effective chip guarding and personal protective equipment.

Clean removed parts with a suitable cleaning solvent. See page 2-29. Dry thoroughly with low pressure air (30 psi or less).

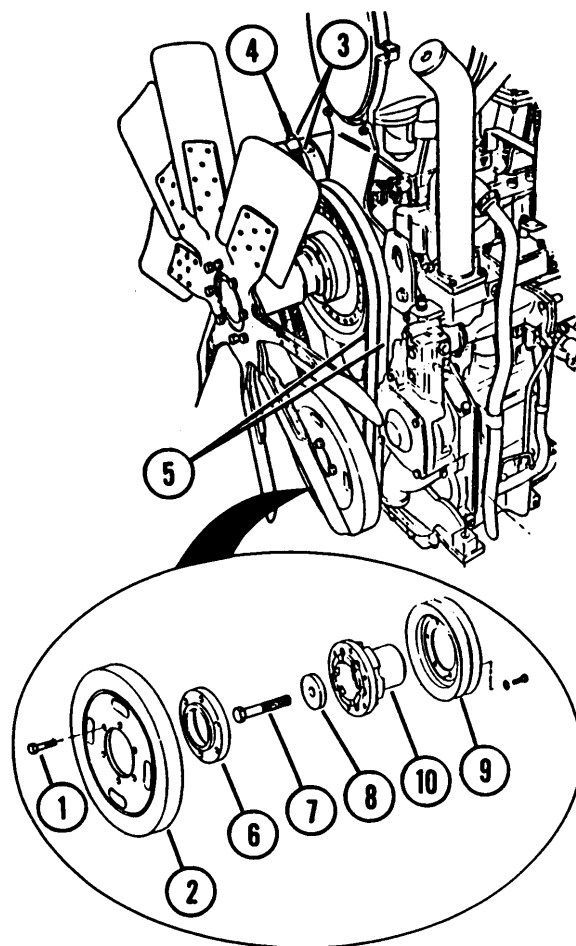
**c. Inspection**

- (1) Inspect vibration damper for excessive wear, cracks or other damage, and replace if necessary.
- (2) Inspect adapter for cracks or other damage, and replace if necessary.
- (3) Inspect bore of hub for excessive wear, pitting, signs of overheating, or other damage. Replace the hub if any of these defects exist.
- (4) See page 2-32 for general Inspection Instructions.

## 3-15. CRANKSHAFT VIBRATION DAMPER - REPLACE (Cont' d)

d. Installation

- (1) Install the crankshaft pulley.  
See page 3-65.
- (2) Lubricate the outside diameter of the front oil seal on the crankshaft and the inside sealing surface of the hub (10) with clean OE/HDO 30 lubricating oil.
- (3) Put hub and pulley assembly on the end of crankshaft.
- (4) Use a push-puller tool to pull the hub and pulley assembly onto the crankshaft until the hub (10) contacts the crankshaft gear.
- (5) Remove push-puller tool and install washer (8), maximum flat surface towards hub (10), and capscrew (7). Use a wrench to tighten capscrew to a torque of  $230 \pm 20$  lb. ft. Tap end of capscrew with a hammer and again tighten capscrew to a torque of  $230 \pm 20$  lb. ft.
- (6) put adapter (6) in position on hub (10).
- (7) Install two Vee belts (5).
- (8) Put vibration damper (2) in position on the hub (6), and install six capscrews (1). Use a wrench to tighten capscrews to  $75 \pm 10$  lb. ft.
- (9) Install radiator. See page 5-4.
- (10) Use a suitable belt tension gauge to measure belt tension. Measure the belt nearest the radiator.
- (11) Use a wrench to tighten bottom nut (3) on adjustment rod (4) until belt tension gauge reads  $120 \pm 5$  lbs.





3-15. CRANKSHAFT VIBRATION DAMPER - REPLACE (Cont'd)

---

- (12) Operate the engine at high idle for a minimum of 30 minutes.
- (13) Turn engine OFF. Make another belt tension adjustment for  $120 \pm 5$  lbs.
- (14) Use a wrench to tighten top nut (3) on adjustment rod (4) to  $75 \pm 10$  lb<sub>e</sub> ft.

e. Place In Service

Run engine and check for proper operation.

---

### 3-16. FLYWHEEL - REPLACE/REPAIR

---

This task covers:

- a. Removal
  - b. Disassembly
  - c. Assembly
  - d. Installation
  - e. Place In Service
- 

#### INITIAL SETUP

##### Applicable Configurations

All

##### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Lifting Equipment 200 lbs.

##### Materials/Parts

Ring Gear (6)  
Block 4" X 4" - 12" Long

##### Equipment Condition

Torque divider removed.  
See page 7-8.

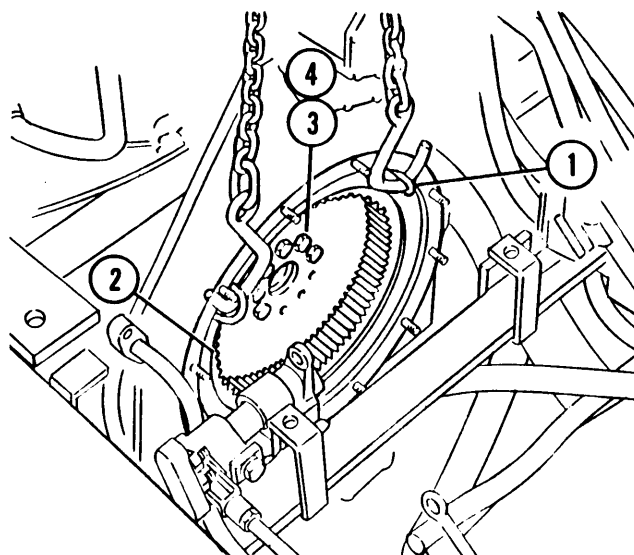
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#### a. Removal

##### NOTE

The weight of the flywheel is 125 lbs.

- (1) Fasten lifting equipment (1) to flywheel (2) as shown.
- (2) Use a socket wrench to remove nine capscrews (3) and nine washers (4) from flywheel (2). Remove flywheel (2).
- (3) Remove gear (5) from flywheel (2).



#### b. Disassembly

- (1) Place flywheel (2) on a block.
- (2) Pound ring gear (6) from flywheel (2).

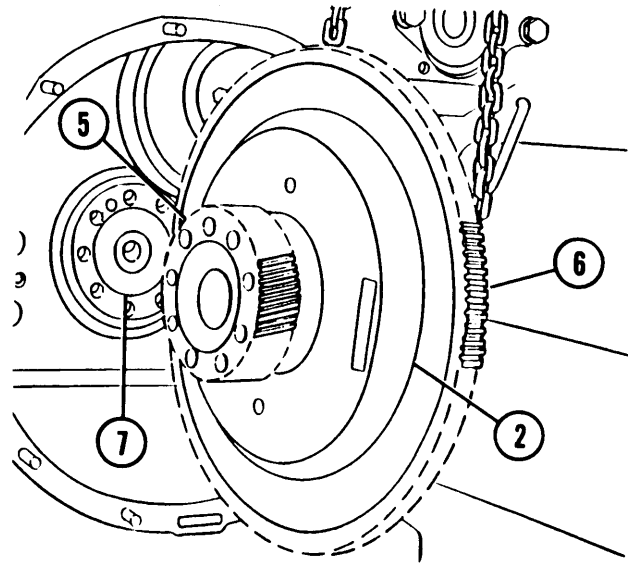
3-16. FLYWHEEL - REPLACE/REPAIR (Cont' d)

c. Assembly

- (1) Heat ring gear (6) to no more than 600 F.
- (2) Install ring gear (6) so the chamfer on the gear teeth is facing toward the engine when the flywheel (2) is installed.

d. Installation

- (1) Make an alignment of the dash marks on flywheel (2) and gear (5). Install gear (5) on flywheel (2).
- (2) Attach flywheel (2) to lifting equipment (1) and lift flywheel (2) into place.
- (3) Make an alignment of the dash marks on flywheel (2) and crankshaft (7) and place flywheel (2) against the rear of the crankshaft (7).
- (4) Use a torque wrench to install nine capscrews (3) and nine washers (4) to a torque of 150±20 lb. ft.
- (5) Remove lifting equipment (1) from flywheel (2).
- (6) Install torque divider. See page 7-8.



e. Place In Service

Run engine and check for proper operation.

---

### 3-17. FLYWHEEL HOUSING - REPLACE/REPAIR

---

This task covers:

- a. Removal
  - b. Disassembly
  - c. Assembly
  - d. Installation
  - e. Place In Service
- 

#### INITIAL SETUP

##### Applicable Configurations

All

##### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Lifting Equipment 400 lbs.

##### Materials/Parts

Gasket (8), (16)  
Grease (App. B, Item 5)

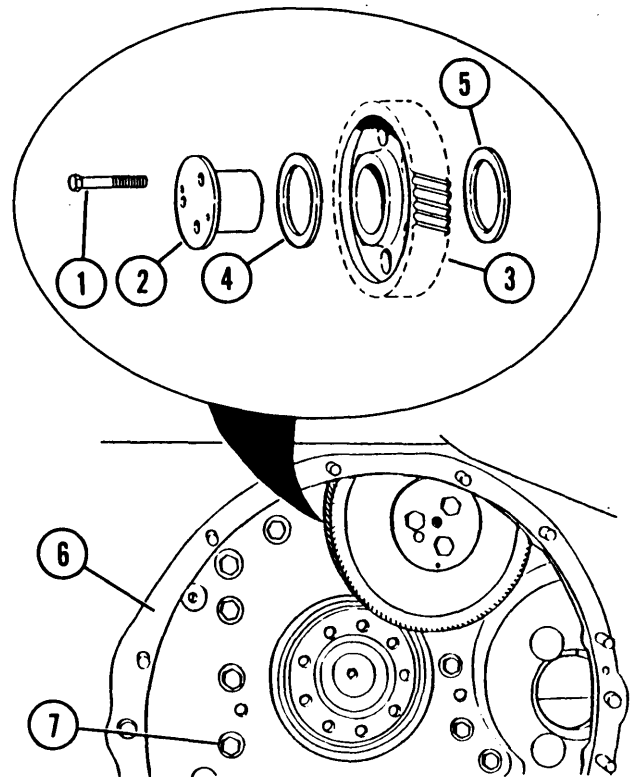
##### Equipment Condition

Engine removed. See page 3-4.  
Flywheel removed. See page 3-71.  
Oil pan plate removed. See page 3-119  
Transmission oil pump removed.  
See page 7-73.  
Hydraulic pump removed. See TM5-2410-237-20.  
Electric starting motor removed.  
See TM5-2410-237-20.

---

#### a. Removal

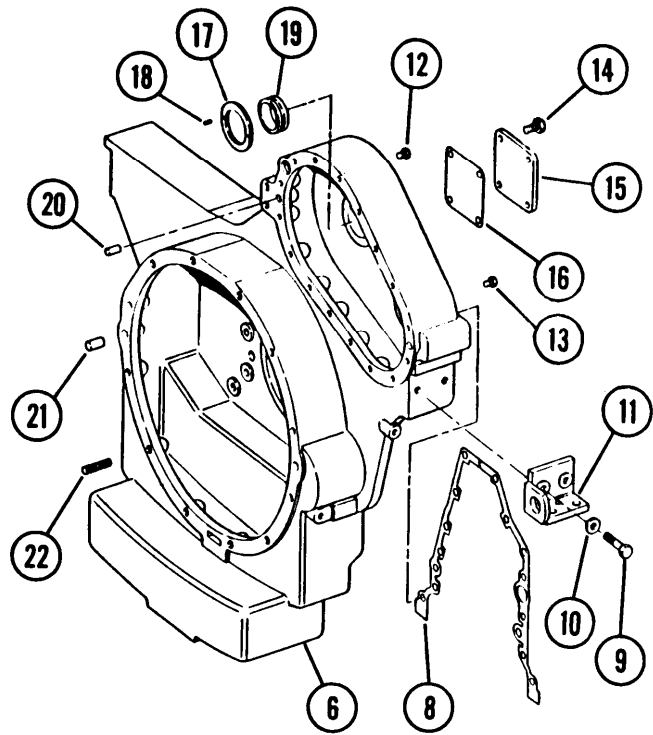
- (1) Use a wrench to remove three capscrews (1).
- (2) Remove shaft assembly (2) and gear (3). Remove washer (4) from shaft assembly (2).
- (3) Remove washer (5) from the flywheel housing (6).
- (4) Fasten lifting equipment to flywheel housing (6).
- (5) Use a wrench to remove thirteen capscrews (7) that hold flywheel housing (6) in place.
- (6) Remove flywheel housing (6). The weight is 350 lbs.
- (7) Remove and discard gasket (8) from flywheel housing (6).



3-17. FLYWHEEL HOUSING - REPLACE/REPAIR (Cont'd)

b. Disassemble

- (1) Remove rear accessory drive gear cover assembly. See page 3-126.
- (2) Remove rear accessory drive gears. See page 3-124.
- (3) Use a wrench to remove four capscrews (9) and washers (10) from each side of the flywheel housing (6) and remove two brackets (11).
- (4) Use a wrench to remove plug (12).
- (5) Use a wrench to remove plug (13).
- (6) Use a wrench to remove four capscrews (14), cover (15) and gasket (16). Discard gasket (16).
- (7) Remove two washers (17) and pins (18).
- (8) Use a bearing puller to remove two bearings (19).
- (9) If necessary, remove dowels (20 and 21) and stud (22) from flywheel housing (6).

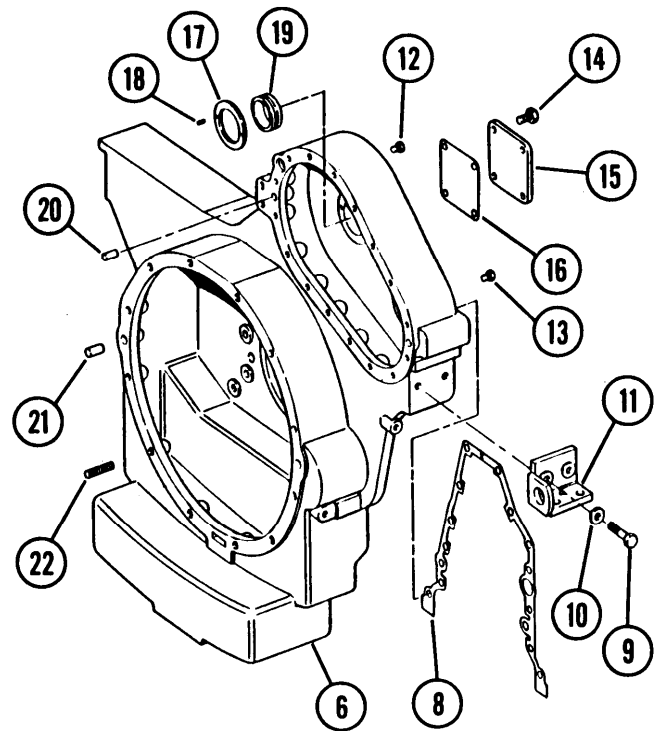


c. Assembly

- (1) If removed, install dowels (20 and 21) and stud (22) into housing (6). Tighten studs to 35-45 lb. ft.
- (2) Use a suitable driving tool to install two bearings (19).
- (3) Install two washers (17) and pins (18).
- (4) Use a wrench to install four capscrews (14), cover (15) and gasket (16).

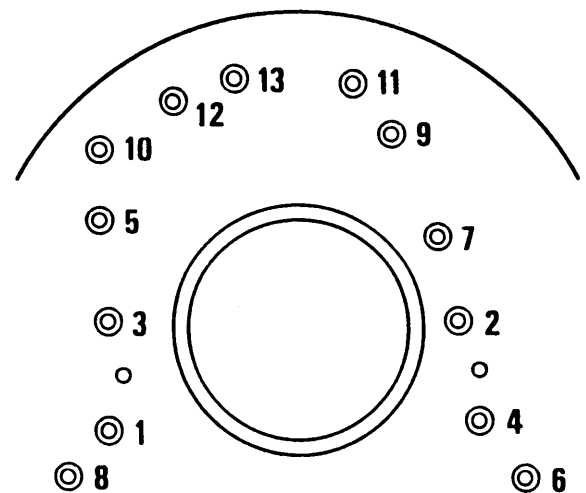
3-17. FLYWHEEL HOUSING - REPLACE/REPAIR (Cont'd)

- (5) Use a wrench to install plug (13).
- (6) Use a wrench to install plug (12).
- (7) Position two brackets (11) on flywheel housing (6) and use a wrench to install four washers (10) and capscrews (9).
- (8) Install rear accessory drive gears. See page 3-124.
- (9) Install rear accessory drive gear cover assembly. See page 3-126.



d. Installation

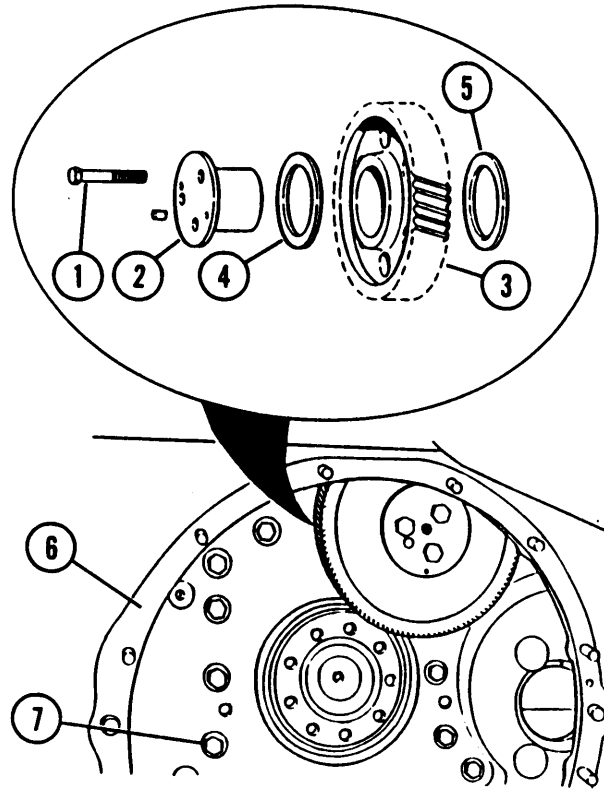
- (1) Install new gasket (8) on flywheel housing (6).
- (2) Use lifting equipment to place flywheel housing (6) in position against the cylinder block.
- (3) Install thirteen capscrews (7) that hold flywheel housing (6) in place. Make sure the two shorter capscrews (7) go into positions 7 and 2.
- (4) Use a wrench to tighten thirteen capscrews (7) in the order shown to 75±10 lb. ft.
- (5) Cut gasket (8) even with the oil pan face of the cylinder block.
- (6) Put clean grease on washer (5) and install in flywheel housing (6).



CAPSCREW TIGHTENING SEQUENCE FOR FLYWHEEL HOUSING

3-17. FLYWHEEL HOUSING - REPLACE/REPAIR (Cont'd)

- (7) Install washer (4) on shaft assembly (2).
- (8) Put gear (3) and shaft assembly (2) in flywheel housing (6).
- (9) Use a wrench to install three capscrews (1) to hold shaft assembly (2) in place.
- (10) Install electric starting motor. See TM5-2410-237-20.
- (11) Install hydraulic pump. See TM5-2410-237-20.
- (12) Install transmission oil pump. See page 7-73.
- (13) Install oil pan plate. See page 3-119.
- (14) Install flywheel. See page 3-71.
- (15) Install engine. See page 3-3.



e. Place In Service

Run engine and check for proper operation.

---

### 3-18. PISTONS, CONNECTING RODS, PISTON PINS AND RINGS - REPLACE/REPAIR

---

This task covers:

- a. Removal
- b. Disassembly
- c. Assembly
- d. Installation
- e. Place In Service

---

#### INITIAL SETUP

##### Applicable Configurations

All

##### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Shop Equipment, Machine Shop:  
 Field Maintenance, Basic  
 NSN 3470-00-754-0708  
 Ring Groove Tool  
 Piston Ring Groove Gage  
 Heat gloves

##### Materials/Parts

Engine Oil OE/HDO-30 (Refer to L05-2410-237-12)

Teflon Tape

##### Equipment Condition

Oil pan plate removed. See page 3-119.

Engine oil pump removed. See page 3-111.

Cylinder head assembly and spacer plate removed. See page 3-30.

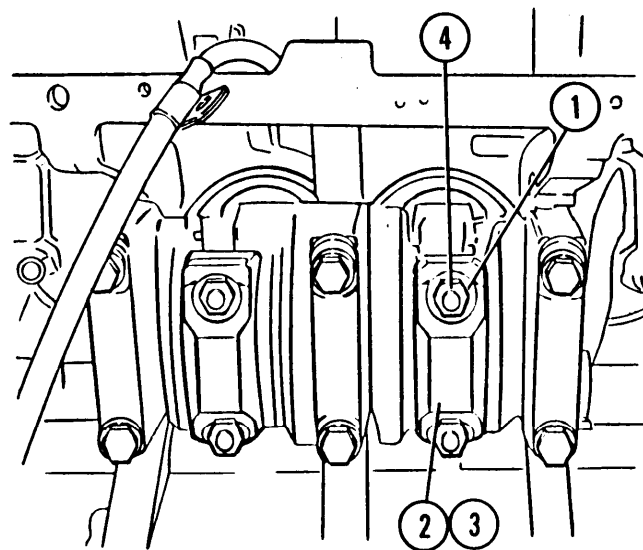
#### a. Removal

- (1) Use a wire brush to clean all carbon from around the inner surface of the cylinder liners.
- (2) Turn the crankshaft until two pistons are bottom center.

##### NOTE

Keep each connecting rod cap (2) together with its respective connecting rod and piston (5). Connecting rod and cap are machined as a set and must be kept that way.

- (3) Use a wrench to remove two nuts (1), connecting rod cap (2), and bearing half (3) from connecting rod.





3-18. PISTONS, CONNECTING RODS, PISTON PINS AND RINGS -  
REPLACE/REPAIR (Cont' d)

CAUTION

Place tape over the threads of the connecting rod capscrews (4). This will prevent damage to the crankshaft when the rods are removed.

CAUTION

Be careful not to damage the crankshaft or the cylinder wall liners while removing the connecting rods. Damage of these components could result in premature engine failure.

- (4) Slide piston and connecting rod assembly (5) up through cylinder block and remove from engine. Remove bearing half (6).

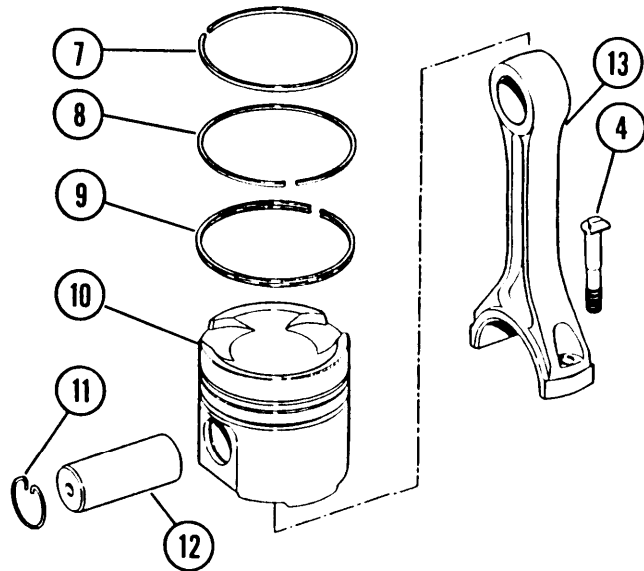
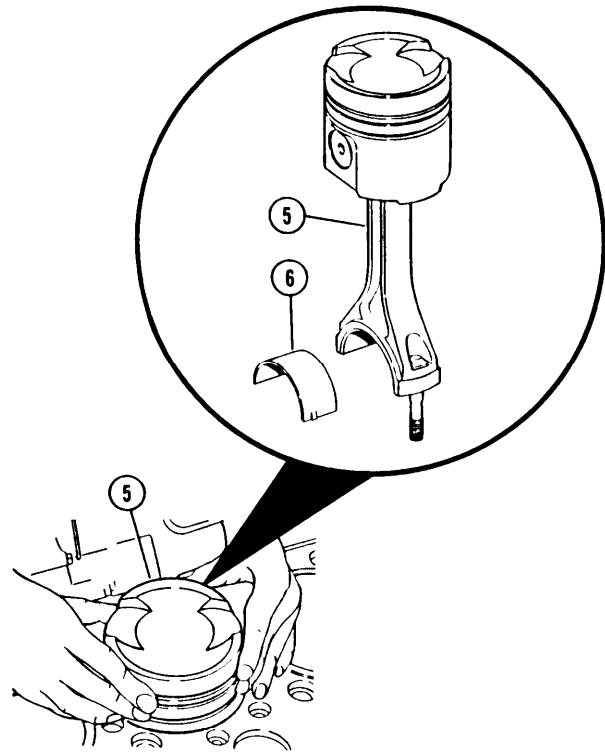
NOTE

Mark each connecting rod and piston assembly with identification as to its proper location in the engine.

- (5) Repeat STEPS 1 through 4 for remaining pistons.

b. Disassemble

- (1) Use a ring expander to remove the rings (7, 8 and 9) from the pistons (10).
- (2) Remove retaining ring (11), piston pin (12) and connecting rod (13) from the piston (10).



WARNING

Use insulated gloves for handling hot and cold parts to avoid personal injury.

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 3-18. PISTONS, CONNECTING RODS, PISTON PINS AND RINGS -  
 REPLACE/REPAIR (Cont'd)
 

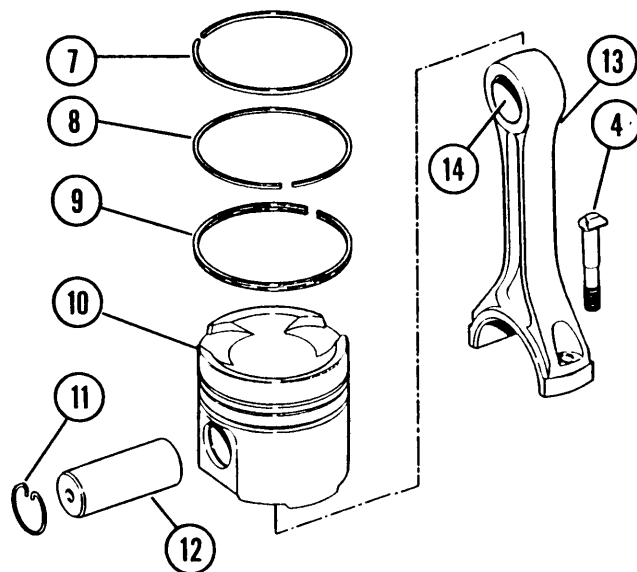
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- (3) Raise the temperature of the connecting rod (13) to a temperature of 350 to 500°F. Never use a direct flame to heat a connecting rod.
- (4) Put a spacer in the base plate. Put the connecting rod (13) on the base plate of tooling.
- (5) Put the connecting rod (13) piston pin bearing end in the center of the port assembly of tooling. Install pin in the center of the bore for the connecting rod bearing.
- (6) Install adapter. Put the hole in the adapter in alignment with the hole in the base plate of tooling.
- (7) Install clamp bar and clamp pin.

## NOTE

The old bearing (14) is pushed out by tooling as the new bearing is installed.

- (8) Put pusher adapter in position with the taper side down. The piston pin bearing (14) joint must be in alignment with the hole in adapter and the base plate of tooling.
- (9) Put pusher on adapter.
- (10) Use tooling to push the new piston pin bearing (14) in to the connecting rod (13) until adapter of tooling makes full contact with the connecting rod surface.
- (11) Remove the connecting rod (13) and the old piston pin bearing (14) from tooling.



3-18. PISTONS, CONNECTING RODS, PISTON PINS AND RINGS -  
REPLACE/REPAIR (Cont'd)

(12) Check the piston pin bearing bore diameter after the bearing (14) is installed. The correct dimension is 1.7012±0.0003 in. The maximum permissible clearance between the bearing and piston pin (12) must not be more than 0.003 in.

(13) If necessary, remove two capscrews (4) from connecting rod (13).

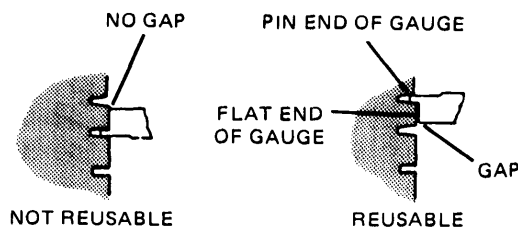
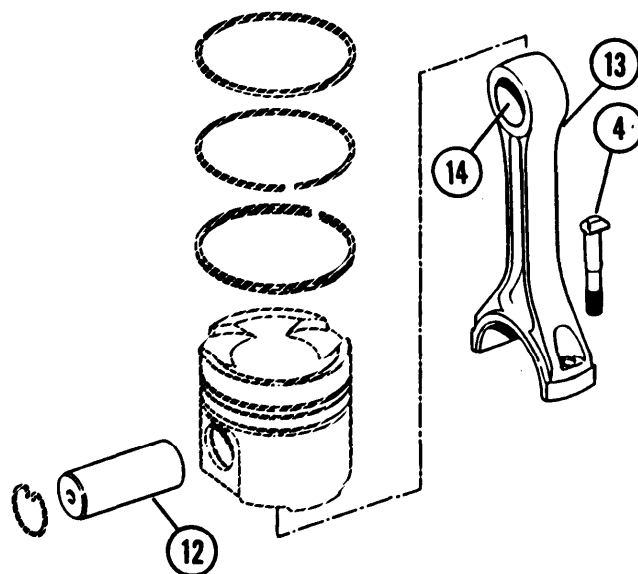
c. Assembly

(1) If it was necessary to remove two capscrews (4), install them on connecting rod (13).

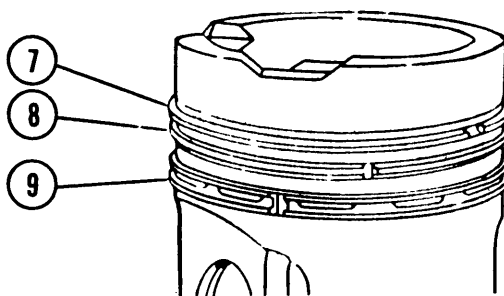
(2) When old pistons are used, clean the piston grooves with an acceptable ring groove tool.

(3) See Table 3-4 for correct piston and ring clearances.

(4) It is necessary to measure the grooves in pistons with a Keystone piston ring groove gage. Put the pin end of in the groove at four places around the circumference. Do this to both grooves. The flat edge of the gage must be between grooves for the top ring and intermediate ring. If there is clearance between the flat edge of the gage and the piston at all test locations, for both grooves, reuse the piston. If the flat edge is in contact with the piston, at any of the test locations, do not reuse the piston. Install a new piston.



3-18. PISTONS, CONNECTING RODS, PISTON PINS AND RINGS -  
REPLACE/REPAIR (Cont'd)



**Table 3-4. Pistons and Piston Rings**

	(7) TOP RING	(8) INTERMEDIATE RING	(9) OIL CONTROL RING
Width of groove in piston for piston ring (new).			0.1233±0.0005 in.
Thickness of piston ring (new).			0.1235±0.0005 in.
Clearance between groove and piston ring (new).			0.0020±0.0010 in.
Maximum permissible clearance (worn).			(0.006 in.)
Clearance between ends of piston ring when installed in a cylinder liner with a bore size of 4.7500 in.	0.0245±0.0075 in.	0.0245±0.0075 in.	0.0225±0.0075 in.
Increase in clearance between ends of piston ring for each 0.001 in. increase in cylinder liner bore size.	0.003 in.	0.003 in.	0.003 in.

3-18. PISTONS, CONNECTING RODS, PISTON PINS AND RINGS -  
REPLACE/REPAIR (Cont' d)

(5) Put connecting rod (13) in position in the piston (10) with bearing tab groove and number identification on the same side as the "V" mark on the top of the piston.

(6) Install piston pin (12) and retaining ring (11) in piston (10).

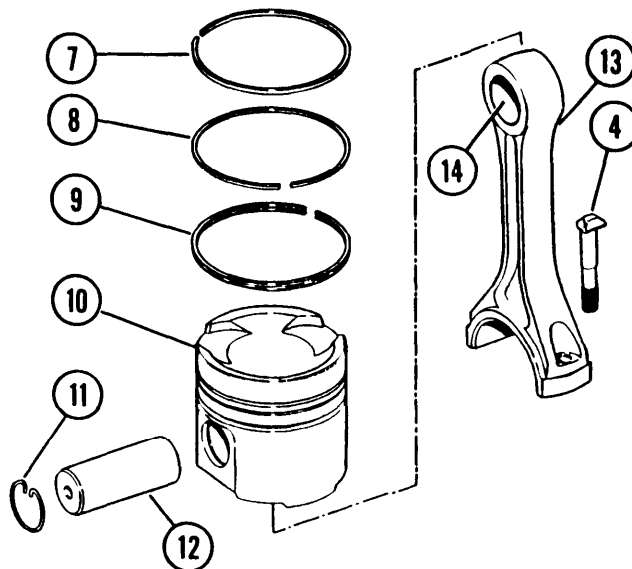
NOTE

The oil ring (9) must be installed on the piston (10) with the ring end gap 180° from the oil ring joint.

(7) Install the oil ring (9) on the piston (1) with tool.

(8) Install the intermediate piston ring (8) with the side that has the mark "UP-2" toward the top of the piston (10) with tool.

(9) Install the top piston ring (7) with the side that has the mark "UP-1" toward the top of the piston (10). Make sure piston ring end gaps are 90° apart before the pistons are installed.



d. Installation

(1) Turn the crankshaft until the bearing journals for the piston and connecting rod assembly being installed are at bottom center.

(2) Put clean engine oil on the crankshaft journals, inside of cylinder liners, piston rings and connecting rod bearings.

(3) Rotate the piston rings so that the ring openings are approximately 90° apart from each other.

### 3-18. PISTONS, CONNECTING RODS, PISTON PINS AND RINGS - REPLACE/REPAIR (Cont'd)

#### CAUTION

Never install the ring compressor without the use of the cylinder liner as a guide. Damage to the piston rings could result.

- (4) Place ring compressor into position on the cylinder liner.
- (5) Put bearing half (6) and connecting rod and piston assembly (5) into the same cylinder it was removed from by carefully sliding it through the ring compressor and at the same time guiding the connecting rod onto the assembly.

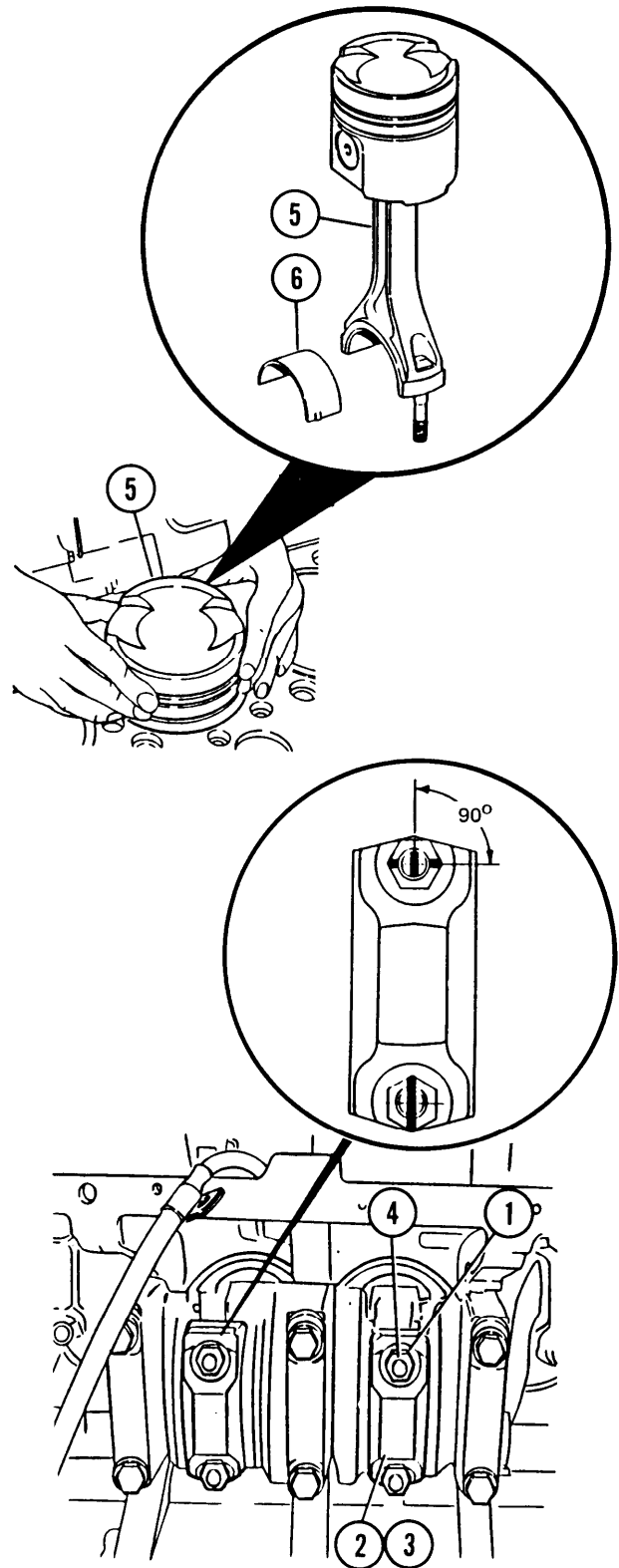
#### NOTE

Make sure the "V" mark on the piston is in alignment with the "V" mark on the cylinder block.

- (6) Put clean engine oil on bearings, bolt threads and surfaces of the nuts (1) that make contact with the connecting rod caps (2). Put connecting rod bearing halves (3) and caps in position on the connecting rods. Make sure that the tabs on the back of bearings are in the tab grooves of the connecting rod and cap. Use a 13/16" wrench to install the nuts onto capscrews (4) and tighten to a torque of  $30 \pm 3$  lb. ft. Put a mark on each nut and the end of each capscrew. Tighten the nuts  $90^\circ$  more.

#### CAUTION

When the connecting rod caps are installed, make sure the number on the side of the cap is next to the same number on the side of the corresponding connecting rod.



3-18. PISTONS, CONNECTING RODS, PISTON PINS AND RINGS -  
REPLACE/REPAIR (Cont'd)

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- (7) Follow STEPS 1 through 6 for the installation of the other pistons.
  - (8) Install the cylinder head assembly and spacer plate. See page 3-30.
  - (9) Install the engine oil pump. See page 3-111.
  - (10) Install the oil pan plate. See page 3-119.
- e. Place In Service
- Run engine and check for proper operation.

---

### 3-19. CONNECTING ROD BEARINGS - REPLACE

---

This task covers:

- a. Removal
  - b. Installation
  - c. Place In Service
- 

#### INITIAL SETUP

##### Applicable Configurations

All

##### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Shop Equipment, Machine Shop:  
Field Maintenance Basic  
NSN 3470-00-754-0708

##### Materials/Parts

Plasti gage  
Engine Oil OE/HDO-30 (Refer to L05-2410-237-12)

##### Equipment Condition

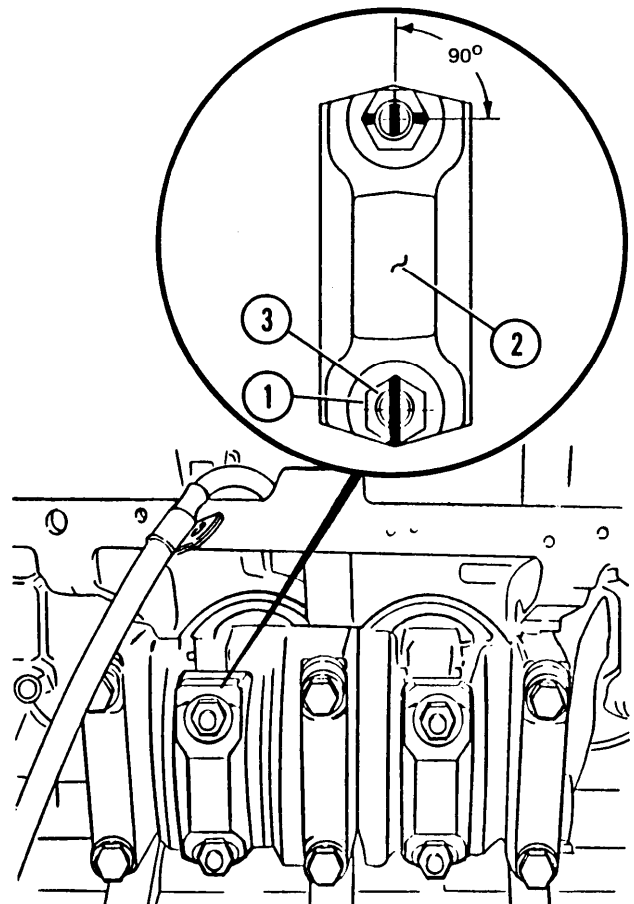
Engine oil pan plate removed. See page 3-119.

#### a. Removal

##### NOTE

Mark each connecting rod cap and connecting rod with identification as to its proper location in the engine. These are machined as a set and must be kept that way.

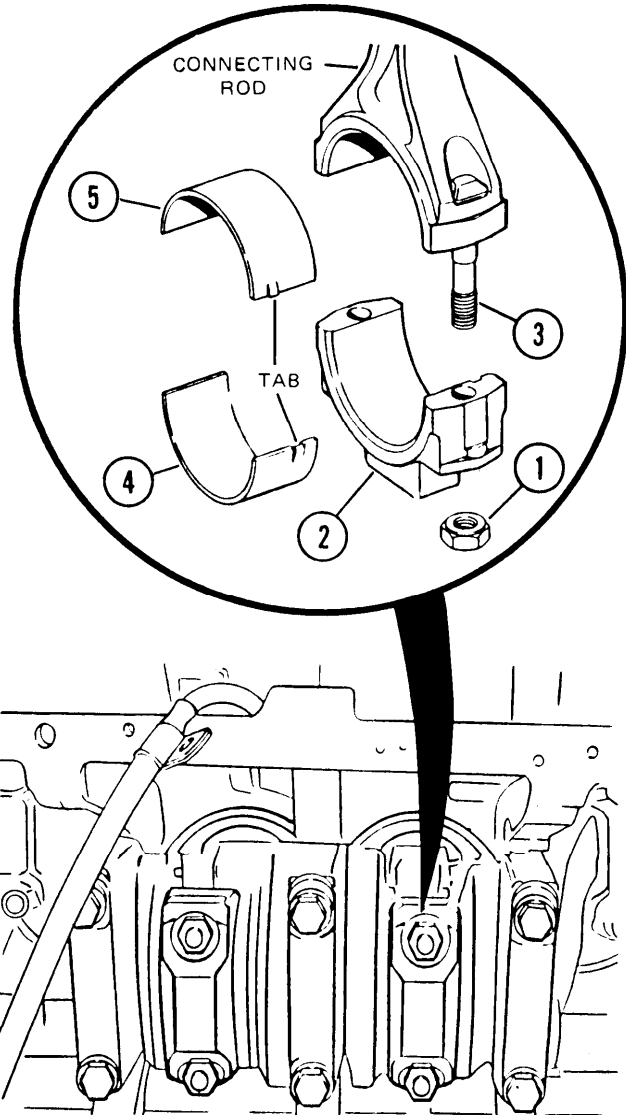
- (1) Use a wrench to remove two nuts (1) and connecting rod cap (2) from the capscrews (3) on the connecting rod.





3-19. CONNECTING ROD BEARINGS - REPLACE (Cont'd)

- (2) Remove the lower half of the connecting rod bearing (4) from the connecting rod cap (2).
- (3) Repeat STEPS 1 and 2 for other five connecting rod bearing halves.
- (4) Push the connecting rods away from the crankshaft. Remove the upper half of the connecting rod bearing (5) from the connecting rod.
- (5) Repeat STEP 3 for the other five connecting rod bearing halves.



b. Installation

NOTE

Install the connecting rod bearings dry when the clearance checks are made.

Ensure that the tabs in the back of the connecting rod bearings are in the tab grooves of the connecting rod and cap.

- (1) Install the upper half of the connecting rod bearings (5) on the connecting rod.
- (2) Repeat STEP 1 for the other five connecting rod bearing halves.
- (3) Install the lower half of the connecting rod bearing (4) in the connecting rod cap (2).
- (4) Repeat STEP 3 for the other five connecting rod bearing halves.
- (5) Put plastigage on the connecting rod bearing to check clearance.

---

**3-19. CONNECTING ROD BEARINGS - REPLACE (Cont'd)**

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- (6) Apply clean engine oil on the threads of the connecting rod capscrews (3) and seat surfaces of the nuts (1).

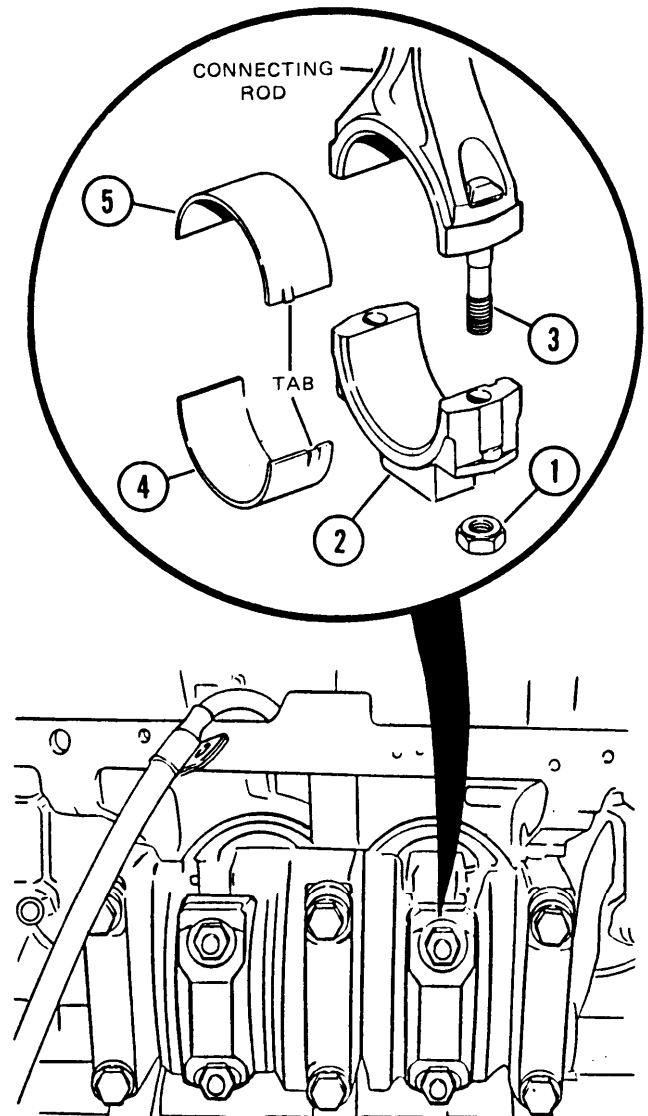
CAUTION

Ensure that the connecting rod caps are installed next to the respective number marked on the side of the connecting rod.

- (7) Install the connecting rod caps (2) and nuts (1). Use a wrench to tighten the nuts to a torque of  $30 \pm 3$  lb. ft.

CAUTION

Do not use an impact wrench when tightening the nuts an additional 90 degrees.



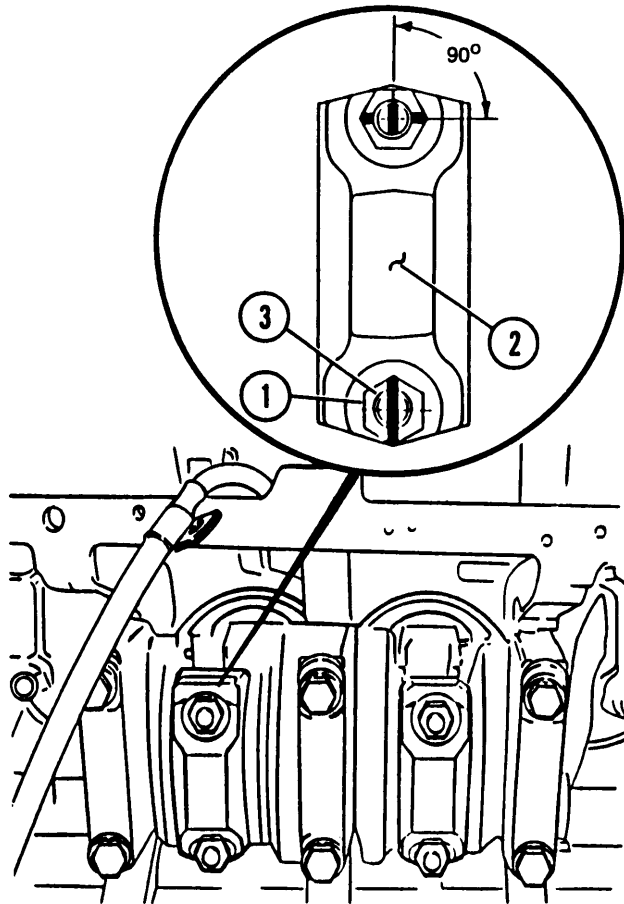
3-19. CONNECTING ROD BEARINGS - REPLACE (Cont'd)

- (8) Mark each nut (1) and the end of the capscrew (3). Tighten the nuts an additional 90 degrees.
- (9) Use a wrench to remove the nuts (1) and the connecting rod caps (2)

NOTE

Do not turn the crankshaft when the plastigage is in position.

- (10) Measure the width of the plastigage. The connecting rod clearance must be 0.0030 to 0.0066 in. for the new bearings. The maximum clearance with the used bearings is 0.010 in. Remove the plastigage.
- (11) Follow STEPS 7 and 8.
- (12) Apply clean engine oil on the connecting rod bearings.
- (13) Install the engine oil pan plate. See page 3-119.



c. Place In Service

Run engine and check for proper operation.

3-20. FRONT HOUSING COVERS - REPLACE/REPAIR

This task covers:

- a. Removal
- b. Installation
- c. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Shop Equipment, Machine Shop: Field Maintenance, Basic  
 NSN 3470-00-754-0708  
 Lifting Equipment 3000 lbs.

Materials/Parts

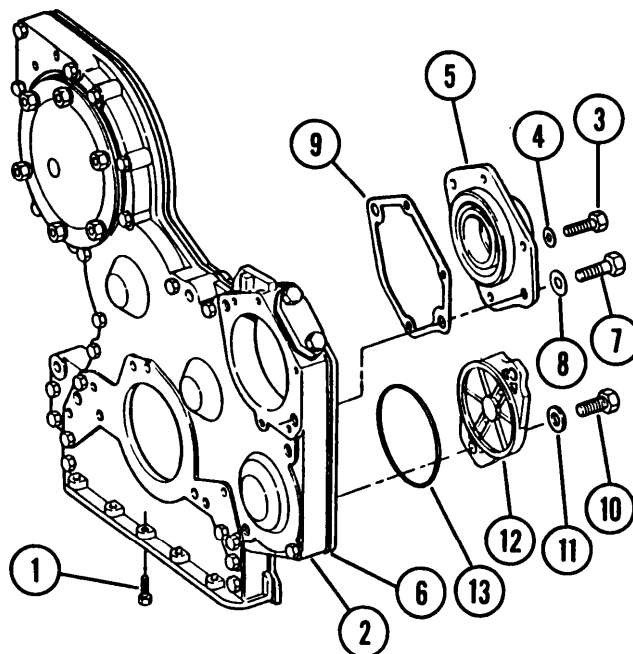
Seal (13)  
 Gaskets (9, 22, 26, 30, 33)  
 Gasket Cement (App. B, Item 1)  
 Plastigage  
 Engine Oil OE/HDO-30 (Refer to L05-2410-237-12)

Equipment Condition

Fan and fan drive adapter removed, See TM5-2410-237-20.  
 Water pump assembly removed, see TM5-2410-237-20.  
 Crankshaft pulley removed, see page 3-65  
 Crankshaft front seal and wear sleeve removed, see page 3-59.  
 Engine trunion removed, see page 3-22.  
 Alternator mounting brackets removed, see TM5-2410-237-20.

a. Removal

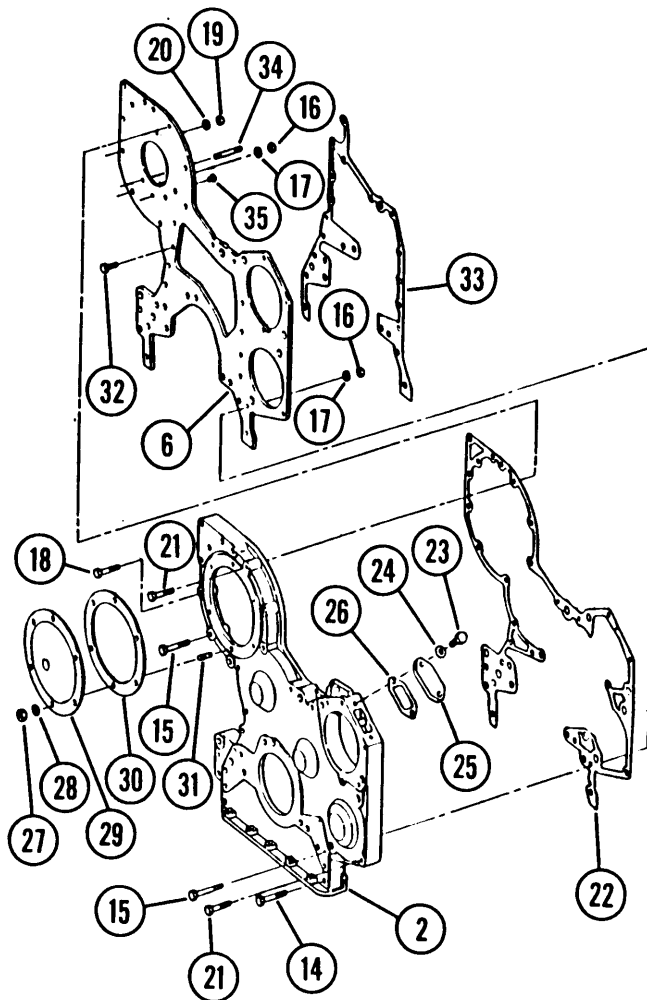
- (1) Fasten lifting equipment to the front of the engine and lift weight of the engine from the hydraulic jacks.
- (a) Use a wrench to remove five capscrews (1) which secure the oil pan to the front housing cover (2).
- (b) Loosen remaining bolts which secure the oil pan to the engine block. Put spacers between the oil pan and oil pan plate.



3-20. FRONT HOUSING COVERS - REPLACE/REPAIR (Cont'd)

(c) Lower the engine onto the jacks.

- (2) Use a wrench to remove three Capscrews (3) and three washers (4) that secure cover (5) to front housing plate (6).
- (3) Use a wrench to remove two capscrews (7) and two washers (8) that secure cover (5) to front housing plate (6). Remove cover and gasket (9). Discard gasket.
- (4) On tractors equipped with a ripper, use a wrench to remove two capscrews (10) and two washers (11) that secure cover (12) to front housing plate (6). Remove cover and seal (13). Discard seal (13).
- (5) Use a wrench to remove twelve capscrews (14) that secure the front housing cover (2) to the block assembly.
- (6) Use two wrenches to remove three capscrews (15), three nuts (16) and three washers (17) that secure front housing cover (2) to front housing plate (6).
- (7) Use two wrenches to remove one capscrew (18), one nut (19) and one washer (20) that secure front housing cover (2) to housing plate (6).
- (8) Use a wrench to remove two capscrews (21) that secure the front housing cover (2) to the block assembly. Remove front housing cover from block assembly.
- (9) Remove and discard gasket (22) from the front housing cover surface that contacts the front housing plate (6).

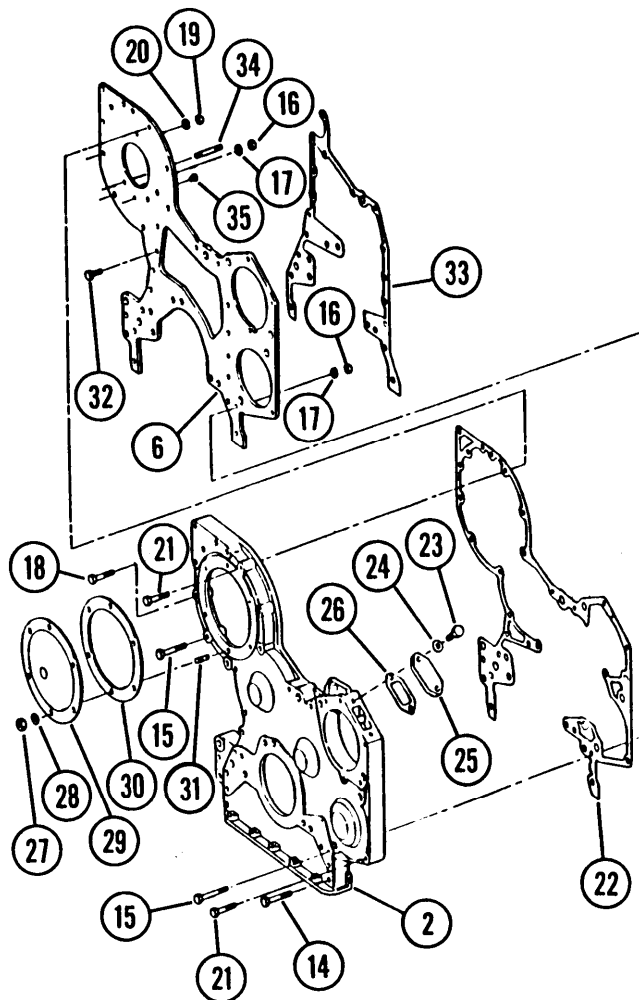


## 3-20. FRONT HOUSING COVERS - REPLACE/REPAIR (Cont' d)

- (10) Use a wrench to remove two capscrews (23), two washers (24), cover (25) and gasket (26) from front housing cover (2). Discard gasket.
- (11) Use a wrench to remove six nuts (27), six washers (28), cover (29) and gasket (30) from front housing cover (2).
- (12) If necessary, remove six studs (31) from front housing cover (2).
- (13) Remove timing gears from the engine. See page 3-108.
- (14) Use a wrench to remove six capscrews (32) and front housing plate (6) from block assembly. Remove and discard gasket (33).
- (15) If necessary, remove three studs (34) from front housing plate (6).
- (16) If necessary, remove plug (35) from front housing plate (6).

b. Installation

- (1) If plug (35) was removed, install it in front housing plate (6).
- (2) If three studs (34) were removed, install them in front housing plate (6).
- (3) Install a new gasket (22) on front housing plate (6). Cut the gasket even with the bottom face of the cylinder block. Put gasket cement on the bottom of the gasket where it makes contact with the gasket of the oil pan plate.
- (4) Install a new gasket (33) on back of front housing plate (6).



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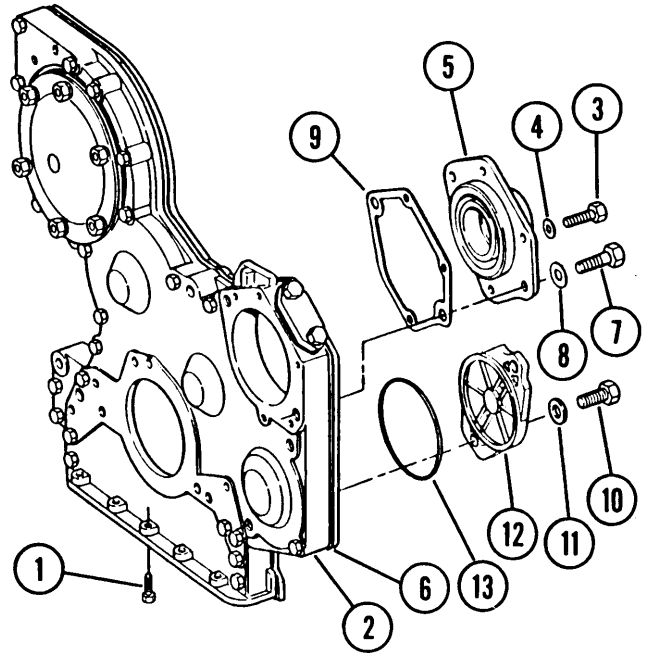
**3-20. FRONT HOUSING COVERS - REPLACE/REPAIR (Cont'd)**

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- (5) Install the front housing plate (6) on block assembly and secure with six capscrews (32). Use a wrench to tighten capscrews.
- (6) Install timing gears on engine. See page 3-108.
- (7) If six studs (31) were removed, install them in front housing cover (2).
- (8) Install the front housing cover (2) in position on the front housing plate (6). Use a wrench to install two capscrews (21) which secure the front housing cover to the block assembly.
- (9) Use two wrenches to install one capscrew (18), one nut (19), and one washer (20) which secure the front housing cover (2) to the front housing plate (6).
- (10) Use two wrenches to install three capscrews (15), three nuts (16), and three washers (17) which secure the front housing cover (2) to front housing plate (6).
- (11) Use a wrench to install twelve capscrews (14) which secure the front housing cover (2) to the block assembly.
- (12) Install a cover (25) and a new gasket (26) onto front housing cover (2). Use a wrench to install two capscrews (23) and two washers (24) which secure cover.
- (13) Install cover (29), gasket (30), six washers (28) and six nuts (27) onto front housing cover (2). Use a wrench to tighten nuts to 15-25 lb. ft.

## 3-20. FRONT HOUSING COVERS - REPLACE/REPAIR (Cont' d)

- (14) On tractors equipped with ripper, install cover (12) with seal (13), two washers (11), and two capscrews (10) onto front housing plate (6). Use a wrench to tighten capscrews.
- (15) Install cover (5), new gasket (9), two washers (8), and two capscrews (7) onto front housing plate (6). Use a wrench to tighten capscrews.
- (16) Use a wrench to install three capscrews (3) and three washers (4) which secure cover (5) to front housing plate (6).
- (a) Fasten lifting equipment to the front of the engine. Lift the engine until weight is off the hydraulic jacks.
- (b) Remove spacers which were installed between the oil pan and oil plate.
- (c) Tighten bolts which secure the oil pan to the block.
- (17) Use a wrench to install five capscrews (1) which attach the oil pan to the front housing cover (2).
- (18) Lower the engine onto the hydraulic jacks.
- (19) Install alternator mounting brackets, see TM5-2410-237-20.
- (20) Install engine trunnion, see page 3-22.
- (21) Install crankshaft front seal and wear sleeve, see page 3-59.
- (22) Install crankshaft pulley, see page 3-65.





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3-20. FRONT HOUSING COVERS - REPLACE/REPAIR (Cont'd)

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(23) Install water pump assembly, see TM5-2410-237-20.

(24) Install fan and fan drive adapter, see TM5-2410-237-20.

c. Place In Service

Run engine and check for proper operation.

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### 3-21. VALVE MECHANISM - REPLACE

---

This task covers:

- a. Removal
  - b. Cleaning
  - c. Inspection
  - d. Installation
  - e. Place In Service
- 

#### INITIAL SETUP

##### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Shop Equipment, Machine Shop:  
Field Maintenance, Basic  
NSN 3470-00-754-0708

##### Materials/Parts

Cleaning Solvent (App. B, Item 19)  
Lubricating Oil OE/HD0-30 (See L05-2410-237-12)  
Anti-Seize Compound (App. B, Item 2)  
Packing (12)  
Plugs (22)

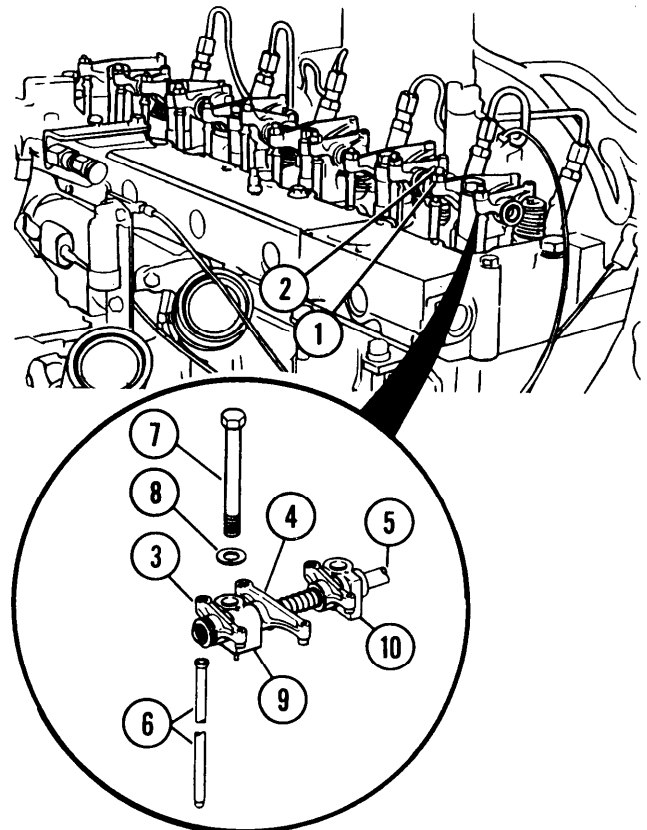
##### Equipment Condition

Valve mechanism cover removed, see TM5-2410-237-20.

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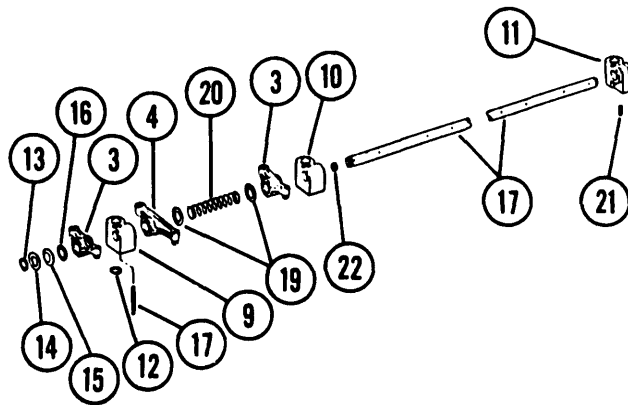
#### a. Removal

- (1) Use a wrench to remove twelve nuts (1) and use a flat blade screwdriver to remove twelve adjustment screws (2) which secured rocker arms (3 and 4) on rocker shaft (5) to push rods (6).
- (2) Use a wrench to remove six capscrews (7) and six washers (8) which secured six brackets (9, 10, and 11) on rocker shaft assembly (5) to cylinder head assembly.
- (3) Remove rocker shaft (5) from cylinder head assembly.
- (4) Remove twelve push rods (6) from cylinder head and block assemblies.



**3-21. VALVE MECHANISM - REPLACE (Cont'd)**

- (5) Remove and discard one packing (12) from bracket (9).
- (6) Use a flat blade screwdriver to remove retaining ring (13), washer (14), spring (15), and washer (16) from each end of rocker shaft (17).
- (7) Remove one small (intake) rocker arm (3).
- (8) Remove one dowel pin (18) from bracket (9). Remove bracket from rocker shaft (17).
- (9) Remove six large (exhaust) rocker arms (4), ten washers (19), five springs (20), five rocker arms (3), four brackets (10) and one bracket (11) from rocker shaft (17) |
- (10) Remove one dowel pin (21) from bracket (11).
- (11) Remove one plug (22) from each end of rocker shaft (17). Discard two plugs.



b. Cleaning

**WARNING**

Compressed air used for cleaning purposes will not exceed 30 psi. Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).

Thoroughly clean all parts in an approved cleaning solvent (see page 2-29) and dry with low pressure air (30 psi or less).

3-21. VALVE MECHANISM - REPLACE (Cont' d)

c. Inspection

- (1) Inspect rocker shaft washers for distortion or other damage, and replace if necessary.
- (2) Inspect brackets for excessive wear, cracks, or other damage, and replace if necessary.
- (3) Inspect rocker shaft springs for distortion, excessive wear, or other damage. Replace a damaged rocker shaft.
- (4) Inspect dowel pins for defects. Replace a bent or out-of-round pin.
- (5) Inspect rocker arms for any signs of excessive wear or other damage. Refer to Table 3-5 for rocker arm wear limits and specifications. If measurements are not within the specified limits, or if a rocker arm is damaged in any way, replace rocker arm.

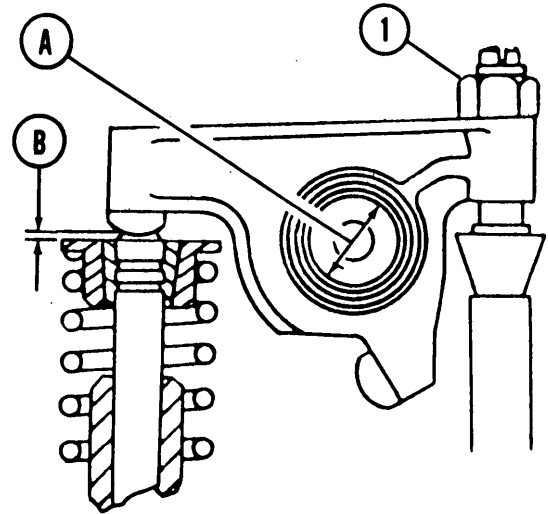


TABLE 3-5

(1) Bore (dimension "A") in bearing for shaft (new)	18.448 ± 0.013 mm (0.7263 ± 0.0005 in.)
Diameter of shaft (new)	18.402 ± 0.013 mm (0.72451 ± 0.0005 in.)
Maximum permissible clearance between bearing and shaft (worn)	0.20 mm (0.008 in.) X 0.008
(2) Torque for Locknut (1) on valve adjustment screw	29 ± 7 N·m (21 ± 5 lb. ft.)
(3) Clearance (dimensions "B") for valves:	
Intake valves	0.38mm (0.015 in.)
Exhaust valves	0.64mm (0.025 in.)

3-21. VALVE MECHANISM - REPLACE (Cont'd)

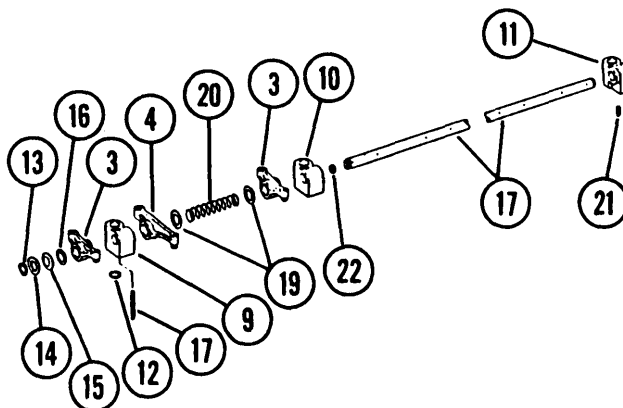
- (6) Inspect push rods for a bent condition, excessive wear, or other damage. Replace a damaged or defective push rod.
- (7) Inspect rocker shaft for excessive wear, bent condition, or other damage. Replace a damaged or defective rocker shaft.
- (8) See page 2-32 for general Inspection Instructions.

d. Installation

CAUTION

Do not use old plugs (22), as worn or defective plugs could cause loss of oil pressure.

- (1) Install a new plug (22) into each end of rocker shaft (17).
- (2) Install washer (16), spring (15), washer (14), and retaining ring (13) onto one end of rocker shaft (17).
- (3) Install a large (exhaust) rocker arm (4), bracket (11) with dowel pin (21), a small (intake) rocker arm (3), washer (19), spring (20), and another washer (19).
- (4) Install remaining five rocker arms (4), two support brackets (9 and 10), eight washers (19), four springs (20), and five rocker arms (3) onto rocker shaft (17).
- (5) Align hole in bracket (9) with hole in rocker shaft (17). Use a hammer to install dowel in (18) into bracket and shaft. The dowel pin must extend 0.378" above the bracket.



3-21. VALVE MECHANISM - REPLACE (Cont'd)

- (6) Install washer (16), spring (15), washer (14) and retaining ring (13) onto the other end of the rocker shaft (17).
- (7) Lightly coat all rocker shaft components with clean OE/HDO 30 lubricating oil.

NOTE

Each time the capscrew (7) is removed, a new packing (12) must be installed in the bracket (9).

- (8) Install a new packing (12) into bracket (9).

NOTE

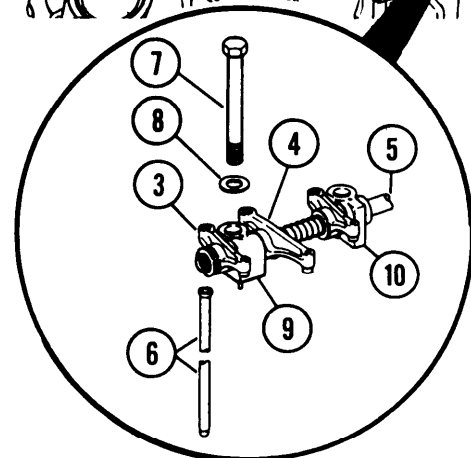
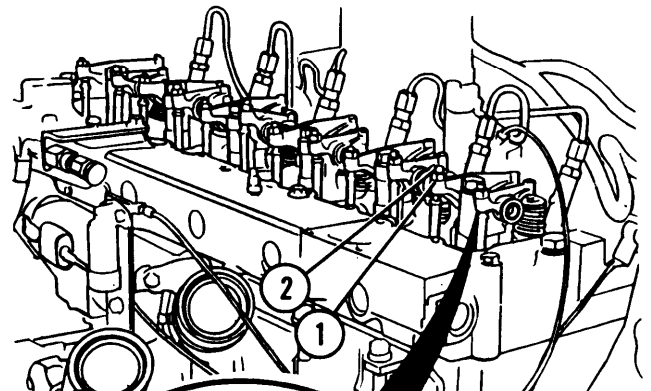
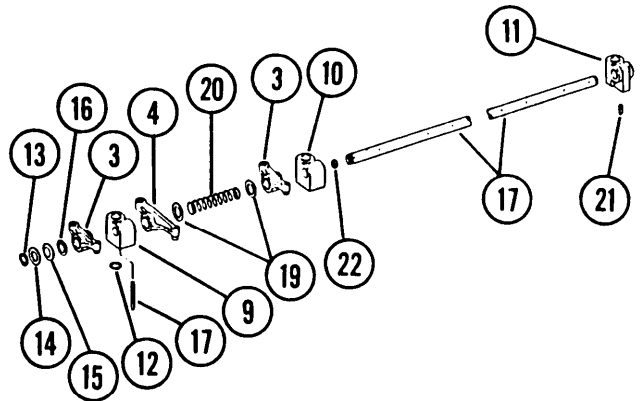
If the original valve lifters are to be installed in the engine, ensure that they are installed in their original locations.

- (9) Install push rods (6) into cylinder head block assemblies.

CAUTION

The dowel pins in the brackets must be in alignment with the holes in the cylinder head. If the pins and holes are not properly aligned when the rocker shaft capscrews are installed and tightened, damage to the rocker shaft could occur.

- (10) Align dowel pins in the brackets (9 and 11) with the holes in the cylinder head assembly, and place rocker shaft (5) in position.

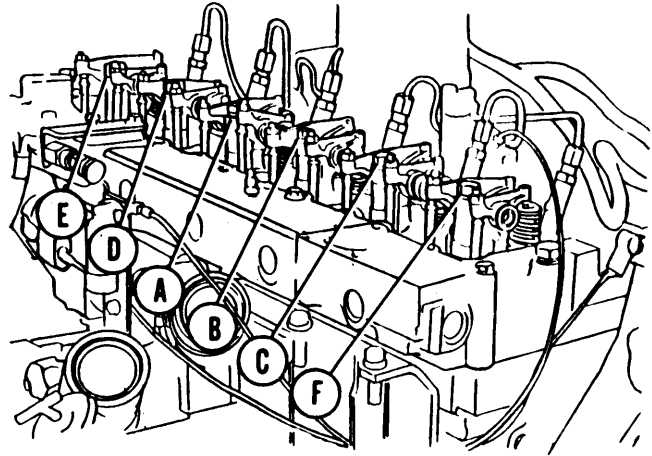


3-21. VALVE MECHANISM - REPLACE (Cont'd)

(11) Put anti-seize compound on the threads of capscrews (7). Install six capscrews and six washers (8) to brackets (9, 10 and 11) which secure the rocker shaft (5) to the cylinder head assembly.

(12) Refer to the illustration and tighten the capscrews (7) as follows:

- (a) Use a wrench to tighten the capscrews, in letter sequence, to torque of 115 lb. ft.
- (b) Use a wrench to tighten the capscrews, in letter sequence, to torque of 185±13 lb. ft.
- (c) Again, tighten the capscrews in letter-sequence, to torque of 185±13 lb. ft.



(13) If new rocker arms (3 or 4) were installed, install new adjustment screws (2) and nuts (1). Use a flat blade screwdriver to install twelve screws and use a wrench to install twelve nuts which secure rocker arms on the rocker shaft assembly (5) to push rods (6).

(14) Adjust the valve mechanism, see TM5-2410-237-20.

(15) Install the valve mechanism cover, see TM5-2410-237-20.

e. Place In Service

Run engine and check for proper operation.

---

### 3-22. VALVE LIFTERS - REPLACE

---

This task covers:

- a. Removal
  - b. Cleaning
  - c. Inspection
  - d. Installation
  - e. Place In Service
- 

#### INITIAL SETUP

##### Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Shop Equipment, Machine Shop:  
Field Maintenance, Basic  
NSN 3470-00-754-0708

##### Materials/Parts

Cleaning Solvent (App. B, Item 19)  
Lubricating Oil OE/HDO 30 (See  
L05-2410-237-12)  
Tags NSN 8135-00-178-9151

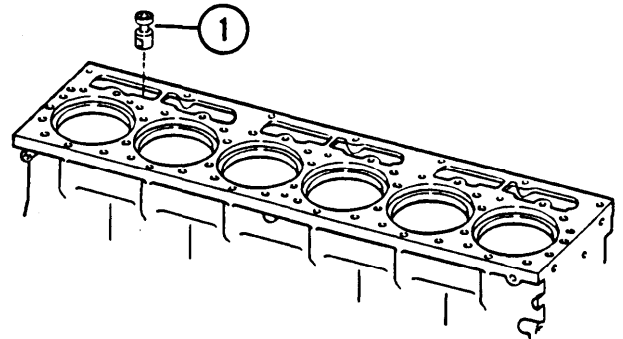
##### Equipment Condition

Cylinder head removed,  
see page 3-30.

---

#### a. Removal

- (1) Identify valve lifter locations.  
IF ORIGINAL LIFTERS ARE  
REINSTALLED, THEY MUST BE PLACED  
IN THEIR ORIGINAL LOCATIONS.  
Tag lifters for installation.
- (2) Use a magnet to remove valve  
lifters (1).



#### b. Cleaning

##### WARNING

Compressed air used for cleaning purposes will not exceed 30 psi. Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).



3-22. VALVE LIFTERS - REPLACE (Cont'd)

Clean valve lifters and valve lifter bores in the cylinder block with an approved cleaning solvent (See page 2-29). Dry thoroughly using low pressure air (30 psi or less).

c. Inspection

- (1) Refer to Table 3-6 for wear limits and specifications applicable to valve lifters. If diameter of valve lifter is not within the specified limits, replace the valve lifter.
- (2) Refer to Table 3-6 for valve lifter bore specifications. If valve lifter bore in cylinder block is not within the limits specified, the engine must be rebuilt.
- (3) See page 2-32 for general Inspection Instructions.

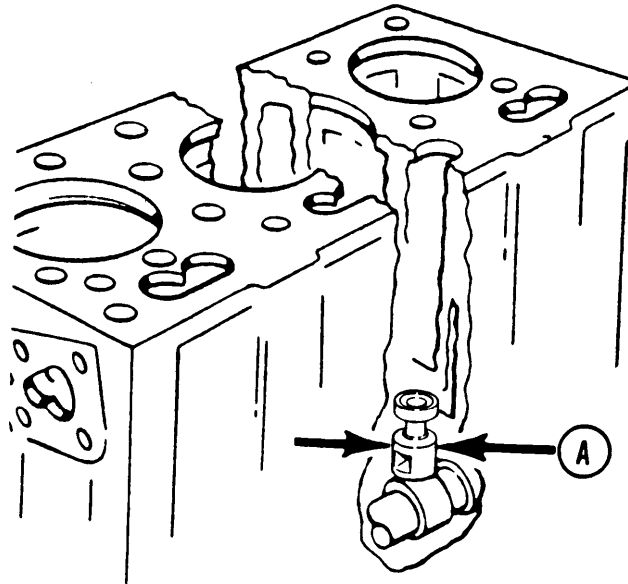


TABLE 3-6

(1) Diameter (dimension "A") of valve lifter (new)	33.287 ± 0.013 mm (1.3105 ± 0.0005 in.)
Bore (dimension "A") in block for valve lifter (new)	33.388 ± 0.050 mm (1.3145 ± 0.0020 in.)
Maximum permissible clearance between lifter and bore for valve lifter (worn)	0.30 mm (0.012 in.)

---

### 3-22. VALVE LIFTERS - REPLACE (Cont'd)

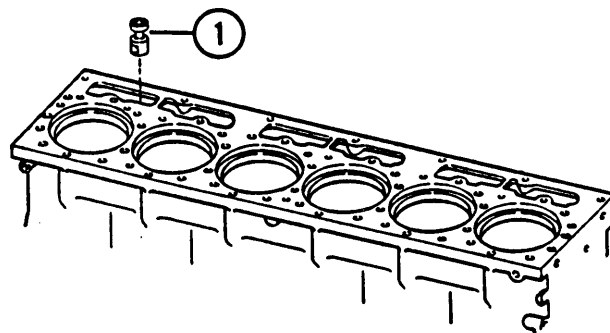
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#### d. Installation

##### NOTE

If original valve lifters are being installed, they **MUST** be installed in their original locations.

- (1) Coat valve lifters and camshaft lobes with clean OE/HDO-30 lubricating oil.
- (2) Use a magnet to install the valve lifters (1) into the cylinder block.
- (3) Install cylinder head. See page 3-30.



#### e. Place In Service

Run engine and check for proper operation.

3-23. CAMSHAFT AND CAMSHAFT BEARINGS - REPLACE

This task covers:

- a. Removal
- b. Installation
- c. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Shop Equipment, Machine Shop:  
 Field Maintenance, Basic  
 NSN 3470-00-754-0708

Materials/Parts

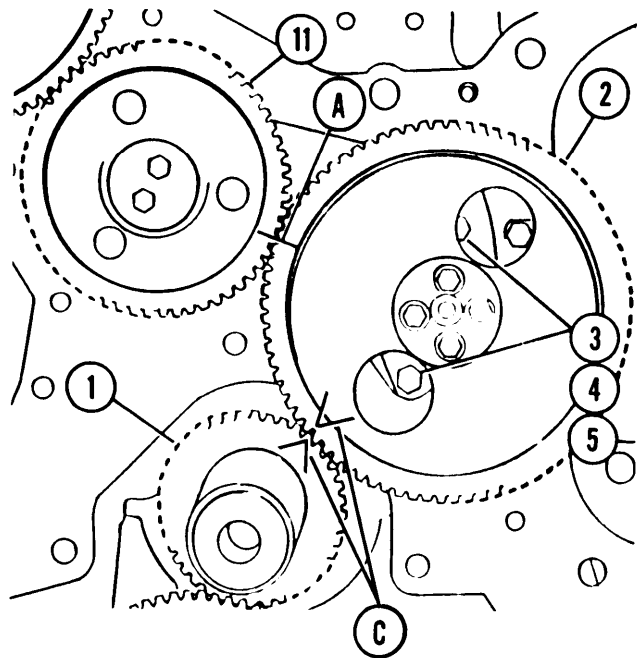
Grease (App. B, Item 6)  
 Engine Oil OE/HDO-30 (See L05-2410-237-12)

Equipment Condition

Valve lifters removed. See page 3-101.  
 Timing gears and front housing plate removed. See page 3-108.  
 Engine oil pan plate removed. See page 3-119.

a. Removal

- (1) Turn the crankshaft until the "C" mark on crankshaft gear (1) is in alignment with the "C" mark on camshaft gear (2).
- (2) Put a mark on the teeth of idler gear and camshaft at location (A). The timing of the fuel injection pump will be correct if the gear teeth have marks.
- (3) Use a wrench to remove camshaft capscrews (3), lock (4) and thrust washer (5).

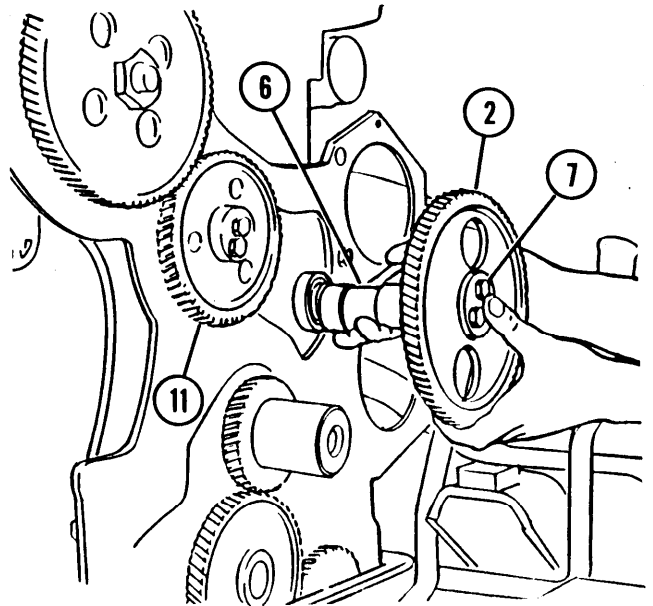


## 3-23. CAMSHAFT AND CAMSHAFT BEARINGS - REPLACE (Cont'd)

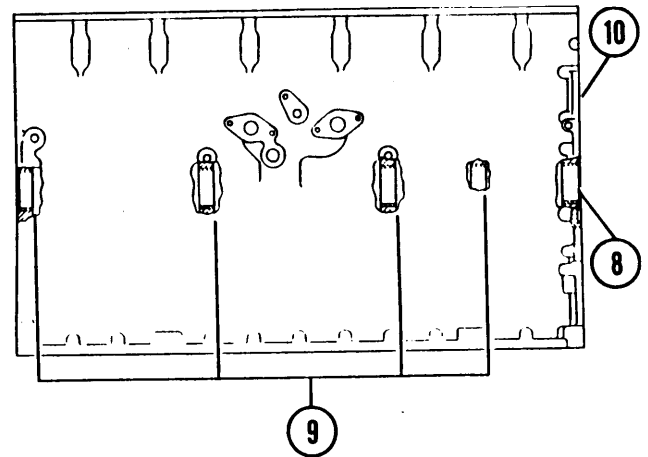
CAUTION

Remove the camshaft with care to avoid damaging the bearing. If bearing is not damaged, do not remove.

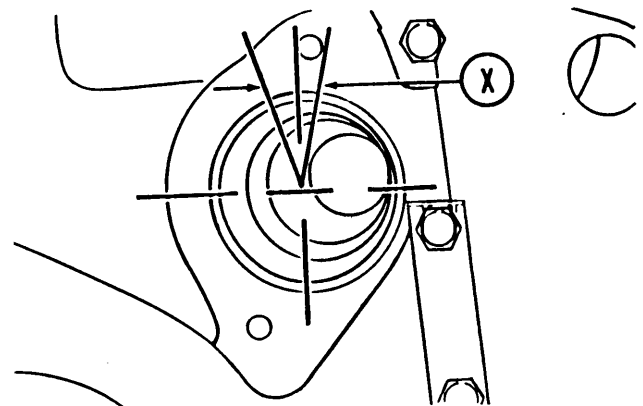
- (4) Pull the camshaft (6) out of the cylinder block.
- (5) Use a wrench to remove the capscrews (7) from the camshaft gear (2). Remove the gear (2) from the camshaft (6).



- (6) If necessary to remove bearings, use bearing puller to remove bearing (8) and four bearings (9) from cylinder block (10).

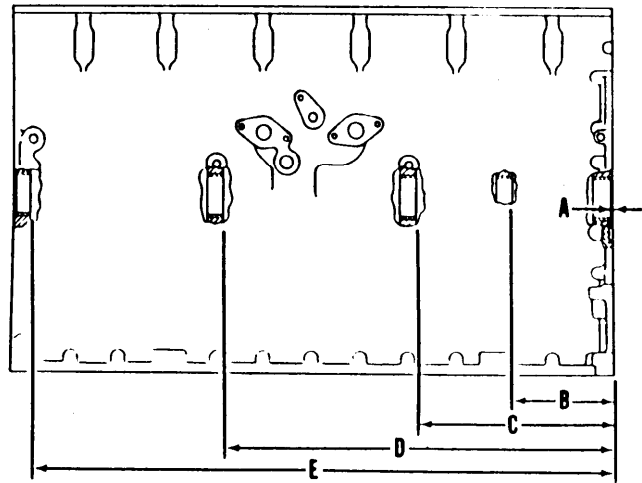
b. Installation

- (1) Use a suitable bearing installation tool to install the front bearing (9) (the bearing with two oil holes) in the cylinder block with the bearing oil holes in alignment with the oil holes in a horizontal position and with the bearing joint at the top. The bearing joint angle must be within the 15° from vertical position (X). The installation depth or dimension A of the front bearing from the front face of the block is 0.02±0.02 in.

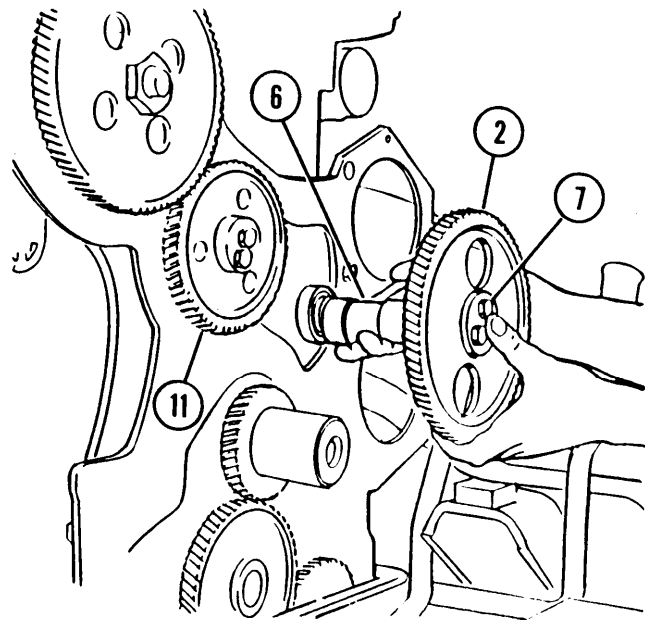


3-23. CAMSHAFT AND CAMSHAFT BEARNINGS - REPLACE (Cont'd)

- (2) Install the remainder of the bearings with the bearing oil hole in alignment with the oil hole in the cylinder block. Install bearings to the dimensions given from the front face of the block: B)  $6.06 \pm 0.02$  in., C)  $11.94 + 0.02$  in., D)  $23.69 \pm 0.02$  in., E)  $35.60 \pm 0.02$  in.



- (3) put the gear (2) for the camshaft (6) in position on the end of the camshaft. Use a wrench to install the capscrews (7) that hold it.
- (4) Put clean engine oil on the bearing journals of the camshaft (6). put grease on the lobes of the cam.



**CAUTION**

Install camshaft with care to avoid damaging bearing.

- (5) Install camshaft (6) in the cylinder block with the timing marks on the camshaft gear (2), idler gear (11) and the crankshaft gear (1) in alignment.

---

 3-23. CAMSHAFT AND CAMSHAFT BEARINGS - REPLACE (Cont'd)
 

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(6) Install the thrust washer (5), the lock (4) and the capscrews (3) that hold the camshaft in the cylinder block. Tighten capscrews to 35-40 lb. ft.

(7) Check the timing of the engine. See page 4-33.

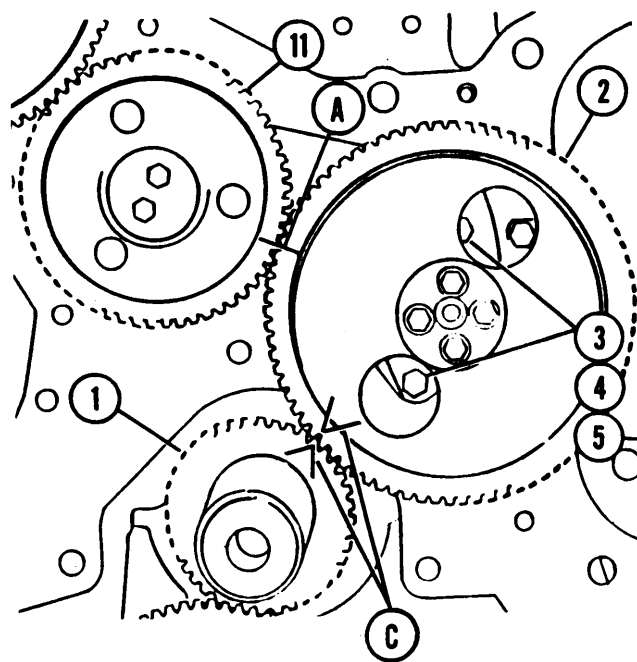
(8) Install valve lifters. See page 3-101.

(9) Install front housing plate and timing gears. See page 3-108.

(10) Install engine oil pan plate. See page 3-119.

c. Place In Service

Run engine and check for proper operation.



3-24. TIMING GEARS, BEARINGS AND TIMING GEAR PLATE - REPLACE

This task covers:

- a. Removal
- b. Installation
- c. Place In Service

INITIAL SETUP

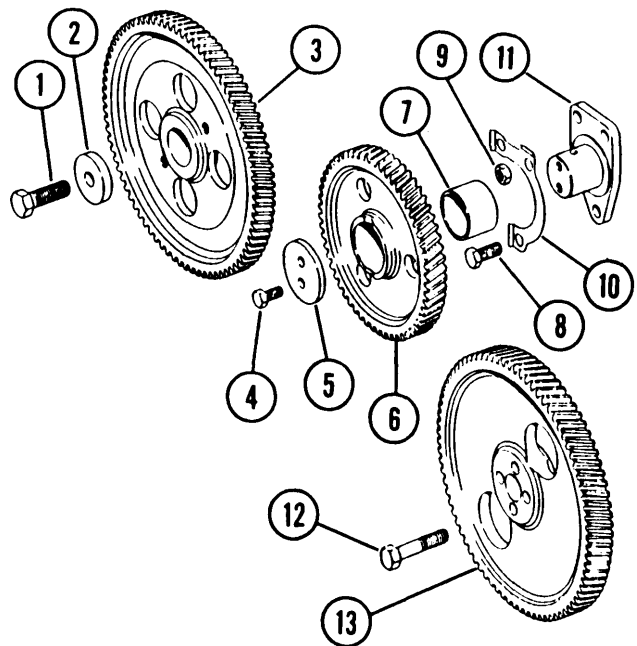
Applicable Configurations  
All

Equipment Condition  
Front housing removed. See page 3-89.

Common Tools  
Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Shop Equipment, Machine Shop:  
Field Maintenance, Basic  
NSN 3470-00-754-0708

a. Removal

- (1) Use a wrench to remove capscrew (1) and washer (2) from gear (3).
- (2) Install a puller on gear (3) and remove gear from engine.
- (3) Use a wrench to remove two capscrews (4) and plate (5).
- (4) Remove gear (6) from the engine. If necessary use a press to remove bearing (7) from gear (6).
- (5) Use a wrench to remove two capscrews (8), one nut (9) and lock (10). Remove shaft (11) from the engine.



NOTE

If necessary, use a soft rubber hammer to tap gear (13).

---

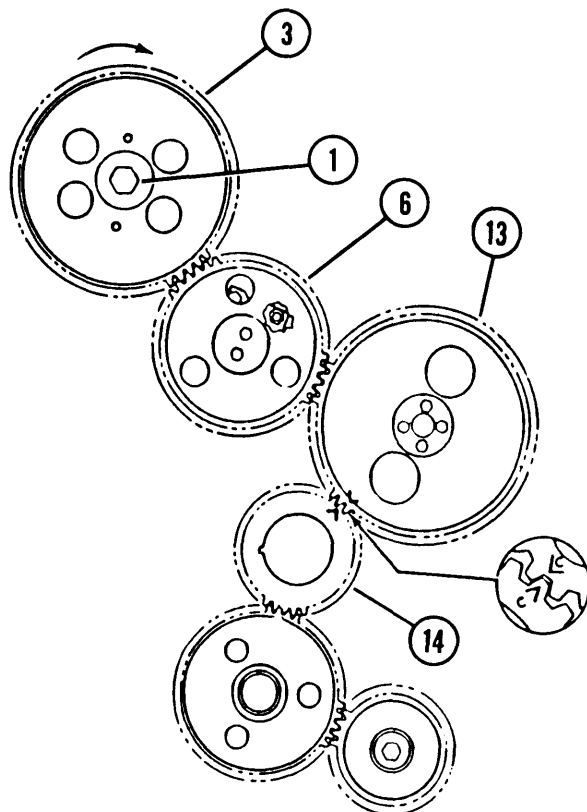
 3-24. TIMING GEARS, BEARINGS AND TIMING GEAR PLATE - REPLACE (Cont'd)
 

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- (6) Use a wrench to remove four capscrews (12) from gear (13). Remove gear (13) from the engine.
- (7) Remove the timing gear plate (page 3-89).

b. Installation

- (1) Install the timing gear plate (page 3-89).
- (1A) Locate no. 1 cylinder TDC (top dead center) on the compression stroke. See TM5-2410-237-20.
- (2) With the engine set at TDC, install camshaft gear (13) so that the "C" mark on the camshaft gear is aligned with the "C" mark on the crankshaft gear (14).
- (3) Use a wrench to install four capscrews (12) that secure camshaft gear (13). Tighten to 35-45 lb. ft.
- (4) Place shaft (11) and lock (10) into position and use a wrench to install capscrew (8) and nut (9). Bend tabs over on lock (10).
- (5) If removed, install bearing (7) into gear (6) using a press so bearing is 0.060" below the outside surface. Bearing diameter after installation must be  $1.3781 \pm 0.0019$  in.
- (6) Install gear (6) on shaft (11) and install washer and two capscrews (4) that secure gear (6). Use a wrench to tighten capscrews (4).
- (7) Refer to page 4-26 to install timing pin in fuel injection pump.





3-24. TIMING GEARS, BEARINGS AND TIMING GEAR PLATE - REPLACE (Cont'd)

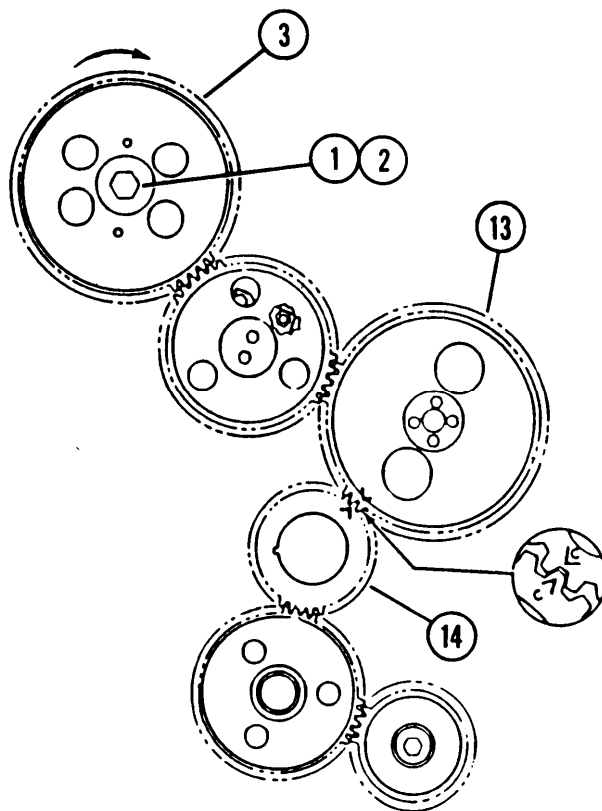
(8) With timing pin installed in fuel injection pump and "C" marks on the camshaft gear (13) and the crankshaft gear (14) aligned, install gear (3).

(9) Use a wrench to install capscrew (1) and washer (2) that secure gear (3) to the engine. Place a clockwise force of 50 lb. ft. on the fuel pump drive gear (3). Tighten capscrew (1) to 200±20 lb. ft.

(10) Install front housing cover.  
See page 3-89.

c. Place In Service

Run engine and check for proper operation.



3-25 I ENGINE OIL PUMP - REPLACE/REPAIR

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning
- d. Inspection
- e. Lubrication
- f. Assembly
- g. Installation
- h. Place In Service

INITIAL SETUP

Applicable Configurations

All

Personnel Required

MOS62B (2)

Common Tools

Shop Equipment, General Purpose Repair; Semi-Trailer Mounted NSN 4940-00-287-4894  
 Shop Equipment, Field Maintenance, Basic NSN 3470-00-754-0708  
 Arbor Press

Materials/Parts

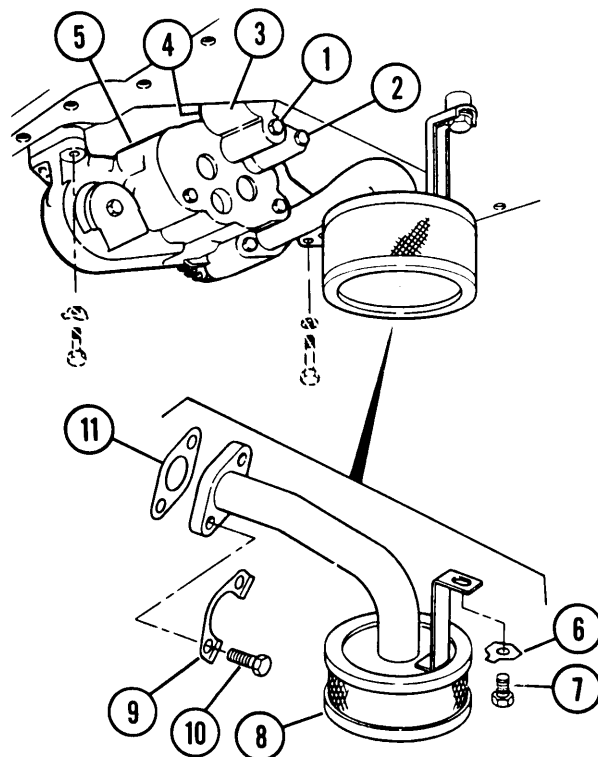
Gasket (4)  
 Lubricating Oil OE/HDO-30 (Refer to L05-2410-237-12)

Equipment Condition

Oil pan removed. See page 3-117.

a. Removal

- (1) Use a wrench to remove two capscrews (1 and 2). Loosen and remove elbow (3) and gasket (4) from the pump body (5). Discard gasket (4).
- (2) Bend lock (6) away from capscrew (7) on the strainer assembly (8) support. Use a wrench to remove capscrew and lock.
- (3) Bend locks (9) away from two capscrews (10). Use a wrench to remove two capscrews and strainer assembly (8). Remove and discard gasket (11).

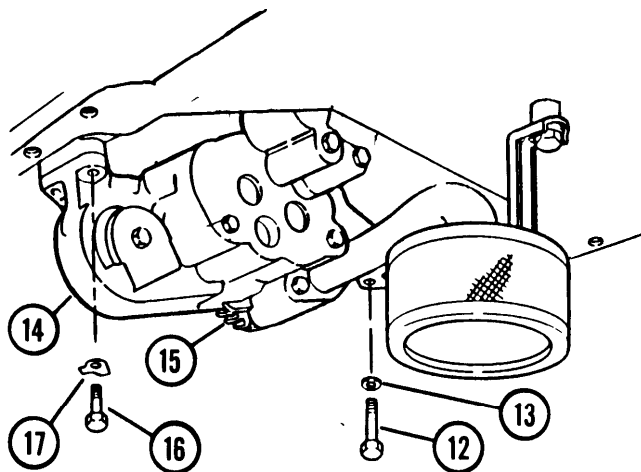


3-25. ENGINE OIL PUMP - REPLACE/REPAIR (Cont'd)

**WARNING**

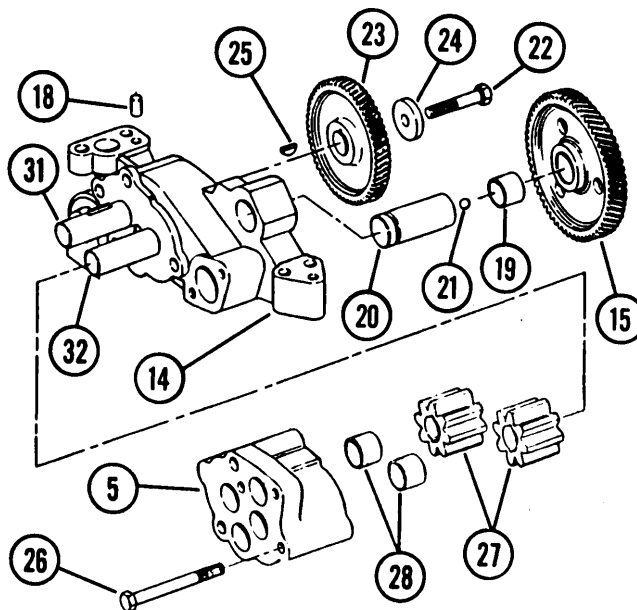
The oil pump idler gear is free to fall when the oil pump is removed.

- (4) Have assistant hold onto pump (14) and idler gear (15). Use a wrench to remove two capscrews (12) and two washers (13). Remove pump.
- (5) Use a wrench to remove two capscrews (16), two locks (17) and oil pump (14).



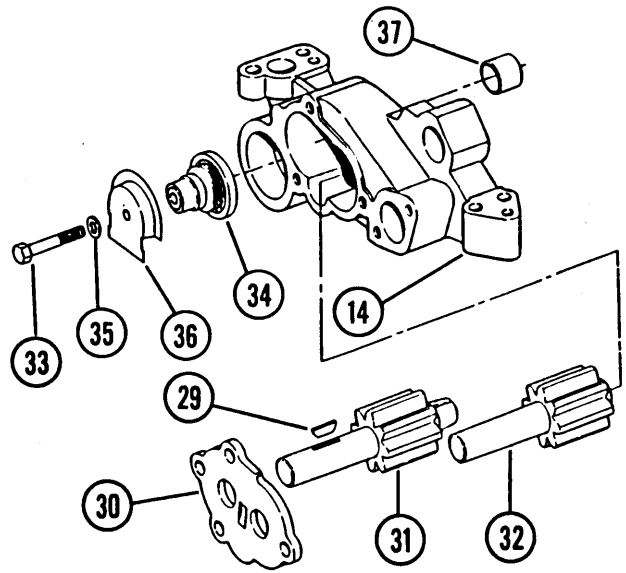
b. Disassembly

- (1) If necessary, remove dowel (18).
- (2) Remove idler gear (15) from oil pump (14).
- (3) Use an arbor press to remove bearing (19) from idler gear (15), if necessary.
- (4) If necessary, use an arbor press to remove shaft (20) and inside ball bearing (21).
- (5) Use a wrench to remove capscrew (22) from pump drive gear (23). Remove washer (24).
- (6) Use puller tooling to remove pump drive gear (23) from shaft (20).
- (7) Use pliers to remove key (25) from shaft (20).
- (8) Use a wrench to remove three capscrews (26) from pump body (5).
- (9) Remove pump body (5) and two gears (27).



3-25. ENGINE OIL PUMP - REPLACE/REPAIR (Cont'd)

- (10) Use an arbor press to remove two bearings (28) from pump body (5), if necessary.
- (11) Use pliers to remove key (29), spacer (30), and two shaft assemblies (31 and 32).
- (12) Use a wrench to remove capscrew (33) which secured valve assembly (34) in pump body (14).
- (13) Remove washer (35), cover (36) and valve assembly (34).
- (14) Use an arbor press to remove two bearings (37) from pump body (14), if necessary.



c. Cleaning

See Cleaning Instructions, page 2-29.

d. Inspection

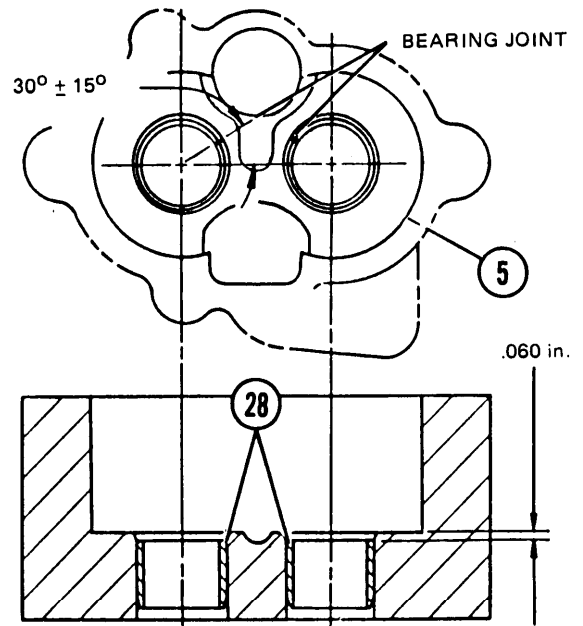
See page 2-32 for general Inspection Instructions.

e. Lubrication

Lubricate all parts of the oil pump.

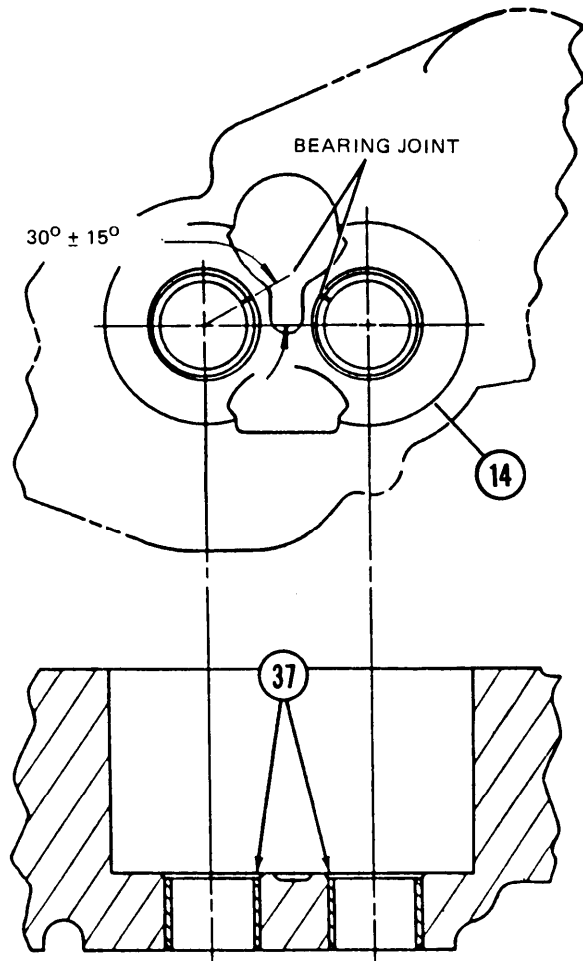
f. Assembly

- (1) Position two bearings (28) inside of pump body (5).
- (2) Use an arbor press to install each bearing (28) until they are 0.060" below inside machined surface of pump body (5). Make sure that joints in bearings are at an angle of  $30^\circ \pm 15^\circ$  from center line through bores in pump body and toward outlet passage of pump. The outlet passage has a cavity between bearing bores.

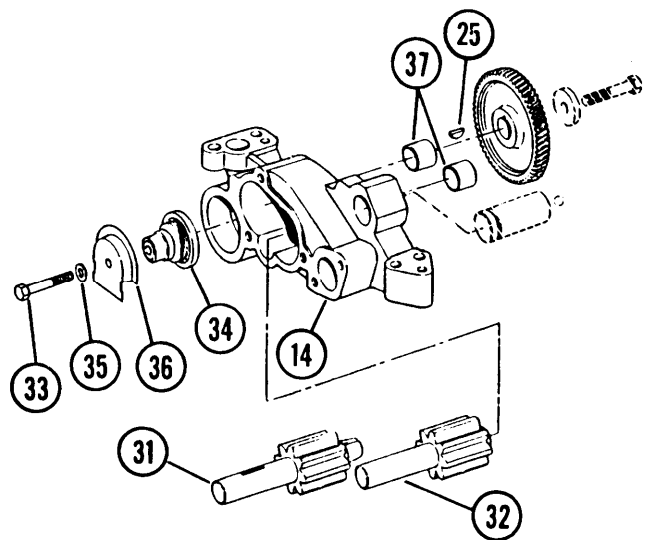


3-25. ENGINE OIL PUMP - REPLACE/REPAIR (Cont' d)

- (3) Position two bearings (37) inside of oil pump body (14).
- (4) Use an arbor press to install each bearing (37) until they are even with outside of oil pump body (14). Make sure that joints in bearings are at an angle of  $30^{\circ} \pm 15^{\circ}$  from center line through bearing bores and toward outlet passage of pump. The outlet passage has a cavity between bearing bores.

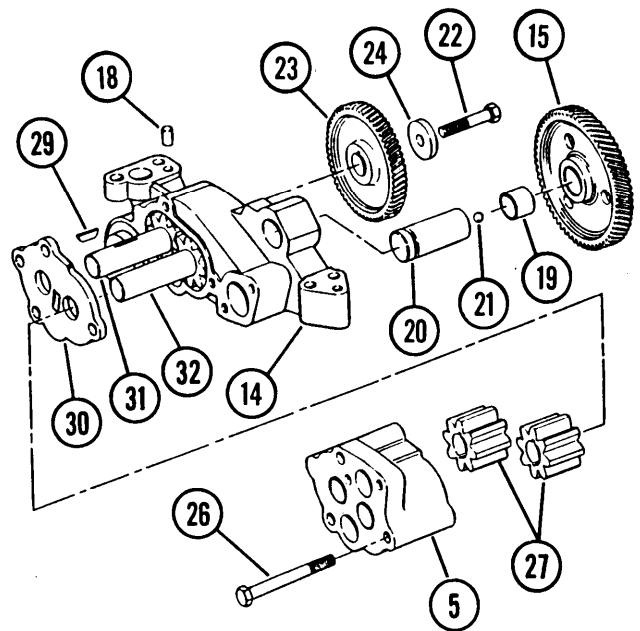


- (5) Install valve assembly (34) and cover (36).
- (6) Install capscrew (33) with washer (35) through cover (36) and valve assembly (34) to secure parts inside pump body (14). Use a wrench to tighten capscrew.
- (7) Use channel lock pliers to install key (25) into shaft assembly (31).
- (8) Install two shaft assemblies (31 and 32) into pump body (14).



## 3-25. ENGINE OIL PUMP - REPLACE/REPAIR (Cont'd)

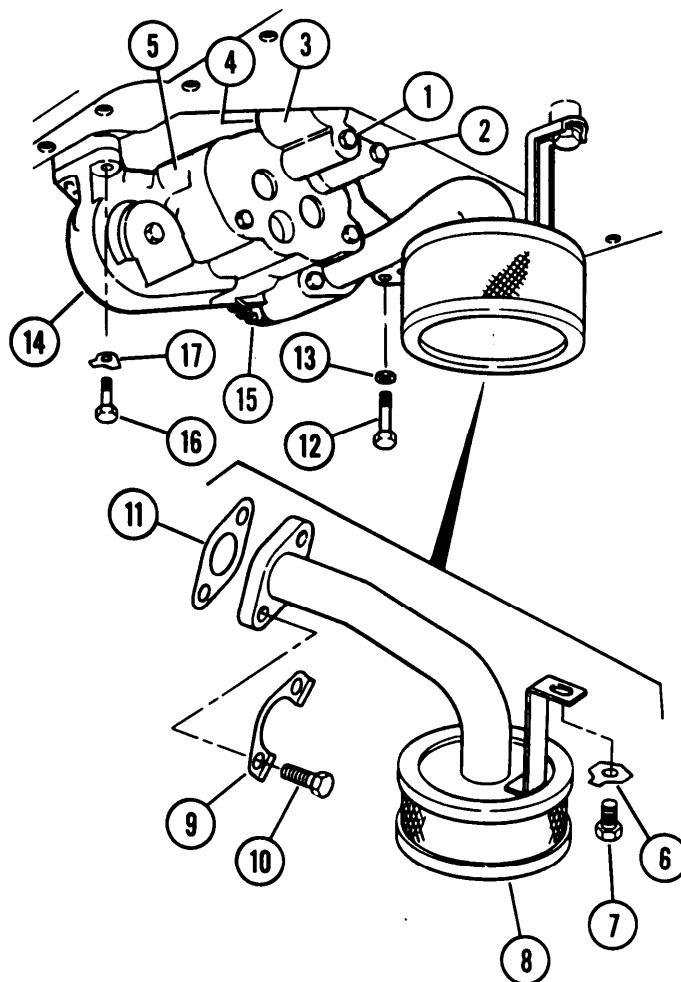
- (9) Install spacer (30), key (29) into shaft assembly (31), two gears (27) and pump body (5).
- (10) Install pump body (5) onto shaft assemblies (31 and 32).
- (11) Install three capscrews (26) into pump body (5) and tighten with a wrench.
- (12) Install pump drive gear (23) onto shaft assembly (31) and secure with washer (24) and capscrew (22). Use a wrench to tighten capscrew to torque of  $32 \pm 5$  lb. ft.
- (13) If shaft (20) and internal ball bearing (21) were removed, install them into pump body (14).
- (14) Use an arbor press to install bearing (19) into idler gear (15). Install idler gear onto shaft.
- (15) If removal of the dowel (18) was necessary, install it.



3-25. ENGINE OIL PUMP - REPLACE/REPAIR (Cont'd)

g. Installation

- (1) Install oil pump assembly (14) in position on the engine. Have assistant hold pump and idler gear (15). Use a wrench to install two capscrews (16) and two locks (17) which secure the pump.
- (2) Install two capscrews (12) and washers (13). Use a wrench to tighten capscrews.
- (3) Place strainer assembly (8) with new gasket (11) in position. Install lock (9) and two capscrews (10). Use a wrench to tighten capscrews. Bend lock down.
- (4) Install lock (6) and capscrew (7) on the strainer assembly (8) support. Use a wrench to tighten capscrew. Bend lock down.
- (5) Install new gasket (4) and elbow (3) onto pump body (5). Install two capscrews (1 and 2) and tighten with a wrench.
- (6) Install oil pan. See page 3-117.



h. Place In Service

Run engine and check for proper operation.

---

### 3-26. OIL PAN - REPLACE

---

This task covers:

- a. Removal
  - b. Installation
  - c. Place In Service
- 

#### INITIAL SETUP

##### Applicable Configurations

All

##### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Shop Equipment, Machine Shop:  
Field Maintenance, Basic  
NSN 3470-00-754-0708  
Floor Jack

##### Materials/Parts

Gaskets (5, 12)  
10 Gallon Drain Pan  
Lint-free Rag (App. B, Item 12)

##### Equipment Condition

Engine oil filler tube removed, see TM5-2410-237-20.  
Crankcase guard removed, see TM5-2410-237-20.

---

#### a. Removal

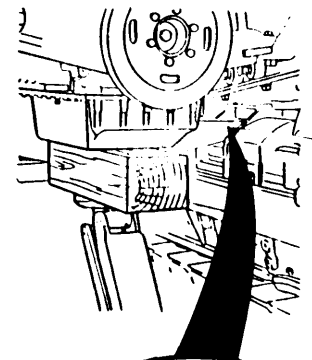
- (1) Use a wrench to remove plug 1 from adapter (2) on oil pan (3) and allow oil to drain into ten gallon container.
- (2) Use a wrench to remove two capscrews (4), adapter (2) and gasket (5) from oil pan. Discard gasket.
- (3) Position floor jack under oil pan (3).
- (4) Use a wrench to remove three 3-1/4" capscrews (6) and washers (7) which secure oil pan (3) underneath engine
- (5) Use a wrench to remove five 2-3/4" capscrews (8) and washers (9) from oil pan (3).
- (6) Use a wrench to remove twenty 1-1/2" capscrews (10) and washers (11) from oil pan (3).



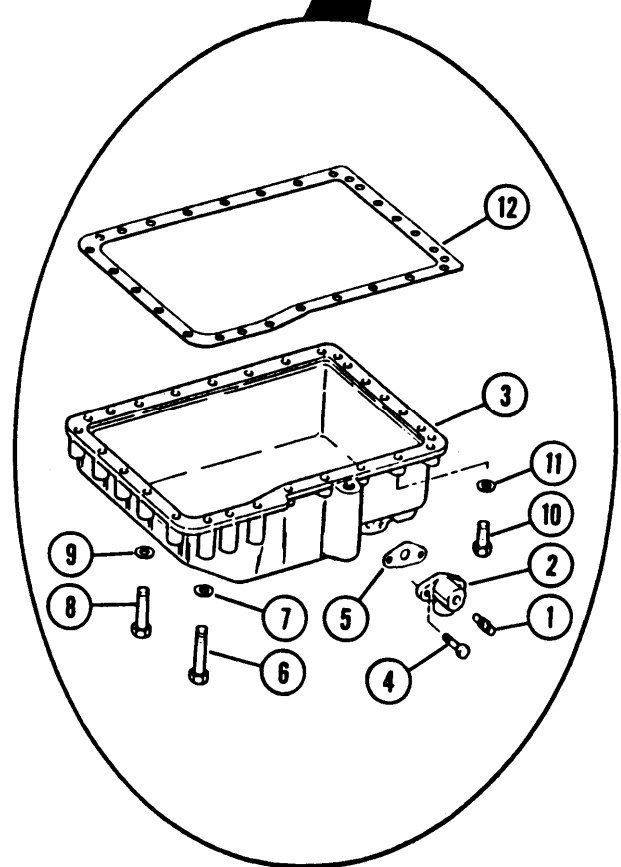
3-26. OIL PAN - REPLACE (Cont' d)

- (7) Lower floor jack, remove oil pan (3) and gasket (12) from engine. Discard gasket.

b. Installation



- (1) Wipe oil pan surface clean and install a new gasket (12).
- (2) Use a floor jack to position oil pan (3) onto engine.
- (3) Use a wrench to install twenty 1-1/2" Capscrews (10) and washers (11) which secure oil pan (3) to engine.
- (4) Use a wrench to install five 2-3/4" Capscrews (8) and washers (9) which secure oil pan (3) to engine.
- (5) Use a wrench to install three 3-1/4" Capscrews (6) and washers (7) which secure oil pan (3) to engine.
- (6) Remove floor jack from oil pan (3).
- (7) Install adapter (2) with a new gasket (5). Use a wrench to install two capscrews (4) which secure adapter to oil pan (3).
- (8) Use a wrench to install plug (1) in adapter (2) on oil pan (3).
- (9) Install engine oil filler tube, see TM5-2410-237-20.
- (10) Install crankcase guard. see TM5-2410-237-20.
- (11) Fill engine with oil, see TM5-2410-237-20.



c. Place In Service

Run engine and check for leaks and proper operation.

---

 3-27. OIL PAN PLATE - REPLACE/REPAIR
 

---

This task covers:

- a. Removal
  - b. Disassembly
  - c. Assembly
  - d. Installation
  - e. Place In Service
- 

### INITIAL SETUP

#### Applicable Configurations

All

#### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Shop Equipment, Machine Shop:  
 Field Maintenance, Basic  
 NSN 3470-00-754-0708

#### Materials/Parts

Gasket (11, 14)  
 Seal (18)  
 Lint-free Rags (App. B, Item 12)

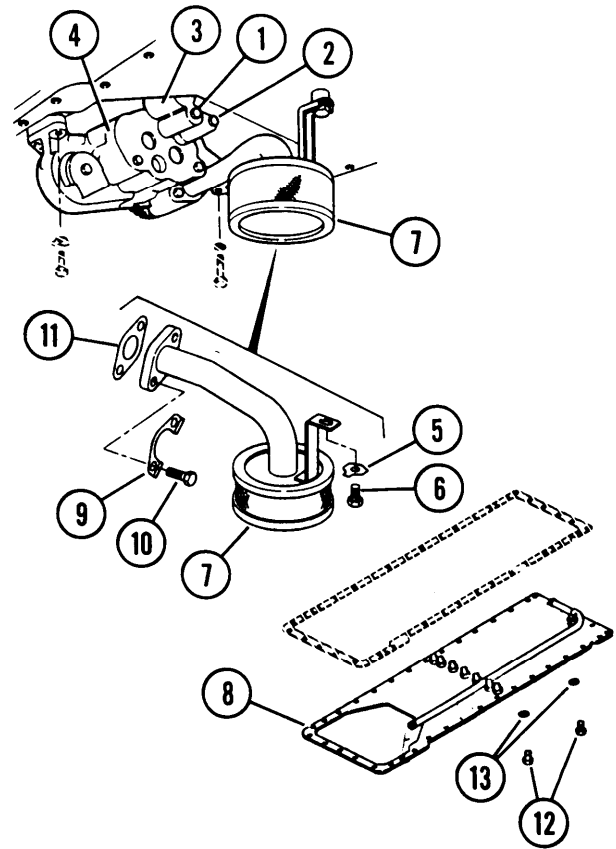
#### Equipment Condition

Oil pan removed, see page 3-117.

---

#### a. Removal

- (1) Use a wrench to remove two capscrews (1 and 2) from elbow (3). Remove elbow from oil pump (4).
- (2) Bend lock (5) down. Use a wrench to remove capscrew (6) which secures strainer assembly (7) support bracket to the oil pan plate (8).
- (3) Bend lock (9) down. Use a wrench to remove two capscrews (10) and lock which secures strainer assembly (7) to the oil pump (4). Remove strainer assembly and gasket (11). Discard gasket.
- (4) Use a wrench to remove fifteen capscrews (12) and fifteen washers (13) that hold oil pan plate (8) in place. Remove oil pan plate from machine.



3-27. OIL PAN PLATE - REPLACE/REPAIR (Cont'd)

- (5) Remove and discard gasket (14) on oil pan plate (8).

b. Disassembly

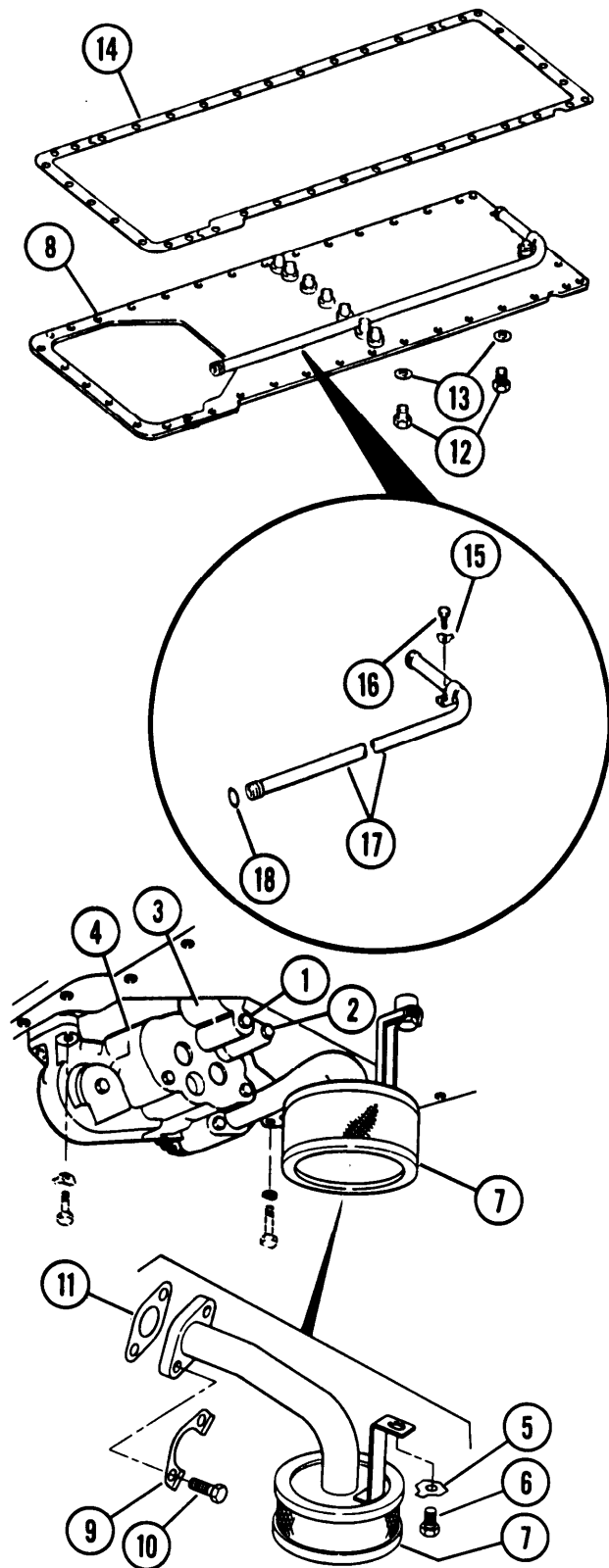
- (1) Bend lock (15) down. Use a wrench to remove capscrew (16) which holds oil pickup tube (17) to oil pan plate (8).
- (2) Remove oil pickup tube (17) and seal (18). Discard seal.

c. Assembly

- (1) Install oil pickup tube (17) and new seal (18) to oil pan plate (8).
- (2) Use a wrench to install lock (15) and capscrew (16) to secure oil pickup tube (17) on oil pan plate (8).

d. Installation

- (1) Wipe surface oil pan plate (8) clean.
- (2) Install new gasket (14) on oil pan plate (8).
- (3) Position oil pan plate (8) on tractor. Use a wrench to install fifteen capscrews (12) and fifteen washers (13).
- (4) Install strainer assembly (7) and new gasket (11) on the oil pump (4). Secure strainer assembly with a lock (9) and two capscrews (10) using a wrench. Bend lock up.
- (5) Install a lock (5) and capscrew (6) to secure strainer assembly (7) support bracket to the oil pan plate (8). Use a wrench to tighten capscrew. Bend lock up.



---

### 3-27. OIL PAN PLATE - REPLACE/REPAIR (Cont'd)

---

(6) Install elbow (3) onto oil pump (4). Use a wrench to install two capscrews (1 and 2) which secure the elbow.

(7) Install oil pan. See page 3-117.

e. Place In Service

Run engine and check for proper operation.

3-28. EXHAUST MANI FOLD - REPLACE

This task covers:

- a. Removal
- b. Installation
- c. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Shop Equipment, Machine Shop: Field Maintenance, Basic  
 NSN 3470-00-754-0708

Materials/Parts

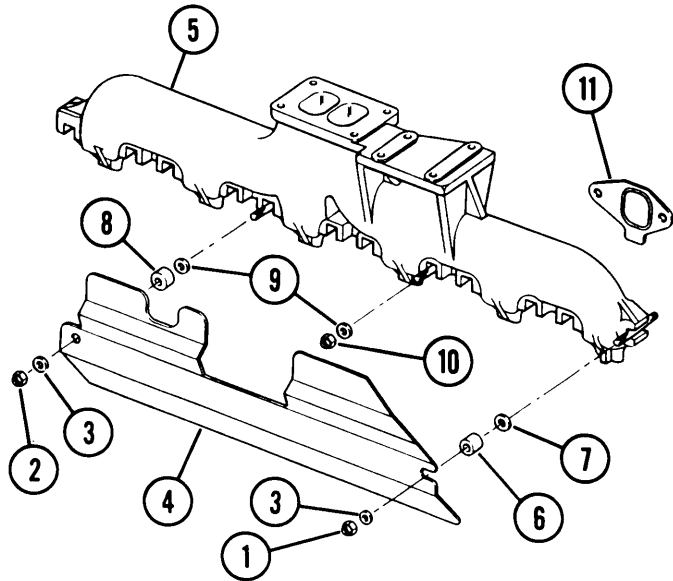
Gaskets (12)  
 Anti-Seize Compound (App. B, Item 2)

Equipment Condition

Engine OFF and cool to the touch.  
 Muffler removed. See TM5-2410-237-20.  
 Turbocharger removed. See TM5-2410-237-20.  
 Fuel injection lines removed. See TM5-2410-237-20.

a. Removal

- (1) Use a wrench to remove nut (1), nut (2), two washers (3) and heat shield (4) from exhaust manifold (5).
- (2) Remove spacer (6) and washer (7). Note their location for proper placement during installation.
- (3) Remove spacer (8) and washer (9). Note their location for proper placement during installation.
- (4) Use a wrench to loosen ten nuts (10) and ten washers (9) that hold exhaust manifold (5) to cylinder head (11).
- (5) Remove exhaust manifold (5).
- (6) Remove and discard six gaskets (11).



---

### 3-28. EXHAUST MANIFOLD - REPLACE (Cont'd)

---

#### b. Installation

##### NOTE

If exhaust manifold studs are loose or if new exhaust manifold studs are being used, put anti-seize compound on threads to be installed in cylinder head and tighten studs to a torque of  $20\pm 3$  lb. ft.

- (1) Install six gaskets (11) on cylinder head studs.
- (2) Put anti-seize compound on threads of exhaust manifold studs.
- (3) Place exhaust manifold (5) in position on studs and install ten washers (9) and ten nuts (10) that hold exhaust manifold (5). Use a wrench to tighten nuts (10) to a torque of  $32\pm 5$  lb. ft.
- (4) Install 1 washer (9) and spacer (8) in correct location.
- (5) Install washer (7) and spacer (6) in correct location.
- (6) Place heat shield (4) in position, and install two washers (3) and two nuts (1) that hold heat shield (4) to exhaust manifold (5). Tighten nuts (1) using a wrench.
- (7) Install fuel injection lines. See TM5-2410-237-20.
- (8) Install turbocharger. See TM5-2410-237-20.
- (9) Install muffler. See TM5-2410-237-20.

#### c. Place In Service

Run engine and check for proper operation.

3-29. REAR ACCESSORY DRIVE GEARS - REPLACE

This task covers:

- a. Removal
- b. Installation
- c. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Shop Equipment, Machine Shop:  
 Field Maintenance, Basic  
 NSN 3470-00-754-0708

Equipment Condition

Parking brake engaged.  
 Rear accessory drive cover removed.  
 See page 3-126.  
 Flywheel removed. See page 3-71.

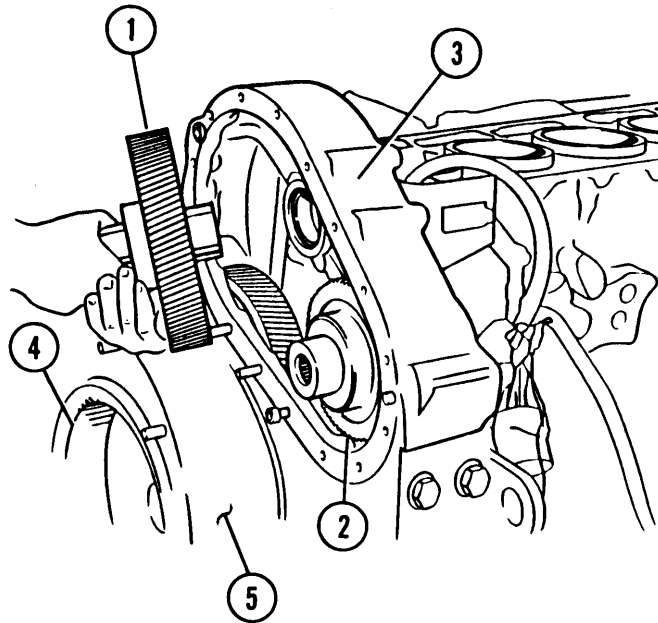
a. Removal

- (1) Remove gears (1 and 2) from flywheel housing (3).
- (2) Remove gear (4) from flywheel (5).

NOTE

Gear (4) was removed from the flywheel housing with the flywheel (5).

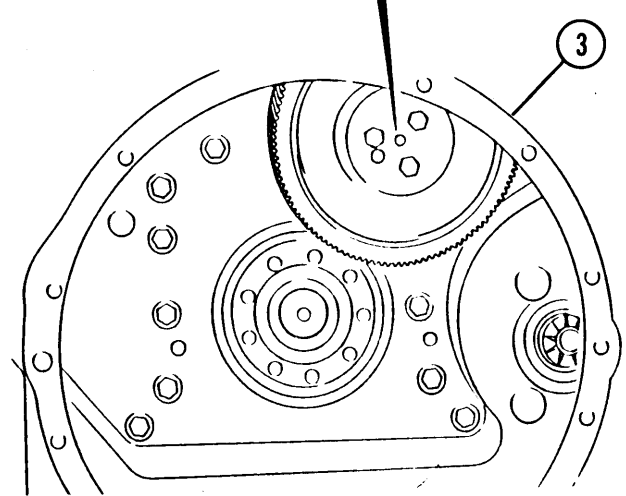
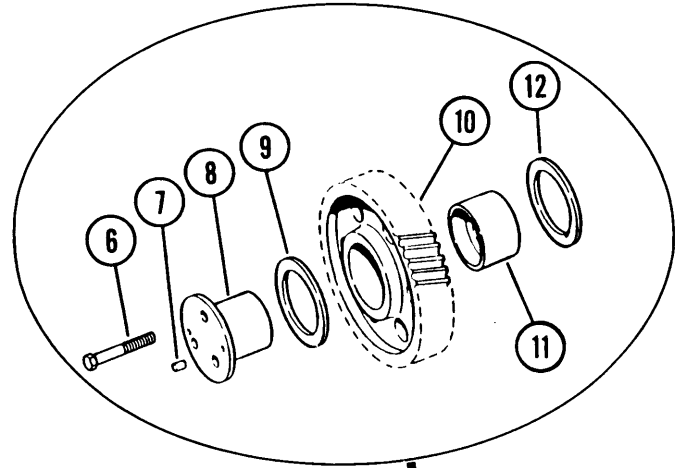
- (3) Use a wrench to remove three capscrews (6), dowel (7), shaft (8), washer (9) and gear (10) from flywheel housing.
- (4) If necessary, use a bearing puller to remove bearing (11) and washer (12) from flywheel housing.



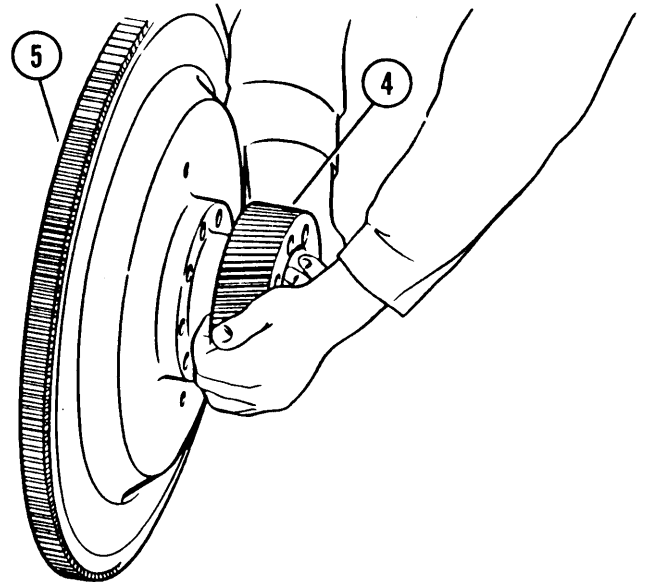
## 3-29. REAR ACCESSORY DRIVE GEARS - REPLACE (Cont' d)

b. Installation

- (1) If removed, use the proper driver to install bearing (11) and washer (12) into the flywheel housing (3).
- (2) Place gear (10), washer (9), shaft (8) and dowel (7) into position. Use a wrench to install three capscrews (6) that secure the shaft assembly to the flywheel.



- (3) Slide gear (4) onto flywheel (5).
- (4) Install gears (1 and 2) into flywheel housing.
- (5) Install rear accessory drive gear cover. See page 3-126.
- (6) Install flywheel. See page 3-71.

c. Place In Service

Run engine and check for proper operation.



3-30. ACCESSORY DRIVE COVER ASSEMBLY - REPLACE

This task covers:

- a. Removal
- b. Installation
- c. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Shop Equipment, Machine Shop  
 Field Maintenance, Basic  
 NSN 3470-00-754-0708

Materials/Parts

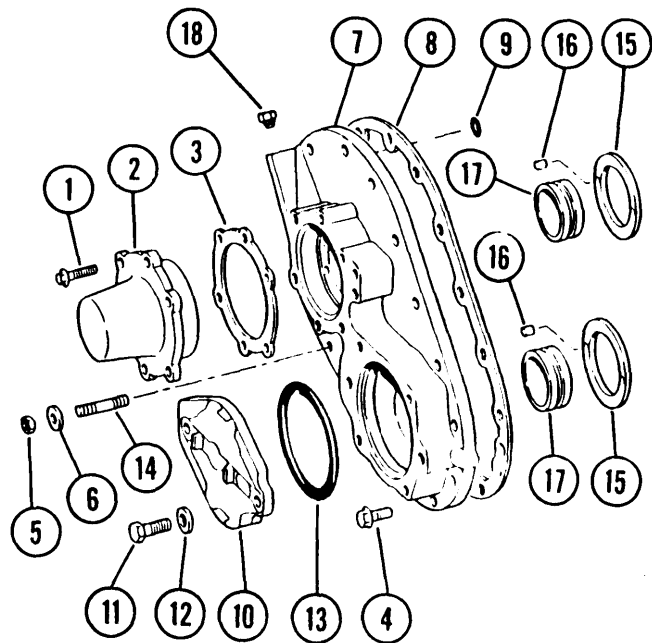
Gasket (3), (8)  
 Seal (9), (13)

Equipment Condition

Engine OFF.  
 Parking brake engaged.  
 Dash assembly removed. See page 11-8.  
 Hydraulic pump removed. See TM5-2410-237-20.

a. Removal

- (1) Use a wrench to remove six capscrews (1) from cover (2). Remove cover and gasket (3). Discard gasket (3).
- (2) Use a wrench to remove thirteen capscrews (4). Use a wrench to remove three nuts (5) and three washers (6). Remove cover (7).
- (3) Remove gasket (8) and seal (9) and discard.
- (4) If required, remove cover plate (10) from cover assembly (7). Use a wrench to remove two capscrews (11) and two washers (12). Remove cover plate (10) and seal (13). Discard seal.
- (5) If necessary, remove three studs (14) from flywheel housing.



---

### 3-30. ACCESSORY DRIVE COVER ASSEMBLY - REPLACE (Cont'd)

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- (6) If necessary, remove two washers (15), pins (16) and plug (18). Use a bearing puller to remove bearings (17) from cover assembly (7).

#### b. Installation

- (1) If removed, install two bearings (17) and pins (16) into case (7) and place washers (15) onto pins. Install plug (18).
- (2) If removed, insert three studs (14) into flywheel housing.
- (3) Put seal (9) and gasket (8) in place on flywheel housing.
- (4) Install cover assembly (7) on three studs (14) in flywheel housing. Secure cover assembly on studs with three washers (6) and three nuts (5). Tighten using a wrench.
- (5) Install thirteen capscrews (4) around cover assembly. Tighten using a wrench.
- (6) If required install cover (2) and gasket (3) to cover assembly. Secure with six capscrews (1). Tighten using a wrench.
- (7) Install hydraulic pump. See TM5-2410-237-20.
- (8) If required, install cover (10) and seal (13) to cover assembly. Secure with two capscrews (11) and two washers (12). Tighten using a wrench.
- (9) Install dash assembly. See page 11-8.

#### c. Place In Service

Run engine and check for proper operation.

## CHAPTER 4

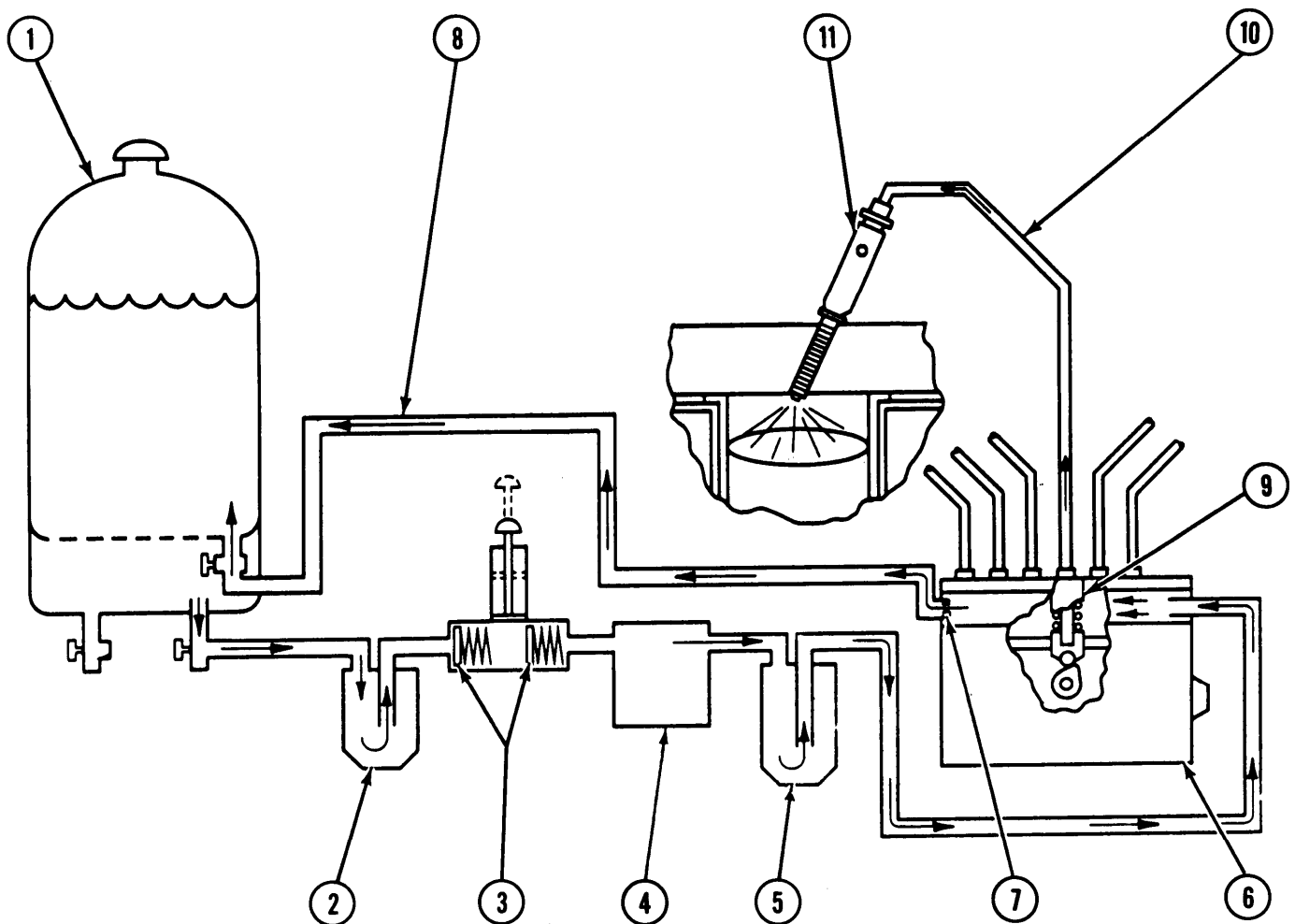
## FUEL SYSTEM MAINTENANCE

## Section 1. DESCRIPTION AND DATA

## 4-1. GENERAL

Fuel system maintenance procedures not covered in this chapter can be found in TM5-2410-237-20.

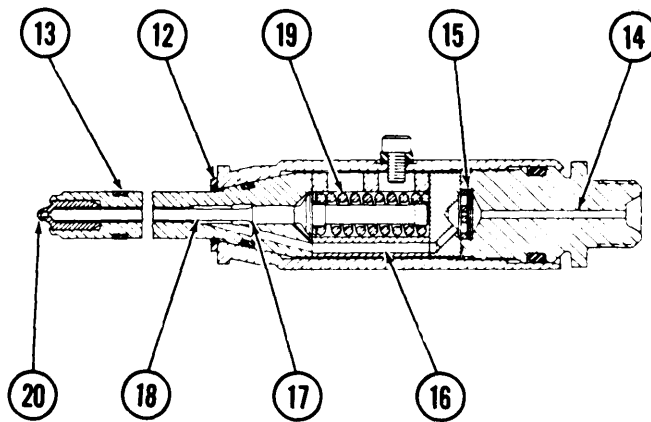
## 4-2. PRINCIPLES OF OPERATION



- a. Fuel Flow. Fuel is pulled from fuel tank (1) through primary fuel filter (2) and priming pump check valves (3) by fuel transfer pump (4). From the fuel transfer pump the fuel is pushed through secondary fuel filter (5) and to the fuel manifold in fuel injection pump housing (6). The pumping spring in the fuel transfer pump keeps the fuel pressure in the system at 25 to 42 psi. Constant bleed orifice (7) lets a constant flow of fuel go through fuel return line (8)

back to fuel tank (1). This helps keep the fuel cool and free of air. Fuel injection pump (9) gets fuel from the fuel manifold and pushes fuel at very high pressure through fuel line (10) to fuel injection nozzle (11). The fuel injection nozzle has very small holes in the tip that change the flow of fuel to a very fine spray that gives good fuel combustion in the cylinder.

- b. Fuel Injection Plunger and Barrel. The fuel injection plunger and barrel (9) increases the pressure of the fuel and sends an exact amount of fuel to the fuel injection nozzle (11). There is one fuel injection plunger and barrel for each cylinder in the engine.
- c. Fuel Injection Nozzle. The fuel injection nozzle goes through the cylinder head into the combustion chamber. The fuel injection pump sends fuel with high pressure to the fuel injection nozzle where the fuel is made into a fine spray for good combustion.

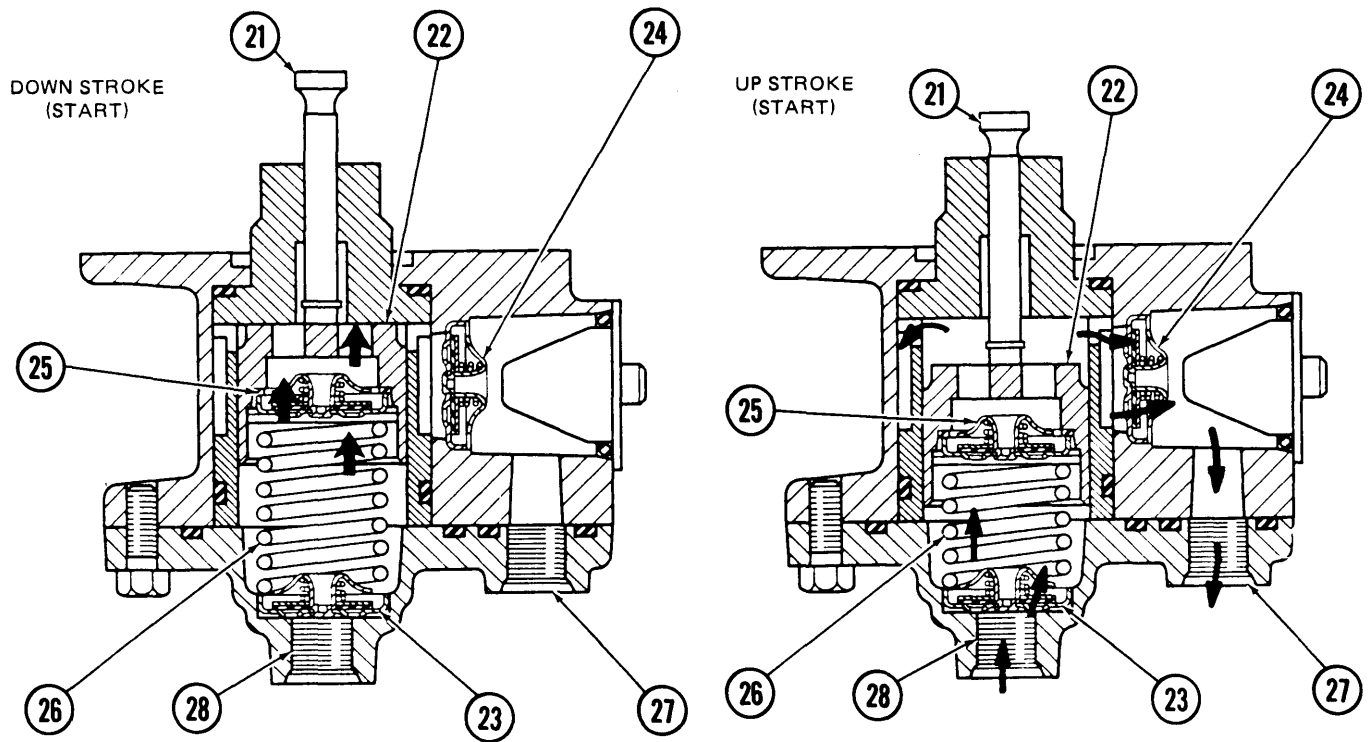


seal (12) goes against the cylinder head and prevents leakage of compression from the cylinder. Carbon dam (13) keeps carbon out of the bore in the cylinder head for the nozzle.

Fuel with high pressure from the fuel injection pump goes into inlet passage (14). Fuel then goes through filter screen (15) and into passage (16) to the area below diameter (17) of valve (18). When the pressure of the fuel that pushes against diameter (17) becomes greater than the force of spring (19), valve (18) lifts up. When valve (18) lifts, the tip of the valve comes off of the nozzle seat and the fuel will go through the nine 0.008 in. orifices (20) into the combustion chamber.

The injection of fuel continues until the pressure of fuel against diameter (17) becomes less than the force of spring (19). With less pressure against diameter (17), spring (19) pushes valve (18) against the nozzle seat and stops the flow of fuel to the combustion chamber.

- d. Fuel Transfer Pump. The fuel transfer pump is a piston pump that is moved by a cam (eccentric) on the camshaft for the fuel injection pump. The transfer pump is located on the bottom side of the fuel injection pump housing.

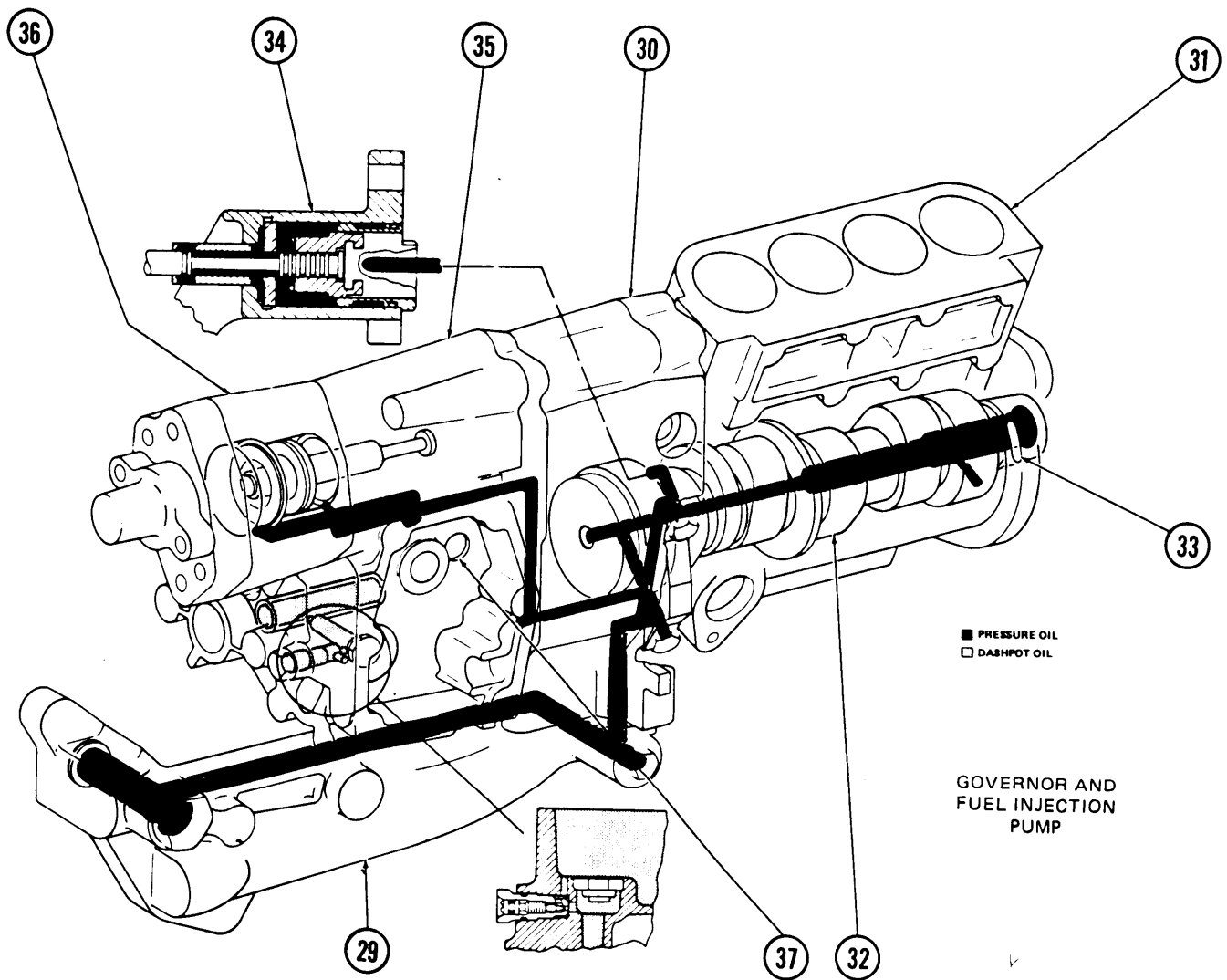


When the fuel injection pump camshaft turns, the cam moves push rod (21) and piston (22) down. As the piston moves down, inlet check valve (23) and outlet check valve (24) close. Pumping check valve (25) opens and allows the fuel below the piston to move into the area above the piston. Pumping spring (26) is compressed as the piston is pushed down by push rod (21).

As the fuel injection pump camshaft continues to turn, the cam no longer puts force on push rod (21). Pumping spring (26) now moves piston (22) up. This causes pumping check valve (25) to close. Inlet check valve (23) and outlet check valve (24) will open. As the piston moves up, the fuel in the area above the piston is pushed through the outlet check valve (24) and out pump outlet port (27). Fuel also moves through pump inlet port (28) and inlet check valve (23) to fill the area below piston (22). The pump is now ready to start a new cycle.

- e. Oil Flow For Pump and Governor. Oil from the side of the cylinder block goes to support (29) and into the bottom of front governor housing (30). The flow of oil now goes in three different directions.

A part of the oil goes to the rear camshaft bearing in fuel pump housing (31). The bearing has a groove around the inside diameter. Oil goes through the groove and into the oil passage in the bearing surface (journal) of camshaft (32). A drilled passage through the center of the camshaft gives oil to the front camshaft bearing and to the thrust face of the camshaft drive gear. Drain hole (33) in the front of fuel pump housing (31) keeps the level of the oil in the housing even with the center of the camshaft. The oil returns to the Oil pan through the timing gear housing.



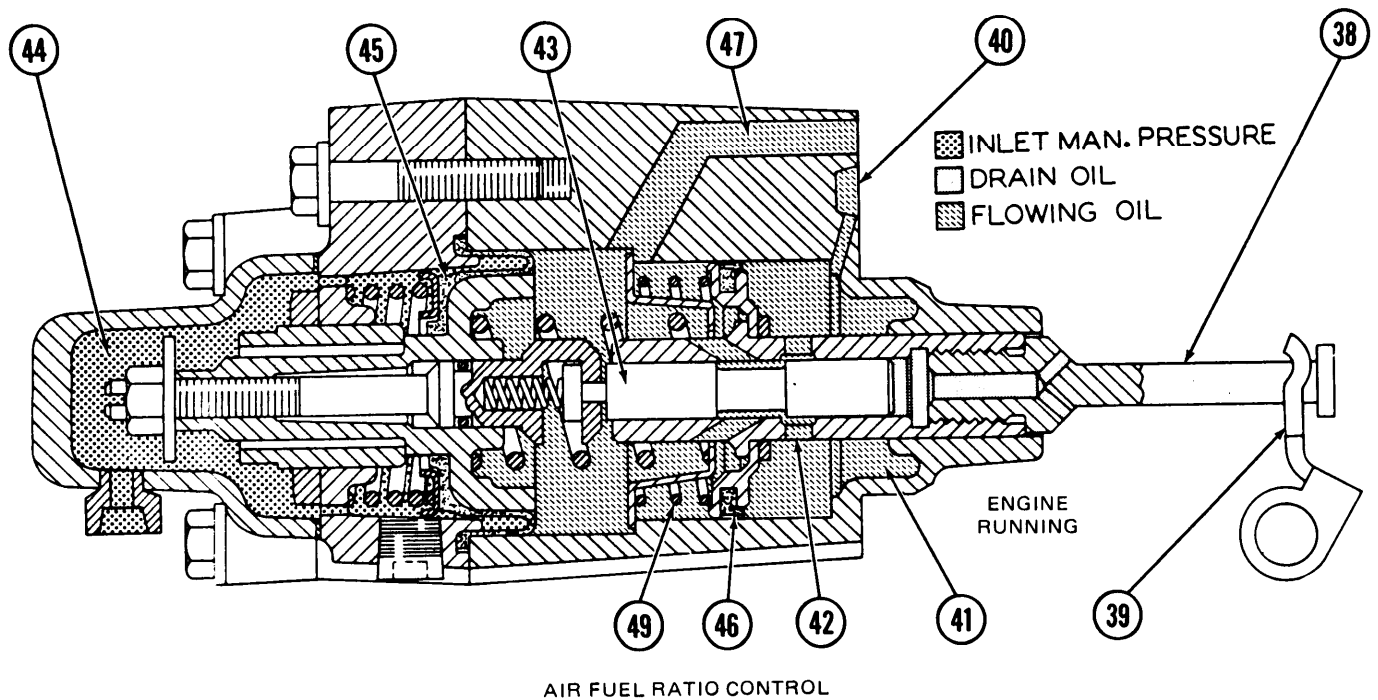
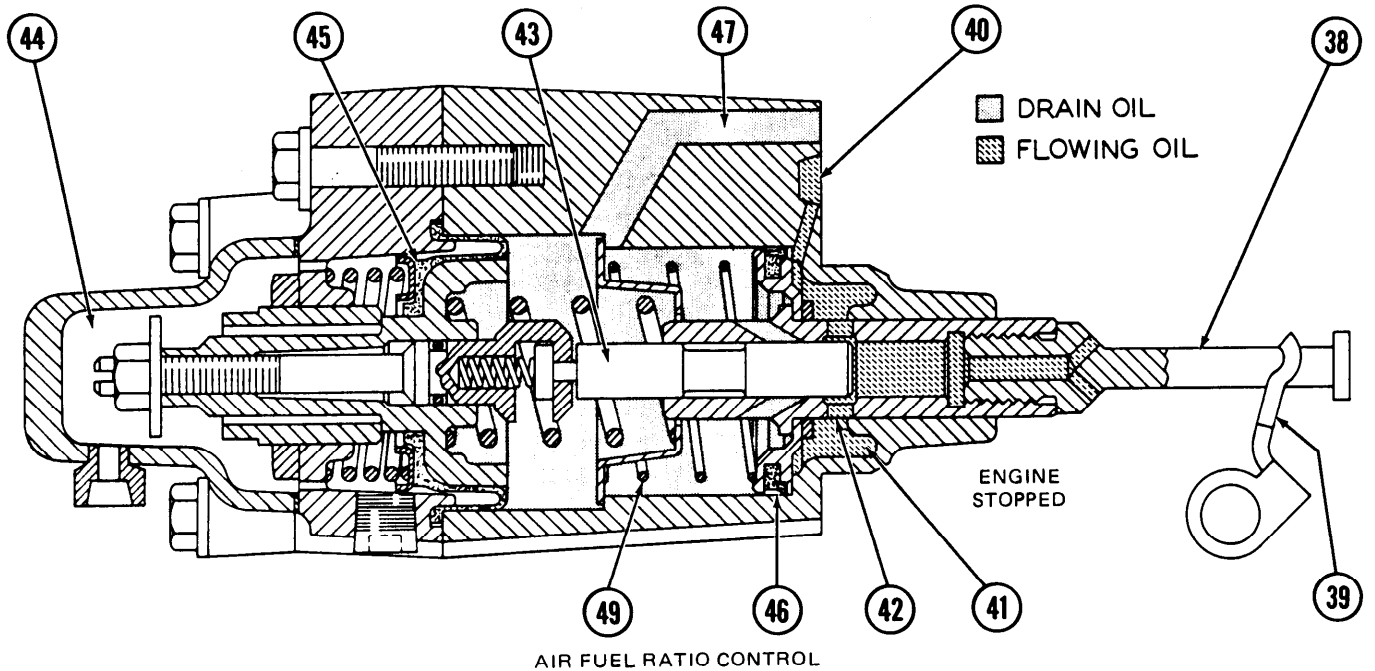
Oil also goes from the bottom of the front governor housing through a passage to the fuel pump housing and to governor servo (34). The governor servo gives hydraulic assistance to move the fuel rack.

The remainder of the oil goes through passages to the rear of rear governor housing (35), through air fuel ratio control (36) and back into another passage in the rear governor housing. Now the oil goes into the compartment for the governor controls. Drain hole (37) keeps the oil at the correct level. The oil in this compartment is used for lubrication of the governor control components and the oil is the supply for the dashpot.

The internal parts of the governor are lubricated by oil leakage from the servo and the oil is thrown by parts in rotation. The flyweight carrier thrust bearing gets oil from the passage at the rear of the camshaft.

Oil from the governor returns to the oil pan through a hole in the bottom of the front governor housing and through passages in the support and cylinder block.

- f. Governor. The governor controls the amount of fuel needed by the engine to maintain a desired rpm and controls the percent of torque rise.
- (1) Governor Servo. The governor servo gives hydraulic assistance to the mechanical governor force to move the fuel rack.
  - (2) Dashpot. The dashpot helps give the governor better speed control when there are sudden speed and load changes.



9. Fuel Ratio Control. The air-fuel ratio control limits the amount of fuel to the cylinders during an increase of engine speed (acceleration) to reduce exhaust smoke.

Stem (38) moves lever (39) which will restrict the movement of the fuel rack in the FUEL ON direction only.

With the engine stopped, stem (38) is in the fully extended position. The movement of the fuel rack and lever (39) is not restricted by stem (38). This gives maximum fuel to the engine for easier starts.

After the engine is started, engine oil flows through oil inlet (40) into pressure oil chamber (41). From oil chamber (41) oil flows through oil passage (42) into internal valve (43) and out oil drain passages in stem (38).

Stem (38) will not move until inlet manifold pressure increases enough to move internal valve (43). A line connects the inlet manifold with inlet air chamber (44) of the air-fuel ratio control.

When inlet manifold pressure increases, it causes diaphragm assembly (45) to move towards the right. This also causes internal valve (43) to move to the right. When internal valve (43) moves to the right, it closes oil passage (42).

When oil passage (42) is closed, oil pressure increases in oil chamber (41). Oil pressure moves piston (46) and stem (38) to the left and into the operating position. The air-fuel ratio control will remain in the operating position until the engine is shut off.

When the governor control is moved to increase fuel to the engine, stem (38) limits the movement of lever (39) in the FUEL ON direction. The oil in oil chamber (41) acts as a restriction to the movement of stem (38) until inlet air pressure increases.

As the inlet air pressure increases, diaphragm assembly (45) and internal valve (43) move to the right. The internal valve opens oil passage (42), and oil in oil chamber (41) goes to oil drain passage (47). With the oil pressure reduced behind piston (46), spring (49) moves the piston and stem (38) to the right. Piston and stem (46 and 38) will move until oil passage (42) is closed by internal valve (43). Lever (39) can now move to let the fuel rack go to the full fuel position. The air-fuel ratio control is designed to restrict the fuel until the air pressure in the inlet manifold is high enough for complete combustion. It prevents large amounts of exhaust smoke caused by an air-fuel mixture with too much fuel.



## Section II. FUEL SYSTEM MAINTENANCE PROCEDURES

## 4-3. FUEL SYSTEM MAINTENANCE TASK SUMMARY

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TASK PARA.	PROCEDURES	PAGE NO.
4-4	Fuel Injection Nozzles - Test/Repair	4-8
4-5	Fuel Transfer Pump - Replace/Repair	4-10
4-6	Fuel Injection Pump - Replace	4-14
4-7	Turbocharger - Repair	4-18
4-8	Fuel Tank - Replace	4-24
4-9	Governor and Fuel Injection Pump Housing - Adjust/Replace	4-26
4-10	Governor - Adjust	4-32

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4-4. FUEL INJECTION NOZZLES - TEST/REPAIR

This task covers:

- a. Disassembly
- b. Test
- c. Assembly
- d. Place In Service

INITIAL SETUP

Applicable Configurations  
All

Common Tools  
Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

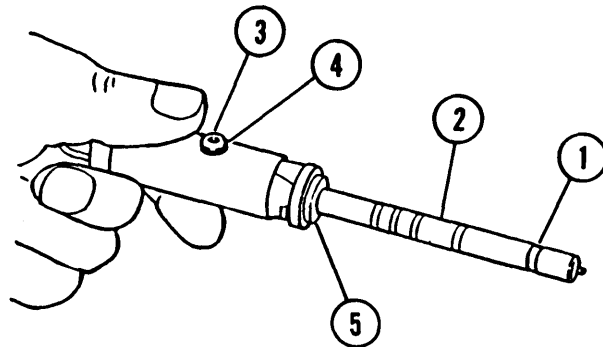
Test Equipment  
Test Set, Diesel Injector  
NSN 4910-00-317-8265

Materials/Parts  
Carbon Seal (1)  
Hex Socket Buttonhead Screw (3)  
Washer (4)  
Washer (5)

Equipment Condition  
Fuel Injection Nozzles removed. (TM5-2410-237-20).

a. Disassembly

- (1) Use needle nose pliers to remove carbon seal (1) from fuel injection nozzle (2). Discard seal.
- (2) Use an allen wrench to remove hex socket, buttonhead screws (3) from nozzle. Remove washer (4).
- (3) Remove washer (5).



b. Test

CAUTION

Do not use a steel brush or wire wheel to clean nozzle body or tip. Using these tools can cause a small reduction of orifice size, and this will cause a large reduction of engine horsepower.

4-4 . FUEL INJECTION NOZZLES - TEST/REPAIR (Cont'd)

- (1) Use a brass wire brush to clean groove for carbon seal, and the body of nozzle below groove. Too much use of brush will damage protective coating on nozzle.
- (2) Use instructions found in tool kit for the diesel injector test set and perform the following tests:
  - Injection valve opening pressure test
  - Nozzle tip leakage test
  - Orifice restriction test
  - Bleed screw (3) pressure test
- (3) Discard nozzle if it fails to pass any of the preceding tests.

c. Assembly

- (1) If installation of hex socket, buttonhead screws (3) and washer (4) were not necessary while testing, install them. Use an allen socket to tighten screw to torque of  $16 \pm 2$  lb. in.

CAUTION

Do not tighten screw more than torque stated above. The screw or washer can be damaged.

- (2) Install washer (5).
- (3) Install 1 new carbon seal (1) onto fuel injection nozzle (2).
- (4) Install nozzles. See TM5-2410-237-20.

d. Place In Service

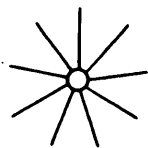
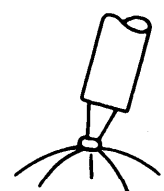
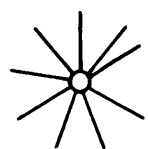
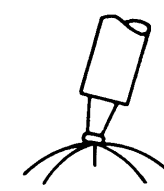
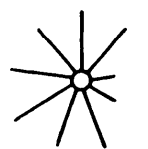
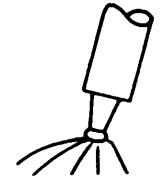
Run engine and check for proper operation.

**Injection Nozzle Tests**

Valve Opening Pressure is  $2200 \pm 149$  psi

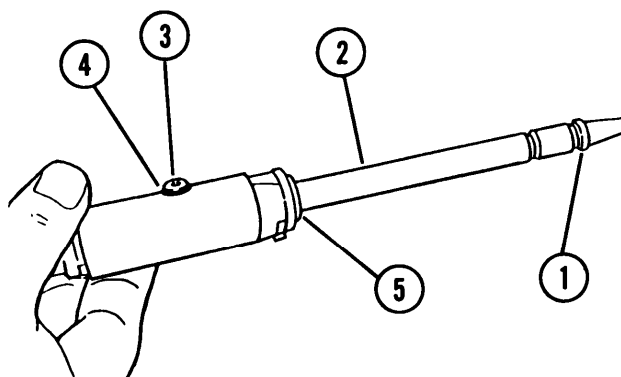
**TIP LEAKAGE TEST SPEC:**  
 (1) APPLY PRESSURE TO THE NOZZLE INLET THAT IS 200 - 290 PSI BELOW VCP. HOLD A CONSTANT PRESSURE FOR 15 SECONDS.  
 (2) MEASURE TIP LEAKAGE DROPS - 5 DROPS MAX TIP LEAKAGE ALLOWED IN 15 SECONDS.

**ORIFICE RESTRICTION TEST**

		<b>GOOD NOZZLE (USE AGAIN)</b>
		<b>HORIZONTAL DISTORTION (REPLACEMENT NECESSARY)</b>
		<b>VERTICAL DISTORTION (REPLACEMENT NECESSARY)</b>

**BLEED SCREW PRESSURE TEST**

THERE MUST BE NO LEAKAGE AROUND BLEED SCREW WHEN NOZZLE IS SUBMERGED IN IE1084 FUEL AND PRESSURIZED TO  $2000 \pm 145$  PSI FOR 10 SECONDS.



4-5. FUEL TRANSFER PUMP - REPLACE/REPAIR

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning
- d. Inspection
- e. Assembly
- f. Installation
- g. Place In Service

INITIAL SETUP

Applicable Configurations  
All

Common Tools  
Shop Equipment, General Purpose  
Repair, Semi-trailer Mounted  
NSN 4940-00-287-4894

Preformed Packings (3), (15),  
(16), (19), (21), (24), 26'  
Seal (14)  
Lubricating Oil OE/HDO-30 (Refer  
to L05-2410-237-12)

Equipment Condition  
Engine cool.

a. Removal

NOTE

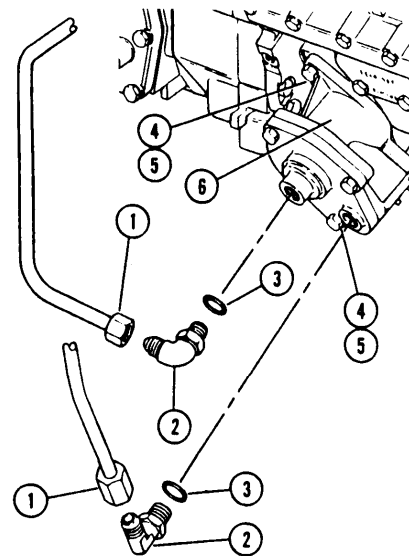
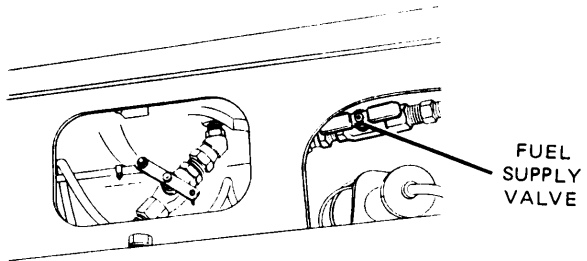
Mark fuel lines for proper installation.

- (1) Close fuel supply valve.
- (2) Use a wrench to remove two fuel lines (1) from elbows (2).

NOTE

Mark elbows for proper installation.

- (3) Use a wrench to remove two elbows (2) and remove and discard two preformed packings (3).
- (4) Use a wrench to remove two capscrews (4) and washers 5 and remove fuel transfer pump (6).



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 4-5. FUEL TRANSFER PUMP - REPLACE/REPAIR (Cont'd)
 

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b. Disassembly

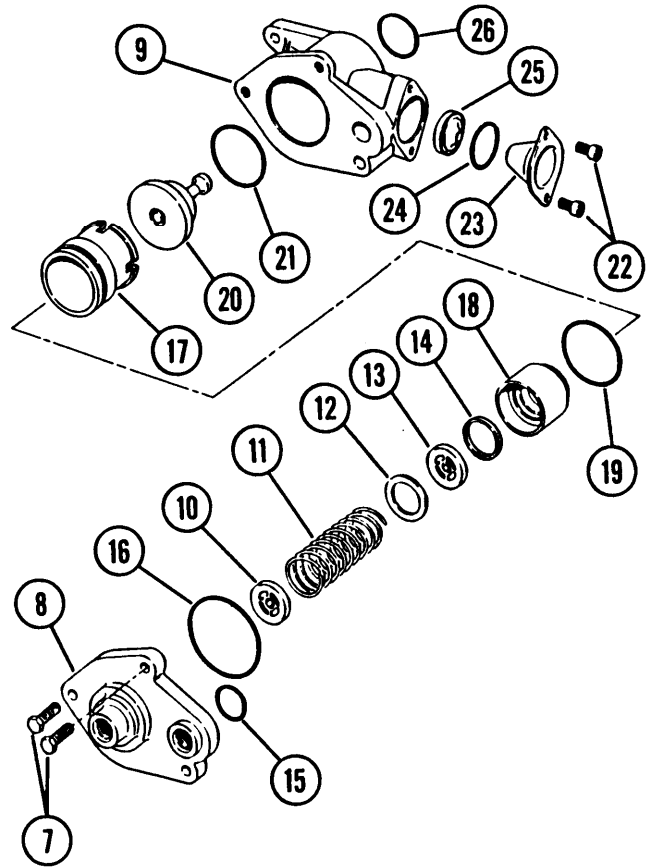

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**WARNING**


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Cover (8) is under spring tension. Use caution when removing.

- (1) Use a wrench to remove two capscrews (7) that hold cover (8) to housing (9). Remove cover (8), valve (10), spring (11), washer (12), valve (13), and seal (14). Remove preformed packings (15 and 16) from cover (8). Discard seal (14) and preformed packings (15 and 16).
- (2) Remove sleeve (17) and piston (18). Remove preformed packing (19) from sleeve (17). Discard preformed packing (19).
- (3) Remove tappet assembly (20), and preformed-packing (21). Discard preformed packing (21).
- (4) Use an allen wrench to remove two capscrews (22), cover (23), preformed packing (24) and valve (25) from housing (9). Discard preformed packing (24).
- (5) Remove and discard preformed packing (26) from housing (9).

c. Cleaning

See Cleaning Instructions, page 2-29.

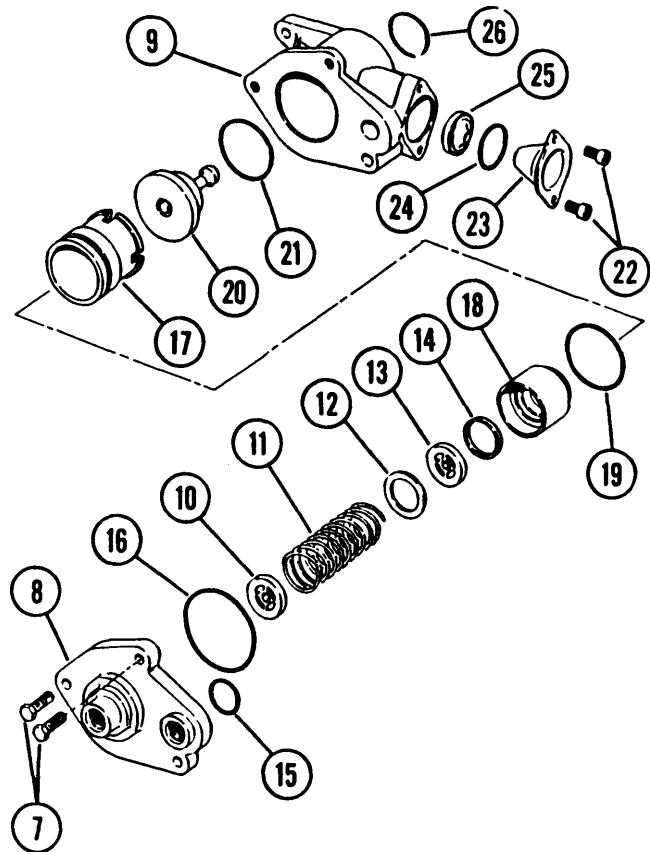
4-5. FUEL TRANSFER PUMP - REPLACE/REPAIR (Cont'd)

d. Inspection

- (1) Inspect piston (18), sleeve (17) and tappet assembly (20) for nicks, scratches or signs of wear. Inspect bores in housing. Replace parts as necessary.
- (2) Inspect the three valves (10, 13, and 25) for clogging or damage.
- (3) See page 2-32 for general Inspection Instructions.

e. Assembly

- (1) Install new preformed packing (26) in housing (9).
- (2) Place valve (25) in side bore of housing (9). Put a film of clean oil on new preformed packing (24) and install preformed packing (24) on cover (23). Place cover (23) on housing (9) and install two capscrews (22) that hold the cover (23) in place. Use an allen wrench to tighten capscrews (22).
- (3) Put a film of clean oil on new preformed packing (21) and place preformed packing (21) on the tappet assembly (20), with preformed packing (21) in housing (9).
- (4) Put a film of clean oil on new preformed packing (19) and install preformed packing (19) on sleeve (17).
- (5) Place piston (18) in sleeve (17). Place sleeve (17) and piston (18) in housing (9).
- (6) Place new seal (14), valve (13), washer (12), spring (11), and valve (10) in housing (9).



4-5. FUEL TRANSFER PUMP - REPLACE/REPAIR (Cont' d)

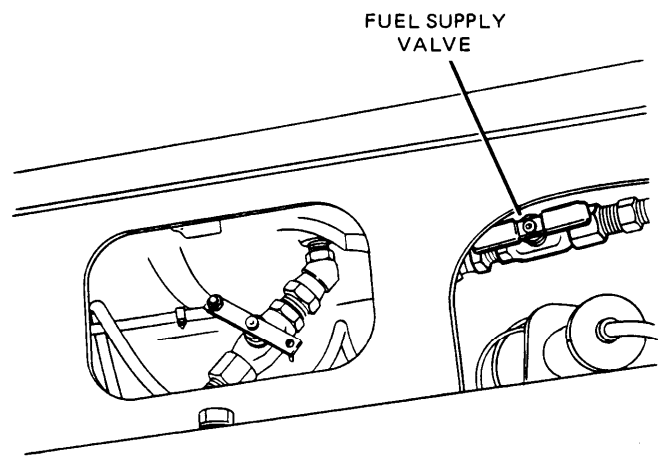
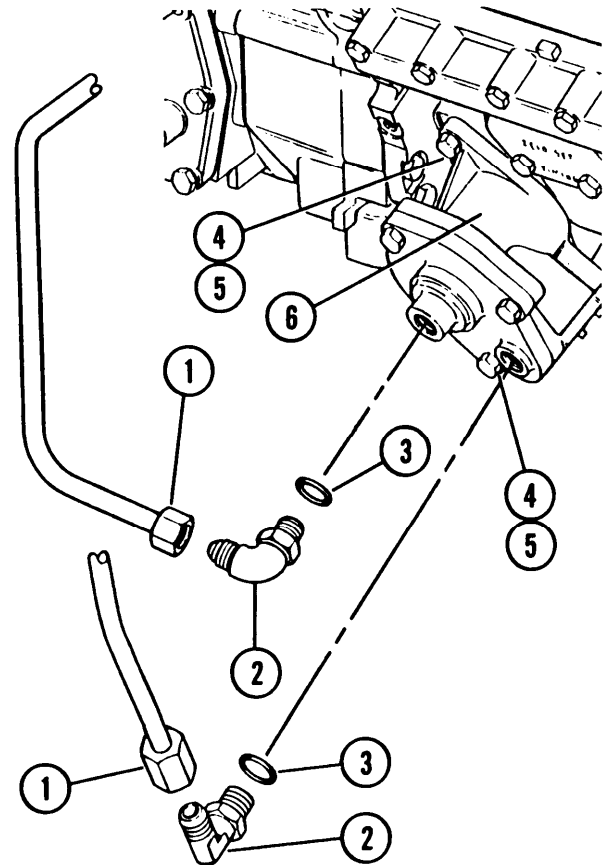
- (7) Put a film of new oil on new preformed packings (15 and 16) and install preformed packings (15 and 16) in cover (9). Place cover (8) on housing (9), compressing spring (11). Install two capscrews (7) that hold cover (8) in place. Use a wrench to tighten capscrew (7).

f. Installation

- (1) Position fuel transfer pump (6) on the fuel injection pump housing. Install two washers (5) and capscrews (4). Use a wrench to tighten capscrews (4).
- (2) Put a film of new oil on new preformed packings (3). Install preformed packings (3) onto elbows (2). Install elbows (2) into fuel transfer pump (6). Use a wrench to tighten elbows (2).
- (3) Install the two fuel lines (1) to elbows (2). Use a wrench to tighten fuel lines (1).
- (4) Open fuel supply valve.
- (5) prime fuel system. See TM5-2410-237-20.

g. Place In Service

Run engine and check fuel transfer pump for proper operation.



4-6. FUEL INJECTION PUMP - REPLACE

This task covers:

- a. Removal
- b. Inspection
- c. Installation
- d. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose  
 Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894

Special Tools

Timing Pin NSN 2815-01-268-2194 (4)  
 Extractor NSN 5120-00-178-1267 (7)  
 Wrench NSN 5120-01-123-5884 (5)

Materials/Parts

Gasket (3)  
 Preformed Packing (9)  
 Lubricating Oil OE/HDO-30 (See  
 L05-2410-237-12)

Equipment Condition

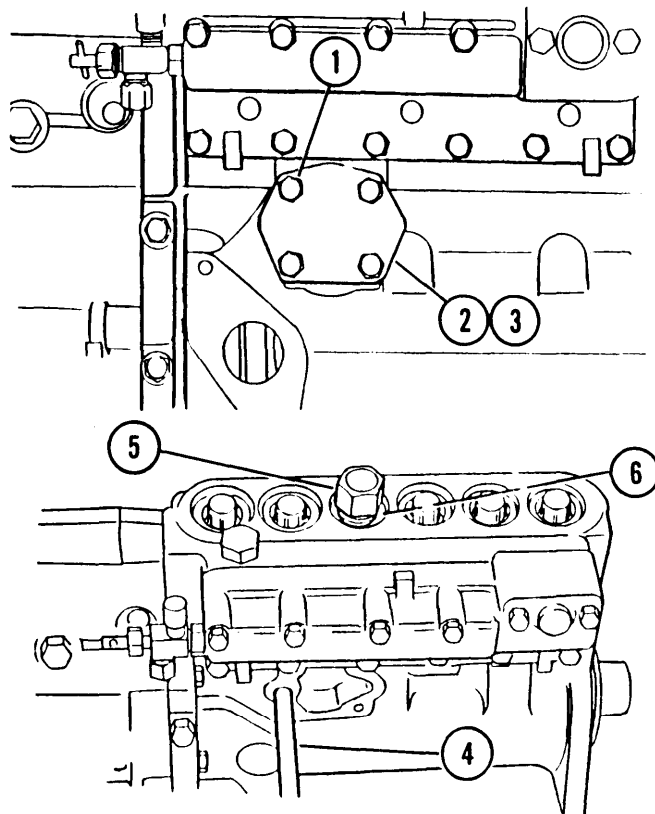
Fuel injection lines removed.  
 (TM5-2410-237-20)

a. Removal

NOTE

It is not necessary to remove fuel transfer pump, fuel injection pump housing, and governor to remove fuel injection pumps.

- (1) Use a socket wrench to remove four capscrews (1) from cover (2). Remove cover (2) and gasket (3). Discard gasket (3).
- (2) Move governor to fuel "OFF" position and install timing pin (4) in the entering hole as shown.





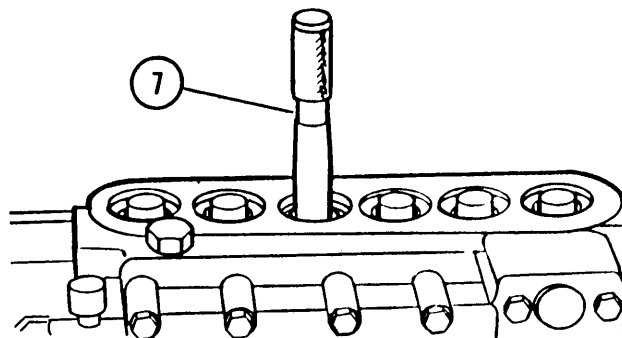
**4-6. FUEL INJECTION PUMP - REPLACE (Cont' d)**

(3) With timing pin in position, move the governor lever to the "HIGH" idle position. The fuel rack slot edge will contact the timing pin and the rack is now at center position. Wire the governor lever in the "HIGH" position.

(4) Use injection pump wrench (5) to remove bushing (6).

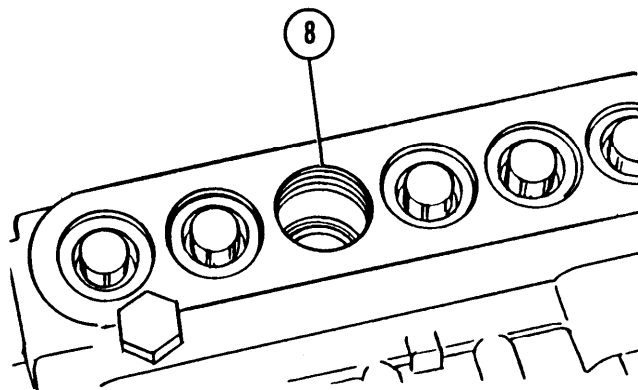
(5) Install extractor (7) on the bonnet and remove fuel injection pump.

(6) Remove spacer (8) from the fuel injection pump housing.



**b. Inspection**

If lifters are worn excessively, replace the lifter. See page 2-32 for general Inspection Instructions\*



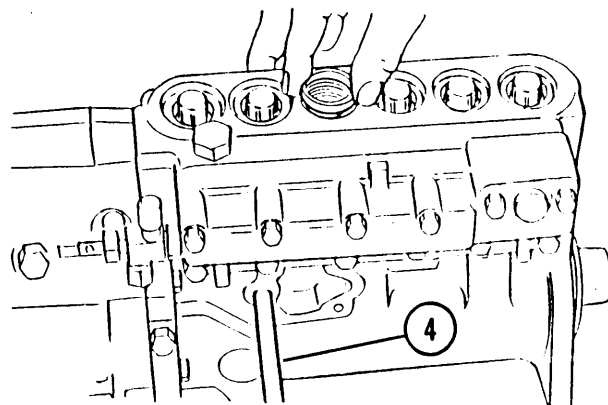
**c. Installation**

**NOTE**

Spacers (8) are the same thickness for each fuel injection pump and can be interchanged. The fuel injection pump plungers and barrels are set and cannot be mixed.

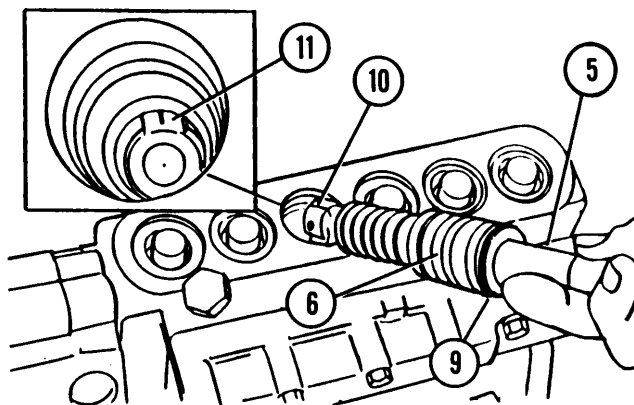
(1) Install spacer (8) in the fuel injection pump housing.

(2) Make sure timing pin (4) is installed. The rack must be in the center position to install the fuel injection pumps.



4-6. FUEL INJECTION PUMP - REPLACE (Cont' d)

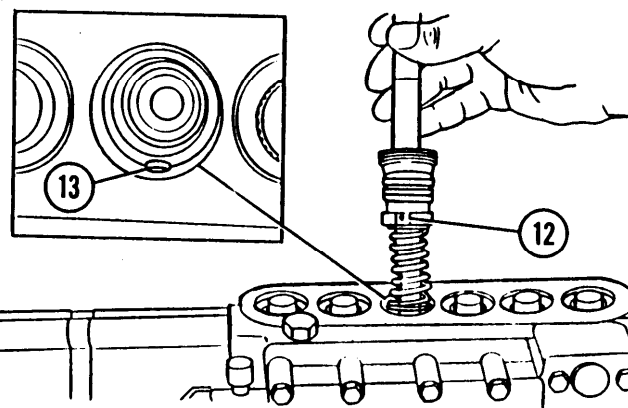
(3) Install extractor (5) on the bonnet of the fuel injection pump. Lightly oil preformed packing (9). Install preformed packing (9) and bushing (6) over extractor (5).



(4) Install the fuel injection pump in the pump housing with saw cut (slot) (11) in the gear aligned with small pin (11) in the lifter assembly and groove (12) in the barrel with the dowel (13) in the pump housing.

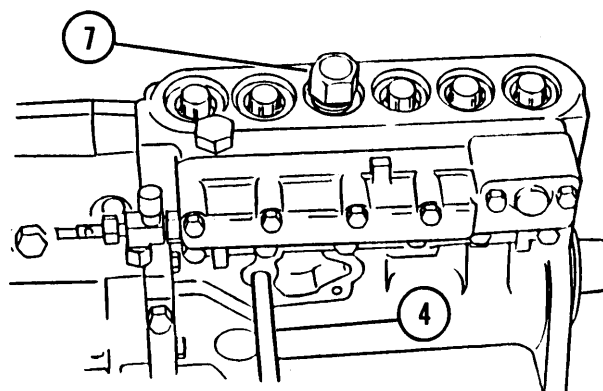
CAUTION

If installation of the pump is correct, the bushing can be tightened by hand until it is even with the face of the pump housing. Make sure the fuel rack is always at the center position during pump installation.



(5) Push down on extractor (5) and tighten bushing (6) by hand until bushing is even with the top of the housing. If installation of the bushing cannot be made this far by hand, remove it. Remove the pump, put extra parts in alignment again and install the bushing.

(6) Remove extractor (5). Install injector pump wrench (7) in the bushing (6). Use injector pump wrench (7) and a torque wrench to tighten bushing (6) to a torque of 120:10 l.b. ft. (1651 14 N.m).



(7) Remove timing pin (4) and injection pump wrench (7).

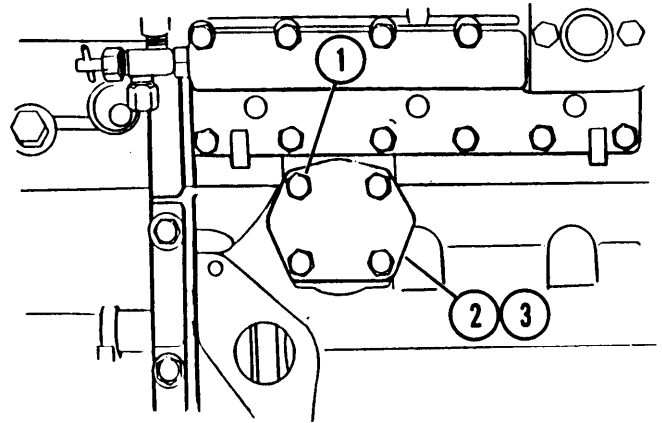
## 4-6. FUEL INJECTION PUMP - REPLACE (Cont' d)

(8) Install new gasket (3) and cover (2) on fuel injection pump housing. Install four capscrews (1) to secure cover. Use a wrench to tighten capscrews (1).

(9) Install fuel injection lines (see TM5-2410-237-20).

## d. Place In Service

Run engine and check for proper fuel system operation.



4-7. TURBOCHARGER - REPAIR

This task covers:

- a. Disassembly
- b. Cleaning
- c. Inspection
- d. Lubrication
- e. Assembly
- f. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Materials/Parts

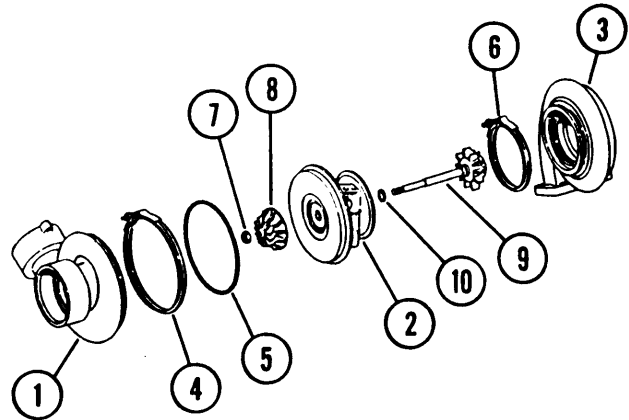
Loctite 262 (App. B, Item 13)  
Repair Kit (2W725)  
Lubricating Oil OE/HDO-30 (Refer to L05-2410-237-12)  
High Temperature Grease (App. B, Item 9a)  
Anti-Seize Compound (App. B, Item 2)  
Preformed Packing (5), (10), (17), (22)  
Seals (21)

Equipment Condition

Turbocharger removed. See TM5-2410-237-20.

a. Disassembly

- (1) Place turbocharger in vise and secure.
- (2) Mark compressor cover (1), the cartridge (2) and turbine housing (3), for proper alignment and installation at assembly.
- (3) Use a wrench to loosen V-clamp (4). Remove compressor cover (1) and V-clamp (4).
- (4) Remove and discard preformed packing (5) from cartridge (2).
- (5) Use a wrench to loosen V-clamp (6). Remove cartridge (2) from turbine housing (3).
- (6) Place cartridge (2) in position on a suitable fixture.



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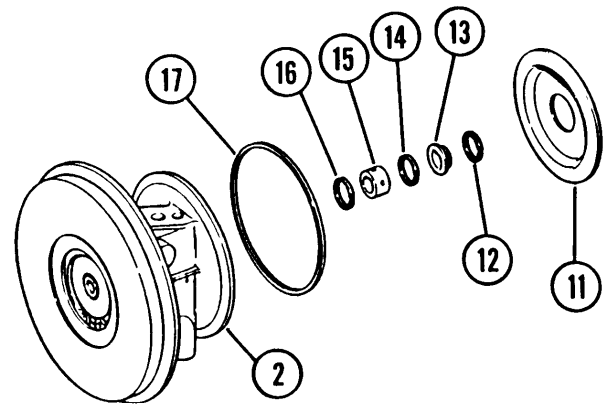
**4-7. TURBOCHARGER - REPAIR (Cont'd)**


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**CAUTION**

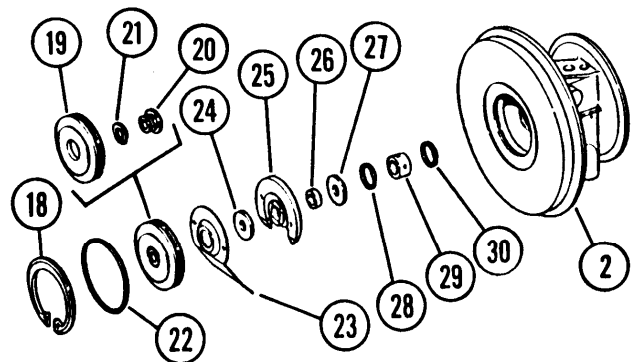
- Do not put a side force on shaft (9) after nut (7) is loosened.
- (7) Use a socket to remove nut (7) and compressor wheel (8) from shaft.
- (8) Remove cartridge (2) from fixture.
- (9) Slide turbine wheel assembly (9) out of cartridge (2). Remove and discard seal (10) from shaft.

- (10) Remove shroud (11) from cartridge (2).
- (11) Use a snap ring pliers to remove snap ring (12). Remove sleeve (13), snap ring (14), bearing (15) and snap ring (16).
- (12) Remove and discard preformed packing (17) from cartridge (2).



- (13) Use a snap ring pliers to remove snap ring (18) from cartridge (2).
- (14) Use two standard screwdrivers to remove insert (19) from cartridge assembly (2).
- (15) Use your thumbs to push sleeve (20) and two seals (21) from insert (19). Remove and discard preformed packing (22) from insert. Discard two seals (21).

- (16) Remove deflector (23), washer (24), bearing (25), sleeve (26), washer (27), snap ring (28), bearing (29) and snap ring (30) from cartridge (2). Use snap ring pliers to remove snap ring.



4-7. **TURBOCHARGER - REPAIR (Cont'd)**

b. Cleaning

See page 2-29 for general cleaning instructions.

c. Inspection

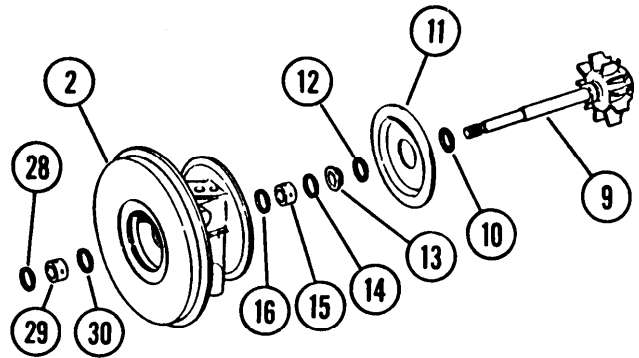
- (1) See page 2-32 for general inspection instructions.
- (2) Inspect oil passages to make sure they are clean and open.

d. Lubrication

Coat all parts with a thin film of engine lubricating oil.

e. Assembly

- (1) Start on smaller side (turbine side) of cartridge (2). Use snap ring pliers to install snap ring (16), with round side out.
- (2) Install bearing (15) and use snap ring pliers to install snap ring (14), with round side out.
- (3) Install sleeve (13) and use snap ring pliers to install snap ring (12).
- (4) On compressor side of cartridge (2) use snap ring pliers to install snap ring (30) into cartridge (2), with round side facing out.
- (5) Install bearing (29) into cartridge (2). Use snap ring pliers to install snap ring (28), with round side toward bearing, into cartridge (2).
- (6) Use high temperature grease on groove for new seal (10) (fill groove all the way around half or more the depth). Install new seal (10) onto shaft of turbine wheel assembly (9).



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## 4-7. TURBOCHARGER - REPAIR (Cont' d)

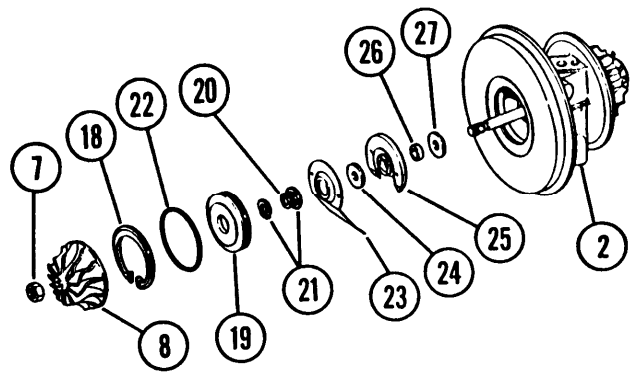
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- (7) Place shroud (11) on small side of cartridge (2). Install turbine wheel assembly (9) through small side of cartridge (2).
- (8) Place cartridge (2), turbine wheel assembly down, on suitable fixture.

### CAUTION

The oil hole in bearing (19) must be open and clean, or damage to bearing will occur.

- (9) Install washer (27), sleeve (26), bearing (25), washer (24) and deflector (23) into cartridge (2).
- (10) Install the two new seal rings (21) onto sleeve (20).
- (11) Push sleeve (20) into insert (19). Put new preformed packing (22) onto insert (19).
- (12) Install insert (19) into cartridge (2) and use a snap ring (18) to secure snap ring (18).
- (13) Put compressor wheel (8) onto shaft.



### CAUTION

Do not let Loctite 262 get into the compressor wheel bore on the shaft. It will make removal of the compressor wheel difficult during future disassembly.

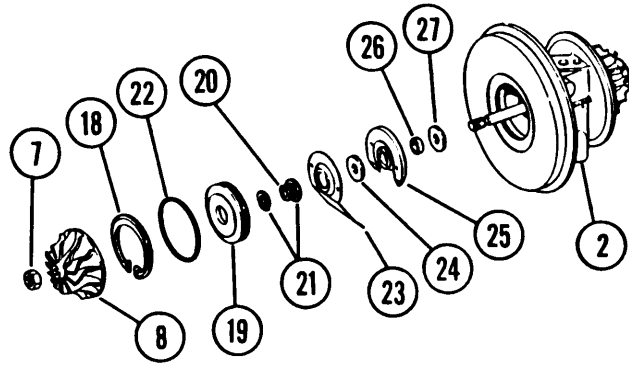
- (14) Clean shaft threads and nut (7). Place small amount of Loctite 262 on nut (7) and shaft threads.
- (15) Put small amount of lubricant on area of nut (7) that comes in contact with compressor wheel (8). Do not put lubricant on threads.

4-7. TURBOCHARGER - REPAIR (Cont'd)

(16) Use a torque wrench and a socket to install and tighten nut (7) to a torque of  $44 \pm 2$  ft. lbs.

(17) Place cartridge (2) into a vise. Check the shaft end play with dial test indicator. The end play must be  $0.0045 \pm 0.0015$ " ( $0.114 + 0.038$  mm). The maximum permissible end play with used parts is  $0.008$ " ( $0.20$  mm).

(18) Use new preformed packings (16 and 5) and put them on proper sides of cartridge (2).



NOTE

Use anti-seize compound on threads of V-clamp (6).

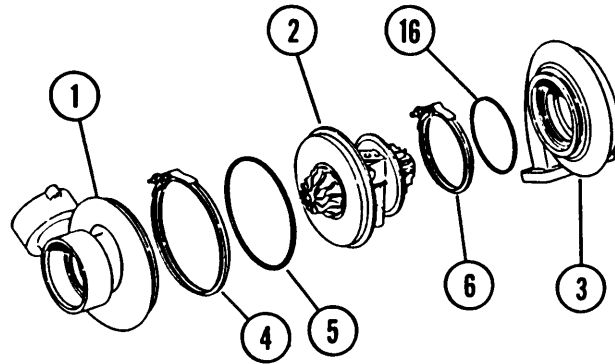
(19) Line up turbine housing (3) and cartridge (2). place V-clamp (6) in position and tighten with a socket to a torque of 120 lb. in.

(20) Use a soft hammer to tap V-clamp (6) to make sure it is in its correct position. Recheck torque.

(21) Put V-clamp (4) and cover (1) in the correct position onto cartridge (2).

(22) Put anti-seize compound on threads of V-clamp (4). Use a socket and torque wrench to tighten V-clamp (4) to a torque of 120 lb. in. Use a soft hammer to tap V-clamp (4) to make sure it is in proper position. Recheck torque.

(23) Install turbocharger. See TM5-2410-237-20.



f. Place In Service

Run engine and check turbocharger for proper operation.



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## 4-8. FUEL TANK - REPLACE

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This task covers:

- a. Removal
  - b. Cleaning
  - c. Inspection
  - d. Installation
  - e. Place In Service
- 

### INITIAL SETUP

#### Applicable Configurations

All

#### Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Lifting Equipment 500 lbs.

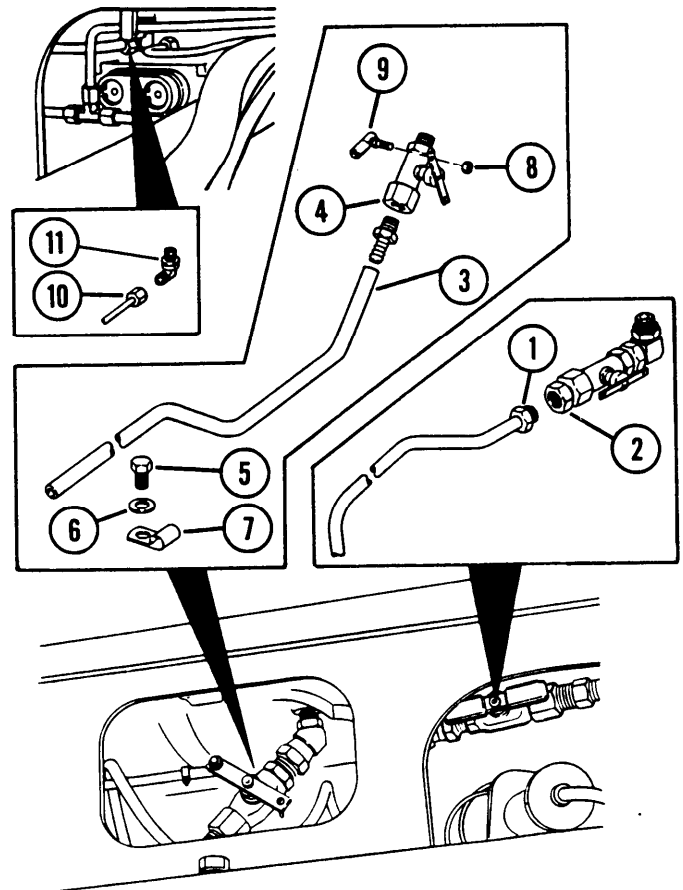
#### Equipment Condition

ROPS mounting dates and brackets  
removed, see TM5-2410-237-20.

Fuel tank drained,  
see TM5-2410-237-20.

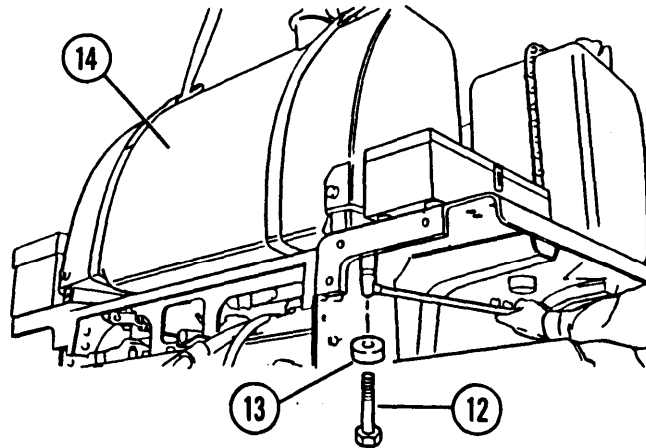
#### a. Removal

- (1) Use a wrench to disconnect fuel supply line (1) from fitting (2).
- (2) Use two wrenches to disconnect drain line (3) from valve (4).
- (3) Use a wrench to remove capscrew (5) and washer (6) from clip (7) and remove drain line (3). Attach lifting equipment to tank.
- (4) Use two wrenches to remove nut (8) from joint assembly (9).
- (5) Use a wrench to disconnect fuel return line (10) from elbow (11).



4-8. FUEL TANK - REPLACE (Cont'd)

- (6) Use a wrench to remove two capscrews (12) and spacers (13) from underneath each fender. Use lifting equipment to remove tank (14).
- (7) Remove plunger (15) and strainer (16) from tank.



b. Cleaning

**WARNING**

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

- (1) Flush fuel tank with clean solvent and let dry thoroughly. See page 2-29.
- (2) Clean strainer and use compressed air to clean screen.

c. Inspection

**WARNING**

Thoroughly steam clean inside of fuel tank before welding. Failure to do so may result in serious or fatal injury.

Inspect tank for cracks and signs of corrosion. Cracks can be repaired by welding. Badly corroded tanks must be replaced.

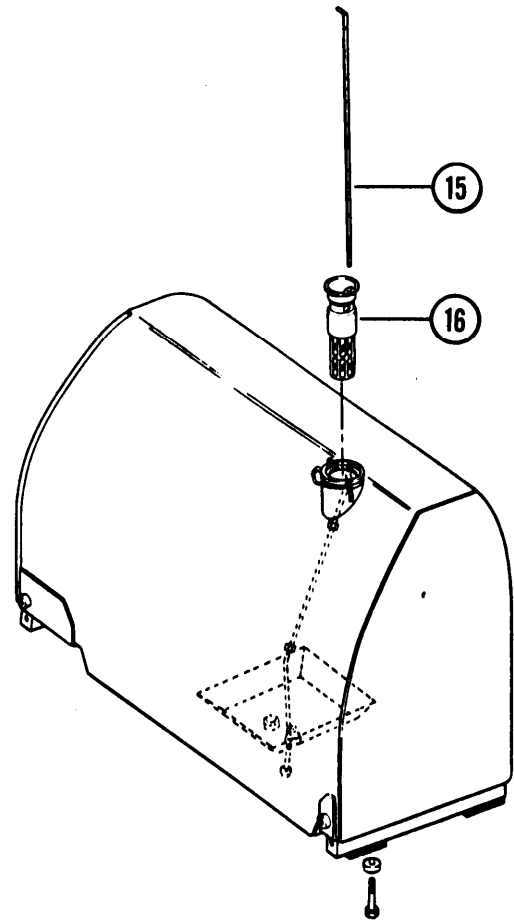
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**4-8. FUEL TANK - REPLACE (Cont'd)**


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**d. Installation**

- (1) Install strainer (16) and plunger (15) in fuel tank.
- (2) Use lifting equipment to install tank (14). Use a wrench to install two capscrews (12) and spacers (13) underneath each fender.
- (3) Connect fuel return line (10) to elbow (11). Use a wrench to tighten.
- (4) Replace nut (8) on joint assembly (9). Use two wrenches to tighten nut (8).
- (5) Position drain line (3) on tractor, and install clip (7). Use a wrench to secure washer (6) and capscrew (5).
- (6) Use two wrenches to reconnect drain line (3) to valve (4).
- (7) Use a wrench to reconnect fuel supply line (1) to fitting (2).
- (8) Fill fuel tank. See TM5-2410-237-20.
- (9) Install ROPS mounting plates and brackets. See TM5-2410-237-20.

**e. Place In Service**

Run engine and check fuel tank for leaks and proper operation.

4-9. **GOVERNOR AND FUEL INJECTION PUMP HOUSING - ADJUST/REPLACE**

This task covers:

- a. Adjust Timing by Timing Pin Method
- b. Removal
- c. Installation
- d. Start-up Procedure

INITIAL SETUP

Applicable Configurations  
All

Personnel Required  
MOS62B (1)

Common Tools  
Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Lifting Equipment 100 lbs.

Equipment Condition  
Hood removed. (TM5-2410-237-20)  
Alternator and brackets removed. (TM5-2410-237-20)  
Fuel injection lines removed. (TM5-2410-237-20)  
Primary Fuel filter assembly removed. (TM - - -20)  
Turbocharger oil lines removed. (TM5-2410-237-  
Secondary fuel filter removed. (TM5-2410-237-20)  
Tachometer drive removed. (TM5-2410-237-20)  
Fuel transfer pump removed. See page 4-10.

Special Tools  
Timing Pin NSN 2815-01-268-2194

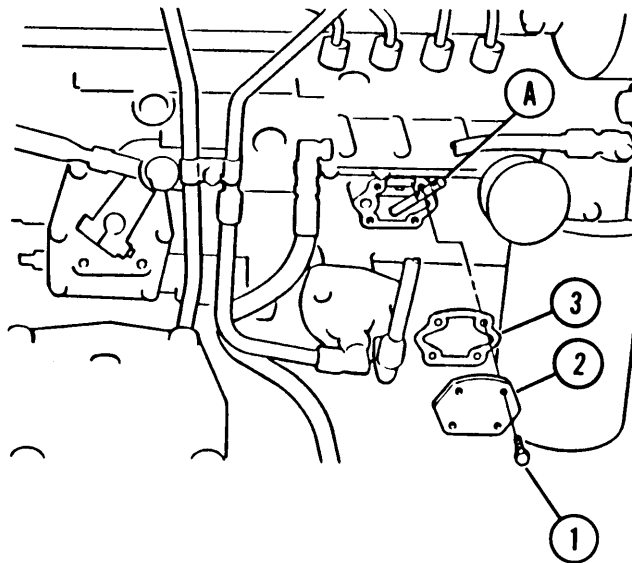
Materials/Parts  
Preformed Packing (21)

a. Adjust Timing by Timing Pin Method

- (1) Find top center compression position for Number 1 piston. See TM5-2410-237-20.
- (2) Use a wrench to remove four capscrews (1), cover (2), and gasket (3) from injection pump housing. Discard gasket (3).

CAUTION

Too much pressure on timing pin (A) can damage the injection pump, camshaft, and the timing pin.

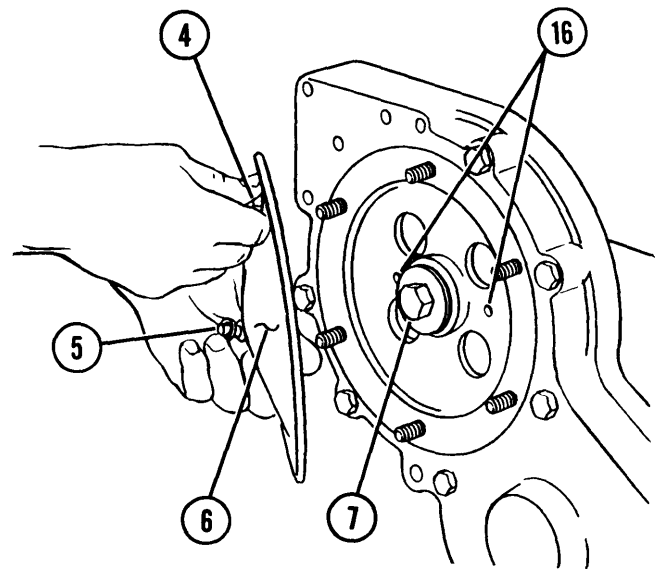


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 4-9. GOVERNOR AND FUEL INJECTION PUMP HOUSING - ADJUST/REPLACE (Cont' d)
 

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- (3) Install timing pin (A) in the fuel injection pump housing. As viewed from rear of engine, slowly rotate the crankshaft counterclockwise until pin (A) goes into the groove in the fuel pump camshaft.
- (4) put the timing capscrew in the timing hole in the flywheel housing. If the capscrew can be installed in the timing hole in the flywheel, the timing of the fuel injection pump is correct.
- (5) If the timing capscrew does not go into the timing hole in the flywheel, the timing of the fuel injection pump is not correct. Do the steps that follow to adjust the fuel injection pump timing.
- (6) Use a wrench to remove six nuts (4), six washers (5) and pump drive gear cover (6).
- (7) Use a wrench to loosen capscrew (7) that holds the timing gear to the fuel pump camshaft. Turn capscrew (7) out (counterclockwise) three turns.
- (8) Install gear puller using holes (16) and loosen the timing gear from the fuel pump camshaft.
- (9) Rotate the crankshaft clockwise 60° before reaching top center No. 1 piston.



## NOTE

Be sure timing pin (A) is still in the groove of the fuel pump camshaft.

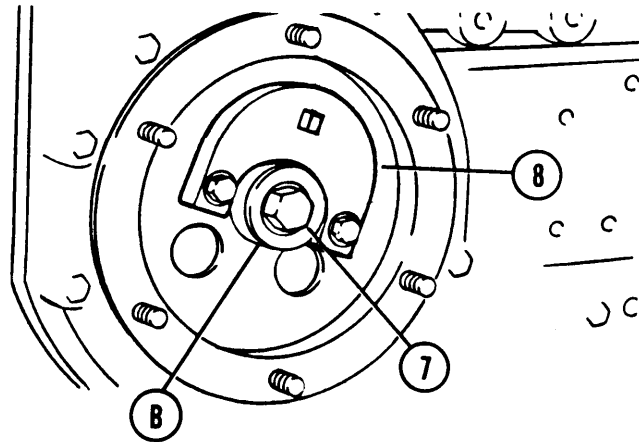
- (10) Tighten capscrew (7) finger tight.

4-9. GOVERNOR AND FUEL INJECTION PUMP HOUSING - ADJUST/REPLACE (Cont'd)

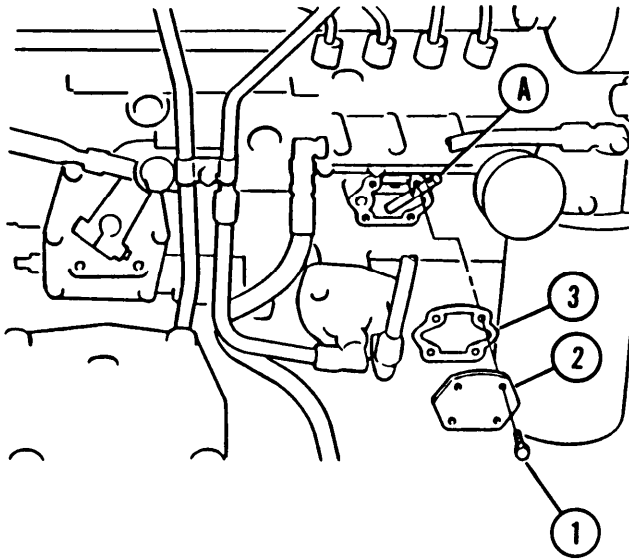
- (11) Slowly rotate the crankshaft counterclockwise until the timing capscrew can be installed in the flywheel.
- (12) Install adapter (8) on the timing gear with two 3/8"-24NF capscrews that are 1 in. long.

NOTE

For some later engines, grind the retainer (B) for the installation of adapter (8) to the timing gear.



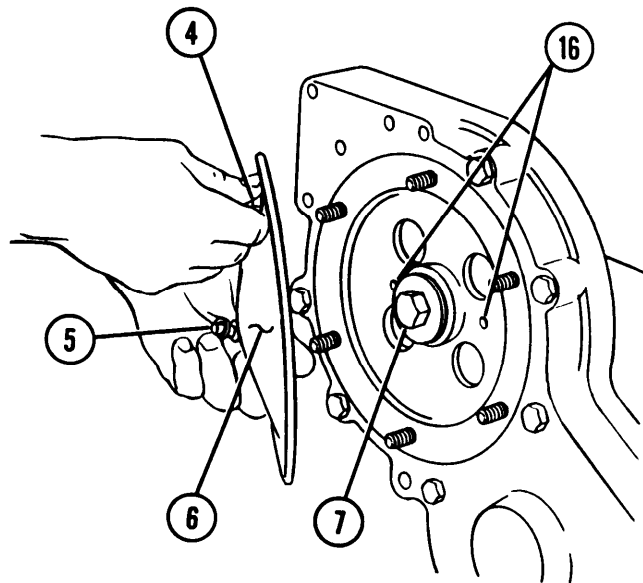
- (13) Hold a torque of 50 lb. ft. on adapter (8) in a clockwise direction, and tighten capscrew (7) to a torque of 200±20 lb. ft.



- (14) Remove the timing capscrew from the flywheel and timing pin (A) from the fuel pump camshaft.
- (15) Rotate the crankshaft counterclockwise two revolutions. If the timing capscrew can be installed in the flywheel and the timing pin can be installed in the fuel pump camshaft, the timing is correct.

- (16) If either the timing pin or the timing capscrew cannot be installed, do STEPS 8 through 16 again.

- (17) Install plug removed to find top center No. 1 piston back in flywheel housing. See TM5-2410-237-20.

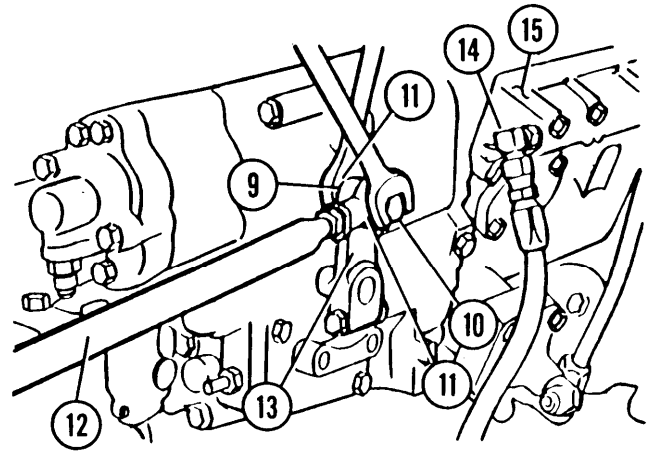


- (18) Use a wrench to install four capscrews (1), timing pin hole cover (2), and gasket (3) to the fuel injection pump housing.
- (19) Use a wrench to install pump drive gear cover (6), six washers (5), and six nuts (4) to engine front housing.

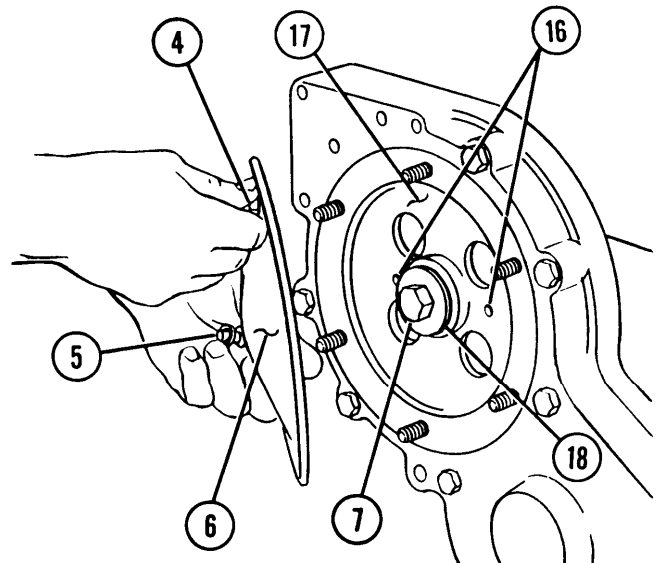
## 4-9. GOVERNOR AND FUEL INJECTION PUMP HOUSING - ADJUST/REPLACE (cont'd)

b. Removal

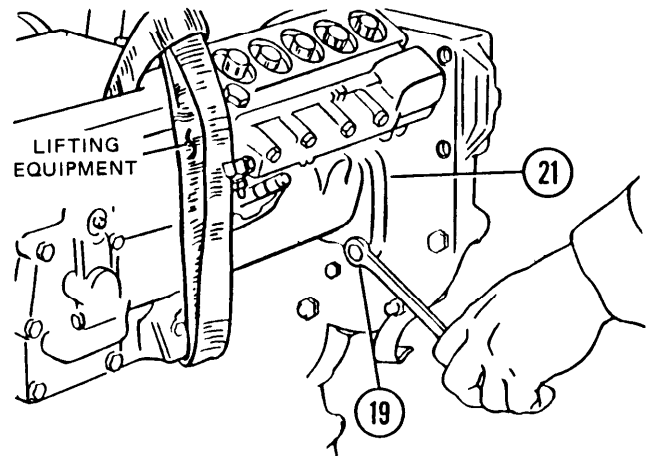
- (1) Use two wrenches to remove nut (9), capscrew (10), washers (11) and rod (12) from lever (13).
- (2) Use a wrench to disconnect fuel return line (14) from fuel manifold (15).



- (3) Use a wrench to remove six nuts (4), six washers (5) and pump drive gear cover (6).
- (4) Use a wrench to loosen capscrew (7). Attach a gear puller at threaded holes (16) of drive gear (17).
- (5) Use gear puller to loosen fuel injection pump drive gear (17) from the taper on the fuel injection pump camshaft. Remove capscrew (17) and washer (18).



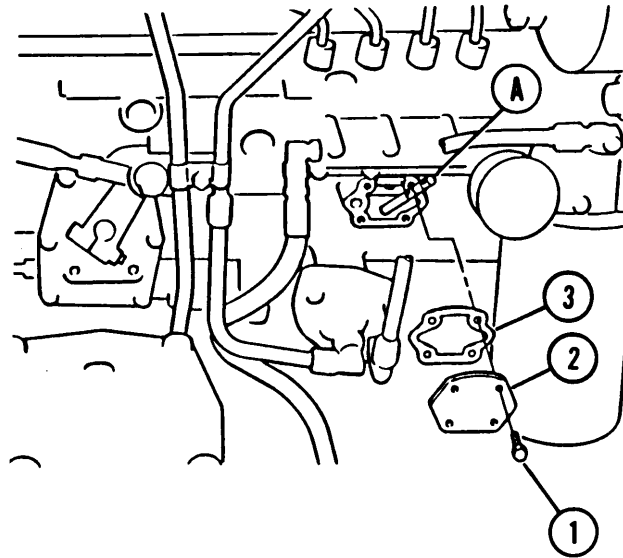
- (6) Fasten lifting equipment to the fuel injection pump housing and governor.
- (7) Use a wrench to remove three nuts (19). Separate injection pump housing from engine front housing cover and use lifting equipment to move housing away from tractor.
- (8) Remove preformed packing (21) from injection pump housing.



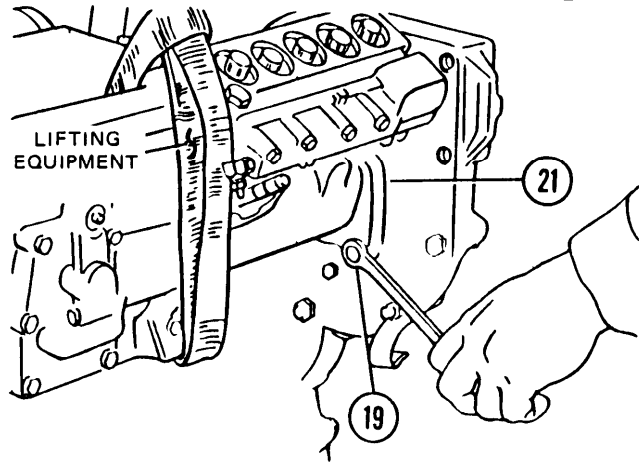
4-9. GOVERNOR AND FUEL INJECTION PUMP HOUSING - ADJUST/REPLACE (Cont' d)

c. Installation

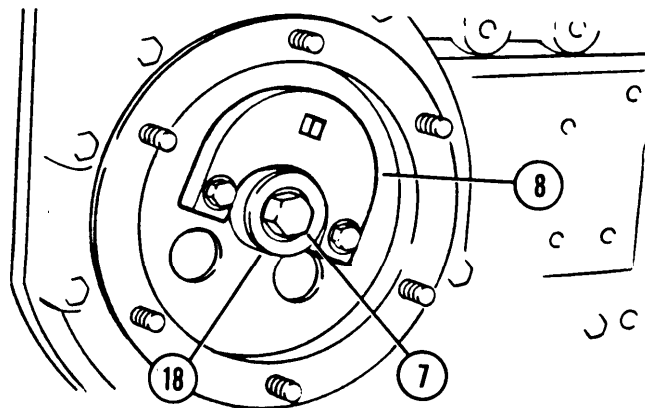
- (1) Find top center compression for number 1 piston. See TM5-2410-237-20.
- (2) Use a wrench to remove four capscrews (1), the timing pin hole cover (2), and gasket (3).
- (3) Rotate injection pump camshaft until timing pin (A) goes in notch in camshaft.



- (4) place a new preformed packing (21) on injection pump housing. Fasten a hoist to the governor and fuel injection pump housing. Use lifting equipment to position housing on the engine.



- (5) Use a wrench to install three nuts (19) that hold the injection pump housing to the timing gear housing.
- (6) Install washer (18) and capscrew (7).
- (7) Install adapter (8) on the injection pump drive gear.

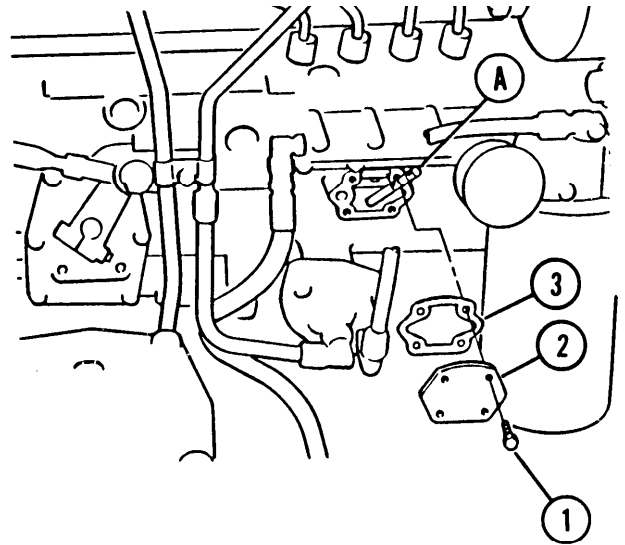


- (8) Use two torque wrenches and hold adapter (8) by applying a torque of 50 lb. ft. in a clockwise direction. While holding adapter, tighten capscrew (7) to a torque of 200±20 lb. ft.

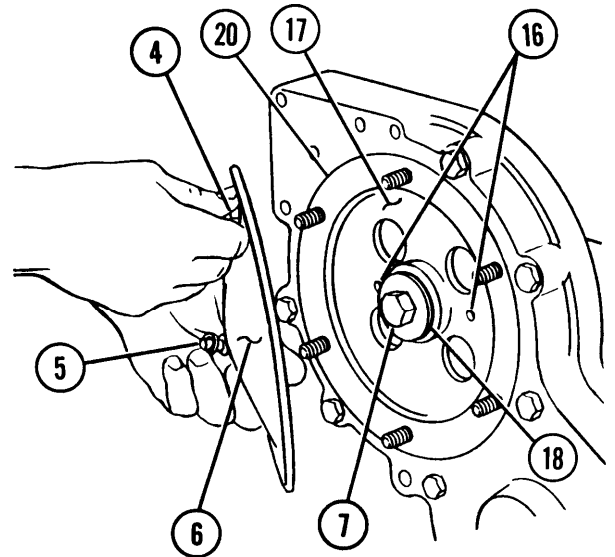


4-9. GOVERNOR AND FUEL INJECTION PUMP HOUSING - ADJUST/REPLACE (Cont'd)

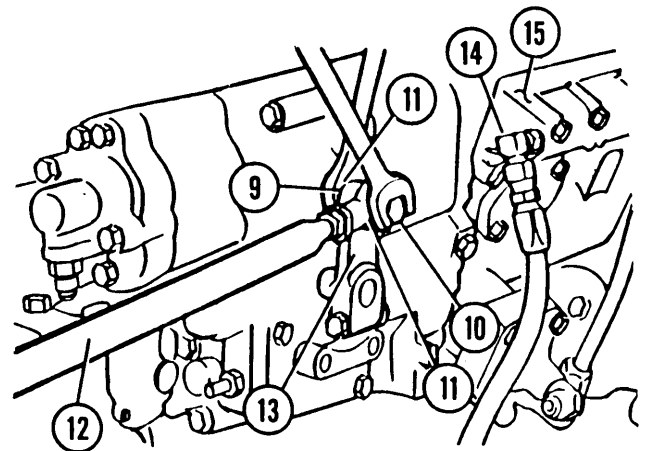
- (9) Remove timing pin (A) from injection pump housing.
- (10) Turn the engine crankshaft clockwise (as seen from the front of the engine) two complete revolutions. If timing pin (A) goes into the notch in the camshaft of the fuel injection pump and a 3/8" -16NC capscrew goes into the flywheel housing at the same time, the timing is correct.
- (11) If timing pin (A) or capscrew cannot be installed, see Adjust Timing by Timing Pin Method in this paragraph-



- (12) Use a wrench to install four capscrews (1) and timing pin hole cover (2), and new gasket (3) to the injection pump housing cover.
- (13) place new gasket (20) and pump drive gear cover (6) in position on engine front housing cover.
- (14) Use a wrench to install six washers (5) and six nuts (4).
- (15) Use a wrench to install fuel return line (14) to fuel manifold (15).



- (16) Use two wrenches to install washers (11), capscrews (10), rod (12), and nut (9) to lever (13).
- (17) Install fuel transfer pump. See page 4-10.
- (18) Install tachometer drive. See TM5-2410-237-20.
- (19) Install secondary fuel filter. See TM5-2410-237-20.
- (20) Install turbocharger oil lines. See TM5-2410-237-20.



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#### 4-9. GOVERNOR AND FUEL INJECTION PUMP HOUSING - ADJUST/REPLACE (Cont'd)

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- (21) Install primary fuel filter assembly. See TM-2410-237-20.
- (22) Install fuel injection lines. See TM5-2410-237-20.
- (23) Install alternator and brackets. See TM5-2410-237-20.
- (24) Perform start-up procedure, d.
- (25) Install hood. See TM5-2410-237-20.

#### d. Start-up Procedure

##### NOTE

Use this procedure to start the engine for the first time after work is done on the fuel pump or governor.

- (1) Remove the air inlet elbow and piping from the air inlet of the turbocharger.
- (2) Start the engine. If the engine runs too fast or does not react correctly to the controls, immediately put a steel plate against the air inlet to the turbocharger. The engine will stop.
- (3) If the engine runs properly, test drive the tractor through all speeds and check for proper operation.

4-10. GOVERNOR - ADJUST

This task covers:  
 Low and High Idle Adjustment

INITIAL SETUP

Applicable Configurations  
 All

Personnel Required  
 MOS62B (2)

Common Tools  
 Shop Equipment, General Purpose  
 Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894

Materials/Parts  
 Lockwire

Low and High Idle Adjustment

NOTE

Use STE/ICE diagnostics to test  
 check RPM.

- (1) Start engine and run until  
 normal operating temperature is  
 reached. Check low and high  
 idle rpm with no load on engine.  
 See Table 4-1 for engine rpm.

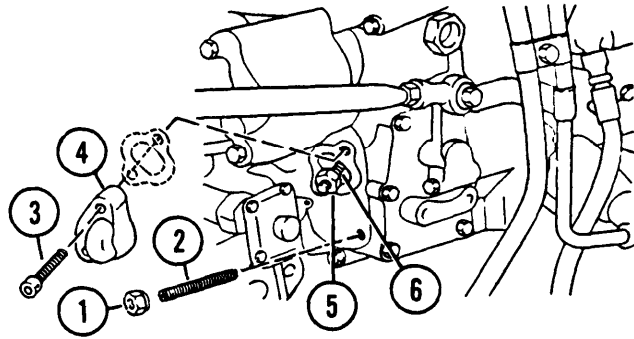
TABLE 4-1. HIGH AND LOW IDLE RPM

Engine speed	Spec.	Min.	Max.
Low Idle	1340±30	1310	1370
High Idle	2094±50	2044	2144

- (2) To adjust low idle, run engine  
 with governor in low idle  
 position.

4-10. GOVERNOR -ADJUST (Cont'd)

- (3) Loosen locknut (1) for low idle screw (2) on governor.
- (4) Turn low idle screw (2) until the correct low idle rpm is obtained.
- (5) Increase engine speed and then return to low idle. Check low idle speed again.
- (6) Tighten locknut (1).
- (7) To adjust high idle, cut lockwire and remove two capscrews (3) and cover (4).
- (8) Loosen locknut (5) on high idle screw (6).
- (9) Turn high idle screw until the high idle rpm is obtained.
- (10) Decrease engine speed and then return to high idle. Check high idle speed again.
- (11) Tighten locknut (5). Place cover (4) in position and install two capscrews (3). Secure capscrews (3) with lockwire.



CHAPTER 5

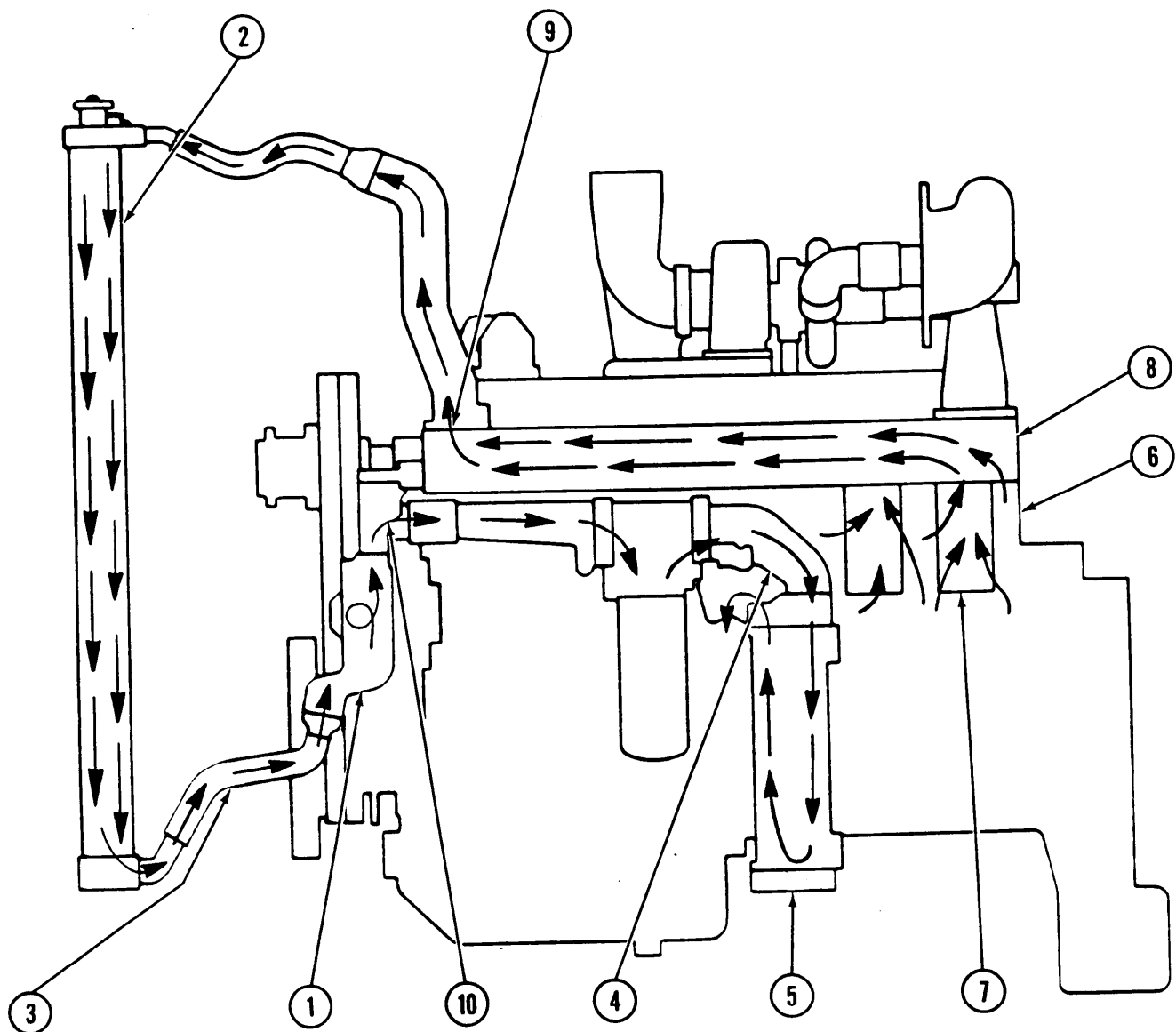
COOLING SYSTEM MAINTENANCE

Section 1. DESCRIPTION AND DATA

5-1. GENERAL

Cooling system maintenance procedures not covered in this chapter can be found in TM5-2410-237-20.

5-2. PRINCIPLES OF OPERATION



- a. Cooling System Operation. Water pump (1) is on the left front side of the engine. It is gear driven by the timing gears. Coolant from the bottom of radiator (2) goes to water pump inlet (3). The rotation of the impeller in water pump (1) pushes the coolant through the system.

Bonnet (4) sends the coolant flow through the transmission cooler (5) which is for the torque converter. The flow goes through one side on the way into cooler (5). At the bottom of cooler (5) the flow turns and goes back up through the other side and into bonnet (4) again. Then bonnet (4) sends the coolant into cylinder block (6).

Inside cylinder block (6) the coolant goes around cylinder liners (7) and up through the water directors into cylinder head (8). The water directors send the flow of coolant around the valves and the passages for exhaust gases in cylinder head (8). The coolant goes to the front of cylinder head (8). Here water temperature regulator (9) controls the direction of the flow. If the coolant temperature is less than normal for engine operation, water temperature regulator (9) is closed. The oil way for the coolant to get out of cylinder head (8) is through internal bypass (10). The coolant from this line goes into water pump (1) which pushes it through the cooling system again. The coolant from internal bypass (10) also works to prevent cavitation (air bubbles) in the coolant. When the coolant gets to the correct temperature, water temperature regulator (9) opens and coolant flow is divided. Most of the coolant goes through the radiator (2) for cooling. The remainder goes through internal bypass (10) to water pump (1). The amount of the two flows is controlled by water temperature regulator (9).

Radiator (2) has a pressure relief cap and filler cap. The pressure relief cap keeps the pressure in the cooling system from getting too high when the engine is running. It also lets air come into the system when the pressure in the system is less than atmospheric.

- b. Cooling System Components.

- (1) Water Pump. The centrifugal-type water pump has two seals. One prevents leakage of water and the other prevents leakage of lubricant.

An opening in the bottom of the pump housing which is plugged by foam allows any leakage at the water seal or the rear bearing oil seal to be detected by the mechanic.

- (2) Fan. The fan is driven by two V-belts, from a pulley on the crankshaft. Belt tension is adjusted by adjusting the alternator group.

- (3) Coolant Flow Switch. The coolant flow switch is installed in the outlet side of the engine oil cooler. It is part of the engine warning system. When the force of the coolant against the paddle of the switch gets too low, the switch closes and activates the system.

## Section II. COOLING SYSTEM MAINTENANCE PROCEDURES

## 5-3. COOLING SYSTEM MAINTENANCE TASK SUMMARY

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TASK PARA .	PROCEDURES	PAGE NO.
5-4	Radiator - Replace/Repair	5-4
5-5	Water Pump Assembly - Repair	5-17
5-6	Fan Guard - Replace	5-21

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5-4. RADIATOR - REPLACE/REPAIR

---

This task covers:

- a. Removal
  - b. Disassembly
  - c. Assembly
  - d. Test
  - e. Installation
  - f. Place In Service
- 

INITIAL SETUP

Applicable Configurations

All

Personnel Required

MOS62B (2)

Common Tools

Shop Equipment, General Purpose  
 Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Shop Equipment  
 Welding, Field Maintenance  
 NSN 4940-00-357-7268  
 Lifting Equipment 500 lbs.  
 Pressurizing Pump

Materials/Parts

Seals (49), (57)  
 Gasket (12)  
 Antifreeze (App. B, Item 2)  
 1/2" -13 Eyebolt (35)  
 Blocks 2 3"X2"X4"  
 Liquid Soap (App. B, Item 16)

Equipment Condition

Engine cool.  
 Headlamp protective guard removed.  
 TM5-2410-237-20.  
 Radiator cap removed. See TM5-  
 2410-237-20.  
 Hood removed. TM5-2410-237-20.

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a. Removal

WARNING

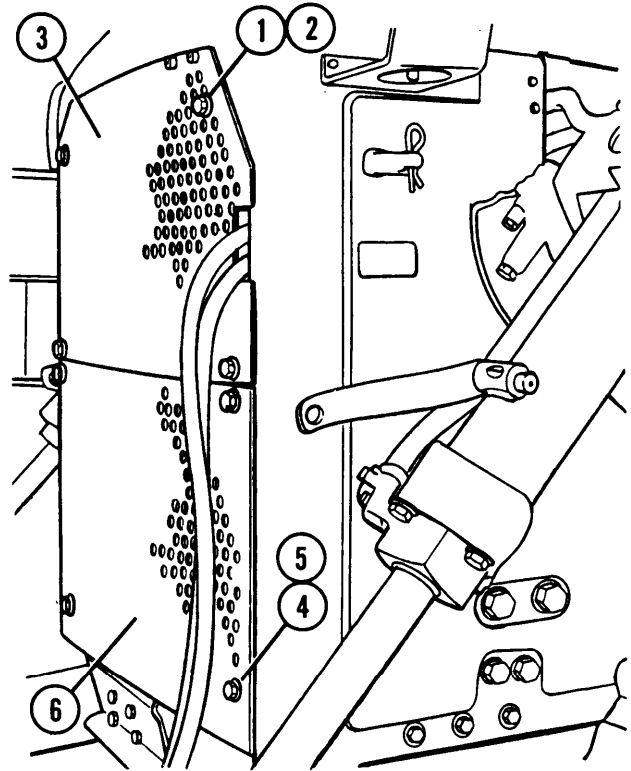
Engine must be cool before  
 starting radiator removal.  
 Personal injury can result  
 if precaution is not followed.

- (1) Drain coolant from cooling  
 system. See TM5-2410-237-20.

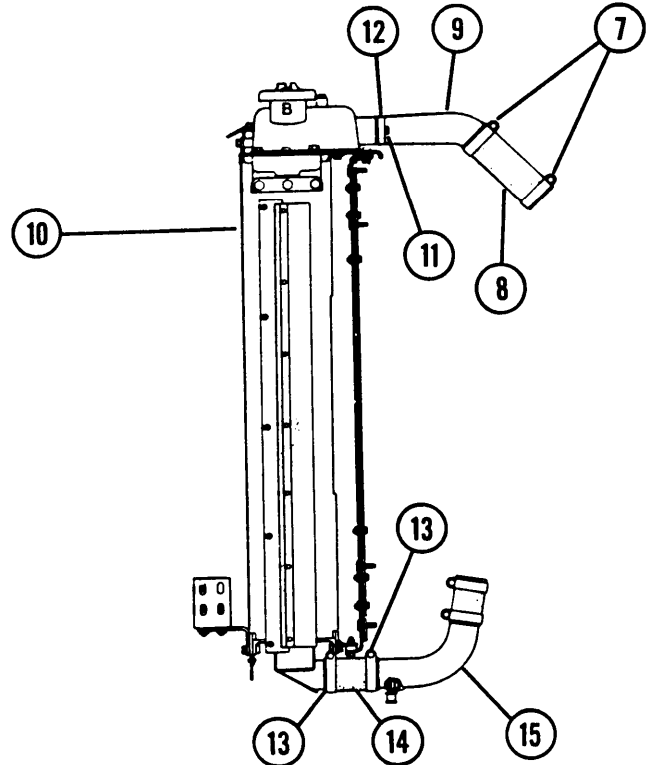


5-4. RADIATOR - REPLACE/REPAIR (Cont'd)

- (2) Use a wrench to remove four capscrews (1), four washers (2) and upper section of radiator plate (3). (Weight 60 lbs. - use two people).
- (3) Use a wrench to remove four capscrews (4), four washers (5) and lower section of radiator plate (6). (Weight 60 lbs. - use two people).

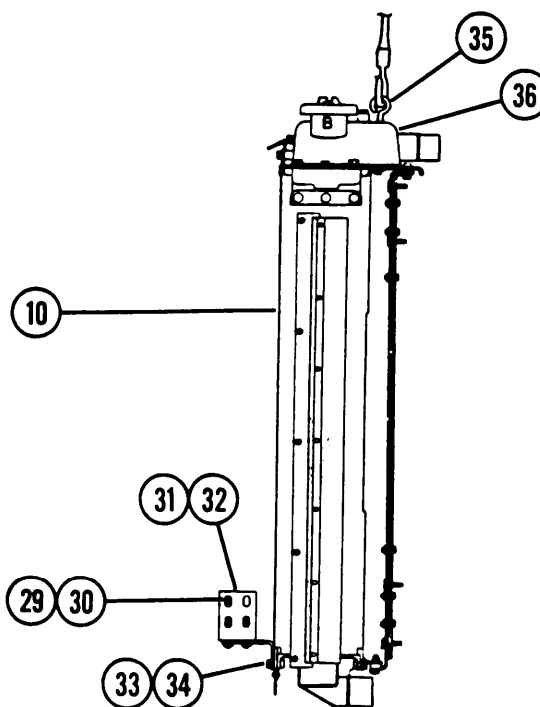
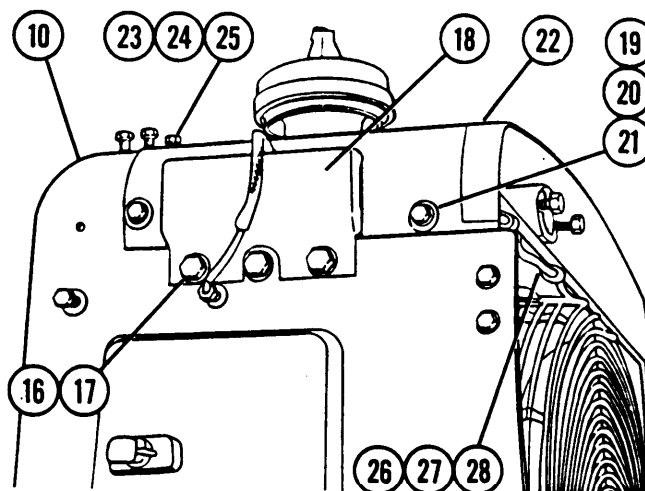


- (4) Loosen two clamps (7) on hose (8) on inlet line (9) at top of radiator (10).
- (5) Use a wrench to remove two capscrews (11), inlet tube (9) and gasket (12) from top of radiator (10). Discard gasket.
- (6) Slide hose (8) off upper inlet tube (9).
- (7) Loosen two clamps (13) on hose (14) in outlet line (15) at bottom of radiator (10).
- (8) Slide hose (14) off radiator section of outlet line (15).



5-4. RADIATOR - REPLACE/REPAIR (Cont'd)

- (9) Use a wrench to remove three capscrews (16), three washers (17) and small cover (18) at one side of radiator (10).
- (10) Use a wrench to remove two capscrews (19), two lockwashers (20) and two washers (21) from radiator cover (22).
- (11) Repeat STEPS 9 and 10 on other side of radiator.
- (12) Use a wrench to remove three capscrews (23), three washers (24) and three lockwashers (25) from top of radiator (10).
- (13) Use a wrench to remove ten capscrews (26), ten washers (27) and shield assembly (28).
- (14) Use a wrench to remove three capscrews (29), three washers (30) and bracket (31) from bottom front of radiator (10).
- (15) Repeat STEP 14 for bracket (32) on other side of radiator.
- (16) Use a wrench to remove three capscrews (33) and three washers (34) from front bottom of radiator assembly (10).
- (17) Install 1/2"-13 eyebolt (35) in radiator tank (36).



CAUTION

Radiator assembly weighs 450 lbs. Use lifting equipment to remove it. Ensure that wiring from horn is clear of radiator. Lift radiator slowly and carefully to avoid damage. Wiring harness to horn is located between radiator and support. Use care when removing radiator so wire harness is not damaged.

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**5-4. RADIATOR - REPLACE/REPAIR (Cont'd)**


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- (18) Attach hoist and remove radiator (10).

b. Disassembly

NOTE

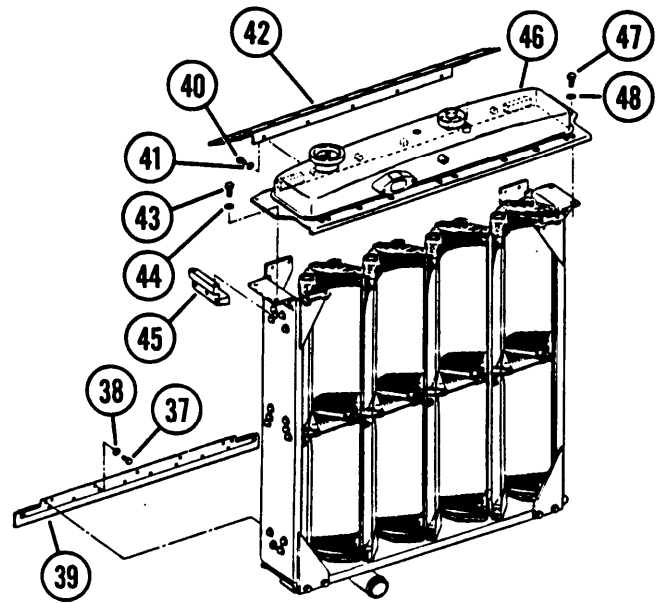
Lay radiator backside down on wood blocks for STEPS 1 and 2.

- (1) Remove four capscrews (37), four washers (38) and baffle (39) from bottom front of radiator assembly.
- (2) Remove five capscrews (40), five washers (41) and baffle (42) from top front of radiator assembly.

NOTE

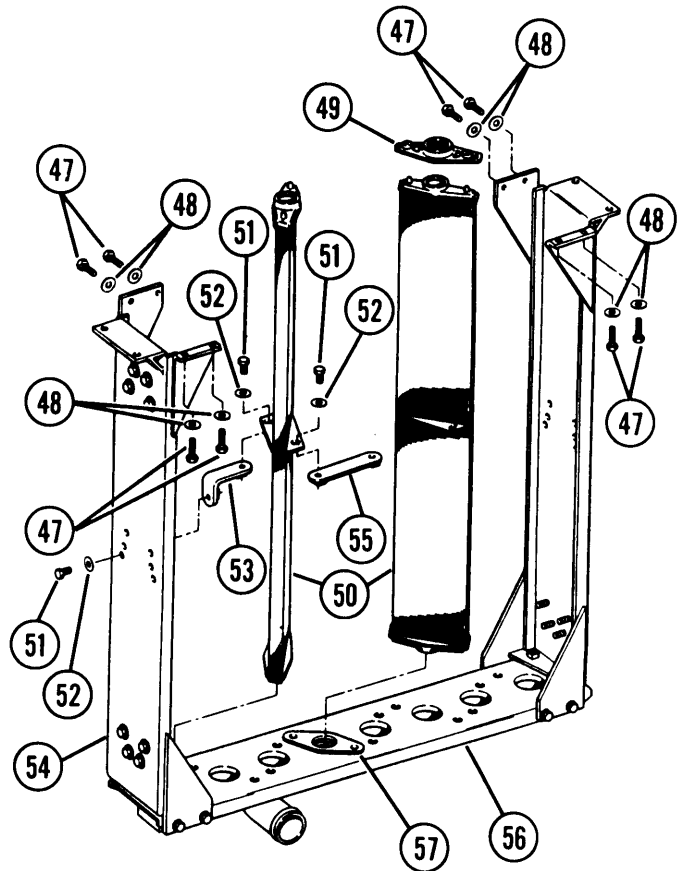
Stand radiator upright and support it securely on wood blocks.

- (3) Remove two capscrews (43), two washers (44) and support (45) from one end of top tank (46).
- (4) Repeat STEP 3 for support on other end of top tank.
- (5) Remove four capscrews (47) and four washers (48) from one end of top tank (46).
- (6) Repeat STEP 5 for other end of top tank.
- (7) Remove top tank (46).



5-4. RADIATOR - REPLACE/REPAIR (Cont'd)

- (8) Remove and discard eight seals (49) from tops of cores (50).
- (9) Remove two capscrews (51), two washers (52) and bracket (53) from side center of core assembly and channel (54).
- (10) Repeat STEP 9 for bracket on other side of core assembly.
- (11) Remove six capscrews (51), six washers (52) and three straps (55) from one side of core assembly.
- (12) Remove eight capscrews (51), eight washers (52) and four straps (55) from other side of core assembly.
- (13) Remove eight cores (50) from bottom tank (56).
- (14) Remove and discard eight seals (57) from bottom tank (56).
- (15) Remove six capscrews (58), six washers (59), and channel (54) from one end of bottom tank (56).
- (16) Remove two capscrews (60), two washers (61) and plate (62) from inside of channel (54).
- (17) Repeat STEPS 15 and 16 for channel at other end of bottom tank.



5-4. RADIATOR - REPLACE/REPAIR (Cont'd)

c. Assembly

- (1) Position bottom tank (56) securely on wood blocks.

**CAUTION**

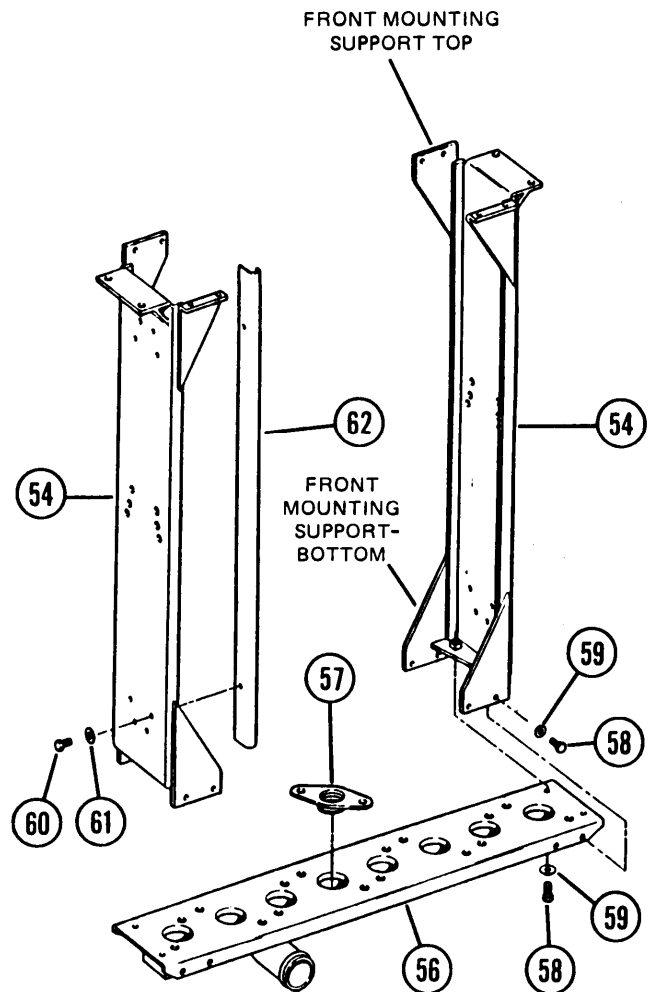
Open side of "U" bend in plate (62) must face front of radiator assembly. On the channel, the front is the side with the two straight mounting supports.

- (2) Install plate (62) in channel (54) with two capscrews (60) and two washers (61).
- (3) Install channel (54) on one end of bottom tank (56) with six capscrews (58) and six washers (59). Make sure front of channel is on side opposite outlet tube in tank.
- (4) Repeat STEPS 2 and 3 for channel on other end of tank.

**CAUTION**

Do not use oil or petroleum based products on seals. Do not use abrasive liquid.

- (5) Apply liquid soap to sealing areas around eight seal holes in tank (56). Be sure seal holes in bottom tank are clean.
- (6) Apply liquid soap to eight seals (57). Install seals in bottom tank (56).



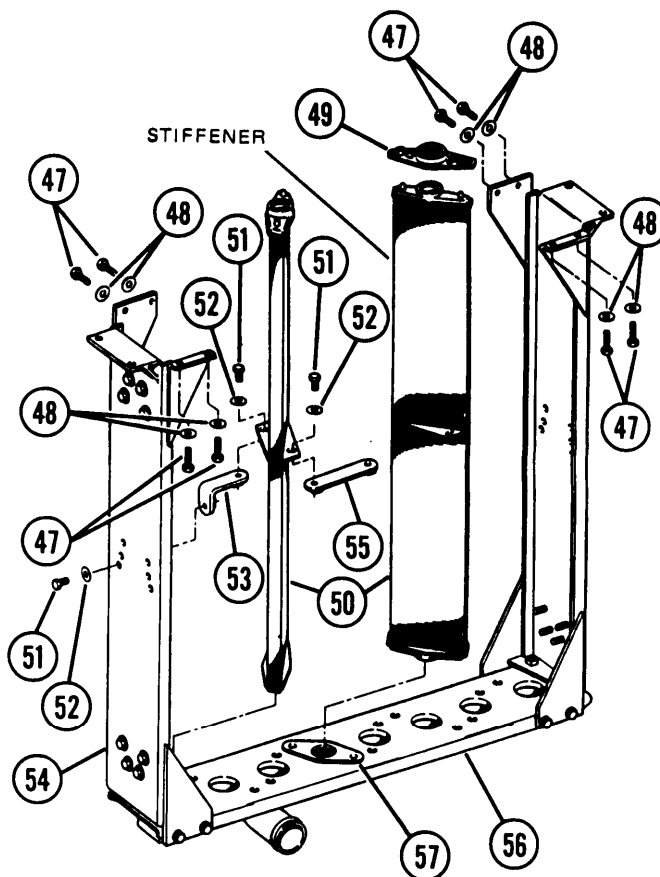
5-4. RADIATOR - REPLACE/REPAIR (Cont'd)

- (7) Install support bracket (53) in end core (50) with capscrew (51) and washer (52).

NOTE

Do not tighten capscrews until radiator is assembled.

- (8) Apply liquid soap to hole in seal (57) and insert end of core (50) in seal.
- (9) Install other end of support bracket (53) in side channel (54) with capscrew (51) and washer (52).
- (10) Apply liquid soap to hole in seal and install next core (50) in seal (57) in bottom tank (56). Install straw (55) at center tabs in cores (50) with two capscrews (51) and two washers (52).
- (11) Repeat STEP 10 for next six cores.
- (12) Install support bracket (53) on end core (50) and side channel (54) at other end of core assembly with four capscrews (51) and four washers (52).



NOTE

Make sure seal holes in top tank are clean.

- (13) Apply liquid soap to sealing area on top end of eight cores (50).
- (14) Apply liquid soap to sealing areas of eight holes in top tank (46). Install seals (49) in top tank (46).
- (15) Apply liquid soap to necks of core assemblies.

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**5-4. RADIATOR - REPLACE/REPAIR (Cont' d)**

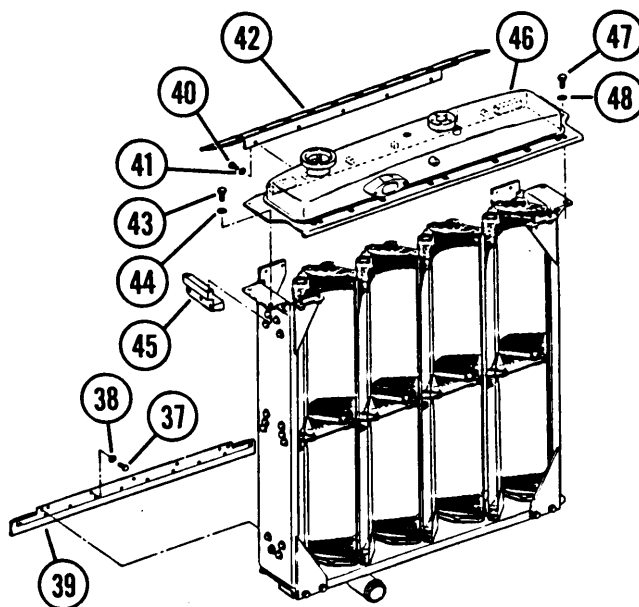

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- (16) With assistant, carefully position top tank (46) over cores (50), line up seals (49) with core necks and press down on tank to seat it on core seals (49) with gentle rocking motion.
- (17) Install one end of top tank (46) on side channel (54) with four capscrews (47) and four washers (48).
- (18) Install support (45) on one end of top tank (46) with two capscrews (43) and two washers (44).
- (19) Repeat STEPS 17 and 18 at other end of top tank.
- (20) Adjust cores (50) to get a 0.25 in. gap between cores at middle by stiffeners of "V" at front of radiator. Tighten capscrews (51) on straps (55) between cores (50) as adjustments are made.
- (21) Make sure back of "V" S are within 1/8" of each other at rear by pinching together.
- (22) Tighten balance of capscrews on radiator.

**NOTE**

Lay radiator backside down on wood blocks.

- (23) Install baffle (42) on top front of radiator with five capscrews (40) and five washers (41).
- (24) Install baffle (39) on bottom front of radiator with four capscrews (37) and four washers (38).



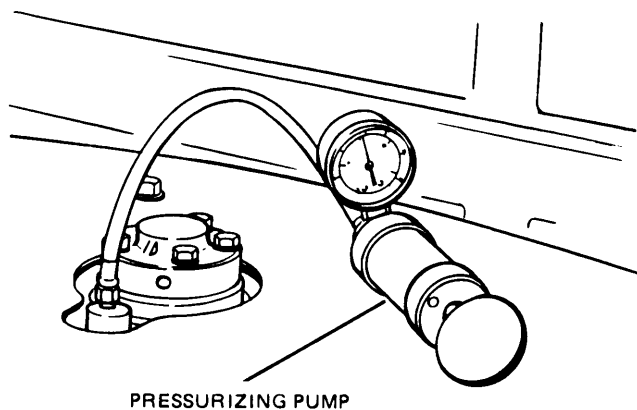
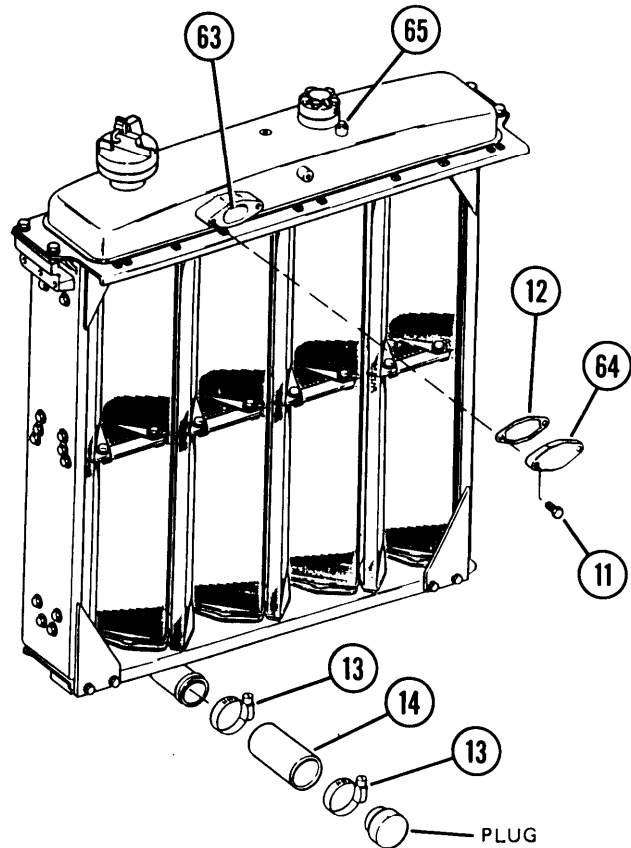
5-4. RADIATOR - REPLACE/REPAIR (Cont' d)

d. Test

CAUTION

Make sure all parts are clean.  
If dirt enters radiator, it  
could cause eventual failure.

- (1) Secure radiator in an upright (operating) position.
- (2) Cover hole (63) with new gasket (12), plate (64), and two capscrews (11). Plate must be at least 3" X 5" with holes bored 2-1/4" from center at each end along length of plate.
- (3) Attach hose (14) with clamp (13) at base of radiator.
- (4) Plug end of hose (hose diameter is 3.5 mm) and secure with clamp (13).
- (5) Remove plug (65) and install pressurizing pump.
- (6) Pump air into the radiator until the pressure reading on the gage reads 15 psi (103.41 kPa).
- (7) Inspect the radiator for outside leakage.
- (8) Check plugs, covers, connections and hoses to make sure that there is no external leakage.
- (9) If no external leakage is evident and the pressure reading on the gage remains constant for 5 minutes, there is no internal leakage in the system.
- (10) If no external leakage is evident and the pressure reading on the gage falls, there is internal leakage. Disassemble and repeat assembly procedures.





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#### 5-4. RADIATOR - REPLACE/REPAIR (Cont'd)

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- (11) If no internal or external leakage is found, pump more air into the radiator. The relief valve must open between 15 and 18 psi (105 and 125 kpa). If not, valve must be replaced. See TM5-2410-237-20.
- (12) When test is completed, open bleed valve on pump to release pressure in radiator.
- (13) Remove pressurizing pump from radiator and install plug. Tighten plug with a socket.
- (14) Remove hose (14) and remove plug from base. Clamps (13) and hose will be needed for installation.
- (15) Remove cover (64) and new gasket (12). Capscrews (11) and new gasket (12) will be needed for installation.

5-4. RADIATOR - REPLACE/REPAIR (Cont'd)

e. Installation

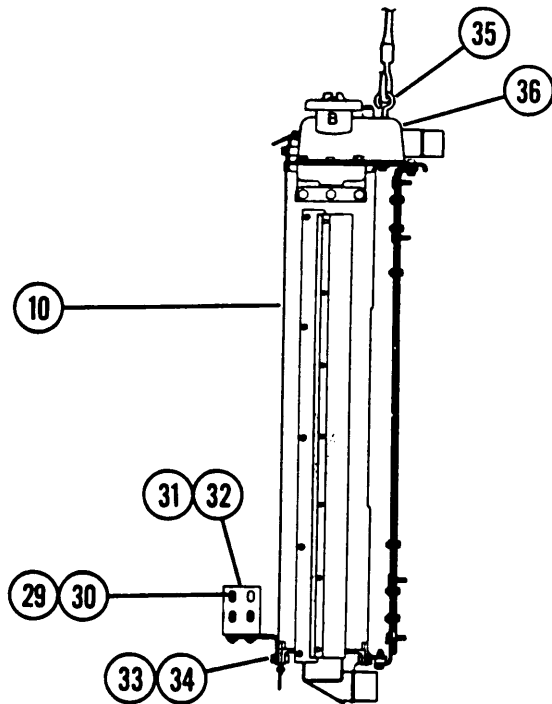
CAUTION

Radiator assembly weighs 450 lbs. Use lifting equipment to install it. Lower radiator slowly and carefully to avoid damage.

- (1) Install 1/2"-13 eyebolt (35) in radiator tank (36).
- (2) Attach lifting equipment and position radiator (10) in radiator guard.

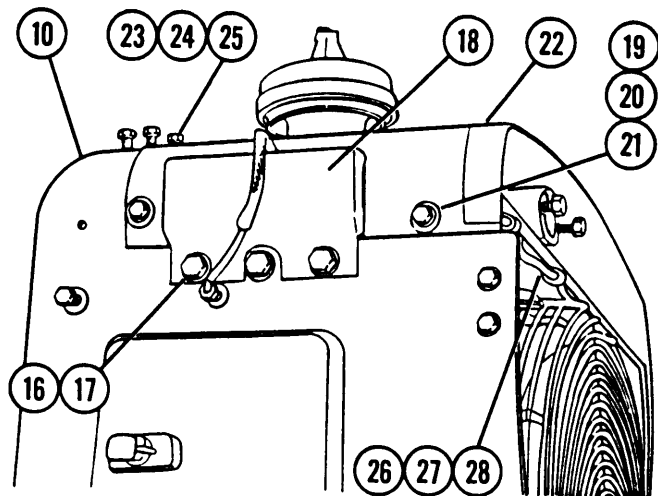
NOTE

Do not tighten capscrews until all radiator mounting hardware has been installed.



- (3) Use a wrench to install three capscrews (33) and three washers (34) at front bottom of radiator (10).
- (4) Use a wrench to install four capscrews (29), four washers (30) and bracket (31) at bottom front of radiator.
- (5) Repeat STEP 4 for bracket (32) on other side of radiator.

- (6) Use a wrench to install ten capscrews (26), ten washers (27) and shield assembly (28).
- (7) Tighten all radiator mounting hardware.
- (8) Use a wrench to install radiator cover (22) on radiator (10) with three capscrews (23), three lockwashers (25) and three washers (24).

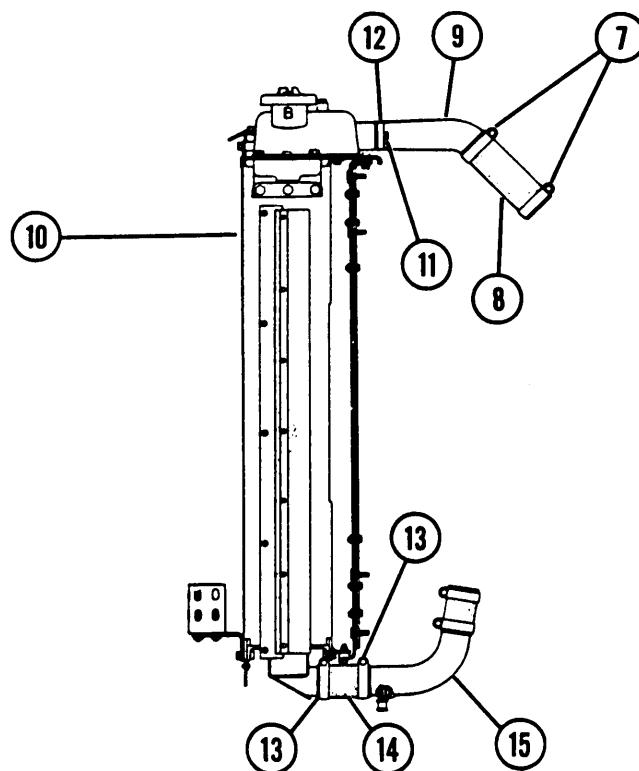


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**5-4. RADIATOR - REPLACE/REPAIR (Cont'd)**

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- (9) Use a wrench to install two capscrews (19), two lockwashers (20) and two washers (21) on one side of radiator cover (22).
- (10) Use a wrench to install three capscrews (16), three washers (17) and small cover (18) on same side of radiator (10).
- (11) Repeat STEPS 9 and 10 on other side of radiator.
- (12) Slide hose (14) with outlet line (15) on outlet fitting at bottom of radiator (10) and tighten two hose clamps (13).
- (13) Slide hose (8) on inlet tube (9) and tighten two hose clamps (7).
- (14) Use a wrench to install inlet tube (9) on top of radiator (10) with new gasket (12) and two capscrews (11).



5-4. RADIATOR - REPLACE/REPAIR (Cont' d)

(15) Use a wrench to install lower section of radiator plate (6) on radiator guard with four capscrews (4) and four washers (5). (Weight 60 lbs. - use two people.)

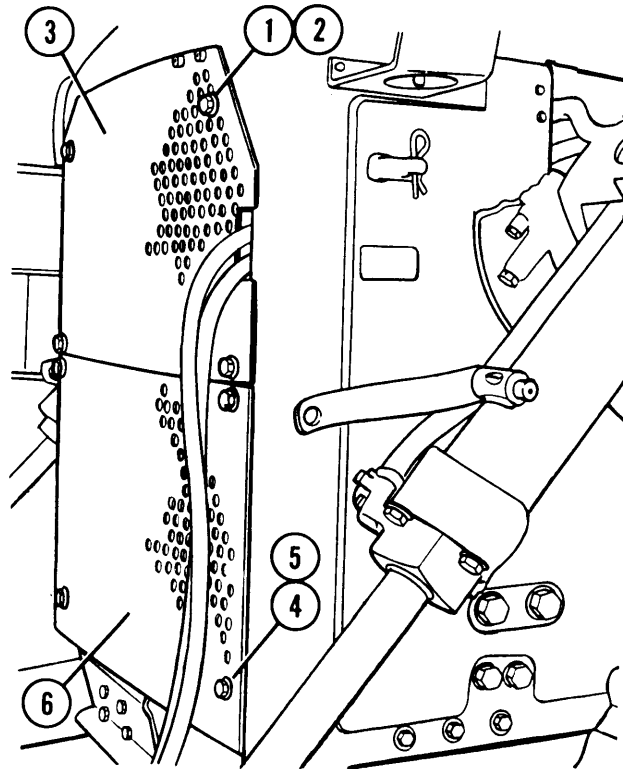
(16) Use a wrench to install upper section of radiator plate (3) on radiator guard with four capscrews (1) and four washers (2). (Weight 60 lbs. - use two people.)

(17) Close drain valve

(18) Fill cooling system with coolant to correct level. See TM5-2410-237-20.

f. Place In Service

Run engine and check radiator for proper operation.



---

## 5-5. WATER PUMP ASSEMBLY - REPAIR

---

This task covers:

- a. Disassembly
  - b. Assembly
  - c. Place In Service
- 

### INITIAL SETUP

#### Applicable Configurations

All

#### Common Tools

Shop Equipment, Machine Shop  
 Field Maintenance Basic  
 NSN 3470-00-754-0708  
 Shop Equipment, General Purpose  
 Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894

#### Materials/Parts

Seal Assembly (16), (18), (19)  
 Gasket (6), (20)  
 Seal Kit  
 Lubricating Oil OE/HDO-30 (See  
 L05-2410-237-12)

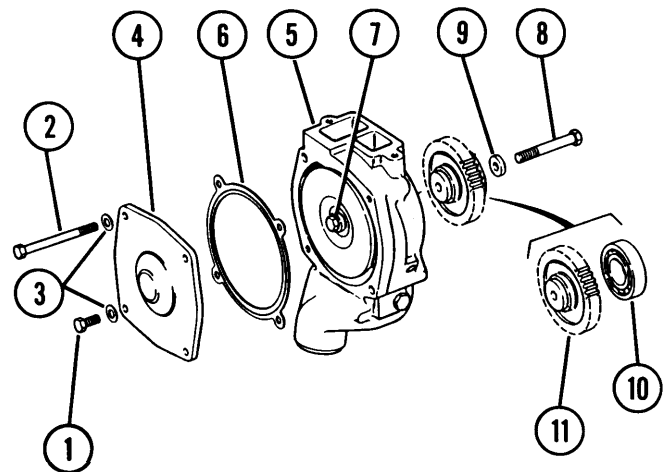
#### Equipment Condition

Water pump removed. See TM5-2410-237-20.

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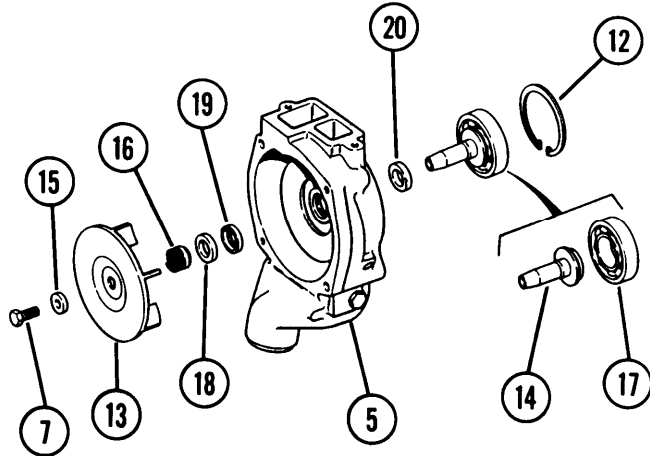
#### a. Disassembly

- (1) Use a wrench to remove two short (1) and two long (2) capscrews and four washers (3) from cover (4).
- (2) Remove cover (4) from water pump housing (5). Remove and discard gasket (6).
- (3) Loosen, but do not remove, capscrew (7) using a wrench. Turn capscrew about three times.
- (4) Turn housing (5) over and remove capscrew (8) and washer (9) using a wrench.
- (5) Use two screwdrivers to remove bearing (10) and gear (11) as a unit.
- (6) Use bearing puller attachment and a press to remove bearing (10) from gear (11).



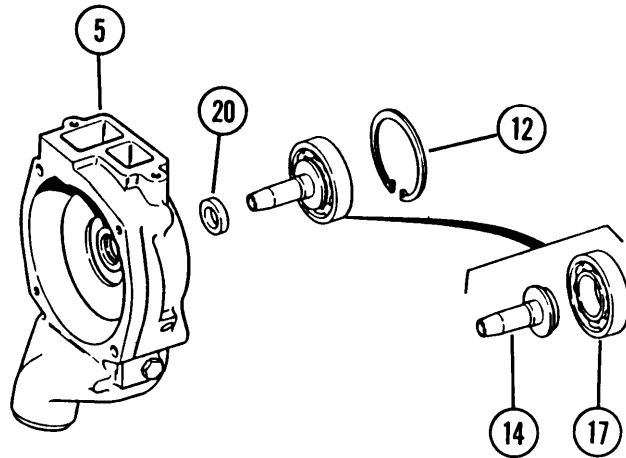
5-5. WATER PUMP ASSEMBLY - REPAIR (Cont'd)

- (7) Remove snap ring (12) with snap ring pliers.
- (8) Use an arbor press to press on capscrew (7) to loosen impeller (13) on shaft (14).
- (9) Remove capscrew (7), washer (15) and impeller (13) from shaft (14).
- (10) Remove spring and seal assembly (16) from shaft (14).
- (11) Remove bearing (17) and shaft (14) as a unit.
- (12) Use bearing puller attachment and a press to remove bearing (17) from the shaft (14).
- (13) Turn housing (5) over and remove ceramic ring (18) and seal (19).
- (14) Remove and discard lip seal (20) from the housing.



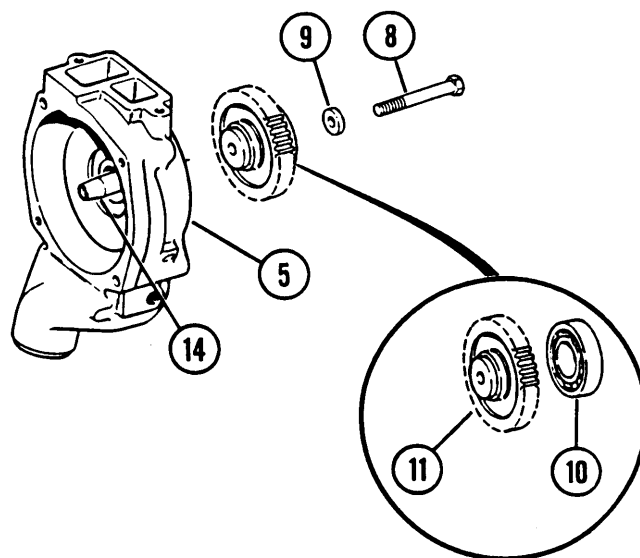
b. Assembly

- (1) Use a press to install shaft (14) in bearing (17).
- (2) Install lip seal (20) in water pump housing (5). The lip of the seal must be toward the bearings. Put clean SAE 30 oil on the lip of the seal.
- (3) Install shaft (14) and bearing (17) in housing (5).
- (4) Install snap ring (12) in housing (5) using snap ring pliers.



5-5. WATER PUMP ASSEMBLY - REPAIR (Cont'd)

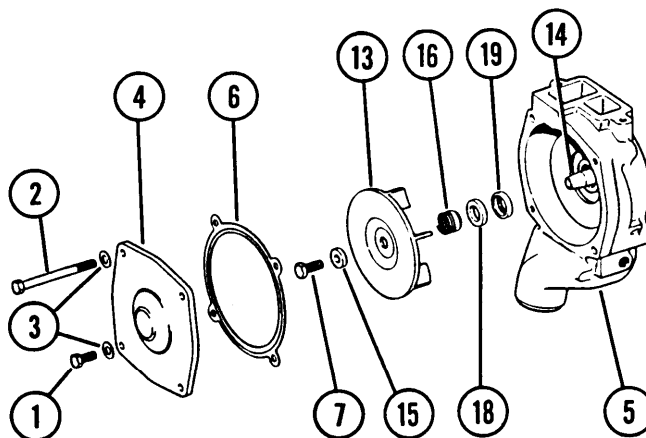
- (5) Heat bearing (10) to maximum temperature of 275°F and install on gear (11). Use press if necessary. Bearing must be relubricated if necessary.
- (6) Align pins in gear (11) with holes in shaft (14) and place in position.
- (7) Install capscrew (8) and washer (9) using a wrench.



CAUTION

Clean water only is permitted for use as a lubricant for assistance at installation. Do not damage or put hands on the wear surface of the new seal (16) or ceramic ring (18). Install the ceramic ring with the smoothest face of the ring toward the carbon seal assembly.

- (8) Turn housing (5) over and put the new ceramic ring (18) and seal (19) in position on the shaft (14). Use hand pressure and old ring to install the ceramic ring. Discard old ceramic ring.
- (9) Remove spring from seal assembly (16). Use hand pressure and old seal to install the seal assembly. Push seal assembly on shaft (14) until seal faces make light contact. Discard old seal assembly. Install spring on seal (16).
- (10) Put impeller (13) in position and install washer (15) and capscrew (7) using a wrench. Tighten the capscrew to a torque of 27+1 lb. ft. Check for free movement of impeller.



5-5. WATER PUMP ASSEMBLY - REPAIR (Cont' d)

NOTE

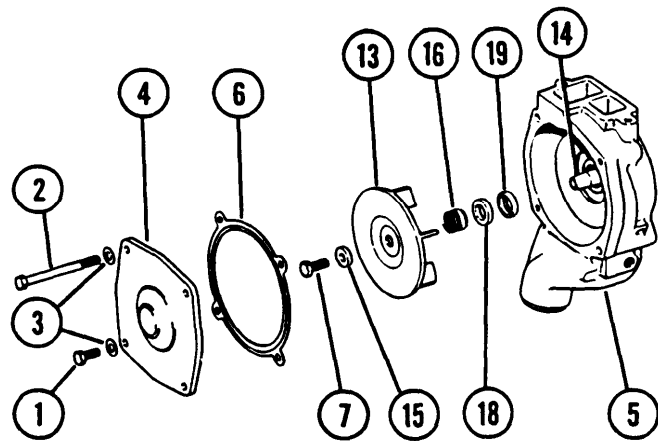
Make sure sealing surfaces of cover (4) and housing (5) are clean and free of old gasket material.

(11) Place gasket (6) and cover (4) in position on housing (5).

(12) Install cover (4) on housing (5) with two short capscrews (1) and two long capscrews (2) and four washers (3).

c. Place In Service

Run engine and check water pump for proper operation.





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## 5-6. FAN GUARD - REPLACE

---

This task covers:

- a. Removal
  - b. Installation
  - c. Place In Service
- 

### INITIAL SETUP

#### Applicable Configurations

All

#### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

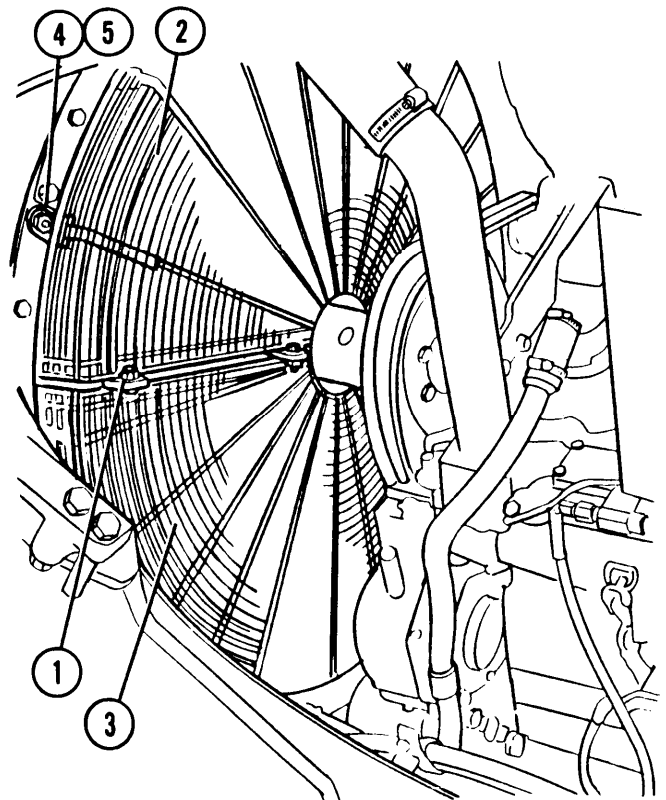
#### Equipment Condition

Blade lift cylinder  
mounting tube removed  
See page 13-76.

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#### a. Removal

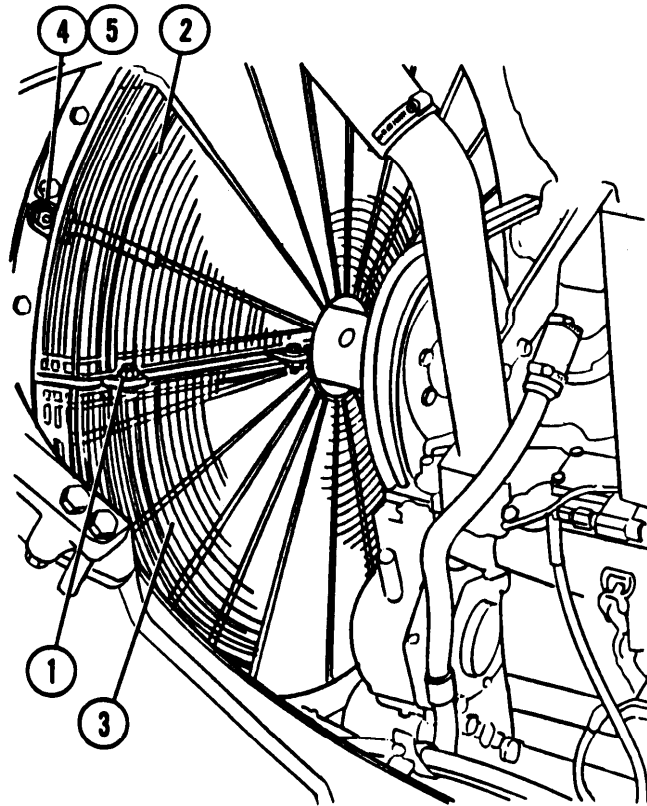
- (1) Use a socket wrench to remove four capscrews (1) joining upper (2) and lower (3) fan guards.
- (2) Use a socket wrench to remove six nuts (4) and six flat washers (5) holding upper fan guard section (2) in place.
- (3) Remove upper fan guard (2).
- (4) Repeat STEP 2 for lower fan guard (3).
- (5) Swing lower fan guard (3) upward around fan and lift out the top.



5-6. FAN GUARD - REPLACE (Cont'd)

b. Installation

- (1) Swing lower fan guard (3) down around fan and position on studs.
- (2) Use a socket wrench to fasten lower fan guard (3) with six washers (5) and six nuts (4).
- (3) Install upper fan guard (2) over fan on studs.
- (4) Repeat STEP 2 for upper fan guard (2) |
- (5) Use a socket wrench to install four capscrews (1) joining upper (2) and lower (3) fan guards.
- (6) Install blade lift cylinder mounting tube. See page 13-76.



c. Place In Service

Run engine and check for proper operation.

## CHAPTER 6

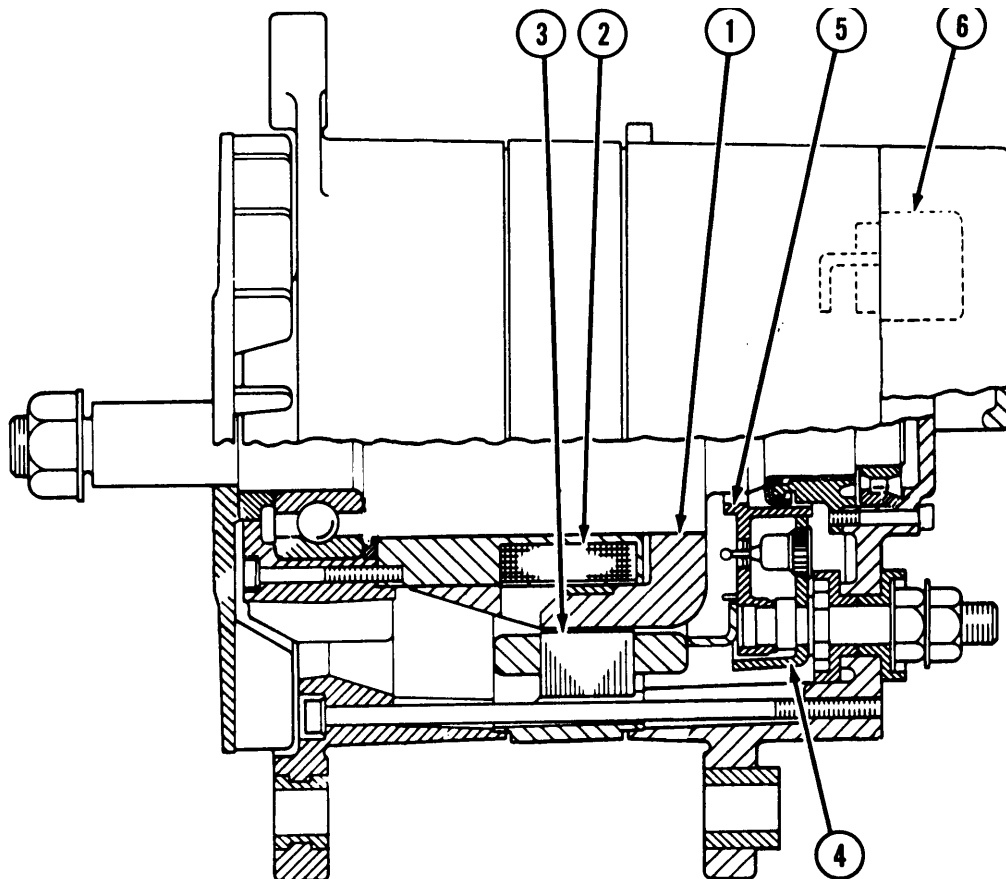
## ELECTRICAL SYSTEM MAINTENANCE

## Section 1. DESCRIPTION AND DATA

## 6-1. GENERAL

Electrical system maintenance procedures not covered in this chapter can be found in TM5-2410-237-20.

## 6-2. PRINCIPLES OF OPERATION



- a. Alternator. The alternator is driven by two V-type belts from the crankshaft pulley. This alternator is a three phase, full-wave rectified output with an integral voltage regulator.

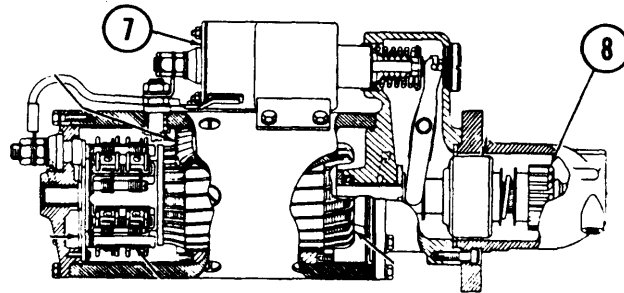
This alternator design has no need for slip rings or brushes, and the only part that has movement is the rotor assembly. All conductors that carry current are stationary. The alternator has a 50 amp output at 28 VDC.

The rotor assembly (1) has many magnetic poles like fingers with air space between each opposite pole. The poles have residual magnetism (like permanent magnets) that produce a small amount of magnet-like lines of force (magnetic field) between the poles. As the rotor assembly begins to turn between the field winding (2) and the stator winding (3), a small amount of alternating current (AC) is produced in the stator winding (3), from the small magnetic

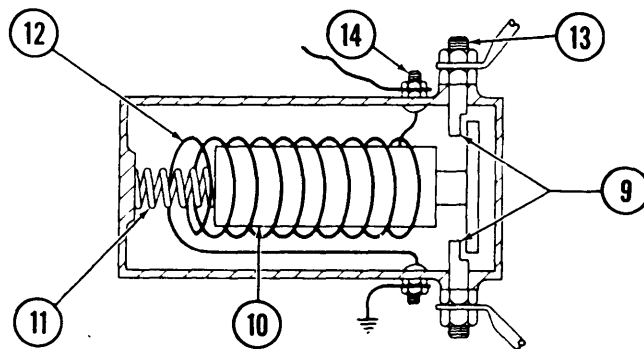
lines of force made by the residual magnetism of the poles. This AC current is changed to direct current (DC) when it passes through the diodes (4) of the rectifier bridge (5). Most of this current goes to charge the battery and to supply the low amperage circuit, and the remainder is sent on to the field windings (2). The DC current flow through the field winding (2) (wires around an iron core) now increases the strength of the magnetic lines of force. These stronger lines of force now increase the amount of AC current produced in the stator winding (3). The increased speed of the rotor assembly (1) also increases the current and voltage output of the alternator.

The voltage regulator (6) is a solid state (transistor, stationary parts) electronic switch. It feels the voltage in the system and switches on and off many times a second to control the field current (DC current to the field windings) for the alternator to make the needed voltage output.

- b. Starter Motor. The starter motor is used to turn the engine flywheel fast enough to get the engine running.



The starter motor has a solenoid (7). When the start switch is activated, electricity from the electrical system will cause the solenoid (7) to move the starter pinion (8) to engage with the ring gear on the flywheel of the engine. The starter pinion (8) will engage with the ring gear before the electric contacts in the solenoid (7) close the circuit between the battery and the starter motor. When the start switch is released, the starter pinion (8) will move away from the ring gear of the flywheel.



- c. Solenoid. A solenoid is a magnetic switch that uses low current to close a high current circuit. The solenoid has an electromagnet with a core which moves.

There are contacts (9) on the end of core (10). The contacts (9) are held in the open position by spring (11) that pushes core (10) from the magnetic center of coil (12). Low current will energize coil (12) and make a magnetic field. The magnetic field pulls core (10) to the center coil (12) and the contacts (9) close, completing the circuit between the battery terminal (13) and starter terminal (14).

## Section II. ELECTRICAL SYSTEM MAINTENANCE PROCEDURES

## 6-3. ELECTRICAL SYSTEM MAINTENANCE TASK SUMMARY

---

TASK PARA .	PROCEDURES	PAGE NO.
6-4	Al ternator - Test/Repair	6-4
6-5	Starti ng Motor - Repair	6-14

---

6-4. ALTERNATOR - TEST/REPAIR

This task covers:

- a. Disassembly
- b. Test of Components
- c. Assembly
- d. Bench Testing

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair  
Semi-Trailer Mounted  
NSN 4940-00-287-4894

Test Equipment

Digital Multimeter  
Test Leads  
Test Lamp  
Generator Test Bench

Personnel Required

MOS62B (1)  
MOS63G (1)

Material/Parts

Solder (App. B, Item 17)  
Epoxy Putty (App. B, Item 11)

Equipment Conditions

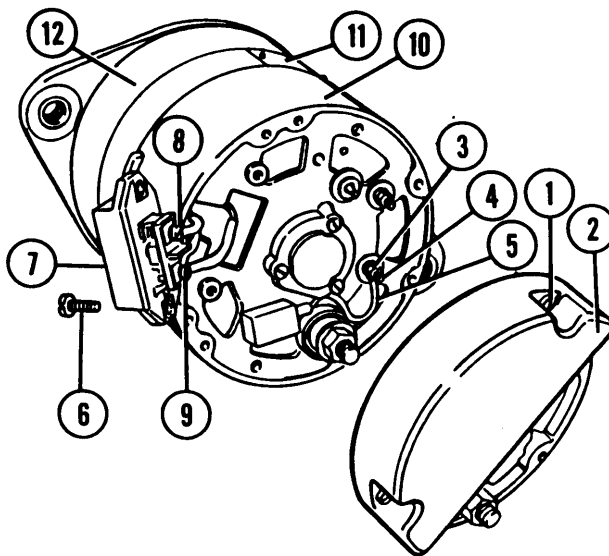
Alternator removed. See TM5-2410-237-20.

a. Disassembly

CAUTION

Care must be taken not to damage alternator by overtightening the vise.

- (1) Position alternator in vise or similar clamping device.
- (2) Remove pulley nut (not shown) and remove pulley (if installed) and fan from alternator.
- (3) Remove two screws (1) from regulator cover (2).
- (4) Use a wrench to remove nut (3) from (D+) terminal (4). Disconnect suppression capacitor lead (5).



## 6-4. ALTERNATOR - TEST/REPAIR (Cont'd)

## NOTE

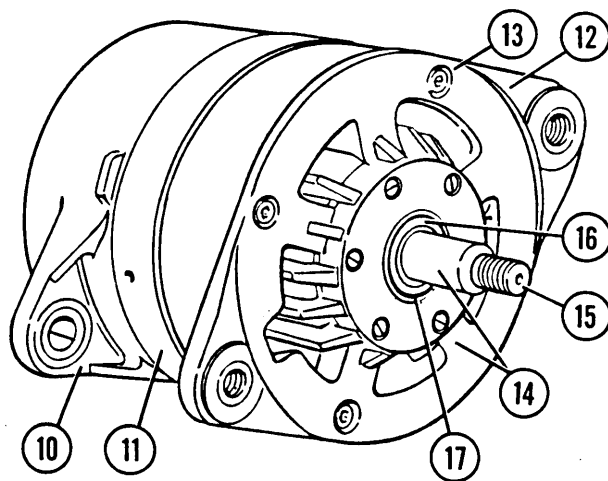
This step may be unnecessary if this test component is not to be tested or replaced.

- (5) Remove two screws (6) and pull regulator (7) partially away from frame to expose regulator terminals (8 and 9). The small diameter screw (8) is D+. The large diameter screw (9) is DF.
- (6) Disconnect two leads from D+ terminal (8) and one lead from DF terminal (9).
- (7) Mark rear housing (10), stator frame (11) and drive end shield (12) for proper alignment.
- (8) Remove four hex-socket head cap-screws (13). Separate drive end shield (12) and rotor as an assembly from the rear housing (10) and stator frame (11).
- (9) Position drive end shield and rotor assembly (14) along with tooling in press.

**CAUTION**

Take care not to damage bearing (16) while pressing out rotor.

- (10) Press out rotor (15) from drive end shield (12).
- (11) Remove ring spacer (17).



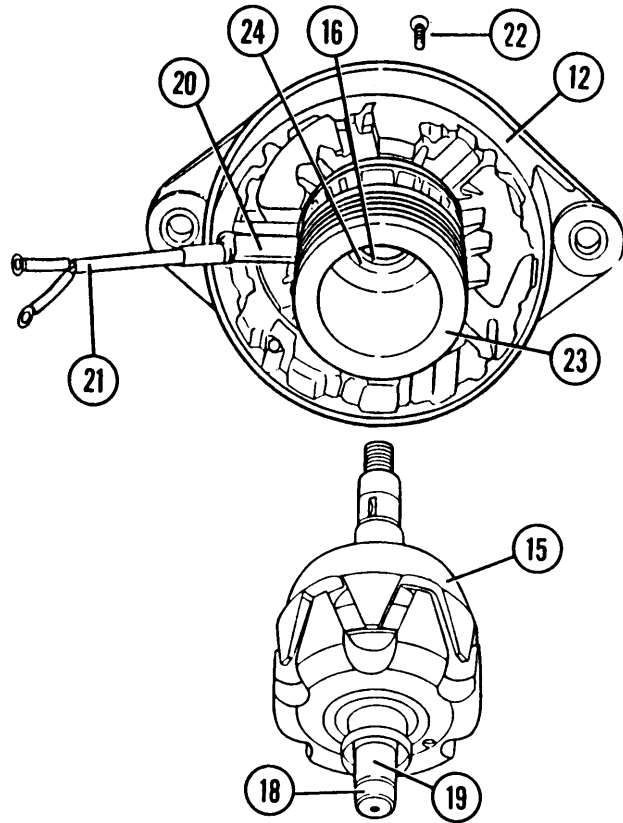
6-4. ALTERNATOR - TEST/REPAIR (Cont'd)

- (12) Inspect bearing inner race (18) on rotor shaft (19) (rectifier end).
- (13) Replace bearing (18) if worn or damaged. Also replace bearing race (18) if bearing (16) is replaced. Use bearing race puller to remove bearing race (18)!

CAUTION

Epoxy putty covers field winding lead (21) in next step. Care must be taken when removing this epoxy so that the lead is not damaged.

- (14) Remove epoxy from deep groove (20) in drive end shield (12).
- (15) Remove six screws (22) on front side of drive end shield (12).
- (16) Remove pole body (field coil winding) (23) and lead (21).
- (17) Remove intermediate ring (24).
- (18) Remove bearing (16) from seat in drive end shield (12).
- (19) Disconnect three stator phase windings (25) from the three rectifier bridge terminals (26) by unsoldering and straightening the bent over leads.
- (20) Remove stator frame (11) from rear housing (10).



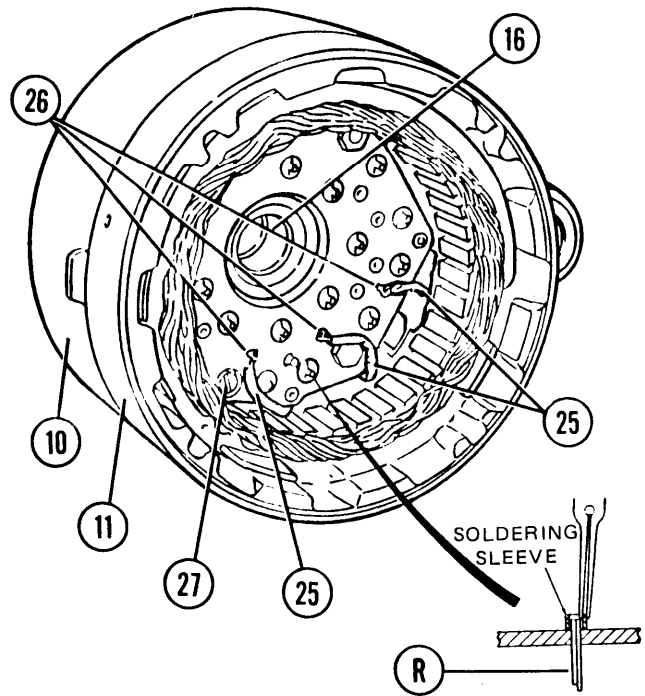


6-4. ALTERNATOR - TEST/REPAIR (Cont' d)

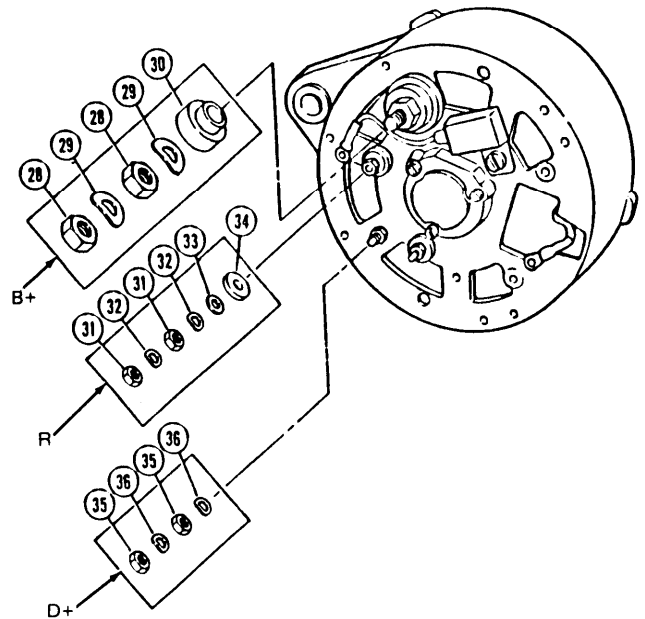
**CAUTION**

When unsoldering the (R) terminal, do not grip the soldering sleeve around its outside diameter. The sleeve will collapse with too much pressure. While heating with iron, grip the edge with long nose pliers.

- (21) Unsolder the soldering sleeve from terminal "R".
- (22) Remove two screws (27).

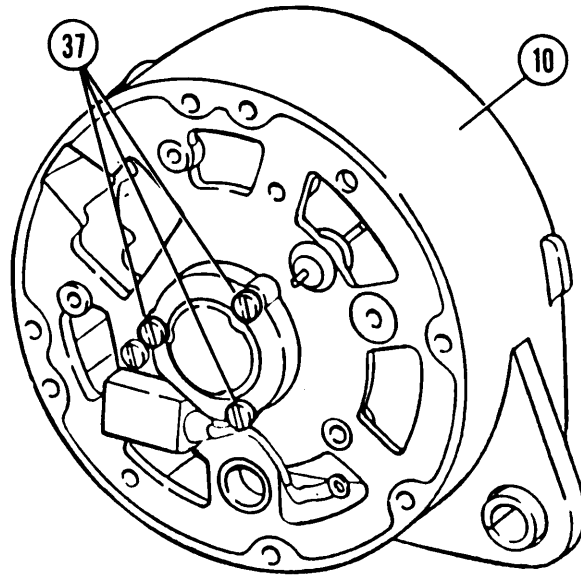


- (23) Remove two rectifier terminal retaining nuts (28) using a wrench, two washers (29) and insulator (30) from outside of rear frame assembly.
- (24) Remove two rectifier terminal retaining nuts (31) using a wrench, two lockwashers (32), washer (33) and insulator (34).
- (25) Remove two rectifier terminal retaining nuts (35) using a wrench and washers (36).



6-4. ALTERNATOR - TEST/REPAIR (Cont'd)

(26) Remove three screws (37).



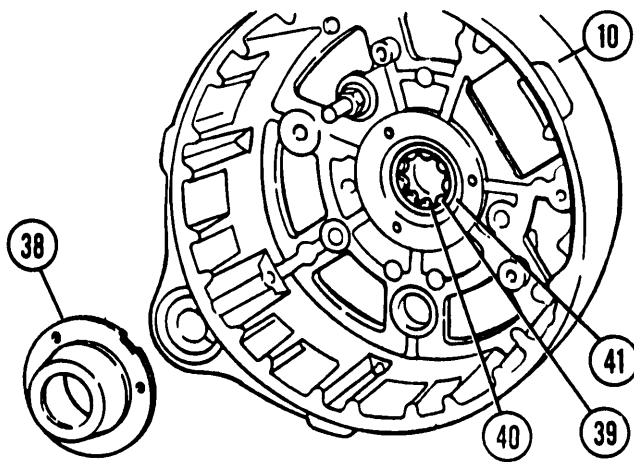
(27) Remove ring (38) from rear frame.

(28) Remove roller bearings (39) and retaining cage (40) with a suitable bearing puller.

**CAUTION**

If bearing is removed in this step, it will be destroyed.

(29) Remove bearing outer race (41) with puller.



b. Test of Components

(1) Stator tests.

**NOTE**

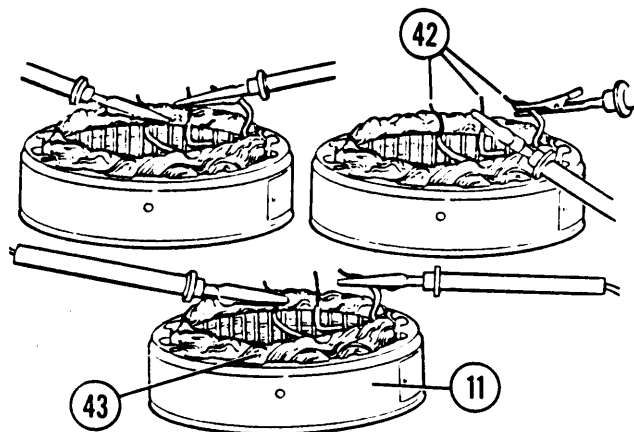
For this test, the stator assembly must be disconnected from the alternator assembly.

(a) Stator winding continuity test.

Connect ohmmeter between pairs of the three stator winding leads (42) (three readings as shown).

Resistance measurements should be 0.15 to 0.25 ohms.

If the resistance measurements are not correct, the stator (43) is defective.



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 6-4. ALTERNATOR - TEST/REPAIR (Cont'd)
 

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(b) Stator winding to frame test.

- 1 Connect the ohmmeter between each of the three stator windings (42) and the frame (11).
- 2 Resistance values should be very high (an indication of no shorts to frame).

(2) Rectifier test.

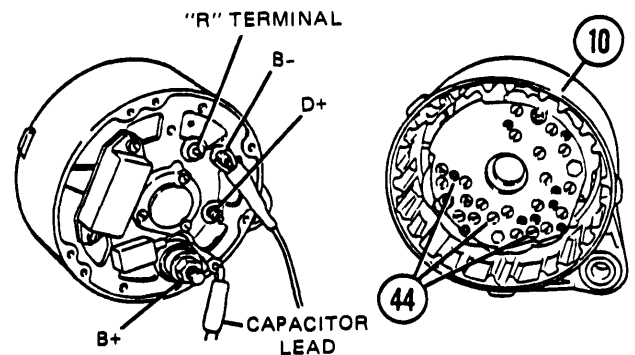
NOTE

For this test, the capacitor lead must be disconnected from the (D+ terminal) and the stator assembly (11) must be removed from the rear housing.

NOTE

On the ohmmeter checks that follow, make one check then reverse the ohmmeter leads. One reading should be high and one low. If not, the rectifier has a defect and should be replaced.

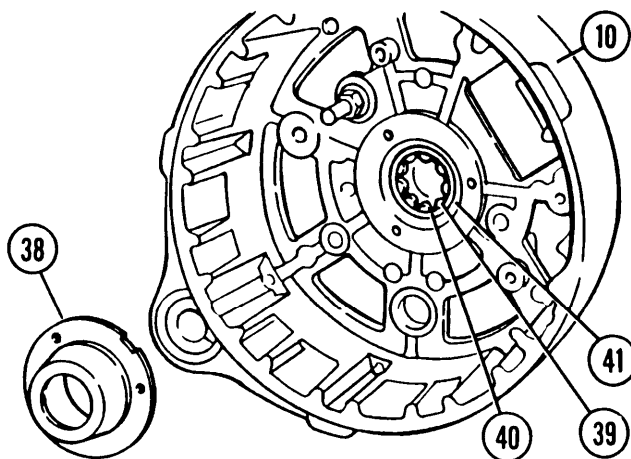
- (a) Minus diode check. Connect ohmmeter between each rectifier solder phase terminal (44) and the frame (10) (ground).
- (b) Plus diode check. Connect ohmmeter between each rectifier solder phase terminal (44) and the B+ terminal.
- (c) Excitation diode check. Connect ohmmeter between each rectifier solder phase terminal (44) and the D+ terminal.



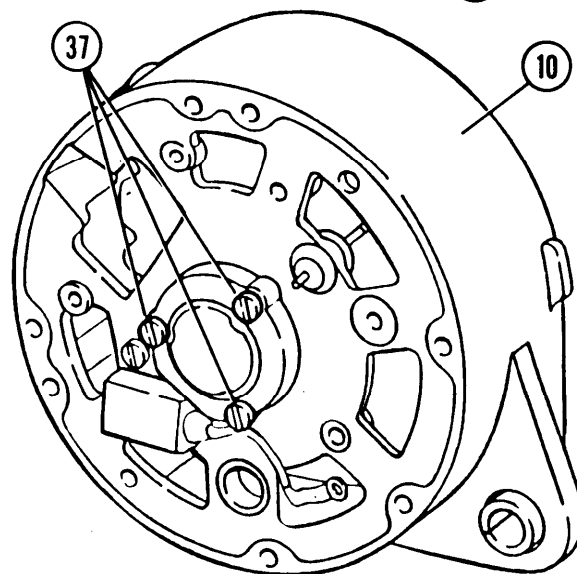
6-4. ALTERNATOR - TEST/REPAIR (Cont'd)

c. Assembly

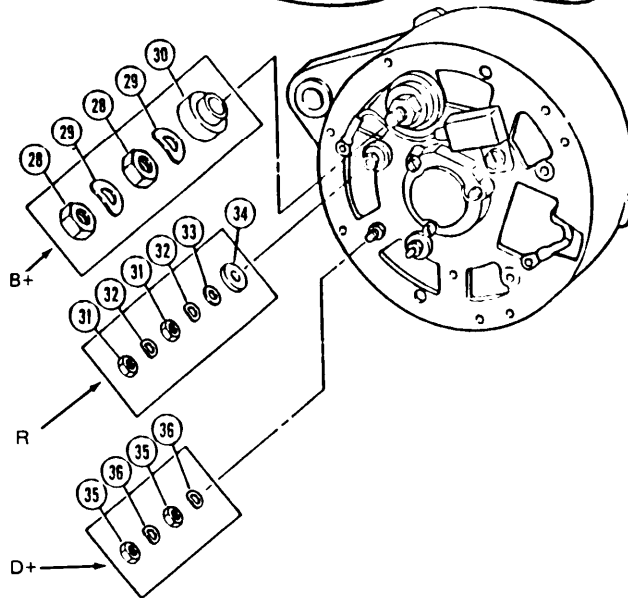
- (1) If removed, install bearing race (41) into housing (10).
- (2) Install roller bearings (39) and retaining cage (40) in rear frame with bearing installation tool.
- (3) Install ring (38) into rear frame.



- (4) Install three screws (37) into housing (10).



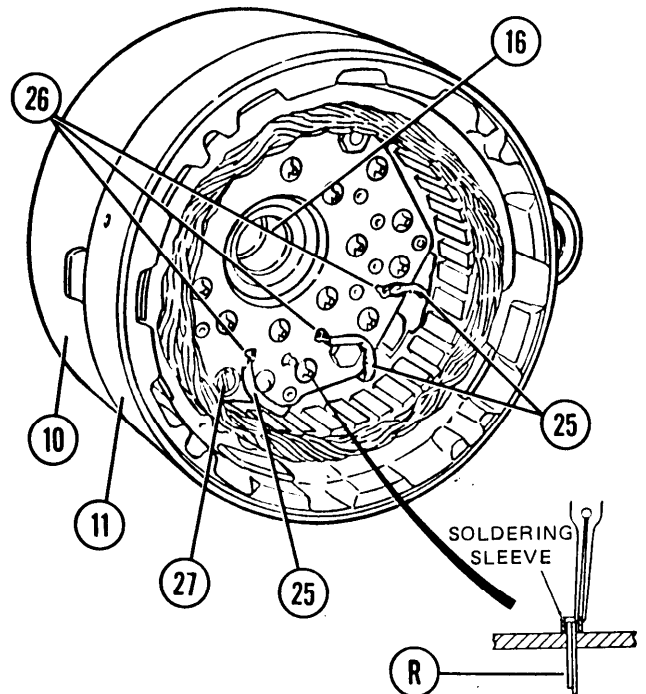
- (5) Install B+ and D+ insulators.
- (6) Install "R" terminal, if removed, by soldering the soldering sleeve to the terminal. "R" terminal includes three insulators, nut, lockwasher, soldering sleeve and terminal.



- (7) Install rectifier in rear frame.
- (8) Install two screws (27).
- (9) Install two washers (36) and use a wrench to install two nuts (35).
- (10) Install insulator (34), washers (33), two lockwashers (32) and use a wrench to install two retaining nuts (31).

## 6-4. ALTERNATOR - TEST/REPAIR (Cont' d)

- (11) Install insulator (30), two washers (29) and use a wrench to install two retaining nuts (28).
- (12) Position stator frame (11) on rear frame (10). Align the marks made during di ssembly.
- (13) Solder three phase stator winding leads (25) to rectifier terminals (26).
- (14) If removed, install bearing (16) in drive end frame (12).



## NOTE

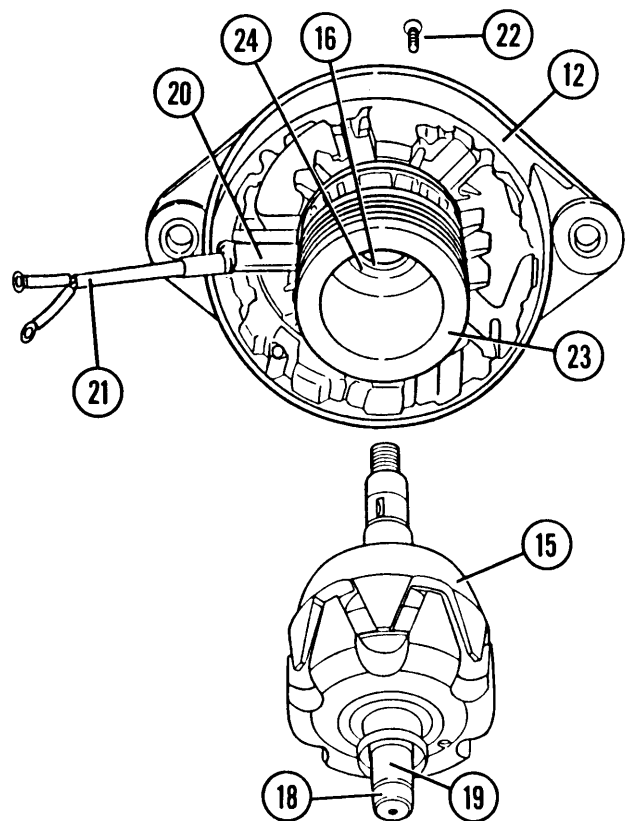
This is a loose fit bearing.

- (15) Install intermediate ring (24) in drive end frame (12).
- (16) Install field coil winding (23). Winding leads (21) must fit in deep groove. Install six screws (22). Apply epoxy putty over lead and groove.
- (17) Install spacer ring (25).

CAUTION

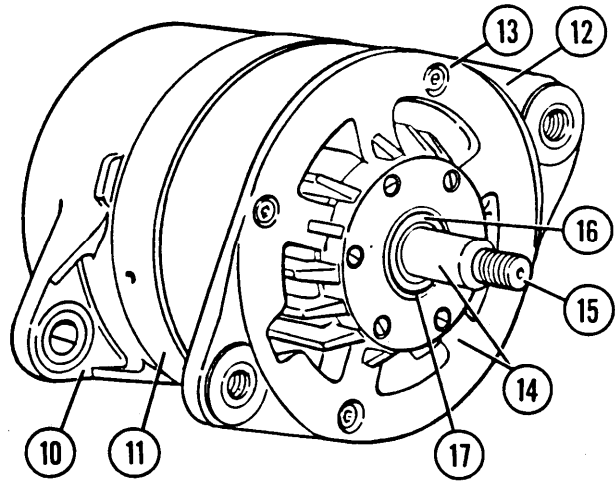
In the next step, the spacer ring must be supported so that the bearing inner race is supported.

- (18) Install rotor assembly (15) in drive end frame (12) using a press.
- (19) Heat bearing race (18) to 275°F. Install bearing race on rotor (15) shaft.



6-4. ALTERNATOR - TEST/REPAIR (Cont' d)

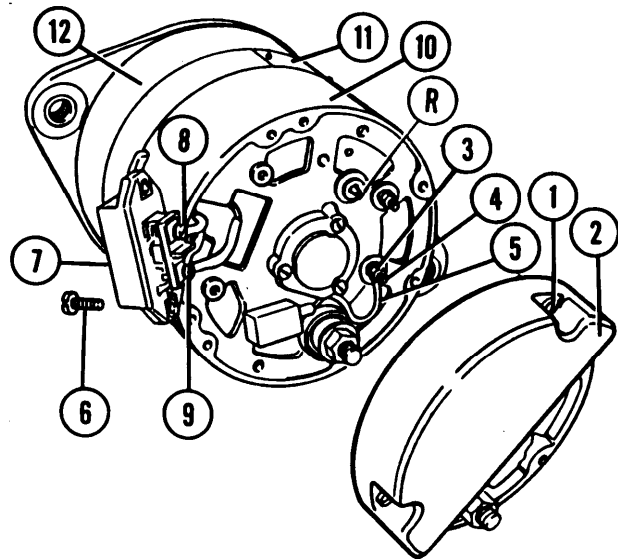
- (20) Connect drive end shield (12) and rotor (15) as an assembly to the rear housing (10) and stator frame assembly (11). Use marks made during disassembly to help alignment.
- (21) Install four hex-socket head cap-screws (13). DO NOT TIGHTEN.
- (22) Insert three 0.3 mm (0.01 in. ) feeler gauges between rotor and stator. Tighten screws (13) to a torque of 3 to 4 ft. lbs.
- (23) Connect the field coil lead (with large diameter hole) to the regulator (7) with a large diameter screw (9). Connect the rectifier lead and the remaining field coil winding lead to the regulator terminal (7) with a small diameter screw (8).



NOTE

To maintain the proper field coil lead polarity, one field coil lead has a small diameter hole.

- (24) place regulator (7) on rear frame assembly and install two screws (6).
- (25) Install suppression capacitor lead (5) on the D+ terminal (4) and install nut (3) using a wrench.
- (26) Install regulator cover (2) and install two screws (1).



## 6-4. ALTERNATOR - TEST/REPAIR (Cont'd)

## d. Bench Testing

**NOTE**

The alternator must be fully assembled before performing this test.

**CAUTION**

Do not recharge battery during tests. Alternator must not be in operation (rotating) when the regulator is connected and disconnected. Alternator and voltmeter must each be connected in parallel (across) with the battery.

- (a) Connect alternator to the alternator test bench. See schematic for proper setup.

**NOTE**

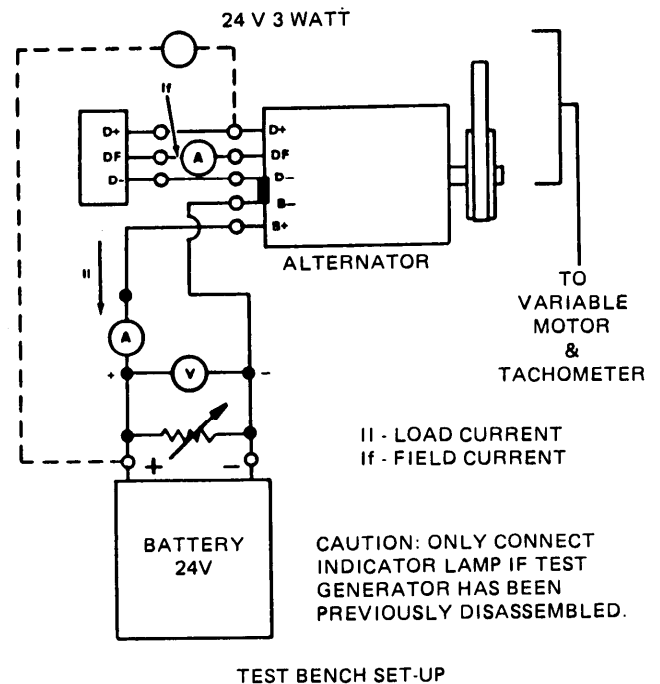
Be sure that the regulator and generator remain at approximately room temperature of 68 F and that the carbon pile is connected in parallel with the battery.

- (b) Connect the battery cable to B- generator terminal.
- (c) Connect positive battery cable to ammeter and from ammeter to B+ generator terminal.

**CAUTION**

Observe correct polarity when connecting voltmeter.

- (d) Connect voltmeter leads to B+ and D- or B- generator terminals.

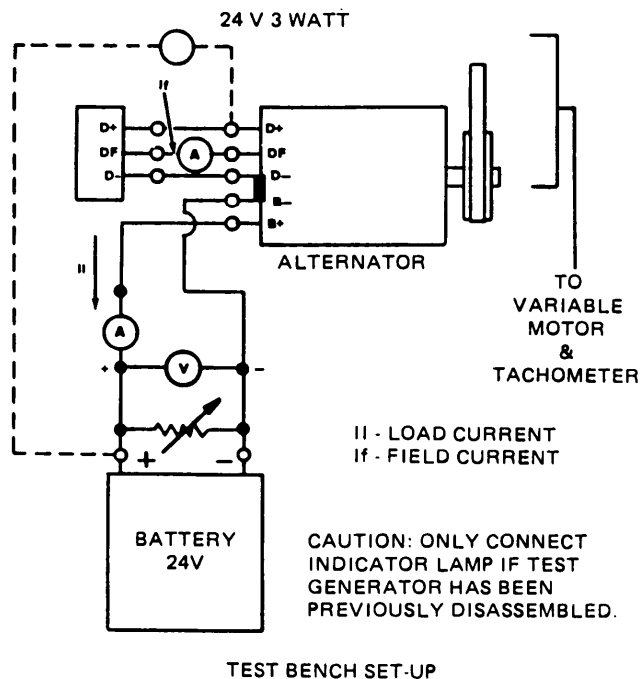


6-4. ALTERNATOR - TEST/REPAIR (Cont' d)

NOTE

If needed for pre-excitation (only after assembly), connect a 24V indicator lamp (3 Watt) between battery positive and generator D+ terminal. This procedure is needed when a new rotor is installed.

- (e) Adjust alternator speed to 5000 rpm.
- (f) Set load current to 5 A by adjusting the carbon pile. If necessary, readjust alternator speed to maintain 5000 rpm. In one minute, the regulated voltage reading should be 27.5V to 28.3V and the output of the alternator





6-5. STARTING MOTOR - REPAIR

This task covers:

- a. Disassembly
- b. Assembly
- c. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Personnel Required

**MOS62B (1)**  
**MOS63G (1)**

Materials/Parts

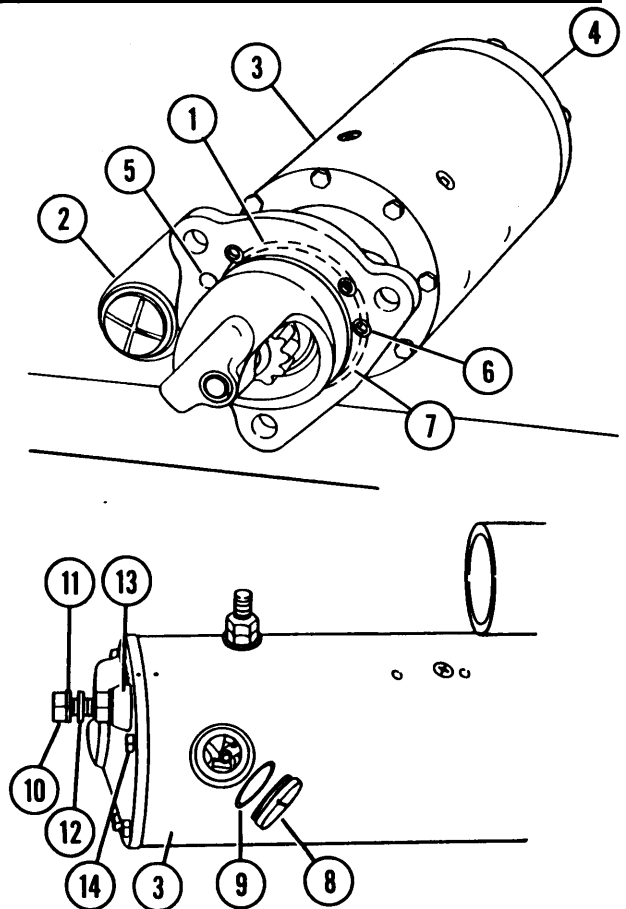
Gaskets (7), (9)  
Seals (22), (23), (32), (66), (67)  
Thread Sealant (App. B, Item 14)  
Lubricant Oil OE/HDO-30 (Refer to L05-2410-237-12)  
O-ring (17)

Equipment Condition

Electric starter motor removed.  
See TM5-2410-237-20.  
Starter solenoid removed. See TM5-2410-237-20.

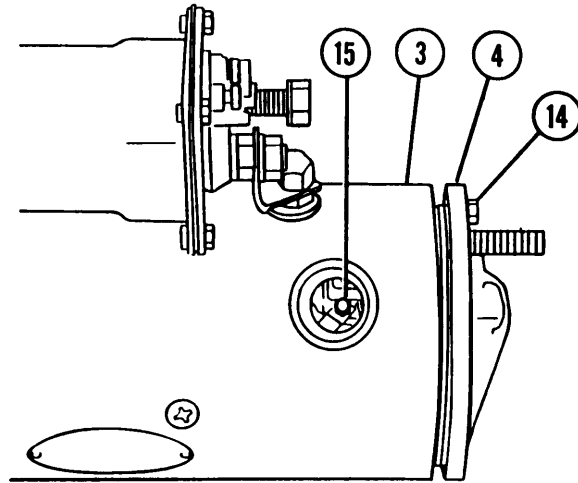
a. Disassembly

- (1) Use a suitable marking tool to scribe a line across the drive housing (1), lever housing (2), armature housing (3) and end plate (4). This will allow for correct alignment during reassembly.
- (2) Use an allen wrench to remove five one and one-half inch screws (5), one seven-eighths inch screw (6), drive housing (1) and gasket (7) from lever housing (2). Discard gasket (7).
- (3) Remove three inspection plugs (8) and three gaskets (9) from armature housing (3). Discard gaskets (9).
- (4) Use a wrench to remove nut (10), lockwasher (11), washer (12) and insulator assembly (13) from terminal stud.

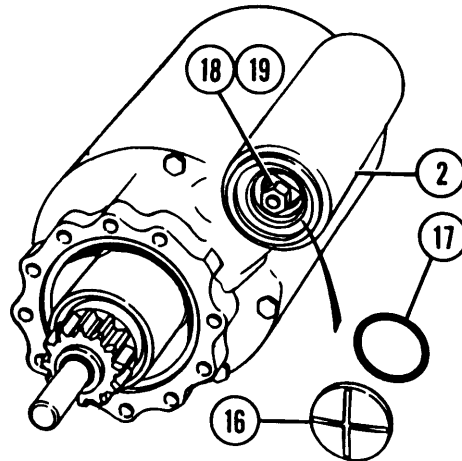


6-5. STARTING MOTOR - REPAIR (Cont'd)

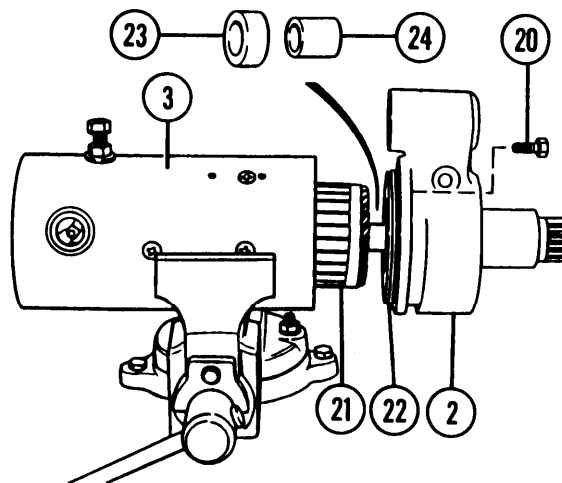
- (5) Use a wrench to remove six capscrews (14). Use a wrench to remove three screws (15) and remove end plate (4) from armature housing (3). Pull up brushes.



- (6) Remove inspection plug (16) and O-ring (17) from lever housing (2). Discard O-ring (17).
- (7) Use a socket to remove nut (18) from shaft of plunger assembly (19).

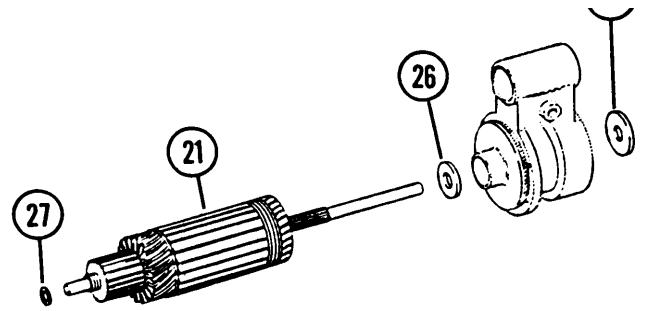


- (8) Use a wrench to remove seven capscrews (20) and lever housing (2) from armature housing (3).
- (9) Remove armature (21) from armature housing (3).
- (10) Remove seal (22) from lever housing (2). Discard seal (22). Remove seal (23) and bushing (24) from lever housing (2). Discard seal (23).

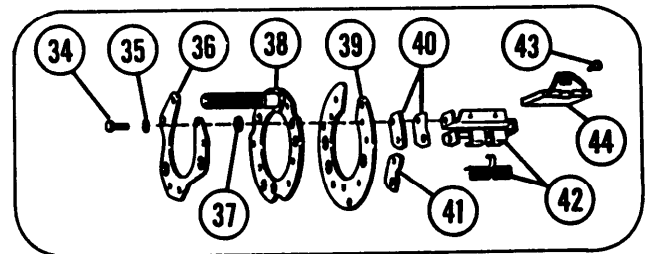


6-5. STARTING MOTOR - REPAIR (Cont'd)

- (11) Remove washers (25, 26 and 27) from armature (21).

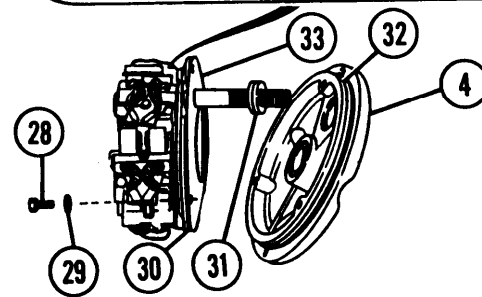


- (12) Use a wrench to remove three screws (28), three lockwashers (29) and plate assembly (30) from end plate (4).



- (13) Remove two washers (31) from terminal stud.

- (14) Remove seal (32) from end plate (4). Discard seal (32). Remove insulator (33) from plate assembly (30).



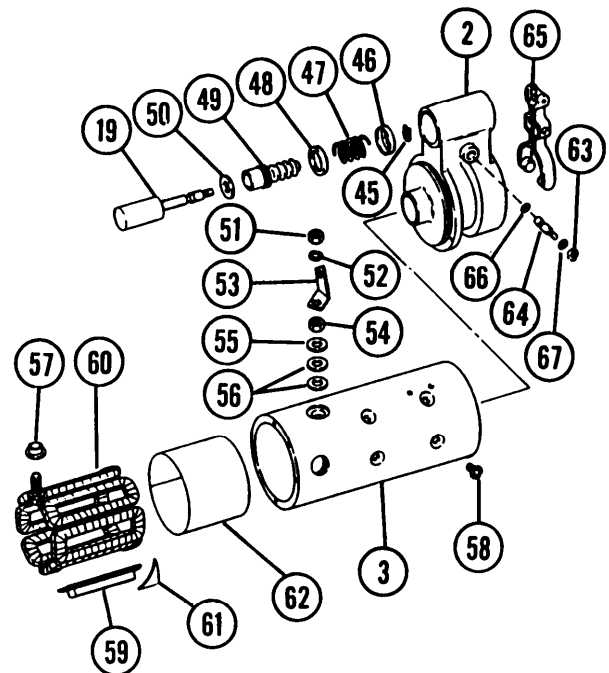
- (15) Remove twelve screws (34), twelve lockwashers (35), plate (36), washers (37), insulator (38), and plates (39, 40, and 41) to free six brush holders (42).

- (16) Remove six screws (43) and six brushes (44) from six brush holders (42).

- (17) Remove plunger assembly (19) from lever housing (2).

- (18) Remove retaining ring (45), retainer (46), spring (47), retainer (48), boot (49) and washer (50) from plunger assembly (19).

- (19) Use a wrench to remove nut (51) lockwasher (52), connector (53), nut (54) and three washers (55 and 56) from armature housing (3).

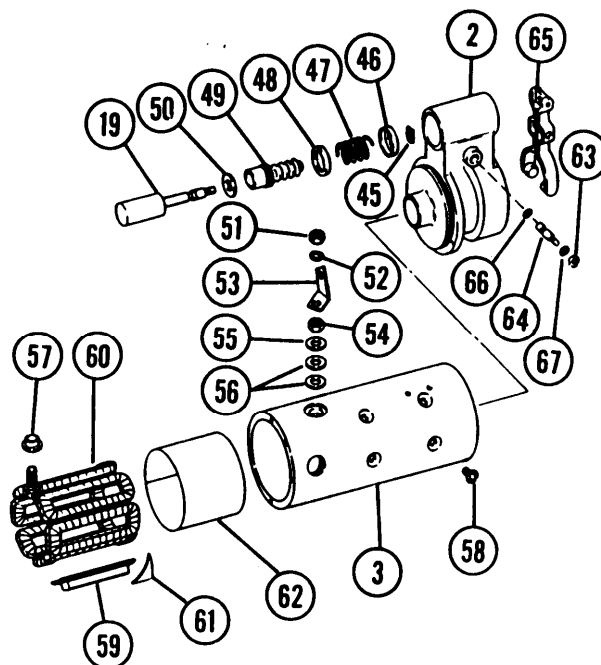


6-5. STARTING MOTOR - REPAIR (Cont'd)

- (20) Remove twelve screws (58), six shoes (59), insulator bushing (57), coil assembly (60), three insulators (61) and insulator (62) from armature housing (3).
- (21) Remove retaining ring (63) and shaft (64) from lever housing (2).
- (22) Remove lever assembly (65) and two seals (66 and 67) from shaft (64). Discard seals (66 and 67).

b. Assembly

- (1) Install two seals (67 and 66) and lever assembly (65) on shaft (64).
- (2) Install shaft (64) in lever housing (2) and install retaining ring (63).
- (3) Position insulator (62), three insulators (61) and coil assembly (60) in armature housing (3).



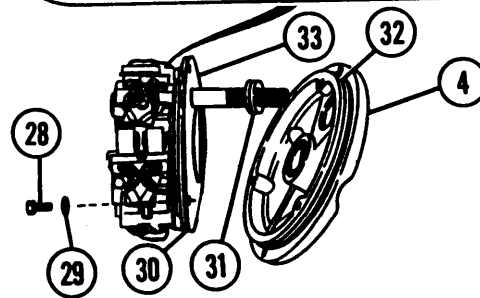
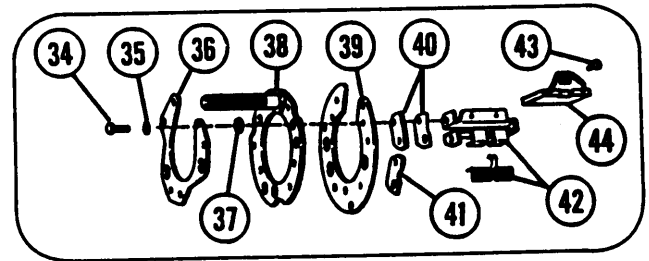
NOTE

Apply thread sealant to screws (18) before installation.

- (4) Install six shoes (59) in armature housing (3) with twelve screws (58).
- (5) Install insulator bushing (57), three washers (56 and 55, nut (54), connector (52), lockwasher (52) and nut (51) on armature housing (3).
- (6) Install washer (50), boot (49), retainer (48), spring (47), retainer (46) and retaining ring (45) on plunger assembly (19).
- (7) Install plunger assembly (19) in lever housing (2).

6-5. STARTING MOTOR - REPAIR (Cont'd)

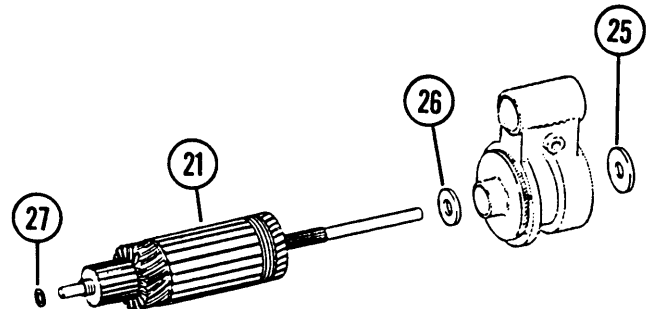
- (8) Install six brushes (44) on six brush holders (42) with twelve screws (43).
- (9) Position brush holders (42), plates (41, 40 and 39), insulator (38) washers (37) and plate (36), and install twelve screws (34) and twelve lockwashers (35) that hold them together.
- (10) Install insulator (33) and seal (32) on plate assembly (30). Lock brushes up.
- (11) Install two washers (31) on terminal stud.
- (12) Install plate assembly (30) to end plate (4) with three screws (28) and three lockwashers (29). Tighten screws (28) using a wrench.



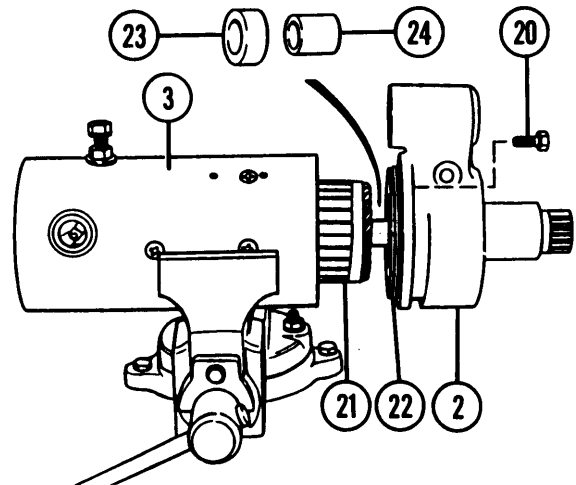
NOTE

Lightly lubricate washers (27, 26, and 25) with lubricant before installation.

- (13) Install washers (27, 26, and 25) on armature (21).



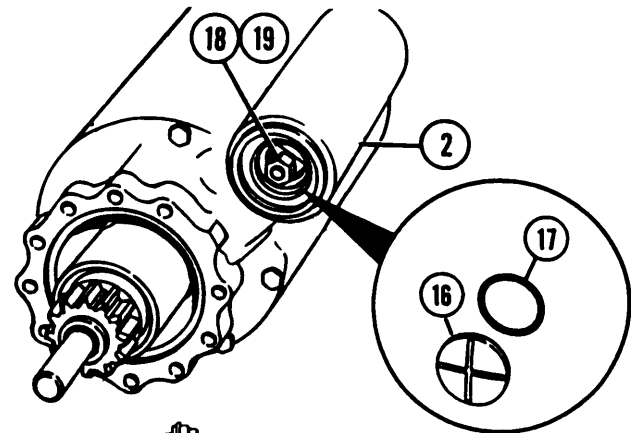
- (14) Install O-ring (22) on lever housing (3).
- (15) Install armature (21) in armature housing (3). Install bushing (24) and seal (23) in lever housing (2).
- (16) Install lever housing (2) to armature housing (3) with seven capscrews (20). Tighten using a wrench.



6-5. STARTING MOTOR - REPAIR (Cont' d)

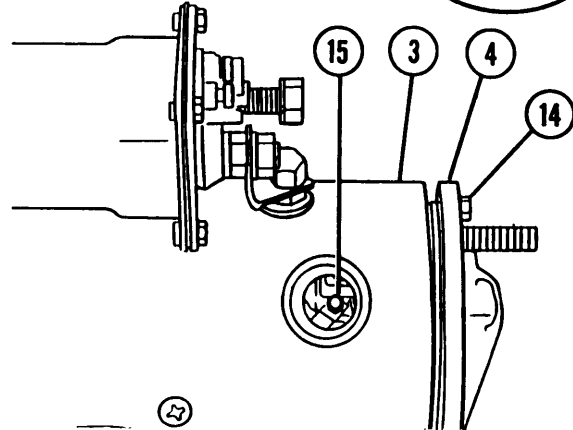
(17) Use a socket to install nut (18) on shaft of plunger assembly (19). Push down brushes.

(18) Install O-ring (17) and inspection plug (16) on lever housing (2). Tighten plug (16).



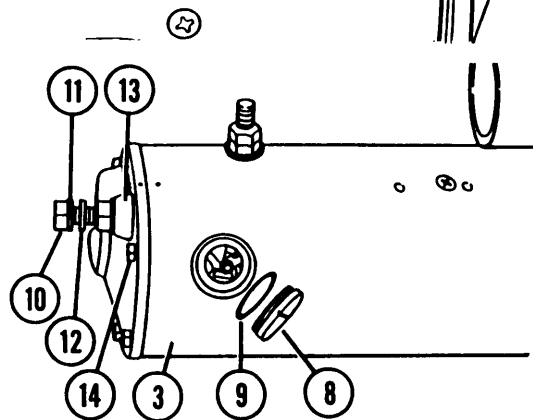
(19) Install end plate (4) to armature housing (3) with six capscrews (14). Tighten capscrews (14) using a wrench.

(20) Install end plate (4) onto armature housing (3). Install three screws (15) and tighten using a wrench.

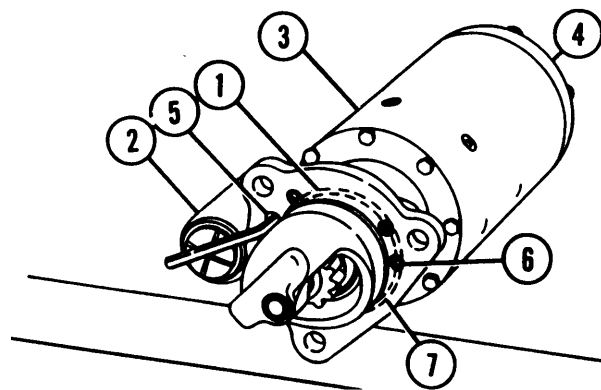


(21) Install insulator assembly (13), washers (12), lockwasher (11) and nut (10) on terminal stud.

(22) Install three inspection plugs (8) and three gaskets (9) to armature housing (3).



(23) Install gasket (7) and drive housing (1) to armature housing (3) with one 7/8 in. screw (6) and five 1-1/2 in. screws (5). Use an allen wrench to tighten screws to a torque of 13 to 17 lb. ft.



c. Place In Service

Check starting motor for proper operation.

CHAPTER 7

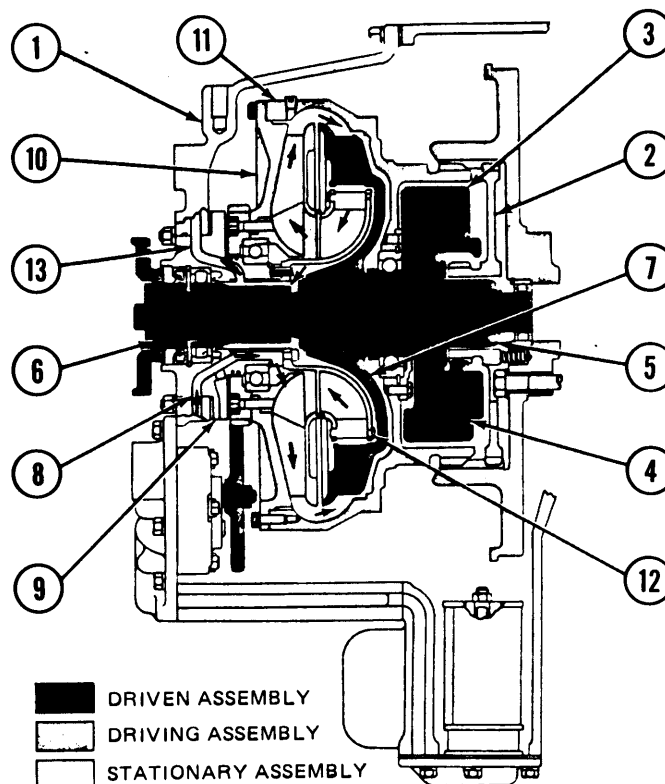
TRANSMISSION MAINTENANCE

Section I. DESCRIPTION AND DATA

7-1. GENERAL

Transmission assembly maintenance procedures not covered in this chapter can be found in TM5-2410-237-20.

7-2. PRINCIPLES OF OPERATION



- a. Torque Divider. The torque divider connects the engine to the planetary transmission. This connection is both a hydraulic connection and a mechanical connection. The hydraulic connection is through a torque converter. The mechanical connection is through a planetary gear set.

The torque converter uses oil to multiply the torque to the transmission. When the machine is working against a low load, the torque multiplication is low. When the machine is working against a high load, the torque multiplication is higher. A higher torque can then be sent to the transmission during high load conditions. The planetary gear set also multiplies the torque from the engine by making an increase gear in the mechanical advantage through its gears. This

torque multiplication also makes an increase as the load on the machine becomes higher. During no load conditions, neither the torque converter or the planetary gear set can multiply the torque from the engine.

Oil for the operation of the torque converter is from the transmission hydraulic controls. A relief valve for converter inlet controls the pressure of the oil to the torque converter. A relief valve for converter outlet controls the pressure of the oil in the converter.

- b. Torque Divider Operation. The torque converter is driven by the engine through housing (1). The planetary gear set is driven by the engine through sun gear (2). These connections let the torque output of the engine go in two separate directions. Because of the larger radius of ring gear (3), most of this torque is sent by the torque converter through the ring gear to planetary gears (4). The remainder of the torque is sent by sun gear (2) to planetary gears (4). If planetary carrier (5) has no resistance to rotation (no load), sun gear (3), planetary gears (4), planetary carrier (5) and ring gear (3) will turn at the same speed. The torque from the converter and from the planetary gear set is now through the planetary carrier to output shaft (6) and the planetary transmission. Neither the torque converter or the planetary gear set can multiply the torque from the engine when they are turning at the same speed.

When the machine has a load, planetary carrier (5) has a resistance to rotation. Since sun gear (2) is turning at the rpm of the engine, this resistance to rotation causes planetary gears (4) to turn on their shafts. Their rotation is opposite the rotation of ring gear (3). This causes a decrease in the speed of the ring gear. Since turbine (7) is connected to the ring gear, a decrease in speed will cause the torque converter to multiply the torque of the engine from housing (1). The torque multiplication is sent to planetary carrier (5) and the output shaft through the ring gear.

With the decrease in the speed of the ring gear, the torque of the engine through sun gear (2) and the planetary gear set also multiplies. This torque multiplication is also sent to planetary carrier (5) and the output shaft.

If the resistance to rotation of planetary carrier (5) becomes higher (more load on the machine), the speed of the ring gear will decrease more. The slower speed will let the torque multiplication through both the torque converter and the sun gear become higher. If the resistance to rotation of the planetary carrier becomes high enough, the ring gear will stop. During some very high load conditions, the rotation of the planetary carrier and the output shaft will also stop. This will cause the ring gear to turn slowly in the opposite direction. At this time the torque multiplication of the torque converter and the sun gear is at its maximum.

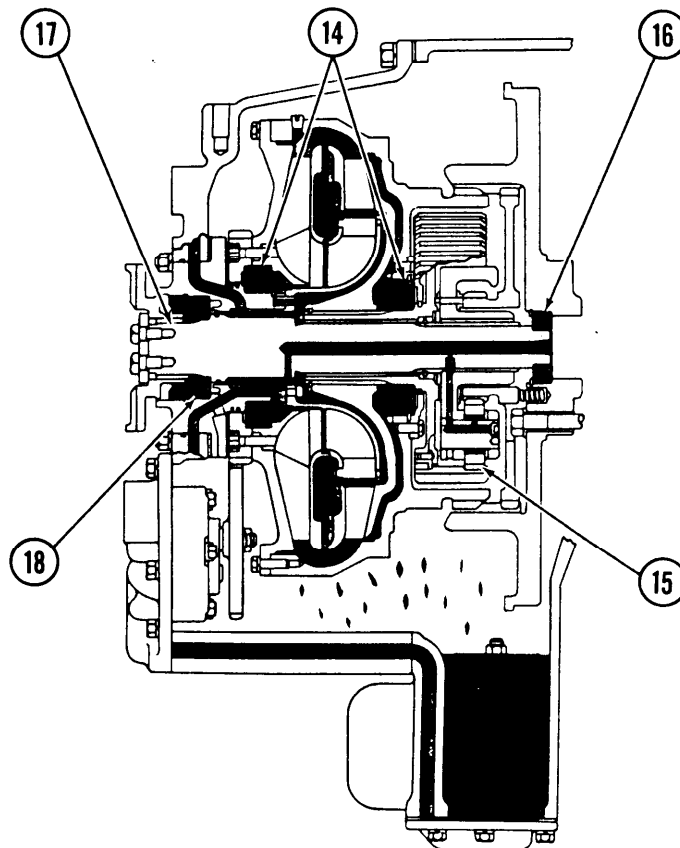
- c. Torque Converter Operation. Oil for the operation of the torque converter goes through inlet passage (8) in carrier (9) to impeller (10). The rotation of the impeller gives force to the oil. The impeller sends the oil toward the outside of the impeller, around the inside of the housing (11) to turbine (7). The force of the oil hitting the blades of the turbine causes the turbine to turn. Since the turbine is connected to ring gear (3), torque is sent to planetary gears (4). At this point in time, the torque given to the turbine by the force of the oil from the impeller cannot be more than the torque output of the engine to the impeller.



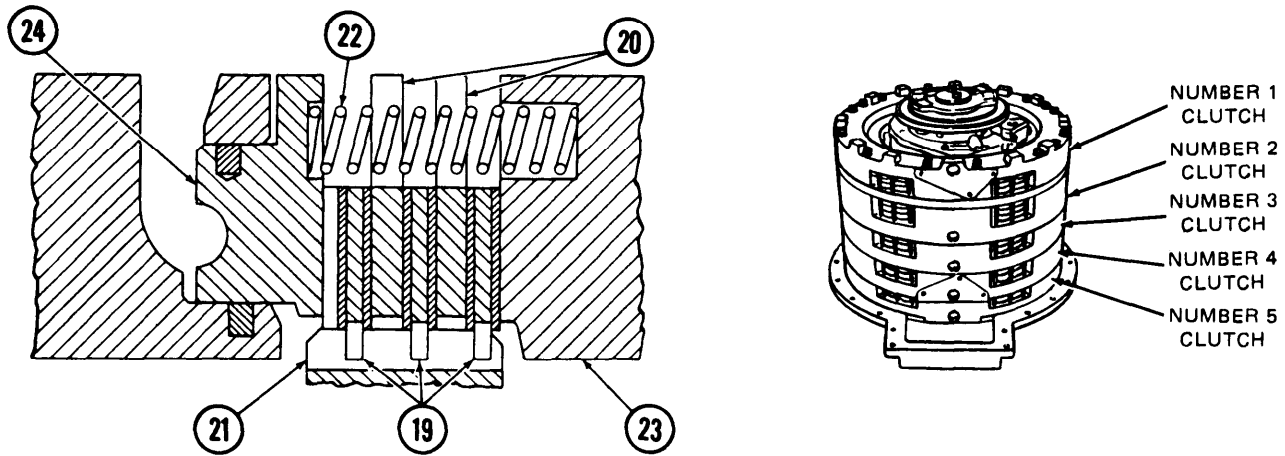
As the oil goes from the turbine, it is moving in a direction opposite to the direction of impeller (10) rotation. Stator (12) causes the oil to change direction. Since the stator is connected to carrier (9) and cannot turn, most of the oil is sent back to impeller (10). The remainder of the oil goes from the stator through outlet passage (13) to the oil cooler and the transmission lubrication system.

The force of the oil from the stator (12) can now add to the torque output from the engine to the impeller (10). This extra force can give an increase to the torque output of the engine to the turbine (7). The larger the difference between the speeds of the impeller and the turbine, the larger the amount of force of the oil from the stator. Since it is the load on the machine that changes the speed of the turbine, the higher the load, the larger the difference in the speeds of the impeller and the turbine. It is then the different loads on the machine that control the amount of torque multiplication that the force of the oil from the stator can add.

- d. Torque Divider Lubrication. Oil for the lubrication of the torque divider bearings and the planetary gear set is from the supply used for the operation of the torque converter. Bearing (14) are constantly running in oil. Bearings and gears in planetary gear set (15) and pilot bearing (16) get lubrication through passages in output shaft (17). Output shaft bearing (18) gets lubrication from normal oil leakage by a piston ring-type seal.



- e. Transmission. The transmission has three speeds forward and three speeds reverse. It has planetary gear systems and five hydraulic clutches.



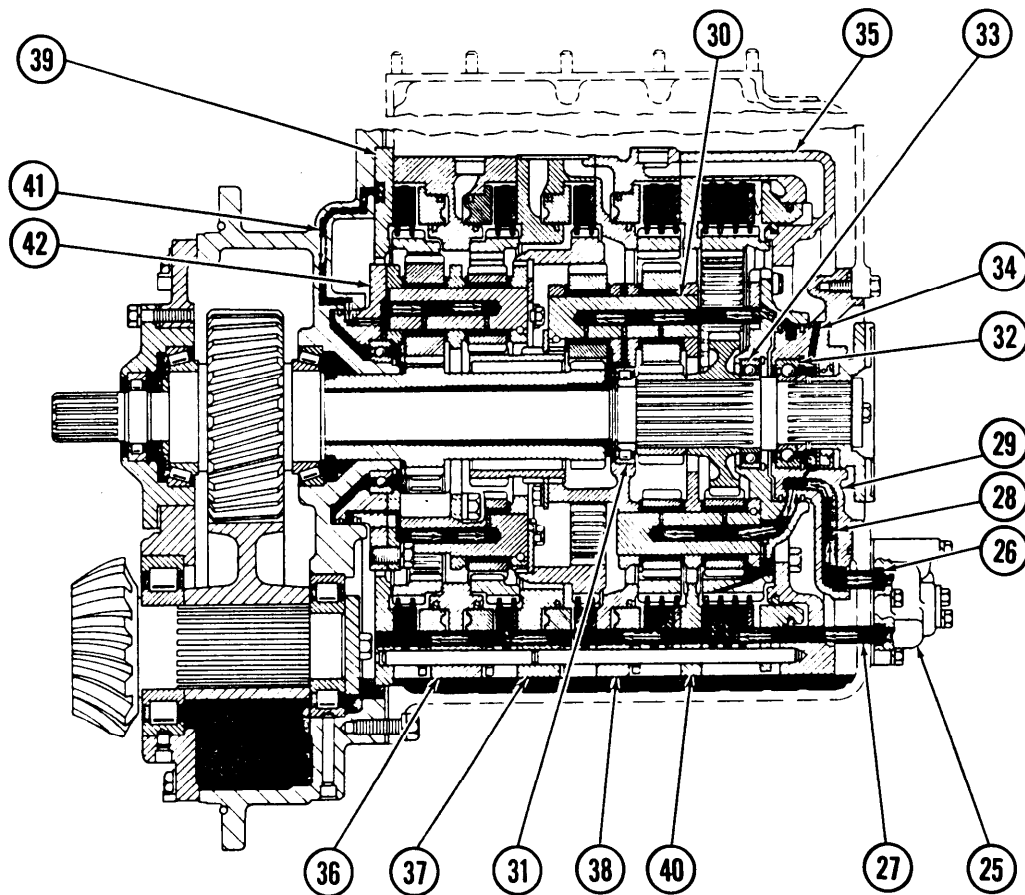
The five transmission clutches are the disc type and in separate housings. Each clutch has discs (19) and plates (20). The inside teeth of discs (19) are engaged with the outside teeth of ring gear (21). Notches on the outside diameter of plates (20) are engaged with pins in the clutch housing. The pins keep the plates from turning.

The springs (22) are between clutch housing (23) and piston (24). The springs keep the clutches disengaged (not engaged). The clutches are engaged when oil is sent into the area behind the piston (24). When the pressure of the oil in the area behind the piston increases, the piston moves to the right. The piston moves against the force of spring (22) and pushes discs and plates together. The clutch is now engaged. The discs keep ring gear (21) from turning. When the clutch is released, the pressure in the area behind piston (24) decreases and the springs now push the piston to the left. The discs and plates are now apart. The clutch is not engaged.

The two front clutches (No. 1 and No. 2) are direction clutches. The No. 1 clutch is the forward direction clutch. The No. 2 clutch is the reverse direction clutch. The three rear clutches (No. 3, No. 4, and No. 5) are speed clutches.

A speed and direction clutch must be engaged in the transmission before power goes through the transmission.

SPEED	CLUTCHES ENGAGED
First Forward	1 and 5
Second Forward	1 and 3
Third Forward	1 and 4
First Reverse	2 and 5
Second Reverse	2 and 3
Third Reverse	2 and 4



f. Transmission Lubrication. The oil for lubrication of the transmission comes from the transmission oil cooler.

From the cooler, the oil goes to manifold (25) on the front of the transmission case. The manifold divides the flow of oil. Oil is sent through tubes (26 and 27). The remainder of the oil goes out a hose to the relief valve for brake cooling and lubrication in the steering clutch compartment.

Oil goes through tube (26) to manifold (28) in front bearing cage (29). The manifold sends oil through a passage to the No. 1 carrier. The oil then goes through passages in the planetary gear shafts to the bearings and thrust washers of the planetary gears. Oil also goes through a passage in shaft (30) to center bearing (31) of the input shaft.

A small passage in bearing cage (29) lets oil go to front bearing (32) and bearing (33). This oil then goes through passage (34) to the bottom of the transmission case.

A small passage in the No. 1 carrier lets oil go to the ring gear of the No. 1 clutch.

A small passage in the ring gear for the No. 1 clutch lets oil go to the discs and plates of the No. 1 clutch.

Tube (27) is installed in a hole in No. 1 clutch housing (35). Each of the clutch housings (36, 37, and 38) have a hole which is in alignment with the hole in No. 1 clutch housing (35). Plates (39 and 40) also have a hole which is in alignment with the hole in the No. 1 clutch housing.

Oil goes through tube (27) to the No. 1 clutch housing. The oil goes through the holes in clutch housings (36, 37 and 38) and plate (40) to plate (37).

Plate (39) has a groove on the rear side of the plate. The oil from manifold (25) goes to the groove. At the groove, the flow of oil divides.

Part of the oil goes through passage (41) in the transfer gear case. The oil goes through the passage to bearing cage (42). The oil then goes to the No. 2 carrier. The oil then goes through passages in the planetary gear shafts to the bearings and thrust washers of the planetary gears. Oil then goes to the rear bearing.

The remainder of the oil from the groove of plate (39) goes through two holes in the plate (39). Each of the clutch housings (35, 36, 37 and 38) and plate (40) have two holes which are in alignment with the two holes in plate (39). Oil goes through the clutch housings and plate (40) toward the front of the transmission. The oil stops in the No. 1 clutch housing.

The No. 1 clutch housing and plate (40) have passages which send the oil to discs and plates of the No. 1 and No. 2 clutches.

The components of the transfer gear get lubrication by oil thrown inside the transfer case.

The remainder of the components in the transmission get lubrication from oil thrown inside the transmission and oil released at points of pressure lubrication.

## Section II. TRANSMISSION ASSEMBLY MAINTENANCE PROCEDURES

## 7-3. TRANSMISSION MAINTENANCE TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
7-4	Torque Divider - Replace/Repair	7-8
7-5	Transmission Assembly - Replace/Repair	7-26
7-6	Transmission Hydraulic Control Valves - Replace/Repair	7-64
7-7	Transmission Oil Pump - Test/Replace/Repair	7-73
13-13	Hydraulic Lines and Fittings	13-77
7-8	Transmission Relief Valve - Replace/Repair	7-79
7-9	Torque Converter Outlet Relief Valve - Replace/Repair	7-86
7-10	Torque Divider Scavenge Pump - Replace/Repair	7-92
7-11	Power Train Hydraulic System - Test	7-98

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## 7-4. TORQUE DIVIDER - REPLACE/REPAIR

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This task covers:

- a. Removal
  - b. Disassembly
  - c. Assembly
  - d. Installation
  - e. Place In Service
- 

### INITIAL SETUP

#### Applicable Configurations

All

#### Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Lifting Equipment 400 lbs.

#### **Materials/Parts**

**Seal (18), (34), (48)**  
Preformed Packing (22)  
Gasket (64)  
Wire  
Oil Pan (20 gallon)  
Grease (App. B, Item 6)  
Two 3/8" -16NC Eyebolts (23)  
Two 5/8" -11NC Eyebolts (1), (67)  
Two 3/8" -16NC Forcing Screws (28)

#### Equipment Condition

Engine OFF  
ROPS removed. (TM5-2410-237-20)  
Floor Plates removed.  
(TM5-2410-237-20)  
Dash assembly removed. (page 11-8)  
Rear bottom guard removed.  
(TM5-2410-237-20)  
Drain oil from torque divider  
housing and transmission. See  
TM5-2410-237-20.  
Remove steering clutch linkage  
that crosses over torque  
divider. See page 10-48.  
Remove brake lock linkage that  
crosses over torque divider.  
See TM5-2410-237-20.  
Remove transmission oil lines  
where they attach to torque  
divider. See TM5-2410-237-20.  
Remove transmission oil cooler  
lines where they attach to  
torque divider. See  
TM5-2410-237-20.  
Remove torque converter outlet  
relief valve from torque  
converter. See page 7-86.

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7-4. TORQUE DIVIDER - REPLACE/REPAIR (Cont'd)

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Equipment Condition (Cont'd)

Remove sequence relief valve from torque divider. See page 7-79.

Remove scavenge pump from torque divider housing. See page 7-92.

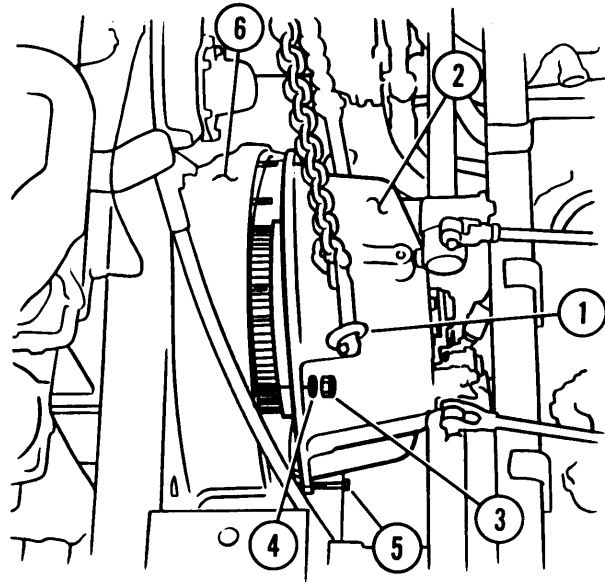
Remove drive shaft from tractor. See TM5-2410-237-20.

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7-4. TORQUE DIVIDER - REPLACE/REPAIR (Cont'd)

a. Removal

- (1) Fasten two 5/8-11NC eyebolts to holes (1) on top of torque divider housing (2).
- (2) Fasten lifting equipment to eyebolts. Weight of torque divider is 325 lbs.
- (3) Place oil pan beneath torque divider housing (2).
- (4) Use a wrench to remove twelve nuts (3) and washers (4).
- (5) Install two 3/8-16NC forcing screws in torque divider housing at location (5).
- (6) Slowly turn forcing screws in until enough pressure is applied to separate torque divider housing (2) from flywheel housing (6).



NOTE

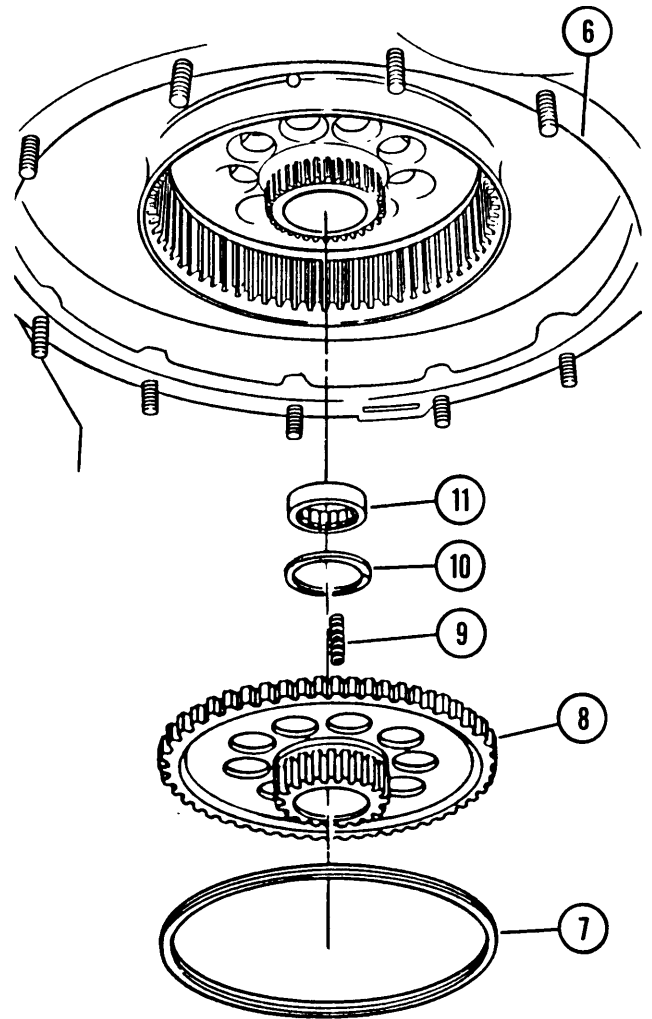
Do not remove torque divider at this point.

- (7) Back torque divider housing (2) away from flywheel housing (6) just enough to slide a piece of wire around planetary carrier and connect each end of wire to forcing screws. This will assure that planetary carrier assembly does not fall when torque divider is removed.
- (8) Slowly back torque divider housing (2) away from flywheel housing (6) and lift assembly from tractor. The weight of torque divider is 325 lbs.

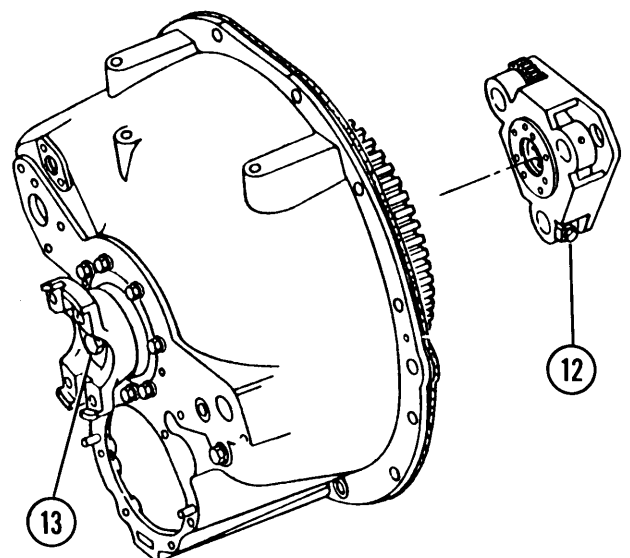


## 7-4. TORQUE DIVIDER - REPLACE/REPAIR (Cont'd)

- (9) Recovering (7) and gear (8) from flywheel housing (4).
- (10) Remove three springs (9) from behind the gear (8).
- (11) Remove retaining ring (10) from housing and using suitable puller, remove bearing (11) from flywheel housing (6).



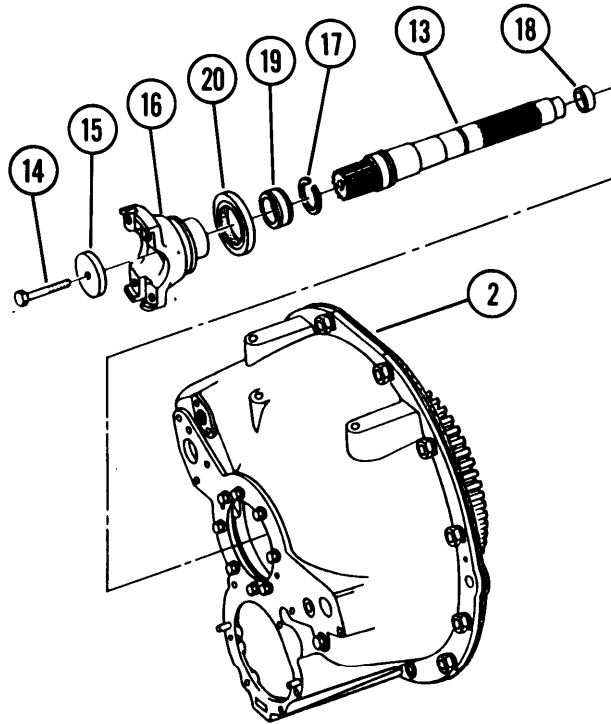
- (12) Remove wire from around torque divider and carefully slide planetary gear assembly (12) from output shaft (13).



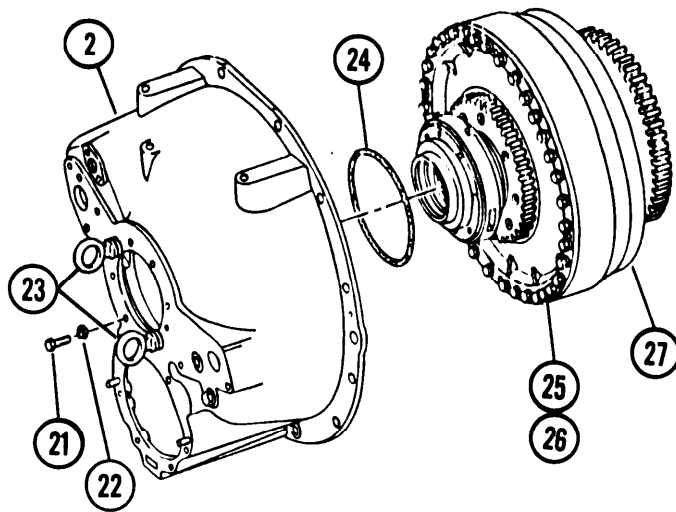
7-4. TORQUE DIVIDER - REPLACE/REPAIR (Cont'd)

b. Disassembly

- (1) Carefully place torque divider on a level surface with housing (2) facing upward.
- (2) Carefully slide output shaft (13) from torque divider housing (2).
- (3) Use a wrench to remove capscrew (14) and washer (15) from output shaft (13). Remove flange (16) from shaft (13).
- (4) Remove ring (17) from output shaft (13).
- (5) If necessary, heat bearings (18 and 19) and remove from output shaft (13).
- (6) Remove seal (20) from torque converter housing (2). Discard seal (20).

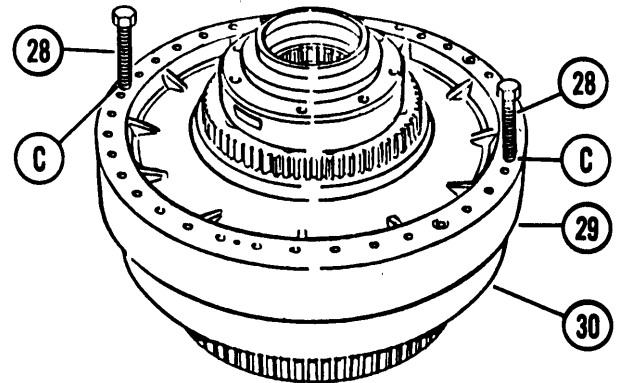


- (7) Use a wrench to remove eight capscrews (21) and lockwashers (22) from torque divider housing (2).
- (8) Install two 3/8-16NC eyebolts (23) in torque divider housing and fasten lifting equipment to eyebolts. Lift housing (2) from torque divider. The housing weighs 89 lbs.

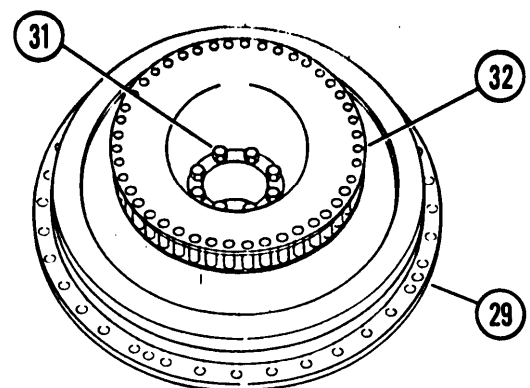


## 7-4. TORQUE DIVIDER - REPLACE/REPAIR (Cont'd)

- (9) Remove preformed packing (24) from torque divider (25). Discard preformed packing (24).
- (10) Use a wrench to remove two capscrews (25) and washers (26) 180° apart from each other. Tip assembly and drain oil into a drain pan.
- (11) Use a wrench to remove remaining thirty-two capscrews (25) and washers (26) from torque divider (27).
- (12) Insert two 3/8-16NC forcing screws (28) into wheel at location (C). Slowly turn screws (28) until Impeller (29) separates from housing (30).
- (13) Remove forcing screws (28) and install two 3/8-16NC eyebolts in impeller (29) and attach lifting equipment to eyebolts. Lift impeller (29) from assembly. The weight of impeller is 54 lbs.



- (14) Turn impeller (29) over. Use a twelve point wrench to remove eight capscrews 31 that hold stator assembly (32) in position.



**7-4. TORQUE DIVIDER - REPLACE/REPAIR (Cont'd)**

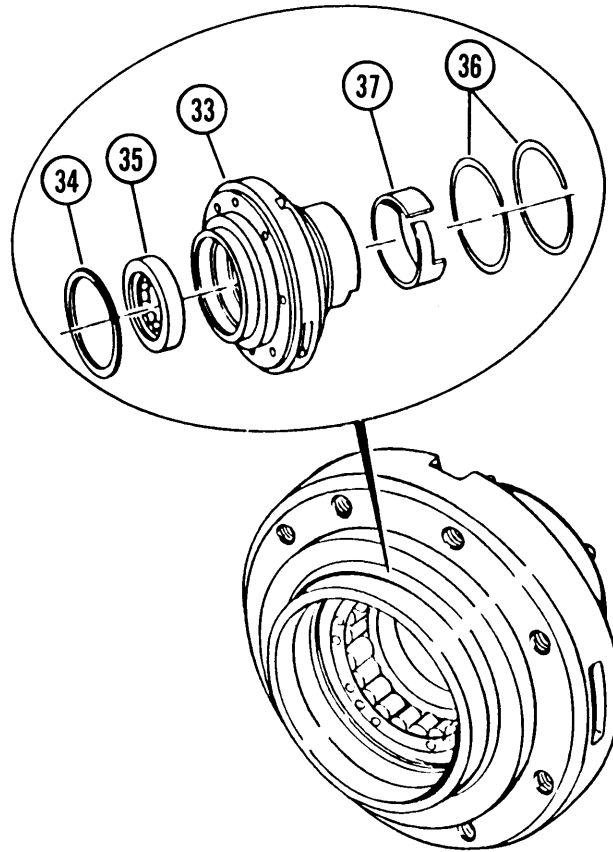
(15) Use two prybars to apply pressure evenly on both sides of stator (32) until stator (32) slides off of impeller (29).

(16) Turn impeller wheel assembly (29) over. Remove carrier assembly (33) by applying equal pressure with two prybars on both sides of carrier assembly (33).

(17) Use a screwdriver to remove ring (34) that holds bearing (35) in position.

(18) Turn carrier assembly (33) over. Use a hammer and a punch to remove bearing (35).

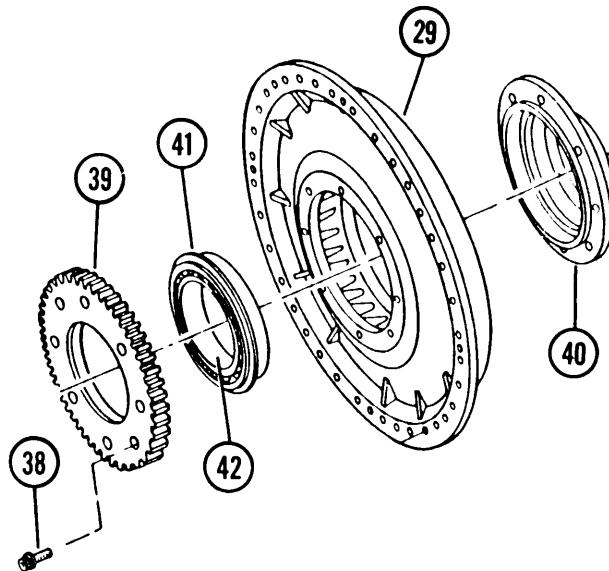
(19) Remove seals (36) and oil director (37) if necessary from carrier assembly (33). Discard seals (36).



(20) Use a twelve point wrench to remove eight capscrews (38) that hold gear (39) to impeller (29). Remove gear (39).

(21) Remove carrier (40) from impeller (29). Use a screwdriver to remove ring (41) that holds bearing (42) in position in carrier (40).

(22) Remove bearing (42) from carrier (40) with a suitable driver group.



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**7-4. TORQUE DIVIDER - REPLACE/REPAIR (Cont'd)**


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- (23) Use a snap ring pliers to remove ring (43).
- (24) Remove turbine (44) and spacer (45) from housing (30).
- (25) Turn housing (30) over. Use a hammer and a punch to remove two pins (46). Use long nose pliers to compress ring (47) and remove gear (48). Remove ring (47).

- (26) Install two 3/8-16NC forcing screws in flange assembly (49). Make a separation of flange assembly (49) from housing (30).

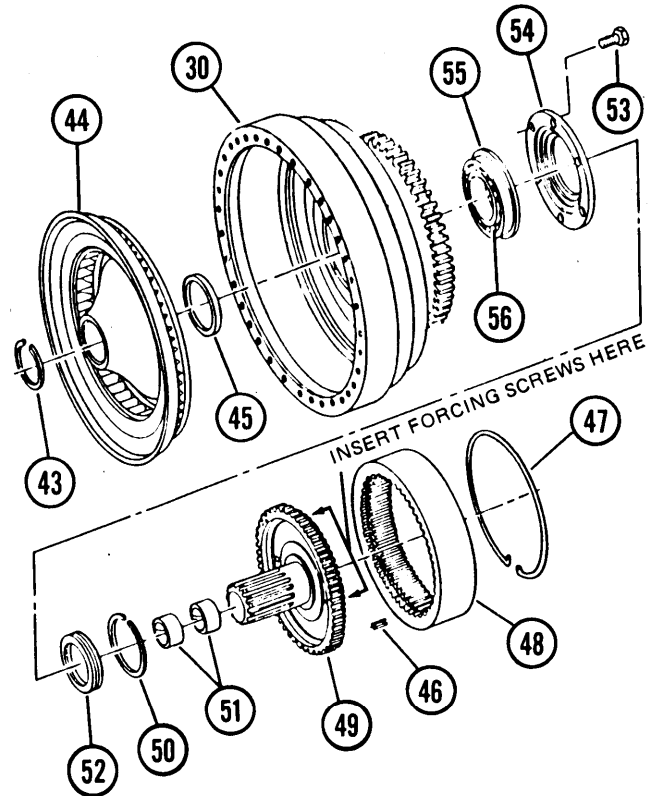
- (27) Remove seal (50) from flange assembly (49). Discard seal (50).

- (28) Remove two bearings (51) from flange (49) with suitable driver.

**NOTE**

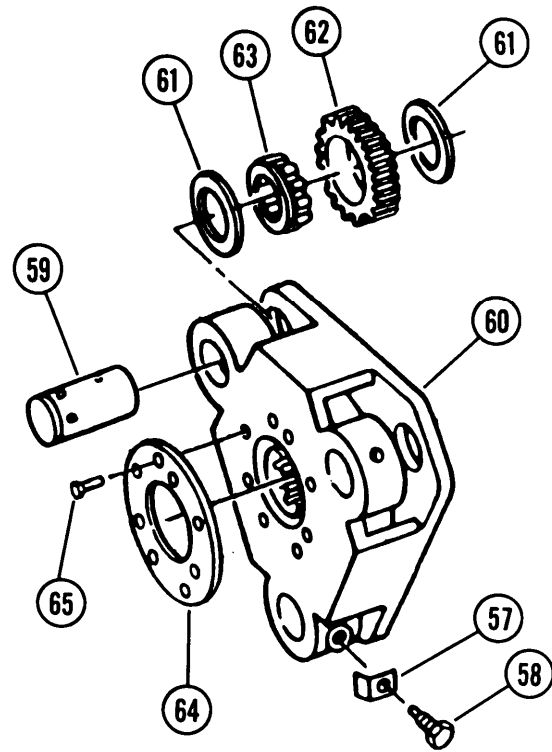
Do not remove carrier (52) from flange unless it will be replaced.

- (29) If carrier (52) is to be removed, use a chisel to break carrier and remove it.
- (30) Use a wrench to remove six capscrews (53) from retainer (54).
- (31) Remove retainer (54) from housing (30).
- (32) Remove ring (55) that holds bearing (56) in position.

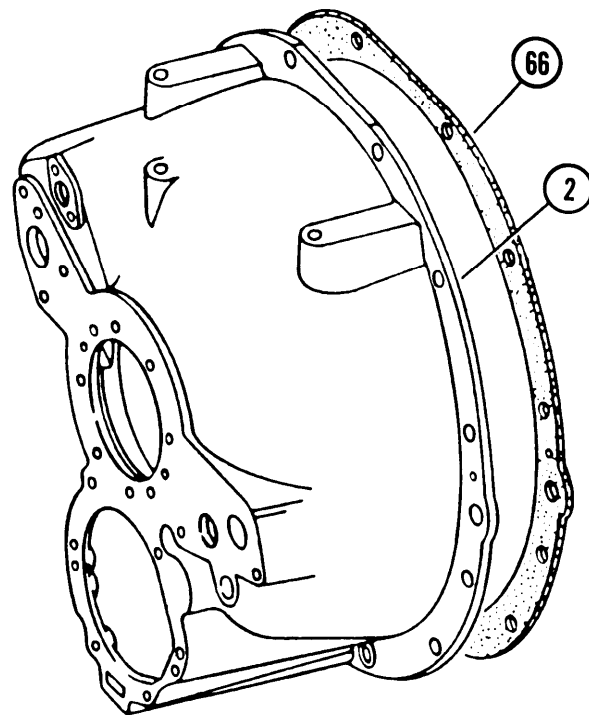


**7-4. TORQUE DIVIDER - REPLACE/REPAIR (Cont'd)**

- (33) Remove bearing (56) from housing (30) with suitable driver.
- (34) Use a chisel and hammer to bend tab (57) flat. Remove capscrew (58), using a wrench.
- (35) Slide shaft (59) from housing (60) and remove washers (61), gear (62) and bearing (63).
- (36) If removal of thrust washers (64) is deemed necessary, use a drill and carefully drill rivet heads from rivets (65). Use a drift punch to punch rivets from washers (64).



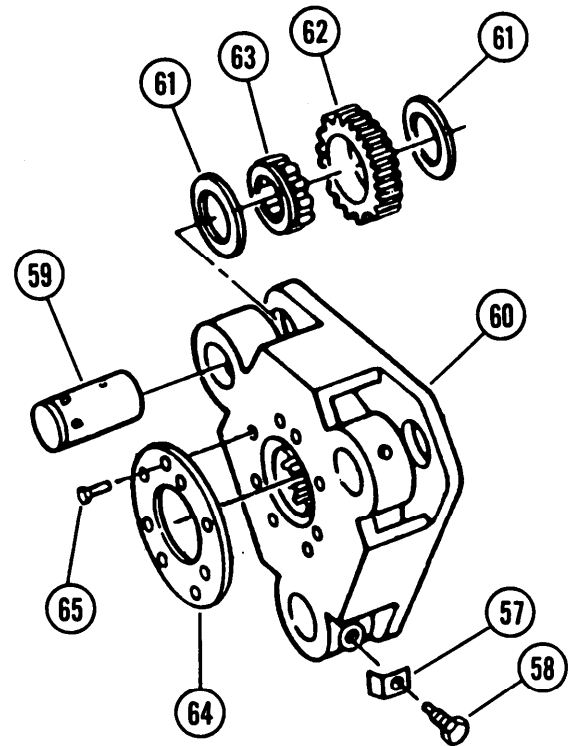
- (37) Remove gasket (66) from torque divider housing (2), and discard.



## 7-4. TORQUE DIVIDER - REPLACE/REPAIR (Cont'd)

### c. Assembly

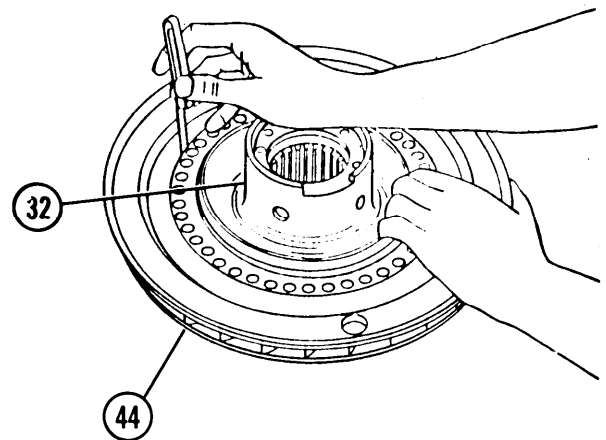
- (1) Place thrust washers (64) into position and insert rivets (65). Flare ends of rivets.
- (2) Place bearing (63) into gear (62).
- (3) Place gear (62) with bearing (63), and two washers (61) into planetary housing (60) and insert shaft (59).
- (4) Insert tab (57) and capscrew (58) and tighten capscrew (58) with a wrench.
- (5) Use a hammer and chisel and bend one end of tab (57) around cap screw and one end around housing.



#### NOTE

Certain tolerances must be maintained in order for torque divider to operate properly. Check the following tolerances prior to reassembly.

- (6) Check clearance between turbine (44) and stator (32) as follows:
  - (a) put stator (32) in position on turbine (44). Hold stator against one side of turbine and use a feeler gage to find clearance between stator and turbine.



**7-4. TORQUE DIVIDER - REPLACE/REPAIR (Cont'd)**

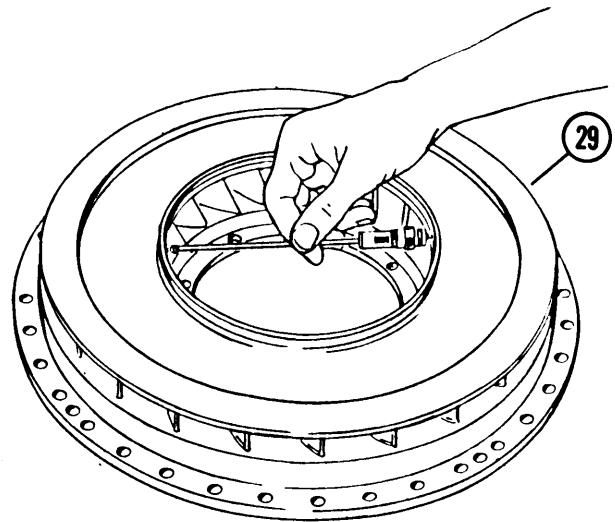
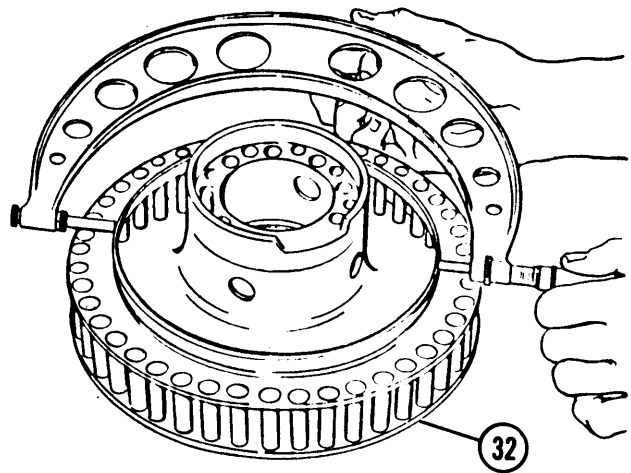
(b) The clearance across diameters between stator (32) and turbine (44) must be 0.012 to 0.018 in. Check the clearance at four points on turbine. The maximum permissible clearance across the diameters is 0.030 in.

(c) The running clearance is one half of the clearance across the diameters between stator (32) and turbine (44). The running clearance must be 0.006 to 0.009 in. The maximum permissible running clearance is 0.015 in.

(7) Check clearance between impeller (29) and stator (32) as follows:

(a) Use an outside diameter micrometer and make a measurement of diameter of stator flange at four points on stator (32). Make a record of lowest reading.

(b) Use an inside diameter micrometer and make a measurement of inside diameter of outer edge of flange on impeller (29) at four points. Make a record of highest reading.





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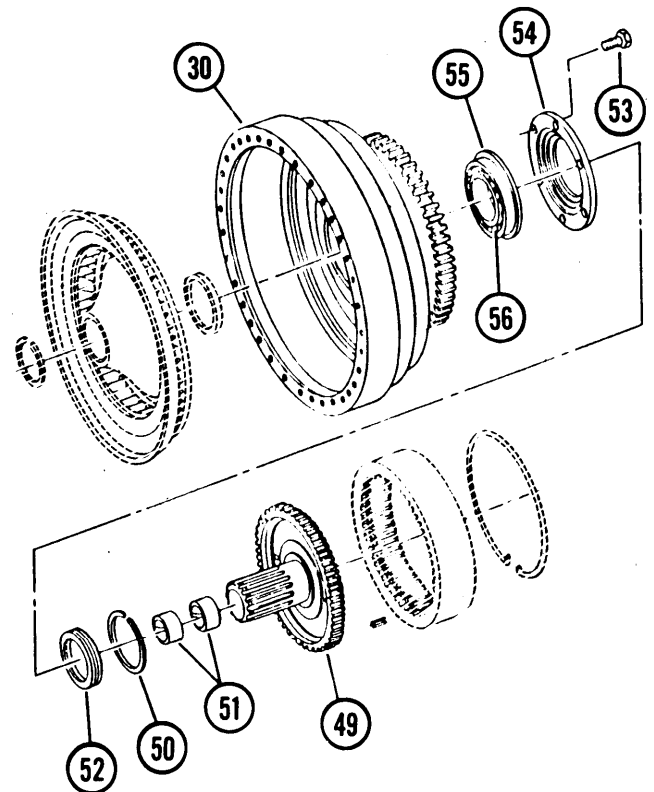
**7-4. TORQUE DIVIDER - REPLACE/REPAIR (Cont'd)**


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- (c) The clearance across diameters between impeller (29) and stator (32) is the difference between the highest reading on impeller (29) and the lowest reading on stator (32). The clearance must be 0.009 to 0.015 in. Maximum permissible clearance across diameters is 0.024 in.
- (d) The running clearance is one half of the measurement made across diameters. Running clearance must be 0.0045 to 0.0075 in. Maximum permissible running clearance is 0.012 in.
- (8) Install ring (55) onto bearing (56).
- (9) Install bearing (56) in housing (30) using suitable driver.
- (10) Place retainer (54) on housing (30) and install capscrews (53) using a wrench. Torque capscrews (53) with a torque wrench to  $36 \pm 2$  lb. ft.
- (11) If carrier (52) was removed from flange (49), heat new carrier to a temperature of 280°F to 330°F for a maximum time of ten minutes. Install carrier (52) on flange (49). Install new seal (50) on carrier.
- (12) Install bearings (51) in both ends of flange (49) with suitable driver group.

**NOTE**

On narrow side of flange (49), install bearing (51) even with outside edge of flange. On wide side of flange, install bearing (51) 1.00 in. inside the edge of the flange.

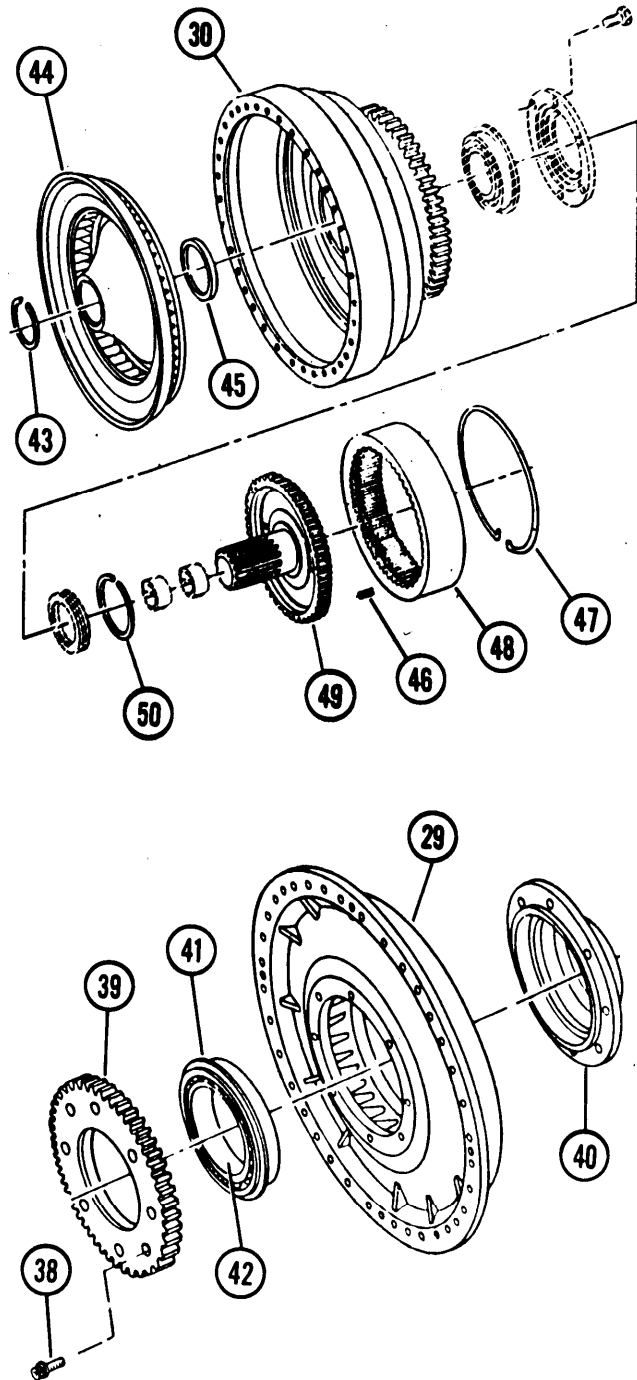


7-4. TORQUE DIVIDER - REPLACE/REPAIR (Cont'd)

**CAUTION**

Be extra careful not to cause damage to seal (50) when flange (49) is installed into housing (30).

- (13) Place clean grease on new seal (50). Pull ends of seal together and install flange (49) in housing.
- (14) Turn the housing (30) over.
- (15) Install spacer (45) and turbine (44) in housing (30). Install ring (43) on end of flange (49).
- (16) Turn housing (30) over. Install ring (47) that holds gear (48) in position.
- (17) Use a long nose pliers to put ring (47) under compression and place gear (48) in position. Release ring (47) so that ring is in groove in gear.
- (18) Install two pins (46) in flange (49).
- (19) Install ring (41) on bearing (42). Install bearing (42) in carrier (40) with suitable driver.
- (20) Put carrier (40) in position in wheel (29).
- (21) Turn wheel (29) over and put gear (39) for scavenge pump in position on wheel. Install eight capscrews (38) using a twelve point wrench. Torque capscrews to  $36 \pm 2$  lb. ft.



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**7-4. TORQUE DIVIDER - REPLACE/REPAIR (Cont'd)**


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- (22) Lower temperature of bearing (35) and install bearing (35) in carrier (33) with suitable driver group.
- (23) Install ring (34) that holds bearing (35) in carrier (33).
- (24) Install new lip-type seal (20) in carrier (33) with suitable driver group. Make sure lip of seal is toward bearing.

**NOTE**

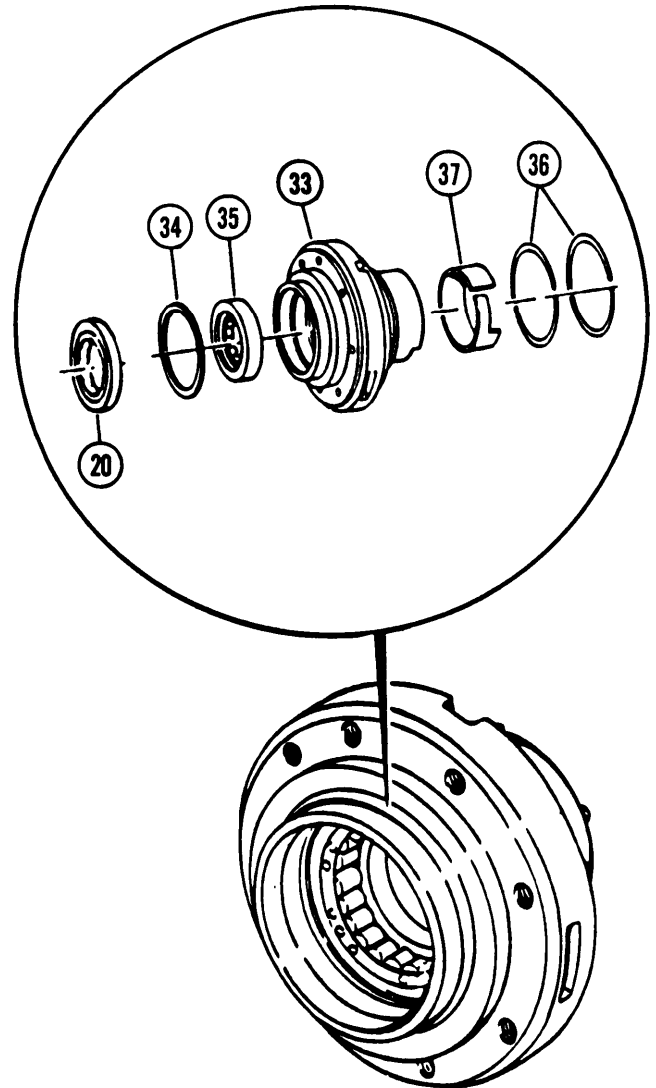
Thoroughly clean all oil passages in carrier (33) before continuing with assembly.

- (25) Install oil director (37) in carrier (33) with cutout in 011 director in alignment with cored opening in carrier.
- (26) Use a flat chisel or punch and move metal (stake) oil director (37) into notch in carrier (33). Make sure metal that is moved (staked) into the notch is  $0.045 \pm 0.015$  in. below surface.
- (27) Install new-seals (36) on carrier (33).

**CAUTION**

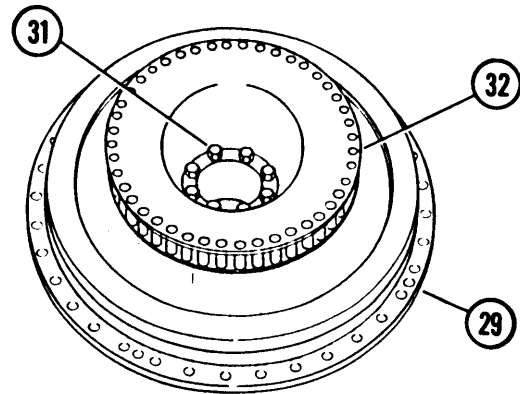
Be extra careful not to cause damage to seals (36) when carrier (33) is installed.

- (28) Put clean grease on seals (36). Pull ends of seals together. Put carrier assembly (33) in position on wheel.

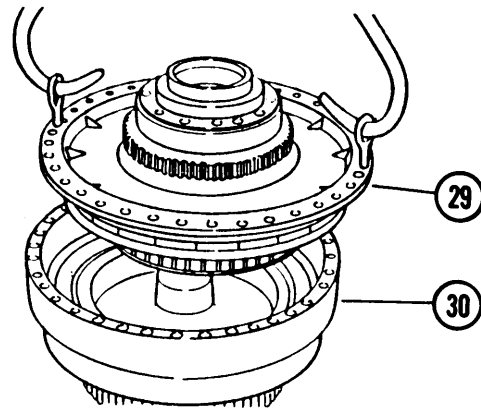


**7-4. TORQUE DIVIDER - REPLACE/REPAIR (Cont'd)**

(29) Turn wheel (29) over. Put stator (32) in position on carrier and install capscrews (31) that hold stator (32) to carrier using a twelve point wrench. Tighten capscrews evenly to a torque of 20  $\pm$  1 lb. ft.



(30) Install two 3/8-16NC forged eyebolts into wheel (29). Fasten lifting equipment to eyebolts and lower the wheel (29) into position on housing (30). Remove eyebolts.

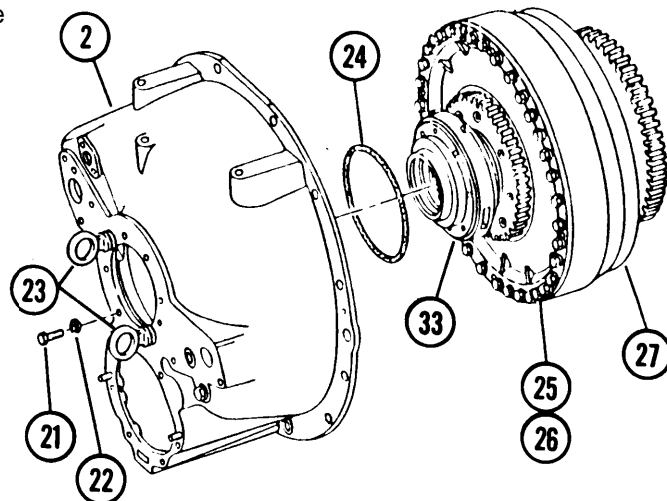


(31) Use a wrench to install capscrews (25) and washers (26) that hold wheel (29) to housing (30). Torque evenly to 20  $\pm$  1 lb. ft.

(32) Install new preformed packing (24) onto carrier (23).

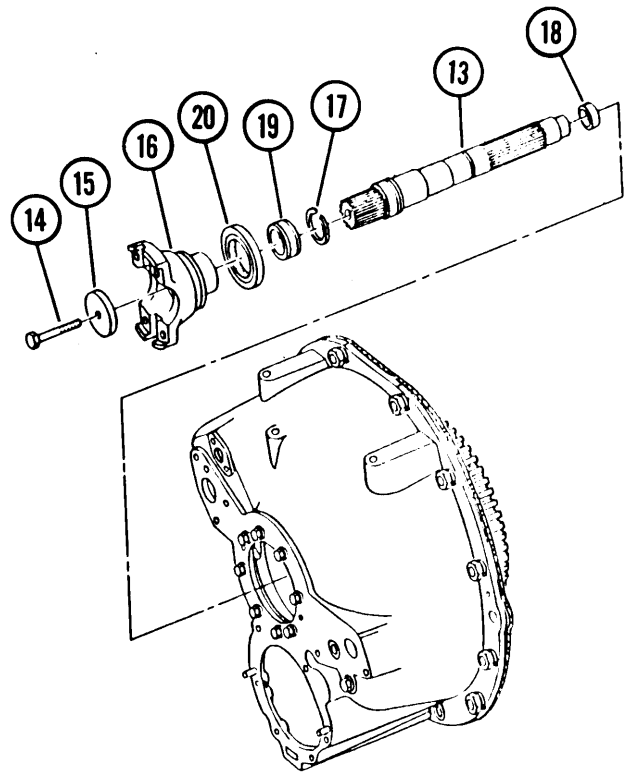
(33) Install two 3/8-16NC forged eyebolts in cover (2). Fasten lifting equipment to eyebolts and put cover (2) in position over torque divider (27). Remove eyebolts.

(34) Use a wrench to install eight capscrews (21) and washers (22) that hold cover (2) to torque divider (27).



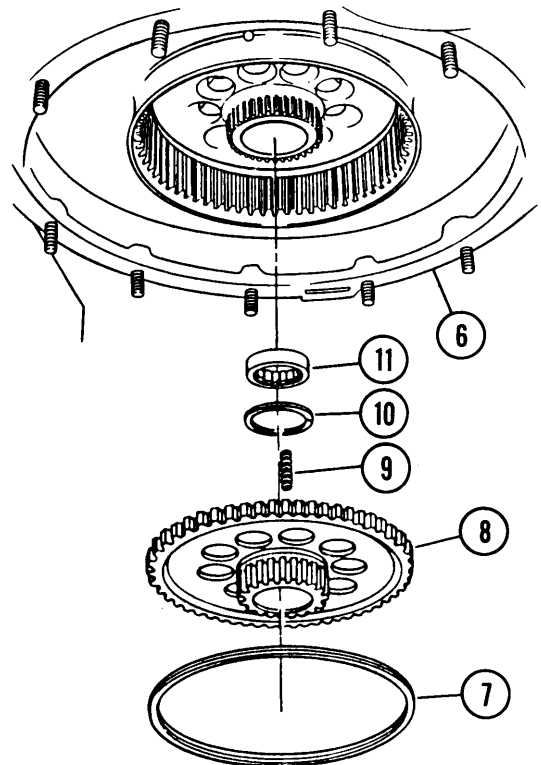
**7-4. TORQUE DIVIDER - REPLACE/REPAIR (Cont'd)**

- (35) If bearing races (18 and 19) were removed, heat races to a temperature of 275°F and install bearing races (18 and 19) on output shaft (13).
- (36) Install new seal (17) on output shaft (13).
- (37) Install flange (16) on output shaft (13) and install washer (15). Use a wrench to attach capscrew (14) that holds flange (16) and washer (15) in place. Torque capscrew to  $40 \pm 5$  lb. ft.
- (38) Place clean grease on seal (17) and insert output shaft (13) into torque divider.



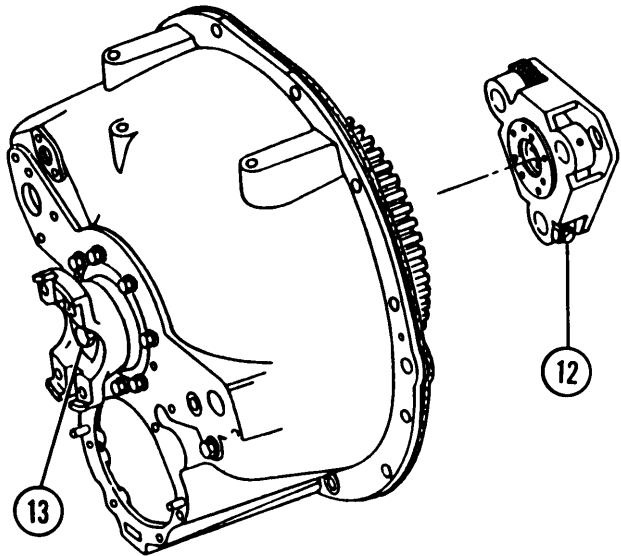
**d. Installation**

- (1) Install bearing (11) into flywheel housing (6) using a suitable driver.
- (2) Install retaining ring (10) and three springs (9) into flywheel housing (6).
- (3) Install gear (8) and retaining ring (7) into flywheel housing (6). Be sure to align marks between ear (7) and flywheel housing (6).



**7-4. TORQUE DIVIDER - REPLACE/REPAIR (Cont'd)**

- (4) Slide planetary gear assembly (12) onto output shaft (13) and wrap a wire around torque divider and planetary gear assembly to prevent gear assembly from sliding off shaft during installation.



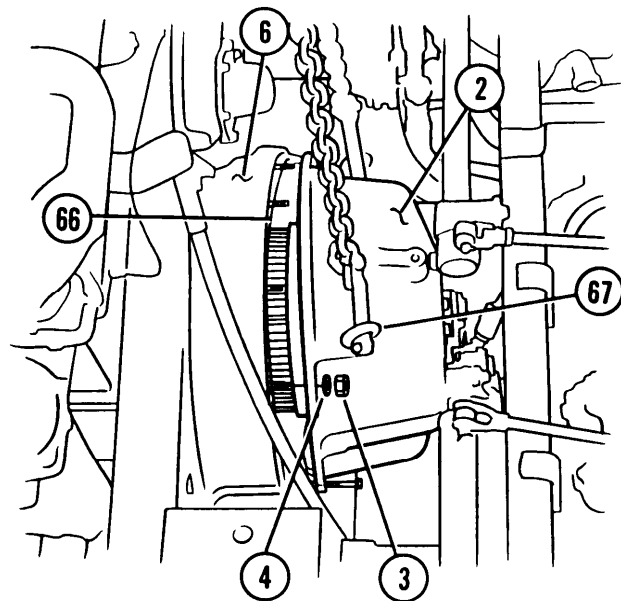
- (5) Install two 5/8-11NC eyebolts (67) into cover of torque divider. Place new gasket (66) on flywheel housing (4).

- (6) Attach lifting equipment to torque divider and carefully lift torque divider into position. The weight of torque divider is 325 lbs. Remove wire from around torque divider assembly.

- (7) Slide torque divider housing (2) onto studs on flywheel housing (6).

**NOTE**

Carefully maneuver torque divider onto housing so that planetary gear engages with flywheel.



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**7-4. TORQUE DIVIDER - REPLACE/REPAIR (Cont'd)**

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- (8) Use a wrench to install twelve washers (4) and nuts (3) that secure torque divider housing (2) to flywheel housing (6). Torque nuts (3) to 75 lb. ft l
- (9) Remove the lifting equipment and two 5/8-11NC eyebolts (1) from top of torque divider housing (2).
- (10) Install drive shaft onto tractor. See TM5-2410-237-20.
- (11) Install scavenge pump onto torque divider housing. See page 7-92.
- (12) Install sequence relief valve on torque divider. See page 7-79.
- (13) Install torque converter outlet relief valve into torque converter. See page 7-86.
- (14) Install transmission oil cooler lines where they attach to torque divider. See TM5-2410-237-20.
- (15) Install transmission oil lines where they attach to torque divider. See TM5-2410-237-20.
- (16) Install brake lock linkage that crosses over torque divider. See TM5-2410-237-20.
- (17) Install steering clutch linkage that crosses over torque divider. See page 10-48.
- (18) Service torque divider housing and transmission with oil. See TM5-2410-237-20.

**e. Place In Service**

Run engine and test drive in all speeds.

**7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR**

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning
- d. Inspection
- e. Assembly
- f. Installation
- g. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair  
 Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Lifting Equipment - 2000 lbs.  
 Capacity

Material/Parts

Replace:

Seals (35), (38)  
 Gasket (72)

Repair:

Seals (66), (68), (75), (93),  
 (113), (114), (116), (122a), (173)  
 Rings (128), (143), (144), (185)  
 (186), (191), (192), (228), (172)  
 Gasket (85), (51)  
 Locks (229)  
 Drain Pan  
 Cleaning Solvent (App. B, Item 19)  
 Lubricating Oil OE/HDO-30 (Refer to  
 L05-2410-237-12)  
 Twelve 1/2"-13NC Forged Eyebolts  
 Eight 3/8"-16NC Forged Eyebolts  
 1/4"-20NC x 2-1/2" Capscrew  
 #10-32NC Capscrew  
 Three 1/2"-13NC Forcing Screws  
 Three 3/8"-16NC Forcing Screws  
 Caps and Plus  
 Cotter Pins (1), (27), (30)

Equipment Condition

or Cab removed. See TM5-2410-237-20.  
 Hydraulic tank mounting brackets and plates removed. See TM5-2410-237-20.  
 Seat assembly removed. See TM5-2410-237-20.  
 Rear crankcase guard removed. See TM5-2410-237-20.  
 Drive shaft and universal joint removed. See TM5-2410-237-20.  
 Transmission oil drained. See TM5-2410-237-20.



**7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)**

a. Removal

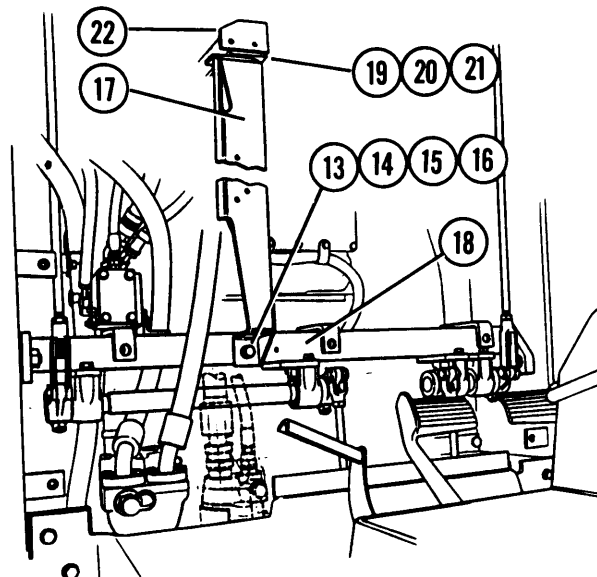
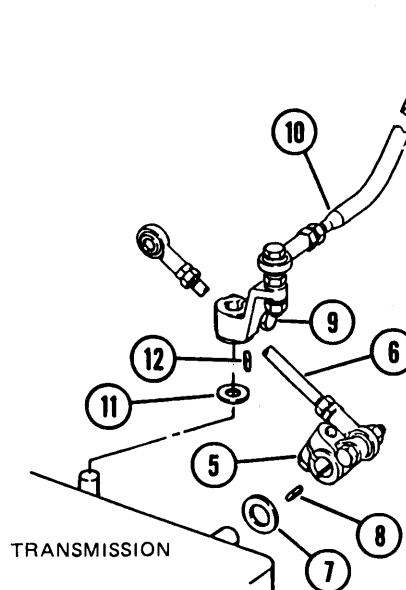
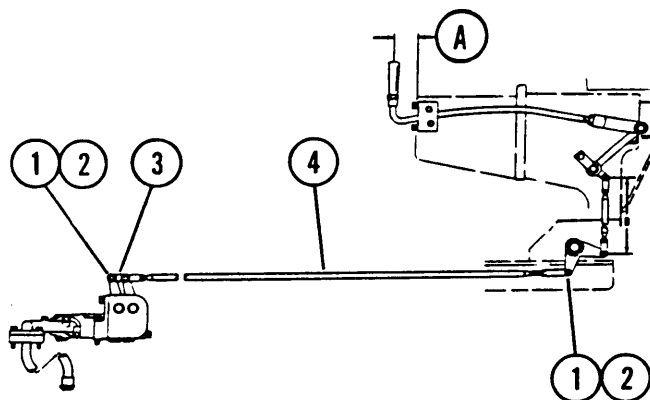
**CAUTION**

Wipe the area clean around all hydraulic connections to be opened during removal and disassembly. Cap oil lines and plug holes after removing lines. Contamination of the hydraulic system could result in premature failure.

**NOTE**

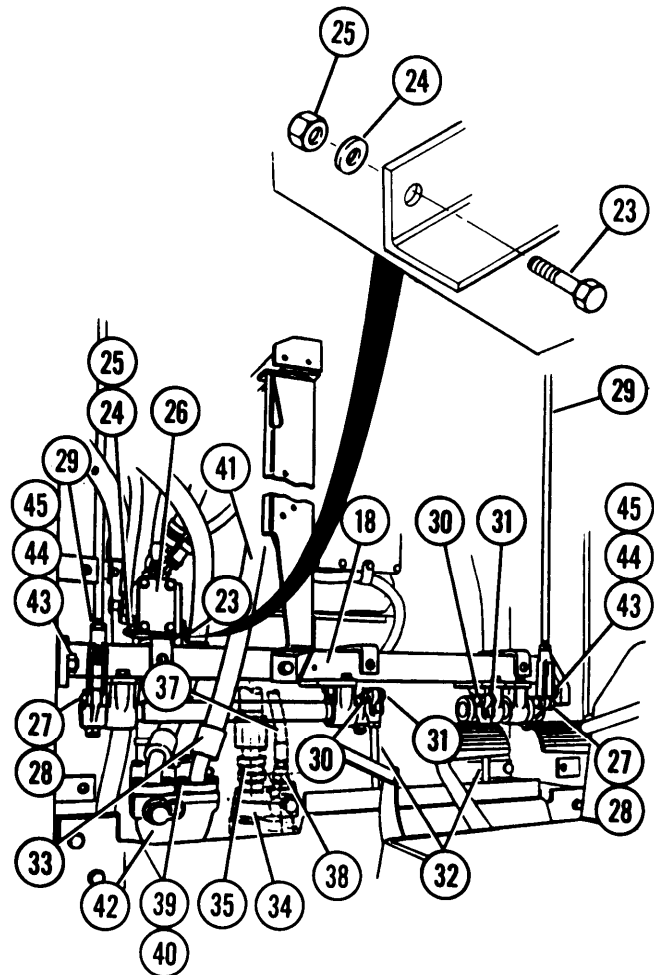
If more than one hydraulic line is to be removed, identify lines to assure proper installation. Use suitable container to catch any hydraulic oil that may drain from the system.

- (1) Use pliers to remove cotter pin (1) and use a vise grip to remove pin (2) from each end of two steering clutch control rods (3 and 4). Remove rods.
- (2) Loosen capscrews (5 and 9) on rod assemblies (6 and 10). Slide rod assemblies from posts on transmission. Remove keys (8 and 12) and washers (7 and 11).
- (3) Use two wrenches to remove capscrew (13), nut (14), lockwasher (15) and washer (16) which secure one end of support assembly (17) to beam assembly (18).
- (4) Use two wrenches to remove two capscrews (19), two lockwasher (20), two nuts (21) and support assembly (17) from support (22).



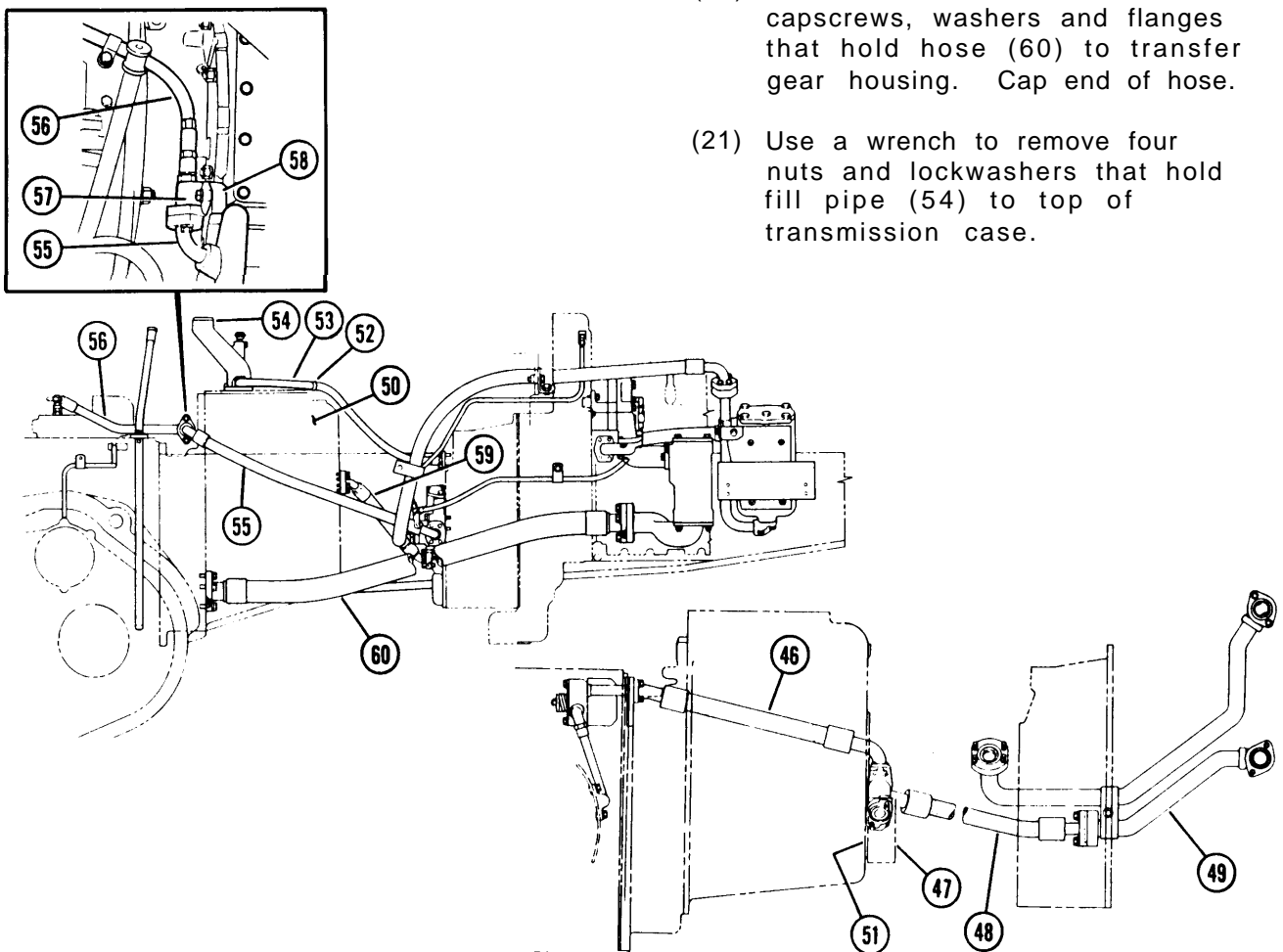
**7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)**

- (5) Use two wrenches to remove two capscrews (23), two flat washers (24), two nuts (25) and disconnect hydraulic pressure control valve (26) from beam assembly (18).
- (6) Use pliers to remove cotter pins (27) and pins (28) from both steering brake control rods (29).
- (7) Use a pliers to remove cotter pins (30) and pins (31) from steering brake control rods (32).
- (8) For tractors equipped with a winch, use a wrench to disconnect hose (33) from pump (34). Remove and discard seal (35) from end of hose. Plug hose and pump.
- (9) For tractors equipped with a winch, use a wrench to disconnect hose (37) from winch gear pump. Remove and discard seal (38) from end of hose. Plug hose and pump.
- (10) For tractors with ripper, use a wrench to remove four capscrews (39), washers (40), and hose (41) from manifold (42).
- (11) Attach lifting equipment with strap to beam assembly. Use a wrench to remove two capscrews (43), two nuts (44) and two lockwashers (45) on each side of beam assembly (18). Use a hoist to remove beam with left side spacer plate and shims.
- (12) Use a wrench to remove capscrews and flanges that connect hose (46) to bevel gear case and manifold (47). Plug hose, manifold and bevel gear case.



## 7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (13) Use a wrench to remove capscrews and flanges from hose (48) and tube (49).
- (14) Use a wrench to remove four capscrews and lockwashers that hold manifold (47) to transmission case (50). Remove manifold, gasket (51) and hose (48) as an assembly.
- (15) Use a wrench to remove capscrews and lockwashers from two clips (52).
- (16) Use a wrench to disconnect hose (53) from transmission fill tube (54). Plug hose.
- (17) Use a wrench to remove capscrews and washers holding hose (55) to hose assembly (56).
- (18) Remove capscrews and washers that hold bracket (57) to transfer gear case (58). Move hose assembly (56) away from transfer gear case to avoid damage during transmission removal.
- (19) Use a wrench to remove capscrews, washers and flanges that connect hose (59) to transmission and torque divider. Plug hose ends and torque divider.
- (20) Use a wrench to remove four capscrews, washers and flanges that hold hose (60) to transfer gear housing. Cap end of hose.
- (21) Use a wrench to remove four nuts and lockwashers that hold fill pipe (54) to top of transmission case.



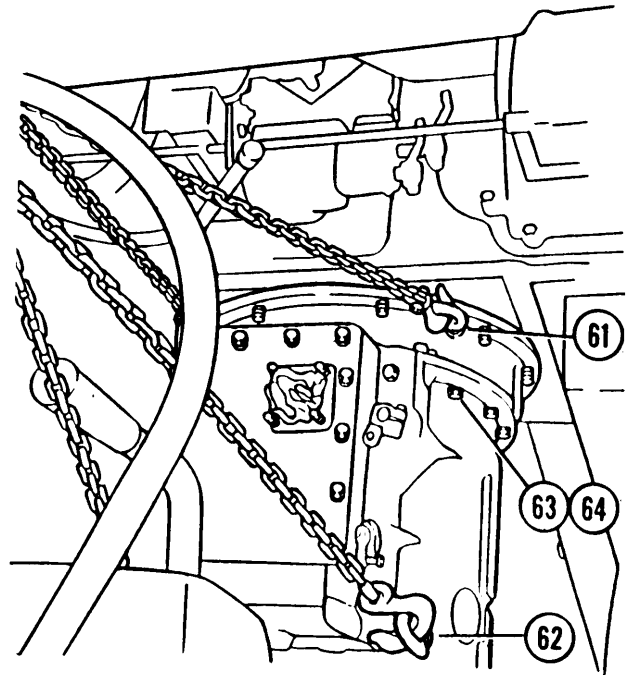
**7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)**

- (22) Install two 5/8" lifting eyes or link brackets to transmission case bosses (61) and two more on transfer gear case bosses (62).
- (23) Attach lifting equipment to lifting eyes and take up slack.
- (24) Use a wrench to remove ten nuts (63) and lockwashers (64) which secure transfer gear case and transmission to bevel gear case.

**CAUTION**

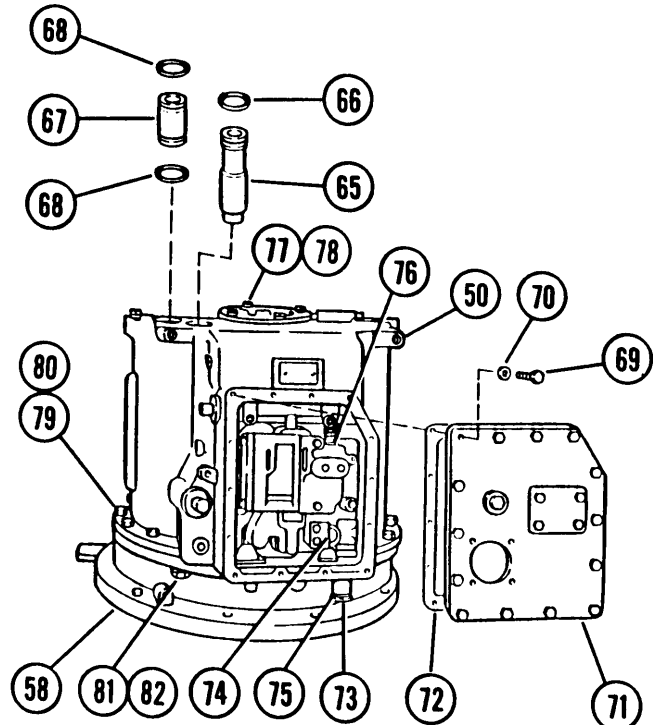
Transmission assembly must be lifted so locator studs are level. This prevents binding and damage to bottom locator studs.

- (25) Carefully move transfer gear case and transmission off of mounting studs and lift from tractor using lifting equipment. Weight of assembly is 1150 lbs.



**b. Disassembly**

- (1) Set transmission and transfer gear case on repair stand.
- (2) Remove sleeve (65) from transmission case (50). Remove and discard seals (66).
- (3) Remove sleeve (67). Remove and discard two seals (68).
- (4) Use a wrench to remove fourteen capscrews (69), fourteen lockwashers (70) and cover (71). Remove and discard gasket (72).
- (5) Use a snap ring pliers to remove sleeve (73) from selector valve (74). Remove and discard two seals (75) from both ends of sleeve.

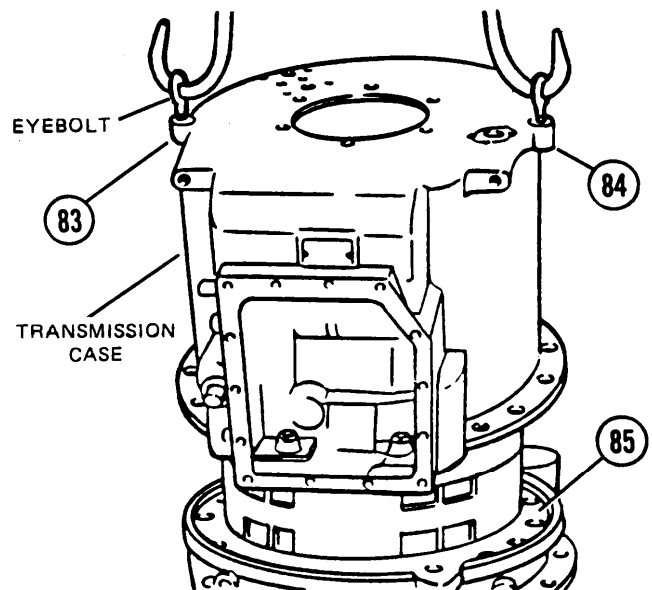


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**7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)**

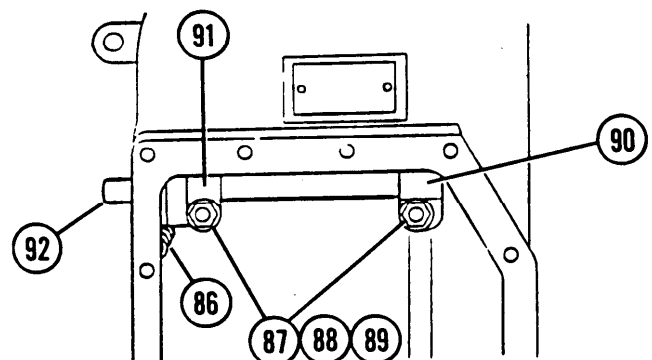

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- (6) Remove transmission hydraulic control valves (74 and 76) from transmission. See page 7-64.
- (7) Use a wrench to remove six capscrews (77) and six lockwashers (78) that secure transmission case (50) to input shaft bearing cage.
- (8) Use a wrench to remove fourteen capscrews (79) and fourteen lockwashers (80) which secure transmission case to transfer gear case (58).
- (9) Use a wrench to remove three nuts (81) and three lockwashers (82) which secure transfer gear case to transmission case.
- (10) Install two forged eyebolts in transmission case bosses (83 and 84). Attach lifting equipment and remove the transmission case. The weight of the transmission case is 140 lbs.
- (11) Remove and discard gasket (85) between transmission case and transfer gear case.
- (12) Use long nose pliers to remove spring (86).

**NOTE**

Use a hammer and punch to loosen pins on levers (90 and 91).

- (13) Use a wrench to remove two nuts (87), two washers (88) and two pins (89) that hold levers (90 and 91).
- (14) Remove shaft (92) from transmission case and levers (90 and 91) from shaft.



**7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)**

(15) Remove and discard lip-type seal (93) from transmission case.

(16) Use a driver to remove two bearings (94) and plug (95) from transmission case.

(17) Use two wrenches to remove one nut (95A), one capscrew (96), lockwasher (97), sleeve (98), washer (99) and detent lever (100) from transmission case.

(18) Remove spring (101) from detent assembly.

(19) Use two wrenches to remove capscrew (102), nut (103), lockwasher (104), washer (105), sleeve (106) and detent lever (107) from transmission case.

(20) Use a wrench to remove nut (108) and washer (109). Use a hammer and punch to loosen pin (110) and directional cam (111).

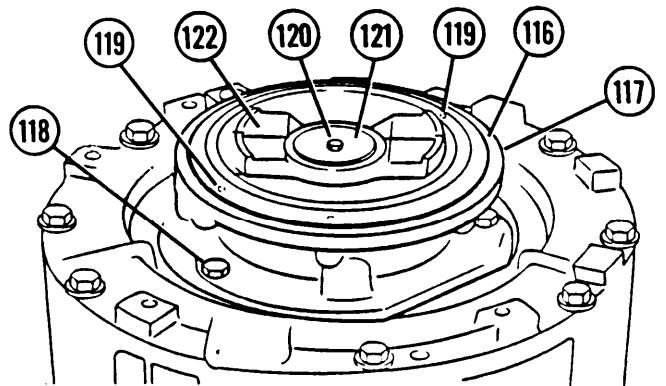
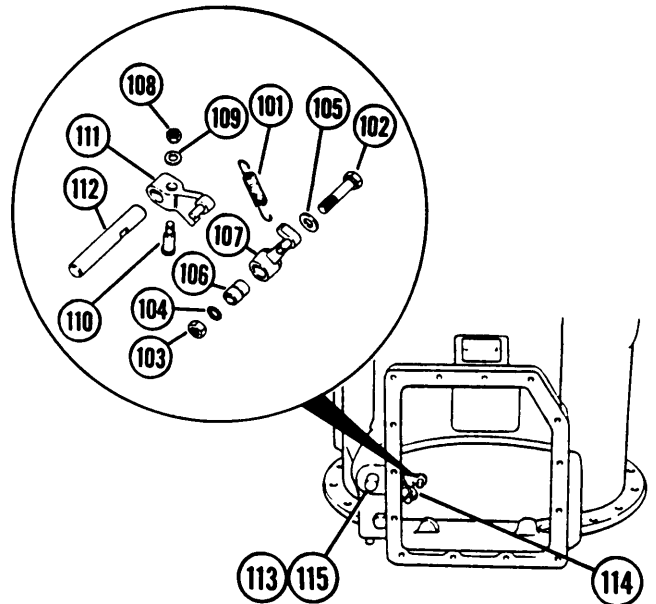
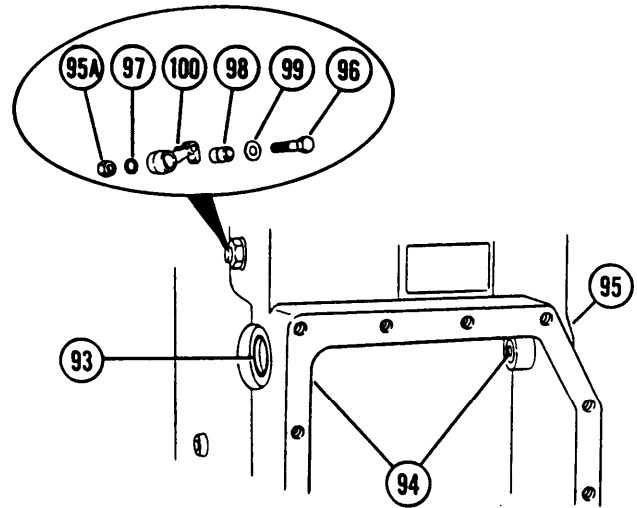
(21) Remove shaft (112).

(22) Remove and discard lip-type seals (113 and 114) and remove one bearing (115) from each side of shaft (112) mounting bores in the transmission case.

(23) Remove and discard seal (116) from input shaft bearing cage (117).

(24) Use a wrench to remove six capscrews (118) that secure input shaft bearing cage to carrier.

(25) Install two 3/8-16NC forged eyebolts or link brackets in bearing cage threaded bores (119). Remove bearing cage and input shaft as a unit. The weight of the unit is 60 lbs.

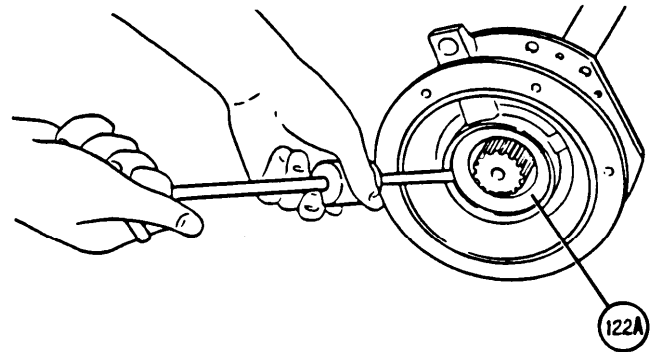


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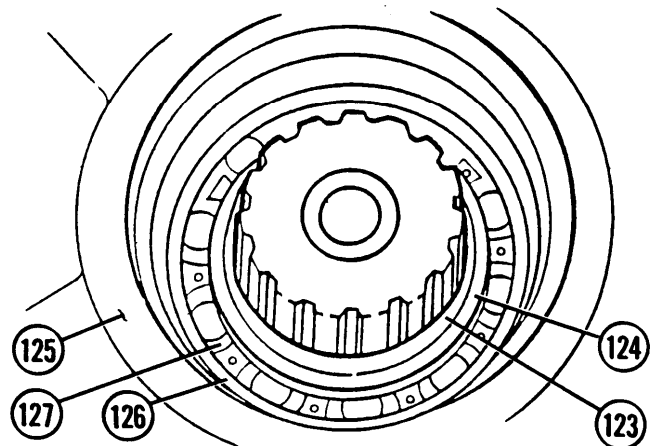
**7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)**


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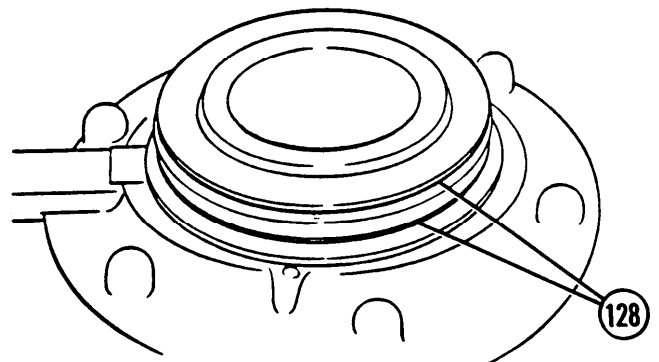
- (26) Use a wrench to remove capscrew (120), washer (121) and flange (122) from input shaft.
- (27) Use a puller tool to remove seal (122A) from bearing cage.



- (28) Use a screwdriver to remove retaining ring (123), spacer (124) and bearing cage (125) from input shaft.
- (29) Use snap ring pliers to remove snap ring (126) that holds bearing (127) in bearing cage (125).
- (30) Use a driver tool to remove bearing (127) from bearing cage (125). Remove bearing from the same side that snap ring (126) was removed.

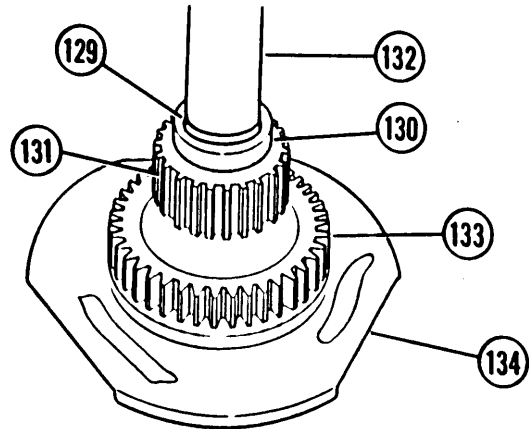


- (31) Remove and discard two rings (128) from bearing cage.



**7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)**

(32) Use snap ring pliers to remove retaining ring (129) that secure inner bearing race (130) and gear (131) on input shaft (132).

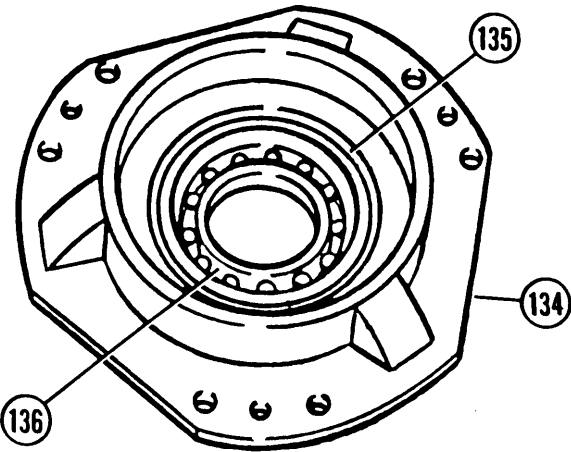


(33) Use a bearing puller to remove two gears (133) and inner bearing race (130) from input shaft (132).

(34) Use a soft faced hammer to remove bearing cage (134) from input shaft (132).

(35) Use snap ring pliers to remove snap ring (135) that retained bearing (136) in bearing cage (134).

(36) Remove bearing (136) from bearing cage (134).



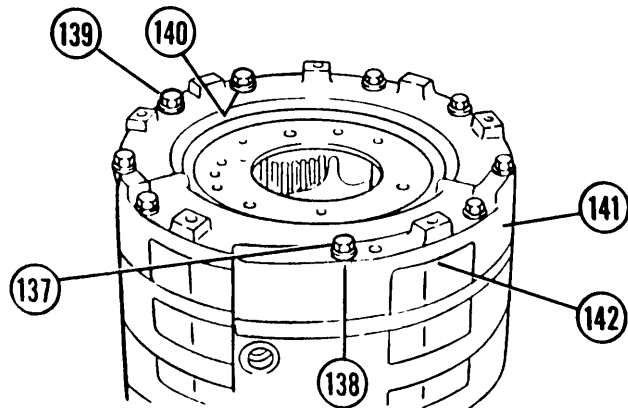
**NOTE**

Put identification on each clutch housing for correct installation and alignment at assembly. If clutch plates and disc assemblies are to be used again, keep these parts together and do not mix them.

(37) Use a wrench to remove seven long capscrews (137) and seven washers (138) that secure clutch housings together.

(38) Mark near two holes that have short capscrews (139). Use a wrench to remove two capscrews (139) and two washers (140).

(39) Install two clamps to retain piston (142) in No. 1 clutch housing (141).



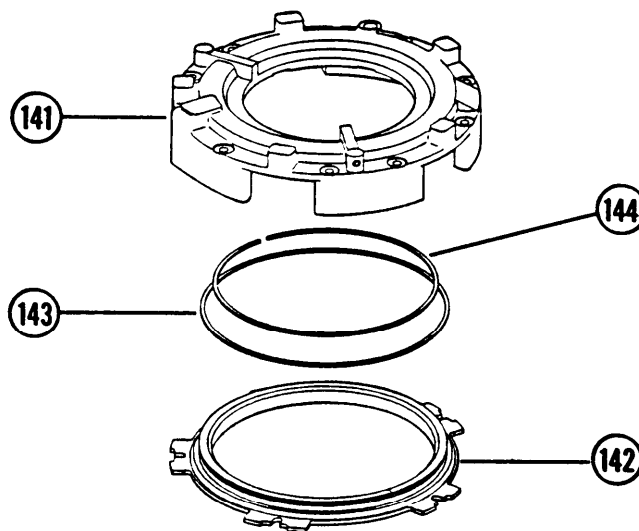


**7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)**

(40) Install two 1/2-13NC forged eyebolts or link brackets in No. 1 clutch housing (141). Attach lifting equipment and remove clutch housing and piston as a unit. The weight of unit is 55 lbs.

(41) Turn No. 1 clutch housing (141) over. Remove clamps. Use two screwdrivers to remove piston (142).

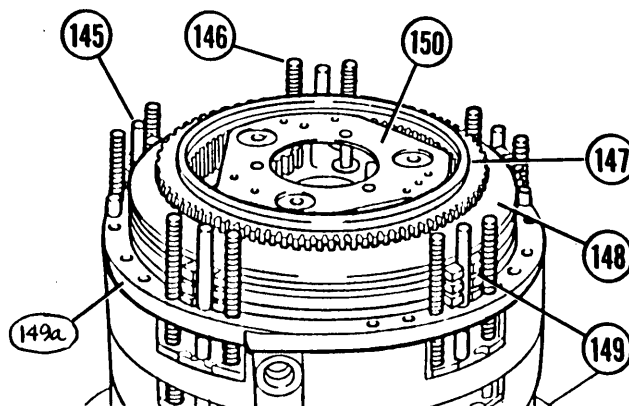
(42) Remove and discard two rings (143 and 144) from No. 1 piston and clutch housing.



(43) Remove five pins (145) and ten springs (146).

(44) Remove ring gear (147), four clutch discs (148) and three clutch plates (149).

(45) Install two 1/2 in. eyebolts to remove plate (149A).



**7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)**

- (46) Install two 3/8-16NC forged eyebolts or link brackets in No. 1 carrier (150). Attach lifting equipment and remove carrier. The weight of the carrier is 70 lbs.

**NOTE**

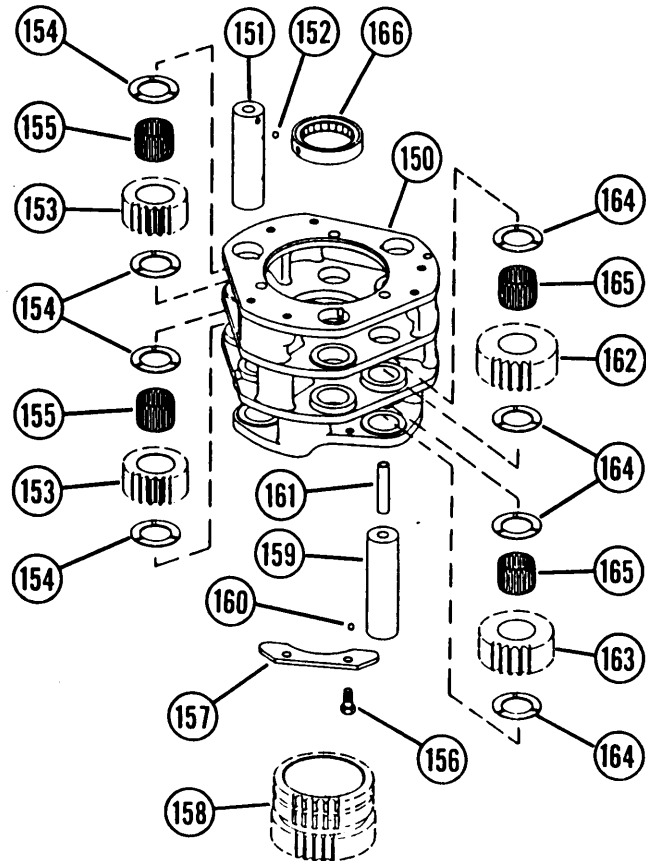
Be careful when shafts (151) are removed. Balls (152) can fall from shafts. Take care not to lose balls.

- (47) Remove three shafts (151), six ears (153) and twelve discs (154) from No. 1 carrier (150). There is a disc on each side of gears. Remove bearings (155) from gears.
- (48) Use a wrench to remove six capscrews (156) and three plates (157) that hold gear (158) in place. Remove gear.

**NOTE**

Be careful when shafts (159) are removed. Balls (160) can fall from shafts. Take care not to lose balls.

- (49) Position No. 1 carrier on its side. Remove three shafts (159) and three tubes (161) from carrier (150).
- (50) Remove six gears (162 and 163) and twelve discs (164) from No. 1 carrier. There is a disc on each side of gears.
- (51) Remove bearings (165) from gears (162 and 163).



**7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)**

(52) Use a driver to remove race and roller assembly (166) from No. 1 carrier (150).

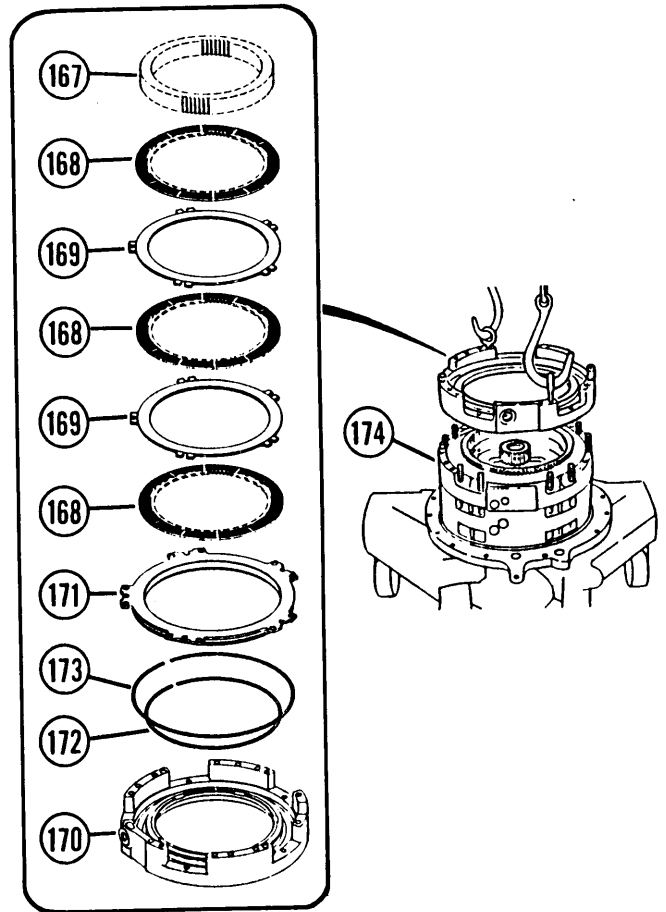
(53) Remove ring gear (167), three clutch discs (168) and two clutch plates (169) from No. 2 clutch housing (170).

(54) Install two 1/2-13NC forged eyebolts or link brackets in No. 2 clutch housing (170). Attach lifting equipment and remove clutch housing. The weight of clutch housing is 75 lbs.

(55) Remove piston (171) from No. 2 clutch housing (170).

(56) Remove and discard ring (172) and seal (173) from No. 2 clutch housing (170) and piston (171).

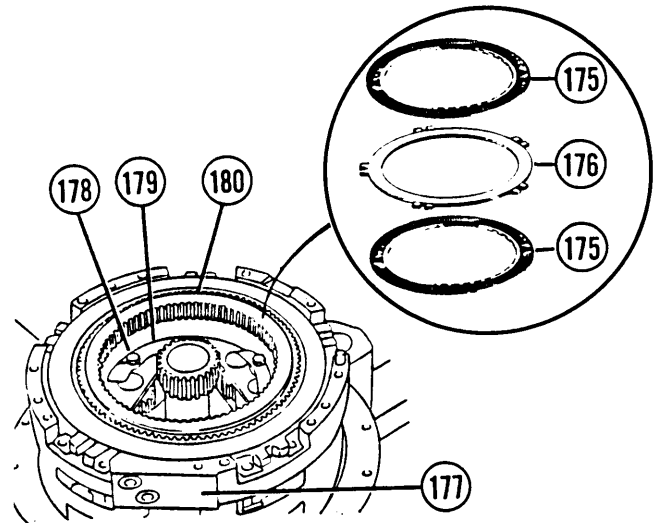
(57) Remove ten springs (174).



(58) Remove two clutch discs (175) and a clutch plate (176) from No. 3 clutch housing (177).

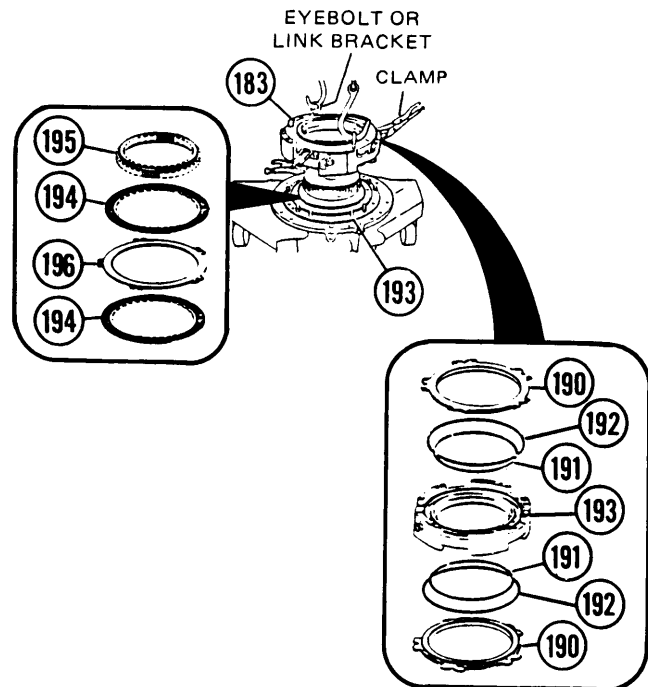
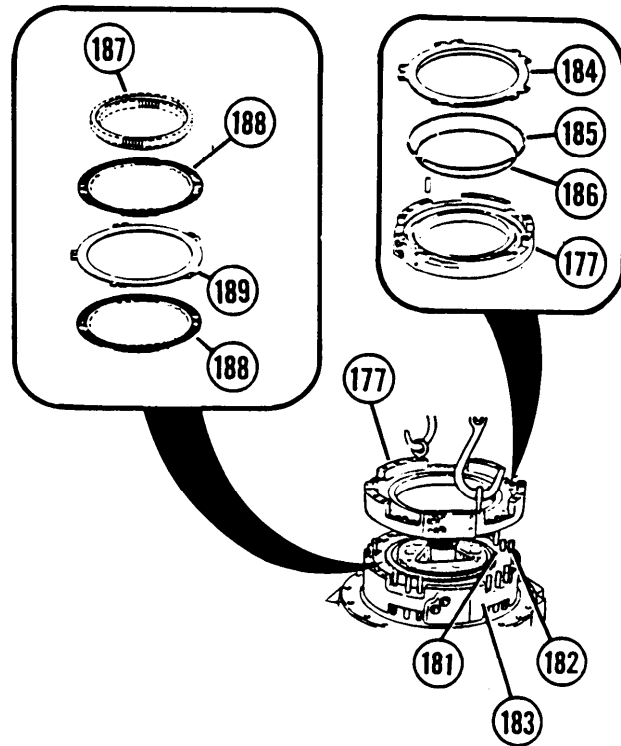
(59) Use a wrench to remove nine capscrews (178) from three plates (179) which secure ring gear (180) to No. 2 carrier.

(60) Remove ring gear (180).



**7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)**

- (61) Remove five pins (181) and ten springs (182) from No. 4 and No. 5 clutch housing (183).
- (62) Install two 1/2-13NC forged eyebolts or link brackets in No. 3 clutch housing (177). Attach lifting equipment and remove clutch. The weight of the clutch is 80 lbs.
- (63) Remove No. 3 piston (184) from No. 3 clutch housing (177).
- (64) Remove and discard two rings (185 and 186) from No. 3 clutch housing (177) and piston (184).
- (65) Remove ring gear (187), two clutch discs (188) and a clutch plate (189) from No. 4 and No. 5 clutch housing (183).
- (66) Install two clamps to retain two pistons (190) in No. 4 and No. 5 clutch housing (183).
- (67) Install two 1/2-13NC forged eyebolts or link brackets in No. 4 and No. 5 clutch housing (183). Attach lifting equipment and remove No. 4 and No. 5 clutch housing. The weight of the No. 4 and No. 5 clutch housing is 100 lbs.
- (68) Remove clamps. Remove two pistons (190) from No. 4 and No. 5 clutch housing (183).
- (69) Remove and discard two rings (191) from No. 4 and No. 5 clutch housing (183).
- (70) Remove and discard a ring (192) from each piston (190).
- (71) Remove ten springs (193), two clutch discs (194), ring gear (195) and clutch plate (196) from transfer gear case.



7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

**NOTE**

Use a bar to prevent No. 2 carrier from turning while turning out capscrews (197).

- (72) Use a wrench to remove three capscrews (197) that secure carrier (198) to bearing cage.

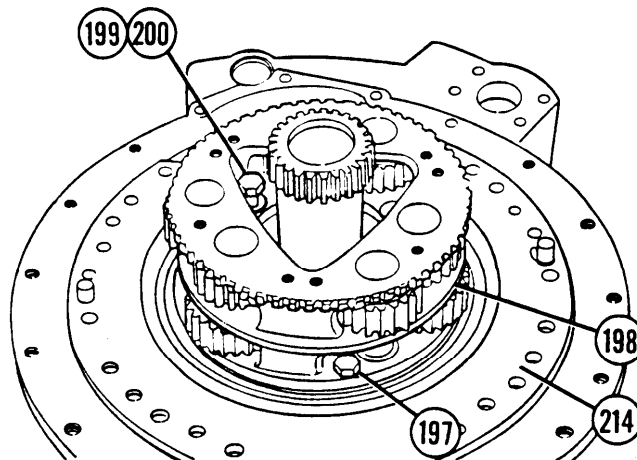
**NOTE**

Use a bar to prevent No. 2 carrier from turning while turning out capscrews (199).

- (73) Use a wrench to remove three capscrews (199) and three washers (200) that secure carrier (198) to bearing cage.

- (74) Install two 3/8-16NC forged eyebolts or link brackets in No. 2 carrier. Attach lifting equipment and remove carrier. The weight of carrier (198) is 50 lbs.

- (75) Remove plate (214) from transfer gear case.

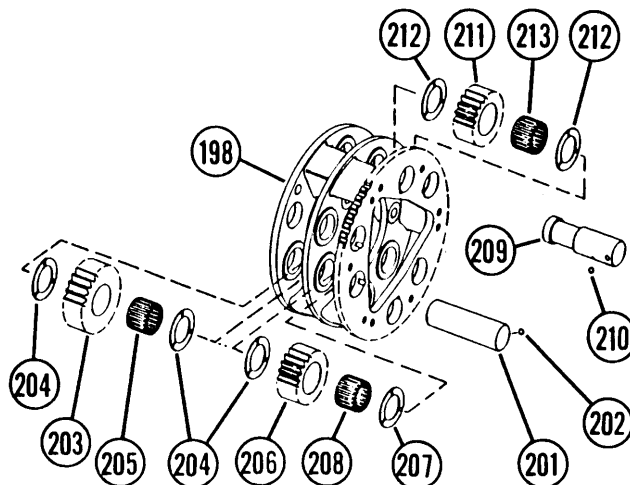


**NOTE**

Be careful when shafts (201) are removed. Balls (202) can fall from shafts. Take care not to lose balls.

- (76) Set No. 2 carrier (198) on its side. Pull three shafts (201) part way out and remove three gears (203) and six discs (204) from carrier. There is a disc on each side of gear.

- (77) Remove three bearings (205) from gears (203).



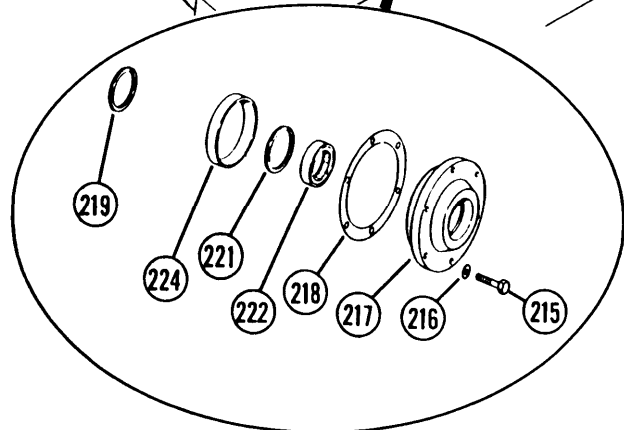
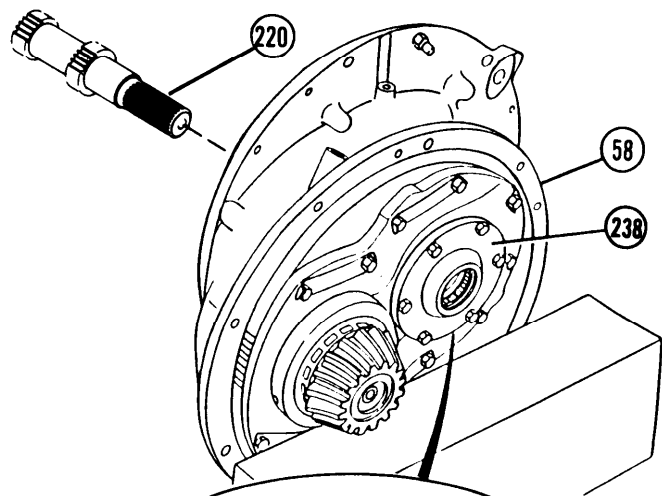
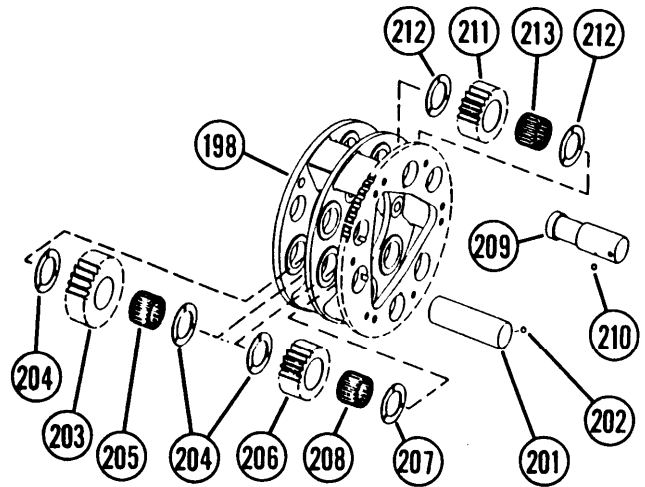
7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (78) Remove three shafts (201), three gears (206) and six discs (207) from No. 2 carrier. There is a disc on each side of gear.
- (79) Remove three bearings (208) from gears (206).

NOTE

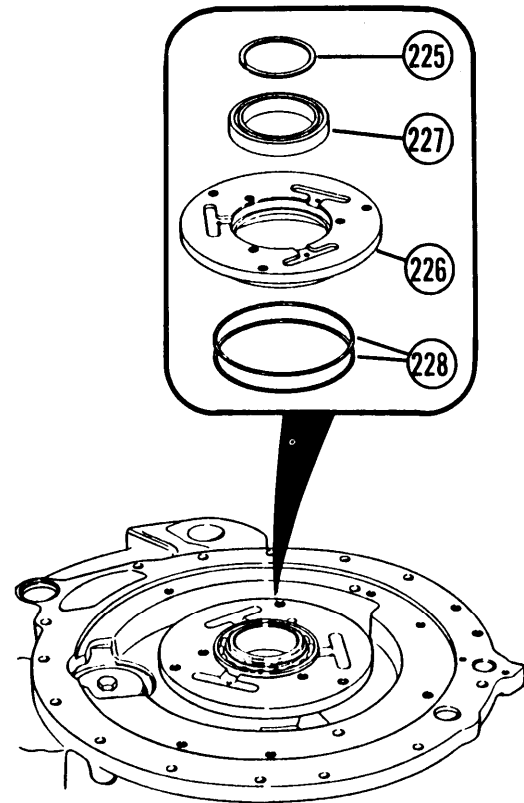
Be careful when shafts (209) are removed. Balls (210) can fall from shafts. Take care not to lose balls.

- (80) Remove three shafts (209), three gears (211) and six discs (212) from No. 2 carrier. There is a disc on each side of gear.
- (81) Remove three bearings (213) from gears (211).
- (82) Remove transfer gear case (58) from repair stand and set it on floor.
- (83) Use a wrench to remove six capscrews (215), six washers (216) and bearing cage (217) from transfer gear case cover (238).
- (84) Remove shims (218), ring (219) and output shaft (220) from transfer gear case (58).
- (85) Remove retaining ring (221) and race and roller assembly (222) from bearing cage.
- (86) Remove cup (224) from bearing cage (217).

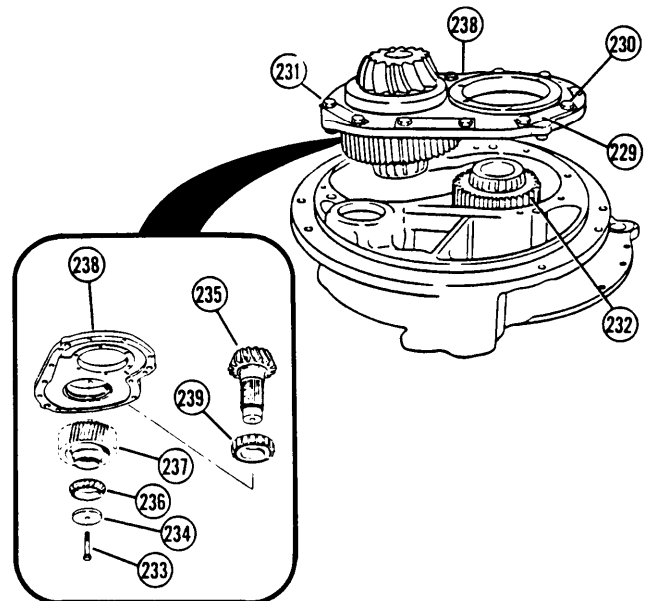


7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (87) Remove retaining ring (225) from transfer gear case.
- (88) Install three 1/2-13NC forcing screws into bearing cage. Tighten forcing screws evenly until bearing cage is free from transfer gear case. Remove bearing cage (226).
- (89) Remove bearing (227) from bearing cage.
- (90) Remove and discard two rings (228) from bearing cage.



- (91) Bend six locks (229) down. Use a wrench to remove eleven capscrews (230) and locks that secure transfer gear case cover (238) to transfer gear case. Discard locks.
- (92) Install three 3/8-16NC forcing screws in threaded bores (231). Tighten forcing screws evenly until case assembly is free from transfer gear case.



- (93) Remove forcing screws and install three 3/8-16NC forged eyebolts or link brackets in threaded bores. Attach lifting equipment and remove case assembly from transfer gear case. Weight of case assembly is 80 lbs.

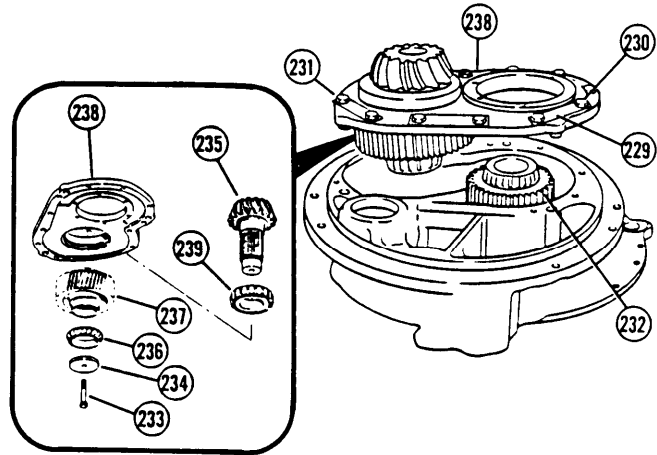
7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont' d)

(94) Remove gear (232) from transfer gear case.

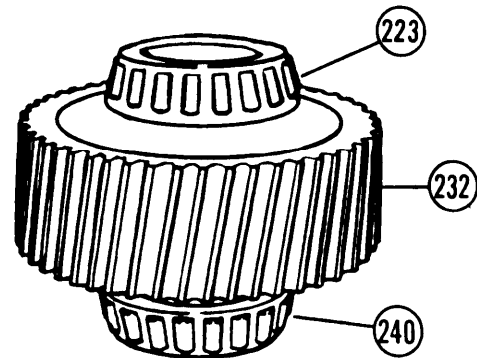
(95) Use a wrench to remove a capscrew (233) and washer (234) from pinion (235).

(96) Use a press to remove race and roller assembly (236), gear (237) and transfer gear case cover (238) from pinion (235).

(97) Use a puller tool to remove race and roller assembly (239) from pinion.

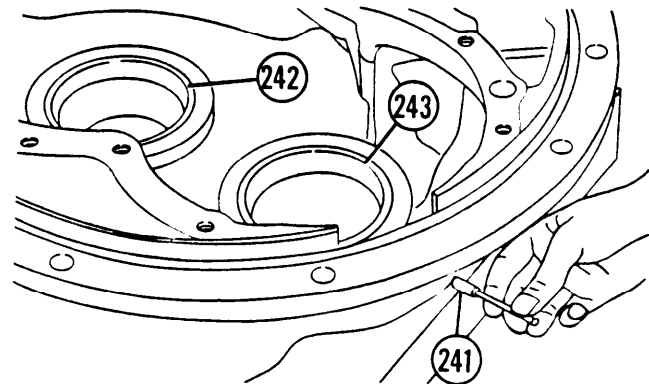


(98) Use a puller tool to remove bearing cones (223 and 240) from gear (232).



(99) Use a #10-32NC capscrew to remove dowel (241) from transfer gear case.

(100) Remove bearing cup (242) and race (243) from transfer gear case.





## 7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

(101) Use a 1/4-20NC X 2-1/2" long capscrew to remove dowel (244) from transfer gear case cover (238). Use a 7/16" NPT bottom tap to remove plug (245).

(102) Remove race (246) from transfer gear case cover.

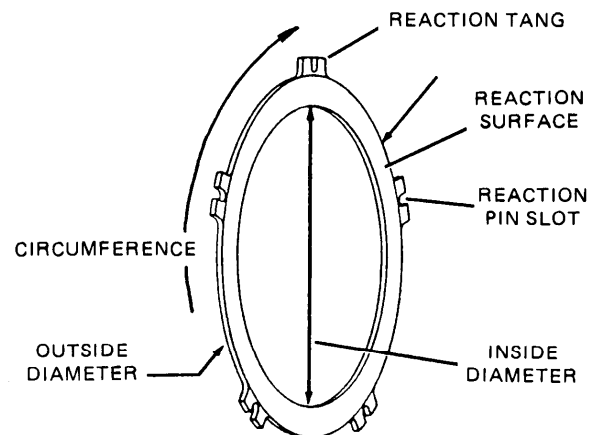
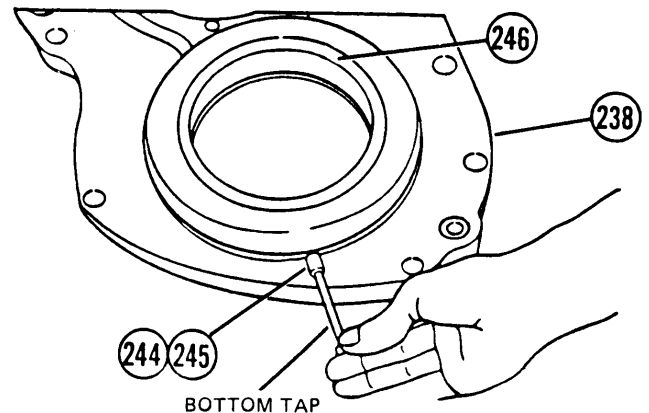
c. Cleaning

Wash all parts in clean solvent and blow dry with pressurized air. See page 2-29.

d. Inspection

(1) Check clutch plates for the following defects and replace if any are visible.

- Clutch plate has a broken reaction tang.
- Clutch plate has a radial crack.
- Measure width of wear in reaction pin slot, maximum permissible wear is 3/16".
- Wear is visible in the bottom of the reaction pin slot.
- Excessive wear is visible on reaction surface. Contact your supervisor for disposition of plate for possible reconditioning.
- Circumferential grooves are visible. Contact your supervisor for disposition of plate for possible reconditioning.

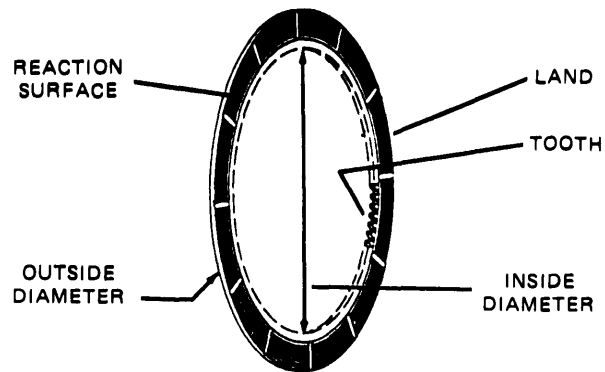


7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

- Clutch plate has a blue black discoloration.
- Clutch plate has light discoloration. Contact your supervisor for disposition of plate for possible reconditioning.
- Clutch plate has high spots (uneven wear).
- Clutch plate reaction surface is heavily smeared. Contact your supervisor for disposition of plate for possible reconditioning.
- Clutch plate reaction surface-has a polished appearance. Contact your supervisor for disposition of plate for possible reconditioning.

(2) Check disc assemblies for the following defects and replace if any are visible.

- Disc assembly is broken.
- Disc assembly is cracked or has deep grooves.
- Disc shows tooth wear.
- Glazed reaction surface. Contact your supervisor for disposition of disc for possible reconditioning.
- Disc assembly shows heavy erosion on reaction surfaces. Light erosion is allowable.
- Disc is chipped on the first and second land of the outside and inside diameter.



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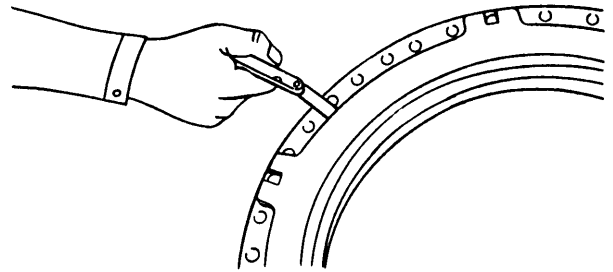
 7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)
 

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- Disc is chipped on the first and second land of outside diameter.

(3) Check for warp on clutch plates and disc assemblies-

- (a) put the plate or disc on a flat surface, like a clutch housing reaction surface, transmission center plate or a surface plate.



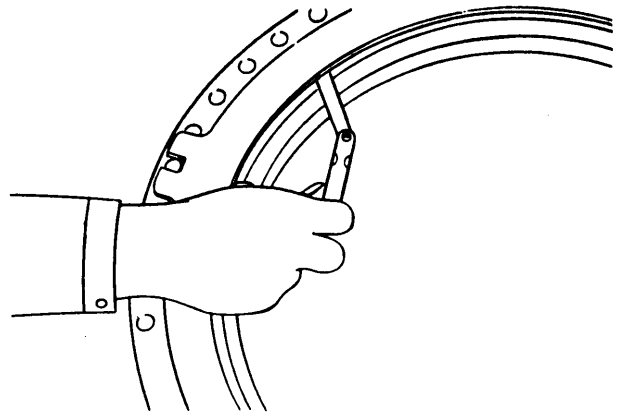
**NOTE**

Remove any rough edges in the area of the reaction pin slot on a clutch plate before flatness is checked.

- (b) Measure the gap between the plate or disc and the inspection surface with a thickness gage around the circumference of the plate or disc. If the gap, at any point around the circumference is more than 0.015 in., the plate or disc cannot be used again.

(4) Check for dish on clutch plates and disc assemblies.

- (a) Measure the gap between the plate or disc and the inspection surface with a thickness gauge at the inside edge of the plate or disc.
- (b) If the gap, at any point is more than 0.005 in., the plate or disc cannot be used again-

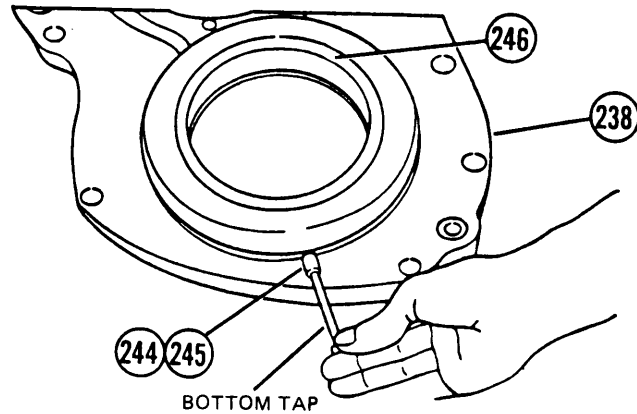


(5) See page 2-32 for general Inspection Instructions.

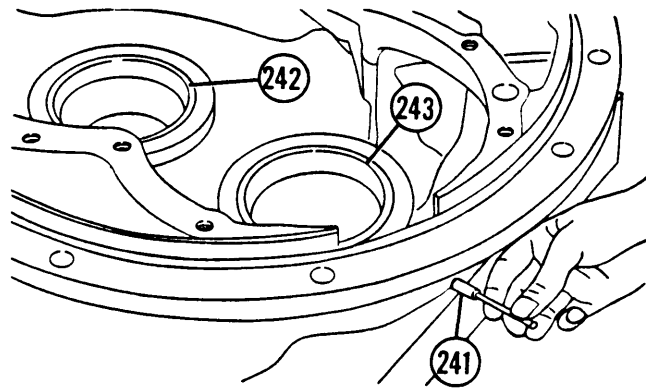
7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

e. Assembly

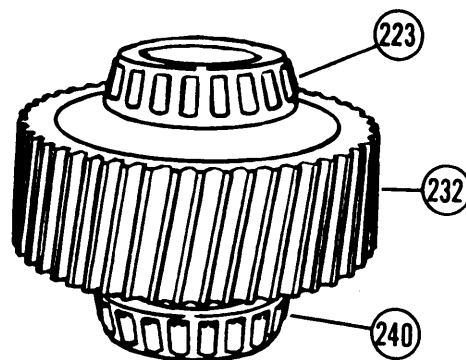
- (1) Lower temperature of race (246) and use driver tools to install it in transfer gear case cover (238). Ensure that hole in race is in alignment with hole in transfer gear case cover.
- (2) Install dowel (244) to retain race (246) in position inside transfer gear case cover. Use a 7/16" NPT bottom tap to install plug (245) over dowel.



- (3) Lower temperature of bearing cup (242) and race (243) and use driver tools to install them in transfer gear case. Ensure that hole in race is in alignment with hole in transfer gear case.
- (4) Use a #10-32NC capscrew to install dowel (241) in transfer gear case.

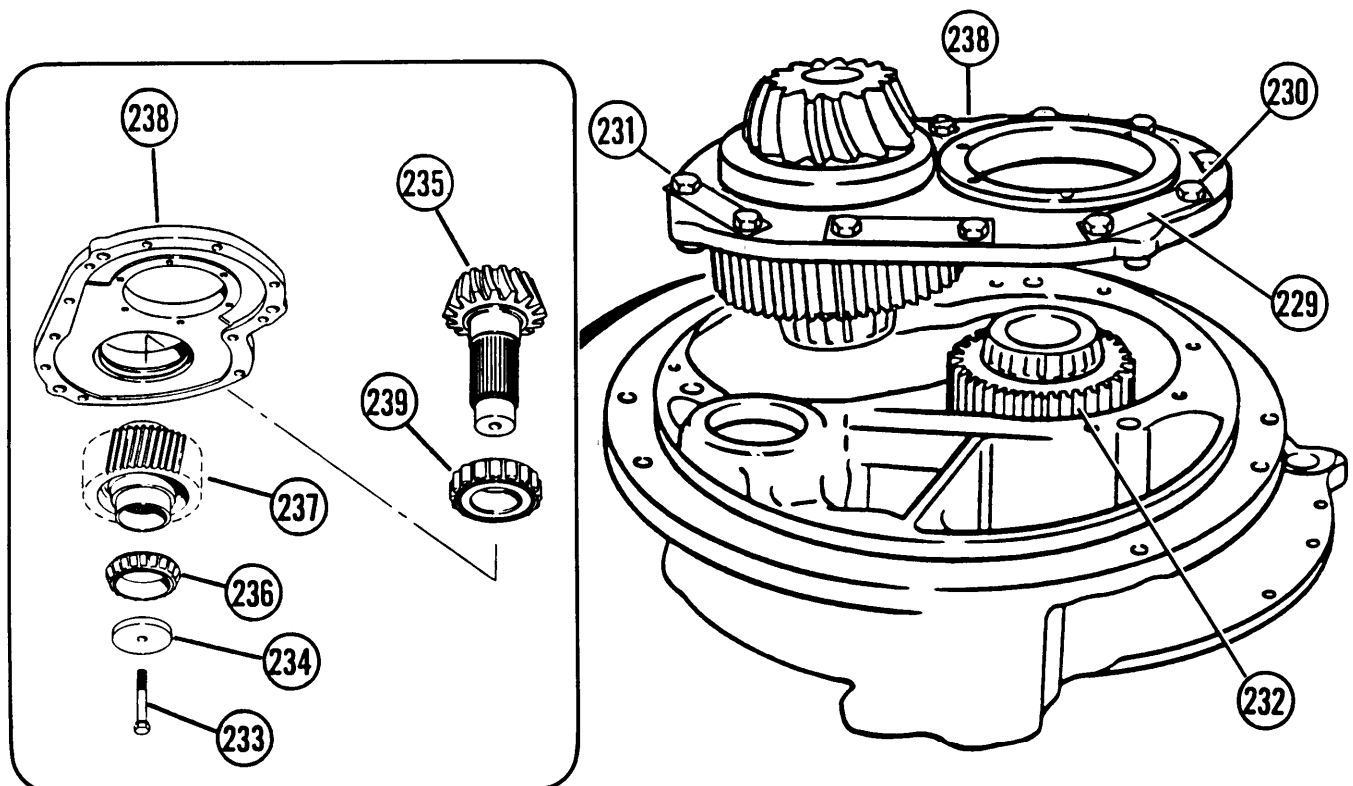


- (5) Heat bearing cones (240 and 223) to a maximum temperature of 275° F. Install bearing cones on gear (232).
- (6) Install gear (232) in transfer gear case.



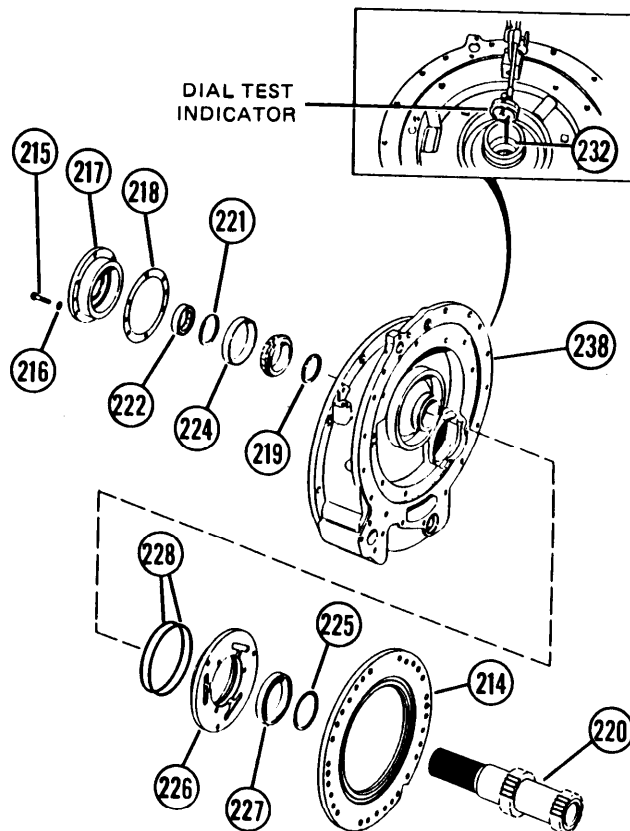
## 7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (7) Heat race and roller assembly (239) to a maximum temperature of 275°F and install on pinion (235).
- (8) Install transfer gear case cover (238) in position over pinion (235).
- (9) Install gear (237) on pinion (235).
- (10) Heat race and roller assembly (236) to a maximum temperature of 275°F. Install race and roller assembly on pinion (235).
- (11) Use a wrench to install a capscrew (233) and washer (234) on pinion. Tighten capscrew to a torque of  $80 \pm 5$  lb. ft.
- (12) Install three 3/8-16NC forged eyebolts or link brackets in case assembly (238). Attach lifting equipment and install cover assembly in position on transfer gear case. The weight of the cover assembly is 80 lbs.
- (13) Use a wrench to install eleven capscrews (230) and six new locks (229) which secure transfer gear case cover (238) to transfer gear case. Bend locks up.



7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (14) Lower temperature of bearing cup (224) and use driver tools to install it in bearing cage (217).
- (15) Lower temperature of race and roller assembly (222) and use driver tools to install it in bearing cage (217).
- (16) Install retaining ring (221) to retain race and roller assembly (222) in place.
- (17) Install original shims (218) and bearing cage (217) on transfer gear case cover (238).
- (18) Use a wrench to install six capscrews (215) and six washers (216) to secure bearing cage (217) to transfer gear case cover. Tighten capscrews to a torque of  $35 \pm 3$  lb. ft.
- (19) Set transfer gear case cover side down.
- (20) Install dial test indicator as shown. Ensure that indicator arm is in contact with gear (232) in transfer gear case. Move gear up and down while checking the end play. The end play must be  $0.046 \pm 0.0026$  in.
- (21) Use a wrench to remove six capscrews (215), six washers (216), bearing cage (217) and shims (218) from transfer gear case cover.
- (22) Lower temperature of bearing (227) and use driver tools to install it in bearing cage (226).
- (23) Install two new rings (228) on bearing cage (226). Put clean oil on rings.



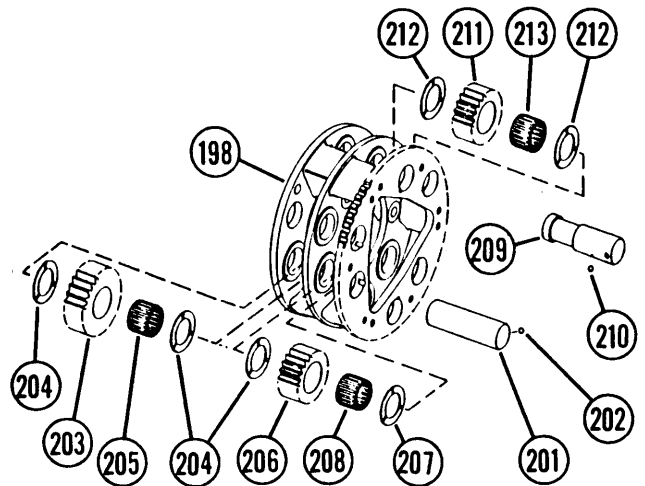
## 7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (24) Install bearing cage (226) in transfer gear case. Ensure that groove in bearing is in alignment.
- (25) Install retaining ring (225) to retain bearing (227) in bearing cage (217).
- (26) Install output shaft (220) in transfer gear case and retain in position with ring (219).
- (27) Install shims (218) and bearing cage (217) on transfer gear case cover (238).
- (28) Use a wrench to install six capscrews (215) and six washers (216) to secure bearing cage (217) to transfer gear cover (238). Tighten capscrews to a torque of  $35 \pm 3$  lb. ft.
- (29) Install plate (214) on transfer gear case.
- (30) Set transfer gear case on a repair stand.
- (31) Set No. 2 carrier (198) on its side.
- (32) Install bearings (213) in gears (211). Put clean oil on bearings.

## NOTE

Ensure that balls (210) are in shafts (209).

- (33) Put three shafts (209) partway in position in No. 2 carrier. Install three gears (211) and six discs (212), one disc on each side of gears in carrier (198) and install shafts through gears into carrier.



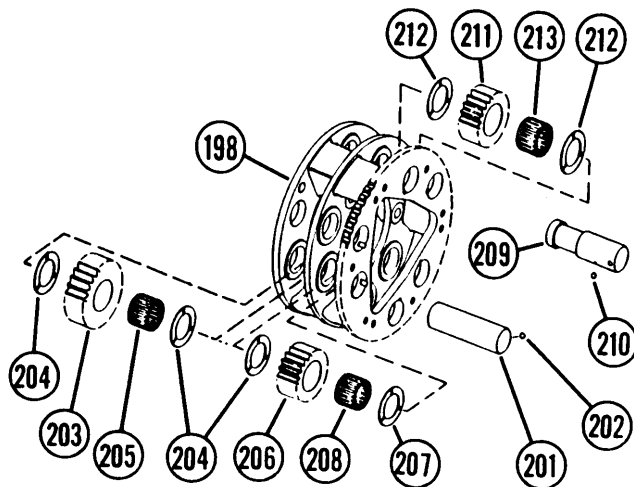
7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (34) Install bearings (208) in gears (206).
- (35) Install bearings (205) in gears (203).

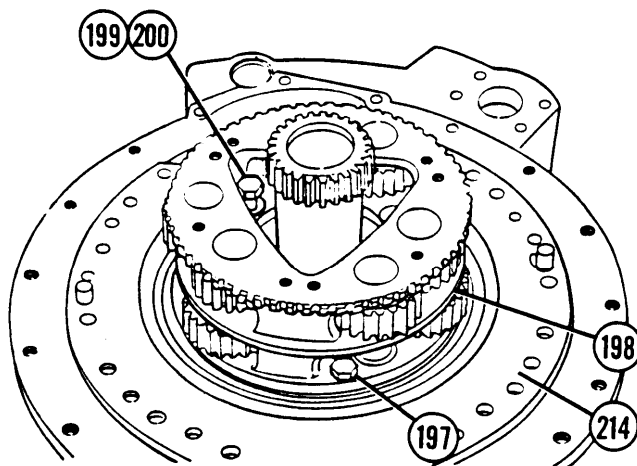
NOTE

Ensure that balls (202) are in shafts (201).

- (36) Put three shafts (201) part way in position in No. 2 carrier. Install six gears (206 and 203), twelve discs (204 and 207), one disc on each side of gears, in carrier and insert shafts through gears into carrier.
- (37) Install two 3/8-16NC forged eyebolts or link brackets in No. 2 carrier (198). Attach lifting equipment and install carrier in position on output shaft. The weight of the No. 2 carrier is 50 lbs.



- (38) Use a bar to prevent No. 2 carrier from turning and use a wrench to install three capscrews (197) to secure carrier (198) to bearing cage.
- (39) Use a bar to prevent No. 2 carrier (198) from turning and use a wrench to install three capscrews (199) and three washers (200) to secure carrier to bearing cage. Tighten capscrews to a torque of  $85 \pm 5$  lb. ft.





7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont' d)

- (40) Install ring gear (195) and ten springs (193).

NOTE

A clutch disc has a friction material on both sides. A clutch plate is a smooth plate that does not have friction material on either side. Put clean oil on all clutch discs and clutch plates before assembly.

- (41) Install two clutch discs (194) and a clutch plate (196) on transfer gear case. Start and end with a clutch disc.
- (42) Install a new ring (192) on No. 4 and No. 5 pistons (190). Put clean oil on rings.
- (43) Install two new rings (191) in No. 4 and No. 5 clutch housing (183). Put clean oil on rings.

- (44) Install No. 5 piston (190) in No. 4 and No. 5 clutch housing (183).

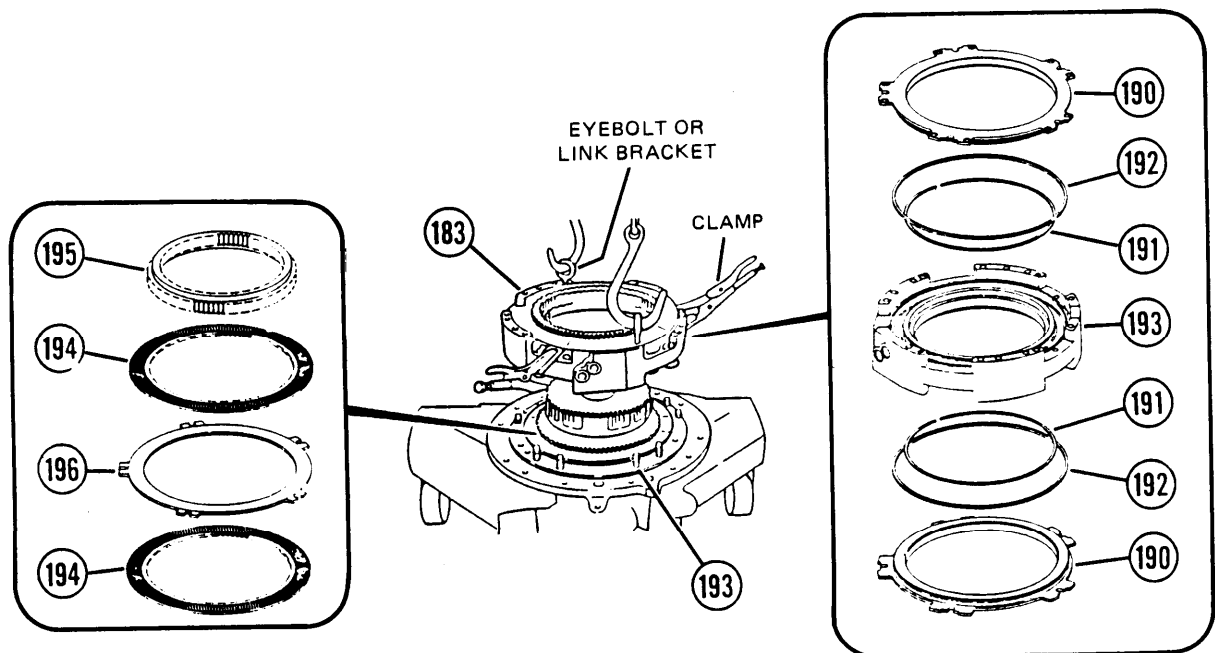
- (45) Install two clamps so No. 5 piston will not fall out. Turn No. 4 and No. 5 clutch housing (183) over.

- (46) Install two 1/2-13NC forged eyebolts or link brackets in No. 4 and No. 5 clutch housing (183). Attach lifting equipment and install clutch housing in position. The weight of the No. 4 and No. 5 clutch housing is 100 lbs. Remove two clamps.

- (47) Install No. 4 piston (190) in No. 4 and No. 5 clutch housing (183).

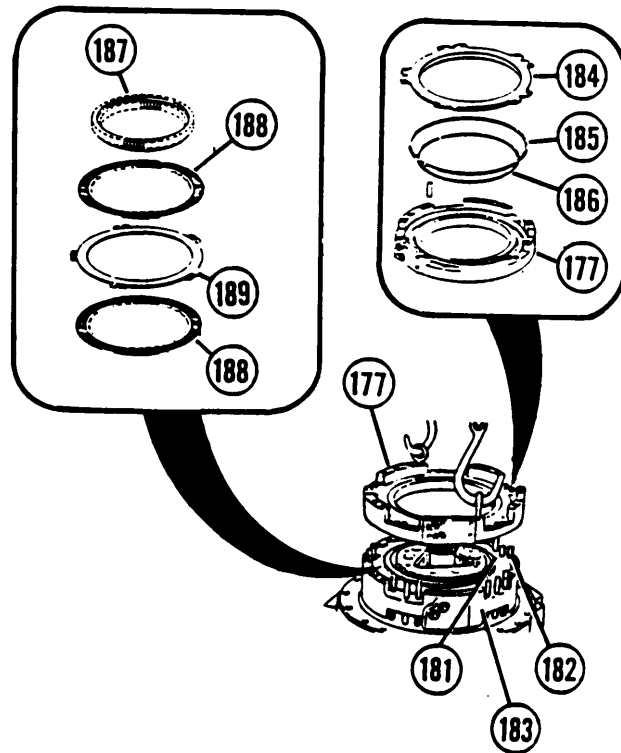
NOTE

Ensure that springs (193) align with recess in No. 4 piston.



7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

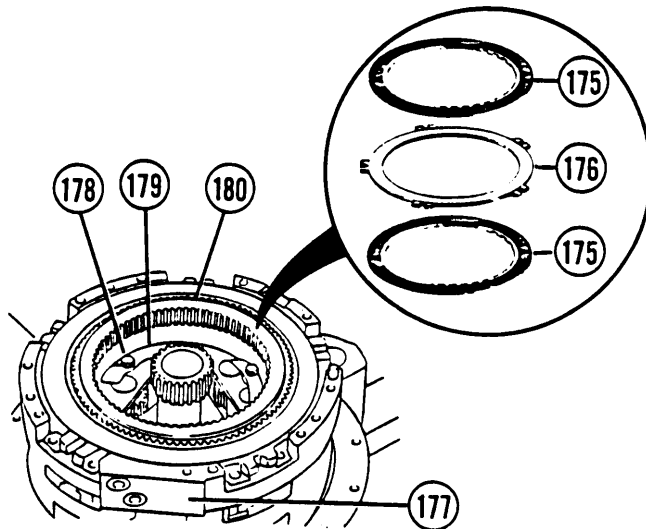
- (48) Install ring gear (187).
- (49) Install two clutch discs (188) and a clutch plate (189) in No. 4 and No. 5 clutch housing (183). Start and end with a clutch disc.
- (50) Install two new rings (186 and 185) on No. 3 clutch housing (177) and No. 3 piston (184). Put clean oil on rings.
- (51) Install piston (184) in No. 3 clutch housing.
- (52) Install ten springs (182) and five pins (181) in No. 4 and No. 5 clutch housing (183).
- (53) Install two 1/2-13NC forged eyebolts or link brackets in No. 3 clutch housing (177). Attach lifting equipment and install clutch in position on springs (182) and pins (181). The weight of the clutch is 80 lbs.



NOTE

Ensure that springs align with recess in No. 3 clutch housing.

- (54) Install ring gear (180).
- (55) Use a wrench to install nine capscrews (178) and three plates (179) which secure ring gear (180) to No. 2 carrier. Tighten capscrews to a torque of  $85 \pm 5$  lb. ft.
- (56) Install two clutch discs (175) and a clutch plate (176) in No. 3 clutch housing (177). Start and end up with a clutch disc.



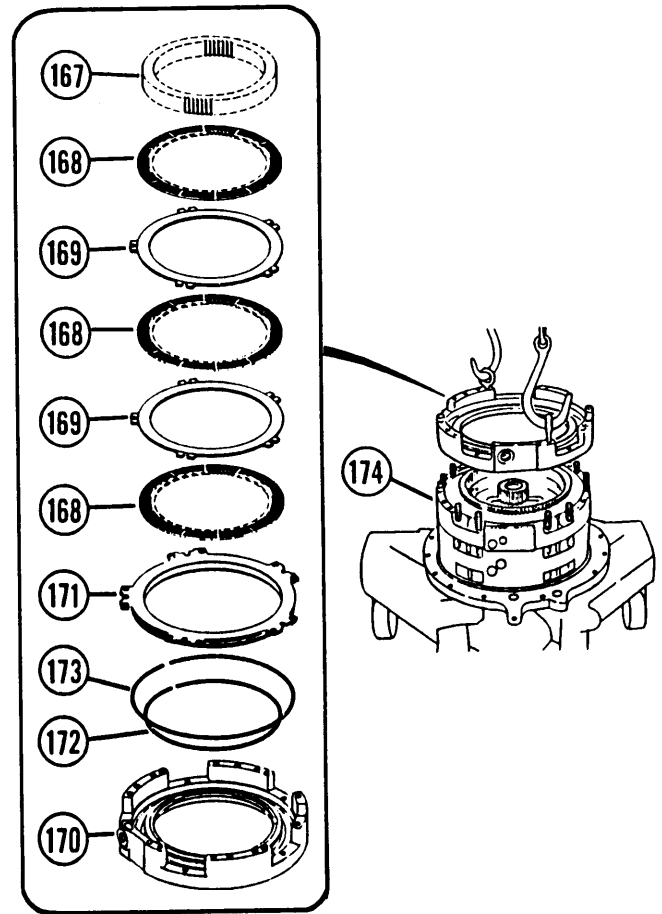
7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (57) Install a new seal (173) and a new ring (172) on No. 2 piston (171) and No. 2 clutch housing (170). Put clean oil on seal and ring.
- (58) Install piston (171) in No. 2 clutch housing.
- (59) Install ten springs (174).
- (60) Install two 1/2-13NC forged eyebolts or link brackets in No. 2 clutch housing (170). Attach lifting equipment to install clutch housing in position on springs. The weight of the clutch housing is 75 lbs.

**NOTE**

Ensure that springs (174) align with recess in No. 2 clutch housing.

- (61) Install ring gear (167).
- (62) Install three clutch discs (168) and two clutch plates (169) in No. 2 clutch housing. Start and end up with a clutch disc.
- (63) Install two 1/2 in. eyebolts to install plate in position on No. 2 clutch housing (170).



7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont' d)

- (64) Lower temperature of race and roller assembly (166). Use driver tools to install race and roller assembly in No. 1 carrier (150).
- (65) Install bearings (165) in six gears (163 and 162).
- (66) Install three tubes (161) in three shafts (159).

NOTE

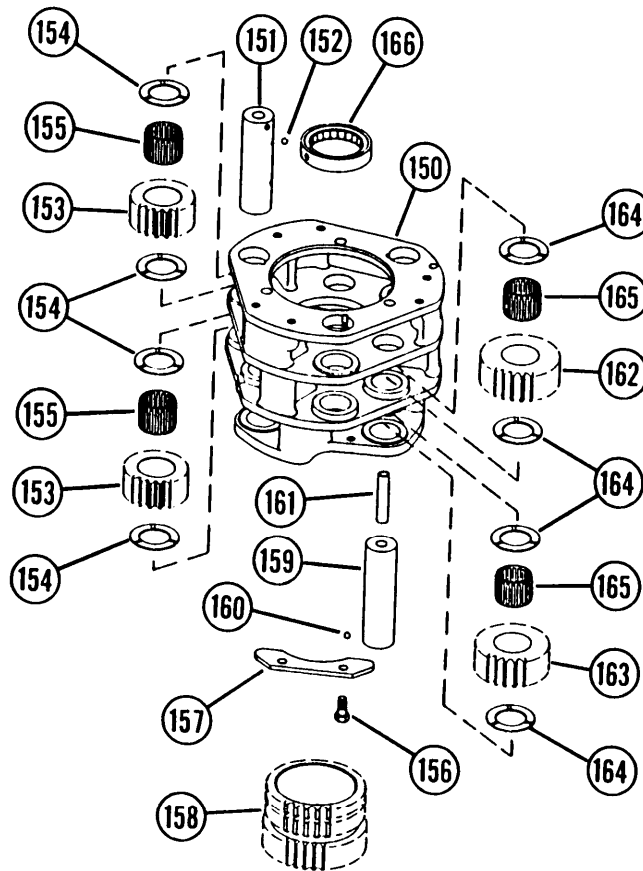
Ensure that balls (160) are in shafts (159).

- (67) put shafts (159) in position in No. 1 carrier. Install balls (160) in shafts.
- (68) Put six gears (163 and 162) and twelve discs (164), one on each side of gears, in position in No. 1 carrier. Install shafts (159) through gears and into No. 1 carrier.
- (69) Install gear (158) in No. 1 carrier. Use a wrench to install six capscrews (156) and three plates (157) that hold gear in place.

NOTE

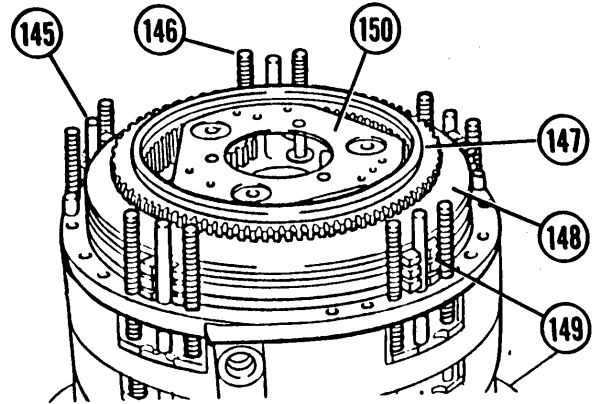
Ensure that balls (152) are in shafts (151).

- (70) Put three shafts (151) in position in No. 1 carrier. Install balls (152) in shafts.
- (71) Install six bearings (155) in six gears (153).
- (72) Install six gears (153) and twelve discs (154), one on each side of gears, in position in No. 1 carrier. Install three shafts (151) through gears and into No. 1 carrier.

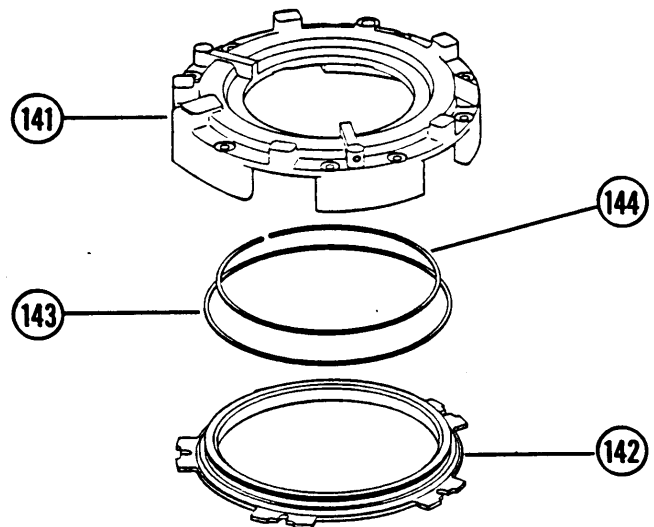


7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (73) Install three 3/8"-16NC forged eyebolts or link brackets in No. 1 carrier (150). Attach lifting equipment and install carrier. The weight of the carrier is 70 lbs.
- (74) Install ring gear (147).
- (75) Install ten springs (146).
- (76) Install five pins (145).
- (77) Install four clutch discs (148) and three clutch plates (149). Start and end up with a clutch disc.



- (78) Turn No. 1 clutch housing upside down and install two new rings (144 and 143), one on the No. 1 piston (142) and one on the No. 1 clutch housing (141). Put clean oil on rings.
- (79) Install No. 1 piston (142) in No. 1 clutch housing.
- (80) Install two clamps to retain No. 1 piston (142) in No. 1 clutch housing (141).
- (81) Turn No. 1 clutch housing right side up and install two 1/2"-13NC forged eyebolts or link brackets. Attach lifting equipment and install clutch housing (141) and piston as a unit. The weight of the unit is 55 lbs.



NOTE

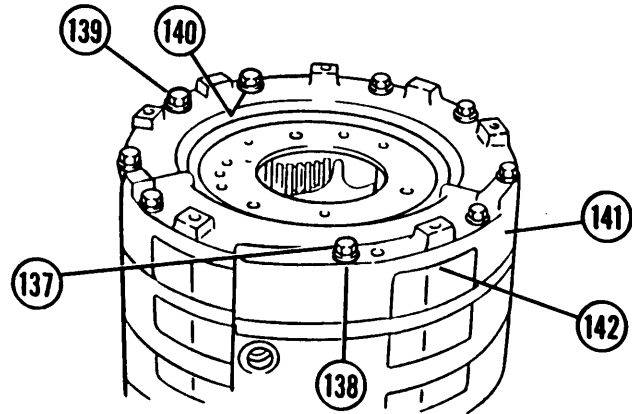
Ensure that springs align with recess in No. 1 piston.

7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont' d)

NOTE

Two capscrews (139) that hold clutch housing together are slightly shorter in length and heads are marked 'X'. These capscrews are located at the openings for manifold that is on outside of transmission.

(82) Use a wrench to install two short capscrews (139) and two washers (140) in marked holes of No. 1 clutch housing (141). The capscrews hold clutch housings together. Tighten capscrews to a torque of  $85 \pm 5$  lbs.

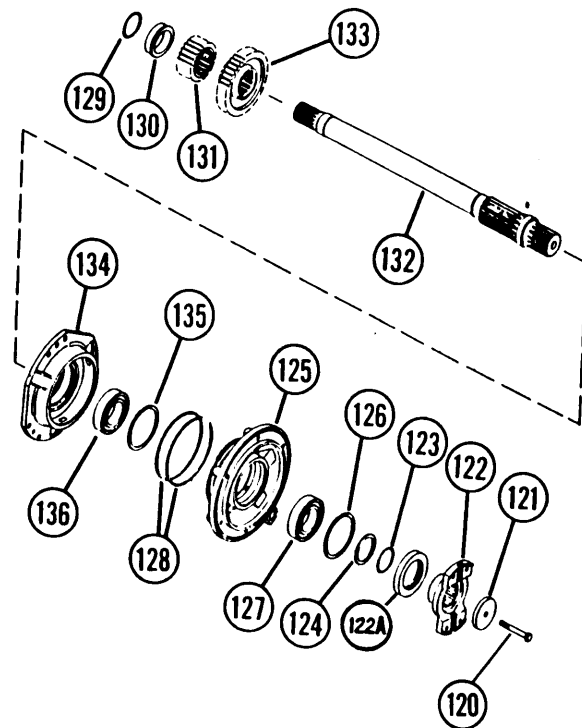


(83) Use a wrench to install seven long capscrews (137) and seven washers (138) which secure clutch housings together. Tighten capscrews to a torque of  $85 \pm 5$  lb. ft.

(84) Lower temperature of bearing (136) and use driver tools to install bearing in bearing cage (134).

(85) Install snap ring (135) to retain bearing in bearing cage.

(86) Slide input shaft (132) through bearing and bearing cage (134). Use a soft faced hammer to install input shaft through bearing.



(87) Slide two gears (133 and 131) on input shaft.

(88) Heat inner bearing race (130 to a maximum temperature of  $275^{\circ}\text{F}$  and install it on input shaft with machined shoulder of race toward gear (131).

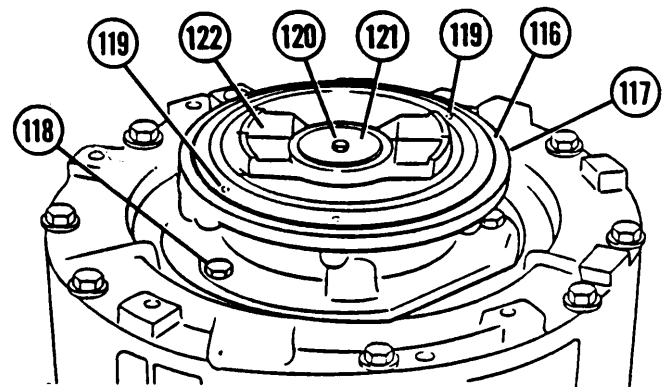
(89) Use snap ring pliers to install retaining ring (129) on input shaft.

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 7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont' d)
 

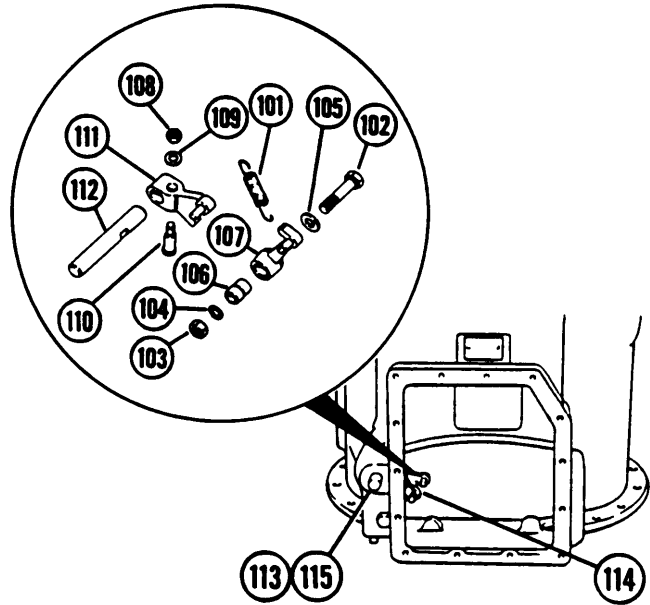
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- (90) Lower temperature of bearing (127) and use driver tools to install bearing in bearing cage (125).
- (91) Install two new rings (128) on bearing cage (125).
- (92) Use snap ring pliers to install snap ring (126) and retain bearing (124) in place.
- (93) Install bearing cage (125) on input shaft and in bearing cage (134).
- (94) Install spacer (124) and use snap ring pliers to install retaining ring (123) to retain bearing cage (125) to input shaft.
- (95) Use a seal guide tool to install seal (122A) in bearing cage (125) until it makes contact with shoulder in bearing cage. Ensure that lip of seal is toward inside. Lubricate seal lightly.
- (96) Install flange (122), washer (121) and capscrew (120). Use a wrench to tighten capscrew to a torque of  $40 \pm 5$  lb. ft.
- (97) Install two 3/8-16NC forged eyebolts or link brackets in bearing cage. Attach lifting equipment and install bearing cage and input shaft as a unit. The weight of the unit is 60 lbs.
- (98) Use a wrench to install six capscrews (118) which secure input shaft bearing cage (117) to carrier.
- (99) Install a new seal (116) on bearing cage (117).

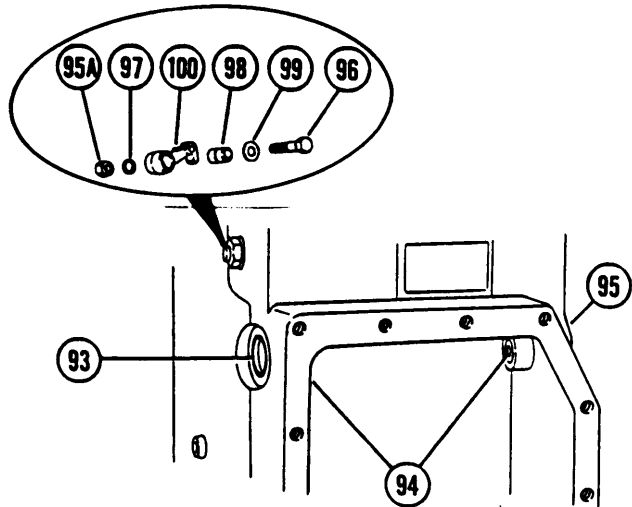


7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (100) Install lip-type seals (113 and 114) and one bearing (115) in transmission case.
- (101) Install shaft (112) part way in transmission case.
- (102) Install cam (111) on shaft (112) and install shaft into bearing in transmission case.
- (103) Install pin (110) in cam (111). Use a wrench to install washer (109) and nut (108).
- (104) Use two wrenches to install detent lever (107), sleeve (106), capscrew (102), nut (103), lockwasher (104) and washer (105).



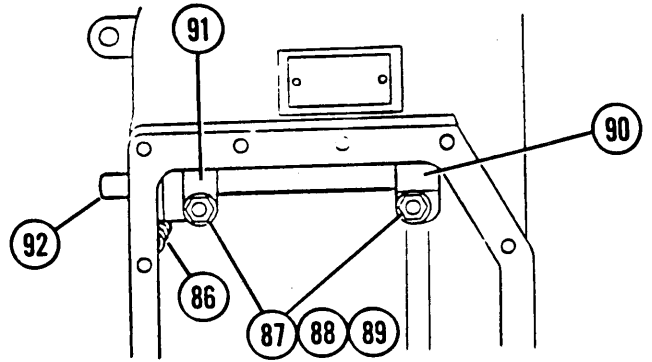
- (105) Install spring (101) on detent assembly.
- (106) Install bearings (94) and seal (93) in transmission case.
- (107) Use two wrenches to install lever (100), sleeve (98), washer (99), lockwasher (97), nut (95A) and screw (96).



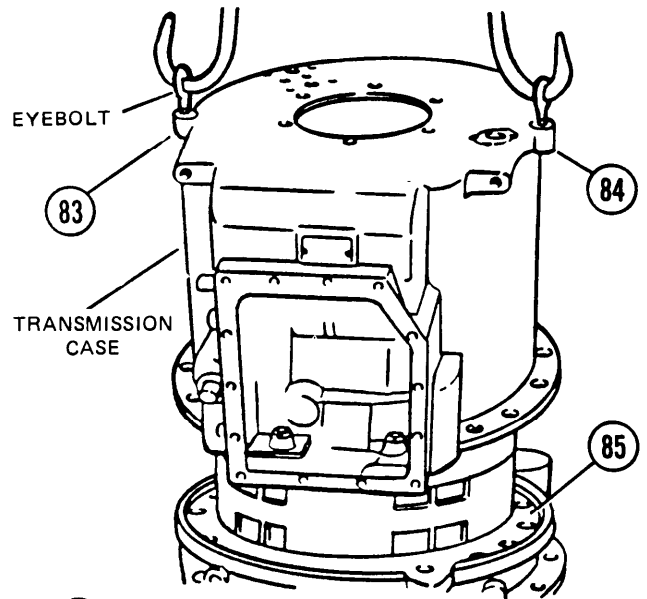


7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

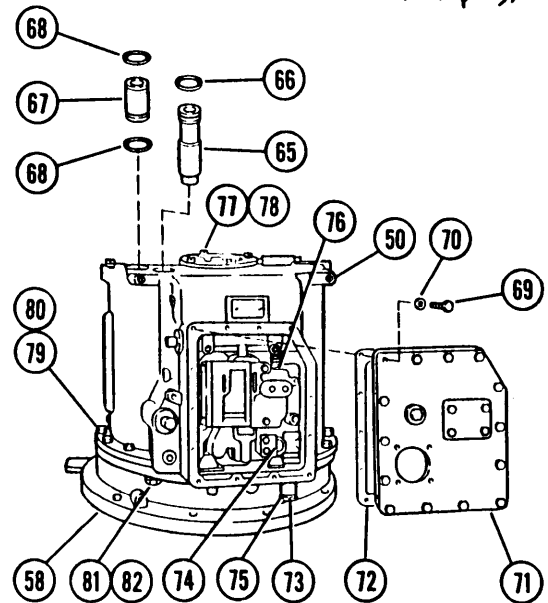
- (108) Install shaft (92) partway through transmission case. Install levers (90 and 91), and insert shaft completely into transmission case.
- (109) Use a wrench to install nuts (87), two washers (88), levers (90 and 91) and pins (89).
- (110) Use a long nose pliers to install spring (86).



- (111) Install gasket (85) between transmission case and transfer gear case.
- (112) Install two forged eyebolts in transmission case bosses (83 and 84). Attach lifting equipment and place transmission case in position on transfer gear case. The weight of transmission case is 140 lbs.

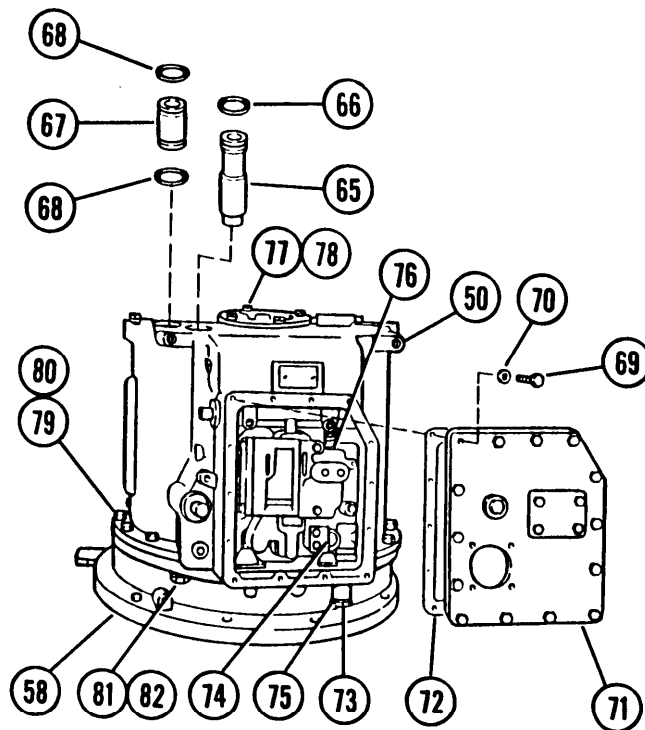


- (113) Use a wrench to install three nuts (81) and lockwashers (82).
- (114) Use a wrench to install fourteen lockwashers (80) and capscrews (79).
- (115) Use a wrench to install six lockwashers (78) and capscrews (77) to secure transmission case (50) to input shaft bearing cage.



7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (116) Install transmission hydraulic control valves (74 and 76).
- (117) Install seals (75) on both ends of sleeve (73). Use a snap ring pliers to install sleeve (73) into selector valve (74).
- (118) Use a wrench to install fourteen lockwashers (70), capscrews (69), cover (71) and gasket (72) to transmission case (50).
- (119) Install two seals (68) on sleeve (67), and seal (66) on sleeve (65). Install sleeves (67 and 65) in transmission case.



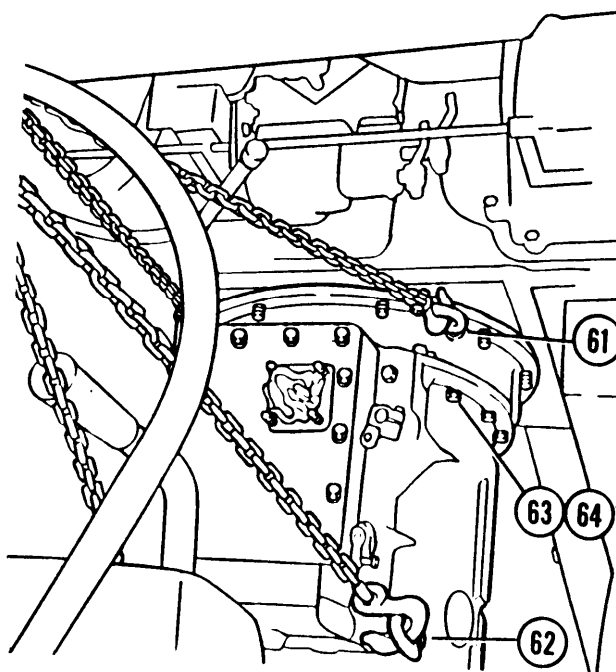
f. Installation

- (1) Install two 5/8 in. lifting eyes or link brackets to transmission case bosses (61), and two more on transfer gear case bosses (62).
- (2) Install a new gasket between transfer gear case and bevel gear case.

**CAUTION**

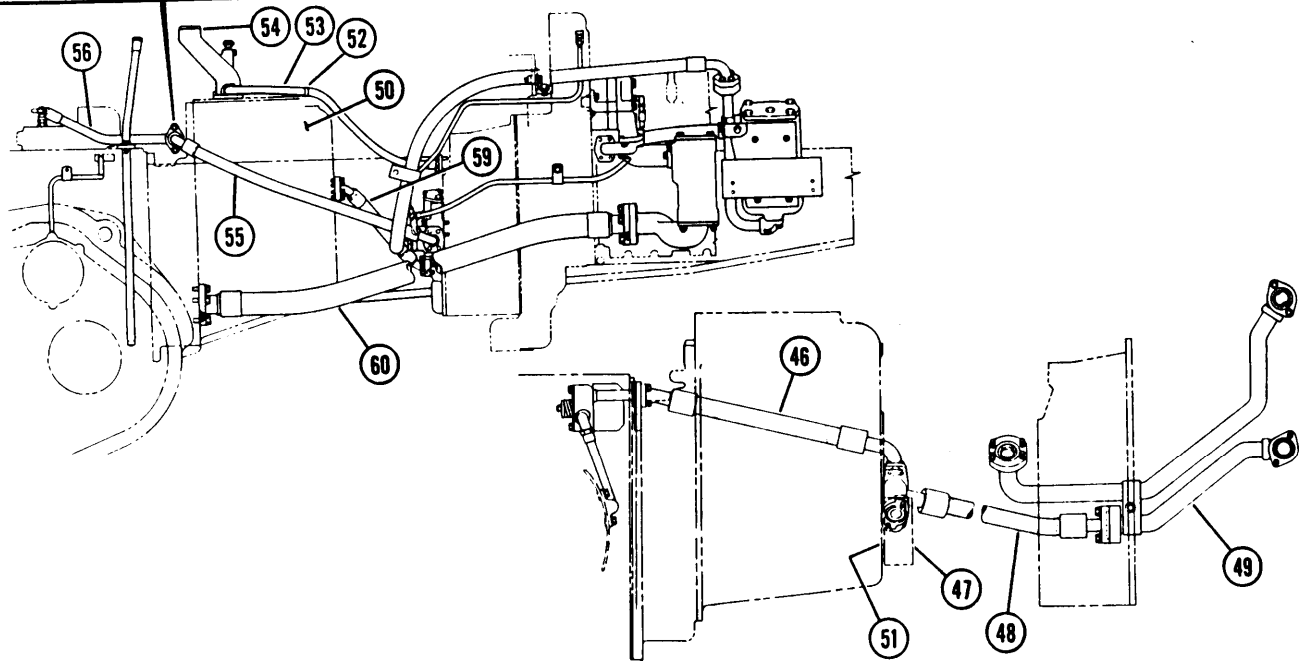
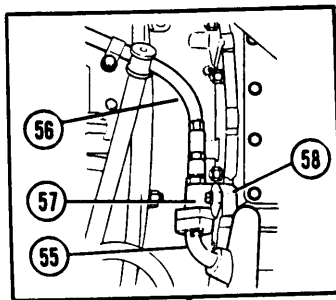
Transmission assembly must be lifted so locator studs are level. This prevents binding and damage to bottom locator studs.

- (3) Attach lifting equipment to lifting eyes and carefully align transfer gear case with mounting studs on bevel gear case.
- (4) Use a wrench to install ten lockwashers (64) and ten nuts (63).
- (5) Remove lifting eyes.



7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

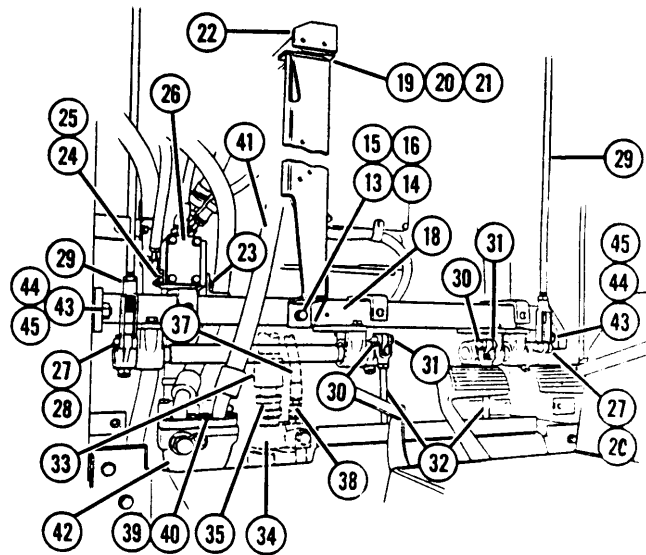
- (6) Use a wrench to install fill pipe (54) and four nuts to top of transmission case.
- (7) Remove cap at end of hose. Use a wrench to install washers, flanges and capscrews that secure hose (60) to transfer gear housing.
- (8) Remove all plugs and caps and use a wrench to install flanges, hose (59), washers and capscrews to transmission and torque divider.
- (9) Remove plugs from hose (55) and hose assembly (56). Use a wrench to install capscrews and washers and connect hose (55) to hose assembly (56).
- (10) Use a wrench to install capscrews, washers, and bracket (57) to transfer gear case (58).
- (11) Remove plug or cap from hose (53). Use a wrench to connect hose (53) to transmission fill tube (54).
- (12) Use a wrench to install capscrews, lockwashers and two clips (52) to hold hose (53) in place.
- (13) Install new gasket (51) to manifold (47). Use a wrench to install four capscrews, lockwashers and manifold (47) with hose (48) to transmission case (50).



- (14) Use a wrench to install flanges, hose (48) and capscrews to tube (49).
- (15) Remove all plugs and use a wrench to install flanges, hose (46) and capscrews to bevel gear case and manifold (47).

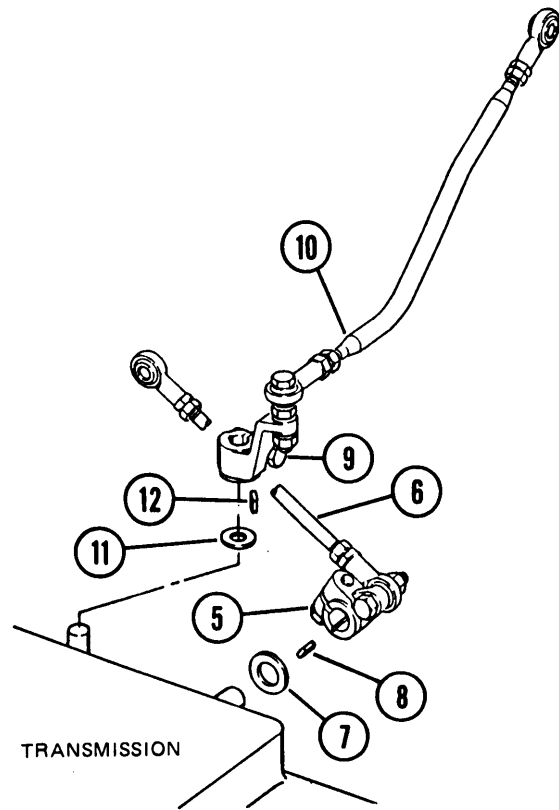
7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont' d)

- (16) Attach lifting equipment to beam (18) and lift into position. Place shims on right side and left side spacer plate in position. Use a wrench to install two capscrews (43), lockwashers (45), and nuts (44) on each side of beam.
- (17) For tractors with ripper, use a wrench to install washers (40), capscrews (39) and hose (41) to manifold (42).
- (18) For tractors equipped with winch, use a wrench to install hose (37) with a new seal (38) on winch gear pump (34). Use a wrench to install hose (33) with new seal (35) to pump (34).
- (19) Attach brake control rods (32) with pins (31) and new cotter pins (30).
- (20) Attach steering brake control rods (29) with pins (28) and new cotter pins (27).
- (21) Place hydraulic pressure control valve (26) in position on beam (18). Use two wrenches to install two flat washers (24), two capscrews (23) and two nuts (25).
- (22) place support (17) in position on beam (18) and support (22). Use two wrenches to install two capscrews (19), lockwashers (20) and two nuts (21) to supports (17 and 22).
- (23) Use two wrenches to install capscrew (13), nut (14), lockwasher (15) and washer (16) to support (17) and beam (18).



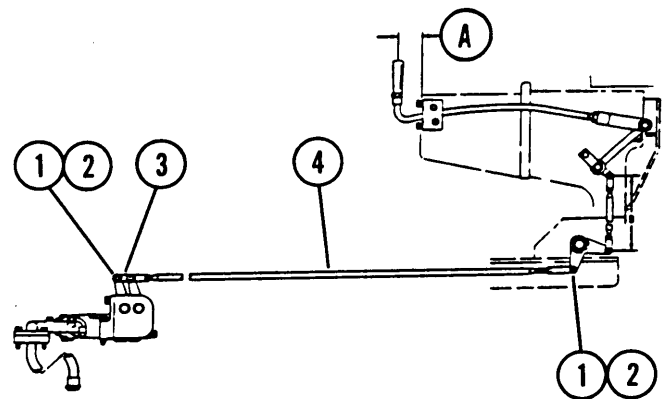
7-5. TRANSMISSION ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (24) Slide washers (7 and 11) and rod assemblies (6 and 10) on posts on transmission. Make sure keys (8 and 12) are seated properly. Tighten capscrews (5 and 9).
- (25) Attach steering clutch control rods (3 and 4) with pins (2) and new cotter pins (1).
- (26) Fill transmission with oil. See TM5-2410-237-20.
- (27) Install drive shaft. See TM5-2410-237-20.
- (28) Install rear crankcase guard. See TM5-2410-237-20.
- (29) Install seat assembly. See TM5-2410-237-20.
- (30) Install hydraulic tank mounting brackets and plates. See TM5-2410-237-20.
- (31) Install ROPS or CAB. See TM5-2410-237-20.



g. Place In Service

Run engine and test drive in all speeds.



7-6. TRANSMISSION HYDRAULIC CONTROL VALVES - REPLACE/REPAIR

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning
- d. Inspection
- e. Lubrication
- f. Assembly
- g. Installation
- h. Relief Valve Setting
- i. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Materials/Parts

Gaskets (8), (21)  
Seals (25), (26), (31), (32), (34), (37), (56), (64)  
Hydraulic Oil (Refer to L05-2410-237-12)  
Lubricating Oil OE/HDO-30 (Refer to L05-2410-237-12)

Equipment Condition

NOTE

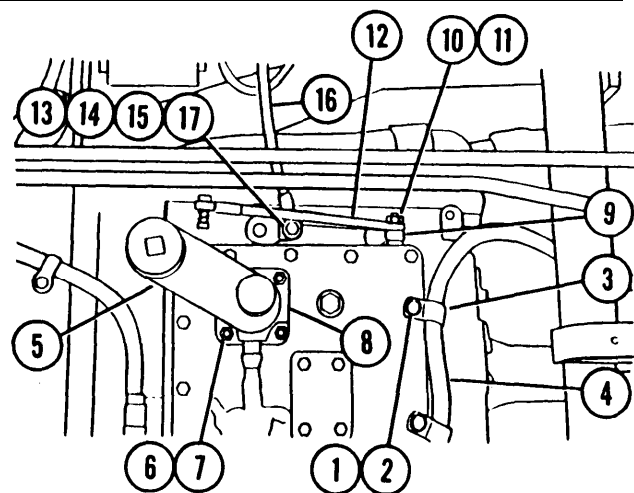
Entire seat assembly does not need to be removed for this procedure. Remove only the seat.  
Seat assembly removed. (TM5-2410-237-20)  
Floor plates removed. (TM5-2410-237-20)

a. Removal

NOTE

The transmission control valves can be removed with transmission in or out of chassis. Proceed to STEPS 6 through 12 if transmission has been removed from chassis.

- (1) Use a wrench to remove two capscrews (1), two lockwashers (2) and two clips (3).



7-6. TRANSMISSION HYDRAULIC CONTROL VALVES - REPLACE/REPAIR (Cont'd)

(2) Use a wrench to disconnect hose assembly (4) from spout (5). Plug end of hose.

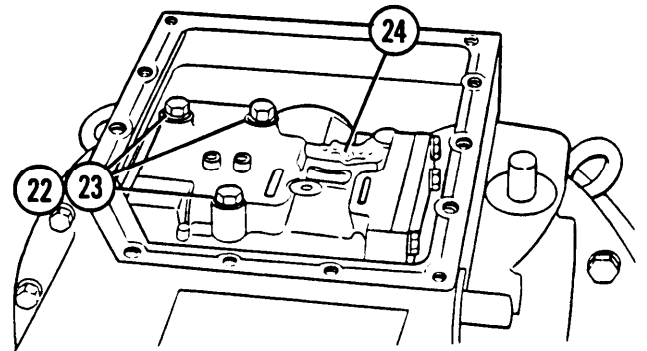
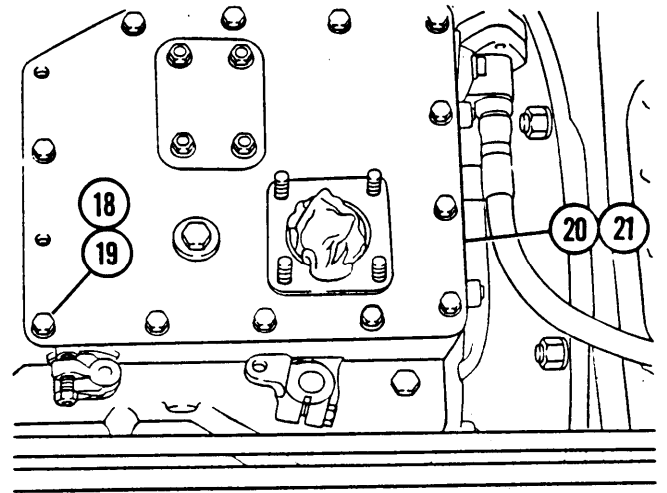
(3) Use a wrench to remove four nuts (6), lockwashers (7) and spout (5). Remove and discard gasket (8).

(4) Use two wrenches to remove capscrew (9), nut (10), lockwasher (11) and disconnect rod (12) from transmission.

(5) Use two wrenches to remove capscrew (13), nut (14), lockwasher (15) and disconnect rod (16) from transmission. Remove nut (17).

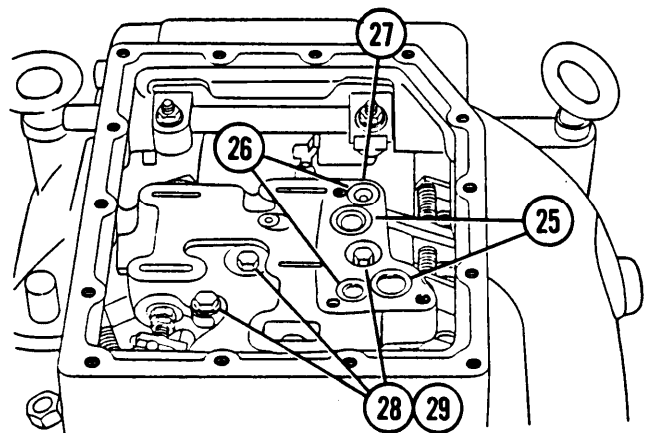
(6) Use a wrench to remove twelve capscrew (18), lockwashers (19) and cover (20). Remove and discard gasket (21).

(7) Use a wrench to remove three capscrews (22), washers (23) and pressure control valve (24) from transmission.



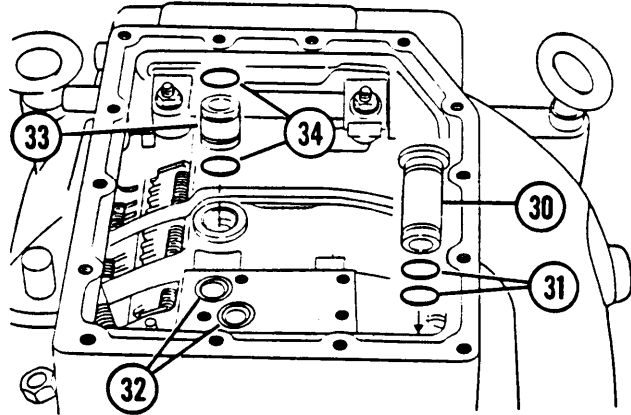
(8) Remove and discard four seals (25 and 26) from top of selector valve (27).

(9) Use a socket to remove three capscrews (28), washers (29) and selector valve.



7-6. TRANSMISSION HYDRAULIC CONTROL VALVES - REPLACE/REPAIR (Cont'd)

- (10) Remove sleeve (30) from transmission. Remove and discard two seals (31) from sleeve.
- (11) Remove and discard two seals (32) |
- (12) Remove three sleeves (33). Remove and discard two seals (34) from each sleeve.

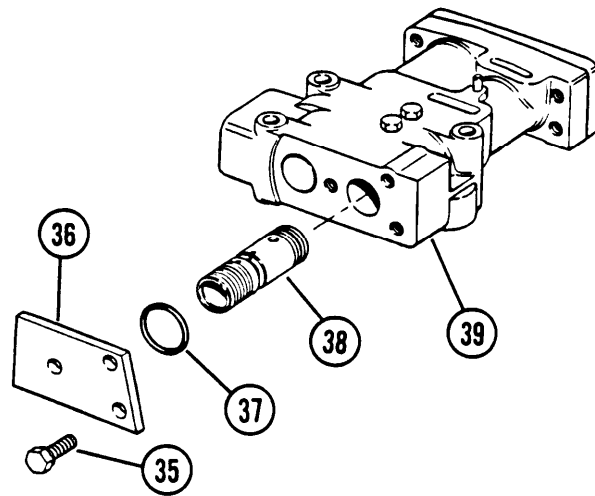


b. Disassembly

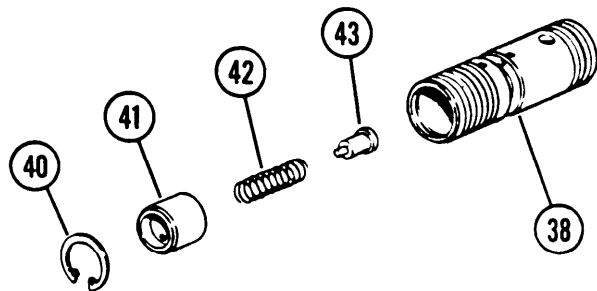
NOTE

Follow STEPS 1 through 11 to disassemble pressure control valve. Follow STEPS 12 through 16 to disassemble selector valve.

- (1) Use a wrench to remove three capscrews (35) and cover (36). Remove and discard seal (37) from cover.
- (2) Remove spool assembly (38) from valve body (39).



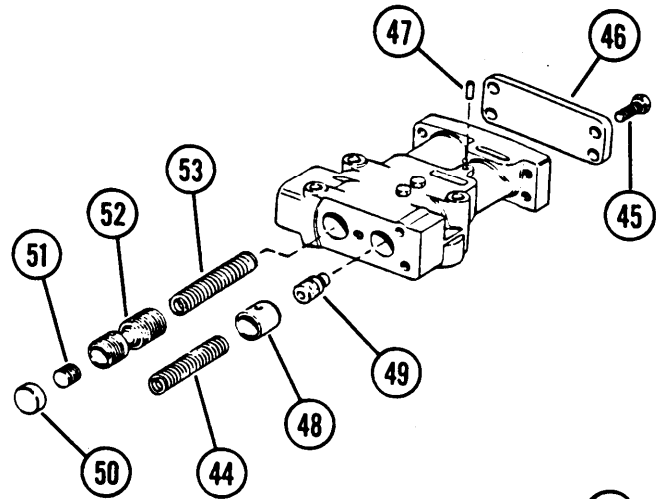
- (3) Use snap ring pliers to remove ring (40). Remove sleeve (41), spring (42) and plunger (43) from SPOOL (38).



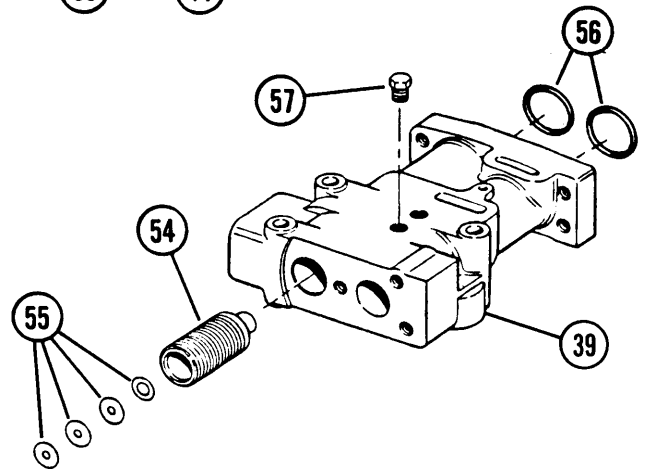


7-6. TRANSMISSION HYDRAULIC CONTROL VALVES - REPLACE/REPAIR (Cont'd)

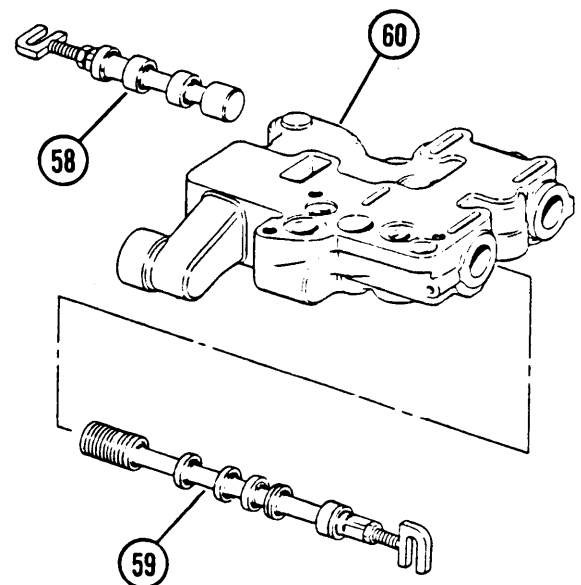
- (4) Remove spring (44).
- (5) Use a wrench to remove four capscrews (45) and cover (46).
- (6) If necessary, use a hammer and punch to remove two dowels (47) and one retainer (48).
- (7) Remove valve (49).
- (8) Remove stop (50), slug (51), spool (52) and spring (53) from valve body.



- (9) Remove piston (54) and spacers (55) from valve body (39).
- (10) Remove and discard two seals (56).
- (11) If necessary, use a wrench to remove two plugs (57).



- (12) Remove directional selector valve spool (58) and speed selector valve spool (59) from selector valve body (60).

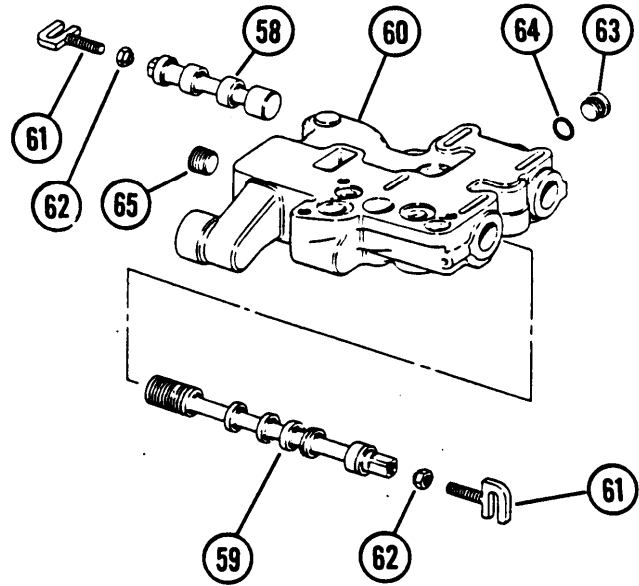


7-6. TRANSMISSION HYDRAULIC CONTROL VALVES - REPLACE/REPAIR (Cont'd)

(13) If replacement is necessary, remove two links (61) and use a wrench to remove two nuts (62) from spools (58 and 59).

(14) Use an allen wrench to remove plug (63). Remove and discard seal (64) from plug.

(15) Use a wrench to remove two plugs (65) |



c. Cleaning

Clean all parts with appropriate solvent. See page 2-29.

d. Inspection

See page 2-32 for general Inspection Instructions.

e. Lubrication

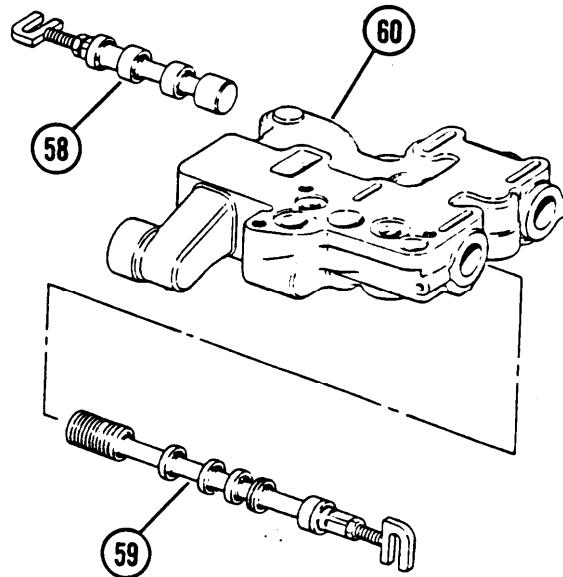
Put clean hydraulic oil on all parts at assembly.

f. Assembly

NOTE

Follow STEPS 1 through 4 to assemble selector valve. Follow STEPS 1 and 5 through 15 to assemble pressure control valve.

- (1) Use a wrench to install two plugs (65).
- (2) Install new seal (64) onto plug (63). Use an allen wrench to install plug.
- (3) If replacement was necessary use a wrench to install nuts (62) onto links (61) and secure to spools (58 and 59).



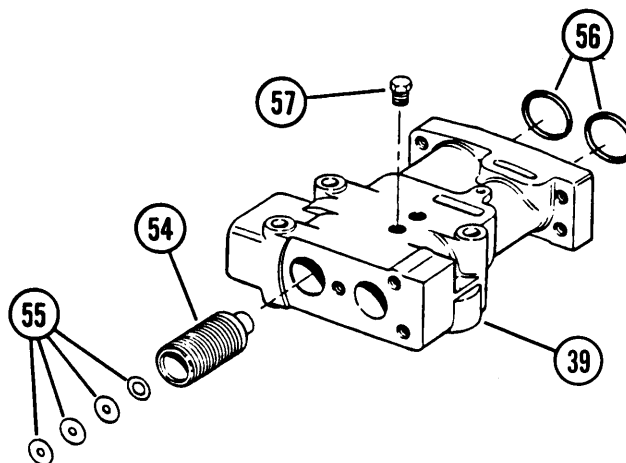
7-6. TRANSMISSION HYDRAULIC CONTROL VALVES - REPLACE/REPAIR (Cont'd)

(4) Install speed selector valve spool (59) and directional selector valve spool (58) into selector valve body (60).

(5) If two plugs (57) were removed, use a wrench to install them.

(6) Install two new seals (56).

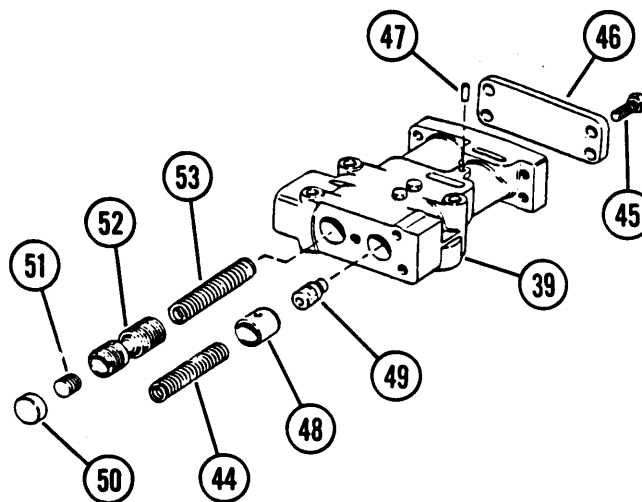
(7) Install spacers (55) inside piston (54). Use the same number and size as were removed from the valve. Spacers may have to be changed after installation to adjust relief setting. Install piston into valve body (39).



(8) Install spring (53), spool (52), slug (51) and stop (50) into valve body.

(9) Install valve (49).

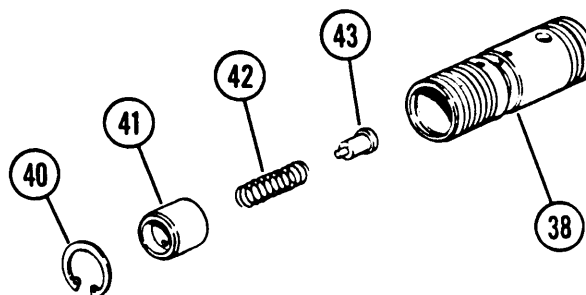
(10) If retainer (48) was removed, install it with large inside diameter toward spring (44). Install two dowels (47) to hold retainer. The dowels must not extend into spring bore of retainer.



(11) Install cover (46) and secure with four cap screws (45) by using a wrench. Tighten to torque of 35+3 lb. ft.

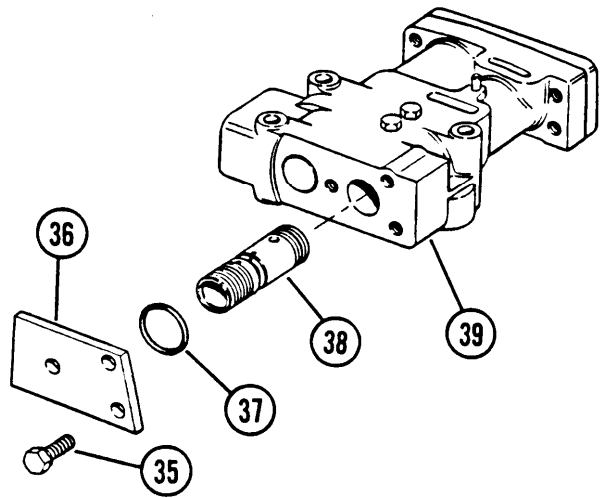
(12) Install spring (44).

(13) Install plunger (43), spring (42) and sleeve (41) into spool (38). Use a snap ring pliers to install ring (40) to secure parts inside spool.



7-6. TRANSMISSION HYDRAULIC CONTROL VALVES - REPLACE/REPAIR (Cont'd)

- (14) Install spool assembly (38) into valve body (39).
- (15) Install new seal (37) into cover (36). Install cover and secure with three capscrews (35) by using a wrench. Tighten to torque of  $35 \pm 3$  lb. ft.

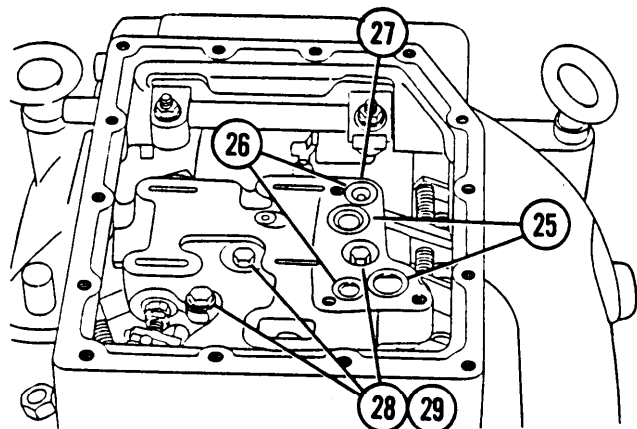
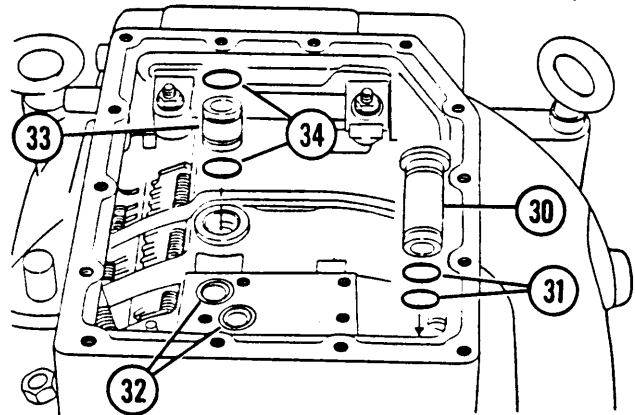


9\* Installation

NOTE

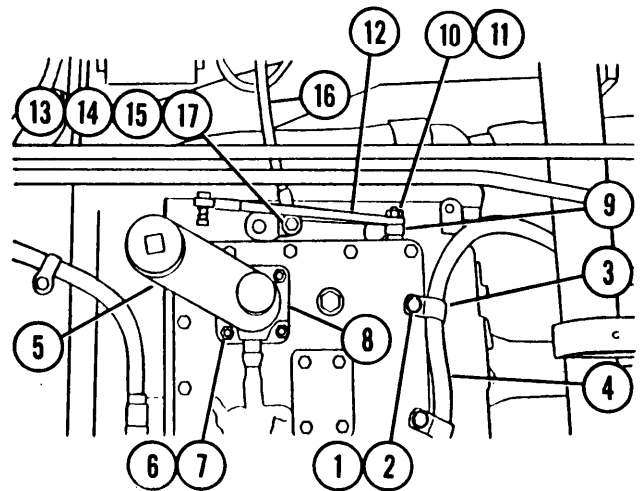
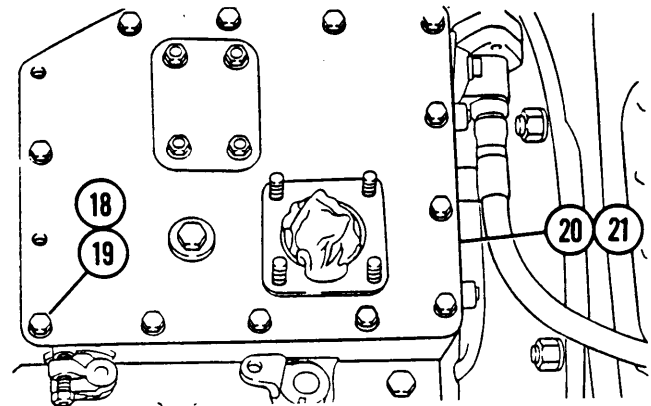
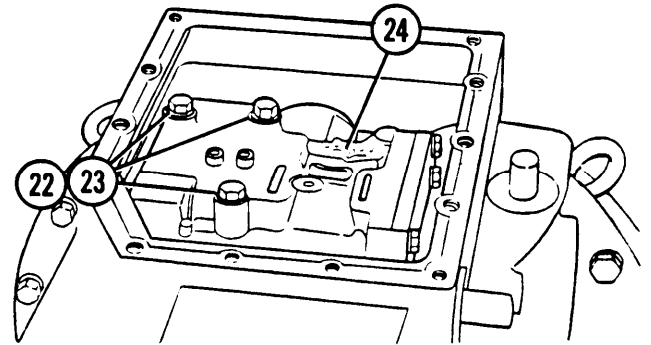
The transmission control valves can be installed with transmission in or out of chassis. Follow STEPS 1 through 9 if transmission was removed from chassis.

- (1) Inspect all parts for damage and replace if necessary. Put clean oil on parts at installation.
- (2) Install two new seals (34) onto each sleeve (33). Install three sleeves into transmission.
- (3) Install two new seals (32).
- (4) Install two new seals (31) onto sleeve (30). Install sleeve in transmission.
- (5) Install selector valve (27) into position in transmission. Ensure that sleeves align with holes in selector valve and that links on ends of valve spools are in position on control levers.
- (6) Use a socket to install three capscrews (28) and washers (29) into selector valve. Tighten to torque of  $35 \pm 3$  lb. ft.
- (7) Install four new seals (25 and 26) into top of selector valve.



## 7-6. TRANSMISSION HYDRAULIC CONTROL VALVES - REPLACE/REPAIR (Cont'd)

- (8) Install pressure control valve (24) in position on top of selector valve. Use a wrench to install three capscrews (22) and washers (23) which secure pressure control valve inside transmission. Tighten to torque of  $35 \pm 3$  lb. ft. Refer to TM5-2410-237-20 for control valve adjustment.
- (9) Install new gasket (21) and cover (20). Use a wrench to install fourteen capscrews (18) and lockwashers (19).
- (10) Install nut (17) and rod (16). Use two wrenches to install capscrew (13), lockwasher (15) and nut (14).
- (11) Install rod (12) onto transmission. Use two wrenches to install capscrew (9), lockwasher (11) and nut (10).
- (12) Adjustment of rods (12 and 16) may be necessary. See TM5-2410-237-20.
- (13) Install new gasket (8) with spout (5). Use a wrench to install four nuts (6) and lockwashers (7) which secure spout.
- (14) Remove plug from end of hose assembly (4). Use a wrench to connect hose to spout (5).
- (15) Install two clips (3). Use a wrench to install two capscrews (1) and two lockwashers (2) which secure hose in clip to transmission.
- (16) Check relief valve setting, para. h.
- (17) Install seat assembly. See TM5-2410-237-20.



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7-6. **TRANSMISSION HYDRAULIC CONTROL VALVES - REPLACE/REPAIR (Cont'd)**

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(18) Install floor plates. See TM5-2410-237-20.

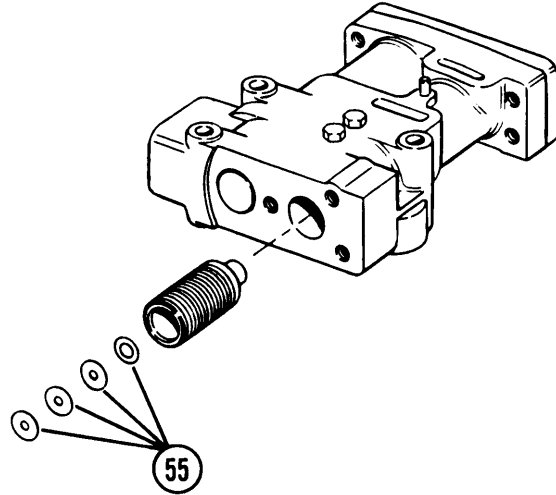
h. Relief Valve Setting

(1) Perform direction clutch tests (primary setting) (page 7-98).

(2) Add or remove spacers (55) in the pressure control valve if required to adjust setting:

(a) Each 0.036" spacer will change setting by 11 psi.

(b) Each 0.010" spacer will change setting by 3 psi.



i. Place In Service

Run engine and test drive in all speeds.

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## 7-7. TRANSMISSION OIL PUMP - TEST/REPLACE/REPAIR

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This task covers:

- a. Removal
  - b. Disassembly
  - c. Cleaning
  - d. Inspection
  - e. Lubrication
  - f. Assembly
  - g. Installation
  - h. Test
- 

### INITIAL SETUP

#### Applicable Configurations

All

#### Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

#### Materials/Parts

Preformed packing (18), (28), (29)  
Seal (37), (39), (34)  
Hydraulic Oil OE/HDO-30 (Refer to  
L05-2410-237-12)

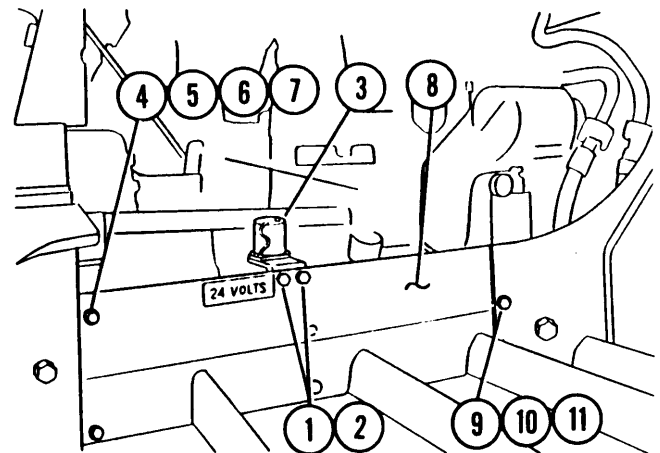
#### Equipment Condition

Engine oil sampling valve removed.  
See TM5-2410-237-20.

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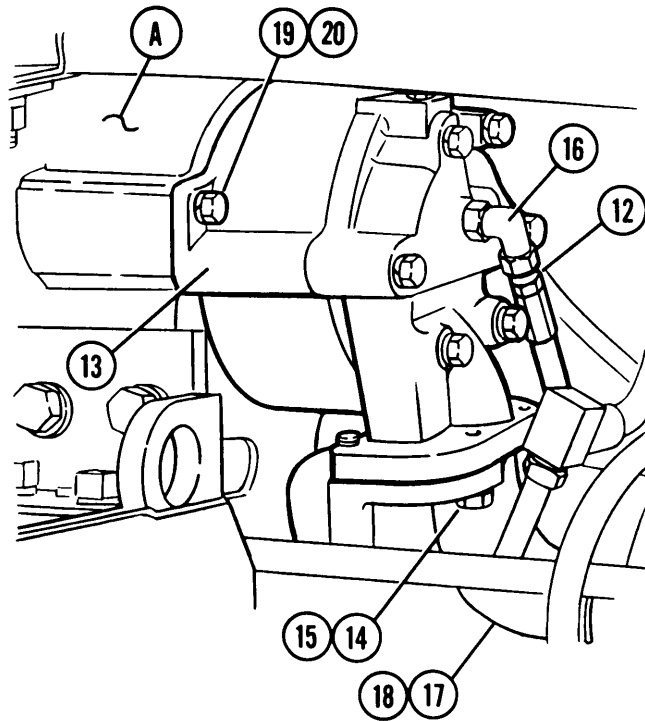
### a. Removal

- (1) Use two wrenches to remove two nuts (1), four flat washers (2), and move starting receptacle (3) out of way.
- (2) Use two wrenches to remove two nuts (4), lockwashers (5), flat washers (6), and capscrews (7) from the left hand guard assembly (8).
- (3) Use a wrench to remove three capscrews (9), flat washers (10), and lockwashers (11) from the left hand guard assembly (8).



7-7. TRANSMISSION OIL PUMP - TEST/REPLACE/REPAIR (Cont'd)

- (4) Use a wrench to disconnect vent line (12) from the transmission oil pump (13).
- (5) Use a wrench to remove four capscrews (14), four flat washers (15), elbow (17) and preformed packing (18). Discard preformed packing (18).
- (6) Remove elbow (16) from transmission oil pump (13).
- (7) Use a wrench to remove two capscrews (19) and two flat washers (20) from the transmission oil pump. Remove transmission oil pump (13) from the flywheel housing (A).

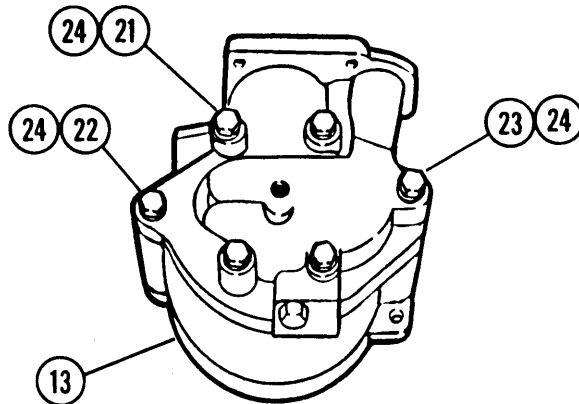


b. Disassembly

NOTE

Put a mark on the outer surface of the transmission oil pump for correct assembly.

- (1) Use a wrench to remove six capscrews (21, 22, and 23) and six flat washers (24) that secure the transmission oil pump (13) as a unit.



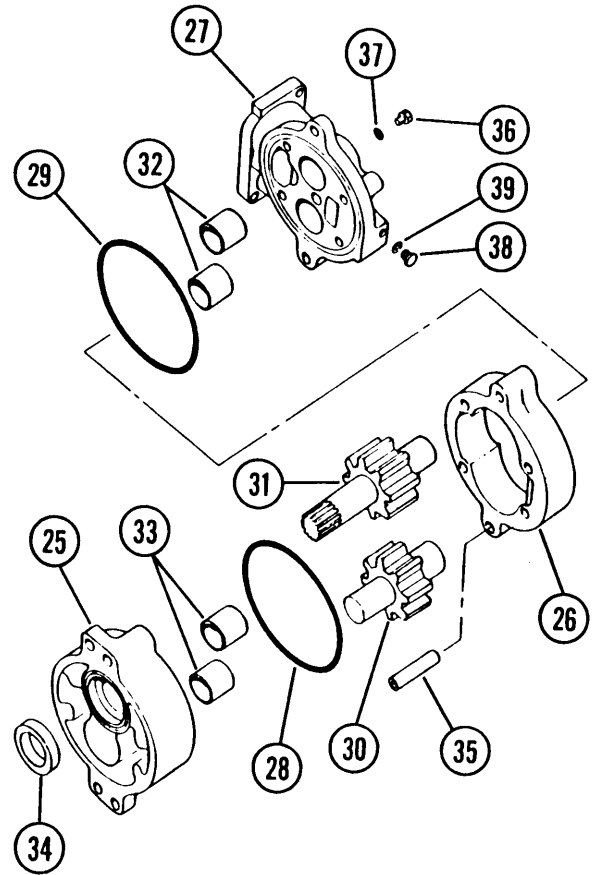


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 7-7. TRANSMISSION OIL PUMP - TEST/REPLACE/REPAIR (Cont'd)
 

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- (2) Remove cover (25) and body (26) from manifold (27).
- (3) Remove two preformed packings (28 and 29) from cover (25) and manifold (27). Discard preformed packings.
- (4) Remove driven gear assembly (30) and drive gear assembly (31) from cover (25).
- (5) Remove the two bearings (32) from the manifold (27). Remove two bearings (33) from the cover (25).
- (6) Remove and discard the lip seal (34) from the cover (25).
- (7) If necessary, remove the two dowels (35) from the body (26).
- (8) If necessary, use a wrench to remove plug (36) and seal (37) from manifold (27). Discard seal.
- (9) If necessary, use a wrench to remove pipe plug (38) and seal (39) from manifold (27). Discard seal.

c. Cleaning

See page 2-29 for general Cleaning Instructions.

d. Inspection

See page 2-32 for general Inspection Instructions\*

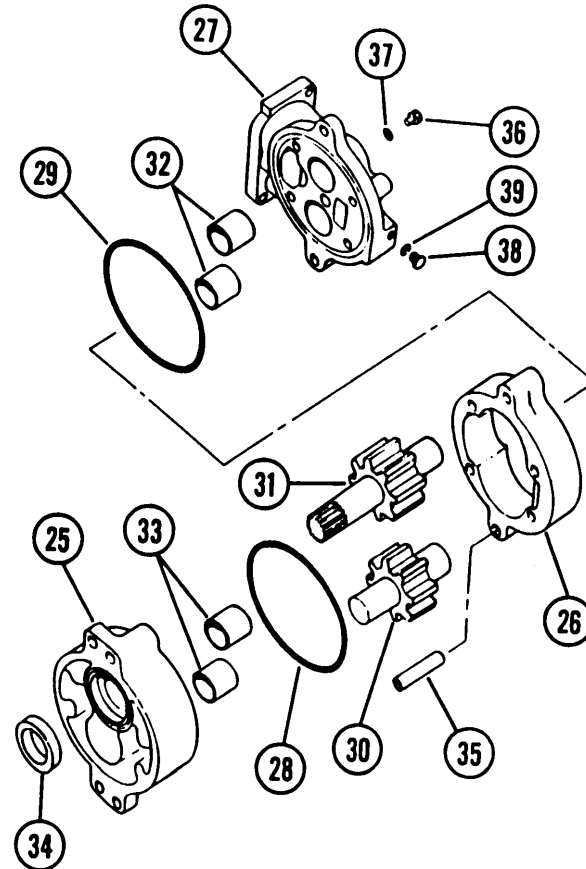
e. Lubrication

Put clean hydraulic oil on internal parts of the transmission oil pump.

## 7-7. TRANSMISSION OIL PUMP - TEST/REPLACE/REPAIR (Cont'd)

f. Assembly

- (1) If removal of the pipe plug (38) was necessary, use a wrench to install the pipe plug with a new seal (39) into the manifold (27).
- (2) If removal of the plug (36) was necessary, use a wrench to install the plug with a new seal (37) into the manifold (27).
- (3) If removal of the two dowels (35) was necessary, install them in the body (26). The dowels must be 0.19 in. above the outer faces of the body.
- (4) Use a driver with press to install two bearings (32) in the manifold (27). Use a driver with a press to install two bearings (33) in the cover (25). Ensure that the joints in the bearings are at an angle of  $30^\circ \pm 15^\circ$  from the center line of the two bearing bores in the direction of the groove in the surfaces of the manifold and cover. Install the bearings to a depth of 0.062 in. below the machined surface of the manifold and cover.
- (5) Use a driver with press to install the lip seal (34) in the cover (25).

CAUTION

Be extra careful not to cause damage to the lip seal (34) when the drive gear assembly (31) is installed.

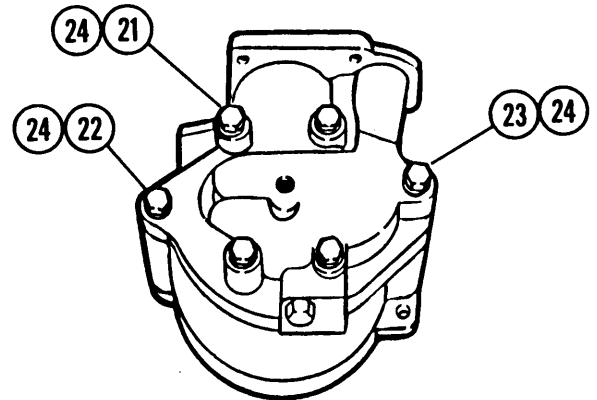
- (6) Install the driven gear assembly (30) and the drive gear assembly (31) in the cover (25).

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 7-7. TRANSMISSION OIL PUMP - TEST/REPLACE/REPAIR (Cont'd)
 

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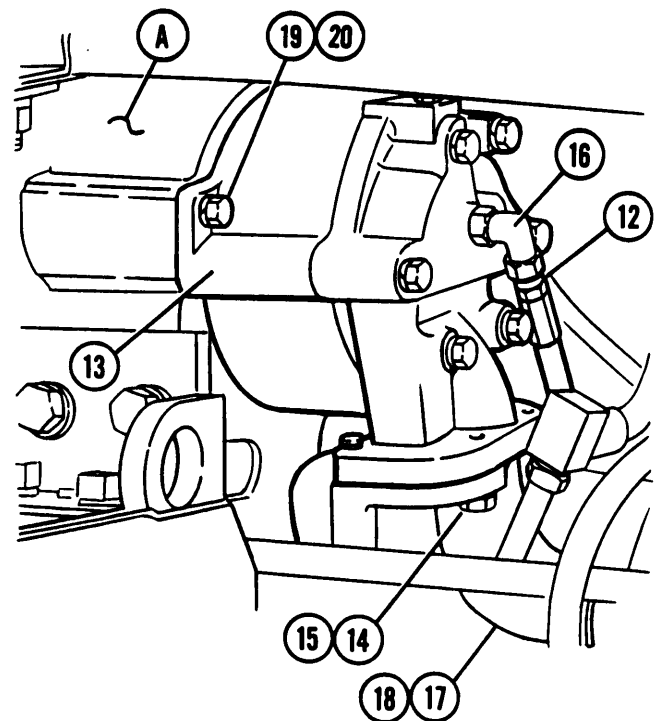
- (7) Install a new preformed packing (28) in the cover (25).
- (8) Install a new preformed packing (29) in the manifold (27).
- (9) Install the manifold (27) on body (26).
- (10) Use a wrench to install six capscrews (21, 22, and 23) and six flat washers (24) which secure the transmission oil pump parts as a unit.

**NOTE**

The transmission oil pump must turn freely by hand before installation.

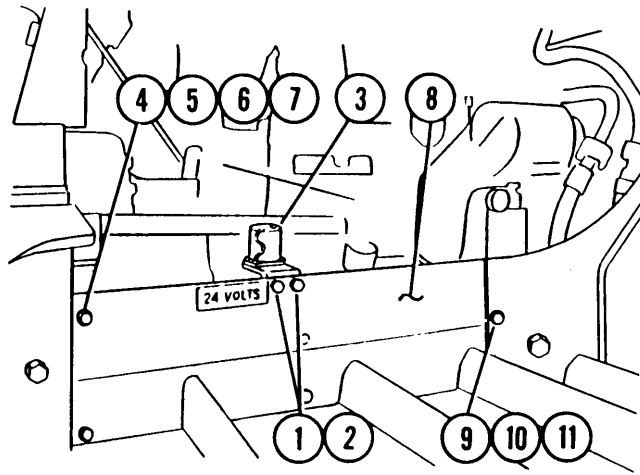
g. Installation

- (1) Ensure that the splines on the drive gear of the oil pump are clean. Install transmission oil pump (13) on the flywheel housing.
- (2) Use a wrench to install two capscrews (19) and two flat washers (20) which secure the transmission oil pump (13) on the flywheel housing (A).
- (3) Install a new preformed packing (18) on elbow (16).
- (4) Install elbows (16 and 17). Use a wrench to install four capscrews (14) and four flat washers (15) which secure elbows to the transmission oil pump.
- (5) Use a wrench to connect vent line (12) to the transmission oil pump (13).



7-7. TRANSMISSION OIL PUMP - TEST/REPLACE/REPAIR (Cont'd)

- (6) Install the left hand guard assembly (8). Use a wrench to install three capscrews (9), flat washers (10), and lockwashers (11) which secure the left hand guard assembly to the tractor.
- (7) Use two wrenches to install two nuts (4), lockwashers (5), flat washers (6), and capscrews (7) which secure the left hand guard assembly (8) to the tractor.
- (8) Put the starting receptacle (3) into position on the left hand guard (8). Use two wrenches to install two nuts (1) and four flat washers (2) which secure the starting receptacle to the left hand guard.

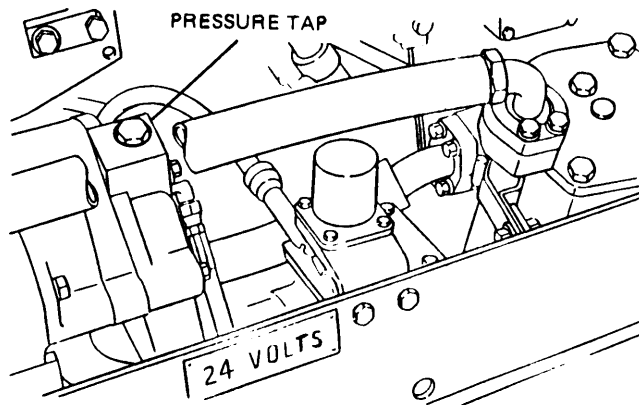


NOTE

Complete the test procedure below before installation of the engine oil sampling valve.

h. Test

- (1) Remove engine oil sampling valve. See TM5-2410-237-20.
- (2) Connect a pressure gage in the pressure tap on the transmission oil pump.
- (3) Run the engine at low idle and read the pressure gage. The pressure should be at or above the minimum of 385 psi.
- (4) Install the engine oil sampling valve. See TM5-2410-237-20.



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## 7-8. TRANSMISSION RELIEF VALVE - REPLACE/REPAIR

---

This task covers:

- a. Removal
  - b. Disassembly
  - c. Cleaning
  - d. Inspection
  - e. Lubrication
  - f. Assembly
  - g. Installation
  - h. Relief Valve Setting
  - i. Place In Service
- 

### INITIAL SETUP

#### Applicable Configurations

All

#### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

#### Materials/Parts

Seal (6), (13), (16), (19),  
(24), (43), (45)

Lubricating Oil OE/HDO-30 (Refer to L05-2410-237-12)

Caps and Plugs

Lint-free Rags (App. B, Item 12)

#### Equipment Condition

Final drive oil drained.

See TM5-2410-237-20.

Transmission assembly oil drained.

See TM5-2410-237-20.

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- a. Removal

#### CAUTION

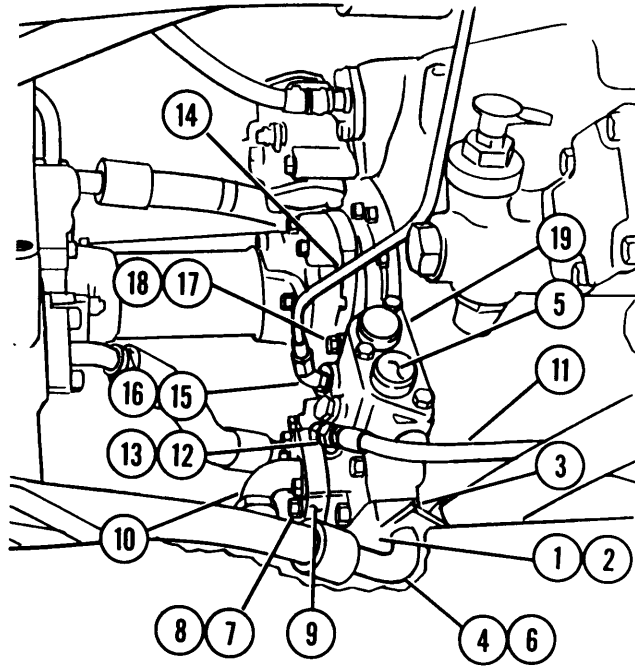
Wipe the area clean around all hydraulic connections to be opened during removal and disassembly. Cap oil lines and plug holes after removing lines. Contamination of the hydraulic system could result in premature failure.

#### NOTE

If more than one hydraulic line is to be removed, identify lines to assure proper installation. Use suitable container to catch any hydraulic oil that may drain from the system.

7-8. TRANSMISSION RELIEF VALVE - REPLACE/REPAIR (Cont' d)

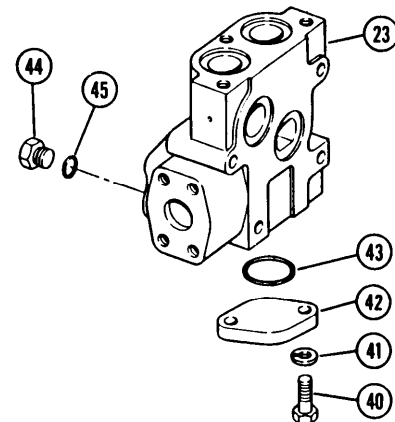
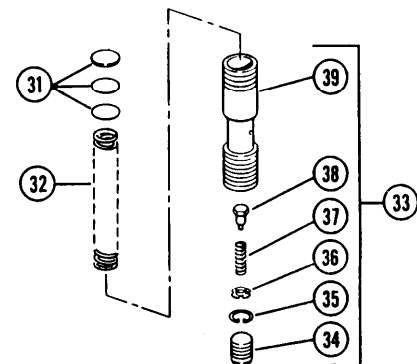
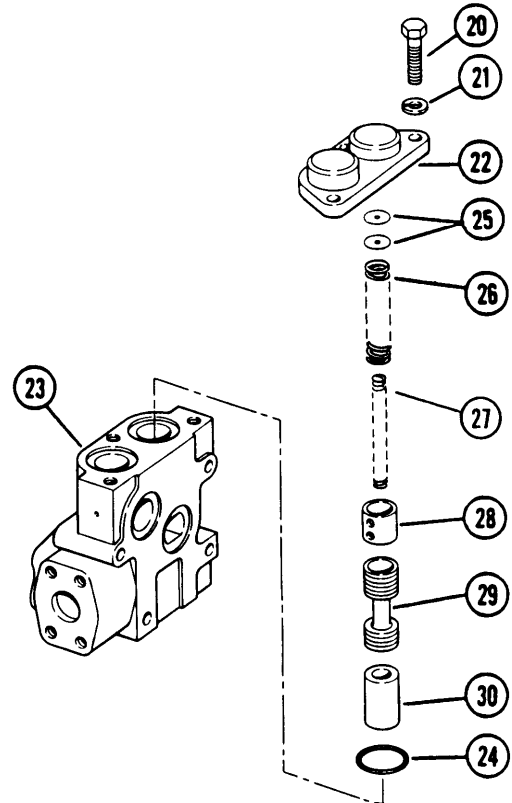
- (1) Use a wrench to remove four capscrews (1), four washers (2), two flanges (3), and disconnect hose assembly (4) from transmission relief valve (5). Remove and discard seal (6).
- (2) Use a wrench to remove four capscrews (7), four washers (8), two flanges (9), and disconnect hose assembly (10) from transmission relief valve (5).
- (3) Use two wrenches to disconnect hose assembly (11) from elbow (12) on transmission relief valve (5). Remove elbow (12) and seal (13). Discard seal (13).
- (4) Use two wrenches to disconnect tube assembly (14) from elbow (15) on transmission relief valve (5). Remove elbow (15) and seal (16). Discard seal (16).
- (5) Use a wrench to remove three capscrews (17), three washers (18), and transmission relief valve (5) from the torque divider. Remove and discard two seals (19) that were between the transmission relief valve and torque divider.



7-8. TRANSMISSION RELIEF VALVE - REPLACE/REPAIR (Cont'd)

b. Disassembly

- (1) Use a wrench to remove three capscrews (20), three lockwashers (21), cover (22), and two seals (24) from housing (23). Discard seals (24).
- (2) Remove spacers (25), springs (26 and 27), stop (28), spool (29), and spacer (30) from inside the housing (23).
- (3) Remove spacers (31), spring (32), and spool assembly (33) from the housing (23).
- (4) Remove the spool (34), retainer (35), ring (36), spring (37), and plunger (38) from inside the spool (39).
- (5) Use a wrench to remove four capscrews (40), four lockwashers (41), and two covers (42) from the housing (23). Remove and discard two seals (43).
- (6) If necessary, use a wrench to remove plug (44) and seal (45) from the housing (23). Discard seal (45).



7-8. TRANSMISSION RELIEF VALVE - REPLACE/REPAIR (Cont'd)

c. Cleaning

See page 2-29 for general Cleaning Instructions.

d. Inspection

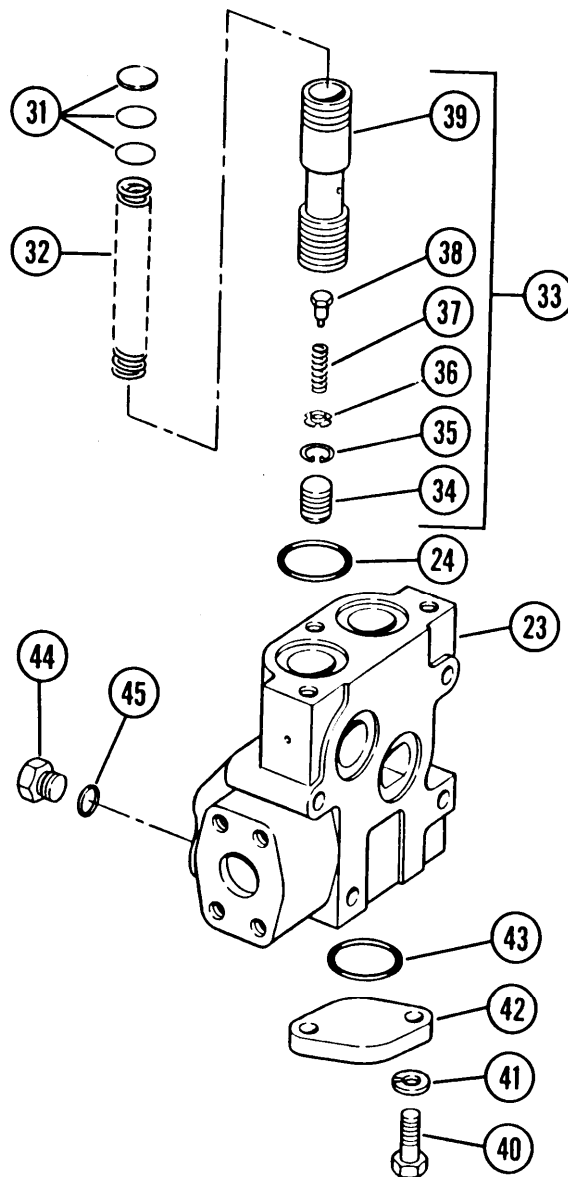
See page 2-32 for general Inspection Instructions.

e. Lubrication

Put clean oil on all parts.

f. Assembly

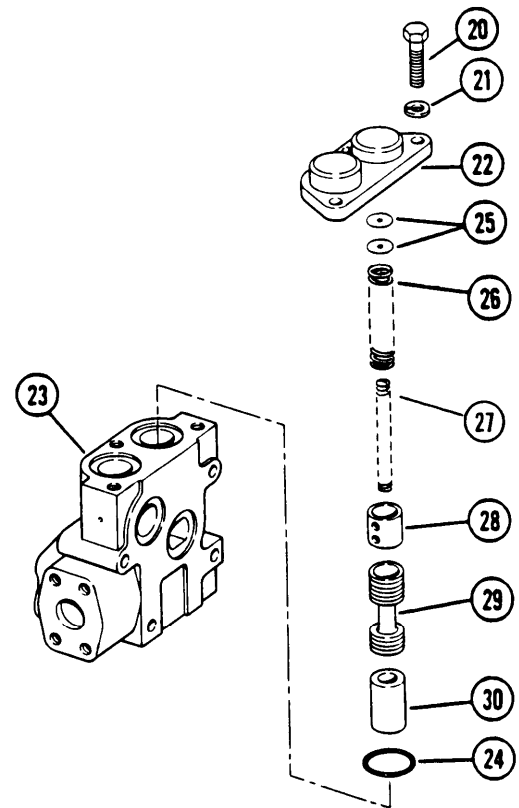
- (1) If removal of the plug (44) and seal (45) was necessary, use a wrench to install plug with a new seal in the housing (23).
- (2) Install two new seals (43) in the housing (23). Install two covers (42), four lockwashers (41), and four capscrews (40). Use a wrench to tighten the capscrews.
- (3) Install plunger (38), spring (37), ring (36), retainer (35), and spool (34) inside the spool (39).
- (4) Install the spool assembly (33), spring (32), and spacers (31) in the housing (23). Install the same number and size spacers as were removed from the valve. Spacers may have to be changed after installation to adjust relief setting.





7-8. TRANSMISSION RELIEF VALVE - REPLACE/REPAIR (Cont'd)

- (5) Install spacer (30), spool (29), stop (28), springs (26 and 27), and spacers (25) in the housing (23). Install the same number and size spacers as were removed from the valve.
- (6) Install two new seals (24), cover (22), three lockwashers (21), and three capscrews (20) on the housing (23). Use a wrench to tighten the capscrews.

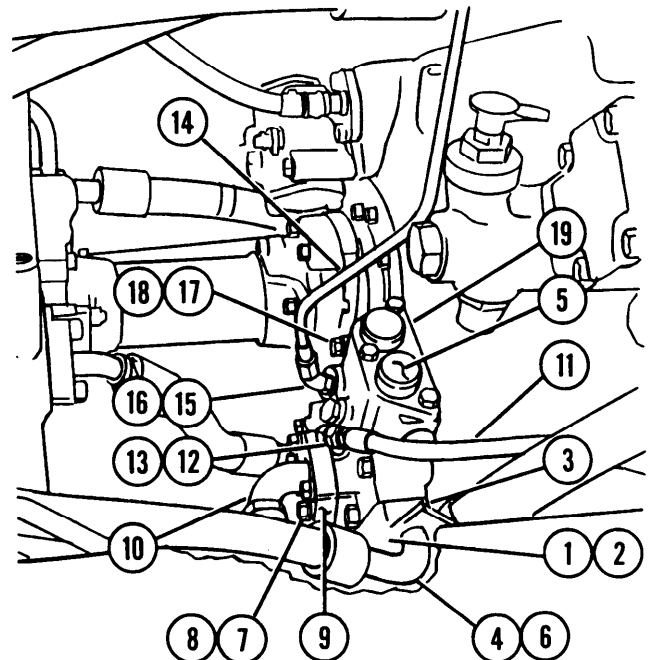


g. Installation

**CAUTION**

Care should be taken not to contaminate hydraulic system during installation of hydraulic lines. Dirt and foreign substances should be removed from surrounding area before lines are installed.

- (1) Install two new seals (19) between the transmission relief valve (5) and the torque divider. Put the transmission relief valve in position on the torque divider. Use a wrench to install three washers (18) and three capscrews (17).
- (2) Install elbow (15) with a new seal (16) on the transmission relief valve (5). Use two wrenches to connect tube assembly (14) on the elbow.
- (3) Install elbow (12) with new seal (13) on the transmission relief valve (5). Use two wrenches to connect hose assembly (11) on the elbow.

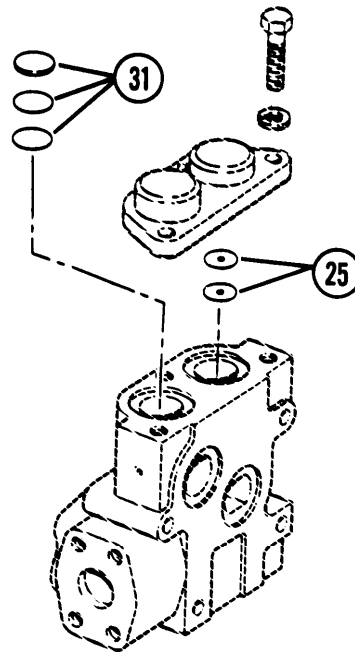


7-8. TRANSMISSION RELIEF VALVE - REPLACE/REPAIR (Cont'd)

- (4) Connect hose assembly (10) to the transmission relief valve (5). Use a wrench to install four capscrews (7), four washers (8), and two flanges (9).
- (5) Install a new seal (6) and connect hose assembly (4) to the transmission relief valve (5). Use a wrench to install four capscrews (1), four washers (2), and two flanges (3).
- (6) Fill the transmission assembly with oil. See TM5-2410-237-20.
- (7) Fill the final drive with oil. See TM5-2410-237-20.
- (8) Check relief valve setting (para. h).

h. Relief Valve Setting

- (1) perform speed clutch and pressure relief valve checks (page 7-98).
- (2) Add or remove spacers (31) if required to adjust relief setting:
  - (a) Each 0.062" spacer will change pressure by 26.4 psi.
  - (b) Each 0.036" spacer will change pressure by 15.1 psi.
  - (c) Each 0.010" spacer will change pressure by 4.2 psi.
- (3) The relief for torque converter inlet can be adjusted by changing spacers (25). Incorrect oil flow to the torque converter means the relief setting should be adjusted:



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7-8. TRANSMISSION RELIEF VALVE - REPLACE/REPAIR (Cont'd)

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- (a) Each 0.010" spacer will change pressure by 1.3 psi.
- (b) Each 0.036" spacer will change pressure by 4.7 psi.

i. Place In Service

Run engine and test drive in all speeds.

7-9. TORQUE CONVERTER OUTLET RELIEF VALVE - REPLACE/REPAIR

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning
- d. Inspection
- e. Lubrication
- f. Assembly
- g. Installation
- h. Relief Valve Setting
- i. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Materials/Parts

Gasket (7)  
Seal (10), (14), (15), (20), (23),  
(28)  
Lubricating Oil OE/HD0-30 (Refer  
to L05-2410-237-12)  
Caps and Plugs  
Lint-free Rag (App. B, Item 12)

Equipment Condition

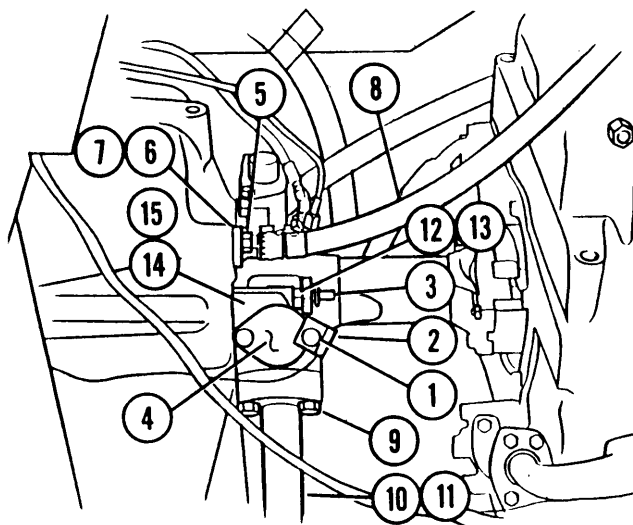
Crankcase guard removed.  
See TM5-2410-237-20  
Transmission assembly oil drained.  
See TM5-2410-237-20

a. Removal

CAUTION

Wipe the area clean around all hydraulic connections to be opened during removal and disassembly. Cap oil lines and plug holes after removing lines. Contamination of the hydraulic system could result in premature failure.

- (1) Use a wrench to remove capscrew (1) and clip (2) that secure torque converter oil temperature sending unit (3) line to the torque converter outlet relief valve (4).



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**7-9. TORQUE CONVERTER OUTLET RELIEF VALVE - REPLACE/REPAIR (Cont'd)**

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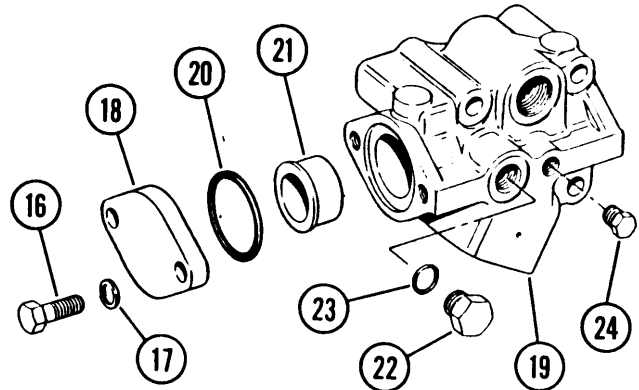
- (2) Use a wrench to remove torque converter oil temperature sending unit (3) from torque converter outlet relief valve (4).
- (3) Use a wrench to remove two capscrews (5), cover (6), gasket (7) and disconnect hose assembly (8) from torque divider. Discard gasket.
- (4) Use a wrench to remove four capscrews (9), seal (10), and disconnect tube assembly (11) from torque converter outlet relief valve (4). Discard seal.
- (5) Use a wrench to remove three capscrews (12) and three lockwashers (13) from the torque converter outlet relief valve (4). Remove the torque converter outlet relief valve from the torque divider.
- (6) Remove and discard two seals (14 and 15) from the torque converter outlet relief valve (4).

7-9. TORQUE CONVERTER OUTLET RELIEF VALVE - REPLACE/REPAIR (Cont' d)

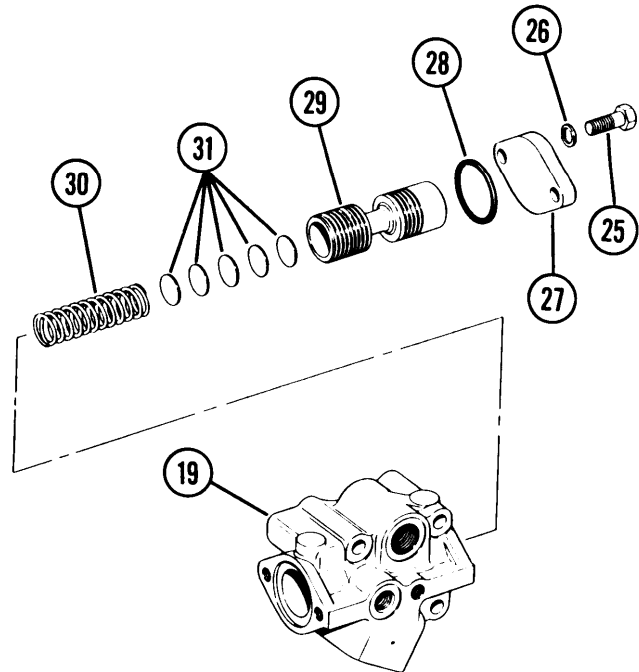
b. Disassembly

CAUTION

Keep pressure on cover (18) when the capscrews (16) are removed. The cover holds the spring under compression.



- (1) Use a wrench to remove two capscrews (16), two lockwashers (17), and cover (18) from housing (19).
- (2) Remove seal (20) and stop (21). Discard seal.
- (3) If necessary, use a wrench to remove plug (22) and seal (23) from housing (19). Discard seal (23).
- (4) If necessary, use a wrench to remove plug (24) from housing (19).



- (5) Use a wrench to remove two capscrews (25), two lockwashers (26), and cover (27) from housing (19).
- (6) Remove seal (28), valve (29), spring (30), and spacers (31) from housing (19). Discard seal (28).

7-9. TORQUE CONVERTER OUTLET RELIEF VALVE - REPLACE/REPAIR (Cont'd)

c. Cleaning

See page 2-29 for general Cleaning Instructions.

d. Inspection

See page 2-32 for general Inspection Instructions.

e. Lubrication

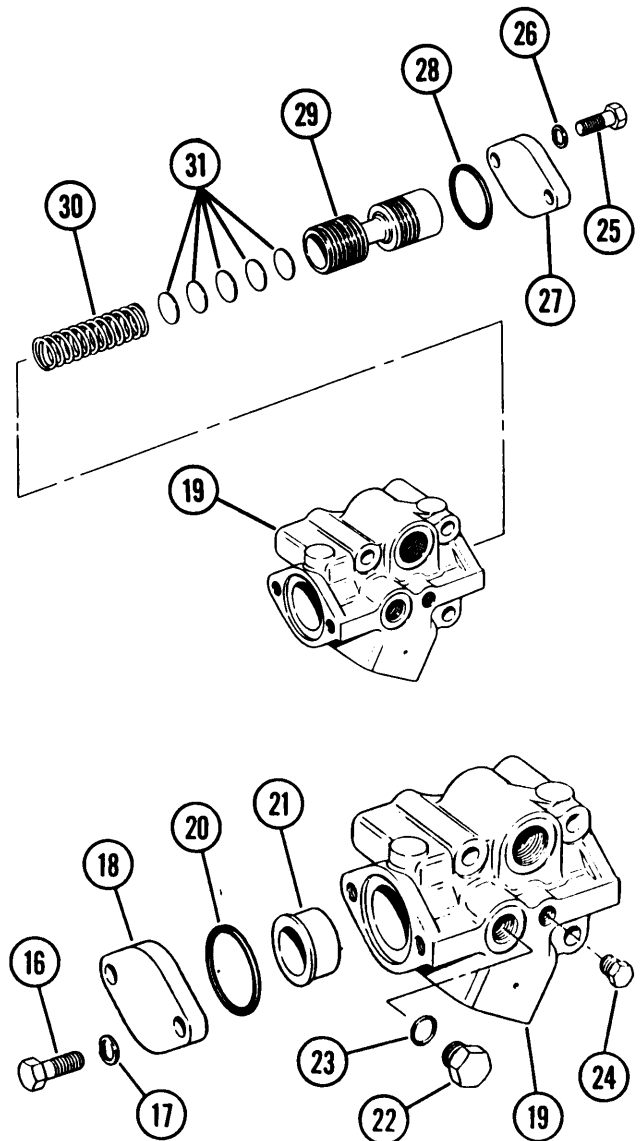
Put clean oil on all parts of the torque converter outlet relief valve.

f. Assembly

NOTE

Install the same number of spacers as were removed from the valve. Spacers may have to be changed after installation to adjust relief setting.

- (1) Put spacers (31), spring (30), valve (29), and a new seal (28) in the housing (19).
- (2) Install the cover (27), two lockwashers (26), and two capscrews (25) onto the housing (19). Use a wrench to tighten the capscrews.
- (3) If removal of the plug (24) was necessary, use a wrench to install it in the housing (19).
- (4) If removal of the plug (22) and seal (23) was necessary, use a wrench to install plug with a new seal in housing (19).
- (5) put stop (21), and a new seal (20) in housing (19).



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7-9. TORQUE CONVERTER OUTLET RELIEF VALVE - REPLACE/REPAIR (Cont'd)

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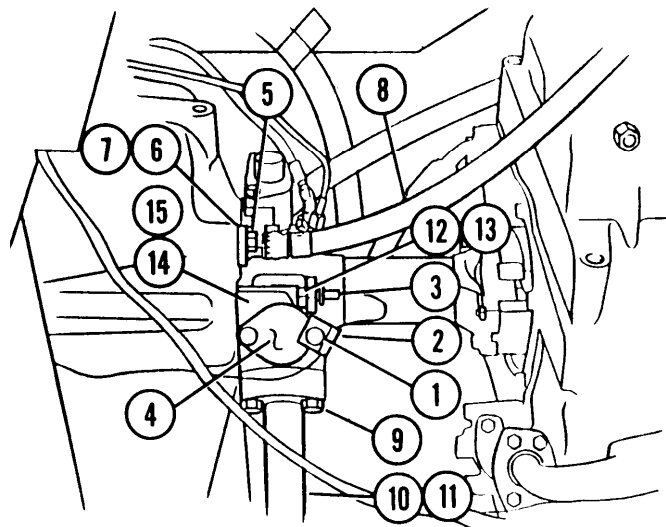
- (6) Use a wrench to install two capscrews (16), two lockwashers (17), and cover (18) on housing (19).

g. Installation

**CAUTION**

Care should be taken not to contaminate hydraulic system during installation of hydraulic lines. Dirt and foreign substances should be removed from surrounding area before lines are installed.

- (1) Install two new seals (14 and 15) on the torque converter outlet relief valve (4).
- (2) Put the torque converter outlet relief valve (4) in position on the torque divider. Use a wrench to install three capscrews (12) and three lockwashers (13) which secure the torque converter outlet relief valve.
- (3) Install a new seal (10) in the tube assembly (11). Connect the tube assembly to the torque converter outlet relief valve (4). Use a wrench to install four capscrews (9) in tube assembly.
- (4) Connect hose assembly (8) to the torque divider and install a new gasket (7), cover (6), and two capscrews (5). Use a wrench to tighten capscrews.
- (5) Use a wrench to install torque converter oil temperature sending unit (3) in the torque converter outlet relief valve (4).





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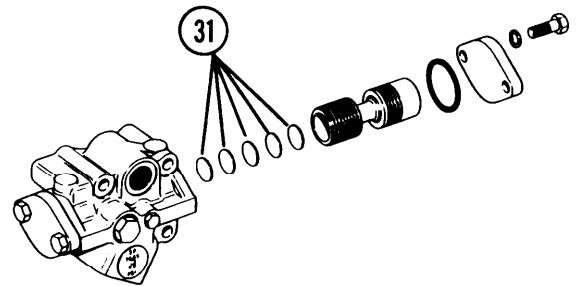
## 7-9. TORQUE CONVERTER OUTLET RELIEF VALVE - REPLACE/REPAIR (Cont'd)

---

- (6) Use a wrench to install capscrews (1) and clip (2) which secure the torque converter oil temperature sending unit (3) line to the torque converter outlet relief valve (4).
- (7) Fill final drive with oil. See TM5-2410-237-20.
- (8) Fill the transmission assembly with oil. See TM5-2410-237-20.
- (9) Install crankcase guard. See TM5-2410-237-20.

### h. Relief Valve Setting

- (1) Perform converter outlet check (page 7-98).
- (2) Add spacers (31) to increase pressure or remove spacers (31) to decrease pressure, if necessary to adjust relief valve setting. Each spacer will change setting by 2.7 psi.



### i. Place In Service

Run engine and test drive in all speeds.

7-10. TORQUE DIVIDER SCAVENGE PUMP - REPLACE/REPAIR

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning
- d. Inspection
- e. Lubrication
- f. Assembly
- g. Installation
- h. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Materials/Parts

Gasket (8)  
Lubricating Oil OE/HDO-30 (Refer to L05-2410-237-12)  
Two 3/8" x 3"-16NC Forcing Screws  
Drain Pan  
Lint-free Rag (App. B, Item 12)

Equipment Condition

Engine cool.  
Crankcase guard removed. See TM5-2410-237-20.

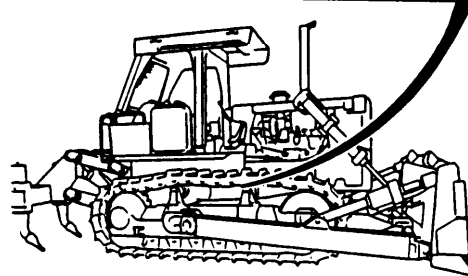
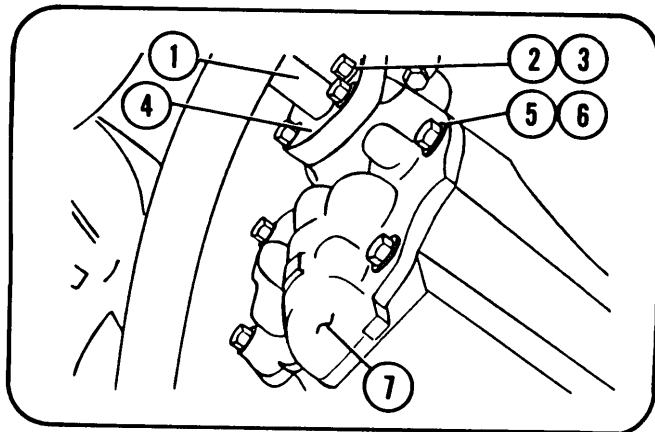
a. Removal

- (1) Drain oil from the torque divider. See TM5-2410-237-20.

CAUTION

Wipe the area clean around all hydraulic connections to be opened during removal and disassembly. Cap oil lines and plug holes after removing lines. Contamination of the hydraulic system could result in premature failure.

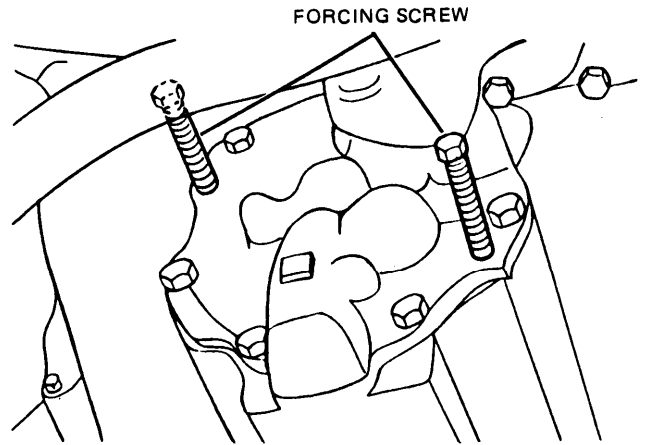
- (2) Remove oil line (1) from torque divider by using a wrench to remove four capscrews (2), washers (3), and two split-type flanges (4).



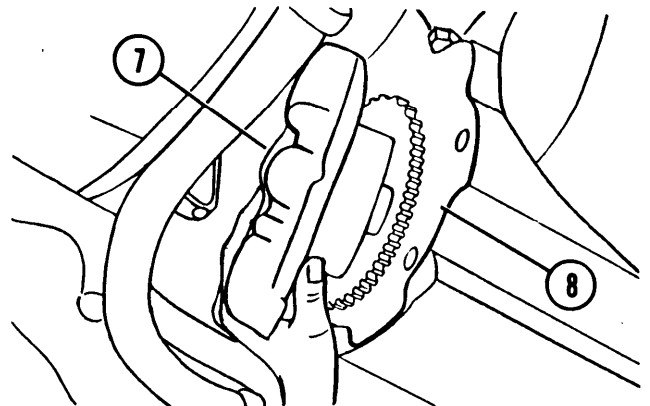
7-10. TORQUE DIVIDER SCAVENGE PUMP - REPLACE/REPAIR (Cont' d)

- (3) Use a wrench to remove six capscrews (5), and washers (6) that hold the scavenge pump (7) to the torque divider housing.

- (4) Install two 3/8"-16NC forcing screws into the scavenge pump.

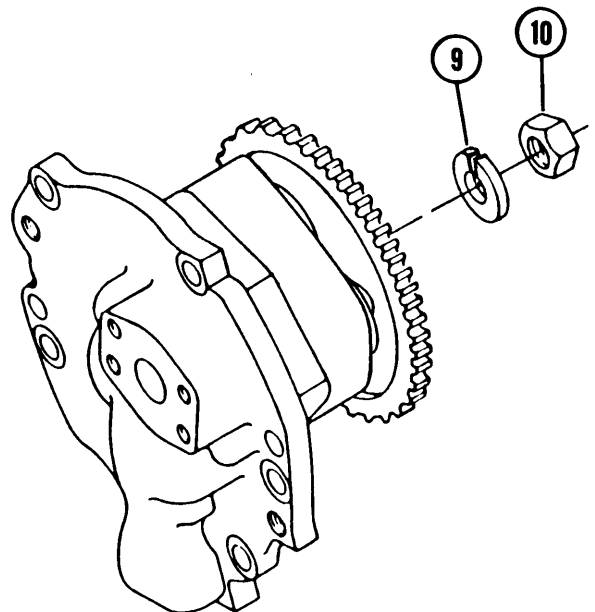


- (5) Slowly and evenly turn in the forcing screws until the scavenge pump (7) pulls free from the torque divider housing. Remove the scavenge pump (7). Remove and discard gasket (8) from the torque divider housing.



b. Disassembly

- (1) Use a chisel or similar tool to bend lock (9) flat to allow removal of nut (10).
- (2) Use a wrench to remove nut (10) from pump. Remove lock (9).



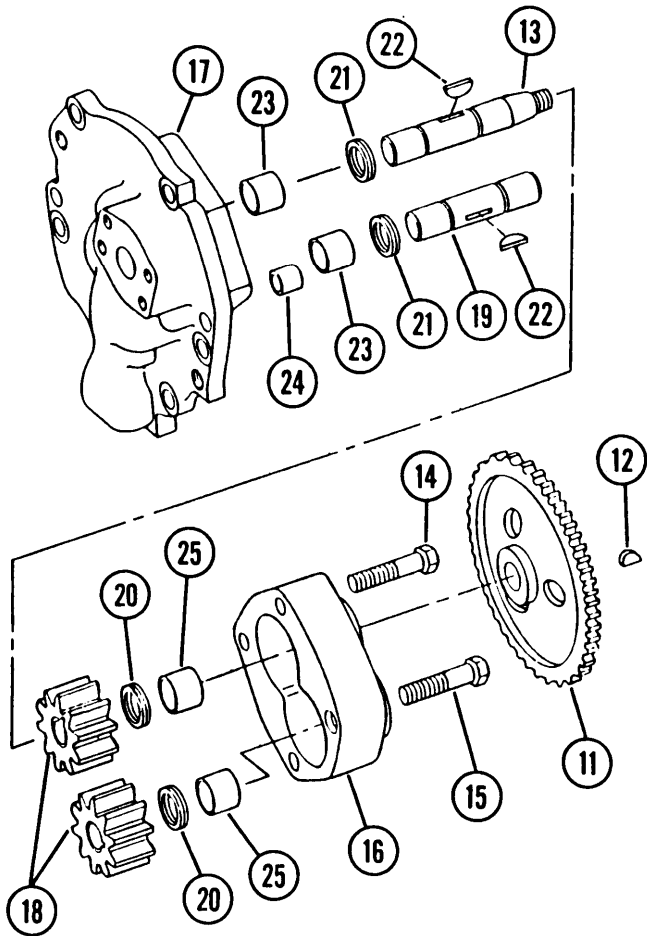
7-10. TORQUE DIVIDER SCAVENGE PUMP - REPLACE/REPAIR (Cont'd)

- (3) Use a gear puller to remove gear (11). Remove key (12) from shaft (13).

NOTE

Capscrews (14 and 15) are different lengths. Mark the capscrews accordingly to assure proper installation.

- (4) Use a wrench to remove four self-locking capscrews (14 and 15).
- (5) Separate body (16) from cover (17).
- (6) Remove two gears (18) and shafts (13 and 19) from the body (16).
- (7) Remove four rings (20 and 21), two gears (18) and two keys (22) from shafts (13 and 19).
- (8) If necessary, remove two bearings (23) and two dowels (24) from cover (17).
- (9) If necessary, remove two bearings (25) from body (16).



c. Cleaning

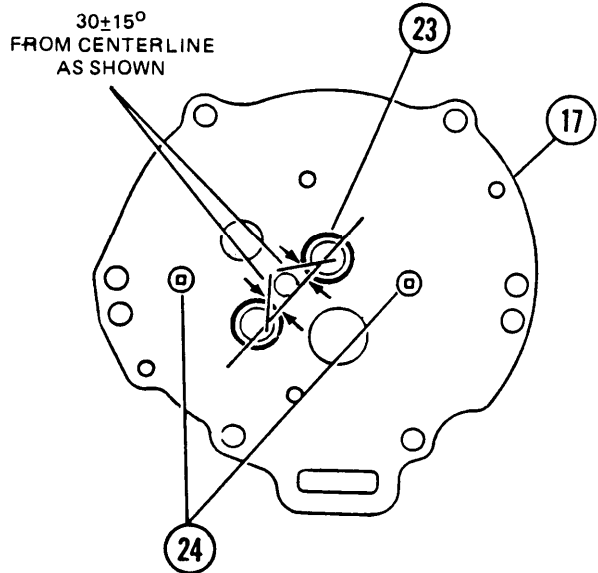
See page 2-29 for general Cleaning Instructions.

d. Inspection

See page 2-32 for general Inspection Instructions.

e. Lubrication

Put clean oil on all parts before assembly.



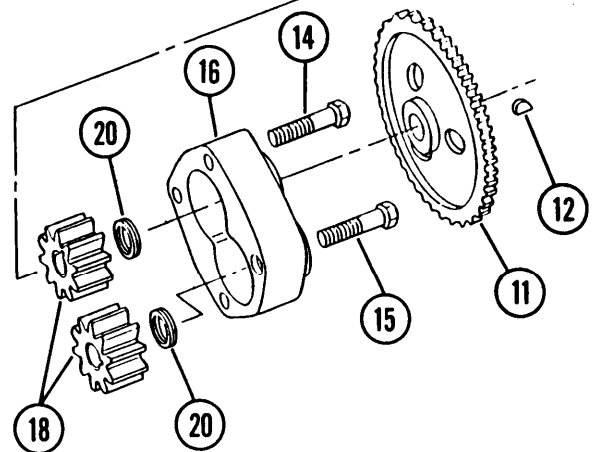
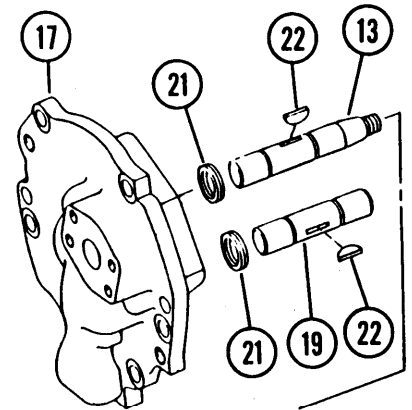
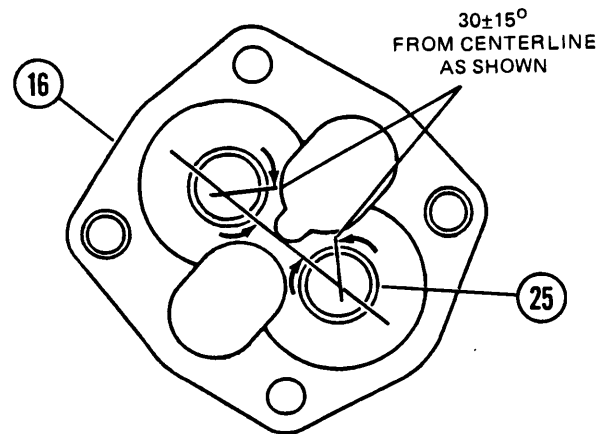
7-10. TORQUE DIVIDER SCAVENGE PUMP - REPLACE/REPAIR (Cont' d)

f. Assembly

NOTE

While installing bearings, make sure the joints in bearings (23 and 25) are in the correct location. The location of the joint is an angle of  $30 \pm 15^\circ$  from the center line of the two bearing bores in the direction shown in the illustrations below. The bearings must be installed 0.080 in. below the inside surfaces of the cover and body.

- (1) If removed, use a drive tool to install two bearings (23) and two dowels (24) into cover (17).
- (2) If removed, use a drive tool to install two bearings (25) in the body (16).
- (3) Place two keys (22), two gears (18), and four rings (20 and 21) on shafts (13 and 19).
- (4) Install two gears (18) and shafts (13 and 19) into body (16).
- (5) Slide body (16) into position on cover (17) and install the four self-locking capscrews (14 and 15). Use a wrench to tighten self-locking capscrews (14 and 15) to a torque of  $35 \pm 5$  lb. ft.
- (6) Install key (12) onto shaft (13) and slide gear (11) onto the shaft.

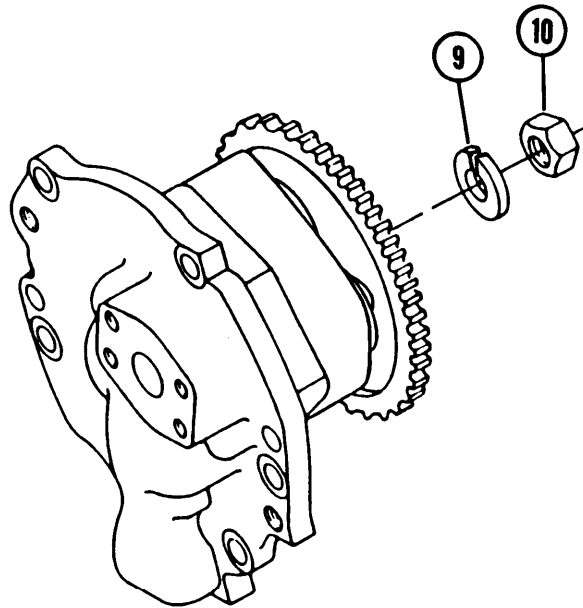


7-10. TORQUE DIVIDER SCAVENGE PUMP - REPLACE/REPAIR (Cont' d)

- (7) Install lock (9) and nut (10) onto the shaft. Use a wrench to tighten nut to a torque of  $40 \pm 5$  lb. ft. Bend lock (9) over the nut (10).

CAUTION

Make sure that the torque divider scavenge pump turns freely by hand after assembly.

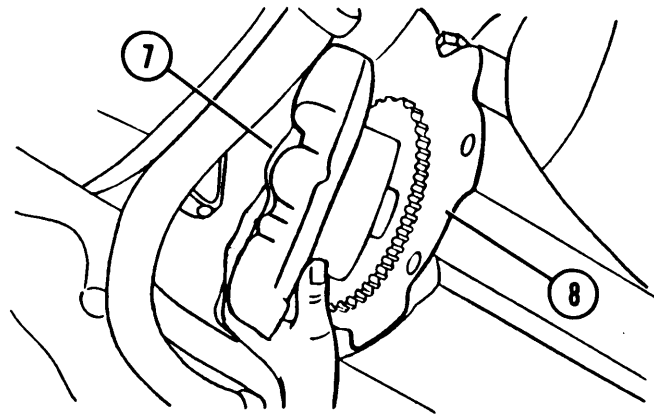


g. Installation

CAUTION

Care should be taken not to contaminate hydraulic system during installation of hydraulic lines. Dirt and foreign substances should be removed from surrounding area before lines are installed.

- (1) Place a new gasket (8) in position on the torque divider housing.
- (2) Put the torque divider scavenge pump (7) in position on the torque divider housing. Make sure the gear on the torque divider scavenge pump is in alignment with the drive gear in the torque divider.

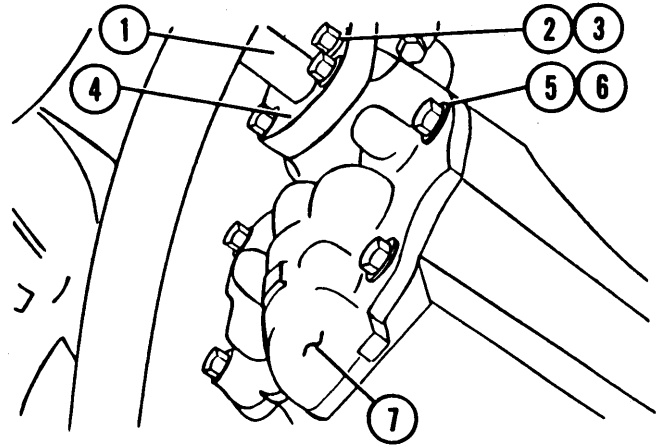


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**7-10. TORQUE DIVIDER SCAVENGE PUMP - REPLACE/REPAIR (Cont'd)**

---

- (3) Use a wrench to install six capscrews (5) and washers (6) which secure the scavenge pump (7) to the torque divider housing.
- (4) Install oil line (1) on torque divider by using a wrench to install four capscrews (2), washers (3), and two split-type flanges (4).
- (5) Service the torque divider and transmission with oil. See TM5-2410-237-20.
- (6) Install crankcase guard. See TM5-2410-237-20.



#### h. Place In Service

Run engine and check scavenge pump for proper operation.

---

7-11. POWER TRAIN HYDRAULIC SYSTEM - TEST

---

This task covers:

- a. General
  - b. Visual Checks
  - c. Pressure Tests
- 

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Tool Outfit, Hydraulic System Test and Repair (HSTRU)  
 NSN 4940-01-036-5784

Equipment Conditions

Blade and ripper fully lowered to the ground.  
 All transmission, brake and steering control linkage adjustments must be correct.  
 Power train oil level is correct.  
 Power train oil is at normal operating temperature.  
 Floor plates removed.  
 (TM5-2410-237-20)

---

a. General

Visual checks should be made before performing the tests outlined in the test chart.

Correct oil flow and pressure are necessary for any hydraulic system operation. The output from the pump (pump flow) increases with an increase in engine rpm and decreases when rpm is decreased. Oil pressure is caused by resistance to the oil flow.

Only authorized personnel should be allowed on the tractor while these tests are being performed.

b. Visual Checks

Perform visual inspection of the power train hydraulic system with the engine turned off and the blade and ripper lowered completely to the ground.

- (1) Inspect all lines and connections for damage and/or leaks.
- (2) Inspect control linkage for bent, broken, or damaged components.
- (3) Verify that power train oil level is correct.

c. Pressure Tests

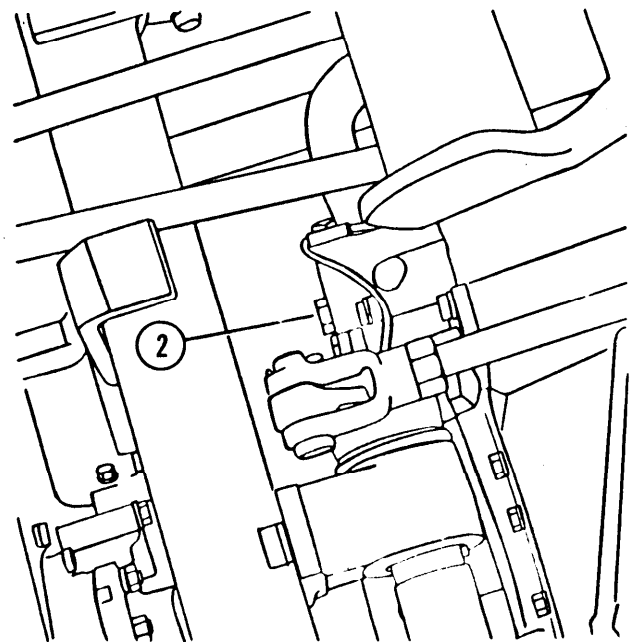
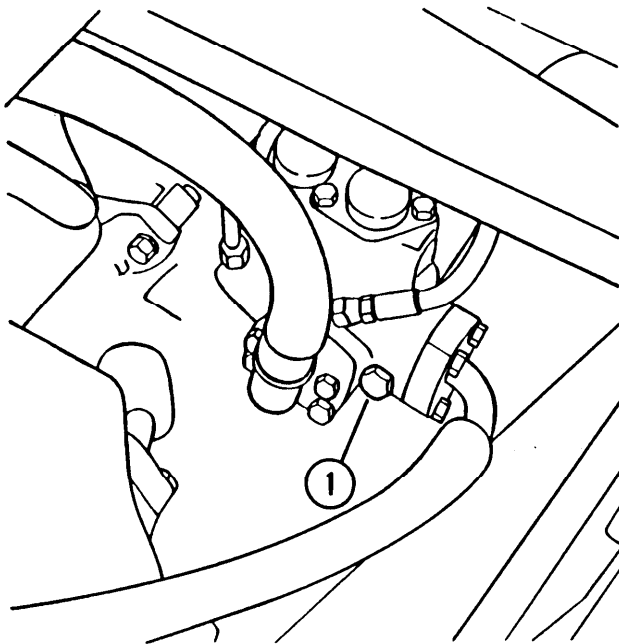
Refer to Table 7-1 for Power Train Pressure Tests.



7-11. POWER TRAIN HYDRAULIC SYSTEM - TEST (Cont'd)

Table 7-1. Power Train Pressure Tests

PRESSURE ②	PRESSURE TAP LOCATION	PRESSURE MEASURED AT GOVERNOR CONTROL LEVER		CORRECTIVE ADJUST- MENT
		MINIMUM SETTING	MAXIMUM SETTING	
Pump	Sequence relief valve port (1)	380 psi min.	415-455 psi.	Adjust transmission relief valve (page 7-79).
		selector lever in NEUTRAL.	Trans. selector lever in NEUTRAL.	
Torque con- verter outlet	(2)		* 37-47 psi with trans. selector lever in THIRD FORWARD and brakes activated with converter in a stall condition.	Adjust converter outlet relief valve (page 7-86).

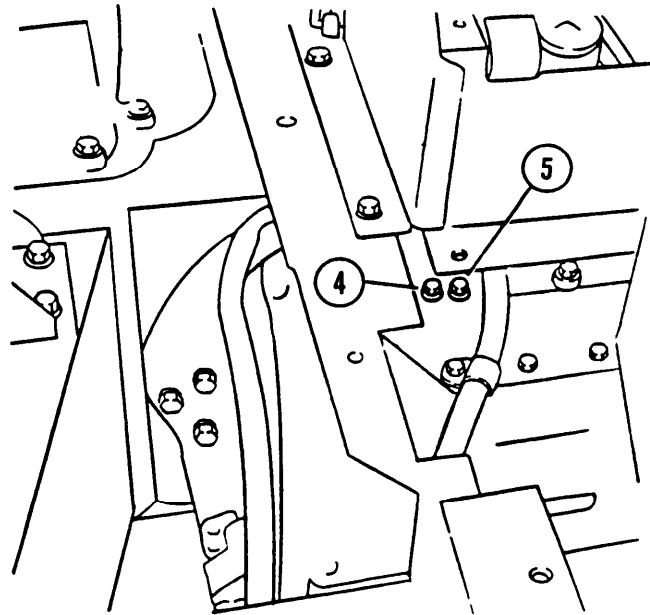
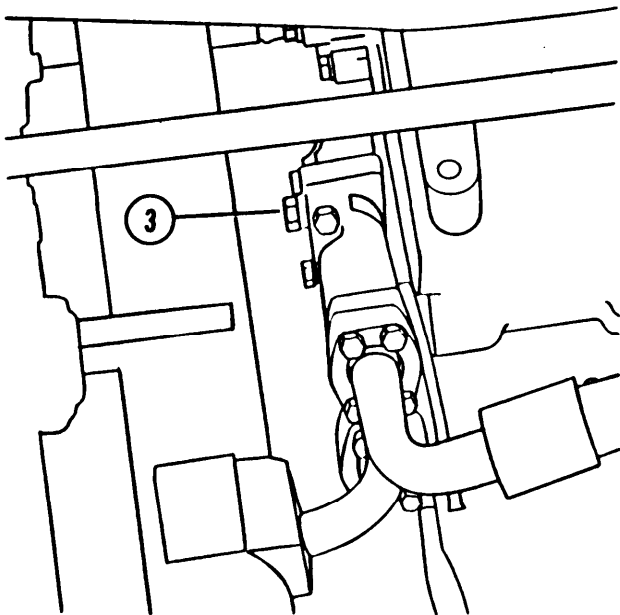


\* - Transmission selection . . . . .THIRD FORWARD = Clutches 1 and 4 engaged in transmission.

7-11. POWER TRAIN HYDRAULIC SYSTEM - TEST (Cont'd)

Table 7-1. Power Train Pressure Tests (Continued)

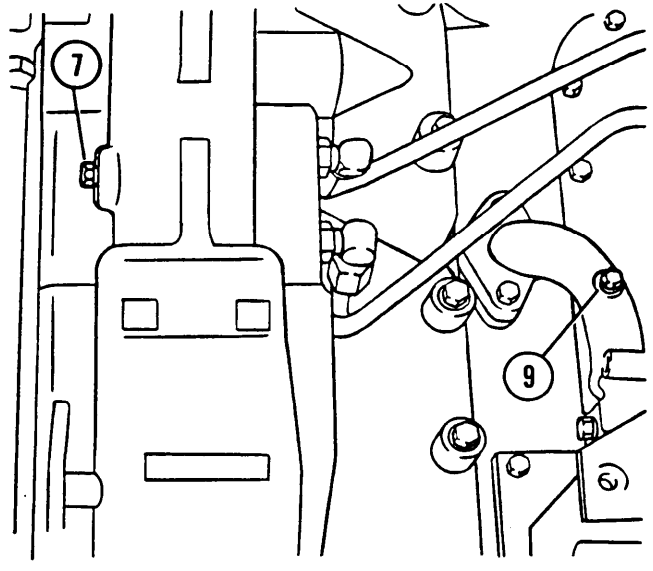
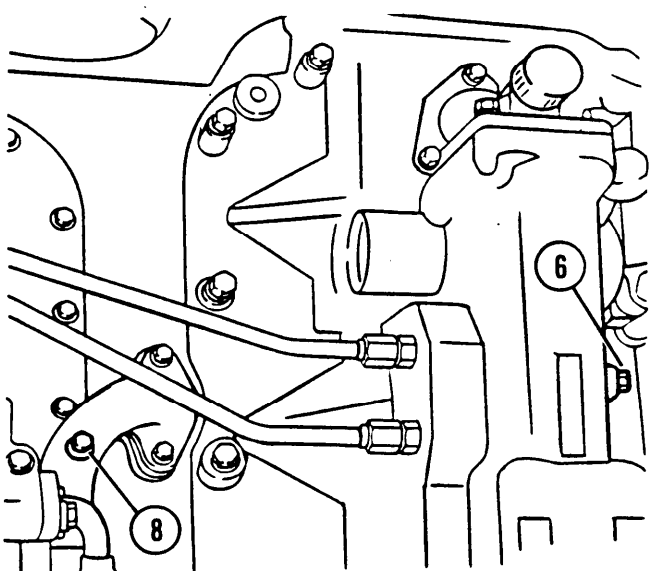
PRESSURE @	PRESSURE TAP LOCATION	PRESSURE MEASURED AT GOVERNOR CONTROL LEVER		CORRECTIVE ADJUSTMENT
		MINIMUM SETTING	MAXIMUM SETTING	
Transmission lubrication oil	Transmission oil cooler manifold port (3)	1-7 psi. Trans. selector lever in NEUTRAL.	28-42 psi. Trans. selector lever in NEUTRAL.	None
Speed clutch	pressure control valve port (4)	380 psi. minimum Trans. selector lever in NEUTRAL.	415-455 psi. Trans. selector lever in NEUTRAL.	None
Direction clutch	Pressure control valve port (5)	47-63 psi less than speed clutch pressure. Trans. selector lever in NEUTRAL.	47-63 psi less than speed clutch pressure. Trans. selector lever in NEUTRAL.	Adjust pressure control valve (page 7-64).



7-11. POWER TRAIN HYDRAULIC SYSTEM - TEST (Cont' d)

Table 7-1. Power Train Pressure Tests (Continued)

PRESSURE @	PRESSURE TAP LOCATION	PRESSURE MEASURED AT GOVERNOR CONTROL LEVER		CORRECTIVE ADJUSTMENT
		MINIMUM SETTING	MAXIMUM SETTING	
Brake boosters	Left booster (6) and right booster (7)	345 psi minimum Brakes activated by the brake pedals	380 psi minimum. Brakes activated by the brake pedals.	
Brake boosters	Left booster (6) and right booster (7)	330 psi minimum Brakes activated by steering control levers.	370 psi minimum. Brakes activated by steering control levers.	
Piston for steering clutches	Left steering clutch (8) and right steering clutch (9)	330 psi minimum Steering clutches released.	370 psi minimum. Steering clutches released.	



## CHAPTER 8

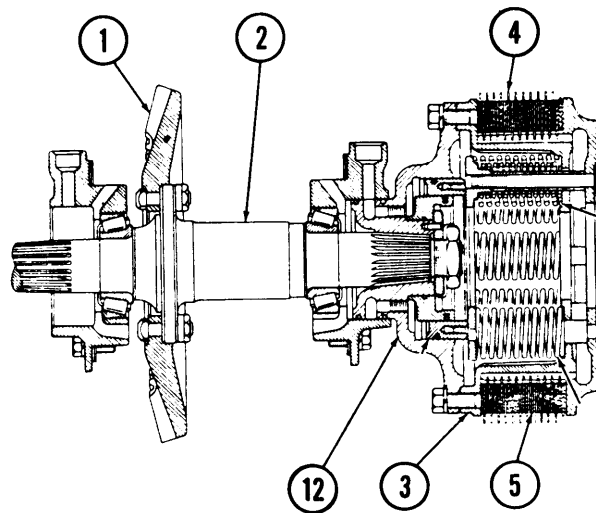
## TRANSFER AND FINAL DRIVE MAINTENANCE

## Section I. DESCRIPTION AND DATA

## 8-1. GENERAL

Transfer and final drive assemblies maintenance procedures not covered in this chapter can be found in TM5-2410-237-20.

## 8-2. PRINCIPLES OF OPERATION



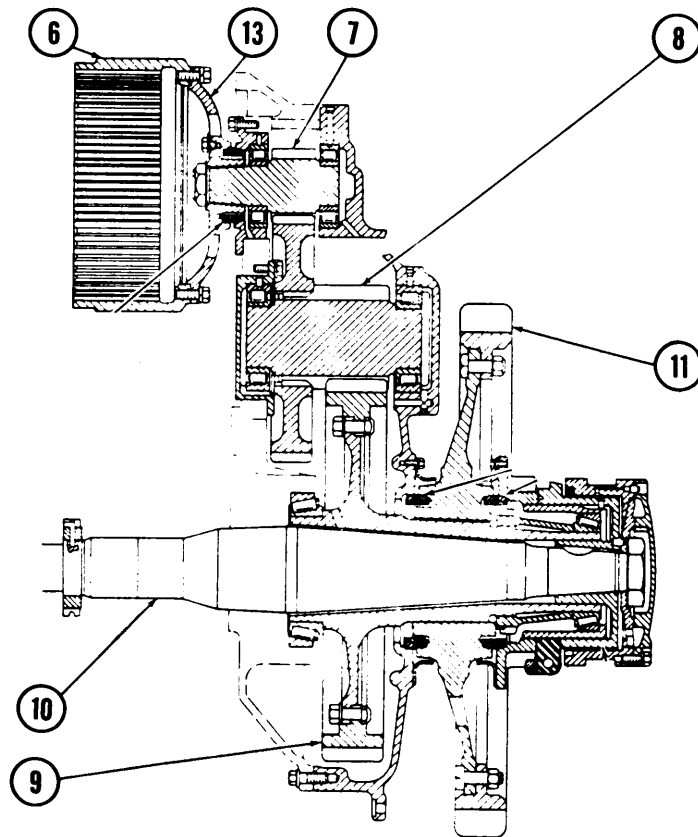
- a. Final Drive. The main components of the final drives are: bevel gear (1), bevel gear shaft (2), steering clutch inner drum (3), disc assemblies (4), steel discs (5), steering clutch outer drum (6) (also the brake drum), final drive pinion (7), idler pinion (8), final drive gear (9), sprocket shaft (10) and sprocket (11).

The bevel gear and steering clutches are in the bevel gear and steering clutch case. The bevel gear case is the reservoir for the transmission and steering hydraulic systems. As the bevel gear turns lubricant is thrown on the bevel gear, bevel pinion and steering clutches for lubrication. The bearings for the bevel gear shaft get lubrication from the control valve for the steering clutches.

The final drive cases are fastened to the bevel gear and steering clutch case. The final drive cases are reservoirs for oil for the final drives.

With a steering clutch engaged, power goes from the inner drum (3), through the discs (4), to the outer drum (6). The steering clutches are normally engaged.

With a steering clutch released, power cannot go from the inner drum to the outer drum.



Splines connect both ends of bevel gear shaft (2) to drive hub (12). The drive hubs are fastened to inner drums (3) of the steering clutches. Teeth connect steel discs (5) to the inner drums (3). Teeth connect disc assemblies (4) to outer drum (6). The outer drum is fastened to drive hub (13) of pinion (7). pinion (7) is engaged with idler gear (8). The idler gear is engaged with the final drive gear (9). Splines connect sprocket (11) to the final drive gear. The teeth of the sprocket are engaged with the track pins.

When a steering clutch is engaged, the flow of power is: From the bevel gear (1) through bevel gear shaft to inner drum (3). The inner drum turns steel discs (5). The steel discs turn disc assemblies (4). The disc assemblies turn outer drum (6). The outer drum turns final drive pinion (7). The final drive pinion turns idler gear (8). The idler gear turns final drive gear (9). The gear turns sprocket (11). The sprocket turns the track.

When a steering clutch is not engaged, the connection between bevel gear (1) and final drive pinion (7) is broken. Power does not go through the final drive to the track.

Section II. TRANSFER AND FINAL DRIVE ASSEMBLIES MAINTENANCE PROCEDURES

8-3. TRANSFER AND FINAL DRIVE MAINTENANCE TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
8-4	Final Drive Cases, Gears, Idler Pinion and Bearings - Replace	8-4
8-5	Final Drive Pinions and Flanges - Replace/Repair	8-12
8-6	Bevel Gear and Shaft - Replace	8-18
8-7	Final Drive Bearings - Adjust	8-29

8-4. FINAL DRIVE CASES, GEARS, IDLER PINION, AND BEARINGS -  
REPLACE

This task covers:

- a. Removal
- b. Cleaning
- c. Inspection
- d. Installation
- e. Place In Service

INITIAL SETUP

Applicable Configurations

ALL

Common Tools

Shop Equipment General Purpose  
Repair, Semi-Trailer, Mounted  
NSN 4940-00-287-4894  
Lifting Equipment 400 lbs.

Materials/Parts

- 4 Locks (26)**
- 8 Locks (17)**
- Plugs (8)
- Lint-free Rag
- Retainer (24)
- 3 Wood Blocks 3' X 4" X 4"
- Piece of Wire 3' X 1/16"
- Two 5/8"-11NC Guide Capscrews
- Three 1/2"-13NC Forcing Screws (5)
- One 1/4"-20NC Capscrew (4)
- #10-32 Screw
- Nylon Strap and Pin
- Grease (App. B, Item 7)
- Liquid Gasket (App. B, Item 3)

Equipment Condition

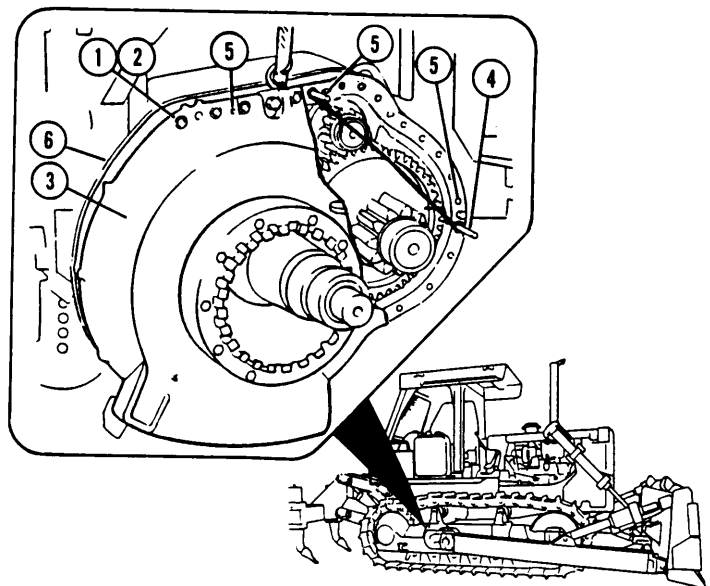
Sprocket assembly removed.  
See page 9-51.

NOTE

This procedure to be used for  
either R. H. or L. H. final  
drive assemblies.

a. Removal

- (1) Use a wrench to remove thirty-one  
capscrews (1) and thirty-one  
washers (2) from final drive case  
(3) |



8-4. FINAL DRIVE CASES, GEARS, IDLER PINION, AND BEARINGS -  
REPLACE (Cont' d)

**WARNING**

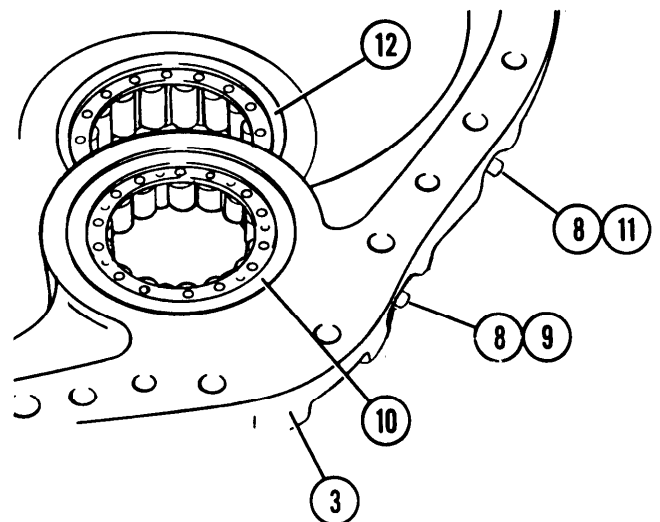
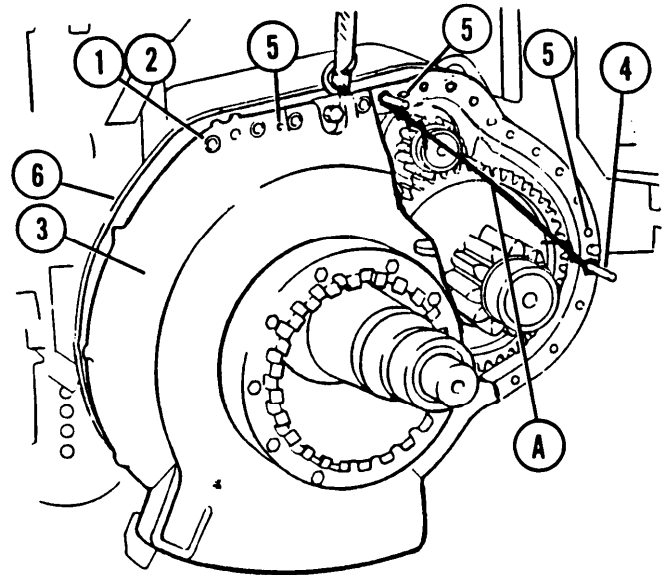
Guide screws must be installed as instructed in STEP (2) to avoid personal injury.

- (2) Install two 5/8"-11NC guide capscrews (4) and three 1/2"-13NC forcing screws (5) in drive case (3).
- (3) Tighten forcing screws evenly until case (3) is approximately 0.25 in. away from steering clutch case (6).

**CAUTION**

Use a piece for wire to keep idler pinion in position so it will not fall from steering clutch case when final drive case is removed.

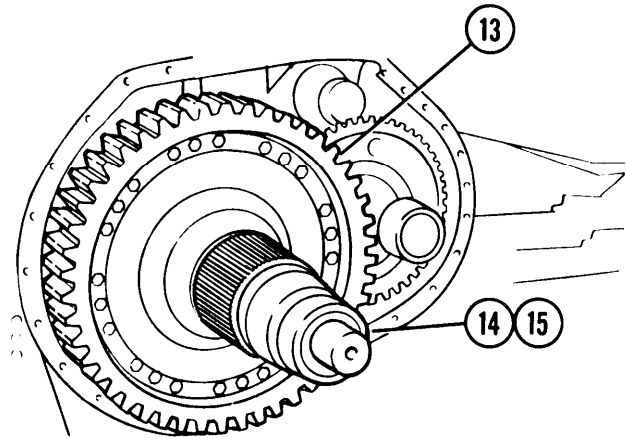
- (4) Install a piece of wire (A) around two guide pins (4) and across face of idler pinion to hold idler pinion in place.
- (5) Tighten forcing screws (5) until lifting equipment can be attached to final drive case (3). Remove final drive case. The weight of drive case is 280 lbs.
- (6) If necessary to remove roller bearings (10 and 12) remove two plugs (8) from dowel holes in drive case (3) with a slide puller. Plugs are destroyed during removal.
- (7) Use a #10-32 screw to remove dowel (9), holding race and roller assembly (10), from drive case (3).





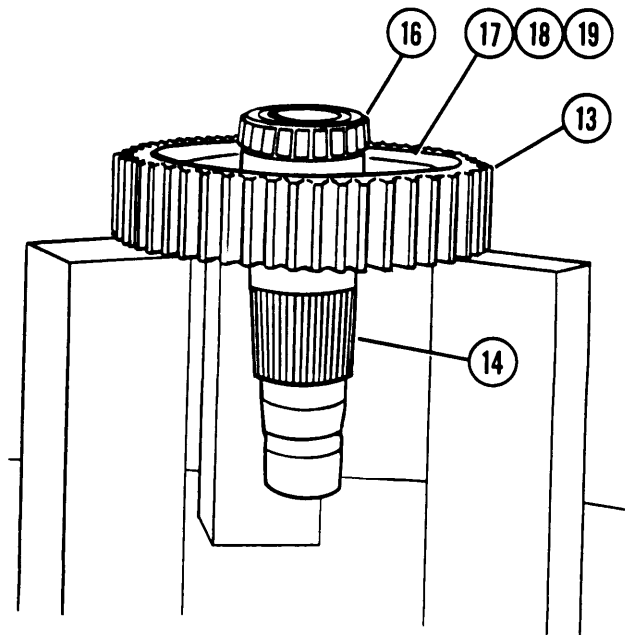
8-4. FINAL DRIVE CASES, GEARS, IDLER PINION, AND BEARINGS -  
REPLACE (Cont'd)

- (8) Use a 1/4"-20 NC capscrew to remove dowel (11), holding race and roller assembly (12), from drive case (3).
- (9) Pull race and roller assemblies (10 and 12) from final drive case (3).
- (10) Attach lifting equipment to remove gear (13), hub (14) and key (15) assembly from sprocket shaft.



- (11) Put gear (13) and hub (14) on wood blocks with long part of hub down. Weight of gear and hub is approximately 350 lbs.

- (12) Pull bearing cone (16) from hub (14).
- (13) Use hammer and chisel to flatten eight locks (17) for removal from hub (14).



- (14) Use a wrench to remove sixteen nuts (18) and eight locks (17) from sixteen capscrews (19). Use a soft punch and hammer to remove capscrews (19) from hub (14). Discard locks (17).

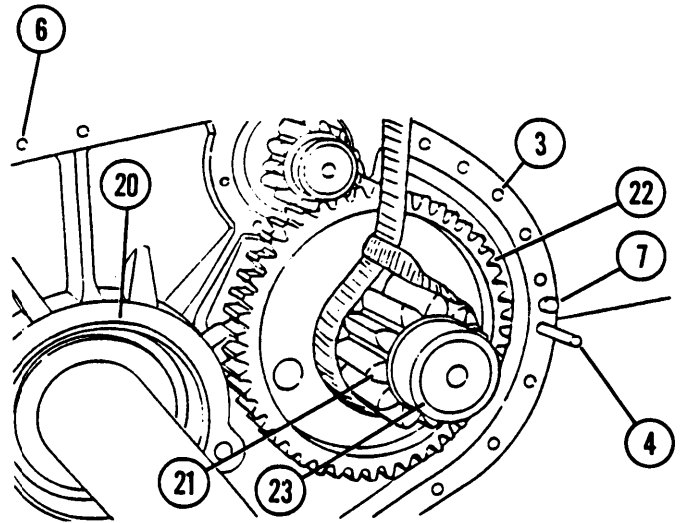
- (15) Use a nylon strap and a pin or capscrew that is longer than bottom end of hub (14) is wide, to attach lifting equipment to hub. Remove hub (14) from gear (13). The weight of hub is 218 lbs.

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 8-4. FINAL DRIVE CASES, GEARS, IDLER PINION, AND BEARINGS -  
 REPLACE (Cont'd)
 

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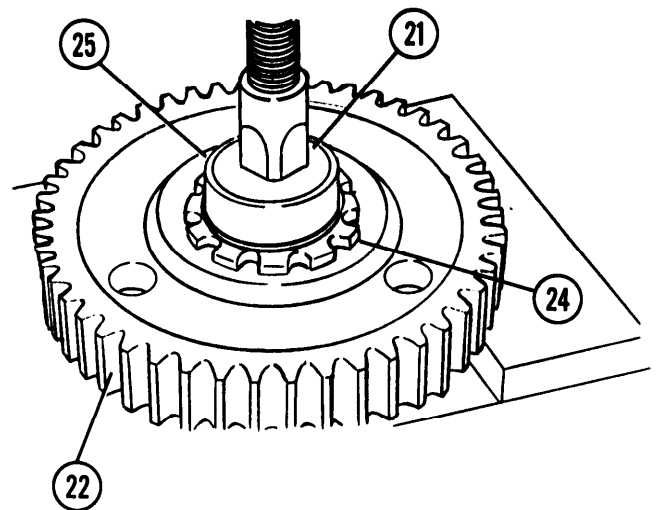
- (16) If necessary, pull bearing cup (20) from steering clutch case (6).
- (17) Attach lifting equipment and sling to idler pinion (21). Remove wire from guide pins (4) that hold idler pinion (21) and gear (22) in place. Remove gear (22) and idler pinion (21) from steering clutch case (6). The weight of gear and idler pinion is 120 lbs.
- (18) Pull bearing race (23) from one end of pinion shaft (21).



CAUTION

Too much pressure on the pinion shaft can cause damage to the gear.

- (19) Put gear (22) and idler pinion (21) in a press. Apply a small amount of pressure on idler pinion shaft (21) with press.
- (20) Use a hammer and punch to push retainer (24) in groove on idler pinion shaft (21). Retainer (24) will stay in groove because of pressure on idler pinion shaft. When retainer (24) is completely in groove, idler pinion shaft (21) will slide out of gear (22). The weight of idler pinion is 85 lbs. Discard retainer (24).
- (21) Pull bearing race (25) from other end of idler pinion shaft (21).
- (22) Drain oil from steering clutch and bevel gear case. See TM5-2410-237-20.



8-4. FINAL DRIVE CASES, GEARS, IDLER PINION, AND BEARINGS -  
REPLACE (Cont'd)

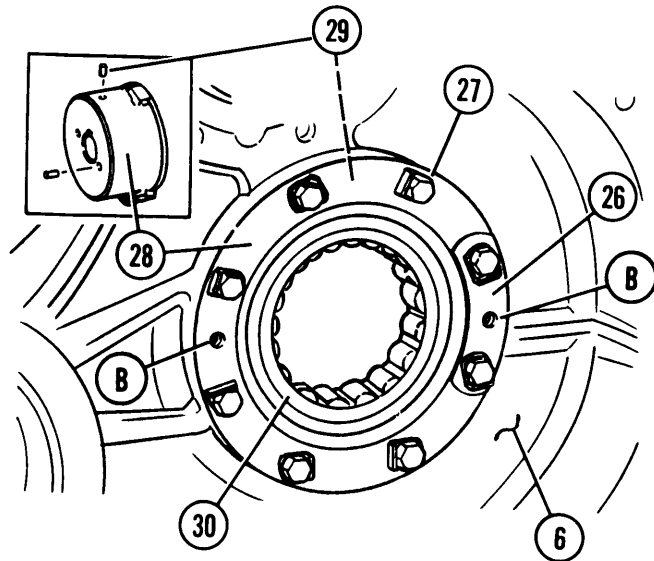
Use a hammer and a chisel to bend four locks (26) down. Use a wrench to remove eight capscrews (27) and four locks (26) from bearing cage (28). Discard locks (26).

(24) Install two 1/2"-13NC forcing screws in bearing cage (28) at tapped holes (B). Tighten forcing screws evenly and remove bearing cage (28) from steering clutch case (6).

(25) Use a 1/4"-20NC capscrew to remove dowel (29) from bearing cage (28). Dowel (29) is located behind flange of bearing cage (28).

(26) Pull race and roller assembly (30) from bearing cage (28).

(27) If necessary, pull bearing race (31) from pinion (32).



b. Cleaning

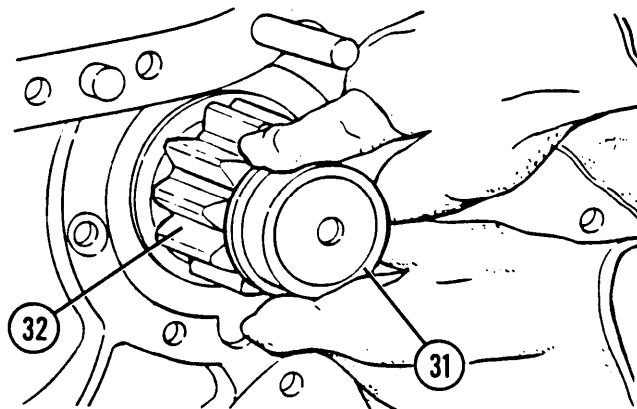
(1) Wipe clean and dry all bearing mounting surfaces in holes and on shafts.

(2) Wipe all gears clean.

(3) Clean all gasket sealing surfaces before installation of new seals.

c. Inspection

See page 2-32 for general inspection instructions.



d. Installation

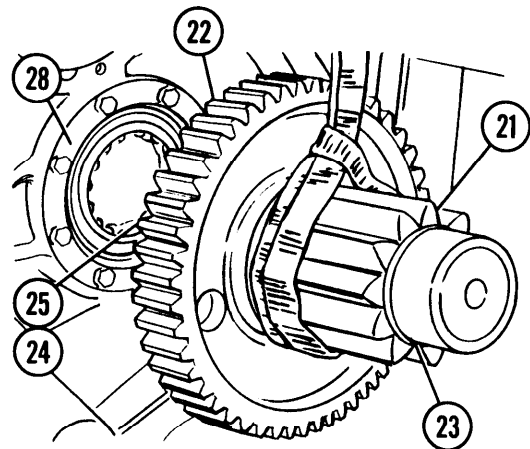
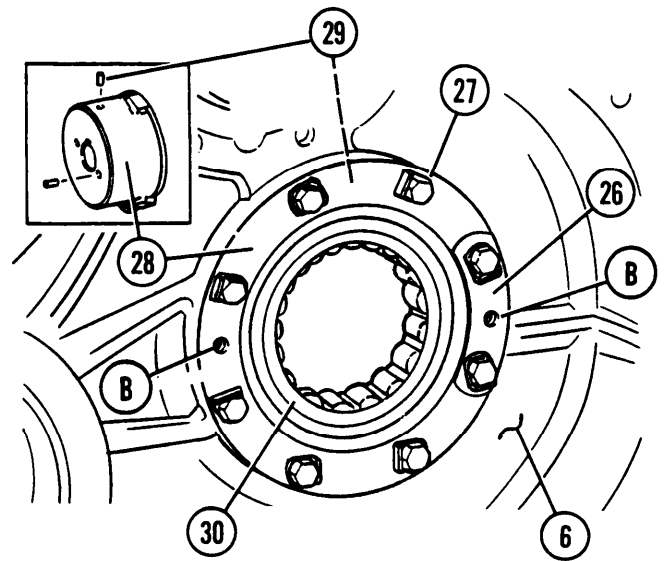
(1) Heat bearing race (31) evenly to a maximum temperature of 275 °F. Install bearing race on pinion (32) shaft.

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 8-4. FINAL DRIVE CASES, GEARS, IDLER PINION, AND BEARINGS -  
 REPLACE (Cont'd)
 

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- (2) Lower temperature of race and roller assembly (30). Align hole in race and roller assembly (30) with hole in bearing cage (28) and install race and roller assembly in cage.
- (3) Use a 1/4" -20NC capscrew to install dowel (29) in bearing cage (28).
- (4) Put liquid gasket material on contact surfaces of bearing cage (28) and steering clutch case (6). Install bearing cage (28) in steering clutch case (6) with oil groove next to race and roller assembly (30) at bottom of hole.
- (5) Install four locks (26) and use a socket to install eight capscrews (27) that secure bearing cage (28) to steering clutch case (6). Bend locks up against flat of capscrew head.
- (6) Install new retainer (24) in idler pinion (21). Install gear (22) over idler pinion so that deep chamfer puts retainer (24) under compression. Retainer must be engaged in groove of gear (22).
- (7) Heat two bearing races (23 and 25) to a maximum temperature of 275°F and install them on each end of idler pinion (21).

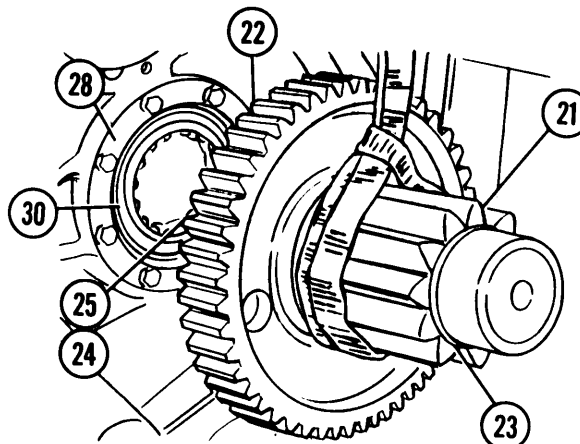


## NOTE

Apply multi purpose type grease in all race and roller assemblies to hold rollers in position for installation of inner races.

8-4. FINAL DRIVE CASES, GEARS, IDLER PINION, AND BEARINGS -  
REPLACE (Cont'd)

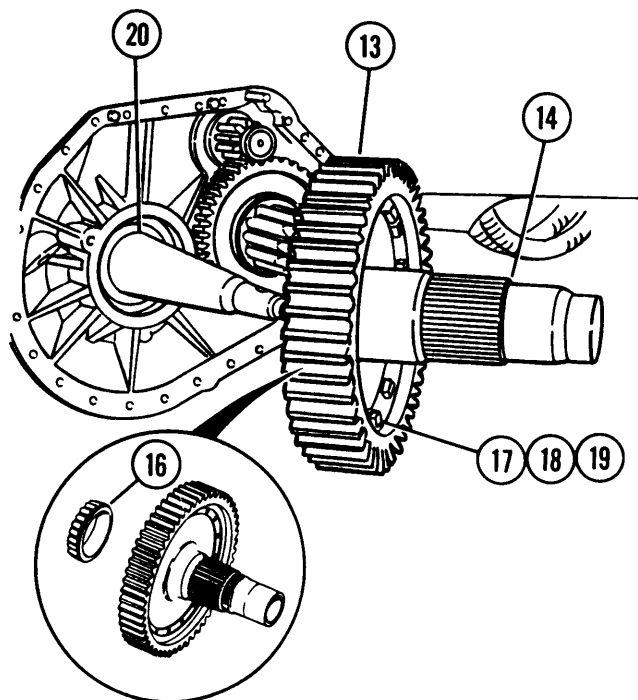
- (8) Attach lifting equipment to gear and pinion assembly. Install race (23) on end of pinion (21) shaft in roller assembly (30) in cage assembly (28). The weight of gear and idler pinion is 20 lbs.



NOTE

The wire will hold the gear and idler pinion in position until final drive case is installed.

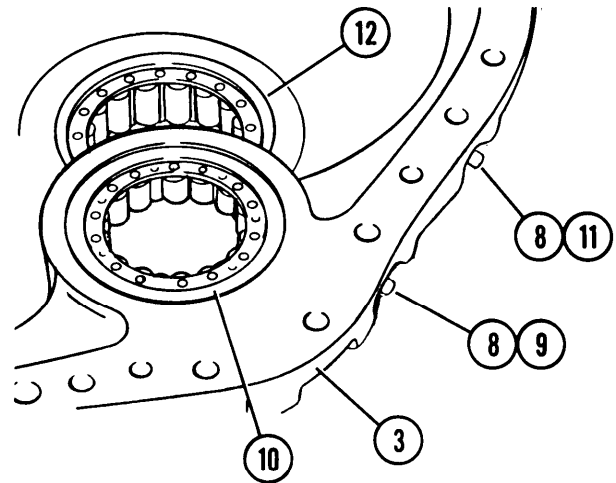
- (9) Fasten a wire around guide pins (4) to hold gear (22) and idler pinion (21) in place.
- (10) Attach lifting equipment to hub (14) and put it in position in gear (13) with long neck side of hub (14) up. The weight of hub is 218 lbs.



- (11) Use two sockets to install sixteen capscrews (19), through hub (14) and gear (13) and secure with eight new locks (17) and sixteen nuts (18). Bend locks up against flat of capscrew head.
- (12) Attach lifting equipment to hub (14) and gear (13) assembly. Turn assembly over and position it on blocks with long neck side of hub (14) down.
- (13) Heat bearing cone (16) to a maximum temperature of 275°F. Install bearing cone (16) on hub (14).
- (14) Attach lifting equipment to gear (13) and put gear (3) and hub (14) in position on sprocket shaft (20). The weight of gear and hub is approximately 350 lbs. Remove lifting equipment.

## 8-4. FINAL DRIVE CASES, GEARS, IDLER PINION, AND BEARINGS - REPLACE (Cont'd)

- (15) Lower temperature of race and roller assemblies (10 and 12). Install race and roller assemblies (10 and 12) in final drive case (3) with dowel hole in race and roller assemblies in line with dowel hole in final drive case (3).



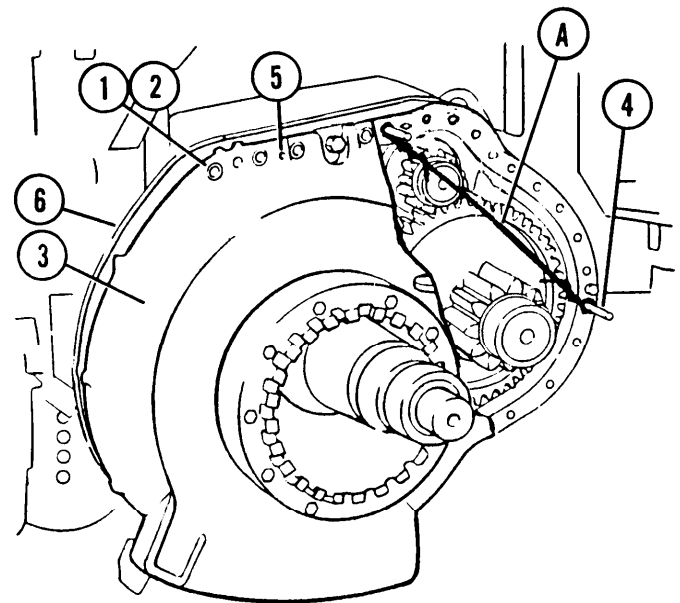
- (16) Use a 1/4"-20NC capscrew to install dowel (11) for race and roller assembly (12).

- (17) Use a #10-32 screw to install dowel (9) for race and roller assembly (10).

- (18) Use a punch and a hammer to install two plugs (8) in dowel holes (9 and 11) in drive case (3).

- (19) Apply liquid gasket material on contact surfaces of steering clutch case (6) and final drive case (3).

- (20) Use lifting equipment to position final drive case (3) on guide pins (4). Remove lifting equipment and wire (A) used to hold idler pinion.



- (21) Push final drive case (3) against steering clutch case (6). Use a socket to install thirty-one capscrews (1) and washers (2) which secure final drive case. Remove two guide pins (4). Tighten capscrews to a torque of  $200 \pm 20$  lb. ft.

- (22) Install sprocket assembly. See page 9-51.

### e. Place In Service

Run engine and test drive.

8-5. FINAL DRIVE PINIONS AND FLANGES - REPLACE/REPAIR

This task covers:

- a. Removal
- b. Disassembly
- c. Assembly
- d. Installation
- e. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Lifting Equipment, 100 lbs.  
 Seal Installer  
 NSN 5120-01-119-1736

Materials/Parts

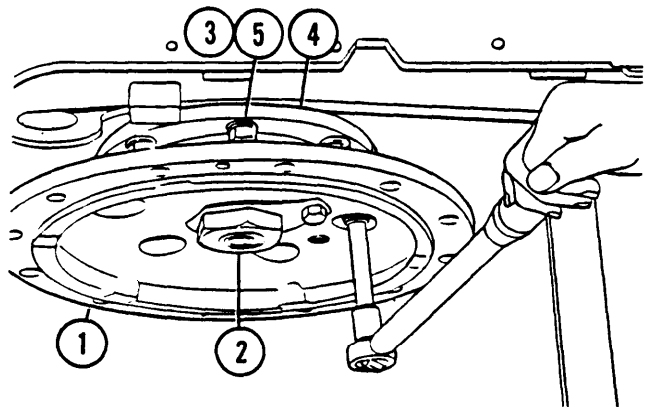
Liquid Gasket Material (App. B, Item )  
 Duo-Cone Seal Assembly (10)  
 O-rings (11)  
 Block of Wood 2' X 2" X 8"  
 Two 3/8" -16NC Forcing Screws  
 #10-32 Screw  
 Gasket (9)  
 Lint-free Rag (App. B, Item 12)

Equipment Condition

Steering clutches removed. See page 10-40.

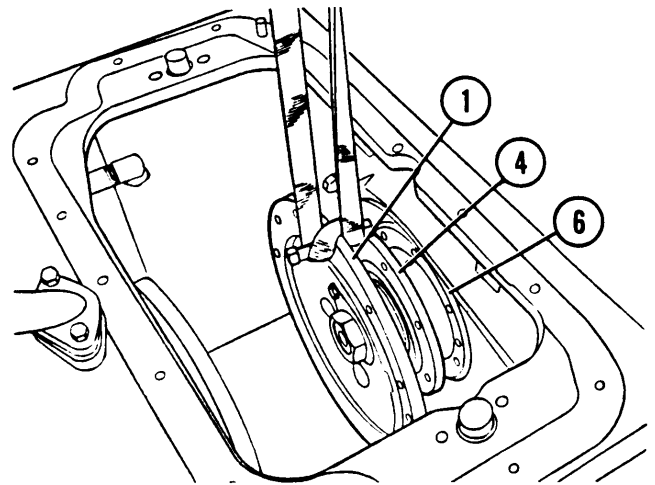
a. Removal

- (1) Wedge block of wood behind final drive flange (1) to prevent it from turning when loosening nut (2).
- (2) If final drive pinion and flange are to be disassembled, use a socket to loosen nut (2).
- (3) Attach lifting equipment to track and move track slightly to align holes in large flange (1) with capscrews (3) in bearing cage (4).
- (4) Use a wrench to remove seven capscrews (3) and seven washers (5) from bearing cage (4). Flange may have to be rotated slightly to get at some of the capscrews.



## 8-5. FINAL DRIVE PINIONS AND FLANGES - REPLACE/REPAIR (Cont'd)

- (5) Rotate flange (1) enough to align holes in flange with forcing screw holes in bearing cage (4) and install two 3/8-16 NC forcing screws in bearing cage.
- (6) Turn forcing screws evenly until bearing cage (4) is free of bevel gear case.
- (7) Attach lifting equipment to final drive pinion (6) and flange (1) as a unit and remove it from gear case. Weight as a unit is 80 lbs.
- (8) Remove gasket material from bearing cage (4) flange and cage mounting surface on bevel gear case.

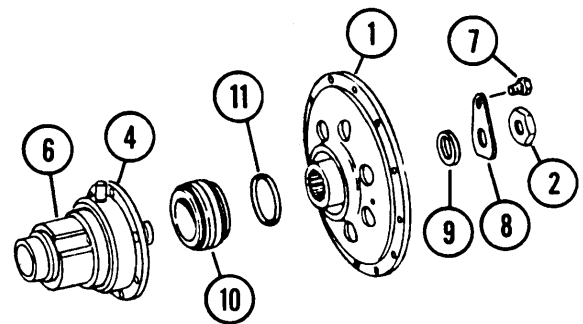


## b. Disassembly

- (1) Remove large nut (2) from pinion (6) shaft.
- (2) Remove capscrew (7) and lock (8) from flange (1).

**WARNING**

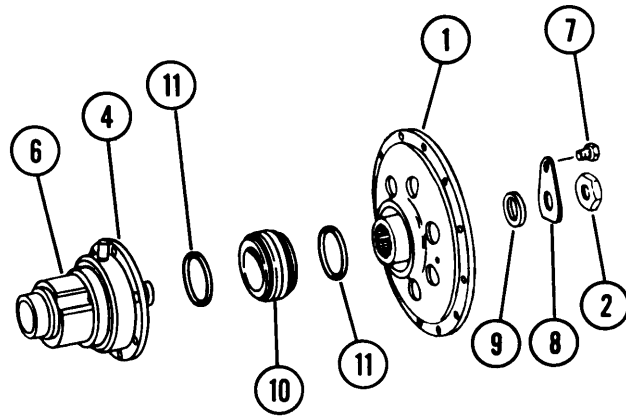
Reinstall large nut (2) on pinion (6) shaft after capscrew (7) and lock (8) have been removed. Because the flange is installed on pinion shaft with force of 35 to 40 tons, nut will prevent flange from coming off and causing personal injury.





8-5. FINAL DRIVE PINIONS AND FLANGES - REPLACE/REPAIR (Cont' d)

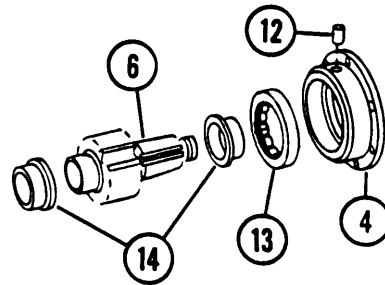
- (3) Install large nut (2) on pinion (6) shaft with distance of 0.125 in. between nut (2) and flange (1).
- (4) Install puller on flange (1) and apply pressure to break flange loose from pinion (6) shaft.
- (5) Remove puller, nut and flange (1) from pinion (6) shaft.
- (6) Remove gasket (9) from hub of flange (1). Discard gasket.



NOTE

Duo-Cone seal assembly is a two piece seal. One half of seal is in flange (1); the other half is in bearing cage (4).

- (7) Remove Duo-Cone seal assembly (10) from flange (1) and bearing cage (4).
- (8) Remove O-ring seal 11 from Duo-Cone seal assembly (10). Discard O-ring. Discard Duo-Cone seal (10).
- (9) Remove bearing cage (4) from pinion (6) shaft.
- (10) Install #10-32 screw in dowel (12) and pull on screw to remove dowel from bearing cage (4).
- (11) Use a punch and hammer to remove race and roller assembly (13) from bearing cage (4).
- (12) Install puller on pinion (6) shaft and remove bearing race (14) from one end of shaft.
- (13) Repeat STEP 12 at other end of pinion shaft.



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## 8-5. FINAL DRIVE PINIONS AND FLANGES - REPLACE/REPAIR (Cont'd)

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### c. Assembly

- (1) Heat two bearing races (14 to a maximum temperature of 275 °F and install one race at each end of pinion (6) shaft. Races must contact shoulders on pinion shaft.
- (2) Lower temperature of race and roller assembly (13) and install assembly in bearing cage (4) with hole in outer race in line with dowel hole in cage.
- (3) Use a #10-32 screw to install dowel (12) in bearing cage (4) to secure race and roller assembly (13).
- (4) Install bearing cage 4 on spline end of pinion (6) shaft with flange toward splines.

#### CAUTION

- Duo-Cone seals (10) must be used as a matched pair or failure will result. Keep together as a set.
- Sealing contact surfaces must be clean. Any foreign material or corrosion will cause seal to leak.

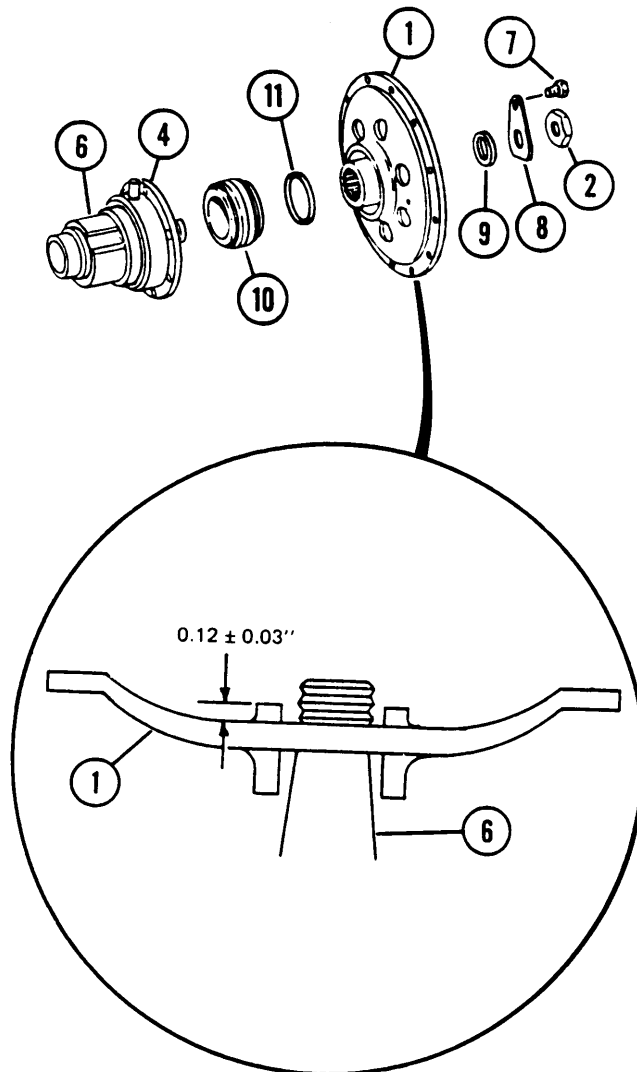
#### NOTE

Seals and seal contact surfaces must be clean and dry. After installation, apply clean oil to contact surfaces of metal seals.

- (5) Replace Duo-Cone seal (10) and install O-ring (11) on Duo-Cone seal (10).

8-5. FINAL DRIVE PINIONS AND FLANKS - REPLACE/REPAIR (Cont'd)

- (6) Install Duo-Cone seal assembly (10) in bearing cage (4).
- (7) Clean and dry splines on pinion (6) shaft.
- (8) Position flange (1) on splines of pinion (6) shaft, install puller, and press flange on pinion shaft with a force of 35 to 40 tons. Remove puller.
- (9) Measure distance from shoulder on pinion (6) shaft to hub face in center of flange (1). This distance must be  $0.12 \pm 0.03$  in.
- (10) If distance in STEP (9) is less than 0.09 inches, replace flange (1) and pinion (4). If distance exceeds 0.15 inches, remove flange (1), clean pinion (4) shaft splines, and reinstall flange (1).
- (11) Wipe gasket seat in flange (1) hub clean and dry. Install gasket (9) in flange hub.
- (12) Install lock (8) on flange (1) with capscrew (7) using wrench.



NOTE

Nut (2) is tightened and lock (8) is formed to secure nut, after pinion and flange assembly is installed in bevel gear case.

- (13) Install nut (2) on pinion (6) shaft finger tight.

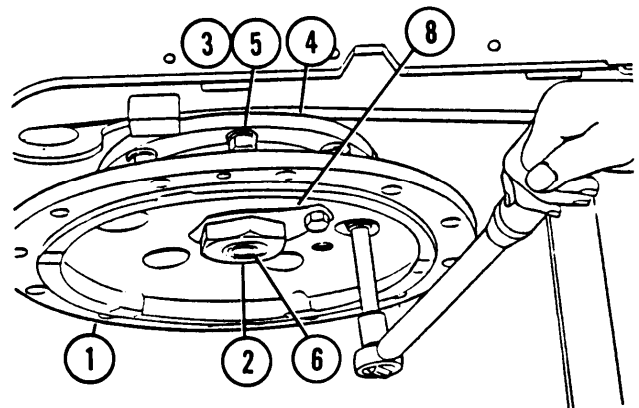
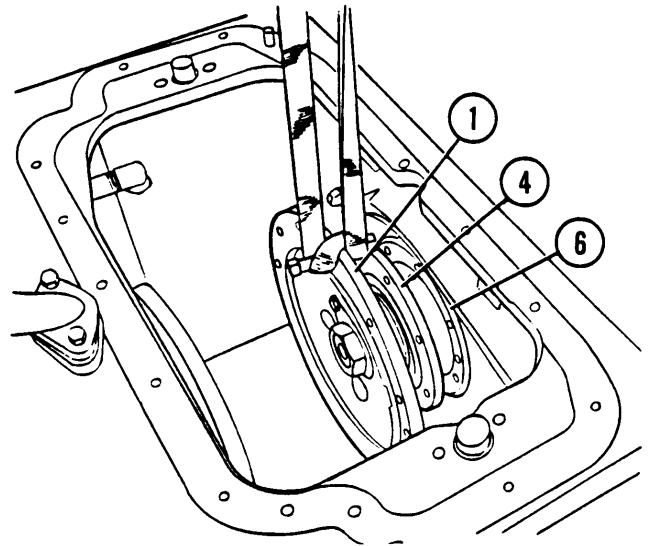
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 8-5. FINAL DRIVE PINIONS AND FLANGES - REPLACE/REPAIR (Cont' d)
 

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d. Installation

- (1) Apply liquid gasket on bearing cage (4) flange and cage mounting surface on bevel gear case.
- (2) Use lifting equipment to install final drive pinion (6) and flange (1) as a unit with teeth on final drive pinion (6) and idler pinion gear (inside bevel gear case) engaged. Seat pinion on bearing race (14) in bearing (inside bevel gear case). Position bearing cage (4) flange with dowel hole up, oil hole down and capscrew holes aligned with holes in bevel gear case.
- (3) Attach lifting equipment to track and move track to align holes in large flange (1) with holes in bearing cage (4).
- (4) Use a wrench to install seven capscrews (3) and seven washers (5) to secure bearing cage (4). Tighten capscrews (3) to a torque of  $100 \pm 16$  ft. Flange (1) may have to be rotated slightly to get at some capscrews.
- (5) Tighten nut (2) on pinion (6) shaft to a torque of  $700 \pm 100$  lb. ft. using 2-5/8" wrench.
- (6) Use a hammer and punch to bend lock (8) against nut (2).
- (7) Install steering clutches. See page 10-40.

e. Place In Service

Run engine and test drive in all speeds.

8-6. BEVEL GEAR AND SHAFT - REPLACE

This task covers:

- a. Removal
- b. Installation
- c. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Lifting Equipment, 100 lbs.

Materials/Parts

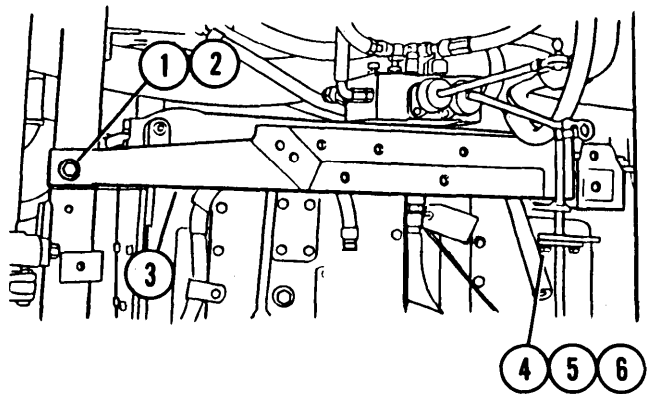
Liquid Gasket (App. B, Item 3)  
 Block of Wood 2' X 2" X 4"  
 Piece of Bar Stock 8" X 1/4" X 1"  
 Two 1/2" -13NC Forcing Screws  
 Prussian Blue, Red Lead or Paint (App. B, Item-10)  
 Nut  
 Vulcanizing Silicone (App. B, Item 15)

Equipment Condition

Steering clutch control valve removed. See page 10-59.  
 Steering clutch hubs removed. See page 10-71.  
 Hydraulic tank mounting brackets and plates removed. See TM5-2410-237-20.

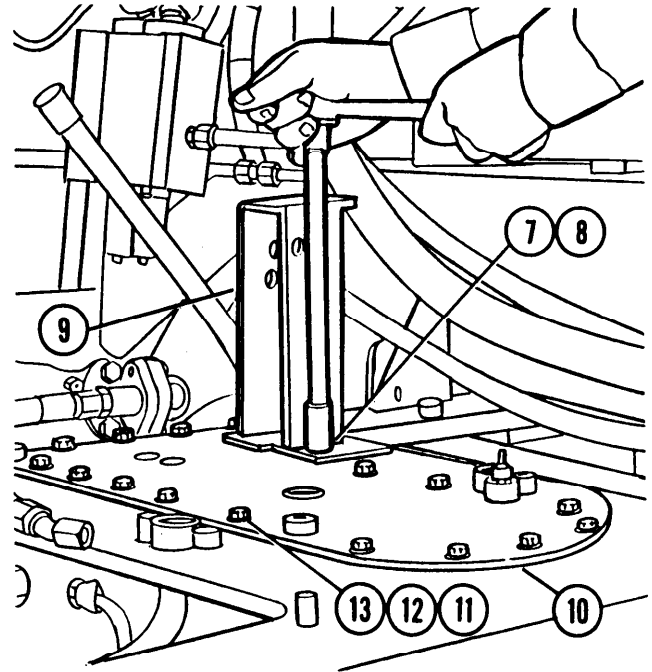
a. Removal

- (1) Use a wrench to remove capscrew (1) and flat washer (2) from end of support assembly (3) at gear case.
- (2) Use two wrenches to remove two capscrews (4), two nuts (5) and two lockwashers (6) from other end of support assembly (3) and remove support assembly.

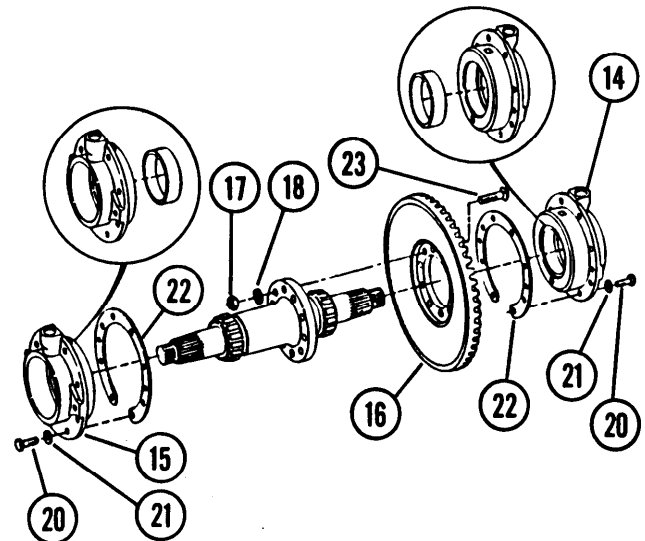


## 8-6. BEVEL GEAR AND SHAFT - REPLACE (Cont'd)

- (3) Use a socket to remove four capscrews (7), four lockwashers (8) and bracket assembly (9) from top of gear case cover (10).
- (4) Use a socket to remove nineteen capscrews (11), nineteen flat washers (12), three spacers (13) and cover (10) from bevel gear case.



- (5) Remove oil lines from two bearing cages (14 and 15).
- (6) Use a piece of bar stock between teeth in bevel gear (16) and bottom of gear case to hold gear while removing ten nuts (17) and ten washers (18) using a wrench.
- (7) Attach lifting equipment to bevel gear shaft (19) for support.
- (8) Use a wrench to remove eight capscrews (20) and eight washers (21) from bearing cage (14) at bevel gear end of bevel gear shaft (19).
- (9) Install two 12"-13NC forcing screws in bearing cage (14) and turn screws evenly to remove cage.
- (10) Remove shims (22) from bearing cage (14).

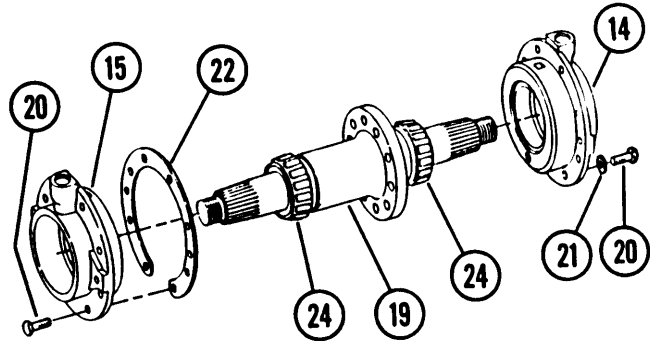


8-6. BEVEL GEAR AND SHAFT - REPLACE (Cont' d)

- (11) Repeat STEPS 8, 9 and 10 for bearing cage (15) steering clutch end of bevel gear shaft (19).

NOTE

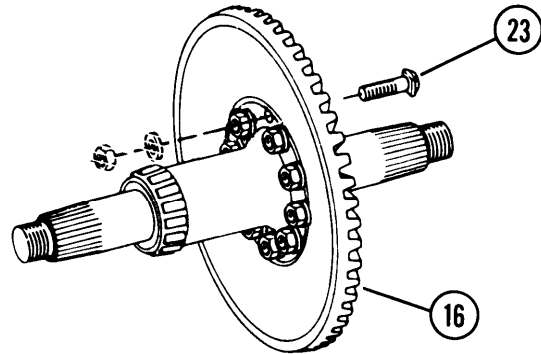
Install large nut on each end of gear shaft to protect threads.



- (12) Slide gear shaft (19) 3 to 4 inches toward clutch compartment and remove ten capscrews (23) from bevel gear (16).

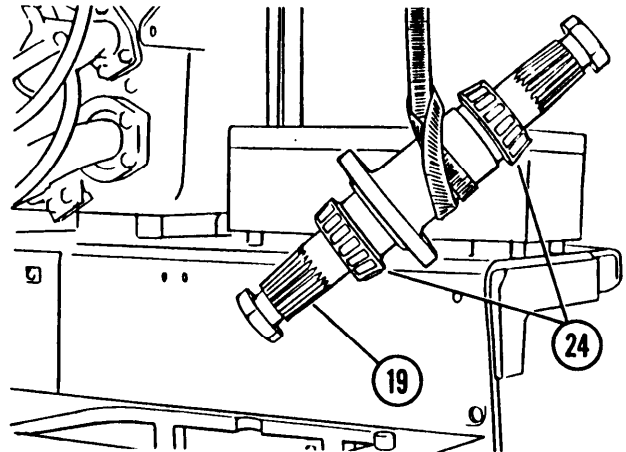
NOTE

Put blocking under bevel gear during removal of gear shaft.

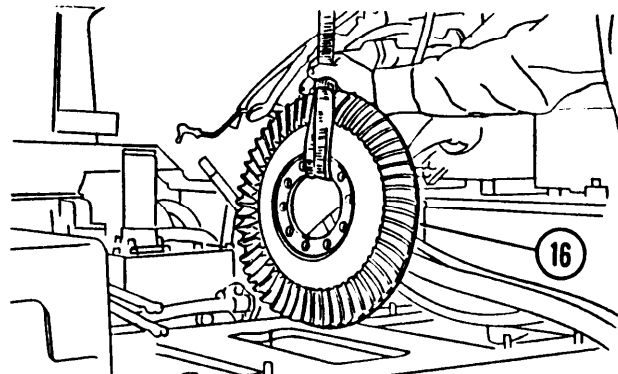


- (13) Use lifting equipment to slowly remove bevel gear shaft (19) through steering clutch compartment. Weight of shaft is 46 lb.

- (14) Remove large nut from each end of shaft and use a puller to remove two bearings (24) from bevel gear shaft (19).



- (15) Use lifting equipment to remove bevel gear (16) from gear case. Weight of bevel gear is 54 lbs.

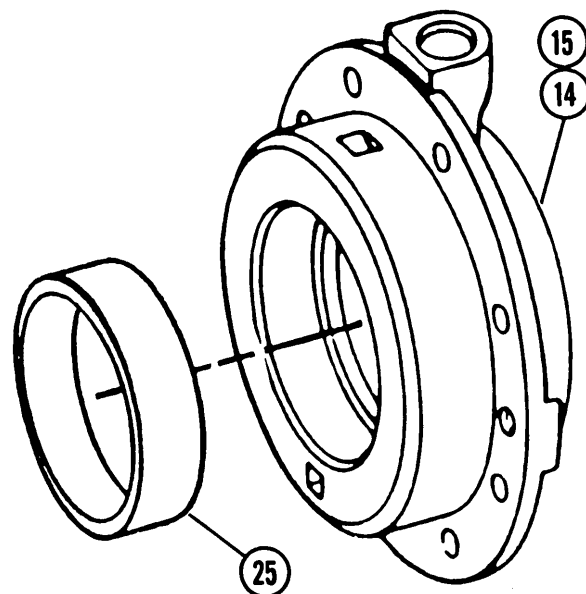


8-6. BEVEL GEAR AND SHAFT - REPLACE (Cont'd)

- (16) Use a puller to remove bearing races (25) from bearing cages (14 and 15).

b. Installation

- (1) Lower temperature of two bearing races (25) and use a suitable bearing installation tool to install in bearing cage (14 and 15). The tool will eliminate accidental locking.
- (2) Heat two bearings (24) to maximum temperature of 275 F and install one on each end of bevel gear shaft (19).



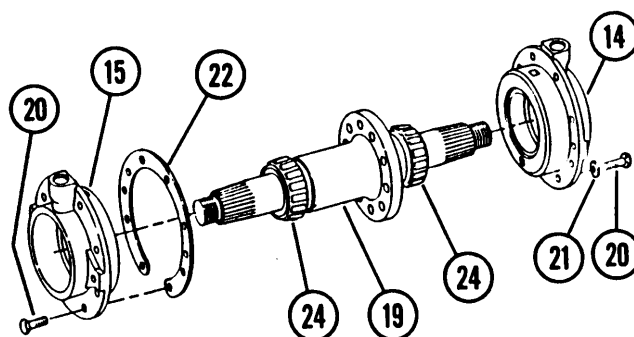
NOTE

If transmission is in tractor, install bevel gear shaft (19) without bevel gear (16) and follow installation procedure starting at STEP 3. If transmission is not in tractor, install bevel gear shaft (19) with bevel gear (16) and follow installation procedure starting at STEP 15. Install large nut on each end of gear shaft to protect threads.

- (3) Use lifting equipment to position bevel gear shaft (19) in bevel gear case.

NOTE

Leave hoist attached to shaft for support during bearing adjustment procedure.





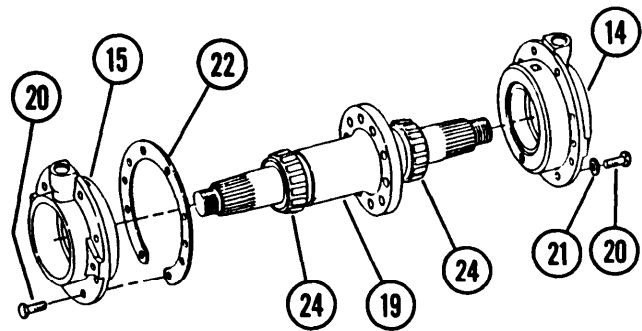
8-6. BEVEL GEAR AND SHAFT - REPLACE (Cont'd)

- (4) Adjust bearings (24) on bevel gear shaft (19) as follows:
- (a) Install bearing cage (15) at steering clutch end of shaft with full package of shims (22) and eight capscrews (20). Tighten capscrews evenly using wrench. No washers used at this time. Thickness of full shim pack is 0.119 to 0.125 in.
  - (b) Install other bearing cage (14) at bevel gear end of shaft (19) with eight capscrews (20) and eight washers (21). No shims used at this time.

CAUTION

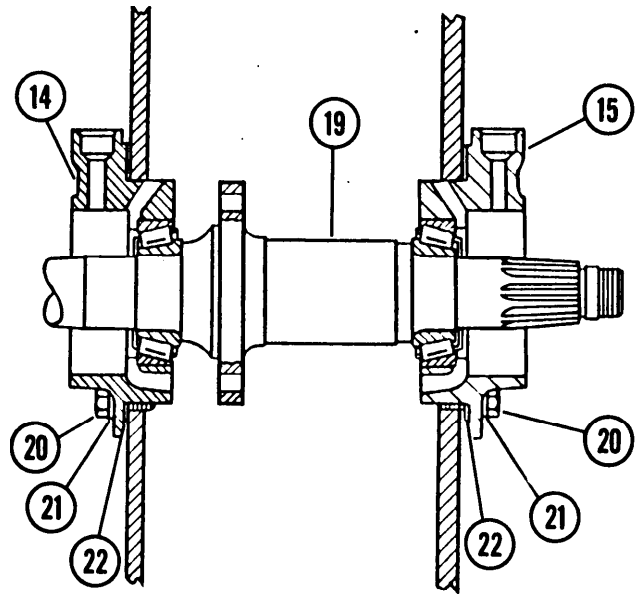
Torque valve is for new bearings.

- (c) Tighten capscrews (20) evenly using wrench while turning gear shaft (19) with torque wrench, until torque reading is 70 to 85 lb. in.
- (d) With feeler gauge, measure gap between flange of bearing cage (14) and face of bevel gear case at each capscrew. Gap must be the same around entire flange.
- (e) Remove bearing cage (14) and install shims (22) on cage equal to feeler gauge reading from previous STEP.



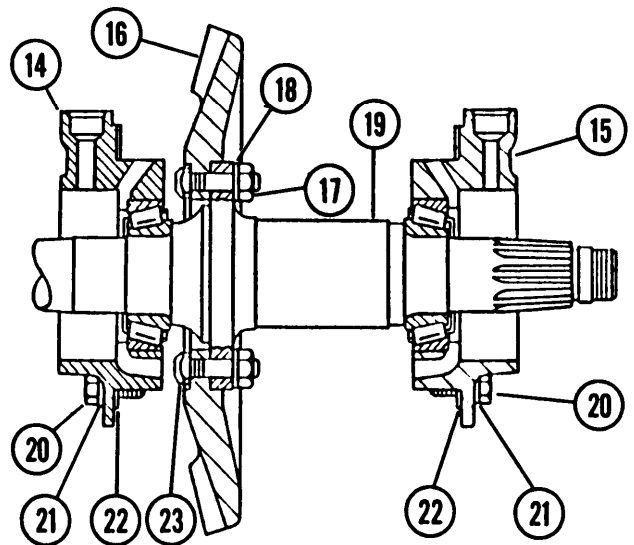
## 8-6. BEVEL GEAR AND SHAFT - REPLACE (Cont'd)

- (f) Reinstall bearing cage (14) and shims (22) on shaft (19) with eight capscrews (20) and eight washers (21). Use a wrench to tighten capscrews evenly to a torque of  $100 \pm 10$  lb. ft.
- (g) Remove eight capscrews (20) from bearing cage (15) at steering clutch end of gear shaft (19). Reinstall capscrews (20) with eight washers (21) and tighten capscrews to a torque of  $100 \pm 10$  lb. ft.
- (h) Check torque on steering clutch end of shaft (19). Torque must be 70 to 85 lb. in. If necessary, remove or add shims (22) under bearing cage (14) until torque is correct.



- (5) Install bevel gear (16) on bevel gear shaft (19) as follows:

- (a) Attach lifting equipment to bevel gear shaft (19) to take weight off bearings.
- (b) Use a wrench to remove eight capscrews (20), eight washers (21), shims (22) and bearing cage (15) at clutch end of shaft (19). Identify shims and bearing cage for assembly.
- (c) Repeat STEP b. for bearing cage (14) at other end of shaft (19).
- (d) Use lifting equipment to remove gear shaft (19) from gear case.
- (e) Use lifting equipment to position bevel gear (16) in gear case with hole centered at bearing cage hole. Block gear in position until gear shaft (19) is installed.



8-6. BEVEL GEAR AND SHAFT - REPLACE (Cont' d)

(f) Use lifting equipment to position bevel gear shaft (19) in gear case with hub end of shaft through bevel gear (16). Leave lifting equipment attached.

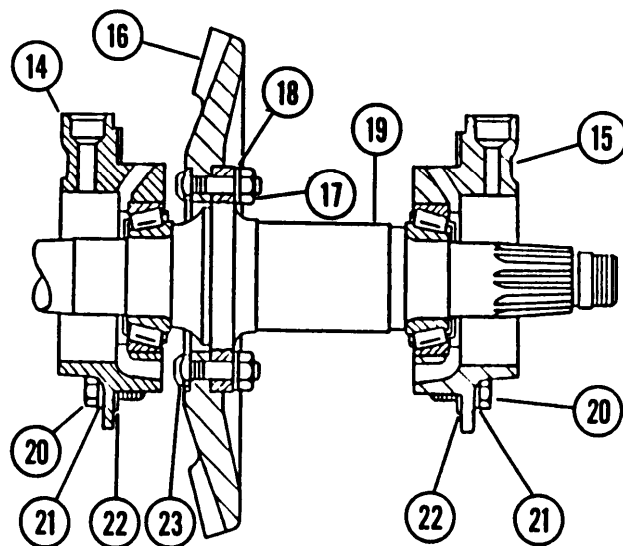
(g) Install bevel gear (16) on shaft (19) with ten capscrews (23), ten washers (18) and ten nuts (17) finger tight.

(h) Install bearing cage (14) at gear end of shaft (19) with eight capscrews (20), eight washers (21) and shims (22). Tighten capscrews finger tight and use lifting equipment to keep weight of shaft (19) off bearings.

(j) Repeat STEP h for bearing cage (15) at other end of gear shaft.

(k) Use a wrench to tighten eight capscrews (20) on bearing cages (14 and 15) evenly to a torque of  $100 \pm 10$  lb. ft.

(l) Use a wrench and bar or block to hold bevel gear (16) in position. Tighten ten nuts (17) to secure gear to shaft (19). Remove lifting equipment.



(6) If necessary, install transmission. See page 7-26.

(7) Make adjustment to bevel gear position for correct gear clearance (backlash) between bevel gear (19) and bevel pinion (from transmission) as follows:

(a) Position magnetic based dial indicator so indicator tip contacts a tooth on bevel pinion.

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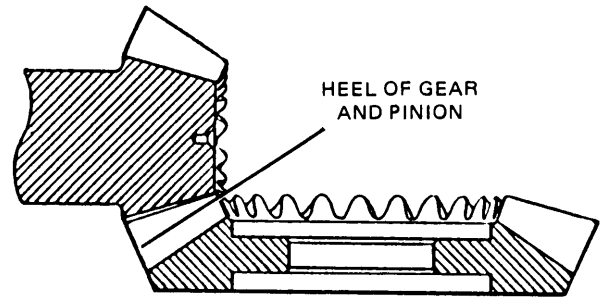
 8-6. BEVEL GEAR AND SHAFT - REPLACE (Cont'd)
 

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- (b) Wedge block of wood between bevel gear (16) and case so bevel gear will not turn.

## NOTE

Make sure bevel pinion (from transmission) is held as far as possible toward front of machine when gear clearance (backlash) is measured. Correct backlash is 0.010 + 0.004 or 0.003 in.

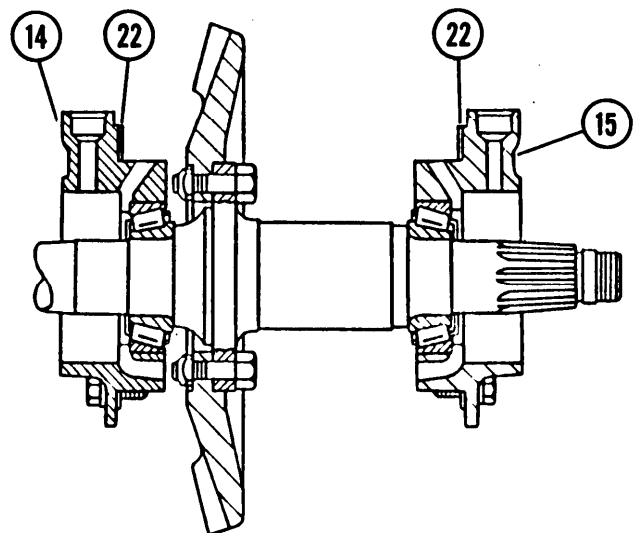


- (c) push bevel pinion toward front of machine as far as possible. Move bevel pinion clockwise and then counterclockwise. The free movement (backlash) will be the difference in values read on dial indicator.
- (d) Repeat STEPS b and c at three more points around bevel gear (16) to find point of smallest gear clearance (backlash).

## NOTE

The adjustment of the bearings for bevel gear shaft (19) will not change by movement of shims from one bearing cage to the other bearing cage as long as total thickness of shims is the same.

- (e) If measurement of smallest gear clearance (backlash) is too large, remove some of shims (22) from behind bearing cage (14). Install shims (that were removed) behind bearing cage (15).
- (f) If measurement of smallest gear clearance (backlash) is too small, remove some of shims (22) from behind bearing cage (15). Install shims (that were removed) behind bearing cage (14).



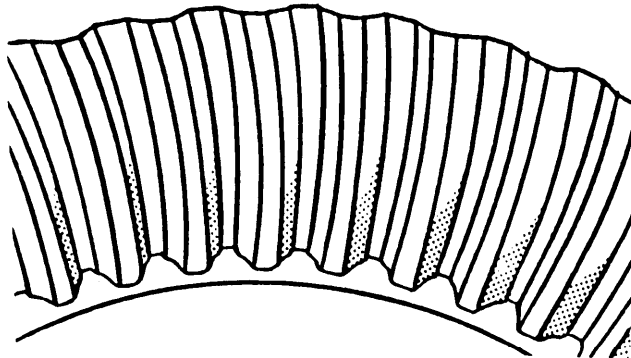
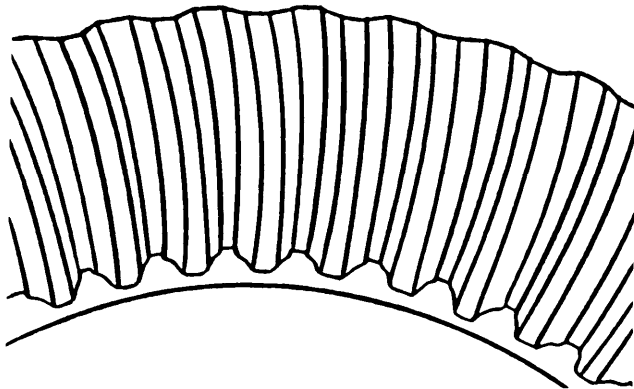
8-6. BEVEL GEAR AND SHAFT - REPLACE (Cont' d)

(8) After bevel gear bearing preload and gear clearance (backlash) adjustments have been made, check tooth contact setting between bevel gear and bevel pinion shaft as follows:

(a) Put thin coat of prussian blue, red lead or paint on bevel gear teeth. Turn bevel pinion shaft and check marks made on bevel gear teeth.

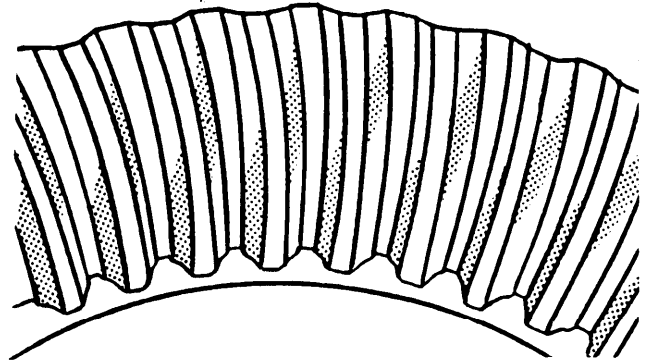
(b) With no load, correct tooth setting will be as shown. The area of contact starts near toe of gear and goes 30% up length of tooth. With this setting, when load is put on gear it will be over correct area of teeth.

(c) If bevel pinion shaft is too far away from bevel gear, short toe contact will be the result as shown. The teeth of bevel pinion shaft will be in contact with toe ends of convex faces (part that makes a curve toward outside), and top edge of heel end of concave faces (part that makes a curve toward inside). To correct this, add shims between bevel pinion shaft and bearing cage of transmission. Check gear clearance (backlash) and tooth contact again.



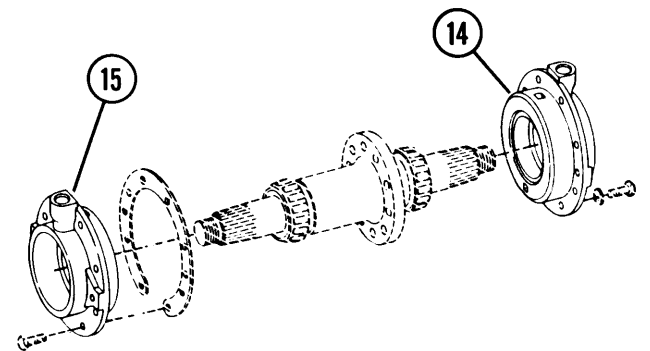
## 8-6. BEVEL GEAR AND SHAFT - REPLACE (Cont'd)

- (d) If bevel pinion shaft is too near to center of bevel gear, short heel contact will be the result as shown. The teeth of bevel pinion shaft will be in contact with toe ends of concave faces (part that makes a curve toward the inside) and the heel ends of convex faces (part that makes a curve toward the outside). To correct this, move pinion shaft away from bevel gear by removal of shims between bearing cage of transmission and bevel pinion shaft. After doing this, check gear clearance (backlash) and tooth contact again.

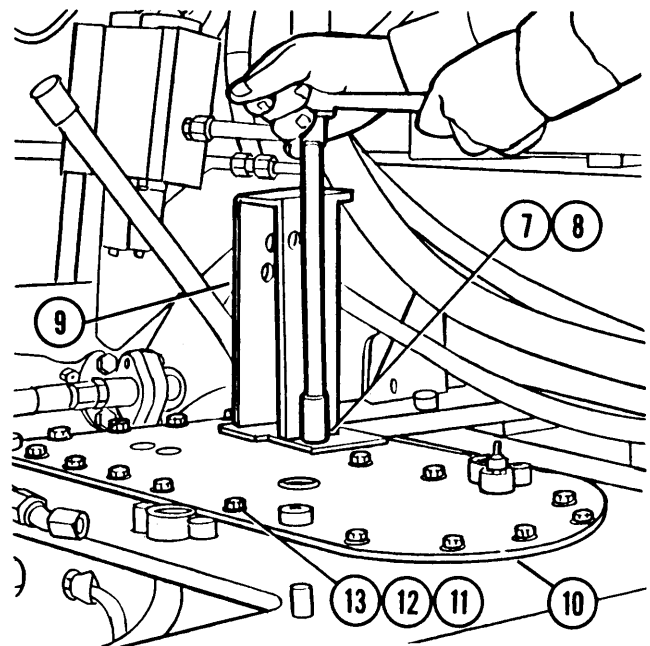


## NOTE

Several adjustments must be made for correct tooth contact setting. If gear clearance (backlash) is changed, tooth contact setting will change.

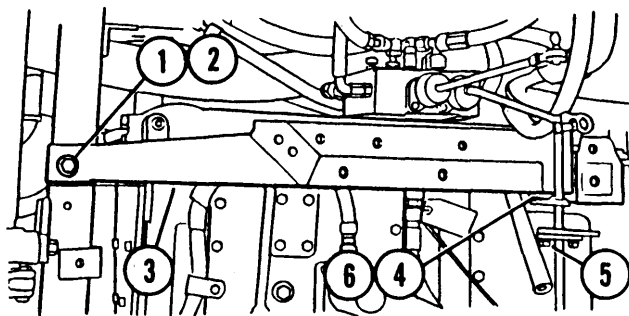


- (9) Remove all of the prussian blue, red lead or paint from bevel gear and bevel pinion shaft.
- (10) Install oil line in bearing cage (14 and 15).
- (11) Place a bead of vulcanizing silicone on cover (10). Use a wrench to install cover (10) on bevel gear case with nineteen capscrews (11), nineteen flat washers (12) and three spacers (13).
- (12) Use a wrench to install bracket (9) on gear case cover (10) with four capscrews (7) and four lockwashers (8).



8-6. BEVEL GEAR AND SHAFT - REPLACE (Cont' d)

- (13) Position support assembly (3) and using two wrenches, install one end of support with two capscrews (4), two lockwashers (6) and two nuts (5).
- (14) Use a wrench to install other end of support (3) with capscrew (1) and flat washer (2).
- (15) Install hydraulic tank mounting brackets and plates. See TM5-2410-237-20.
- (16) Install steering clutch hubs. See page 10-71.
- (17) If transmission is not in tractor use the following procedure:
  - (a) Install bevel gear (16) on bevel gear shaft (19) using 5e, f and g.
  - (b) Adjust bearings using STEPS 4a through h.
  - (c) Use STEPS 6 through 14 to complete the procedure.



c. Place In Service

Run engine and test drive in all speeds.

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## 8-7. FINAL DRIVE BEARINGS -ADJUST

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This task covers:

Adjustment of Final Drive Bearings

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### INITIAL SETUP

#### Applicable Configurations

All

#### Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

#### Special Tools

6V0082 Tool Arrangement

#### Materials/Parts

Gasket (7)  
Lint-free Rag (App. B, Item 12)  
Final Drive Compartment Oil  
OE/HDO-30 (See L05-2410-237-12)  
Final Drive Bearings

---

### Adjustment of Final Drive Bearings

#### NOTE

When adjusting bearings, the track must be loosened, not removed.

- (1) Refer to track removal procedure, page 9-73, STEPS (1) through (6), to loosen track.

#### NOTE

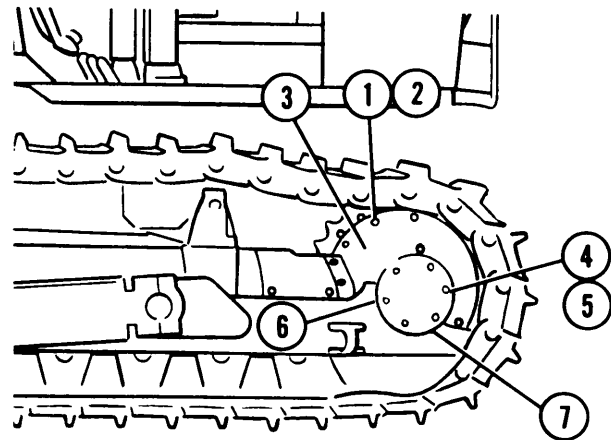
The sprocket assembly must turn while the adjustment to the final drive bearing is made.

- (2) Lift machine according to Ground Handling, page 11-33.



8-7. FINAL DRIVE BEARINGS -ADJUST (Cont'd)

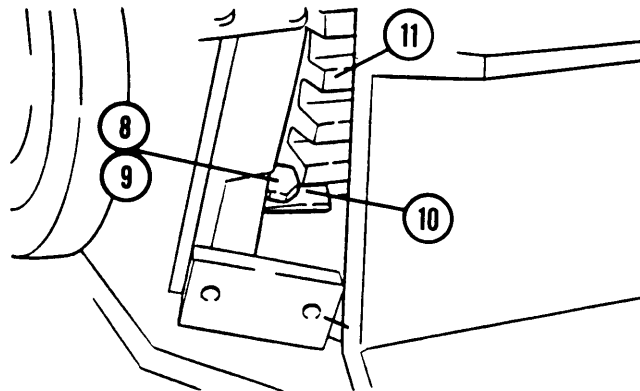
- (3) Use a wrench to remove six capscrews (7), six washers (8) and guard (9) from the track roller frame.
- (4) Use a wrench to remove six capscrews (4), six lockwashers (5), and cap (6) from the support.
- (5) Remove and discard gasket (7).



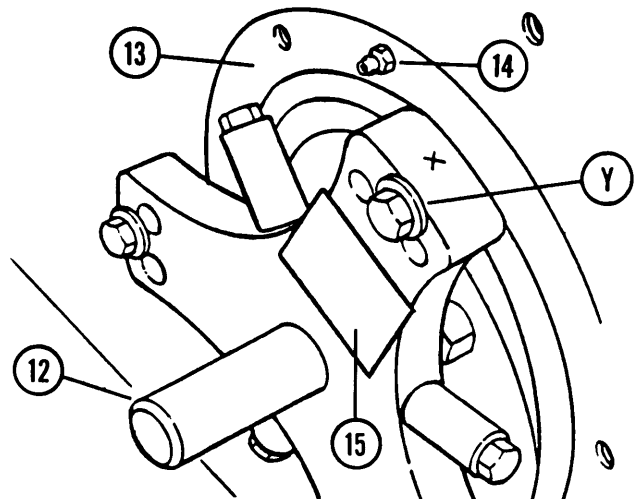
- (6) Remove capscrew (8), nut (9) and lock (10) from lock ring (11) using two wrenches.

NOTE

All parts must be clean. The bearings must have final drive compartment oil on them. The adjusting nut must run freely on the threads and the bearing cage must move freely in the holder.

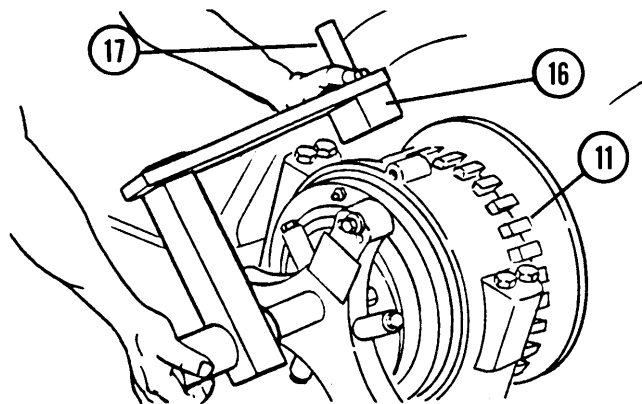


- (7) Install stand, 6V0082 tool arrangement, washer and capscrew as follows:
  - (a) Install trunion group (12) (use holes (Y)) on the track roller frame support assembly (13). The trunion arm with the identification "X" must be fastened to the first hole with threads clockwise from grease fitting (14). See decal (15).

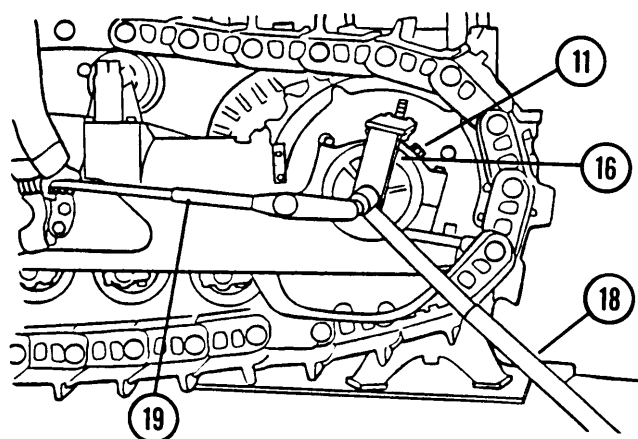


## 8-7. FINAL DRIVE BEARINGS -ADJUST (Cont'd)

- (b) Install driver group (16) on the trunnion. Pin (17) must be in the retracted position as shown.
- (c) Push pin (17) down between two lugs on adjusting nut (11).



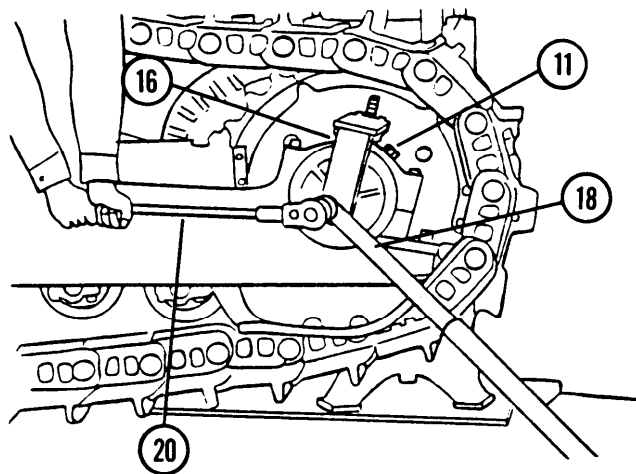
- (8) Install torque multiplier (18) and torque wrench (19) over driver group (16). Start machine and turn sprocket slowly while adjusting nut (11) is turned counterclockwise to tighten to a torque of  $2500 \pm 300$  ft. lbs.
- (9) Remove torque wrench (19) and install ratchet wrench (20). Turn adjusting nut (11) clockwise (six to ten lugs) to lower the torque to less than  $350 \pm 10$  ft. lbs.



## NOTE

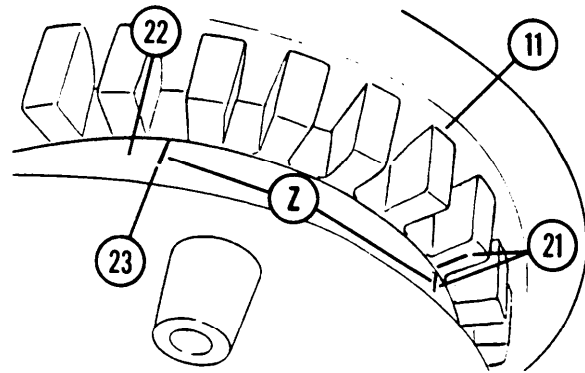
If it is not possible to get a torque below  $350 \pm 10$  ft. lbs. after the adjusting nut is loosened, a separation of the tracks must be made to make the adjustment of the bearings. See page 9-74.

- (10) Remove torque multiplier (18) and install torque wrench (19) and adapter. Tighten adjusting nut (11) to a torque of  $250 \pm 10$  ft. lbs.

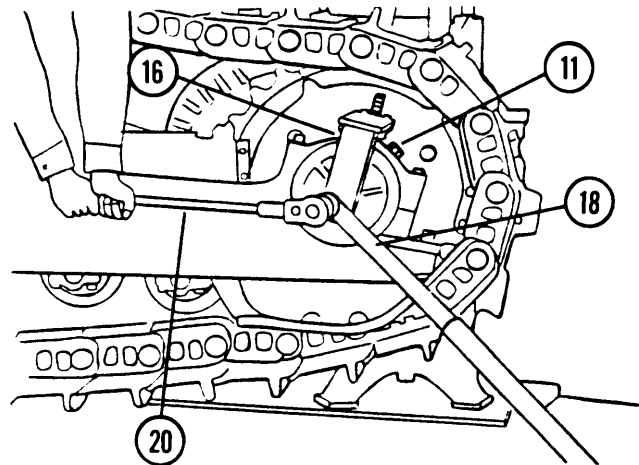


8-7. FINAL DRIVE BEARINGS - ADJUST (Cont'd)

- (11) Move the drive group (16) out of the way and put a mark (21) on adjusting nut (11) and holder assembly (22) in alignment with each other. Put a mark (23) on holder assembly (22) counterclockwise from mark (21) (distance (Z)) that is  $5.84 \pm 0.06$  in. ( $148.3 \pm 1.5$  mm) from mark (23).



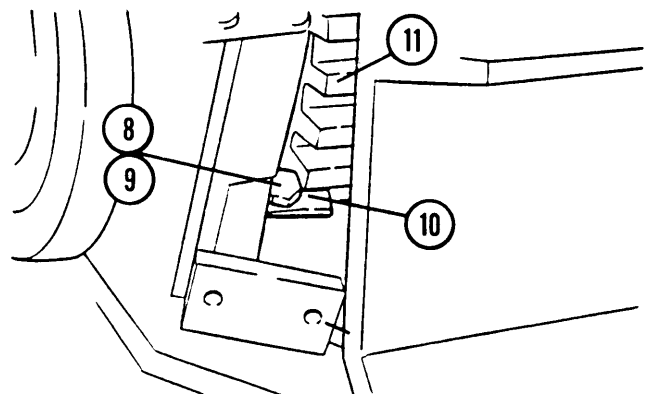
- (12) Install driver group (16) on the shaft of the trunnion group.
- (13) Install torque multiplier (18) and tighten the adjusting nut (11) until marks (21) and (23) are in alignment.



NOTE

If necessary, tighten adjusting nut (11) more to install lock (10) in one of the notches of the adjusting nut (11).

- (14) Install lock (10) with capscrew (8) and nut (9) using a wrench.
- (15) Remove the following tooling: capscrew, washer, tool arrangement and stand.

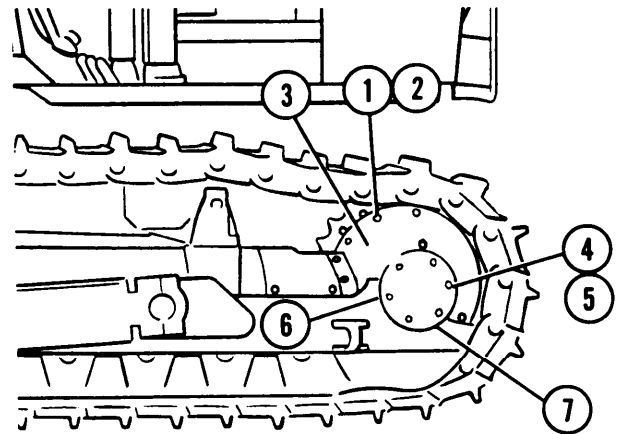


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**8-7. FINAL DRIVE BEARINGS -ADJUST (Cont' d)**

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- (16) Place gasket (7) and cap (6) into position and install six capscrews (4) and six washers (5) that hold cap in position. Tighten with wrench.
- (17) Install guard (3) with six capscrews (1) and six lockwashers (2). Tighten capscrews (1) with a wrench.
- (18) Fill with grease. See Drive Sprockets - Replace, page 9-62, STEPS 31 and 32.
- (19) Lower machine to the ground following procedure in Ground Handling, page 11-33.
- (20) Adjust the track. See TM5-2410-237-20.



## CHAPTER 9

## TRACK MAINTENANCE

## Section I. DESCRIPTION AND DATA

## 9-1. GENERAL

Track maintenance procedures not covered in this chapter can be found in TM5-2410-237-20.

## 9-2. PRINCIPLES OF OPERATION

- a. Undercarriage. The undercarriage connects to the body and final drives. Two track assemblies are kept in parallel alignment by the diagonal braces of the track roller frames. Each track assembly can move up and down by itself.

The components of the undercarriage are: equalizer bar, track rollers, track carrier rollers, tracks, front idlers, track roller frames, track adjusters and recoil springs.

The front idlers, track rollers and track carrier rollers use seals to prevent the loss of lubricant and to keep out foreign material.

- b. Track Roller Frames. The track roller frames are fastened to the final drive bearing cage and to the steering clutch and bevel gear case.

The track rollers, track carrier rollers, front idlers, track adjusters and recoil springs are fastened to the track roller frames.

The alignment of the track roller frames and final drives is controlled by the shim adjustment of the final drives.

- c. Track Carrier Rollers. The track carrier rollers give support to the track between the sprocket and the front idler. The shaft of the track carrier roller is fastened to a support bracket by a clamp. The support bracket is fastened to the track roller frame.

The track carrier rollers must be in alignment with the sprocket and the front idler. The alignment is done by the movement of the roller shaft inside the support bracket. The carrier rollers turn on two tapered roller bearings.

- d. Track Rollers. The track rollers are fastened to the track roller frames. The track rollers are in contact with the inside surfaces of the track links. Flanges on the track rollers prevent the movement of the track from side to side. The inside surfaces of the track links cause an equal distribution of the weight of the machine along the track.

Each track roller frame has six track rollers, three single flange and three double flange.

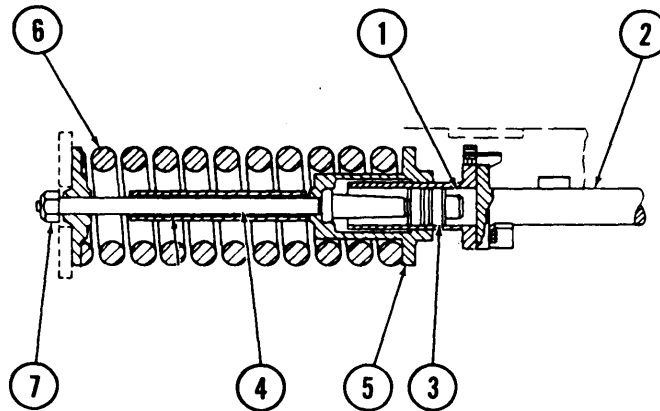
The flange at the center of shaft gets the side load on the roller. Bearings also get the side load on the roller. The amount of side movement or end clearance of the shaft cannot be adjusted.

- e. Front Idlers. The front idlers put the tracks in position in front of the track rollers. They also keep the tracks in alignment with the sprockets.

The adjustment of the tracks is done by the movement of the front idlers. The track adjusters move the front idlers and hold them in position.

The position of the front idlers is controlled by shims. The front idlers must have correct alignment with the track roller frames.

- f. Recoil Springs and Track Adjuster. The recoil springs are normally in compression. They are held between brackets and stops on the track roller frames. Normally, the force of the springs is not against the tracks. The force against the track for the correct setting of track curve (sag) is controlled by the track adjuster.



Track adjustment is made by adding to cavity (1) through a fill valve. This moves recoil rod (2) and the front idler toward the front of the machine. The movement of the recoil rod and front idler tightens the track. The tension on the track is released by a relief valve.

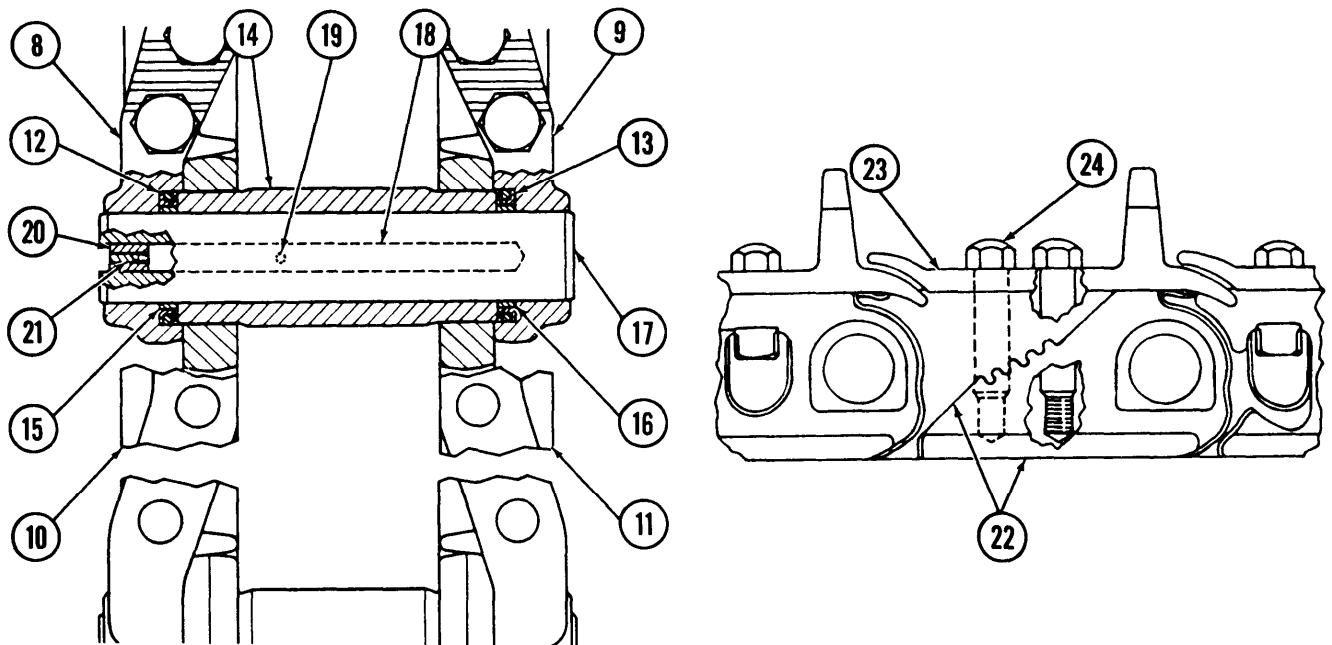
If rocks or debris get between the track and the rollers, idler or sprocket, recoil rod (2) moves toward the rear of the machine. The movement of the recoil rod tightens the track. Since the grease in cavity (1) cannot be put in compression, piston (3) and bolt (4) move toward the rear of the machine. Bolt (4) pushes pilot (5) toward the rear of the machine. Pilot (5) pushes on spring (6). This puts spring (6) in compression. The movement of pilot (5) and the compression of spring (6) prevent too much tension on the track.

Nut (7) is used to keep recoil spring in compression when it is installed in the machine.

- g. Track. The machine has sealed and lubricated track. Each track assembly has links, pins, bushings, thrust rings, polyurethane seal assemblies, rubber stoppers and polyurethane plugs.

Each of the track links (8 and 9) makes a fit over the track links in front of them. Link (8) makes a fit over link (10). Link (9) makes a fit over link (11). The connection of the track links makes the track assembly.

Each link has a counterbore in the end which makes a fit with the link in front of it. Seal assemblies (12 and 13) are installed in the counterbores of the links. Each seal assembly has a load ring and a seal ring. The load ring pushes the seal ring against the end of bushing (14) and the link counterbore.



The seal ring gives a positive seal between the bushing and the link counterbore. The edge of the seal ring is against the end of the bushing. The thrust rings (15 and 16) are installed on the pin (17). The thrust rings give a specific amount of compression to the seal assemblies and control the end play (free movement) of the joint. The arrangement of the seal assemblies and thrust rings keeps foreign materials out of the joint and oil in the joint.

The pin (17) has a hole (18) almost the full length of the pin. Hole (19) is drilled radially in the pin near the center of the pin. The radial hole (19) lets oil go to the surface between the pin (17) and the bushing (14) and to the lip of the seal rings. The oil gives lubrication to the pin and bushing and also makes the lip of the seal ring wet. The lip of the seal ring must be kept wet to prevent wear of the lip of the seal ring. Oil is kept in the pin by a stopper (20) and a plug (21). The oil is installed in the pin through a hole in the center of the stopper (20). When the chambers in the pin are filled, the plug (21) is installed in the stopper (20).

Each pin and bushing assembly is sealed and has its own lubrication; the result is no internal wear on the joint. The interval for the turning of the track pins and bushings is much longer because the only wear will be on the outside of the bushings and the links.

The two piece master links (22) and the master shoe (23) are held together with capscrews (24).

Section II. TRACK PROCEDURES

9-3. TRACK MAINTENANCE TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
9-4	Equalizer Bar Assembly - Replace	9-5
9-5	Track Rollers - Replace/Repair	9-15
9-6	Track Roller Frame Assembly - Replace/Adjust	9-23
9-7	Recoil Spring - Replace	9-29
9-8	Track Carrier Rollers - Replace/Repair	9-31
9-9	Track Idlers - Replace/Repair	9-37
9-10	Track Idler Yokes - Replace	9-46
9-11	Track Adjuster Cylinder - Replace/Repair	9-48
9-12	Track Drive Sprockets/Hubs - Replace	9-53
9-13	Drive Sprocket Shaft - Replace	9-65
9-14	Track Assembly - Repair	9-70
9-15	Track Assembly - Replace	9-75



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## 9-4. EQUALIZER BAR ASSEMBLY - REPLACE

---

This task covers:

- a. Removal
  - b. Installation
  - c. Place In Service
- 

### INITIAL SETUP

#### Applicable Configurations

All

#### Personnel Required

MOS62B (2)

#### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

#### Materials/Parts

8-Inch Wood Blocks

#### Special Tools

Hydraulic Jack Stands (two 4C6486)  
Tube (two 8S7621)  
Collar (two 87625)  
Cylinder (two 8S7650)  
Pin (four 8S7615)  
Pump (3S6224)

#### Equipment Condition

Blade and push arms removed. See TM5-2410-237-20.  
Right front track carrier roller only, removed. See page 9-29.  
Right track roller frame covers removed. See TM5-2410-237-20.  
Crankcase guards removed. See TM5-2410-237-20.

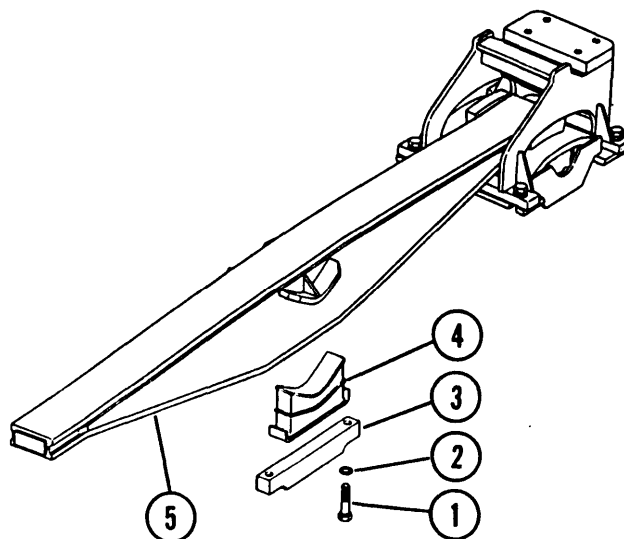
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### **WARNING**

This task must be performed on a flat, level concrete surface. Hydraulic jack stands can become unstable if used on any other surface. Instability can allow the tractor to fall, causing personal injury or death.

#### a. Removal

- (1) Use a socket to remove two capscrews (1), two lockwashers (2), plate (3), and pad (4) from front side of equalizer bar (5).
- (2) Repeat STEP 1 for rear side of equalizer bar (5).



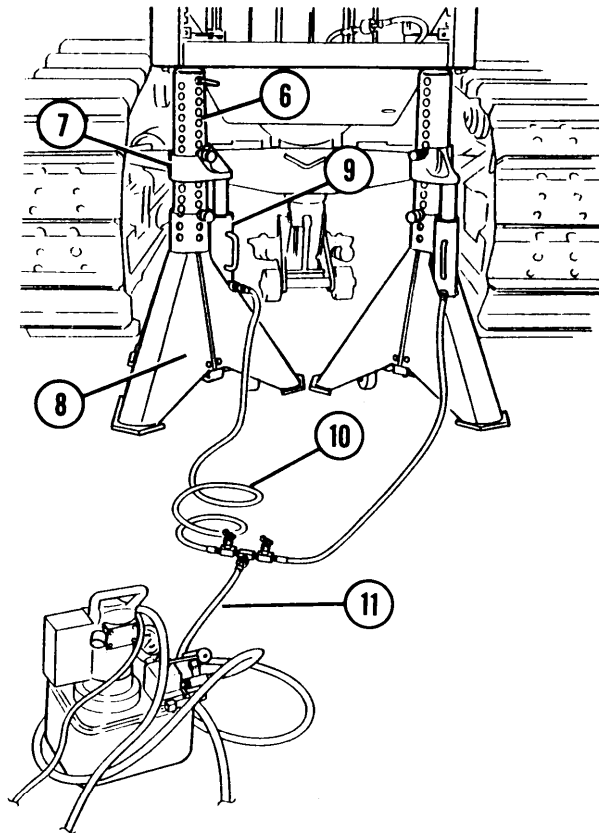
9-4. EQUALIZER BAR ASSEMBLY - REPLACE (Cont'd)

**WARNING**

All damage or leaks to the hydraulic jack stands must be repaired before use. Failure to make repairs can cause serious injury or death.

(3) Assemble hydraulic jack stands:

- (a) Install extension tube (6) and collar (7) on stand (8).
- (b) Install hydraulic cylinder (9) in stand and under tab of Collar.
- (c) Connect hydraulic lines (10) from throttle valves, one to each cylinder.
- (d) Connect hose (11) from valve tee to hydraulic pump.
- (e) Open both throttle valves and control valve on pump to make sure cylinders are fully retracted. If necessary, push down on extension tube.



**CAUTION**

Tractor must not be driven onto wood blocks past centerline of idler. Tractor will begin to lower if driven past center of idler.

- (4) Put 8-inch wood blocks in front of each track. Drive tractor up on wood blocks.

---

 9-4. EQUALIZER BAR ASSEMBLY - REPLACE (Cont'd)
 

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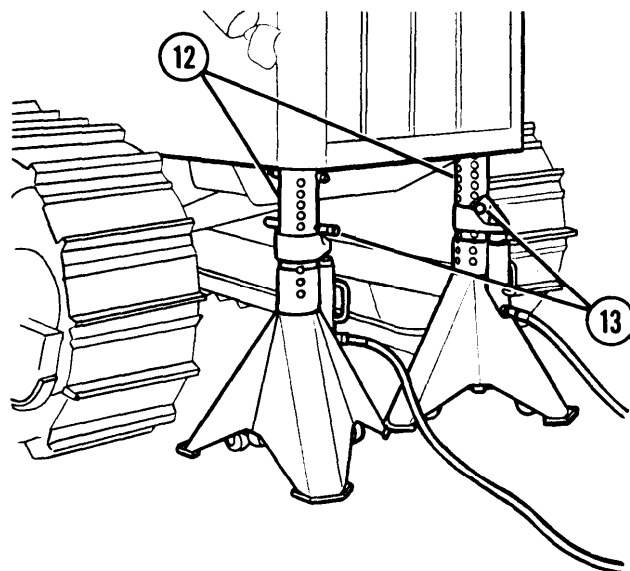
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**WARNING**


---

Put wood blocks behind the tracks at the rear of the machine. Put the parking brake in the engaged position. This is so the machine will not move backwards when the front of the machine is lifted with hydraulic jacks.

- (5) While tractor is still in forward gear, engage parking brake. Put blocks behind tracks at the rear of the machine.
- (6) Move gear selector to neutral and stop the engine.
- (7) Put hydraulic jack stands (12) under main frame.
- (8) Move extension tube of jack stands up to bottom of main frame. Install pin (13) in first hole above collar. Make sure pin fits into groove of collar.
- (9) Lift the front of tractor until equalizer bar is clear of main frame. Use the following procedure:
  - (a) Close the control valve on hydraulic pump.




---

**CAUTION**


---

Extension tube may bind in stand when tube is lifted by hydraulic cylinder. Observe jack stands carefully during the lifting procedure. Tapping with a hammer may free binding.

- (b) Operate pump to raise jack stands.

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 9-4. EQUALIZER BAR ASSEMBLY - REPLACE (Cont'd)
 

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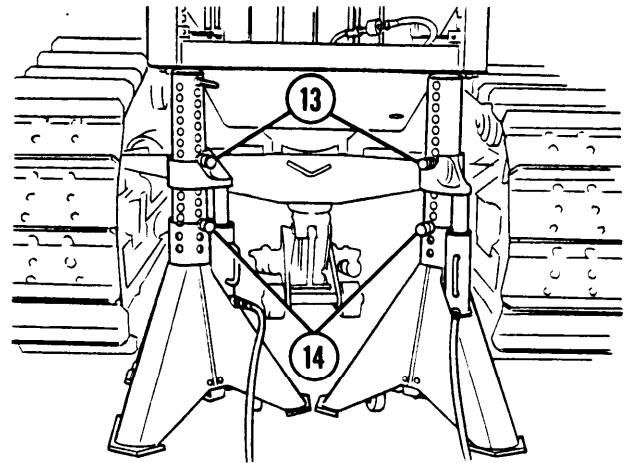
- (c) If jack stands do not raise evenly, the throttle valve connected to the higher jack stand must be partially closed. While pumping, close the valve until the jack stands raise evenly when operating the pump.

---

**WARNING**


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Extension tube can only be raised until the bottom hole of the extension tube is aligned with the top hole of the stand. Hydraulic jack stands become unstable if raised higher. Instability can allow the tractor to fall causing personal injury or death.



- (d) If the hydraulic cylinders are fully extended, but the tractor is not lifted enough, install a pin (14) through each stand and extension tube. This will keep the stand raised while the cylinders are retracted. If the stands are high enough, go to STEP (j).
- (e) Open control valve on pump and remove pin above each collar.
- (f) Retract hydraulic cylinders and lower collars.
- (g) Install pin (13) in first hole above collars.
- (h) Close control valve on pump and operate pump to raise jack stands.

---

**9-4. EQUALIZER BAR ASSEMBLY - REPLACE (Cont'd)**


---

- (i) Repeat STEPS (d) through (h) only until the tractor is lifted high enough or the bottom hole of the extension tube is aligned with the top hole of the stand.
- (j) Install pin (14) through each stand and extension tube. This will keep the stand raised and the hydraulic pressure can be removed by opening the control valve on the pump.

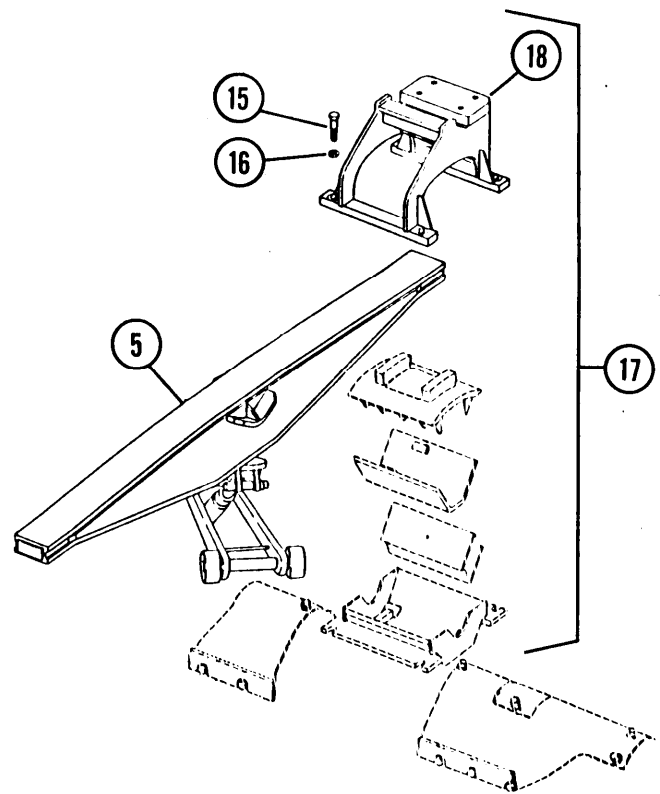
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**WARNING**


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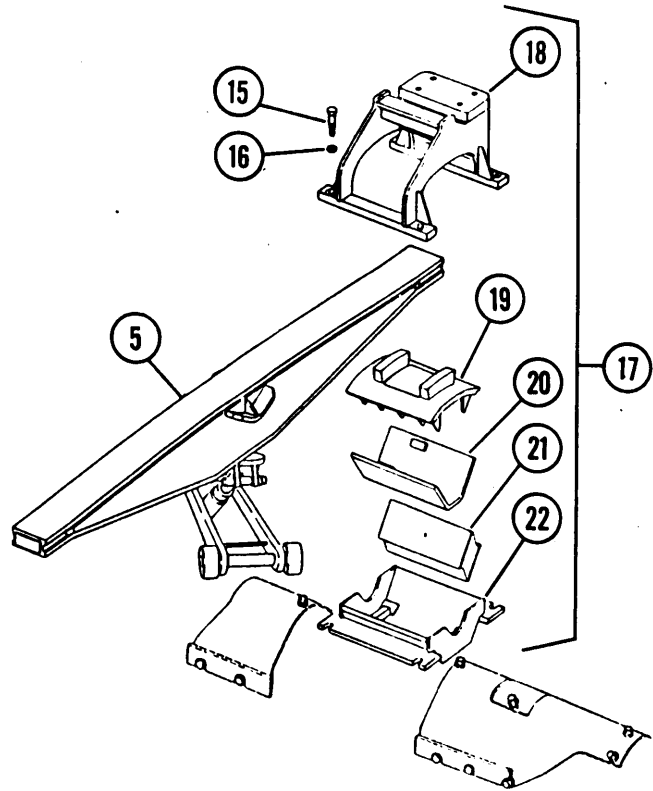
Equalizer bar weighs 300 lbs. Use caution and proper handling equipment to prevent personal injury and damage to tractor.

- (10) From the rear of the tractor, put hydraulic floor jack under equalizer bar (5). Raise jack until tracks are lifted only enough to remove jack stands from front of tracks.
- (11) Lower hydraulic floor jack to lower tracks to the ground.
- (12) Use a socket to remove four capscrews (15) and four lockwashers (16) from right support assembly (17) on right track frame.
- (13) Use hydraulic floor jack to lift equalizer bar (5) enough to remove support (18).
- (14) Carefully remove equalizer bar (5) by rotating bar and pulling floor jack towards the rear of the tractor. Lower equalizer bar as soon as bar clears track frames.



9-4. EQUALIZER BAR ASSEMBLY - REPLACE (Cont'd)

- (15) Use lifting equipment to remove equalizer bar from floor jack.
- (16) If necessary, remove remaining right support assembly (17) from right track roller frame as follows:
  - (a) Remove upper plate assembly (19).
  - (b) Remove lower plate assembly (20).
  - (c) Remove pad assembly (21).
  - (d) Remove lower suspension assembly (22).
- (17) If necessary, remove left front track carrier roller and repeat STEP 12 to remove left support.
- (18) Repeat STEP 16, a through d, for left support assembly, if necessary.



b. Installation

**WARNING**

Make sure all jacks and blocking are properly placed and secure to prevent movement of tractor before starting installation procedure. Failure to follow this precaution could result in serious or even fatal injuries.

- (1) If removed, install left support assembly (17) as follows:
  - (a) Install lower suspension assembly (22).
  - (b) Install pad assembly (21).

---

**9-4. EQUALIZER BAR ASSEMBLY - REPLACE (Cont' d)**

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- (c) Install lower plate assembly (20).
- (d) Install upper plate assembly (19).
- (2) Install left support (18) with four capscrews (15) and four lockwashers (16). Tighten capscrews to a torque of  $350 \pm 45$  lb. ft.
- (3) If removed, repeat STEP 1, a through d, for the right support assembly.
- (4) Use lifting equipment to put equalizer bar (5) on hydraulic floor jack.
- (5) Push floor jack with equalizer bar (5) between tracks at the rear of the tractor. equalizer bar and rotate bar to align one end with left support assembly (17).
- (6) Move floor jack forward to position other end of equalizer bar in line with right upper plate assembly.
- (7) Install right support (18) over end of equalizer bar (5) and on track frame.

**NOTE**

Make sure equalizer bar is centered on the upper plate assembly.

- (8) Lower hydraulic jack until weight of equalizer bar is on upper plate assembly (19).
- (9) Install four capscrews (15) and four lockwashers (16) on right support. Tighten capscrews to a torque of  $350 \pm 45$  lb. ft.

9-4. EQUALIZER BAR ASSEMBLY - REPLACE (Cont'd)

NOTE

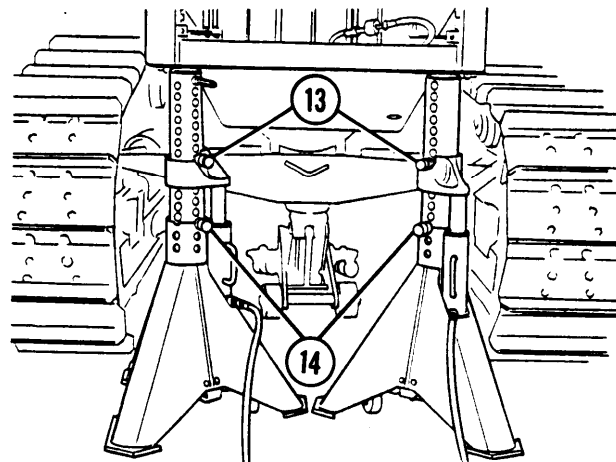
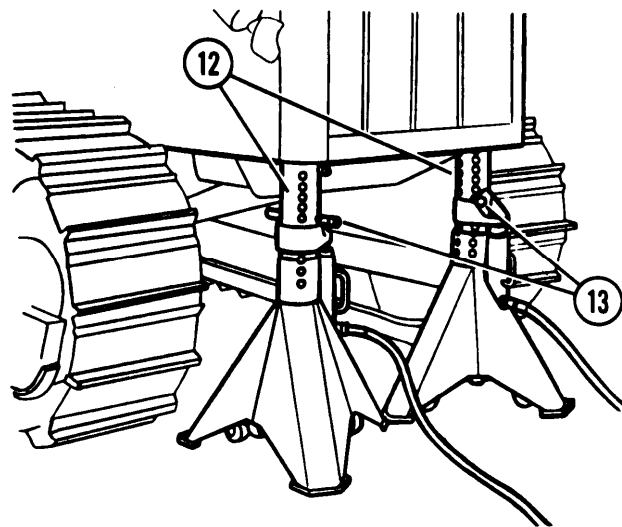
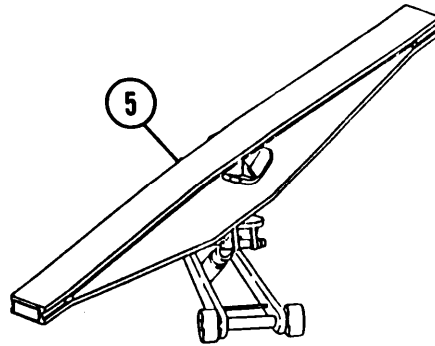
Wood blocks must be installed under tracks to allow for clearance to remove hydraulic jack stands later.

- (10) Use hydraulic floor jack under equalizer bar (5) to lift tracks high enough to install 8-inch wood blocks under front of both tracks.
- (11) Lower floor jack to lower tracks onto wood blocks. Remove floor jack.
- (12) Slowly lower hydraulic jacks (12) using the following procedure:

CAUTION

Extension tube may bind in stand when tube is lowered by retracting hydraulic cylinder. Observe jack stands carefully during the lowering procedure. Tapping tube with a hammer may free binding.

- (a) Slowly open control valve on hydraulic pump. Allow hydraulic cylinders to retract completely.
- (b) If the hydraulic cylinders are fully retracted, but the tractor is not lowered completely, close control valve on hydraulic pump.
- (c) Operate hydraulic pump until a hole in the extension tube and the stand are in alignment. Install a pin (11) in this hole for each stand.



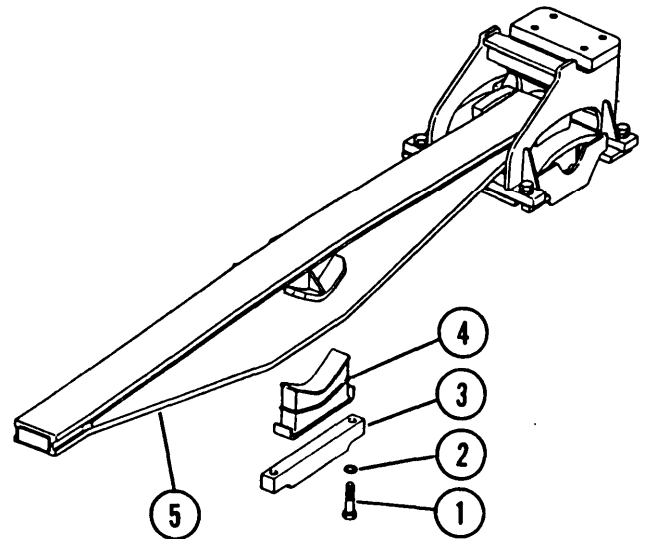


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 9-4. EQUALIZER BAR ASSEMBLY - REPLACE (Cont'd)
 

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- (d) Open control valve on hydraulic pump to retract hydraulic cylinders. Remove pin (13) from above each collar.
- (e) Close control valve on hydraulic pump. Operate pump to extend hydraulic cylinders and raise collars. Do not extend cylinders completely. Cylinders must be extended to remove the weight from the lower pins.
- (f) Install pins (13) in first hole above collars.
- (g) Operate hydraulic pump to lift tractor so lower pins (14) can be removed.
- (h) Repeat STEPS a through g until weight of the tractor is completely off the jack stands.
- (i) Remove hydraulic jack stands.
- (13) Start engine and engage brakes.
- (14) Remove blocks from tracks at rear of tractor.
- (15) Slowly release brakes to allow tractor to roll back off wood blocks. Only if necessary, put gear selector in reverse to move backwards.
- (16) Install pad (4), plate (3), two lockwashers (2), and two capscrews (1) on front and rear sides of equalizer bar (5).
- (17) Tighten four capscrews (1) to a torque of 350+45 lb. ft.



9-4. EQUALIZER BAR ASSEMBLY - REPLACE (Cont'd)

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(18) Install right front carrier roller. If removed, install left front carrier roller. See page 9-29.

(19) Install track roller frame covers. Refer to TM5-2410-237-20.

c. Place In Service

Operate tractor and check for proper operation.

9-5. TRACK ROLLERS - REPLACE/REPAIR

This task covers:

- a. Removal
- b. Disassembly
- c. Assembly
- d. Installation
- e. Place In Service

INITIAL SETUP

Applicable Configurations

All

Personnel Required

MOS62B (2)

Common Tools

Shop Equipment, General Repair  
NSN 4940-00-287-4894

Materials/Parts

Preformed packing (11), (14), (7)  
Bushing (20)  
Pins (21)  
Seals (22)  
Lint-free rag (App. B, Item 12)  
Duo-Cone Seals (12), (16)  
Lubricating Oil OE/HDO-30 (Refer  
to L05-2410-237-12)  
Trichloroethane (App. B, Item 21)

Equipment Condition

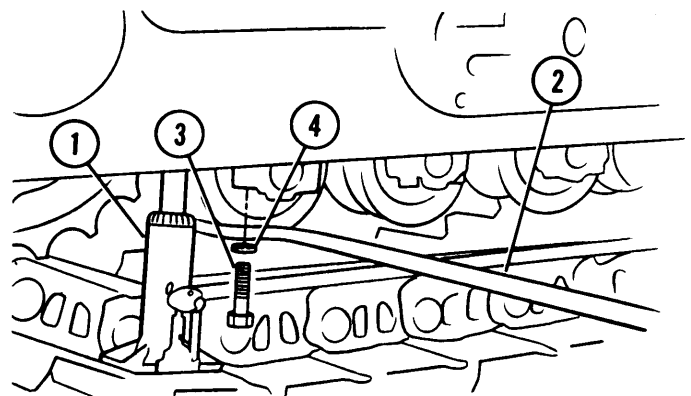
Track roller guards removed.  
See TM5-2410-237-20.  
Track loose. See TM5-2410-237-20.

a. Removal

NOTE

If the tractor has less than one thousand hours on it, you may have to remove the track to remove the support rollers.

- (1) Lift machine according to Ground Handling, page 11-32.
- (2) If necessary, use a jack (1) to move track away from track roller.



9-5. TRACK ROLLERS - REPLACE/REPAIR (Cont'd)

- (3) Use a tanker bar (2) to hold roller in position.

**WARNING**

Use care when loosening mounting hardware. Rollers can weigh up to 170 lbs. Failure to follow this precaution could result in personal injury.

**NOTE**

To remove an end roller it may be necessary to remove the roller next to it for clearance.

- (4) Use a socket to remove four capscrews (3) and washers (4) that hold track roller in place.

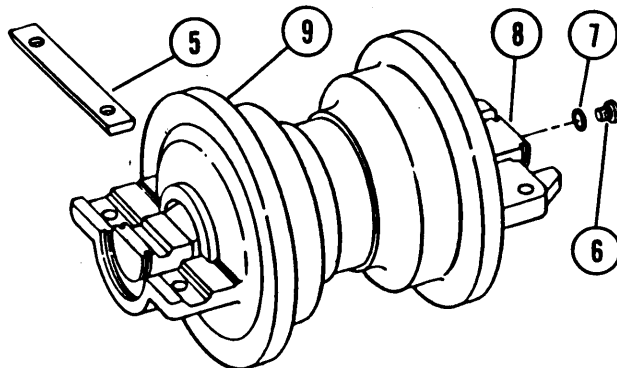
**NOTE**

The picture shows a single flanged roller. The location of the capscrews is the same for both single and double flanged rollers.

- (5) Remove track roller. The weight of a single flange roller is 155 lbs. The weight of a double flange roller is 170 lbs.

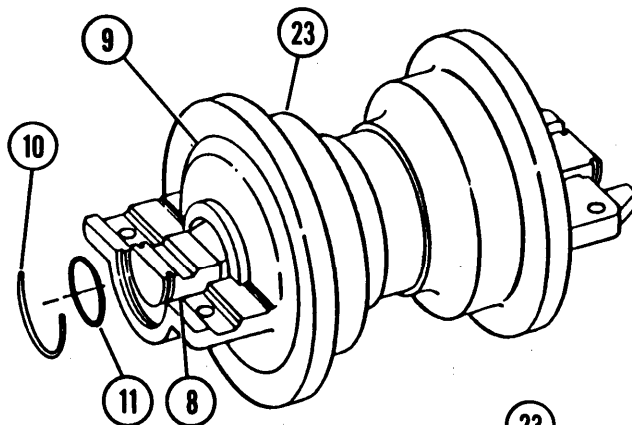
b. Disassemble

- (1) Remove locking plate (5).
- (2) Use a socket to remove plug (6) and preformed packing (7) from end of shaft (8). Discard preformed packing (7).
- (3) Drain oil from roller. Install plug in shaft to keep dirt out of roller.
- (4) Put roller in a hydraulic press.

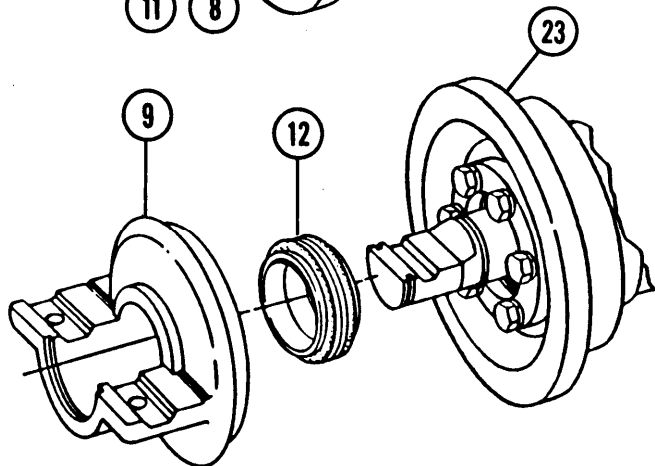


9-5. TRACK ROLLERS - REPLACE/REPAIR (Cont' d)

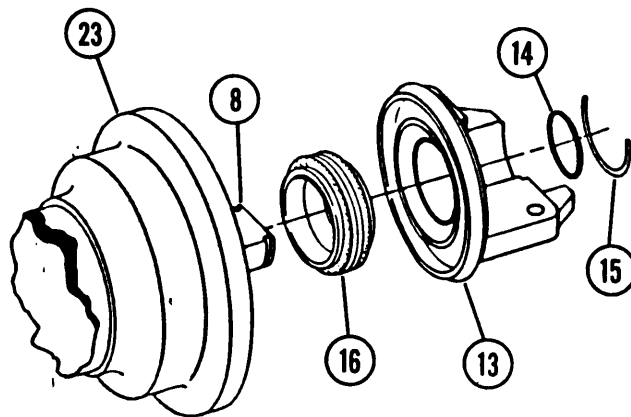
- (5) Put collar (9) under compression until retaining ring (10) can be removed.
- (6) Use a screwdriver to remove retaining ring (10). Release pressure. Remove collar (9).
- (7) Remove preformed packing (11) from shaft (8). Discard preformed packing (11).



- (8) Remove Duo-Cone seal (12) from collar (9) and roller. Discard seal assembly (12).
- (9) Turn roller (23) around in press.



- (10) Put collar (13) under compression until retaining ring (15) can be removed.
- (11) Use a screwdriver to remove retaining ring (15). Release pressure. Remove collar (13).
- (12) Remove preformed packing (14) from shaft (8). Discard preformed packing (14).
- (13) Remove Duo-Cone seal (16) from collar (13) and roller. Discard seal assembly (16).

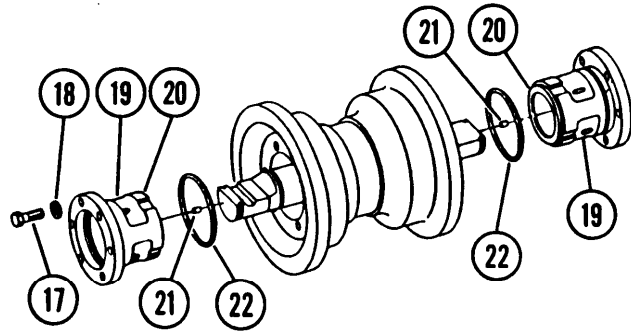


9-5. TRACK ROLLERS - REPLACE/REPAIR (Cont'd)

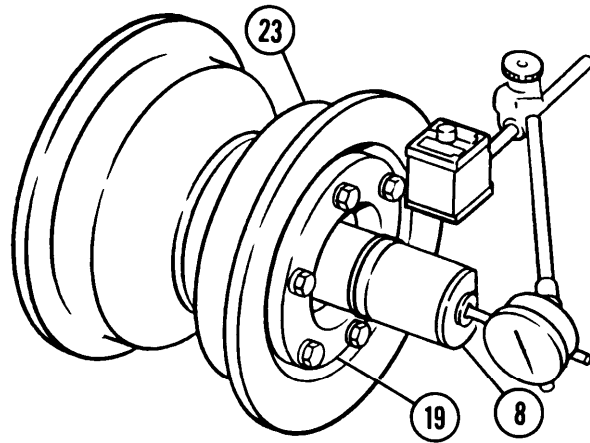
- (14) Using a dial indicator, measure clearance between roller and bushings. Clearance must be 0.011 to 0.029 inches.

NOTE

If roller to bushings clearance is not within limits specified in STEP 14, perform STEPS 15 through 19.



- (15) Use a wrench to remove six capscrews (17) and six lockwashers (18) from each side of roller.
- (16) Remove two bushing assemblies (19) and shaft (8) with a hydraulic press.
- (17) Remove bushing (20) from each bushing assembly (19) with a press. Discard bushing (20).
- (18) Use a hacksaw to cut pins (21) off even with housing. Use a file to smooth surface of bushing.
- (19) Remove seals (22) and discard,

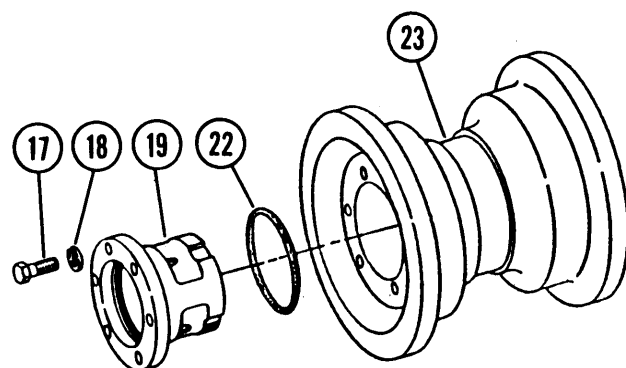
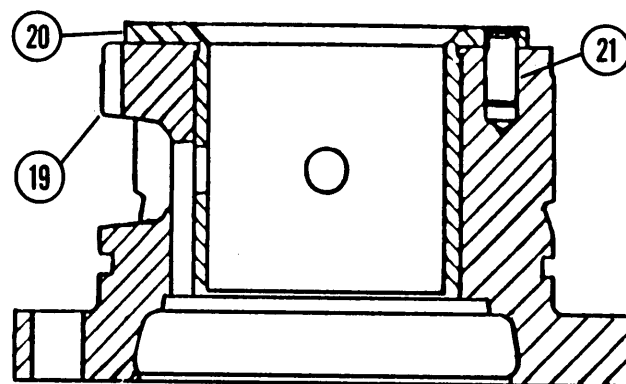


c. Assembly

- (1) Align oil holes in bushings (19 and 20).
- (2) Install bushings (20) in bushing assembly (19) with a press.

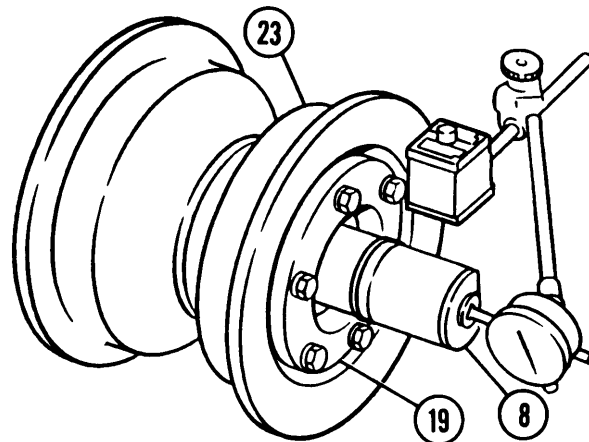
## 9-5. TRACK ROLLERS - REPLACE/REPAIR (Cont'd)

- (3) Drill two holes 0.281 in. (9/32") in diameter, 180° apart and 0.81 in. deep through bushing (20) and into bushing assembly (19). Do not drill holes through lubrication grooves in bushing assembly (19).
- (4) Enlarge holes drilled above with a reamer to 0.3052±0.0003 in. diameter and 0.69 in. deep. Make holes larger again to a diameter of 0.308±0.001 in. diameter and 0.25 in. deep.
- (5) Install two new pins (21) that are 0.306 to 0.307 in. in diameter to a depth of 0.031 in. below the outside surface of bushing assembly (19).
- (6) Install packing (22) on bushing assemblies (19).
- (7) Put oil on packings (22) and contact surfaces of bushing assemblies (19) and roller (23).
- (8) Install one bushing assembly (19) in roller using a hydraulic press. Use guide pins to maintain alignment.
- (9) Install six capscrews (17) and six lockwashers (18) that hold bushing assembly (19) to roller (23). Tighten bolts to a torque of 40±5 lb. ft.
- (10) Install shaft (8) in roller (23).



9-5. TRACK ROLLERS - REPLACE/REPAIR (Cont'd)

- (11) Install other bushing assembly (19) in roller (23) with a hydraulic press. Use guide pins to maintain alignment.
- (12) Install six capscrews (17) and six lockwashers (18) that hold bushing (19) in roller (23). Tighten bolts to a torque of  $40 \pm 5$  lb. ft.
- (13) Install dial indicator and check end clearance between roller (23) and bushings (19). Clearance must be 0.011 to 0.029 in.



**WARNING**

Avoid prolonged skin contact with trichloroethane. Avoid breathing the vapors in enclosed areas without adequate ventilation and do not smoke. Do not use near open flame or welding operations or other heated surfaces exceeding  $482^{\circ}\text{C}$  ( $900^{\circ}\text{F}$ ).

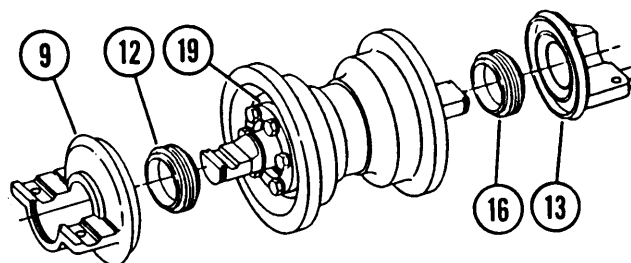
**CAUTION**

Duo-Cone seals must never be separated, or failure will result. Do not mix and match seal halves.

- (14) Install Duo-Cone seals (12 and 16) in bushing assemblies (19) and collars (9 and 13) using seal installer.

**NOTE**

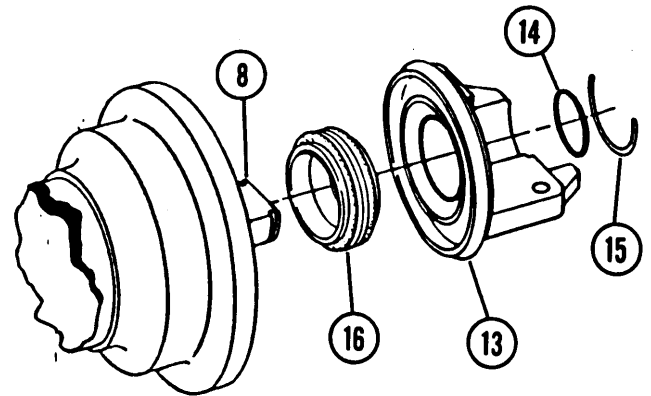
Rubber seals and all surfaces that make contact with them must be cleaned with trichloroethane and dry. After installation of seals, put oil on contact surfaces of metal seals.



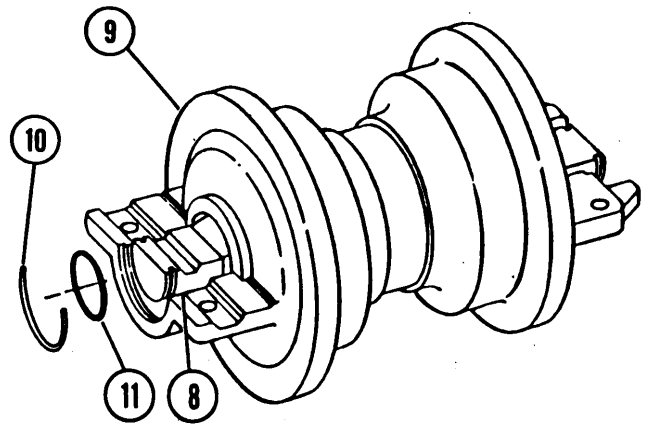


9-5. TRACK ROLLERS - REPLACE/REPAIR (Cont'd)

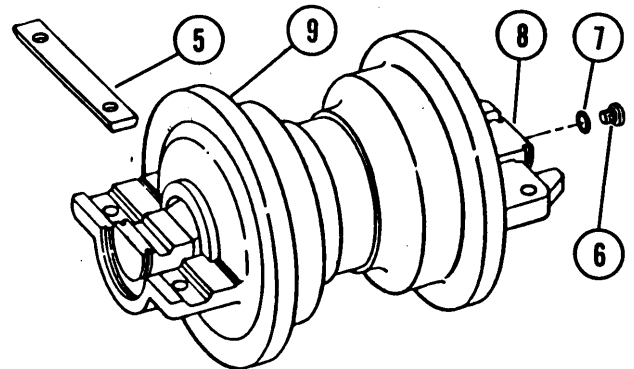
- (15) Install preformed packings (11 and 14) on shaft (8).
- (16) Put oil on seals (12 and 16) and install collars (9 and 13).
- (17) Put collar (13) under compression with a hydraulic press.
- (18) Install retaining ring (15).



- (19) Put collar (9) under compression with a hydraulic press.
- (20) Install retaining ring (10).
- (21) Put assembled track roller at 30° angle from horizontal with fill hole at the high end.
- (22) Use compressor and nozzle to put 0.88 pint OE/HDO-30 oil in track roller.



- (23) Install preformed packing (7) on plug (6).
- (24) Install plug (6) with plug socket. Tighten plug to a torque of 125±15 lb. ft.



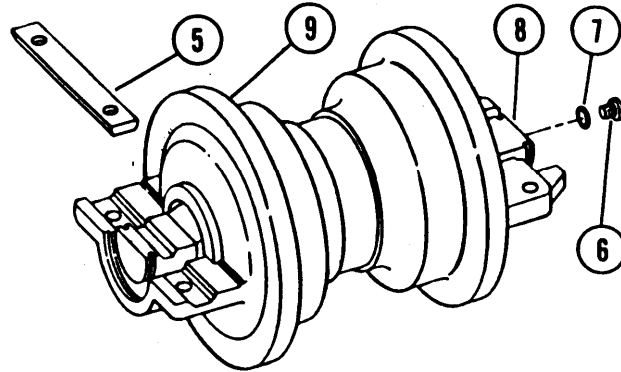
9-5. TRACK ROLLERS - REPLACE/REPAIR (Cont'd)

d. Installation

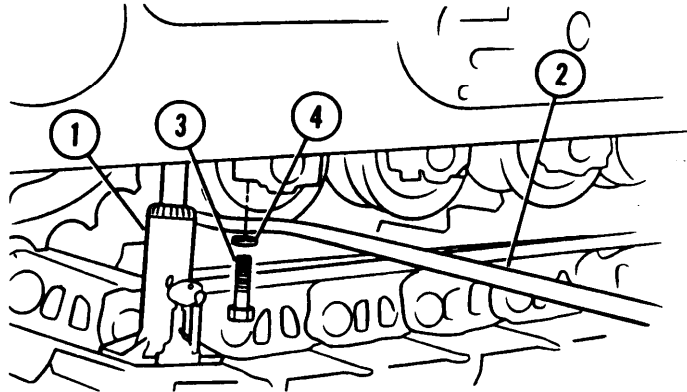
- (1) Install locking plate (5) on collar (9).

**WARNING**

Use care when placing roller in position. Roller may weigh up to 170 lbs. Failure-to follow this precaution could result in personal injury.



- (2) Use a tanker bar and place track roller in position.
- (3) Install four capscrews (3) and washers (4) that hold track roller in place. Tighten the capscrews to a torque of  $550 \pm 50$  lb. ft.
- (4) If a jack was used between track and roller frame, remove it.
- (5) Lower tractor according to Ground Handling, page 11-33.
- (6) Adjust track. See TM5-2410-237-20.
- (7) Install track roller guards. Refer to TM5-2410-237-20.



e. Place In Service

Test drive and check track for proper operation.

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 9-6. TRACK ROLLER FRAME ASSEMBLY - REPLACE/ADJUST
 

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This task covers:

- a. Removal
- b. Installation
- c. Alignment
- d. Place In Service

---

 INITIAL SETUP
 

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Applicable Configurations

All

Personnel Required

MOS62B (2)

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Lifting Equipment, 4,000 lbs.  
 Two Link Brackets

Equipment Condition

Track removed. See page 9-75.  
 Front track carrier roller removed. See page 9-29.  
 Track recoil mechanism guards removed.  
 See TM5-2410-237-20.

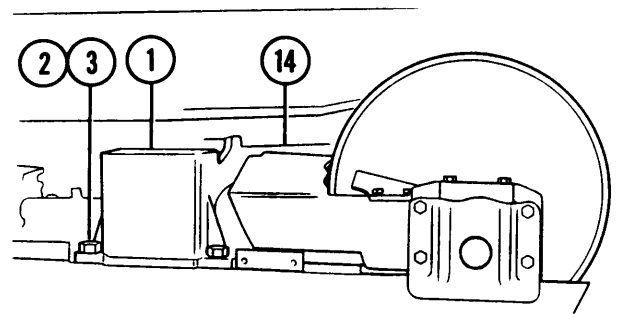
Special Tools

Link Bracket (6V2157)  
 Link Bracket (5P9736)

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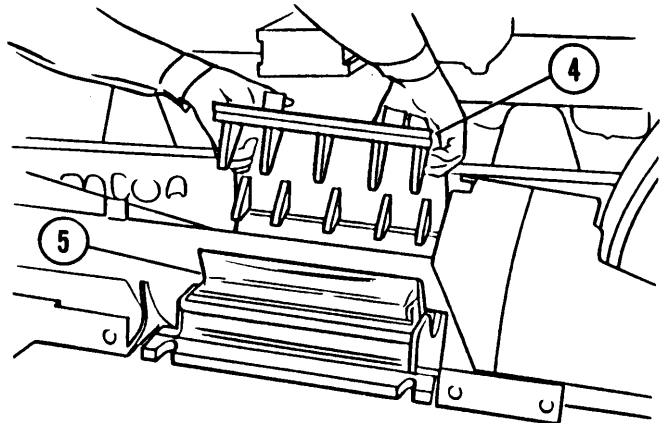
 a. Removal

- (1) Fasten lifting equipment (capacity 4,000 lbs. ) to the front of track roller frame (A). Fasten second lifting equipment to the support assembly (1). Lift front of track roller frame to remove tension on equalizer bar (14).
- (2) Use a socket to remove four capscrews (2) and four lockwashers (3) that hold support assembly (1) to the track roller frame.
- (3) Lower front of track roller frame onto track. Remove support assembly (1). The weight is approximately 70 lbs.



9-6. TRACK ROLLER FRAME ASSEMBLY - REPLACE/ADJUST (Cont' d)

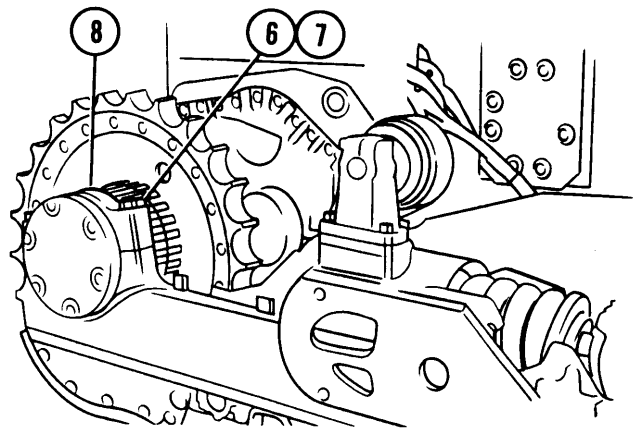
- (4) Remove plate (4) and pads (5) from the track roller frame support assembly.



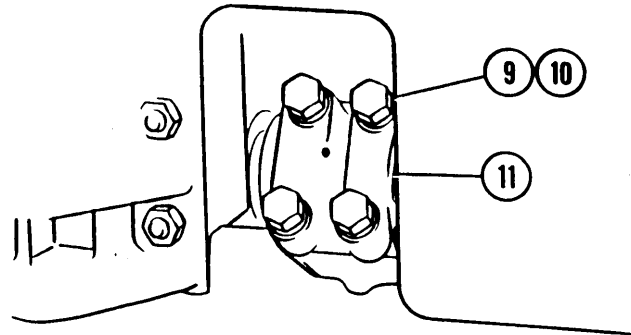
**WARNING**

Lifting equipment must be hooked up in a manner to balance the weight of the frame.

- (5) Fasten lifting equipment to the rear track carrier roller and track roller frame and support.
- (6) Use a socket to remove four capscrews (6) and four lockwashers (7) and remove cap (8) from the track roller frame.



- (7) Use a socket to remove four capscrews (9) and four lockwashers (10) and remove cap (11) from the rear of the track roller frame.



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 9-6. TRACK ROLLER FRAME ASSEMBLY - REPLACE/ADJUST (Cont'd)
 

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- (8) Lower track roller frame (12) onto the track.

---

**WARNING**


---

Lifting equipment must be attached to the track roller frame in a manner to evenly distribute the weight of the frame. Failure to do so may cause the frame to tip causing personal injury.

- (9) Attach lifting equipment to the track roller frame and remove track roller frame (12). The weight is 3900 lbs.

b. Installation

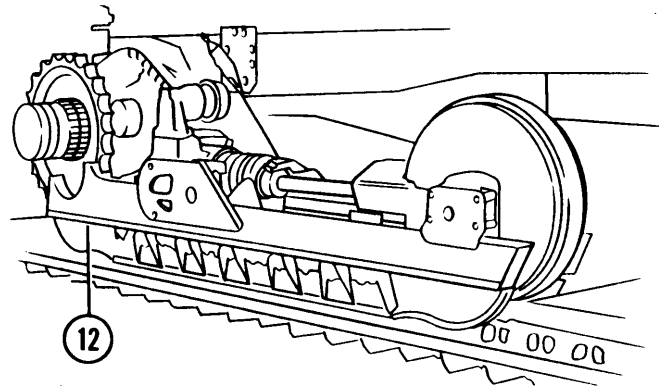
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**WARNING**


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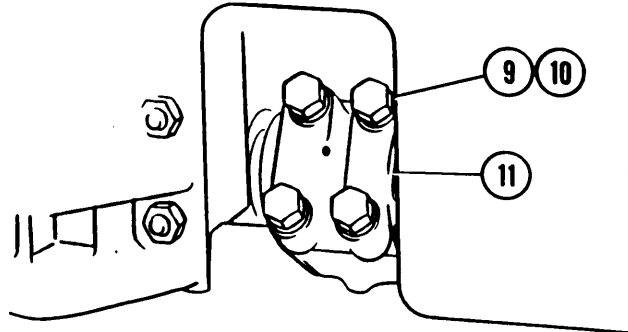
Lifting equipment must be attached to the track roller frame in a manner to evenly distribute the weight of the frame. Failure to do so may cause the frame to tip causing personal injury.

- (1) Connect track roller frame to lifting equipment.
- (2) Place track roller frame (12) in position on the track. Weight of an assembled track roller frame is 3900 lbs.
- (3) Lift rear of track roller frame in position on the final drive outer hub.

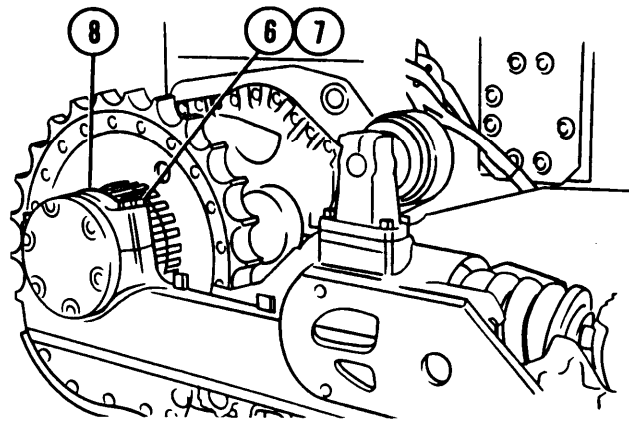


9-6. TRACK ROLLER FRAME ASSEMBLY - REPLACE/ADJUST (Cont' d)

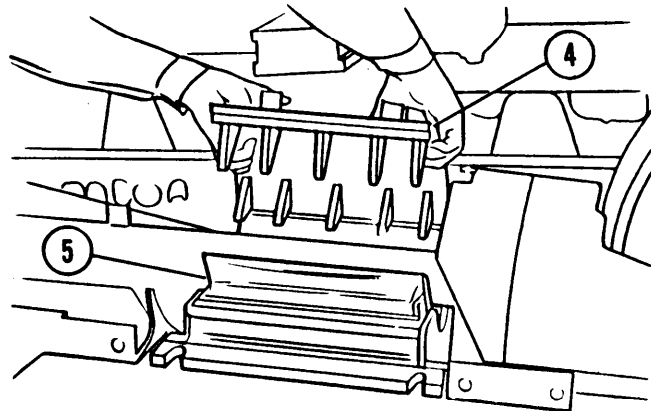
- (4) Put cap (11) in position on the final drive outer hub. Install lockwashers (10) and capscrews (9) that hold cap to the track roller frame. Use a socket to tighten capscrews to a torque of  $375 \pm 50$  lb. ft.



- (5) put cap (8) in position on track roller frame and install lockwashers (7) and capscrews (6). Use a socket to tighten capscrews.



- (6) put pads (5) and plate (4) in position on track roller frame.



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**9-6. TRACK ROLLER FRAME ASSEMBLY - REPLACE/ADJUST (Cont'd)**

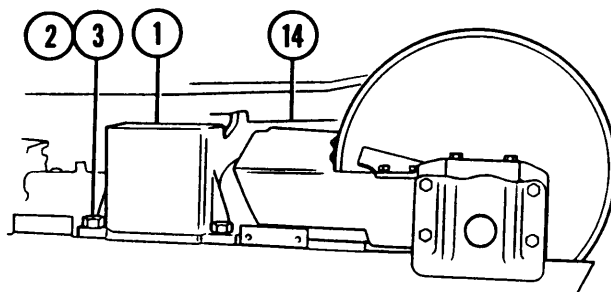
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- (7) Use lifting equipment and put support assembly (1) in position on the equalizer bar.

**NOTE**

Do not hit support assembly (1) when the track roller frame is put into position under the equalizer bar.

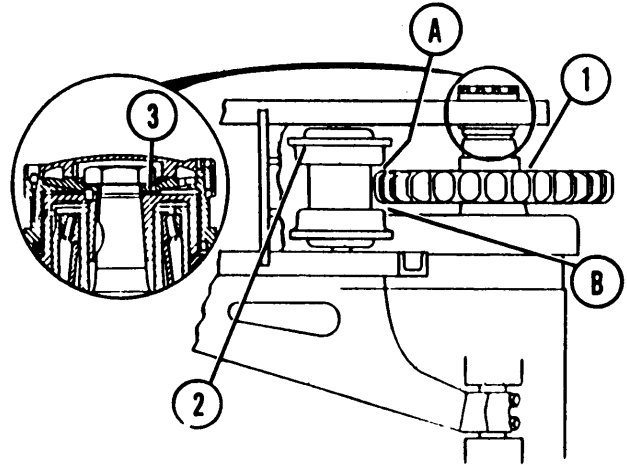
- (8) Using lifting equipment (capacity 4000 lbs.) lift track roller frame until capscrew holes in support assembly (1) are in alignment with capscrew holes in track roller frame.
- (9) Install capscrews (2). Use a wrench to tighten capscrews to a torque of  $350 \pm 45$  lb. ft.
- (10) Lower track roller frame until weight of track roller frame is on equalizer bar (14). Remove lifting equipment.
- (11) Install track recoil mechanism guard's covers. See TM5-2410-237-20.
- (12) Install track carrier roller (front). See page 9-29.
- (13) Check sprocket alignment and adjust if necessary. See task c., Alignment.
- (14) Install track. See page 9-68.



9-6. TRACK ROLLER FRAME ASSEMBLY - REPLACE/ADJUST (Cont'd)

c. Alignment

- (1) The center of the sprocket (1) is to be not more than 0.06 in. from the center of rear track roller (2). Distance (A) is to be the same as distance (B).
- (2) Change location of rear track roller (2) to sprocket (1) by installing or removing shims (3) from final drive support.
  - (a) Install shims (3) between retainer assembly and holder assembly of final drive to move roller frame out.
  - (b) Remove shims (3) between retainer assembly and holder assembly of final drive to move roller frame in.



d. Place In Service

Run machine and check track for proper operation.



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## 9-7. RECOIL SPRING - REPLACE

---

This task covers:

- a. Removal
  - b. Installation
  - c. Place In Service
- 

### INITIAL SETUP

#### Applicable Configurations

All

#### Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Lifting Equipment, 350 lbs.

#### Equipment Condition

Tractor parked on level ground.  
Hydraulic track adjuster cylinder  
removed. See page 9-47.

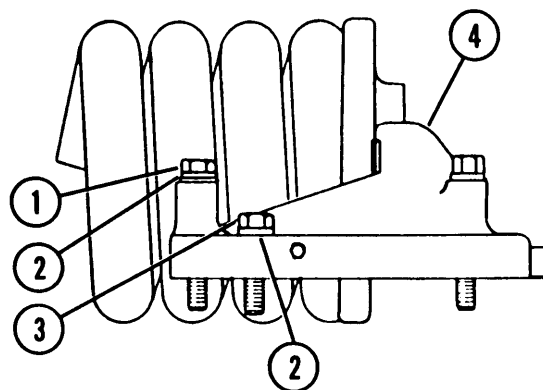
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### a. Removal

#### WARNING

Make sure there is no spring pressure on the two front stops. Do not remove the recoil spring from the track roller frame until the pressure is released from the two front spring stops.

- (1) Fasten lifting equipment to the recoil spring. Weight of the recoil spring is 300 lbs.
- (2) Use a socket to remove four capscrews (1), two capscrews (3) and six washers (2) from the two front stops (4). Remove the front stops.



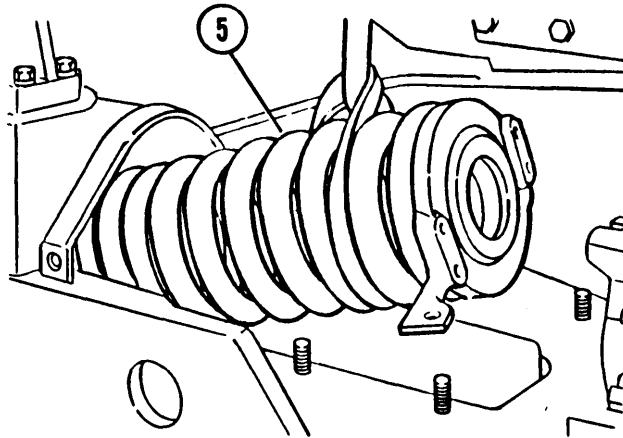
9-7. RECOIL SPRING - REPLACE (Cont'd)

- (3) Remove recoil spring (5) from the track roller frame.

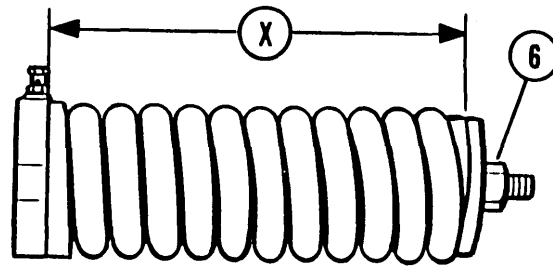
b. Installation

**WARNING**

Make sure the press is equipped with guards to hold the spring assembly in position while it is under compression.



- (1) If the recoil spring is to be replaced, put the recoil spring in a press and put the spring under compression.
- (a) Remove nut (6) and slowly release the spring. The spring is under compression until the length of the spring is  $31.61 \pm 0.44$  in.
- (b) Put newsprint in position and put the spring under compression until the distance (x) is 24.75 in. Tighten nut (6) to hold the spring and retainers.
- (2) Fasten lifting equipment and put recoil spring (5) in position in the track roller frame.
- (3) Put front stops (4) in position. Use a socket to install two capscrews (3), four capscrews (1) and six washers (2). Tighten capscrews to a torque of  $200 \pm 25$  lb. ft.
- (4) Install hydraulic track adjuster. See page 9-47.



c. Place In Service

Test drive and check recoil spring for proper operation.

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## 9-8. TRACK CARRIER ROLLERS - REPLACE/REPAIR

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This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning
- d. Inspection
- e. Assembly
- f. Installation
- g. Place In Service

---

### INITIAL SETUP

#### Applicable Configurations

All

#### Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Nozzle Assembly  
NSN 4930-00-968-4148  
Lifting Equipment, 200 lbs.

#### Materials/Parts

Seal (10), (13), (14), (20)  
Cups (25)  
Cone (23), (24)  
Trichloroethane (App. B, Item 21)  
Duo-Cone Seal (13)  
Lubrication Oil OE/HDO-30 (Refer  
to L05-2410-237-12)  
1 Quart Drain Pan

#### Equipment Condition

Track Loose. See TM-2410-237-20.

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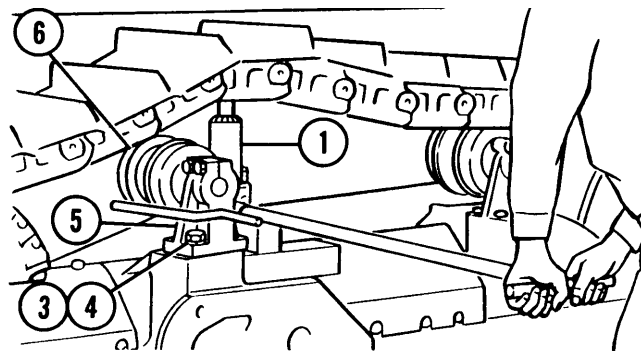
### a. Removal

#### NOTE

To lift track off of rear rollers a jack may be used. For front rollers, suitable lifting equipment may be used.

- (1) Lift track off of roller using jack or suitable lifting equipment.
- (2) Fasten lifting equipment to carrier roller and support.
- (3) Use a wrench to remove four capscrews (3) and lockwashers (4) that hold track carrier bracket (5) to roller frame.

- (4) Remove track carrier roller assembly (6) and bracket (5) as a unit. Weight is 120 lbs.

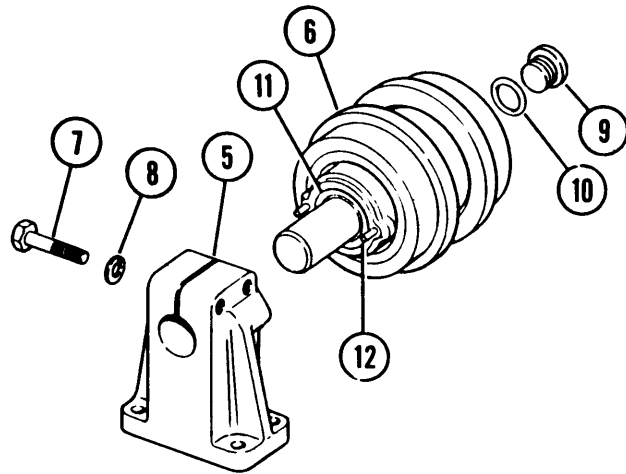


9-8. TRACK CARRIER ROLLERS - REPLACE/REPAIR (Cont'd)

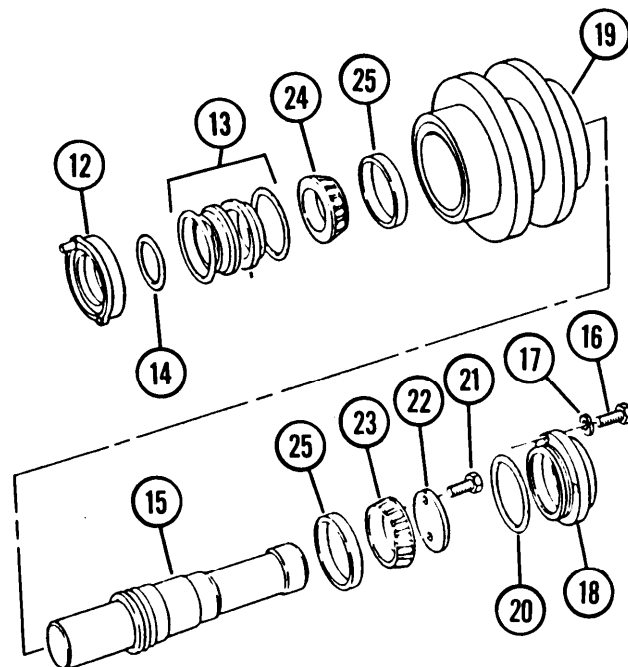
b. Disassembly

NOTE

Secure base (5) in vise to permit easy removal of capscrews (7).



- (1) Use a wrench to remove two capscrews (7) and lockwashers (8).
- (2) Remove bracket (5) from roller assembly (6).
- (3) Place track roller assembly (6) on its side over container that can hold at least 1.05 qt. of liquid.
- (4) Use a socket to remove plug (9) and seal (10). Discard seal (10).
- (5) Tip track carrier roller assembly (6) to drain it of all oil, then stand it upright.
- (6) Use a small screwdriver to remove spiral ring (11).
- (7) Remove collar assembly (12) from roller assembly (6).
- (8) Remove Duo-Cone seal assembly (13) from collar assembly (12) and roller assembly (6). Discard seal (13).
- (9) Remove seal (14) from shaft (1). Discard seal (14).
- (10) Turn roller assembly over. Use a wrench to remove three capscrews (16) and three lockwashers (17) that hold cover (18) to roller (19).

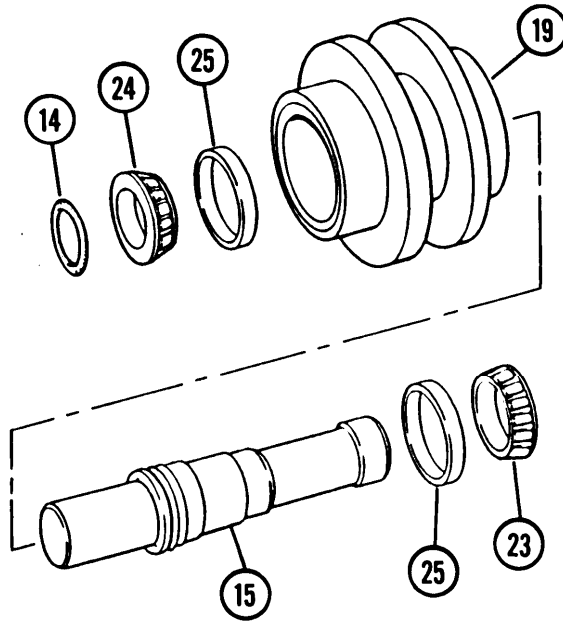




9-8. TRACK CARRIER ROLLERS - REPLACE/REPAIR (Cont'd)

e. Assembly

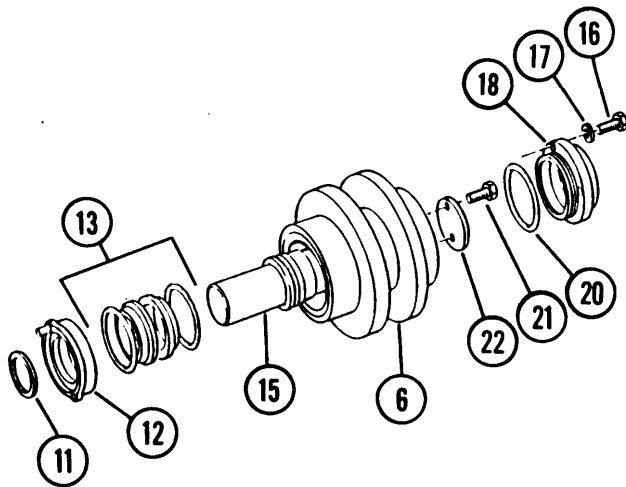
- (1) Lower the temperature of bearing cups (25). Install bearing cups in roller (19).
- (2) Install seal (14) in groove on shaft (15). Put oil on the seal (14).
- (3) Heat inboard bearing cone (24) to a maximum temperature of 275°F. Install inboard bearing cone (24) on the shaft (15).
- (4) Install shaft (15) and inboard bearing cone (24) in roller (19).
- (5) Heat second outboard bearing cone (23) to a maximum temperature of 275°F. Install the outboard bearing cone (23) on shaft (15).



NOTE

Install plate (22) with the machined (ground) face toward the end of the shaft.

- (6) put plate (22) in position on the shaft.
- (7) Install two capscrews (21) that hold plate in position. Use a wrench to tighten capscrews (21).
- (8) Install new seal (20) on cover (18). Put oil on the soil. Install cover (18), three lockwashers (17), and capscrews (16) that hold cover (18) to roller assembly (6). Use a wrench to tighten capscrews (16).



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 9-8. TRACK CARRIER ROLLERS - REPLACE/REPAIR (Cont'd)
 

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**WARNING**


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Avoid prolonged skin contact with trichloroethane. Avoid breathing the vapors in enclosed areas without adequate ventilation and do not smoke. Do not use near open flame or welding operations or other heated surfaces exceeding 482°C (900°F).

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**CAUTION**


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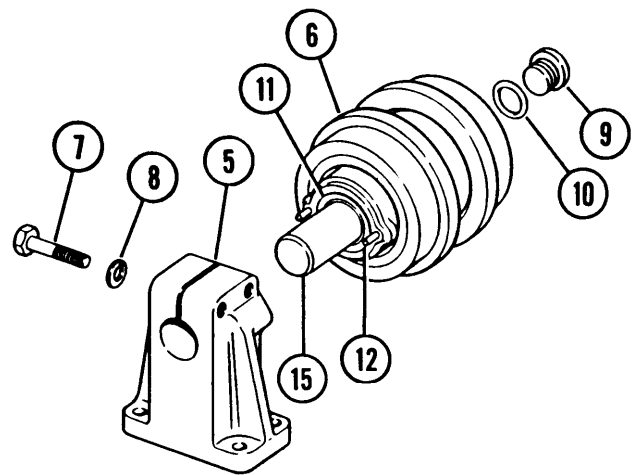
Duo-Cone seals (13) must be used as a matched pair or failure will result. Do not separate.

- (9) Install Duo-Cone seal (13) on collar assembly (12) and on roller assembly (6) using seal installer.
- (10) Install collar assembly (12) on the shaft (15). Install puller assembly on the roller. Put the two piece seal under compression with seal installer and press until the spiral ring (11) can be installed. Install the spiral ring (11).

**NOTE**

Secure base (5) in a vise to permit easy installation of capscrews (7).

- (11) Make sure dowels in collar assembly (12) are in alignment with the holes in the mounting bracket (5). Put bracket (5) in position even with the end of the shaft and install two capscrews (7), and lockwashers (8). Use a wrench to tighten capscrews (7).

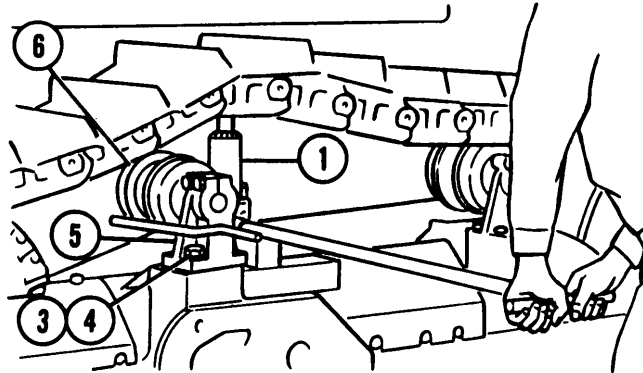


9-8. TRACK CARRIER ROLLERS - REPLACE/REPAIR (Cont'd)

- (12) Use a nozzle and compressor assemble to put  $1.25 \pm 0.06$  pints of lubricating oil in the roller assembly (6). Install the plug (9), and a new seal (10), with a socket and tighten the plug to a torque of  $125 \pm 15$  lb. ft.

f. Installation

- (1) Put track carrier roller assembly (6) and bracket (5) in position on the track roller frame with a tanker bar (2).
- (2) Install four capscrews (3) and lockwashers (4) that hold the bracket (5) to the track roller frame.



NOTE

To lower track onto rear roller, a jack may be used. For front roller, suitable lifting equipment may be used.

- (3) Use a hydraulic jack (1) or suitable lifting equipment to lower the track onto the carrier roller.
- (4) Adjust the track. See TM5-2410-237-20.

g. Place In Service

Test drive and check track for proper operation.



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## 9-9. TRACK IDLERS - REPLACE/REPAIR

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This task covers:

- a. Removal
  - b. Disassembly
  - c. Assembly
  - d. Installation
  - e. Place In Service
- 

### INITIAL SETUP

#### Applicable Configurations

All

#### Personnel Required

MOS62B (2)

#### Common Tools

Shop Equipment, General Repair  
NSN 4940-00-287-4894  
Lifting Equipment, 500 lbs.

#### Materials/Parts

Anti-Seize Compound  
(App. B, Item 2)  
Preformed packing (27)  
Duo-Cone Seals (25)  
Seal (20)  
Drain Pan  
Lubricating Oil OE/HDO-30 (Refer  
to L05-2410-237-12)  
2 Blocks 3' X 4" X 4"  
Trichloroethane (App. B, Item 21)  
Lint-free Rag (App. B, Item 12)

#### Equipment Condition

Track separated. See TM5-2410-237-20.

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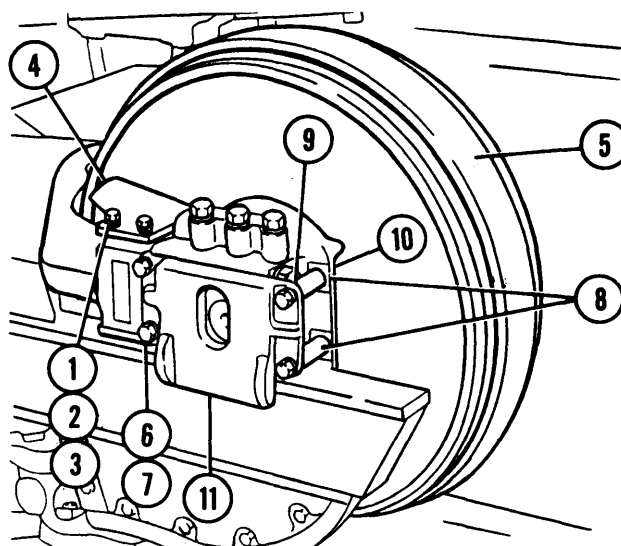
#### a. Removal

- (1) Use a wrench to remove two capscrews (1), two washers (2), two lockwashers (3) and guard (4) from both sides of front idler (5).

#### NOTE

Keep shims with respective plates for assembly.

- (2) Use a wrench to remove four capscrews (6), four washers (7), two spacers (8), shims (9), strip (10) and plate (11) from both sides of front idler (5).



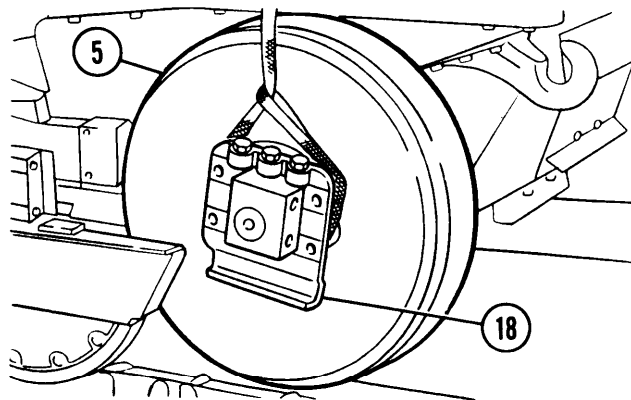
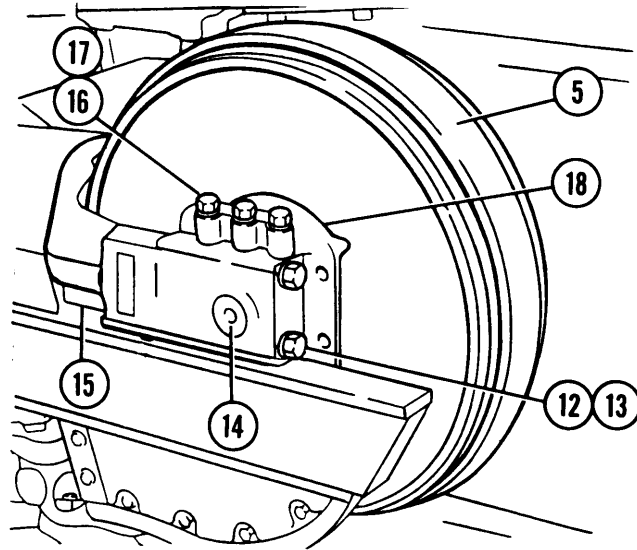
9-9. TRACK IDLERS - REPLACE/REPAIR (Cont'd)

- (3) Use a socket to remove two capscrews (12) and lockwashers (13) from bearing (14) and yoke (15) on both sides of front idler (5).

WARNING

Front idler weighs 500 lb. Use caution and proper handling equipment to avoid personal injury or damage to machine.

- (4) Attach lifting equipment to both sides of idler (5) and support.
- (5) Use a wrench to remove three capscrews (16) and lockwashers (17) at top of collar (18), at yoke end only, on both sides of front idler.
- (6) Use lifting equipment to move idler (5) forward until collars (18) clear end of track roller frame.
- (7) Remove idler (5).



## 9-9. TRACK IDLERS - REPLACE/REPAIR (Cont' d)

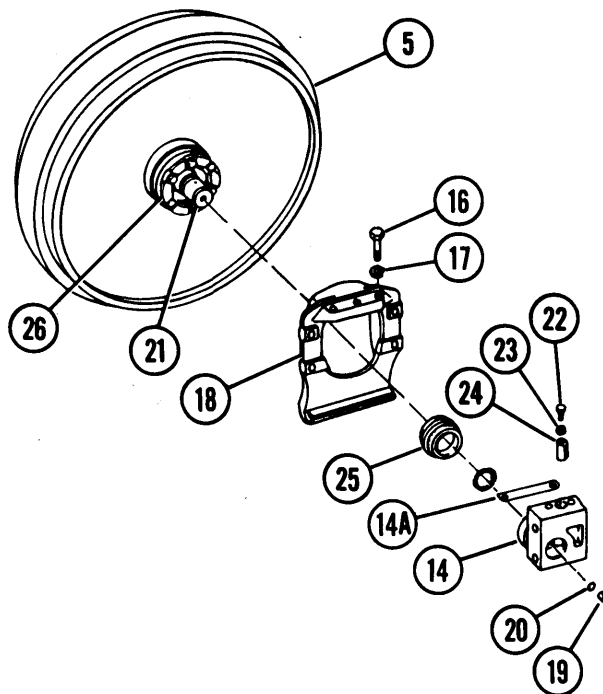
b. Disassembly**WARNING**

Front idler weighs 500 lbs.  
Use caution and proper  
handling equipment to avoid  
personal injury or damage to  
machine.

**NOTE**

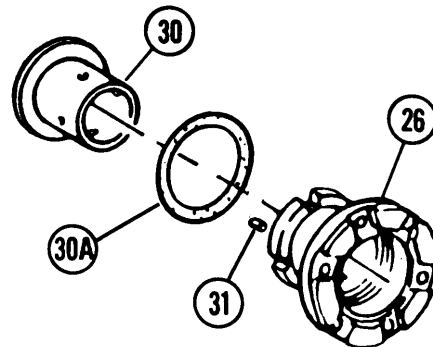
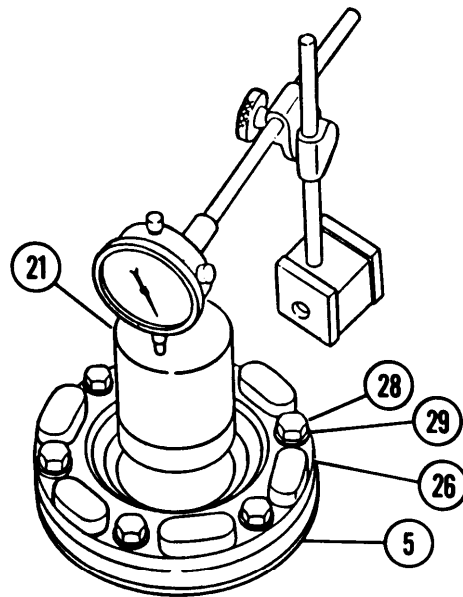
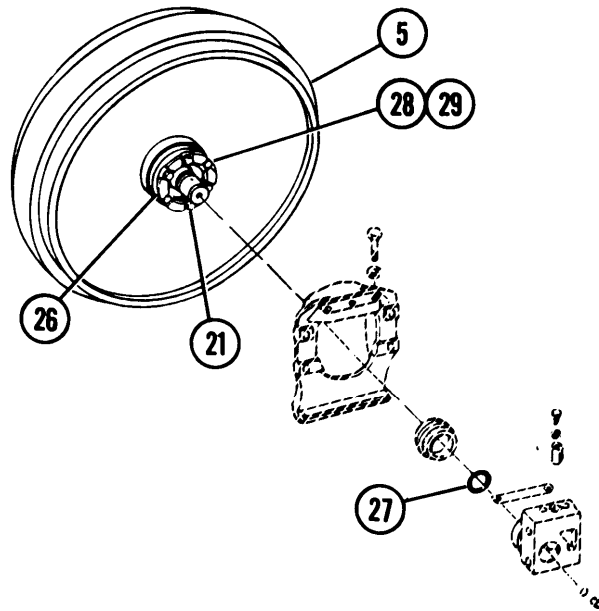
Start disassembly with idler  
laying flat on blocks and drain  
plug down.

- (1) Use a socket to remove plug (19) and seal (20) from front idler shaft (21) to drain oil. Discard seal (20).
- (2) After oil is drained, install plug (19) in idler shaft (21) to keep dirt out of idler.
- (3) Use a wrench to remove two remaining capscrews (16), two lockwashers (17) and collar (18) from bearing (14) on top side of idler. Remove shims (14A).
- (4) Use a wrench to remove capscrew (22) and lockwasher (23) from bearing (14).
- (5) Remove lock (24) from bearing (14) with punch and hammer.
- (6) Remove bearing (14) from idler shaft (21). Use bearing puller if bearing cannot be removed by hand.
- (7) Remove Duo-Cone seal assembly (25) from back of bearing (14) and from bushing assembly (26). Discard seal assembly (25).



9-9. TRACK IDLERS - REPLACE/REPAIR (Cont'd)

- (8) Remove and discard preformed packing (27) from idler shaft (21).
- (9) Use lifting equipment to turn idler over to opposite side.
- (10) Repeat STEPS 3 through 8 on other side of idler (5).
- (11) Use a dial indicator to measure end play. End play limits are 0.011 to 0.029 inches at end of shaft. If end play does not meet these specifications, perform STEPS (12) through (18).
- (12) Use a wrench to remove six capscrews (28) and six lockwashers (29) from bushing assembly (26).
- (13) Press shaft (21) and bushing (26) to remove them from hub of idler (5).
- (14) Use lifting equipment to turn idler over to opposite side.
- (15) Use a wrench to remove six capscrews (28) and six lockwashers (29) from bushing assembly (26).
- (16) Press other bushing (26) out of idler hub.
- (17) Press bearing (30) from bushing (26). Remove and discard gasket (30A).
- (18) Use a hacksaw to cut two pins (31) off flush with face of bushing and file pins smooth.
- (19) Repeat STEPS 17 and 18 for other bushing.



## 9-9. TRACK IDLERS - REPLACE/REPAIR (Cont'd)

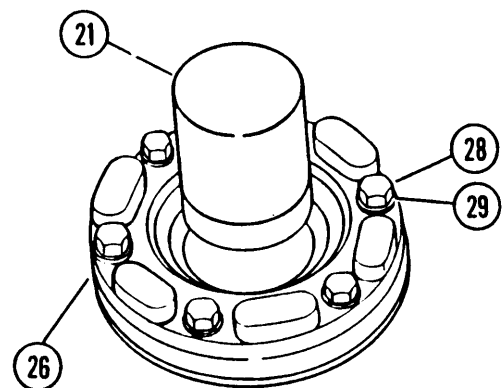
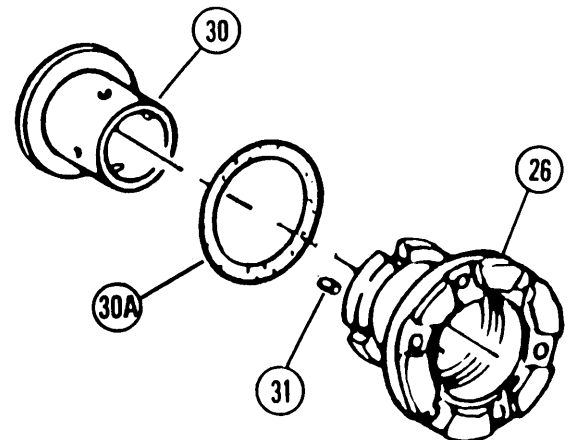
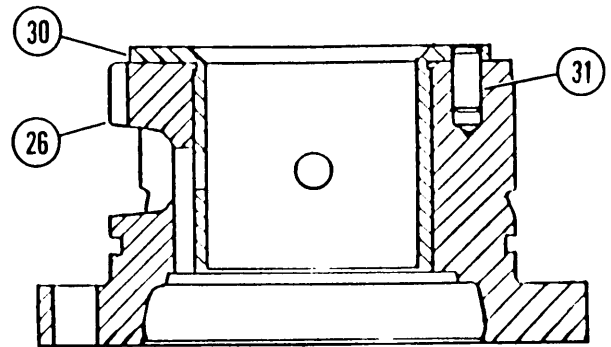
c. Assembly

- (1) Place new gasket (30A) on flange of bearing (30). Align oil holes in bearing (30) with oil holes in bushing (26) and press bearing into bushing.
- (2) Drill two holes 180° apart through lip of bearing (30) and into bushing (26) as follows:
  - (a) Drill two holes 0.281 in. (9/32") in diameter and 0.81 in. deep. Do not drill through lubrication grooves in bushing (26).
  - (b) Ream the two holes to 0.3052 in.  $\pm 0.0003$  in. in diameter and 0.69 in. deep.
  - (c) Ream the two holes again to 0.308 in.  $\pm 0.001$  in. in diameter and 0.25 in. deep.
- (3) Press two pins (31) 0.306 in. to 0.307 in. in diameter into the two holes until tops of pins are 0.031 in. below face of bearing (30) lip.
- (4) Repeat STEPS 1 through 3 for other bushing assembly.
- (5) Press bushing (26) into hub.
- (6) Install six capscrews (28) and six lockwashers (29) to secure bushing (26) in idler.

**WARNING**

Front idler weighs 500 lbs. Use caution and proper handling equipment to avoid personal injury or damage to machine.

- (7) Use lifting equipment to turn idler (5) over to opposite side.



9-9. TRACK IDLERS - REPLACE/REPAIR (Cont'd)

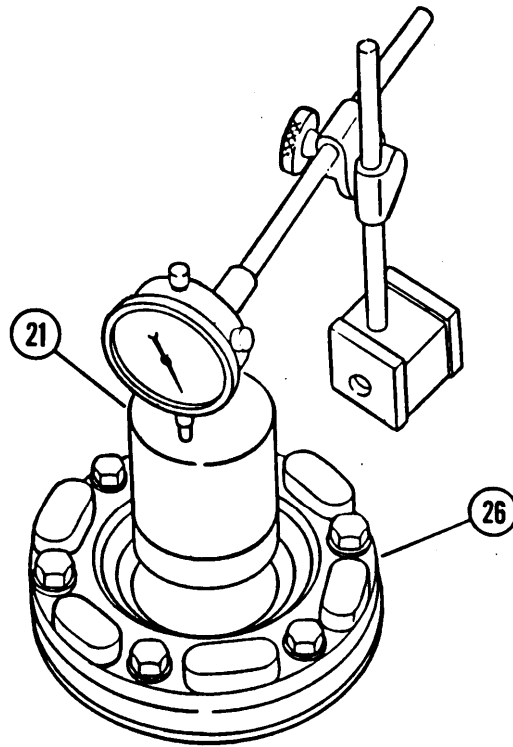
- (8) Install shaft (21) in other bushing assembly (26).
- (9) Repeat STEPS 5 and 6 for other bushing assembly.
- (10) Use a dial indicator and check for end play of 0.011 in. to 0.029 in. at end of shaft (21).

**WARNING**

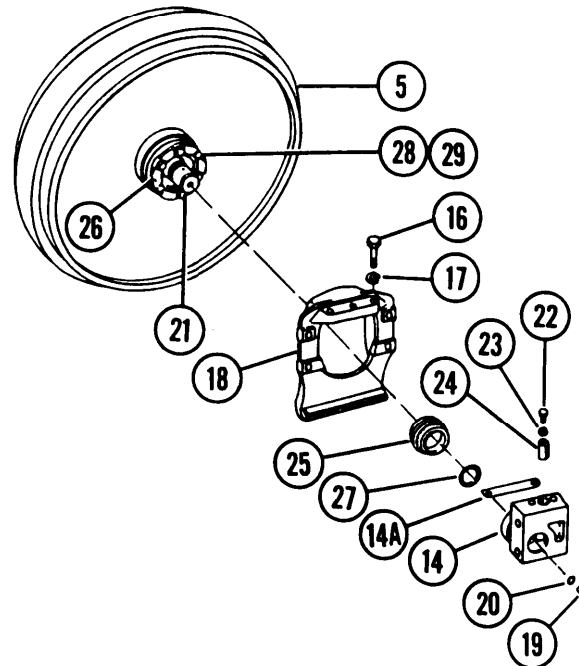
Avoid prolonged skin contact with trichloroethane. Avoid breathing the vapors in enclosed areas without adequate ventilation and do not smoke. Do not use near open flame or welding operations or other heated surfaces exceeding 482°C (900°F).

**CAUTION**

Duo-Cone seals (25) must be used as a matched pair or failure will result. Do not separate.

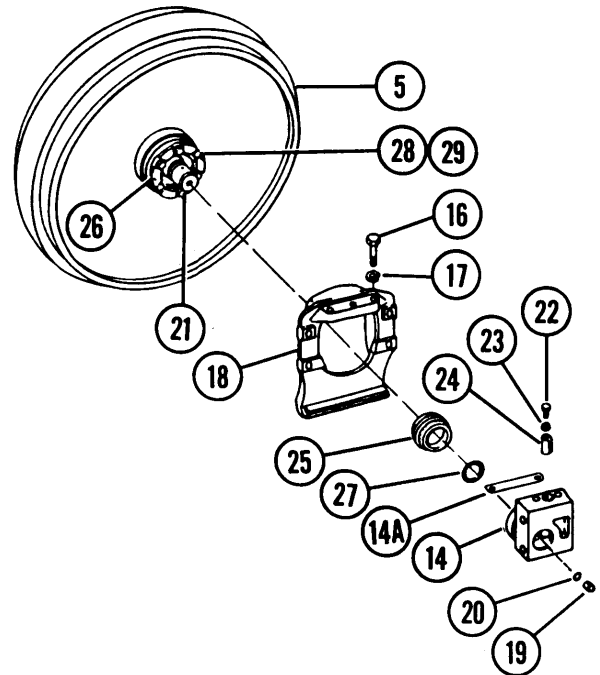


- (11) Clean new Duo-Cone seals (25), and all surfaces that make contact with the seals, with trichloroethane. All contact surfaces must be clean and dry, with no damage to the contact surfaces. Install new Duo-Cone seal (25) in bushing (26) on idler (5). Apply a film of oil to the contact surfaces of the seals.
- (12) Install new Duo-Cone seal (25) in bearing (14). Apply a film of oil to the contact surfaces of the seals.
- (13) Apply light film of oil to new preformed packing (27) and install seal on shaft (21).



## 9-9. TRACK IDLERS - REPLACE/REPAIR (Cont' d)

- (14) Apply anti-seize compound to contact surfaces on shaft (21) and bearing (14).
- (15) Align hole in bearing (14) with groove in shaft (22) and install bearing on shaft.
- (16) Apply anti-seize compound to bearing lock (24) and insert lock into bearing (14).
- (17) Install capscrew (22) and lockwasher (23) to secure lock (24) in bearing (14). Tighten capscrew to a torque of  $50 \pm 10$  lb. ft. Hit capscrew (22) using hammer and punch. Retighten capscrew.
- (18) Install collar (18) on bearing (14) with original shims (14A), two capscrews (16) and two lockwashers (17).
- (19) Use lifting equipment to turn front idler to opposite side.
- (20) Repeat STEPS 10 through 18 on "up" side of idler.
- (21) Remove filler plug (19) from end of shaft (21).
- (22) Use funnel and put 1.1 pints of lubricating oil in the front idler (5).
- (23) Install filler plug (19) and seal (20) in end of shaft (21). Tighten plug to a torque of  $125 \pm 15$  lb. ft.



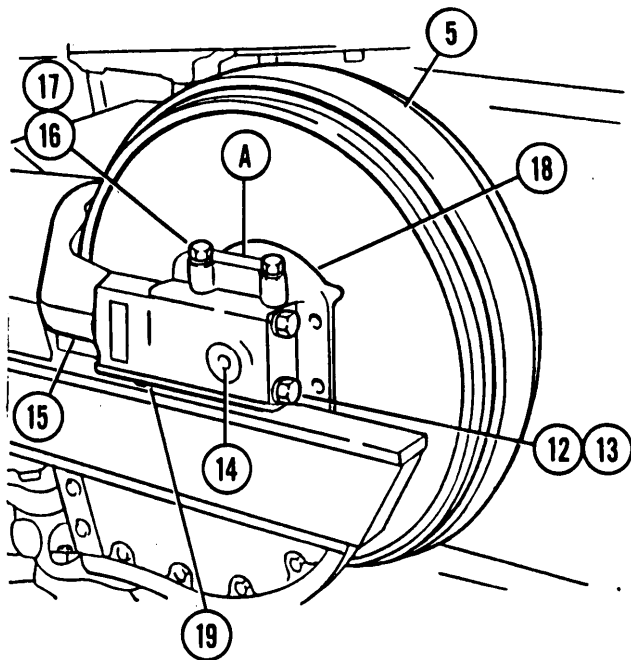
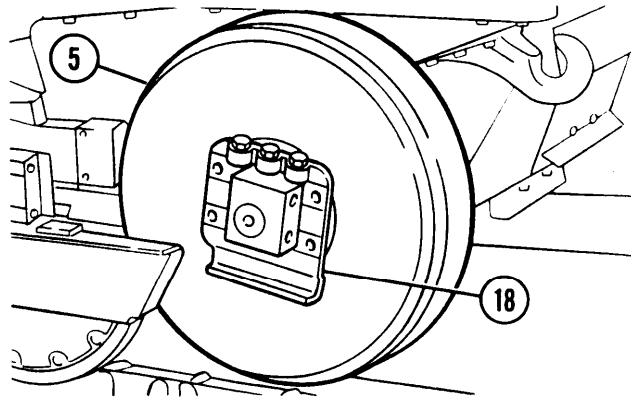
9-9. TRACK IDLERS - REPLACE/REPAIR (Cont' d)

d. Installation

**WARNING**

Front idler weighs 500 lbs. Use caution and proper handling equipment to avoid injury or damage to machine.

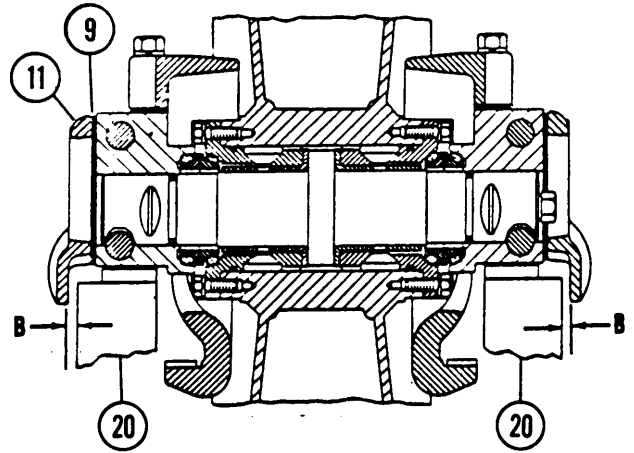
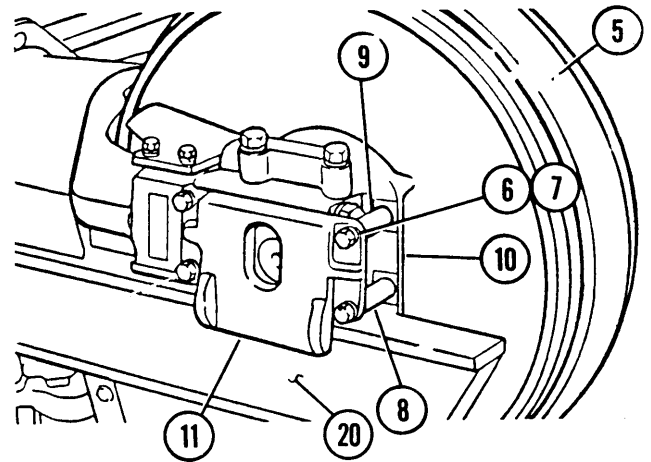
- (1) Attach lifting equipment to both sides of front idler (5) and, with lifting equipment lift idler into position on track roller frame.
- (2) Install two capscrews (12) and lockwashers (13) through bearing (14) into yoke (15) on both sides of front idler (5).
- (3) Install one capscrew (16) and lockwasher (17) at top of collar (18) and bearing (14) on both sides of front idler (5). Shim to give a minimum clearance of 0.030 in. to 0.075 in. between yoke (15) and plate assembly (19). Add or remove shims at point (A) as necessary.





9-9. TRACK IDLERS - REPLACE/REPAIR (Cont'd)

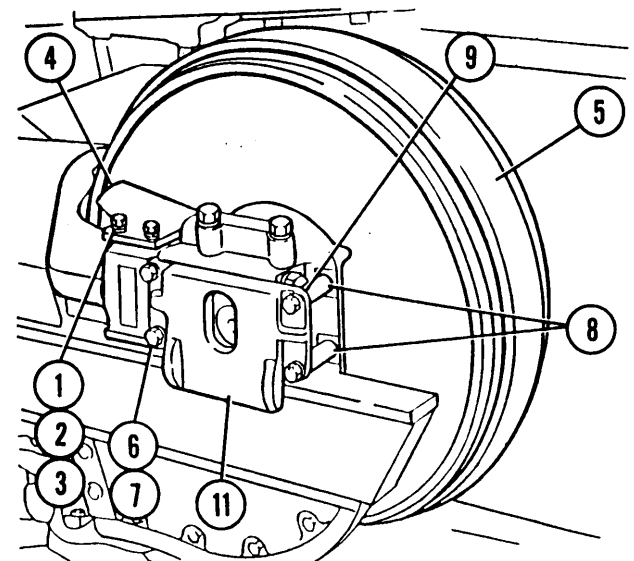
- (4) Install plate (11), two spacers (8), four capscrews (6), four lockwashers (7) and two strips (10) to both sides of front idler (5). Leave bolts loose for shimming.
- (5) Insert shims (9) between plate (11) and spacers (8) to provide 0.030 in.  $\pm$ 0.020 in. "B" dimension between plate (11) and side of track roller frame (20) on both sides of front idler.
- (6) Remove two capscrews (6) and lockwashers (7). Install shims (9) between plate (11) and spacers (8) on both sides of the front idler with two capscrews (6) and two lockwashers (7). Tighten four capscrews (6) to a torque of 200 $\pm$ 25 lb. ft.



- (7) Install guard (4) on yoke with two capscrews (1), two lockwashers (3) and two washers (2) on both sides of idler.
- (8) Reconnect track. See TM5-2410-237-20.

e. Place In Service

Test drive and check track for proper operation.



9-10. TRACK IDLER YOKES - REPLACE

This task covers:

- a. Removal
- b. Installation
- c. Place In Service

INITIAL SETUP

Applicable Configurations

All

Personnel Required

MOS62B (2)

Common Tools

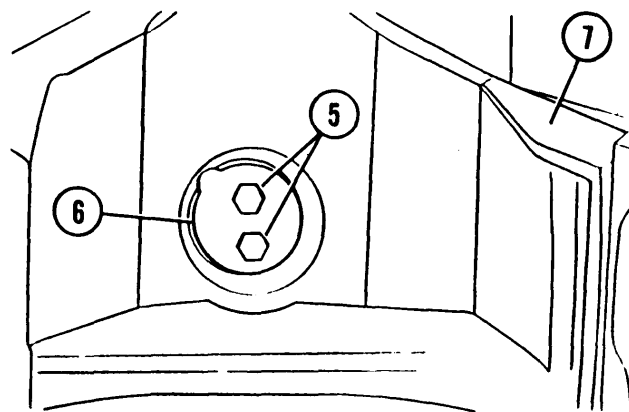
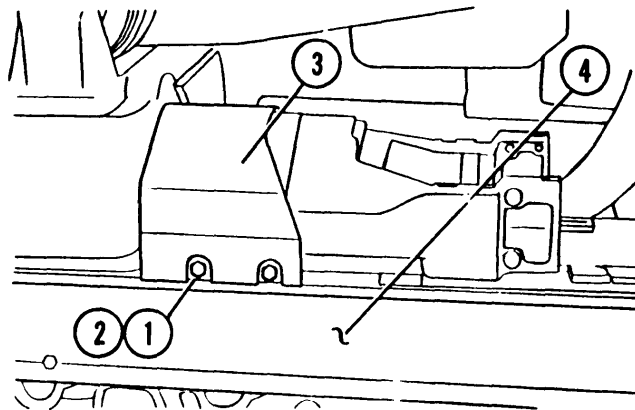
Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Lifting Equipment, 200 lbs.

Equipment Condition

Front idler removed. See page 9-35.

a. Removal

- (1) Use a wrench to remove four capscrews (1), four washers (2) and guard (3) from track roller frame (4).
- (2) Use a wrench to remove two capscrews (5) and plate (6) from center of yoke (7).



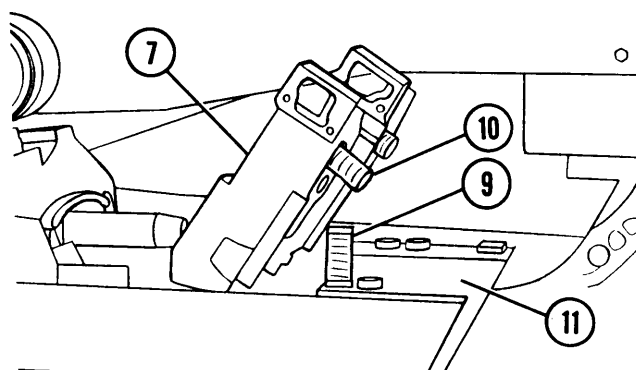
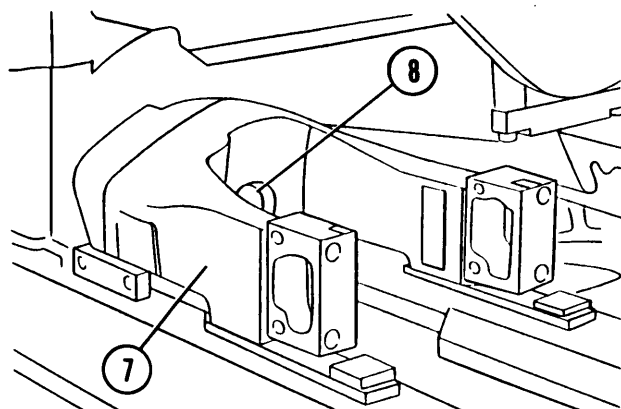
9-10. TRACK IDLER YOKES - REPLACE (Cont'd)

- (3) Hit rod (8) inside center of yoke (7) to break rod taper loose and free yoke. Pull yoke away from rod.

**WARNING**

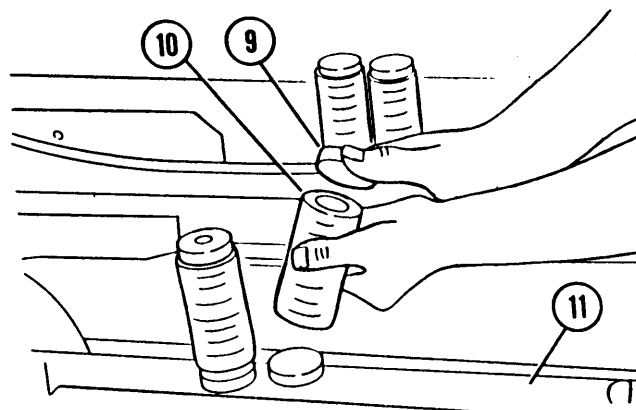
Yoke weighs 110 lbs. Use proper handling equipment to prevent personal injury or damage to machine.

- (4) Use lifting equipment to raise open end of yoke (7) and remove four plates (9), four springs (10) and two plate assemblies (11).
- (5) Remove yoke (7) with lifting equipment.



b. Installation

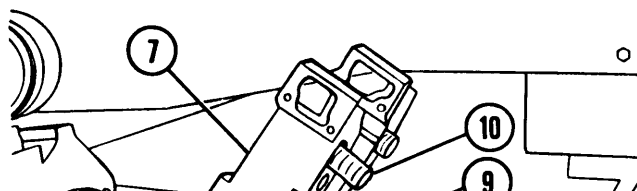
- (1) Position two plate assemblies (11) on track roller frame.
- (2) Install two springs (10) and two plates (9) on each plate assembly (11).



**WARNING**

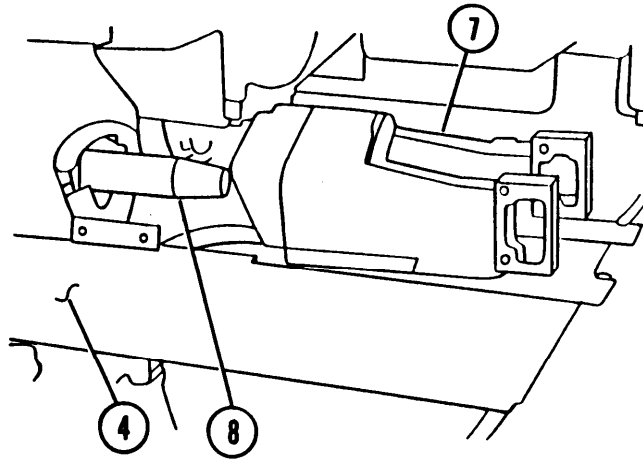
Yoke weighs 110 lbs. Use proper handling equipment to prevent personal injury or damage to machine.

- (3) Use lifting equipment to lift yoke (7) into position on track roller frame (4) and lower yoke (7) down over plates (9) and springs (10).

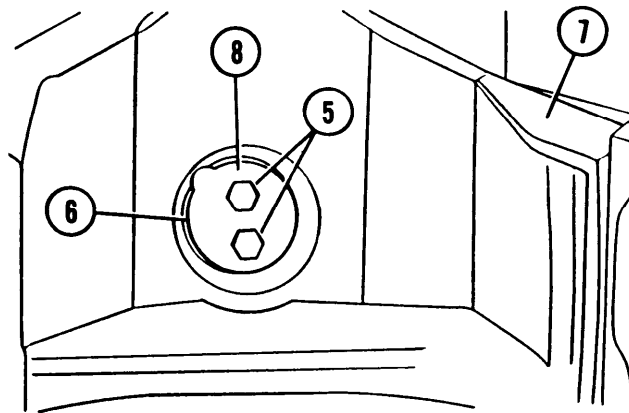


9-10. TRACK IDLER YOKES - REPLACE (Cont'd)

(4) Push yoke (7) forward onto end of rod (8).



(5) Install plate (6) and two capscrews (5) over end of rod (8).

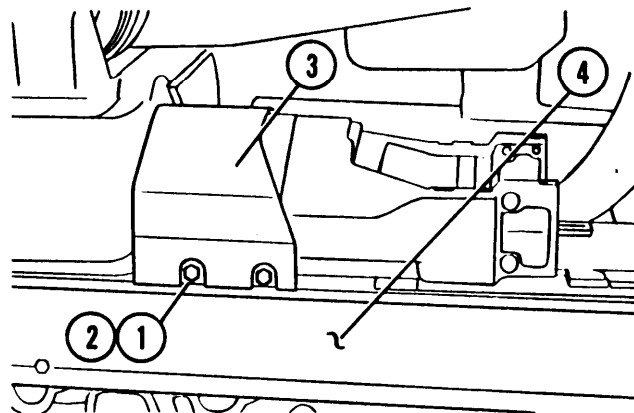


Install guard (3) on track roller frame (4) with four capscrews (1) and four washers (2).

7 Install front idler. See page 9-35.

c. Place In Service

Test drive and check for proper operation.



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## 9-11. TRACK ADJUSTER CYLINDER - REPLACE/REPAIR

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This task covers:

- a. Removal
  - b. Disassembly
  - c. Assembly
  - d. Installation
  - e. Place In Service
- 

### INITIAL SETUP

#### Applicable Configurations

All

#### Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Lubricating-Oil OE/HDO-30 (See  
L05-2410-237-12)  
Grease (App. B, Item 5)

#### Equipment Condition

Track separated. See TM5-2410-237-20.  
Track recoil mechanism guards removed.  
See TM5-2410-237-20.

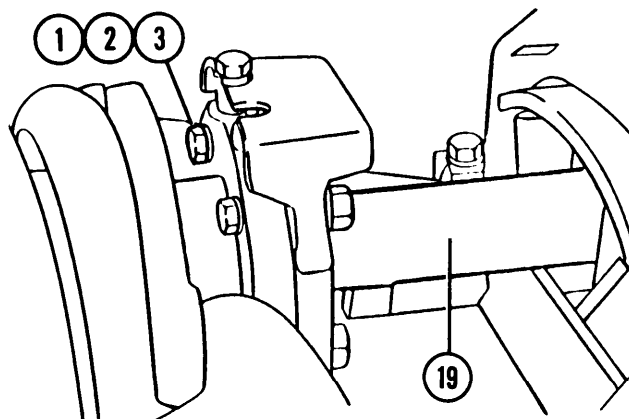
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### a. Removal

#### WARNING

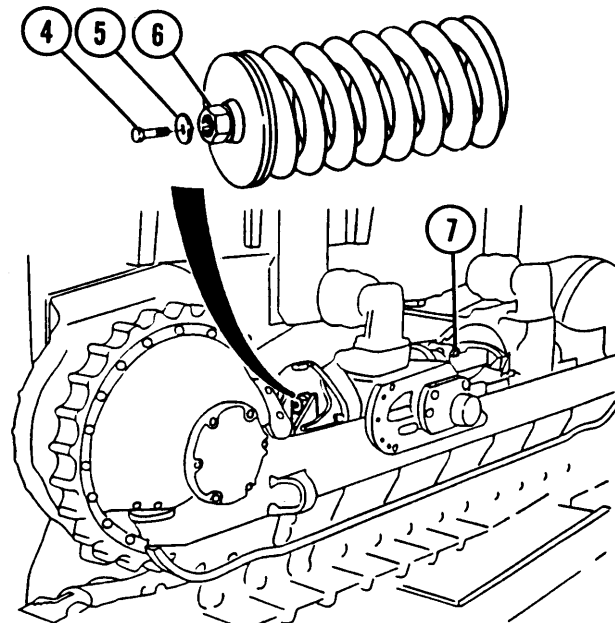
Make sure the hydraulic pressure in the track adjusting mechanism is completely released and the cylinder can be moved to the rear into the front pilot of the recoil spring before removing the hydraulic track adjuster.

- (1) Use two wrenches to remove five capscrews (1), nuts (2) and lockwashers (3) that hold the cylinder to the yoke (19).
- (2) Pull the front idler and yoke (19) forward on the track roller frame.

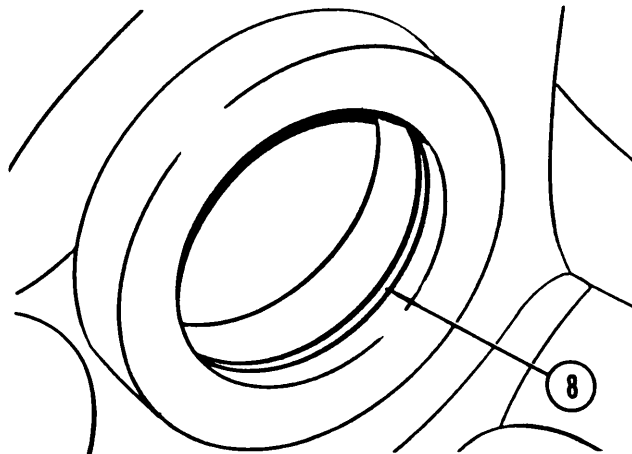


9-11. TRACK ADJUSTER CYLINDER - REPLACE/REPAIR (Cont' d)

- (3) Use a wrench to remove capscrew (4) and washer (5) from the shaft of the recoil spring. Use a wrench to tighten nut (6) against the rear pilot of the recoil spring until the pressure against the front stops (7) is released.
- (4) Remove the hydraulic track adjuster from the front pilot of the recoil spring.

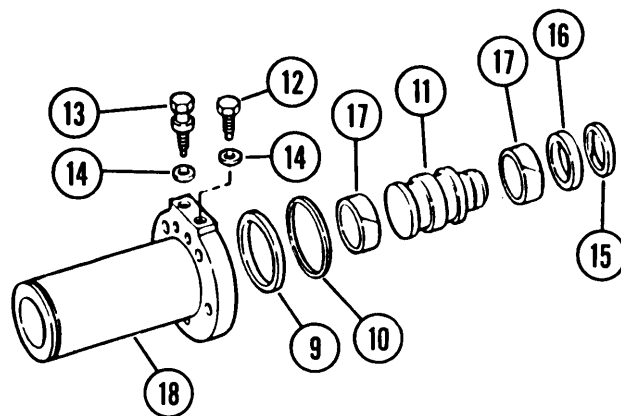


- (5) Remove seal (8) from the front pilot of the recoil spring. Discard seal (8).



b. Disassembly

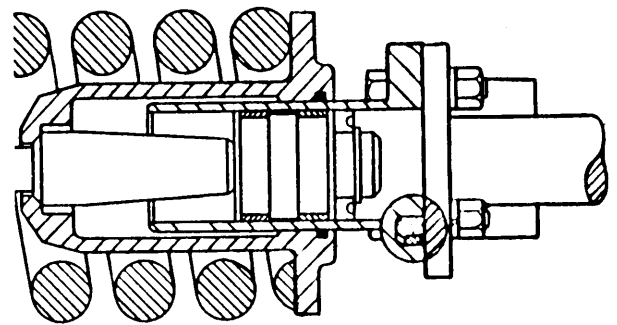
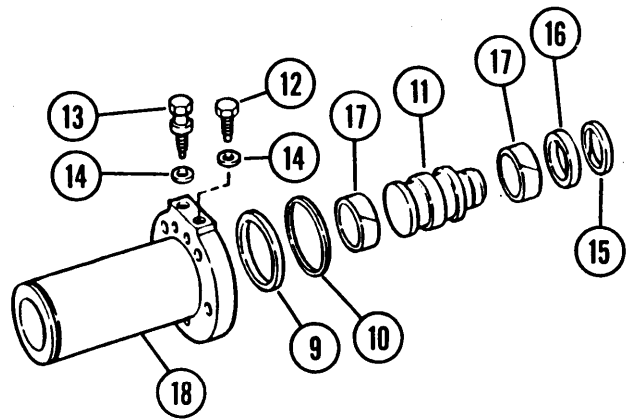
- (1) Remove seal (9) and ring (10) from the cylinder (18). Discard seal (9).
- (2) Remove piston assembly (11) from the cylinder (18).
- (3) Use a wrench to remove fill valve (12) and relief valve (13) from the cylinder (18).
- (4) Remove washers (14) from valves (12 and 13). Discard washers (14).
- (5) Use a small screwdriver to remove the ring (15) that holds seal (16) in position on the piston (11). Remove and discard seal (16).
- (6) Remove two rings (17) from the piston (11).



9-11. TRACK ADJUSTER CYLINDER - REPLACE/REPAIR (Cont' d)

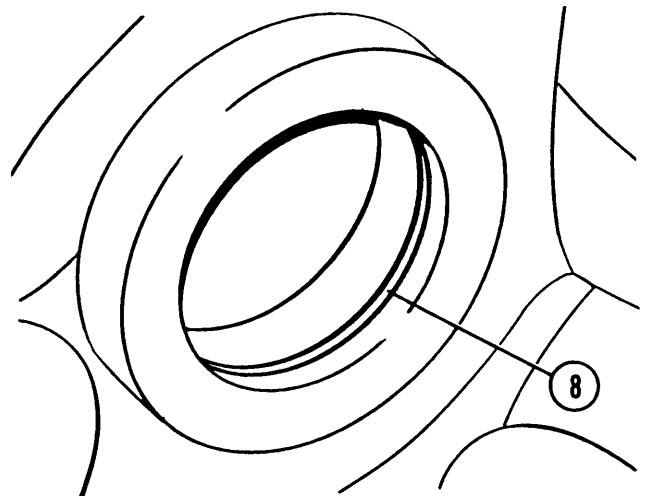
c. Assembly

- (1) Install the fill valve (12) and washer (14) in the cylinder. Install the relief valve (13) and washer (14) in the cylinder. Tighten the two valves to a torque of  $25 \pm 5$  lb. ft.
- (2) Install two rings (17) on piston (11). Install seal (16) on the piston with the sealing lip toward the ring that holds the seal in position (15). Install ring (15) to secure seal (16).
- (3) Install the piston assembly (11) in the cylinder (18).
- (4) Install seal (9) in the cylinder. Put clean lubricating oil on the seal. Install the ring (10) next to the seal with the chamfer toward the cylinder.



d. Installation

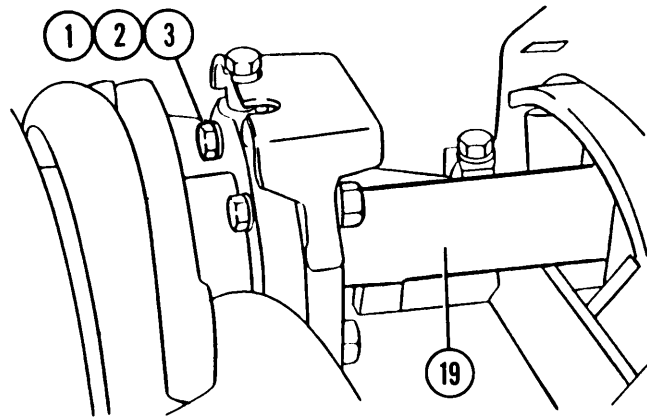
- (1) Put a new seal (8) in the front pilot of the recoil spring. Put grease on the seal.
- (2) Put the hydraulic track adjuster assembly in position in the front pilot of the recoil spring.



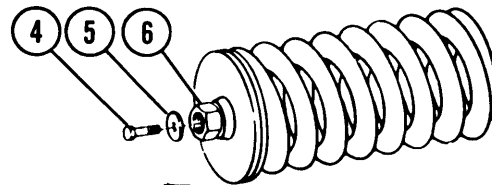
9-11. TRACK ADJUSTER CYLINDER - REPLACE/REPAIR (Cont' d)

(3) Move the front idler and yoke toward the hydraulic track adjuster. Make sure the hydraulic track adjuster is against the yoke.

(4) Use two wrenches to install five capscrews (1), nuts (2) and lockwashers (3) that hold the hydraulic track adjuster to the yoke (19).

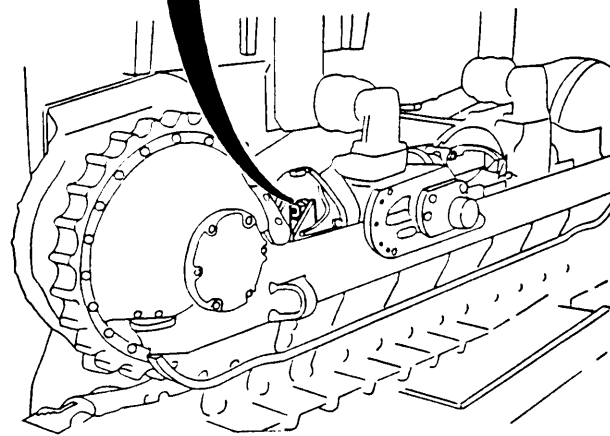


(5) Use a wrench to loosen nut (6) on the shaft of the recoil spring until the nut is extended beyond the end of the shaft  $0.06 \pm 0.03$  in. Install washer (5) and capscrew (4) in the end of the shaft.



(6) Install track recoils mechanism guards. See TM5-2410-237-20.

(7) Connect track. TM5-2410-237-20.



e. Place In Service

Test drive and check track for proper operation.



9-12. TRACK DRIVE SPROCKETS/HUBS - REPLACE

This task covers:

- a. Removal
- b. Installation
- c. Place In Service

INITIAL SETUP

Applicable Configurations

All

Personnel Required

MOS62B (2)

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Lifting Equipment, 500 lbs.

Materials/Parts

Seals (12)  
 Lock (27)  
 Gasket (16), (22)  
 Trichloroethane (App. B, Item 21)  
 Multipurpose grease (App. B, Item 5)  
 Duo-Cone seals (20), (25), (41), (42)  
 Lubricating Oil OE/HDO-30 (See L05-2410-237-12)  
 Lint-free rag (App. B, Item 12)  
 Drain pan (10 gallon capacity)

Equipment Condition

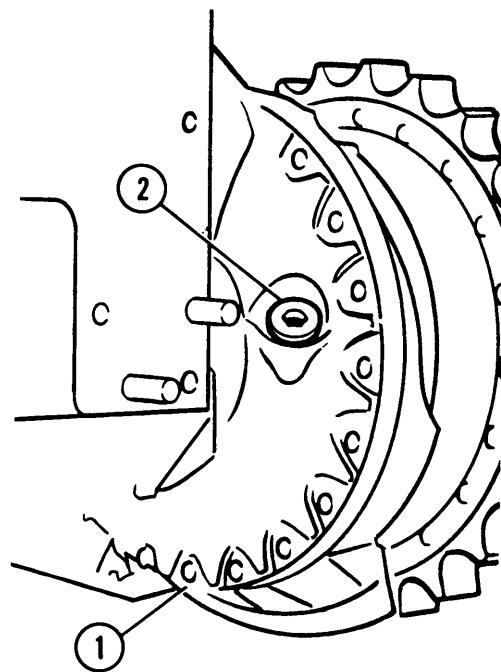
Track roller frame removed. See page 9-20.

NOTE

Place a drip pan beneath drain plug to catch oil.

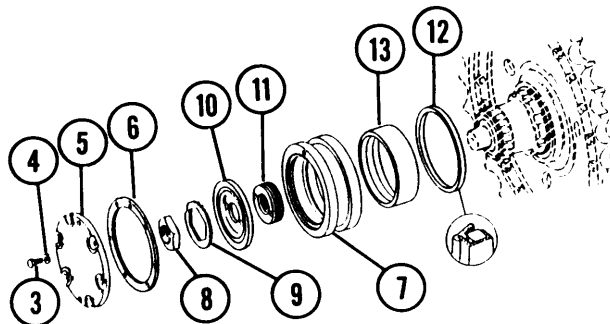
a. Removal

- (1) Use a square wrench to remove drain plug (1) at bottom of final drive case and drain oil. Loosen filler plug (2) to speed draining.
- (2) When oil draining is completed, put drain plug (1) back in drive case finger tight to keep out dirt.



9-12. TRACK DRIVE SPROCKETS/HUBS - REPLACE (Cont' d)

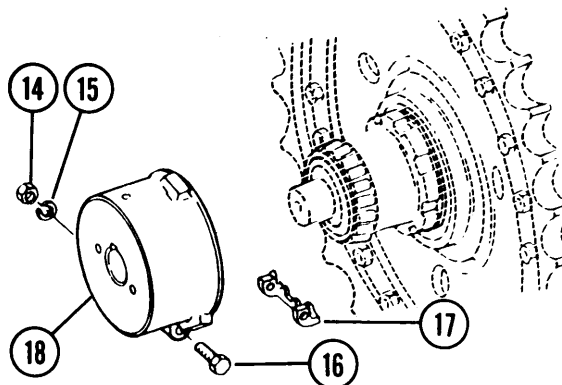
- (3) Use a wrench to remove six capscrews (3), six lockwashers (4), cap (5) and gasket (6) from support assembly (7). Discard gasket (6).
- (4) Remove lock (9) and use a socket to remove nut (8) from the sprocket shaft.
- (5) Remove retainer (10), shims (11) and support assembly (7) from the holder assembly.
- (6) Remove seal (12) and bearing (13) from support assembly (7). Discard seal (12).



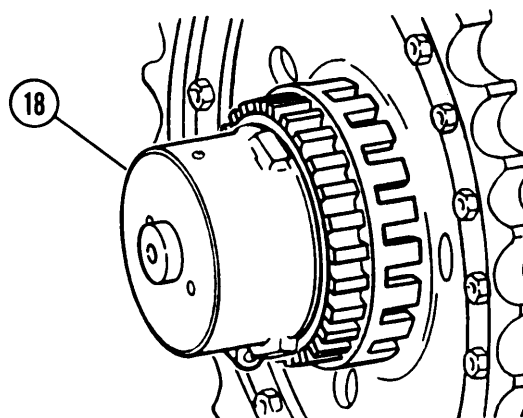
- (7) Use two wrenches to remove nut (14), lockwasher (15), capscrew (16) and lock (17) from holder assembly (18).

NOTE

Do not use more than 50 tons of pressure to remove the holder assembly.



- (8) Install puller with a 100 ton capacity on holder assembly (18) and loosen holder assembly from taper on the final drive hub.

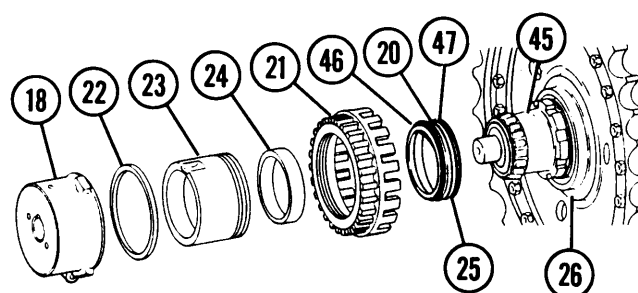
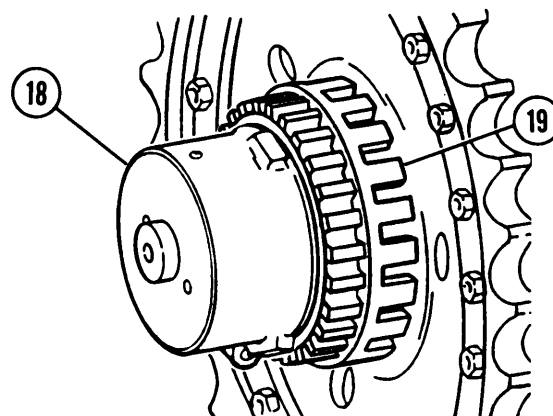


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 9-12. TRACK DRIVE SPROCKETS/HUBS - REPLACE (Cont' d)
 

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- (9) Use lifting equipment to remove holder assembly (18) and adjusting nut (19) as a unit. Weight approximately 80 lbs.
- (10) Remove key (45) from shaft.
- (11) Remove Duo-Cone seal half (20) and preformed packing (46) from inside of adjusting nut (21). Discard preformed packing (46).
- (12) Remove adjusting nut (21) from holder assembly (18).
- (13) Remove gasket (22) from holder assembly (18). Discard gasket (22).
- (14) Pull cage (23) from holder (18).
- (15) Pull bearing cup (24) from cage (23).
- (16) Remove Duo-Cone seal half (25) and preformed packing (47) from sprocket (26) and discard seal (25). Keep seal halves (20 and 25) together so they will not be mixed during installation.
- (17) Use a hammer and a chisel to bend sprocket lock (27) down.
- (18) Loosen nut (28) with spanner wrench until there is a 1.0 in. gap between nut (28) and sprocket (26).



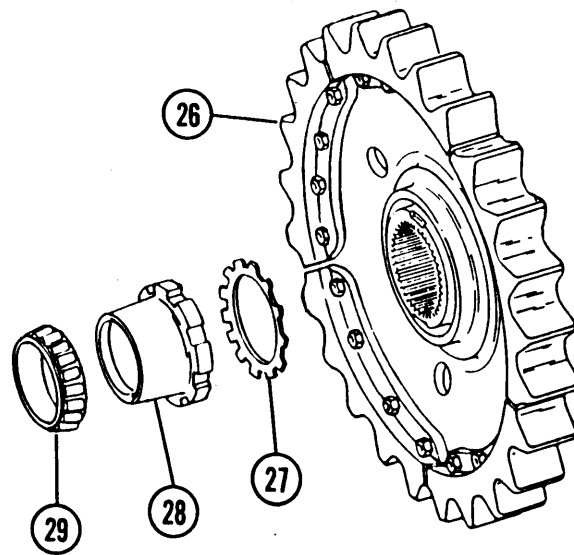
9-12. TRACK DRIVE SPROCKETS/HUBS - REPLACE (Cont' d)

- (19) Use a spanner wrench to turn nut (28) toward sprocket (26) until a remover tool can be inserted between nut (28) and bearing cone (29).

**CAUTION**

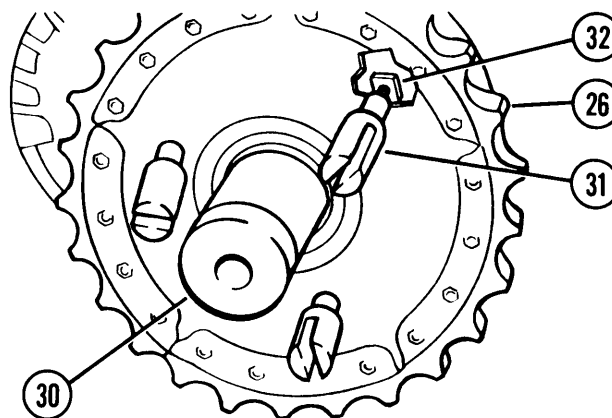
Use care when removing bearing and nut. Haste or improper choice of removal tool will damage parts.

- (20) Use a spanner wrench to turn nut (28) away from sprocket (26) and remove bearing cone (29), remover tool, nut (28) and lock (27). Discard lock (27).



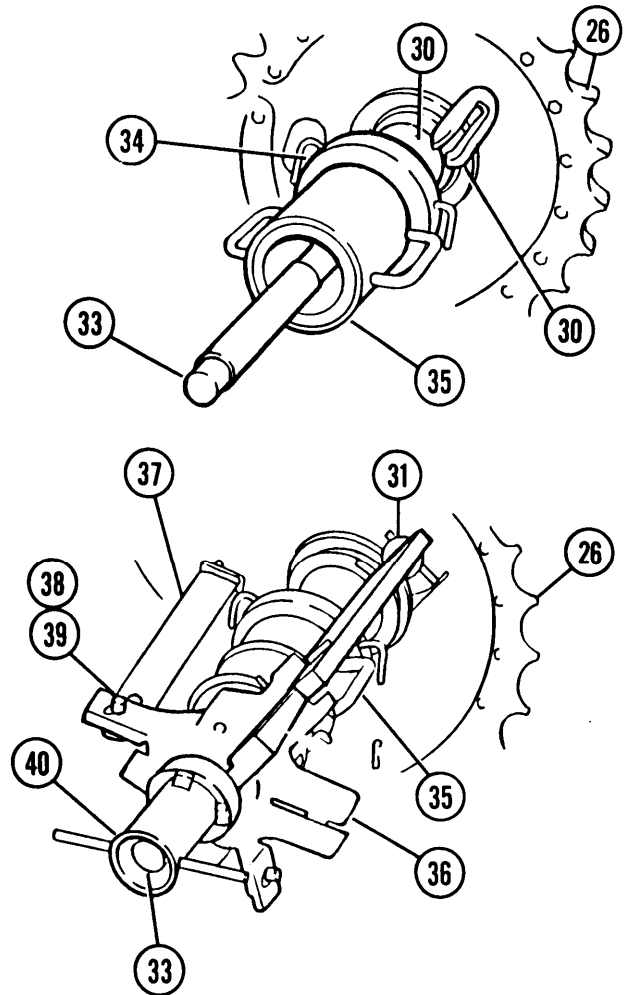
- (21) Install a sprocket puller and adapters to remove sprocket (26) as follows:

- (a) Install an adapter (30) on drive hub and turn to within 0.25 in. of sprocket (26) hub.
- (b) Install adapters (31) in the three puller holes in sprocket (26).
- (c) Install three nuts (32) on adapters (31) with angle side toward sprocket (26) and flat side even with threaded end of adapter (31). Position drill point on nut (32) toward outer edge of sprocket (26).



## 9-12. TRACK DRIVE SPROCKETS/HUBS - REPLACE (Cont'd)

- (d) Install a stud (33) in adapter (30). Install a plate (34) and cylinder (35) on stud (33) and against adapter (30). Piston end of cylinder (35) should face away from sprocket (26).
- (e) Install a head (36) on stud (33) with flat side against the cylinder (35).
- (f) Install three arms (37) to connect head (36) with adapters (31) in sprocket (26) and secure arms with pins (38) and lock pins (39) at each end.
- (g) Install a nut (40) on stud (33) to within 1.0 in. from head (36).

**WARNING**

Sprocket has been installed with 60 to 65 tons force and requires considerable force to loosen. Stand clear of sprocket during loosening procedure to avoid personal injury.

- (h) Connect a hydraulic pump to cylinder (35) and apply pressure to break sprocket (26) loose.

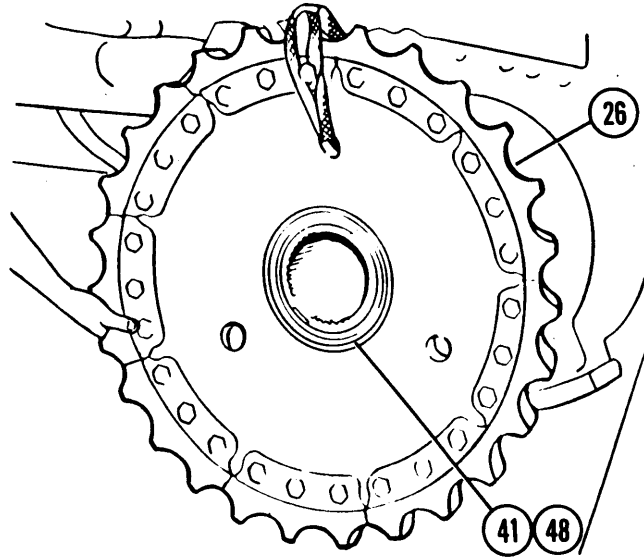
**WARNING**

Sprocket weighs 400 lbs. Use caution and proper handling equipment to prevent personal injury or damage to machine.

- (22) Remove sprocket puller tooling from shaft (34).

9-12. TRACK DRIVE SPROCKETS/HUBS - REPLACE (Cont'd)

- (23) Use lifting equipment to carefully remove sprocket (26) from hub.
- (24) Remove Duo-Cone seals (41) and preformed packing (48) from hub of sprocket (26) and discard preformed packing (48).
- (25) Remove Duo-Cone seal halves (42) and preformed packing (49), final drive case and discard preformed packing (49). Keep seal halves (41 and 42) together so they will not be mixed during installation.



b. Installation

WARNING

Avoid prolonged skin contact with trichloroethane. Avoid breathing the vapors in enclosed areas without adequate ventilation and do not smoke. Do not use near open flame or welding operations or other heated surfaces exceeding 482°C (900°F).

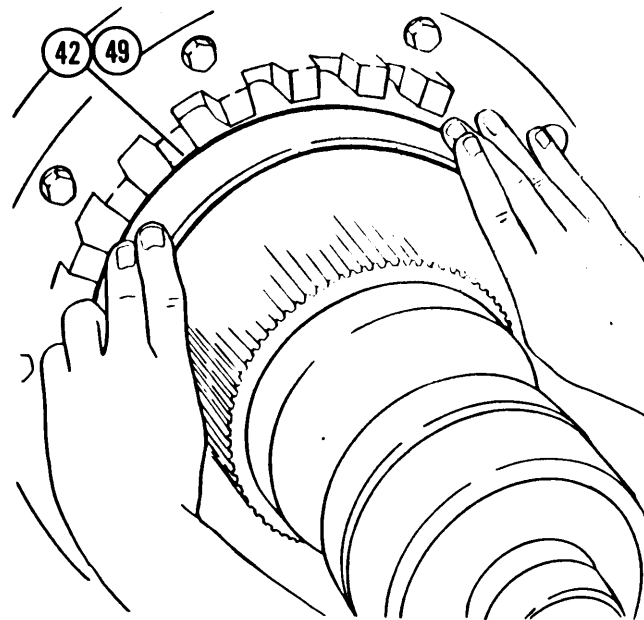
CAUTION

Duo-Cone seal halves (41 and 42) must be used as a matched pair or failure will result. Do not separate.

NOTE

Duo-Cone seals and preformed packings must be clean and dry with no damage to the contact surfaces.

- (1) Apply trichloroethane to seal (42). Install Duo-Cone seal half (42) and preformed packing (49) in the final drive case with a seal installer. Coat metal contact surface of seal with clean oil.

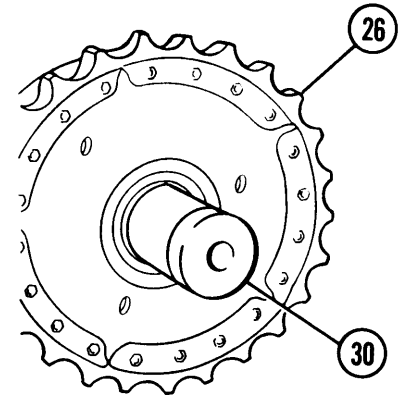


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 9-12. TRACK DRIVE SPROCKETS/HUBS - REPLACE (Cont' d)
 

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- (2) Apply trichloroethane to seal (41). Install Duo-Cone seal half (41) and preformed packing (48) in hub of sprocket (26) with a seal installer. Coat metal contact surface of seal with clean oil.
- (3) Wipe splines on drive hub and sprocket (26) hub clean and dry.



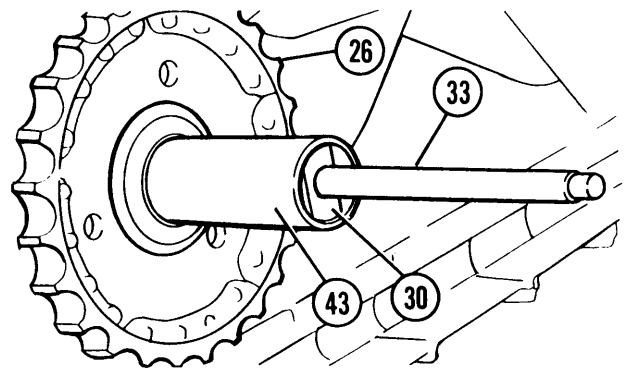

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 WARNING
 

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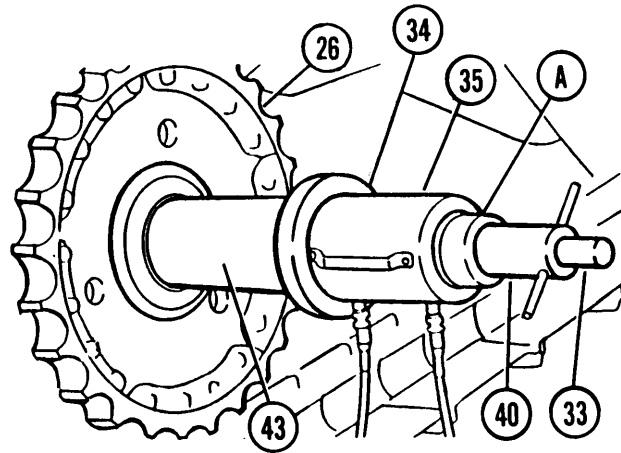
Sprocket weighs 400 lbs. Use caution and proper handling equipment to prevent personal injury or damage to machine.

- (4) Use lifting equipment to lift sprocket (26) into position at end of drive hub, align splines and carefully push sprocket (26) onto drive hub as far as possible by hand.
- (5) Install sprocket (26) on the drive hub with sprocket installation tooling as follows:
- Install adapter (30) on drive hub and turn adapter until it is fully on hub.
  - Install stud (33) in adapter (30).



9-12. TRACK DRIVE SPROCKETS/HUBS - REPLACE (Cont'd)

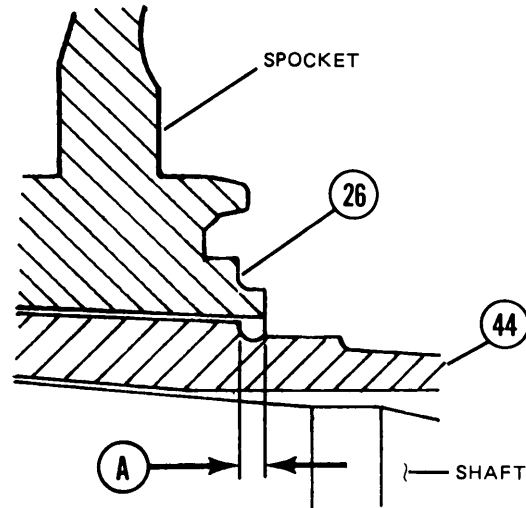
- (c) Install a sleeve (43) over stud (33) and adapter (30) until it makes contact with sprocket (26).
- (d) Install plate (34) on stud (33) until it makes contact with sleeve (43).
- (e) Install retracted cylinder (35) on stud (33) until it makes contact with plate (34). Piston end (A) of cylinder (35) to face away from sprocket (26).
- (f) Install a nut (40) on stud (33) to within 0.25 in. from cylinder (35).
- (g) Connect a hydraulic pump to the cylinder (35) and apply 60 to 65 ton pressure to force sprocket (26) fully onto drive hub.



**WARNING**

Make sure pressure is off cylinder of sprocket installation tool before trying to remove it from sprocket shaft. Failure to follow this precaution could result in serious personal injury.

- (6) Remove sprocket installation tooling from sprocket shaft.
- (7) Check distance from sprocket (26) hub face to spline shoulder on final drive gear hub (44). Distance must be  $0.500 \pm 0.060$  in. at "A".
- (8) If distance measured in STEP (7) is less than 0.44 inches, replace sprocket and final drive gear hub. If distance exceeds 0.56 inches, remove sprocket, clean hub splines, and reinstall sprocket.





9-12. TRACK DRIVE SPROCKETS/HUBS - REPLACE (Cont' d)

- (9) Install new lock (27) and nut (28). Tighten nut with a spanner wrench. Bend one tab of lock (27) in notch of nut (28) and one tab in notch of sprocket hub.

**WARNING**

Use insulated gloves for handling hot and cold parts to avoid personal injury.

- (10) Heat bearing cone (29) to 275°F maximum and install bearing cone (29) on final drive hub against nut (28).

- (11) Lower temperature of bearing cup (24) and install cup in cage (23).

- (12) Install cage (23) in holder (18) being careful to align slot in cage over dowel in holder.

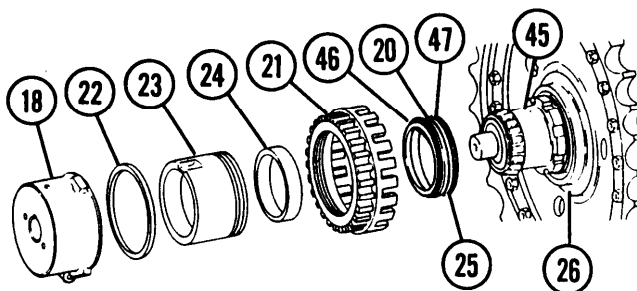
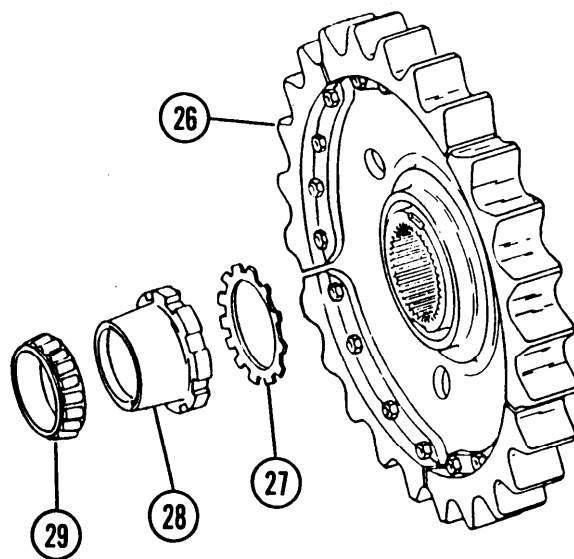
- (13) Install new gasket (22) in groove in holder (8).

- (14) Apply multipurpose type grease to threads of adjusting nut (21) and on face of nut that contacts gasket (22) in holder (18).

- (15) Install adjusting nut (21) on holder (18). Tighten it all the way down to end of thread travel.

**WARNING**

Avoid prolonged skin contact with trichloroethane. Avoid breathing the vapors in enclosed areas without adequate ventilation and do not smoke. Do not use near open flame or welding operations or other heated surfaces exceeding 482°C (900°F).



9-12. TRACK DRIVE SPROCKETS/HUBS - REPLACE (Cont'd)

CAUTION

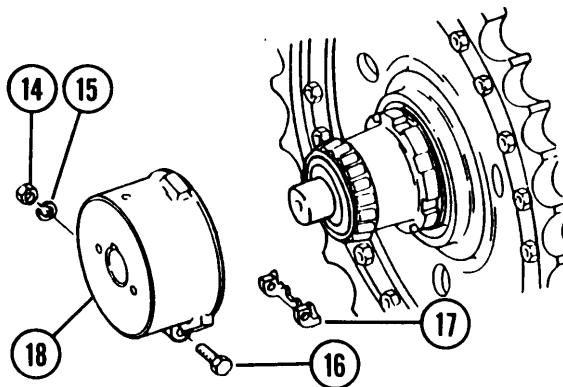
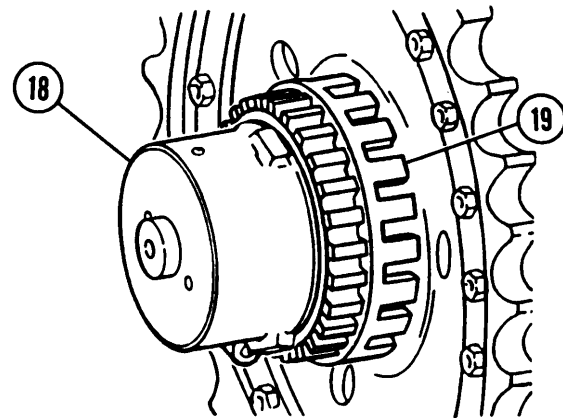
Duo-Cone seal halves (20 and 25) must be used as a matched pair or failure will result. Do not separate.

- (16) Install Duo-Cone seal half (20) and preformed packing (46) in adjusting nut (21) using a seal installer. Coat metal contact surface of seal with clean oil.
- (17) Install Duo-Cone seal half (25) and preformed packing (47) in hub of sprocket (26) with a seal installer. Coat metal contact surface of seal with clean oil.
- (18) Install key (45) in shaft keyway.
- (19) Use lifting equipment to position holder assembly (18) and adjusting nut (19) on sprocket shaft, being careful to align keyway in holder with key in shaft.

NOTE

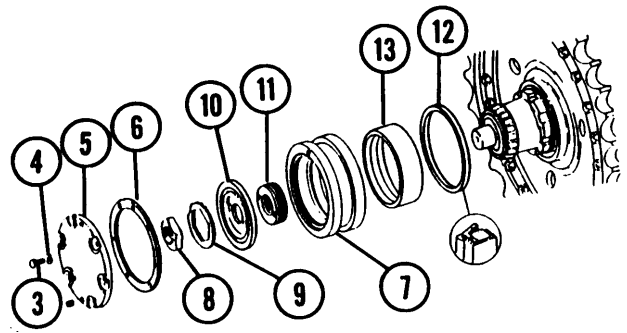
Do not install lock (17) on holder (18) with capscrew (16) at this time to accommodate bearing adjustment.

- (20) Lower temperature of bearing (13) and install bearing (13) in support assembly (7).
- (21) Install seal (12) in support (7) with lip of seal toward and even with outside edge of support (7). Apply clean oil to lip of seal.
- (22) Apply multipurpose type grease on inside diameter of support (7) and install support over holder assembly (18).



9-12. TRACK DRIVE SPROCKETS/HUBS - REPLACE (Cont'd)

- (23) Install shims (11) on sprocket shaft for correct alignment of sprocket and track roller frame. See page for shimming procedure and specifications.
- (24) Fill the inside of retainer (10) with multipurpose type grease and install retainer (10) on dowels in holder (18).
- (25) Use a socket to install nut (8) on sprocket shaft. Use a torque wrench to tighten to a torque of 1100 to 1200 lb. ft.
- (26) Tighten adjusting nut (21) until snug. Final tightening will occur during adjustment.
- (27) Install lock (9) over nut (8).



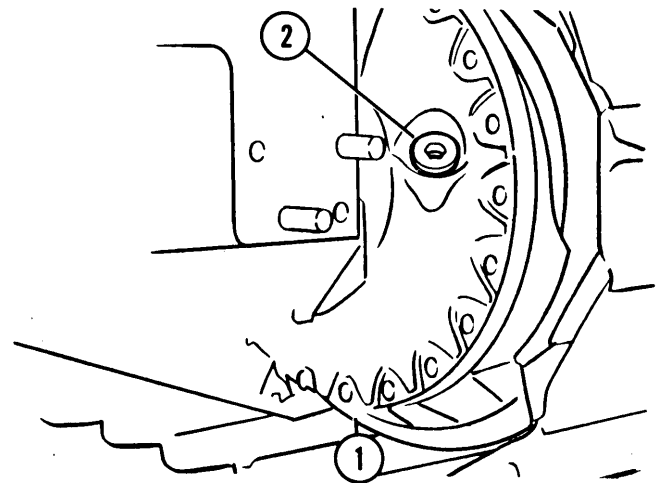
NOTE

Do not install gasket (6) or cap (5) at this time because they need to be off for bearing adjustment.

- (28) Tighten drain plug (1) at bottom of final drive case.
- (29) Remove filler plug (2) and fill final drive case with oil to the correct level. See TM5-2410-237-20. Install filler plug.

NOTE

Use pressure relief valve with grease fitting to release pressure before removing grease fitting from cap (5) after adding grease.



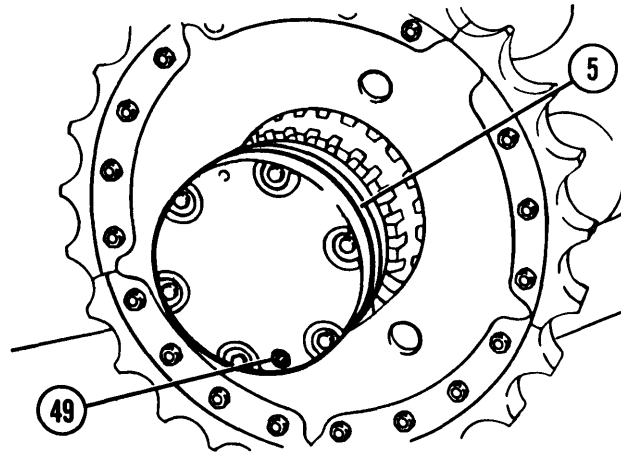
- (30) Adjust final drive bearings. See page 8-30: begin with STEP (7), end with STEP (17).

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9-12. TRACK DRIVE SPROCKETS/HUBS - REPLACE (Cont' d)

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- (31) Remove hex head socket plug (49) from cap (5) and install grease fitting. Fill retainer cavity with multi purpose type grease.
- (32) Remove grease fitting and install plug (49) in cap (5).
- (33) Install track roller frames. See page 9-21.
- (34) Connect track. See page 9-68.



c. Place In Service

Test drive and check track for proper operation.

---

## 9-13. DRIVE SPROCKET SHAFT - REPLACE

---

This task covers:

- a. Removal
- b. Installation
- c. Place In Service

---

### INITIAL SETUP

#### Applicable Configurations

All

#### Personnel Required

MOS62B (2)

#### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Lifting Equipment, 200 lbs.  
Sleeve NSN 5120-01-119-1931  
Head NSN 5120-00-972-0345

#### Materials/Parts

Stud 5P5207  
Nut 5P5208

#### Equipment Condition

Final drive cases, gears idler  
Pini ons and bearing removed. See page 8-4.

### a. Removal

- (1) Use a screwdriver to remove ring (1) and pin (2) from nut (3) at steering clutch case.

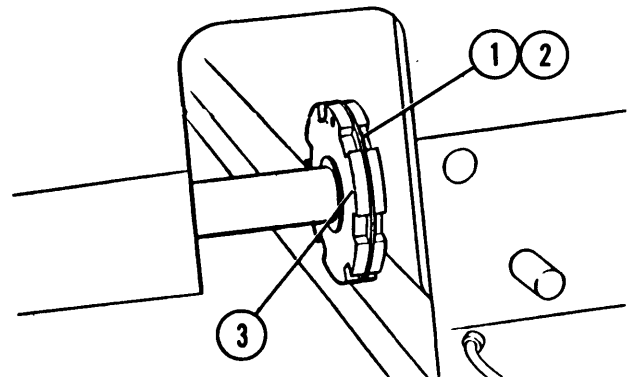
#### CAUTION

Loosen, but do not remove nut from threaded portion of sprocket shaft. Failure to follow this precaution could result in thread damage on shaft and in steering clutch case.

- (2) Use a spanner wrench to loosen nut (3) until there is a 0.125 in gap between nut (3) and steering clutch case.

#### NOTE

STEP 3 is a general STEP. The exact procedure will differ depending on the tools available.



9-13. DRIVE SPROCKET SHAFT - REPLACE (Cont'd)

(3) Install tooling to remove the sprocket shaft (5):

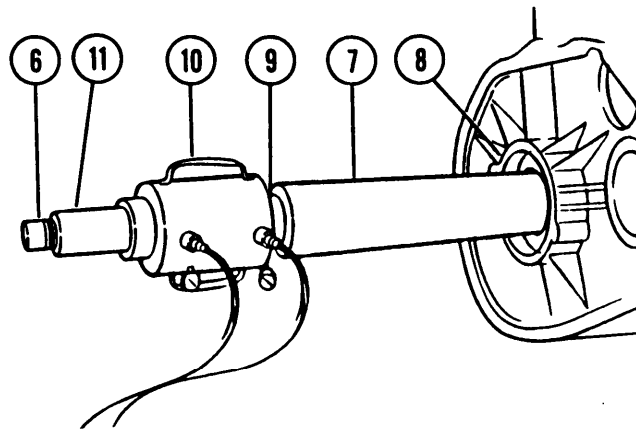
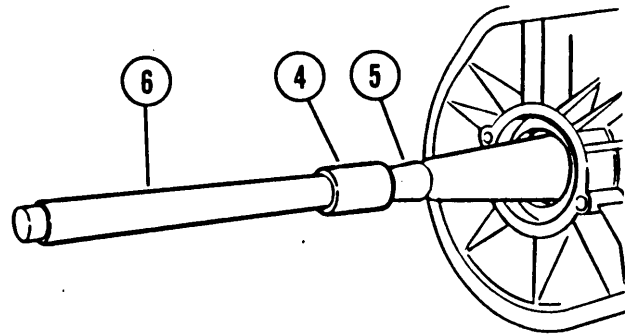
(a) Place a threaded adapter (4) on the sprocket shaft and turn in until all threads are engaged.

(b) Screw a stud extension (6) into the adapter as far as it will go.

(c) Install a protective sleeve (7) over stud (6) until it contacts bevel gear case (8).

(d) Attach a head (9) and cylinder (10) and secure with nut (11).

(e) Connect a hydraulic pump to the cylinder. Hold sleeve (7) and head (9) in alignment and apply pressure to the sprocket shaft (5) to loosen from the taper.

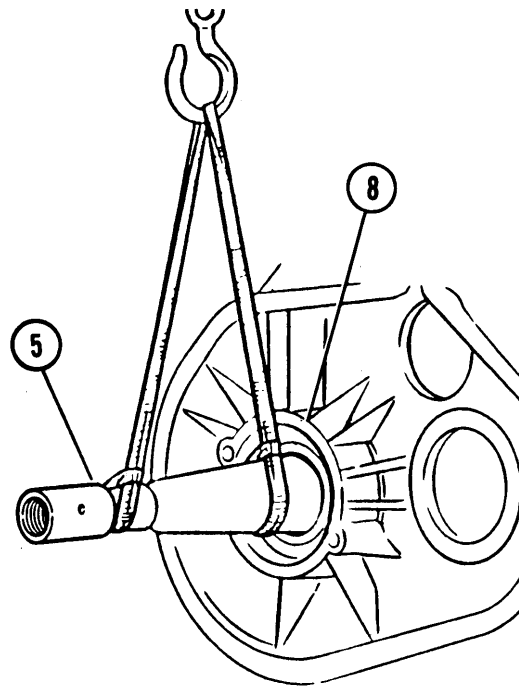


**WARNING**

Make sure Pressure is off cylinder before attempting to remove tooling. Failure to follow this precaution would result in personal injury.

(4) Release cylinder pressure and remove tooling from sprocket shaft (5).

(5) Attach lifting equipment to sprocket shaft (5) close to gear case (8) and raise lifting equipment to take weight off shaft.



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 9-13. DRIVE SPROCKET SHAFT - REPLACE (Cont'd)
 

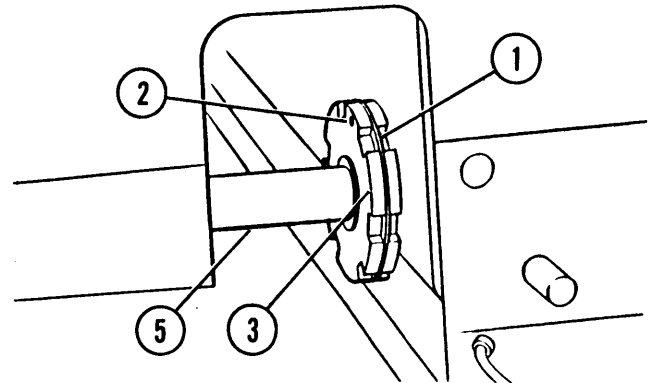
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- (6) Remove nut (3) from other end of shaft (5) at steering clutch case.

CAUTION

Sprocket shaft weighs approximately 185 lbs. Remove it slowly and carefully to avoid damage to threads on shaft and in gear case.

- (7) Remove sprocket shaft (5) from gear case (8).

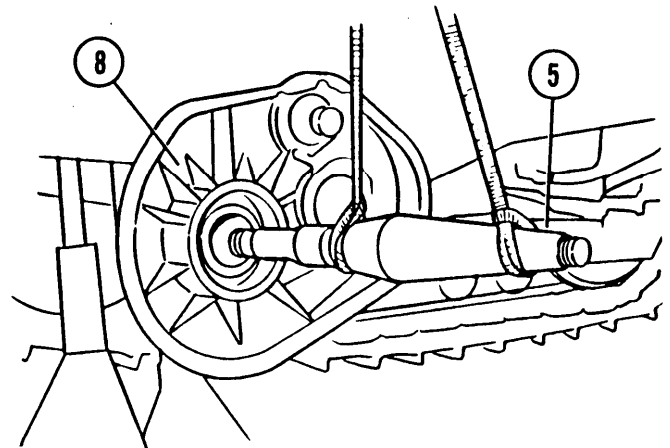


b. Installation

CAUTION

Sprocket shaft weighs approximately 185 lbs. Install it slowly and carefully to avoid damage to threads on shaft and in gear case.

- (1) Use lifting equipment to position sprocket shaft (5) through gear case (8). Push shaft through nut (3) in as far as it will go using only hand pressure.
- (2) Install tooling for installation of sprocket shaft (5):

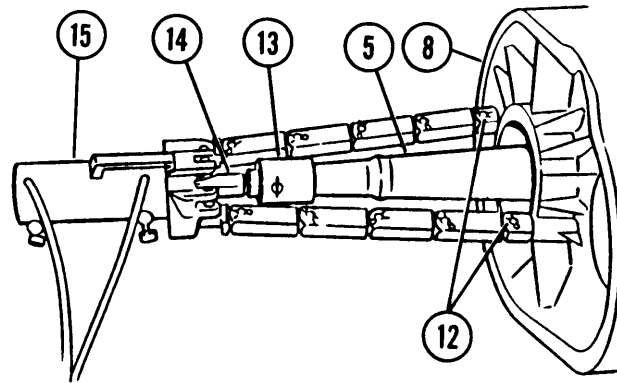


CAUTION

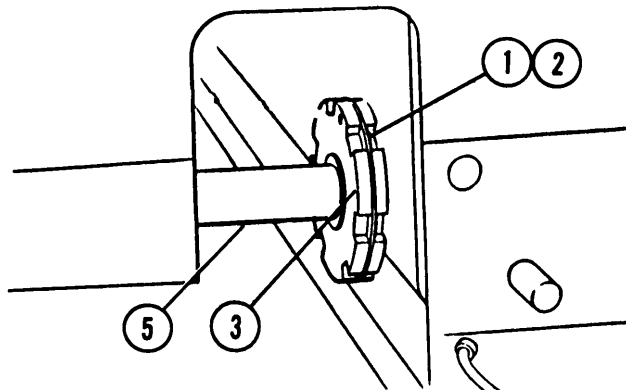
To avoid damage to bevel gear case threads, be sure to install the adapters in the bevel gear case so the shoulder of the adapter is against the bevel gear case. After the shoulder of the adapter comes in contact with the bevel gear case, the adapters can be tightened a maximum of 1/8 turn or loosened a maximum of 3/8 turn to put the adapter in the correct position so the remainder of the tooling can be installed. When the remainder of tooling is installed, do not let the weight of the tooling or lifting equipment put a load on the adapters. Keep all tooling level.

9-13. DRIVE SPROCKET SHAFT - REPLACE (Cont' d)

- (a) Install two adapters (12) into two large threaded holes in gear case (8).
- (b) Install an adapter (13) on end of sprocket shaft (5) and connect a rod (14) to the adapter.
- (c) Connect a hydraulic cylinder (15) to adapters (12) in gear case (8).
- (d) Attach a pump to cylinder (15) and apply 55 to 60 tons force to the shaft to push it into position. Keep face on shaft (5).



- (3) Use torque/spanner wrench PX774092 to tighten nut (3) to a torque of  $750 \pm 50$  lb. ft. While force is still on shaft (5), release cylinder pressure.



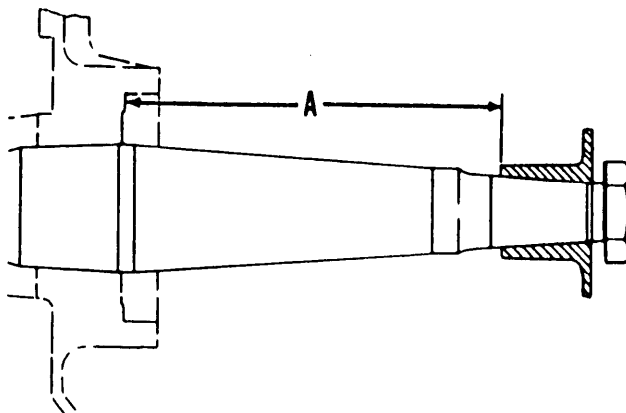
**WARNING**

Make sure pressure is off cylinder before attempting to remove tooling. Failure to follow this precaution could result in personal injury.

- (4) Remove tooling from shaft (5) and gear case (8).
- (5) Measure distance (A) from inner edge of holder assembly to bottom of counterbore for inner bearing cup in gear case (8). Dimension should be  $17.258 \pm 0.062$  in.

**NOTE**

If original nut (3) and shaft (5) are reused and pinning holes line up, proceed to step 7.



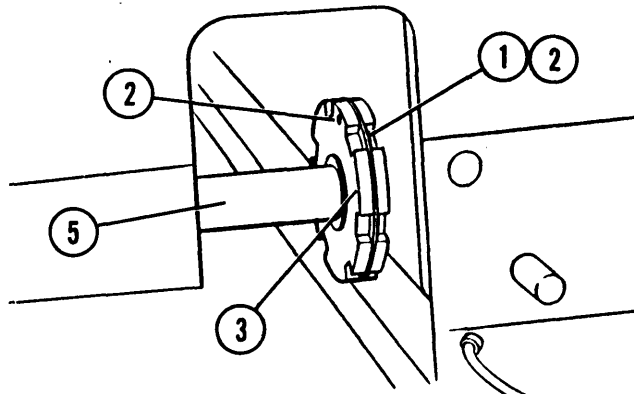


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 9-13. DRIVE SPROCKET SHAFT - REPLACE (Cont'd)
 

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- (6) Drill a 0.368 in. (3/8") hole in one of the grooves through nut, perpendicular to the centerline of the shaft (3), and 0.56 in. deep into sprocket shaft (5).
- (7) Install pin (2) through hole in nut (3) into shaft (5).
- (8) Install ring (1) in groove in nut (3) to secure pin (2).
- (9) Install final drive cases, gears, idler pinions and bearings. See page 8-4.


 c. Place In Service

Test drive and check drive sprocket shaft for proper operation.

9-14. TRACK ASSEMBLY - REPAIR

This task covers:

- a. Disassembly
- b. Cleaning
- c. Inspection
- d. Assembly
- e. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Materials/Parts

Shim Stock 1/16" X 1" X 6"  
Two Wood Blocks 6" X 2" X 4"  
Lubricating Oil G0-80/90 (See L05-2410-237-12)  
Rubber Stopper (6)  
Plug (7)  
Liquid Gasket (App. B, Item 3)  
Seals (5)  
Lint-free Rag

Equipment Condition

Track separated and removed.  
See TM5-2410-237-20.

a. Disassembly

- (1) Put both ends of the track at the separation point on 6 in. wood blocks.

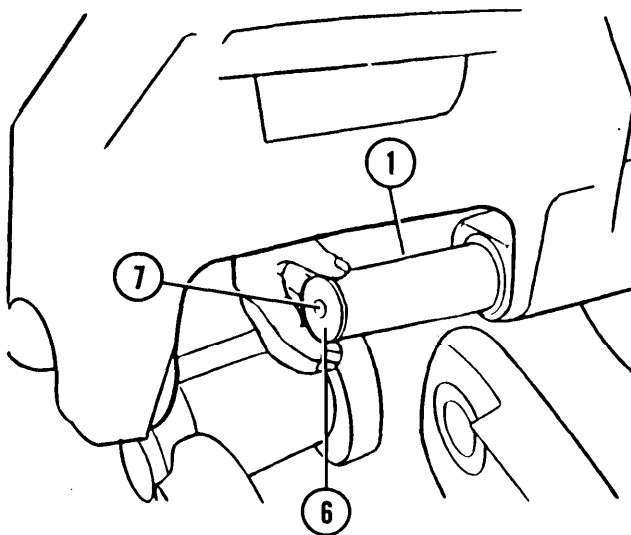
CAUTION

Be careful not to damage parts while disassembling the track. Protect ends of bushings, thrust rings, pins and seals after they are removed.

CAUTION

Do not remove the track pin all of the way with the press. The pin bore and link will be damaged.

- (2) **Remove three track shoes over area to be worked on.**

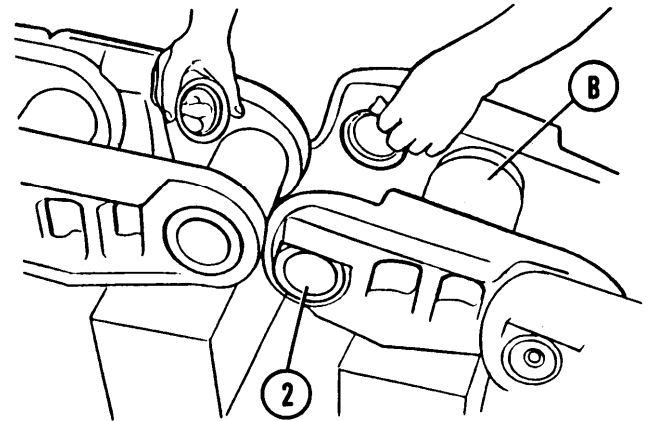


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 9-14. TRACK ASSEMBLY - REPAIR (Cont'd)
 

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- (3) Use a hydraulic press to push track pin (1) part way out of the track assembly.
- (4) Check the track pin for a groove (wear step) caused by wear. If the track pin does not have a groove (wear step), remove pin and continue with STEP 6. If the track pin has a groove (wear step), push the track Pin out 2/3 of its length.
- (5) If old track pin (1) is being reused, press plug (7) through rubber stopper (6). Remove stopper and plug from pin and discard.
- (6) Cut the worn track pin with a cutting torch. Hit the short end of the track pin with a hammer until it is inside the bushing.
- (7) Perform STEPS 2 through 4 for other track pins to be removed.
- (8) Use a hydraulic press (B) between the track links. Push the links away from each other enough to separate the track chain.



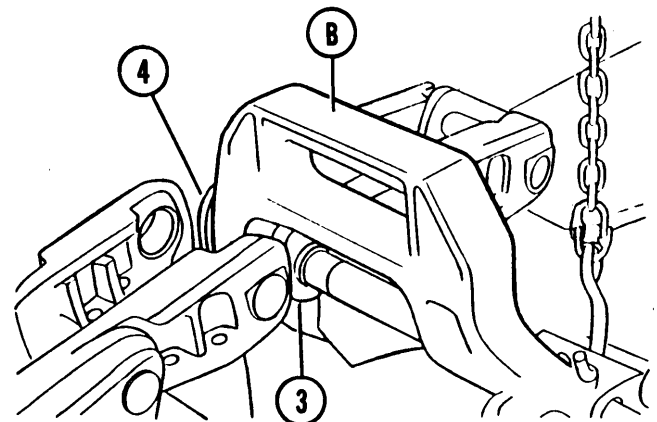

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 CAUTION
 

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Use shim stock to protect the face of seals when the track chain is pulled apart.

- (9) Remove thrust rings (2) from the links.
- (10) Use a hydraulic press (B) to remove the link (3) and bushing (4).
- (11) Use press (B) to press bushing (4) from link (3). Remove and discard seals (5) from the links. Remove cut pin from bushing if required.



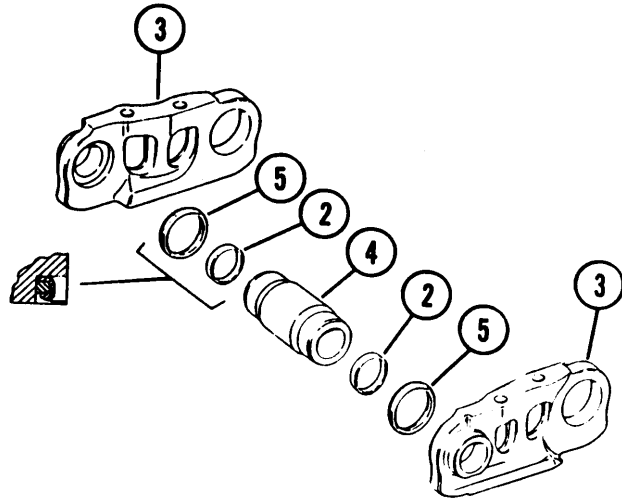
9-14. TRACK ASSEMBLY - REPAIR (Cont'd)

b. Cleaning

Ensure that all parts are clean and dry. Refer to page 2-29.

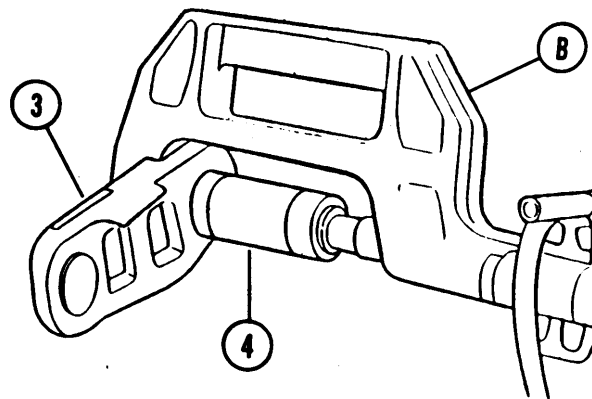
c. Inspection

- (1) Inspect all parts for wear or damage.
- (2) Check thrust rings for wear. New thrust rings are  $0.437 \pm 0.003$  in. thick.
- (3) If any seal or bushing is damaged, replace with new parts. Do not use parts from another track assembly.



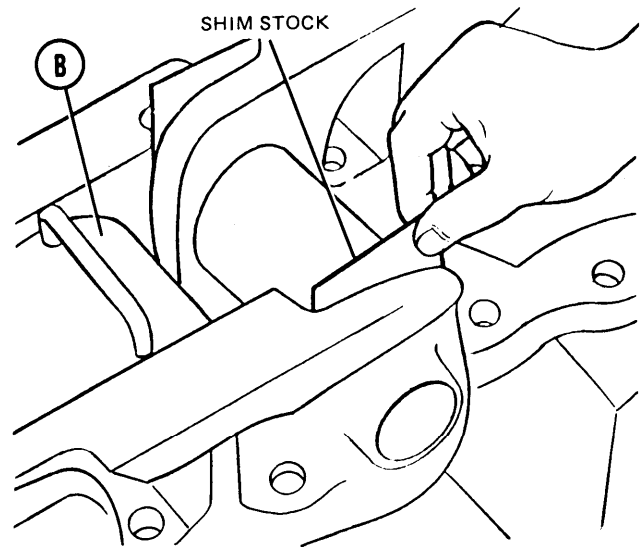
d. Assembly

- (1) Install thrust rings (2) and seals (5) into links (3) as shown. Put clean lubricating oil on the lip of the seals only. Do not apply oil to the outside diameter of the seal.
- (2) Put lubricating oil on each end of bushings (4) to cover at least 0.20 in. of the surface.
- (3) Use a hydraulic press (B) to push bushings (4) into links (3). Insert the bushing so  $0.071 \pm 0.011$  in. extends beyond the outer surface of the link.
- (4) Clean and dry both ends of bushing (4). Put clean lubricating oil on both ends of the bushing.



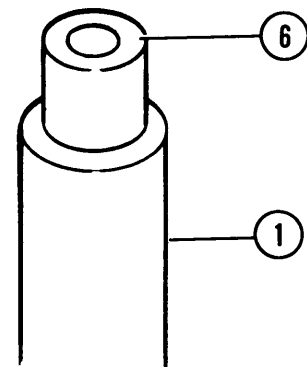
## 9-14. TRACK ASSEMBLY - REPAIR (Cont'd)

- (5) Put shim stock between the bushings and links to protect the face of the seals.
- (6) Use a hydraulic press (B) between the track links to push the links apart just far enough to let the links and bushings slide together. Use a pilot pin to hold the links and bushings in alignment.
- (7) Remove the shims and hydraulic press (B).
- (8) Put clean 60-80/90 oil on the rubber stopper (6). Use an installer and hammer to press the stopper into the track pin.



## NOTE

Install the pin to the track link so all the rubber stopper ends are on the same side of the track. The oil crosshole in the pin must be within 20° of the vertical center line of the pin bore and closest to the rail of the link. The pins have a mark on the end for crosshole location.



9-14. TRACK ASSEMBLY - REPAIR (Cont' d)

- (9) Put track pin (1) in hydraulic press (B) with oil hole up toward the link rails as shown and with the rubber stopper (hole end) on the same side as the other pins in the track.

CAUTION

To prevent damage to the thrust rings, install the track pin adapter so the track pin will push against the large diameter of the pilot pin.

- (10) Push the track pins into the links until 0.75 in. of the pin is shown. Remove the pilot pin.

- (11) put liquid gasket material on track pin (1) and in the pin bore of link (3). Do not put the liquid gasket material closer than 0.512 in. from the seal counterbore. Install the track pin within 5 minutes of applying liquid gasket material.

- (12) Fill the track pins with lubricant. Use a pump to fill the track pins with lubricating oil. Fill the pins with a minimum of 0.11 pint.

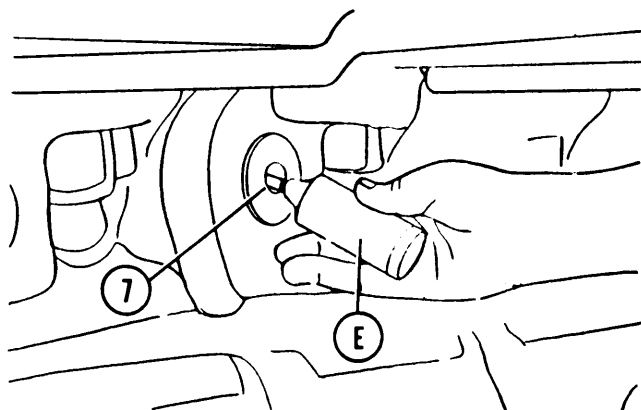
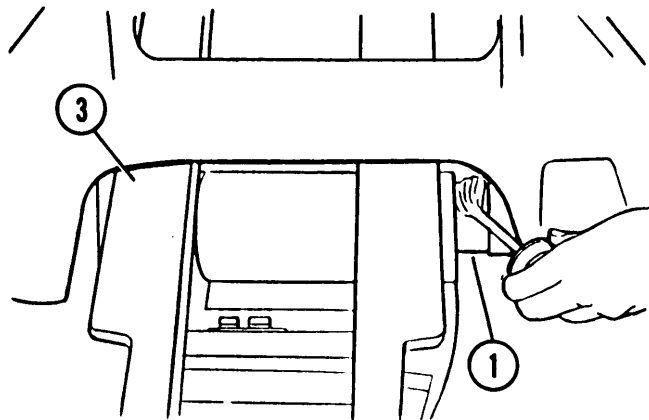
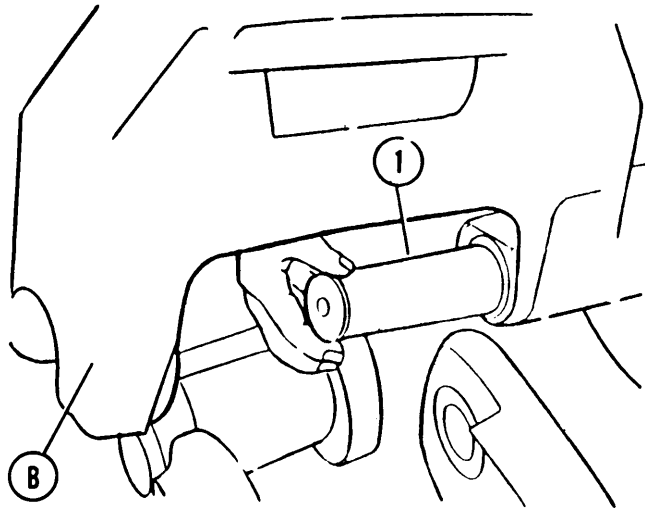
- (13) Use an adapter (E) to install new plug (7).

- (14) Install track shoes. Tighten track shoe bolts to  $220 \pm 40$  lb. ft. and then tighten them  $120^\circ \pm 5^\circ$  more.

- (15) Install the track. See TM5-2410-237-20.

e. Place In Service

Test drive and check track for proper operation.



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 9-15. TRACK ASSEMBLY - REPLACE
 

---

This task covers:

- a. Removal
  - b. Installation
  - c. Place In Service
- 

### INITIAL SETUP

#### Applicable Configurations

All

#### Personnel Required

MOS62B (2)

#### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Lifting Equipment, 4,000 lbs.

#### Materials/Parts

Anti-Seize Compound (App. B, Item 2)  
3" dia. X 3.5" Long Slug

#### Equipment Condition

Blade and pusharm removed. See TM5-2410-237-20.  
Rear implement (if equipped). See page 14-8.

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#### a. Removal

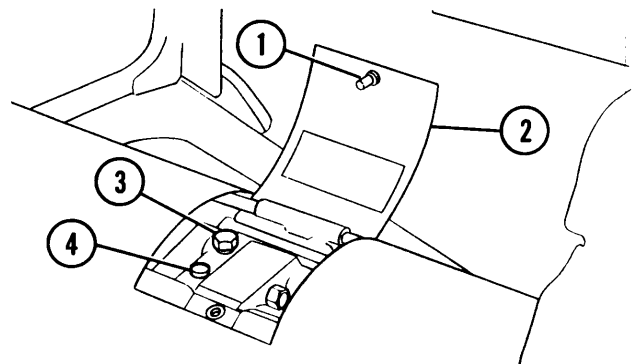
##### WARNING

Keep all personnel clear of front and rear of machine during positioning and connection of track ends. Track moves fast and uncontrolled if separation occurs. At least 20 feet of clearance required in front. Stand at side of track when installing master shoe and bolts. Failure to follow these precautions could result in serious or even fatal injuries.

##### CAUTION

This task is to be performed on an inoperable machine in a General Support shop only. Failure to follow these guidelines may result in damage to equipment.

- (1) Lift machine according to Ground Handling, page 11-33.
- (2) Use a wrench to loosen bolt (1) and open track adjuster panel (2).

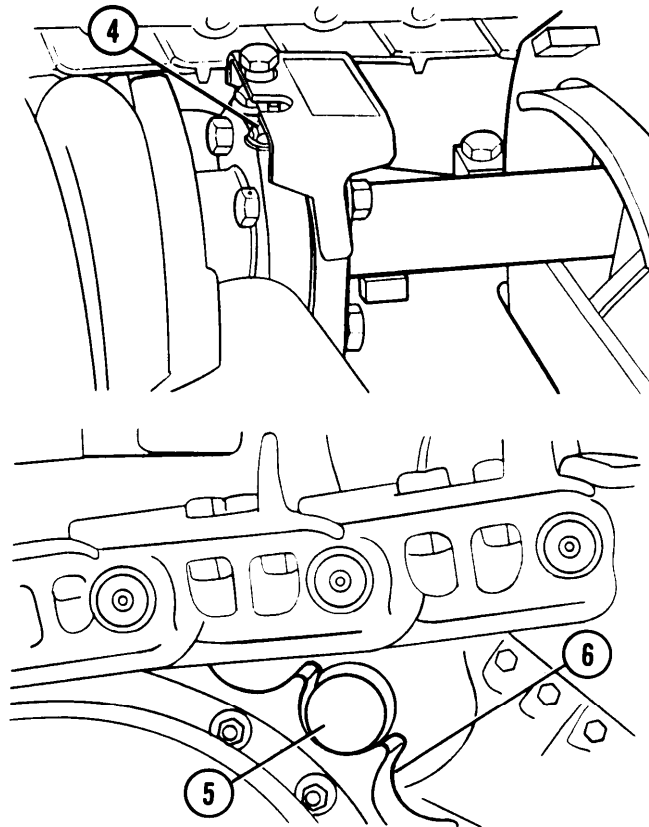


9-15. TRACK ASSEMBLY - REPLACE (Cont'd)

WARNING

The adjuster cylinder for the track is under high hydraulic pressure. Use the following procedure to relieve this pressure and observe the relaxing of tension on the track. Do not observe the grease coming from the relief valve. Do not, under any circumstances, attempt to relieve the hydraulic pressure by excessive loosening or removal of relieve valve. Failure to follow these precautions could result in serious personal injury. Wear eye protection.

- (3) Use a socket to turn relief valve (3) one turn counter-clockwise to release grease from vent hole below relief valve. If track does not loosen, proceed to STEP 4.
- (4) If track did not loosen, turn fill valve (4) one turn counter-clockwise to release grease. If track does not loosen, proceed to STEP 5.
- (5) If track did not loosen, start machine and move forward and backward to loosen track. If track does not loosen, proceed to STEP 6.
- (6) If track did not loosen, position a 3" diameter by 3.5" long steel slug (5) on sprocket (6) teeth. Slug must have contact with track bushing when sprocket is turned in reverse. Move the machine to the rear. This puts tension to the rear against the force of the recoil spring and pushes grease out of vent holes.





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 9-15. TRACK ASSEMBLY - REPLACE (Cont' d)
 

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- (7) Move machine forward to release tension on track. If necessary, remove slug (5) from sprocket (6).
- (8) Move track until master link is in the eight o'clock position on sprocket (6).
- (9) Position track block (7) under track shoe (8) next to master shoe (9). Move track until track shoe (8) makes contact with track block (7).

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 WARNING
 

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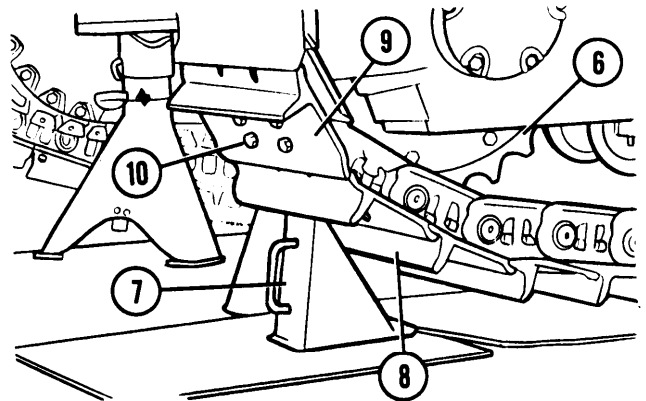
Keep all personnel clear of front and rear of machine during track separation. Track moves fast and uncontrolled at separation. At least 20 feet of clearance required in front. Stand at side of track when installing master shoe and when making track separation. Failure to follow these precautions could result in serious or even fatal injuries.

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 WARNING
 

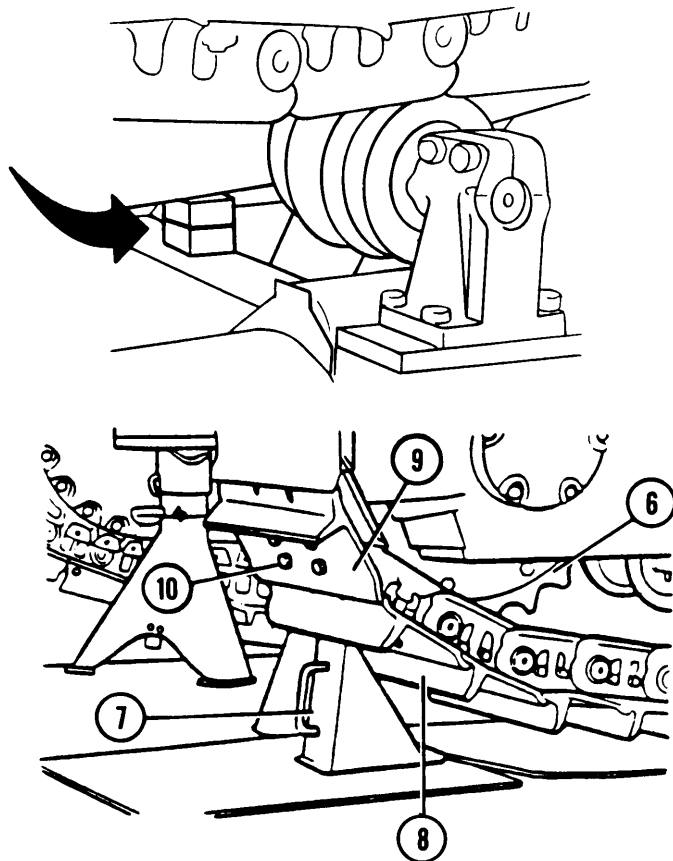
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To compensate for the weight imbalance that removing one track causes, place a metal block between the frame and the equalizer bar on the same side from which track is to be removed. Failure to follow this precaution can result in serious personal injury.



9-15. TRACK ASSEMBLY - REPLACE (Cont'd)

- (10) Put an approximately 2-1/4 in. thick metal block between frame and equalizer bar on same side of tractor from which track is to be removed.
- (11) Use a wrench to remove four capscrews (10) and master shoe (9) from track.
- (12) Use lifting equipment to lift track and remove track block (7) from undertrick. Ensure that track still makes contact with sprocket.
- (13) Start engine and slowly move sprocket (6) clockwise (counterclockwise for left-hand track) to separate and remove track from roller frame.



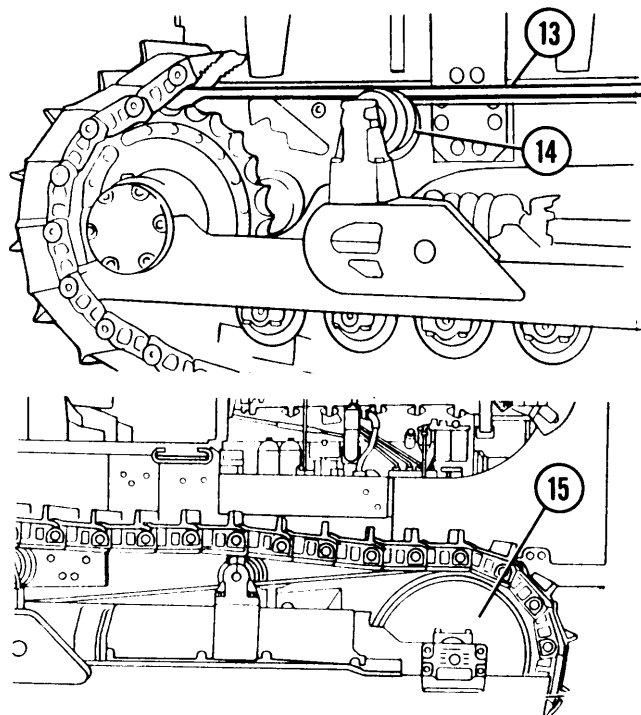
b. Installation

- (1) Position track with master link one link past bottom center line of sprocket (6).

NOTE

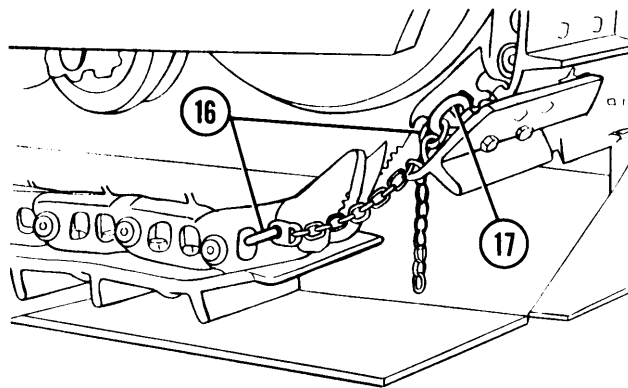
Use tanker bar to keep track taut during installation.

- (2) Start machine and slowly rotate sprocket until until track is pulled at least one link past top center line of sprocket.
- (3) Position long bar (13) across track carrier roller (14) and between track and sprocket.
- (4) Rotate sprocket clockwise (counterclockwise for left-hand track) slowly to feed track over two carrier rollers (14) and front idler (15). Use bar (13) to guide track. Move bar along with track. Stop rotation when the first link reaches the four o'clock position on the front idler (15).



9-15. TRACK ASSEMBLY - REPLACE (Cont' d)

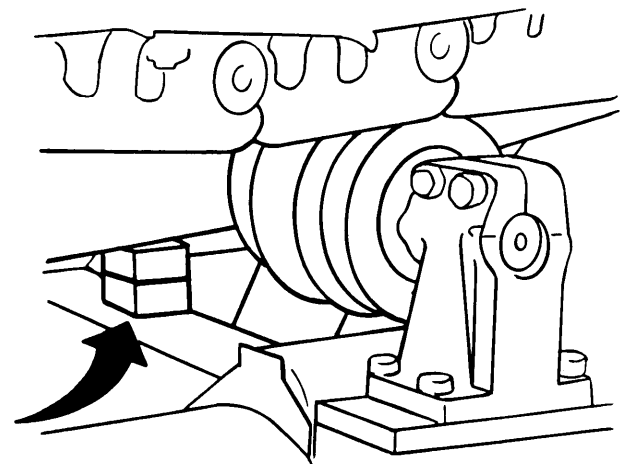
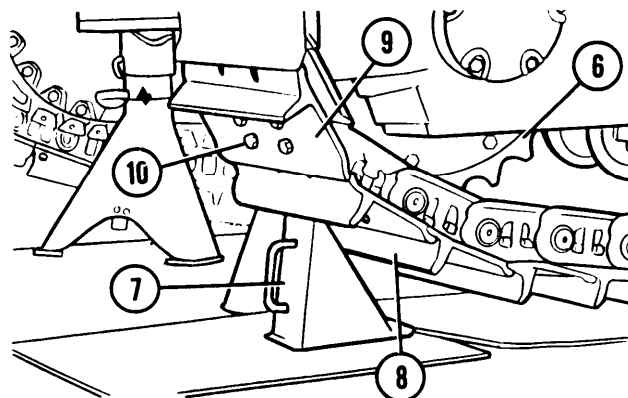
- (5) Install an eye and pin half of special chain coupling group (17) and special coupling tool (16) between the track links in the ends of the track. Leave about four inches of clearance between chain and track pins.
- (6) Move the track clockwise (counterclockwise for left-hand track) until the bottom link is below a horizontal line through the center of the sprocket. Put block (7) in position under the track. Remove chain and pin tooling (16 and 17).



NOTE

Some adjustment of master link angle will be-needed to engage the teeth.

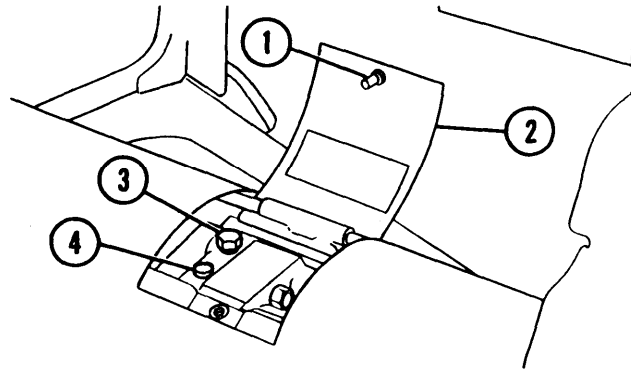
- (7) Rotate sprocket counterclockwise (clockwise for the left-hand track) until the upper end of the master link is in alignment with the lower end of the master link. Make sure the teeth of both ends of the master link are engaged. Check for hole alignment with a capscrew and adjust with a hammer if necessary.
- (8) Apply anti-seize compound to capscrews (10) for master link.
- (9) Install four capscrews (10) on master link. Tighten capscrews to a torque of  $220 \pm 40$  lb. ft. ( $300 \pm 50$  N.m). Turn capscrews (10) an additional  $180^\circ$  ( $1/2$  turn).
- (10) Rotate sprocket clockwise (counterclockwise for left-hand track) and remove track block (7).
- (11) Remove metal block between frame and equalizer bar.



9-15. TRACK ASSEMBLY - REPLACE (Cont'd)

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- (12) Lower machine according to Ground Handling, page 11-33.
- (13) Make track adjustments. See TM5-2410-237-20.
- (14) Tighten fill valve (4) and tighten relief valve (3) to a torque of  $25 \pm 5$  lb. ft. ( $35 \pm 7$  N.m).
- (15) Close track adjuster access panel (2) and tighten bolt (1).
- (16) Use lifting equipment to lift the other track and remove metal block from the frame.



c. Place In Service

Test drive and check track for proper operation.

## CHAPTER 10

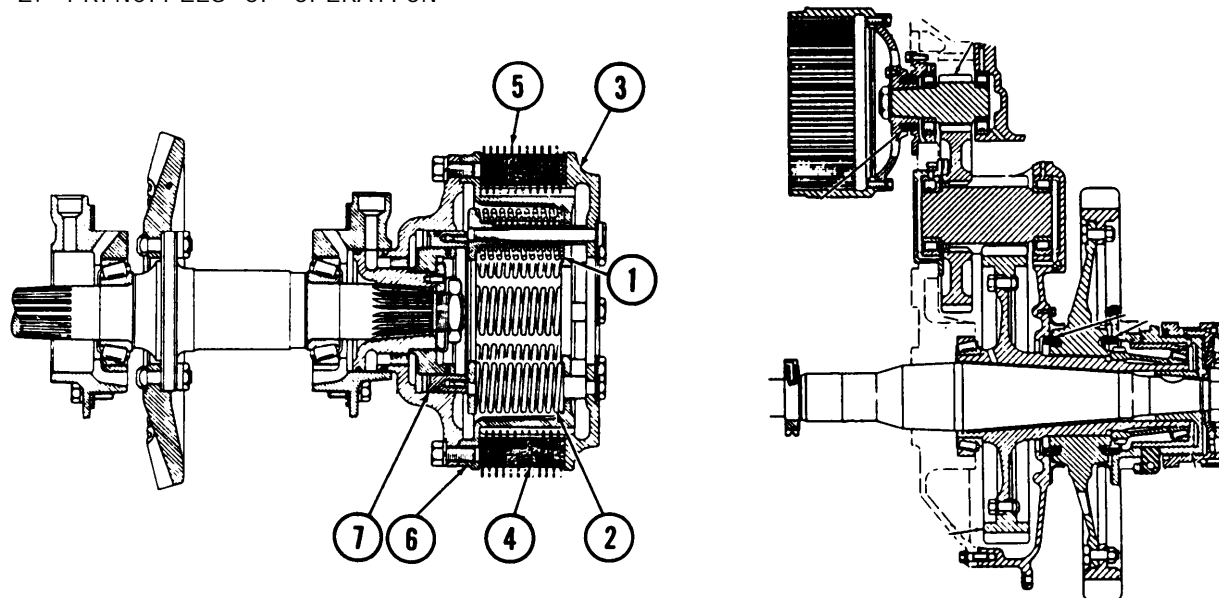
## STEERING AND BRAKE MAINTENANCE

## Section I. DESCRIPTION AND DATA

## 10-1. GENERAL

Steering and brake maintenance procedures not covered in this chapter can be found in TM5-2410-237-20.

## 10-2. PRINCIPLES OF OPERATION

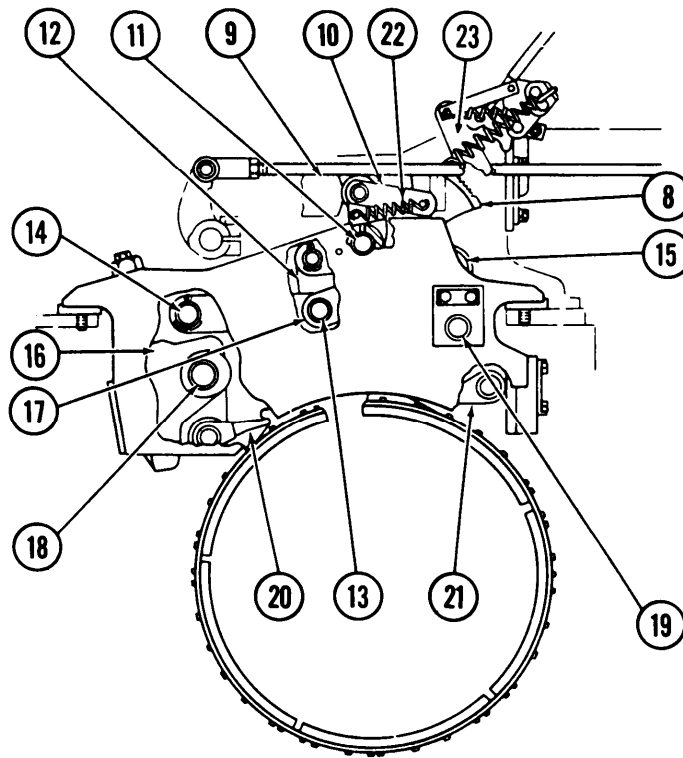


- a. Steering Clutch. With a steering clutch engaged, the force of springs (1 and 2) keeps pressure plate (3), steel discs (4) and disc assemblies (5) against inner drum (6). Power goes from the inner drum, through the discs, to the outer drum (brake drum). The steering clutches are normally engaged.

With a steering clutch released, pressure oil from the hydraulic controls for the steering clutches moves piston (7) toward the outside of the machine. The piston pushes on the spring retainer. The spring retainer pushes on springs (1 and 2) and puts them in compression. At the same time, the spring retainer pushes pressure plate (3) toward the outside of the machine. The pressure plate is now not in contact with steel discs (4) and disc assemblies (5). The disc and disc assemblies are not held together. Power cannot go from the inner drum to the outer drum.

- b. Hydraulic Control Valve for the Steering Clutches. Pressure oil is sent to the hydraulic control valve by the transmission oil pump. When the control levers are pulled, levers move plungers to the left. The plungers move spring tensioned valve spools. The movement of the valve spools lets oil go to the steering clutch pistons. The oil pushes against the pistons. The pistons push against the springs and move the pressure plates away from the disc assemblies—releases the steering clutches.

- c. Brakes. Two band-type brakes, one on each steering clutch drum, stop the movement of the machine. The brakes also give assistance to the steering clutches to turn the machine. The operation of each brake gets assistance from a hydraulic control mechanism. The operation of each brake is separate from the other. Both brakes can be held in the "ON" position by pawl (8) on the brake linkage.



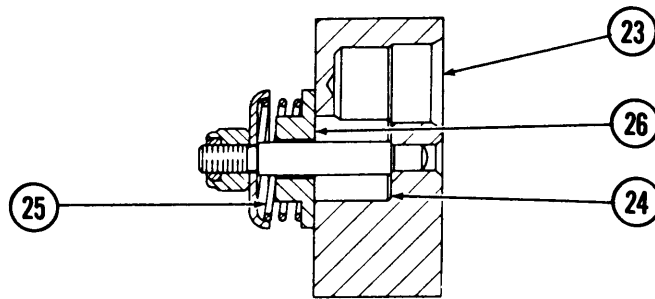
The operation of both brakes is the same. When a brake pedal is pushed toward the front of the machine, mechanical linkage moves piston (9) in the hydraulic control mechanism. The piston (9) pushes against the roller on bellcrank (10). The bellcrank turns on the shaft (11) and moves the link (12) toward the top. This moves pin (13) toward the top and pins (14 and 15) away from each other. The levers (16 and 17) then turn on shafts (18 and 19). Levers (16 and 17) move struts (20 and 21) toward each other. As the struts move toward each other, they push on the ends of the brake band. This causes the brake band to make contact with the brake drum. Now, the movement of the machine stops or becomes slower.

When the brake pedal is released, spring (22) and springs inside the hydraulic control mechanism move the mechanical linkage and brake pedal. The struts move away from each other. The brake band is not in contact with the steering clutch drum. Now, the brakes are in the "OFF" position.

Both brakes can be held in the "ON" position. Push both brake pedals toward the front of the machine. At the same time, push the parking brake lever forward and down. The parking brake lever is at the right side of the seat. The movement of the pawl moves rod (23) and engages the teeth of the ratchet (8) with the teeth of the ratchet. The brakes are held in the "ON" position by the link. The links push against the bellcrank (10). To release the brakes, push on the brake pedals and pull the parking brake lever up and backwards.

An oil line sends pressure oil to each brake band. This oil is for lubrication and cooling of the brake bands.

- d. Relief Valve for Brake Cooling and Lubrication. The relief valve for brake cooling and lubrication is in the compartment for the left steering clutch. It lets oil at a specific pressure go to the brake bands. Cool oil goes in the valve through opening (23) and fills chamber (24). The oil comes from the oil cooler and goes through the lubrication manifold on the transmission case. Chamber (24) has two openings. A hose is connected to each of the openings. One hose goes to the right brake band and the other hose goes to the left brake band. The oil goes from chamber (24) through the two hoses to the brake bands. The oil pressure to the brake bands is controlled by spring (25) and valve (26). When the pressure of the oil in chamber (24) goes above 50±5 psi, valve (26) moves and lets the extra oil go to the compartment for the left steering clutch.



Section II. STEERING AND BRAKE SYSTEMS MAINTENANCE PROCEDURES

10-3. STEERING AND BRAKE SYSTEMS MAINTENANCE TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
10-4	Steering Brakes Actuating Mechanisms - Replace/Repair	10-4
10-5	Steering Brake Hydraulic Control Assembly - Replace/Repair	10-12
10-6	Steering Brake Pedals and Linkage - Replace/Repair	10-30
10-7	Steering Brake Lining - Replace	10-38
10-8	Steering Clutch - Replace/Repair	10-40
10-9	Steering Clutch Levers and Linkage - Replace/Repair	10-48
10-10	Steering Brake Relief Valve - Replace	10-57
10-11	Steering Clutch Control Valve - Replace/Repair	10-59
10-12	Steering Clutch Hubs - Replace	10-71

10-4. STEERING BRAKES ACTUATING MECHANISMS - REPLACE/REPAIR

This task covers:

- a. Removal
- b. Disassembly
- c. Assembly
- d. Installation
- e. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Lifting Equipment 100 lb.

Materials/Parts

Support Blocks 6" X 4" X 4"  
 Cotter Pin (9), (25), (44)

Equipment Condition

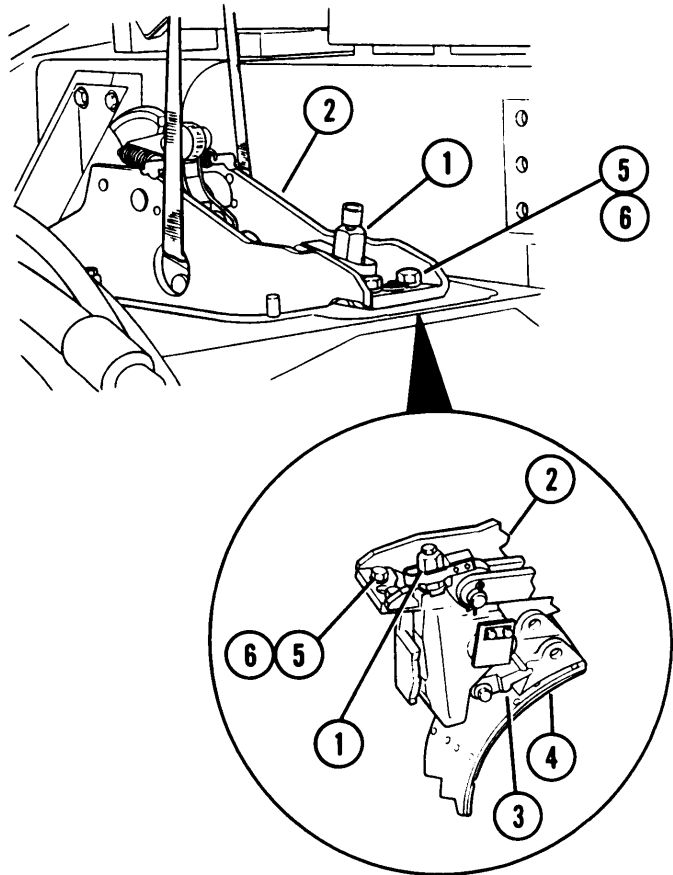
Brake hydraulic control removed.  
 See Page 10-12.

a. Removal

**NOTE**

This vehicle contains a right-hand and left-hand steering brake actuating mechanism. This procedure covers one side.

- (1) Use a wrench to loosen socket assembly (1) in brake actuating mechanism (2) to disengage struts (3) from brake band (4).
- (2) Use a wrench to remove four capscrews (5) and four lockwashers (6) from brake mechanism (2).
- (3) Use lifting equipment and if necessary a pry bar, to remove brake mechanism (2) from gear case. The weight is 100 lbs.





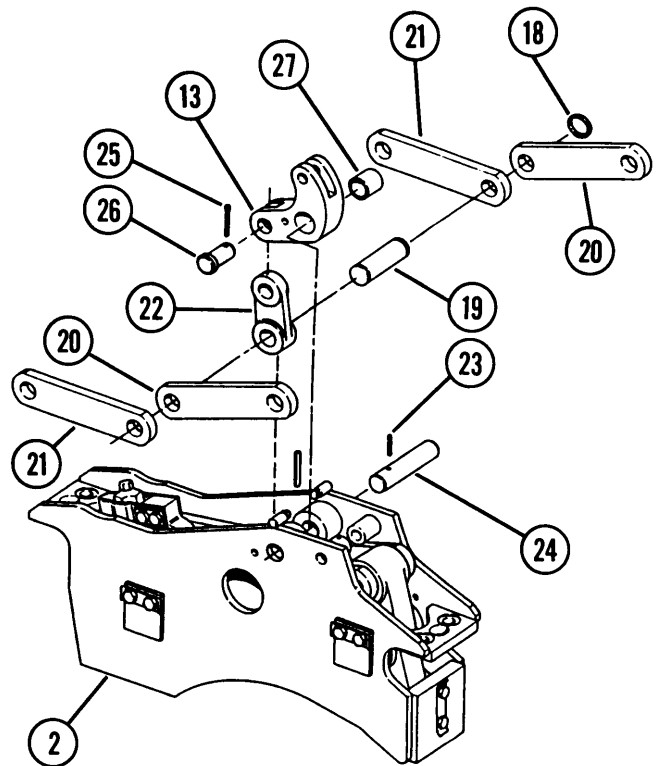
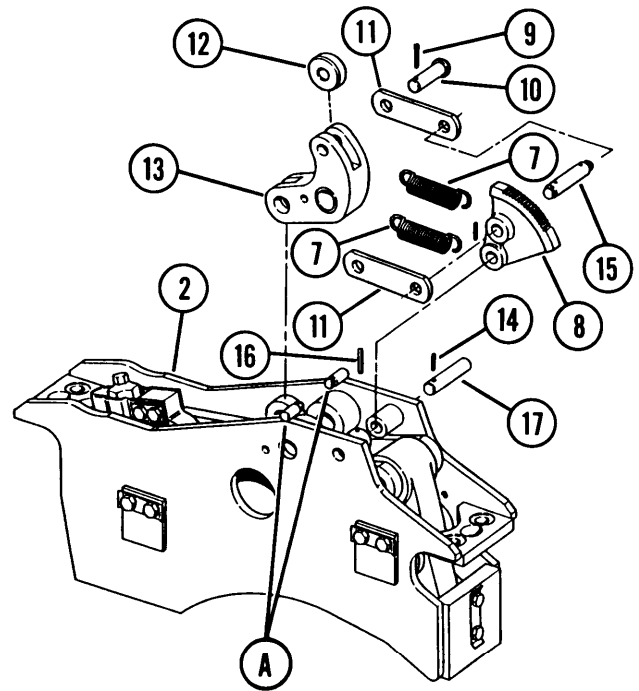
10-4. STEERING BRAKES ACTUATING MECHANISMS - REPLACE/REPAIR (Cont'd)

b. Disassembly

NOTE

For ease of parts removal, position brake actuating mechanism securely on support blocks 4 to 6 inches off work surface.

- (1) Use pliers to remove two springs (7) from welded pins (A) on support assembly (2) and both sides of pin (15).
- (2) Use pliers to remove cotter pin (9), pin (10), two links (11) and roller (12) from bellcrank (13). Discard cotter pin (9).
- (3) Use punch and hammer to remove roll pin (14), pin (15) and two links (11) from ratchet (8).
- (4) Use punch and hammer to remove roll pin (16), shaft (17) and ratchet (8) from support assembly (2).
- (5) At large hole in side of support assembly (2), remove retaining ring (18) and pin (19) that connect two links (20), two links (21) and lever (22). If necessary, remove other retaining ring (18) from pin (19).
- (6) Use punch and hammer to remove roll pin (23), shaft (24) and bellcrank (13) from support assembly (2).
- (7) Use pliers to remove cotter pin (25), pin (26) and lever (22) from bellcrank (13). Discard cotter pin (25).
- (8) Remove bearing (27) from bellcrank (13).

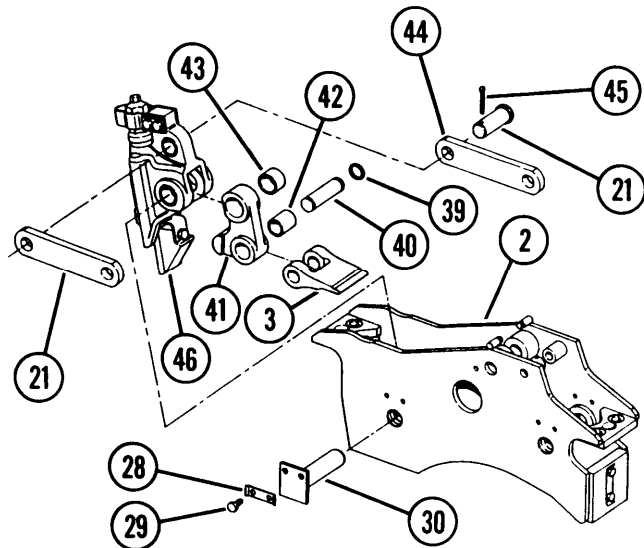
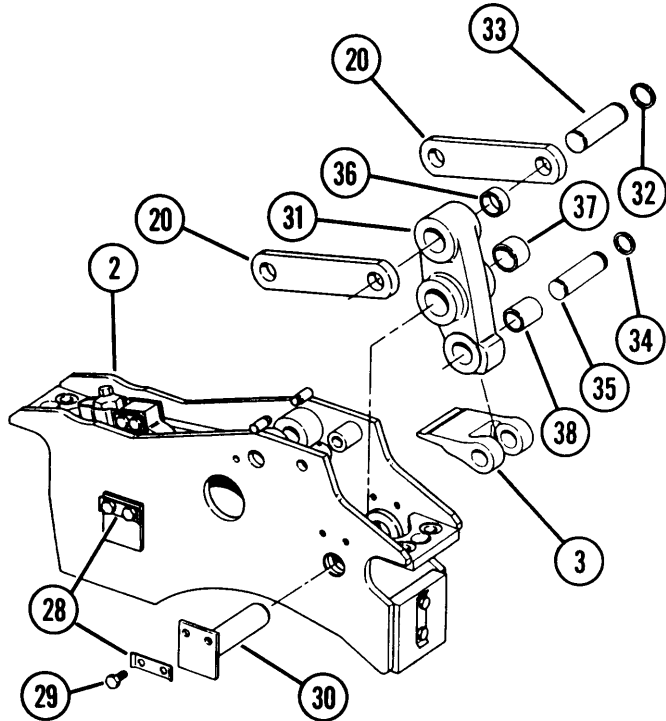


10-4. STEERING BRAKES ACTUATING MECHANISMS - REPLACE/REPAIR (Cont'd)

NOTE

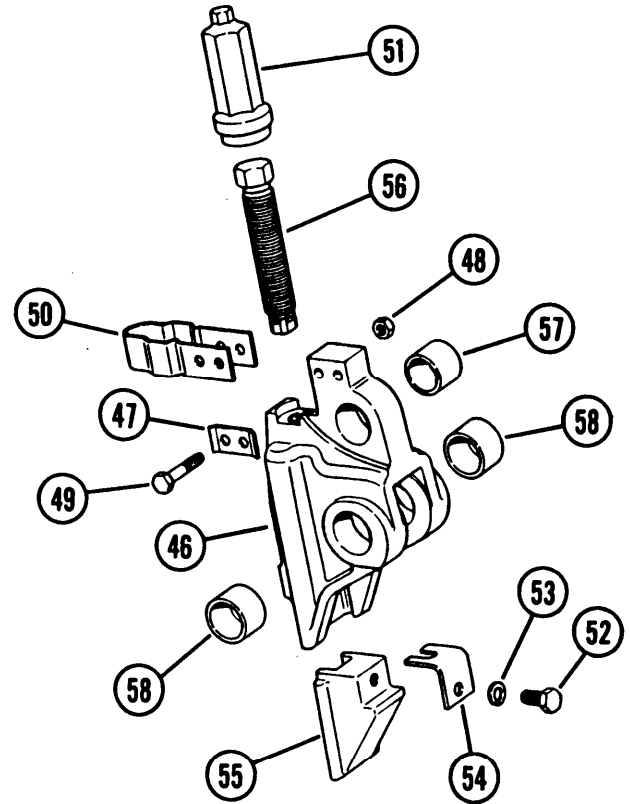
Turn brake activating mechanism over on its side, with capscrews facing up, to complete the disassembly.

- (9) Use hammer and chisel to flatten two locks (28) for removal.
- (10) Use a wrench to remove two capscrews (29), lock (28), brake lever shaft (30) and brake lever assembly (31) from support assembly (2).
- (11) Remove retaining ring (32), pin (33) and two links (20) from one end of lever (31). If necessary, remove other retaining ring (32) from pin (33).
- (12) Remove retaining ring (34), pin (35) and strut (3) from other end of lever (31). If necessary, remove other retaining ring (34) from pin (35).
- (13) Remove bearing (36), bearing (37) and bearing (38) from lever assembly (31).
- (14) Use a wrench to remove two capscrews (29), lock (28), shaft (30) and two lever assemblies from other end of support assembly (2).
- (15) Remove retaining ring (39), pin (40) and strut (3) from lever (41). If necessary, remove the other retaining ring (39) from pin (40).
- (16) Remove one small bearing (42) and one larger bearing (43) from lever (41).



10-4. STEERING BRAKES ACTUATING MECHANISMS - REPLACE/REPAIR (Cont'd)

- (17) Use pliers to remove cotter pin (44), pin (45) and two toggle links (21) from lever assembly (46). Discard cotter pin (44).
- (18) Use punch and hammer to flatten lock (47) for removal.
- (19) Use two wrenches to remove two nuts (48), two capscrews (49), lock (47), spring (50) and socket assembly (51) from lever assembly (46).
- (20) Use a wrench to remove capscrew (52), washer (53), spring (54) and support (55) from lever (46).
- (21) Remove adjusting screw (56) from lever (46).
- (22) Remove one small bearing (57) and two larger bearings (58) from lever (46).
- (23) Use a wrench to remove two capscrews (59), lock (60), shims (61) and plate (62) from end of support assembly (2).

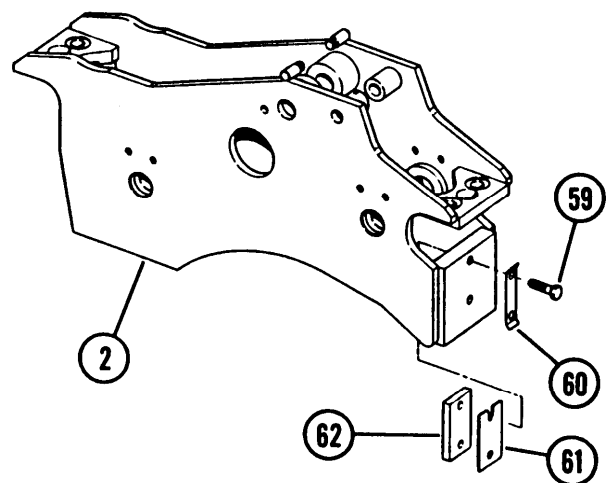


c. Assembly

NOTE

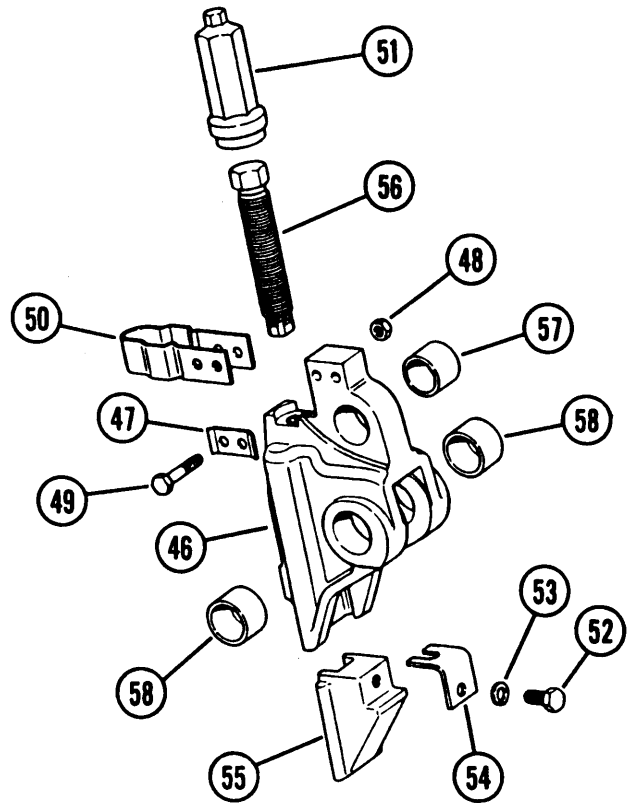
For ease of assembly, position support assembly securely on support blocks 4 to 6 inches above work surface. All bearings must be centered from side to side in bearing holes.

- (1) Install shims (61), plate (62), lock (60) and two capscrews (59) on end of support assembly (2). Bend locks using a hammer and chisel. Tighten capscrews using a wrench.

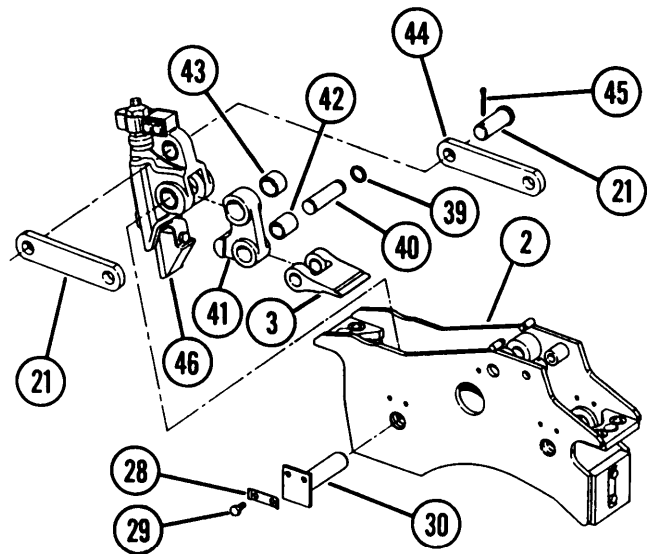


10-4. STEERING BRAKES ACTUATING MECHANISMS - REPLACE/REPAIR (Cont'd)

- (2) Install two larger bearings (58) and one smaller bearing (57) in lever (46).
- (3) Install adjusting screw (56) through top of lever (46) and install support (55) in bottom of lever (46) until it contacts end of adjusting screw (56).
- (4) Install spring (54) with capscrew (52) and washer (53) in support (55) with open end of spring (54) in groove at end of adjusting screw (56). Tighten capscrew using a wrench.
- (5) Install socket (57) over adjusting screw (56) and secure socket with spring (50), two capscrews (49), lock (47) and two nuts (48). Tighten nuts using two wrenches.

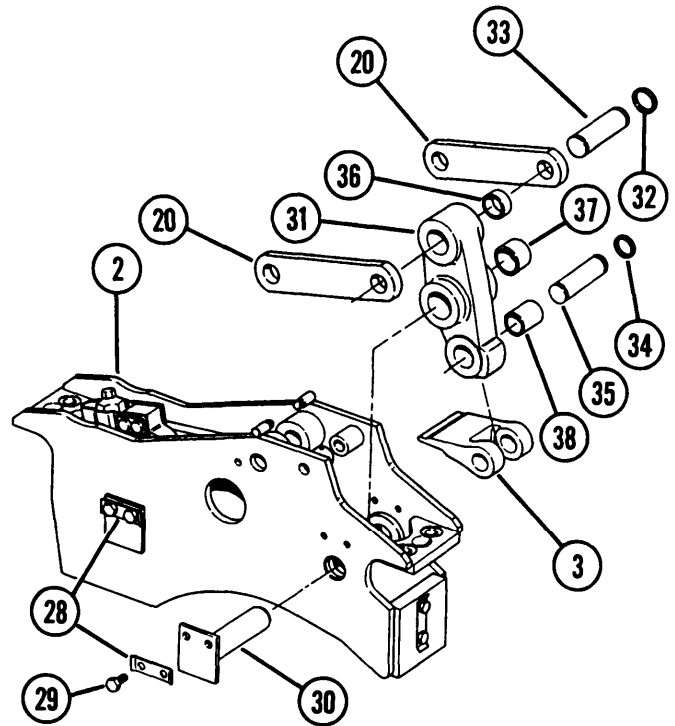


- (6) Install two links (21) on lever (46) with pin (45) and use a pliers to install new cotter pin (44).
- (7) Install bearing (42) and bearing (43) in lever (41).
- (8) Install strut (3) on lever (41) with pin (40) and retaining ring (39). If removed, install the other retaining ring (39).



## 10-4. STEERING BRAKES ACTUATING MECHANISMS - REPLACE/REPAIR (Cont'd)

- (9) Position lever (46) with socket assembly in support assembly (2). Line up holes and partially insert shaft assembly (30) into one side of lever (46).
- (10) Position lever (41) with strut (3) in lever (46) with socket assembly (51). Align holes and push shaft (30) through both levers and support (2).
- (11) Install two capscrews (29) and lock (28) to secure shaft assembly (30). Bend lock (28) using a hammer and a chisel. Tighten bolts (29) using a wrench.
- (12) Install bearing (36), bearing (37) and bearing (38) in lever (31).
- (13) Install strut (3) on lever (31) with pin (35) and retaining ring (34). If removed, install the other retaining ring (34).
- (14) Install two links (20) on other end of lever (31) with pin (33) and retaining ring (32). If removed, install the other retaining ring (32).
- (15) Position lever (31) and strut (3) assembly in support assembly (2). Line up holes and insert shaft assembly (30) through support assembly and lever (31).
- (16) Install two capscrews (29) and lock (28) to secure shaft assembly (30). Bend lock (28) using a hammer and a chisel. Tighten capscrews (29) using a wrench.



10-4. STEERING BRAKES ACTUATING MECHANISMS - REPLACE/REPAIR (Cont' d)

(17) Install bearing (27) in bellcrank (13).

(18) Install small lever (22) in bellcrank (13) with pin (26) and new cotter pin (25).

(19) Install bellcrank (13) in support assembly (2) between two large bosses with pin (24) and use a hammer and punch to install roll pin (23).

(20) Align bottom hole in small lever (22) with holes in two links (20) and two links (21) at large center hole in support assembly (2) and insert pin (19) through the four links and lever (22).

(21) Secure pin (19) with retaining ring (18). If removed, install the other retaining ring (18).

(22) Install ratchet (8) in support assembly (2) between two small bosses with shaft (17). Use a hammer and a punch to secure shaft with roll pin (16).

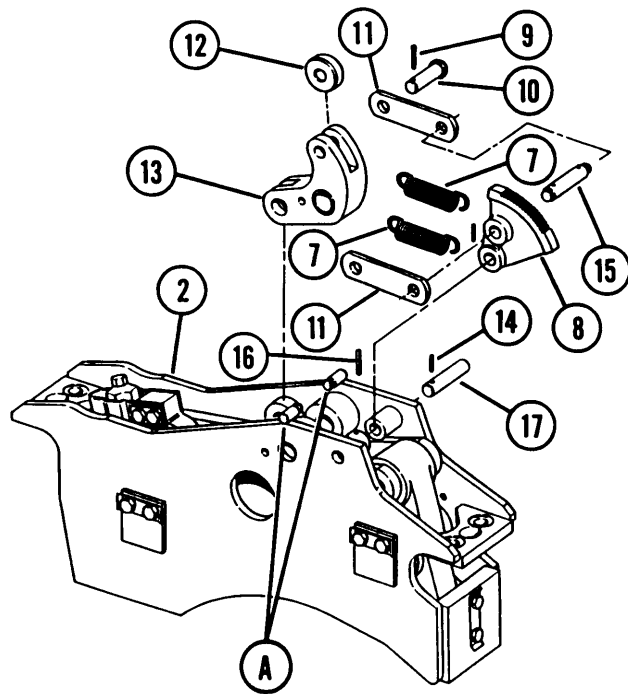
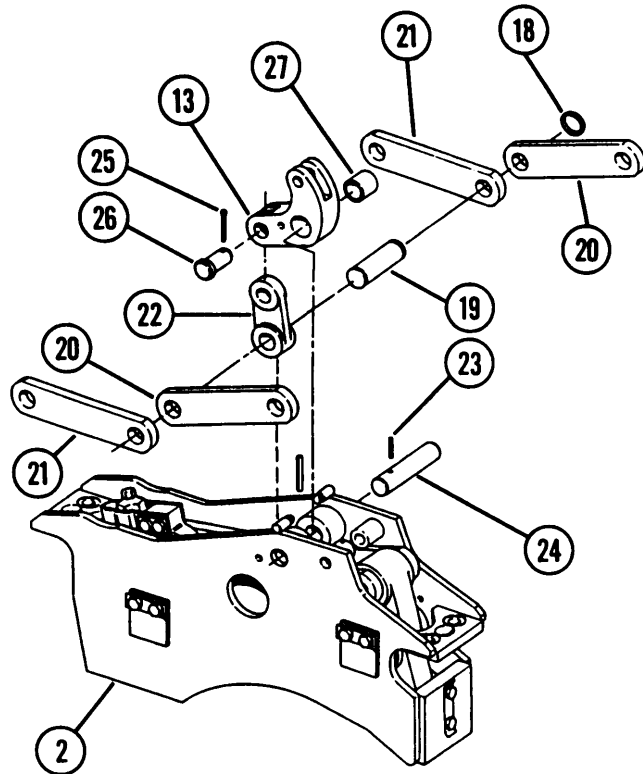
(23) Install pin (15) in ratchet (8). Use a hammer and a punch to secure pin with roll pin (14).

(24) Install two links (11) on pin (15) in ratchet (8).

(25) Install other end of the two links (11) and roller (12) in bellcrank (13) with pin (10) and new cotter pin (9).

(26) Use pliers to install two springs (7) on both sides of pin (15) and on welded pins (A) on support assembly (2).

(27) Adjust brake mechanism. See TM5-2410-237-20.



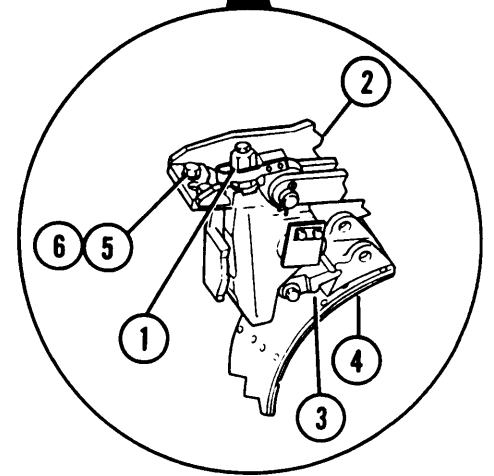
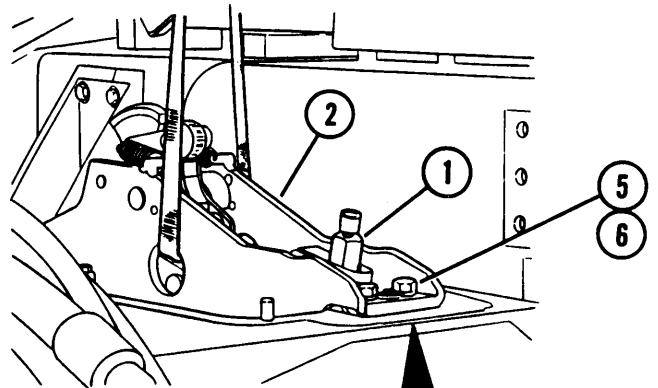
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**10-4. STEERING BRAKES ACTUATING MECHANISMS - REPLACE/REPAIR (Cont' d)**

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**d. Installation**

- (1) Use lifting equipment to position brake mechanism (2) in gear case.
- (2) Adjust socket assembly (1) to allow struts (3) to engage brake band (4).
- (3) Install four capscrews (5) and four washers (6) to secure brake mechanism (2). Tighten capscrews (5) using a wrench.
- (4) Install brake hydraulic control assembly. See page 10-12.

**e. Place In Service**

Test drive and check for proper operation.

10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR

---

This task covers:

- a. Removal
  - b. Disassembly
  - c. Assembly
  - d. Installation
  - e. Place In Service
- 

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Lifting Equipment 100 lbs.  
Handle NSN 4910-01-124-1723

Materials/Parts

Hydraulic Oil OE/HDO-10 (See  
LO5-2410-237-12)  
Liquid gasket (App. B, Item 3)  
Gasket (23), (100)  
Plug (71), (93)  
Seal (39), (60), (94), (96)  
Two 1/2"-13NC 4" Long Forcing  
Screws (51)  
Two 1/2"-13NC Eyebolts (53)  
Cotter pin (9), (16), (73), (87)  
Caps and plugs  
Drain pan  
Lint-free rag

Equipment Condition

Engine cool.  
Fuel tank removed. See page 4-23.  
Seat assembly removed. See TM5-  
2410-237-20.  
Floor plates removed. See TM5-2410-  
237-20.  
ROPS removed. See TM5-2410-237-20.  
Brake lock lever removed. See TM5-  
2410-237-20.  
Hydraulic tank mounting brackets  
removed. See TM5-2410-237-10.

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10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR (Cont' d)

a. Removal

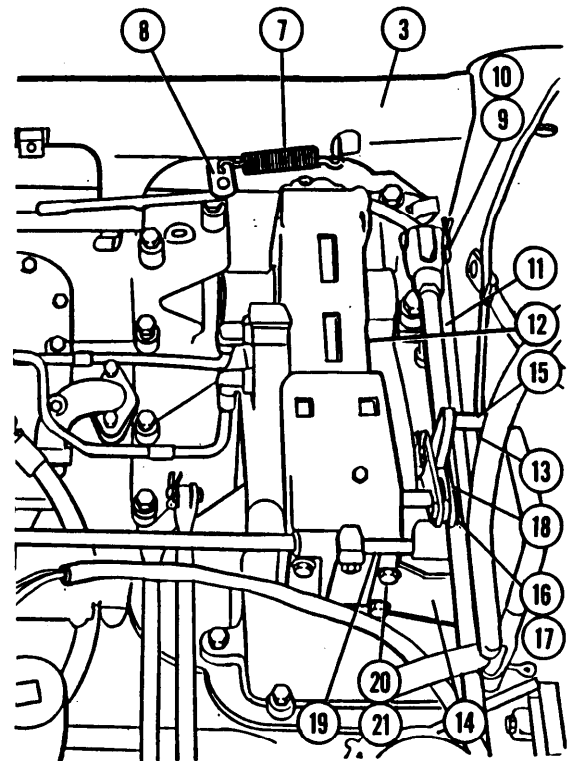
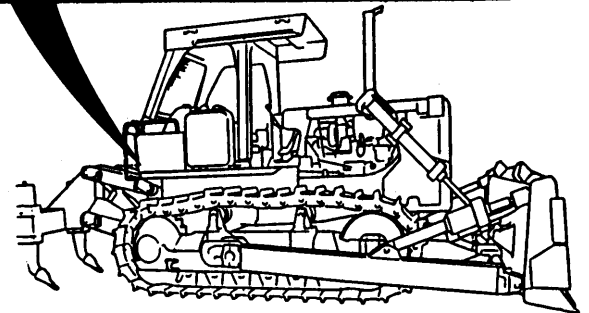
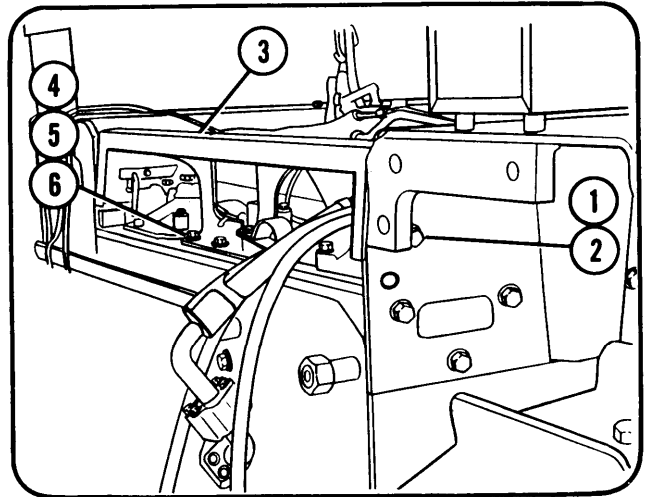
CAUTION

Wipe the area clean around all hydraulic connections to be opened during removal and disassembly. Cap oil lines and plug holes after removing lines. Contamination of the hydraulic system could result in premature failure.

NOTE

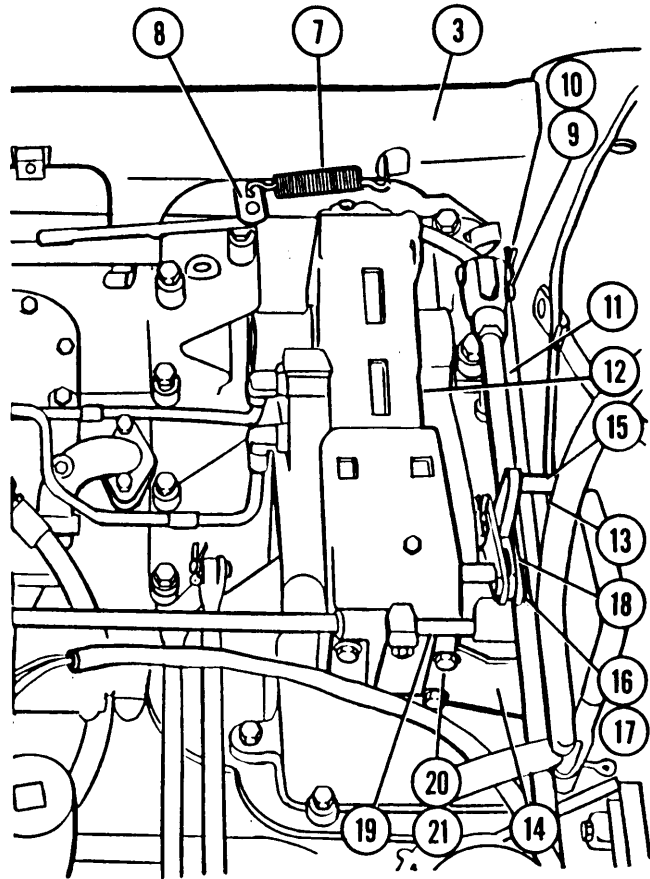
This procedure to be used for either R.H. or L.H. steering brake hydraulic control.

- (1) Use a wrench to remove three capscrews (1) and three lockwashers (2) from one end of fender brace (3).
- (2) Repeat STEP 1 for other end of fender brace (3).
- (3) Use a wrench to remove three capscrews (4), three flat washers (5) and three lockwashers (6) from center of fender brace (3).
- (4) Use a pliers to remove spring (7) from brace (3) and fuel shut-off lever (8).
- (5) Tap fender brace (3) on underside to break it loose and remove brace.
- (6) Use a pliers to remove cotter pin (9), pin (10) and end of brake control rod (11) from lever on steering brake hydraulic control (12). Discard cotter pin (9).
- (7) Repeat STEP 6 at other end of rod and remove rod (11).

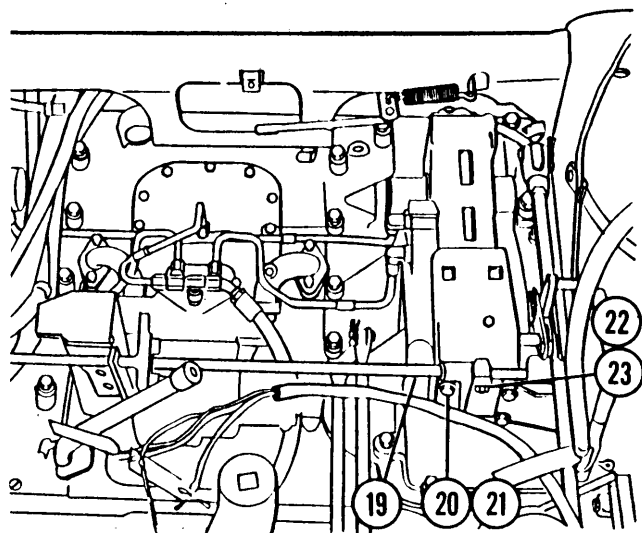


10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR (Cont' d)

- (8) Use a pliers to remove spring (13) from bracket (14) and lever (15).
- (9) Use a pliers to remove cotter pin (16), pin (17) and two links (18) from lever on end of shaft assembly (19). Discard cotter pin (16).
- (10) Repeat STEPS 8 and 9 on other end of shaft assembly (19).
- (11) Use a wrench to remove two capscrews (20), two lockwashers (21) and bracket (14) from front of brake control housing (12).



- (12) Use a wrench to remove other two capscrews (20), two lockwashers (21) and shaft assembly (19) bracket from front of brake control housing (12).
- (13) Repeat STEP 12 at other end of shaft assembly (19) and remove shaft assembly.
- (14) Remove cover (22) and gasket (23) from control housing (12). Discard gasket.

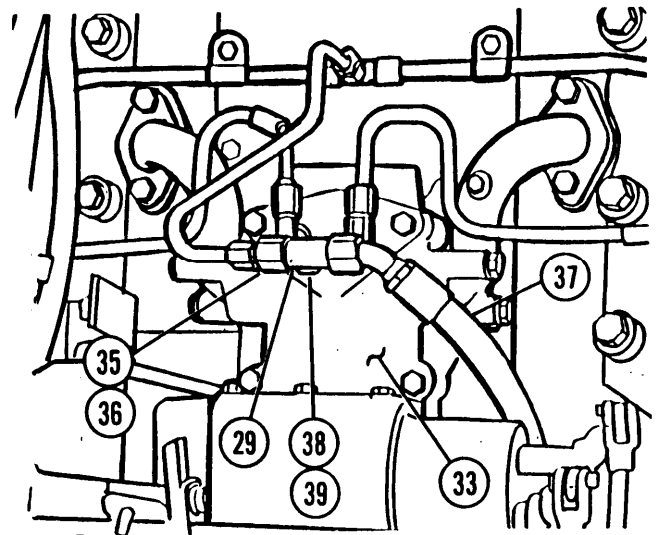
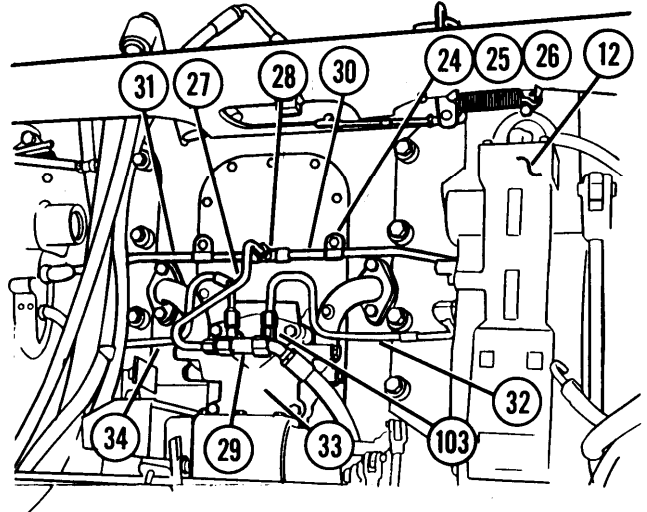


NOTE

On tractors equipped with ripper, move ripper hydraulic lines away from brake fluid lines connecting the two brake control housings.

## 10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (15) Use a wrench to remove two capscrews (24), two spacers (25) and two clips (26) holding tube assembly on frame.
- (16) Use a wrench to disconnect and remove tube assembly (27) from tee (28) and tee (29) at center of tubing assembly.
- (17) Use a wrench to disconnect and remove tube assembly (30) between brake control housing (12) and tee (28) in center of tubing assembly.
- (18) Repeat STEP 17 for tube assembly (31) from other brake control housing to tee (28).
- (19) Use a wrench to disconnect and remove tube assembly (32) between brake control housing (12) and elbow (103) on top of steering clutch control valve (33).
- (20) Repeat STEP 19 for tube assembly (34) from other brake control housing to control valve (33).
- (21) Use two wrenches to remove nut (35) and adapter (36) from one side of tee (29) on control valve (33).
- (22) Use a wrench to remove hose assembly (37) from other side of tee (29).
- (23) Use two wrenches to remove tee (29) and adapter (38) from top of control valve (33).
- (24) Remove seal (39) from adapter (38) and discard seal.

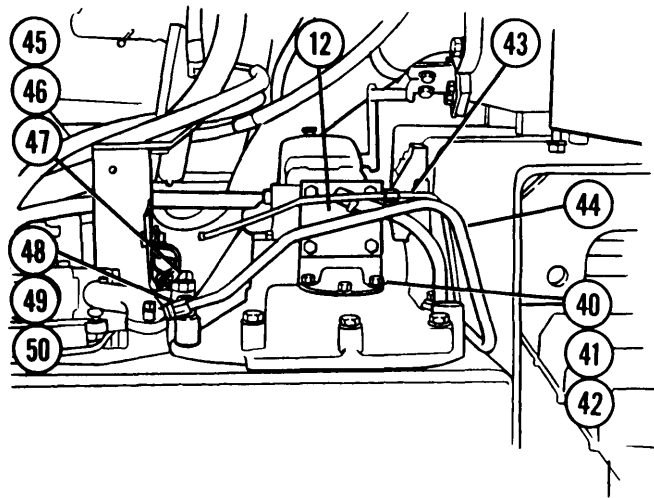


10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR (Cont'd)

NOTE

If R.H. brake control housing is being removed, fuel lines (43 and 44) must be removed at side of housing first. See STEPS 25, 26 and 27. If L.H. control is being removed, proceed to STEP 28 or 29.

- (25) Use a wrench to remove capscrew (40), flat washer (41), clip (42) and two tube assemblies (43 and 44) from right side of brake housing (12).
- (26) Use two wrenches to disconnect and separate one tube assembly (43) from smaller fuel line below hydraulic tank.
- (27) Use two wrenches to disconnect and remove other tube assembly (44) from larger fuel line below hydraulic tank.



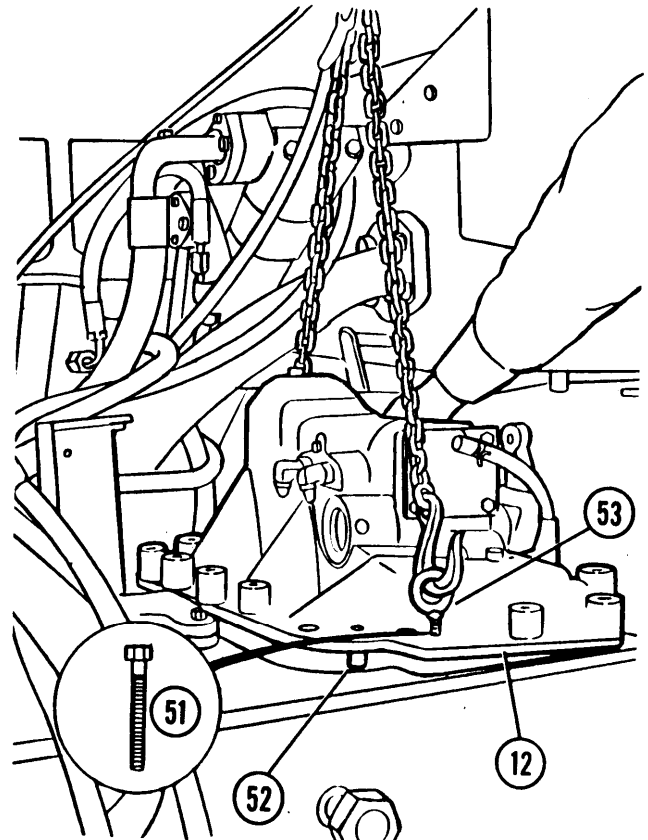
NOTE

If tractor has ripper and R.H. brake control housing is being removed, remove hydraulic hose to ripper from clamp at left side of R.H. control and move all hoses away from control housing. See STEP 28.

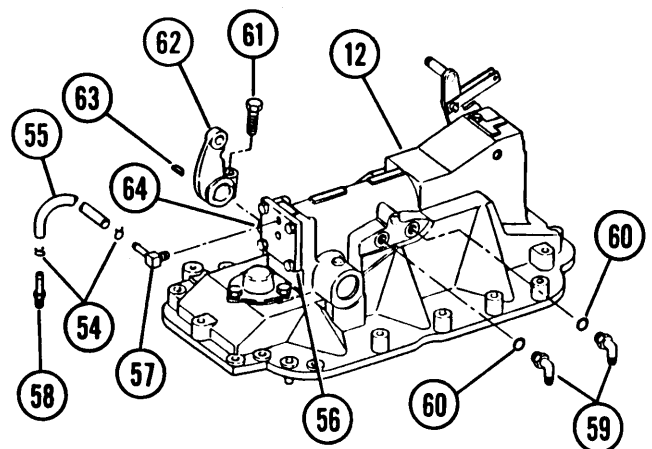
- (28) Use a wrench to remove capscrew (45), washer (46) and clamp (47) from ripper hydraulic line.
- (29) Use a wrench to remove sixteen capscrews (48), sixteen washers (49) and two spacers (50) from edge of control housing (12).

## 10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR (Cont' d)

- (30) Install two (1/2-13NC X 4" lg.) forcing screws (51), one at each end of control housing (12).
- (31) Turn forcing screws (51) evenly until brake control housing is raised of locating pins (52) in frame.
- (32) Remove two forcing screws (51) and install two (1/2-13NC) eyebolts (53), one at each end of control housing (12).
- (33) Use lifting equipment to remove brake control housing (12) from tractor.

b. Disassembly

- (1) Use a pliers to remove two hose clamps (54) and hose (55) from cover (56) on end of brake control housing (12).
- (2) Use a wrench to remove elbow (57) from cover (56) and remove hose fitting (58) from control housing (12).
- (3) Use a wrench to remove two elbows (59) and two seals (60) from side of control housing (12). Discard seals.
- (4) Use a wrench to remove capscrew (61) from lever (62) at side of control housing (12).
- (5) Use a hammer and chisel to remove lever (62) and key (63) from shaft (64).



10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR (Cont' d)

- (6) Turn housing (12) upside down.

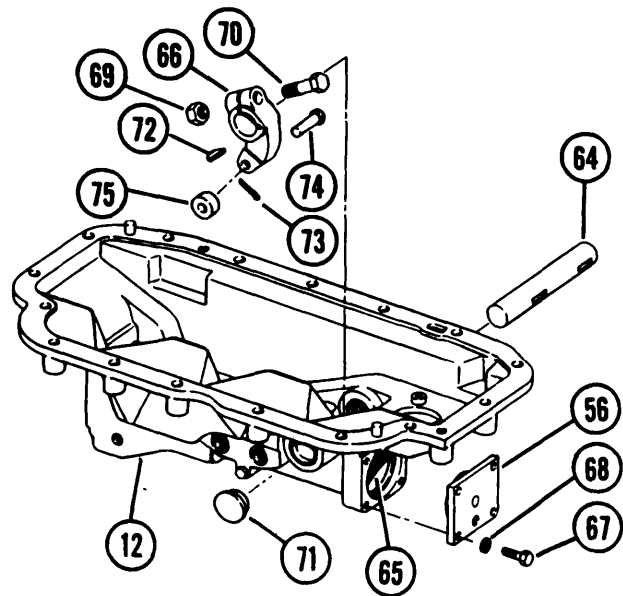
**WARNING**

Plunger assembly, lever arm, and cover are under spring pressure. Use caution when removing these parts to prevent personal injury or damaged or lost parts.

**WARNING**

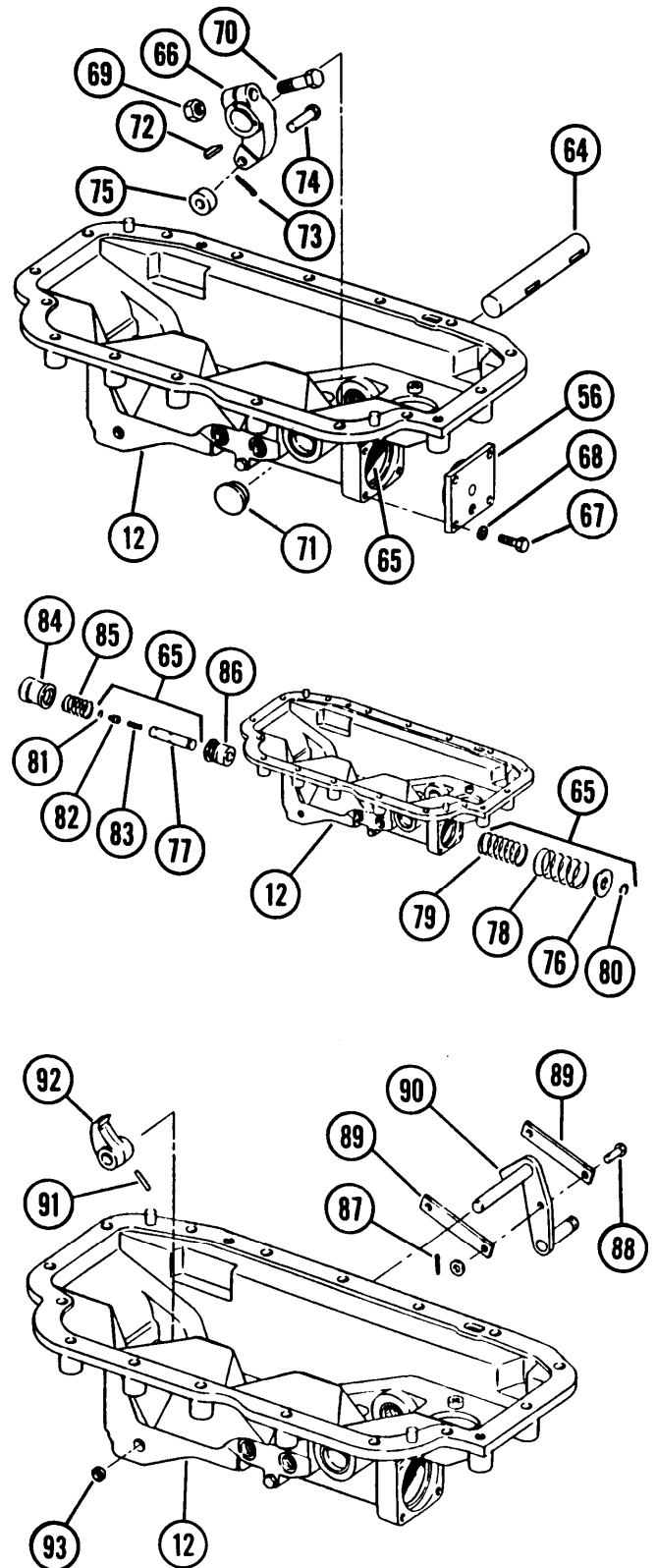
To prevent injury or lost parts remove cover (56) and install it backwards with two capscrews and leave in place until ready to remove plunger.

- (7) Use a large screwdriver to compress plunger assembly (65) and place capscrew between plunger (65) and cover mounting lip inside housing (12) to keep pressure off lever (66).
- (8) Use a wrench to remove four capscrews (67), four lockwashers (68) and cover assembly (56) from end of control housing (12). Use two capscrews (67) to install cover assembly (56) backwards over opening to prevent plunger from flying out.
- (9) Use two wrenches to remove nut (69) and capscrew (70) from lever (66).
- (10) Drive small chisel into lever (66) to loosen it on shaft (64).
- (11) Use a soft bar and hammer to drive shaft (64) far enough to remove plug (71) and to expose key (72) holding lever (66). Remove key (72).
- (12) Drive shaft (64) out of housing (12) and remove lever (66).



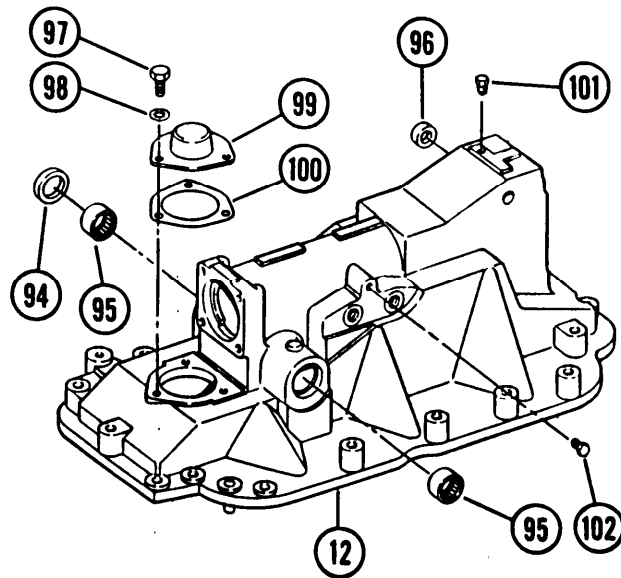
10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR (Cont' d)

- (13) Use a pliers to remove cotter pin (73), pin (74) and roller (75) from lever (66). Discard cotter pin (73).
- (14) Hold cover assembly (56) and slowly remove two capscrews (67) and cover (56) to prevent plunger (65) from flying out.
- (15) Use a large screwdriver to apply pressure on plunger (65). While applying pressure, remove cap-screw jamming plunger. Slowly release plunger until all spring pressure is relieved.
- (16) Remove retainer (76), plunger (77), outer spring (78) and inner spring (79) through end of housing (12).
- (17) If necessary, remove retaining ring (80) from plunger (77).
- (18) Remove retaining ring (81), valve (82) and valve spring (83) from other end of plunger (77).
- (19) Remove piston (84) and spring (85) from brake control housing (12).
- (20) Remove sleeve (86) from housing.
- (21) Use a pliers to remove cotter pin (87), pin (88) and two links (89) from parking brake lever assembly (90). Discard cotter pin (87).
- (22) Use a small punch and hammer to remove pin (91) from pawl (92) and shaft of parking brake lever assembly (90).
- (23) Tap lever assembly (90) to knock plug (93) out of housing (12) and remove lever assembly (90) and pawl (92).



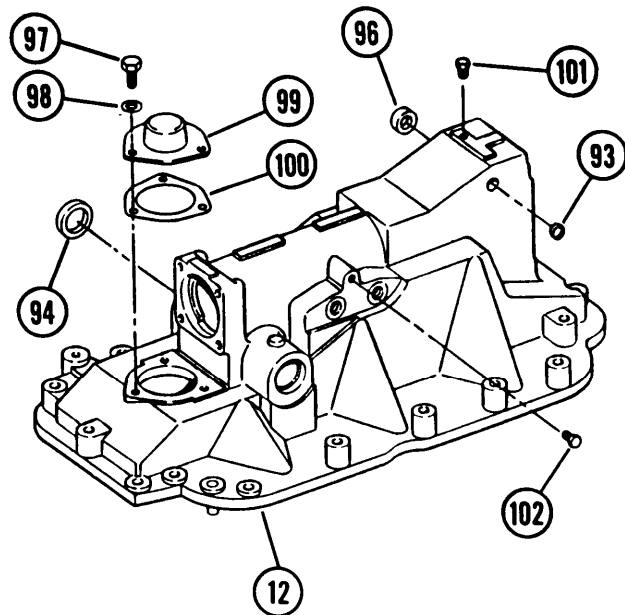
10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (24) Remove seal (94) and two bearings (95) from shaft (64) mounting holes in housing (12). Discard seal (94).
- (25) Turn brake control housing (12) to open side down.
- (26) Remove seal (96) from parking brake lever assembly (90) hole in housing (12). Discard seal (96).
- (27) Use a wrench to remove three capscrews (97), three lockwashers (98), cover (99) and gasket (100) from end of control housing (12). Discard gasket.
- (28) Use a wrench to remove plug (101) from top of housing (12).
- (29) Use a wrench to remove plug (102) from side of housing (12).



c. Assembly

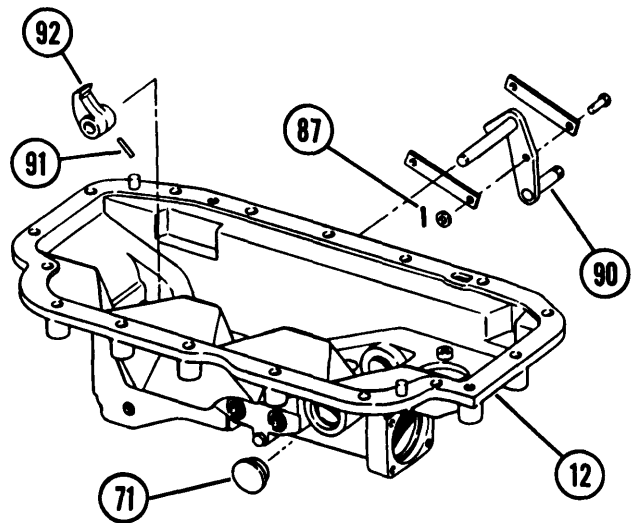
- (1) Use a wrench to install plug (102) on side of brake control housing (12).
- (2) Use a wrench to install plug (101) in top of housing (12).
- (3) Wipe gasket surface on cover (99) and control housing (12) clean.
- (4) Install gasket (100) and cover (99) on housing (12) with three capscrews (97) and three lockwashers (98).
- (5) Apply coat of clean oil to lip of seal (96). Insert seal, lip first, into hole for parking brake lever shaft. Seat seal (96) in hole with small bar and hammer.
- (6) Install plug (93) in lever shaft hole on opposite side of control housing (12).





10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR (Cont' d)

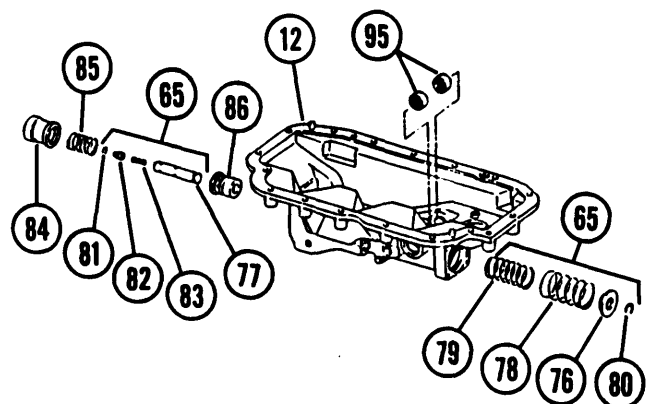
- (7) Repeat STEPS 5 and 6 for seal (94) and plug (71) for large shaft (64) holes in housing (12).
- (8) Turn housing (12) to open side up.
- (9) Insert shaft of parking brake lever assembly (90) through seal (96) in housing (12) and through pawl (92) into hole in opposite side of housing.
- (10) Line up hole in pawl (92) with hole in lever shaft (90) and insert pin (91).



NOTE

Install the two shaft bearings with the identification lettering facing center of housing so lettering can be seen after installation.

- (11) Install two bearings (95) in brake control shaft hole on inside of housing with small bar. Lettered edge of bearings to be 0.031 in. below edge of hole in housing (12).
- (12) Install sleeve (86) in counter-bore inside control housing (12). Sleeve must bottom in counter-bore.
- (13) Insert spring (85) in piston (84) and install piston in counter-bore and make contact with sleeve (86).
- (14) Install valve spring (83), and valve (82) in plunger (77) and secure with ring (81).
- (15) Install retainer (76) on other end of plunger (77) and secure with ring (80).

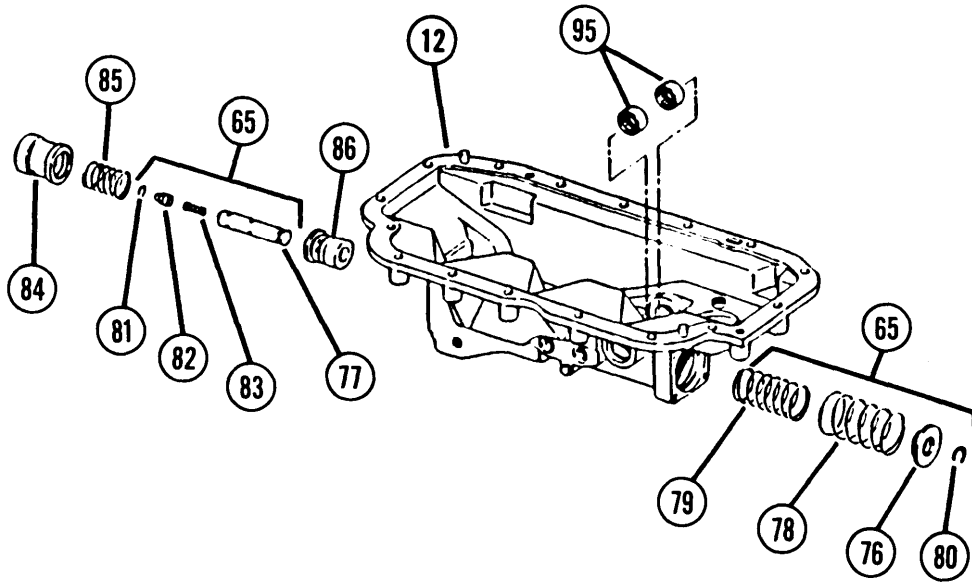


10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (16) Install inner spring (79) and outer spring (78) over plunger (77) and seat on retainer (76).
- (17) Install plunger assembly (65) with plunger (77) through sleeve (86) and inner spring (79) and outer spring (78) over sleeve (86).
- (18) With large screwdriver apply pressure to retainer (76) to compress springs and insert capscrew between retainer (76) and inside of booster housing.

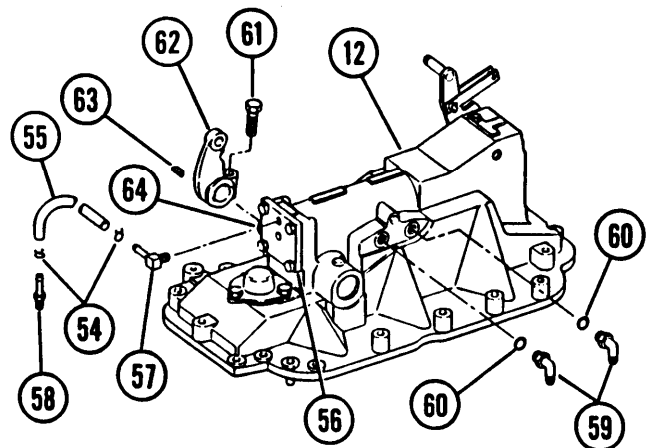
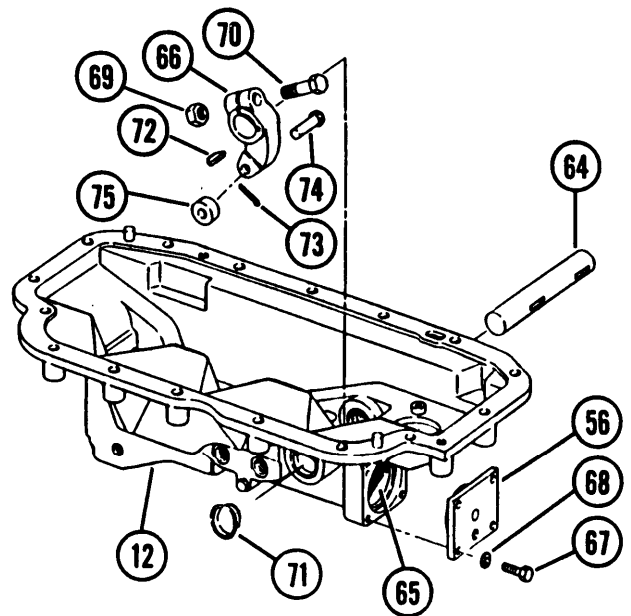
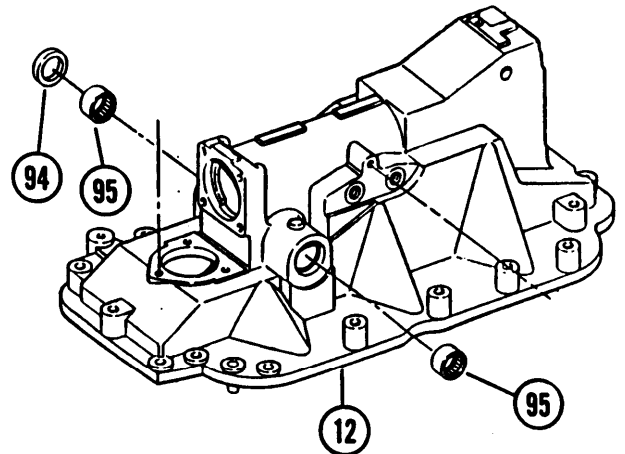
**WARNING**

Do not disturb capscrew holding plunger assembly until lever and cover assemblies are in place. Spring pressure behind plunger could cause injury or lost parts.



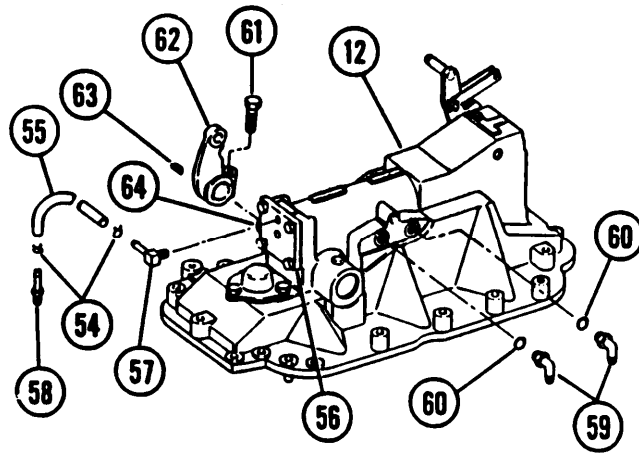
10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (19) Install roller (75) in lever (66) with pin (74) and using pliers, secure pin (77) with new cotter pin (73).
- (20) Drive small chisel into lever (66) to open it up for assembly.
- (21) Insert shaft (64) through seal (94), bearing (95), one side of housing (12), lever (66) and into other side of housing.
- (22) Insert key (72) in shaft (64). Align key (72) with slot in lever (66) and slide lever onto key as far as possible.
- (23) Use a punch and hammer to drive shaft (64) to center lever (66) on key (72) and center shaft in housing (12). Remove chisel from lever.
- (24) Use two wrenches to install capscrew (70) and nut (69) to secure lever (66) to shaft (64) inside housing (12).
- (25) Turn brake control housing (12) over to open side down.
- (26) Use a punch and hammer to stake plug (71) at large shaft (64) in three places.
- (27) Use a wrench to install cover assembly (56) on end of housing (12) with four capscrews (67) and four lockwashers (68).
- (28) Drive small chisel in lever (62) to open it up for assembly.
- (29) Install key (63) in shaft (64).
- (30) Align slot in lever (62) with key (63), slide lever on key and shaft (64) centering lever over key. Remove chisel from lever.



10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR (Cont' d)

- (31) Use a wrench to install capscrew (61) in lever (62).
- (32) Push on lever (62) to put pressure on springs inside housing and drop capscrew from between plunger and housing. Slowly release pressure on lever (62) until plunger bottoms on roller (75) and cover assembly (56).
- (33) Apply light film of clean hydraulic oil to two seals (60) and install seals on two elbows (59).
- (34) Use a wrench to install two elbows (59) in side of brake control housing (12).
- (35) Use a wrench to install hose fitting (58) in control housing 12 and elbow (57) in cover (56).
- (36) Use a pliers to install hose (55) on elbow (57) and fitting (58) and secure hose with two hose clamps (54).



d. Installation

CAUTION

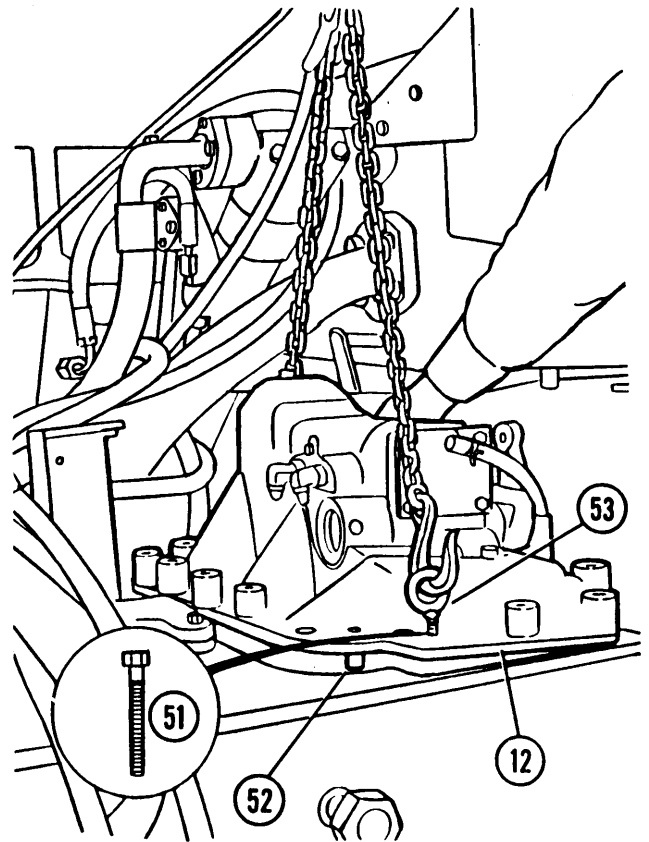
Care should be taken not to contaminate hydraulic system during installation of hydraulic lines. Dirt and foreign substances should be removed from surrounding area before lines are installed.

NOTE

This procedure to be used for either R.H. or L.H. steering brake hydraulic control.

## 10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (1) Install two (1/2 -13NC) eyebolts (53), one at each end of brake control housing (12).
- (2) Clean old gasket material off mounting flange of control housing (12) and mounting surface on top of gear case at back of tractor. Wipe both surfaces clean.
- (3) Apply liquid gasket material on mounting flange of control housing (12) and mounting surface on top of gear case at back of tractor.
- (4) Use lifting equipment to position control housing (12) on two locating pins (52) on top of gear case.
- (5) Use a wrench to install sixteen capscrews (48), sixteen washers (49) and two spacers (50) around edge of control housing (12). Tighten capscrews to a torque of  $100 \pm 5$  lb. ft.



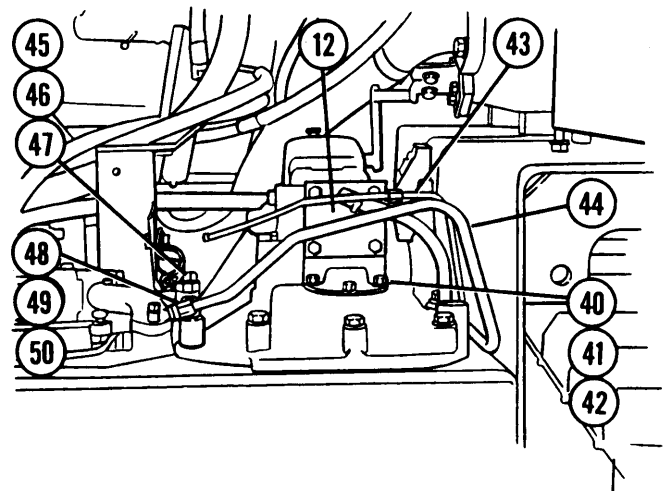
## NOTE

If tractor has ripper attachment and R.H. brake control housing is being installed, install clamp with hose at left side of R.H. control (STEP 6).

- (6) Use a wrench to secure ripper hose with clamp (47), capscrew (45) and washer (46).

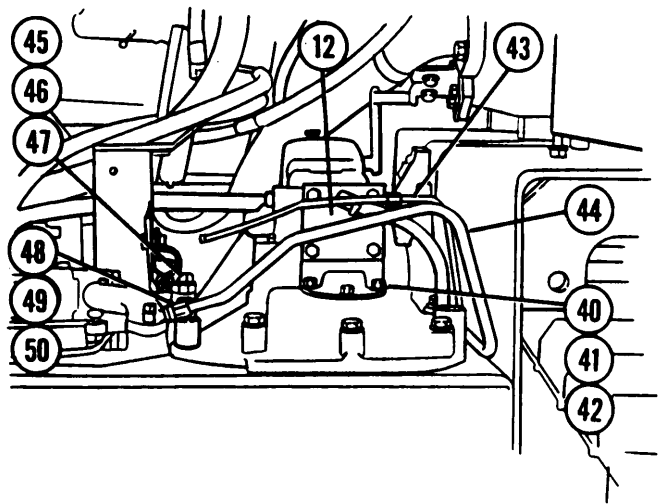
## NOTE

If R.H. brake control housing is being installed, fuel lines (43) and (44) must be installed after control housing is bolted down (STEPS 7, 8 and 9). If L.H. control housing is being installed, proceed to STEP 10.

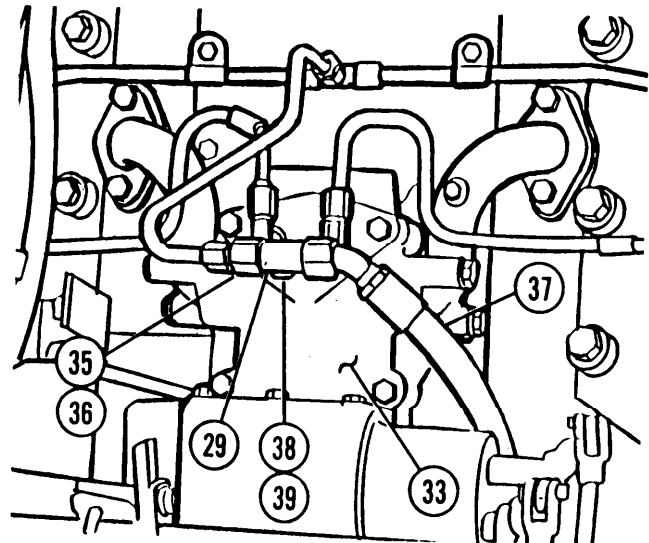


10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (7) Use two wrenches to connect tube assembly (44) to the large fuel line below hydraulic tank.
- (8) Use two wrenches to connect tube assembly (43) to the smaller fuel line below hydraulic tank.
- (9) Use a wrench to secure two fuel lines (43 and 44) to R.H. side of control housing (12) with clip (42), capscrew (40) and washer (41).



- (10) Apply light film of clean hydraulic oil to seal (39) and install seal on adapter (38).
- (11) Use two wrenches to install adapter (38) and tee (29) in top of brake control valve (33).
- (12) Use a wrench to install hose assembly (37) on one side of tee (29).
- (13) Use two wrenches to install adapter (36) and nut (35) on other side of tee (29).

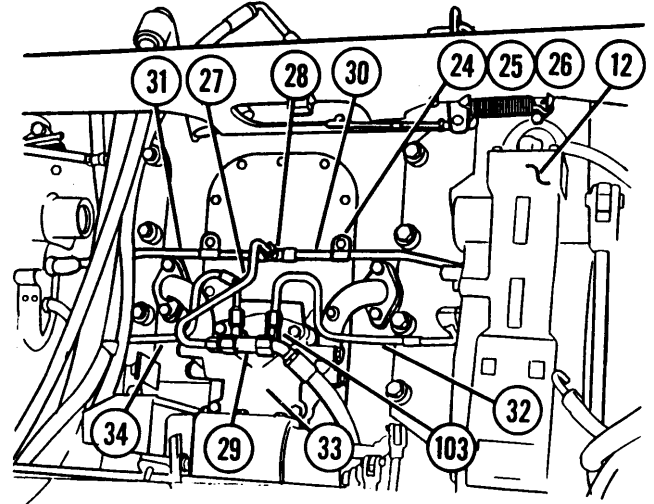


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 10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR (Cont'd)
 

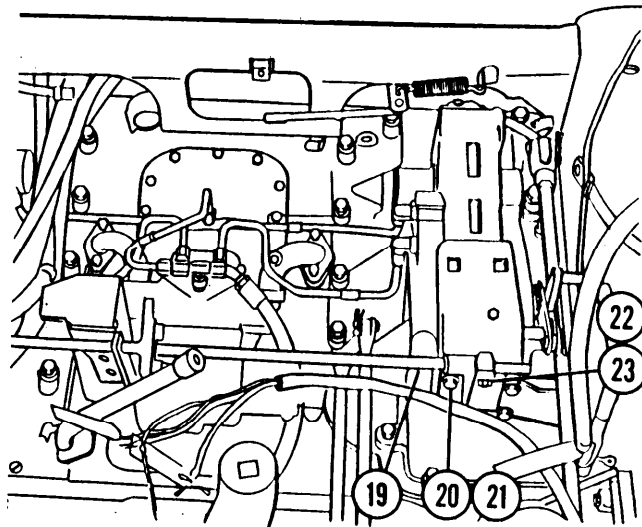
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- (14) Use a wrench to install tube assembly (32) between control housing (12) and elbow (103) on control valve (33).
- (15) Repeat STEP 14 for tube assembly (34) to other control housing.
- (16) Use two wrenches to install one end of tube assembly (30) on tee (28).
- (17) Repeat STEP 16 for one end of tube assembly (31).
- (18) Position tube assemblies and tee to brake control housings and using two wrenches, install end of tube assembly (30) on control housing (12).
- (19) Repeat STEP 18 for end of tube assembly (31) on other control housing.
- (20) Use a wrench to install tube assembly (27) between lower tee (28) and upper tee (29) on control valve (33).
- (21) Use a wrench to secure tube assemblies (30 and 31) on frame with two clips (26), two spacers (25) and two capscrews (24).

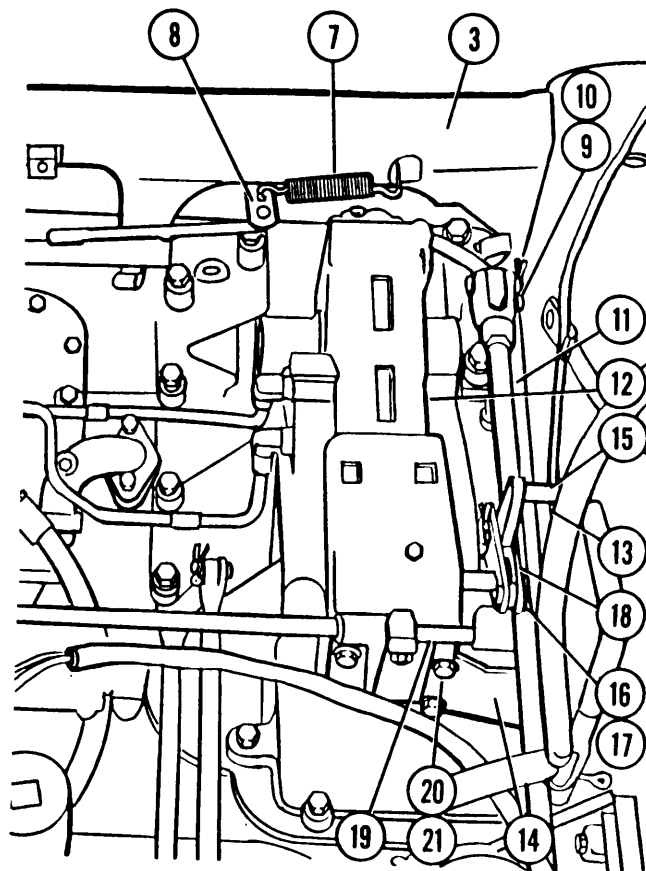


10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR (Cont' d)

- (22) Use a wrench to install gasket (23), cover (22) and bracket (14) to front of brake control housing (12) with two capscrews (20) and two lockwashers (21). Do not tighten.
- (23) Use a wrench to install shaft assembly (19) bracket on front of control housing (12) over cover (22) with two capscrews (20) and two lockwashers (21). Do not tighten.
- (24) Repeat STEP 23 for other end of shaft assembly (19).
- (25) Use a wrench to tighten six capscrews (20).



- (26) Use a pliers to install two links (18) on shaft assembly (19) with pin (17) and new cotter pin (16).
- (27) Use a pliers to install spring (13) between bracket (14) and lever (15) on shaft assembly (19).
- (28) Repeat STEPS 26 and 27 at other end of shaft assembly (19).
- (29) Use a pliers to install one end of brake control rod (11) on lever on brake control housing (12) with pin (10) and new cotter pin (9).
- (30) Repeat STEP 29 at other end of brake control rod (11).





10-5. STEERING BRAKE HYDRAULIC CONTROL ASSEMBLY - REPLACE/REPAIR (Cont'd)

(31) Position fender brace (3) between fenders. Tap brace with hammer to align capscrew holes if necessary.

(32) Use a wrench to secure bottom of brace (3) to frame with three capscrews (4), three flat washers (5) and three lockwashers (6).

(33) Use a wrench to secure one end of brace (3) to fender with three capscrews (1) and three lockwashers (2).

(34) Repeat STEP 33 at other end of fender brace.

(35) Use a pliers to install spring (7) on brace (3) and fuel shut-off lever (8).

(36) Install brake lock lever. See TM5-2410-237-20.

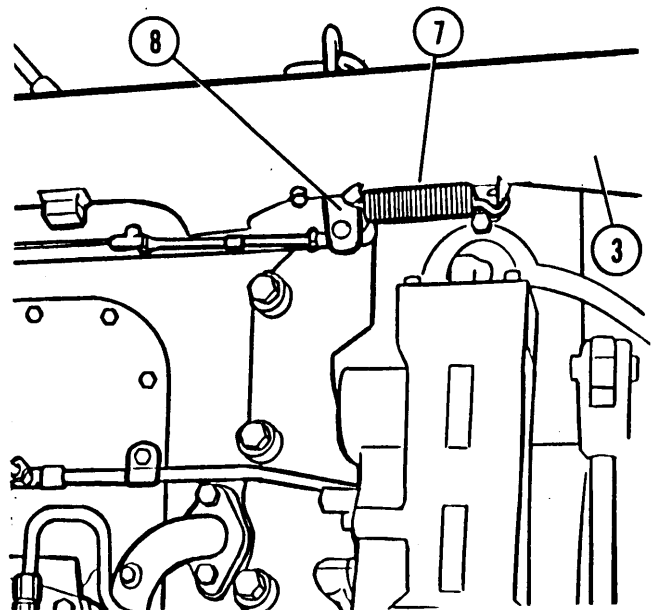
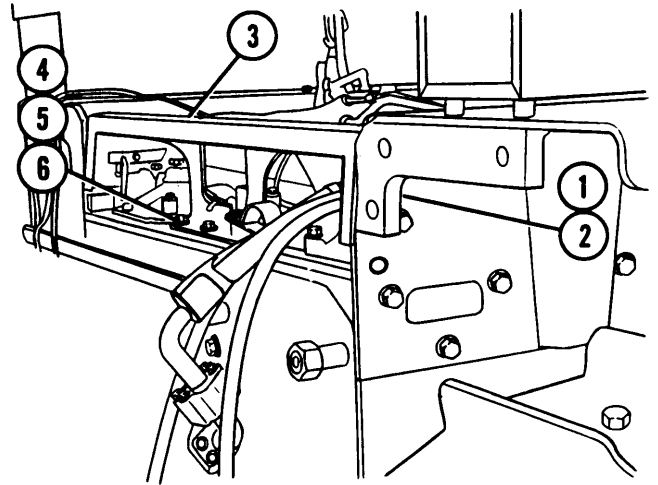
(37) Install seat assembly. See TM5-2410-237-20.

(38) Install floor plates. See TM5-2410-237-20.

(39) Install fuel tank. See page 4-23.

(40) Install ROPS. See TM5-2410-237-20.

(41) Install hydraulic tank mounting brackets. See TM5-2410-237-20.



e. Place In Service

Test drive and check for proper operation

10-6. STEERING BRAKE PEDALS AND LINKAGE - REPLACE/REPAIR

This task covers:

- a. Removal
- b. Disassembly
- c. Assembly
- d. Installation
- e. Place In Service

INITIAL SETUP

Applicable Configurations  
All

Common Tools  
Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Materials/Parts  
Cotter pin (6), (11), (23)

Equipment Condition  
Floor plates removed. See TM5-2410-237-20.

a. Removal

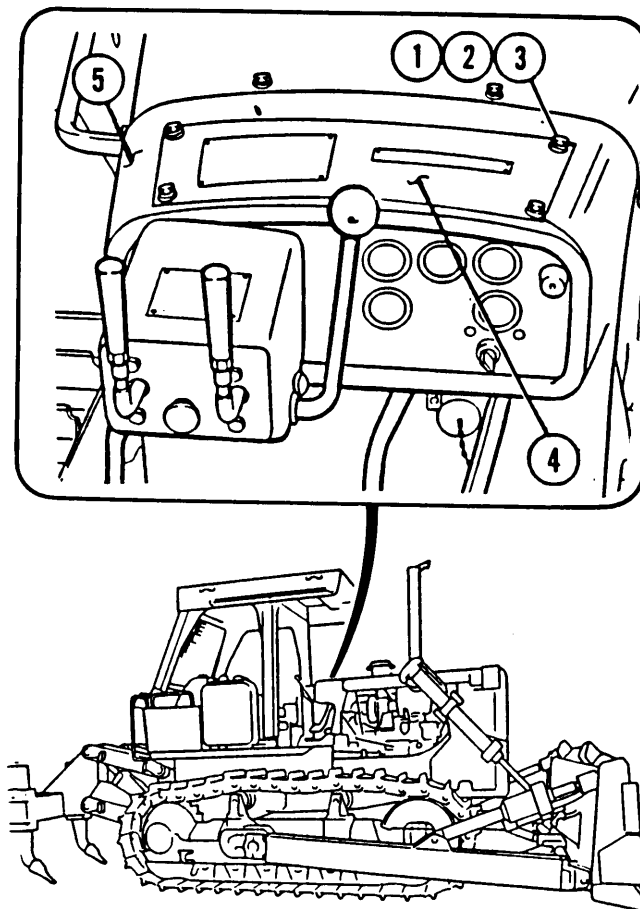
WARNING

Turn battery disconnect switch to OFF before working inside dash assembly. Failure to follow this precaution could result in personal injury and damage to equipment.

NOTE

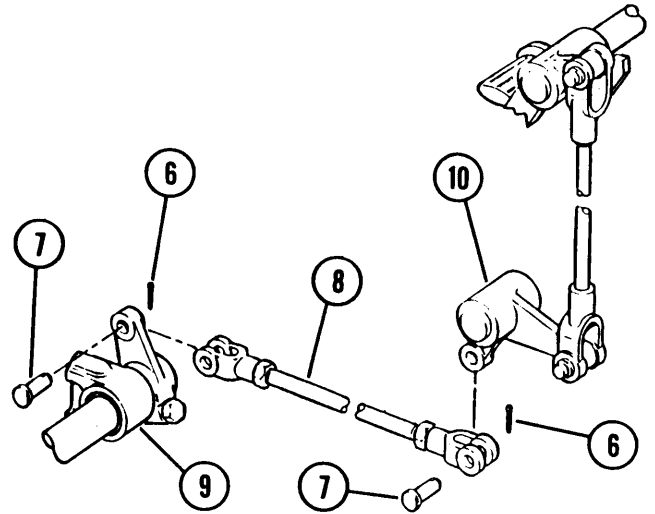
This procedure to be used for R.H. or L.H. brake linkages.

- (1) Use a wrench to remove four capscrews (1), four lockwashers (2), four flat washers (3) and cover (4) from top of dash assembly (5).

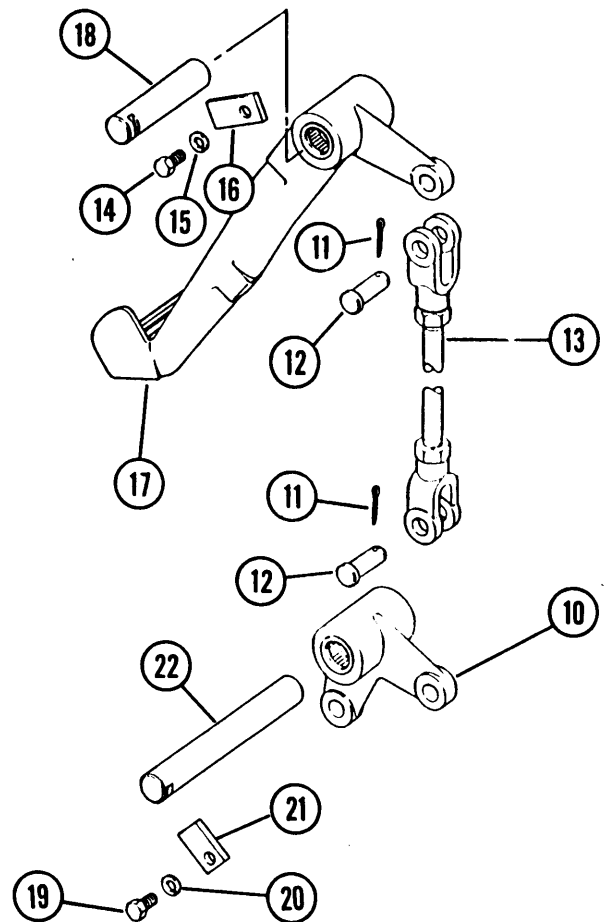


10-6. STEERING BRAKE PEDALS AND LINKAGE - REPLACE/REPAIR (Cont'd)

- (2) Use a pliers to remove cotter pin (6) and pin (7) from rod assembly (8) at shaft (9) under floor. Discard cotter pin (6).
- (3) Repeat STEP 2 for other end of rod assembly (8) at bellcrank (10) located at bottom rear of dash assembly (5) and remove rod assembly (8).

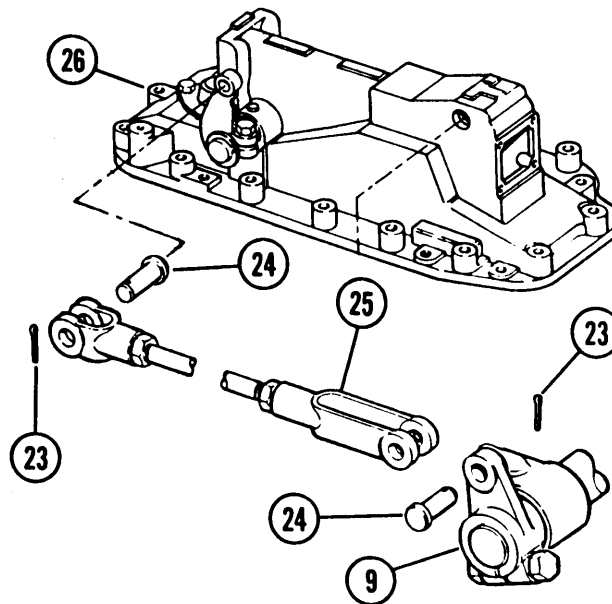


- (4) Use a pliers to remove cotter pin (11) and pin (12) from top end of rod assembly (13) at foot pedal support. Discard cotter pin (11).
- (5) Repeat STEP 4 for bottom of rod assembly (13) at bellcrank (10) and remove rod.
- (6) Use a wrench to remove capscrew (14), lockwasher (15), and lock (16) from pedal (17) and support bracket in dash assembly (5).
- (7) Remove shaft (18) and pedal (17) from dash assembly (5).
- (8) Use a wrench to remove capscrew (19), lockwasher (20) and lock (21) from bellcrank (10) and mounting bracket at bottom rear of dash assembly (5).
- (9) Remove shaft (22) from steering clutch bellcrank and brake bellcrank (10). Remove brake bellcrank and reinsert shaft (22) through clutch bellcrank and support bracket.



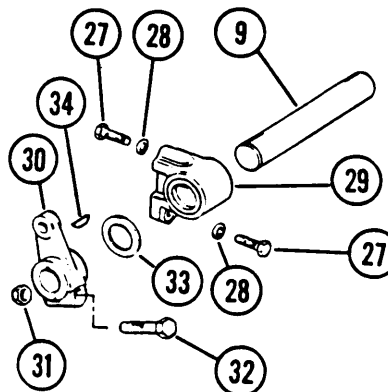
10-6. STEERING BRAKE PEDALS AND LINKAGE - REPLACE/REPAIR (Cont'd)

- (10) Use a pliers to remove cotter pin (23) and pin (24) from rod assembly (25) at end of shaft (9) under floor. Discard cotter pin (23).
- (11) Repeat STEP 8 for other end of rod assembly (25) at brake actuating mechanism (26) and remove rod assembly (25).



- (12) Use a wrench to remove four capscrews (27), four lockwashers (28) and two brackets (29) with shaft (9) and levers (30) from crossbeam in floor.

- (13) Use two wrenches to remove nut (31), capscrew (32), lever (30), washer (33) and key (34) from one end of shaft (9).

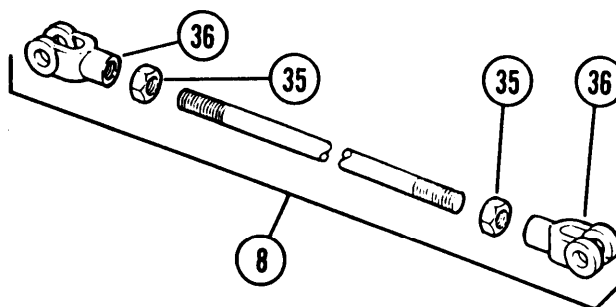


- (14) Repeat STEP 11 for lever at other end of shaft (9).

- (15) Remove two brackets (29) from shaft (9).

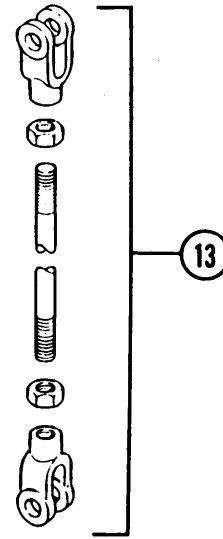
b. Disassembly

- (1) Loosen nut (35) at each end of rod assembly (8). Remove two rod ends (36) and two nuts (35).

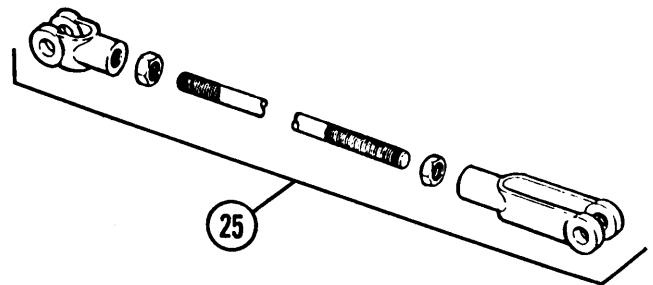


10-6. STEERING BRAKE PEDALS AND LINKAGE - REPLACE/REPAIR (Cont'd)

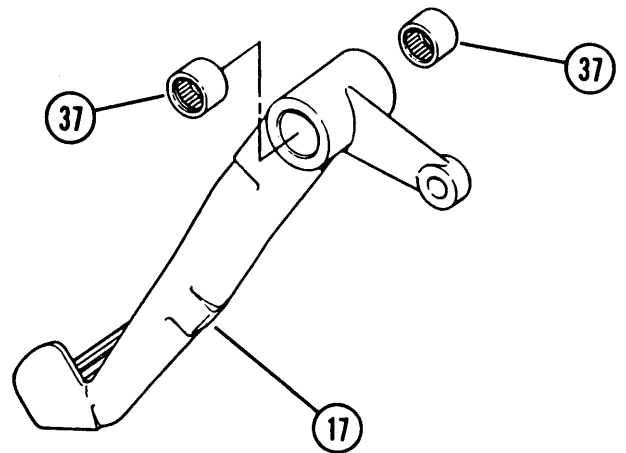
(2) Repeat STEP 1 for rod assembly (13).



(3) Repeat STEP 1 for rod assembly (25).

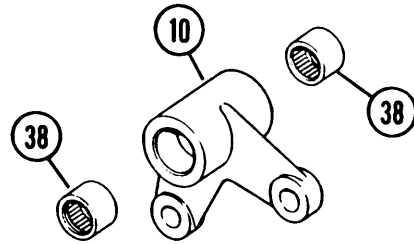


(4) Remove two bearings (37) from foot pedal (17).



10-6. STEERING BRAKE PEDALS AND LINKAGE - REPLACE/REPAIR (Cont' d)

- (5) Remove two bearings (38) from bellcrank (10).



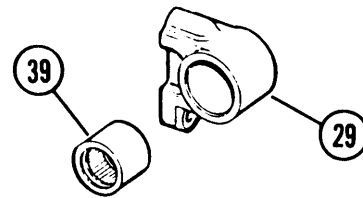
- (6) Remove bearing (39) from shaft mounting bracket (29).

- (7) Repeat STEP 6 for other bracket.

c. Assembly

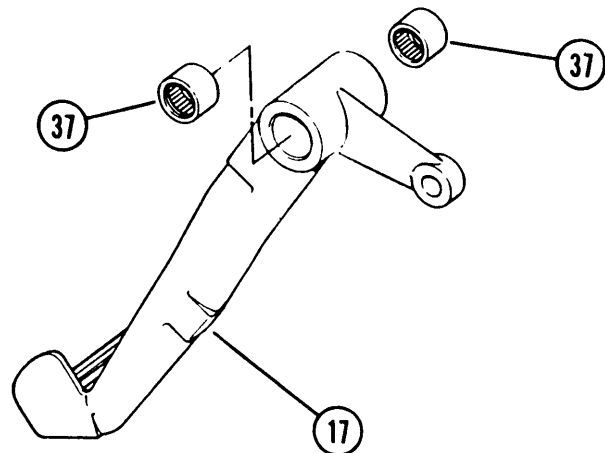
- (1) Install bearing (39) in shaft mounting bracket (29).

- (2) Repeat STEP 1 for other bracket.



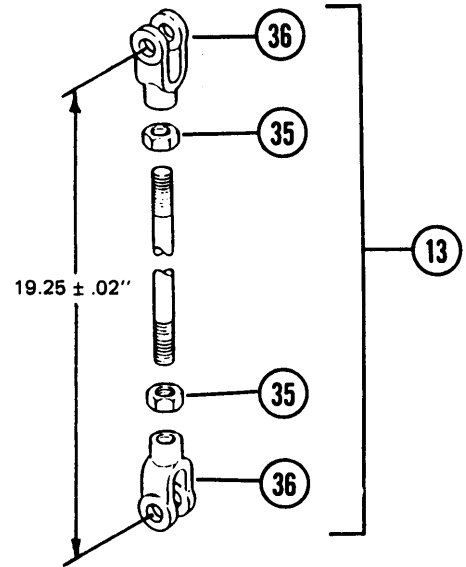
- (3) Install two bearings (38) in bellcrank (10).

- (4) Install two bearings (37) in foot pedal (17).

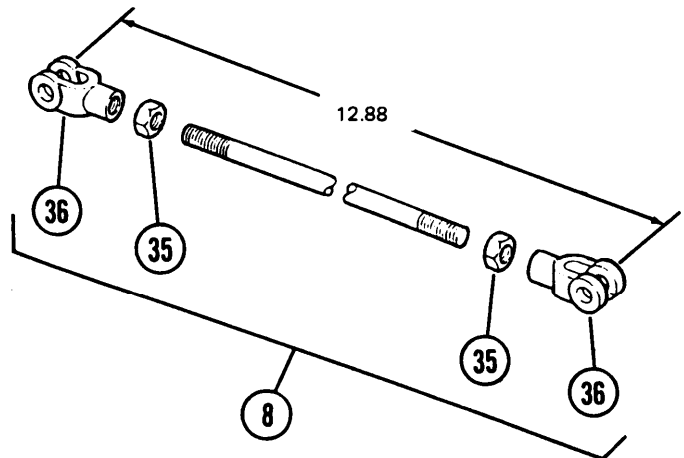


10-6. STEERING BRAKE PEDALS AND LINKAGE - REPLACE/REPAIR (Cont'd)

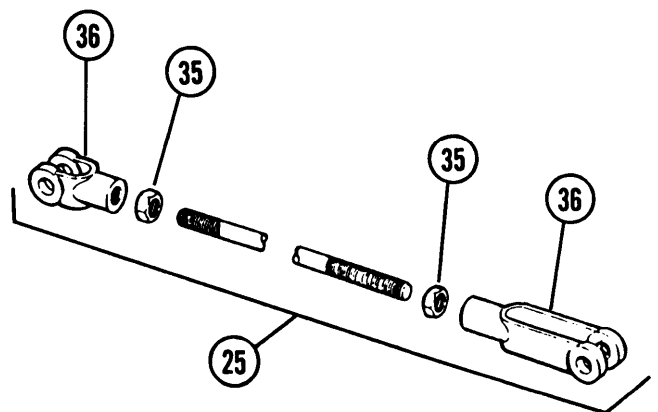
- (5) Install nut (35) on each end of rod (13).
- (6) Install rod end (36) on each end of rod (13), adjust rod ends to a distance of  $19.25 \pm 0.02$  in. between center lines of holes in rod ends.
- (7) Tighten nuts (35) against rod ends (36) to a torque of  $75 \pm 10$  lb. ft.



- (8) Repeat STEPS 5, 6 and 7 for rod assembly (8). Distance between center lines is 12.88 in.



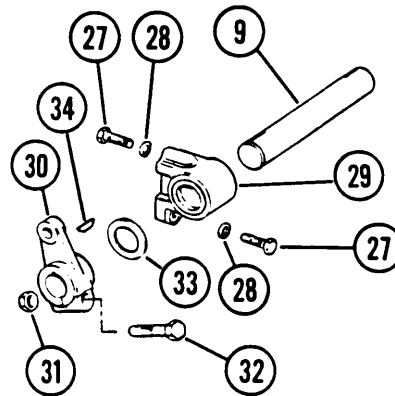
- (9) Install nut (35) and rod end (36) on each end of rod (25). Do not tighten nuts at this time.



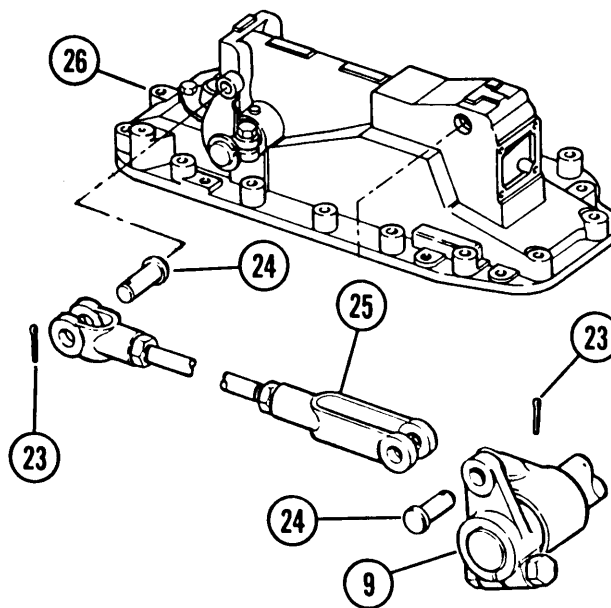
10-6. STEERING BRAKE PEDALS AND LINKAGE - REPLACE/REPAIR (Cont' d)

d. Installation

- (1) Install two brackets (29) on shaft (9).
- (2) Install washer (33), key (34) and lever (30) on end of shaft (9).
- (3) Use two wrenches to install capscrew (32) and nut (31) in lever (30) to secure lever to shaft (9).
- (4) Repeat STEPS 2 and 3 for lever at other end of shaft.
- (5) Use a wrench to install two brackets (29) with shaft and levers on crossbeam in floor using four capscrews (27) and four lockwashers (28).



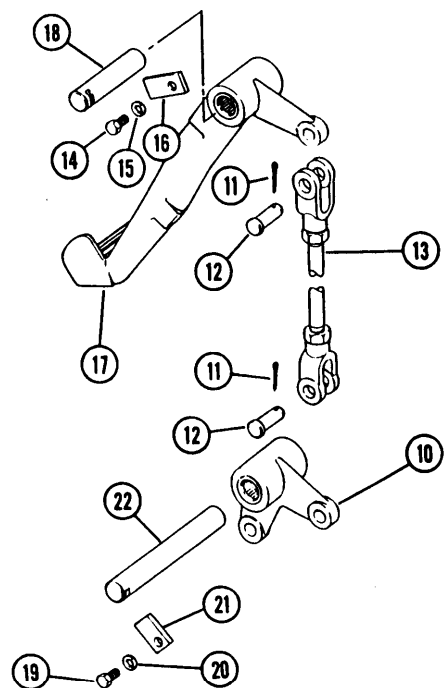
- (6) Install one end of rod assembly (25) on brake actuating mechanism (26) with pin (24) and using pliers, secure pin (24) with new cotter pin (23). Do not tighten nut at this time.
- (7) Repeat STEP 6 for other end of rod assembly (25) on lever (30) at end of shaft (9). Do not tighten nut at this time.
- (8) Remove shaft (22) from steering clutch bellcrank. Position brake bellcrank (10) and reinsert shaft through both bellcranks and support bracket.



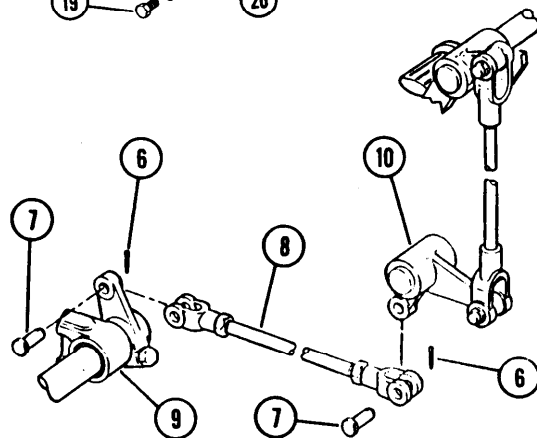


10-6. STEERING BRAKE PEDALS AND LINKAGE - REPLACE/REPAIR (Cont'd)

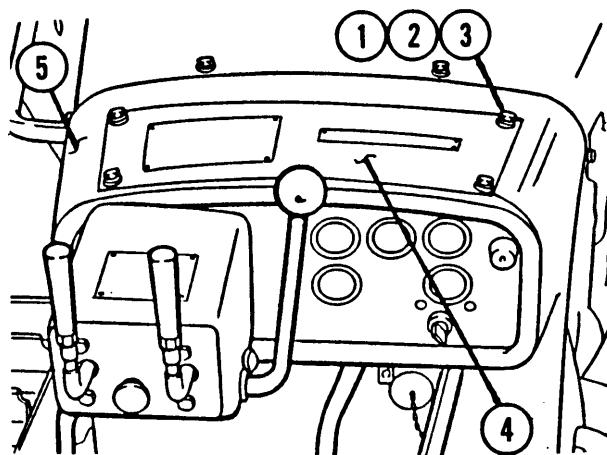
- (9) Use a wrench to install lock (21) on bellcrank support bracket with capscrew (19) and lockwasher (20).
- (10) Install pedal (17) in dash assembly (5) with shaft (18).
- (11) Use a wrench to install lock (16) on pedal support bracket with capscrew (14) and lockwasher (15).
- (12) Install end of rod assembly (13) on foot pedal (17) lever with pin (12) and with pliers, install new cotter pin (11).
- (13) Repeat STEP 12 at bellcrank (10) end of rod assembly (13).



- (14) Install rod assembly (8) at shaft (9) with pin (7) and using pliers, install new cotter pin (6) in pin (7).
- (15) Repeat STEP 14 for other end of rod assembly (8) at bellcrank (10).
- (16) Adjust linkages. See TM5-2410-237-20.



- (17) Use a wrench to install cover (4) on top of dash assembly (5) with four capscrews (1), four lockwashers (2) and four flat washers (3).
- (18) Install floor plates. See TM5-2410-237-20.



e. Place In Service

Test drive and check for proper operation.

10-7. STEERING BRAKE LINING - REPLACE

This task covers:

- a. Removal
- b. Installation
- c. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Materials/Parts

Brake Lining (3)  
Support Block 1' X 2" X 4"  
Rivets (2)

Equipment Condition

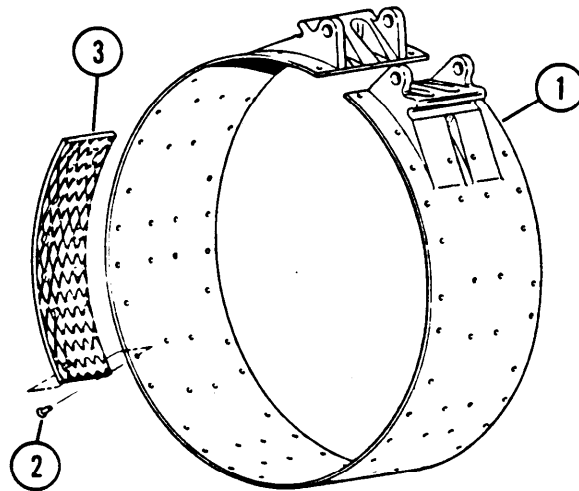
Steering clutch removed. See page 10-40.

a. Removal

CAUTION

Drill all rivets from the rolled edge side of the rivet (outside the brake band). Take care to keep the drill perpendicular at all times so as not to distort the diameter of the hole in the brake band.

- (1) Place brake band (1) on a support block and using an 11/64" drill bit, drill all 100 rivets (2) around brake band (1).
- (2) Remove 10 linings (3). Use an 11/64 drift punch to clean any rivets that remain in the holes after drilling.



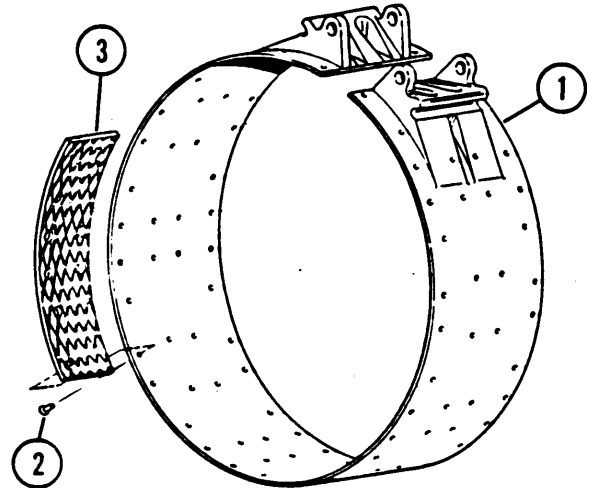
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 10-7. STEERING BRAKE LINING - REPLACE (Cont'd)
 

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b. Installation

- (1) Install new brake lining (3) in brake band (1) with ten rivets (2) using riveting fixture.
- (2) Repeat STEP 1 for other nine brake linings.
- (3) Check to make sure that linings (3) are tight against brake band (1) at each rivet (2) location and that a 0.004" feeler gage does not go within 0.25 in. radius of center line of rivets.
- (4) Check for 0.010 in. maximum gap between other areas of lining (3) and brake band (1).



CAUTION

Lining must be free of any abrasive particles or irregularities.

- (5) Remove any burrs on the lining (3) that are caused by the rivets (2).
  - (6) Install steering clutch. See page 10-40.
- c. Place In Service

Test drive and check for proper operation.

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10-8. STEERING CLUTCH - REPLACE/REPAIR

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This task covers:

- a. Removal
- b. Disassembly
- c. Assembly
- d. Installation
- e. Place In Service

---

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Lifting Equipment 200 lbs.  
 Compressor Plates  
 NSN 5120-01-119-1733  
 NSN 2530-00-623-5789

Materials/Parts

Anti-Seize Compound (App. B, Item 2)  
 Hydraulic Oil OE/HDO-10" (Refer to L05-2410-237-12)  
 Two 5/8"-11NC Eyebolts  
 Two 8-5/8"-11NC Long Capscrews (15)  
 Two 3/8"-16" X 4" Long Capscrews  
 Two 3/8" Hex Nuts  
 Drain Pan

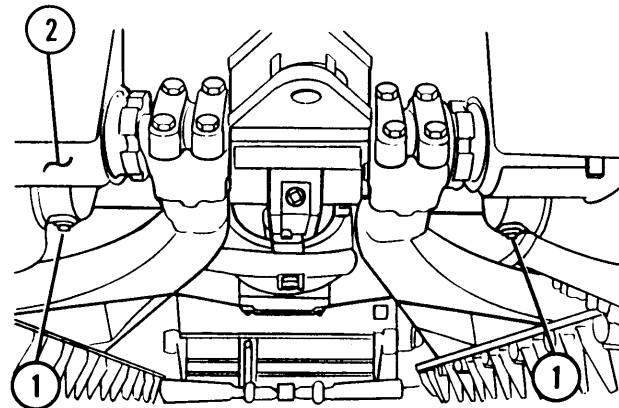
Equipment Condition

Seat assembly removed. See TM5-2410-237-20.  
 Brake actuating mechanism removed. See page 10-4.

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a. Removal

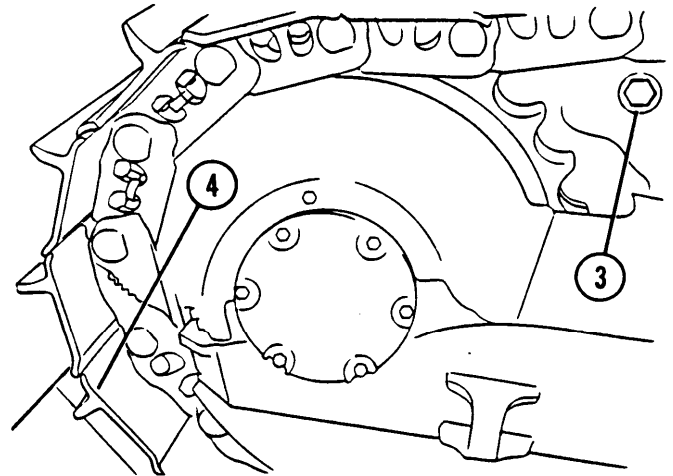
- (1) Use a square wrench to remove drain plug (1) at bottom of steering clutch case (2) and drain oil.



REAR OF TRACTOR

10-8. STEERING CLUTCH - REPLACE/REPAIR (Cont'd)

- (2) Use a square wrench to remove plug (3) at side of steering clutch case to gain access to capscrews (10).
- (3) Position jack under tooth of track (4).
- (4) Align capscrews (10) with hole at plug (3).
- (5) Use a wrench to remove hose assembly (5) from oil line (6) in clutch case.
- (6) Use a wrench to remove two nuts (7), two flat washers (8) and hose assembly (5) from brake band (9).



**WARNING**

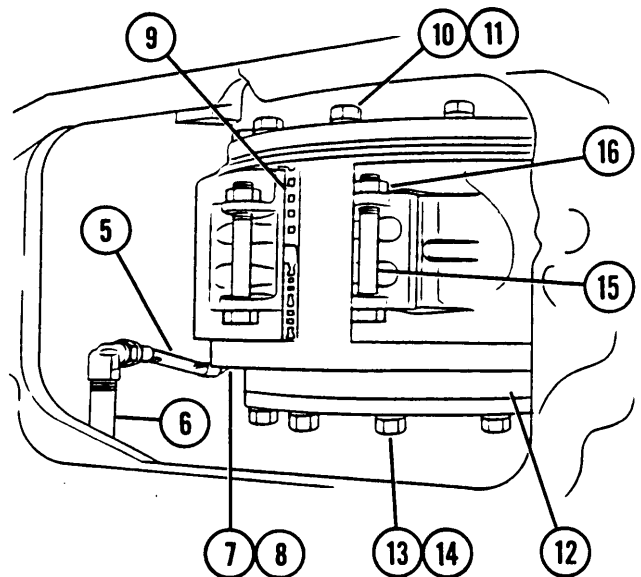
Do not remove all capscrews. Leave one capscrew on each side of clutch. If clutch drops before sling is attached, personal injury and equipment damage will result.

- (7) Use a wrench to remove eleven capscrews (13) and eleven washers (14) from hub on one side of steering clutch (12).

**NOTE**

Turn steering clutch to line up capscrews (10) with plug (3) hole by using a jack to push on grouser of track shoe (4).

- (8) Use a socket wrench with extension to remove eight capscrews (13) and eight washers (11) on flange side of clutch (12) through plug (3) hole in side of gear case.



10-8. STEERING CLUTCH - REPLACE/REPAIR (Cont'd)

- (9) Install two 3/8-16X4" lg. capscrews (15) through brake band (9) clamp and secure capscrews with two 3/8" hex nuts (16).

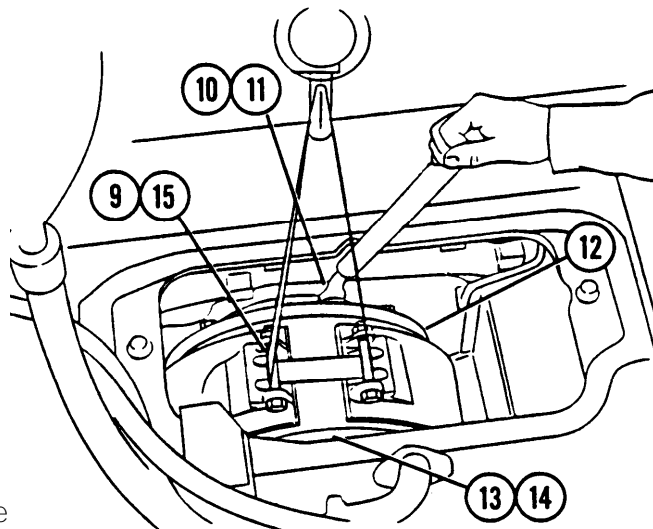
- (10) Attach lift in equipment to capscrews (15) in brake band (9) clamp and raise lifting equipment to take out slack.

NOTE

Tractor must be moved, using jack, to position clutch for removal of last capscrew on each side of steering clutch.

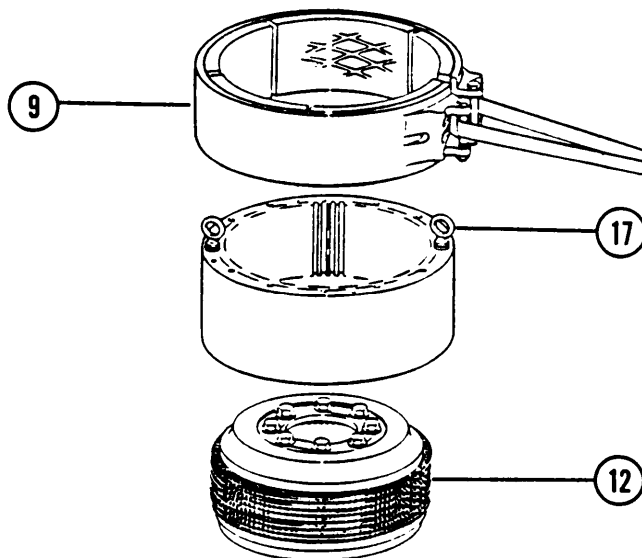
- (11) Use a wrench to remove capscrew (10) and washer (11) from one side of clutch (12) and capscrew (13) and washer (14) from other side.

- (12) Use lifting equipment to remove steering clutch (12) from clutch case. Clutch weighs 175 lbs.



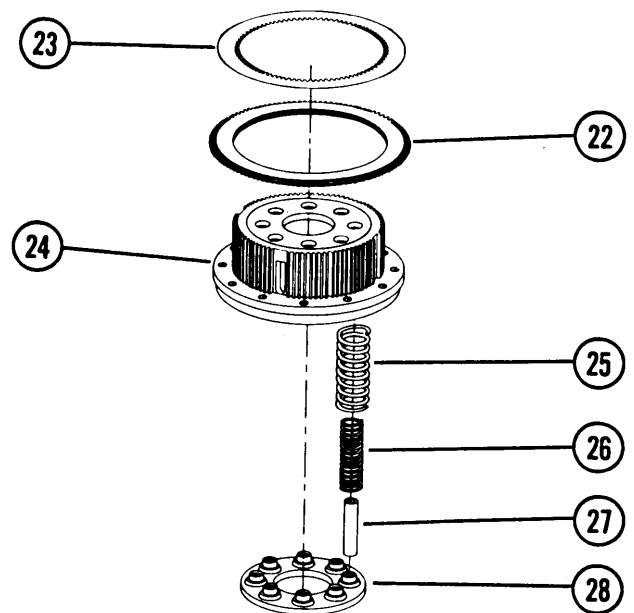
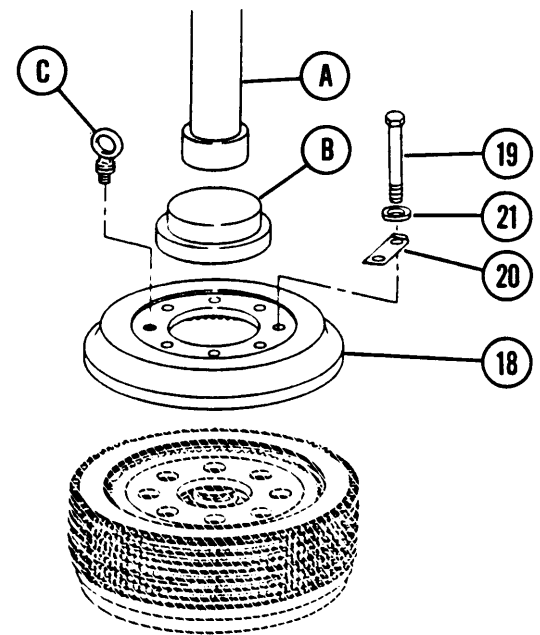
b. Disassembly

- (1) Use lifting equipment to position steering clutch (12) on bench with capscrew side up.
- (2) Remove lifting equipment and brake band (9) from clutch assembly (12).
- (3) Install two (5/8-11NC) eyebolts in outer drum (17) 180° apart. Outer drum weighs 110 lbs.
- (4) Use lifting equipment to remove outer drum (17) off steering clutch (12).
- (5) Use lifting equipment to position steering clutch (12) on hydraulic arbor press (A) over round block (B) with capscrew side of clutch facing up.



10-8. STEERING CLUTCH - REPLACE/REPAIR (Cont'd)

- (6) Position round block (B) on top pressure plate (18) inside circle of capscrews (19). Apply pressure to plate (18) with press to take pressure off capscrews (19).
  - (7) Use a hammer and chisel to flatten four locks (20).
  - (8) Use a wrench to remove eight capscrews (19), four locks (20) and eight flat washers (21).
  - (9) Release pressure on plate (18) and remove top block (B).
  - (10) Install two eyebolts (C) in pressure plate (18) 180° apart.
  - (11) Use lifting equipment to remove pressure plate (18) from clutch.
  - (12) Measure height of disc stack. Compare height with dimension of new stack 3.060 to 3.382 in. If disc stack is below these limits, replace discs or stack as necessary.
  - (13) Remove eight disc assemblies (22) and seven discs (23) from inner hub (24). Identify discs and disc assemblies for assembly sequencing.
  - (14) Remove inner hub (24) from clutch assembly.
  - (15) Remove eight outer springs (25), eight inner springs (26) and eight sleeves (27) from retainer (28).
- Remove retainer (28) from round block.



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 10-8. STEERING CLUTCH - REPLACE/REPAIR (Cont'd)
 

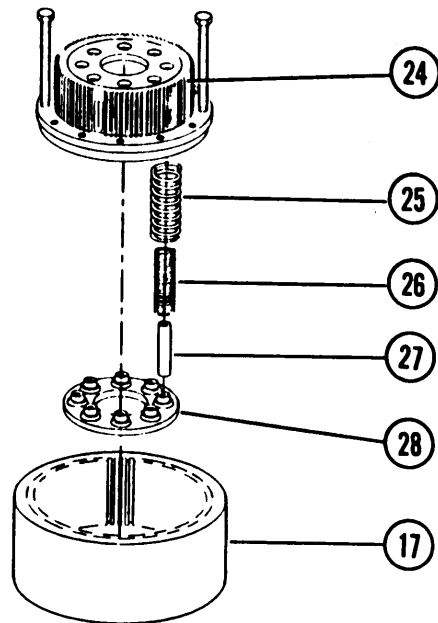
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## c. Assembly

## NOTE

Assemble steering clutch on bed of hydraulic arbor press. Compression of the stack is required in order to assemble steering clutch. Assemble steering clutch inside of outer drum (17) to make sure of correct spline alignment for discs (23) and disc assemblies (22).

- (1) Position outer drum (17) with threaded bores facing down, on bed of hydraulic press.
- (2) Center round block inside outer drum (17) and place retainer (28), with boss side up, on block.
- (3) Install eight sleeves (27) in bosses on retainer (28).
- (4) Install eight inner springs (26) and eight outer springs (25) over sleeves (27) and bosses on retainer (28).
- (5) Install two 8" long capscrews in inner hub (24) 180° apart.
- (6) Use two long capscrews as handles to lift inner hub (24) and position it over springs and retainer (28). Align threaded bores in hub (24) with sleeves (27) inside springs. Remove two capscrews.



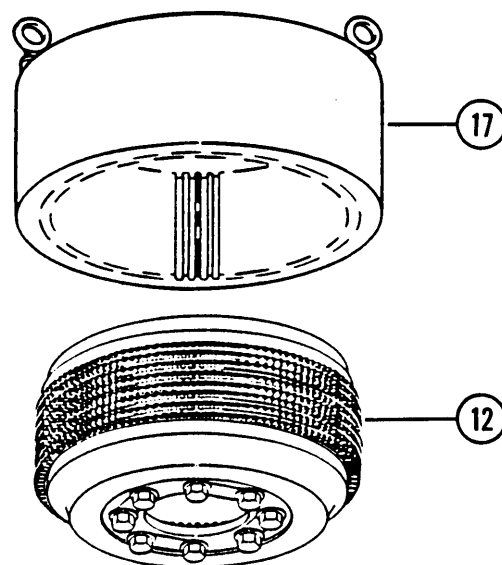
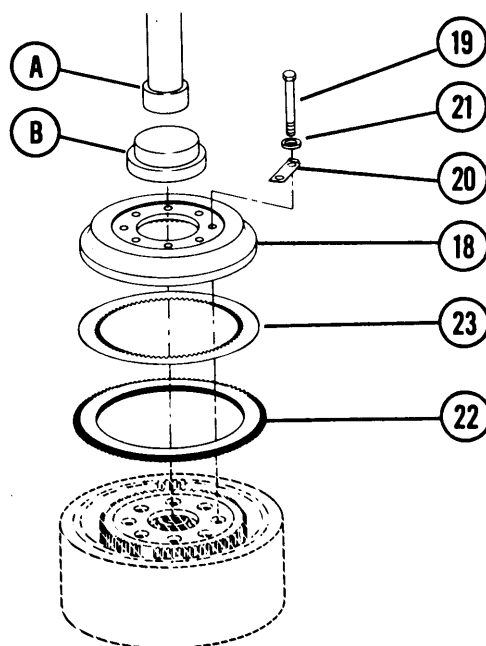
## NOTE

For better wear distribution, install discs and disc assemblies in reverse order of disassembly. For example, top is now installed on bottom.



10-8. STEERING CLUTCH - REPLACE/REPAIR (Cont'd)

- (7) Install eight disc assemblies (22) and seven discs (23) in alternating sequence, starting with a disc assembly (22) and finishing with a disc assembly. Center disc assemblies in outer drum (17).
- (8) Install pressure plate (18) on top of stack and align threaded bores with sleeves (27).
- (9) Position round block (B) on pressure plate (18) inside circle of threaded bores and apply only enough pressure with press (A) to get capscrews started.
- (10) Apply anti-seize compound on threads of eight capscrews (19).
- (11) Install eight capscrews (19), eight washers (21) and four locks (20) to secure pressure plate (18) to retainer (28). Tighten capscrews to a torque of 150±20 lb. ft.
- (12) Use a hammer and punch to form four locks (20) on eight capscrews (19).
- (13) Release pressure on clutch assembly (12) and remove block (B).
- (14) Use lifting equipment to lift clutch (12) and outer drum (17) off press and position assembly on bench.
- (15) Use lifting equipment to reposition assembly with threaded bores in outer drum (17) facing up. Install two (5/8-11NC) eyebolts in outer drum (17) 180° apart.
- (16) Use lifting equipment to remove outer drum (17) from clutch assembly (12) and set drum aside. Leave eyebolts in place.

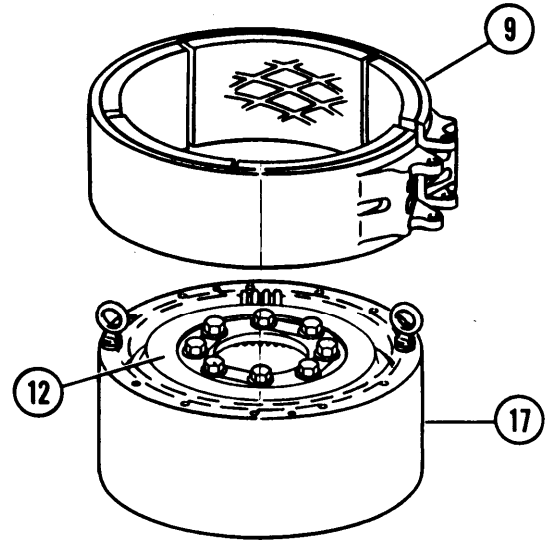


10-8. STEERING CLUTCH - REPLACE/REPAIR (Cont'd)

(17) Use lifting equipment to turn clutch assembly (12) over on bench (capscrew side up). Clutch weighs 175 lbs.

(18) Use lifting equipment to install outer drum (17) on clutch assembly (12). Remove eyebolts. Outer drum weighs 110 lbs.

(19) Install brake band (9) on outer drum (17).



d. Installation

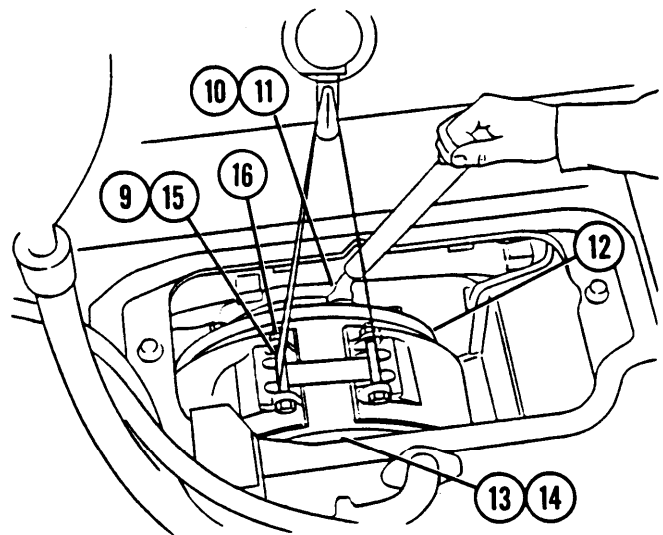
(1) Install two 3/8-16X4" lg. capscrews (15) through brake band (9) clamps and secure capscrews with two 3/8-16 hex nuts (16).

(2) Attach lifting equipment to capscrews (15), and lift steering clutch (12) into clutch case between hub and flange.

(3) Put anti-seize compound on threads of all capscrews (10 and 13).

(4) Use a wrench to install one capscrew (10) and one washer (11) on hub side of clutch (12). Tighten capscrew to 200±20 lb. ft.

(5) Use a wrench to install one capscrew (13) and one washer (14) on flange side of clutch (12). Tighten capscrew to 200±20 lb. ft.



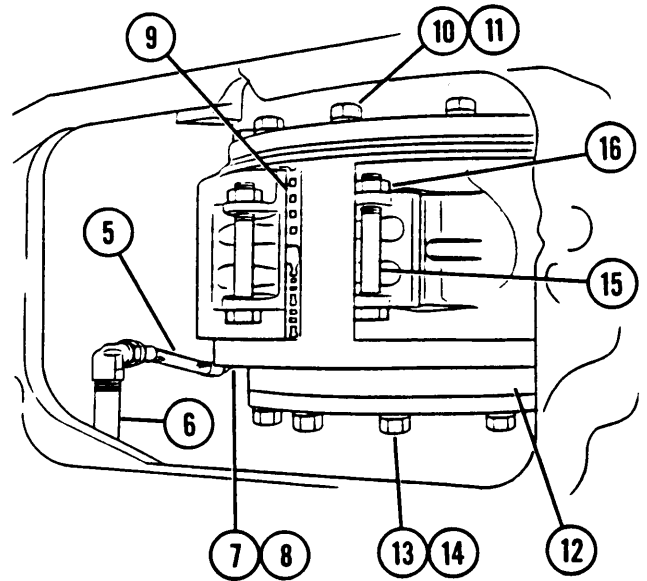
NOTE

Tractor must be moved, using jack, to position clutch for installation of remaining capscrews and washers.

(6) Remove lifting equipment, two nuts (16) and two capscrews (15).

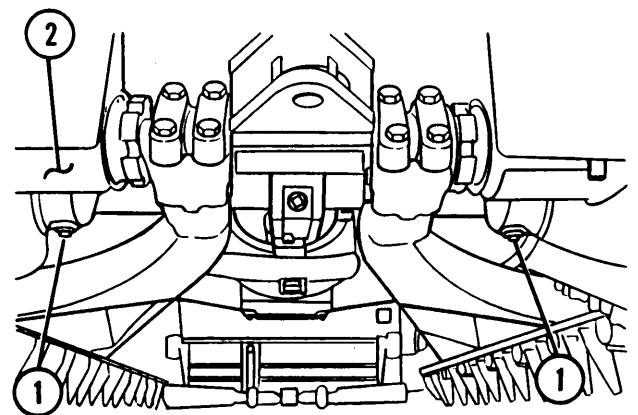
10-8. STEERING CLUTCH - REPLACE/REPAIR (Cont'd)

- (7) Use a socket wrench with extension to install eight capscrews (10) and eight washers (11) on flange side of clutch (12) through plug (3) opening in clutch case.
- (8) Use a wrench to install eleven capscrews (13) and eleven washers (14) on hub side of clutch (12).
- (9) Use a wrench to install one end of hose assembly (5) on brake band (9) with two washers (8) and two nuts (7).
- (10) Use a wrench to install other end of hose (5) on oil line in clutch case.



Use a square wrench to install drain plug (1) in bottom of steering clutch case (2).

- (12) Install brake actuating mechanism. See page 10-4.

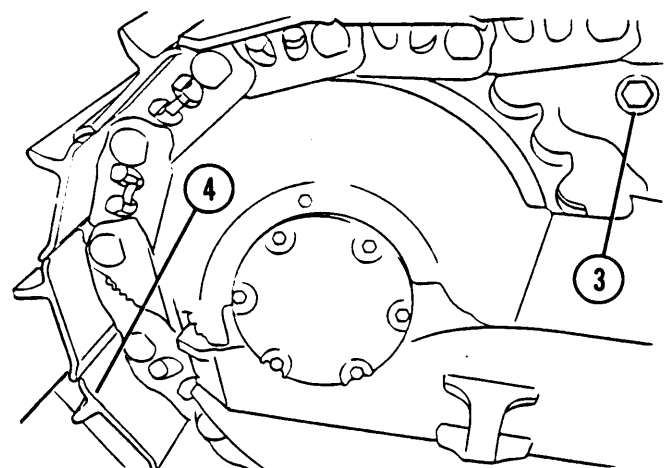


REAR OF TRACTOR

- (13) Fill steering clutch case with oil per L05-2410-237-20.
- (14) Adjust brakes. See TM5-2410-237-20.

e. Place In Service

Test drive and check steering for proper operation.



10-9. STEERING CLUTCH LEVERS AND LINKAGE - REPLACE/REPAIR

This task covers:

- a. Removal
- b. Disassembly
- c. Assembly
- d. Installation
- e. Place In Service

INITIAL SETUP

Applicable Configurations

All

Materials/Parts

Cotter pin (6), (15), (20), (30), (40)

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Equipment Condition

Floor plates removed. See TM5-2410-237-20.

a. Removal

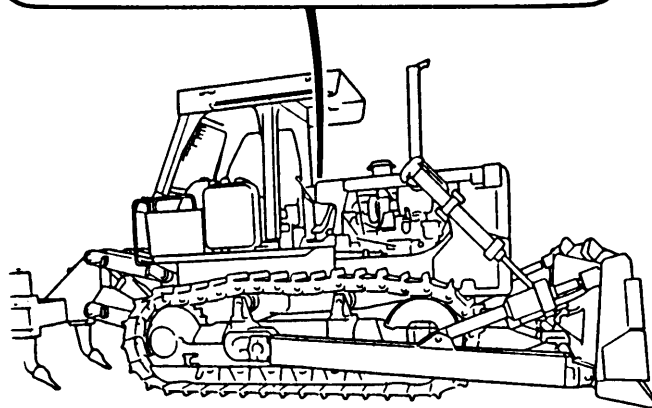
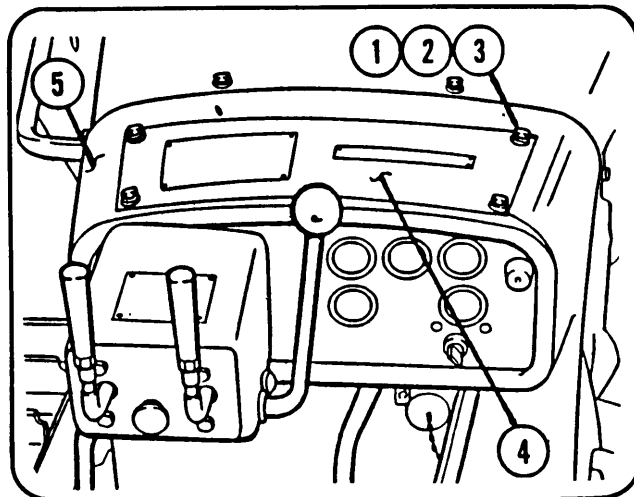
WARNING

Turn battery disconnect switch to OFF before working inside dash assembly. Failure to follow this precaution could result in personal injury.

NOTE

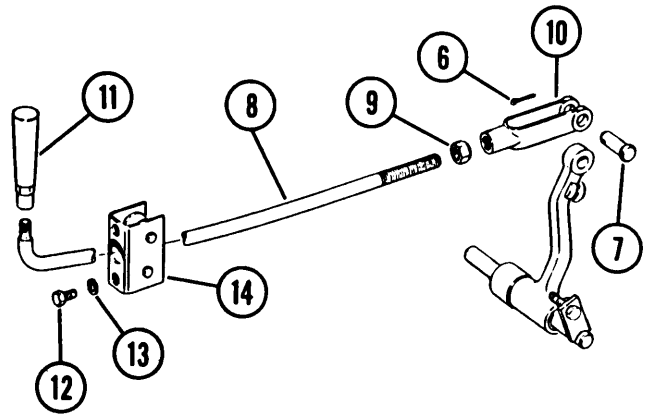
This procedure to be used for either R.H. or L.H. steering clutch control.

- (1) Remove four capscrews (1), four lockwashers (2), four flat washers (3) and cover (4) from top of dash assembly (5).

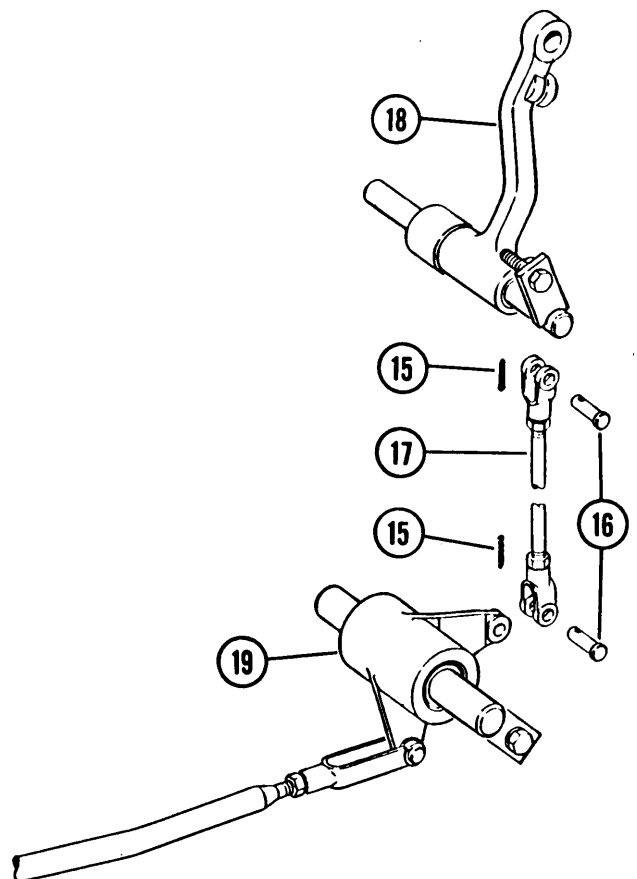


10-9. STEERING CLUTCH LEVERS AND LINKAGE - REPLACE/REPAIR (Cont' d)

- (2) Use a pliers to remove cotter pin (6) and pin (7) from end of rod assembly (8) inside dash assembly. Discard cotter pin (6).
- (3) Use a wrench and pry bar to loosen nut (9), remove rod end (10) and nut (9) from end of rod assembly (8).
- (4) Remove handle (11) from rod (8) and remove rod from dash assembly.
- (5) Use a wrench to remove two capscrews (12), two lockwashers (13) and bracket assembly (14) from dash assembly.



- (6) Use a pliers to remove cotter pin (15) and pin (16) from top end of rod (17) at lever (18). Discard cotter pin (15).
- (7) Repeat STEP 7 for bottom end of rod (17) at bellcrank (19).

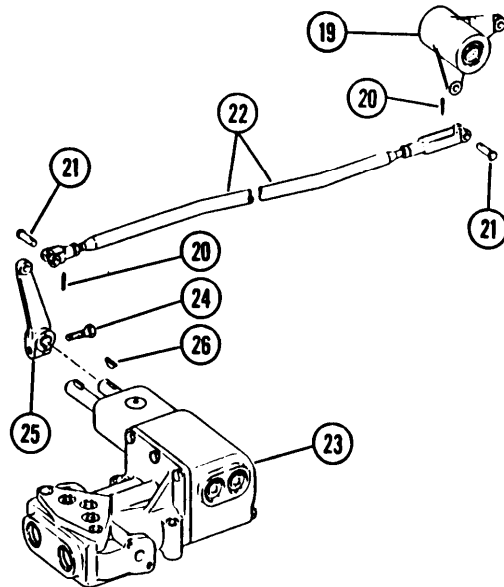


10-9. STEERING CLUTCH LEVERS AND LINKAGE - REPLACE/REPAIR (Cont'd)

(8) Use a pliers to remove cotter pin (20) and pin (21) from end of rod (22) at bellcrank (19). Discard cotter pin (20).

(9) Repeat STEP 8 for other end of rod (22) at control valve (23) and remove rod.

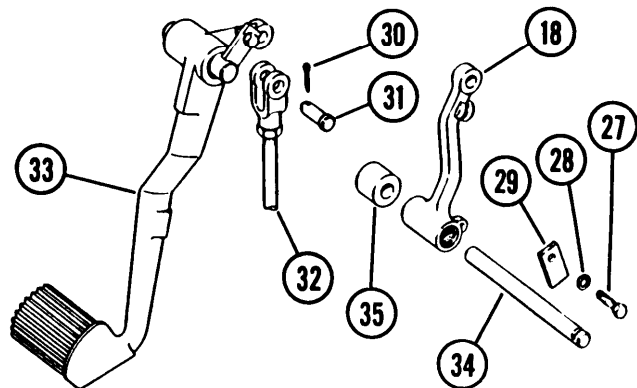
(10) Use a wrench to remove capscrew (24), lever (25) and key (26) from control valve (23).



(11) Use a wrench to remove capscrew (27), lockwasher (28), and lock (29) from lever mounting bracket.

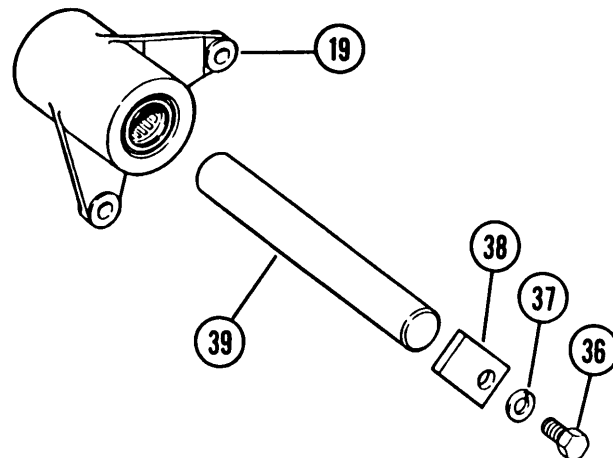
(12) Use a pliers to remove cotter pin (30), pin (31) and end of rod (32) from brake foot pedal (33). Discard cotter pin (30).

(13) Raise brake foot pedal (33) as high as possible and remove shaft (34), spacer (35) and lever (18) from dash assembly.



(14) Use a wrench to remove capscrew (36), lockwasher (37) and lock (38) from bellcrank shaft support bracket.

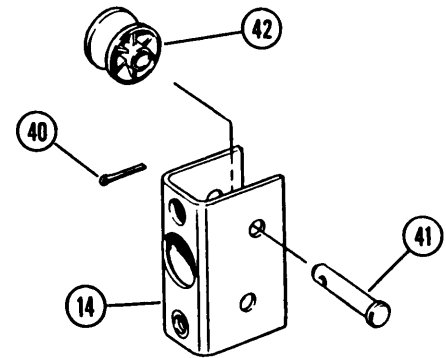
(15) Pull shaft (39) out far enough to remove clutch linkage bellcrank (19) and reinsert shaft (39) into support bracket to secure brake linkage bellcrank.



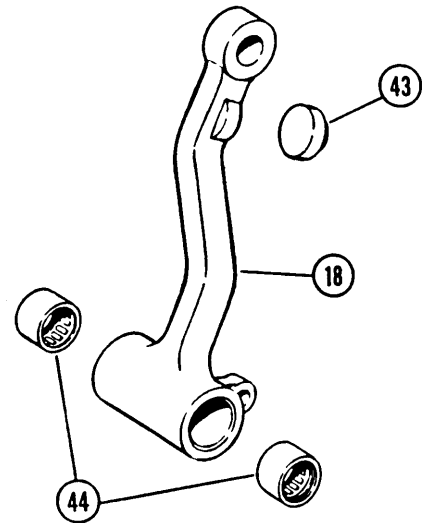
10-9. STEERING CLUTCH LEVERS AND LINKAGE - REPLACE/REPAIR (Cont'd)

b. Disassembly

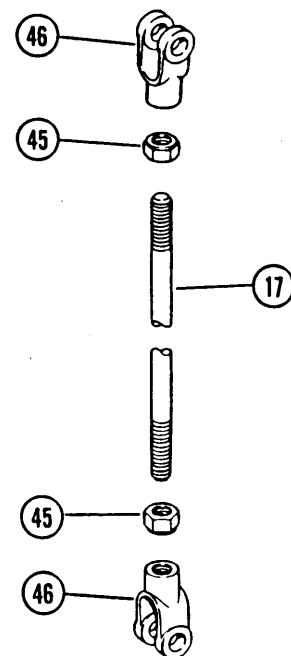
- (1) With pliers, remove cotter pin (40), pin (41) and roller (42) from bracket (14). Discard cotter pin (40).
- (2) Repeat STEP 1 for other roller in bracket.



- (3) Remove bumper (43) and two bearings (44) from lever (18).

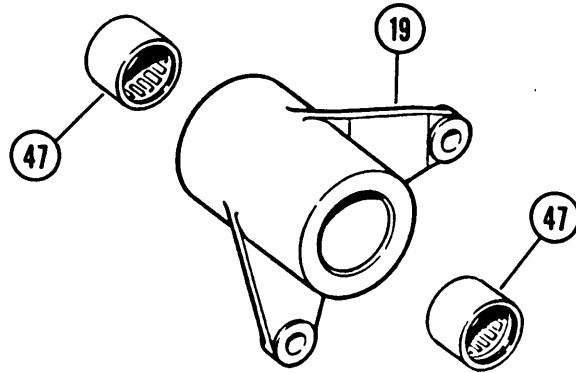


- (4) Loosen two nuts (45) on rod (17). Remove two rod ends (46) and two nuts (45).

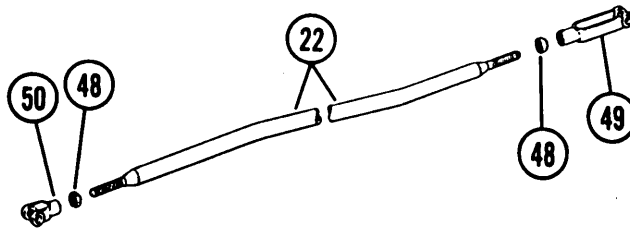


10-9. STEERING CLUTCH LEVERS AND LINKAGE - REPLACE/REPAIR (Cont'd)

- (5) Remove two bearings (47) from bellcrank (19).

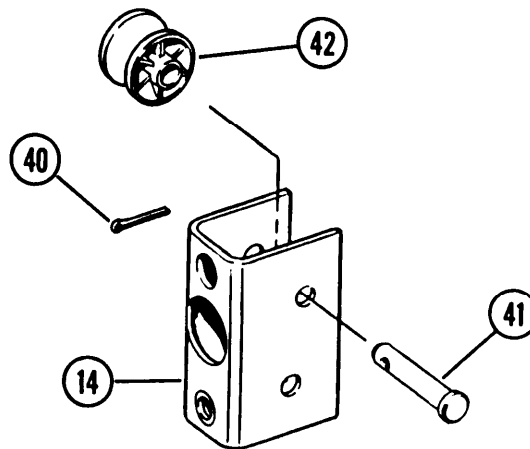


- (6) Loosen two nuts (48) on rod (22). Remove rod ends (49 and 50) and two nuts (48).



c. Assembly

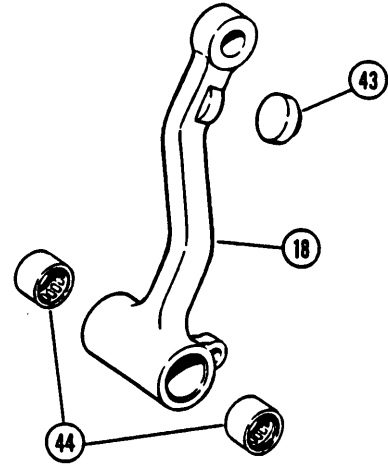
- (1) Install roller (42) and pin (41) in bracket (14) and with pliers, install new cotter pin (40) in pin (41).
- (2) Repeat STEP 1 for other roller in bracket.



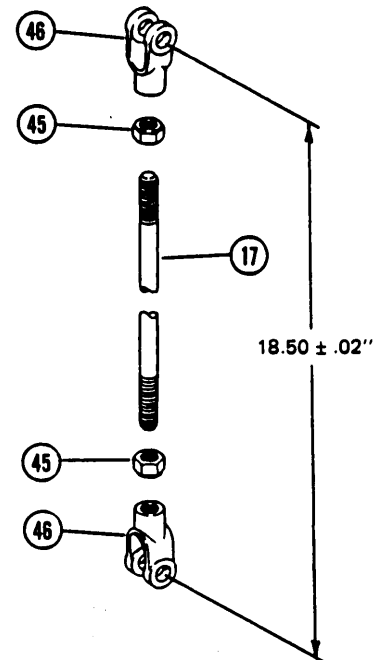


## 10-9. STEERING CLUTCH LEVERS AND LINKAGE - REPLACE/REPAIR (Cont'd)

- (3) Install two bearings (44) and bumper (43) in lever (18).

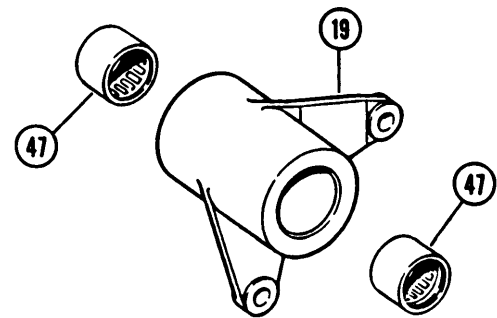


- (4) Install two nuts (45) and two rod ends (46) on rod (17). Adjust rod ends (46) to a dimension of  $18.50 \pm 0.02$  in. between center lines of holes in rod ends.



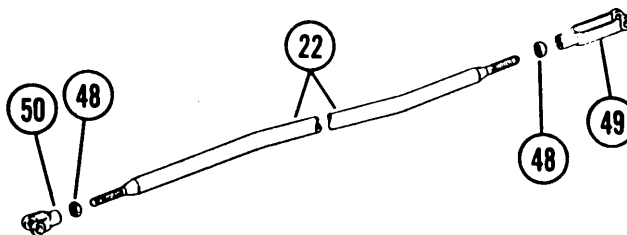
- (5) Tighten two nuts (45) against rod ends (46) to a torque of  $9 \pm 3$  lb. ft.

- (6) Install two bearings (47) in bellcrank (19).



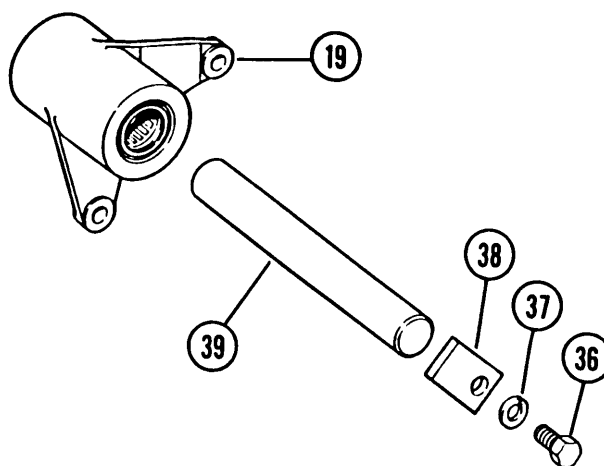
10-9. STEERING CLUTCH LEVERS AND LINKAGE - REPLACE/REPAIR (Cont' d)

- (7) Install two nuts (48) and rod ends (49 and 50) on rod (22). Do not tighten nuts at this time.

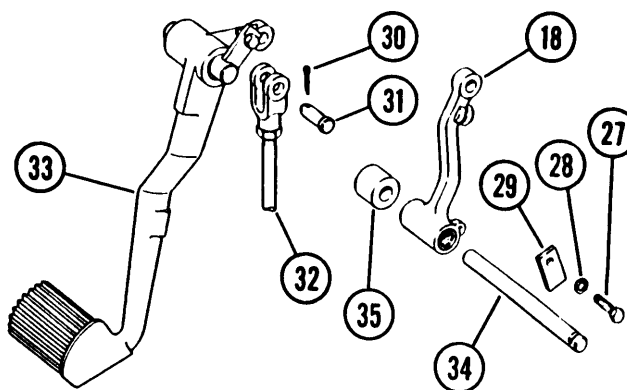


d. Installation

- (1) Pull shaft (39) out far enough to install clutch linkage bellcrank (19) on shaft (39) and reinsert shaft into support bracket.
- (2) Use a wrench to install lock (38) with capscrew (36) and lockwasher (37) to secure shaft (39).



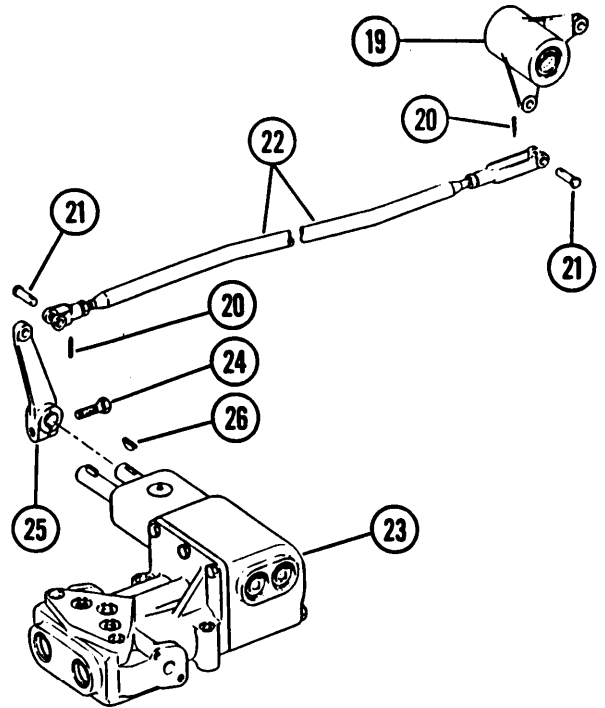
- (3) Raise brake foot pedal (33) as high as possible. Position lever (18) and spacer (35) between mounting bracket and other clutch linkage lever.
- (4) Insert shaft (34) through mounting bracket, lever (18), spacer (35) and other lever and mounting bracket.
- (5) Use a wrench to install lock (29) with capscrew (27) and lockwasher (28) to secure shaft (34).



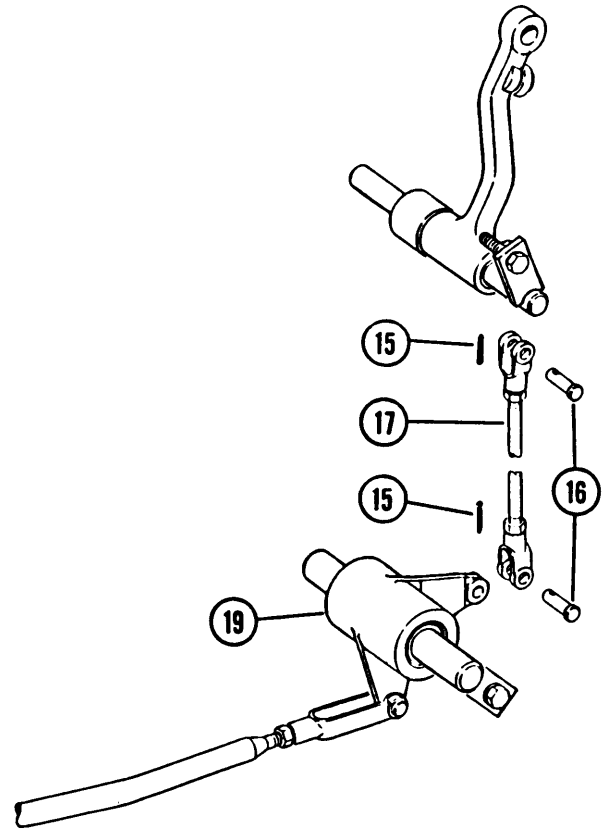
- (6) Install end of rod (32) on foot pedal (33) with pin (31) and using pliers, secure pin with new cotter pin (30).

10-9. STEERING CLUTCH LEVERS AND LINKAGE - REPLACE/REPAIR (Cont' d)

- (7) Use a wrench to install Lever (25) on control valve (23) with key (26) and capscrew (24).
- (8) Install one end of rod (22) on control valve (23) with pin (21) and using pliers, secure pin with new cotter pin (20).
- (9) Repeat STEP 7 for other end of rod (22) at bellcrank (19).

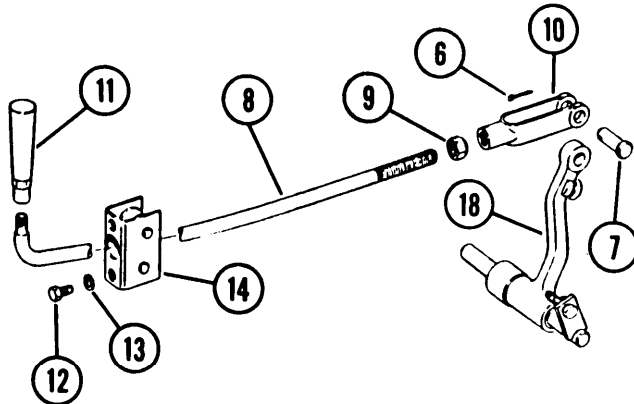


- (10) Install one end of rod (17) on bellcrank (19) with pin (16) and using pliers secure pin with new cotter pin (15).
- (11) Repeat STEP 9 for other end of rod (17) at Lever (18).

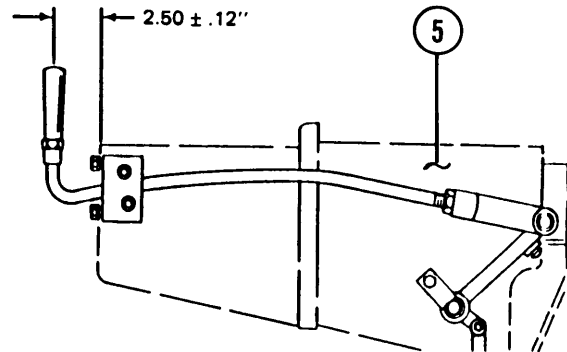


10-9. STEERING CLUTCH LEVERS AND LINKAGE - REPLACE/REPAIR (Cont'd)

- (12) Use a wrench to install bracket assembly (14) in dash assembly with two capscrews (12) and two lockwashers (13).
- (13) Insert rod (8) through rollers in bracket assembly (14) and install handle (11) on rod (8).
- (14) Install nut (9) and rod end (10) on rod (8) loosely and connect end of rod to lever (18) with pin (7).



- (15) Check dimension between front face of dash assembly (5) and center line of handle (11) on rod (8). Adjust rod end (10) until this dimension is  $2.50 \pm 0.12$  in.

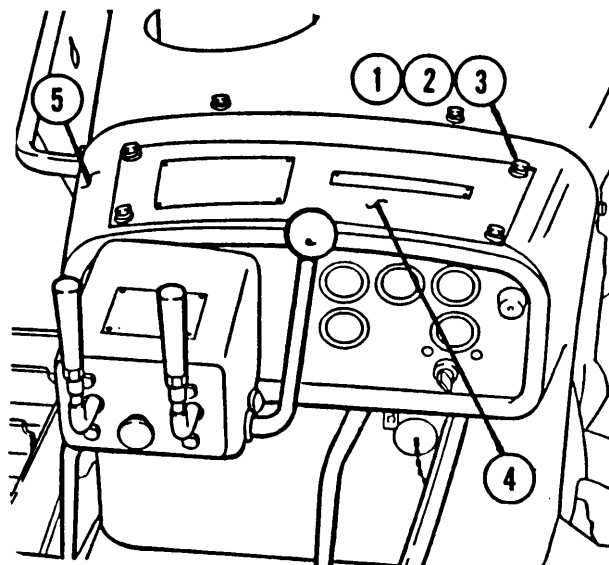


- (16) Install end of rod (8) on lever (18) with pin (7) and using pliers, secure pin with new cotter pin (6).
- (17) Tighten nut (9) against rod end (10) to a torque of  $75 \pm 10$  lb. ft. Use pry bar in rod end-if necessary.

- (18) Adjust linkages. See TM5-2410-237-20.

- (19) Use a wrench to install cover (4) on top of dash assembly (5) with four capscrews (1), four lockwashers (2) and four flat washers (3).

- (20) Install floor plates. See TM5-2410-237-20.



e. Place In Service

Test drive and check steering for proper operation.

10-10. STEERING BRAKE RELIEF VALVE - REPLACE

This task covers:

- a. Removal
- b. Cleaning
- c. Inspection
- d. Installation
- e. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Materials/parts

Lubricating Oil OE/HDO-30 (See L05-2410-237-12)  
Lint-free rags

Equipment Condition

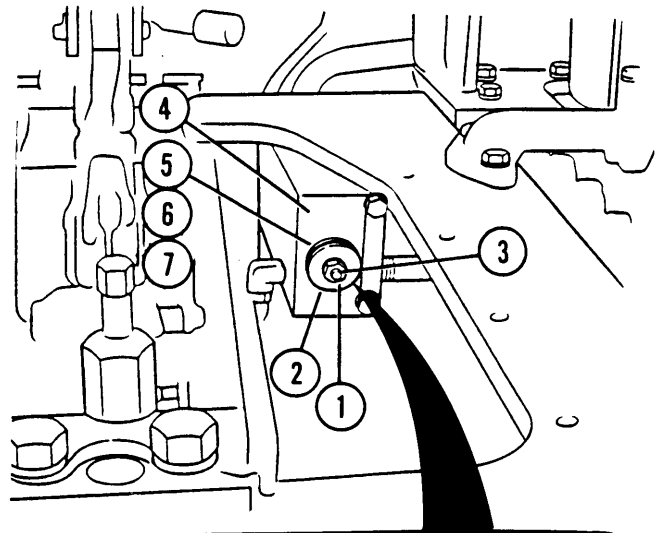
L.H. Brake hydraulic control removed.  
See page 10-12.

a. Removal

NOTE

This valve is located next to brake activating mechanism on left side of machine only.

- (1) Use a wrench to remove nut (1) and washer (2) from pin (3) in block assembly (4).
- (2) Remove spring retainer (5), spring (6) and valve (7) from block assembly (4).

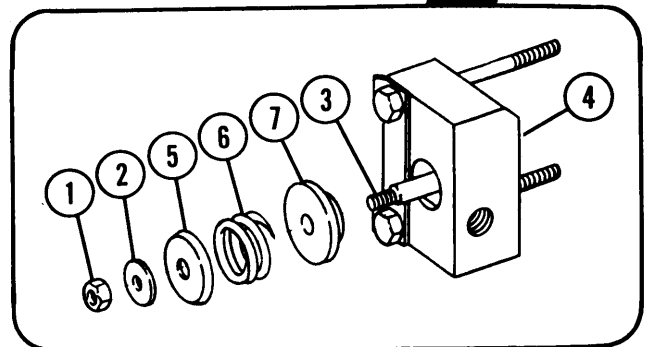


b. Cleaning

Wipe all parts clean and dry.  
Refer to page 2-29.

c. Inspection

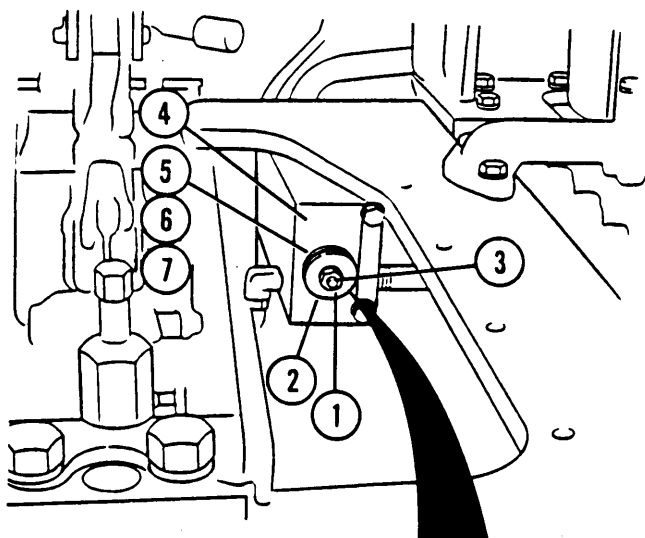
Check parts for wear and replace, if necessary



10-10. STEERING BRAKE RELIEF VALVE - REPLACE (Cont' d)

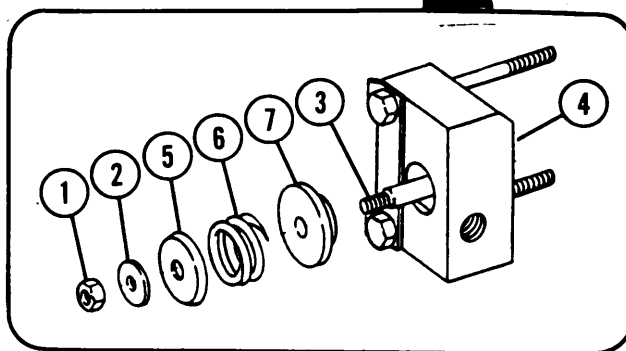
d. Installation

- (1) Apply film of clean lubricating oil on valve (7) and install valve in block assembly (4) over pin (3).
- (2) Install spring (6) and spring retainer (5) on valve (7) over pin (3).
- (3) Install washer (2) and nut (1) on pin (3). Tighten nut (1) using a wrench.
- (4) Install L.H. brake hydraulic control. See page 10-12.



e. Place In Service

Test drive and check steering for proper operation.



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 10-11. STEERING CLUTCH CONTROL VALVE - REPLACE/REPAIR
 

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This task covers:

- a. Removal
  - b. Disassembly
  - c. Cleaning
  - d. Inspection
  - e. Lubrication
  - f. Assembly
  - g. Installation
  - h. Place In Service
- 

INITIAL SETUP
Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose  
 Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894

Materials/Parts

Liquid Gasket (App. B, Item 2)

Gasket (35)

3 Seals (28)

O-ring Seals (12), (24), (25)

2 Seals (14), (65)

Lubricating Oil OE/HDO-30 (Refer  
 to L05-2410-237-12)

2 Seals (53)

3/8" Capscrew, any thread size

Caps and Plugs

Cotter Pin (15), (67)

Equipment Condition

Fuel tank removed. See page 4-23.

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10-11. STEERING CLUTCH CONTROL VALVE - REPLACE/REPAIR (Cont'd)

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a. Removal

WARNING

Hydraulic oil in the system can be under pressures over 2500 psi with the engine and pump OFF. ALWAYS relieve pressure in hydraulic lines before attempting to remove any component in the hydraulic system. With engine OFF and hydraulic attachments on the ground, move control levers through all operating position several times to relieve line pressure. Relieve pressure in hydraulic oil tank, by loosening filler cap very slowly. Failure to follow these precautions could result in serious personal injury.

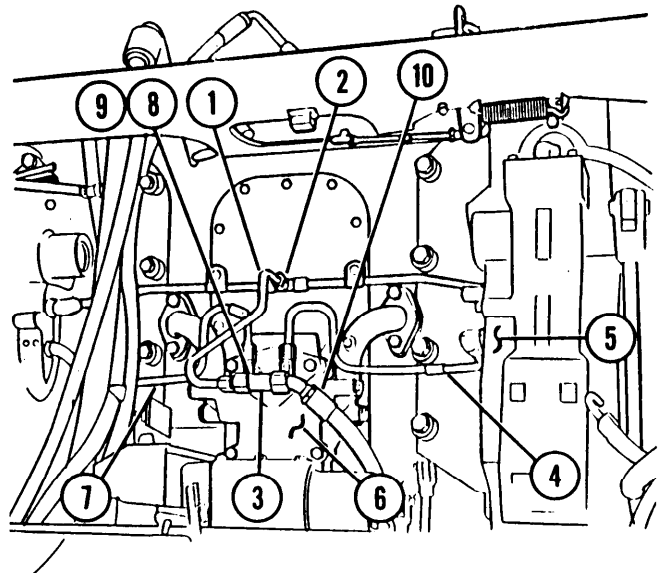
CAUTION

Wipe the area clean around all hydraulic connections to be opened during removal and disassembly. Cap oil lines and plug holes after removing lines. Contamination of the hydraulic system could result in premature failure.

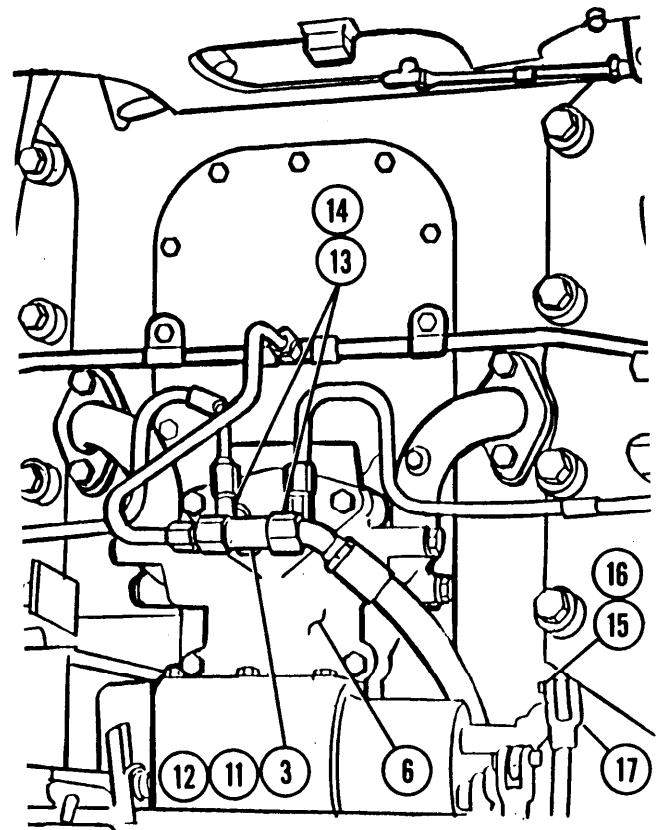


## 10-11. STEERING CLUTCH CONTROL VALVE - REPLACE/REPAIR (Cont' d)

- (1) Use a wrench to disconnect and remove tube assembly (1) from tee (2) to tee (3) at center of tubing assembly.
- (2) Use a wrench to disconnect and remove tube assembly (4) between brake control housing (5) and tee (3) on top of steering clutch control valve (6).
- (3) Repeat STEP 2 for tube assembly (7) from other brake control housing to control valve (6).
- (4) Use two wrenches to remove nut (8) and adapter (9) from one side of tee (3) on control valve (6).
- (5) Use a wrench to remove hose assembly (10) from other side of tee (3).

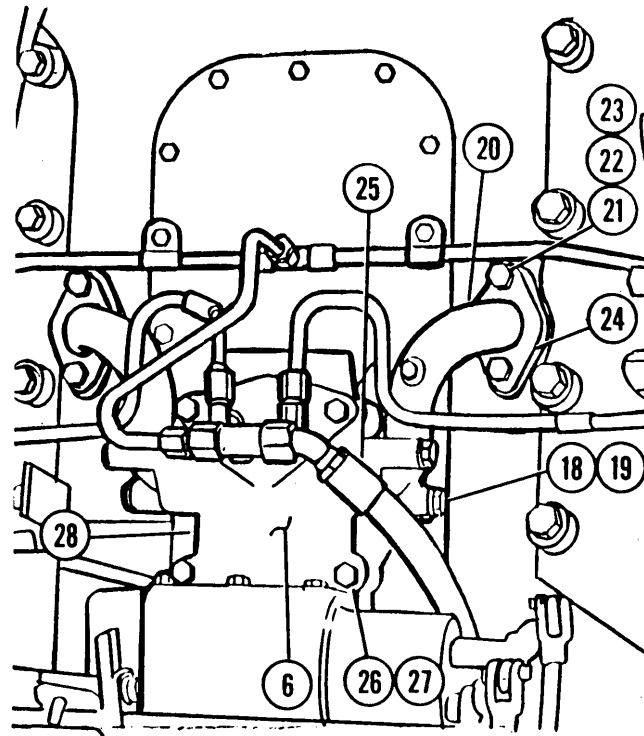


- (6) Use two wrenches to remove tee (3) and adapter (11) from top of control valve (6).
- (7) Remove seal (12) from adapter (11) and discard seal.
- (8) Use a wrench to remove two elbows (13) and two seals (14) from top of control valve (6). Discard seals.
- (9) Use a pliers to remove cotter pin (15), pin (16) and end of clutch control rod (17) from control valve. Discard cotter pin (15).
- (10) Repeat STEP 9 for other control rod.



10-11. STEERING CLUTCH CONTROL VALVE - REPLACE/REPAIR (Cont'd)

- (11) Use a wrench to remove two capscrews (18) and two lockwashers (19) from elbow (20) mounting on side of control valve (6).
- (12) Use a wrench to remove two capscrews (21), two lockwashers (22) and flat washer (23) at other end of elbow assembly (20) and remove elbow assembly.
- (13) Remove seal (24) from one end of elbow (20) and seal (25) from other end. Discard seals.
- (14) Repeat STEPS 1, 2 and 3 for elbow on other side of control valve (6).
- (15) Use a wrench to remove four capscrews (26), four lockwashers (27) and control valve (6) from top of gear case.
- (16) Remove three seals (28) from gear case. Discard seals.



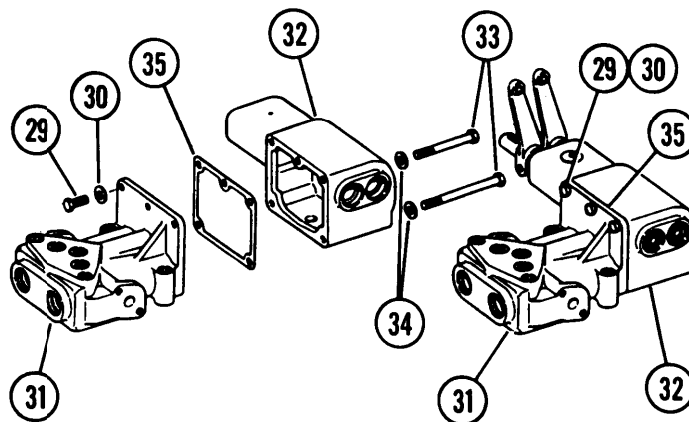
b. Disassembly

- (1) Use a wrench to remove three capscrews (29) and three washers (30) from spool housing (31) and lever housing (32).

**WARNING**

Spool and lever housings are spring loaded. Separate housings carefully to prevent personal injury or parts damage.

- (2) Use a wrench to remove two capscrews (33) and two washers (34) from other side of lever housing (32) and separate spool housing (32).
- (3) Remove gasket (35) at separation of housings. Discard gasket (35)



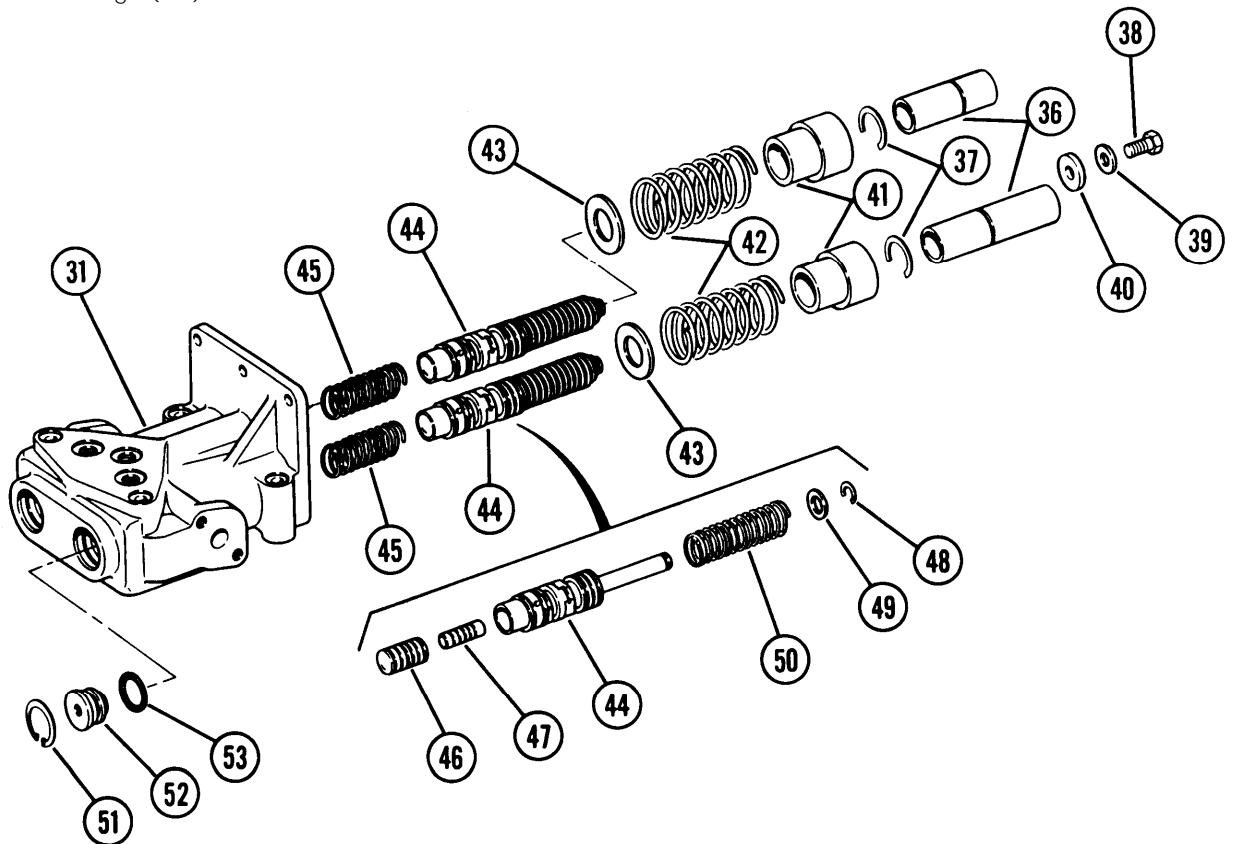
10-11. STEERING CLUTCH CONTROL VALVE - REPLACE/REPAIR (Cont'd)

Remove two plungers (36) with retaining rings (37) from spool housing (31). If necessary, remove retaining rings (37) from plungers (36).

**WARNING**

Capscrew (38) and washers (39 and 40) are under spring pressure. Remove carefully to prevent personal injury or parts damage.

- (5) Use a wrench to remove capscrew (38), lockwasher (39) and washer (40) from spool housing (31).
- (6) Remove bushing (41), outer spring (42), washer (43), spool (44) and spring (45) from spool housing (31).
- (7) Remove slug (46) and piston (47) from end of valve spool (44).
- (8) Remove retaining ring (48), washer (49) and spring (50) on other end of spool (44).
- (9) Repeat STEPS 6, 7 and 8 for other spool assembly.
- (10) Use a snap ring pliers to remove two retaining rings (57) and use a 3/8" coarse thread capscrew to remove two plugs (52) from end of spool housing (31).
- (11) Remove two seals (53) from two plugs (52). Discard seals.



10-11. STEERING CLUTCH CONTROL VALVE - REPLACE/REPAIR (Cont'd)

(12) Use a wrench to remove capscrew (54), lever (55) and use a pliers to remove key (56) from one shaft (57) in lever housing (32).

(13) Repeat STEP 12 on other shaft.

(14) Use a wrench to loosen two capscrews (58) in two levers (59) inside lever housing (32).

(15) Tap end of shaft (57) with soft hammer to remove bearing (60) and spacers (61) from housing (32) at opposite end of shaft (57).

(16) Use a hammer and a pliers to remove retaining ring (62) from shaft (57).

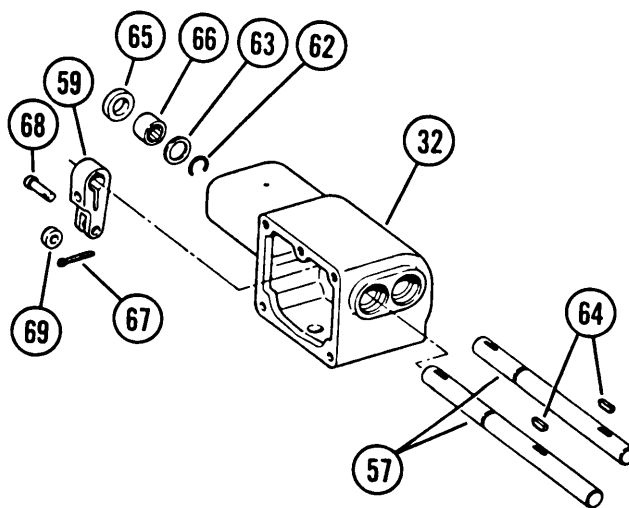
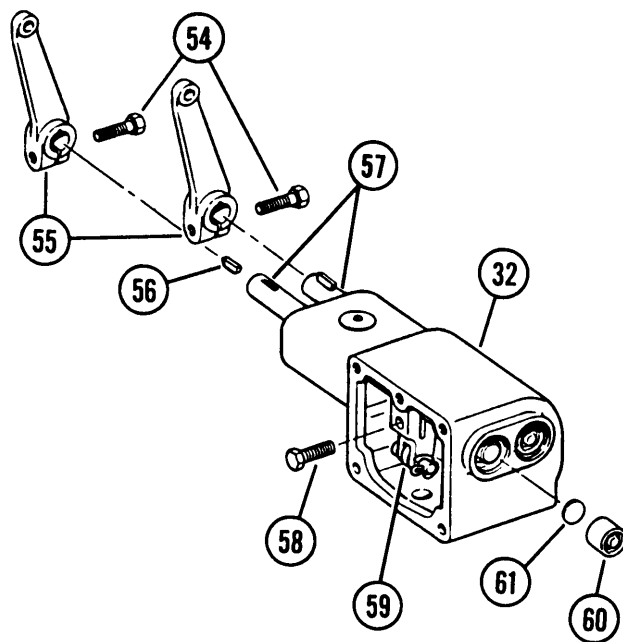
(17) Remove shaft (57), washer (63), key (64) and lever assembly (59) from housing (32).

(18) Repeat STEPS 15, 16 and 17 for other shaft.

(19) Use a seal puller and a hammer to remove two seals (65) and use a drive plate and handle to remove two bearings (66) from two shaft holes in housing (32). Discard seals (65).

(20) Use a pliers to remove cotter pin (67), pin (68) and roller (69) from one lever (59). Discard cotter pin (67).

(21) Repeat STEP 20 for other lever.



c. Cleaning

Wipe all parts clean and dry.  
Refer to page 2-29.

d. Inspection

Inspect all parts for wear or damage and replace, if needed.

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 10-11. STEERING CLUTCH CONTROL VALVE - REPLACE/REPAIR (Cont'd)
 

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e. Lubrication

Apply a light coat of clean hydraulic oil on all parts before assembly.

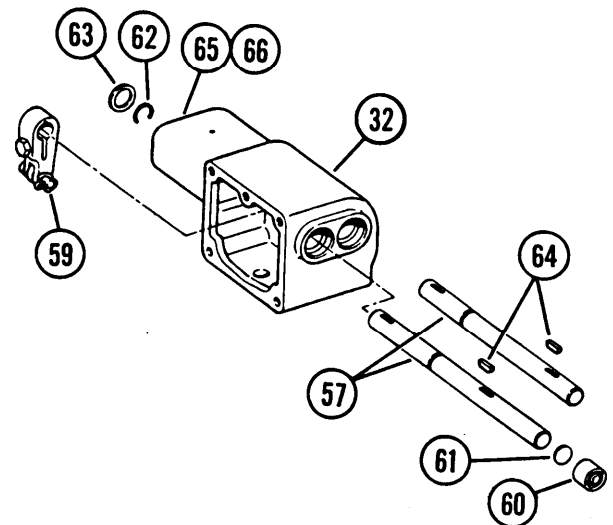
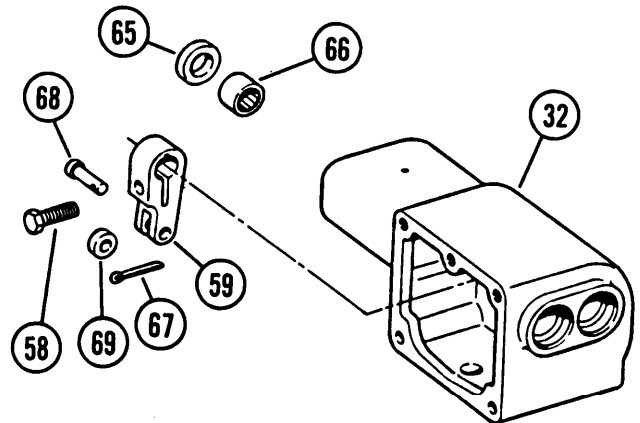
f. Assembly

- (1) Install two bearings (66) in shaft holes in lever housing (32).

## NOTE

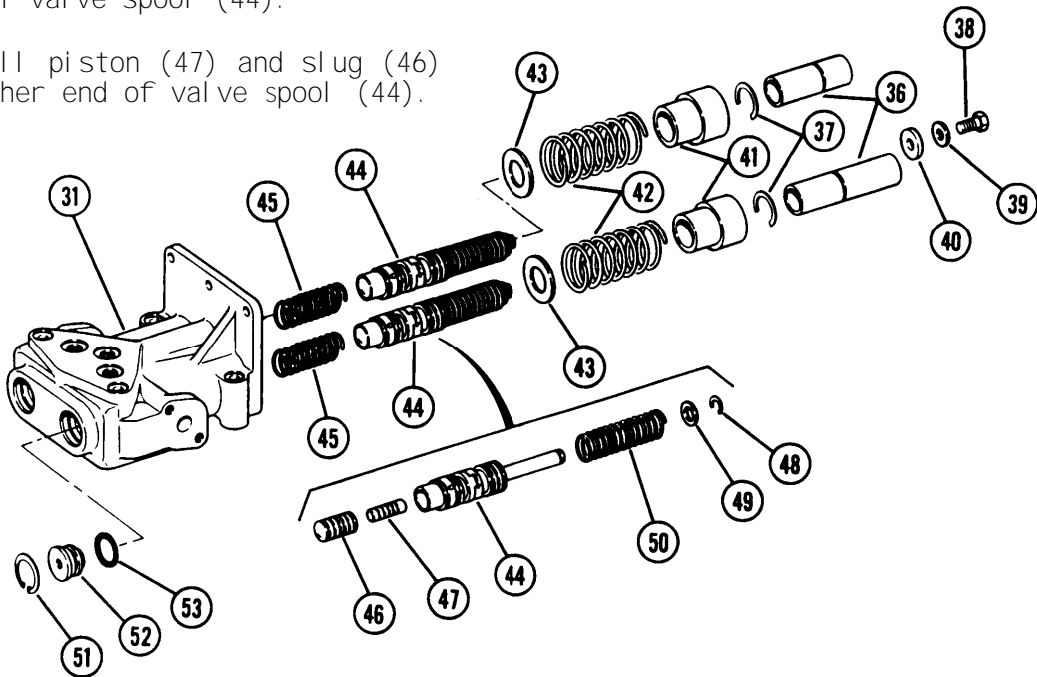
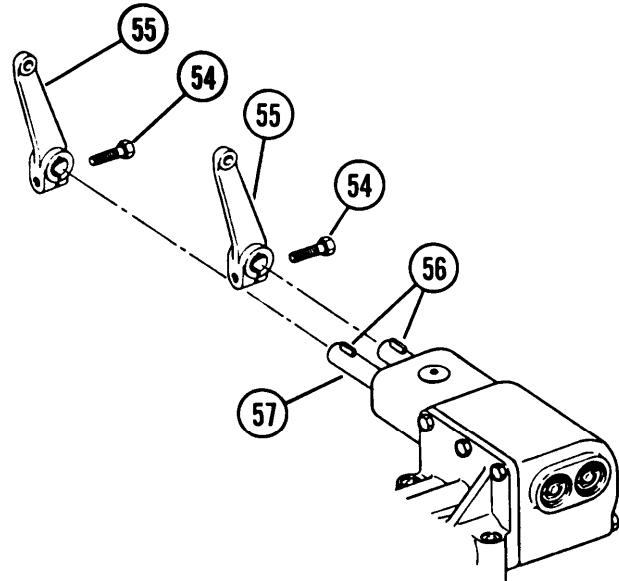
Before installing seals (65) apply liquid gasket material to seal seat in lever housing and let it dry.

- (2) Install two seals (65) in shaft holes in lever housing (32).
- (3) Install roller (69) in lever (59) with pin (68) and new cotter pin (67). Bend cotter pin (67) using pliers.
- (4) Install capscrew (58) in lever (59), but do not tighten.
- (5) Repeat STEPS 3 and 4 for other lever.
- (6) Insert shaft (57) through end of lever housing (32) and install lever (59), washer (63), key (64) and retaining ring (62) on shaft. Push shaft (57) through bearing (66) and seal (65) in other end of housing.
- (7) Install spacer (61) and bearing (60) in lever housing (32) at other end of shaft (57).
- (8) Align slot in lever (59) with key (64) in shaft (57). Slide lever (59) over key (64) and center lever with plunger hole in side of lever housing (32). Tighten capscrew (58) in lever using a wrench.



10-11. STEERING CLUTCH CONTROL VALVE - REPLACE/REPAIR (Cont' d)

- (9) Install capscrew (54) in lever (55), but do not tighten.
- (10) Use a pliers to install key (56) in key slot in end of shaft (57).
- (11) Install lever (55) on shaft (57) over key (56) and use a wrench to tighten capscrew (54).
- (12) Repeat STEPS 6 through 11 for other shaft.
- (13) Apply light film of oil on seal (53) and install seal on plug (52).
- (14) Use a 3/8" capscrew as a handle to install plug (52) in end of spool housing (31).
- (15) Use a snap ring pliers to install retaining ring (51) to secure plug (52).
- (16) Repeat STEPS 13, 14 and 15 for other plug.
- (17) Install spring (50), washer (49) and retaining ring (48) on one end of valve spool (44).
- (18) Install piston (47) and slug (46) in other end of valve spool (44).

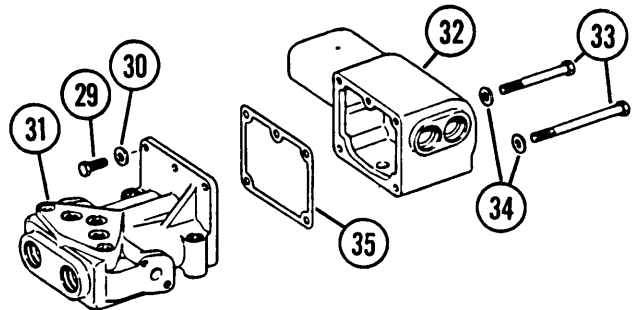


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 10-11. STEERING CLUTCH CONTROL VALVE - REPLACE/REPAIR (Cont' d)
 

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- (19) Apply light film of oil on spool (44) and install spool and spring (45) in spool housing (31).
- (20) Install washer (43), spring (42) and bushing (41) over spool (44).
- (21) Repeat STEPS 17 through 20 for other spool.
- (22) Apply pressure on two bushings (41) and install washer (40), lockwasher (39) and capscrew (38) in housing (31) to secure both spool assemblies. Tighten capscrew using a wrench.
- (23) Install two retaining rings (37) on two plungers (36) and insert plungers in housing (31) over ends of spools.
- (24) Position gasket (35) on mating surface of spool housing (31) and position spool housing to lever housing (32).
- (25) Install two capscrews (33) and two washers (34) through lever housing (32) into spool housing (31). Tighten capscrews (33) using a wrench.
- (26) Install three capscrews (29) and three washers (30) to secure the two housings. Tighten capscrews (29) using a wrench.



## 10-11. STEERING CLUTCH CONTROL VALVE - REPLACE/REPAIR (Cont'd)

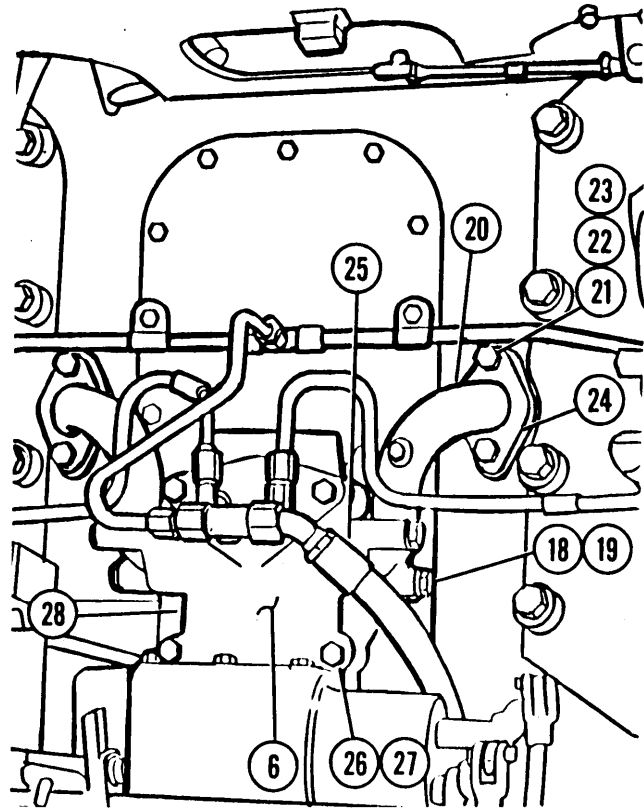
g. InstallationCAUTION

Care should be taken not to contaminate hydraulic system during installation of hydraulic lines. Dirt and foreign substances should be removed from surrounding area before lines are installed.

NOTE

Check valve for worn or damaged parts and replace as necessary. All sealing surfaces should be wiped clean before installation of seals.

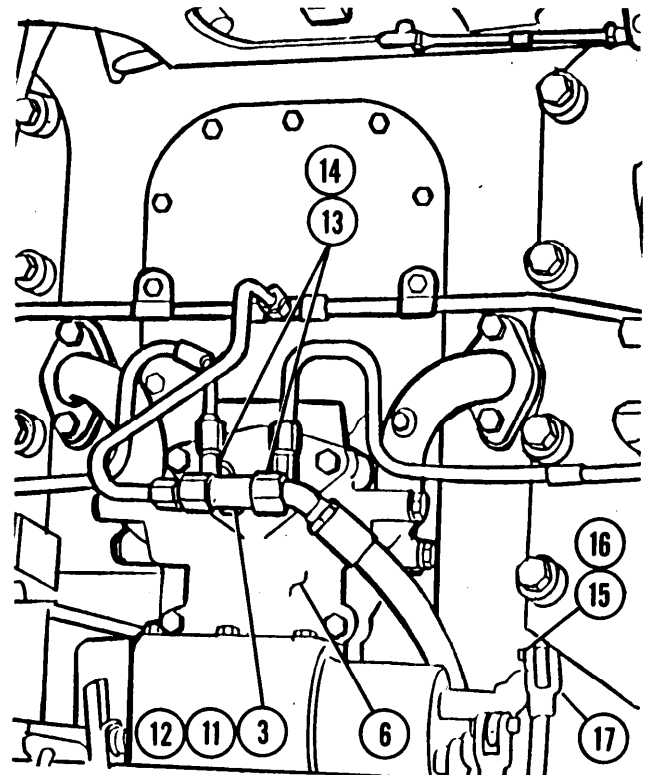
- (1) Apply light film of clean oil on three seals (28) and position seals on bevel gear case.
- (2) Position steering clutch hydraulic control valve (6) on gear case. Make sure seals (28) are properly seated.
- (3) Install four capscrews (26) and four lockwashers (27) to secure control valve (6) on gear case.
- (4) Apply light film of clean oil to seal (24) and seal (25). Install seals in flange at each end of elbow (20).
- (5) Install one end of elbow (20) on control valve (6) with two capscrews (18) and two lockwashers (19).
- (6) Install other end of elbow (20) with two capscrews (21), two lockwashers (22) and washer (23).
- (7) Repeat STEPS 4, 5 and 6 for elbow on other side of control valve.



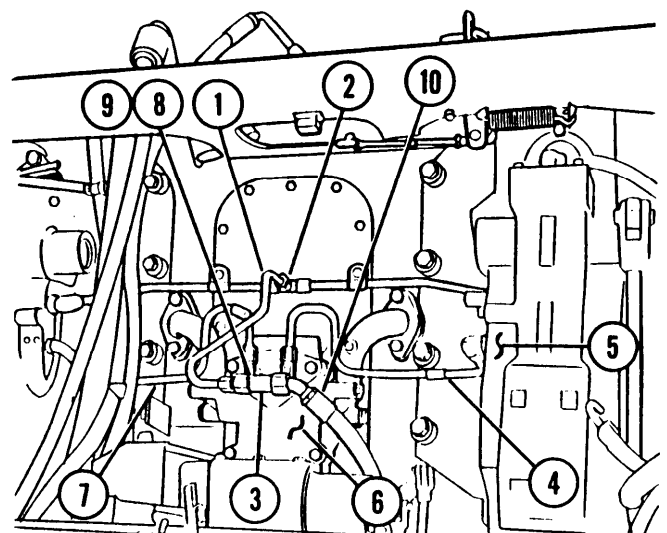


10-11. STEERING CLUTCH CONTROL VALVE - REPLACE/REPAIR (Cont'd)

- (8) Use a pliers to install new cotter pin (15), pin (16) and end of clutch control rod (17) on control valve.
- (9) Repeat STEP 8 for other control rod.
- (10) Apply light film of clean oil on two seals (14) and install seals on elbows (13).
- (11) Use a wrench to install two elbows (13) and two seals (14) on top of control valve (6).
- (12) Apply light film of clean oil on seal (12) and install on adapter (11).
- (13) Use two wrenches to install tee (3) and adapter (11) on top of control valve (6).



- (14) Use two wrenches to install nut (8) and adapter (9) on one side of tee (3) on control valve (6).
- (15) Use a wrench to install hose assembly (10) on other side of tee (3).
- (16) Use a wrench to install tube assembly (4) between brake control housing (5) and tee (3) on top of steering clutch control valve (6).
- (17) Repeat STEP 2 for tube assembly (7) from other brake control housing to control valve (6).
- (18) Use a wrench to connect tube assembly (1) to tee (2) and tee (3) at center of tubing assembly.



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10-11. STEERING CLUTCH CONTROL VALVE - REPLACE/REPAIR (Cont' d)

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(19) Install fuel tank. See TM5-2410-237-20.

h. Place In Service

Test drive and check steering clutch for proper operation.

10-12. STEERING CLUTCH HUBS - REPLACE

This task covers:

- a. Removal
- b. Cleaning
- c. Installation
- d. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Materials/Parts

Ring (4), (9), (10), (12)  
Lubricating Oil OE/HDO-30 (Refer to L05-2410-237-12)  
Two 3" X 3/8"-16NC Forcing Screws (1)  
Lint-free Rags

Equipment Condition

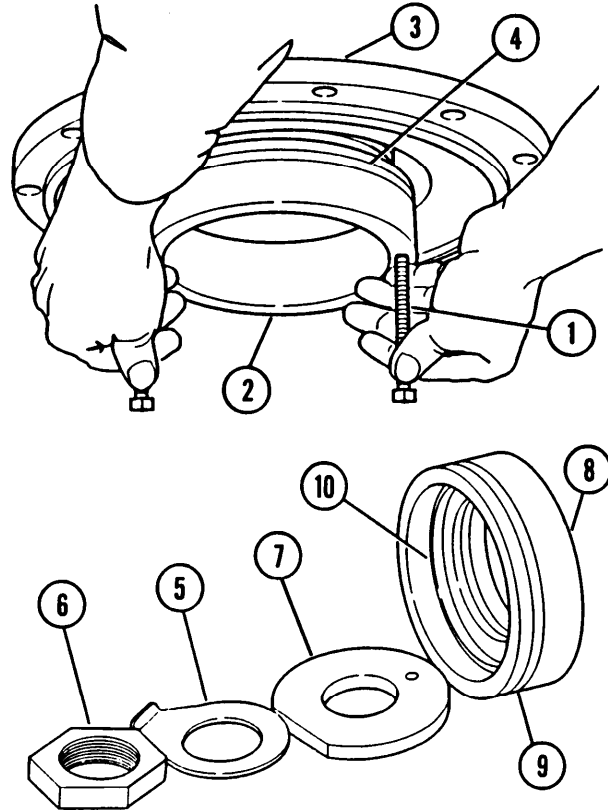
Seat assembly removed. See TM5-2410-237-20.  
Steering clutch removed.  
See page 10-40.

a. Removal

NOTE

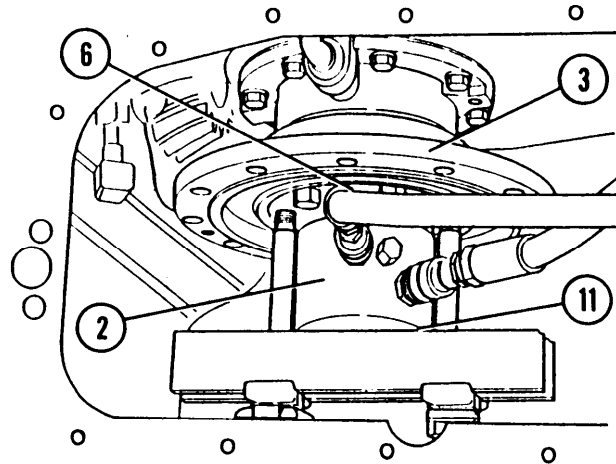
This procedure applies to R.H. and L.H. steering clutch hubs.

- (1) Install two 3/8"-16NC forcing screws (1) in piston (2). Turn screws evenly and remove piston (2) from steering clutch hub (3).
- (2) Remove ring (4) from piston (2). Discard ring.
- (3) Use a hammer and punch to bend lock (5) under nut (6) straight.
- (4) Use a socket to remove nut (6), lock (5) and washer (7) from bevel gear shaft.
- (5) Remove pilot (8) from shaft and remove one ring (9) from outside and one ring (10) from inside of pilot (8). Discard rings.



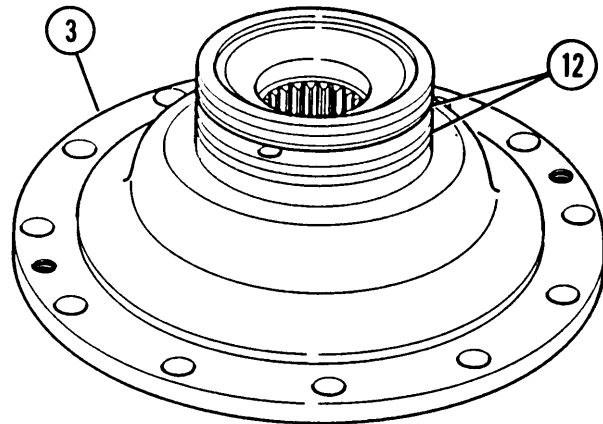
10-12. STEERING CLUTCH HUBS - REPLACE (Cont'd)

- (6) Install nut (6) on shaft with 0.375 in. clearance between nut and hub (3).
- (7) Install puller (11) on hub (3) and break hub loose from shaft.
- (8) Remove nut (6) from shaft and puller (11) from hub (3).
- (9) Remove hub (3) from shaft.
- (10) Remove two rings (12) from hub (3). Discard rings.



b. Cleaning

- (1) Wipe splines on bevel gear shaft and steering clutch hub clean and dry. Refer to page 2-29.
- (2) Wipe ring grooves on hub, piston, and pilot clean and dry. Refer to page 2-29.

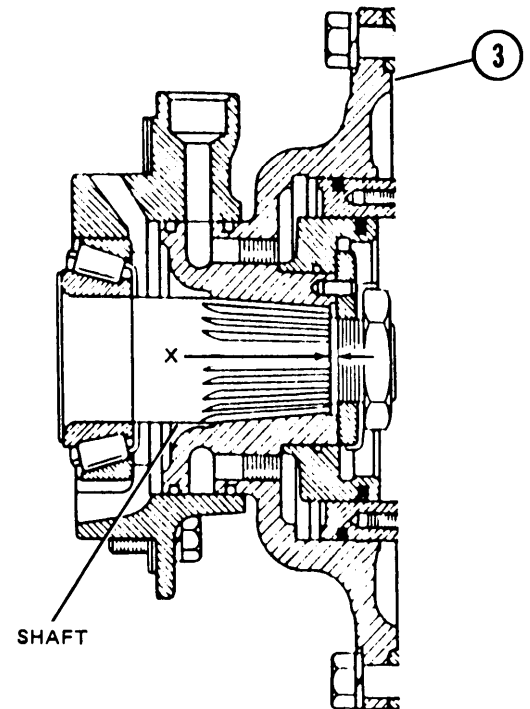


c. Installation

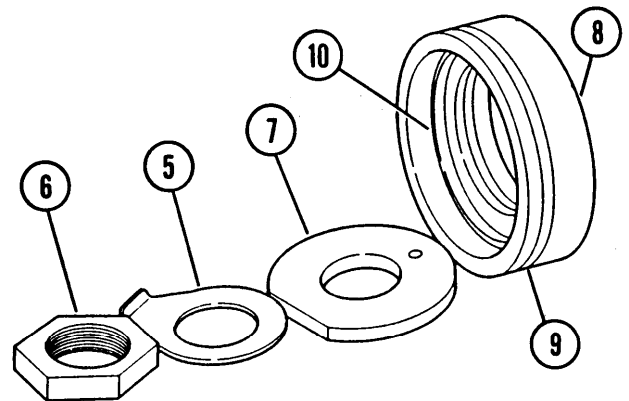
- (1) Apply light film of clean oil on two rings (12) and install rings on hub (3).
- (2) Position hub (3) on shaft, align splines and slide hub on shaft as far as possible.
- (3) Install puller (11) and nut (6) on shaft and apply force of 35 to 40 tons to seat hub (3).
- (4) Remove nut (6) and puller (11).

## 10-12. STEERING CLUTCH HUBS - REPLACE (Cont' d)

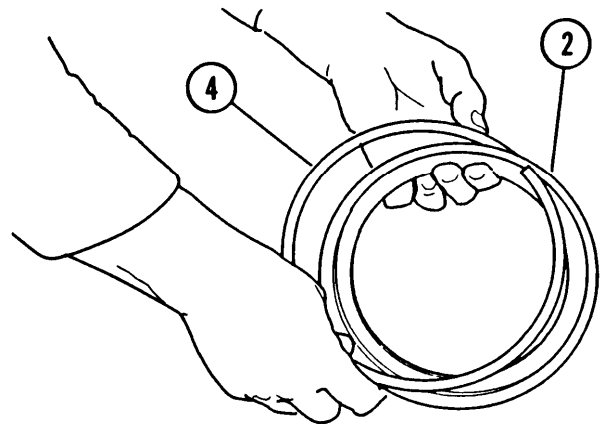
- (5) Measure dimension between face of steering clutch (3) hub and shoulder of bevel gear shaft. See "X". Dimension must be  $0.12 \pm 0.03$  in.



- (6) Apply Light film of clean oil to rings (9 and 10). Install ring (10) inside of pilot and ring (9) on outside of pilot (8).
- (7) Install pilot (8), washer (7), lock (5) and nut (6) on bevel gear shaft.
- (8) Tighten nut (6) to a torque of  $700 \pm 100$  lb. ft. Bend lock (5) using hammer and chisel.



- (9) Apply light film of clean oil to ring (4) and install ring on piston (2).

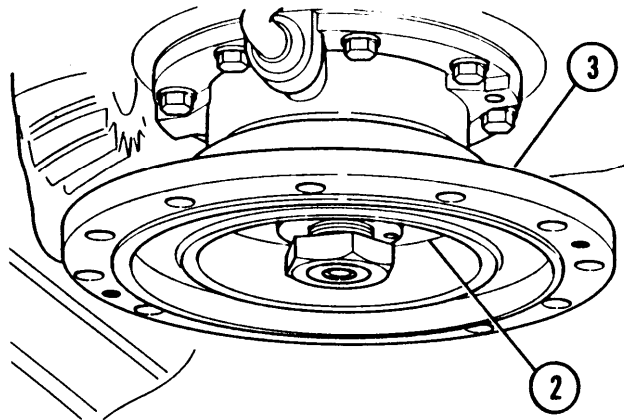


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10-12. STEERING CLUTCH HUBS - REPLACE (Cont' d)

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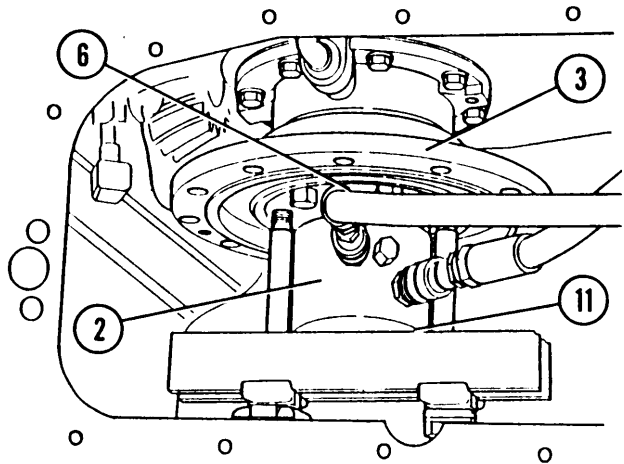
(10) Position piston (2) in hub (3) as far as possible.



(11) Install puller (11) over piston (2) with two anchor capscrews located in outer circle of threaded bores in hub (3).

(12) Press piston (2) into hub (3) and remove puller.

(13) Install steering clutch. See page 10-40.



d. Place In Service

Test drive and check steering clutch hubs for proper operation.

## CHAPTER 11

## FRAME, BODY, CAB, HOOD AND HULL MAINTENANCE

## Section I. DESCRIPTION AND DATA

## 11-1. GENERAL

Frame, body, cab, hood and hull maintenance procedures not covered in this chapter can be found in TM5-2410-237-20.

## 11-2. DESCRIPTION AND DATA

Refer to TM5-2410-237-20 for complete description and data regarding frame and cab components.

## Section II. FRAME, BODY, CAB, HOOD AND HULL MAINTENANCE PROCEDURES

## 11-3. FRAME, BODY, CAB, HOOD AND HULL MAINTENANCE TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
11-4	Frame and Case Assembly - Repair	11-2
11-5	Radiator Guard - Repair	11-4
11-6	Dash - Replace/Repair	11-8
11-7	Seat Hinge - Replace/Repair	11-14
11-8	Seat Vertical Adjuster - Replace/Repair/Adjust	11-18
11-9	Seat - Repair	11-22
11-10	Seat Base - Repair	11-24
11-11	Fenders - Replace	11-26
11-12	Ground Handling	11-33

---

11-4. FRAME AND CASE ASSEMBLY - REPAIR

---

This task covers:

- a. Disassembly
- b. Repair
- c. Assembly

---

INITIAL SETUP

Applicable Configurations

All

Gasket (3)

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Equipment Condition

Will vary depending on maintenance to be performed.

---

NOTE

Remove only those items that are necessary to gain access to the part of the frame on which you are working.

- (6) Use a wrench to remove three capscrews (14) and washers (15) and remove eighteen capscrews (16) and washers (17). Remove cover (18) from tractor.

a. Disassembly

- (1) Use a 1/2" drive plug socket to remove two plugs (1), two plugs (2) and two gaskets (3) from the frame (4). Discard gaskets (3).
- (2) Remove plugs (5, 6 and 7) from the frame assembly (4) as necessary.
- (3) If necessary, remove clips (8) and dowels (9).
- (4) Remove seal (10) and discard seal.
- (5) Use a wrench to remove nuts (11), washers (12) and if necessary, studs (13) from frame (4).

b. Repair

WARNING

Take necessary precautions to insure adequate personal safety while welding on or around the frame. Use caution while welding near hydraulic and fuel lines; personal injury or death could result. See TM9-273 for proper welding procedures.

- (1) Inspect frame assembly for cracks and if necessary, weld cracks; see TM9-237



11-4. FRAME AND CASE ASSEMBLY - REPAIR (Cont'd)

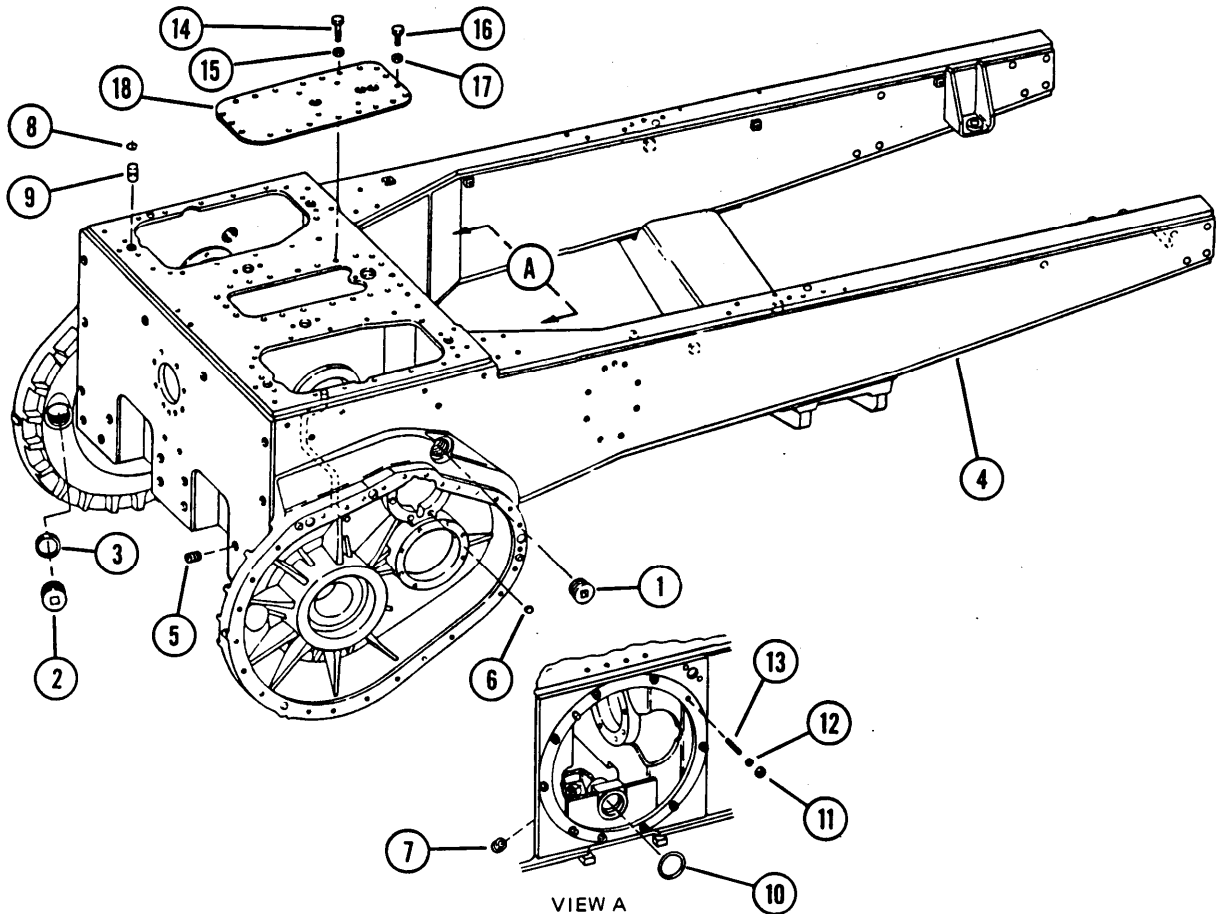
- (2) Inspect nut plates that are welded to the frame. If nut plates are damaged, remove with a cutting torch and weld new nut plates as required.
- (3) Inspect studs and replace as necessary.

- (2) Use a wrench to install nuts (11), washers (12) and if necessary, studs (13) onto frame (4).
- (3) Install new seal (10) on tractor.
- (4) If removed, install clips (8) and dowels (9).

c. Assembly

- (1) Place cover (18) in position on tractor. Use a wrench to install three capscrews (14) and washers (15) and install eighteen capscrews (16) and washers (17).

- (5) Install plugs (5, 6 and 7) into the frame assembly (4) as necessary.
- (6) Use a 1/2" drive plug socket to install plugs (1 and 2) and gaskets (3) into the frame (4).



11-5. RADIATOR GUARD - REPAIR

This task covers:

- a. Removal
- b. Installation
- c. Place In Service

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Lifting Equipment 2,000 lbs.

Materials/Parts

Lint-free rag  
 Caps and plugs

Equipment Condition

Air cleaner removed. See TM5-2410-237-20.  
 Crankcase guard removed. See TM5-2410-237-20.  
 Radiator removed. See page 5-4.  
 Blade lift cylinder mounting tube removed. See page 13-78.  
 Fan guard removed. See page 5-21.  
 Horn removed. See TM5-241-237-20.  
 Headlamps removed. See TM5-2410-237-20.

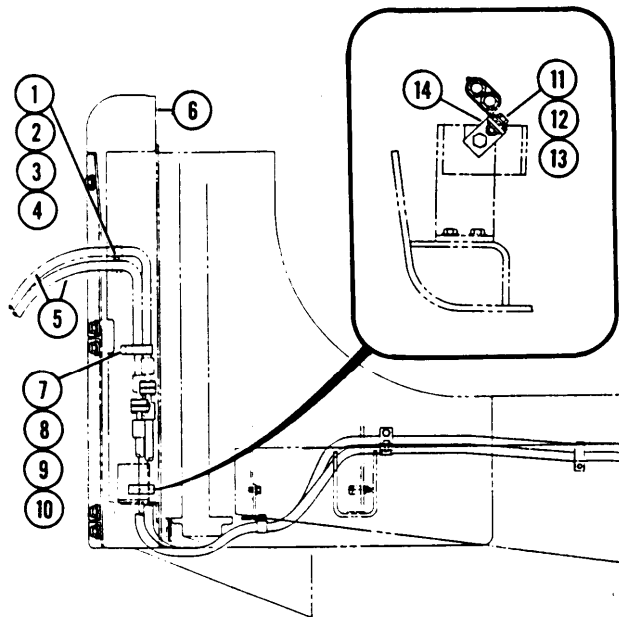
a. Removal

CAUTION

Wipe the area clean around all hydraulic connections to be opened during removal and disassembly. Cap oil lines and plug holes after removing lines. Contamination of the hydraulic system could result in premature failure.

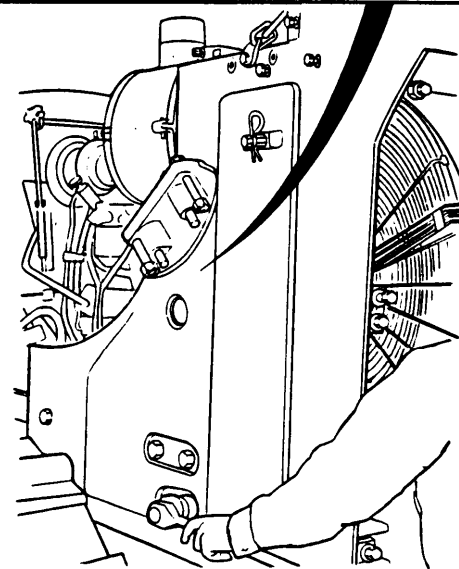
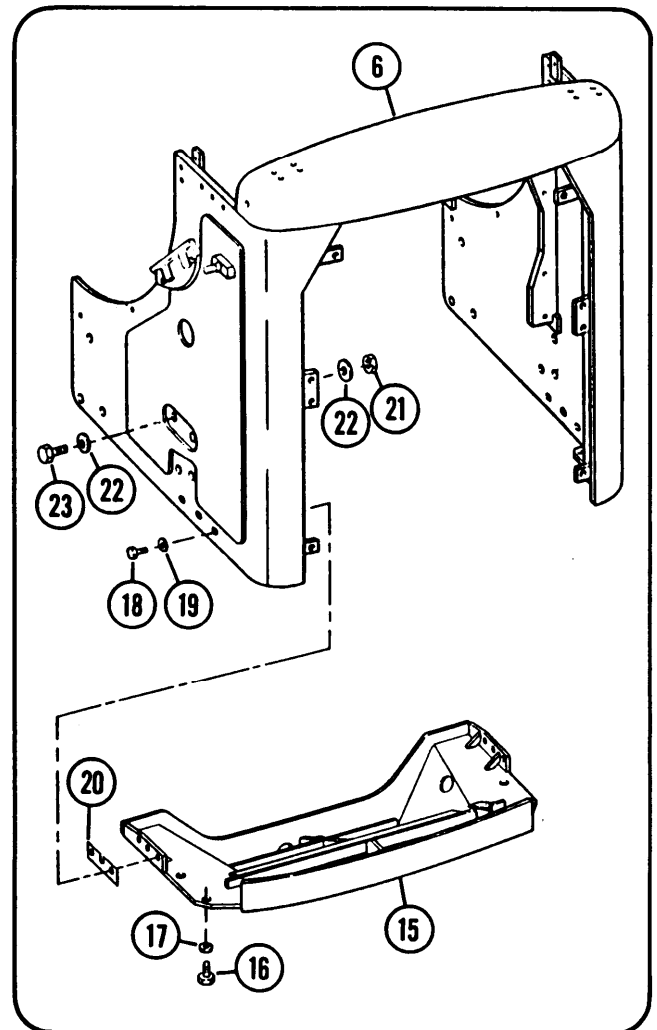
NOTE

If more than one hydraulic line is to be removed, identify lines to assure proper installation. Use suitable container to catch any hydraulic oil that may drain from the system.



## 11-5. RADIATOR GUARD - REPAIR (Cont'd)

- (1) Use a wrench to remove capscrew (1), flat washer (2), clamp (3), and spacer (4) which secured two blade tilt cylinder hoses (5) to radiator guard (6).
- (2) Use a wrench to remove capscrew (7), flat washer (8), clamp (9) and spacer (10) which secure two blade tilt cylinder hoses to radiator guard.
- (3) Use two wrenches to remove two nuts (11), four washers (12), two capscrews (13) and two clamp halves (14) which secured two blade tilt cylinder hoses at bottom of radiator guard.
- (4) Position a jack underneath guard (15).
- (5) Use a wrench to remove four capscrews (16) and four flat washers (17) from underneath guard (15).
- (6) Use a wrench to remove six capscrews (18), six flat washers (19), and shims (20), if used. Lower jack to remove guard (15) from radiator guard.
- (7) Attach lifting equipment to radiator guard (6).
- (8) Use two wrenches to remove seven nuts (21), fourteen washers (22) and seven capscrews (23) from one side of radiator guard.
- (9) Repeat STEP 8 on other side of radiator guard.
- (10) Use lifting equipment to lift radiator guard carefully off tractor.



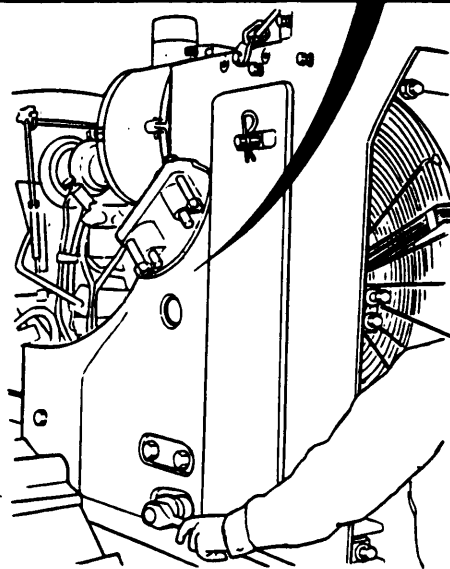
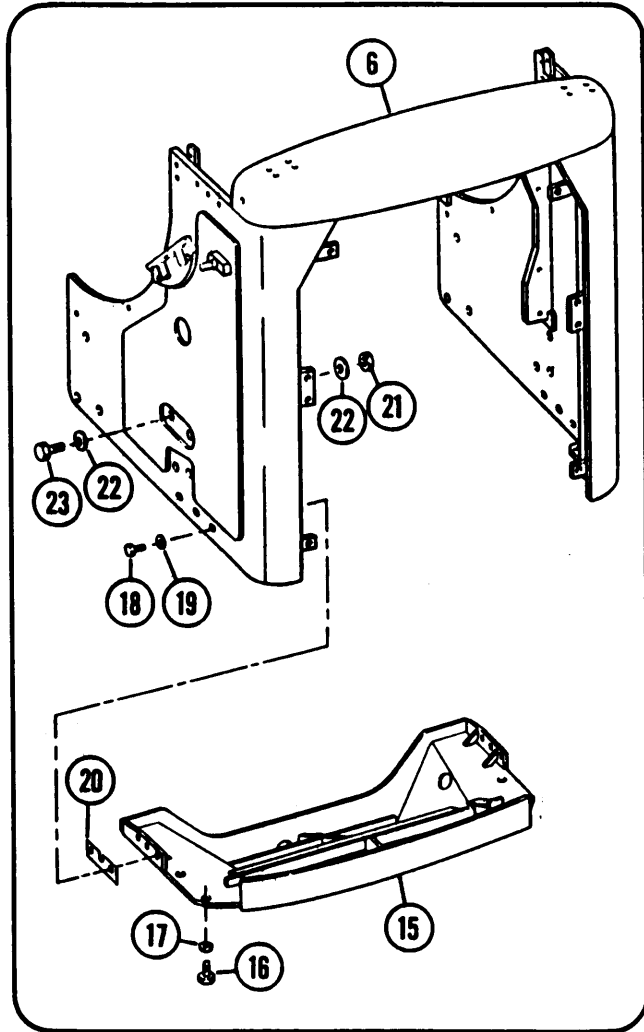
11-5. RADIATOR GUARD - REPAIR (Cont' d)

b. Installation

CAUTION

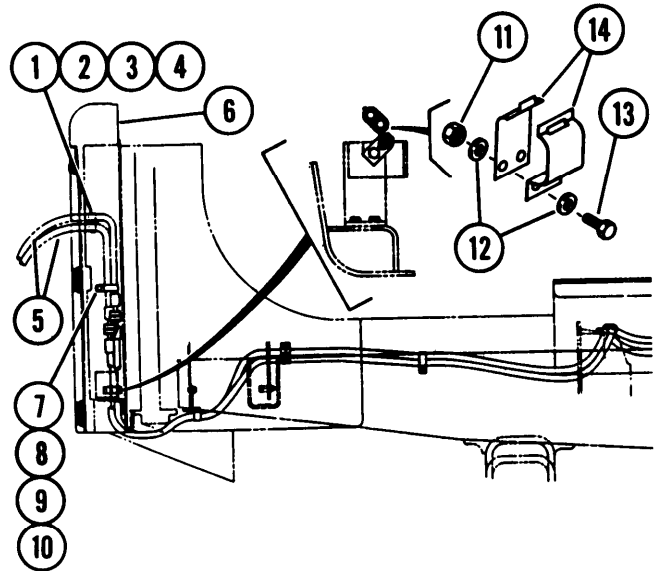
Care should be taken not to contaminate hydraulic system during installation of hydraulic lines. Dirt and foreign substances should be removed from surrounding area before lines are installed.

- (1) Attach lifting equipment to the radiator guard (6) and install it into position on tractor.
- (2) Use two wrenches to install seven nuts (21), fourteen washers (22) and seven capscrews (23) into one side of radiator guard.
- (3) Repeat STEP 2 on other side of radiator guard.
- (4) Use a jack to install guard (15) into position on radiator guard.
- (5) Use a wrench to install six capscrews (18), six flat washers (19), shims (20), if used to secure guard (15) to radiator guard.
- (6) Use a wrench to install four capscrews (16) and four flat washers (17) underneath guard (15).



## 11-5. RADIATOR GUARD - REPAIR (Cont'd)

- (7) Move two blade tilt cylinder hoses (5) into position at bottom of radiator guard and install two clamp halves (14), two nuts (11), four washers (12) and two capscrews (13). Use two wrenches to tighten capscrews and nuts.
- (8) Use a wrench to install a capscrew (7), flat washer (8), clamp (9) and spacer (10) which secure two blade tilt cylinder hoses (5) to radiator guard (6).
- (9) Use a wrench to install a capscrew (1), flat washer (2), clamp (3) and spacer (4) which secure two blade tilt cylinder hoses (5) to radiator guard (6).
- (10) Install radiator. See page 5-4.
- (11) Install air cleaner, hood, crankcase guard, horn, and headlamps. See TM5-2410-237-20.
- (12) Install blade lift cylinder mounting tube. See page 13-94.
- (13) Install fan guard. See page 5-21.

c. Place In Service

Run engine and check for leaks and proper operation.

---

11-6. DASH - REPLACE/REPAIR

---

This task covers:

- a. Removal
- b. Disassembly
- c. Assembly
- d. Installation
- e. Place In Service

---

INITIAL SETUP

Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Lifting Equipment 300 lbs.

Materials/Parts

Two 3/8" -16 Lifting eyes (33)  
Tags  
Cotter pins (9), (24)

Equipment Condition

ROPS or winterization cab removed.  
See TM5-2410-237-20.  
Radiator drained. See TM5-  
2410-237-20.

---

a. Removal

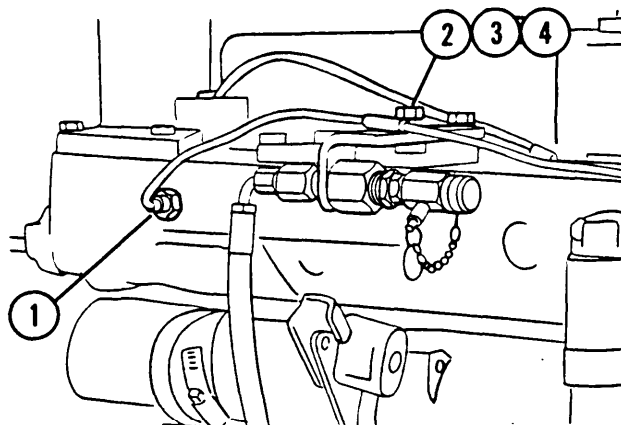
WARNING

When disconnecting electrical wiring, make sure the battery disconnect switch is in the off position. Failure to do so could result in personal injury.

NOTE

Mark all wires for installation.

- (1) Tag engine temperature sensor (1) and use a wrench to remove sensor. Use a wrench to remove three capscrews (2), washers (3), and clips (4). Roll up sensor tubing and fasten to dash.



11-6. DASH - REPLACE/REPAIR (Cont' d)

(2) Tag torque converter oil temperature sensor (5) and use a wrench to remove sensor. Use a wrench to remove capscrew (6), washer (7), and clip (8). Roll up sensor tubing and fasten to dash.

(3) Use a pliers to remove four cotter pins (9), and pins (10) and disconnect two steering rods (11) and two brake rods (18). Discard cotter pins (9).

(4) Use a two wrenches to disconnect engine oil pressure line (13).

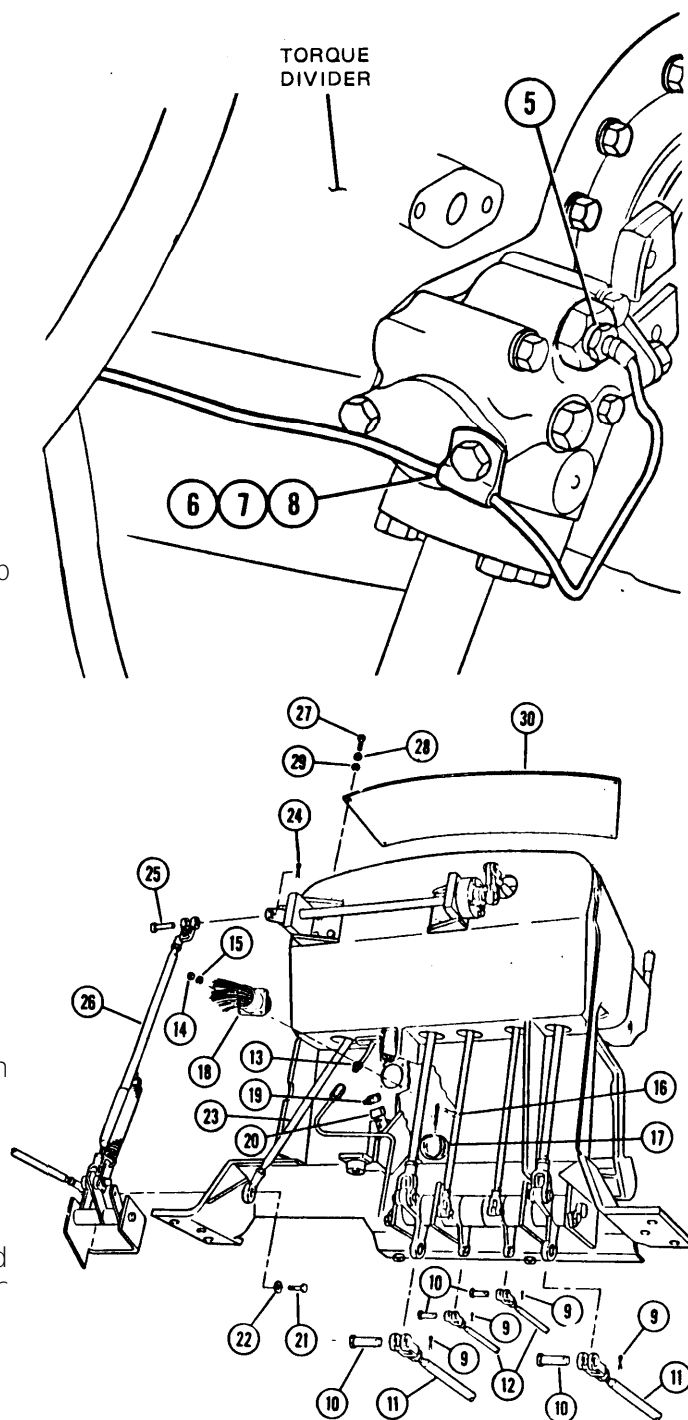
(5) Use a screwdriver to loosen clamp (19) and disconnect chassis wiring harness (20).

(6) Use a screwdriver and a wrench to remove four nuts (14), lockwashers (15), slotted screws (16), and cover (17) and remove STE/ICE wire harness (18) from dash.

(7) Use a wrench to remove capscrew (21), and washer (22) and disconnect decelerator control rod (23).

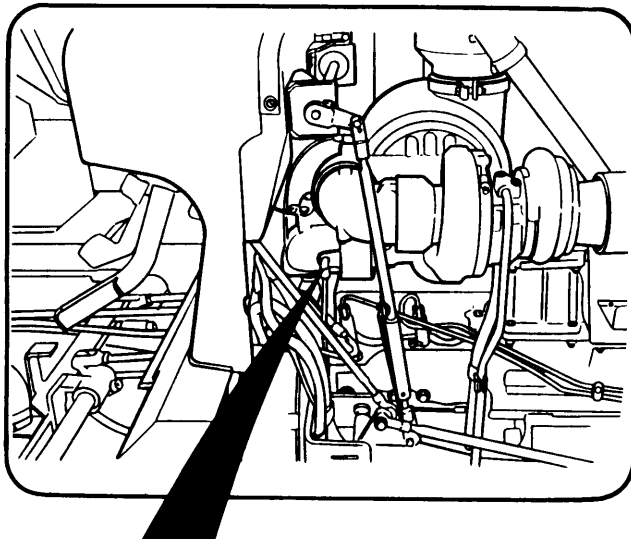
(8) Use a pliers to remove cotter pin (24), and pin (25), and remove throttle control rod (26). Discard cotter pin (24).

(9) Use a wrench to remove four capscrews (27), washers (28), and lockwashers (29) and remove cover (30).



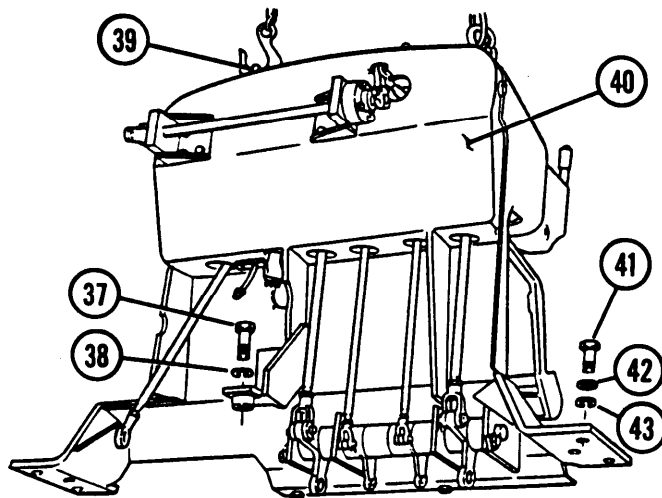
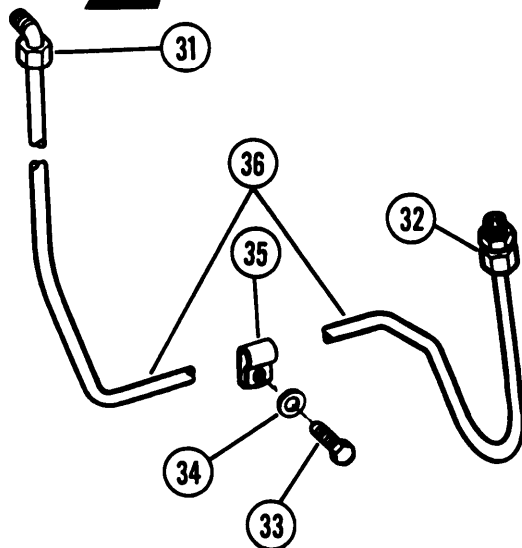
11-6. DASH - REPLACE/REPAIR (Cont'd)

- (10) Loosen fittings (31 and 32). Remove two capscrews (33), washers (34) and clips (35). Remove tube assembly (36).
- (11) Use a wrench to remove capscrew (37), and lockwasher (38).
- (12) Install two 3/8" -16 lifting eyes (39) in top of dash assembly (40) and fasten lifting equipment.
- (13) Use a wrench to remove six capscrews (41), lockwashers (42), and washers (43). Remove dash assembly (40) using lifting equipment.



b. Disassembly

- (1) Remove electrical gages. See TM5-2410-237-20.
- (2) Remove heater switch. See TM5-2410-237-20.
- (3) If equipped with cab, remove wire (44).
- (4) Remove engine oil pressure gage. See TM5-2410-237-20.
- (5) Remove governor linkage. See TM5-2410-237-20.
- (6) Remove steering clutch levers and linkage. See page 10-48.
- (7) Remove steering brake pedals and linkage. See page 10-30.





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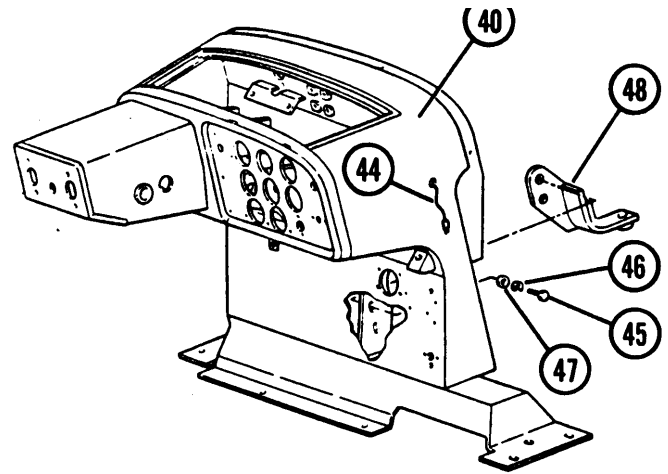
 11-6. DASH - REPLACE/REPAIR (Cont'd)
 

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- (8) Use a wrench to remove capscrew (45), lockwasher (46), and washer (47) and remove support assembly (48) from dash assembly (40).

c. Assembly

- (1) Position support assembly (48) onto dash assembly (40). Use a wrench to secure washer (47), lockwasher (46), and capscrew (45).
- (2) Replace steering brake pedals and linkage. See page 10-30.
- (3) Replace steering clutch levers and linkage. See page 10-48.
- (4) Replace governor linkage. See TM5-2410-237-20.
- (5) Replace engine oil pressure gage. See TM5-2410-237-20.
- (6) If equipped with cab, install wire (44).
- (7) Install heater switch. See TM5-2410-237-20.
- (8) Replace electrical gages. See TM5-2410-237-20.



d. Installation

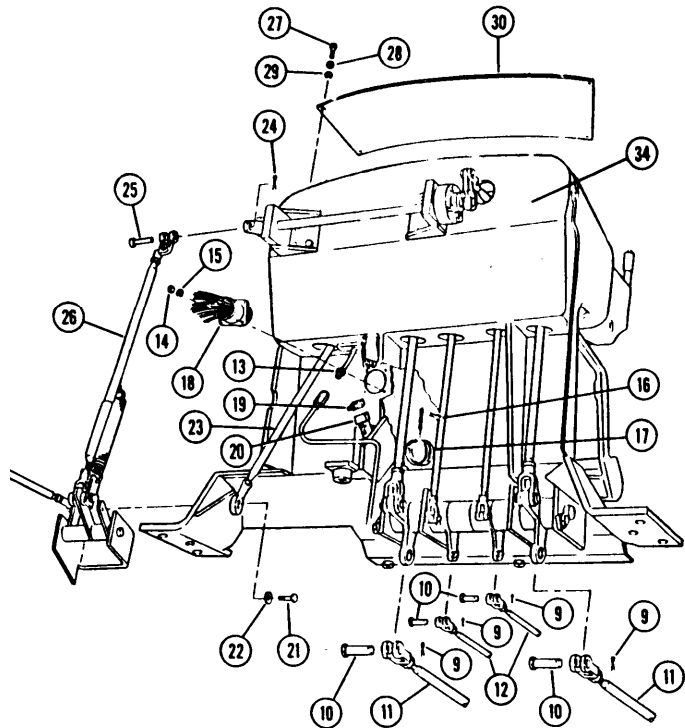
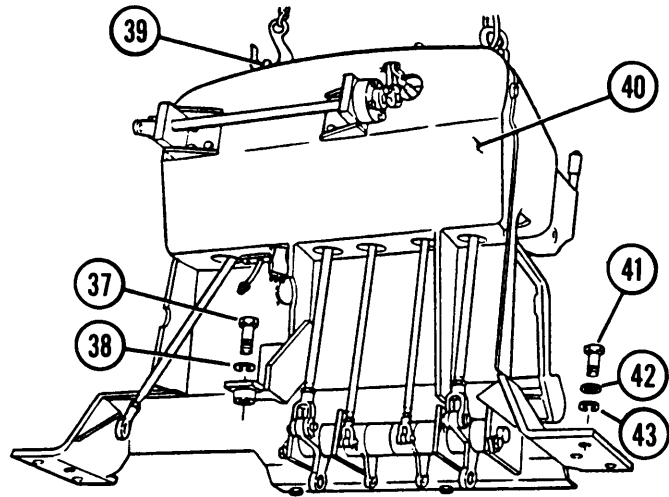
**WARNING**

Make sure the battery disconnect switch is in the off position.

- (1) Use lifting equipment to position dash assembly (40) on frame. Use a wrench to secure six washers (43), lockwashers (42), and capscrews (41).

11-6. DASH - REPLACE/REPAIR (Cont'd)

- (2) Remove lifting equipment and remove two 3/8"-16 lifting eyes (39) from dash assembly (40).
- (3) Use a wrench to secure lockwasher (38), and capscrew (37).
- (4) Position cover (30) on dash assembly (34). Use a wrench to secure four lockwashers (29), washers (28), and capscrews (27).
- (5) Position throttle control rod (26) and replace pin (25), and new cotter pin (24). Use a pliers to bend cotter pin (24).
- (6) Position decelerator control rod (23) and use a wrench to secure washer (22), and capscrew (21).
- (7) Reconnect chassis wiring harness (20) and use a screwdriver to tighten clamp (19).
- (8) Position STE/ICE wire harness (18) on dash and use a screwdriver and a wrench to secure cover (17), four slotted screws (16), lockwashers (15), and nuts (14).
- (9) Use two wrenches to reconnect engine oil pressure line (13).
- (10) Position two brake rods (12), and two steering rods (11) and secure with four pins (10), and new cotter pins (9). Use a pliers to bend cotter pins (9).



11-6. DASH - REPLACE/REPAIR (Cont'd)

(11) Use a wrench to install sensor (5). Use a wrench to secure washer (7), capscrew (6), clip (8), and sensor tubing.

(12) Use a wrench to install temperature sensor (1). Use a wrench to secure three washers (3), capscrews (2), clips (4), and sensor tubing.

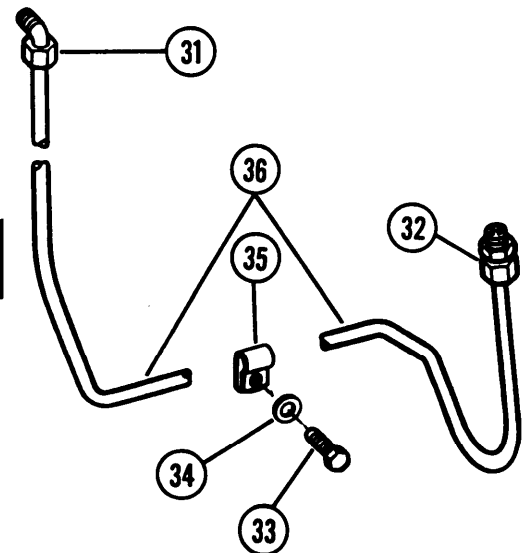
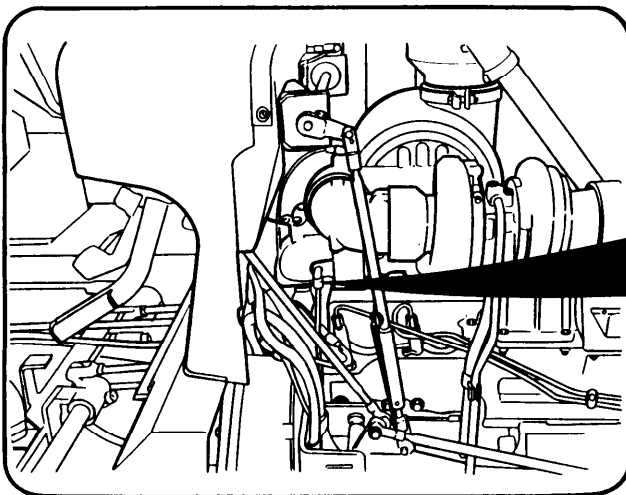
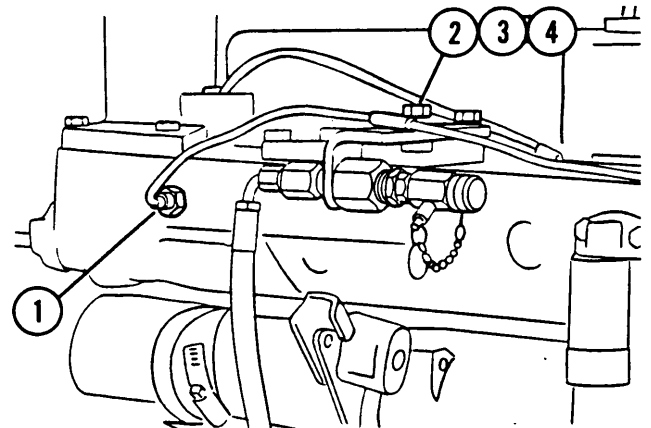
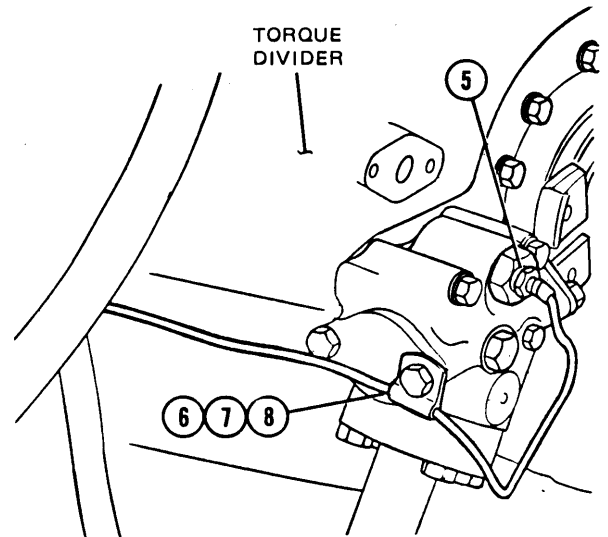
(13) Install tube assembly (36) and secure with two clips (35), washers (34) and capscrews (33). Tighten fittings (31 and 32).

(14) Install ROPS or CAB. See TM5-2410-237-20.

(15) Refill radiator with water.

e. Place In Service

Run engine and ensure all dash switches/gages work.



---

11-7. SEAT HINGE - REPLACE/REPAIR

---

This task covers:

- a. Removal
- b. Disassembly
- c. Assembly
- d. Installation

---

INITIAL SETUP

Applicable Configurations

ALL

Common Tools

Shop Equipment, Automotive  
Maintenance and Repair Common #1  
Less Power  
NSN 4910-00-754-0654

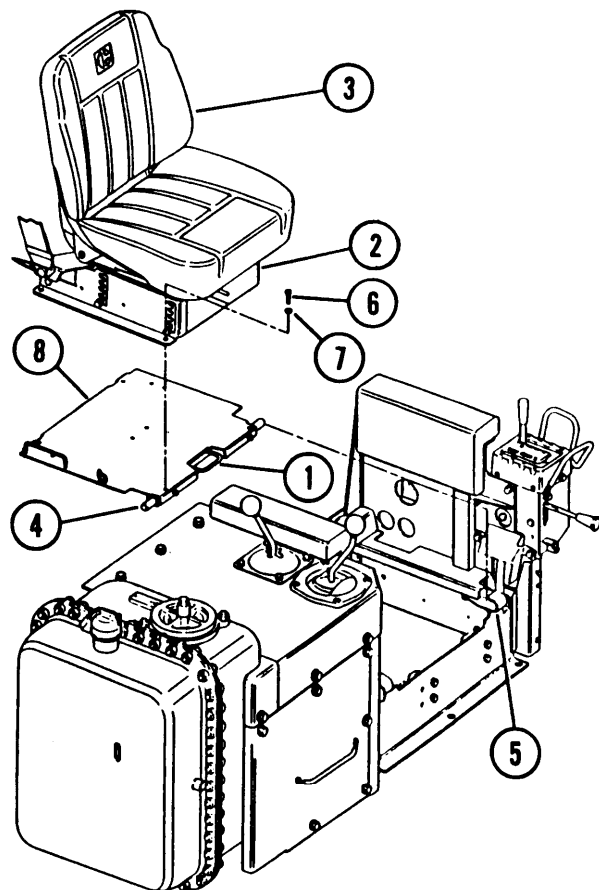
Equipment Condition

ROPS/Winterization cab removed.  
See TM5-2410-237-20.

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a. Removal

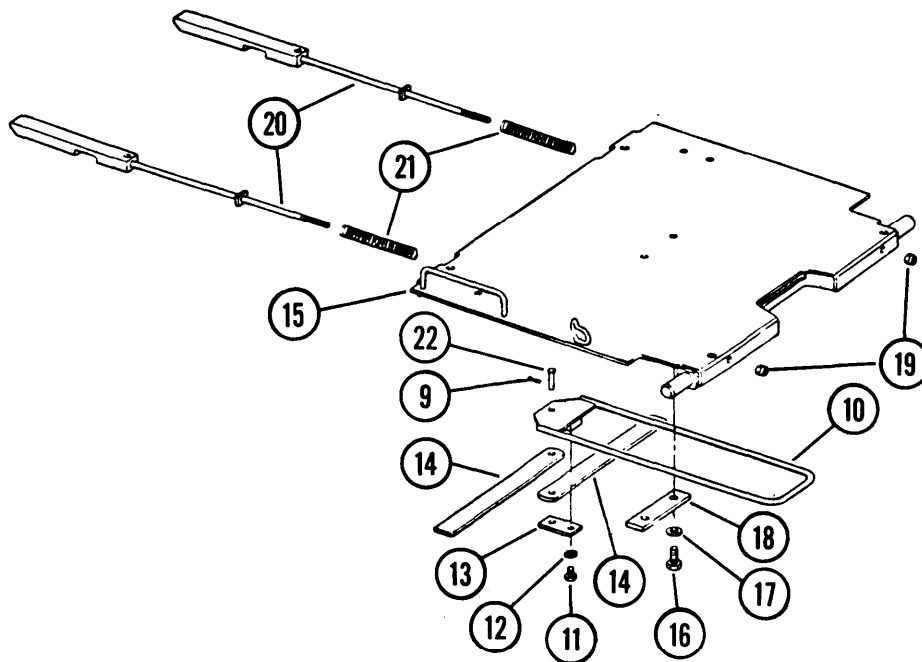
- (1) Pull hinge lock rod (1) at front of seat vertical adjuster (2) forward to release seat lock.
- (2) Tilt seat (3) forward. Slide seat back and straight up so hinge pins (4) slide out of hooks in seat base assembly (5).
- (3) Set seat (3) on work bench and tip it on its front.
- (4) Use a wrench to remove four capscrews (6) and four washers (7) securing hinge assembly (8) to vertical adjuster (2). Remove hinge assembly.



## 11-7. SEAT HINGE - REPLACE/REPAIR (Cont' d)

b. Disassembly

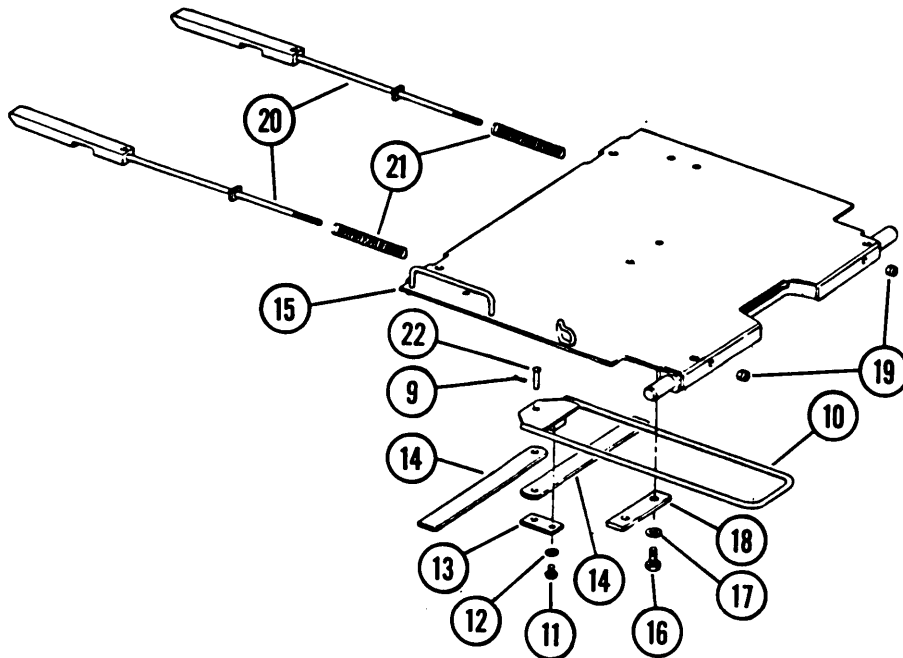
- (1) Remove cotter pin (9) from pin (22) at back end of rod assembly (10). Remove pin (22). Discard cotter pin (9).
- (2) Use a wrench to remove capscrew (11), washer (12) and plate (13) at back end of rod assembly (10).
- (3) Remove two plates (14) from rod assembly (10) and hinge plate (15).
- (4) Use a wrench to remove two capscrews (16), two washers (17) plate (18) and rod assembly (10).
- (5) Use a wrench to remove nuts (19) at front end of latch assembly (20).
- (6) Remove latch assembly (20) through back end of hinge plate (15).
- (7) Remove spring (21) from latch assembly (20).
- (8) Repeat STEPS 5, 6 and 7 for other latch assembly.



11-7. SEAT HINGE - REPLACE/REPAIR (Cont'd)

c. Assembly

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>(1) Install spring (21) on latch assembly (20).</li> <li>(2) Insert latch assembly (20) into back of hinge plate (15) with threaded rod through hole in front of hinge plate.</li> <li>(3) Use a wrench to install nut (19) on front end of latch assembly (20).</li> <li>(4) Adjust nuts (19) on latch assembly (20) so latch extends 0.8 in. beyond hinge plate (15).</li> <li>(5) Repeat STEPS 1, 2, 3 and 4 for other latch assembly.</li> </ul> | <ul style="list-style-type: none"> <li>(6) Install rod assembly (10) in hinge plate (15) with plate (18), two capscrews (16), and two washers (17). Tighten capscrews using a wrench.</li> <li>(7) Install pin (22) in rod assembly (10).</li> <li>(8) Install two plates (14) in hinge plate (15) and on pin (22) of rod assembly (10).</li> <li>(9) Install plate (13), washer (12) and capscrews (11) on rod assembly (10). Tighten capscrew using a wrench.</li> <li>(10) Install new cotter pin (9) in pin (22) on rod assembly (10).</li> </ul> |
|---|---|



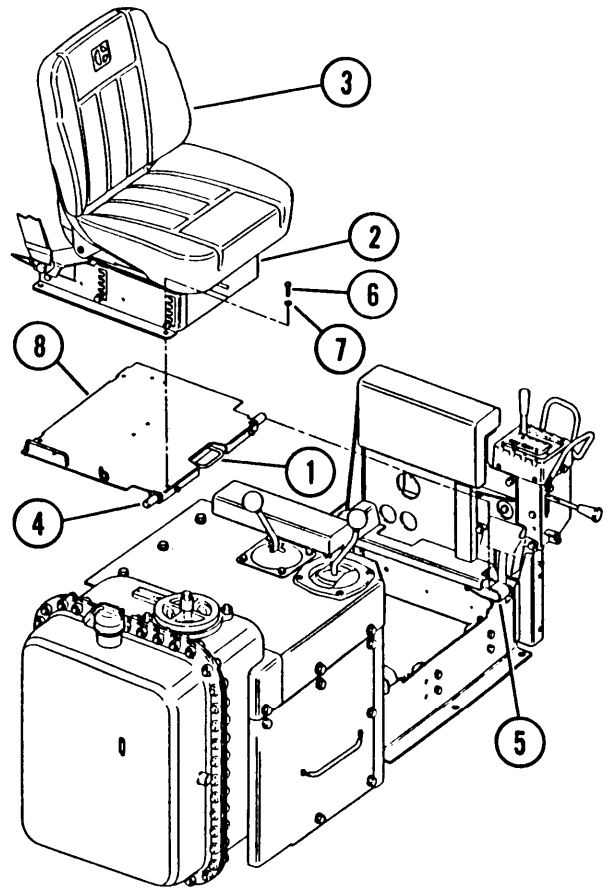
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## 11-7. SEAT HINGE - REPLACE/REPAIR (Cont'd)

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### d. Installation

- (1) Position hinge assembly (8) on vertical adjuster (2) and secure with four capscrews (6) and four washers (7) using a wrench.
- (2) Lift seat (3) and position over seat base assembly (5) so that hinge pins (4) are slightly behind hooks in seat base assembly.
- (3) Slowly lower seat. Make sure that hinge pins (4) engage with hooks in seat base assembly (5).
- (4) Push back of seat (3) down until the latches snap into position. See that hinge lock rod (1) at front of seat vertical adjuster (2) locks seat in place.
- (5) Install ROPS/Winterized cab.  
See TM5-2410-237-20.



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## 11-8. SEAT VERTICAL ADJUSTER - REPLACE/REPAIR/ADJUST

---

This task covers:

- a. Removal
- b. Disassembly
- c. Assembly
- d. Installation
- e. Adjustment

---

### INITIAL SETUP

Applicable Configurations  
ALL

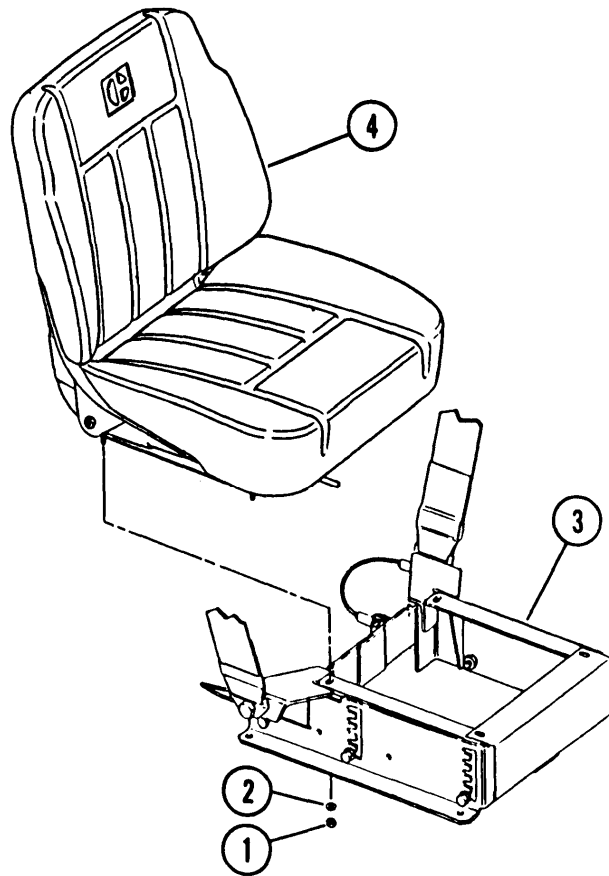
Equipment Condition  
Seat hinge removed. See page 11-14.

Common Tools  
Shop Equipment, General  
Repair; Semi-Trailer Mounted  
NSN 4940-00-287-4894

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#### a. Removal

- (1) Remove four nuts (1) and four washers (2).
- (2) Remove adjuster assembly (3) from seat (4).

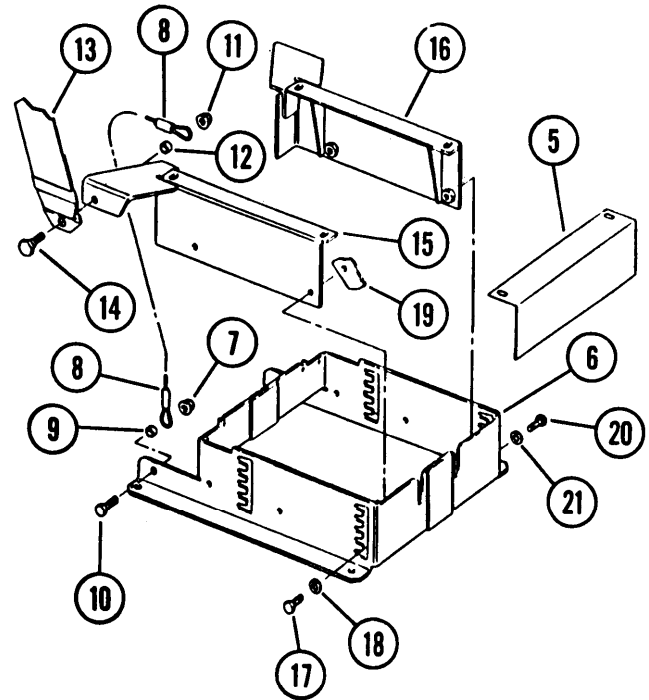




## 11-8. SEAT VERTICAL ADJUSTER - REPLACE/REPAIR/ADJUST (Cont'd)

b. Disassemble

- (1) Remove sheet (5) from front of base (6).
- (2) Use two wrenches to remove nut (7), spacer (9), capscrew (10), and end of cable (8) from back of base (6).
- (3) Use two wrenches to remove nut (11), other end of cable (8), spacer (12), half of seat belt (13) and capscrew (14) from R.H. support (15).
- (4) Repeat STEPS 2 and 3 for cable on L.H. support (16).
- (5) Use a wrench to remove two capscrews (17), two washers (18), plate (19) and R.H. support (15) from base (6).
- (6) Use a wrench to remove two capscrews (20), two washers (21) and L.H. support (16) from base (6).
- (7) Carefully inspect seat belt (13) for wear. Discard seat belt if wear is evident.

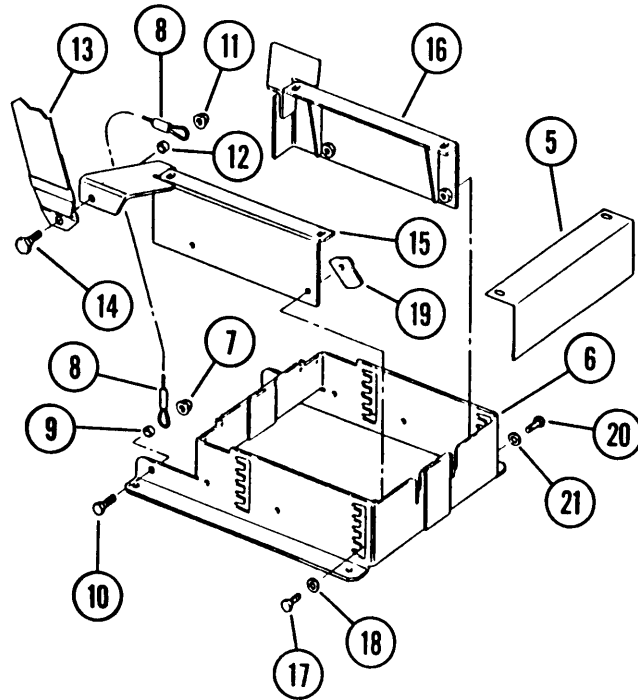
**NOTE**

Always position L.H. and R.H. supports in lowest slots in base unless directed otherwise.

11-8. SEAT VERTICAL ADJUSTER - REPLACE/REPAIR/ADJUST (Cont'd)

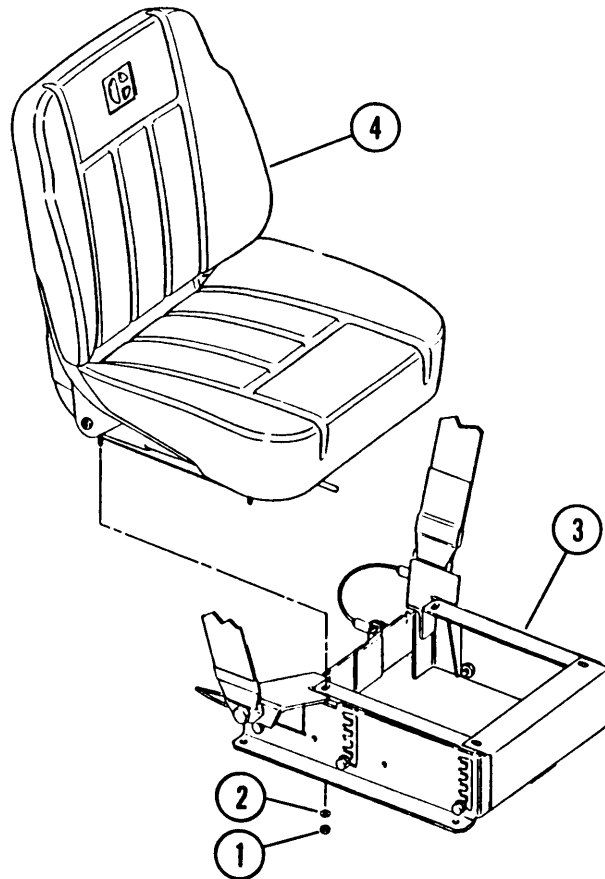
c. Assembly

- (1) Position L.H. support (16) on base (6) and secure with two capscrews (20) and two washers (21).
- (2) Position R.H. support (15) on base (6) and secure with two capscrews (17), two washers (18) and plate (19). Use a wrench to tighten capscrews.
- (3) Install half of seat belt (13) and one end of cable (8) on R.H. support (15). Secure with capscrew (14), spacer (12) and nut (11). Use two wrenches to tighten nut.
- (4) Install other end of cable (8) on back of base (6) and secure with capscrew (10), spacer (9) and nut (7). Use two wrenches to tighten nut.
- (5) Repeat STEPS 3 and 4 for L.H. support (16).
- (6) Install sheet (5) on front of base (6).



d. Installation

- (1) Position adjuster assembly (3) on seat (4) and secure with four nuts (1) and four washers (2).
- (2) Use a wrench to tighten nuts (1).
- (3) Install seat hinge assembly. See page 11-14.



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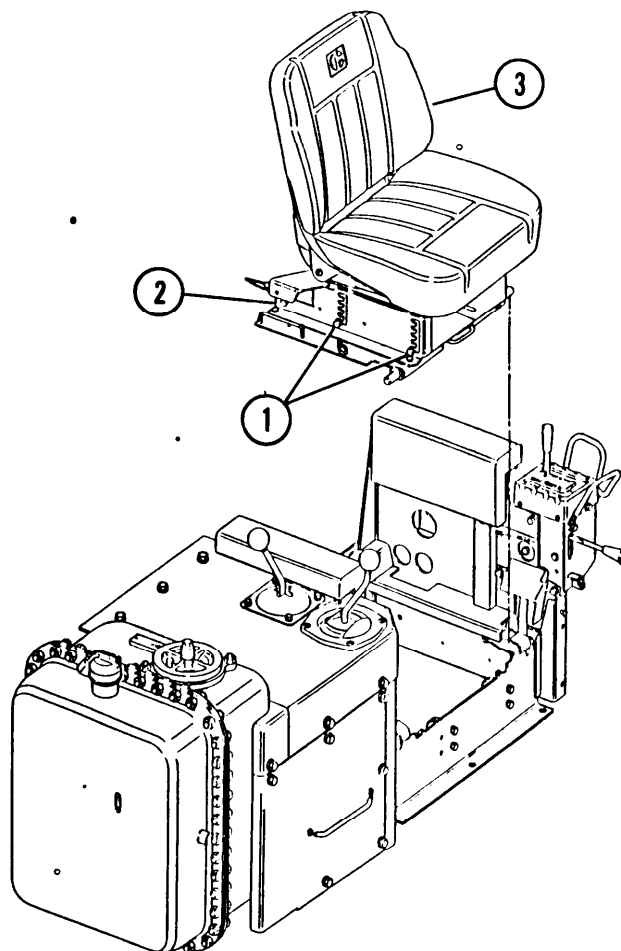
 11-8. SEAT VERTICAL ADJUSTER - REPLACE/REPAIR/ADJUST (Cont'd)
 

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e. AdjustmentWARNING

Immediately after adjustment, check to see that the operator can fully depress the tractor brake pedals. All controls must be in proper operating distance from the operator. An unsafe condition exists when control cannot be reached. Failure to make proper adjustments may result in serious personal injury or death.

- (1) Use a wrench to loosen two capscrews (1) on each side of vertical adjuster (2) three full turns each.
- (2) With the help of another person, slide seat (3) back and then up or down as needed. Slide seat forward again after reaching desired height.
- (3) Use a wrench to tighten capscrews (1).



11-9. SEAT - REPAIR

This task covers:

- a. Disassembly
- b. Assembly

INITIAL SETUP

Applicable Configurations  
ALL

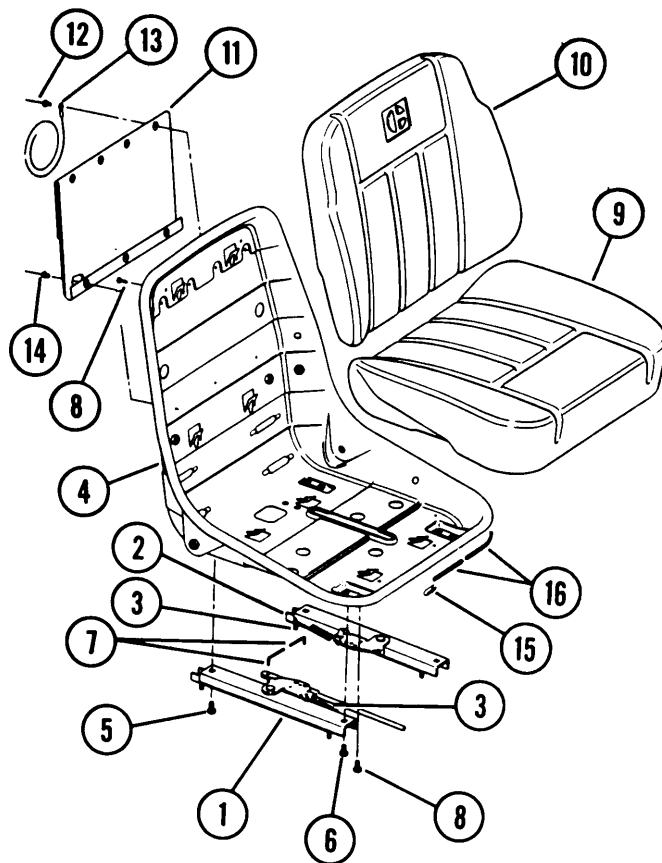
Materials/Parts  
Rivets (12), (14)

Common Tools  
Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Equipment Condition  
Seat vertical adjuster removed.  
See page 11-18.

a. Disassembly

- (1) Lay seat assembly on its back.
- (2) Operate handle on seat adjuster (1) to remove spring tension from adjusters (1) and (2).
- (3) Use pliers to remove two springs (3).
- (4) Slide adjusters (1 and 2) to front end of seat frame (4).
- (5) Use a wrench to remove capscrews (5).
- (6) Slide adjusters (1 and 2) to rear end of seat frame (4).
- (7) Use a wrench to remove two capscrews (6) and adjusters (1 and 2).
- (8) Remove release rod (7) connecting adjusters (1 and 2).
- (9) Use a wrench to remove four capscrews (8).



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## 11-9. SEAT - REPAIR (Cont'd)

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- (10) Remove seat cushion (9) and back cushion (10) from seat frame (4) by lifting up and out.
  - (11) Open holder (11). Remove and discard four top rivets (12), and remove lanyard (13).
  - (12) Allow holder (11) to fold down and remove three bottom rivets (14) and holder (11).
  - (13) Remove clip (15) and seal (16) if necessary.
- b. Assembly
- (1) Install seal (16) on seat frame (4). Start seal at bottom, center of seat frame. Secure ends of seal with clip (15).
  - (2) Position bottom edge of holder (11) on back of seat frame, so that top of holder is hanging down. Secure bottom edge with three rivets (14).
  - (3) Hold holder (11) up with flap open and install three rivets (12) on the R.H. side. Position lanyard over the L.H. hole and install rivet (12).
  - (4) Install seat cushion (9) and back cushion (10) in seat frame (4).
  - (5) Use a wrench to install four capscrews (8).
  - (6) Install release rod (7) between adjusters (1 and 2).
  - (7) Position adjusters (1 and 2) on bottom of seat frame (4). Secure adjusters with capscrews (5 and 6). Tighten capscrews with a wrench.
  - (8) Use pliers to install two springs (3).
  - (9) Install seat vertical adjuster. See page 11-18.

11-10. SEAT BASE - REPAIR

This task covers:

- a. Disassembly
- b. Assembly

INITIAL SETUP

Applicable Configurations

All

Materials/Parts

Cotter Pin (1)

Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Equipment Condition

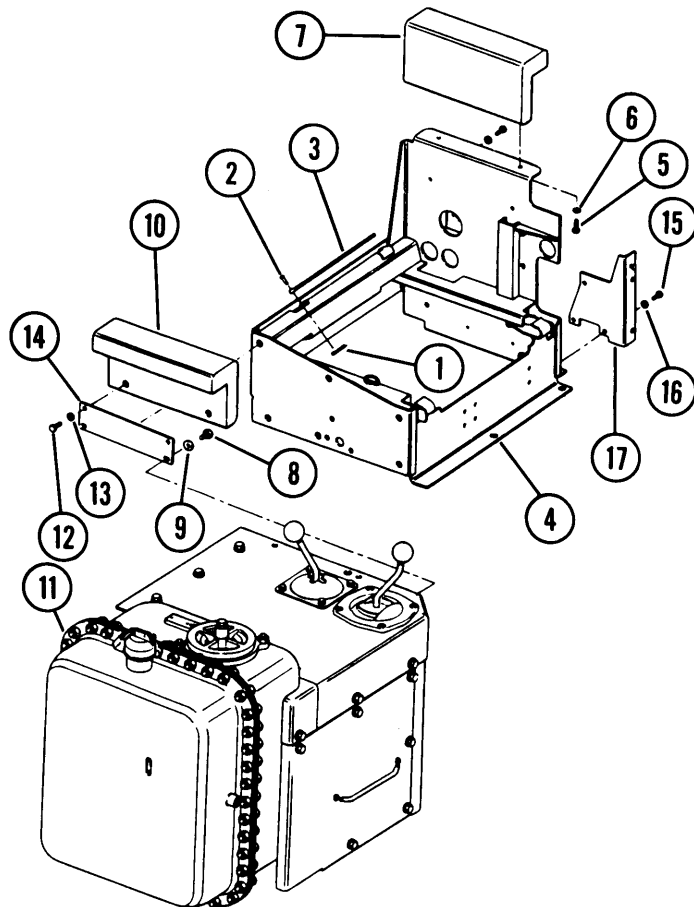
Seat assembly removed.  
See TM5-2410-237-20.

a. Disassembly

NOTE

Seat base assembly (4) need not be removed unless it is damaged. Replacement of other parts may be done by just removing the seat assembly.

- (1) Remove cotter pin (1), pin (2) and rod (3) from back of seat base assembly (4). Discard cotter pin (1).
- (2) Use a wrench to remove four capscrews (5), four washers (6) and armrest (7) from left side of seat base (4).
- (3) Use a wrench to remove two capscrews (8), two washers (9) and right armrest assembly (10) from hydraulic control cover (11).
- (4) Use a wrench to remove two capscrews (12), two washers (13) and bracket (14) from armrest (10)\*



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## 11-10. SEAT BASE - REPAIR (Cont'd)

---

- (5) Use a wrench to remove three capscrews (15), three washers (16) and plate (17) from seat base assembly (4).

### b. Assembly

- (1) position plate (17) on seat base assembly (4) and secure with three capscrews (15) and three washers (16). Use a wrench to tighten capscrews.
- (2) Position bracket (14) on armrest (10) and secure with two capscrews (12) and two washers (13). Use a wrench to tighten capscrews.
- (3) Position armrest assembly (10) on hydraulic control cover (11) and secure with two capscrews (8) and two washers (9). Use a wrench to tighten capscrews.
- (4) Position left armrest (7) on side of seat base assembly (4) and secure with four capscrews (5) and four washers (6). Use a wrench to tighten capscrews.
- (5) Install rod (3) at back of seat base (4) with pin (2). Secure with new cotter pin (1).
- (6) Install 1 seat. See TM5-2410-237-20.

11-11. FENDERS - REPLACE

This task covers:

- a. Removal
- b. Installation
- c. Place In Service

INITIAL SETUP

Applicable Configurations

Common Tools

Shop Equipment, General Purpose  
 Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Lifting Equipment 400 lbs.  
 Straps (2)

Material Parts

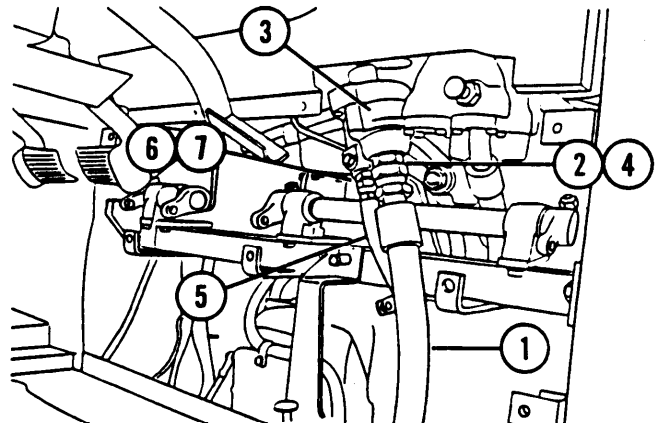
Seal (4), (7)

Equipment Condition

For either fender removal:  
 ROPS mounting brackets and plates removed. See TM5-2410-237-20.  
 Fuel tank removed. See page 4-23.  
 Steering clutch levers and linkage removed. See page 10-48.  
 Steering brake pedals and linkage removed. See page 10-30.  
 Hydraulic control valve removed. See page 13-16.  
 Additional conditions for R.H. fender:  
 Tool box removed. See TM5-2410-237-20.  
 Hydraulic tank removed. See page 13-105.  
 Additional conditions for L.H. fender:  
 Battery box removed. See TM5-2410-237-20.  
 Seat assembly removed. See TM5-2410-237-20.

a. Removal

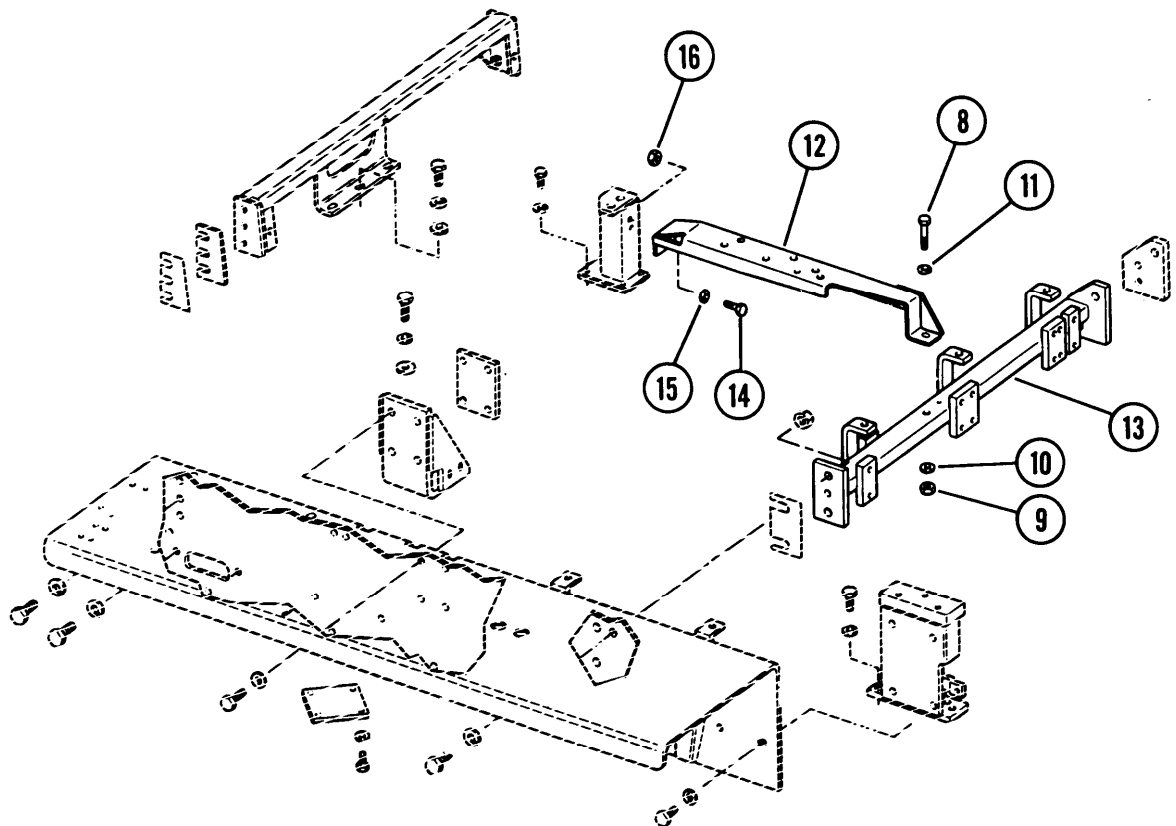
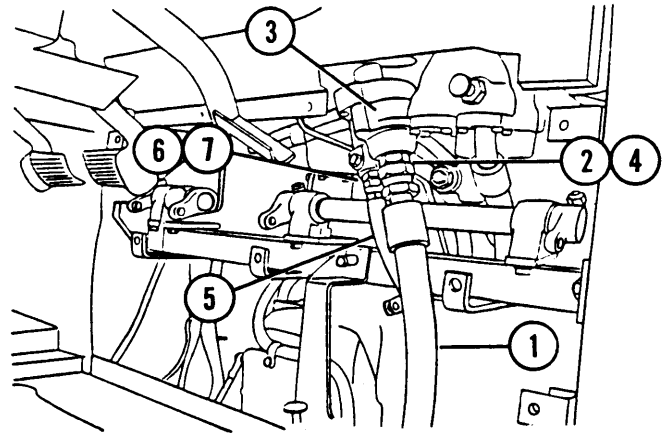
- (1) If tractor is equipped with a winch, use an adjustable wrench to disconnect hose (1) from connector (2) on winch gear pump (3). Remove and discard seal (4) from end of hose. Plug end of hose.





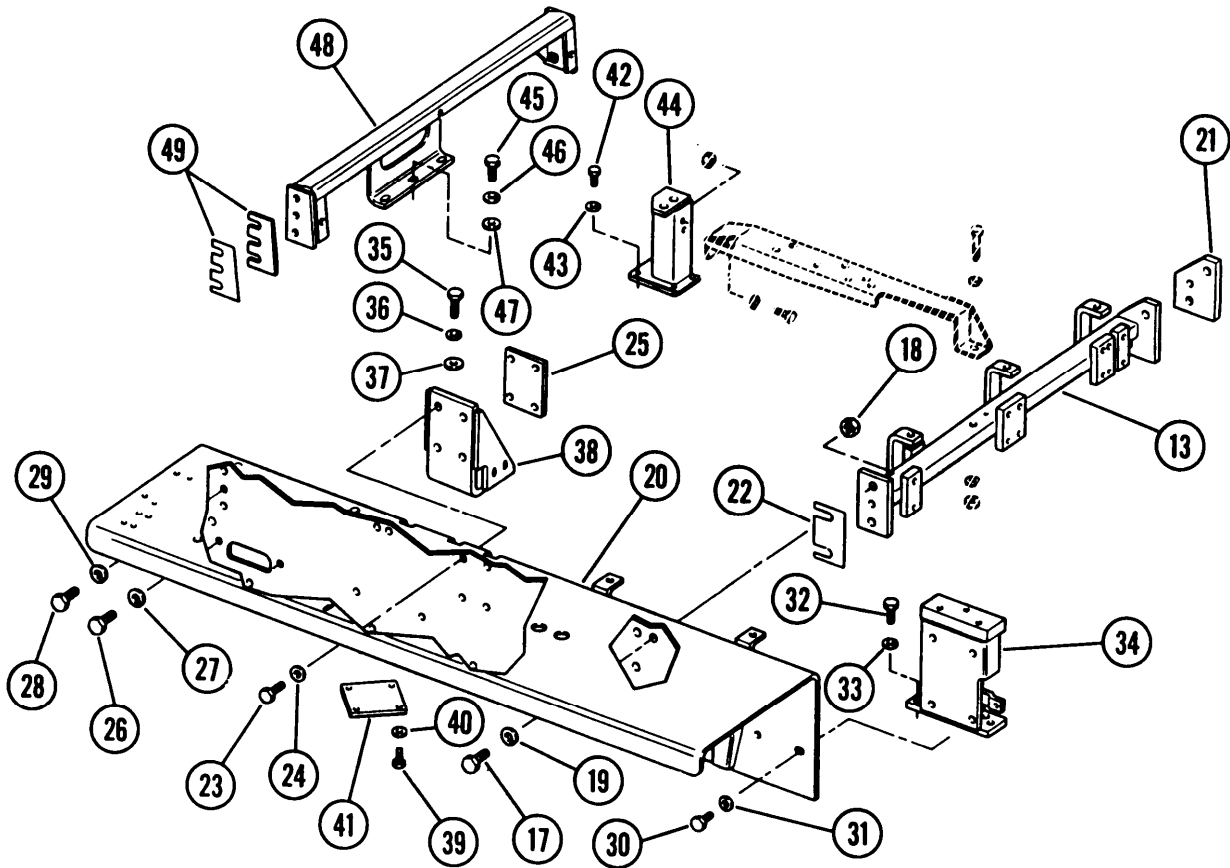
11-11. FENDERS - REPLACE (Cont'd)

- (2) If tractor is equipped with a winch, use a wrench to disconnect hose (5) from connector (6) on winch gear pump (3). Remove and discard seal (7) from end of hose. Plug end of hose (5).
- (3) Use two wrenches to remove capscrew (8), nut (9), lockwasher (10), and washer (11) which secured one end of support assembly (12) to beam assembly (13).
- (4) Use two wrenches to remove two capscrews (14), two lockwashers (15), two nuts (16), and support assembly (12) from beam assembly (13).



11-11. FENDERS - REPLACE (Cont'd)

- (5) Attach lifting equipment with strap to beam assembly (13). Use a wrench to remove four capscrews (17), four nuts (18) and four lockwashers (19) which secure beam assembly to fenders (20). Use lifting equipment to remove beam assembly (13).
- (6) Remove one spacer plate (21) and shims (22).
- (7) Attach lifting equipment to R.H. fender (20) and take out slack.
- (8) Use a wrench to remove four capscrews (23), four lockwashers (24), and plate (25) from center of R.H. fender (20) mounting.
- (9) Use a wrench to remove seven capscrews (26) and seven lockwashers (27) from along rear bottom section of fender (20).
- (10) Use a wrench to remove three capscrews (28) and three lockwashers (29) from rear fender (20) mounting.
- (11) Use a wrench to remove four capscrews (30) and four lockwashers (31) from front fender (20) mounting. Remove fender with lifting equipment.
- (12) If necessary, use a wrench to remove four capscrews (32) and four lockwashers (33) from bracket assembly (34). Remove bracket assembly.



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 11-11. FENDERS - REPLACE (Cont'd)
 

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- |   |  |
|---|--|
| <p>(13) If necessary, use a wrench to remove four capscrews (35), four lockwashers (36), and four washers (37) from bracket assembly (38). Remove bracket assembly.</p> <p>(14) Repeat STEPS 7 through 13 if L.H. fender is to be removed.</p> <p>(15) If necessary, use a wrench to remove four capscrews (39), four washers (40), and cover (41) from R.H. fender (20).</p> <p>(16) If necessary, use a wrench to remove four capscrews (42), four lockwashers (43), and bracket assembly (44).</p> <p>(17) If necessary, use a wrench to remove three capscrews (45), three lockwashers (46), three washers (47), support assembly (48), and shims (49).</p> | <p>(4) If removal was necessary, install bracket assembly (38), four washers (37), four lockwashers (36), and four capscrews (35). Use a wrench to tighten capscrews.</p> <p>(5) If removal was necessary, install bracket assembly (34), four lockwashers (33), and four capscrews (32). Use a wrench to tighten capscrews.</p> |
|---|--|

## NOTE

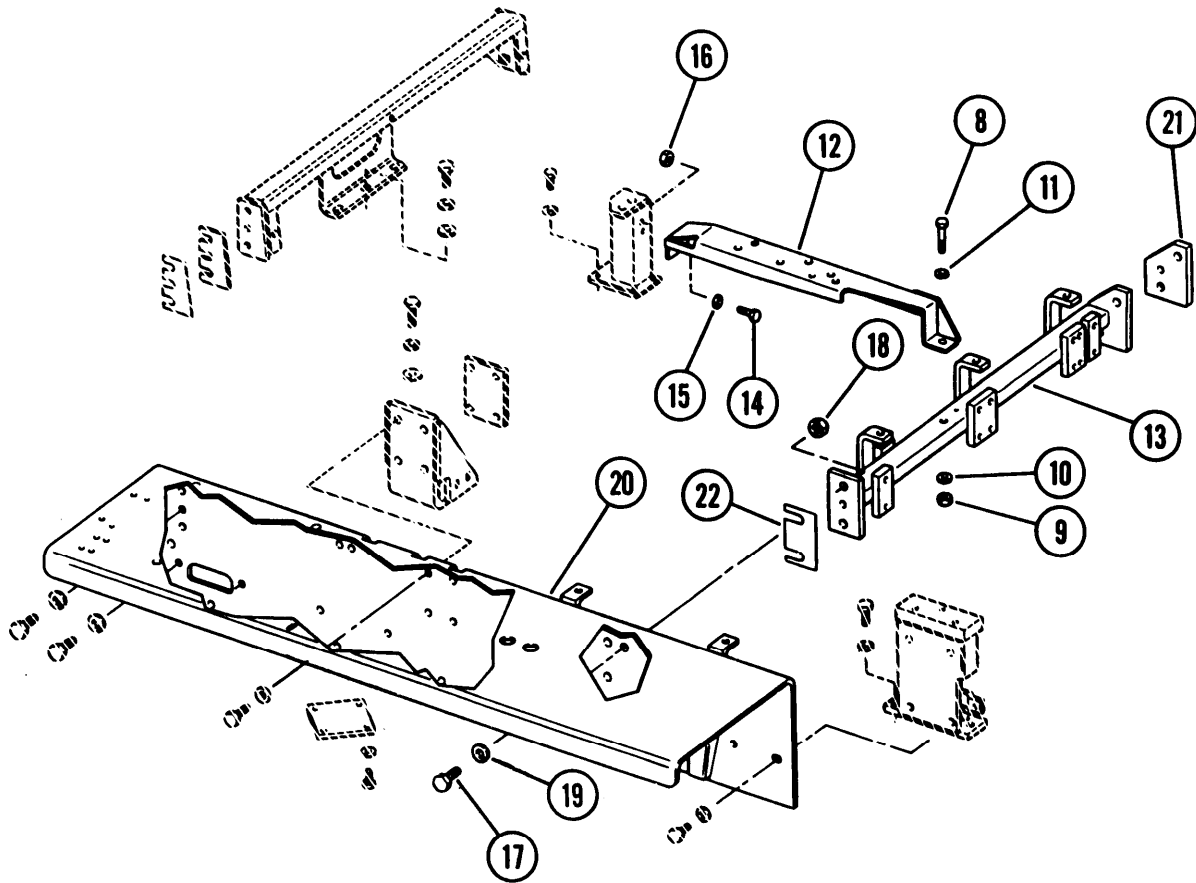
Do not tighten fender mounting capscrews until all of them have been installed. This will aid in hole line-up and hardware installation.

b. Installation

- |   |  |
|---|--|
| <p>(1) If removal was necessary, install support assembly (48), shims (49), three washers (47), three lockwashers (46), and three capscrews (45). Use a wrench to tighten capscrews.</p> <p>(2) If removal was necessary, install bracket assembly (44), four lockwashers (43), and four capscrews (42). Use a wrench to tighten capscrews.</p> <p>(3) If removal was necessary, install cover (41), four washers (40), and four capscrews (39) to the R.H. fender (20). Use a wrench to tighten capscrews.</p> | <p>(6) Attach lifting equipment to R.H. fender (20) and lift into position.</p> <p>(7) Use a wrench to install four capscrews (30) and four lockwashers (31) at front fender (20) mounting.</p> <p>(8) Use a wrench to install three capscrews (28) and three lockwashers (29) at rear fender (20) mounting.</p> <p>(9) Use a wrench to install seven capscrews (26) and seven lockwashers (27) along rear bottom section of fender (20).</p> <p>(10) Use a wrench to install four capscrews (23), four lockwashers (24), and plate (25) to center of R.H. fender (20) mounting.</p> |
|---|--|

11-11. FENDERS - REPLACE (Cont'd)

- (11) Repeat STEPS 4 through 10 to install L.H. fender, if removal was necessary.
- (12) Attach lifting equipment to beam assembly (13). Use lifting equipment to install beam assembly. Install shims (22) on right-hand side of beam (13) and spacer plate (21) on left-hand side of beam (13).
- (13) Use a wrench to install four capscrews (17), four nuts (18), and four lockwashers 19 which secure beam assembly (13) to fenders (20).
- (14) Tighten all capscrews and remove strap.
- (15) Install support assembly (12). Use two wrenches to install two capscrews (14), two lockwashers (15), and two nuts (16) which secure one end of support assembly.
- (16) Use two wrenches to install capscrew (8), nut (9), lockwasher (10), and washer (11) which secure one end of support assembly (12) to beam assembly (13).

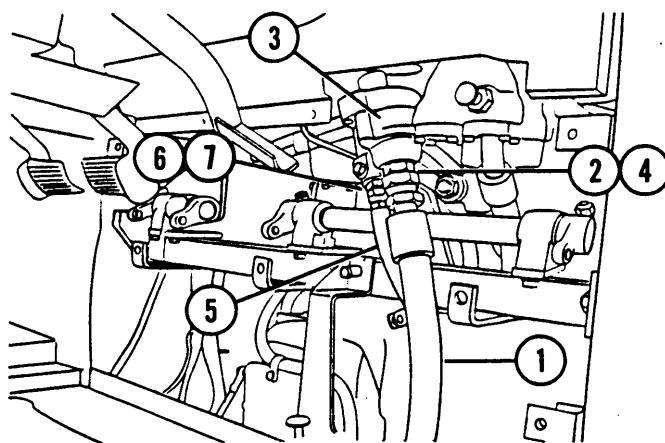


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**11-11. FENDERS - REPLACE (Cont' d)**

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- (17) If tractor is equipped with a winch, install a new seal (7) in hose (5). Use a wrench to connect hose (5) to connector (6) on winch gear pump (3).
- (18) If tractor is equipped with a winch, install a new seal (4) in the hose (1). Use an adjustable wrench to connect hose to connector (2) on the winch gear pump (3).
- (19) Install the following:
- (a) Hydraulic control valve. See page 13-16.
  - (b) Steering brake pedals and linkage. See page 10-30.
  - (c) Steering clutch levers and linkage. See page 10-48.
  - (d) Fuel tank. See TM5-2410-237-20.
  - (e) ROPS mounting brackets and plates. See TM5-2410-237-20.
- (20) If R. H. fender was removed, install:
- (a) Tool box. See TM5-2410-237-20.
  - (b) Hydraulic tank. See page 13-105.



11-11. FENDERS - REPLACE (Cont'd)

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(21) If L.H. Fender was removed,  
install:

(a) Battery box. See TM5-2410-  
237-20.

(b) Seat assembly. See TM5-  
2410-237-20."

c. Place In Service

Run engine, test drive, and  
check for proper operation.

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## 11-12. GROUND HANDLING

---

This task covers:

- a. Operating/Adjust Hydraulic Jacks
  - b. Jacking to Elevate Tractor
  - c. Lowering Elevated Tractor
- 

### INITIAL SETUP

#### Applicable Configurations

All

#### Personnel Required

MOS62B 2

#### Common Tools

Shop Equipment, Contact Maintenance  
Truck Mounted  
NSN 4940-00-294-9518  
Shop Equipment, Automotive  
Maintenance, Common #2 Less Power  
NSN 4910-00-754-0650

#### Equipment Condition

Blade and push arms removed. See  
TM5-2410-237-20.  
Rear implement removed.  
Ripper - See page 14-8.  
Winch - See TM5-2410-237-20.  
Track tension released. See page  
9-73, STEP a, 1 through 6.

#### Special Tools

Hydraulic Jack Stands (two 4C6486)  
Hydraulic Cylinders (8S7650)  
Pin (four 867615)  
Collar (two 8S7625)  
Extension Tube (two 8S7621)  
Pump (3S6224)  
Jack Stands (two 8S7640)  
Pin (two 8S7615)  
Extension Tube (two 8S7611)

#### Materials/Parts

8-inch wood block (2)

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### WARNING

This task must be performed on a flat, level concrete surface. Hydraulic jack stands can become unstable if used on any other surface. Instability can allow the tractor to fall, causing personal injury or death.

11-12. GROUND HANDLING (Cont' d)

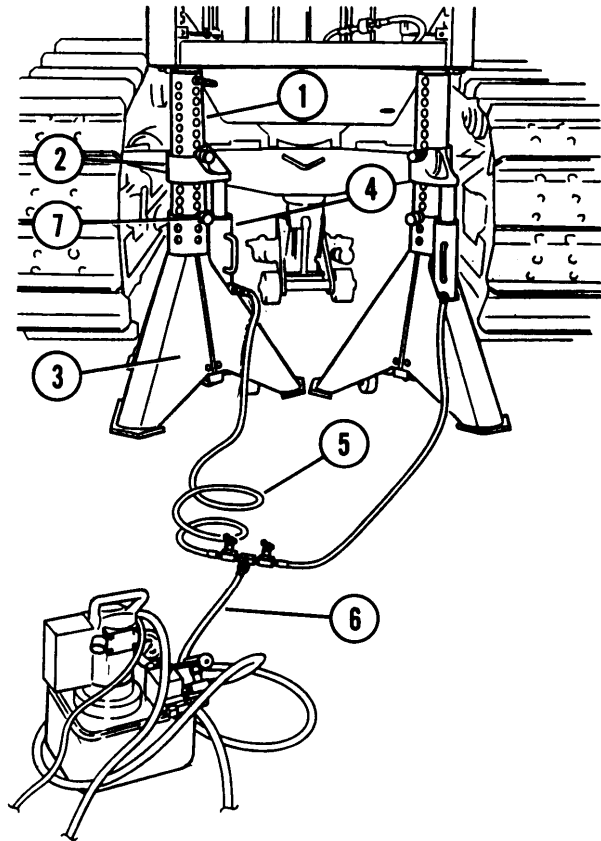
a. Operating/Adjusting Hydraulic Jack stands

**WARNING**

All damage or leaks to the hydraulic jack stands must be repaired before use. Failure to make repairs can cause serious injury or death.

(1) Assemble hydraulic jack stands:

- (a) Install extension tube (1) and collar (2) on stand (3).
- (b) Install hydraulic cylinder (4) in stand and under tab of collar.
- (c) Connect hydraulic lines (5) from throttle valves to each cylinder.
- (d) Connect hose (6) from valve tee to hydraulic pump.
- (e) Open both throttle valves and control valve on pump to make sure cylinders are fully retracted. If necessary, push down on extension tube.



**WARNING**

Make sure all jacks and blocking are properly placed and secure to prevent movement of item to be lifted. Failure to follow this precaution could result in serious or fatal injuries.

- (2) Put jack stand under item to be lifted. Make sure lifting point is sturdy.



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 11-12. GROUND HANDLING (Cont'd)
 

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(3) Lift the item using the following procedure:

(a) Close the control valve on hydraulic pump.

CAUTION

Extension tube may bind in stand when tube is lifted by hydraulic cylinder. Observe jack stands carefully during the lifting procedure. Tapping with a hammer may free binding.

(b) Operate pump to raise jack stands.

(c) If jack stands do not raise evenly, the throttle valve connected to the higher jack stand must be partially closed. While pumping, close the valve until the jack stands raise evenly when operating the pump.

WARNING

Extension tube can only be raised until the bottom hole of the extension tube is aligned with the top hole of the stand. Hydraulic jack stands become unstable if raised higher. Instability can allow the item to fall, causing personal injury or death.

(d) If the hydraulic cylinders are fully extended, but the item is not lifted enough, install a pin (7) through each stand and extension tube. This will keep the stand raised while the cylinders are retracted. If the stands are high enough, go to STEP (j).

(e) Open control valve on pump and remove pin above each collar.

(f) Retract hydraulic cylinders and lower collars.

(g) Install pin (8) in first hole above collars.

(h) Close control valve on pump and operate pump to raise jack stands.

(i) Repeat steps (d) through (h) only until the item is lifted high enough or the bottom hole of the extension tube is aligned with the top hole of the stand.

(j) Install pin (7) through each stand and extension tube. This will keep the stand raised and the hydraulic pressure can be removed by opening the control valve on the pump.

(4) Slowly lower the item, using the following procedure:

CAUTION

Extension tube may bind in stand when tube is lowered by retracting hydraulic cylinder. Observe jack stands carefully during the lowering procedure. Tapping tube with a hammer may free binding.

(a) Slowly open control valve on hydraulic pump. Allow hydraulic cylinders to retract completely.

11-12. GROUND HANDLING (Cont'd)

---

- (b) If the hydraulic cylinders are fully retracted, but the item is not lowered completely, close control valve on hydraulic pump.
- (c) Operate hydraulic pump until a hole in the extension tube and the stand are in alignment. Install a pin (7) in this hole for each stand.
- (d) Open control valve on hydraulic pump to retract hydraulic cylinders. Remove pin (8) from above each collar.
- (e) Close control valve on hydraulic pump. Operate pump to extend hydraulic cylinders and raise collars. Do not extend cylinders completely. Cylinders must be extended to remove the weight from the lower pins.
- (f) Install pins (8) in first hole above collars.
- (g) Operate hydraulic pump to lift item so lower pins (7) can be removed.
- (h) Repeat steps a through g until weight of the item is completely off the jack stands.
- (1) Remove hydraulic jack stands.

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 11-12. GROUND HANDLING (Cont' d)
 

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b. Jacking to Elevate TractorCAUTION

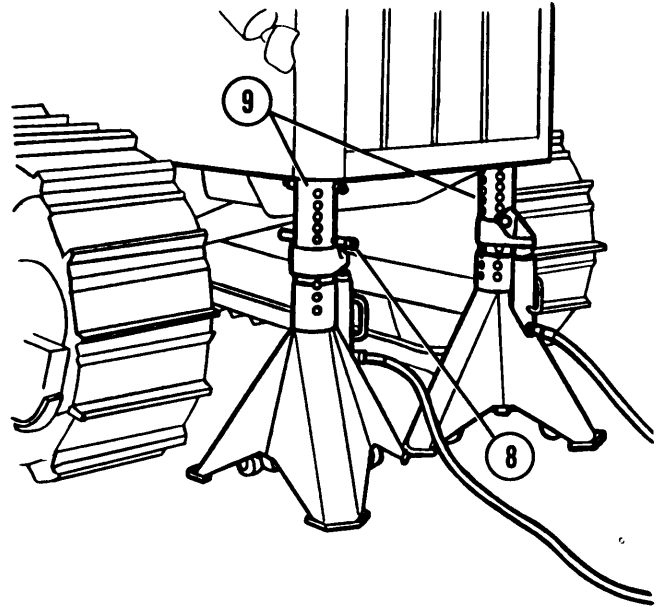
Tractor must not be driven onto wood blocks past centerline of idler. Tractor will begin to lower if driven past center of idler.

- (1) Put 8-inch wood blocks (1) in front of each track. Drive tractor up on wood blocks.

WARNING

Put wood blocks behind the tracks at the rear of the machine. Put the parking brake in the engaged position. This is so the machine will not move backwards when the front of the machine is lifted with hydraulic jacks.

- (2) While tractor is still in forward gear, engage parking brake. Put blocks behind tracks at the rear of the machine.
- (3) Move gear selector to neutral and stop the engine.
- (4) Put hydraulic jack stands (9) under main frame.
- (5) Move extension tube of hydraulic jack stands up to bottom of main frame. Install pin (8) in first hole above collar. Make sure pin fits into groove of collar.
- (6) Lift the front of the tractor using the hydraulic jack stands until the wood block under idlers can be removed. Refer to STEP a for lifting procedures.



11-12. GROUND HANDLING (Cont' d)

- (7) Remove wood blocks.
- (8) Put 30-ton hydraulic jack (10) under the center of the frame at the rear of the tractor.
- (9) Raise the hydraulic jack to lift rear of tractor.

**WARNING**

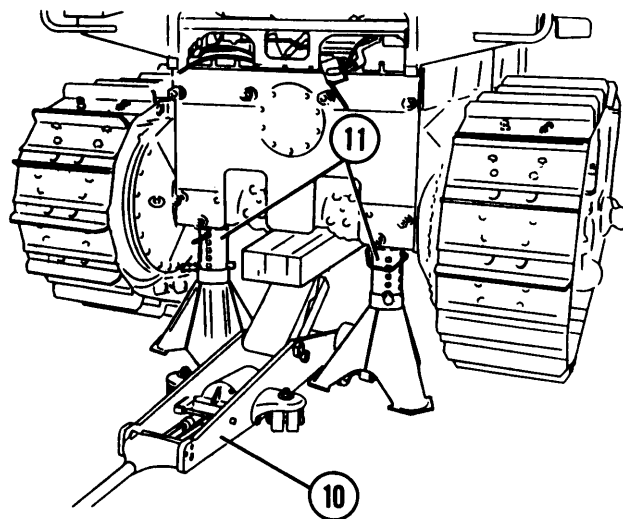
Keep tractor level when tractor is elevated on jack stands to maintain stability and safety.

- (10) Install two jack stands (11) under the rear of the frame at the corners of the steering clutch case. Use hydraulic jack to lower tractor onto jack stands.

**WARNING**

Tractor must be level and the lowest grouser must be 2 in. (50 mm) off the floor when tractor is elevated. Tractor must not be lifted any higher than necessary. Stability and safety will then be maintained.

- (11) Repeat STEPS 6 and 9, as often as necessary, until the lowest track grouser is 2 inches (50 mm) off the floor and the tractor is at a level position.



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 11-12. GROUND HANDLING (Cont' d)
 

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 WARNING
 

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Make sure all jacks and blocking are properly placed and secure to prevent movement of tractor. Use extreme care when operating tractor in the elevated position.

- (12) If tractor operation is necessary in the elevated position, use extreme care and slow engine speed.

c. Lowering Elevated Tractor

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 WARNING
 

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Make sure parking brake is engaged to prevent tractor from moving backwards when rear of tractor is lowered to the ground.

- (1) Make sure parking brake is engaged.
- (2) Position 30-ton hydraulic jack under the center of the frame at the rear of tractor.
- (3) Raise hydraulic jack to lift machine off jack stands. Remove jack stands from rear of tractor.

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 WARNING
 

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Put blocks behind the tracks at the rear of the tractor.

- (4) Slowly lower tractor to the ground and install blocks behind tracks at rear of tractor. Remove hydraulic jack.

## NOTE

Wood blocks must be installed under tracks to allow for clearance to remove hydraulic jack stands later.

- (5) Put wood blocks under front of both track idlers. Front of tractor may have to be raised to install wood blocks.
- (6) Slowly lower the front of the tractor, using the hydraulic jack stands, until the weight of the tractor is completely off the hydraulic jack stands. Refer to STEP a for lowering procedures.
- (7) Remove hydraulic jack stands.
- (8) Start engine and engage brakes.
- (9) Remove blocks from tracks at rear of tractor.
- (10) Release parking brake. Slowly release brakes to allow tractor to roll back off lifting assemblies. Only if necessary, put gear selector in reverse to move backwards.
- (11) Make track adjustments. See TM5-2410-237-20.
- (12) Install blade and pusharms. See TM5-2410-237-20.
- (13) Install rear implement:  
Ripper - See page 14-8  
Winch - See TM5-2410-237-20.

## CHAPTER 12

## WINCH MAINTENANCE

## Section I. DESCRIPTION AND DATA

## 12-1. GENERAL

Winch maintenance procedures not covered in this chapter can be found in TM5-2410-237-20.

## 12-2. PRINCIPLES OF OPERATION

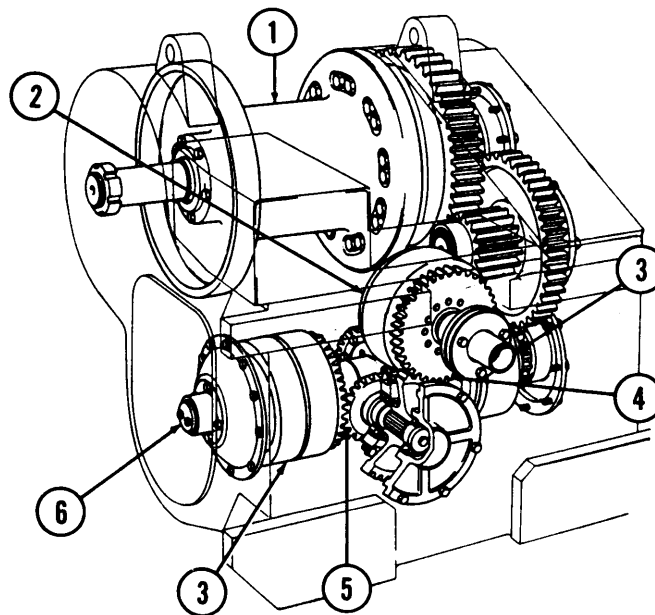
- a. Winch Mechanical Description. The winch is bolted directly to the tractor main frame. The splined winch input shaft plugs directly into tractor PTO shaft.

All winch functions are hydraulically actuated by means of a hydraulic control unit located inside the winch case. The control unit is connected to the operator's winch hand control lever by means of linkage. System hydraulic flow is provided by an engine mounted gear pump.

The winch case is fabricated steel with an integral drawbar. Access covers allow service to components without removing the winch from the tractor.

The tractor's transmission center shaft is the power source for winch. It is essentially an extension of tractor's main drive shaft driven by the output portion of the transfer case. The end of center shaft (6) is splined and acts as the tractor's power take-off (PTO). The winch input shaft is splined to plug directly into the tractor's PTO.

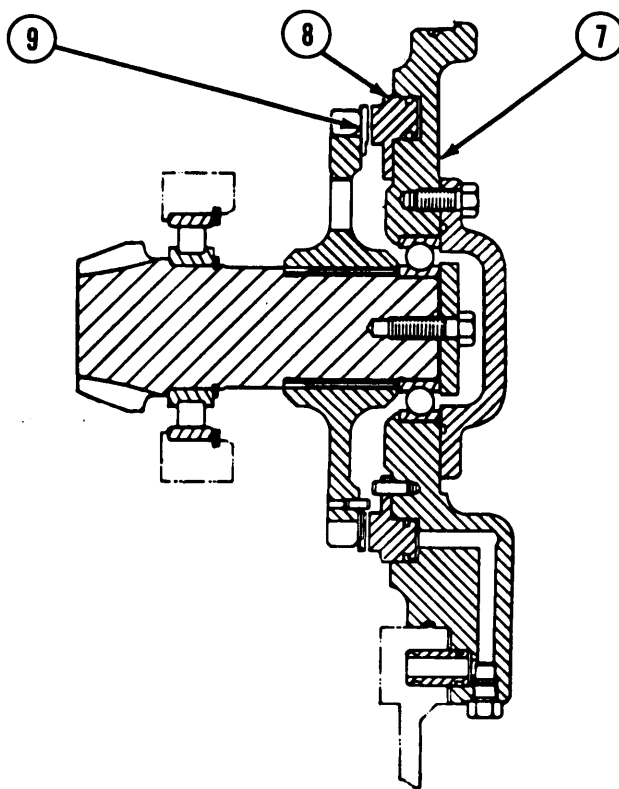
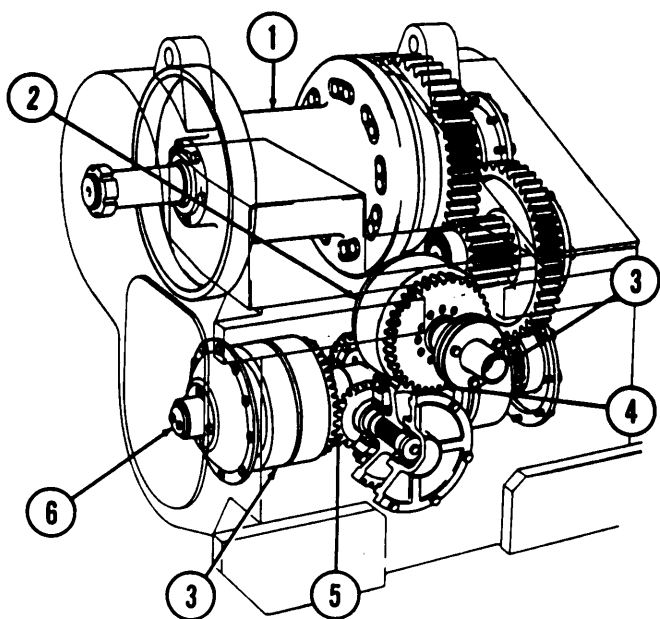
A high load on the winch will cause an increase in torque output and cable pull on winch drum (1). The hydraulic control valve controls input clutch (2) and directional clutches (3).



Input clutch (2) is a hydraulically activated disc-type oil clutch. There is no connection between the input shaft of the clutch and the output gear (4) until oil pressure causes a solid connection between clutch plates and clutch discs (engaged clutch). The operator moves a hand control lever to direct oil to the clutch to engage the clutch. Input clutch (2) can be modulated to provide inching control in the reel-in mode. In order to handle the engagement and disengagement modulation the winch uses four disc assemblies and four plates in the input clutch. When the input clutch is engaged, power goes through gears (4) to bevel gear and pinion (5).

A connection between gear and pinion (5) and shaft (6) is made by the directional clutches (3). The connection in clutches (3) is made by springs holding the discs against the plates (clutches engaged). Both clutches (3) are engaged until oil pressure of the hydraulic control system moves the piston of one clutch or the pistons of both clutches. This causes the discs and plates to move apart (clutch disengaged).

Directional clutches (3) turn in opposite directions. When both are engaged, the winch drum cannot turn. When the input clutch is engaged, one directional clutch must be disengaged. Disengagement of one clutch will cause the winch to "reel in". Disengagement of the other clutch will cause the winch to "reel out". This is the reason for the name, "directional clutch" because they change the direction that the cable moves.



when the winch control lever is in the brake on position, the viscous drag brake stops the winch from spooling cable in. A portion of the lube oil which is 32 Psi at low idle is sent through manifold (7) to piston (8). The force of the oil moves piston (8) to the left against disc (9) which is pinned to gear (10). The friction between the piston and disc is great enough to prevent the viscous drag of the input clutch from turning the bevel gear and shaft assembly.

- b. Winch Hydraulic System. The winch hydraulic system consists of a pump, a filter, a directional control valve, a pressure control valve and piping. The system reservoir is located in the bottom of the winch case. The same hydraulic oil is used as lubricating oil for the gearing, bearings and other moving parts of the winch.

The winch control valve allows the winch to be placed in any of four conditions: 1) Hold (Brake On); 2) Reel In; 3) Reel Out; or 4) Brake Off.

In the Hold condition, both directional clutches are engaged. The input clutch is disengaged, disconnecting the winch from the power takeoff. Engaging the two spring-applied directional clutches "locks up" the winch drive shaft and keeps the winch from turning. In this condition, a load can be towed using the winch cable.

For either Reel In or Reel Out, the input clutch must be engaged and the appropriate directional clutch must be disengaged. The opposite directional clutch remains engaged. Torque from the power takeoff shaft can then be transmitted through the input clutch, transfer gearing, the housing of the disengaged directional clutch, the winch shaft, planetary gearing and winch drive gears to the winch drum. Selecting the opposite direction of winch rotation, with the control valve, will cause the disengaged directional clutch to re-engage and the other directional clutch to disengage. The input clutch remains engaged.

placing the control valve in the Brake Off position will establish an Oil flow such that both directional clutches are disengaged while the input clutch remains disengaged. In this condition, cable can be spooled off the winch drum either by pulling the cable or by attaching the cable to an object and driving the tractor forward.

1. Winch Hold Position. In the hold position, the pump draws oil from the reservoir, through a strainer, and discharges the oil to an inlet port on the pressure control valve. Porting within the pressure control valve and the directional valve directs the oil flow, under low pressure, to the lubrication circuit. No pressure is applied to any of the clutches.
2. Reel Out Position. In the reel out position, the winch drum will be rotated, under power, in the direction necessary to unspool cable from the drum. To do this, the input clutch must be engaged and the right directional clutch must be disengaged. A sequence valve (17), built into the pressure control valve (2), insures that the input clutch will be fully engaged before the directional clutch is allowed to disengage.

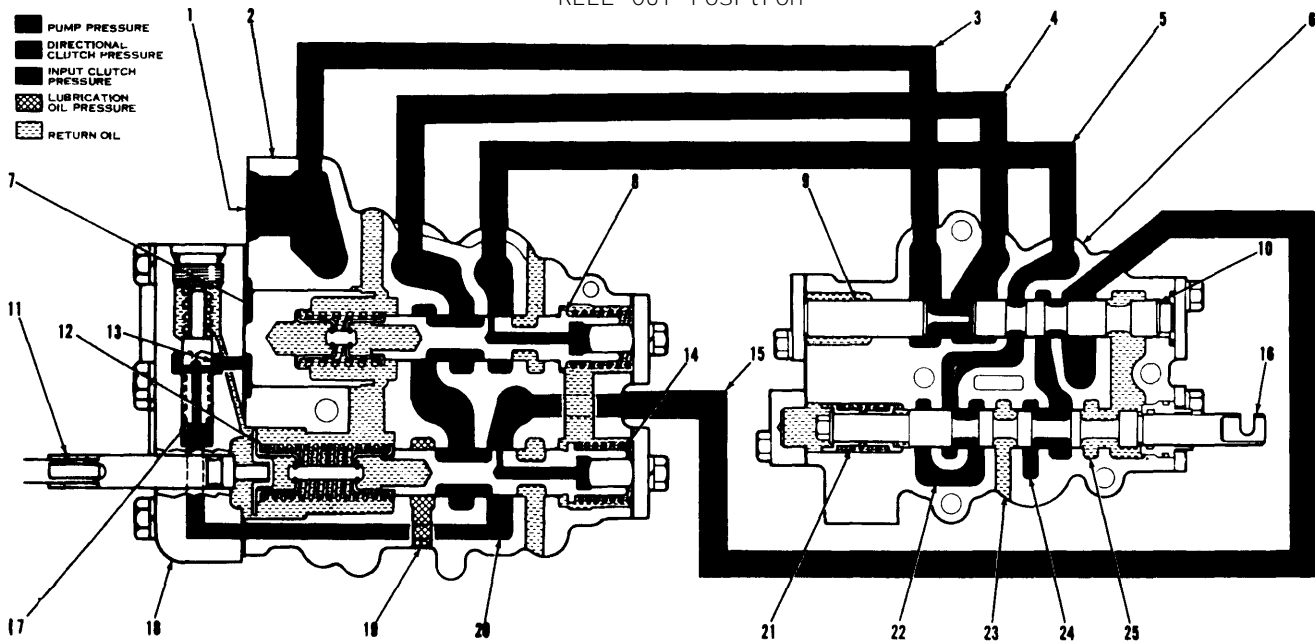
#### NOTE

The lag between input clutch engagement and directional clutch disengagement is of very short duration, by necessity. Allowing the input clutch to be engaged for any appreciable length of time while the winch shaft is locked up would stall the engine. In the following description, it is assumed that the control lever is moved briskly and fully into the "Reel Out" position.

Spool (16) moves out of valve body (6) and coupling (11) is moved into valve body (2), as the control lever moved into the "Reel Out" position. Inward



REEL OUT Position



CONTROL SYSTEM OIL FLOW SCHEMATIC  
(REEL OUT POSITION)

- |  |                      |                     |   |
|--|----------------------|---------------------|---|
| 1. Supply port.                              | 7. Load piston.      | 14. spool.          | 21. Centering spring.                                   |
| 2. Body of pressure control valve.           | 8. Spool.            | 15. Oil passage.    | 22. Fill chamber for the input clutch.                  |
| 3. Oil passage.                              | 9. stop.             | 16. Spool.          | 23. Drain.  |
| 4. Oil passage.                              | 10. spool.           | 17. Sequence valve. | 24. Fill chamber for the right side directional clutch. |
| 5. Oil passage.                              | 11. Coupling.        | 18. Cover.          | 25. Fill chamber for the left side directional clutch.  |
| 6. Body of valve for selection of direction. | 12. Spring assembly. | 19. Oil line.       |   |
|  | 13. Oil passage.     | 20. Oil passage.    |   |

movement of coupling (11) compresses spring (12) and also shifts spool (14) to the right. Spool (14) ports pump flow through passage (15) to chamber (24) and through passage (20) to sequence valve (17). Chamber (24) is connected to the right directional clutch. When pressure in the chamber below the dequence valve reaches 80 psi, the sequence valve will unseat. Oil then flows around the sequence valve and through passage (13) to load piston (7). The load piston will move spool (8) to the right, closing off pump flow to the chamber of spool (14) and opening passage (5) to pump flow. Oil flows through passage (5) and chamber (22) to the input clutch.

The pressure buildup in chamber (22) is reflected back to the slug chamber of SPOOL (8). This pressure, which is the input clutch operating pressure, builds quickly. At 300 psi ± 15 pressure in the slug chamber, when combined with the force of the spool return spring, will overcome the force imposed by load piston (7) and will shift spool (8) to the left.

The pressure in right directional clutch chamber (24) (presently at 80 psi) will now build quickly toward its maximum of 275 ± 15 psi. At a pressure of 180 psi, the directional clutch begins to release; at 275 psi it is fully released. Spool (14) will be shifted to the left by the combined force of the system pressure felt in the slug chamber and the spool return spring.

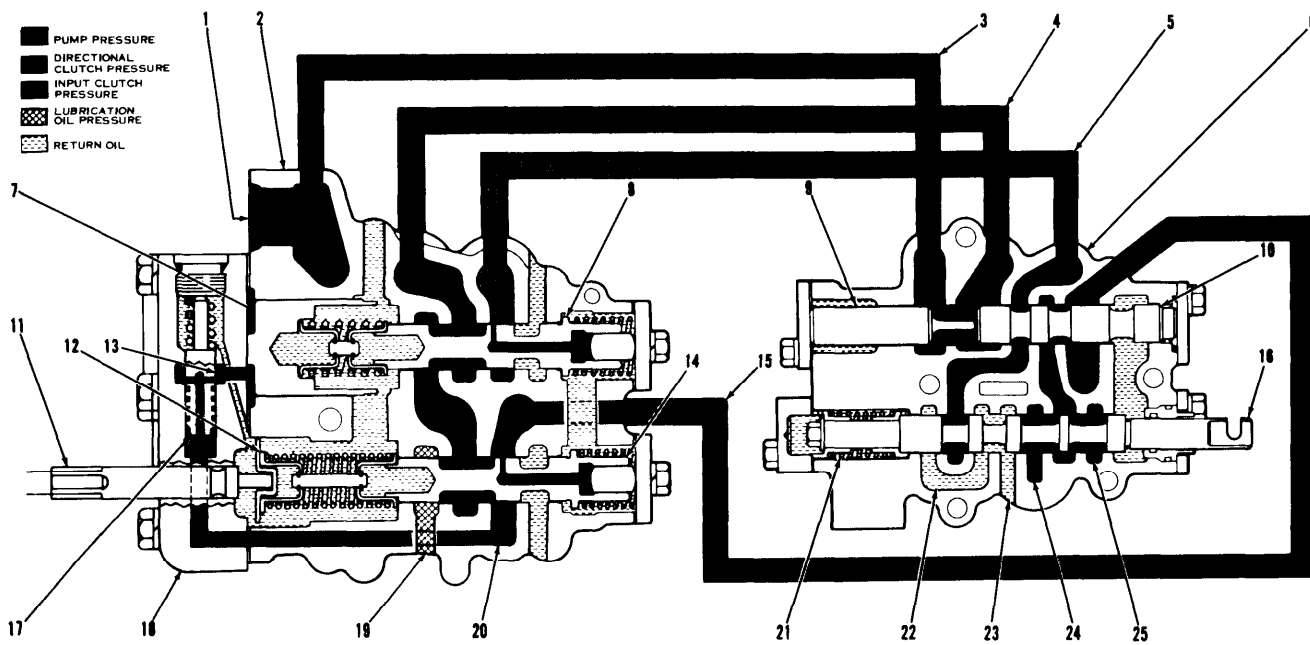
So long as the control lever is held in the "Reel Out" position, spools (8 and 14) will regulate the respective clutch operating pressures. In the case of the input clutch, operating pressure (300 ± 15 psi) is determined by the force of the load piston spring.

The operating pressure of the directional clutch is determined by the compression of spring (12), which can be varied by the amount that coupling (11) is moved into the valve body by the control lever. The design of spring (12) allows the directional clutch operating pressure to be regulated in a range of 180 to 275 psi, thereby varying winch drum speed.

3. Reel In Position. The sequence of operation for "Reel In" is identical to that for "Reel Out". The only difference is in control lever throw, which results in spool (16) being moved into valve body (6). Chamber (25) fills instead of chamber (24). Chamber (25) is connected to the left directional clutch and winch drum rotation will reverse.
4. Brake Off Position. In this position, the winch drum is free to rotate in either direction because both directional clutches will be disengaged. The input clutch will also be disengaged.

When in the Brake Off position, spool (16) is centered in valve body (6), connecting both chambers (24 and 25) to passage (15). The outlet from chamber (22) to the input clutch is blocked by spool (16). Coupling (11) is moved into valve body (2) in the same manner as described for "Reel Out" operation. The shifting of spools (8 and 14) and the function of sequence valve (17) is also the same. Passage (15) and chambers (24 and 25) will remain pressurized, keeping both directional clutches disengaged, until the control lever is returned to the "Hold" position.

**BRAKE OFF Position**



CONTROL SYSTEM OIL FLOW SCHEMATIC  
(BRAKE OFF POSITION)

- |  |                      |                     |   |
|--|----------------------|---------------------|---|
| 1. Supply port.                              | 7. Load piston.      | 14. spool.          | 21. Centering spring.                                   |
| 2. Body of pressure control valve.           | 8. SPOOL.            | 15. Oil passage.    | 22. Fill chamber for the input clutch.                  |
| 3. Oil passage.                              | 9. stop.             | 16. Spool.          | 23. Drain.  |
| 4. Oil passage.                              | 10. Spool.           | 17. Sequence valve. | 24. Fill chamber for the right side directional clutch. |
| 5. Oil passage.                              | 11. Coupling.        | 18. Cover.          | 25. Fill chamber for the left side directional clutch.  |
| 6. Body of valve for selection of direction. | 12. Spring assembly. | 19. Oil line.       |   |
|  | 13. Oil passage.     | 20. Oil passage.    |   |

Section II. WINCH MAINTENANCE PROCEDURES

12-3. WINCH MAINTENANCE TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
12-4	Winch Assembly - Repair	12-7
12-5	Winch Control Lever and Linkage - Replace	12-48
12-6	Winch Control Valve - Repair	12-54
12-7	Winch Gear Pump - Repair	12-64
13-13	Hydraulic Lines and Fittings - Repair	13-77

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## 12-4. WINCH ASSEMBLY - REPAIR

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This task covers:

- a. Disassembly
  - b. Assembly
  - c. Winch System Test
  - d. Place In Service
- 

### INITIAL SETUP

#### Applicable Configurations

Winch Model

#### Common Tools

Shop Equipment, General Repair  
NSN 4940-00-287-4894  
Lifting Equipment 200 lbs.

#### Special Tools

Gaging Bars (3) - 7.023±.001  
For Winch Tests:  
8T0846 Pressure Gage 10-60 psi  
8T0856 Pressure Gage 0-600 psi  
(quantity 4)  
Straps (1/2 Ton capacity)  
Spanner Wrench 2P2345  
Lifting Bracket FT120

#### Materials/Parts

Seal (50), (56)  
Wire  
Liquid Gasket (App. B, Item 3)  
Gasket (4), (60)  
Preformed Packing (7), (13), (23),  
(28), (37), 46), (55), (66), (69),  
(87), (88), 89), (93), (104), (121),  
(142), (148), (185), (186), (187)  
Lubrication Oil OE/HDO-30 (Refer to  
L05-2410-237-12)  
Wood Blocks 2' X 2" X 4"  
Two 3/8" - 16NC 2" Long  
Forcing Screws  
One 3/4" - 10NC Eyebolt  
Two 1 3/4" X 5/8" - 11NC Capscrews  
Two 2" X 5/8" - 11NC Guide Pins

#### Equipment Condition

Winch oil drained. See TM5-2410-237-20.  
Winch control valve removed. See TM5-2410-237-20.  
Winch magnetic strainer removed. See TM5-2410-237-20.  
Winch oil filter removed. See TM5-2410-237-20.  
Winch breather removed. See TM5-2410-237-20.  
Winch drawbar pin removed. See TM5-2410-237-20.  
Winch cable assembly removed. See TM5-2410-237-20.  
Winch removed from tractor. See TM5-2410-237-20.

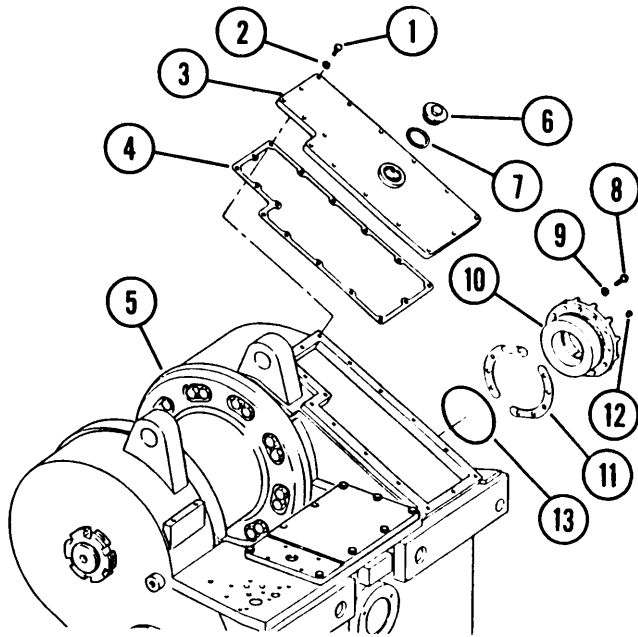
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12-4. WINCH ASSEMBLY - REPAIR (Cont' d)

a. Disassembly

(1) Idler gears

- (a) Use a wrench to remove sixteen capscrews (1), lockwashers (2), cover plate (3) and gasket (4) from idler gear compartment of case (5). Use a wrench to remove plug (6) and gasket (7) from cover (3). Discard gasket (4) and preformed packing (7).
- (b) Use a wrench to remove ten capscrews (8) and ten washers (9) holding bearing cage (10) to winch case (5).
- (c) Install two 3/8-16 forcing screws into the forcing holes of the bearing cage (10). Alternately tighten forcing screws to remove cage (10) and shims (11).



NOTE

Keep the shims with the cage for use during installation.

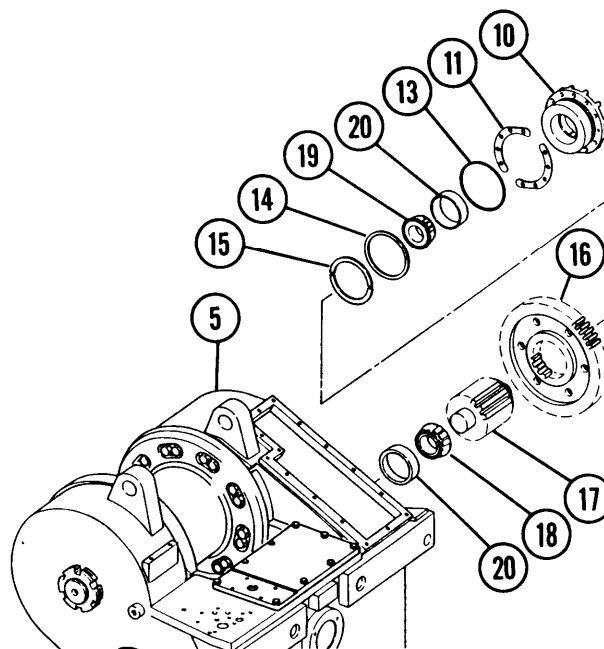
- (d) Use a plug socket to remove plug (12) from cage (10).
- (e) Remove and discard preformed packing (13) from bearing cage (10).

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**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

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- (f) Remove retaining ring (14) and two piece plate (15) that hold idler gear (16) in the gear assembly.
- (g) Pull pinion gear assembly (17) part way out of the idler gear (16). Use one hand to balance idler gear until pinion gear is out of the way. Weight of the pinion gear is 38 lbs.
- (h) Let idler gear (16) roll slowly to one side against the case. Remove the pinion gear (17) from the case. Remove idler gear (16) from the case. Weight of the idler gear is 40 lbs.
- (i) Remove bearing cones (18 and 19) using a bearing puller.
- (j) Remove bearing cups (20) from the bearing cage (10) and case (5).



12-4. WINCH ASSEMBLY - REPAIR (Cont'd)

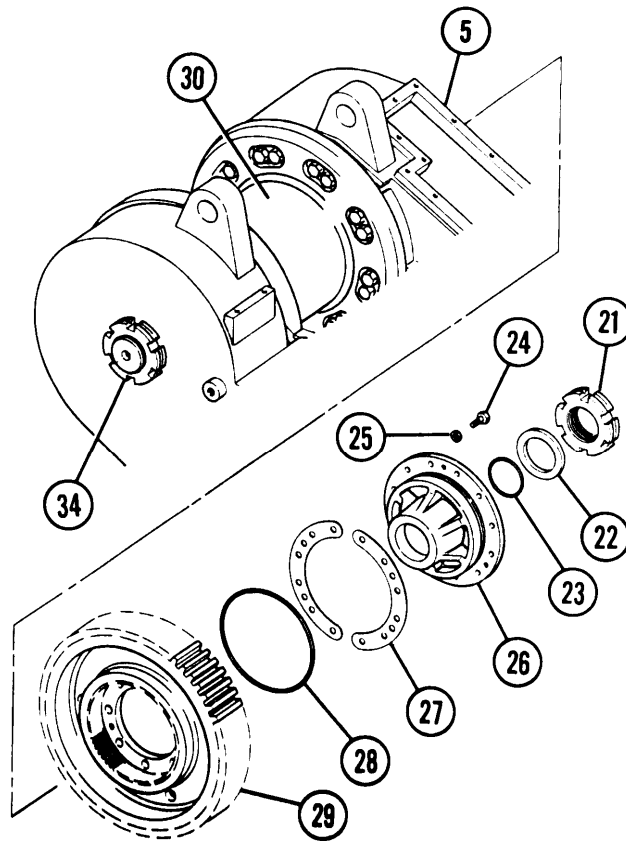
(2) Winch drum

- (a) Use a spanner wrench (2P2345) and a torque multiplier to remove nut (21).
- (b) Remove washer (22) and preformed packing (23). Discard preformed packing (23).
- (c) Remove twelve capscrews (24) and twelve washers (25) from drive shaft support flange (26) using a wrench.

**NOTE**

Keep shims (27) with drive shaft support flange (26) for use during installation.

- (d) Install three forcing screws of the correct size in flange (26) and tighten evenly. Remove flange and shims (27). Remove forcing screws.
- (e) Remove and discard preformed packing (28) from flange (26).
- (f) Place a wood block between drum drive ear (29) and case (5). The block will hold the drum in position during the following steps.
- (g) Remove all but three drum capscrews (31) and washers (32). The three remaining capscrews will hold drum support flange (33) in place when drum shaft (34) is removed.
- (h) Use a spanner wrench to remove nut (35), washer (36) and preformed packing (37) from other end of drum shaft (34).



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**12-4 WINCH ASSEMBLY - REPAIR (Cont'd)**


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**NOTE**

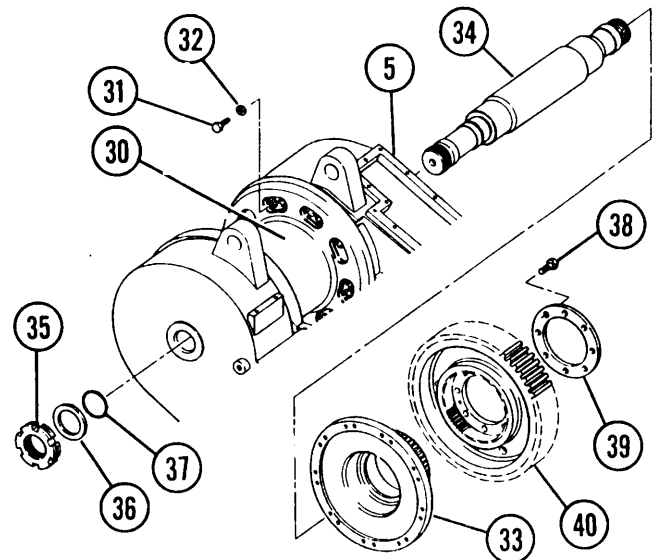
If necessary, install a forged eyebolt of the correct size in left end of drum shaft (34) and put a bar through the eyebolt to hold shaft in place when nut (35) is removed.

- (i) Use a wrench to remove eight capscrews (38) and bearing retaining ring (39) from drum drive gear (40).

**NOTE**

The capscrews used in the following step must be shorter than the original capscrews by the thickness of the retaining ring (39) just removed.

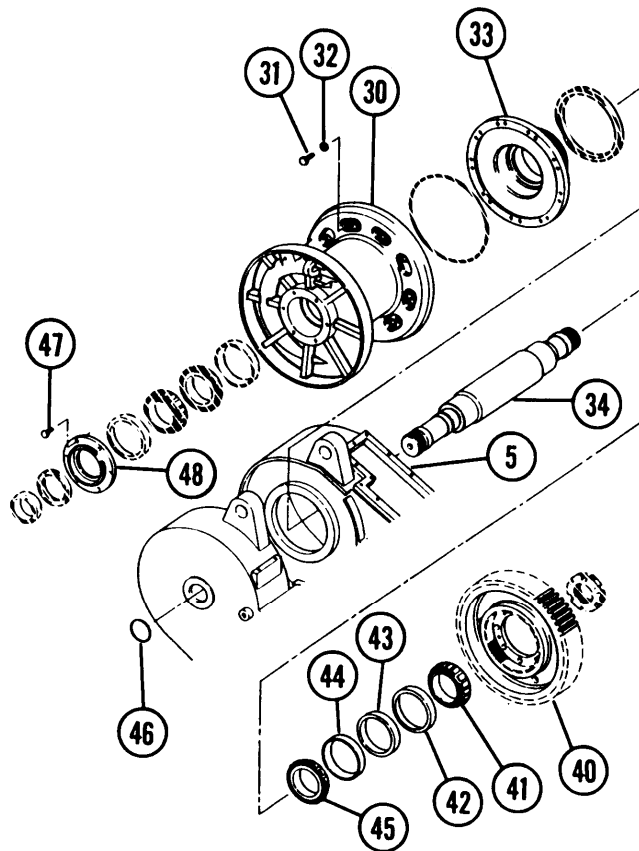
- (j) Use a wrench to install two capscrews into support flange (33) to hold drive gear (40) in place when drum shaft (34) and bearings are removed.
- (k) Remove wood block between drive gear (40) and case (5). Turn drum (30) until the two forcing screw holes in the drive gear line up vertically.
- (l) Thread nut (21) on shaft (34).
- (m) Put a wood block and a floor jack under the right side of the drum (30).





## 12-4. WINCH ASSEMBLY - REPAIR (Cont'd)

- (n) Install tooling on end of drum shaft. Fasten lifting equipment to the shaft.
- (o) Use a hydraulic puller to pull on shaft (34) until bearing assembly (41 through 45) is out of the drum drive gear (40).
- (p) Pull shaft (34) out of drum (30) partway, then slide hoist toward center of shaft (34). Remove shaft. Weight of shaft is 150 lbs.
- (q) Remove bearing assembly (41 through 45) and preformed packing (46) from shaft (34). Discard preformed packing (46).
- (r) Remove the two capscrews that hold the drum drive gear (40) and install two guide pins and two forcing screws of the correct size.
- (s) Tighten the forcing screws evenly to push drive gear (40) off spline and onto guide pins. Remove forcing screws.
- (t) Fasten a (FT 120) lifting bracket to lifting equipment and to top forcing screw hole in drive gear (40).
- (u) Remove guide pins and lower hoist to set drive gear (40) in case. Use a block of wood to hold gear in position in case (5). Remove lifting bracket from gear.



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**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

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- (v) Fasten lifting equipment to drive gear (40). Lift gear until block can be removed. Remove block, then remove drive gear (40) from case (5). Weight of drive gear is 126 lbs.
- (w) Fasten lifting equipment to drum (30). Remove the three capscrews (31) and three washers (32) that were left in the drum.
- (x) Remove floor jack and block from underneath drum.
- (y) Install two eyebolts of the correct size in drum support flange (33).
- (z) Place pry bar through the eyebolts. Pull support flange (33) from drum (30).
- (aa) Fasten a wire from one eyebolt to the boss outside case (32) to keep flange (33) in position when drum (30) is removed.

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**WARNING**

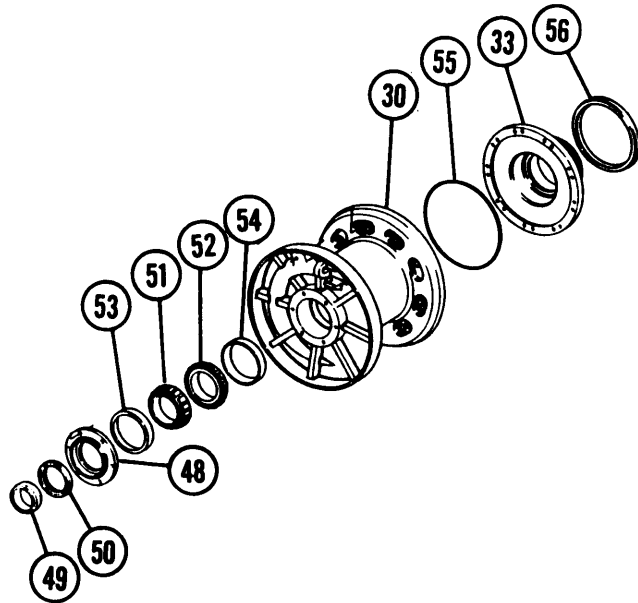
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Use caution when handling drum (30) to prevent damage to equipment or serious injury.

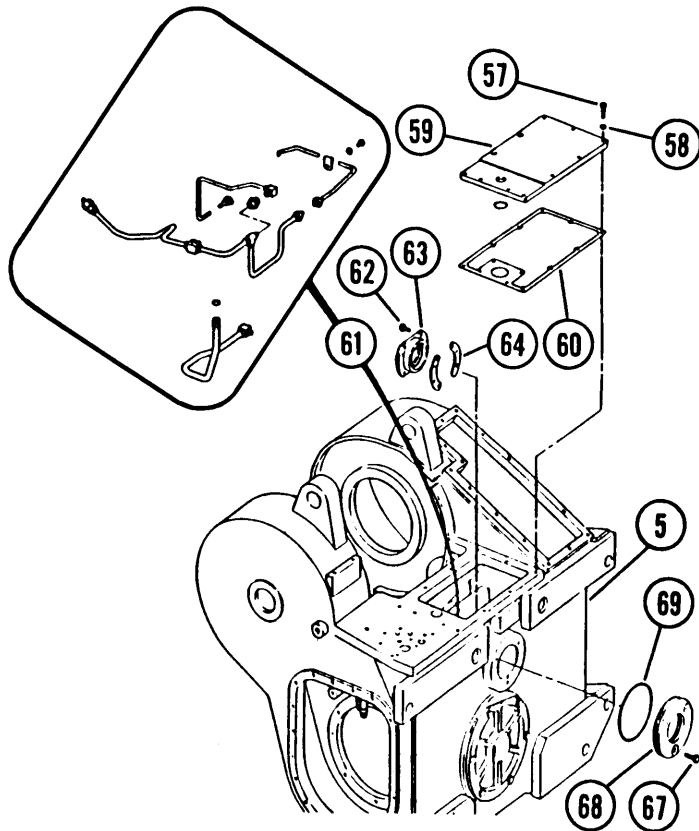
- (ab) Remove drum (30) from case (5). Weight is 261 lbs.
- (ac) Use a wrench to remove six capscrews (47) that hold bearing retainer (48) to drum (30).
- (ad) Install two forcing screws of the correct size and remove retainer (48).

**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

- (ae) Remove spacer (49) and seal (50) from retainer (48). Discard seal (50).
- (af) Remove two cones (51 and 52) from drum (30).
- (ag) Remove cups (53 and 54) from retainer (48) and drum (30).
- (ah) Remove and discard preformed packing (55) from drum (30).
- (ai) Fasten lifting equipment to support flange (33). Remove the wire and eyebolts and remove support-flange. Weight is 70 lbs.
- (aj) Remove and discard lip seal (56) from case (5).



- (3) Input clutch
  - (a) Use a wrench to remove nine capscrews (57), washers (58) cover (59) and gasket (60). Discard gasket (60).
  - (b) Disconnect lines (61) as necessary from winch case (5).
  - (c) Use a wrench to remove four capscrews (62) that hold input clutch bearing cage (63) in place.
  - (d) Remove bearing cage (63) and shims (64). keep shims with cage for installation.
  - (e) Fasten lifting equipment and strap to clutch assembly.

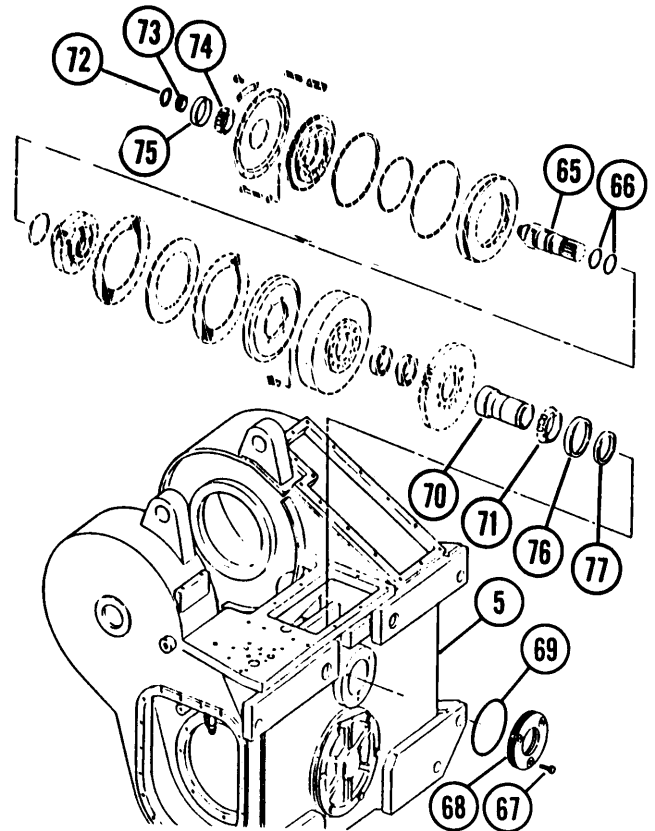


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**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**


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- (f) Raise clutch assembly and remove shaft (65). Remove and discard preformed packing (66) on shaft (65).
- (g) Remove clutch assembly from case (5). Weight is 150 lbs.
- (h) Use a wrench to remove three capscrews (67), retainer (68) and preformed packing (69). Discard preformed packing (69).
- (i) Remove coupling (70) from case (5).
- (j) Remove bearing cone (71) from coupling (70) with a bearing puller.
- (k) Remove rings (72) and carrier (73) from shaft (65).
- (l) Remove bearing cone (74) from shaft (65) with a bearing puller.
- (m) Remove bearing cup (75) from cage (63).
- (n) Remove bearing cup (76) and seal (77) from retainer (68).




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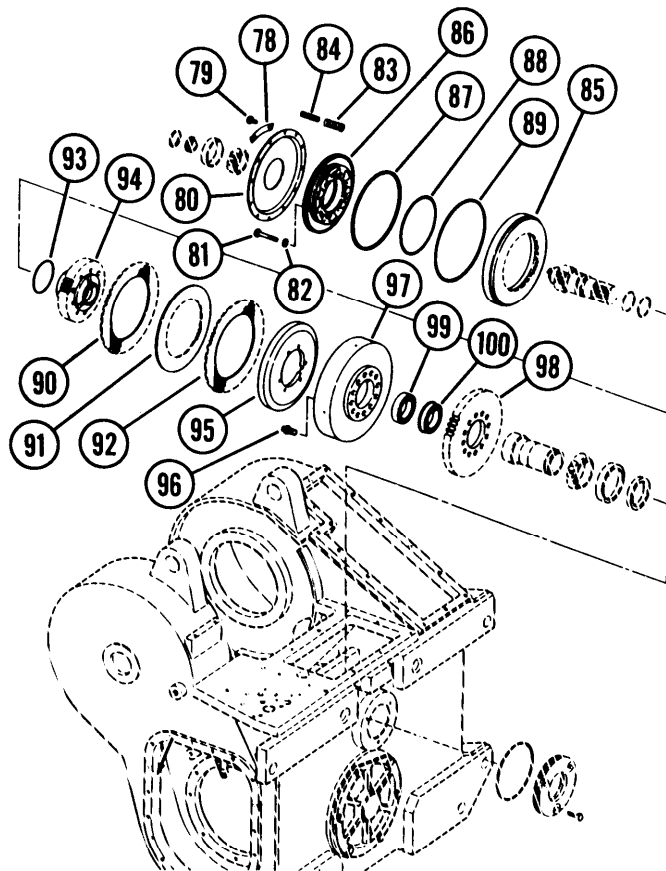
**WARNING**


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Capscrews on clutch cover plate are under spring tension. Remove slowly to avoid injury.

**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

- (o) Bend down locks (78) and use a wrench to remove twelve capscrews (79) slowly and evenly. Remove plate (80).
- (p) Use a wrench to remove six clutch tie capscrews (81) and six washers (82). Remove six of each springs (83 and 84).
- (q) Remove piston (85) and manifold (86) as a unit.
- (r) Remove manifold (86) from piston (85).
- (s) Remove and discard rings (87 and 88) and seal (89) from piston (85).
- (t) Remove first clutch disc (90), plates (91) and second clutch disc (92).
- (u) Remove and discard seal (93) from clutch hub (94).
- (v) Remove clutch hub (94).
- (w) Remove pressure plate (95).
- (x) Use a wrench to remove twelve capscrews (96) and ring gear (97) from drive gear (98).
- (y) Remove bearing (99) from ring gear (97).
- (z) Remove bearing (100) from drive gear (98).



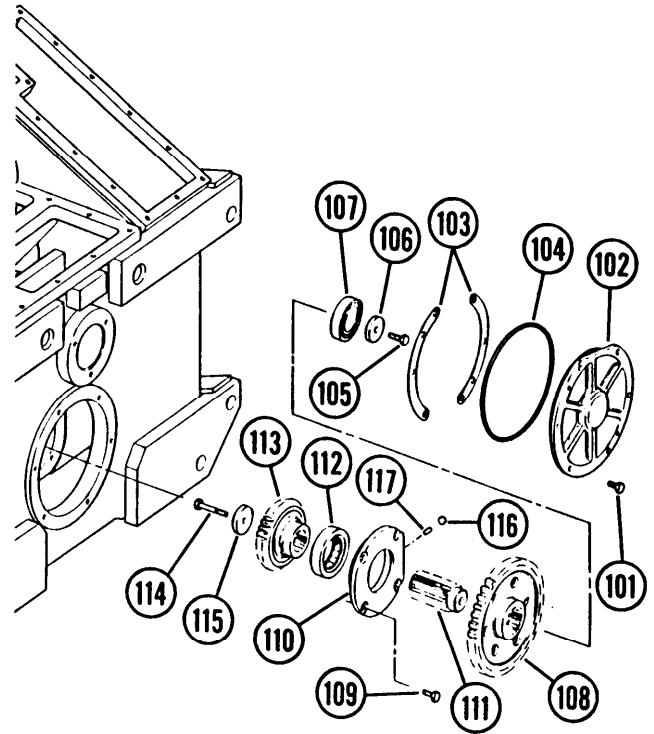
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**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**


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## (4) Winch pinion

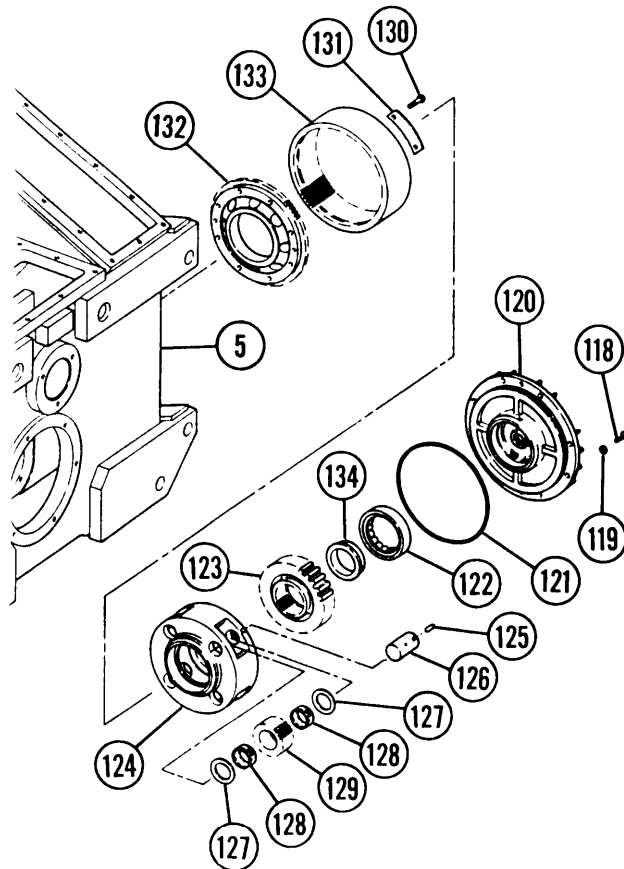
- (a) Use a wrench to remove six capscrews (101). Install two forcing screws into bearing cage (102) and tighten evenly until bearing cage is removed.
- (b) Remove shims (103) and keep with bearing cage (102). Remove preformed packing (104) from bearing cage. Discard preformed packing (104)0
- (c) Use a wrench to remove capscrew (105) and plate (106).
- (d) Use a puller to remove bearing (107) and drive gear (108).
- (e) Use a wrench to remove four capscrews (109). Install two forcing screws and loosen cage (110).
- (f) Remove cage (110), shaft (111), bearing (112) and pinion (113) as a unit.
- (g) Use a wrench to remove capscrew (114) and plate (115). Remove pinion (113) from shaft (111).
- (h) Remove plug (116) and dowel (117) from cage (110).
- (i) Remove bearing (112) from case with a bearing puller.



**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

(5) Planetary carrier

- (a) Use a wrench to remove eight capscrews (118) and eight washers (119) from cover (120) on planetary carrier assembly. Install two guide pins in place of capscrews (118).
- (b) Remove bearing cover (120) with two 3/8"-16NC forcing screws.
- (c) Remove and discard preformed packing (121).
- (d) Remove bearing (122) and drive gear (123). (No tools are needed. The bearing will come off easily.)
- (e) Remove planetary assembly (124 through 129) from shaft (not shown).
- (f) Use a wrench to remove eight capscrews (130) and four plates (131) from cage (132).



**NOTE**

Ring gear (133) will not come out through bearing cover (120) opening. Before ring gear is removed, drum drive gear (not shown) must be removed first. Refer to STEP 2.

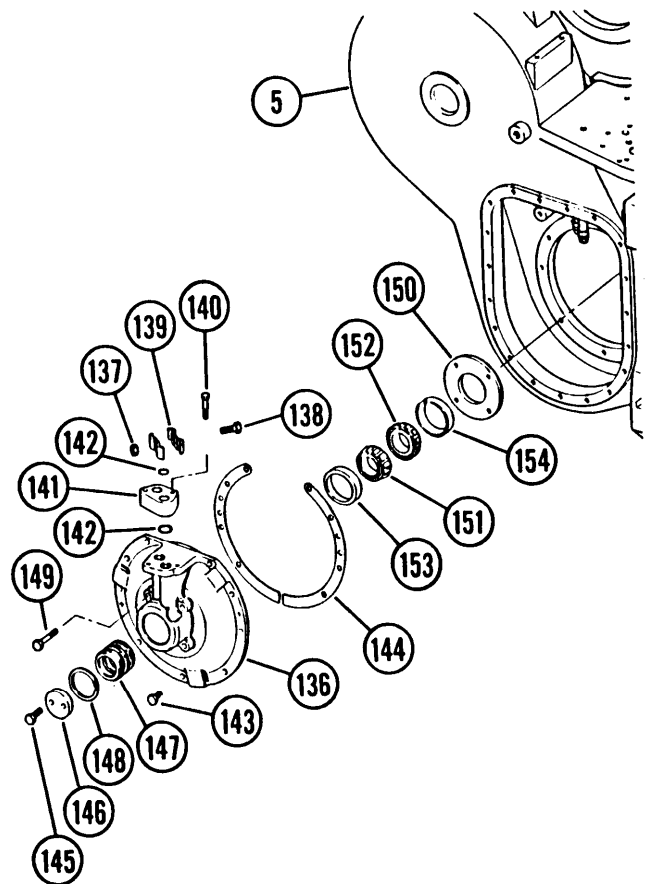
- (g) Slide ring gear (133) off cage (132) and remove through opening in top of case (5).
- (h) Remove shaft bearing cage (132) from shaft (not shown). (No tools are needed for removal. The cage will slide freely over the bearings).

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**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**


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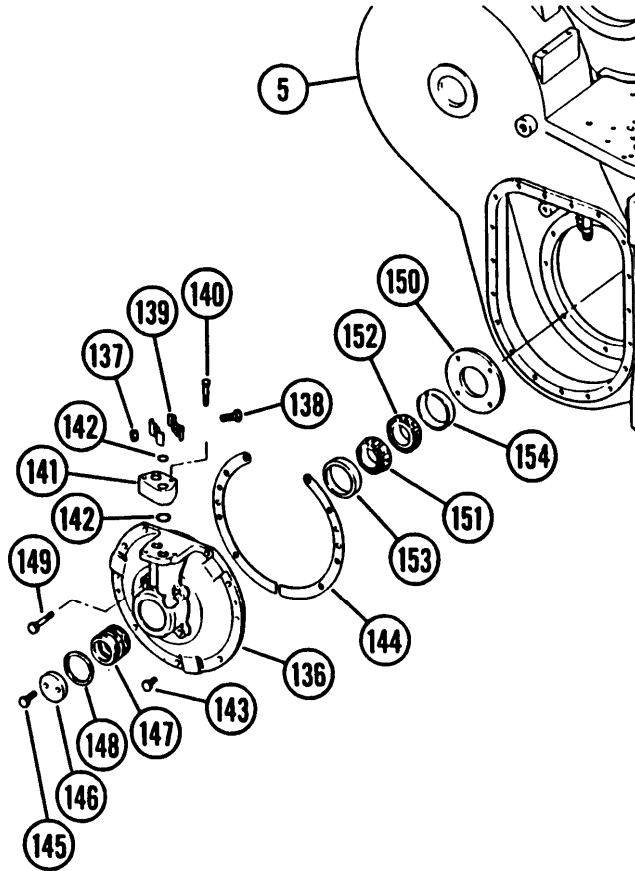
- (i) Push pin (125) into shaft (126).
  - (j) Push shaft (126) out of carrier (124).
  - (k) Remove gear (129), bearings (128) and thrust washers (127) from carrier (124).
  - (l) Repeat STEPS j, k and l for the three remaining pins.
  - (m) Remove pins (125) from shafts (126).
  - (n) Remove bearing race (134) from gear (123).
- (6) Winch bevel gear and shaft
- (a) Lower lifting equipment through winch case (5) and fasten to center of clutch shaft (135).
  - (b) Disconnect oil tubes not shown) from manifold (136) by using a wrench and removing two nuts (137), two capscrews (138) and clamps (139).
  - (c) Use a wrench to remove two capscrews (140) to remove block (141) and four preformed packings (142). Discard preformed packings (142).
  - (d) Remove nine manifold capscrews (143) from manifold (136).
  - (e) Remove manifold (136) and shims (144) with two 3/8-16NC forcing screws. Keep shims with manifold for installation.





**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

- (f) Use a wrench to remove two capscrews (145) and plate (146) from end of shaft (135).
- (g) Remove seal carrier (147) and seals (148) from manifold (136). Discard seals (148).
- (h) Use a wrench to remove capscrews (149) and retainer (150) from manifold (136).
- (i) Remove bearing cones (151 and 152) from shaft (135).
- (j) Use a bearing puller to remove bearing cup (153) from manifold (136). Use bearing puller to remove bearing cup (154) from retainer (150).
- (k) Move shaft (135) part way out of case (5).
- (l) Move lifting equipment so it is outside housing, and remove clutch shaft (135). Weight is 350 lbs.
- (m) Stand clutch shaft (135) vertically on blocks.
- (n) Use a wrench to remove eight capscrews (155) and use forcing screws to remove plate (156).



**WARNING**

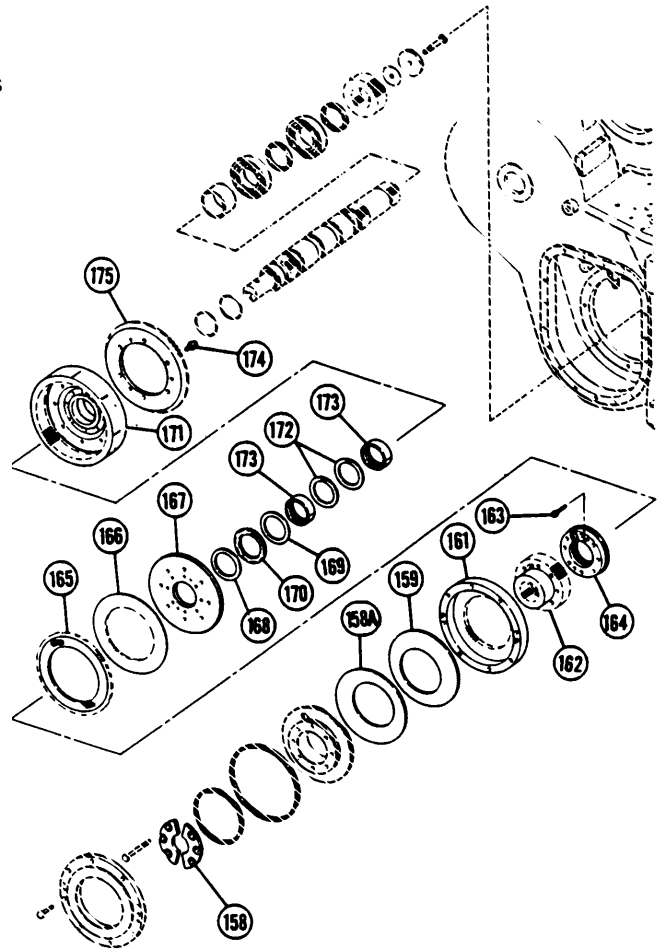
There is spring tension on the bolts in the following step. Spring throw can cause personal injury. Unscrew each capscrew a little at a time in rotation. Do not remove the capscrews too fast.

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**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**


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- (o) Use a wrench to remove six of eight capscrews (157) and plates (158). Remove capscrews slowly so clutch springs (158A and 159) release evenly.
- (p) Remove remaining two capscrews (157) and remove manifold (160).
- (q) Remove clutch springs (158A and 159).
- (r) Remove hub assembly (161).
- (s) Remove hub (162).
- (t) Use a wrench to remove eight capscrews (163) and manifold (164).
- (u) Remove clutch discs (165) and plates (166).
- (v) Remove reaction plate (167).
- (w) Remove washers (168 and 169) and thrust bearing (170).
- (x) Remove clutch housing (171) from shaft.
- (y) Remove bearing spacers (172) and bearing ring (173).
- (z) Use a wrench to remove six capscrews (174).
- (aa) Remove gear (175).



**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

- (ab) Repeat STEPS (n through aa) for other clutch assembly.
- (ac) Use a wrench to remove capscrew (176), washer (177) and shim (178).
- (ad) Remove gear (179) and spacer (180) from shaft (135).
- (ae) Separate spacers (181 and 182) and bearings (183 and 184).
- (af) Remove and discard preformed packings (185, 186, and 187).

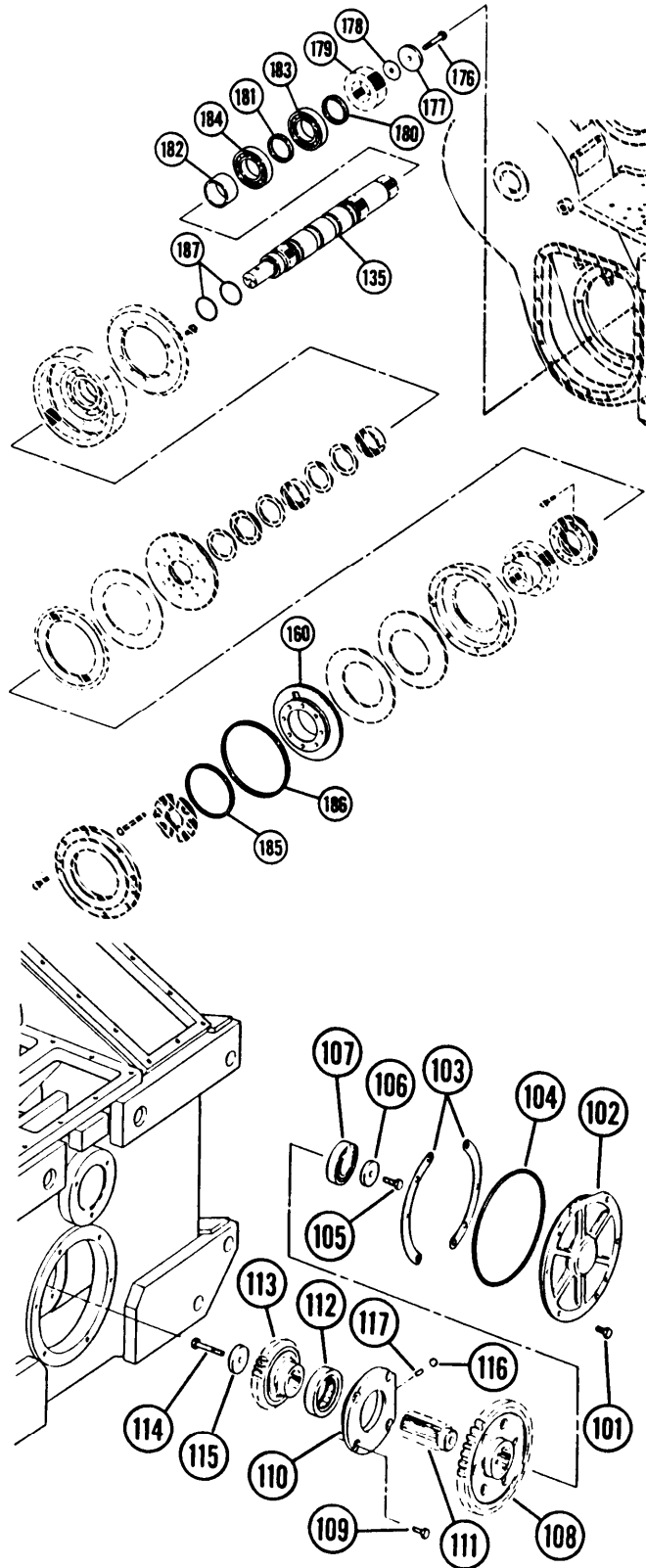
**b. Assembly**

- (1) Winch pinion

**NOTE**

The pinion assembly is required for adjusting the bevel gear and shaft assembly. Therefore, it should be assembled first, but not installed at this time! Make sure hole in bearing (112) is aligned with hole in cage (110) when bearing is installed.

- (a) Cool bearing (112) to approximately 32° F. Install bearing (112) in cage (110).



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**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**


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- (b) Install dowel (117) through cage (110) and into bearing (112).
- (c) Install plug (116).
- (d) Cool shaft (111) and position bearing (107) on shaft (111).

**NOTE**

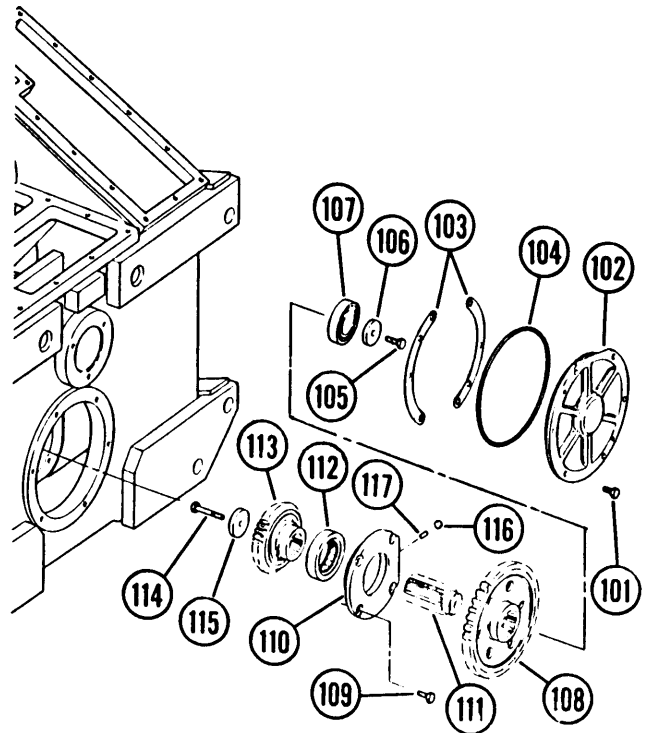
Bearing (107) must be installed with longer end towards drive gear (108).

- (e) Install plate (106) and use a socket to install capscrew (105). Tighten capscrew to a torque of  $36 \pm 2$  lb. ft.
- (f) Install drive gear (108) on shaft (111).
- (g) Install bearing cage (110) on pinion (113).
- (h) Install pinion (113) on shaft (111).
- (i) Install plate (115) and capscrew (114) on shaft (111) using a socket. Tighten capscrew to a torque

**NOTE**

Do not install preformed packing (104), shims (103) or capscrews (101) at this time.

- (j) position shaft assembly (105 through 114) on cage (102) and put pinion assembly aside.



**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

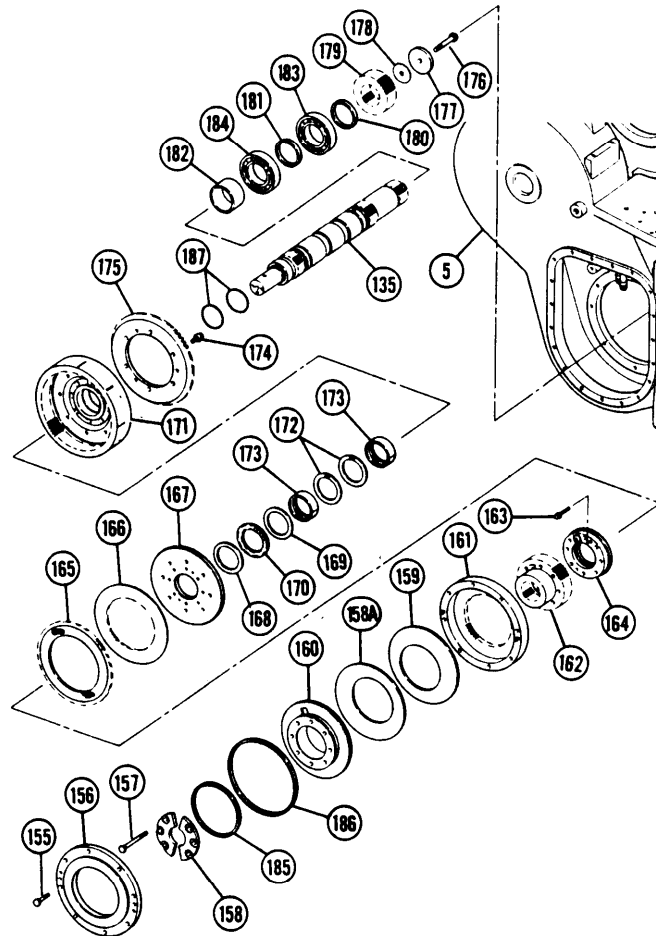
(2) Winch bevel gear and shaft assembly.

- (a) Install thrust bearing (170) and washers (168 and 169) in clutch housing (171).
- (b) Install spacers (173) and washers (172) onto shaft (135).
- (c) Install reaction plate (167) in clutch housing (171).
- (d) Install manifold (164) on plate (167). Align threaded bores in manifold (164) with threaded bores in plate (167),

**NOTE**

If holes will not line up, turn plate over and install manifold again.

- (e) Install two guide pins to keep threaded bores aligned and to keep manifold (164) in position.
- (f) Install hub (162) on pins and manifold (164). Make sure oil passage in hub is aligned with oil passage in manifold (164).
- (g) Install clutch plates and discs (165 and 166). Make sure bottom clutch plate is not under hub (162).
- (h) Install hub assembly (161) with two capscrews (163).
- (i) Install clutch springs (158A and 159) with the inside diameters against each other.



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**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

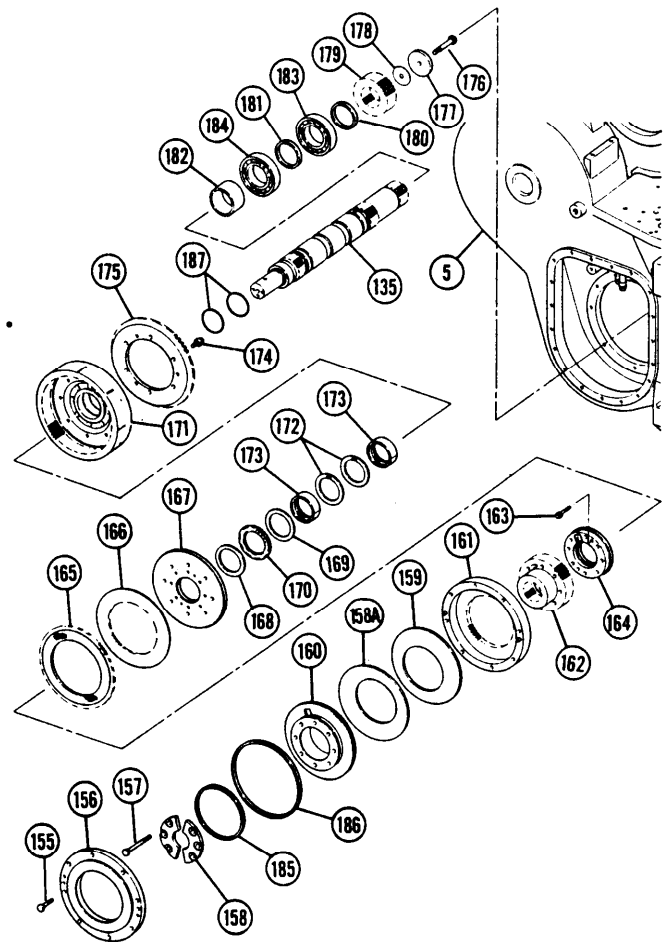

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- (j) Lubricate seals (185 and 186) with a small amount of oil and install on manifold (160).
- (k) Install manifold (160).
- (l) Use a wrench to install two capscrews (157) at this time. Doing so compresses spring which allows plates to be installed. See photo. Remove guide pins and install plates (158) with six capscrews (157). Use a socket to tighten capscrews to a torque of  $36 \pm 2$  lb. ft.

**NOTE**

If all six capscrews cannot be installed, repeat STEPS 2 (2b) through (2k) above. Check alignment of each part as it is installed.

- (m) Use a socket to install plate (156), eight capscrews (155) and plate on hub assembly (161). Tighten capscrews (155) to a torque of  $36 \pm 2$  lb. ft.
- (n) Repeat STEPS (a through n) for second clutch assembly.
- (o) Lubricate preformed packings (187) and install on shaft (135).
- (p) Install shaft (135) through clutch assembly.



**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

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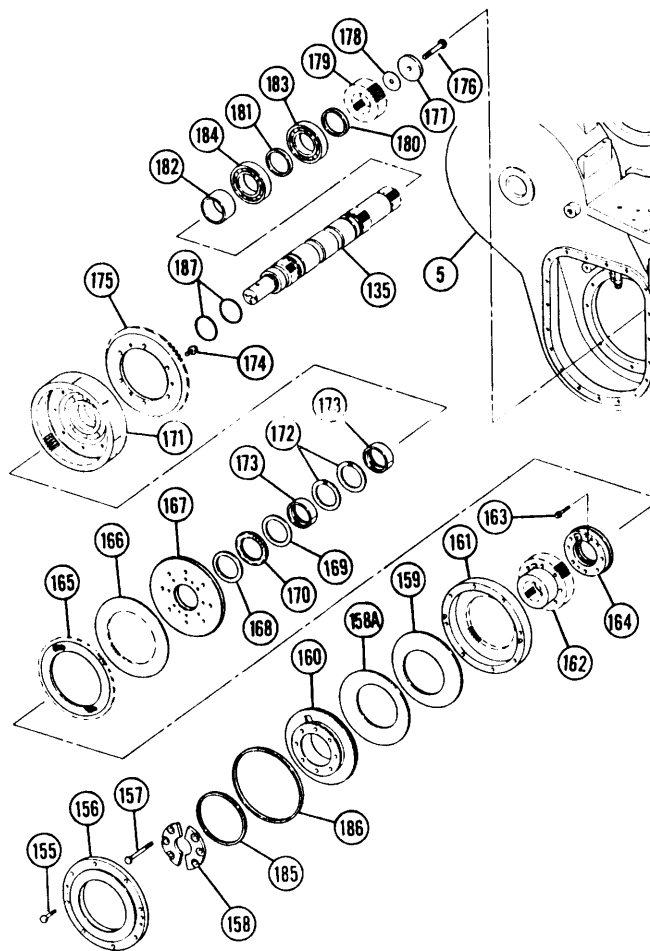
- (q) Place manifold (136) on a suitable work surface.
- (r) Install clutch assembly and shaft on manifold (136). The manifold keeps shaft vertical.
- (s) Put bevel gear (175) in position on clutch housing as shown. Do not install capscrews (174) holding bevel gear to clutch housing now.
- (t) Put the other bevel gear (175) in place on first bevel gear so their teeth face each other.
- (u) Install the other clutch assembly on the shaft (135).
- (v) Finished faces of clutch housing must be  $7.024 \pm 0.002$  in. apart. Move clutch assembly toward top of shaft (185) and install three  $7.023 \pm 0.001$  in. gaging bars between clutch housing as shown.
- (w) Install spacer (182) on shaft (135).
- (x) Install bearings (183 and 184) and spacers (180 and 181) on shaft (135).
- (y) Put gear (179) in position on shaft (135) and install washer (177) and capscrew (176) using a wrench.
- (z) Use a wrench to tighten capscrews (176) as necessary to push bearings (183 and 184) onto shaft (135).

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**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**


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- (aa) After bearings are in the correct positions, remove capscrew (176) and washer (177).
- (ab) Measure and record the distance between end of the shaft (135) and face of gear (179) with depth micrometer.
- (ac) Remove three gaging bars from between clutch housings.
- (ad) Install shims (178) totaling the thickness recorded above between the end of the shaft (135) and gear (179).
- (ae) Install washer (177) and capscrew (176) using a socket. Tighten capscrew to a torque of  $100 \pm 10$  lb. ft.
- (af) put bevel gears (175) in position on clutch housings (171).
- (ag) Install one bevel gear (175) to clutch housing (171) with nine capscrews (174). Use a socket to tighten capscrews (174) to a torque of  $85 \pm$  lb. ft.
- (ah) Repeat STEP (aj) on other clutch. Install safety wires on bolts (174).
- (ai) Use a wrench to loosen capscrews (157) to release the clutch.



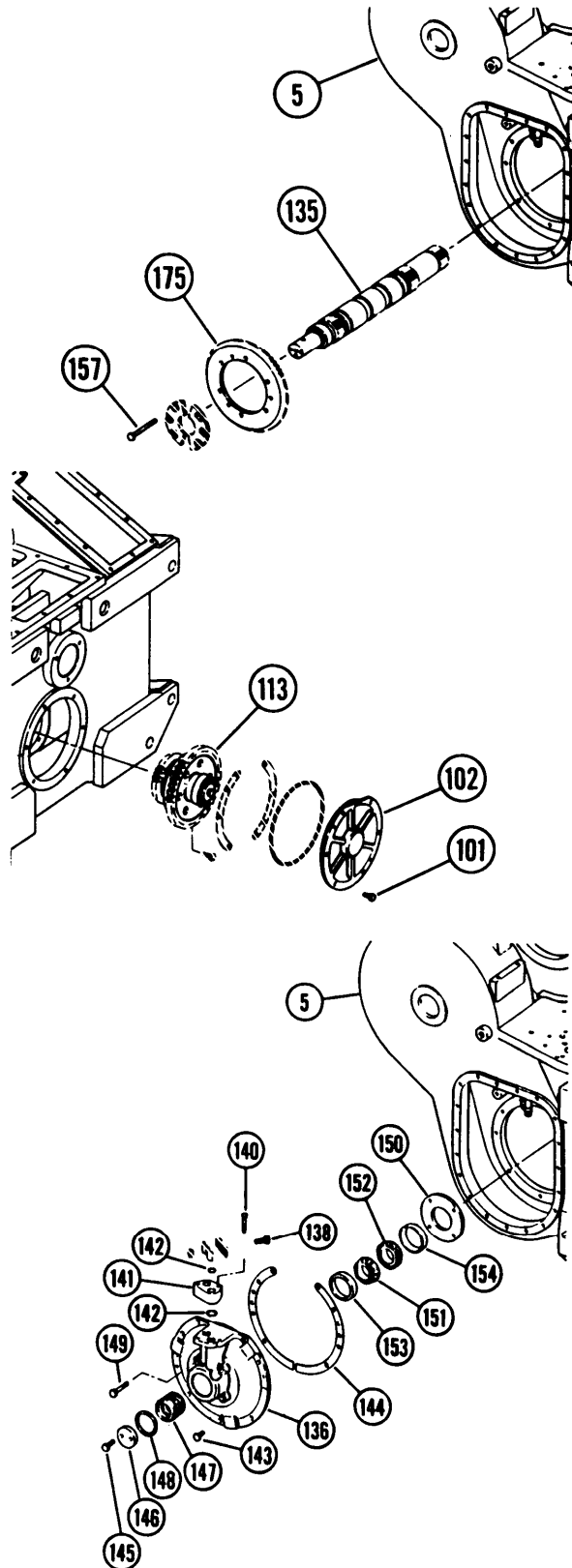
**NOTE**

Bevel gear must be aligned before pinion gear can be installed in winch. If bevel gears are not aligned, correct pinion adjustments will not be possible.



**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

- (aj) With capscrews (157) loose and clutch free to turn, put pinion gear (113) between the two bevel gears.
- (ak) Push pinion (113) as far as it will go to be sure gears (175) are aligned.
- (al) Use a socket to tighten clutch capscrews (157) to a torque of  $36 \pm 2$  lb. ft.
- (am) Connect lifting equipment and position clutch assembly part way into winch case (5).
- (an) Support shaft (135) and reconnect lifting equipment from inside winch case and move clutch assembly all the way into case.
- (ao) Install bearings (151 and 152) and bearing cups (153 and 154) in manifold (136).
- (ap) Install retainer (150) and use a socket to tighten four capscrews (149) to a torque of  $36 \pm 2$  lb. ft.
- (aq) Install seals (148) in carrier (147) and install carrier in manifold (136).
- (ar) Install bearing cage (132) in case (5). Use a hoist to align clutch shaft with cage.



**CAUTION**

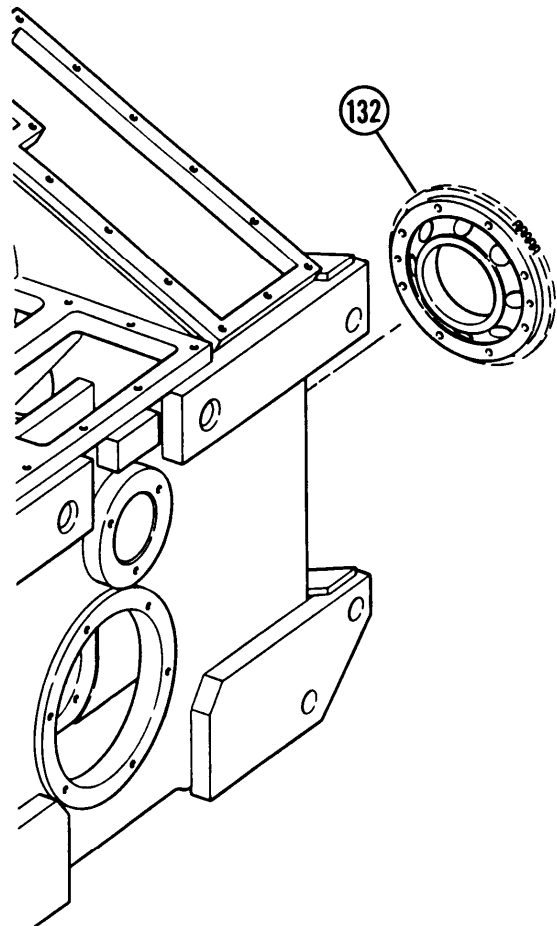
Clutch shaft must be centered within 0.005 in. to allow the same gear clearance (backlash) at each bevel gear. Damage to equipment or mechanical failure may result if clutch shaft is not properly centered.

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**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**


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- (as) Install manifold (136) on shaft (135) with no shims.
- (at) Use a wrench to install four capscrews (143) in manifold (136).
- (au) Install pinion assembly to case (5) with three capscrews (101) using a wrench. Do not use any shims at this time.
- (av) Use a wrench to tighten three capscrews (101) on pinion cover (102) until pinion (113) slides between bevel gears (175) on clutch assemblies and moves shaft to center position.
- (aw) After shaft (135) is centered, measure and record distance between manifold (136) and case (5) with depth micrometer.
- (ax) Remove manifold (136).
- (ay) Install manifold (136) and shims (144) with a total thickness equal to the value recorded above on end of shaft (135).
- (az) Install plate (146) on end of shaft (135) and use a socket to install two capscrews (145) and tighten to a torque of  $36 \pm 2$  lb. ft.
- (ba) Install oil tubes (not shown) with block (141), capscrews (140) and seals (142). Use a socket to tighten capscrews to a torque of  $36 \pm 2$  lb. ft.

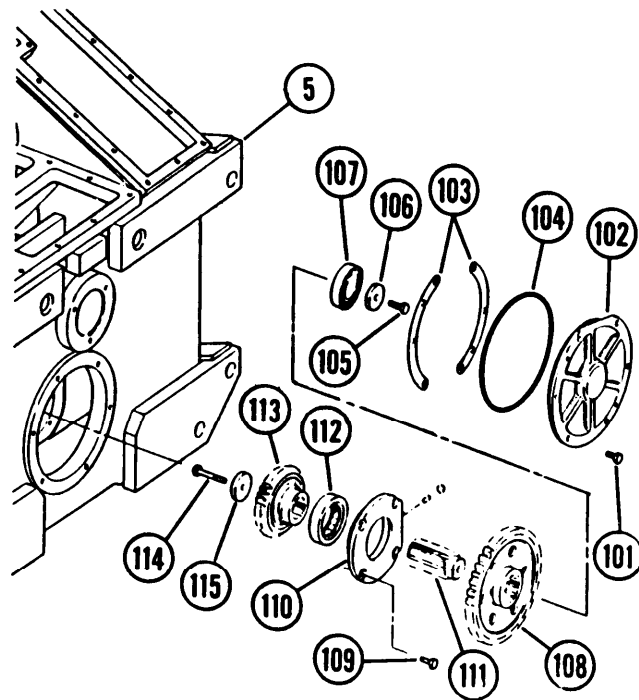
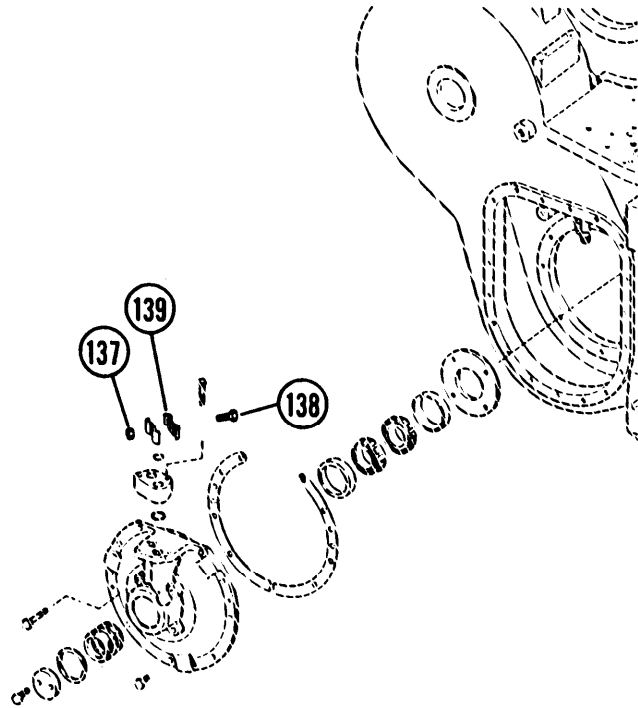


**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

(bb) Install clamp (139) with two capscrews (138) and two nuts (137) using a wrench.

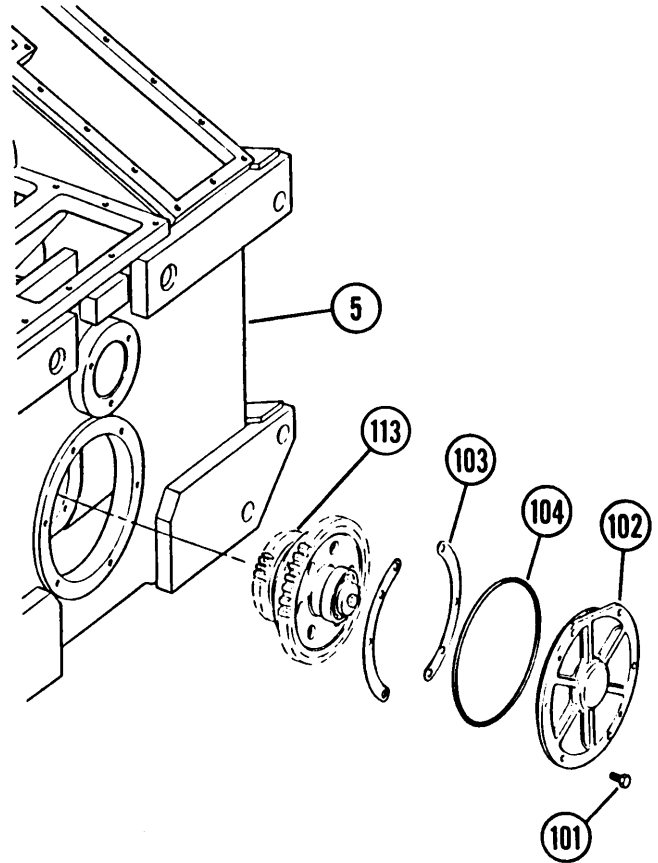
(3) Install winch pinion

- (a) Remove pinion assembly from case (5).
- (b) Measure and record dimension between mounting surface of pinion cage (102) and back face of pinion (113).
- (c) Measure and record dimension between face of case and bevel gear shaft through gap between the two clutch housings.
- (d) Find the difference between dimension in STEP (b) and dimension in STEP (c).
- (e) Subtract the difference found in the previous STEP from 4.375 in. to find the thickness of shims needed to get the correct free movement (backlash) between pinion and bevel gears when the pinion is installed.
- (f) Obtain shims (103) with a total thickness equal to the value determined in the previous step.
- (g) Install shaft assembly (102 through 115) in case (5) with four capscrews (109) inserted through holes in drive gear (108).
- (h) Use a socket to tighten capscrews (109) to a torque of  $36 \pm 2$  lb. ft.



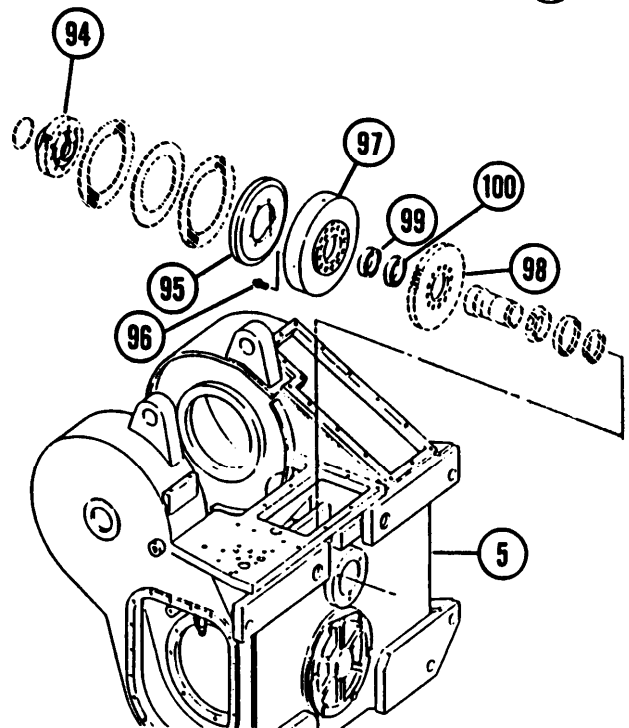
**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

- (i) Lubricate preformed packing (104) and install on cage (102).
- (j) Install cage (102) with shims (103) in case (5).
- (k) Use a socket to install six capscrews (101) that secure cage (102) to case (5). Tighten capscrews to a torque of  $36 \pm 2$  lb. ft.
- (l) To measure free movement (backlash) of pinion (113) between bevel gears, install a dial indicator so the tip of the indicator is in contact with one of the teeth of the pinion. Measure at four places. The free movement (backlash) must be no smaller than 0.005 in. Add or remove shims (103) as necessary.



**(4) Input clutch**

- (a) Install bearing (100) in drive gear (98) of input clutch.
- (b) Install bearing (99) in ring gear (97).
- (c) Install ring gear (97) on drive gear (98) with twelve capscrews (96). Use a 5/8" socket to tighten capscrews (96) to  $175 \pm 15$  lb. ft.
- (d) Position pressure plate (95) on clutch hub (94).

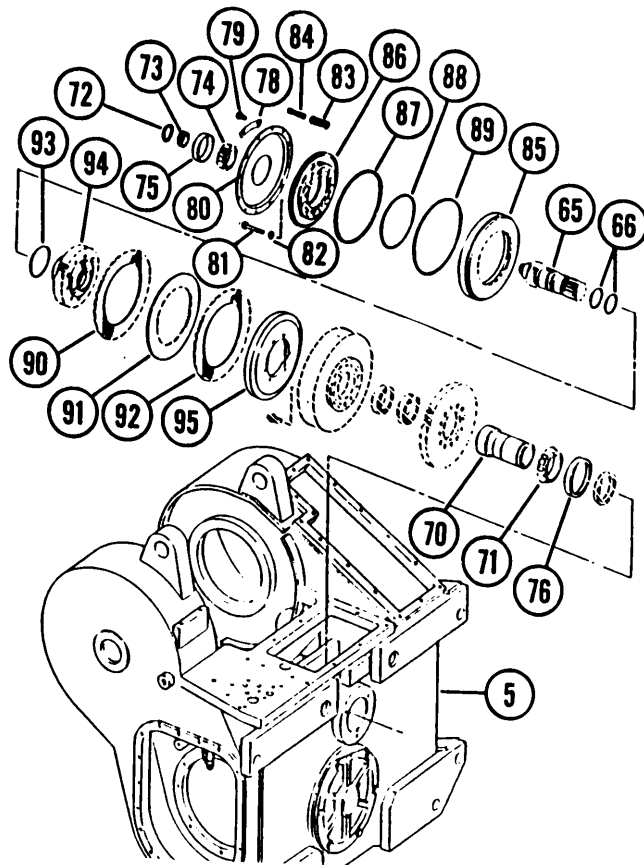


## 12-4. WINCH ASSEMBLY - REPAIR (Cont'd)

**CAUTION**

Be sure to align all oil return notches when installing clutch discs. Failure to properly align the notches could result in machine failure and damage to equipment.

- (e) Position second clutch disc (92), plates (91) and first clutch disc (90) over clutch hub (94) in pressure plate (95).
- (f) Install new seal (93) on clutch hub (94).
- (g) Install seal (87) and seal rings (88 and 89) on piston (86).
- (h) Install piston (86) and manifold (85) on hub assembly.
- (i) Install piston (86) in manifold (85). Install capscrews (81) using a socket and washers (82) and tighten to a torque of  $36 \pm 2$  lb. ft.
- (j) Install piston return springs (83 and 84) in piston (86).
- (k) Install clutch spring retainer plate (80), locks (78), and capscrew (79) using a wrench.
- (l) Cool bearing cups (75 and 76) to approximately  $32^{\circ}$  F. Install cups in retainer (68) and bearing cage (63).



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**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**


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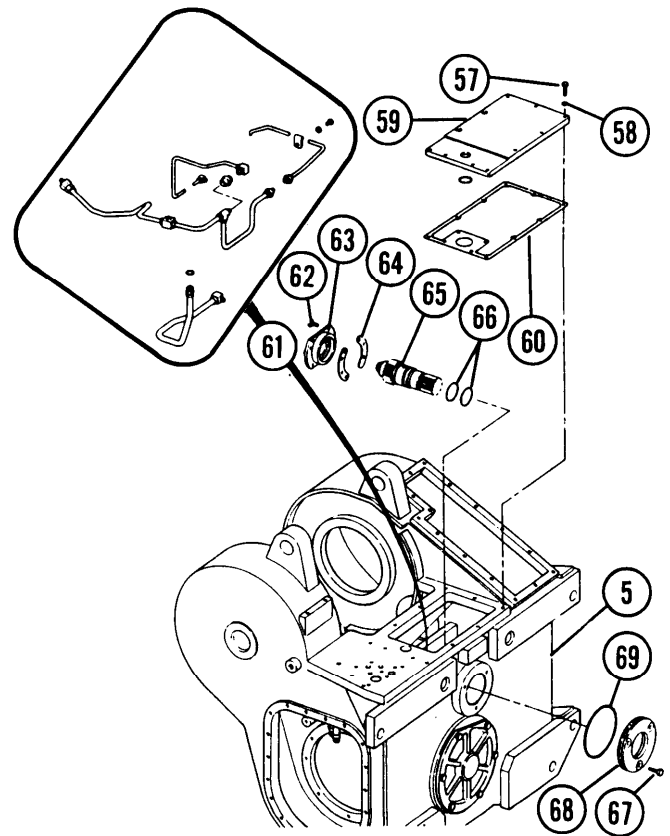
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**WARNING**


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Hot oil or metal parts can cause severe burns. Wear insulated gloves, long sleeves, and eye protection when working with heated parts.

- (m) Heat bearing cones (71 and 74) in oil at 275°F.
- (n) Install bearing cone (74) on shaft (65).
- (o) Install seal ring (73) on shaft (65).
- (p) Install bearing cone (71) on coupling (70).
- (q) Fasten lifting equipment to in clutch clutch assembly. Install clutch into case (5).
- (r) Insert coupling (70) into clutch assembly.
- (s) Install three capscrews (67) through retainer (68) and into case (5). Use a socket to tighten alternately to a torque of  $36 \pm 2$  lb. ft.
- (t) Install fresh preformed packings (66) on shaft (65). Install shaft through clutch assembly.
- (u) Use a wrench to install bearing cage (63) with four capscrews (62) and enough shims (64) to give between 0.003 and 0.007 in. end play on shaft (65).
- (v) Connect input clutch control lines (61) which come from control valve.

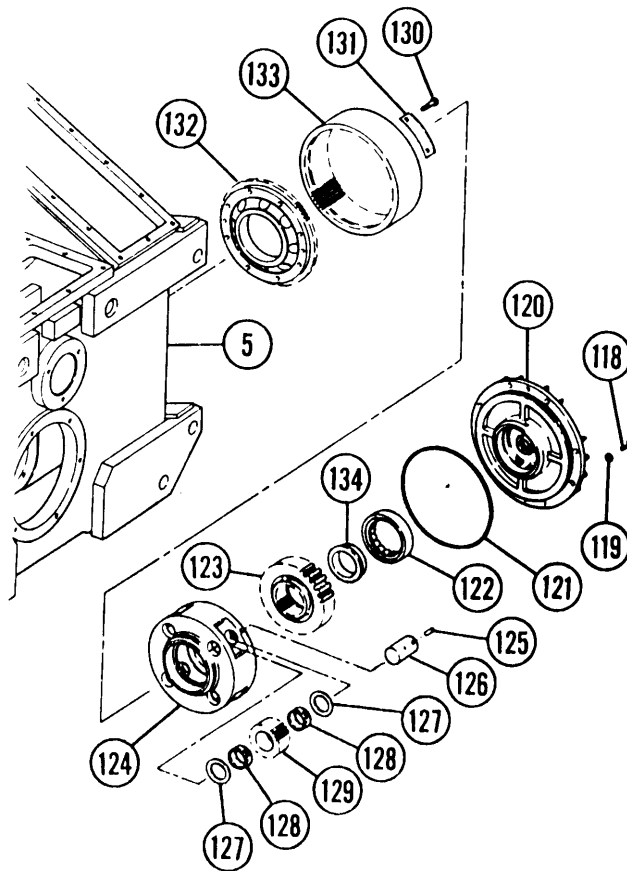


**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

- (w) place gasket (60) and cover (59) into position. Use a wrench to secure cover (59) with nine capscrews (57) and washers (58).

(5) Planetary carrier

- (a) Install bearings (128) and thrust washers (127) in gear (129) for planetary carrier assembly.
- (b) Install ear (129) in carrier (124).
- (c) Install shaft (126) in carrier (124). Align pin hole in shaft with pin hole in carrier.
- (d) Push pin (125) in carrier (124) and shaft (126).
- (e) Repeat STEPS (a through d) for other three gears.
- (f) Put ring gear (133) in position on bearing cage (132).
- (g) Install plates (131) and capscrews (130). Use a socket to tighten capscrews to a torque of  $36 \pm 2$  lb. ft.
- (h) Install planetary assembly (124 through 129) inside ring gear (133).
- (i) Install drive gear (123), race (134) and bearing (122) inside on carrier (124).
- (j) Lubricate preformed packing (121) and install on cover (120).
- (k) Use guide pins to position cover (120) on case (5) and install capscrews (118) and washers (119) using a wrench.



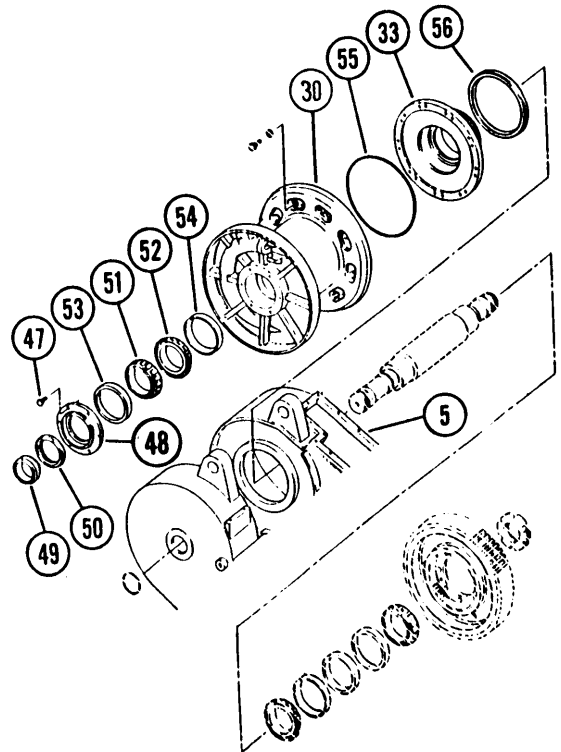
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**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**


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## (6) Winch drum

- (a) Lubricate lip seal (56) and install in case (5) for drum assembly.
- (b) Fasten lifting equipment to support flange (33) and position flange in case (5).
- (c) Install an eyebolt in the end of the support flange (33) inside case (5). Fasten a wire from the eyebolt to the boss on the outside of the case (5).
- (d) Clean surfaces on retainer (48) and drum (30). Install bearing cups (53 and 54).
- (e) Install spacer (49) and lip seal (50) in retainer (48).
- (f) Install cones (51 and 52) in drum (30).
- (g) Put liquid gasket material on mating surfaces on both retainer (48) and drum (30).
- (h) Position retainer (48) on drum (30). Use a socket to install six capscrews (47) and tighten to a torque of  $85 \pm 5$  lb. ft.
- (i) Lubricate preformed packing (55) and install on drum (30).
- (j) Fasten lifting equipment to drum (30) and position it in case (5).





## 12-4. WINCH ASSEMBLY - REPAIR (Cont'd)

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### CAUTION

Tighten capscrews (31) evenly in next step to avoid damage to preformed packing (55).

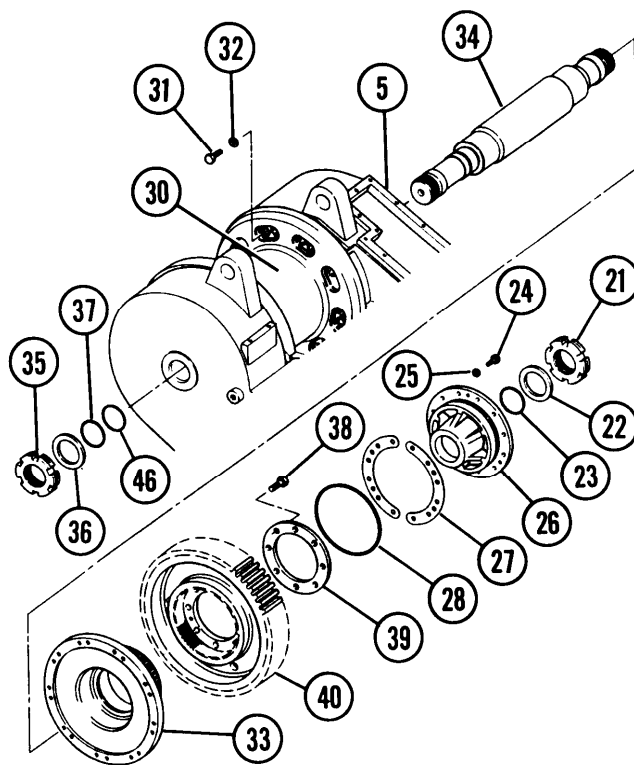
- (k) Use a wrench to install only three capscrews (31) and three washers (32) to hold drum support flange (33) to drum (30).
- (l) Remove the wire and eyebolt from support flange (33). Position a floor jack and wood block under right side of drum (30). Remove lifting equipment from drum.
- (m) Fasten lifting equipment to drum drive gear (40) and position gear in case (5). Place block of wood against gear (40) to hold it in this position.
- (n) Turn drum drive gear (40) so that the two forcing screw holes are aligned vertically.
- (o) Fasten a suitable lifting bracket to upper forcing screw hole in drum drive gear (40) and fasten a lifting equipment to lifting bracket.
- (p) Lift the drive gear (40) to align holes in gear with holes in drum support flange (33).
- (q) Install two guide pins of the correct size into support flange (33).
- (r) Align spline of drum drive gear (40) with spline of support flange (33).

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**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

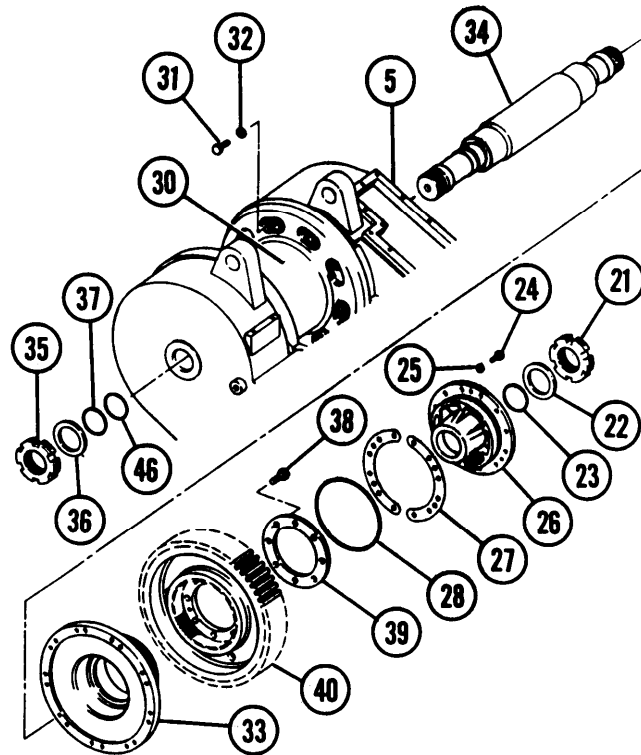

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- (s) Remove lifting bracket and guide pins.
- (t) Look into left side of drum (30) and adjust floor jack until bearings in drum are aligned with shaft hole at right side of case (5).
- (u) Install bearing assembly (41 through 45) on drum shaft (34).
- (v) Lubricate preformed packing 46 and install on shaft (34).
- (w) Fasten lifting equipment to drum shaft (34) and position shaft in case (5).
- (x) Install gear puller on case. Push against face of bearing assembly to move shaft into position.
- (y) Remove puller assembly. Remove floor jack and wood block.
- (z) Put bearing retaining ring (39) in position on drive gear (40) and use a wrench to install eight capscrews (38) hand tight.
- (aa) Wedge a wood block between drum driver gear teeth (40) and case (5) to keep the gear from turning.
- (ah) Use a socket to tighten the eight capscrews (38) to a torque of  $175 \pm 15$  lb. ft.



**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

- (ac) Use a socket to install remainder of capscrews (31) and washers (32) in drum (30). Tighten capscrews to a torque of  $200 \pm 20$  lb. ft. Remove wood block between drive gear and case.
- (ad) Lubricate preformed packing (37) and install on right side of drum shaft (34).
- (ae) Install washer (36) and nut (35) on shaft (34) and tighten nut to a torque of  $500 \pm 25$  lb. ft. with suitable spanner wrench and torque multiplier.
- (af) Fasten lifting equipment to left side of drum (30). Install two guide pins in case (5) where capscrews (24) will be inserted. This will help guide flanges (26) into position.



**NOTE**

Do not install either preformed packing (28 and 23) or shims (27) during the following six steps. The purpose of those steps is to determine the shim thickness required for final assembly.

- (ag) Put drum support flange (26) in position on guide pins.
- (ah) Lift drum (30) with hoist to align shaft (34) with flange (26). Install flange and lower lifting equipment to release tension on drum.
- (ai) Install washer (22) and nut (21) on shaft (34).

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**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

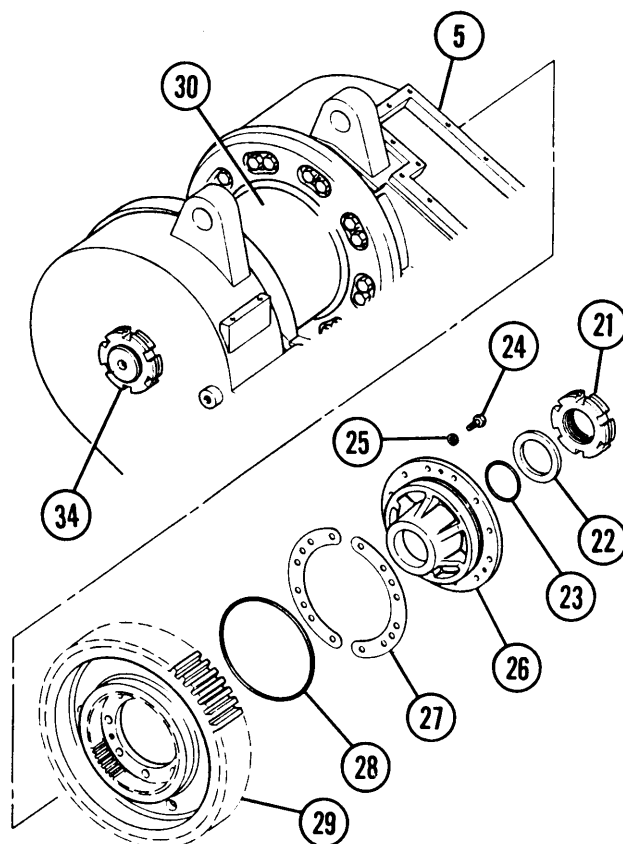

---

- (aj) Tighten nut (21) with a spanner wrench and a torque multiplier to a torque of 500+25 lb. ft. Turn drum (30) with one hand while tightening the nut to allow the bearings to seat themselves.
- (ak) Measure gap between support flange (26) and case (5) with feeler gage at three locations and record the values.
- (al) Obtain shims (27) with a total thickness equal to the average measured gap in the preceding step.

**NOTE**

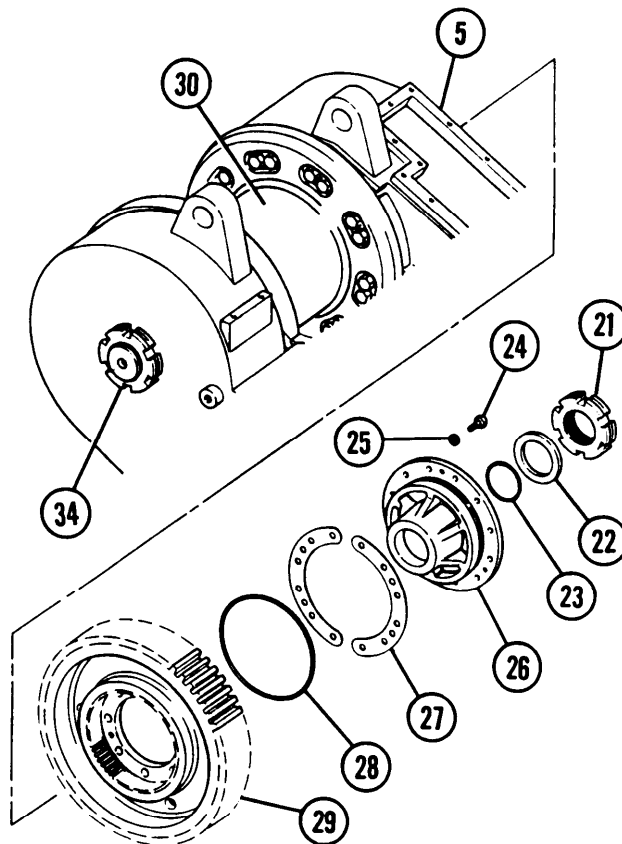
The only purpose of the shims (27) is to fill the gap between flange (26) and case (5) after bearing preload has been set with drum shaft nut (21). This prevents any distortion of case when the flange capscrews (24) are tightened.

- (am) Remove nut (21) and washer (22).
- (an) Remove support flange (26).
- (ao) Lubricate preformed packing (28) and install on flange (26).
- (ap) Lift drum with hoist to align shaft (34) and flange (26).
- (aq) Install shims (27) and shaft support flange (26) on drum shaft (34).



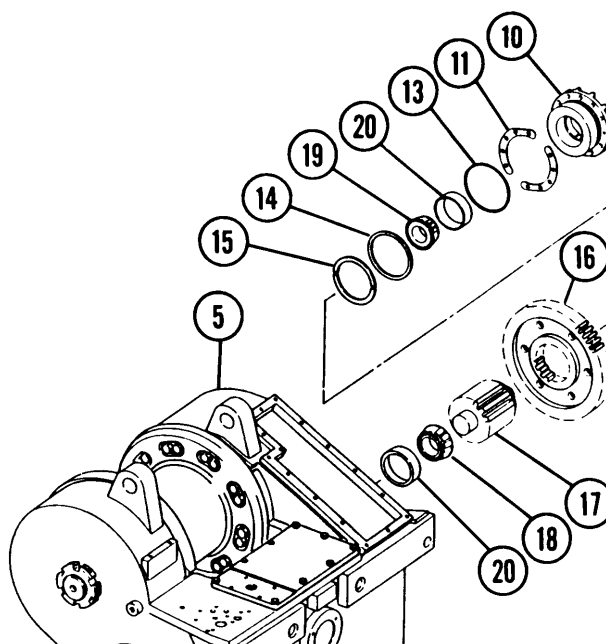
**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

- (ar) Install three capscrews (24) and washers (25) to position shaft support flange (26) on case (5) and use a wrench to tighten evenly.
- (as) Remove guide pins and use a socket to install and tighten remainder of capscrews (24) and washers (25). Tighten all capscrews (24) a little at a time in rotation to a torque of  $500 \pm 25$  lb. ft.
- (at) Remove lifting equipment.
- (au) Lubricate preformed packing (23) and install on drum shaft (34).
- (av) Install washer (22) and nut (21) on shaft. Tighten nut with suitable spanner wrench and a torque multiplier to a torque of  $500+25$  lb. ft. Turn drum (30) with one hand while tightening the nut to allow the bearings to seat themselves.



**(7) Idler gears**

- (a) put idler assembly bearing cups (20) to approximately 32° F.
- (b) Install inner bearing cup (20) in case (5).
- (c) Install outer bearing cup (20) in cage (10).
- (d) Heat bearing cones (18 and 19) in oil to a maximum of 275°F.
- (e) Install bearing cones (18 and 19) on ends of pinion gear (17).



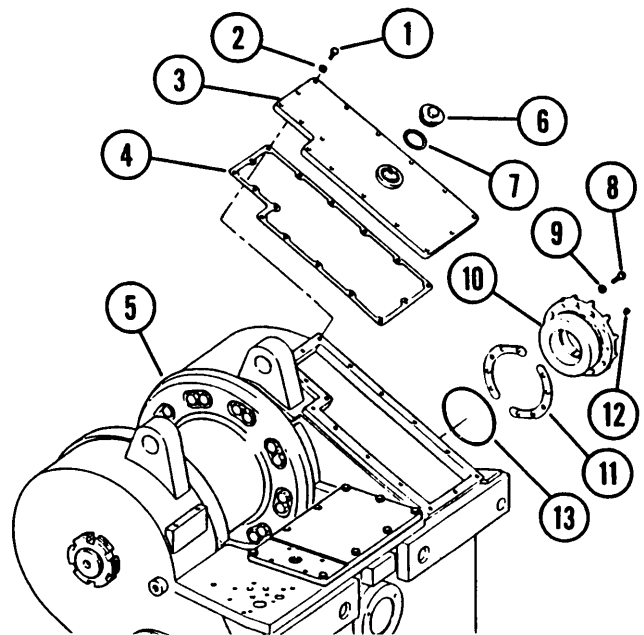
## 12-4. WINCH ASSEMBLY - REPAIR (Cont'd)

- (f) Install idler gear (16) in case (5).

**NOTE**

Be sure idler gear (16) is installed with grooves for spiral retaining ring (14) toward outside.

- (g) position pinion gear (17) at cage opening. Roll idler gear (16) into place for tooth alignment with one hand while installing pinion gear (17).
- (h) Turn drum (30) to align drive gear teeth (40) with pinion gear (17).
- (i) Push gear assembly into case until bearing (18) is in position in cup (20).
- (j) Install two-piece plate (15) and spiral retaining ring (14) into groove of idler gear (16).
- (k) Install bearing cage (10) in case (5) without preformed packing (13) or shims (11). Install three capscrews (8) in cage (10) using a wrench. Install plug (12) in cage (10) with a plug socket.
- (l) Install dial indicator to check end play of gear assembly. Use a wrench to tighten evenly three capscrews (8) until zero end play is measured.

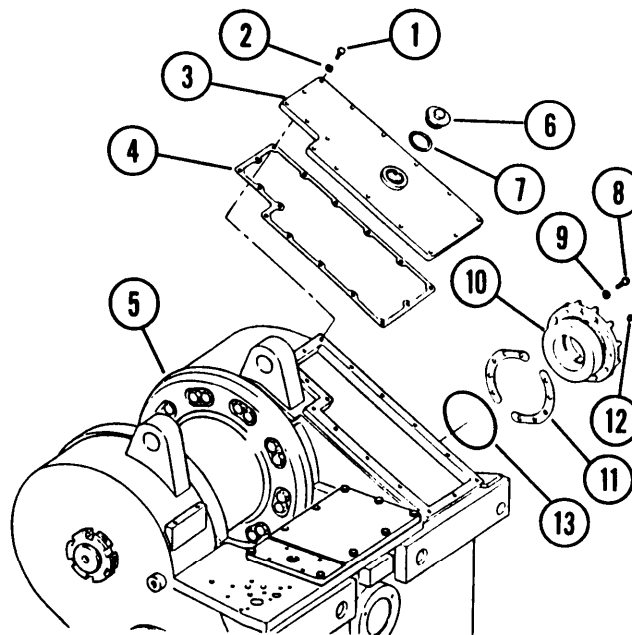


**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

- (m) Measure and record gap between bearing cage (10) and case (5) at the three capscrew locations.
- (n) Obtain shims (11) with a total thickness equal to 0.002 in. more than the average measured gap in the previous step.
- (o) Remove cage (10) from case (5). Lubricate preformed packing (13) and install on cage (5). Put shims (11) in place on cage (10).

**NOTE**

Bolts installed part of the way in the forcing screw holes will keep the shims in position while the cage is being installed.



- (p) Use a wrench to install cap screws (8) and lockwashers (9). Tighten evenly so preformed packing (13) is not damaged.
- (q) Check the end play again with the indicator. If the end play is not 0.001 to 0.003 in., remove cage (10) and adjust shims (11) as necessary.
- (r) Place gasket (4) and cover (3) on case (5).
- (s) Install washers (2) and cap screws (1) in cover (3) and tighten evenly using a wrench.
- (t) Install preformed packing (7) and plug (6) using a wrench.

---

**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**


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- (8) Install winch. See TM5-2410-237-20.
- (9) Install winch cable, drawbar pin, breather, oil filter, magnetic strainer, and winch control valve. See TM5-2410-237-20.
- (10) Fill winch with lubricating oil. See TM5-2410-237-20.

**c. Winch System Test**


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**WARNING**


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To prevent personal injury while checking pressures, disconnect and remove cable from drum.

**NOTE**

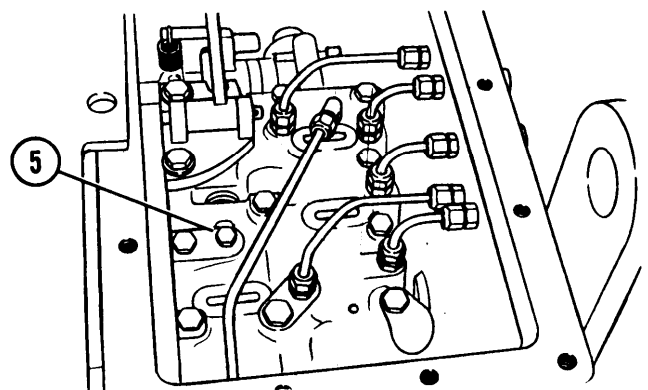
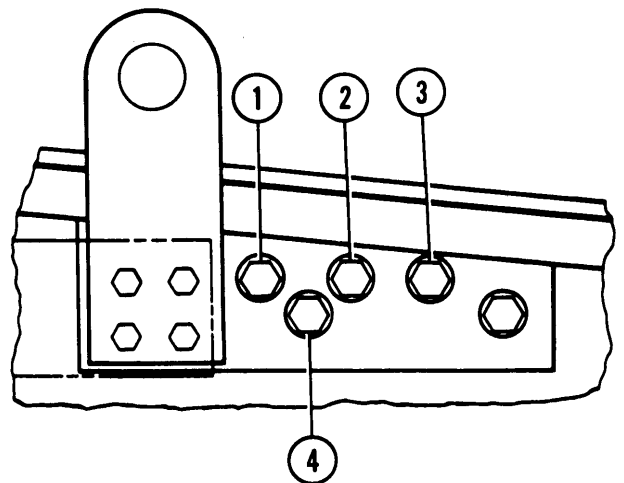
Perform PMCS for the winch as outlined in TM5-2410-237-20 before proceeding.

- (1) Install a 0-60 psi pressure gage in location (1).
- (2) Install 0-600 psi pressure gages in locations (2), (3), (4) and (5).

**NOTE**

All tests must be made with hydraulic oil temperature at normal operating temperature, and the oil level in the winch sump maintained at the center of the sight gage.

- (3) Place winch control lever in the BRAKE ON position and start the engine.





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**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

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(4) Operate engine at low idle and record pressure at locations (1) through (5) with control lever in positions shown in Table 12-1.

**Table 12-1. Low Idle Pressures (psi)**

---

LEVER POSITION	PUMP PRESSURE (5)	INPUT CLUTCH (4)	REEL IN CLUTCH (3)	REEL OUT CLUTCH (2)	LUB (1)
BRAKE ON	44 MAX.	0	0	0	32 MIN.
REEL IN	255 MIN*	250 MIN*	250 MIN	0	22 MIN**
REEL OUT	255 MIN	250 MIN*	0	250 MIN*	22 MIN**
BRAKE OFF	250 MIN	0	240 MIN	240 MIN	10 MIN

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 \* Pressures must not differ more than 10 psi between REEL IN and REEL OUT.

\*\* Pressures must not differ more than 2 psi between REEL IN and REEL OUT.

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**12-4. WINCH ASSEMBLY -REPAIR (Cont'd)**

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(5) Operate engine at high idle and record pressures at locations (1) through (5), with control lever in positions shown Table 12-2.

**Table 12-2. High Idle Pressures (psi)**

---

LEVER POSITION	PUMP PRESSURE (5)	INPUT CLUTCH (4)	REEL IN CLUTCH (3)	REEL OUT CLUTCH (2)	LUB (1)
BRAKE ON	54-74	0	0	0	39-49
REEL IN	290-310	280-300	280-300	0	*26-46 MIN
REEL OUT	290-310	280-300	0	280-300	*26-46 MIN
BRAKE OFF	290-310	0	280-300	280-300	*25-35

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 \*Pressures must not differ more than 2 psi between REEL IN and REEL OUT.

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**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**

- (6) Place the control lever in the BRAKE OFF position. The winch drum must not rotate.
- (7) Refer to Table 12-3 if winch test results do not meet the values of Tables 12-1 and 12-2.
- (8) If the winch tests OK, remove pressure gages.

**Table 12-3. Interpreting Winch Test Results**

TEST RESULT	WHAT TO DO
<ul style="list-style-type: none"> <li>1. No oil pressure at any pressure tap.</li> <li>2. Pressure at tap 1 is too high.</li> <li>3. Pressure at tap 1 is too low.</li> </ul>	<ul style="list-style-type: none"> <li>Check for defective oil line, pump or pump drive.</li> <li>a. Check the lubrication valve in the filter base. (See TM5-2410-237-20).</li> <li>b. Pressure control valve relief setting may be too high. Add spacers to decrease setting (page 12-38).</li> <li>a. Check for failure of the lubrication relief valve spring. (See TM5-2410-237-20).</li> <li>b. Check for oil leakage in the clutch or lubrication circuits:                             <ul style="list-style-type: none"> <li>● If the leak is only in the lubrication circuit, oil pressure at taps 2, 3, and 4 will be OK.</li> <li>● If leak is in input clutch circuit, pressure will be low at tap 4.</li> <li>● If leak is in directional clutch circuit, pressure will be low at taps 2 and 3.</li> </ul> </li> </ul>

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**12-4. WINCH ASSEMBLY - REPAIR (Cont'd)**


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**Table 12-3. Interpreting Winch Test Results (Cont'd)**

TEST RESULT	WHAT TO DO
4. Pressure at tap 4 is zero.	a. Check for defective spool in the pressure control valve (page 12-54). b. Check for defective spool in the selector and pressure control valve (page 12-54).
5. Pressure at tap 4 is too high.	Check for defective pressure control valve or incorrect relief setting (page 12-54).
6. Pressure at tap 4 is too low.	a. Check for defective pressure control valve (page 12-54). b. Check for leak in input clutch circuit.
7. Pressure at tap 2 or 3 is zero.	Check for defective selector and pressure control valve (page 12-54).
8. Pressure at tap 2 or 3 is too high.	a. Relief setting of pressure control valve may be too high. Add shims to decrease setting (page 12-54). b. Check for defect in pressure control valve (page 12-54).
9. Pressure at tap 2 or 3 is too low.	a. Check for defective spring in pressure control valve (page 12-54). b. Check for leaks in the directional clutch circuits.
10. Pressure at taps 1, 2, 3 and 4 goes up and down.	Check for low oil level which is causing pump cavitation

**d. Place In Service**

Test run the winch and check for proper operation.

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## 12-5. WINCH CONTROL LEVER AND LINKAGE - REPLACE

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This task covers:

- a. Removal
- b. Installation
- c. Place In Service

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### INITIAL SETUP

#### Applicable Configurations

All

#### Materials/Parts

Wire I.D. Tags

#### Common Tools

Shop Equipment, General Purpose  
Repair; Semi-Trailer Mounted  
NSN 4940-00-287-4894

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#### a. Removal

##### CAUTION

Wipe the area clean around all hydraulic connections to be opened during removal. Cap oil lines and plug holes after removing lines. Contamination of the hydraulic system could result in premature failure.

##### **NOTE**

If more than one hydraulic line is to be removed, identify lines to assure proper installation. Use suitable container to catch any hydraulic oil that may drain from the system.

##### **NOTE**

If tractor is so equipped, remove sound suppression panels from control console.

- (1) Remove knobs (1) from winch control lever (2) and bulldozer control lever.

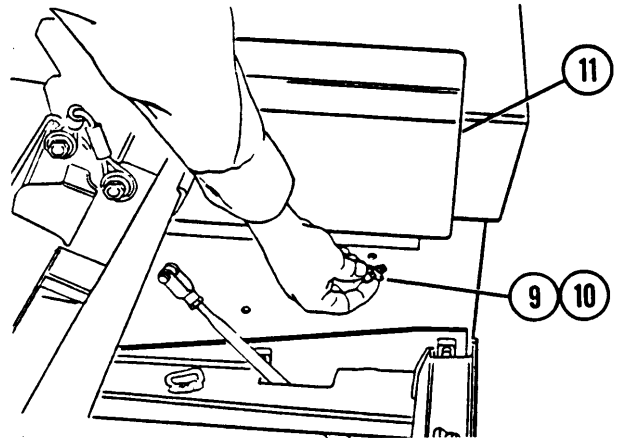
- (2) Remove four screws (3) from control lever guide (4). Remove guide (4).
- (3) Use a wrench to remove nut (5), screw (6), washer (7) and clip (8) from guide (4).

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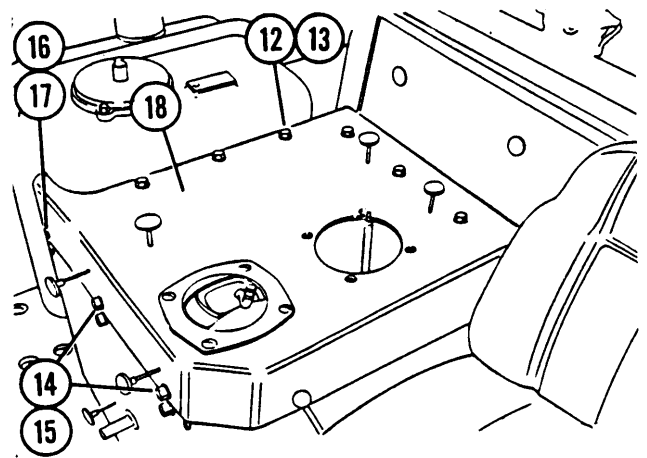
**12-5. WINCH CONTROL LEVER AND LINKAGE - REPLACE (Cont'd)**

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- (4) Lift seat and remove two capscrews (9) and washers (10) that secure armrest (11) to the control console.

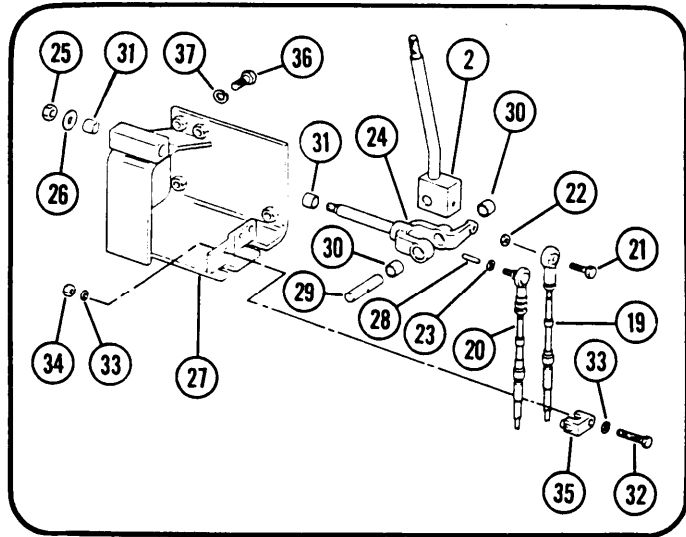


- (5) Use a wrench to remove six capscrews (12) and washers (13), two capscrews (14) and washers (15) and one capscrew (16) and washer (17) that secure the cover (18) to the control console. Remove the cover (18).



**12-5. WINCH CONTROL LEVER AND LINKAGE - REPLACE (Cont'd)**

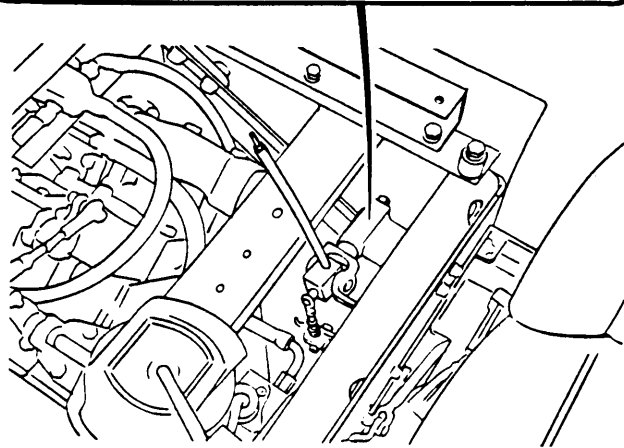
- (6) Tag control cables (19 and 20) for identification. Use a wrench to remove bolt (21) and nut (22) from control cable (19). Use a wrench to unscrew cable (20) and remove washer (23).
- (7) Use a wrench to remove nut (25) and washer (26) from bellcrank assembly (24).
- (8) Remove bellcrank assembly (24) with lever assembly (2) from bracket assembly (27).



**CAUTION**

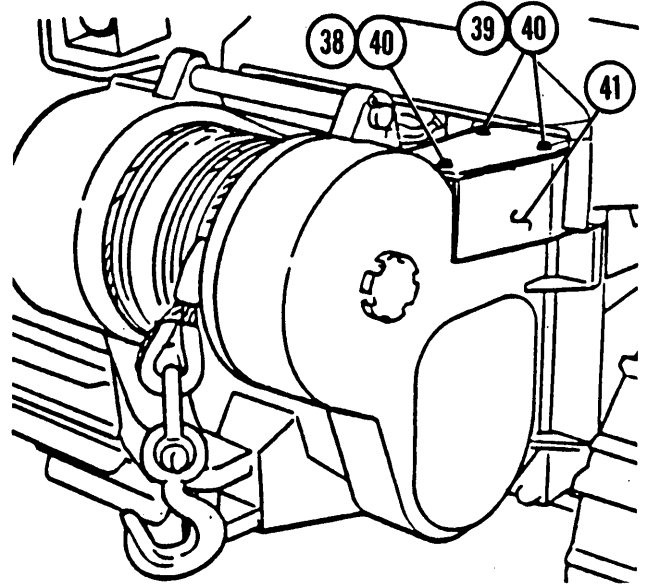
Drive pin (28) through backside of block on lever assembly to avoid damaging threads at front end of hole.

- (9) Remove pin (28) from bellcrank assembly (24).
- (10) Remove shaft (29) and lever assembly (2) from bellcrank assembly (24).
- (11) Remove two bushings (30) from bellcrank (24) using hammer and suitable drift punch.
- (12) Remove two bushings (31) from bracket (27) using hammer and suitable drift punch.
- (13) Use a wrench to remove bolt (32), two washers (33) and nut (34) from two clamps (35). Remove two clamps (35) that hold control cables (19 and 20) to bracket assembly (27).
- (14) Remove four capscrews (36) and four lockwashers (37) from bracket (27) using a wrench. Remove bracket (27).

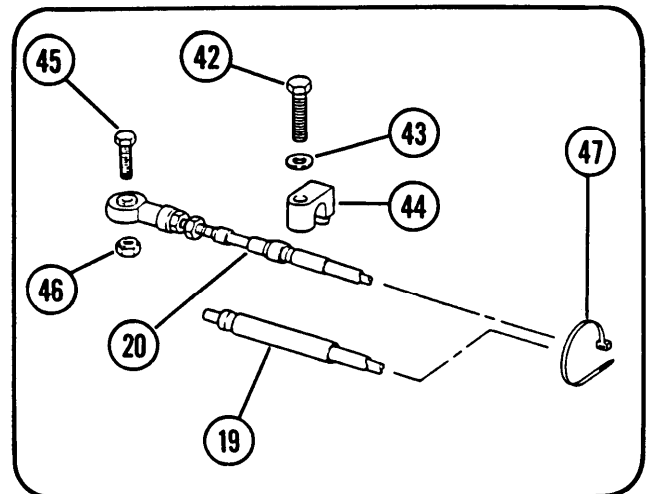


## 12-5. WINCH CONTROL LEVER AND LINKAGE - REPLACE (Cont'd)

- (15) Remove two capscrews (38), two capscrews (39) and four washers (40) and remove cover (41) from winch control valve.

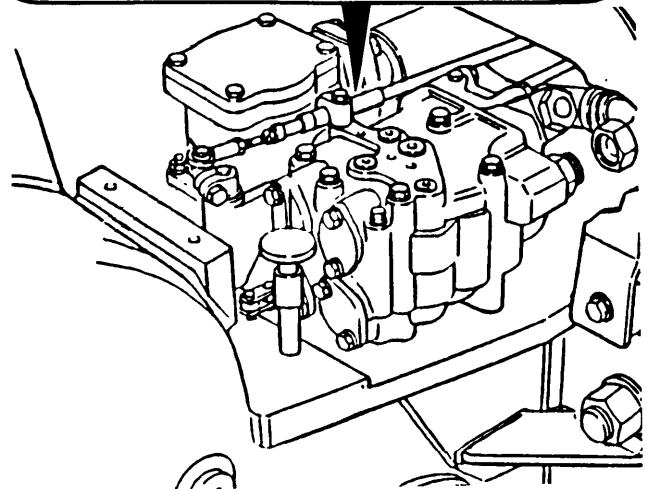


- (16) Use a wrench to remove capscrew (42) and lockwasher (43) from clamp (44). Remove clamp (44) from control cable (20).
- (17) Use a wrench to remove capscrew (45) and nut (46) from cable (20) and remove cable (19) from control valve.
- (18) Remove cable assemblies (19 and 20) from vehicle. Remove strap (47) as necessary.



### b. Installation

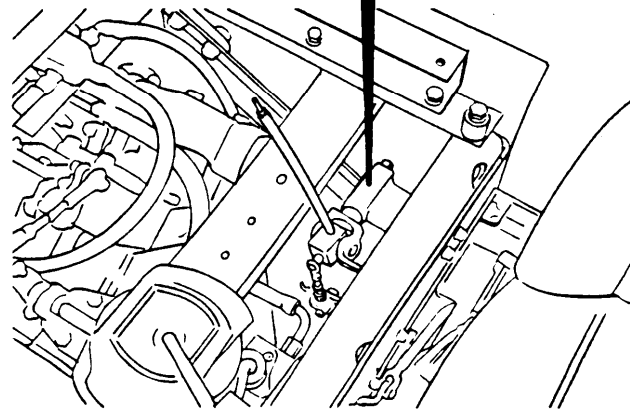
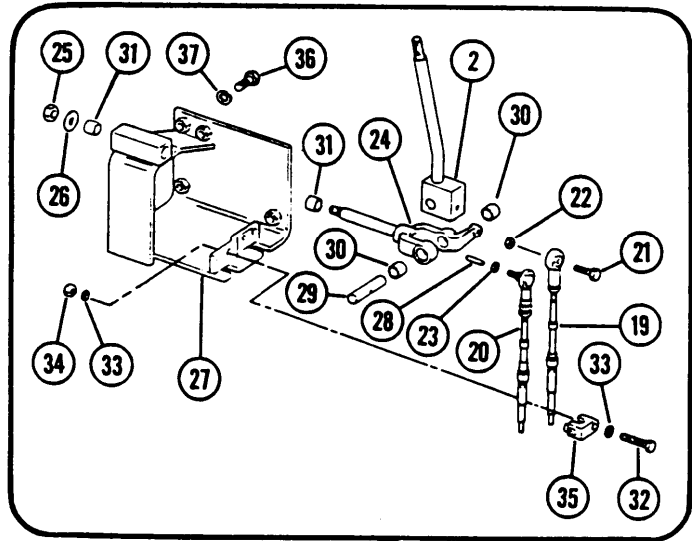
- (1) Install cable assemblies (19 and 20) onto vehicle. Install straps (47) as necessary.
- (2) Install cable (19) onto control valve. Use a wrench to install capscrew (45) and nut (46) that holds cable (20) onto control valve.
- (3) Use a wrench to install capscrew (42), lockwasher (43) and clamp (44) that secure control cable (20) onto tractor.





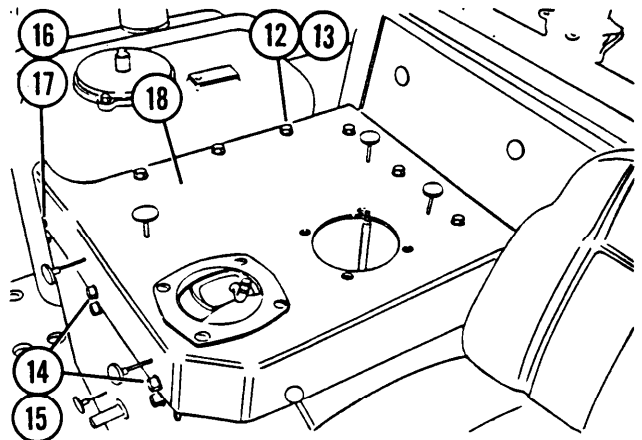
**12-5. WINCH CONTROL LEVER AND LINKAGE - REPLACE (Cont' d)**

- (4) Place cover (41) into position. Install two capscrews (38), two capscrews (39) and four washers (40) that secure cover (41) onto winch control valve.
- (5) Place bracket (27) into position. Install four capscrews (36) and four lockwashers (37) that secure bracket (27) using a wrench.
- (6) Place two clamps (35) into position that hold cables (19 and 20) onto bracket (27). Use a wrench to install capscrew (32), two washers (33) and nut (34) that secure two clamps (35).
- (7) Install two bushings (31) into bracket (27) using hammer and suitable drift punch.
- (8) Install two bushings (30) onto bellcrank (24) using hammer and suitable drift punch.
- (9) Install shaft (29) and lever assembly (2) onto bellcrank assembly (24).
- (10) Drive pin (28) into lever assembly (2) and shaft (29) using a hammer and suitable drift punch.
- (11) Install bellcrank assembly (24) with lever assembly (2) onto bracket assembly (27).
- (12) Use a wrench to install nut (25) and washer (26) onto bellcrank assembly (24).
- (13) Use a wrench to install bolt (21) and nut (22) that secure control cable (19) to bellcrank (24). Use a 3/8" wrench to install washer (23) and cable (20).

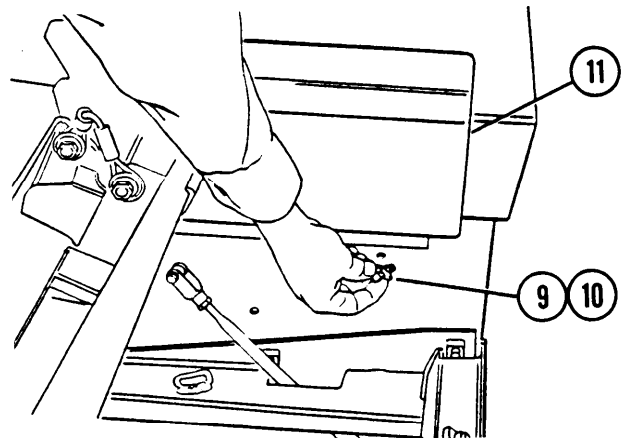


## 12-5. WINCH CONTROL LEVER AND LINKAGE - REPLACE (Cont'd)

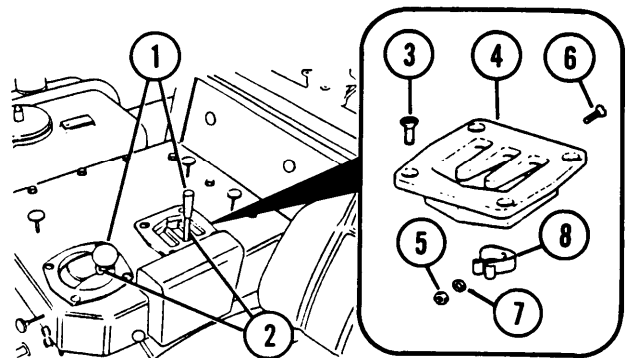
- (14) Place cover (18) into position on control console. Use a wrench to install six capscrews (12) and washers (13), two capscrews (14) and washers (15) and one capscrew (16) and washer (17) that secure the cover (18) to the control console.



- (15) Place armrest (11) into position on control console. Install two capscrews (9) and washers (10).



- (16) Use a wrench to install screw (6), nut (5), washer (7) and clip (8) onto guide (4).
- (17) Place guide (4) into position and install four screws (3) that secure guide (4) to console.
- (18) Install knobs (1) onto winch control lever (2) and bulldozer control lever.



### NOTE

If so equipped, install sound suppression panels onto control console.

- (19) Make any necessary adjustments to control linkage (see TM5-2410-237-20).

### c. Place In Service

Test run winch and check for proper operation.

## 12-6. WINCH CONTROL VALVE - REPAIR

This task covers:

- a. Disassembly
- b. Cleaning
- c. Lubrication
- d. Assembly
- e. Place In Service

### INITIAL SETUP

#### Applicable Configurations

Tractor with Winch

#### Common Tools

Shop Equipment, General Purpose  
 Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Tool Outfit, Hydraulic System  
 Test and Repair (HSTRU)  
 NSN 4940-01-036-5784

#### Materials/Parts

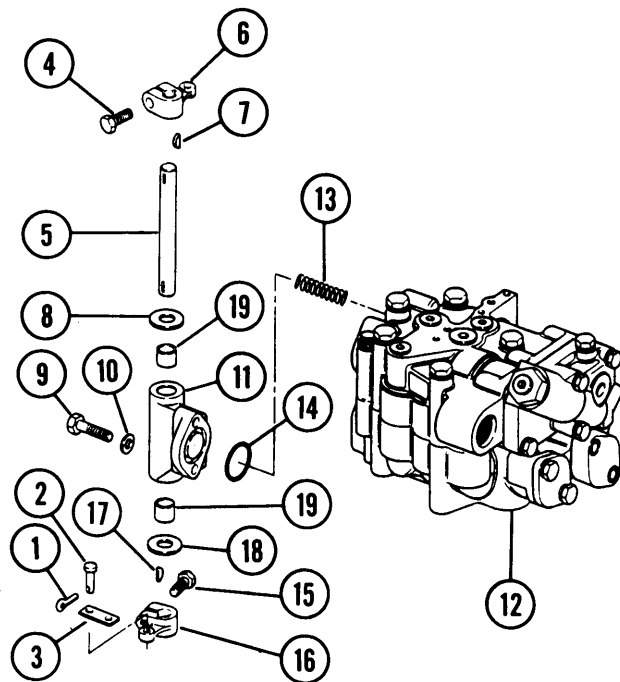
Preformed Packings (14), (28), (29),  
 (44), (45), (48), (55), (58), (60),  
 (69), (71), (73), (79), (89), (92),  
 (96), (98), (100)  
 Gasket (26), (32), (49), (68), (83)  
 Lubricating Oil OE/HDO-10 (See L05-  
 2410-237-12)  
 Cotter pin (1)

#### Equipment Condition

Winch control valve removed. See  
 TM5-2410-237-20.

#### a. Disassembly

- (1) Remove two cotter pins 1 and two straight head pins (2). Remove two links (3). Discard cotter pins (1).
- (2) Loosen capscrew (4) using a wrench. Remove lever (6) from shaft (5).
- (3) Use a screwdriver to remove key (7) from shaft (6).
- (4) Slide shaft (5) from bracket (11) and remove washer (8) from shaft (5).



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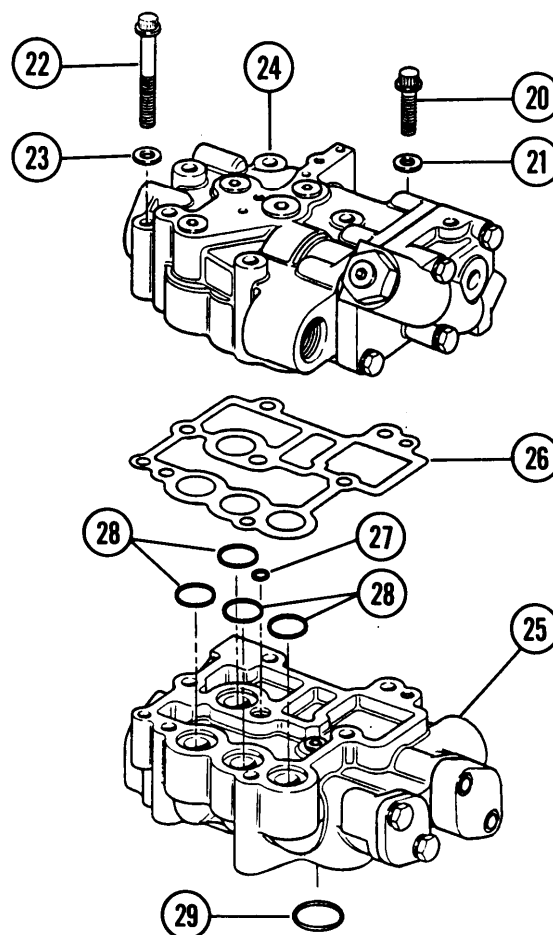
**12-6. WINCH CONTROL VALVE - REPAIR (Cont'd)**


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**WARNING**

Bracket (11) is under spring pressure. Remove carefully so as not to lose parts or cause personal injury.

- (5) Use a wrench to remove two capscrews (9) and two lock-washers (10) from bracket (11). Carefully remove bracket (11) from valve body (12). Remove spring (13).
- (6) Remove and discard preformed packing (14) from bracket (11).
- (7) Use a wrench to loosen capscrew (15) on lever (16). Remove lever (16) from shaft (5).
- (8) Remove key (17) from shaft (5).
- (9) Remove washer (18) from shaft (5).
- (10) Use a mallet and suitable drift to remove two bushings (19) from bracket (11).
- (11) Remove three preformed packings (29).
- (12) Use a wrench to remove twelve point capscrew (20) and washer (21).
- (13) Use a wrench to remove twelve point capscrew (22) and washer (23).
- (14) Separate pressure control valve (24) from selector valve (25).
- (15) Remove and discard gasket (26), four preformed packings (28) and preformed packing (27) from selector valve (25).



**12-6. WINCH CONTROL VALVE - REPAIR (Cont'd)**

- (16) Use a wrench to remove two capscrews (30) from cover (31). Remove cover (31) and gasket (32). Discard gasket (32).
- (17) Remove valve spool assembly (33) from selector valve body (25).

**WARNING**

There is a spring force behind capscrew (34). Remove capscrew (34) slowly to prevent personal injury.

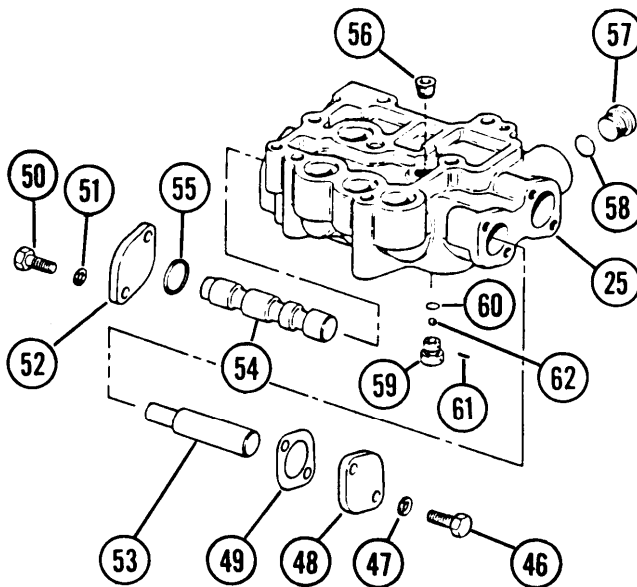
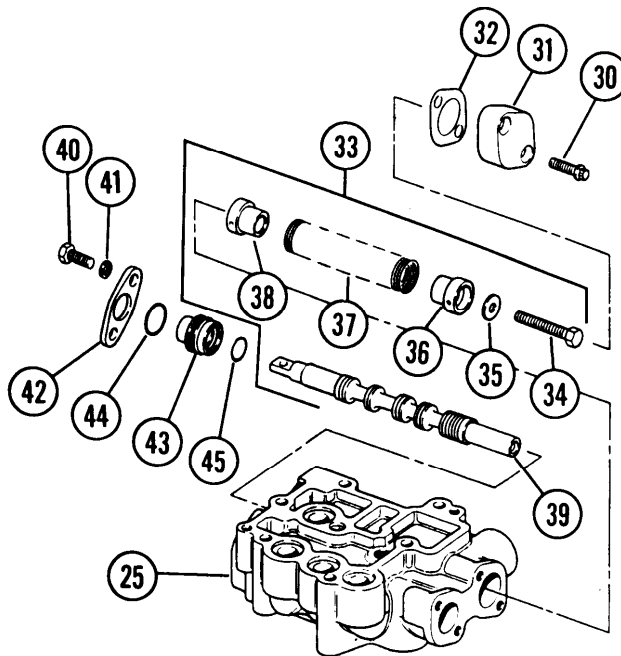
- (18) Use a wrench to remove capscrew (34), washer (35), retainer (36), spring (37) and retainer (38) from valve spool (39).
- (19) Use a wrench to remove two capscrews (40) and two lock-washers (41) from flange (42). Remove flange (42) from selector valve body (25).

- (20) Remove bushing (43) from valve body (25). Remove and discard preformed packings (44 and 45).

- (21) Use a wrench to remove two capscrews (46) and two lock-washers (47) from cover (48).

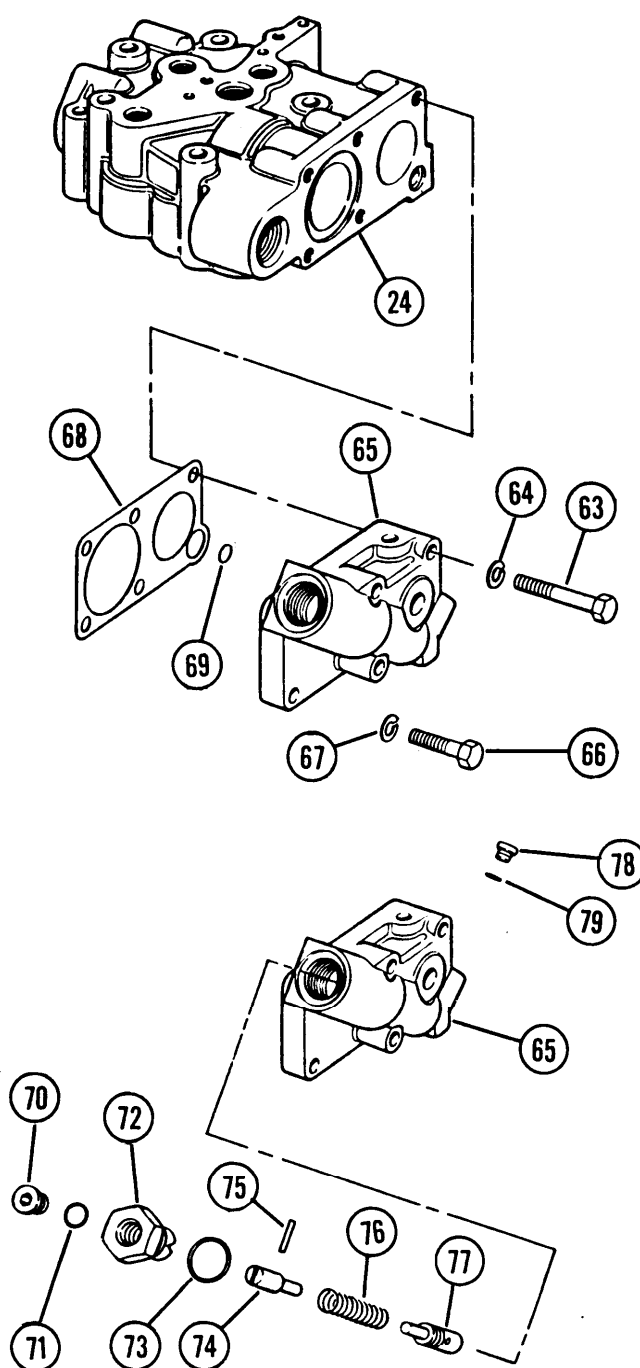
- (22) Remove cover (48) and gasket (49) from valve body (25). Discard gasket (49).

- (23) Use a wrench to remove two capscrews (50) and two lock-washers (51) from cover (52). Remove cover (52) from valve body (25).



## 12-6. WINCH CONTROL VALVE - REPAIR (Cont'd)

- (24) Remove stop (53) and valve spool (54) from valve body (25). Remove and discard preformed packing (55) from valve body (25).
- (25) Use an allen wrench to remove plug (56).
- (26) Use an allen wrench to remove plug (57) and preformed packing (58). Discard preformed packing (58).
- (27) Remove seat (59) by lifting straight out. Remove preformed packing (60). Discard preformed packing (60). If necessary, remove pin (61) and ball (62) from seat (59).
- (28) Use a wrench to remove three capscrews (63) and lockwashers (64) from sequence valve (65).
- (29) Use a wrench to remove capscrew (66) and lockwasher (67) from sequence valve (65).
- (30) Separate sequence valve (65) from pressure control valve (24). Remove and discard gasket (68) and preformed packing (69).
- (31) Use an allen wrench to remove plug (70). Remove and discard preformed packing (71) from plug (70).
- (32) Use a wrench to remove plug (72). Remove and discard preformed packing (73) from plug (72).
- (33) Remove retainer (74) from valve (65). Do not remove in (75) from retainer (74) unless damaged.





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## 12-6. UNCH CONTROL VALVE - REPAIR (Cont'd)

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(44) Use an allen wrench to remove plug (97). Remove and discard preformed packing (98).

(45) Use an allen wrench to remove plug (99). Remove and discard preformed packing (92).

### b. Cleaning

Clean all parts thoroughly.  
Refer to page 2-29.

### c. Lubrication

Coat all parts with clean lubricating oil during assembly.

### d. Assembly

(1) Install preformed packing (92) in valve body (10). Use an allen wrench to install plug (99) in valve body (10).

(2) Install preformed packing (98) in valve body (10). Use an allen wrench to install plug (97) in valve body (10).

(3) Install three preformed packings (96) in valve body (10). Use an allen wrench to install three plugs (95) in valve body (10).

(4) Install spring assembly (94) and retainer (93) in valve body (10).

(5) Install spring assembly (91) and piston (90) in valve body (10).

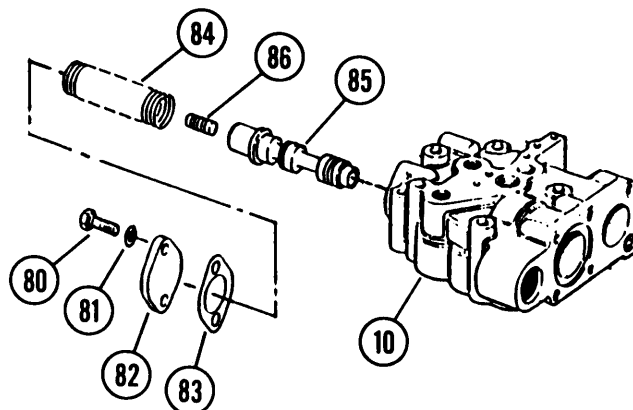
(6) Install preformed packing (89) in valve (10).

(7) Install slug (88) in valve s 001 (87). Install valve spool (87) in valve body (10).



12-6. WINCH CONTROL VALVE - REPAIR (Cont'd)

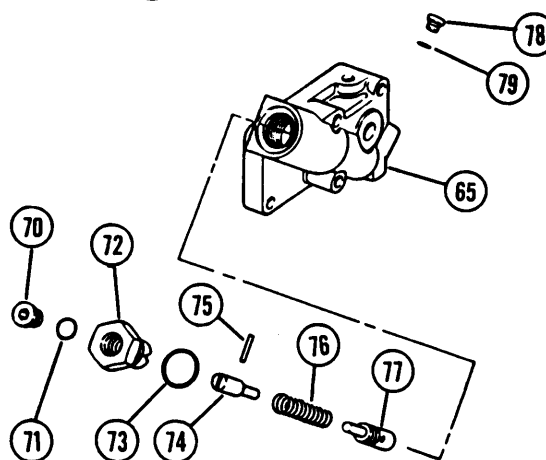
(8) Install slug (86) in valve spool (85). Install spring (84) and valve spool assembly in valve body (10).



(9) Install gasket (83) and cover (82) on pressure control valve (10).

(10) Install two lockwashers (81) and two cap screws (80) in cover (82) using a wrench.

(11) Install preformed packing (79) on plug (78). Install plug (78) using a wrench.



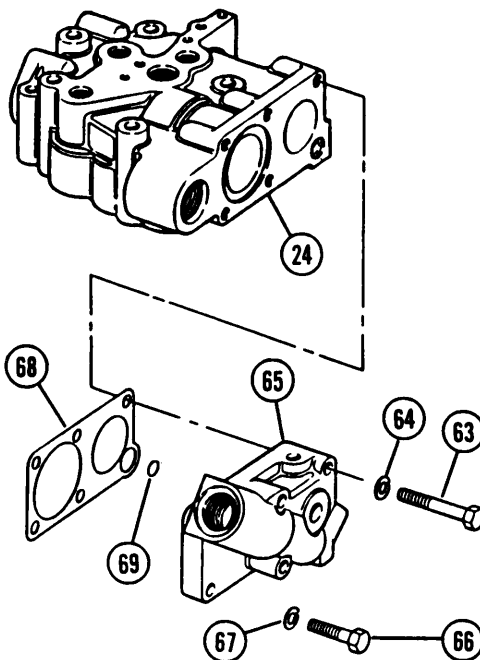
(12) Install valve spool (77) and spring (76) in sequence valve (65).

(13) Install retainer (74) with pin (75) in valve (65).

(14) Install preformed packing (73) on plug (72). Install plug (72) on valve (65) using a wrench.

(15) Install preformed packing (71) on plug (70). Install plug (70) on plug (72) using an allen wrench.

(16) Install preformed packing (69) in sequence valve (65). Install gasket (68) on sequence valve (65).

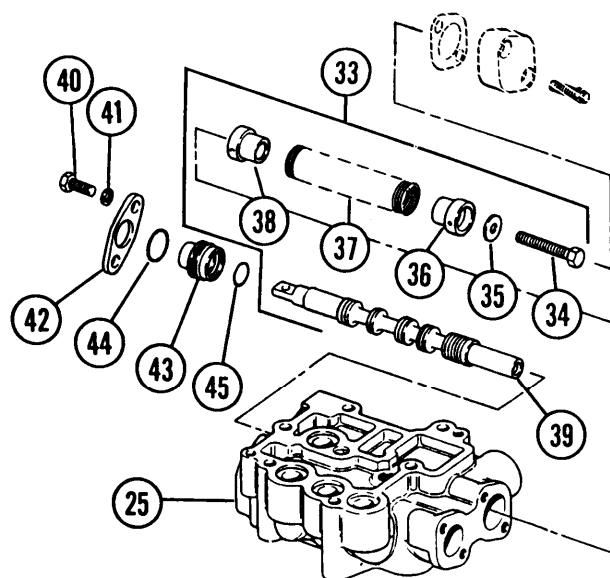
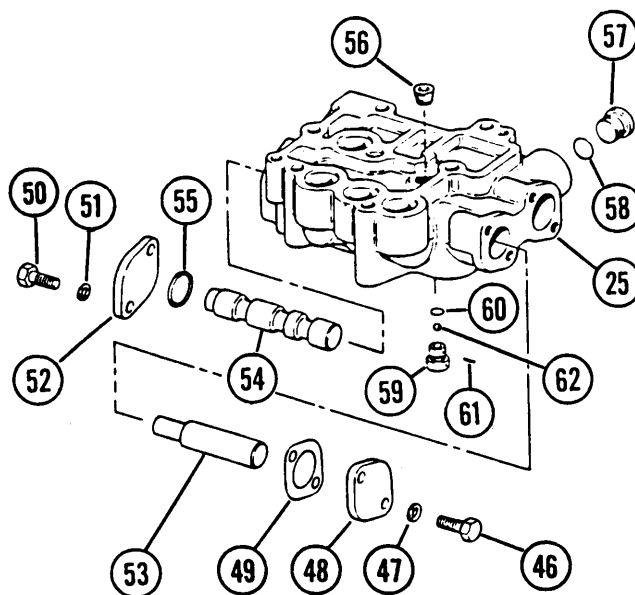


(17) Place sequence valve (65) in position on pressure control valve (24). Install lockwasher (67) and cap screw (66) using a wrench to secure sequence valve (65) to pressure control valve (24).

(18) Use a wrench to install three lockwashers (64) and three cap screws (63) in sequence valve (65).

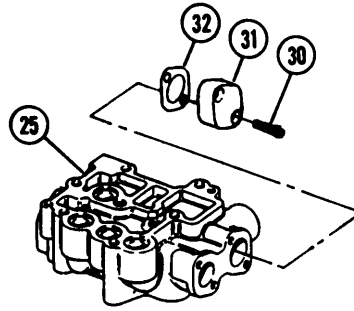
## 12-6. WINCH CONTROL VALVE - REPAIR (Cont'd)

- (19) Install preformed packing (60) on seat (59). Install ball (62) and pin (61) in seat (59). Install seat assembly (59) in valve (25).
- (20) Install preformed packing (58) on plug (57). Install plug (57) on valve (25) using a wrench.
- (21) Install plug (56) in selector valve (25) using an allen wrench.
- (22) Install preformed packing (55) on valve spool (54). Install valve spool (54) and stop (53) in valve body (25).
- (23) Position cover (52) on valve body (25). Install two washers (51) and two capscrews (50) in cover (52) using a wrench.
- (24) Install gasket (49) and cover (48) in position on valve body (25).
- (25) Install two washers (47) and two capscrews (46) to secure cover (48) using a wrench.
- (26) Install preformed packings (44 and 45) on bushing (43). Install bushing (43) in valve body (25).
- (27) Position flange (42) on selector valve body (25). Use a wrench to install two lockwashers (41) and two capscrews (40) to secure flange (42).
- (28) Install retainer (38), spring (37), retainer (36), washer (35) and capscrew (34) on valve spool (39). Use a wrench to tighten capscrew (34) to a torque of  $22\pm 3$  lb. ft.
- (29) Install valve spool assembly (33) in selector valve body (25).



12-6. WINCH CONTROL VALVE - REPAIR (Cont'd)

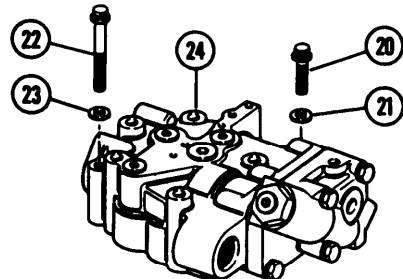
(30) Position gasket (32) and cover (31) on selector valve (25). Use a wrench to install two capscrews (30) to secure cover (31).



(31) Install four preformed packings (28), preformed packings (27) and gasket (26) on selector valve (25).

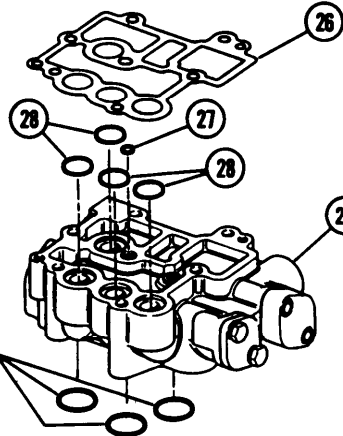
(32) Position pressure control valve (24) on selector valve (25).

(33) Use a wrench to install washer (23) and twelve point capscrew (22) in pressure control valve (24).



(34) Use a wrench to install washer (21) and twelve point capscrew (20) in pressure control valve (24).

(35) Install three preformed packings (29) in selector valve (25).

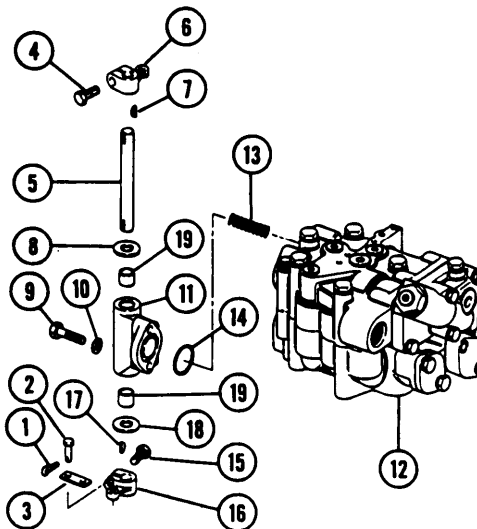


(36) Use a press to install two bushings (19) in bracket (11). Bushings (19) must be installed 0.06 in. below end surfaces of bracket (11).

(37) Install washer (18) on shaft (5).

(38) Install key (17) on shaft (5).

(39) Slide lever (16) on shaft (5). Use a wrench to tighten capscrew (15) on lever (16).



(40) Install spring (13) into valve assembly (12). Install preformed packing (14) on bracket (11).

(41) Install bracket (11) on valve body (12). Install two washers (10) and two capscrews (9) using a wrench.

---

## 12-6. WINCH CONTROL VALVE - REPAIR (Cont'd)

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- (42) Install shaft assembly (5) in bracket (11).
- (43) Install washer (8) on shaft (5).
- (44) Install key (7) on shaft (5).
- (45) Install lever (6) on shaft (5).
- (46) Install two links (3) on valve spool assembly (33) and lever (16). Install two straight head pins (2) and two new cotter pins (1) to secure links (3).
- (47) Install winch control valve (12). See TM5-2410-237-20.

### c. Place In Service

Test run winch and check for proper operation.

12-7. WINCH GEAR PUMP - REPAIR

This task covers:

- a. Disassembly
- b. Assembly
- c. Place In Service

INITIAL SETUP

Applicable Configurations

Tractor with Winch

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Materials/Parts

Bearings (10), (11), (12), 13)  
Preformed Packings (6) and (7)  
Seal (14)  
Lubrication Oil OE/HDO-10  
(Refer to L05-2410-237-12)

Equipment Condition

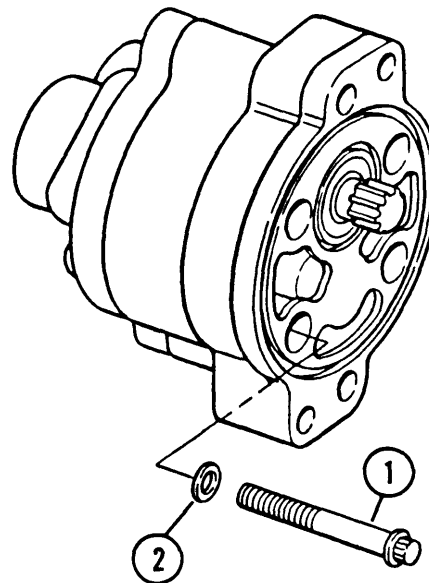
Gear pump removed. See TM5-2410-237-20.

a. Disassembly

NOTE

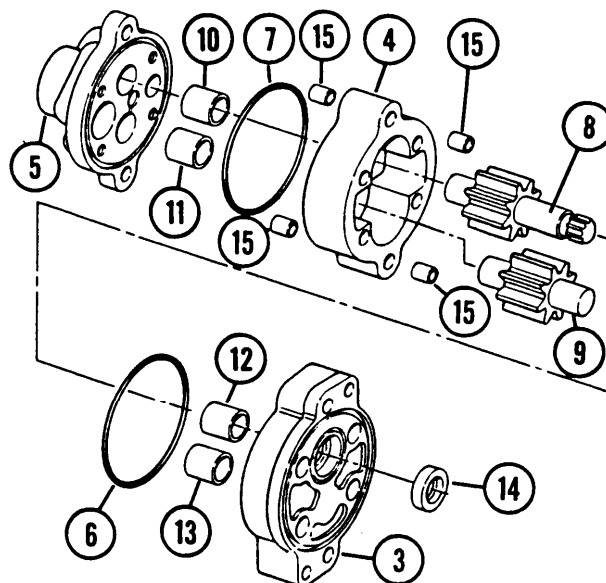
Mark gear pump housing prior to disassembly with a line across all segments of the body. This will simplify assembly.

- (1) Use a twelve point wrench to remove four screws (1) and washers (2).



## 12-7. WINCH GEAR PUMP - REPAIR (Cont'd)

- (2) Separate cover (3) from body (4) and body (4) from manifold (5). Remove and discard preformed packings (6 and 7).
- (3) Remove gears (8 and 9) from body (4).
- (4) Remove bearings (10 and 11) from manifold (5). Remove bearings (12 and 13) and seal (14) from cover (3). Discard bearings (10-13) and seal (14).
- (5) If damaged, remove dowels (15) from body (4).

b. Assembly

- (1) Install new bearings (10 and 11) in manifold (5). Install bearings (12 and 13) and seal (14) in cover (3).
- (2) If removed, install dowels (15) in body (4).
- (3) Place new preformed packing (7) on manifold (5) and join manifold (5) to body (4).
- (4) Place gear (9) in bottom position of body (4), sliding shaft into bearing (11).
- (5) Place gear (8) in top position of body (4), sliding shaft into bearing (10).
- (6) Put new preformed packing (6) on cover (3) and use a twelve point wrench to secure cover (3) to body (4) with four capscrews (1) and washers (2). Torque capscrews (1) to 32±5 lb. ft.

## NOTE

Before running, lubricate pump with oil.

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12-7. WINCH GEAR PUMP - REPAIR (Cont'd)

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NOTE

Pump must rotate freely by hand.

c. Place In Service

Check winch for proper operation.

## CHAPTER 13

## HYDRAULIC SYSTEM MAINTENANCE

## Section I. DESCRIPTION AND DATA

## 13-1. GENERAL

Hydraulic system maintenance procedures not covered in this chapter can be found in TM5-2410-237-20.

## 13-2. PRINCIPLES OF OPERATION

- a. System Description. The implement hydraulic system supplies a controlled flow of filtered hydraulic oil for operation of the dozer and the ripper.

Principal components of the system are:

<u>Component</u>	<u>Index No. (page 13-2)</u>
Pilot valves	1 & 2
Pump	3 & 4
Pressure control valve	5
Ripper control valve	9
Quick drop valves	13
Dozer lift cylinders	14
Bulldozer control valve	17
Dozer tilt cylinder	18
Ripper lift cylinders	22
Filter	25
Hydraulic tank	26

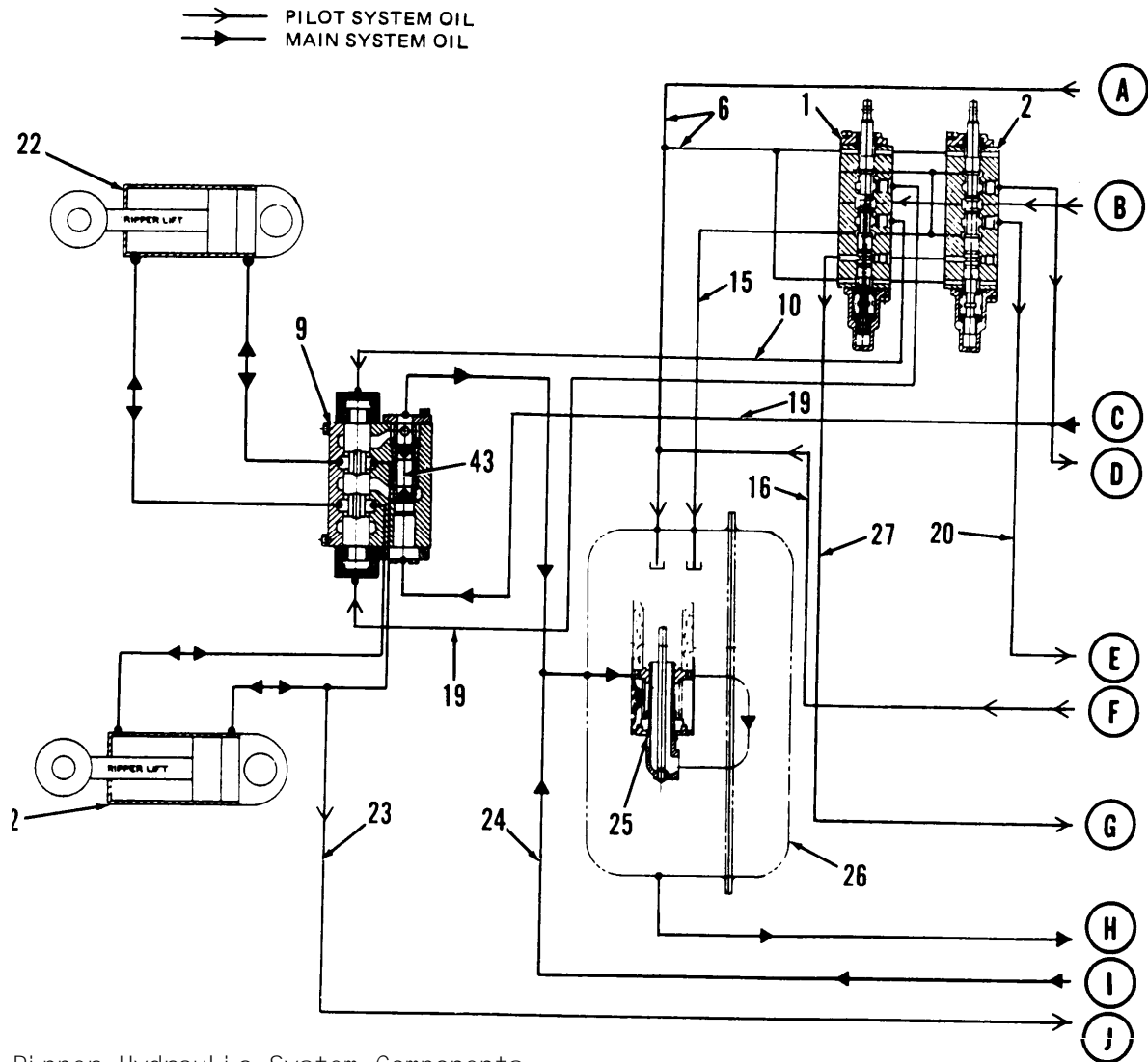
A two-section vane pump (3 and 4) draws oil from the hydraulic tank (26) whenever the engine is running. The small section of the pump (4) supplies oil for the pilot system and operation of the blade tilt cylinders (18). The large section of the pump (3) supplies oil to operate the blade lift cylinders (14) and the ripper lift cylinders (22). If the tilt cylinder is not being operated, oil flow from both sections of the pump is combined within the bulldozer control valve (17) to supply the lift cylinders (14).

Pilot oil flows from the small section of the pump to the pressure control valve (5). This oil flow moves a valve spool against concentric springs. The force of these springs produces a back pressure of 115 psi on the small section of the pump, and also provides operating pressure for the pilot valves (1 and 2).

The blade tilt and ripper lift functions are controlled by pilot valves (1 and 2). The respective control levers connect to the spools of the pilot valves. The blade lift control lever directly controls the spool (36) of the dozer lift control valve; no pilot valve is involved.

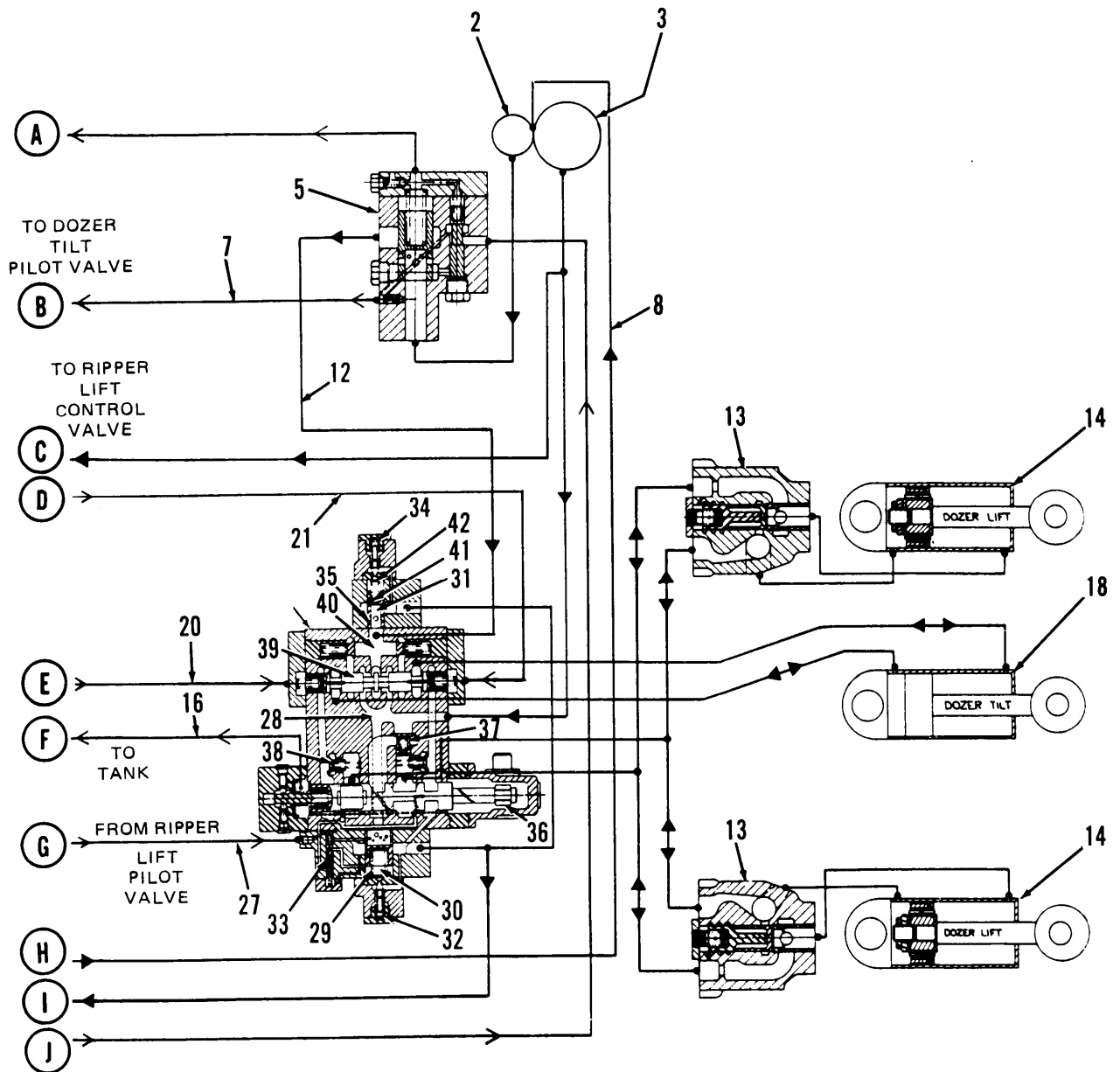
Return oil from all circuits is passed through a filter (25) before entering the tank. The filter has a bypass feature, which operates a visual indicator that shows when bypassing is occurring.





Dozer and Ripper Hydraulic System Components

- |   |  |
|---|--|
| 1. Ripper lift pilot valve                  | 16. Oil return line  |
| 2. Dozer tilt pilot valve                   | 17. Bulldozer control valve (lift and tilt)  |
| 3. & 4. Large and small section oil pump    | 18. Dozer tilt cylinder  |
| 5. Pressure control valve                   | 19. Ripper control valve pilot line (lower)  |
| 6. Pilot valves return lines                | 20. Dozer tilt pilot line (head end)   |
| 7. Pilot valves supply lines                | 21. Dozer tilt pilot line (rod end)  |
| 8. Pump supply line                         | 22. Ripper cylinders   |
| 9. Ripper lift control valve                | 22. Ripper cylinder-to-pressure control valve pressure line (for ripper lower with engine off) |
| 10. Ripper control valve pilot line (raise) | 24. Oil return-line  |
| 11. Oil return lines                        | 25. Oil filter   |
| 12. Tilt control valve supply line          | 26. Hydraulic tank   |
| 13. Quick drop valves                       | 27. Shuttle valve pilot line   |
| 14. Dozer lift cylinders                    |  |
| 15. Pilot system return lines               |  |



Bulldozer Control Valve Components

- |                                     |  |
|-------------------------------------|--|
| 28. Passage                         | 37. Load check valve                                 |
| 29. Dump valve spring               | 38. Makeup valve<br>(for head end of lift cylinders) |
| 30. Main system dump valve          | 39. Tilt control spool                               |
| 31. Dump valve                      | 40. Oil chamber                                      |
| 32. Blade lift relief valve         | 41. Orifice  |
| 33. Shuttle valve                   | 42. Chamber<br>(Ripper lift control valve component) |
| 34. Blade tilt relief valve         | 43. Makeup valve                                     |
| 35. Dump valve (small pump section) |  |
| 36. Blade lift control valve spool  |  |

- b. Dozer Blade Lift System. The bulldozer control valve (17) has four operating positions: RAISE, HOLD, LOWER and FLOAT. The lift valve spool is moved to the desired operating position by fore and aft movement of the blade control lever.

The RAISE and LOWER positions raise or lower the blade. In the HOLD position, the spool is centered and oil flow to and from the lift cylinders is blocked. The FLOAT position (lever fully forward) has detents to hold the valve spool in position. In the FLOAT position, both ends of the blade lift cylinders are at "tank" pressure; thus, the blade can be moved up or down by outside forces.

With the blade control lever in the HOLD position and the engine running, oil flow from both pump sections combines in passage (28) of the control valve. When pressure in passage (28) exceeds the 80 psi pressure exerted by spring (29), dump valve (30) will unseat and the oil flow from both pump sections will return to tank via line (24).

With the blade lever in the RAISE position, blade lift valve spool (36) is moved into the valve body. Pressure buildup in the valve unseats load check valve (37). Oil then flows under pressure through quick-drop valves (13) to the rod ends of the blade lift cylinders (14). Cylinder movement raises the dozer blade. Exhaust oil from the head ends of the cylinders returns to tank through passages in the control valve (17).

Moving the blade lift control lever to the LOWER position directs pressurized flow to the head ends of the dozer lift cylinders (14). Return oil from the rod ends of the dozer lift cylinders can either pass to tank through the control valve (17) or it can be added to the flow going to the head ends through the makeup valve (38) in the control valve.

If working pressure of the lift cylinders is greater than the setting of relief valve (32), the relief valve will unseat. Dump valve (30) will then open, allowing overflow to momentarily return to the tank. The relief valve (32) will reseat when cylinder working pressure drops below relief setting. The relief setting is adjusted by adding or removing shims.

- c. Dozer Tilt System. The blade tilt control spool and related valves are located in the upper portion of the bulldozer control valve.

Pilot oil to operate the blade tilt control spool and supply oil for the tilt cylinder (18) is provided by the small section of the pump (4). All flow from the small section of the pump goes into pressure control valve (5). As mentioned previously, spring force within the pressure control valve sets a minimum pump operating pressure of 115 psi.

To tilt the blade to the right, the tilt control lever is moved to the right. This will move the tilt control pilot valve (2) spool into the valve body, allowing flow to be ported through the pilot valve (2) to one end of the tilt control spool (39) in the bulldozer control valve (17). As the tilt control spool moves, the tilt system oil chamber (40) in the bulldozer control valve will be sealed off from the lift system chamber (28) and pressure will build up quickly in chamber (40). Oil then flows under pressure to the head end of the cylinder and the blade tilts to the right (up). Exhaust oil from the rod end of the cylinder returns through the bulldozer control valve to the tank.

To tilt the blade to the left (left side up), the control lever is moved left, reversing the pilot valve spool movement and changing the porting through the bulldozer control valve. Oil then flows under pressure to the rod end of the cylinder.

Components of the blade tilt system are protected against overpressure by a pilot-operated relief valve (34) which is built into the bulldozer control valve (17). Cylinder working pressure in chamber (40) is applied against relief valve (34) through orifice (41). If cylinder working pressure rises above the setting of valve (34), the poppet will unseat and vent chamber (42) to tank via return line (24) and the pressure in chamber (42) will drop. The pressure in chamber (40) will remain relatively high because of the restriction caused by orifice (41), and dump valve (43) will move upward against its spring. Upward movement of dump valve (43) will open chamber (40) to line (24) and the overpressure will be "dumped" to tank. When the pressure returns to normal, dump valve (31) and relief valve (34) will both reset.

- d. Ripper Lift System. When the ripper lift control lever is moved to the right, the spool of ripper pilot valve (1) moves out of the valve body, allowing pilot pressure through line (10) to the upper end of the ripper lift control valve (9) spool. Pilot pressure causes the spool to shift, allowing system oil to flow to the head ends of the ripper lift cylinders (22).

As pressurized oil forces the cylinder pistons outward, exhaust oil from the rod ends returns to the ripper control valve (9). Within the valve, exhaust oil can either be returned to tank or, when necessary, sent through the makeup valve (44) and combined with main system flow going to the head ends of the cylinders.

To lower the ripper, the pilot valve (1) directs pilot oil to the lower end of the ripper control valve (9). Main system oil flow is then directed to the rod ends of the ripper cylinders (22). Again, exhaust oil from the cylinders can be used as makeup oil when demanded.

During both the raising and lowering operations, pilot oil from the ripper pilot valve (1) is directed, via line (27), to the shuttle valve (33) in the bulldozer control valve. The shuttle valve shifts to open a passage (28) for main system oil to flow into the chamber between dump valve (30) and blade lift relief valve (32). This chamber is then at system pressure. If an excessive pressure builds up, the relief valve will unseat and open passage (28) to tank return line (24). When system pressure drops back to normal, the relief valve reseats and flow back to tank is cut off.

- e. Lowering Ripper With Engine Off. The design of the pressure control valve allows the ripper to be lowered while the engine is not running. Oil pressure to accomplish this is created in the head ends of the ripper lift cylinders (22) by the weight of the ripper acting on the cylinder pistons.

With the ripper control lever in HOLD, oil pressure in the head ends of the cylinders is transmitted to a port on the ripper lift pilot valve (1) via line (23), internal passages in the pressure control valve (5), and through line (7). This pressure also exists in a chamber in the ripper lift control valve (9). Moving the ripper lift control lever to the LOWER position allows the cylinder pressure to be applied to the spool in the ripper control valve (43) just as in normal lowering operation. All the exhaust oil not needed for pilot flow is routed through the makeup valve (43) of the ripper control valve to the head ends of the cylinders as makeup oil.

## Section II. HYDRAULIC SYSTEM MAINTENANCE PROCEDURES

## 13-3. HYDRAULIC SYSTEM MAINTENANCE TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
13-4	Hydraulic Pump - Test/Repair	13-7
13-5	Bulldozer Control Valve - Replace/Repair	13-15
13-6	Hydraulic Pressure Control Valve - Replace/Repair	13-35
13-7	Blade and Ripper Pilot Valves - Replace/Repair	13-43
13-8	Ripper Control Valve - Replace/Repair	13-51
13-9	Blade Control Lever and Linkage - Replace	13-59
13-10	Ripper Control Lever and Linkage - Replace	13-67
13-11	Blade Tilt Cylinder - Repair	13-71
13-12	Blade Adjustable Brace - Repair	13-75
13-13	Hydraulic Lines and Fittings - Repair	13-77
13-13.1	Hydraulic Filter Screen Assembly - Repair	13-91
13-14	Blade Lift Cylinder - Repair	13-93
13-15	Blade Lift Cylinder Mounting Tube - Replace	13-97
13-16	Ripper Lift Cylinder - Repair	13-99
13-17	Hydraulic Tank - Replace/Repair	13-104
13-18	Hydraulic System - Test	13-111
13-19	Quick Drop Valves - Replace/Repair	13-137

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## 13-4. HYDRAULIC PUMP - TEST/REPAIR

---

This task covers:

- a. Disassembly
- b. Cleaning
- c. Inspection
- d. Lubrication
- e. Assembly
- f. Test

---

### INITIAL SETUP

#### Applicable Configurations

All

#### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Tool Outfit, Hydraulic System Test and Repair (HSTRU)  
 NSN 4940-01-036-5784

#### Materials/Parts

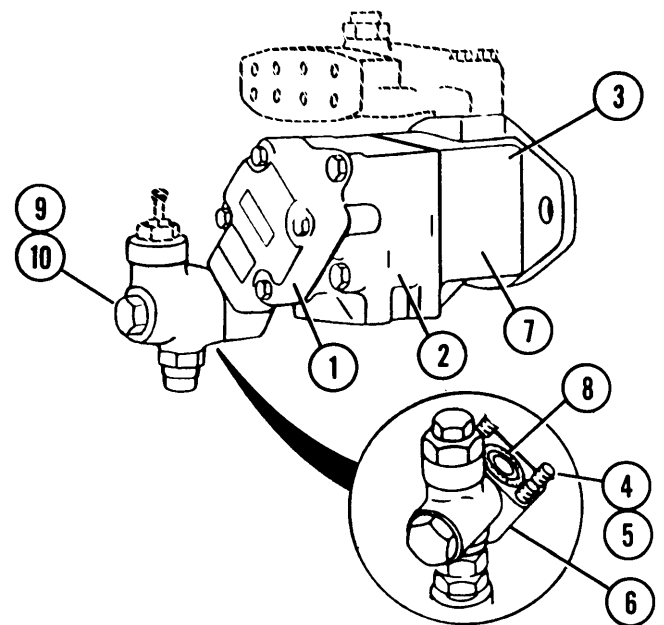
Seal (8), (10), (12), (14), (18), (21), (24), (26), (28), (32), (34), (36), (37), (40), (44), (46), (52), (53)  
 Plug (54)  
 1" dia. X 8" Long pipe  
 Lubricating Oil OE/HDO-10 (See L05-2410-237-12)

#### Equipment Condition

Hydraulic pump removed. See TM5-2410-237-20.

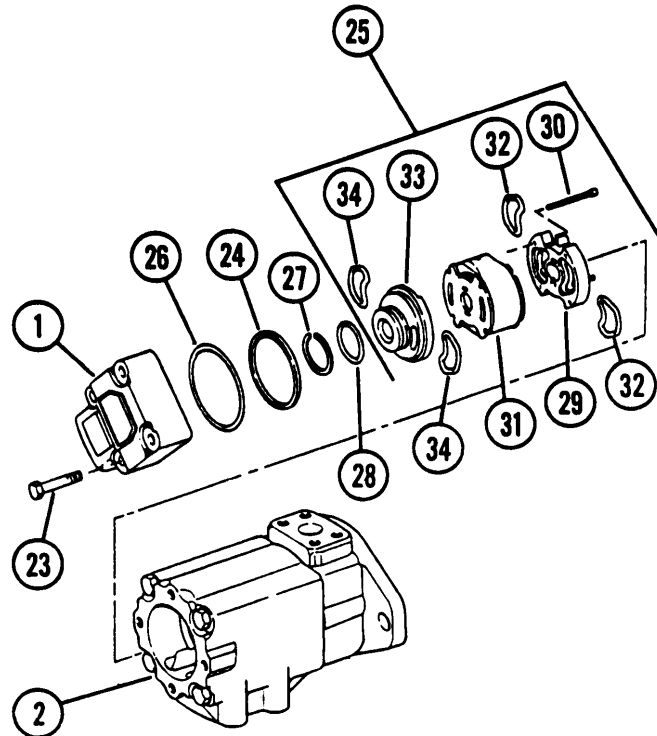
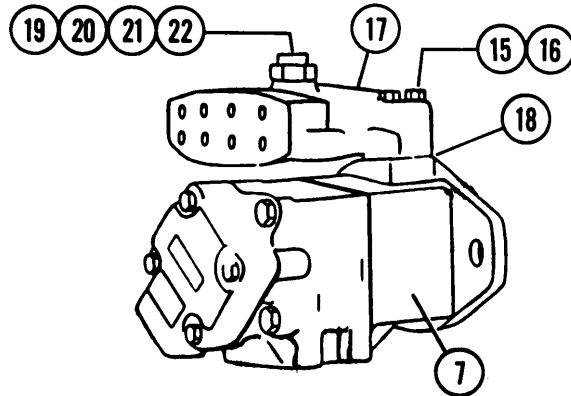
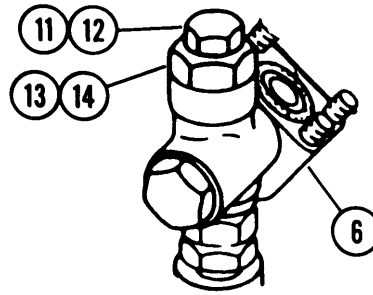
#### a. Disassembly

- (1) Clean the outside of the pump body and cover. Put reference marks between the end cover (1) and center cover (2) and center cover and pump body (3) prior to pump disassembly. These marks will reference the correct port relation at assembly.
- (2) Use a wrench to remove four capscrews (4), four washers (5) and elbow (6) from hydraulic pump (7). Remove and discard seal (8) from elbow (6).
- (3) If necessary, use a wrench to remove plug (9) from elbow (6). Remove and discard seal (10) from plug.



13-4. HYDRAULIC PUMP - TEST/REPAIR (Cont'd)

- (4) If necessary, use a wrench to remove plug (11) from elbow (6). Remove and discard seal (12) from plug.
- (5) If necessary, use a wrench to remove adapter (13) from elbow (6). Remove and discard seal (14) from adapter (13).
- (6) Use a wrench to remove four capscrews (15), four washers (16), and manifold (17) from hydraulic pump (7). Remove and discard seal (18) from manifold.
- (7) If necessary, remove nipple assembly (19), dust cap (20) and seal (21) from adapter (22). Discard seal (21).
- (8) If necessary, use a wrench to remove adapter (22) from manifold (17).
- (9) Use a wrench to remove four capscrews (23) and end cover (1) from center cover (2).
- (10) Remove seal (24) and cartridge (25) from end cover (1). Discard seal (24).
- (11) Remove and discard seal (26) from end cover (1).
- (12) Remove backup ring (27) and seal (28) from cartridge (25). Discard seal (28).



NOTE

Put an alignment mark across the components of the cartridge to give reference for correct assembly.

13-4. HYDRAULIC PUMP - TEST/REPAIR (Cont' d)

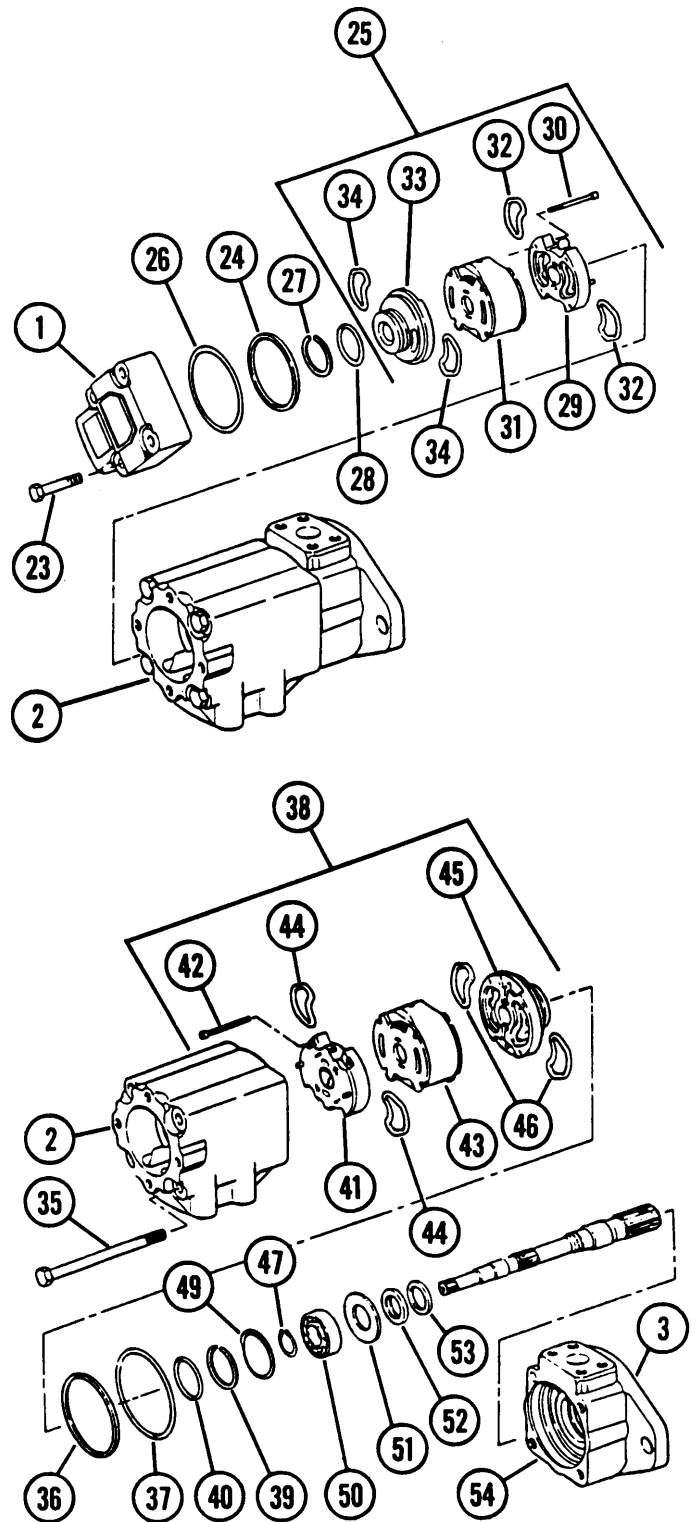
NOTE

Make a note of the directions of the arrows on plate (29) and the location of capscrews (30) for correct assembly. The arrows show the rotation direction of the hydraulic pump. Capscrews are installed in the holes next to the arrows that show the direction of pump rotation.

- (13) Remove four capscrews (30) that secure the cartridge (25) together.
- (14) Remove plate (29) from the plate (31).
- (15) Remove and discard two seals (32) from plate (29).
- (16) Remove plate (33) from plate (31).
- (17) Remove and discard two seals (34) from plate (33).
- (18) Use a wrench to remove four capscrews (35) that hold center cover (2) in place. Remove cover and seal (36). Discard seal.
- (19) Remove seal (37) and cartridge (38) from pump body (3). Discard seal.
- (20) Remove backup ring (39) and seal (40) from cartridge (38). Discard seal.

NOTE

Put an alignment mark across the components of the cartridge to give reference for correct assembly.





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 13-4. HYDRAULIC PUMP - TEST/REPAIR (Cont'd)
 

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## NOTE

Make a note of the direction of the arrows on plate (41) and the location of capscrews (42) for correct assembly. The arrows show the rotation direction of the hydraulic pump. Capscrews are installed in the holes next to the arrows that show the direction of pump rotation.

- (21) Remove four capscrews (42) that secure the cartridge (38) together.
- (22) Remove plate (41) from plate (43).
- (23) Remove and discard two seals (44) from plate (41).
- (24) Remove plate (45) from plate (43).
- (25) Remove and discard two seals (46) from plate (45).
- (26) Use snap ring pliers to remove retaining ring (47) from the shaft (48).
- (27) Use a press and tool to remove shaft (48) from pump body (3).
- (28) Remove retaining ring (49) that holds the bearing (50) in place.
- (29) Remove bearing (50) and washer (51) from the pump body (3).
- (30) Remove and discard two lip type seals (52 and 53) from the pump body (3).
- (31) If necessary, remove and discard plug (54) from pump body (3).

b. Cleaning

Thoroughly clean and dry all parts. Refer to page 2-29.

c. Inspection

Inspect all parts for wear or damage. Damage to any component of either cartridge group, except seals, will cause replacement of the complete cartridge group.

d. Lubrication

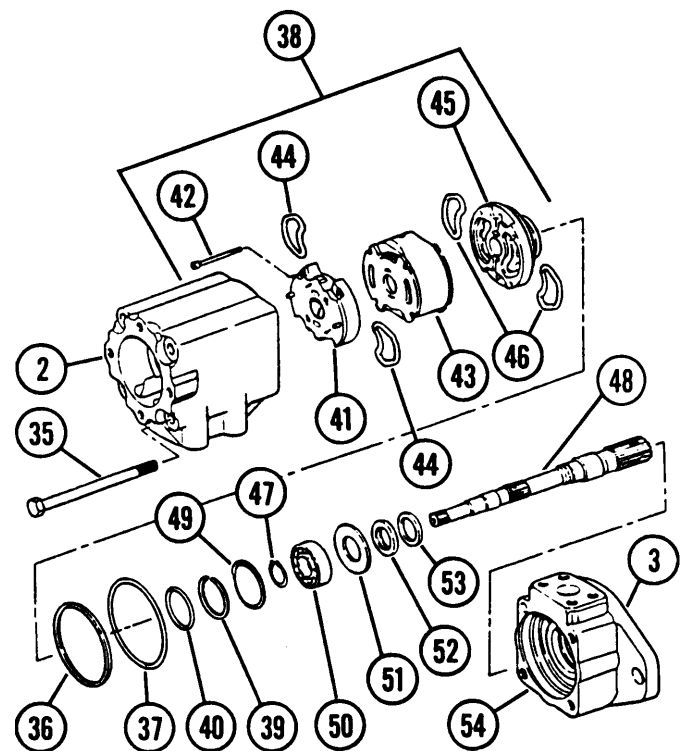
Put clean oil on all parts during assembly.

e. Assembly

- (1) During assembly all components must be installed in the correct direction of pump rotation. Pump rotation as seen from the splined end of the shaft is counter-clockwise.
- (2) If removal of the plug (54) was necessary, install a new plug in pump body (3).
- (3) Use a driver tool to install new outer lip type seal (53) in pump body (3). Install the seal with the spring loaded lip toward the pump bearing.
- (4) Turn pump body (3) over and use a driver tool to install new inner lip type seal (52) in pump body (3). Install the seal with the spring loaded lip toward the pump bearing.
- (5) Install washer (51) and bearing (50) in pump body (3).
- (6) Install retaining ring (49) that holds the bearing (50) and washer (51) in place.

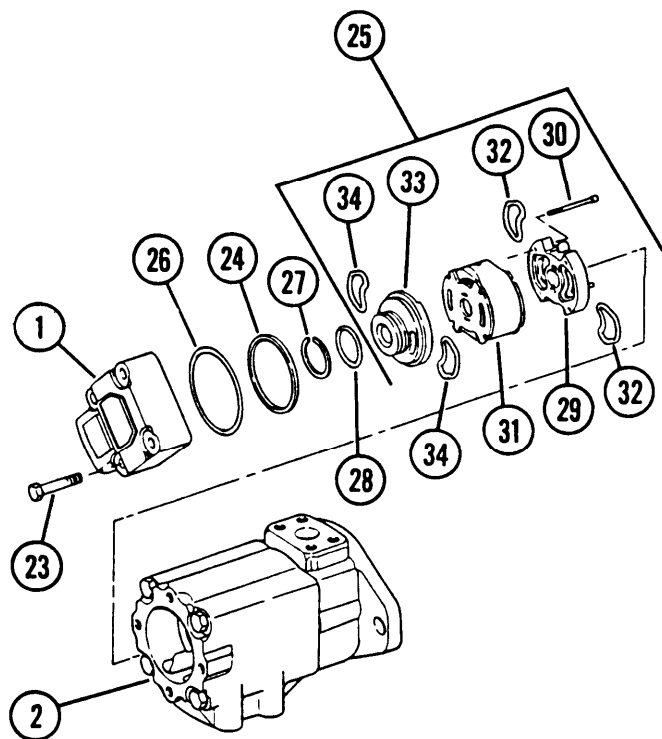
## 13-4. HYDRAULIC PUMP - TEST/REPAIR (Cont'd)

- (7) Put a piece of 1 in. diameter pipe that is 8 in. long in position against the inner race of bearing (50). Use a driver tool, pipe and a press to install shaft (48).
- (8) Use pliers to install retaining ring (47) on the shaft (48).
- (9) Install a new seal (37) in pump body (3).
- (10) Seals (46) are a two piece seal. Ensure that preformed packing seal is in plastic seal before seals are installed. Install two new seals with the preformed packing in contact with end plate (45).
- (11) Seals (44) are a two piece seal. Ensure that preformed packing is in plastic seal before seals are installed. Install two new seals with the preformed packing in contact with plate (41).
- (12) Put plates (41 and 45) in position on the plate (43).
- (13) Loosely install four capscrews (42) in the holes nearest the arrows that are in the same direction as the arrow on plate (41). These arrows show the direction of pump rotation and must be assembled with the arrows in the same direction.
- (14) Install a new seal (40) and backup ring (39) on the cartridge (38). Install the seal toward the pressure source.
- (15) Install cartridge (38) on pump body (3). Put the cartridge in position so pins in the plate are in alignment with mounting holes of pump body.



13-4. HYDRAULIC PUMP - TEST/REPAIR (Cont'd)

- (16) Tighten four capscrews (42).
- (17) Install a new seal (36).
- (18) Ensure that pins in the plate of the cartridge (38) are in alignment with the holes in center cover (2). Install pump body (3) and cartridge in center cover according to markings made at disassembly. Use a wrench to install four capscrews (35) that secure the cover to the pump body. Tighten the capscrews to a torque of  $70 \pm 10$  lb. ft.
- (19) Seals (32) are a two piece seal. Ensure that preformed packing is in plastic seal before seals are installed. Install two new seals with the preformed packing in contact with end plate (29).
- (20) Seals (34) are a two piece seal. Ensure that preformed packing is in plastic seal before seals are installed. Install two new seals with the preformed packing in contact with plate (33).
- (21) Put plates (33 and 29) in position on the plate (31).
- (22) Install four capscrews (30) in the holes nearest the arrows that are in the same direction as the arrow on plate (29). These arrows show the direction of pump rotation and must be assembled with the arrows in the same direction.
- (23) Install a new seal (28) and backup ring (27) on the cartridge (25). Install the seal toward the pressure source.
- (24) Install a new seal (26) in end cover (1).



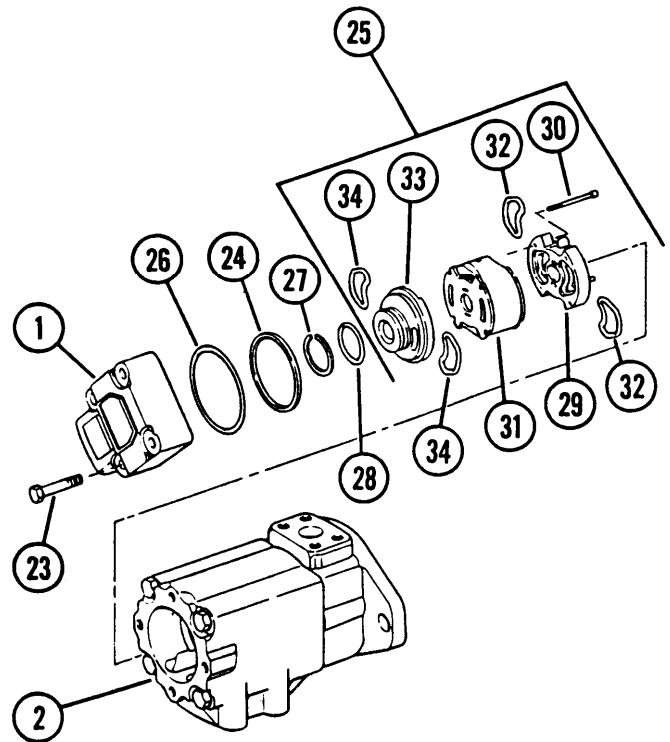
13-4. HYDRAULIC PUMP - TEST/REPAIR (Cont'd)

(25) Install cartridge (25) on end cover (1). Put the cartridge in position so pins in the plate are in alignment with mounting holes in the cover.

(26) Install a new seal (24) on end cover (1).

(27) Ensure that pins in the plate of the cartridge (25) are in alignment with the holes in end cover (1). Install cartridge in cover.

(28) Align the covers properly and use a wrench to install the four capscrews (23) that secure the covers together. Tighten the capscrews to a torque of 45±5 lb. ft.



NOTE

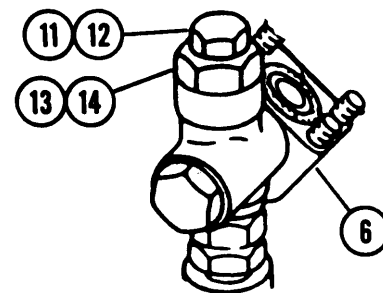
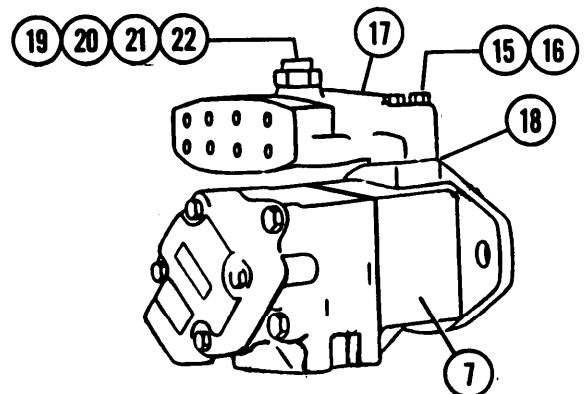
After assembly of the hydraulic pump, the pump shaft must turn by hand.

(29) If removal of the adapter (22) was necessary, use a wrench to install it in the manifold (17).

(30) If removal of the seal (21), dust cap (20) and nipple assembly (19) was necessary, install a new seal, dust cap and nipple assembly in manifold (17).

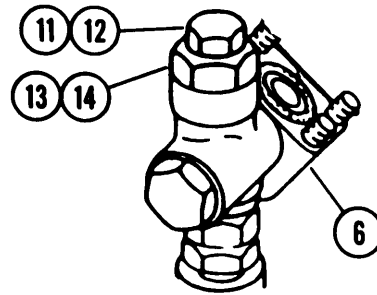
(31) Install a new seal (18) in manifold (17). Install manifold onto hydraulic pump (7) and secure with four capscrews (15) and four washers (16). Use a wrench to tighten capscrews.

(32) If removal of the seal (14) and adapter (13) was necessary, use a wrench to install adapter with a new seal in elbow (6).



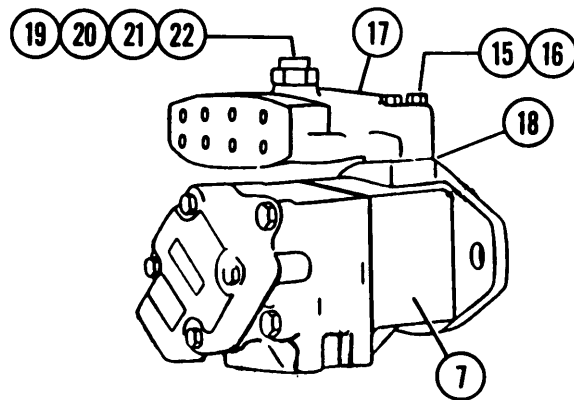
13-4. HYDRAULIC PUMP - TEST/REPAIR (Cont'd)

(33) If removal of seal (12) and plug (11) was necessary, use a wrench to install plug with a new seal in elbow (6).



(34) If removal of seal (10) and plug (9) was necessary, use a wrench to install plug with a new seal in elbow (6).

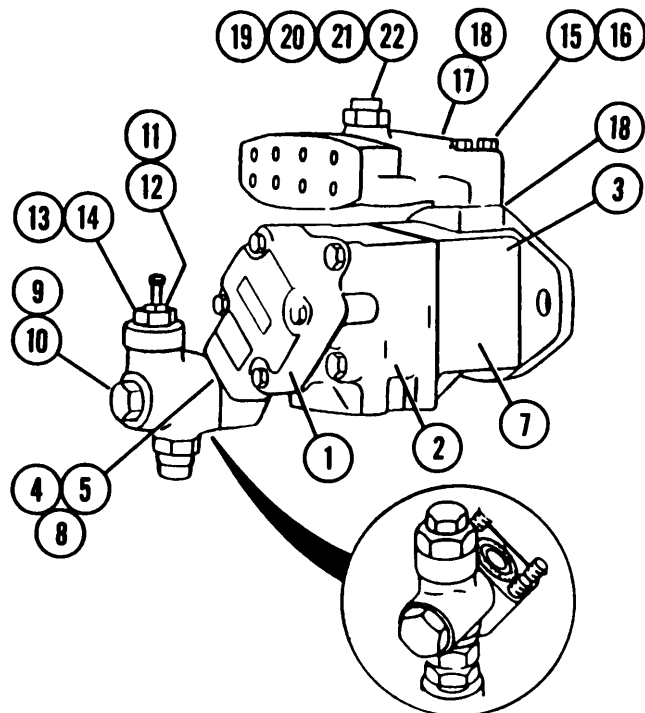
(35) Install a new seal (8) on elbow (6). Install elbow on hydraulic pump (7) and secure with four capscrews (4) and four washers (5). Use a wrench to tighten capscrews.



(36) Install the hydraulic pump. See TM5-2410-237-20.

f. Test

Before returning the machine to service, perform pump tests to make sure operation is correct. Pump tests are contained in the Hydraulic System Test, page 13-111. Do the Test Setup and proceed to Pump Tests. Be sure to follow all safety precautions.



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 13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR
 

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This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning
- d. Inspection
- e. Lubrication
- f. Assembly
- g. Installation
- h. Place In Service
- i. Relief Valve Adjustment

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 INITIAL SETUP
 

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Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose  
 Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Lifting Equipment 300 lbs.

Materials/Parts

Seal (10), (13), (26), (28), (34),  
 (43A), (43), (44), (47), (48) (58),  
 (59), (60), (61), (62), (66), (68),  
 (70), (72), (75), (77), (80), (82),  
 (84), (86), (90), (91), (100), (103),  
 (106), (111), (113), (114), (122),  
 (129), (131), (134), (136), (141),  
 (145)  
 Lubricating Oil OE/HDO-10  
 (Refer to L05-2410-237-12)  
 Anti-seizing Tape (App. B, Item 21)  
 16 gallon Pail  
 Thread Sealant (App. B, Item 14)  
 Lint-free rag  
 1/4"-20 X 2" Capscrew  
 3/8"-16 X 2" Capscrew  
 Gasket (95)  
 Caps and Plugs

Equipment Condition

Hydraulic tank mounting brackets and  
 plates removed.  
 See TM5-2410-237-20.  
 Pilot valve removed. See page 13-43.

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13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont' d)

a. Removal

**WARNING**

Relieve pressure in hydraulic oil tank by loosening filler cap very slowly. Failure to follow these precautions could result in serious personal injury.

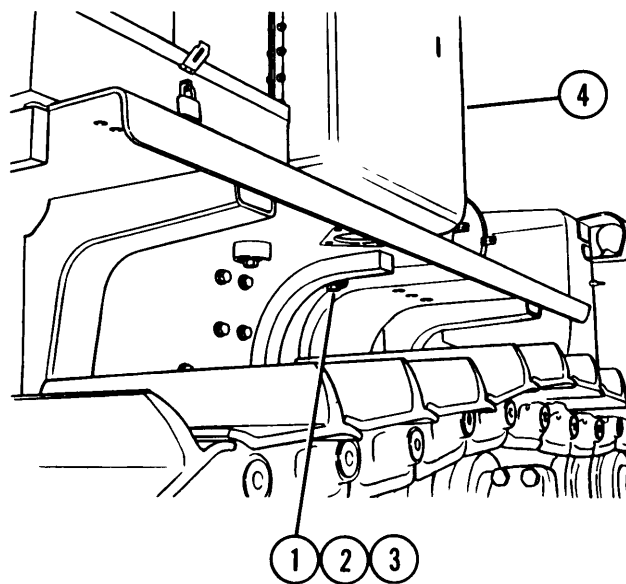
**CAUTION**

Wipe the area clean around all hydraulic connections to be opened during removal and disassembly. Cap oil lines and plug holes after removing lines. Contamination of the hydraulic system could result in premature failure.

**NOTE**

If more than one hydraulic line is to be removed, identify lines to assure proper installation. Use suitable container to catch any hydraulic oil that may drain from system.

- (1) Use a wrench to remove four capscrews (1), four washers (2) and cover plate (3) from underside of fender at hydraulic tank (4).
- (2) Drain oil from hydraulic tank (4) into suitable container. Capacity of tank is 16 gal.

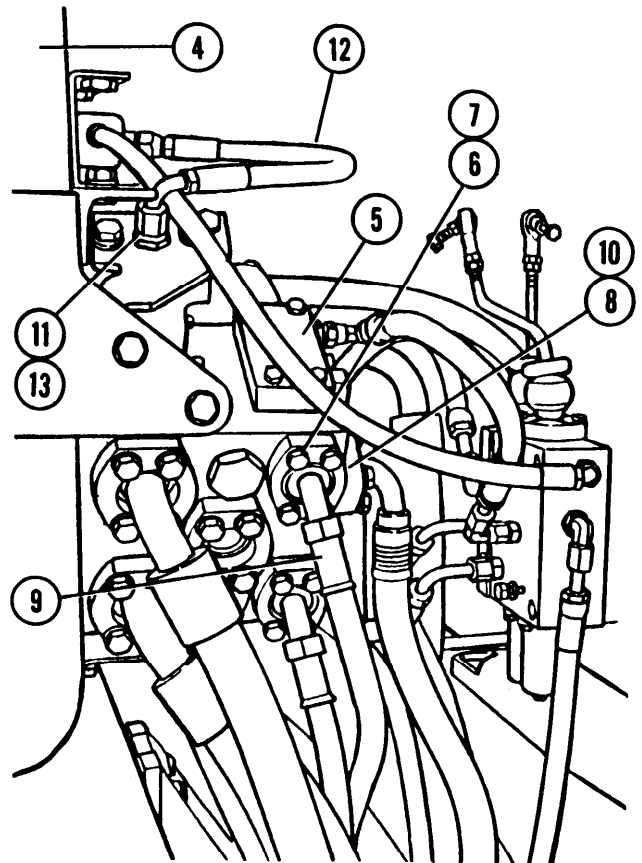


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**13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont'd)**

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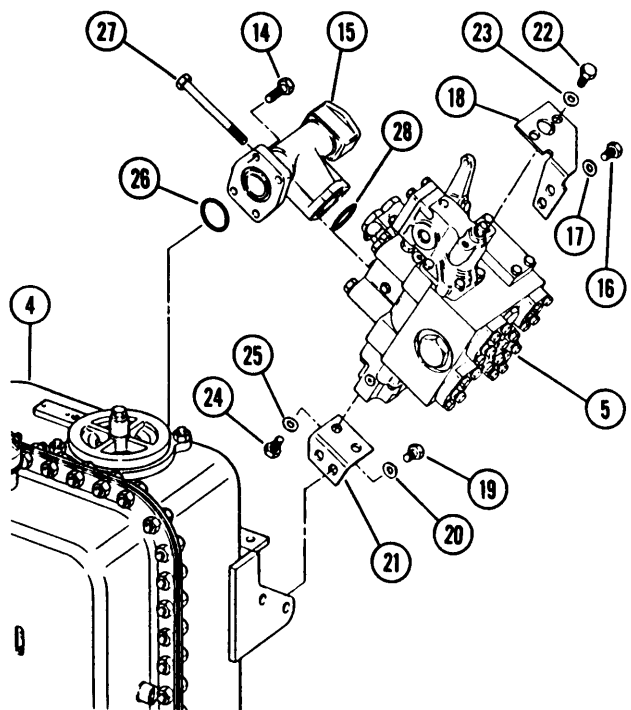
- (3) Remove all hydraulic lines from blade control valve (5) and hydraulic tank (4), using the following procedures:
- For hydraulic lines with flange fittings, use proper size wrench to remove four capscrews (6), four washers (7), two split flanges (8), line (9) and seal (10). Discard seal.
  - For hydraulic lines with connector fittings, use proper size wrench to loosen connector (11) and remove line (12) from fitting. Remove seal (13) from connector (11) and discard seal.





13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont'd)

- (4) Use a wrench to remove four capscrews (14) holding manifold (15) on hydraulic tank (4).
- (5) Attach lifting equipment to control valve assembly (5) to take weight off capscrews during removal.
- (6) Use a wrench to remove two capscrews (16) and two washers (17) from upper bracket (18) and tank (4).
- (7) Use a wrench to remove two capscrews (19) and two washers (20) from lower bracket (21) and tank (4).
- (8) Use lifting equipment to remove control valve (5) from tank (4).
- (9) Use a wrench to remove two capscrews (22), two washers (23) and upper bracket (18) from valve (5).
- (10) Use a wrench to remove two capscrews (24), two washers (25) and lower bracket (21) from valve (5).
- (11) Remove seal (26) from manifold (15) and discard seal.
- (12) Use a wrench to remove two capscrews (27), manifold (15) and seal (28) from control valve (5). Discard seal (28).



13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont'd)

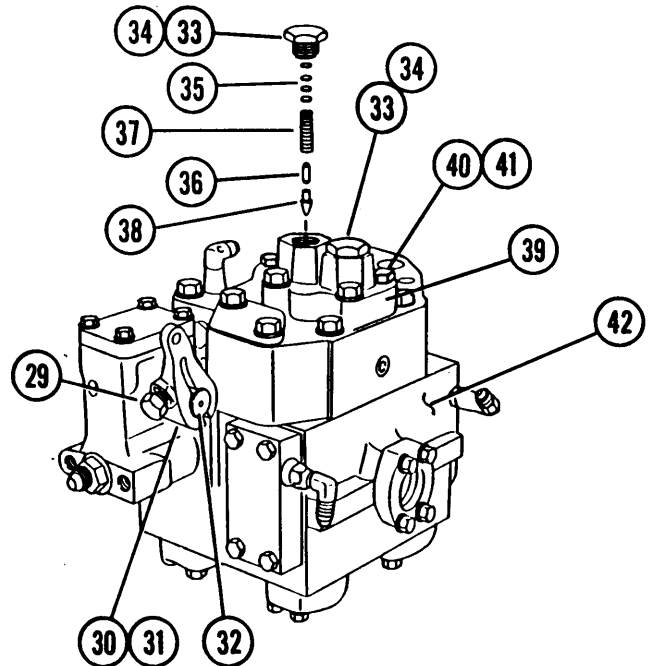
b. Disassembly

- (1) Use a wrench to loosen capscrew (29) and remove lever (30) and key (31) from shaft (32).

NOTE

Two plugs (33) are marked with pressure settings for respective valve. Mark plugs for proper placement during assembly.

- (2) Use a wrench to remove two plugs (33) and two seals (34) from plugs. Discard seals.
- (3) Remove four shims (35), two pistons (36), two springs (37) and two relief pilot valves (38) from cover (39).

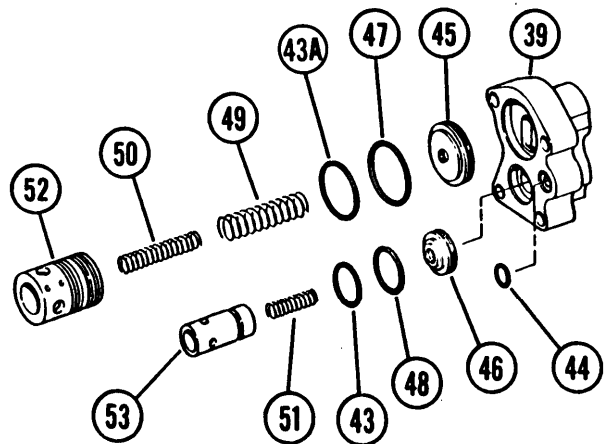


- (4) Use a wrench to remove four capscrews (40), four washers (41) and cover (39) from valve body (42).

- (5) Remove three seals (43A, 43 and 44) from bottom of cover (39). Discard seals.

- (6) Remove two valve seats (45 and 46) from bottom of cover (39).

- (7) Remove two seals (47 and 48) from valve seats (45 and 46). Discard seals.



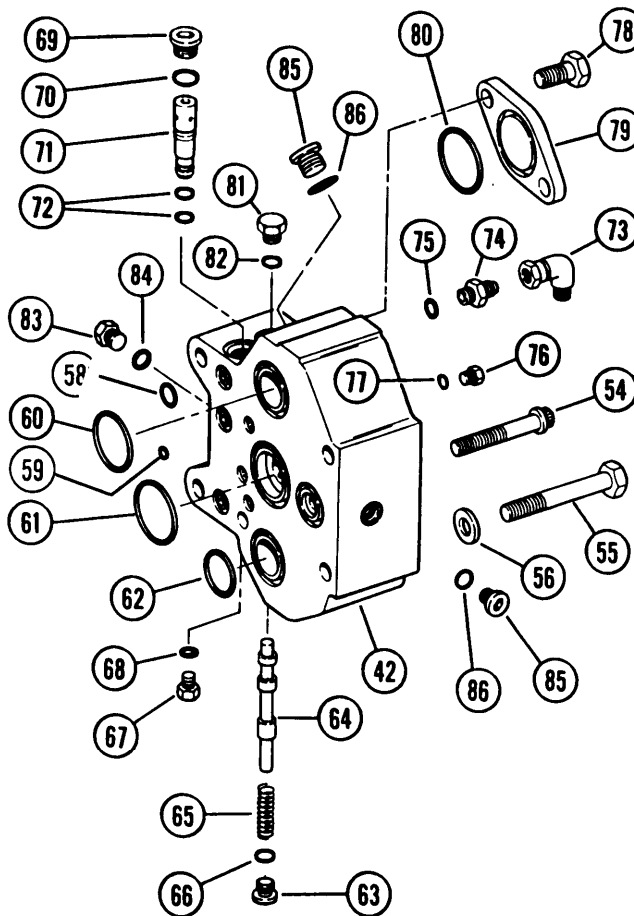
- (8) Remove two springs (49 and 50) from valve body (42).

- (9) Remove small spring (51) from valve body (42).

- (10) Remove main relief valve (52) and tilt relief valve (53) from valve body (42).

13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont' d)

- (11) Use a twelve point wrench to remove capscrew (54) from valve body (42).
- (12) Use a wrench to remove four capscrews (55), four washers (56) and valve body (42) from main valve body (57).
- (13) Remove three seals (58), three seals (59), two seals (60), seal (61) and seal (62) from bottom of valve body (42). Discard seals.
- (14) Use a wrench to remove plug (63), valve (64) and spring (65) from valve body (42). Remove seal (66) from plug (63) and discard seal.
- (15) Use an allen wrench to remove plug (67) from valve body (42). Remove seal (68) from plug (67) and discard seal.
- (16) Use an allen wrench to remove plug (69) from valve body (42). Remove seal (70) from plug (69) and discard seal.
- (17) Screw 1/4" -20 X 2" lg. capscrew into resolver valve (71) and pull valve from valve body (42).
- (18) Remove two seals (72) from resolver valve (71) and discard seals.
- (19) Use a wrench to remove elbow (73) and adapter (74) from valve body (42). Remove seal (75) from adapter (74) and discard seal.
- (20) Use a wrench to remove plug (76) from valve body (42). Remove seal (77) from plug (76) and discard seal.



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### 13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont'd)

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- (21) Use a wrench to remove two capscrews (78) and cover (79) from valve body (42). Remove seal (80) from cover (79) and discard seal.
- (22) Use a wrench to remove plug (81) from valve body (42). Remove seal (82) from plug (81) and discard seal.
- (23) Use a wrench to remove plug (83) from valve body (42). Remove seal (84) from plug (83) and discard seal.
- (24) Use an allen wrench to remove two plugs (85) from valve body (42). Remove seals (86) from plug (85) and discard seals.

#### CAUTION

Lever inside lever housing is interlocked with spool in main valve body. Move lever housing horizontally to remove lever from spool and then lift housing off valve body to avoid damage to parts.



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 13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont' d)
 

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- (32) Use an allen wrench to remove plug (104) from one side of spool end housing (105). Remove seal (106) from plug (104) and discard seal.
- (33) Use an allen wrench to remove plug (107), spring (108), seat (109) and ball (110) from one side of housing (105). Remove seal (111) from plug (107) and discard seal.
- (34) Repeat STEP 33 on other side of housing (105).

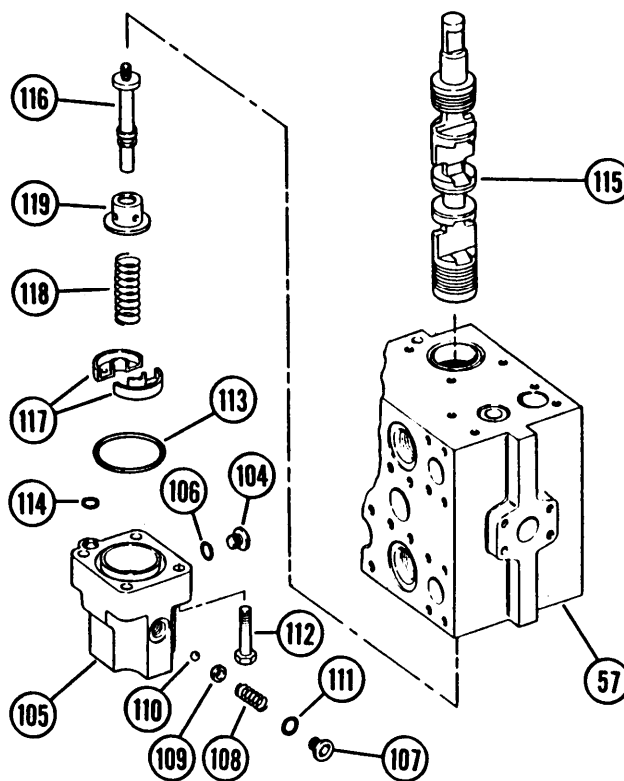
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**WARNING**


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Housing (105) is under spring pressure. Remove housing slowly to avoid injury and lost or damaged parts.

- (35) Use a wrench to remove four capscrews (112) and housing (105) from main valve body (57). Remove large seal (113) and small seal (114) from housing (105) and discard seals.
- (36) Carefully remove spool (115) with bolt (116), split retainer (117), spring (118) and retainer (119) from main valve body (57).
- (37) Use an allen wrench to remove split retainer (117), capscrew (116), spring (118) and retainer (119) from spool (115).




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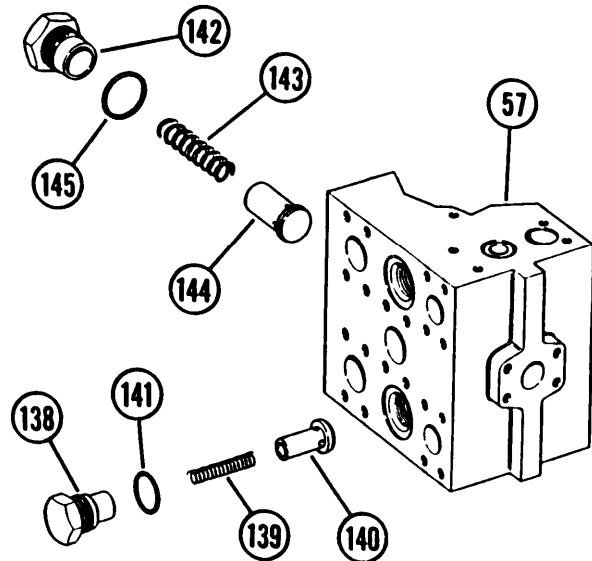
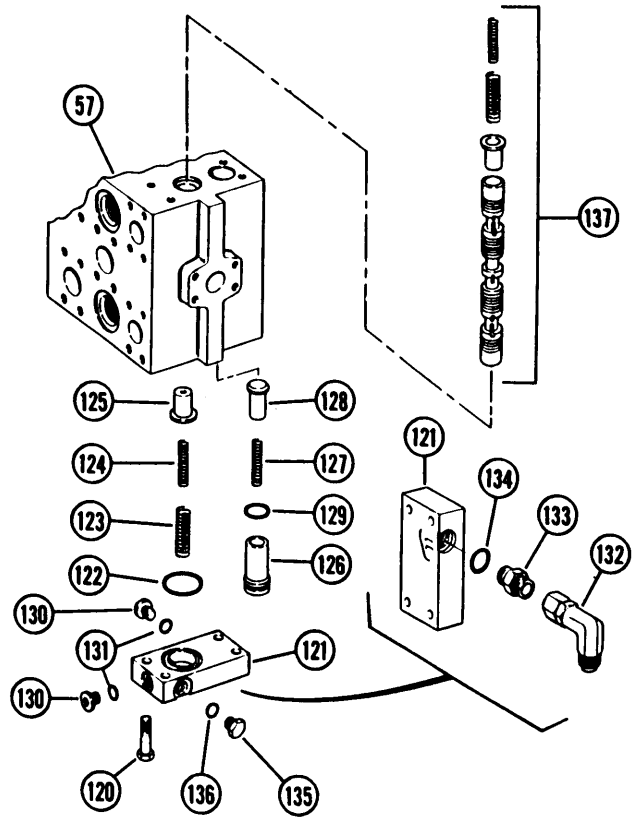
**WARNING**


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Covers on each side of main valve body are under spring pressure. Remove covers slowly to avoid injury and lost or damaged parts.

13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont'd)

- (38) Use a wrench to remove four capscrews (120) and cover (121) from main valve body (57). Remove seal (122) from cover (121) and discard seal.
- (39) Remove outer spring (123), inner spring (124) and retainer (125) from main valve body (57).
- (40) Use a 3/8" -16 X 2" capscrew to remove plug (126), spring (127) and valve (128) from main valve body (57). Remove seal (129) from plug (126) and discard seal.
- (41) Use an allen wrench to remove two plugs (130) from cover (121). Remove seals (131) from two plugs (130) and discard seals.
- (42) If tractor has ripper attachment, use a wrench to remove elbow (132) and adapter (133) from cover (121). Remove seal (134) from adapter (133) and discard seal.
- (43) If tractor has winch attachment, use a wrench to remove plug (135) from cover (121). Remove seal (136) from plug (135) and discard seal.
- (44) Repeat STEPS 38 through 43 for cover on other side of main valve body.
- (45) Carefully remove spool (137) from valve body (57).
- (46) Use a wrench to remove plug (138), spring (139) and valve (140) from valve body (57). Remove seal (141) from plug (138) and discard seal.
- (47) Repeat STEPS 45 and 46 for second plug.



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 13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont'd)
 

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- (48) Use a socket to remove plug (142), spring (143) and valve (144). Remove seal (145) from plug (142) and discard seal.

c. Cleaning

Clean and dry all parts before assembly. Refer to page 2-29.

d. Inspection

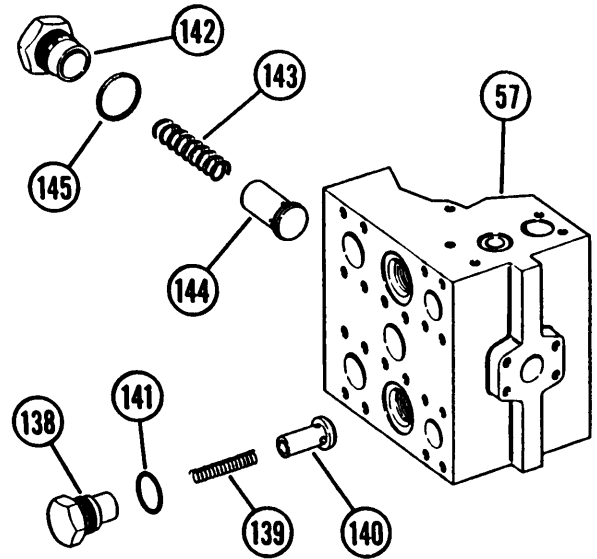
Check parts for wear or damage. Check valve for irregular scoring. Replace if necessary.

e. Lubrication

Apply film of clean hydraulic oil to all moving parts and seals before assembly.

f. Assembly

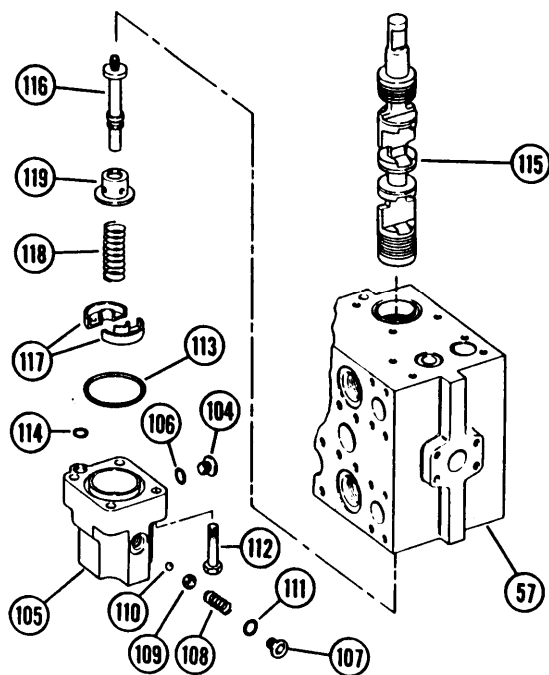
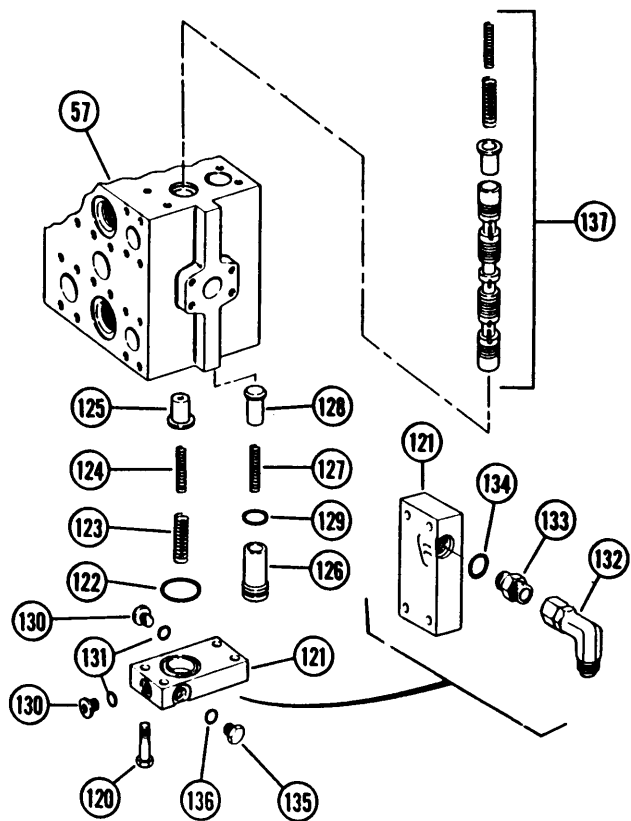
- (1) Install seal (145) on plug (142) and use a wrench to install valve (144), spring (143) and plug (142) in main valve body (57).
- (2) Install seal (141) on plug (138) and use a socket to install valve (140), spring (139) and plug (138) in valve body (57).
- (3) Repeat STEP 2 for other plug.
- (4) Carefully insert spool (137) into valve body (57).
- (5) If tractor has ripper attachment, install seal (134) on adapter (133) and use a wrench to install adapter (133) in cover (121).
- (6) Apply teflon tape to elbow (132) and use a wrench to install elbow (132) in adapter (133).





13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont'd)

- (7) If tractor has winch attachment, install seal (136) on plug (135) and use a wrench to install plug (135) in cover (121).
- (8) Install seals (131) on two plugs (130) and use an allen wrench to install two plugs (130) in cover (121).
- (9) Install seal (129) on plug (126). Use 3/8"-16 X 2" capscrew to install valve (128), spring (127) and plug (126) on one side of main valve body (57).
- (10) Install retainer (125), inner spring (124) and outer spring (123) in valve body (57).
- (11) Install seal (122) in cover (121).
- (12) Use a wrench to install cover (121) on one side of valve body (57) with four capscrews (120).
- (13) Repeat STEPS 5 through 12 for cover on other side of valve body (57).
- (14) Apply sealant to threads on capscrew (116) and use a wrench to install retainer (119), capscrew (116), spring (118) and split retainer (117) on end of spool (115).
- (15) Carefully insert spool (115) into valve body (57).
- (16) Install seal (111) on plug (107) and use an allen wrench to install ball (110), seat (109), spring (108) and plug (107) in one side of housing (105).
- (17) Repeat STEP 15 on other side of housing (105).



13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont' d)

(18) Install seal (106) on plug (104) and use an allen wrench to install plug (104) in housing (105).

(19) Install large seal (113) and small seal (114) in face of housing (105) and use a wrench to install housing (105) on valve body (57) with four capscrews (112).

(20) Install seal (103) on adapter (102) and use a wrench to install adapter (102) in control lever housing (89).

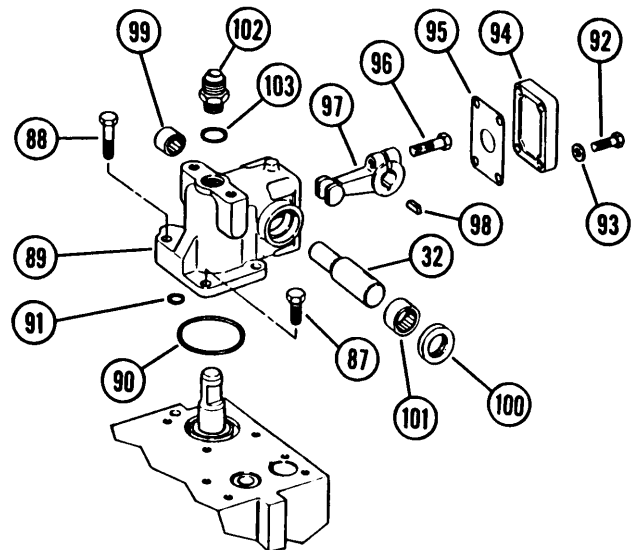
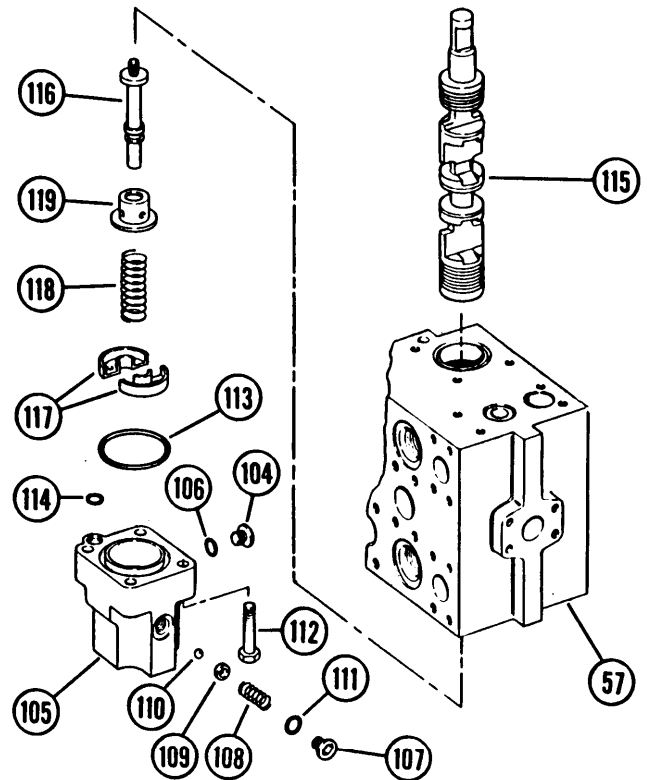
(21) Install bearing (101) and seal (100) on one side of housing (89) and install bearing (99) on other side.

(22) Install capscrew (96) loosely into lever (97).

(23) Insert key (98) into shaft (32) and insert shaft partially through housing (89). Position lever (97) on shaft (32) over key (98) and push shaft into position in housing (89). Use soft punch and hammer, if necessary, to seat shaft.

(24) Use a wrench to tighten capscrew (96) in lever (97).

(25) Install large seal (90) and small seal (91) in face of housing (89).

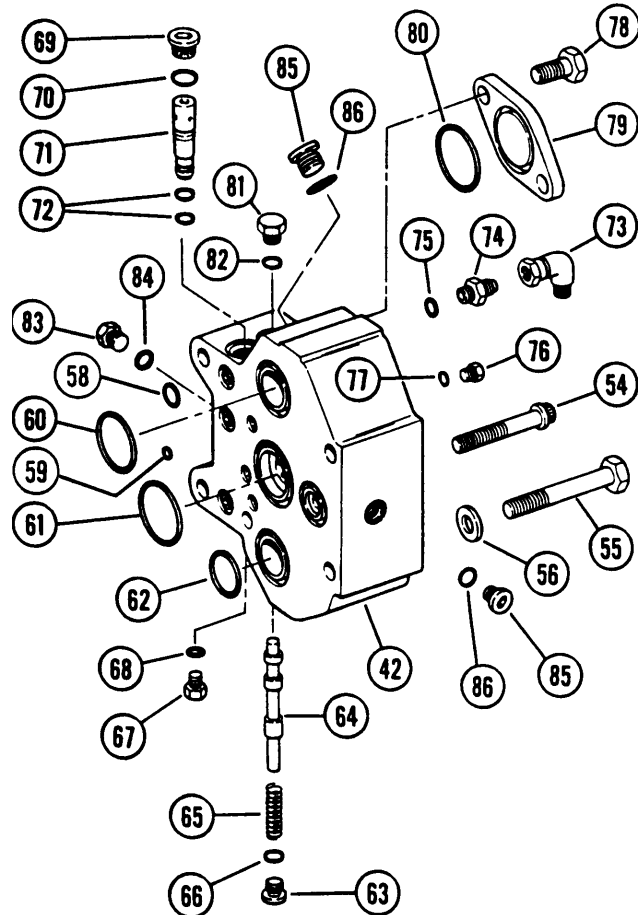


13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont' d)

CAUTION

When installing control lever housing (89) make sure lever (97) is properly engaged in end of spool (115) to avoid a malfunction and damage to parts.

- (26) Position control lever housing (89) on main valve body (57) over end of spool (115). Use a wrench to install three capscrews (87) and one capscrew (88) to secure housing.
- (27) Use a wrench to install gasket (95) and cover (94) on housing (89) with four capscrews (92) and four washers (93).
- (28) Install seals (86) on two plugs (85) and use an allen wrench to install plugs (85) in valve body (42).
- (29) Install seal (84) on plug (83) and use a wrench to install plug (83) in valve body (42).
- (30) Install seal (82) on plug (81) and use a wrench to install plug (81) in valve body (42).
- (31) Install seal (80) in cover (79) and use a wrench to install cover (79) in valve body (42).
- (32) Install seal (77) on plug (76) and use a wrench to install plug (76) in valve body (42).
- (33) Install seal (75) on adapter (74) and use a wrench to install adapter (74) in valve body (42).
- (34) Apply teflon tape to elbow (73) and use a wrench to install elbow (73) in adapter (74).



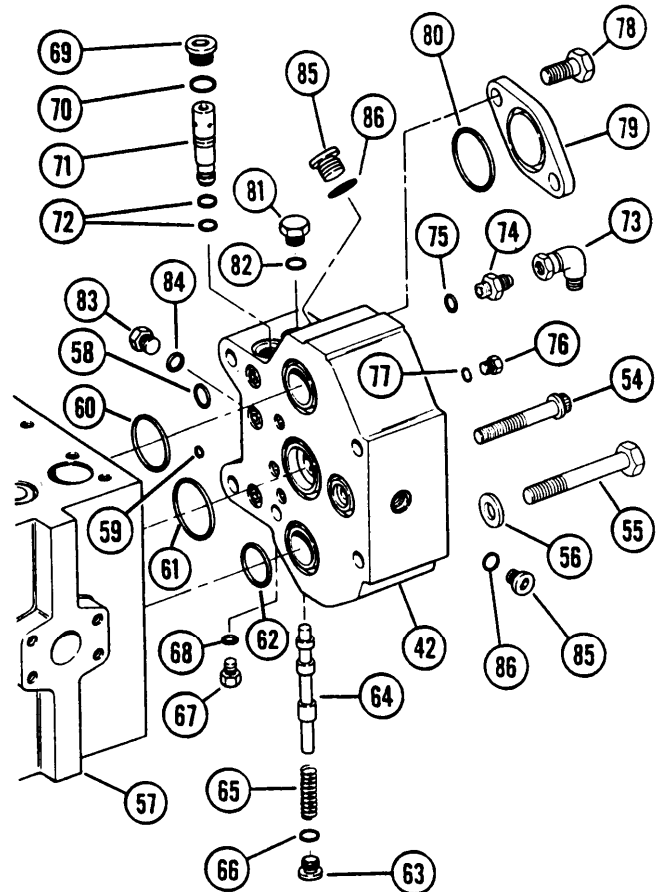
## 13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont' d)

- (35) Install two seals (72) on resolver valve (71) and insert valve in valve body (42).
- (36) Install seal (70) on plug (69) and use an allen wrench to install plug (69) in valve body (42).
- (37) Install seal (68) on plug (67) and use an allen wrench to install plug (67) in valve body (42).
- (38) Install seal (66) on plug (63) and use a wrench to install valve (64), spring (65) and plug (63) in valve body (42).
- (39) Install three seals (58), three seals (59), two seals (60) seal (61) and seal (62) on bottom of valve body (42).

**CAUTION**

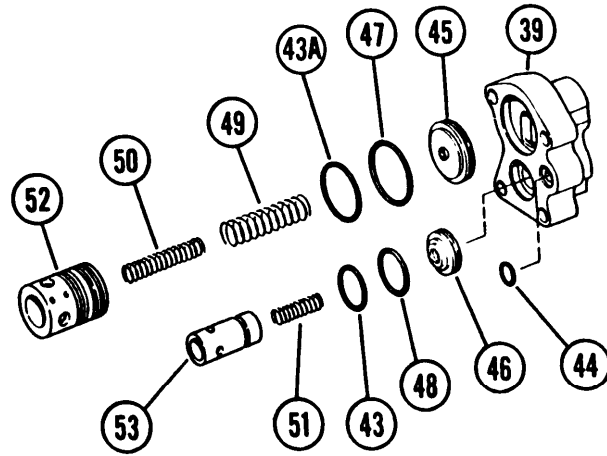
Make sure all seals are seated properly when assembling valve body (42) to main valve body (57) to avoid cutting or pinching seals which could cause leaking and malfunctioning.

- (40) Carefully position valve body (42) on main valve body (57), align threaded bores and use a wrench to install four capscrews (55) and four washers (56) to secure valve body (42).
- (41) Use a twelve point wrench to install capscrew (54) in valve body (42).



13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont'd)

- (42) Install small spring (51) in tilt relief valve (53).
- (43) Install inner (50) and outer (49) springs in main relief valve (52).
- (44) Install tilt relief valve (53) and main relief valve (52) in valve body (42).
- (45) Install seal (48) on valve seat (46) and seal (47) on valve seat (45).
- (46) Install valve seats (46) and (45) in cover (39).
- (47) Install three seals (43A, 43), and 44) in bottom of cover (39).



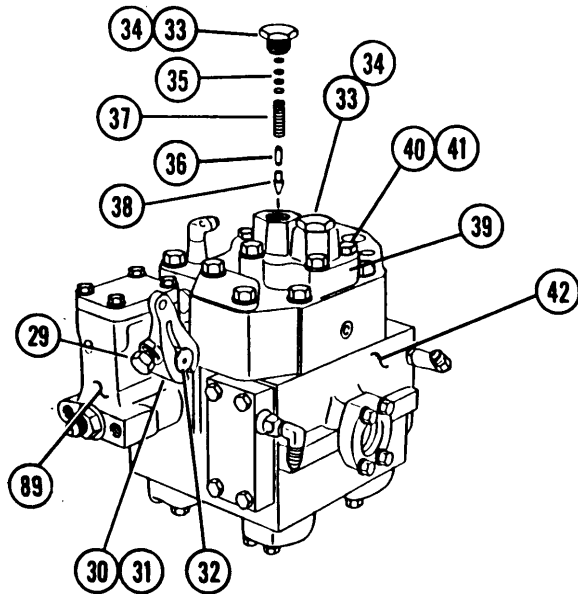
CAUTION

Make sure all seals are seated properly when assembling cover (39) to valve body (42). Cut or pinched seals will cause leaks and malfunctions.

- (48) Carefully position cover (39) on valve body (42) and use a wrench to install four capscrews (40) and four washers (41) to secure cover.
- (49) Install two relief pilot valves (38), two springs (37), two pistons (36) and shims (35) in cover (39).

NOTE

Two plugs (33) are marked with pressure settings for respective valve and must be installed per marking.



## 13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont' d)

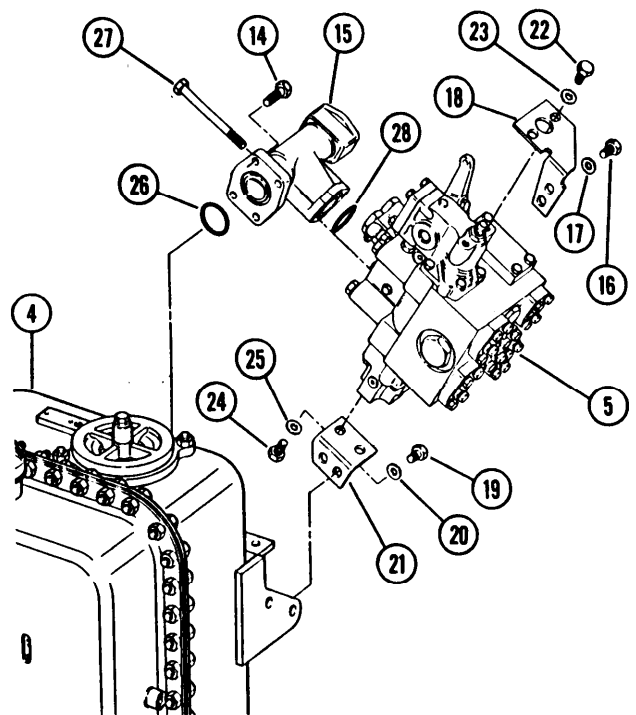
- (50) Install seals (34) on two plugs (33) and use a wrench to install plugs (33) in cover (39). Tighten plugs to  $80 \pm 3$  lb. ft.
- (51) Install key (31) and lever (30) on shaft (32) at lever housing (89) and use a wrench to tighten capscrew (29) to secure lever (30).

g. Installation

## NOTE

Wipe all hose line connectors and sealing surfaces on tank and control valve clean and dry before installation. Apply film of clean hydraulic oil to all seals before installation.

- (1) Use a wrench to install manifold (15) and seal (28) on blade control valve (5).
- (2) Install seal (26) in manifold (15).
- (3) Use a wrench to install lower bracket (21) on valve (5) with two capscrews (24) and two washers (25).
- (4) Use a wrench to install upper bracket (18) on valve (5) with two capscrews (22) and two washers (23).



13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont'd)

(5) Use lifting equipment to position control valve (5) to hydraulic oil tank (4).

(6) Use a wrench to install lower bracket (21) on tank (4) with two capscrews (19) and two washers (20).

(7) Use a wrench to install upper bracket (18) on tank (4) with two capscrews (16) and two washers (17).

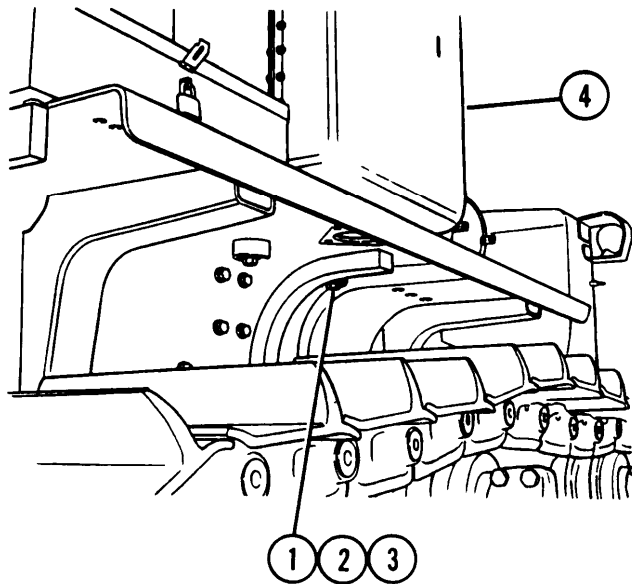
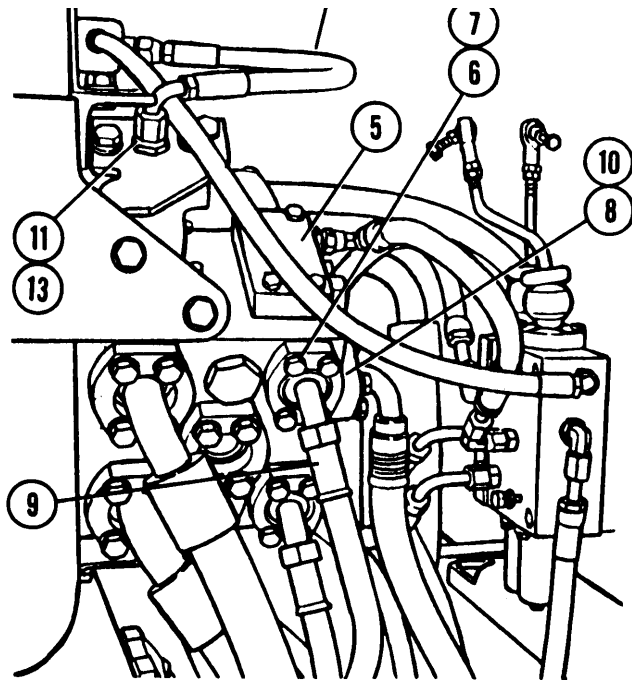
(8) Use a wrench to install manifold (15) on tank (4) with four capscrews (27).

(9) Install all hydraulic line on control valve (5) and tank (4) using one of the following procedures:

(a) For hydraulic lines with flange fittings: Using proper size wrench, install end of line (9) with seal (10), two split flanges (8), four capscrews (6) and four washers (7). Remove identification tag, if necessary.

(b) For hydraulic line with connector fittings: Install seal (13) on connector (11) and using proper size wrench, install connector (11) at end of line (12) to the proper location. Remove identification tags, if necessary.

(10) Secure drain valve at bottom of hydraulic tank (4) and use a wrench to install cover plate (3) on underside of fender with four capscrews (1) and four washers (2).

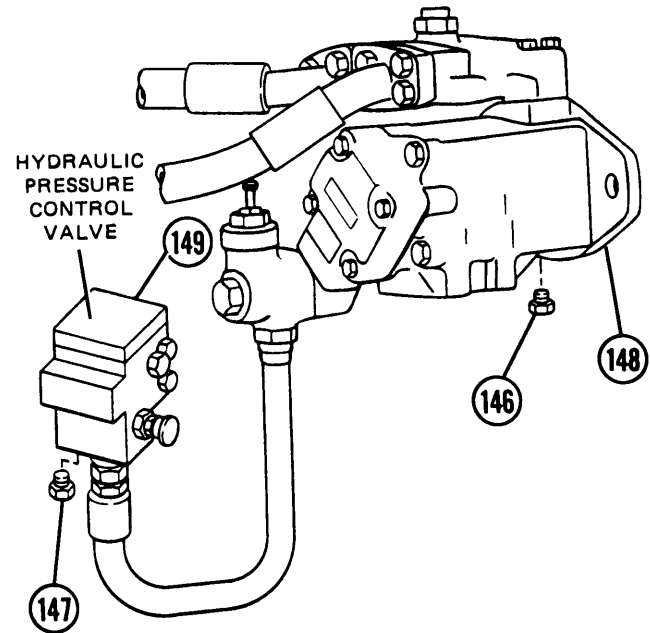


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 13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont'd)
 

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- (11) Install pilot valve. See page 13-43.
- (12) Install hydraulic oil tank. See TM5-2410-237-20.
- (13) Remove plugs (146 and 147) from hydraulic pump (148) and hydraulic pressure control valve (149).
- (14) Let air out and replace plugs (146 and 147) as soon as oil starts to flow out.
- (15) Check and fill hydraulic tank, if necessary.



#### h. Place In Service

- (1) Run the bulldozer and check for proper operation with the control levers in the various operating positions.
- (2) Perform hydraulic system tests (page 13-111) to make sure the valve is operating properly.
- (3) If tests indicate incorrect relief valve settings, adjust valves (paragraph i).
- (4) If tests indicate correct operation of the valve, install hydraulic tank mounting group. See TM5-2410-237-20.



## 13-5. BULLDOZER CONTROL VALVE - REPLACE/REPAIR (Cont' d)

i. Relief Valve Adjustment

If tests indicate one or both relief valves need adjustment, do the following.

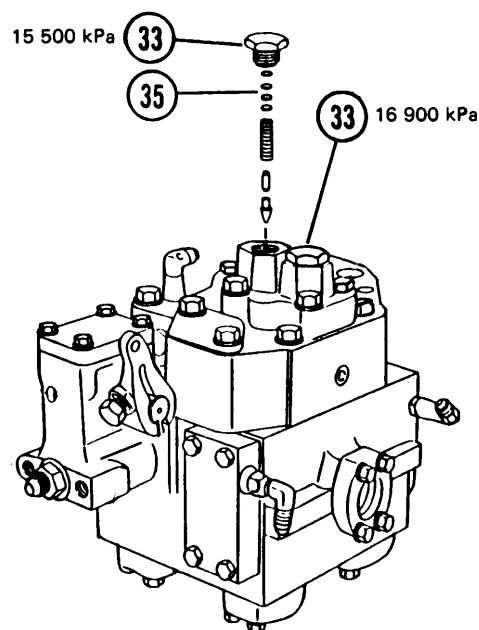
**WARNING**

Move the control levers through the OPERATE and HOLD positions to release pressure. Personal injury can result when the relief valve plugs are removed. Remove plugs slowly to release spring tension.

**NOTE**

The plug for dozer lift and ripper lift is stamped "15 500 KPA" and the plug for tilt is stamped "16 900 KPA."

- (1) Use a wrench to slowly remove Plug(s) (33).
- (2) Add shims (35) to increase relief setting or remove shims to decrease setting. One 0.005" shim will change relief pressure by 35 psi. One 0.048" shim will change relief pressure by 335 psi.
- (3) Install plug(s) and use a socket to tighten to  $80 \pm 3$  lb. ft.
- (4) Repeat test, page 13-111, to make sure settings are correct.



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 13-6. HYDRAULIC PRESSURE CONTROL VALVE - REPLACE/REPAIR
 

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This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning
- d. Lubrication
- e. Assembly
- f. Installation
- g. Place In Service

---

INITIAL SETUP
Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Materials/Parts

Seals (5), (7), (9), (14), (17),  
(19), (22), (25), (28), (30), (37),  
(38), (45), (47), (49), (51), (53),  
(55)  
Lubricating Oil OE/HD0-10 (Refer to  
LO5-2410-237-12)  
Teflon Tape  
Lint-free Rag  
Caps and Plugs  
Drain Pan

Equipment Conditions

Floor plates removed. See TM5-  
2410-237-20.

 a. Removal
WARNING

be under pressures over 2500 psi with the engine and pump OFF. ALWAYS relieve pressure in hydraulic lines before attempting to remove any component in the hydraulic system. With engine OFF and hydraulic attachments on the ground, move control levers through all operating positions several times to relieve line pressure. Relieve pressure in hydraulic oil tank by loosening filler cap very slowly. Failure to follow these precautions could result in serious personal injury.

CAUTION

Wipe the area clean around all hydraulic connections to be opened during removal and disassembly. Cap oil lines and plug holes after removing lines. Contamination of the hydraulic system could result in premature failure.

NOTE

If more than one hydraulic line is to be removed, identify lines to assure proper installation. Use suitable container to catch any hydraulic oil that may drain from system.

13-6. HYDRAULIC PRESSURE CONTROL VALVE - REPLACE/REPAIR (Cont'd)

CAUTION

Before removing pressure control valve, relieve any pressure in hydraulic tank.

NOTE

Mark all hoses prior to removal to assist in installation.

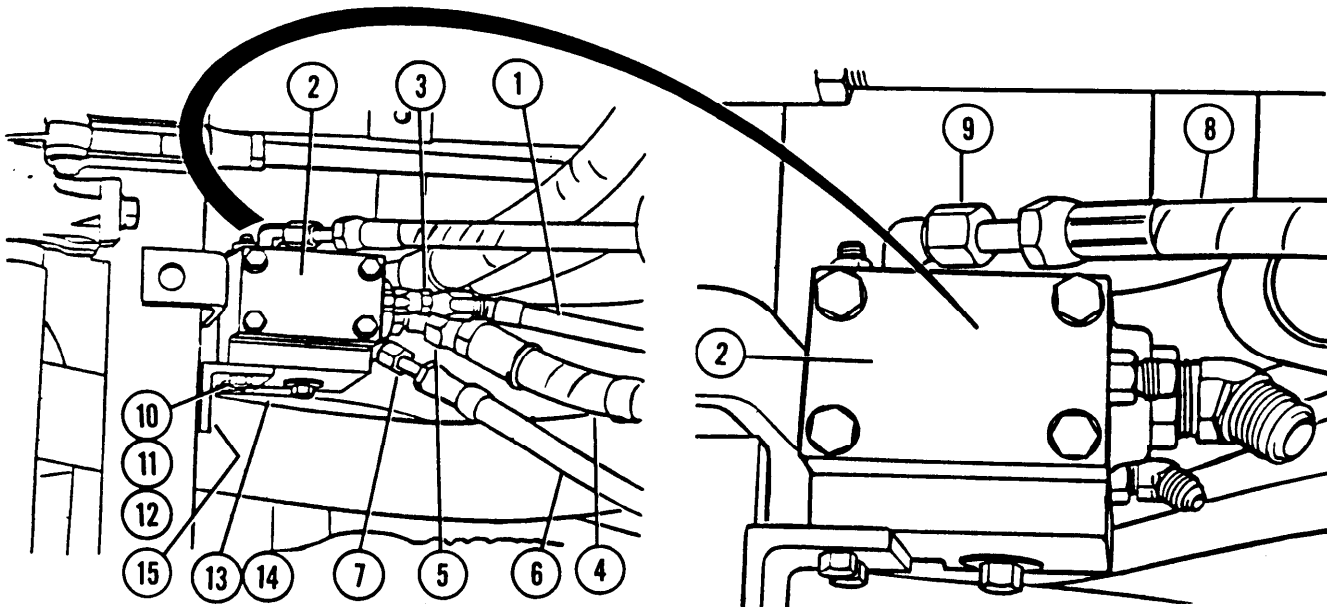
- (1) Use a wrench to remove hose (1) from front face of hydraulic control valve (2).
- (2) Remove seal (3) from end of hose (1) and discard seal.
- (3) Use a wrench to remove hose (4) from front face of valve (2).
- (4) Remove seal (5) from end of hose (4) and discard seal.
- (5) Use a wrench to remove hose (6) from front face of valve (2).

- (6) Remove seal (7) from end of hose (6) and discard seal.
- (7) If equipped with ripper, use a wrench to remove hose (8) from side of valve (2).
- (8) Remove seal (9) from end of hose (8) and discard seal.

NOTE

The valve (2) cannot be removed until after disconnecting hose (13).

- (9) Use two wrenches to remove two capscrews (10), two nuts (11), two flat washers (12) and valve (2) from fender brace assembly (15).
- (10) Use a wrench to remove hose (13) from underside of valve (2).
- (11) Remove seal (14) from end of hose (13) and discard seal.



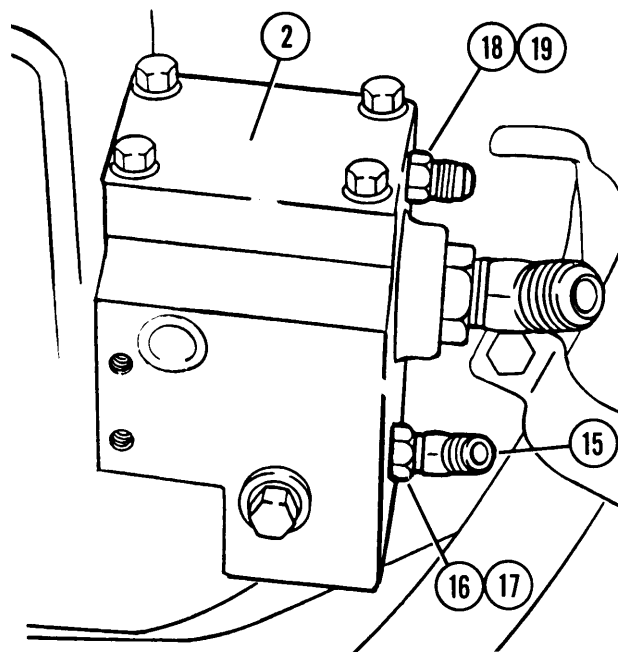
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**13-6. HYDRAULIC PRESSURE CONTROL VALVE - REPLACE/REPAIR (Cont'd)**

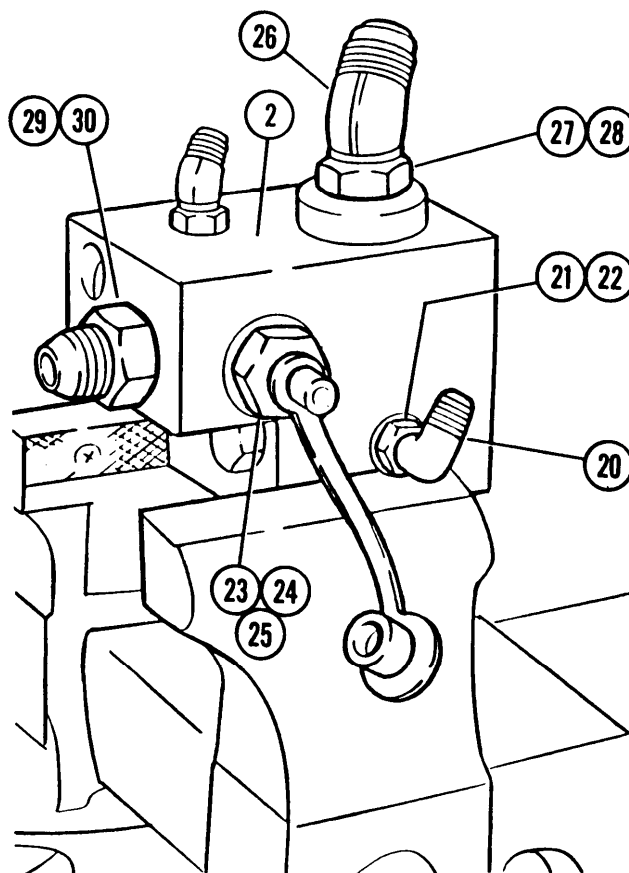

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**b. Disassembly**

- (1) Use a wrench to remove elbow (15) at lower front corner of valve (2).
- (2) Use a wrench to remove adapter (16). Remove and discard seal (17).
- (3) Use a wrench to remove adapter (18) at upper front cover of valve (2). Remove and discard seal (19).



- (4) Use a wrench to remove elbow (20) at side of valve (2).
- (5) Use a wrench to remove adapter (21). Remove and discard seal (22).
- (6) Use a wrench to remove quick disconnect fitting (23) and dust cap (24) at side of valve (2). Remove and discard seal (25).
- (7) Use a wrench to remove elbow (26) at front of valve (2).
- (8) Use a wrench to remove adapter (27). Remove and discard seal (28).
- (9) Use a wrench to remove adapter (29) from bottom of valve (2). Remove and discard seal (30).



13-6. HYDRAULIC PRESSURE CONTROL VALVE - REPLACE/REPAIR (Cont'd)

**WARNING**

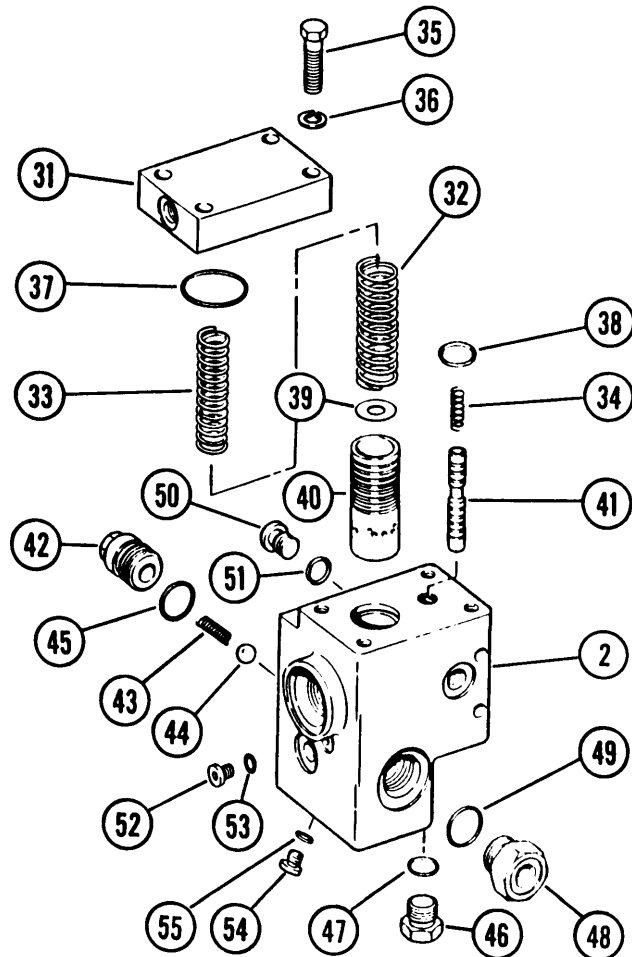
Cover (31) holds springs (32, 33 and 34) under compression. Remove bolts slowly and evenly to prevent possible personal injury.

- (10) Use a wrench to remove four capscrews (35), four lockwashers (36) and cover (31) from top of valve.
- (11) Remove and discard seals (37 and 38) from cover (31).
- (12) Remove outer spring (32), inner spring (33), small spring (34), shims (39), valve (40) and stem (41) from valve.

**NOTE**

If valve (40) or stem (41) or their seats (not shown) are damaged, the entire valve must be replaced. Valve (40), stem (41) or seat (not shown) cannot be replaced individually.

- (13) Use a wrench to remove plug assembly (42), spring (43) and ball (44).
- (14) Remove and discard seal (45) from plug assembly (42).
- (15) Use a wrench to remove plug (46). Remove and discard seal (47).
- (16) Use a wrench to remove adapter (48). Remove and discard seal (49).
- (17) Use an allen wrench to remove plug (50). Remove and discard seal (51).



13-6. HYDRAULIC PRESSURE CONTROL VALVE - REPLACE/REPAIR (Cont' d)

(18) Use an allen wrench to remove plug (52). Remove and discard seal (53).

(19) Use an allen wrench to remove plug (54). Remove and discard seal (55).

c. Cleaning

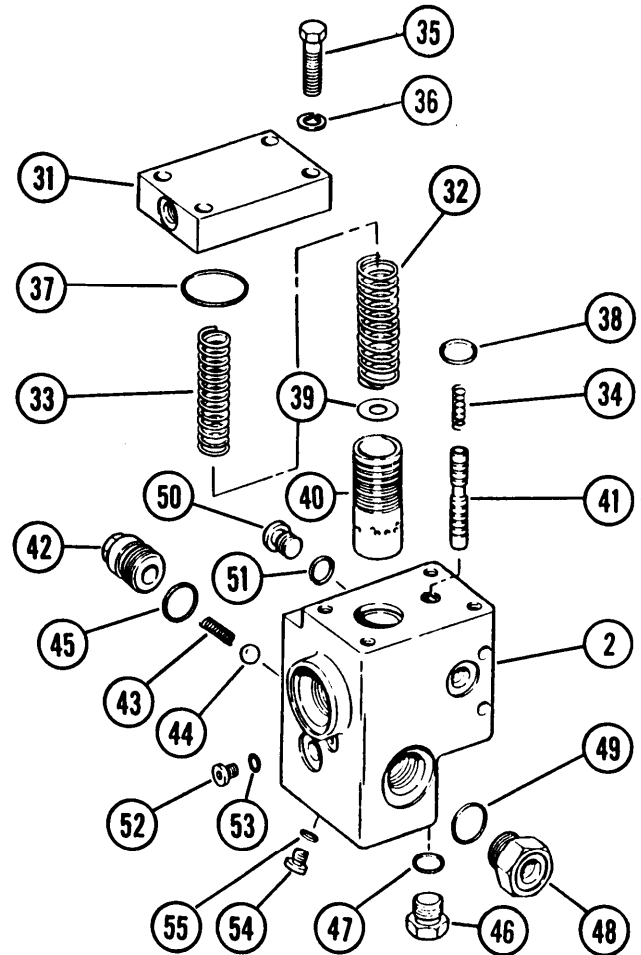
Clean and dry all parts. Refer to page 2-29.

d. Lubrication

Apply film of clean lubricating oil to all moving parts and seals before assembly.

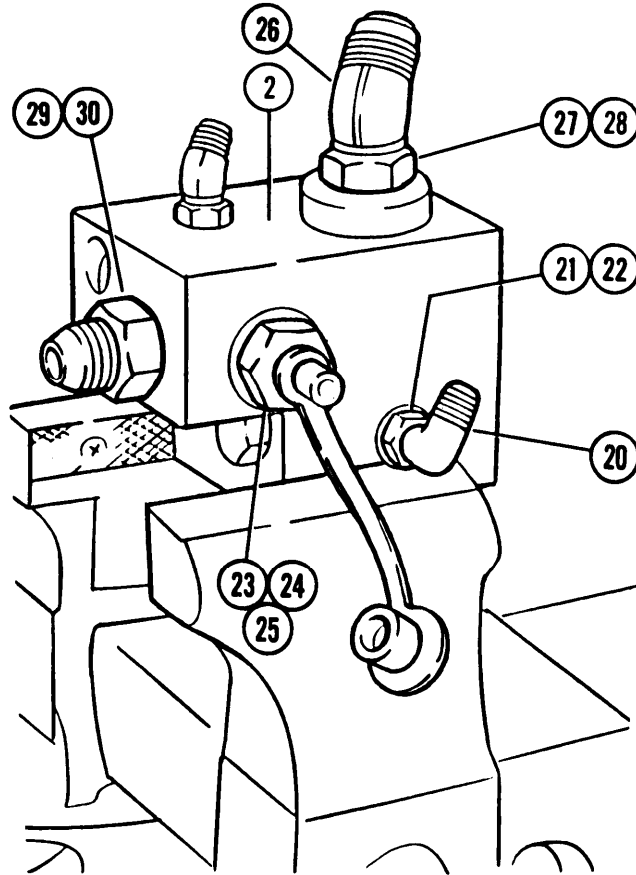
e. Assembly

- (1) Install seal (55) on plug (54) and use an allen wrench to install plug (54) in valve (2).
- (2) Install seal (53) on plug (52) and use an allen wrench to install plug (52).
- (3) Install seal (51) on plug (50) and use an allen wrench to install plug (50).
- (4) Install seal (49) on adapter (48) and use a wrench to install adapter (48).
- (5) Install seal (47) on plug (46) and use a wrench to install plug (46).
- (6) Install spring (43) and ball (44).
- (7) Install seal (45) on plug (42). Use a wrench to install plug (42). Torque to 25±2 lb. ft.



13-6. HYDRAULIC PRESSURE CONTROL VALVE - REPLACE/REPAIR (Cont'd)

- (8) Install stem (41), valve (40), shims (39), spring (34), inner spring (33) and outer spring (32).
- (9) Install seals (37 and 38) onto cover (31).
- (10) Position cover (31) onto valve (2) and using a wrench, install four capscrews (35) and lockwashers (36).
- (11) Install seal (30) on adapter (29). Use a wrench to install adapter (29).
- (12) Install seal (28) on adapter (27). Use a wrench to install adapter (27).
- (13) Apply teflon tape to elbow (36) and use a wrench to install elbow (26) in adapter (27).
- (14) Install seal (25) on quick disconnect (23) and use a wrench to install quick disconnect (23) and dust cap (24).
- (15) Install seal (22) on adapter (21) and use a wrench to install adapter (21).
- (16) Apply teflon tape to elbow (20) and use a wrench to install elbow (20) in adapter (21).

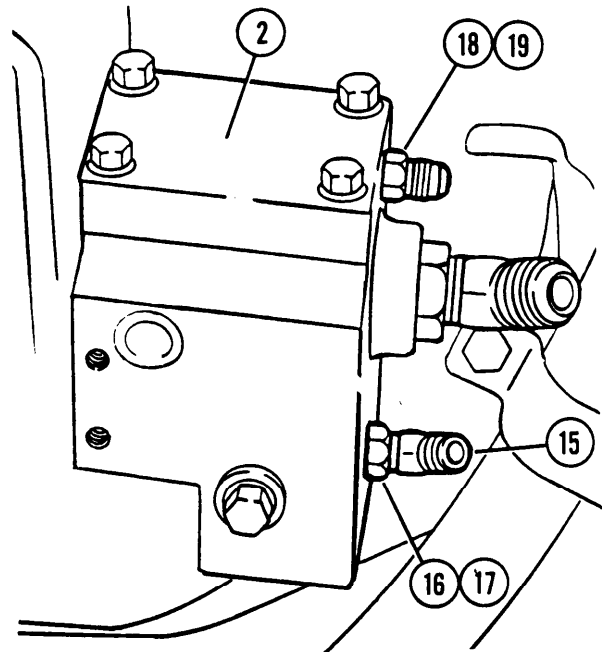


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 13-6. HYDRAULIC PRESSURE CONTROL VALVE - REPLACE/REPAIR (Cont' d)
 

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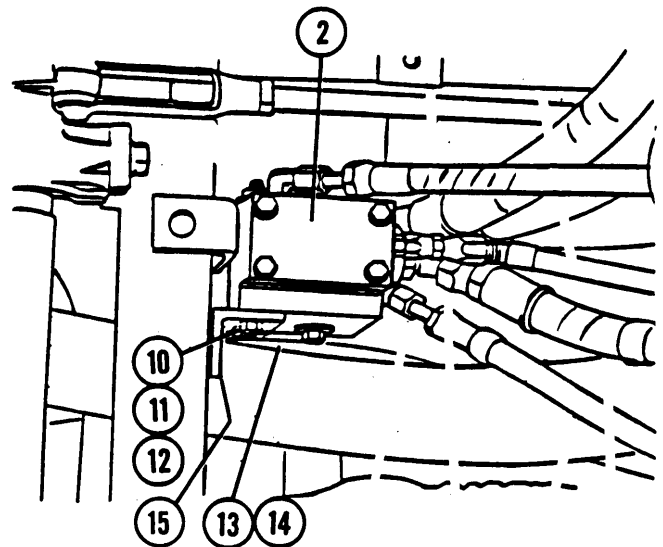
- (17) Install seal (19) on adapter (18) and use a wrench to install adapter (18) |
- (18) Install seal (17) on adapter (16) and use a wrench to install adapter (16).
- (19) Apply teflon tape to elbow (15) and use a wrench to install elbow (15) in adapter (16).

f. Installation

## NOTE

Wipe hose fittings and ends of hoses clean and dry before installation. Apply film of clean hydraulic oil on seals before installation.

- (1) Install seal (14) in end of hose (13) and use a wrench to install hose (13) at bottom of valve (2).
- (2) Position valve (2) to fender brace assembly (15) and use two wrenches to install two capscrews (10), two washers (12) and two nuts (11) to secure valve (2).



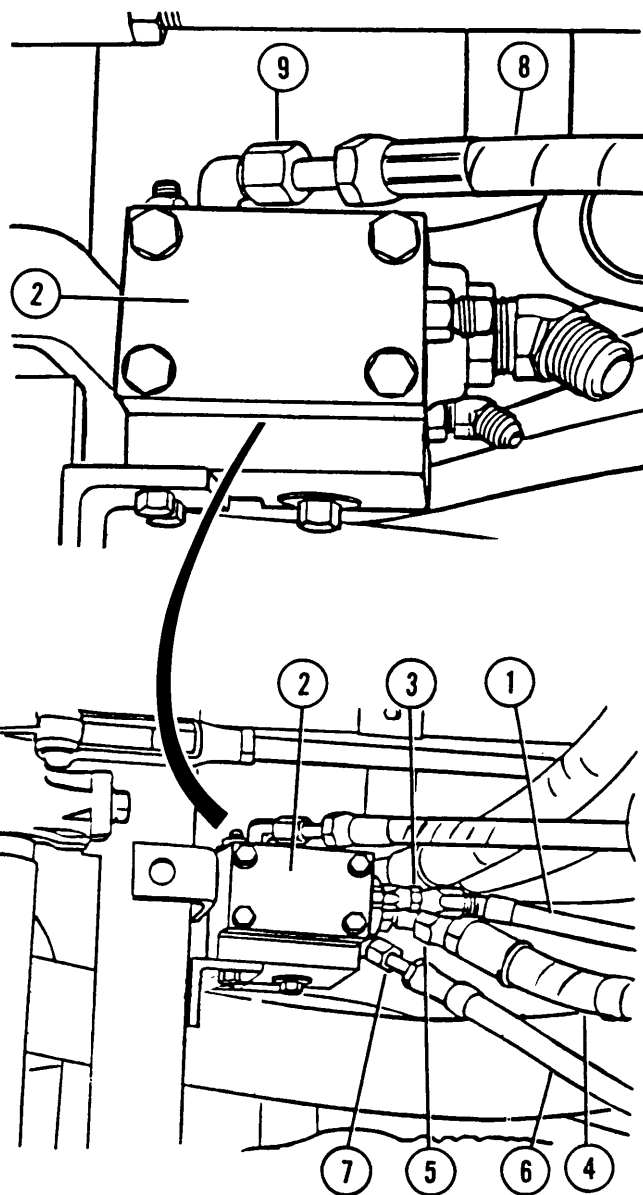


13-6. HYDRAULIC PRESSURE CONTROL VALVE - REPLACE/REPAIR (Cont'd)

- (3) Install seal (9) on hose (8) and use a wrench to install hose (8) on side of valve (2).
- (4) Install seal (7) on hose (6) and use a wrench to install hose (6) on front of valve (2).
- (5) Install seal (5) on hose (4) and use a wrench to install hose (4) on front of valve (2).
- (6) Install seal (3) on hose (1) and use a wrench to install hose (1) on front of valve (2).
- (7) Install floor plates. See TM5-2410-237-20.

g. Place In Service

Run tractor and ensure hydraulic pressure control valve is operating properly.



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## 13-7. BLADE AND RIPPER PILOT VALVES - REPLACE/REPAIR

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This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning
- d. Lubrication
- e. Assembly
- f. Installation
- g. Place In Service

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### INITIAL SETUP

#### Applicable Configurations

Tractor with Ripper

#### Common Tool

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

#### Materials/Parts

Seals (8), (11), (14), (16), (21),  
(22), (30), (31), (32), (36), (38),  
(43) and (45)  
Lubricating Oil OE/HDO-10 (Refer to  
L05-2410-237-12)  
Teflon Tape  
Lint-free Rag  
Drain Pan  
Caps and Plugs

#### Equipment Condition

Blade control Lever and linkage  
removed. See page 13-59.  
Ripper control Lever and linkage  
removed. See page 13-67.

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13-7. BLADE AND RIPPER PILOT VALVES - REPLACE/REPAIR (Cont'd)

a. Removal

WARNING

Hydraulic oil in the system can be under pressures over 2500 psi with the engine and pump OFF. ALWAYS relieve pressure in hydraulic lines before attempting to remove any component in the hydraulic system. With engine OFF and hydraulic attachments on the ground, move control levers through all operating positions several times to relieve line pressure. Relieve pressure in hydraulic oil tank by loosening filler cap very slowly. Failure to follow these precautions could result in serious personal injury.

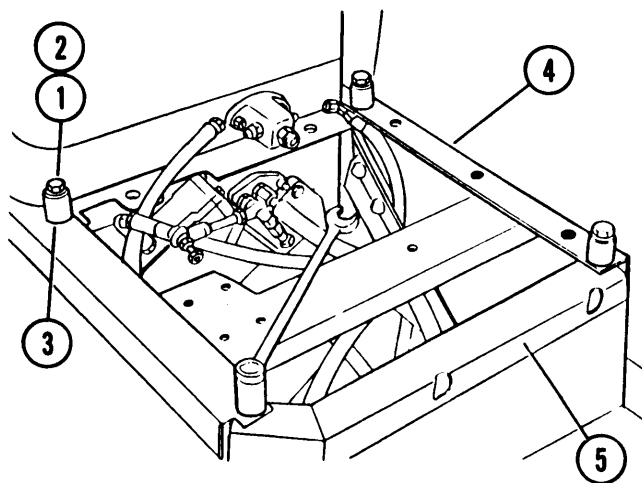
CAUTION

Wipe the area clean around all hydraulic connections to be opened during removal and disassembly. Cap oil lines and plug holes after removing lines. Contamination of the hydraulic system could result in premature failure.

NOTE

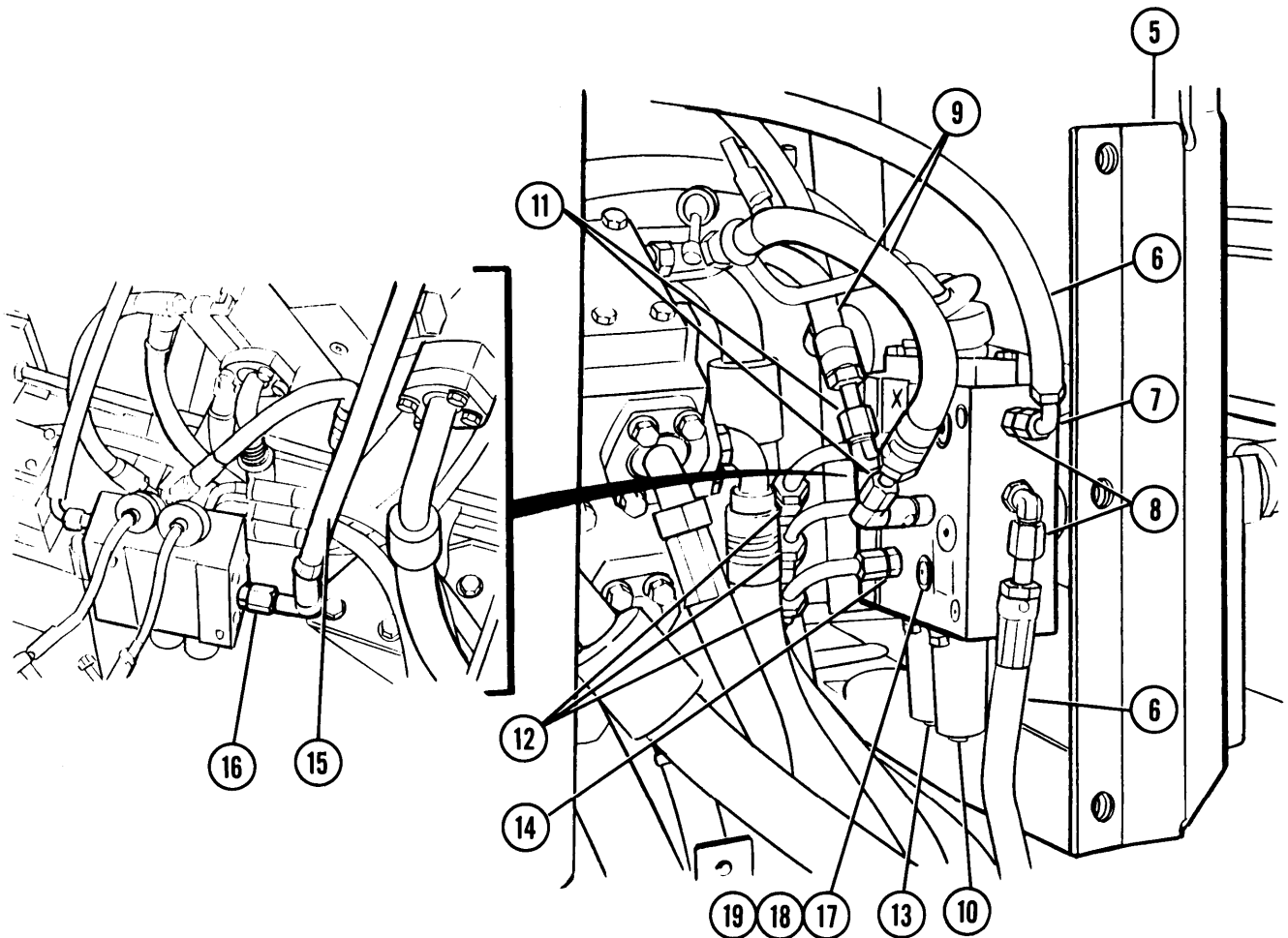
If more than one hydraulic line is to be removed, identify lines to assure proper installation. Use suitable container to catch any hydraulic oil that may drain from system.

- (1) Use a wrench to remove four capscrews (1), four washers (2), four spacers (3) and frame (4) from control housing (5).



## 13-7. BLADE AND RIPPER PILOT VALVES - REPLACE/REPAIR (Cont'd)

- (2) Use a wrench to remove two hoses (6) at front side of pilot valve (7).
- (3) Remove seals (8) from two hoses (6) and discard seals.
- (4) Use a wrench to remove two hoses (9) from blade tilt section (10) of pilot valve (7).
- (5) Remove seals (11) from two hoses (9) and discard seals.
- (6) Use a wrench to remove three hoses (12) from ripper section (13) of pilot valve (7).
- (7) Remove seals (14) from three hoses (12) and discard seals.
- (8) Use a wrench to remove hose (15) to hydraulic tank from backside of pilot valve (7).
- (9) Remove seal (16) from hose (15) and discard seal.
- (10) Use two wrenches to remove three nuts (17), three capscrews (18), three washers (19) and pilot valve (7) from side of control housing (5).

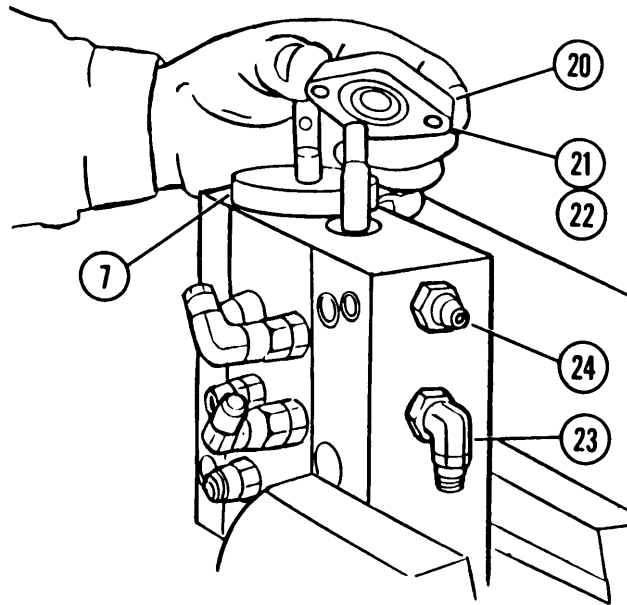


13-7. BLADE AND RIPPER PILOT VALVES - REPLACE/REPAIR (Cont'd)

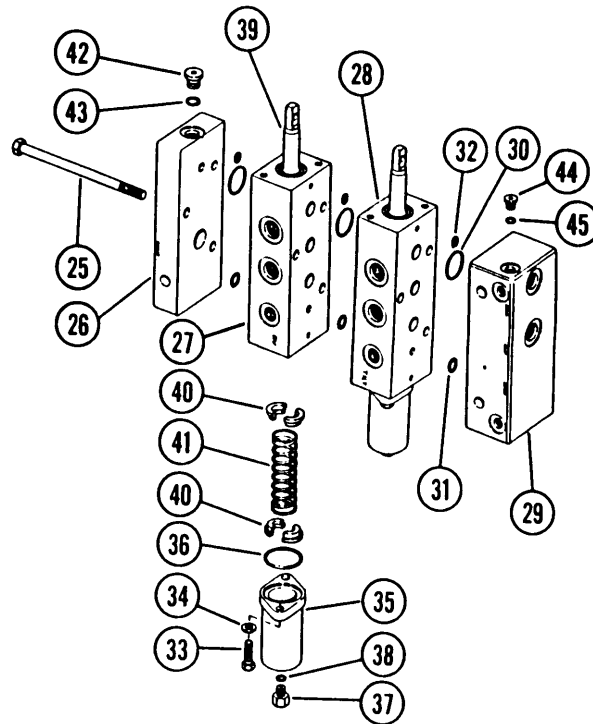
b. Disassembly

NOTE

The capscrews used for holding the housings (20) on the two pilot valves are removed when the ripper and blade control levers and linkages are removed. Mark valves and manifolds for proper assembly. Keep stem parts with proper valve body for assembly.



- (1) Remove two housings (20) from top of pilot valve (7). Remove housing seal (21) and shaft seal (22) from both housings (20). Discard seals.
- (2) Use a wrench to remove three elbows (23) from pilot valve (7).
- (3) Use a wrench to remove eight adapters (24) from pilot valve (7).
- (4) Use a wrench to remove three capscrews (25) and separate outlet manifold (26), ripper pilot valve (27), blade tilt pilot valve (28) and inlet manifold (29).
- (5) Remove three seals (30) from three large valve ports, one seal (31) from smaller port and two small seals (32) from two smallest ports in inlet manifold (29). Discard seals (30, 31 and 32).
- (6) Repeat STEP 5 for blade tilt pilot valve (28).
- (7) Repeat STEP 5 for ripper pilot valve (27).
- (8) Use a wrench to remove two capscrews (33), two washers (34) and housing (35) from ripper pilot valve (27).



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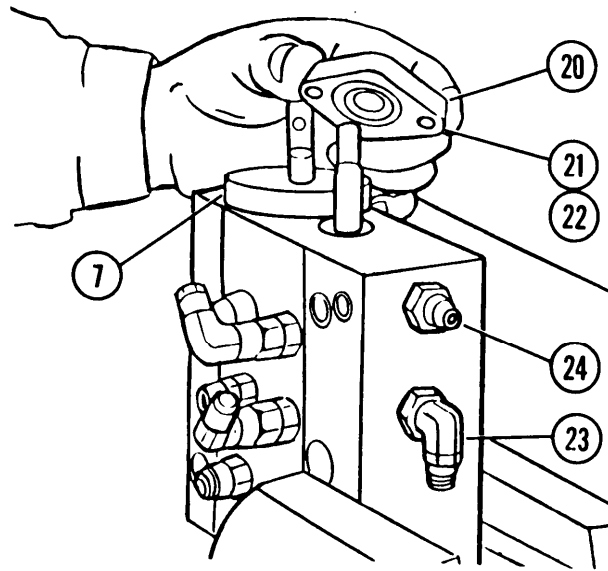
 13-7. BLADE AND RIPPER PILOT VALVES - REPLACE/REPAIR (Cont' d)
 

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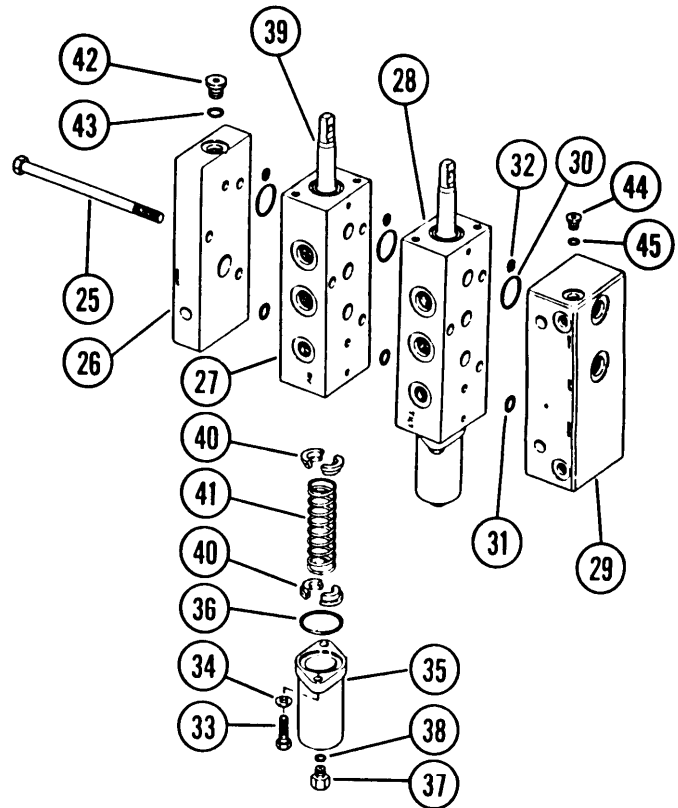
- |  |   |
|--|---|
| <p>(9) Remove seal (36) from housing (35) and discard seal.</p> <p>(10) If necessary, use a wrench to remove plug (37) from housing (35) and remove seal (38) from plug (37). Discard seal.</p> <p>(11) Remove valve stem (39) from valve (27).</p> <p>(12) Remove two split retainers (40) and spring (41) from stem (39).</p> <p>(13) Repeat STEPS 8 through 12 for blade tilt pilot valve (28).</p> <p>(14) If necessary, use allen wrench to remove plug (42) from outlet manifold (26). Remove seal (43) from plug (42) and discard seal.</p> <p>(15) If necessary, repeat STEP 14 for inlet manifold (29) and plug (44) and seal (45).</p> | <p>(4) Install stem (39) in ripper pilot valve (27).</p> <p>(5) If necessary, install seal (38) on plug (37) and install plug (37) in housing (35), using a wrench.</p> <p>(6) Install seal (36) in housing (35).</p> <p>(7) Use a wrench to install housing (35) on valve (27) with two capscrews (33) and two washers (34).</p> <p>(8) Repeat STEPS 3 through 7 for blade tilt pilot valve (28).</p> <p>(9) Install three seals (30) at three large valve ports, one seal (31) at smaller port and two small seals (32) at two smallest ports in inlet manifold (29).</p> <p>(10) Repeat STEP 9 for ripper pilot valve (27).</p> <p>(11) Repeat STEP 9 for blade tilt pilot valve (28).</p> |
|--|---|
- c. Cleaning
- Clean and dry all parts thoroughly. Refer to page 2-29.
- d. Lubrication
- Apply film of hydraulic oil to all valve stem parts and to all seals before assembly.
- e. Assembly
- |   |  |
|---|--|
| <p>(1) If necessary, install seal (43) on plug (42) and install plug (42) in outlet manifold (26) using allen wrench.</p> <p>(2) If necessary, repeat STEP 1 for inlet manifold (29) and plug (44) and seal (45).</p> <p>(3) Install two split retainers (40) and spring (41) on valve stem (39).</p> | <p style="text-align: center;"><u>CAUTION</u></p> <p>Make sure all seals are properly seated when assembling manifolds and valves to avoid pinching or cutting seals which could cause leaks and system malfunctions.</p> <p>(12) Position and carefully align inlet manifold (29), blade tilt pilot valve (28), ripper pilot valve (27) and outlet manifold (26) all together.</p> <p>(13) Use a wrench to install three capscrews (25) to secure manifolds and valves.</p> |
|---|--|

13-7. BLADE AND RIPPER PILOT VALVES - REPLACE/REPAIR (Cont'd)

- (14) Apply teflon tape to adapters (24) and use a wrench to install eight adapters (24) in pilot valve (7).
- (15) Apply teflon tape to elbows (23) and use a wrench to install three elbows (23) in pilot valve (7).
- (16) Install shaft seal (22) and housing seal (21) in housing (20). Install housing (20) over stem (39) onto ripper pilot valve (27).



- (17) Install two capscrews finger tight to hold housing (20) on valve (27).
- (18) Repeat STEPS 16 and 17 for blade tilt pilot valve (28).



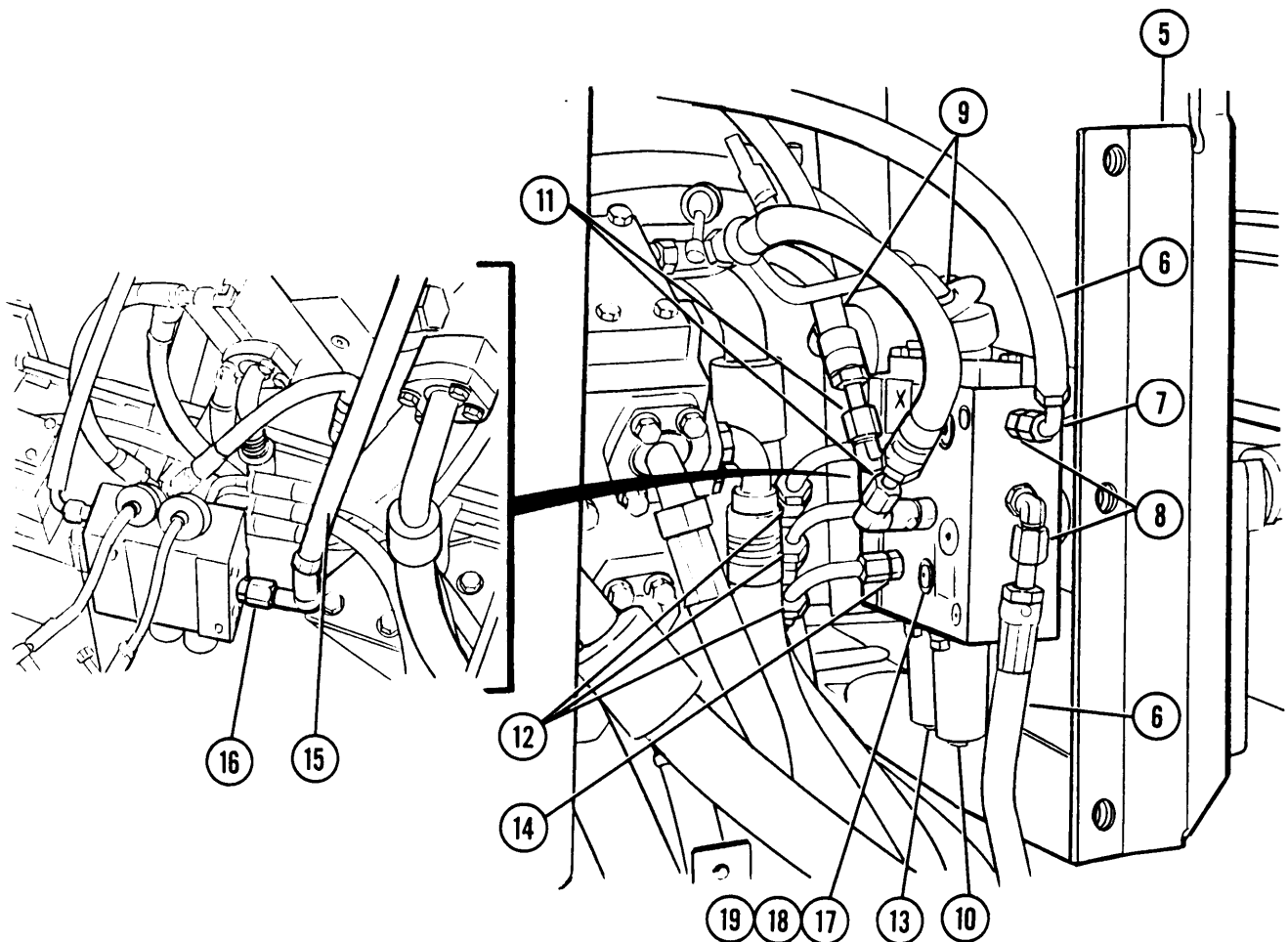
f. Installation

NOTE

Wipe all sealing surfaces on hoses and valve clean and dry. Apply film of clean hydraulic oil on seals as they are installed.

## 13-7. BLADE AND RIPPER PILOT VALVES - REPLACE/REPAIR (Cont' d)

- (1) Use two wrenches to install pilot valve (7) on side of control housing (5) with three capscrews (18), three washers (19) and three nuts (17).
- (2) Install seal (16) on hose (15) and install hose (15) on back-side of pilot valve (7) using a wrench.
- (3) Install seals (14) on three hoses (12). Install hoses (12) in ripper section (13) of pilot valve (7), using a wrench.
- (4) Install seals (11) on two hoses (9) and install hoses (9) in blade tilt section (10) of pilot valve (7), using a wrench.
- (5) Install seals (8) on two hoses (6) and install hoses (6) in front side of pilot valve (7), using a wrench.





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13-7. BLADE AND RIPPER PILOT VALVES - REPLACE/REPAIR (Cont'd)

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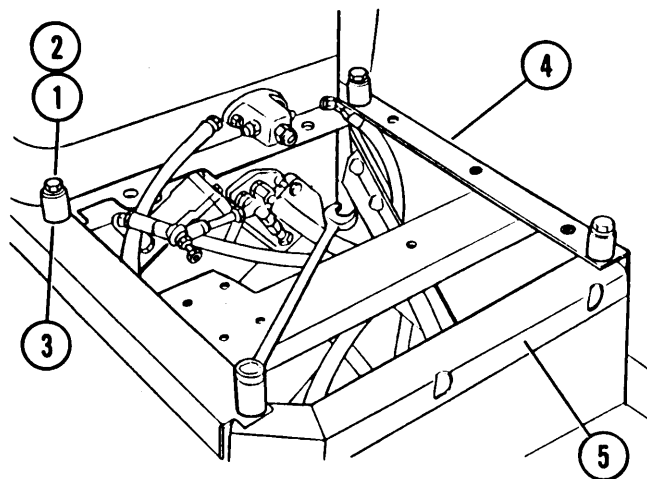
(6) Use a wrench to install frame (4) in control housing (5) with four capscrews (1), four washers (2) and four spacers (3).

(7) Install blade control lever and linkage. See page 13-59.

(8) Install ripper control lever and linkage. See page 13-67.

g. Place In Service

Run tractor and check blade and ripper for proper operation.



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## 13-8. RIPPER CONTROL VALVE - REPLACE/REPAIR

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This task covers:

- a. Removal
  - b. Disassembly
  - c. Cleaning
  - d. Lubrication
  - e. Assembly
  - f. Installation
  - g. Place In Service
- 

### INITIAL SETUP

Applicable Configurations  
Tractor with Ripper

Personnel Required  
MOS62B (1)

Common Tools  
Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Lifting Equipment 200 lbs.

Materials/Parts  
Seals (9), (10), (17), (18), (19),  
(24), (26), (30), (34), (43)  
Lubricating Oil OE/HDO-10 (See L05  
2410-237-12)  
Lint-free Rags  
Drain Pan, 5 Gallon  
Tags  
Caps and Plugs

Equipment Condition  
Ripper resting on ground.

---

#### a. Removal

#### **WARNING**

Hydraulic oil in the system can be under pressures over 2500 psi with the engine and pump OFF. ALWAYS relieve pressure in hydraulic lines before attempting to remove any component in the hydraulic system. With engine OFF and hydraulic attachments on the ground, move control levers through all operating positions several times to relieve line pressure. Relieve pressure in hydraulic oil tank by loosening filler cap very slowly. Failure to follow these precautions could result in serious personal injury.

13-8. RIPPER CONTROL VALVE - REPLACE/REPAIR (Cont' d)

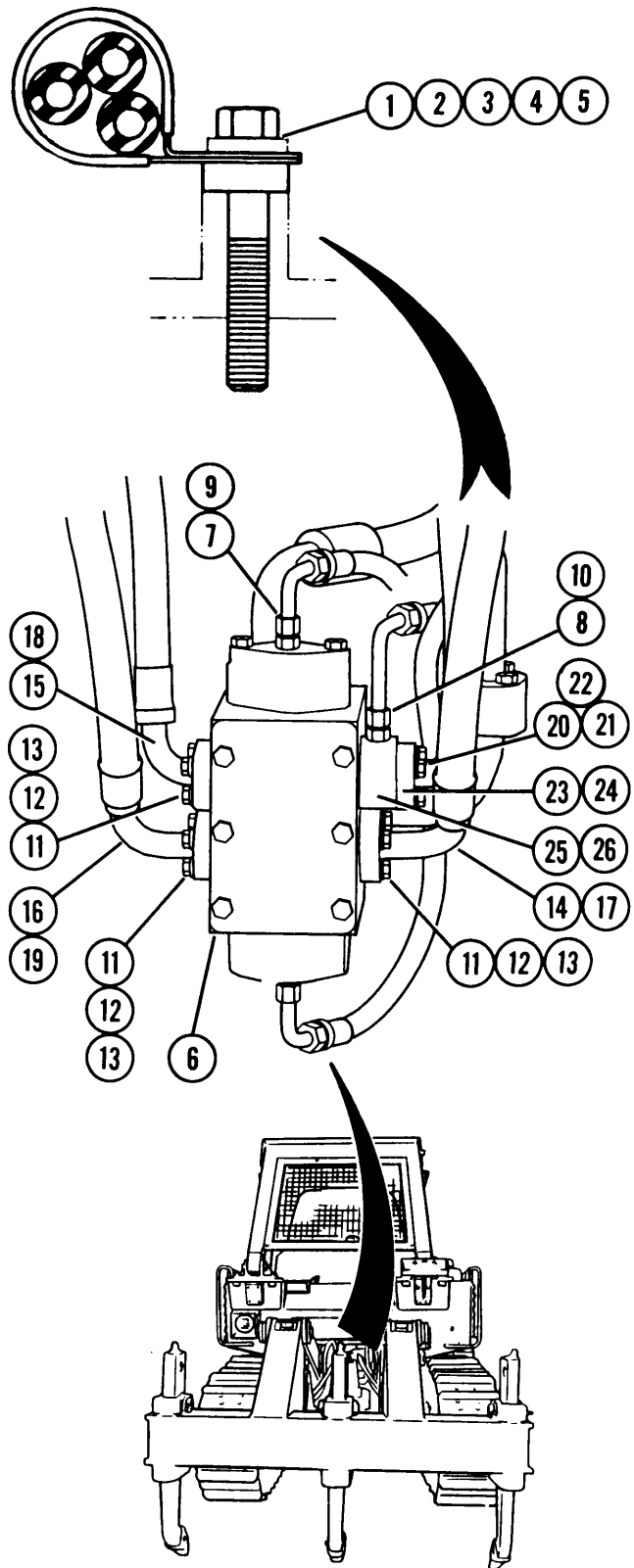
**CAUTION**

Wipe the area clean around all hydraulic connections to be opened during removal and disassembly. Cap oil lines and plug holes after removing lines. Contamination of the hydraulic system could result in premature failure.

**NOTE**

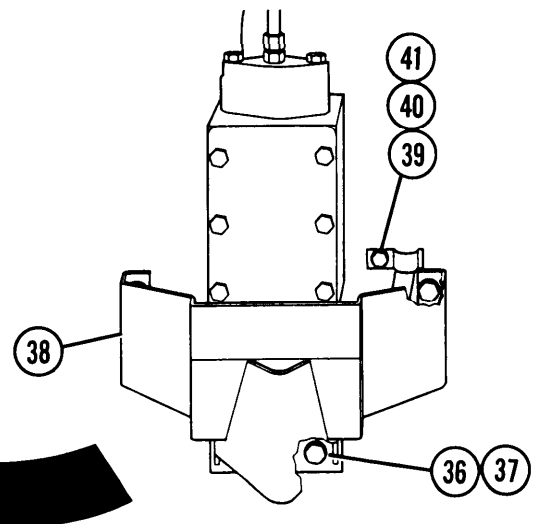
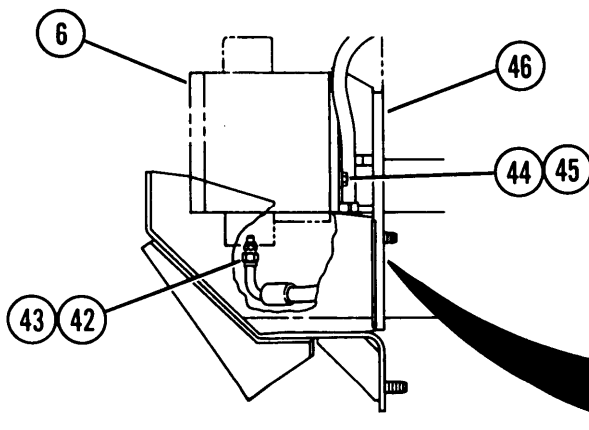
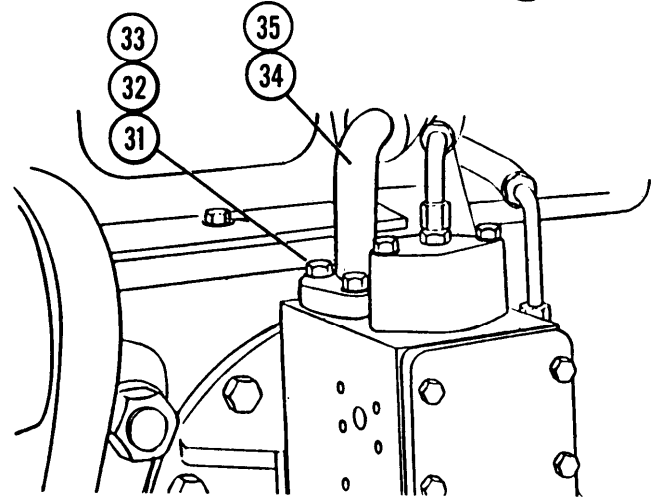
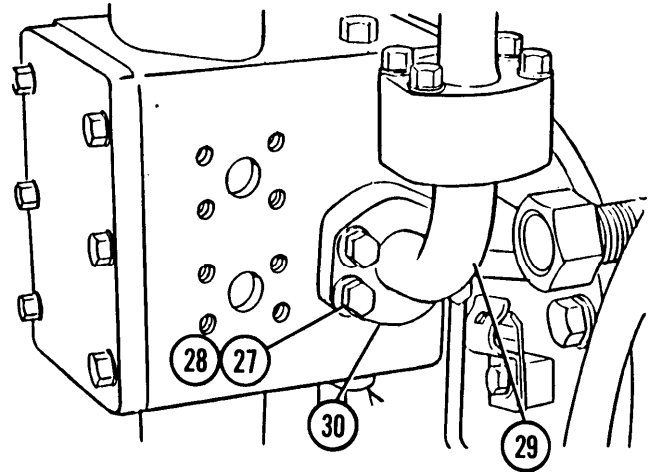
If more than one hydraulic line is to be removed, identify lines to assure proper installation.

- (1) Use a wrench to remove capscrew (1), spacer (2), clamp (3), washer (4) and lockwasher (5) securing three oil lines to final drive case above valve (6).
- (2) Use two wrenches to remove two oil lines (7 and 8). Remove seals (9 and 10) from oil lines. Discard seals.
- (3) Use a socket to remove four capscrews (11), four washers (12) and two split flanges (13) from each of three hoses (14, 15 and 16).
- (4) Remove seals (17, 18 and 19) from each hose (14, 15 and 16). Discard seals.
- (5) Use a wrench to remove four capscrews (20), four washers (21) and two split flanges (22) from hose (23). Remove seal (24) from hose. Discard seal.
- (6) Remove adapter (25) and seal (26). Discard seal.



13-8. RIPPER CONTROL VALVE - REPLACE/REPAIR (Cont' d)

- (7) Use a wrench to remove four capscrews (27), four washers (28) and elbow (29).
- (8) Remove seal (30) from elbow (29). Discard seal.
- (9) Use a wrench to remove four capscrews (31), four washers (32) and two split flanges (33).
- (10) Remove seal (34) from end of hose (35). Discard seal.
- (11) Use a socket to remove four capscrews (36), four washers (37) and guard (38).
- (12) Use a socket to remove capscrew (39), washer (40) and clamp (41).
- (13) Use two wrenches to remove pilot oil line (42). Remove seal (43) from line. Discard seal.
- (14) Attach lifting equipment to ripper control valve (6) to take weight off capscrews (44) during removal.
- (15) Use a wrench to remove four capscrews (44), four washers (45) and ripper control valve (6) from mounting bracket (46).



13-8. RIPPER CONTROL VALVE - REPLACE/REPAIR (Cont'd)

b. Disassembly

WARNING

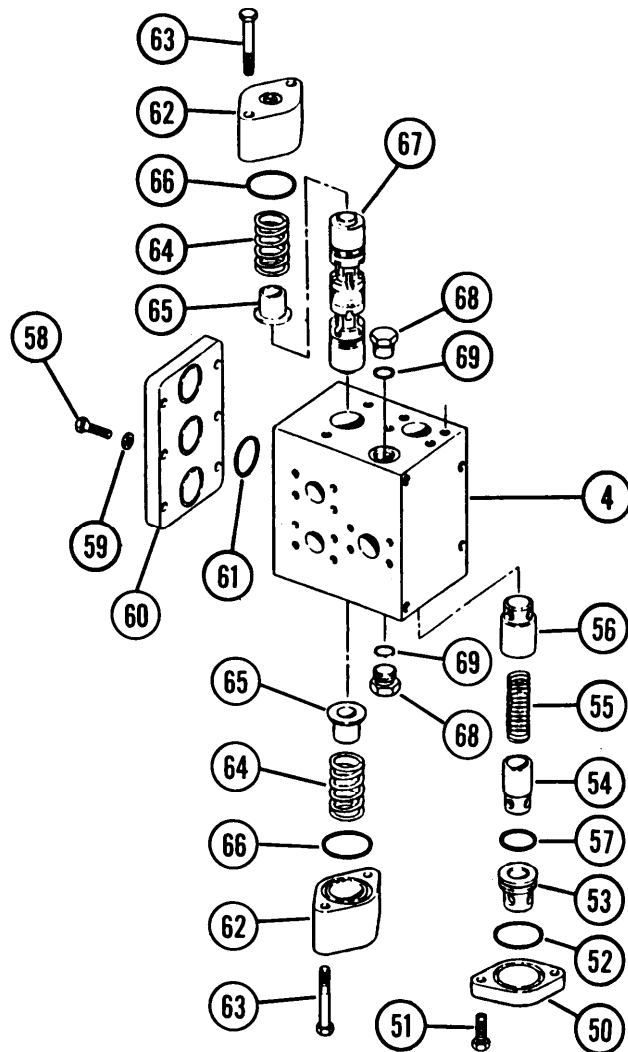
Cover (50) is under spring pressure. Remove capscrews and cover slowly and carefully to avoid injury and lost or damaged parts.

- (1) Use a wrench to remove two capscrews (51) and cover (50) from ripper control valve (4).
- (2) Remove seal (52) from cover (50). Discard seal.
- (3) Remove seat (53), valve (54), spring (55) and valve (56) from ripper control valve (4).
- (4) Remove seal (57) from seat (53). Discard seal.
- (5) Use a wrench to remove six capscrews (58), six washers (59) and plate (60) from valve (4).
- (6) Remove three seals (61) from plate (60). Discard seals.

WARNING

Housing (62) is under spring pressure. Remove capscrews and housing slowly and carefully to avoid injury and lost or damaged parts.

- (7) Use a wrench to remove two capscrews (63), housing (62), spring (64) and retainer (65) from valve (4).
- (8) Remove seal (66) from housing (62). Discard seal.
- (9) Remove spool (67) from control valve (4).



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## 13-8. RIPPER CONTROL VALVE - REPLACE/REPAIR (Cont'd)

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- (10) Repeat STEPS 7 and 8 on other end of valve.
- (11) Use a wrench to remove plug (68) from one end of valve (4). Remove seal (69) from plug (68). Discard seal.
- (12) Repeat STEP 11 for plug on other end of valve.

### c. Cleaning

Wipe all parts clean and dry.

### d. Lubrication

Apply film of clean hydraulic oil to all seals and internal valve parts before assembly.

### e. Assembly

- (1) Install plug (68) and new seal (69) using a wrench.
- (2) Repeat STEP 1 for plug at other end.
- (3) Install new seal (66) in housing (62).

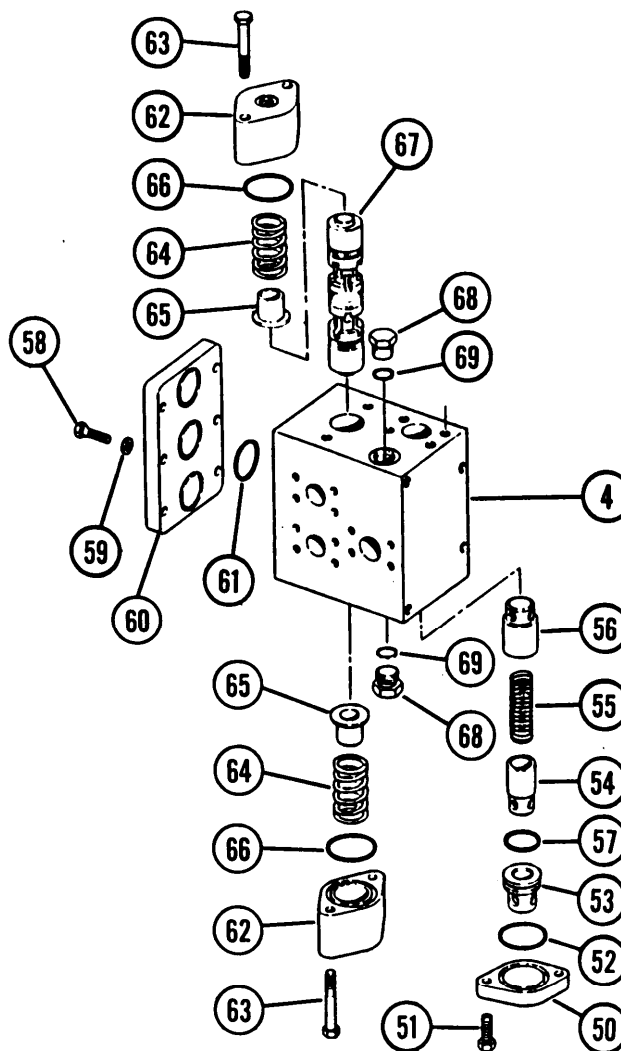
### **WARNING**

During installation, housing (44) will be put under spring pressure. Install slowly and carefully to avoid injury and lost or damaged parts.

- (4) Use a wrench to install retainer (65), spring (64) and housing (62) on valve (4) with two capscrews (63).
- (5) Insert spool (67) in opposite end of valve (4).

13-8. RIPPER CONTROL VALVE - REPLACE/REPAIR (Cont' d)

- (6) Repeat STEP 4 to secure spool (67) in valve (4).
- (7) Install three new seals (61) in plate (60).
- (8) Use a wrench to install plate (60) on valve (4) with six capscrews (58) and six washers (59).
- (9) Install new seal (57) on seat (53) and new seal (52) in cover (50).
- (10) Install valve (56), spring (55), valve (54), seat (53) and cover (50) on valve (4) with two capscrews (51). Tighten with a wrench.

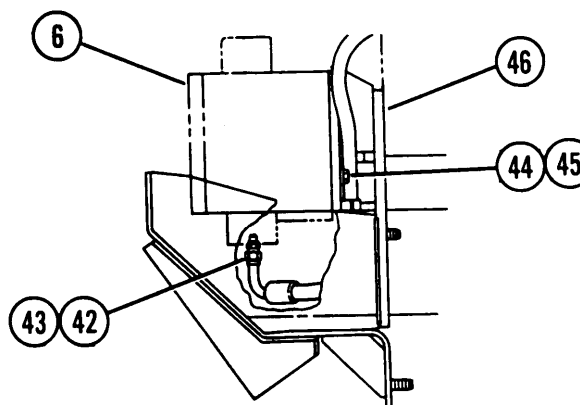


f. Installation

NOTE

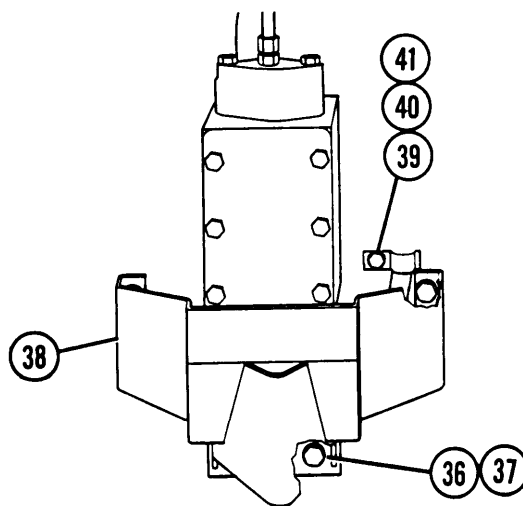
Remove caps and plugs as hoses are installed. Wipe all sealing surfaces on valve and hoses clean and dry. Apply film of clean hydraulic oil to all seals as they are installed.

- (1) Use lifting equipment to position the ripper control valve (6) on mounting plate (46). Secure valve to plate using four capscrews (44) and four washers (45).
- (2) Install new seal (43) on pilot oil line (42). Use two wrenches to install pilot oil line to bottom of control valve (6).

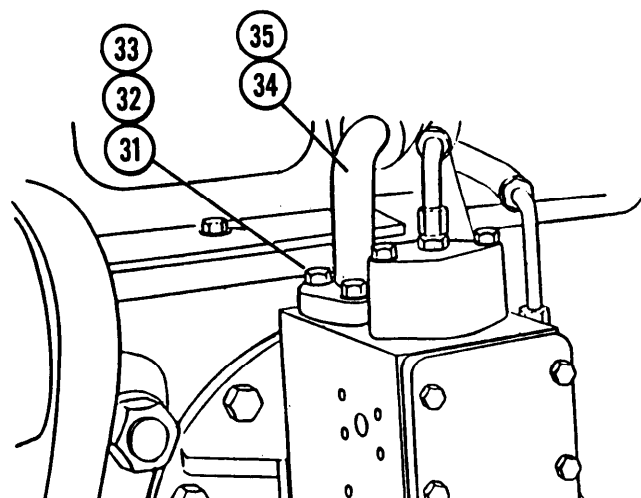


13-8. RIPPER CONTROL VALVE - REPLACE/REPAIR (Cont' d)

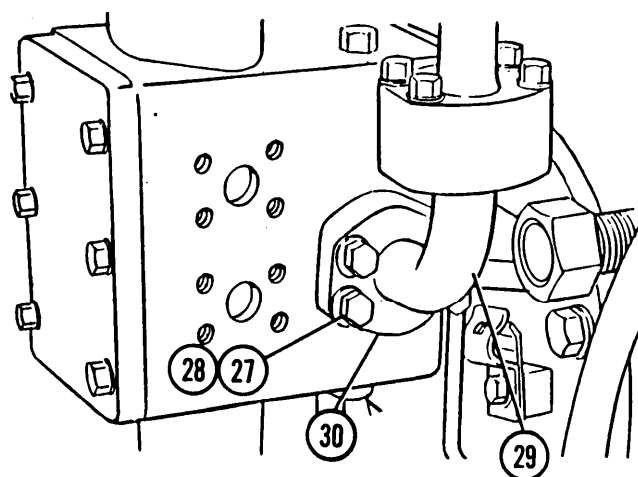
- (3) Install clamp (41) on pilot line (42) and secure with capscrew (39) and washer (40).
- (4) Place guard (38) in position. Use a socket to install four capscrews (36) and four washers (37).



- (5) Install new seal (34) in the end of hose (35). Attach hose to valve using two split flanges (33), four capscrews (31) and four washers (32).



- (6) Install new seal (30) in elbow (29). Attach elbow to valve using four capscrews (27) and four washers (28).





13-8. RIPPER CONTROL VALVE - REPLACE/REPAIR (Cont' d)

(7) Install new seal (26) in adapter (25). Position adapter on valve body (6).

(8) Install new seal (24) in end of hose (23). Attach hose and adapter (25) to valve (6) using two split flanges (22), four capscrews (20) and four washers (21).

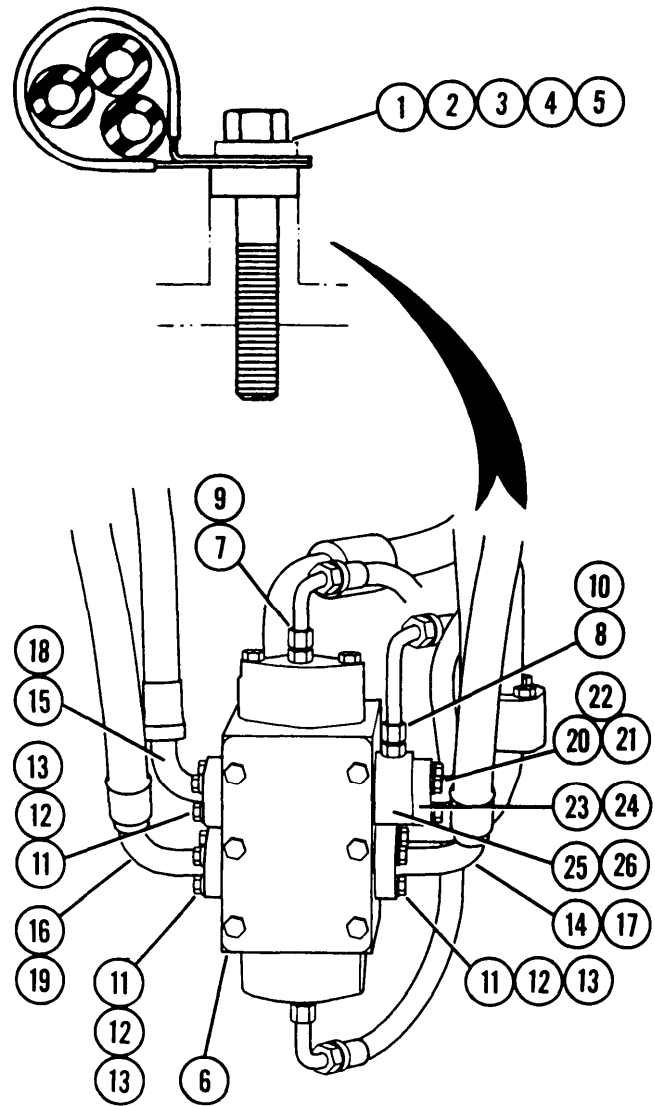
(9) Install a new seal (17, 18 and 19) in each of three hoses (14, 15 and 16). Attach each hose to valve using four capscrews (11), four washers (12) and split flanges (13).

(10) Install a new seal (9 and 10) in each of two oil lines (7 and 8). Use two wrenches to install oil lines to valve.

(11) Secure three oil lines to final drive case above valve with capscrew (1), spacer (2), clamp (3), washer (4) and lockwasher (5).

g. Place In Service

Run tractor and check ripper for proper operation.



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## 13-9. BLADE CONTROL LEVER AND LINKAGE - REPLACE

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This task covers:

- a. Removal
  - b. Cleaning
  - c. Lubrication
  - d. Installation
  - e. Place In Service
- 

### INITIAL SETUP

#### Applicable Configurations

All

#### Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

#### Materials/Parts

Lubricating Oil OE/HDO-10 (Refer  
to L05-2410-237-12)  
Cotter Pin (23)  
Lint-free Rag (App. B, Item 12)  
Grease (App. B, Item 6)

#### Equipment Condition

Engine cool.  
Steering brake lock lever removed.  
See TM5-2410-237-20.

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- a. Removal

#### WARNING

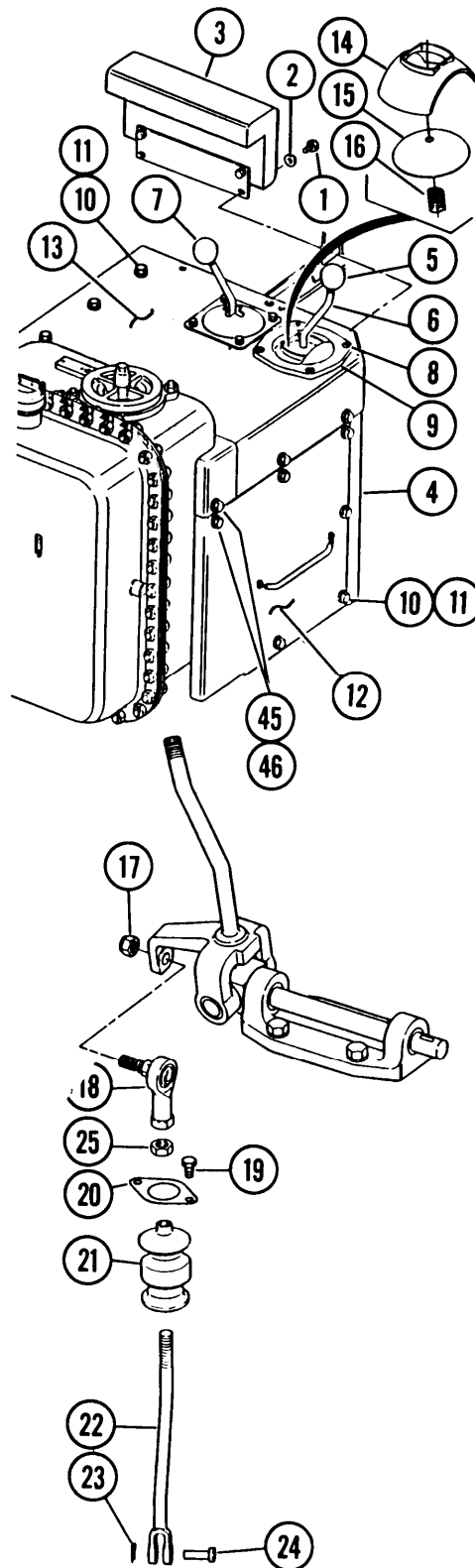
Hydraulic oil in the system can be under pressures over 2500 psi with the engine and pump off. ALWAYS relieve pressure in hydraulic lines before attempting to remove any component in the hydraulic system. With engine OFF and hydraulic attachments on the ground, move control levers through all operating positions several times to relieve line pressure. Relieve pressure in hydraulic oil tank by loosening filler cap very slowly. Failure to follow these precautions could result in serious personal injury.

13-9. BLADE CONTROL LEVER AND LINKAGE - REPLACE (Cont' d)

CAUTION

Relieve pressure in hydraulic system by moving dozer control lever back and forth several times after engine is turned OFF.

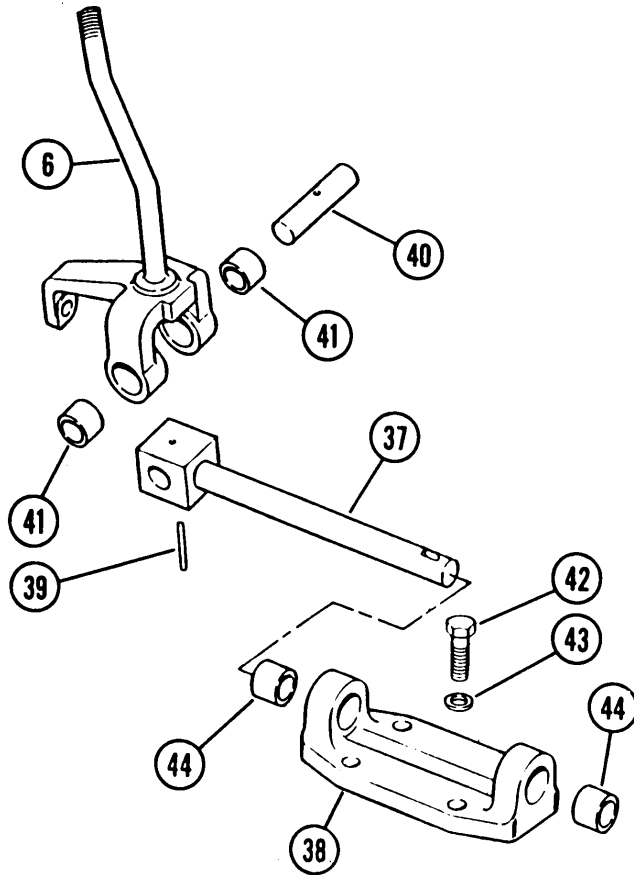
- (1) Use a wrench to remove two capscrews (1), two washers (2) and armrest (3) from control stand (4).
- (2) Remove handle (5) from dozer control lever (6).
- (3) Remove handle (7) from ripper control lever or winch control lever (whichever applies).
- (4) Remove four screws (8) and cover (9) from dozer control lever (6).
- (5) Use a wrench to remove nine capscrews (10 and 45), nine washers (11 and 46) and cover (13) from control stand (4).
- (6) Use a wrench to remove six capscrews (10 and 45), six washers (11 and 46) and plate (12) from front of control stand (4).
- (7) Remove guide (14), dome (15) and spring (16) from dozer control lever assembly (6).
- (8) Use a wrench to remove nut (17) and rod end (18) from control lever (6).
- (9) Remove two capscrews (19) from boot flange (20) and slide boot (21) and flange (20) partially up rod (22).
- (10) Use pliers to remove cotter pin (23), pin (24) and rod (22) from pilot valve. Discard cotter pin (23).





13-9. BLADE CONTROL LEVER AND LINKAGE - REPLACE (Cont'd)

- (18) Use a hammer and punch to remove pin (39) from shaft assembly (37) and shaft (40).
- (19) Use a hammer and punch to remove shaft (40) and control lever (6) from shaft assembly (37).
- (20) Remove two bearings (41) from lever assembly (6).
- (21) Use a wrench to remove four capscrews (42), four washers (43) and bracket assembly (38) from control stand frame (4).
- (22) Remove two bearings (44) from bracket assembly (38).



b. Cleaning

Wipe all bearings and all pivot holes clean and dry. Refer to page 2-29.

c. Lubrication

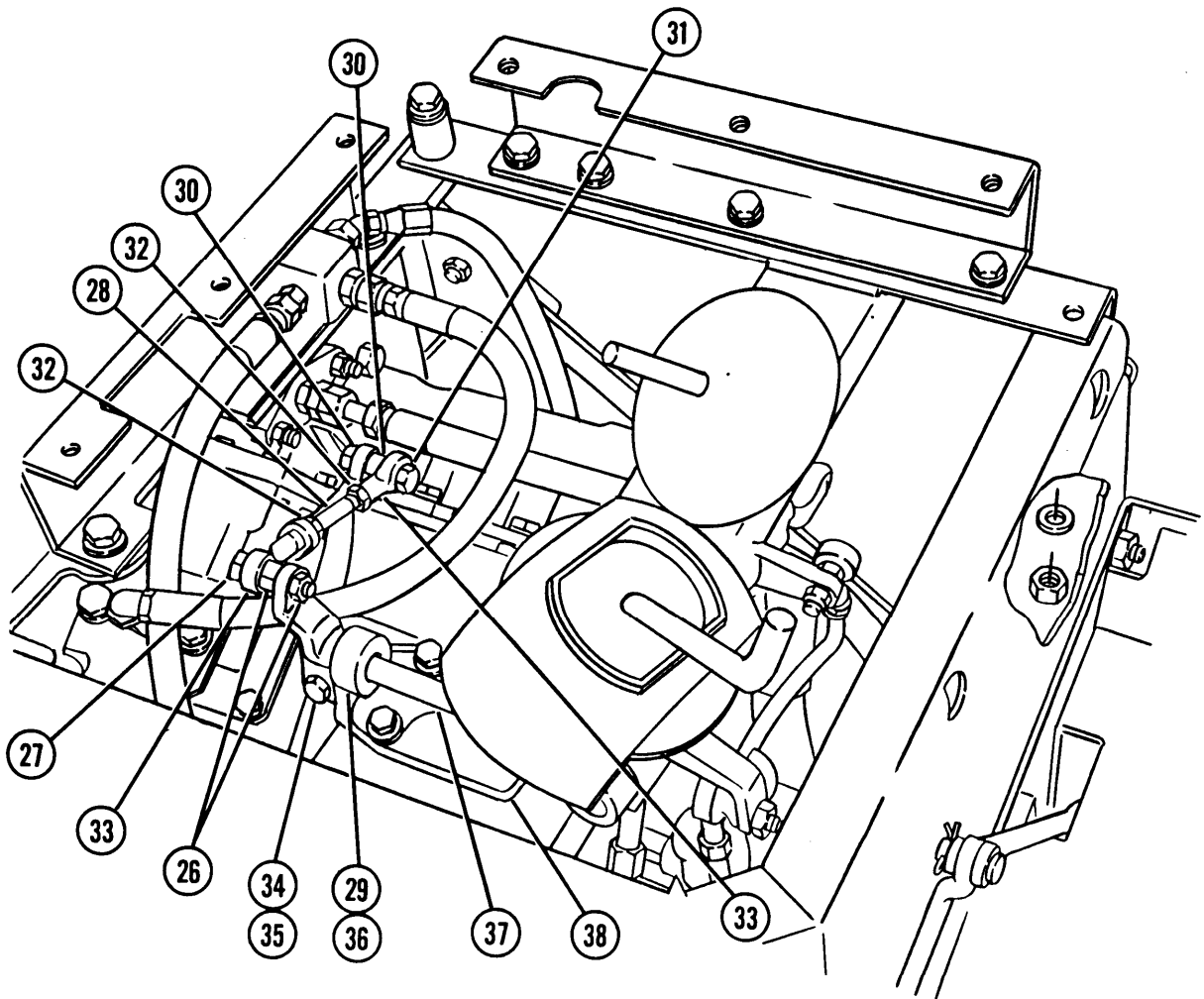
Apply lubricating oil to all bearings and grease to pivot holes during installation.

d. Installation

- (1) Install two bearings (44) in bracket assembly (38).
- (2) Use a wrench to install bracket assembly (38) on control stand frame (4) with four capscrews (42) and four washers (43).
- (3) Install two bearings (41) in lever assembly (6).
- (4) Position lever assembly (6) over block end of shaft assembly (37) and insert shaft (40) through lever and shaft assemblies.

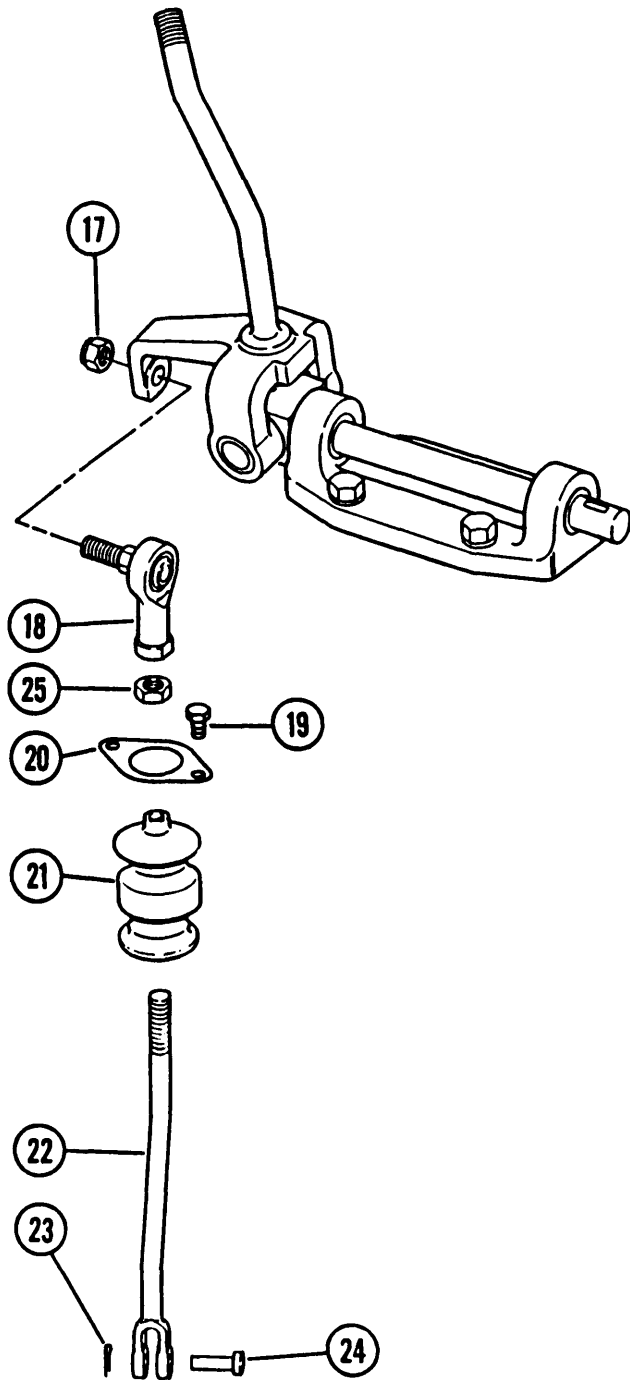
## 13-9. BLADE CONTROL LEVER AND LINKAGE - REPLACE (Cont' d)

- (5) Align pin holes in shaft (40) and shaft assembly (37) and with a hammer and punch, install pin (39) in shaft assembly and shaft.
- (6) Install shaft assembly (37) in bracket assembly (38).
- (7) Install key (36) and lever (29) on shaft assembly (37).
- (8) Use a wrench to install capscrew (35) and nut (34) in lever (29).
- (9) Install nut (32) and rod end (33) on each end of rod (28). Do not tighten nuts at this time.
- (10) Use two wrenches to install lower end of rod (28) assembly with capscrew (31) and two nuts (30).
- (11) Install top end of rod (28) assembly in lever (29) with capscrew (27) and two nuts (26) finger tight only.



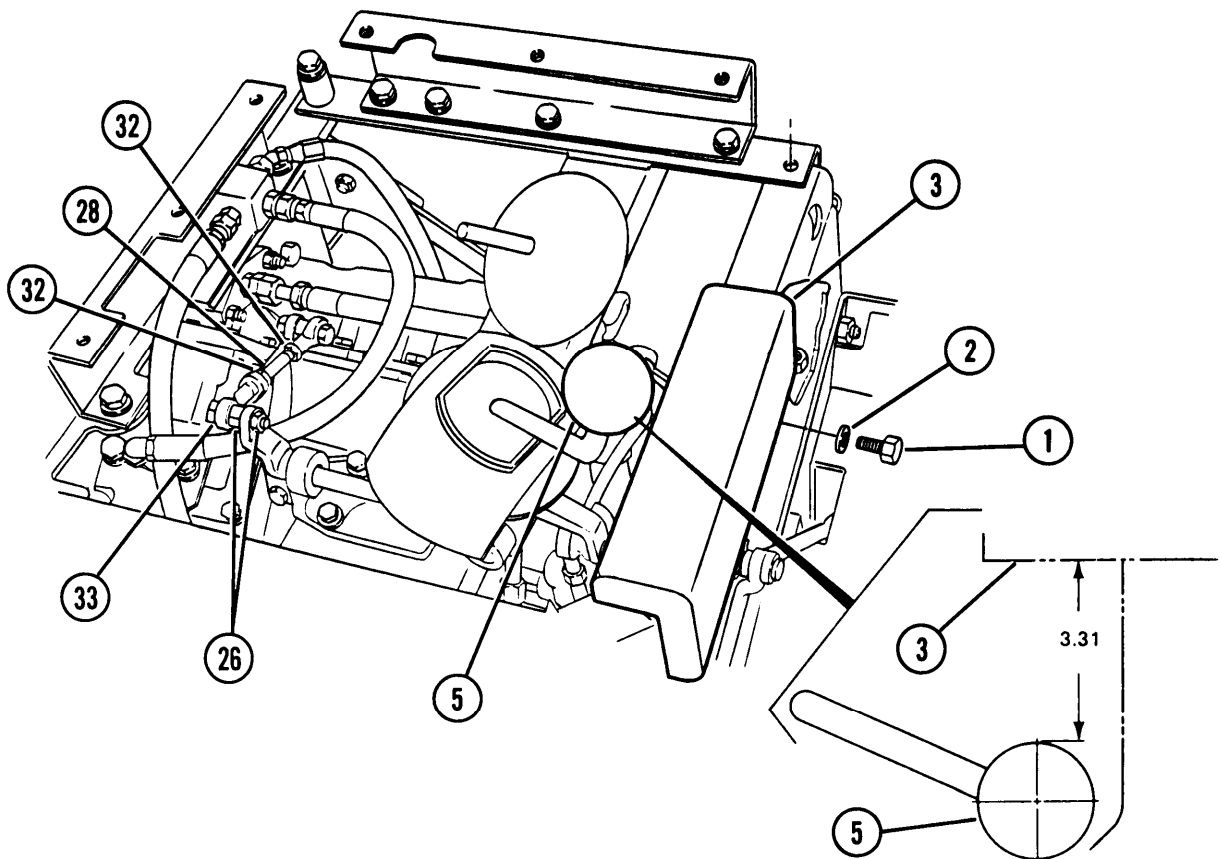
13-9. BLADE CONTROL LEVER AND LINKAGE - REPLACE (Cont'd)

- (12) Install flange (20) on boot (21) and slide boot about halfway down on rod (22).
- (13) Install nut (25) and rod end (18) on rod (22). Do not tighten nut at this time.
- (14) Install bottom end of rod (22) assembly on valve with pin (24) and new cotter pin (23).
- (15) Slide boot (21) over rod (22) end and secure boot flange (20) with two capscrews (19).
- (16) Adjust rod end (18) on rod (22) and with control lever (6) in vertical position, install rod end in lever (6) with nut (17). Use a wrench to tighten nut (17) and nut (25).



## 13-9. BLADE CONTROL LEVER AND LINKAGE - REPLACE (Cont'd)

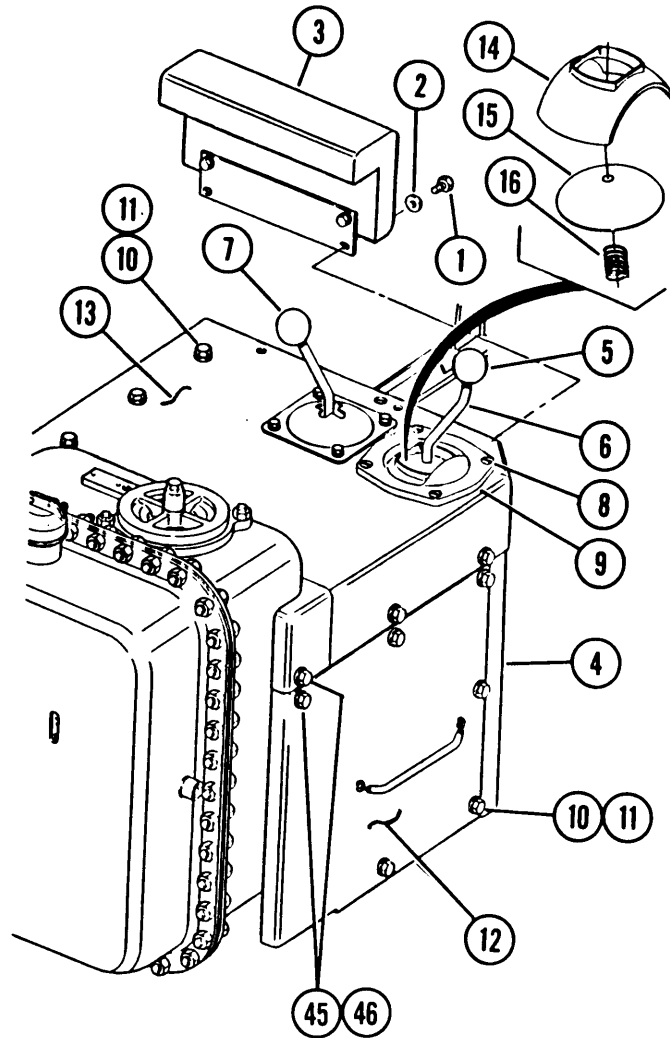
- (17) To adjust dozer control lever for proper neutral position, temporarily install armrest (3) with two capscrews (1) and two washers (2) finger tight. Install handle (5) on dozer control lever (6).
- (18) Adjust length of rod (28) assembly to obtain a distance of 3.31 in. between surface of handle and front edge of armrest (3).
- (19) Remove two capscrews (1), two washers (2), armrest (3) and handle (5).
- (20) Use two wrenches to tighten two nuts (26) on end of rod (28) assembly. Tighten nut (32) at each end of rod assembly against rod ends (33).





13-9. BLADE CONTROL LEVER AND LINKAGE - REPLACE (Cont' d)

- (21) Install spring (16), dome (15) and guide (14) on lever assembly (6).
- (22) Install front cover (12) on control stand (4), with six capscrews (10 and 45) and six washers (11 and 46) using a wrench.
- (23) Install top cover (13) on control stand (4) with nine capscrews (10 and 45) and nine washers (11 and 46) using a wrench.
- (24) Position cover (9) over control lever (6), position guide (14) in cover (9) and secure cover to control stand cover (13) with four screws (8).
- (25) Install handle (5) on dozer control lever (6) and handle (7) on ripper or winch control lever (whichever applies).
- (26) Install armrest (3) on control stand (4) with two capscrews (1) and two washers (2) using a wrench.
- (27) Install brake lock lever. See TM5-2410-237-20.



e. Place In Service

Run tractor and check blade for proper operation.

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 13-10. RIPPER CONTROL LEVER AND LINKAGE - REPLACE
 

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This task covers:

- a. Removal
  - b. Installation
  - c. Place In Service
- 

INITIAL SETUP
Applicable Configurations

Tractor with Ripper

Materials/Parts

Cotter pin (19)

Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Equipment Condition

Seat removed. See TM5-2410-237-20.

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 a. Removal


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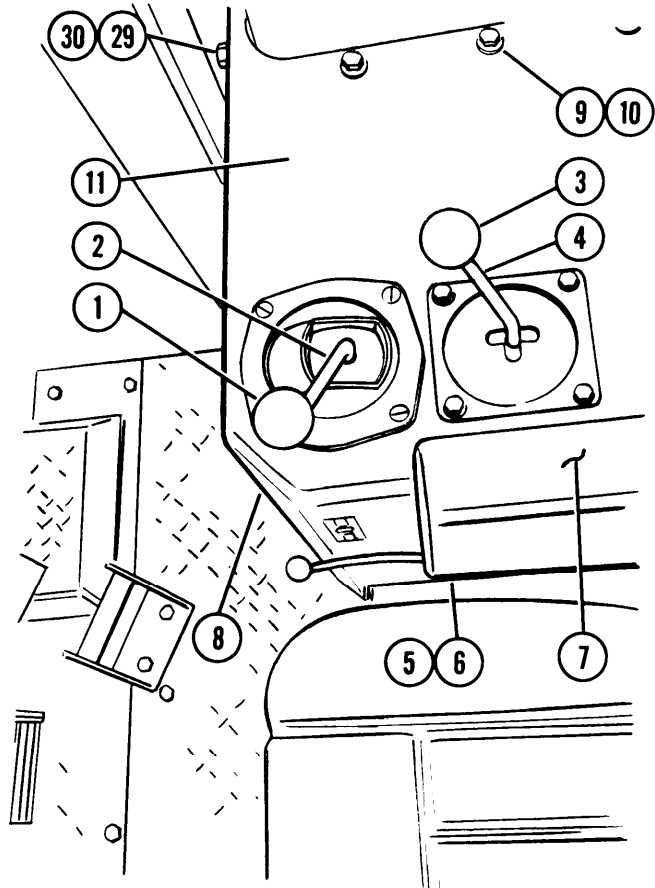
WARNING


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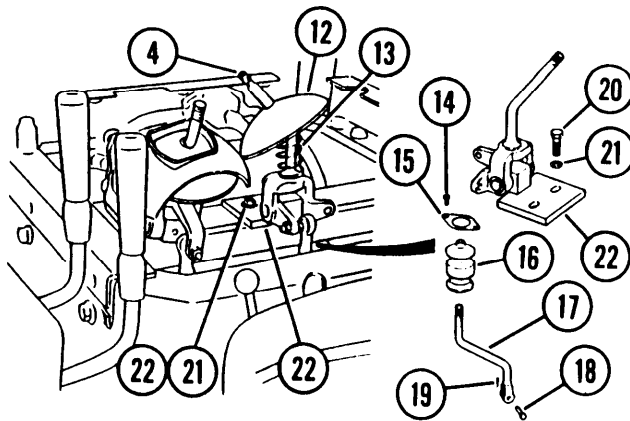
Hydraulic oil in the system can be under pressures over 2500 psi with the engine and pump off. ALWAYS relieve pressure in hydraulic lines before attempting to remove any component in the hydraulic system. With engine OFF and hydraulic attachments on the ground, move control levers through all operating positions several times to relieve line pressure. Relieve pressure in hydraulic oil tank by loosening filler cap very slowly. Failure to follow these precautions could result in serious personal injury.

13-10. RIPPER CONTROL LEVER AND LINKAGE - REPLACE (Cont' d)

- (1) Remove knob (1) from dozer blade control lever (2).
- (2) Remove knob (3) from ripper control lever (4).
- (3) Remove two capscrews (5) and two washers (6) securing armrest (7) to side of control housing (8).
- (4) Using a socket wrench remove eight capscrews (9), eight washers (10), capscrew (29) and washer (30) from cover assembly (11).
- (5) Remove cover (11) from control housing (8).



- (6) Remove seal (12) and spring (13) from ripper control lever (4).
- (7) Remove two capscrews (14) from boot flange (15) at bottom of control linkage using a wrench.
- (8) Slide boot (16) up lower rod (17) to clear pin (18).
- (9) Remove cotter pin (19) and pin (18) from lower rod (17) and control valve. Discard cotter pin (19).
- (10) Remove two capscrews (20) and two washers (21) from bracket assembly (22) and remove ripper control linkage from control housing.



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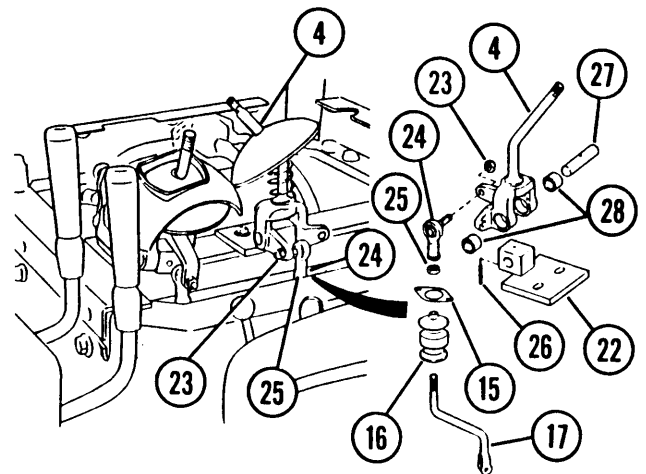
 13-10. RIPPER CONTROL LEVER AND LINKAGE - REPLACE (Cont'd)
 

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- (11) Remove nut (23) from rod end (24) and remove lower rod assembly from ripper control lever (4) using two wrenches.
- (12) Loosen nut (25) and remove rod (24) from lower rod (17) using a wrench.
- (13) Remove nut (25), boot (16) and flange (15) from rod (17).
- (14) Secure bracket assembly (22) in vise and drive pin (26) out of bracket assembly using a hammer and punch.
- (15) Remove shaft (27) and ripper control lever (4) from bracket assembly (22).
- (16) Remove two bearings (28) from ripper control lever (4).

 b. Installation

- (1) Install two bearings (28) in ripper control lever (4).
- (2) Secure bracket assembly (22) in vise.
- (3) Install ripper control lever (4) on bracket assembly (22) and insert shaft (27) through both.
- (4) Align hole in shaft (27) with hole in block on bracket assembly (22) and drive pin (26) through both using a hammer and punch.
- (5) Install flange (15) on boot (16) and slide both midway onto lower rod (17).
- (6) Install nut (25) and rod end (24) on rod (17). Do not tighten nut.
- (7) Adjust rod end (24) and install end in ripper control lever (4) with nut (23).

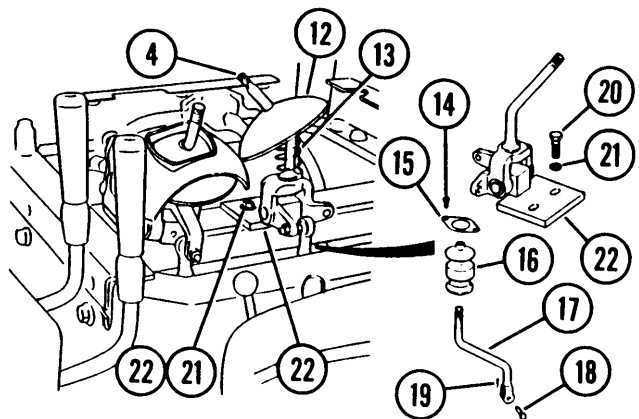


13-10. RIPPER CONTROL LEVER AND LINKAGE - REPLACE (Cont'd)

(8) Position ripper control linkage in control housing and install bracket assembly (22) with two capscrews (20) and two washers (21).

(9) Install pin (18) in lower rod (17) and control valve.

Install new cotter pin 19 in pin (18). Tighten nut (25) using a wrench.



(11) Slide boot (16) down over end of lower rod (17).

(12) Install boot flange (15) with two capscrews (14) using a wrench.

(13) Install spring (13) and seal (12) on ripper control lever (4).

(14) Position cover (11) on control housing (8).

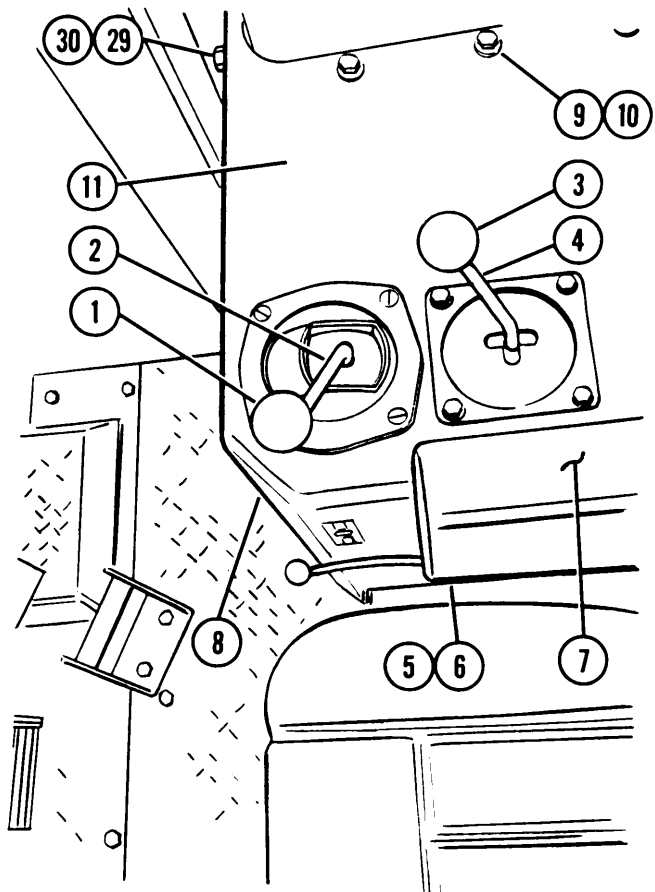
(15) Install eight capscrews (9), eight washers (10), capscrew (29), and washer (30) to secure cover (11) using a socket wrench.

(16) Install two capscrews (5) and two washers (6) at bottom of armrest (7) to control housing (8) using a socket.

(17) Install knob (3) on ripper control lever (4).

(18) Install knob (1) on dozer blade control lever (2).

(19) Install seat. See TM5-2410-237-20.



c. Place In Service

Run tractor and check ripper for proper operation.

---

## 13-11. BLADE TILT CYLINDER - REPAIR

---

This task covers:

- a. Disassembly
- b. Cleaning
- c. Inspection
- d. Assembly
- e. Place In Service

---

### INITIAL SETUP

#### Applicable Configurations

All

#### Personnel Required

MOS62B (1)

#### Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

#### Materials/Parts

Ring (9), (12)  
Seal Assembly (10)  
Packing (11), (15)  
Seal (13), (14)  
Nut (5), (16)  
Lubricating Oil OE/HDO-10 (Refer  
to L05-2410-237-12)  
Lint-free Rag (App. B, Item 12)

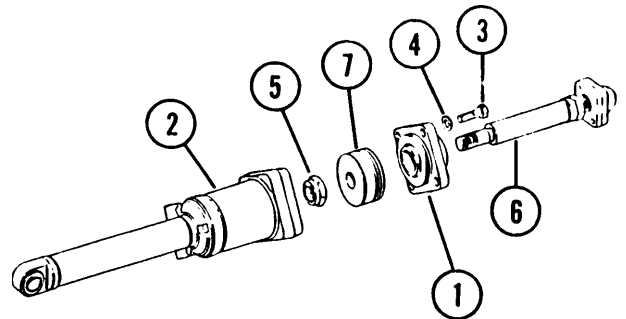
#### Equipment Condition

Tilt cylinder removed.  
See TM5-2410-237-20.

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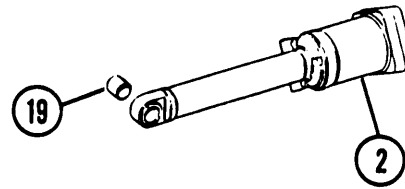
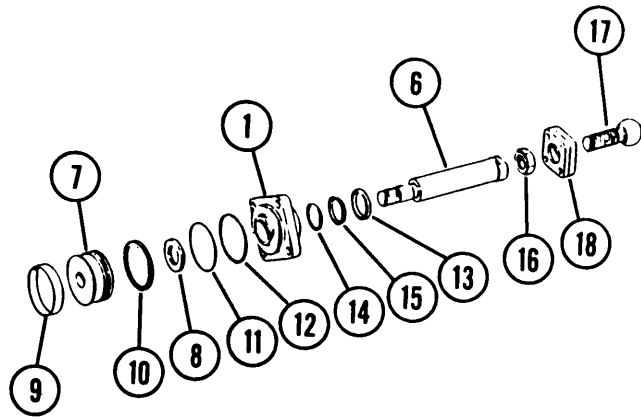
### a. Disassembly

- (1) Secure tilt cylinder in horizontal position. Mark across edge of head (1) and onto cylinder (2) to provide lineup mark for assembly.
- (2) Use socket and breaker bar to remove four capscrews (3) and four washers (4) from head (1).
- (3) Remove rod (6), head (1), and piston (7) assembly from cylinder (2).
- (4) Use a socket to remove nut (5) from rod (6).
- (5) Remove piston (7) and head (1) from rod (6).



13-11. BLADE TILT CYLINDER - REPAIR (Cont'd)

- (6) Remove washer (8), wear ring (9), and seal (10) from piston (7). Discard wear ring and seal.
- (7) Remove seal (11) and wiper ring (12) from head (1). Discard seal and ring.
- (8) Remove outer seal (13) and two wiper seals (14 and 15) from head (1). Discard the seals.
- (9) Use two wrenches to loosen nut (16) and remove ball (17) from rod (6).
- (10) Remove nut (16) and cap (18) from ball (17).
- (11) Use hammer and drift or press to remove bushing (19) from end of cylinder (2).



b. Cleaning

Wipe all parts clean and dry.  
Refer to page 2-29.

c. Inspection

Inspect all metal parts for wear or damage and replace, if necessary.

d. Assembly

- (1) Use a press to install bushing (19) in cylinder (2).

## 13-11. BLADE TILT CYLINDER - REPAIR (Cont'd)

(2) Install ball joint cap (18), and nut (16) on ball stud (17). If ball stud is being reused, dress threads to repair peen damage from prior installation. Thread ball stud (17) into rod (6) until it bottoms.

(3) Peen nut (16) against rod (6). While holding nut (16) with a wrench, use torque wrench on nut (5) to tighten to a torque of  $1600 \pm 200$  lb. ft. Peen nut (16) to ball stud (17) in three places equally spaced.

CAUTION

Correct installation of seal (15) and packing (13) is critical for proper operation of cylinder.

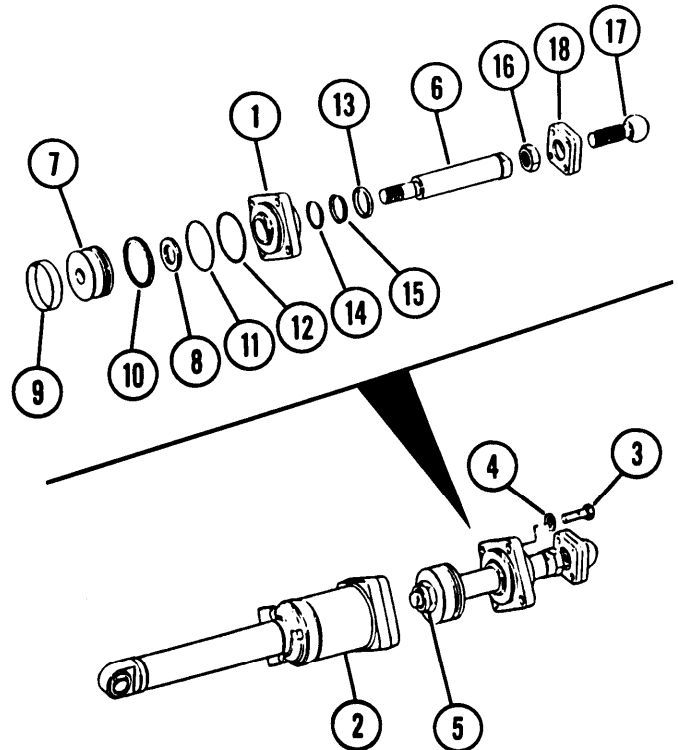
(4) Install seal (13), seal (14) and packing (15) in head (1), making sure the lips of seal (15) and packing (13) are facing away from each other.

Rod (6) and cylinder (2) must be kept horizontal and in alignment at all times to prevent damage to seals or cylinders.

(5) Put clean hydraulic oil on seals (13 and 14) and packing (15), in head (1). Push head (1) on rod (6).

(6) Install wiper ring (11) and packing (12) on head (1). packing (12) must face toward cylinder (2) when installed.

(7) Apply film of clean hydraulic oil to seal (10) and install seal in groove in piston (7).





13-11. BLADE TILT CYLINDER - REPAIR (Cont'd)

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- (8) Install wear ring (9) on piston (7).
- (9) Install washer (8) and piston (7) on rod (6). Put clean hydraulic oil on threads of rod (6) and install nut (5).
- (10) Use a socket and torque wrench to tighten nut (5) to a torque of 1600±200 lb. ft.
- (11) Put clean hydraulic oil on seal (10) and ring (9) of piston (7) and packing (11) and ring (12) of head (1). Slide piston, rod and head assembly into cylinder (2).

NOTE

For proper fit, make sure scribe marks on head (1) and cylinder (2) are in alignment before head (1) is installed on cylinder.

- (12) Use a wrench to install four capscrews (3) and four washers (4) with rod (6) fully extended.

e. Place In Service

Run tractor and check for proper blade operation.

---

## 13-12. BLADE ADJUSTABLE BRACE - REPAIR

---

This task covers:

- a. Disassembly
  - b. Cleaning
  - c. Inspection
  - d. Repair
  - e. Assembly
  - f. Place In Service
- 

### INITIAL SETUP

#### Applicable Configurations

All

#### Common Tools

Shop Equipment, General  
Purpose Repair, Semi-Trailer  
Mounted, NSN 4940-00-287-4894

#### Materials/Parts

Cleaning Solvent (App. B, Item 19)

#### Equipment Condition

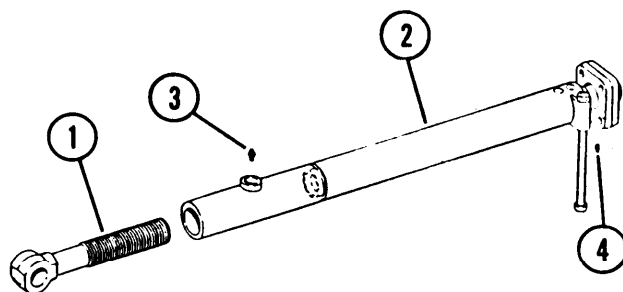
Blade adjustable brace removed.

See TM5-2410-237-20.

---

#### a. Disassembly

- (1) Insert a large screwdriver or similar tool through eye bore of screw (1) and remove screw from brace assembly (2).
- (2) Remove fitting (3) and plug (4).



#### b. Cleaning

Clean all parts with an approved cleaning solvent and dry thoroughly. Refer to page 2-29.

#### c. Inspection

- (1) Inspect screw for distortion, damaged threads, abrasion or elongated eye bore. Replace if necessary.
- (2) Inspect fitting and plug for damaged threads. Replace if necessary.
- (3) Inspect brace assembly for bends, cracks, and internal thread damage.

13-12. BLADE ADJUSTABLE BRACE - REPAIR (Cont'd)

---

d. Repair

- (1) Straighten bends if possible. Replace brace assembly if repair is not possible.
- (2) Repair cracks by welding (refer to MIL-W-13773). Replace brace assembly if repair is not possible.
- (3) Replace brace assembly if internal threads are damaged.

e. Assembly

- (1) Install plug (4) and fitting (3).
- (2) Install screw (1) into brace assembly (2). Hand turn screw several turns. Screw adjustment is discussed at installation.
- (3) Install blade adjustable brace (refer to TM5-2410-237-20).

f. Place In Service

Run tractor and check blade for proper operation.

---

## 13-13. HYDRAULIC LINES AND FITTINGS - REPAIR

---

This task covers:

- a. Disassembly of Reusable Hose Assemblies
- b. Reconditioning of Used Couplings
- c. Assembly of Reusable Hose Assemblies
- d. Place In Service

---

### INITIAL SETUP

#### Applicable Configurations

All

#### Common Tools

Shop Equipment, General Purpose  
Repair  
Semi-Trailer Mounted  
Tool Outfit, Hydraulic System,  
4940-01-036-5784  
Hacksaw, Carbide Blade  
Pipe-Cutter, 3/8" - 2" Dia.  
Hammer, Plastic-Tipped  
Block of Wood

#### Special Tools

Hydraulic Press, 5P4180  
Hydraulic Hand Pump, 2D2825

#### Materials/Parts

Hose (as required)  
Couplings (as required)

#### Equipment Condition

Appropriate lines and fittings  
removed.

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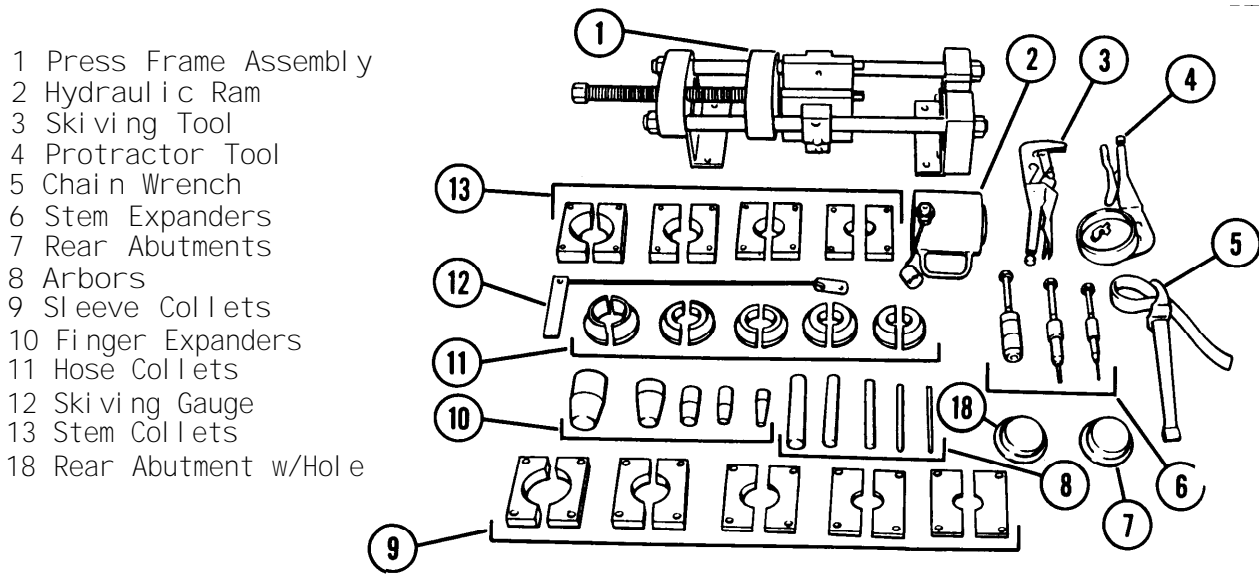
### NOTE

This procedure covers hydraulic line repair for ripper, blade, winch and transmission hydraulic systems.

### NOTE

Refer to Table 13-1 to determine appropriate tools for hose I.D. being worked on.

13-13. HYDRAULIC LINES AND FITTINGS - REPAIR (Cont'd)



- 1 Press Frame Assembly
- 2 Hydraulic Ram
- 3 Ski vining Tool
- 4 Protractor Tool
- 5 Chain Wrench
- 6 Stem Expanders
- 7 Rear Abutments
- 8 Arbors
- 9 Sleeve Collets
- 10 Finger Expanders
- 11 Hose Collets
- 12 Ski vining Gauge
- 13 Stem Collets
- 18 Rear Abutment w/Hole

Table 13-1. Hose Disassembly

HOSE		STEM COLLETS (13)	HOSE COLLETS (11)	SLEEVE COLLETS (9)	REAR ABUTMENT W/O HOLE (7)	ARBORS (8)	FINGER EXPANDER (10)	STEM EXPANDER (6)	REAR ABUTMENT W/HOLE (18)
TYPE	I. D.	PART NUMBER	PART NUMBER	PART NUMBER	PART NUMBER	PART NUMBER	PART NUMBER	PART NUMBER	PART NUMBER
XT-3	0.38"	6V9071	5P268	5P282	5P284	5S2808	5S2805	5P5232	*5P283
	0.50"	5P965	5P269	5P281	5P284	5S2814	5S2811	5P5233	*5P283
	0.75"	5P966	5P271	5P280	5P284	5S2826	5S2823	5P5232	
	1.00"	5P967	5P272	5P279	5P284	5S2834	5P973	5P5233	
	1.25"	5P968	5P273	5P278	5P284	5S2840	5S2837	5P5234	

\*During disassembly of 0.38" and 0.50" hose, use 5P283 rear abutment in place of hose collets.

a. Disassembly of Reusable Hose Assemblies

NOTE

Measure hose length and stem angularity (if required) before cutting hose assembly. This measurement will be used when cutting new hose in Assembly of Reusable Hose Assemblies.

13-13. HYDRAULIC LINES AND FITTINGS - REPAIR (Cont'd)

- (1) Measure and record hose length (A).
- (2) Measure between end of stem and stem fingers (B). Calculate and record dimension (C) as follows:

$$(B) \times 2 = (C)$$

- (3) Calculate and record actual hose length (D) required as follows:

$$(A) - (C) = (D)$$

- (4) Record angularity of stems (E), if required.

- (5) Cut used hose (14) 3 inches behind sleeve (15).

- (6) Apply oil to inside diameter of hose (14). Install arbor (8) in hose.

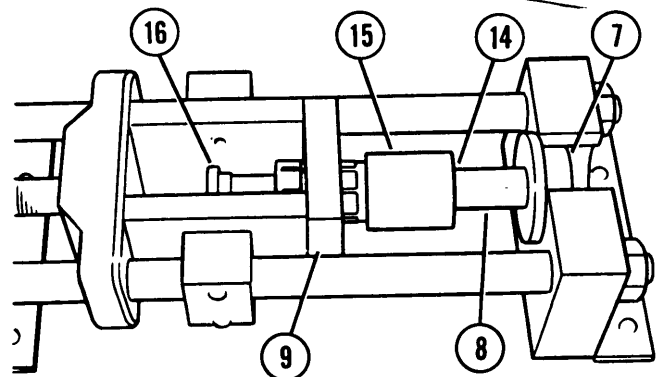
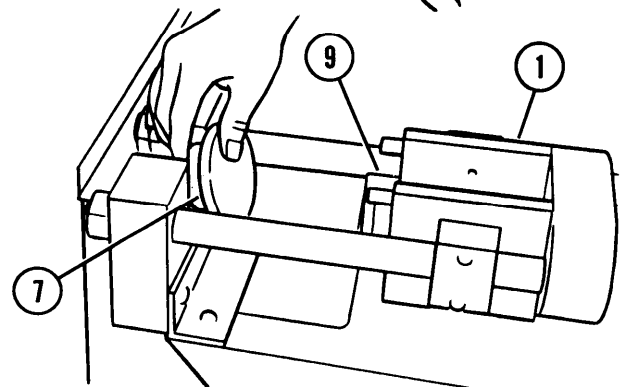
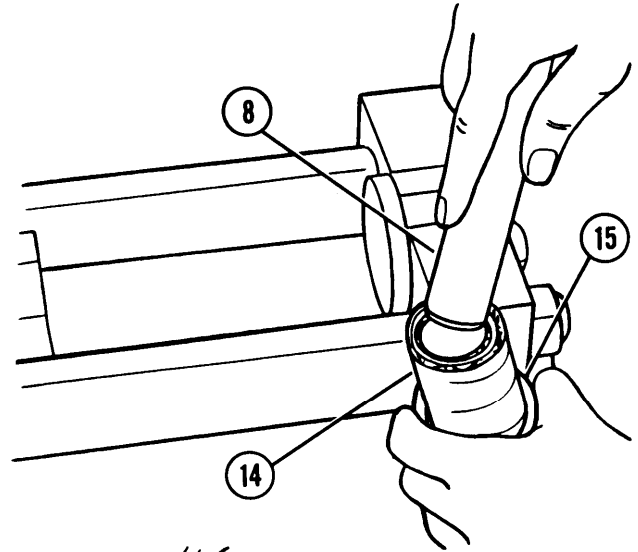
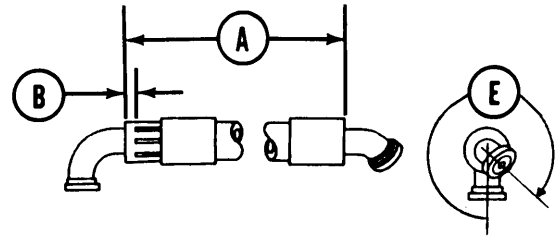
- (7) Install bottom half of sleeve collet (9) in press frame assembly (1). Install sleeve collet so counterbore (A) is away from dowel pins.

- (8) Install rear abutment (7) in press frame assembly.

- (9) Position stem (16), hose (14), and arbor (8) in press frame assembly (1). Slide sleeve (15) into counterbore of sleeve collet (9). Place arbor (8) against rear abutment (7).

- (10) Install top half of sleeve collet (9) in press frame assembly (1). Install sleeve collet so counterbore is away from dowel pins.

- (11) Tighten forcing screw to remove sleeve (15).

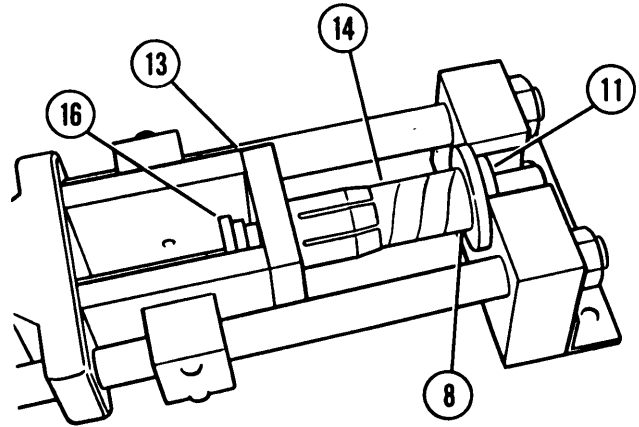


13-13. HYDRAULIC LINES AND FITTINGS - REPAIR (Cont'd)

NOTE

It may be necessary to install grease ram to remove sleeve on larger sizes of hose.

- (12) Remove stem (16), hose (14), and arbor (8) from press frame assembly (1). Remove sleeve collets (9) and rear abutment (7).
- (13) Install bottom half of stem collet (13) in press frame assembly (1). Install stem collet so counterbore is toward dowel pins.



NOTE

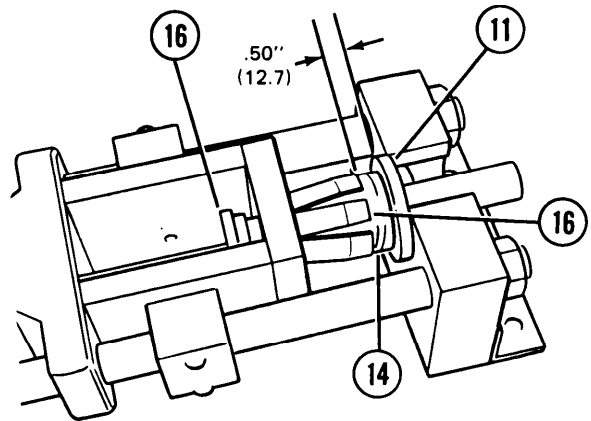
During disassembly of 0.38" and 0.58" I.D. hose, use 5P283 rear abutment (18) in place of hose collets.

- (14) Install bottom half of hose collet (11) in press frame assembly (1).
- (15) Install stem (16), hose (14) and arbor (8) in press frame assembly (1).
- (16) Install top half of stem collet (13) and top half of hose collet (11) in press frame assembly (1). Install stem collet so counterbore is toward dowel pins.

NOTE

On 0.38" and 0.50" I.D. hoses, fingers on stem (16) are approximately 1/2" from abutment (18).

- (17) Tighten forcing screw until fingers on stem (16) are approximately 1/2" from hose collet (11).

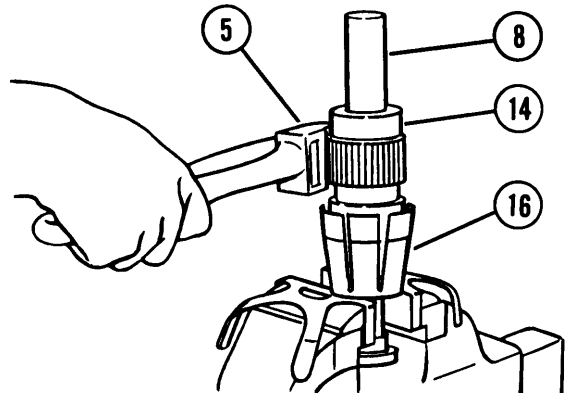


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 13-13. HYDRAULIC LINES AND FITTINGS - REPAIR (Cont' d)
 

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- (18) Remove stem (16) and hose (14) from press frame assembly (1).
- (19) Install stem (16), hose (14) and arbor (8) in vise. Install chain wrench (5). Turn chain wrench until hose (14) and arbor (8) can be removed.


 b. Reconditioning of Used Couplings
CAUTION

When couplings are reused, use care to ensure that reconditioning has been performed correctly and completely. Do not use damaged or defective couplings.

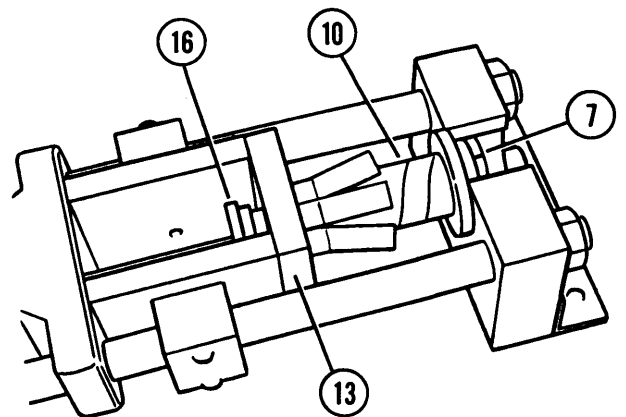
WARNING

Before installation of a coupling that has been used before, inside diameter of stem must be returned to original specifications. Failure to do so may cause hose failure and personal injury.

## NOTE

Refer to Table 13-1 to determine appropriate tools for hose I.D. being worked on.

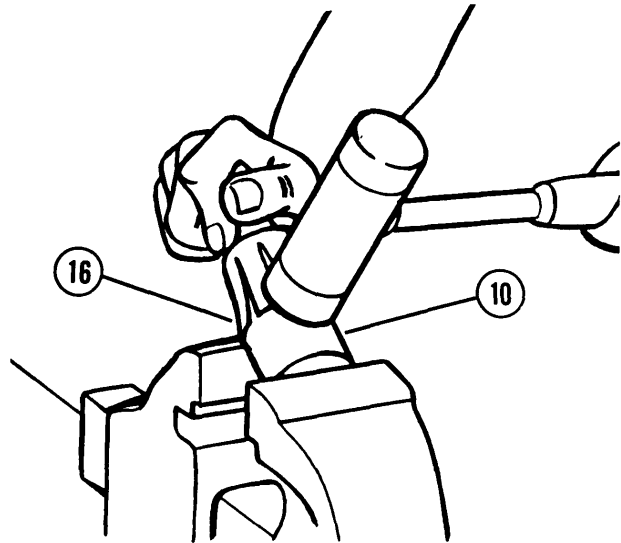
- (1) Insert bottom half of stem collet (13) in press frame assembly. Install stem collet so counter-bore is away from dowel pins.
- (2) Install rear abutment (7) in press frame assembly (1).
- (3) Install finger expander (10) on stem (16), tapered end first. place stem and finger expander in press frame assembly (1).





13-13. HYDRAULIC LINES AND FITTINGS -REPAIR (Cont' d)

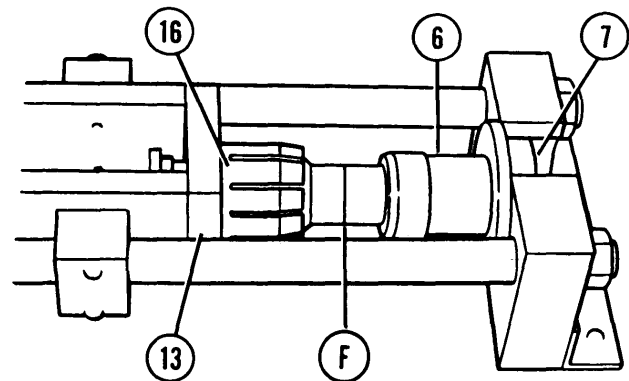
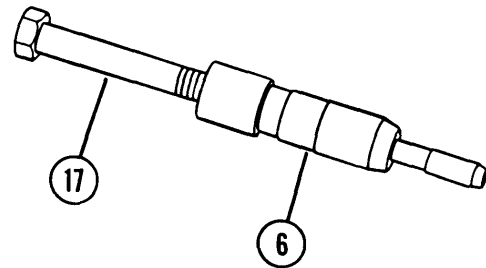
- (4) Install top half of stem collet (13) in press frame assembly (1). Install stem collet so counter-bore is away from dowel pins.
- (5) Tighten forcing screw until end of finger expander (10) reaches bottom of fingers on stem (16).
- (6) Remove finger expander (10) and stem (16) from press frame assembly (1). Place finger expander and stem in vise.
- (7) Hammer fingers on stem (16) down against finger expander (10) using a plastic-tipped hammer.
- (8) Remove finger expander (10) from stem (16).



NOTE

On straight stem hose assemblies with swivel nut, install bottom half of stem collet (13) in press assembly with counterbore toward dowel pins.

- (9) Install bottom half of stem collet (13) in press frame assembly (1) with counterbore away from dowel pins.
- (10) Install rear abutment (7) in press frame assembly (1).
- (11) Remove bolt (17) from stem expander (6). Bolt will not be used in this procedure.
- (12) Apply oil to inside diameter of stem (16). Install stem (16) and stem expander (6) in press frame assembly (1).
- (13) Install top half of stem collet (13) in press frame assembly (1).



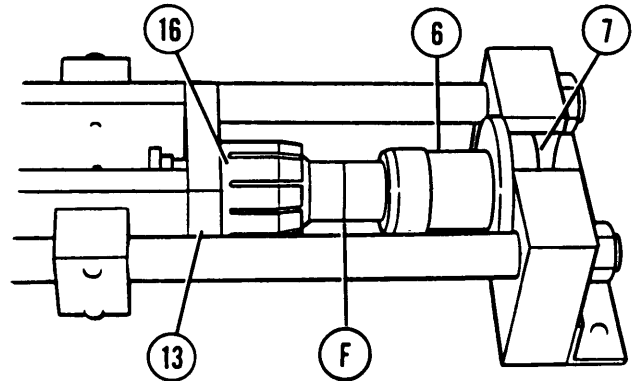
13-13. HYDRAULIC LINES AND FITTINGS - REPAIR (Cont'd)

- (14) Turn forcing screw until shoulder (F) of stem expander (6) reaches end of stem (16).

**CAUTION**

Do not go beyond shoulder F, on stem expander. Damage to stem may result.

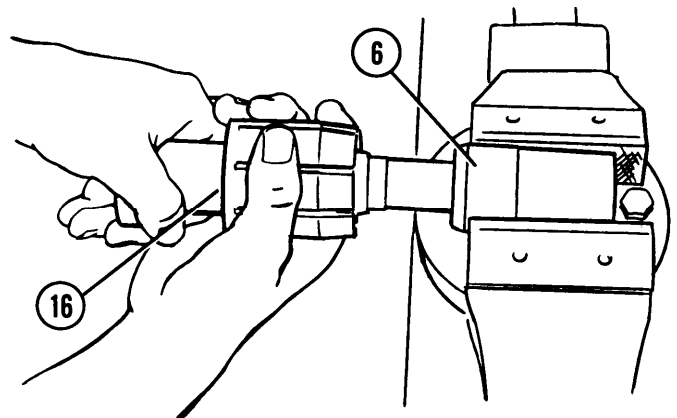
- (15) Place stem expander (6) in vise. Pull stem (16) from stem expander. Remove any rough pieces of metal from inside of stem (16).



c. Assembly of Reusable Hose Assemblies

**CAUTION**

When couplings are reused, use care to ensure that reconditioning has been performed correctly and completely. Do not use damaged or defective couplings.



**NOTE**

Hose couplings with double collet couplings cannot be assembled using 5P4180 Hydraulic Hose Press.

**NOTE**

When installing a long stem O-ring coupling with a 1.25" I.D. hose, install collets with counterbore facing toward locating pins.

**WARNING**

Use only XT-3 couplings and XT-3 sleeves with XT-3 hose. All XT-3 couplings and sleeves have a triangular identification mark.

13-13. HYDRAULIC LINES AND FITTINGS - REPAIR (Cont'd)

**WARNING**

Never install couplings on used hose.

**NOTE**

Both ends of hose must be cut neat and square.

- (1) Make a mark (G) 2" longer than measurement (D), as recorded in Disassembly of Reusable Hose Assemblies. Use a hacksaw and cut at mark (G).
- (2) Measure 1" from mark (G) and make a mark (H).
- (3) Measure (D), as recorded in Disassembly of Reusable Hose Assemblies, from mark (H) and make a mark (J).
- (4) Install correct size arbor (8) in hose (14). Place hose and arbor in vise.

**NOTE**

Refer to Table 13-2 to determine appropriate tools for hose I.D. being worked on.

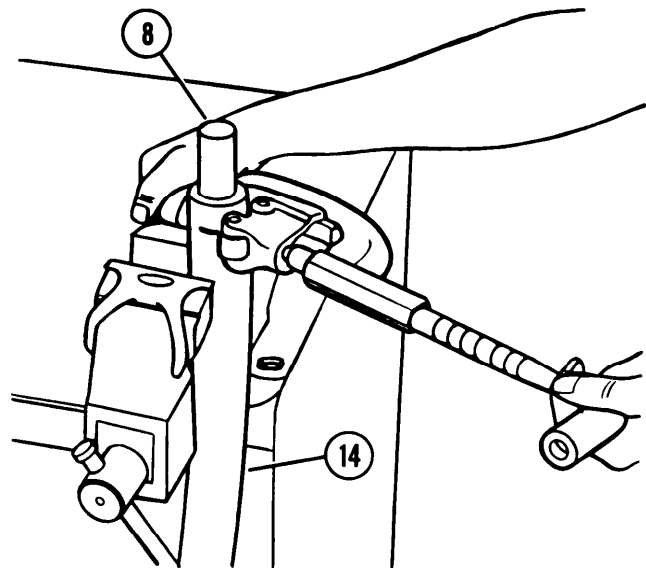
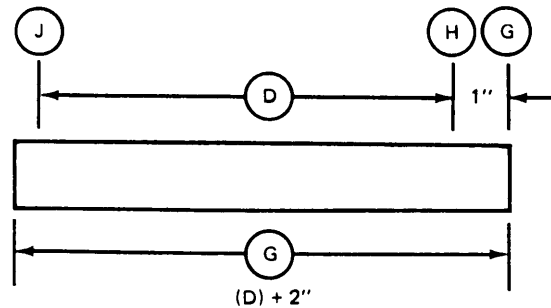


Table 13-2. Hose Assembly

HOSE I. D.	STEM COLLETS (13)	HOSE COLLETS (11)	ARBORS (8)	FINGER EXPANDER (10)	SKI VINING GAUGE (12)
	PART NUMBER	PART NUMBER	PART NUMBER	PART NUMBER	PART NUMBER
0.38"	6V9071	5P268	5S2808	5S2805	6V6022
0.50"	5P965	5P269	5S2814	5S2811	<b>6V6022</b>
0.75"	5P966	5P271	5S2826	5S2823	<b>6V6022</b>
1.00"	5P967	5P272	5S2834	5P973	6V6022
1.25"	5P968	5P273	5S2840	5S2837	6V6022

13-13. HYDRAULIC LINES AND FITTINGS - REPAIR (Cont'd)

NOTE

Both ends of hose must be cut neat and square.

- (5) Use a pipe cutter to cut through hose at marks (H) and (J) indicating exact length required.

NOTE

Refer to Table 13-3 for tolerances of finish cut hose length. Make sure finished cut is made evenly.

Table 13-3. Finish Cut Hose Length

Hose Length	Tolerance
0 to 12"	± 0.06"
12" to 36"	+ 0.10"
36" to 72"	± 0.20"
72" to 120"	± 0.40"
over 120"	± 0.50"

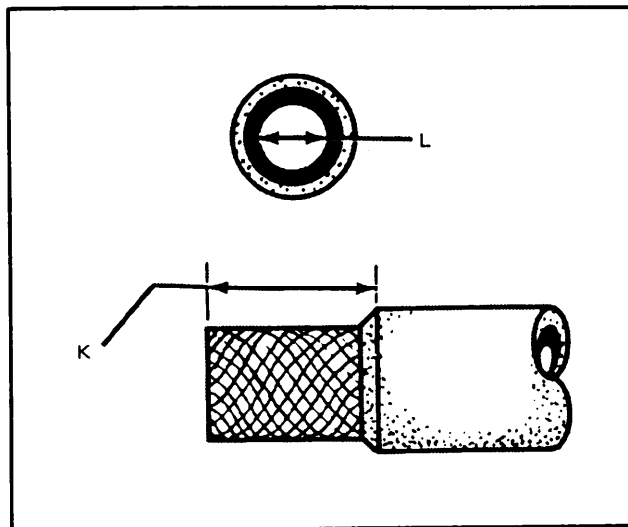
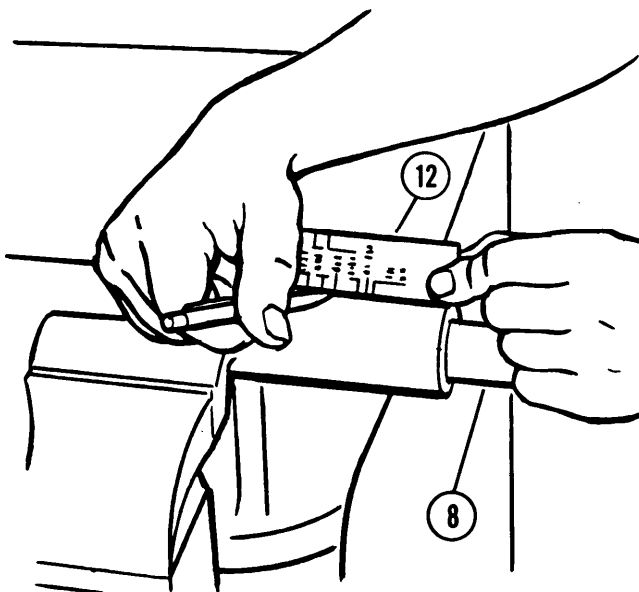
- (6) Measure length (K) of hose cover to be removed using skiving gauge (12)

NOTE

Refer to Table 13-4 for correct skiving lengths. Do not expose wire beyond end of the stem fingers.

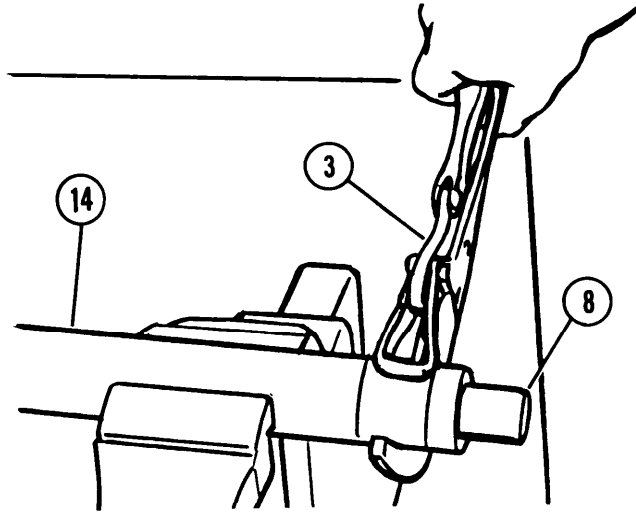
Table 13-4. Skiving Lengths

Hose I.D. (Dimension L)	Skiving Length (Dimension K)
0.38"	1.31" ± 0.03"
0.50"	1.31" ± 0.03"
0.75"	1.48" ± 0.03"
1.00"	1.52" ± 0.06"
1.25"	1.82" ± 0.06"



13-13. HYDRAULIC LINES AND FITTINGS -REPAIR (Cont'd)

- (7) Remove hose cover from mark to end of hose (14) using skiving tool (3). Turn skiving tool counterclockwise to make first cut. Remove skiving tool and reverse position. Turn skiving tool clockwise to finish cut. Remove arbor (8).



- (8) Repeat STEP 7 for other end of hose (14).

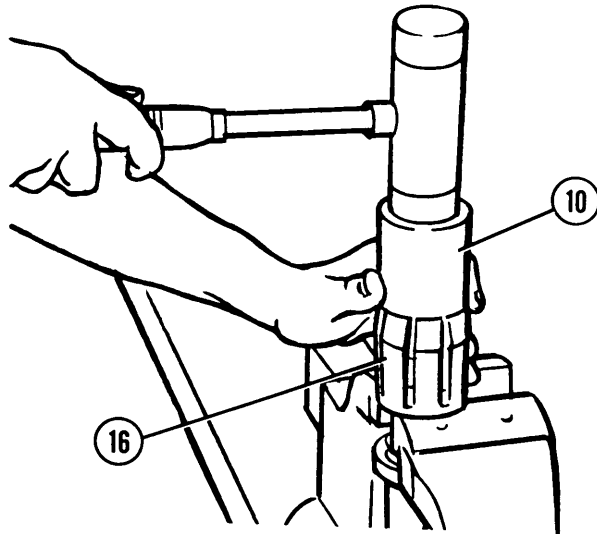
NOTE

For used fittings, STEP 9 was already done in STEP b, 6 through 8. STEP 7 must be followed for new fittings.

NOTE

Do not put lubricant inside hose or on stem.

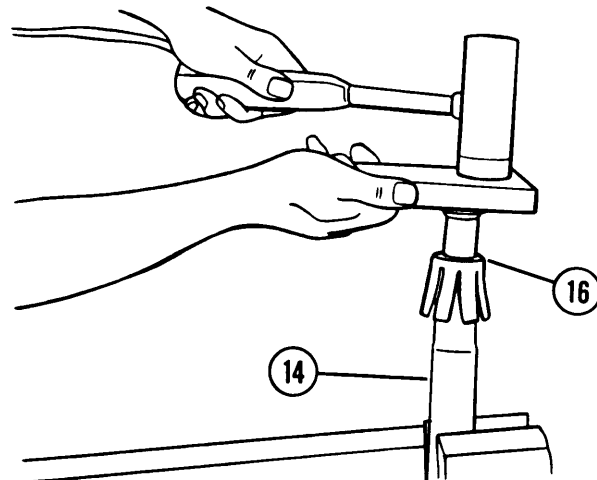
- (9) place stem (16) in vise. Install finger expander (10) in stem. Tap finger expander with plastic-tipped hammer to bend out stem fingers. Tap side of finger expander against vise to remove finger expander from stem.



NOTE

If opposite end of hose is already assembled, install sleeve on hose before installing stem.

- (10) Push stem onto hose (14) by hand. Place hose and stem (16) in vise. Tap stem using a plastic-tipped hammer and wooden block. Drive end of hose to bottom of stem.



## 13-13. HYDRAULIC LINES AND FITTINGS - REPAIR (Cont'd)

- (11) Tap fingers on stem (16) until all fingers are tight against hose (14).

## NOTE

On straight stem hose assemblies with swivel nut, install bottom half of stem collet (13) in press assembly with counterbore toward dowel pins.

- (12) Install bottom half of stem collet (13) and hose collet (11) on dowel pins in press frame assembly (1). Install stem collet with counterbore away from dowel pins.

- (13) Place sleeve (15) on hose (14) with chamfer on inside diameter of sleeve toward mating fingers on stem (16).

- (14) Place hose assembly in press frame assembly (1). Align smallest part of stem (16) in stem collet (13). Slide hose (14) into hose collet (11).

- (15) Place top half of stem collet (13) and top half of hose collet (11) in press frame assembly (1). Install stem collet with counterbore away from dowel pins.

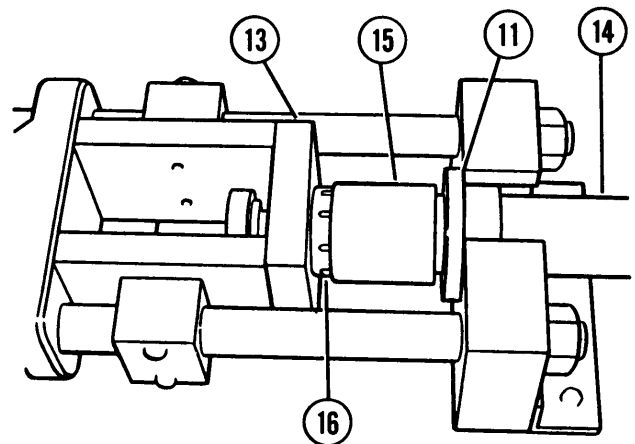
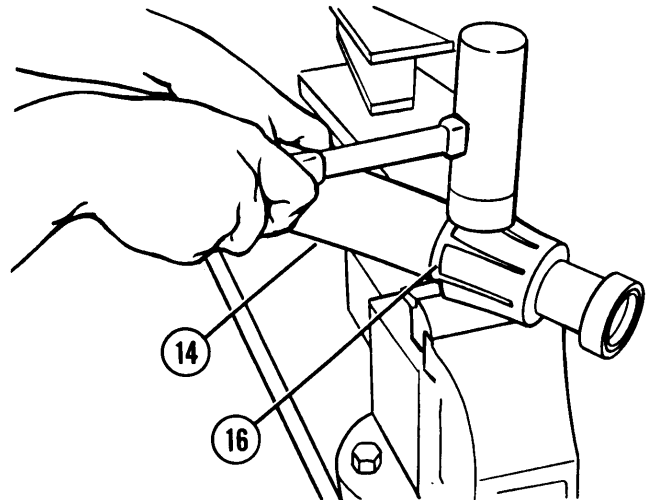
## NOTE

Apply oil on outside of fingers on stem (16) to ease installation of sleeve.

- (16) Turn forcing screw to press sleeve (15) over fingers on stem (16).

## NOTE

On 1.00" or 1.25" I.D. hose, use hydraulic hand pump to install sleeve over last 1/2" of stem fingers.

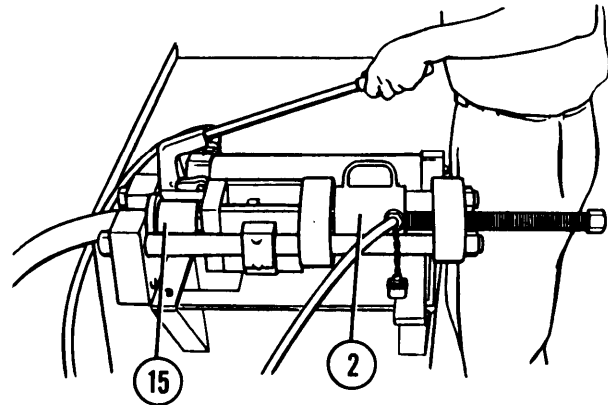


13-13. HYDRAULIC LINES AND FITTINGS - REPAIR (Cont'd)

NOTE

One end of ram is made to fit forcing screw. The other end of ram is made to fit bolster.

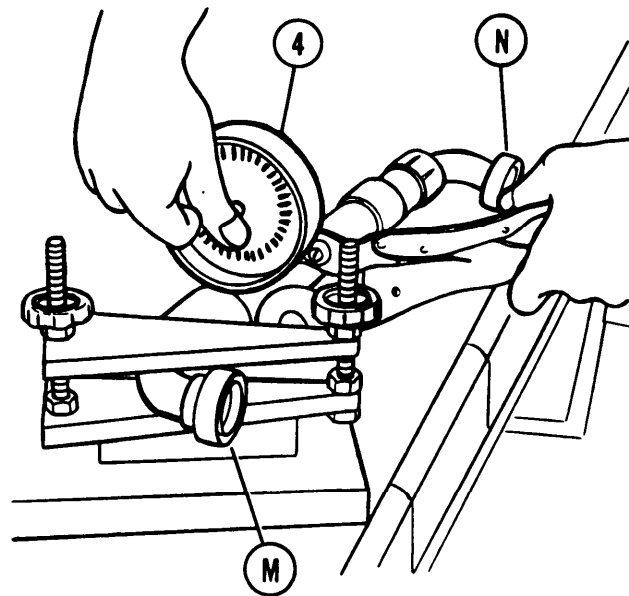
- (17) If necessary, install hydraulic ram (2) between forcing screw and bolster. Use hydraulic hand pump to completely install sleeve (15).



NOTE

Make sure sleeve is secured to hose before installing stem on other end of hose.

- (18) Release pressure on hydraulic hand pump by opening control valve, then tightening forcing screw to retract ram.
- (19) For hoses with straight fitting on one or both ends, assemble as follows:
  - (a) Repeat STEPS 9 through 16 to complete hose assembly.
- (20) For hoses with angled fittings at both ends, assemble as follows:
  - (a) Place hose (14) and installed coupling (M) in vise.
  - (b) Put loose sleeve and stem (N) on opposite end of hose (14), while keeping hose straight. Align loose stem (N) so flange is in same direction as installed coupling (M).



13-13. HYDRAULIC LINES AND FITTINGS - REPAIR (Cont'd)

- (c) Install protractor tool (4) with face toward installed coupling (M). Adjust dial setting to zero. clamp to hose (14) at a point 1" from installed coupling.
- (d) Remove hose (14) from vise and turn hose end for end. Put loose stem (N) in vise, with protractor dial on top of hose.
- (e) Adjust dial to desired angle setting (refer to (E) recorded in Disassembly of Reusable Hose Assemblies), referring to Table 13-5. Hold installed coupling (M) and turn hose clockwise until bubble is in level position.

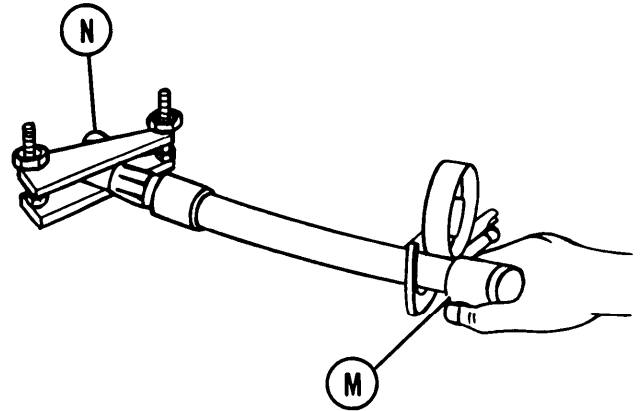
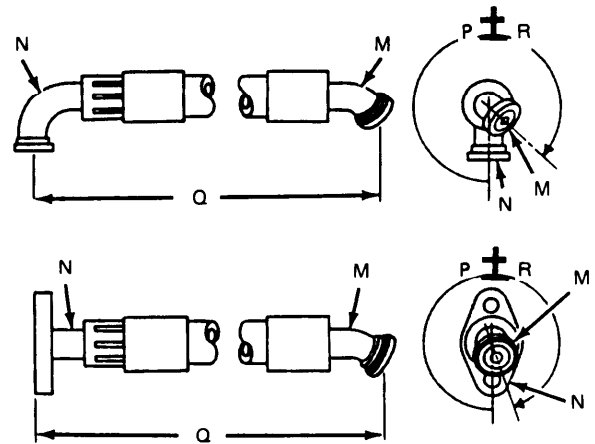


Table 13-5. Coupling Angles

Length of Hose Assembly (Dimension Q)	Degree Tolerance (Dimension R)
0" to 36"	±3°
36" to 59"	±4°
59" to 84"	±5°
84" to 108"	±6°
over 108"	±8°



NOTE

Coupling angle (P) is measured from position of stem (N) clockwise to stem (M).

- (f) Repeat STEPS (a) through (f) for other end of hose (14).



13-13. HYDRAULIC LINES AND FITTINGS - REPAIR (Cont' d)

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NOTE

Install sleeve on hose before installing stem.

(g) Repeat STEPS 11 through 16 to complete hose assembly.

d. Place In Service

Run tractor and check reconditioned and new parts for proper operation.

13-13.1 HYDRAULIC FILTER SCREEN ASSEMBLY - REPAIR

This task covers:

- a. Disassembly of Screen Assembly
- b. Cleaning Filter Screen
- c. Assembly of Screen Assembly

INITIAL SETUP

Applicable Configurations

All

Equipment Condition

Filter element removed. See TM5-2410-237-20.

Common Tools

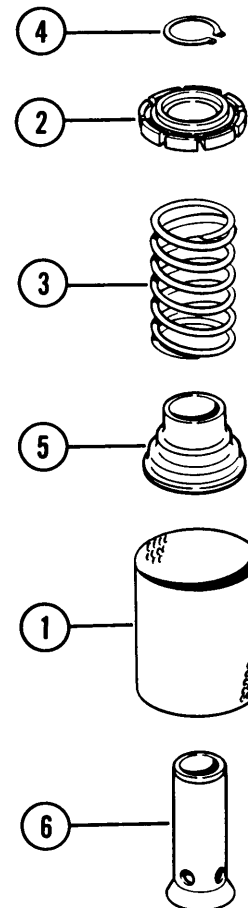
Shop Equipment, Automotive  
NSN 4910-00-754-0654  
Arbor Press

Special Tools

Puller Plate 1P2393

a. Disassembly of Screen Assembly

- (1) Put screen assembly (1) in a press and place a 4-1/4" ring compressor in a position to set on spacer (2).
- (2) place a puller plate with a 4-1/2" bore on top of ring compressor and use press to compress spring (3) until spacer (2) is below snap ring (4). Use a snap ring pliers to remove snap ring (4).
- (3) Slowly release the force on spacer (2).
- (4) Remove spacer (2), valve (5), tube (6), and spring (3) from screen (1).



b. Cleaning Filter Screen

Wash screen assembly (1) in clean solvent. Refer to page 2-29.

13-13.1 HYDRAULIC FILTER SCREEN ASSEMBLY - REPAIR (Cont'd)

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c. Assembly of Screen Assembly

- (1) Install tube (6) in bottom of screen assembly (1).
- (2) Install valve (5), spring (3) and spacer (2) in top of screen assembly on tube (6).
- (3) Use arbor press to hold screen assembly (1) and compress spring (3). Install snap ring (4) with a snap ring pliers.
- (4) Install filter element. Refer to TM5-2410-237-20.

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## 13-14. BLADE LIFT CYLINDER - REPAIR

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This task covers:

- a. Disassembly
  - b. Assembly
  - c. Place In Service
- 

### INITIAL SETUP

#### Applicable Configurations

All

#### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

#### Materials/Parts

Wear Ring (10)  
Seals (11) (18)  
Ring (12)  
Preformed Packings (16) (19) (20)  
Washer (17)  
Lubricating Oil OE/HDO-10  
(Refer to L05-2410-237-12)

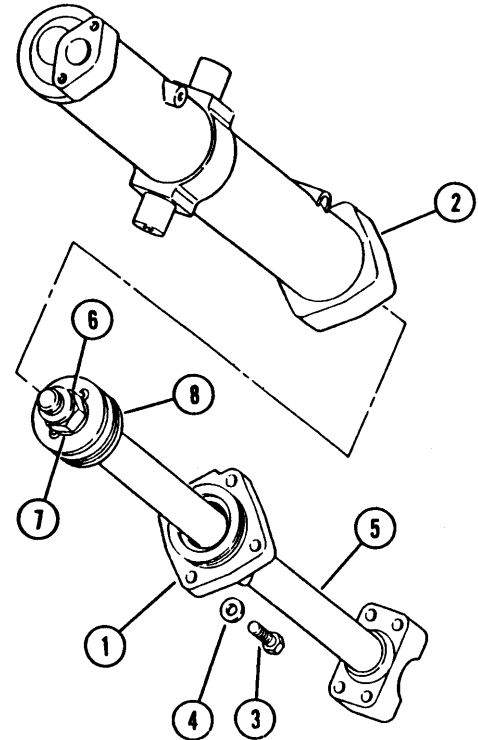
#### Equipment Condition

Lift cylinder removed. See TM5-2410-237-20  
Quick drop valves removed. See page 13-137.

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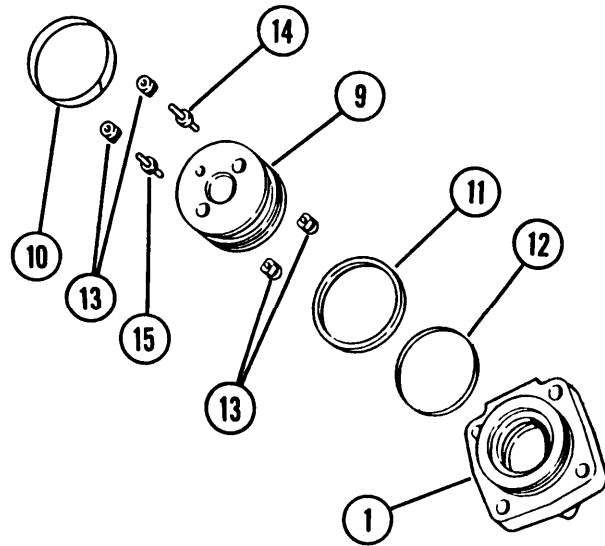
### a. Disassembly

- (1) Position cylinder assembly on a repair stand or Vee blocks. Scribe a mark on head assembly (1) and cylinder (2) for correct alignment at assembly.
- (2) Use a wrench to remove four capscrews (3) and washers (4) from head assembly (1).
- (3) Pull rod (5) and head assembly (1) from cylinder (2).
- (4) Put rod (5) in a vise and use a torque multiplier with a socket to remove nut (6) and washer (7) from rod. Remove piston assembly (8) from rod.



13-14. BLADE LIFT CYLINDER - REPAIR (Cont'd)

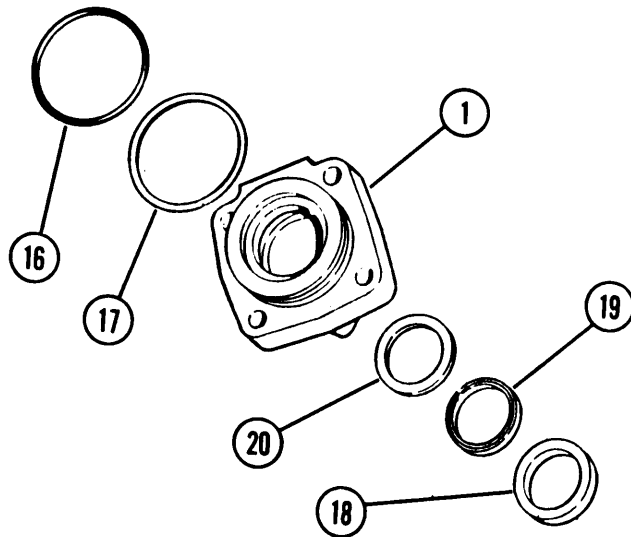
- (5) Remove wear ring (10), seal (11) and expansion ring (12) from piston (9). Discard wear ring (10), seal (11) and ring (12).
- (6) If necessary, use a press to remove four inserts (13) and two plungers (14 and 15) out of piston (9).



- (7) Remove preformed packing (16) and washer (17) from head assembly (1). Discard packing and washer.
- (8) Remove seal (18) and two preformed packings (19 and 20). Discard seal (18) and preformed packings (19 and 20).

b. Assembly

- (1) Install new seal (18) and two new preformed packings (19 and 20) in head (1), making sure lips of preformed packing (19) and seal (18) are facing away from each other.
- (2) Install new backup washer 17 and new preformed packing (16) in the groove on head (1). The preformed packing (16) must be toward the cylinder when it is installed.

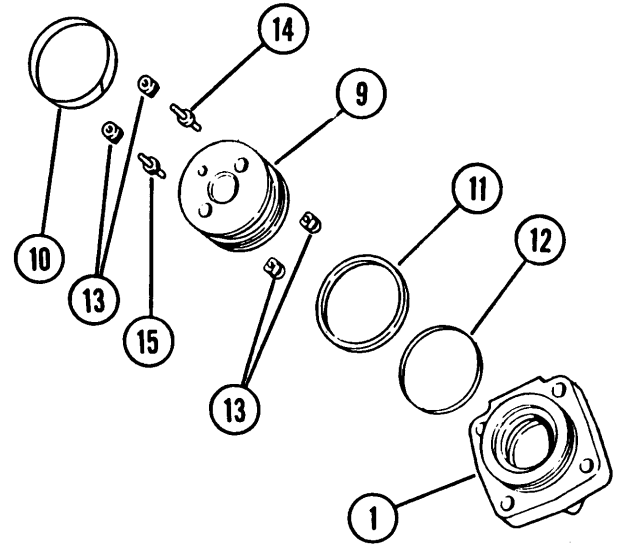


## 13-14. BLADE LIFT CYLINDER - REPAIR (Cont'd)

## NOTE

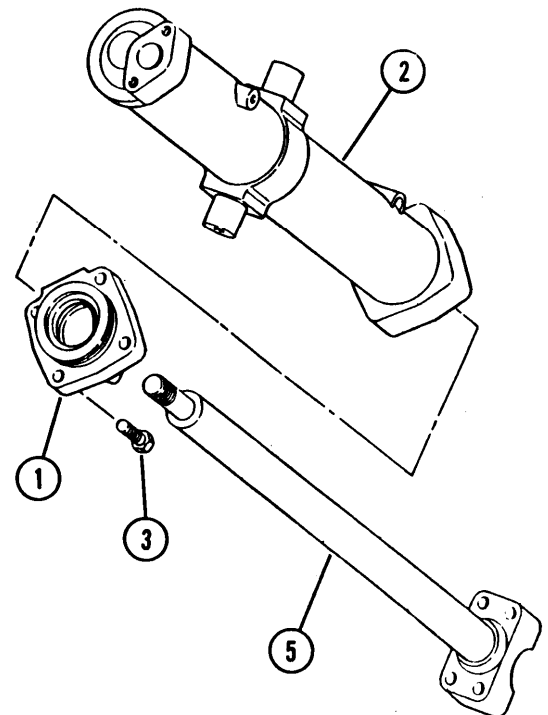
Make sure the flat sides of inserts (13) are parallel to a center line from center of insert of piston.

- (3) Use a press to install two inserts (13) in one side of piston (9).
- (4) Install plungers (15 and 14) in piston (9). Use a press to install two inserts (13) in piston.
- (5) Install new rubber expansion ring (12) in groove of piston (9). If necessary, use seal expander to make seal (11) larger for installation. Install seal (11) over expansion ring (12) on piston (9).
- (6) Install new wear ring (10) on piston (9).
- (7) Place head assembly (1) on cylinder (2) and install two capscrews (3) to hold head (1) in place.

CAUTION

Piston rod must be supported and kept level at all times to avoid damaging the seals in the head.

- (8) Put clean hydraulic oil on the seals in head (1). Install a seal guide on the end of rod (5) and push rod (5) into head (1) and cylinder (2).
- (9) Remove two capscrews (3) and separate head (1) from cylinder (2).



13-14. BLADE LIFT CYLINDER - REPAIR (Cont'd)

- (10) Install piston assembly (8) on rod (5).
- (11) Put clean hydraulic oil on the threads and install washer (7) and nut (6) on rod (5).
- (12) Use a torque multiplier and a socket to tighten nut (6) to a torque of  $1620 \pm 160$  lbs. ft.

NOTE

For proper fit, be sure scribe mark on head (1) and cylinder (2) are in alignment before head (1) is installed in cylinder (2).

- (13) Put clean hydraulic oil on seals of piston assembly (8) and head (1). Push head (1) and rod (5) in cylinder (2).

- (14) Install four capscrews (3) and washers (4). Use a wrench to tighten capscrews (3) evenly to pull the head (1) all the way in the cylinder (2).

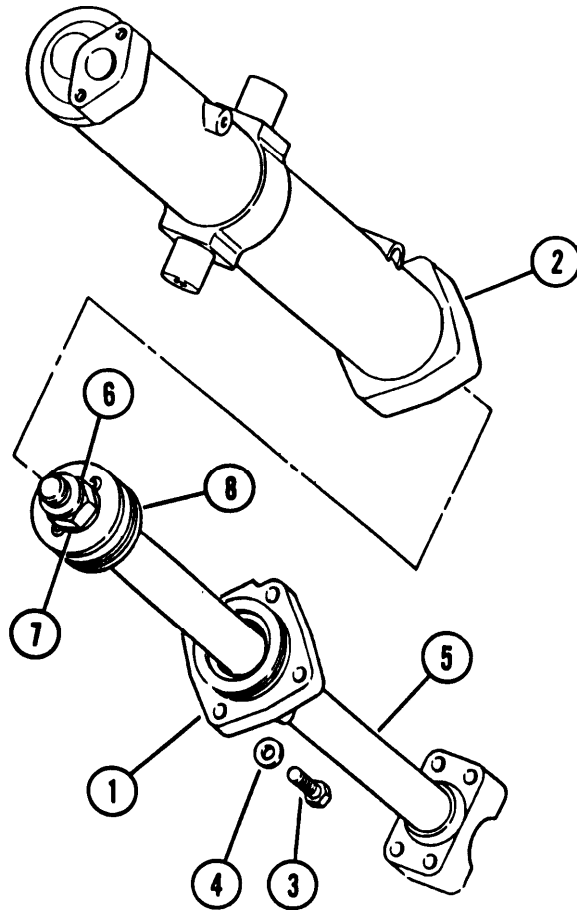
NOTE

Rod (5) must be fully extended when capscrews (3) are tightened for correct alignment of cylinder (2) and head (1).

- (15) Tighten capscrews (3) to a torque of  $265 \pm 35$  lbs. ft.

c. Place In Service

Run tractor and check blade for proper operation.



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 13-15. BLADE LIFT CYLINDER MOUNTING TUBE - REPLACE
 

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This task covers:

- a. Removal
  - b. Installation
  - c. Place In Service
- 

### INITIAL SETUP

Applicable Configurations  
All

Common Tools

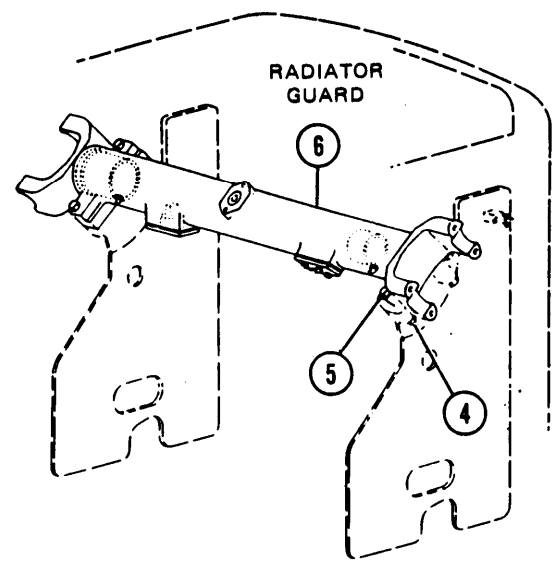
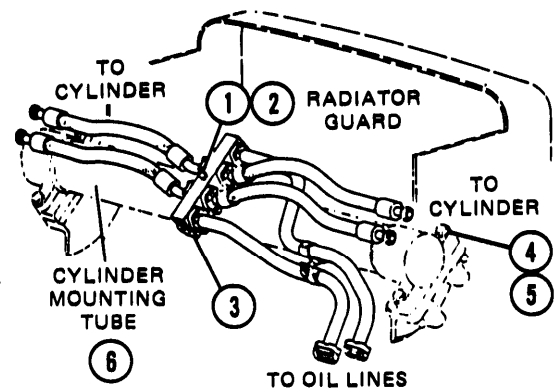
Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Equipment Condition

Lift cylinders removed. See  
TM5-2410-237-200  
Hood removed. See TM5-2410-237-20.

#### a. Removal

- (1) Use a wrench to remove capscrew (1) and lockwasher (2).
- (2) Lift manifold (3) away from cylinder mounting tube (6).
- (3) Use a wrench to remove four capscrews (5) and nuts (4).
- (4) Remove cylinder mounting tube (6) from radiator guard.

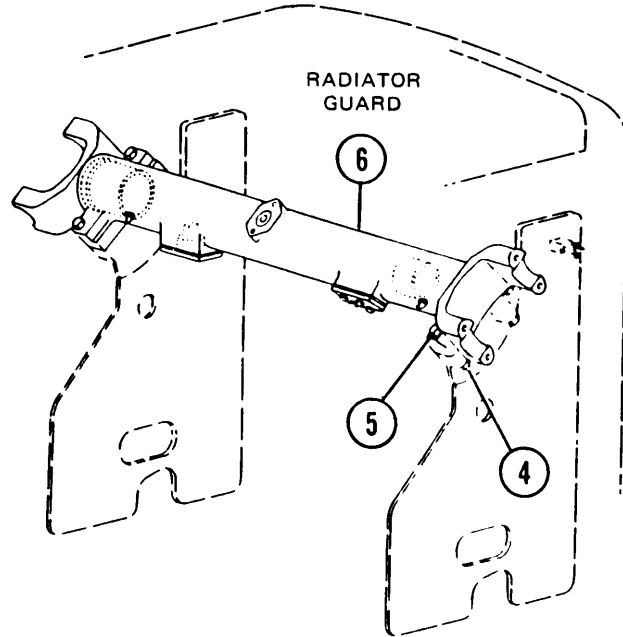




13-15. BLADE LIFT CYLINDER MOUNTING TUBE - REPLACE (Cont' d)

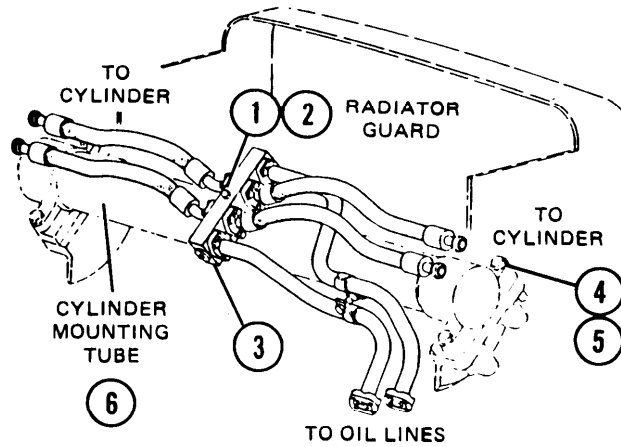
b. Installation

- (1) Install lift cylinder mounting tube (6) on radiator guard.
- (2) Install four capscrews (5) and nuts (4). Use a wrench to tighten capscrews and nuts.
- (3) Install manifold (3) with capscrew (1) and lockwasher (2). Tighten capscrew with a wrench.
- (4) Install lift cylinders. See TM5-2410-237-20.
- (5) Install hood. See TM5-2410-237-20.



c. Place In Service

Run tractor and check blade for proper operation.



13-16. RIPPER LIFT CYLINDER - REPAIR

This task covers:

- a. Disassembly
- b. Assembly
- c. Place In Service

INITIAL SETUP

Applicable Configurations  
All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Press with shaft 3.5" and 2.75"  
Torque multiplier with 2-3/8" socket

Materials/Parts

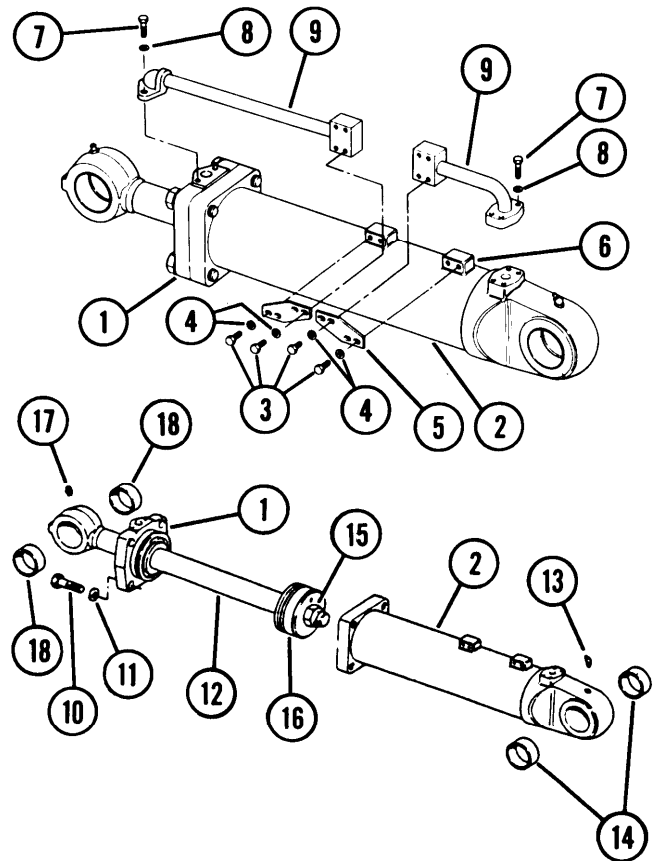
Rings (19), (25), (24), (26)  
Seals (21), (20), (28)  
Nut (8)  
Lubricating Oil OE/HDO-10 (Refer to L05-2410-237-12)  
Repair Stand or Vee Blocks  
Caps and Plugs  
Drain Pan

Equipment Condition

Ripper removed. See page 14-8.

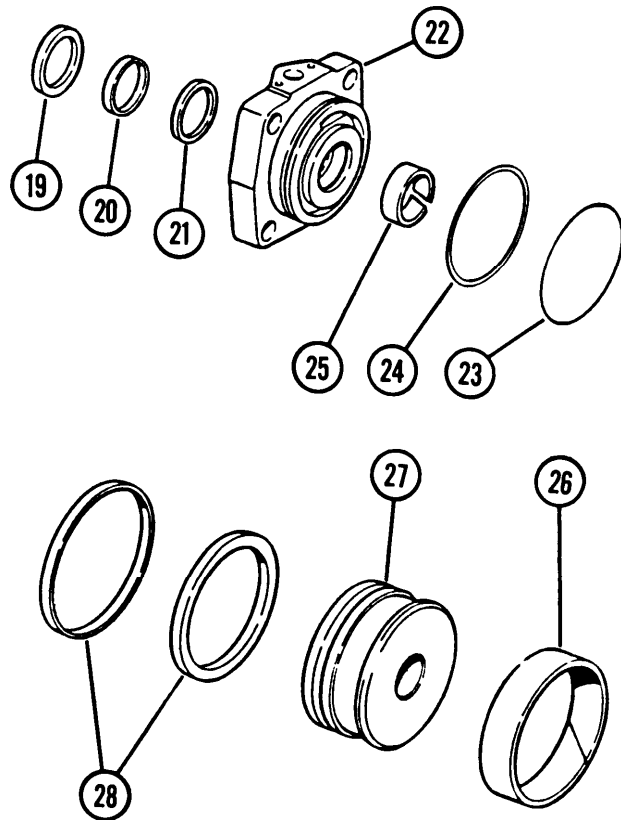
a. Disassembly

- (1) Position cylinder assembly on a repair stand or Vee blocks. Scribe a mark on head assembly (1) and cylinder (2) for correct alignment at assembly.
- (2) Using a wrench, remove eight capscrews (3) and eight washers (4) holding line brackets (5) to bosses (6) on cylinder (2).
- (3) Using a wrench, remove six capscrews (7) and six washers (8) holding line flanges to cylinder. Remove and plug lines (9) and plug all oil parts on cylinder (2).



13-16. RIPPER LIFT CYLINDER - REPAIR (Cont' d)

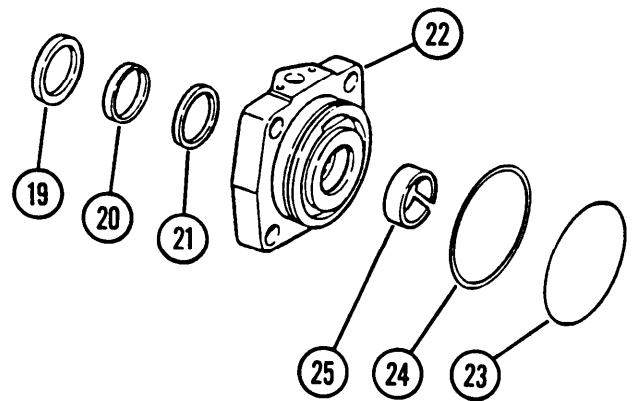
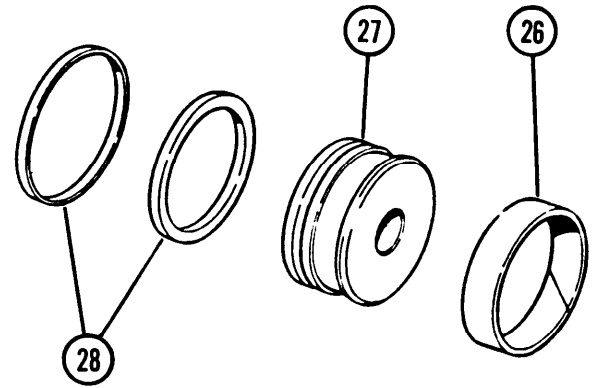
- (4) Use a wrench to remove four capscrews (10) and washers (11) from head assembly (1).
- (5) Pull rod and piston assembly (12) slowly from cylinder to allow oil to escape.
- (6) If necessary, use channel lock to remove grease fitting (13) from cylinder (2).
- (7) If necessary, press bearings (14) from cylinder (2).
- (8) Put rod (12) in a vise and use a torque multiplier with a socket to remove and discard nut (15) from rod. Remove piston assembly (16) from rod.
- (9) If necessary, remove grease fitting (17) from rod (12).
- (10) If necessary, press bearings (18) from rod (12).
- (11) Remove and discard ring (25) from the inner diameter of head (22).
- (12) Remove ring (19) and two seals (20 and 21) from head (22). Discard ring and two seals.
- (13) Remove and discard seal (23) and ring (24) from head (22).
- (14) Remove and discard ring (26) from piston (27).
- (15) Remove and discard seal assembly (28) from Piston (27).



13-16. RIPPER LIFT CYLINDER - REPAIR (Cont'd)

b. Assembly

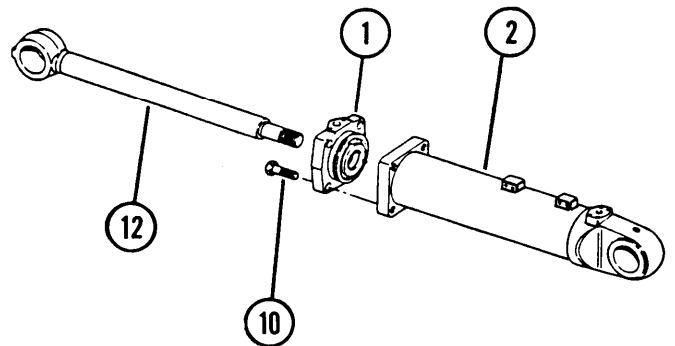
- (1) Install new seal assembly (28) in piston (27).
- (2) Install new ring (26) on piston (27).
- (3) Install new ring (25) in the inner diameter of head (22).
- (4) Install new ring (24) and seal (23) on head (22).
- (5) Install new seals (20 and 21) and ring (19) in head (22), making sure lips of seal (20) and ring (19) are facing away from each other.
- (6) Place head assembly (1) on cylinder (2) and install two capscrews (10) to hold head assembly (1) in place.



CAUTION

Piston rod must be supported and kept level at all times to avoid damaging the seals in the head.

- (7) Put clean hydraulic oil on the seals in head assembly (1). Install a seal guide on the end of rod (12) and push rod (12) into head assembly (1) and cylinder (2).
- (8) Remove two capscrews (10) and separate head (1) from cylinder (2).

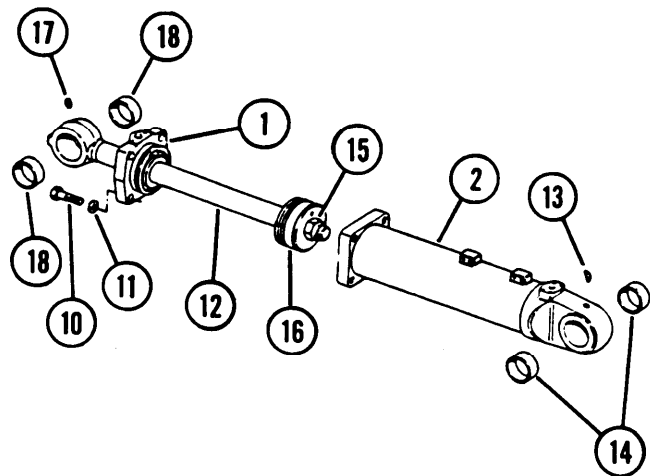


13-16. RIPPER LIFT CYLINDER - REPAIR (Cont'd)

- (9) Install bearings (18) in rod (12) eye.
- (10) Install grease fitting (17) on rod (12), if removed.
- (11) Install bearings (14) in cylinder (2) eye.
- (12) Install grease fitting (13) in cylinder (2) and tighten with channel lock pliers.

**NOTE**

For proper fit, be sure scribe mark on head assembly (1) and cylinder (2) are in alignment before head (1) is attached to cylinder (2).



- (13) Put clean hydraulic oil on the threads and install new nut (15) on rod (12).
- (14) Use a torque multiplier and a socket to tighten nut (15) to a torque of  $1620 \pm 160$  lb. ft.
- (15) Put clean hydraulic oil on piston seals. push piston and head assembly (1) into cylinder (2).
- (16) Install four capscrews (10) and washers (11). Use a wrench to tighten capscrews (10) evenly to pull the head assembly (1) all the way in the cylinder (2).

**NOTE**

Rod (12) must be fully retracted when capscrews (10) are tightened for correct alignment of cylinder (2) and head (1).

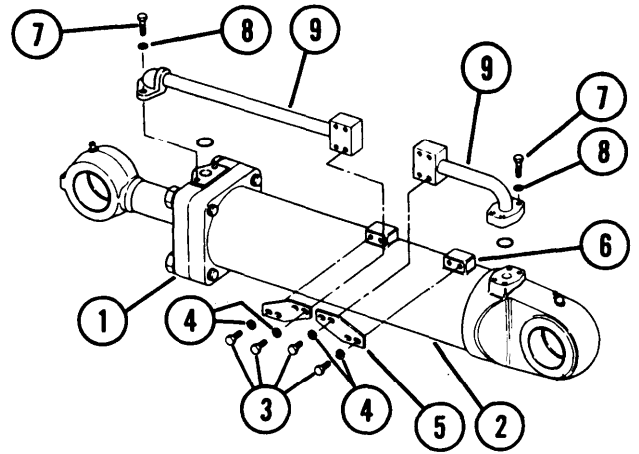
- (17) Tighten capscrews (10) to a torque of  $265 \pm 35$  lb. ft.

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**13-16. RIPPER LIFT CYLINDER - REPAIR (Cont' d)**

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- (18) Attach two brackets (5) to braces (6) on cylinder with four capscrews (3) and washers (4).
- (19) Attach lines (9) to brackets (5), cylinder (2) and head (1) with ten capscrews (3 and 7) and washers (4 and 8). Start all capscrews before tightening any. Tighten capscrews evenly on flanges first, then tighten mounting screws to bracket.
- (20) Install ripper. See page 14-8.



c. Place In Service

Run tractor and check ripper for proper operation.

13-17. HYDRAULIC TANK - REPLACE/REPAIR

This task covers:

- a. Removal
- b. Disassembly
- c. Cleaning
- d. Lubrication
- e. Assembly
- f. Installation
- g. Place In Service

INITIAL SETUP

Applicable Configurations

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
 NSN 4940-00-287-4894  
 Lifting Equipment 500 lbs.

Materials/Parts

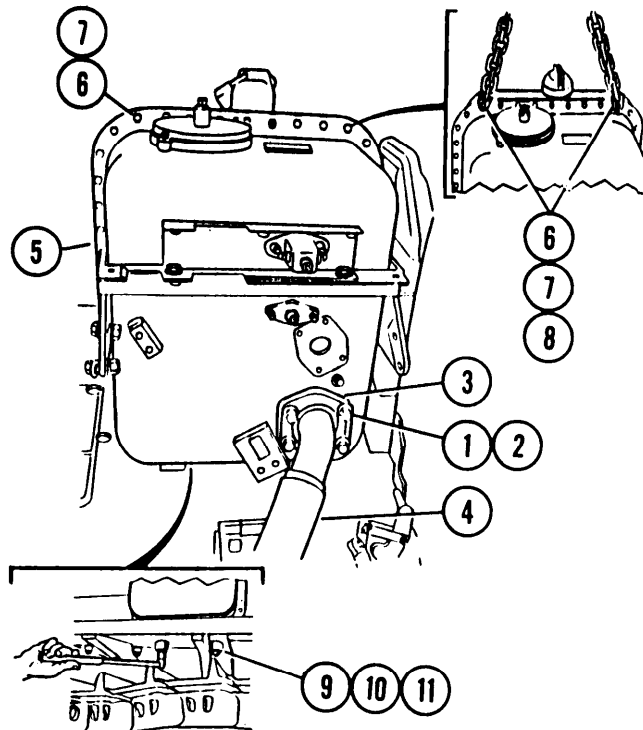
Seals (19), (23), (27), (28), (31), (44), (45), (52), (56), (63) and (67)  
 Gasket (14), (33), (59)  
 Hydraulic Oil OE/HDO-10 (Refer to L05-2410-237-12)  
 Grommet (70)  
 Lint-free Rag (App. B, Item 12)

Equipment Condition

Control valve removed. See page 13-150  
 Filter assembly removed. See TM5-2410-237-20.

a. Removal

- (1) Use a wrench to remove four capscrews (1), four washers (2), two flange halves (3) and end of hydraulic pump hose (4) from side of hydraulic oil tank (5). Cap end of pump hose.
- (2) Use two wrenches to remove two capscrews (6) and two nuts (7) near top corners of tank (5).
- (3) Install two lifting lugs (8) with the capscrews (6) and two nuts (7).
- (4) Attach lifting equipment to lifting lugs (8) to support tank (5).



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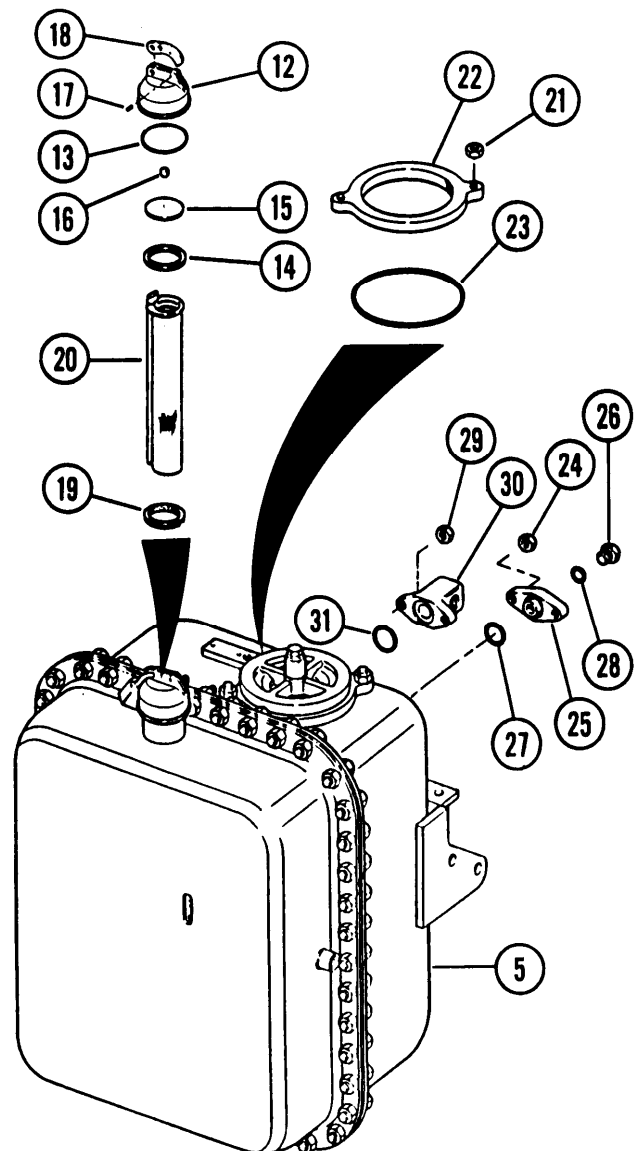
 13-17. HYDRAULIC TANK - REPLACE/REPAIR (Cont'd)
 

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- (5) Use a wrench to remove two capscrews (9), two spacers (10) and two washers (11) from tank (5) at underside of fender.
- (6) Use lifting equipment to remove hydraulic oil tank (5). Weight is 248 lbs.

 b. Disassembly

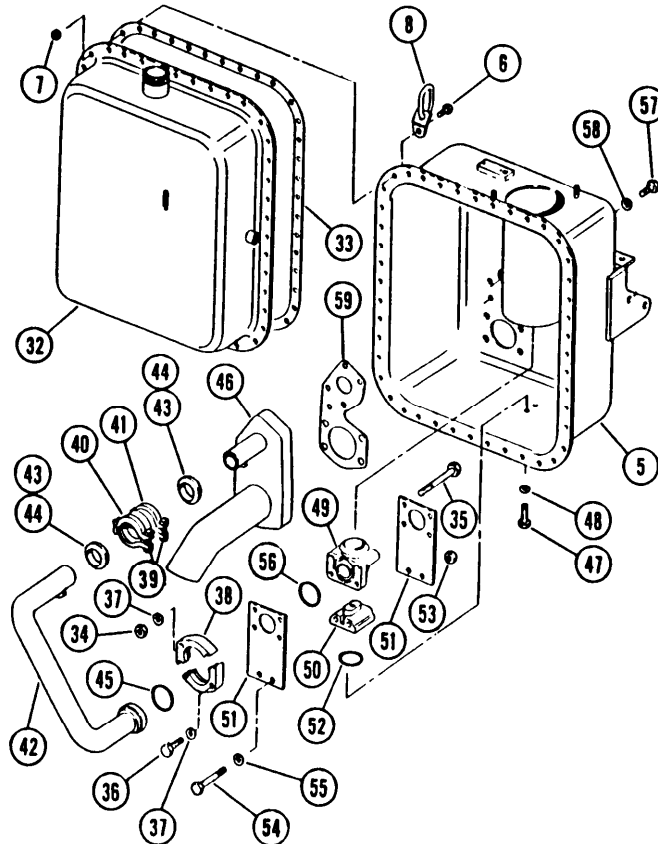
- (1) Remove cap assembly (12) from top of tank (5).
- (2) Remove retaining ring (13), gasket (14), plate (15) and ball (16) from inside of cap (12). Discard gasket.
- (3) If necessary, remove pin (17) and latch (18) from cap (12).
- (4) Remove ring (19) and strainer assembly (10) from top of hydraulic tank assembly (5). Discard ring (19).
- (5) Use a wrench to remove two nuts (21), spacer (22) and seal (23) from hydraulic tank assembly (5). Discard seal (23).
- (6) Use a wrench to remove two nuts (24), cover (25), plug (26) and seal (27) from back of hydraulic tank assembly (5). Discard seal.
- (7) Remove seal (28) from plug (26). Discard seal.
- (8) Use a wrench to remove two nuts (29), manifold (30) and seal (31) from tank (5). Discard seal.





13-17. HYDRAULIC TANK - REPLACE/REPAIR (Cont'd)

- (9) Use two wrenches to remove forty-four nuts (7) holding cover (32) to tank (5).
- (10) Remove cover (32) and gasket (33) from tank (5). Discard gasket.
- (11) Use two wrenches to remove locknuts (34), from capscrews (35 and 36), washers (37) and flanges (38) from tank (5).
- (12) Use a wrench to remove two nuts (39), two clamps (40), joint (41) and tube (42) from tank (5).
- (13) Remove collar (43) and seal (44) from one end of tube (42). Discard seal.
- (14) Remove seal (45) from other end of tube (42). Discard seal.
- (15) Remove collar (43) and seal (44) from tube assembly (46).
- (16) Use a wrench to remove two capscrews (47) and two washers (48) from bottom of tank (5).
- (17) Remove base (49), block (50) and two plates (51) from tank (5) as a unit.
- (18) Remove seal (52) from bottom of block (51). Discard seal.
- (19) Remove two capscrews (35) from plate and block assembly.
- (20) Use two wrenches to remove two nuts (53), two capscrews (54) and two washers (55). Separate two plates (51), block (50) and base (49).



13-17. HYDRAULIC TANK - REPLACE/REPAIR (Cont' d)

- (21) Remove seal (56) from base (49). Discard seal.
- (22) Use a wrench to remove capscrew (57), washer (58), gasket (59) and tube assembly (46) from tank (5).
- (23) Use a wrench to remove two nuts (60) and drain plug body (61) from cover (32).
- (24) Remove plug (62) from body (61) and remove seal (63) from plug (62). Discard seal.
- (25) Remove guide (64), valve (65) and spring (66) from body (61).
- (26) Remove seal (67) from body (61). Discard seal.
- (27) Use a wrench to remove four nuts (68) and retainer (69) from cover (32).
- (28) Remove grommet (70) and glass (71) from retainer (69). Discard grommet.

c. Cleaning

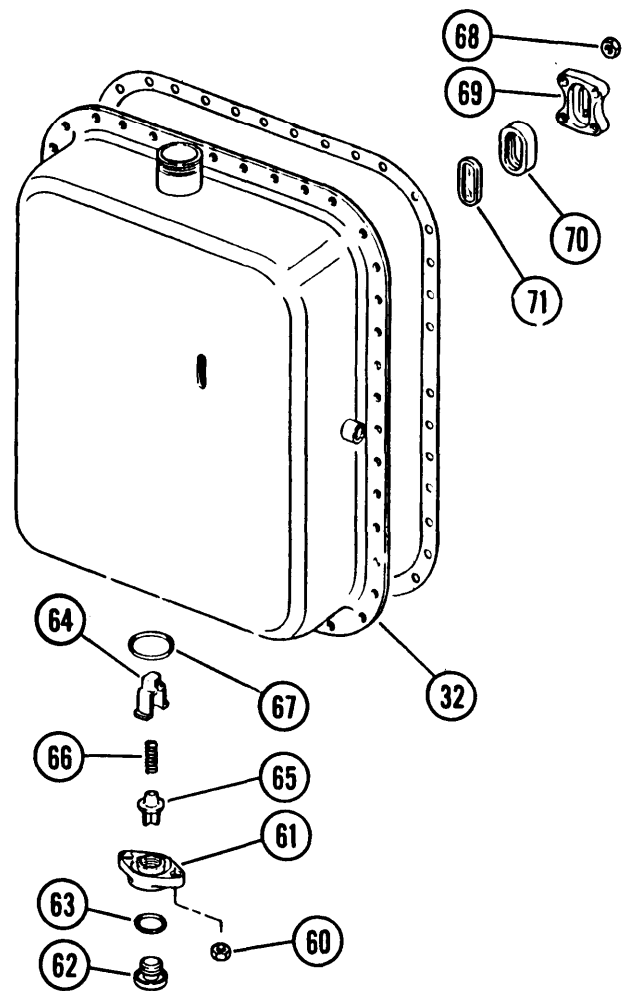
Wipe sealing surfaces on all parts clean and dry. Refer to page 2-29.

d. Lubrication

Apply film of clean hydraulic oil to all seals at time of installation.

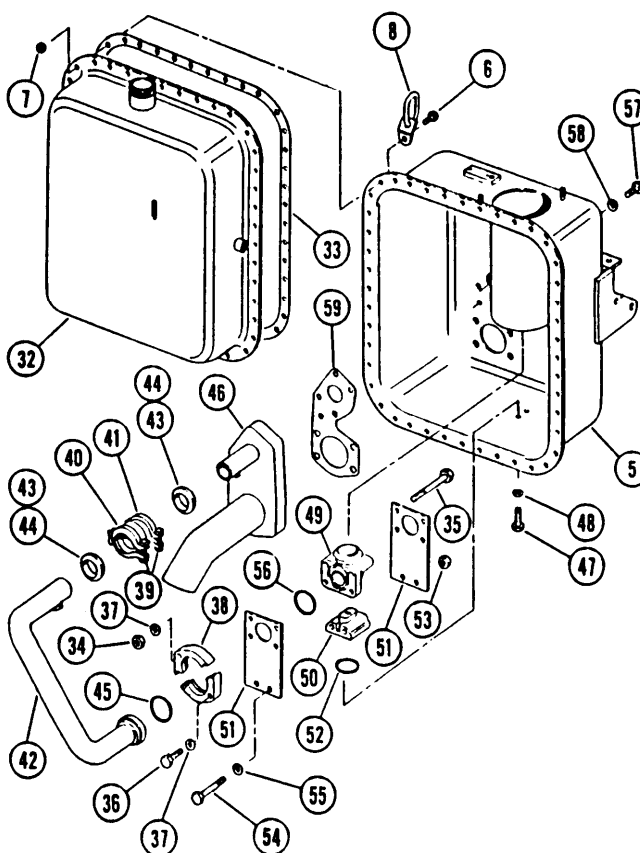
e. Assembly

- (1) Install glass (71) and grommet (70) in retainer (69).
- (2) Install retainer (69) in cover (32) with four nuts (68). Tighten nuts using a wrench.



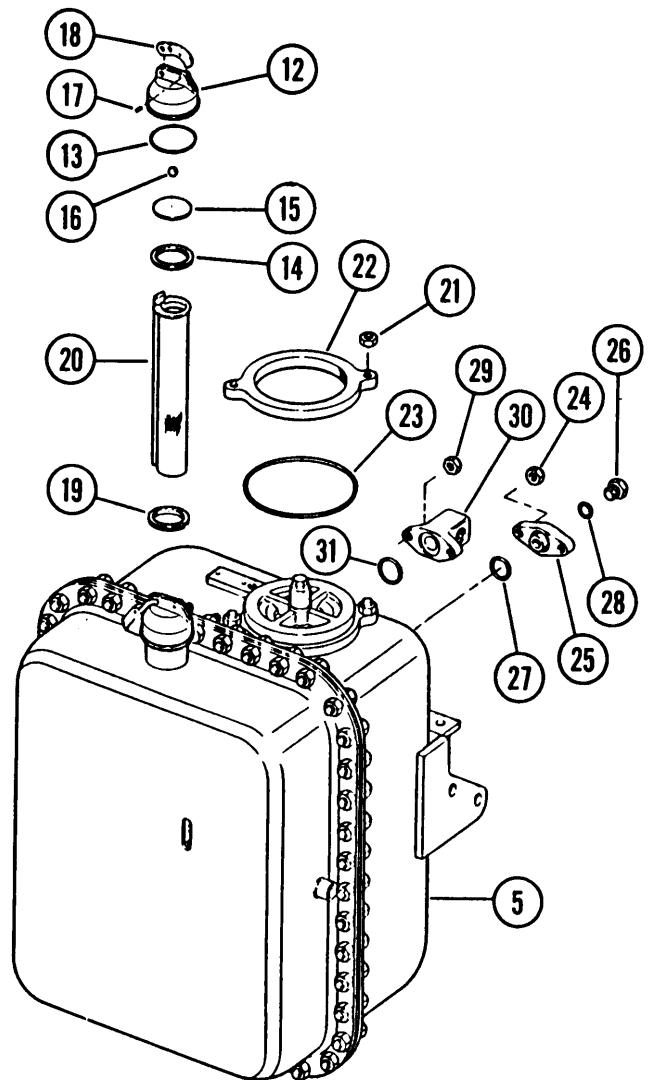
13-17. HYDRAULIC TANK - REPLACE/REPAIR (Cont' d)

- (3) Install spring (66) and valve (65) in guide (64).
- (4) Install guide (64) in body (61).
- (5) Install body (61) and seal (67) on cover (32) with two nuts (60). Tighten using a wrench.
- (6) Install seal (63) on plug (62) and install plug (62) in body (61).
- (7) Install tube assembly (46) in tank (5) with gasket (59), capscrew (57) and washer (58). Tighten using a wrench.
- (8) Install seal (56) in base (49).
- (9) Assemble block (50) and two plates (51) with two bolts (55), two washers (56) and two locknuts (54). Tighten using two wrenches.
- (10) Position base (49) between plates (51) and insert two capscrews (35) through top two holes in plates and base.
- (11) Install seal (52) in bottom of block (50).
- (12) Install two plates (51), block (50) and base (49) in tank (5) as a unit with two capscrews (47) and two washers (48). Tighten using a wrench.
- (13) Install collar (43) and seal (44) on tube assembly (46).
- (14) Install seal (45) on tube (42).
- (15) Install collar (43) and seal (44) on tube (42).



## 13-17. HYDRAULIC TANK - REPLACE/REPAIR (Cont'd)

- (16) Connect upper tube in tube assembly (46) with one end of tube (42) using joint (41) and two clamps (40). Tighten nuts (39) on two clamps, using a wrench.
- (17) Connect other end of tube (42) to plate (51) and base (49) assembly with two flanges (38), two capscrews (36), two nuts (34) and four washers (37).
- (18) Position cover (32) and gasket (33) on tank (5) and install forty-four capscrews (6), forty-four nuts (7) and two lifting lugs (8) (at top corners) to secure cover and tank. Tighten capscrews (6) with two wrenches.
- (19) Install manifold (30) on tank (5) with seal (31) and two nuts (29). Tighten nuts (29) with a wrench.
- (20) Install seal (27) on cover (25) and install cover on tank (5) with two nuts (24). Tighten with a wrench.
- (21) Install seal (28) on plug (26) and install plug in cover (25).
- (22) Install seal (23) and spacer (22) on top of tank (5) with two nuts (21). Tighten with a wrench.
- (23) Install strainer (20) and ring (19) in tank (5).
- (24) If necessary, install latch (18) in cap (12) with pin (17).
- (25) Install ball (16), plate (15), gasket (14) and retaining ring (13) in cap (12).
- (26) Install cap (12) on tank.



13-17. HYDRAULIC TANK - REPLACE/REPAIR (Cont'd)

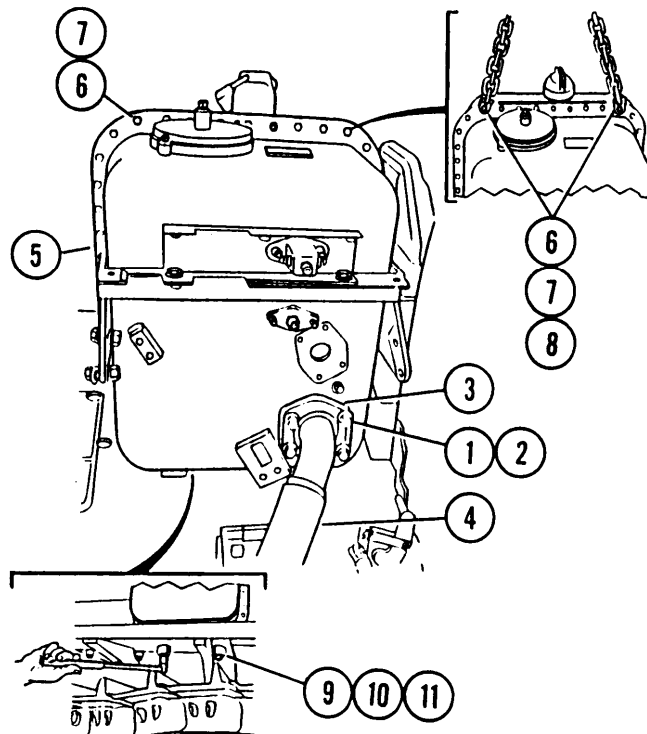
f. Installation

- (1) Use lifting equipment to position hydraulic oil tank (5) on fender. Weight is 248 lbs.

NOTE

Helper required to assist in alignment of capscrew holes in tank with capscrew holes in fender. Mounting hardware is installed from underside of fender.

- (2) Install tank (5) on fender with two capscrews (9), two spacers (10) and two washers (11). Tighten capscrews with a wrench. Remove lifting equipment from tank.
- (3) Use two wrenches to remove capscrews (6), two washers (7) and two lifting lugs (8) from top of tank (5). Reinstall capscrews and washers.
- (4) Wipe area around pump hose (4) mounting on tank (5) clean.
- (5) Wipe end of pump hose (4) clean and apply film of clean hydraulic oil on seal in hose connector.
- (6) Install hydraulic pump hose (4) on hydraulic oil tank (5) with two flange halves (3), four capscrews (1) and four washers (2). Tighten capscrews with a wrench.
- (7) Install new oil filter. See TM5-2410-237-20.
- (8) Install hydraulic control valve. See page 13-15.



g. Place In Service

Run tractor and check for proper hydraulic system operation.

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## 13-18. HYDRAULIC SYSTEM - TEST

---

This task covers:

- |                                  |                                     |
|----------------------------------|-------------------------------------|
| a. Test Setup                    | e. Pump Tests                       |
| b. Cylinder Circuits Speed Tests | f. Blocked Cylinders Test           |
| c. Cylinder Drift Tests          | g. Right Side Blocked Cylinder Test |
| d. Flow Test                     | h. Restoring Equipment              |
- 

### INITIAL SETUP

#### Applicable Configurations

**ATT**

#### Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Tool Outfit, Hydraulic System Test and Repair (HSTRU)  
NSN 4940-01-036-5784

#### Personnel Required

**MOS62B (2)**

#### Materials/Parts

Caps and Lugs  
Shims  
Springs

#### Equipment Condition

Tractor parked on level ground.  
Floor plates removed.  
See TM5-2410-237-20.  
Oil in system must be SAE 10.

---

### NOTE

Hydraulic system tests are performed when required by troubleshooting to confirm a problem or identify the faulty component within the system. These tests can also be performed after repair operations to ensure faults have been corrected and performance is within specifications.

Hydraulic system tests consist of operating checks and analysis of test results to indicate if corrective action is needed.

13-18. HYDRAULIC SYSTEM -TEST (Cont' d)

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## NOTE

Perform PMCS for the hydraulic system as outlined in TM5-2410-237-20.

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**WARNING**

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Hydraulic oil, under pressure that can be higher than 2500 psi, can remain in the hydraulic system on this tractor after the engine and pump have been stopped. Serious injury can be caused if this pressure is not released before any service or test is done on the hydraulic system. To prevent possible injury, be sure that the pressure in the system is released before any fitting, hose, or component is loosened, tightened, removed, or adjusted. When possible, the blade and ripper must always be completely lowered to the ground before service is started. When it is necessary for the blade and/or ripper to be raised while tests or adjustments are done, be sure that it has the correct support. Always move the tractor to a location away from the travel of other machines. Be sure that other personnel are not near the tractor when the engine is running and tests or adjustments are being made.

a. Test Setup

- (1) Start engine and raise blade.
- (2) Remove the filler cap and screen from the hydraulic tank. Connect a return line assembly between hydraulic tank and hydraulic circuit tester.

## 13-18. HYDRAULIC SYSTEM - TEST (Cont'd)

- (3) Lower blade to the ground.
- (4) Shutoff the engine.

**WARNING**

Do not install hydraulic circuit tester to the pump supply line with the engine running. Oil could be hot and under pressure, and cause serious personal injury.

- (5) Remove plug (1) for the tee test from the supply line for the large pump section. connect hydraulic circuit tester input to point (1).

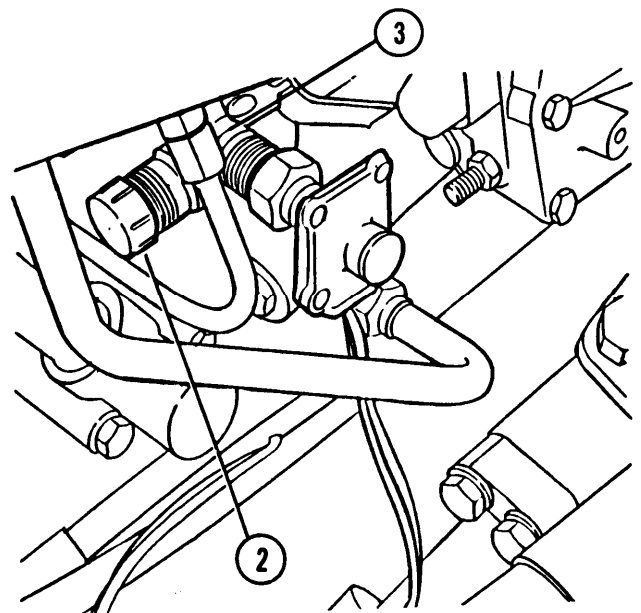
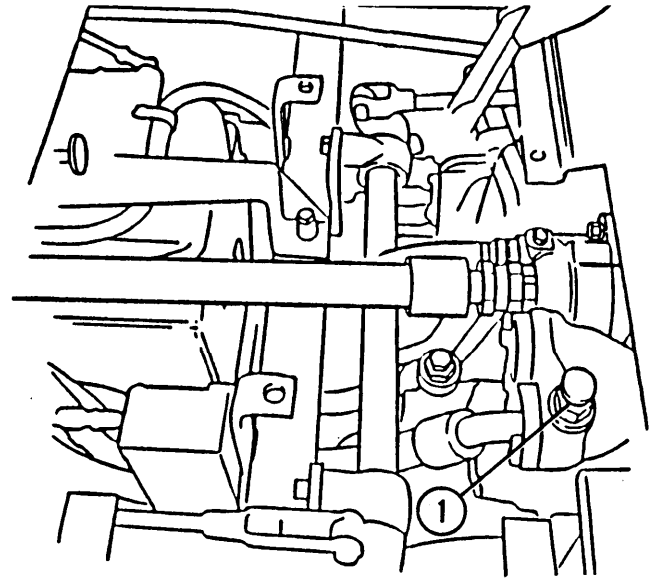
**NOTE**

Connect test equipment as rapidly as possible to keep the oil loss at a minimum.

**NOTE**

A plain coupler will not open the valve in the adapter for the supply line or return line assembly. Use a valve coupler against a valved nipple when connecting hoses.

- (6) Remove cap (2) and connect tachometer-generator to drive (3) located on the fuel pump governor.
- (7) Install electrical cable between generator and the input connection for the tachometer-generator (rpm) on the circuit tester.





13-18. HYDRAULIC SYSTEM - TEST (Cont'd)

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- (8) Be sure blade and ripper are lowered to the ground. Move the control levers through all positions to release all pressure oil in the cylinder lines.

b. Cylinder Circuits Speed Tests

- (1) Start the engine and operate dozer and ripper hydraulic controls until hydraulic oil temperature is 145-155° F as indicated on the test gage.
- (2) Operate engine at high idle.
- (3) Refer to Table 13-6 and observe the travel times of the circuits. If only one of the circuit speeds is slow, check that circuit for cylinder drift. See following paragraph c.

If speed tests on all circuits are slow, perform flow test. See following paragraph d.

13-18. HYDRAULIC SYSTEM - TEST (Cont'd)

Table 13-6. Hydraulic System Circuit Speed Test

CIRCUIT SPEED TEST	TRAVEL TIME SPEED IN SECONDS
<u>Tilt Circuit</u> Time needed to move the tilt cylinder rod from fully retracted position to fully extended position (blade tilt left to blade tilt right)	2.2
<u>Lift Circuit</u> Time needed to raise the blade from ground level to maximum height	3.0
<u>Ripper</u> Time needed to raise the ripper from fully extended to fully retracted position	4.8

c. Cylinder Drift Tests

NOTE

If test results are not as indicated, refer to "Troubleshooting" section, page 2-1 for corrective action.

(1) Blade Lift Circuit

Refer to Table 13-7 for correct test results for the following checks.

- (a) Raise front of tractor off the ground by lowering level blade. Put blade control lever in HOLD position. Shut off the engine and watch lift cylinder rods for movement.

- (b) Raise front of tractor off the ground by lowering a level blade. Shut off the engine and hold the blade control lever in LOWER position. Watch lift cylinder rods for movement.
- (c) Raise blade off the ground. Hold blade control lever in HOLD position. Shut off the engine and watch the lift cylinder rods for movement.
- (d) Raise blade off the ground and shut off engine. Hold the blade control lever in RAISE position. Watch the lift cylinder rods for movement.

13-18. HYDRAULIC SYSTEM - TEST (Cont'd)

Table 13-7. Blade Lift Cylinder Drift Test

MAX CYLINDER MOVEMENT/TIME	OIL TEMPERATURE
1.5 in./5 min	100°F
1.5 in./2.7 min	135°F
1.5 in./1.7 min	175°F

(2) Blade Tilt Circuit

Refer to Table 13-8 for correct test results.

- (a) Lower blade flat on the ground. Raise front of tractor by lowering the right side of blade (tilt right). Place blade control lever in HOLD position. Shut off engine and watch tilt cylinder movement.
- (b) Lower blade flat on the ground. Raise front of tractor by lowering left side of blade (tilt left). Place blade control lever in HOLD position. Shut off the engine and watch the tilt cylinder rod for movement.

Table 13-8. Blade Tilt Cylinder Drift Test

MAX CYLINDER MOVEMENT/TIME	OIL TEMPERATURE
0.44 in./5 min	100°F
0.44 in./2.7 min	135°F
0.44 in./1.7 min	175°F

(3) Ripper Circuit

Refer to Table 13-9 for correct test results.

- (a) Raise rear of tractor by lowering the ripper. Place ripper control lever in HOLD position and shut off the engine. Watch ripper cylinder rods for movement.
- (b) Raise the ripper and place ripper control lever in HOLD position. Shut off the engine and watch ripper cylinder rods for movement.

Table 13-9. Ripper Lift Cylinder Drift Test

MAX CYLINDER MOVEMENT/TIME	OIL TEMPERATURE
0.38 in./5 min	100°F
0.38 in./2.7 min	135°F
0.38 in./1.7 min	175°F

d. Flow Test

NOTE

If test results in STEPS b and c, above, were abnormal, replace suspected defective cylinder before proceeding with this flow test.

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**13-18. HYDRAULIC SYSTEM - TEST (Cont' d)**

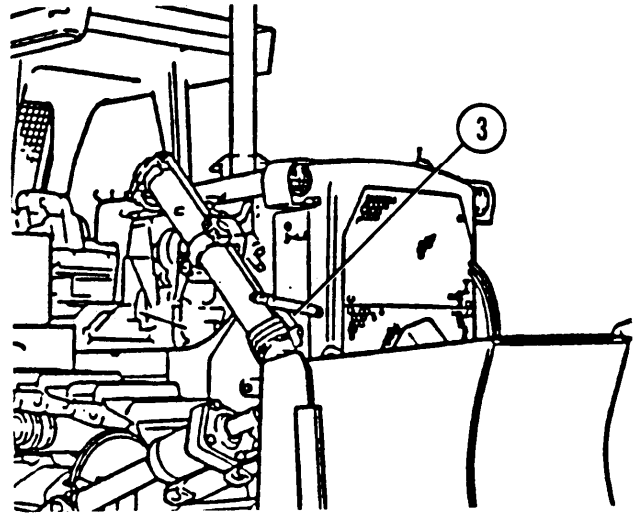
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(1) preparation

**WARNING**

Personal injury and equipment damage can result when disconnecting lines to install flow blocking devices, caps, or plugs. The blade and ripper can move and pressure oil can be released.

- (a) Install the flow blocking devices in the lift/lower lines (3) of the blade only.
- (b) Fully open the manual load valve on circuit tester.
- (c) Start the engine and bring engine speed up to full load rpm.
- (d) Move the blade control lever to LOWER position.
- (e) Slowly close the manual load valve until the pressure reaches 1000 psi, then read circuit tester temperature gage.
- (f) When oil temperature is 100°F, close the manual load valve until the pressure is 1500 psi.
- (g) When oil temperature is 145°F, fully open the manual load valve.
- (h) Reduce engine speed to low idle.



## 13-18. HYDRAULIC SYSTEM - TEST (Cont' d)

## NOTE

Record the basic test data for the following tests as shown in Table 13-10. Conditions in the hydraulic system must be constant before recording test data. The control levers must be held in the exact position desired. Best results can be obtained when hydraulic oil temperature is 145-155°F.

## (2) Test 1 (Maximum Pressure Relief Valve Setting).

- (a) Fully open the manual load valve if it is not already in that position.
- (b) Start the engine and slowly bring engine speed up to full load rpm.
- (c) Move blade control lever to the LOWER position.
- (d) Slowly close the manual load valve until oil flow through the flow meter stops (0 gpm).
- (e) Record the maximum pressure. The setting for the-relief valve for maximum pressure must be 2200-2300 psi.

**CAUTION**

Release the blade control lever slowly. This will prevent possible damage to the circuit tester pressure gage.

- (f) Slowly move the blade control lever to HOLD position observing to see that the pressure drops to near 100 psi.

## (3) Test 2 (System Oil Temperature).

- (a) Fully open the manual load valve.
- (b) Place blade control lever in the LOWER position.
- (c) Record oil temperature. Oil temperature must be 145-155°F.

## (4) Test 3 (System Base Flow Rate).

- (a) Fully open the manual load valve.
- (b) Place blade control lever in the LOWER position.
- (c) Operate the engine at full load rpm.
- (d) Check pressure to make sure it is at a minimum value of approximately 100 psi.
- (e) Record flow rate (gpm).
- (f) The base flow rate of the system will be the same as the low pressure flow of the hydraulic pump. Because there will be minimum leakage in the control valves, restrictor valve, and relief valves at 100 psi, the base flow rate can be used to find the flow differential in Tests 4 through 7.

13-18. HYDRAULIC SYSTEM - TEST (Cont'd)

(5) Tests 4 through 7 (System Flow Rates).

These four tests are similar. perform each test as follows:

(a) Place control levers in position indicated for each test:

- Blade LOWER . . . . . Test 4
- Blade RAISE . . . . . Test 5
- Ripper LOWER . . . . . Test 6
- Ripper RAISE . . . . . Test 7

(b) Operate engine at full load rpm.

(c) Adjust manual load valve to obtain 1000 psi.

(d) Make the system constant with these conditions.

(e) Record flow rate (gpm) for each test.

(f) The flow differential for each test (4 through 7) is determined by subtracting flow rate for each test from the base flow rate (Test 3). The percent of flow loss for each test (4 through 7) is calculated by dividing flow differential for each test by the base flow rate (Test 3), and multiplying that answer by 100.

Differential Flow = Test 3 - Each test (4-7)

$$\text{Percent Flow Loss} = \frac{\text{Flow Differential}}{\text{Test 3}} \times 100$$

(6) Test 10 (Large Section Base Flow Rate).

(a) Fully open the manual load valve.

(b) Move blade control lever to LOWER and TILT RIGHT positions.

(c) Operate engine at full load rpm.

(d) Check pressure to make sure it is at a minimum value of approximately 100 psi.

(e) Record the oil flow (gpm).

(f) The base flow rate of the system will be the same as the low pressure flow of the hydraulic pump. Because there will be minimum leakage in the control valves, restrictor valve, and relief valves at 100 psi, the base flow rate can be used to find the flow differential in Tests 11 and 12.

(7) Tests 11 and 12 (Large Section Flow Rates). These two tests are similar. Perform each test as follows:

(a) Place control lever in the position indicated for each test:

- Blade TILT RIGHT . . . . . Test 11
- Blade TILT LEFT . . . . . Test 12

(b) Operate engine at full load rpm.

(c) Adjust manual load valve to obtain 1000 psi pressure.

(d) Keep system constant under these conditions-

(e) Record flow rate (gpm) for each test.

13-18. HYDRAULIC SYSTEM -TEST (Cont'd)

- (8) Test 13 (System Oil Temperature).
  - (a) Fully open manual load valve.
  - (b) Place blade control lever in LOWER position.
  - (c) Record oil temperature.
  - (d) Compare oil temperatures of Tests 2 and 13. Test 2 must be 145-155°F and Test 13 must be within 10 degrees of Test 2. For each 10 degrees that Test 13 is higher than Test 2, subtract 1.0 gallon from the leakage rate. For each 10 degrees that Test 13 is lower than Test 2, add 1.0 gallon to the flow rate.
- (9) Test A (Small Section Base Flow Rate).
  - (a) Fully open the manual load valve.
  - (b) Move the tilt control lever to TILT RIGHT position.
  - (c) Run the engine at full load rpm.
  - (d) Check pressure to make sure it is at least 100 psi (approximately).
  - (e) Record the base flow rate.
- (10) Tests B (Small Section Tilt Right Flow Rate).
  - (a) Move the dozer control lever to TILT RIGHT.
  - (b) Run the engine at full load rpm.
  - (c) Adjust the manual load valve to get 1000 psi pressure. Let the system stabilize.
  - (d) Record the flow rate.
- (11) Test C (Small Section Tilt Left Flow Rate).
  - (a) Repeat test B with the dozer control lever in the TILT LEFT position.
  - (b) Record the flow rate.
- (12) Test D (Tilt System Pressure Relief Valve Setting).
  - (a) Fully open the manual load valve.
  - (b) Move blade control lever to TILT LEFT position.
  - (c) operate engine at full load rpm and slowly close manual load valve until oil flow through the flow meter stops (0 gpm).
  - (d) Record maximum pressure. Relief valve setting must be 2400-2500 psi.

CAUTION

Slowly open manual load valve before releasing blade control lever. This will help prevent possible damage to the circuit tester pressure gage.

- (e) Slowly turn manual load valve, then release blade control lever.

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## 13-18. HYDRAULIC SYSTEM - TEST (Cont'd)

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- (13) Comparison of Test Flow Data.
- (a) Compare your test data with the data in Table 13-10 for the particular tractor being tested. The percent flow loss on Chart A is the maximum for best performance. If percent of flow loss is acceptable, tests are complete. Go to paragraph 13-16 and restore equipment for operation.
  - (b) If percent of flow loss is not acceptable in one or more circuits, go to Table 13-11 to identify the problem.



13-18. HYDRAULIC SYSTEM - TEST (Cont' d)

Table 13-10. Flow Test Procedure Data

Test Name	Maximum Pressure Relief Valve Setting	System Oil Temperature (Start)	System Base Flow Rate	Dozer LOWER Flow Rate	Dozer RAISE Flow Rate	Ripper LOWER Flow Rate	Ripper RAISE Flow Rate	Ripper TIP FWD Flow Rate
Test Number	1	2	3	4	5	6	7	8
Control Lever Position	Dozer LOWER	Dozer LOWER	Dozer LOWER	Dozer LOWER	Dozer RAISE	Ripper LOWER	Ripper RAISE	Ripper Tip FORWARD
Implement Position	Fully On Ground	Fully On Ground	Fully On Ground	Fully On Ground	Fully On Ground	Fully Lowered	Fully Raised	Fully Raised Fully Forward
Engine Speed	2000 RPM	Any Speed	2000 RPM	2000 RPM	2000 RPM	2000 RPM	2000 RPM	2000 RPM
System Test Pressure	Maximum	0 - 100 PSI	100 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI
Test Data	2250 PSI	150 F	80 GPM	51 GPM	51 GPM	48 GPM	48 GPM	48 GPM
Flow Differential				(3-4) 8 GPM	(3-5) 8 GPM	(3-6) 12 GPM	(3-7) 12 GPM	(3-8) 12 GPM
Percent Flow Loss **				(3-4) 3 x 100 15%	(3-5) 3 x 100 15%	(3-6) 3 x 100 20%	(3-7) 3 x 100 20%	(3-8) 3 x 100 20%

Test Name	Ripper TIP BACK Flow Rate	Large Section Base Flow Rate	Large Section TILT RIGHT Flow Rate	Large Section TILT LEFT Flow Rate	System Oil Temperature (Finish)	Small Section Base Flow Rate	Small Section TILT RIGHT Flow Rate	Small Section TILT LEFT Flow Rate	Tilt System Pressure Relief Valve Setting
Test Number	9	10	11	12	13	A	B	C	D
Control Lever Position	Ripper Tip BACK	Dozer LOWER Tilt RIGHT	Dozer LOWER Tilt RIGHT	Dozer LOWER Tilt LEFT	Dozer LOWER	Tilt RIGHT	Tilt RIGHT	Tilt LEFT	Tilt LEFT
Implement Position	Fully Raised Fully Back	Fully Tilted Right	Fully Tilted Right	Fully Tilted Left	Fully On Ground	Fully Tilted Right	Fully Tilted Right	Fully Tilted Left	Fully Tilted Left
Engine Speed	2000 RPM	2000 RPM	2000 RPM	2000 RPM	Any Speed	2000 RPM	2000 RPM	2000 RPM	2000 RPM
System Test Pressure	1000 PSI	100 PSI	1000 PSI	1000 PSI	0-100 PSI	100 PSI	1000 PSI	1000 PSI	Maximum
Test Data	48 GPM	35 GPM	30 GPM	30 GPM	150 F	(3-10)* 25 ( ) GPM	(4-11)* 20 ( ) GPM	(4-12)* 20 ( ) GPM	2450 PSI
Flow Differential	(3-9) 12 GPM		(10-11) 5 GPM	(10-12) 5 GPM			(A-B) 5 ( ) GPM	(A-C) 5 ( ) GPM	
Percent Flow Loss **	(3-9) 3 x 100 20%		(10-11) 10 x 100 15%	(10-12) 10 x 100 15%			(A-B) A x 100 20% ( )	(A-B) A x 100 20% ( )	

13-18. HYDRAULIC SYSTEM -TEST (Cont' d)

Table 13-11. Interpreting Flow Test Results

NOTE

Remember that the dozer cylinders were blocked before the flow tests were performed. Tests will not detect faults in the dozer cylinders.

TEST RESULT	WHAT TO DO
<p>1. Relief valve setting Test 1 is too high or low.</p>	<p>One or both relief valves need to be adjusted. Repeat Test 1 with both the dozer tilt and dozer lift controls engaged. If the pressure reading is now correct, only the tilt relief valve needs to be adjusted (page 13-15).</p>
<p>2. Percent of flow loss for Tests 4-7 too high.</p>	<p>a. If the machine has a ripper, block the supply line to the ripper valve and repeat Tests 3, 4 and 5. If the flow loss is OK, repair ripper control valve (page 13-51).</p> <p>b. If the machine does not have a ripper or if flow loss was still too high after STEP a:</p> <ul style="list-style-type: none"> <li>• Do the pump tests, paragraph e, following, to determine if the pump is bad.</li> <li>• If the pump is OK, problem is in bulldozer control valve (page 13-15).</li> </ul>
<p>3. Percent of flow loss for Tests 4 and/or 5 and Tests 10 and/or 12 too high. Tests 6 and 7 are OK.</p>	<p>Problem is in the bulldozer control valve dozer circuit. Repair or replace (page 13-15).</p>

13-18. HYDRAULIC SYSTEM - TEST (Cont' d)

Table 13-11. Interpreting Flow Test Results (Cont' d)

TEST RESULT	WHAT TO DO
<p>4. Percent of flow loss for Tests 6 and 7 (both) too high. Test 4 and 5 OK.</p>	<p>a. Do the Blocked Cylinders Tests 27 and 28, paragraph f, to determine if cylinders are leaking.</p> <p>b. Do the Large Section and Small Section Blocked Pump Test 15 to determine if valves are leaking.</p> <p>c. Check ripper control valve (page 13-51) and pilot valves (page 13-43) and repair or replace.</p>
<p>5. Percent of flow loss for Test 6 only or Test 7 only too high. Test 4 and 5 OK.</p>	<p>Problem is in the ripper control valve. Repair or replace (page 13-51).</p>
<p>6. All percent flow loss for Tests 4-7, 11 and 12 too high. Tests B and C OK.</p>	<p>Do the Large Section Pump Tests, paragraph e, following, to locate fault in the hydraulic pump. Repair or replace (page 13-7).</p>
<p>7. Percent of flow loss for test 4-7 and B and C too high. Test 11 and 12 OK.</p>	<p>a. Check for leakage in the tilt relief valve or the restrictor valve. Repair or replace bulldozer control valve (page 13-15).</p> <p>b. Do the Small Section Pump Test, paragraph e, following to locate fault in the hydraulic pump.</p>
<p>8. percent of flow loss for tests 11 and 12 too high. All other tests OK.</p>	<p>Do Large Section Pump Test, paragraph e, following to locate fault in the hydraulic pump.</p>
<p>9. Percent of flow loss for Test 11 only or Test 12 only too high.</p>	<p>Problem is in the tilt control valve. Inspect and repair or replace (page 13-15).</p>
<p>10. percent of flow loss for Test B only or C only too high. All the tests OK.</p>	<p>Problem is in the tilt control valve. Inspect and repair or replace (page 13-15).</p>

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 13-18. HYDRAULIC SYSTEM -TEST (Cont'd)
 

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e. Pump Tests

## NOTE

These tests will determine the operating efficiency of the system hydraulic pump. The pump is isolated from the system during test.

## (1) preparation

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 WARNING
 

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Personal injury and equipment damage can result when disconnecting lines to install flow blocking devices. The blade and ripper can move and pressure oil can be released.

## NOTE

Do all tests for the large section then the small section. Record results as shown in Table 13-12 (large section or 13-13 (small section).

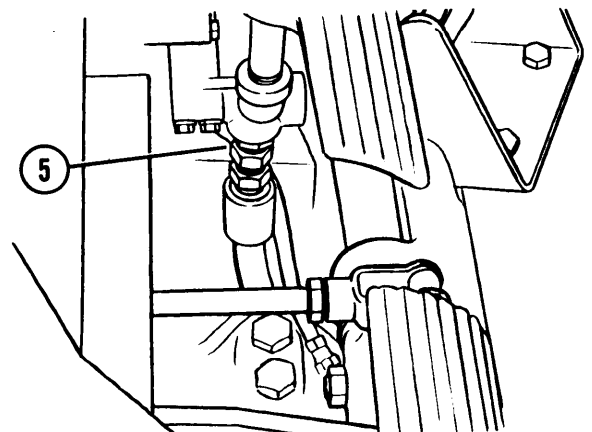
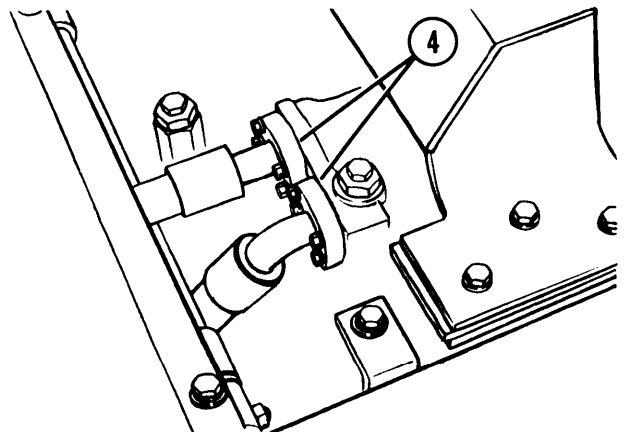
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 WARNING
 

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The main relief valve is NOT in the pump test circuit. Injury to personnel or damage to the machine can result if excessive pressure is created. Fully open the manual load valve on the flow meter before starting the engine for these tests.

- (a) For test of the large section pump, install blocking plates (4).
- (b) For test of the small section pump, install blocking plate (5).



13-18. HYDRAULIC SYSTEM - TEST (Cont' d)

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- (2) Test 14 (Full Speed Pump Flow-Low Pressure).
  - (a) Fully open the manual load valve.
  - (b) Slowly close the manual load valve to get 100 psi.
  - (c) Record the oil temperature and flow rate (gpm).
- (3) Test 15 (Full Speed Pump Flow-High Pressure).
  - (a) With engine speed at full load rpm, slowly close the manual load valve to get 1000 psi.
  - (b) Record oil temperature and flow rate (gpm).
- (4) Test 16 (Half Speed Pump Flow-Low Pressure).
  - (a) Decrease engine speed to 1/2 full load rpm.
  - (b) Set the manual load valve to get 100 psi.
  - (c) Record oil temperature and flow rate (gpm).
- (5) Test 17 (Half Speed Pump Flow-High Pressure).
  - (a) With engine at 1/2 full load rpm, slowly close the manual load valve to get 100 psi.
  - (b) Record oil temperature and flow rate (gpm).

---

**13-18. HYDRAULIC SYSTEM - TEST (Cont'd)**

---

**(6) Comparison of Data**

- (a) Compare your test data with the data in Tables 13-12 and 13-13. Data shown is the maximum allowable for the best performance. If your values are not acceptable, go to Table 13-14 to identify the problem.
  
- (b) Remove blocking plate from the pump.

13-18. HYDRAULIC SYSTEM- TEST (Cont'd)

**Table 13-12. Large Section Pump Test Data**

Test Name	Full Speed Pump Flow		Half Speed Pump Flow	
	Low Pressure	High Pressure	Low Pressure	High Pressure
Test Number	14	15	16	17
Engine Speed	2000 RPM	2000 RPM	1000 RPM	1000 RPM
Pump Test Pressure	100 PSI	1000 PSI	100 PSI	1000 PSI
Oil Temperature	150 ±5°F	150 ±5°F	150 ±5°F	150 ±5°F
Test Data	35.0 GPM	31.5 GPM	17.5 GPM	14.0 GPM
Flow Differential		(14-15) 3.5 GPM		(16-17) 3.5 GPM
Percent Flow Loss		$\frac{(14-15)}{14} \times 100$ 10%		

**Table 13-13. Small Section Pump Test Data**

Test Name	Full Speed Pump Flow		Half Speed Pump Flow	
	Low Pressure	High Pressure	Low Pressure	High Pressure
Test Number	14	15	16	17
Engine Speed	2000 RPM	2000 RPM	1000 RPM	1000 RPM
Pump Test Pressure	100 PSI	1000 PSI	100 PSI	1000 PSI
Oil Temperature	150 ±5°F	150 ±5°F	150 ±5°F	150 ±5°F
Test Data	25.0 GPM	21.2 GPM	12.5 GPM	8.7 GPM
Flow Differential		(14-15) 3.8 GPM		(16-17) 3.8 GPM
Percent Flow Loss		$\frac{(14-15)}{14} \times 100$ 15%		

Table 13-14. Interpreting Pump Test Results

TEST RESULT	WHAT TO DO
1. Percent of flow loss for Test 15 is too high. Flow differential for Test 15 is 0 to 2 gpm greater than flow differential for Test 17.	Hydraulic pump is worn. Repair or replace pump (page 13-7).
2. Percent of flow loss for Test 15 is too high. Flow differential for Test 15 is at least 2 gpm higher than flow differential for Test 17.	<p>a. Check for oil aeration caused by low oil level, wrong type of hydraulic oil, air leak in the pump suction line, or oil leaks in the tank. Correct as required.</p> <p>b. Check for pump cavitation which may be caused by a restriction in the pump suction line or wrong type of hydraulic oil. Correct the cause of cavitation and repair the pump (page 13-7) as required.</p>

## 13-18. HYDRAULIC SYSTEM - TEST (Cont'd)

f. Blocked Cylinders Test

## NOTE

This test will tell you if leakage is in the control valves and/or cylinders

## (1) Preparation

- (a) Start the engine.
- (b) Move the dozer TILT control so the dozer blade is parallel with the ground. Lower the dozer and ripper to the ground.
- (c) Stop the engine.

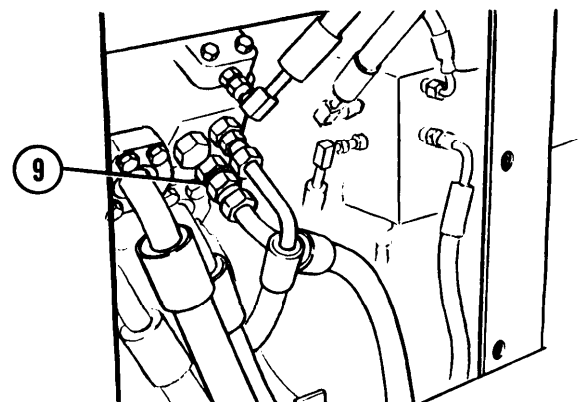
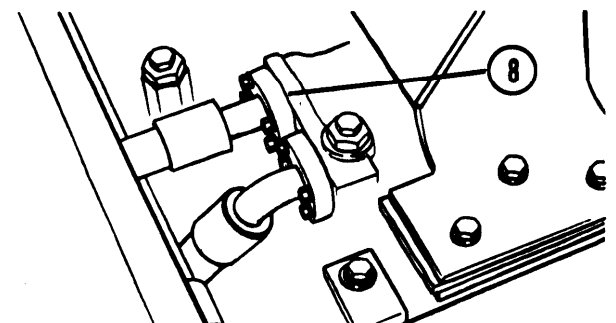
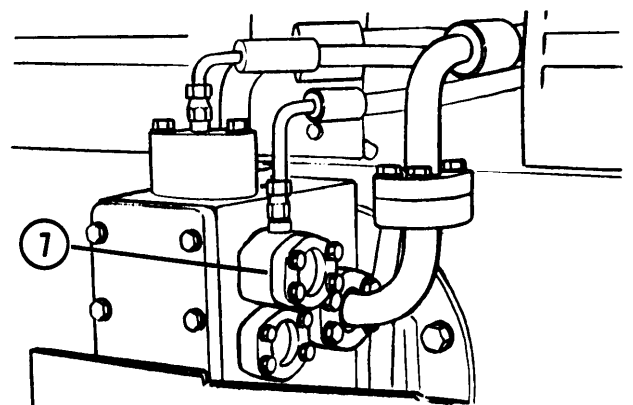
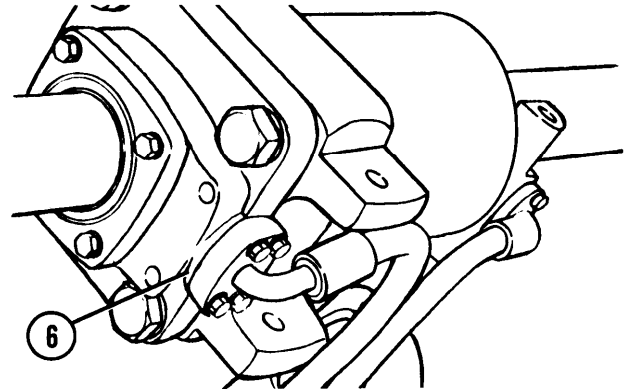
**WARNING**

Move the control levers through the OPERATE and HOLD positions to release pressure from the cylinder lines. Personal injury and damage to equipment can result when disconnecting lines to install flow blocking devices. The blade and ripper can move and pressure oil can be released.

- (d) Install blocking plates or caps and plugs for components as shown.

- ° Dozer tilt cylinder (6)
- Ripper lift cylinder (7)
- Ripper control valve (8)
- Tilt valve (9)

- (e) Place all control levers in HOLD position.
- (f) Fully open the manual load valve.
- (g) Start the diesel engine.





13-18. HYDRAULIC SYSTEM - TEST (Cont'd)

NOTE

Record test results as shown in Table 13-15.

(2) Test 26 (System Oil Temperature)

- (a) Put control lever in the RIPPER LOWER position.
- (b) Run the engine at any rpm with the system pressure at 0 to 100 psi.
- (c) Record oil temperature.

(3) Test 27, 28, 31, 32 (Leakage Rates)

- (a) With the manual load valve fully open, move the control lever to the (\*) position.

\*=RIPPER LOWER (Test 27)  
 RIPPER RAISE (Test 28)  
 TILT RIGHT (Test 31)  
 TILT LEFT (Test 32)

- (b) Run the engine at full load rpm.
- (c) Slowly close the manual load valve to get 1000 psi pressure.
- (d) Record the flow rate (gpm).

(4) Test 33 (System Oil Temperature)

Repeat Test 26 and record temperature.

(5) Finding Leakage Rates of the Cylinders and the Control Valves.

- (a) Find the cylinder leakage rate and control valve leakage rate for each function by subtracting the leakage rates for the indicated tests in Table 13-15.

Example: Find the cylinder leakage rate for the ripper circuit in the LOWER position.

Solution: Tests 27 and 6 check all the same components except the cylinders. The difference between the two test values will be the leakage in the cylinders. Using the sample values in Tables 13-10 and 13-15.

Cylinder leakage rate

= Test 27 - Test 6  
 = 49.0 gpm - 48.0 gpm  
 = 1.0 gpm

13-18. HYDRAULIC SYSTEM - TEST (Cont' d)

Table 13-15. Blocked Cylinders Test Data

Test Name							Right Cylinder or Tilt Valve Blocked			
	System Oil Temperature (Start)	Ripper LOWER Flow Rate	Ripper RAISE Flow Rate	Tilt RIGHT Flow Rate	Tilt LEFT Flow Rate	System Oil Temperature (Finish)	System Oil Temperature (Start)	Ripper LOWER Flow Rate	Tilt Valve Flow Rate	System Oil Temperature (Finish)
Test Number	26	27	28	31	32	33	34	35	37	38
Control Lever Position	Ripper LOWER	Ripper LOWER	Ripper RAISE	Tilt RIGHT	Tilt LEFT	Ripper LOWER	Ripper LOWER	Ripper LOWER	Tilt RIGHT	Ripper LOWER
Engine Speed	Any Speed	2000 RPM	2000 RPM	2000 RPM	2000 RPM	Any Speed	Any Speed	2000 RPM	2000 RPM	Any Speed
System Test Pressure	0 - 100 PSI	1000 PSI	1000 PSI	1000 PSI	1000 PSI	0 - 100 PSI	0 - 100 PSI	1000 PSI	1000 PSI	0 - 100 PSI
Test Data	150 ±5°F	49.0 GPM	49.0 GPM	20.5 GPM	20.5 GPM	150 ±5°F	150 ±5°F	49.0 - 48.0 GPM	21.2 - 20.5 GPM	150 ±5°F
Cylinder Leakage Rate		(27 - 6) 1.0 GPM	(28 - 7) 1.0 GPM	(31 - 8) 0.5 GPM	(32 - C) 0.5 GPM		RIGHT Cylinder or Tilt Control Valve Leakage	(35 - 6) 0 - 1.0 GPM	(37 - 31) 0 - 0.7 GPM	
Control Valves Leakage		(15-27) 4.0 GPM	(15-28) 4.0 GPM	(15S-31) 0.7 GPM	(15S-32) 0.7 GPM		LEFT Cylinder or Restrictor Valve Leakage	(27 - 35) 1.0 - 0 GPM	(15S - 37) 0.7 - 0 GPM	

L = Large Section of Pump  
S = Small Section of Pump

15 = 15L plus 15S added together

---

 13-18. HYDRAULIC SYSTEM - TEST (Cont'd)
 

---

Example: Find the control valves leakage rate for the ripper circuit in the LOWER position.

Solution: Tests 15 and 27 test the same components except control valves. The difference between these two test values will be the leakage in the control valves. Using the sample values in Table 13-12, 13-13, and 13-15.

$$\begin{aligned} \text{Value Leakage rate} &= \text{Test 15 (large + small)} - \text{Test 27} \\ &= (31.5 + 21.2) - 49.0 \\ &= 3.7 \text{ gpm} \end{aligned}$$

- (b) Perform all leakage calculations and record as illustrated in Table 13-15.
- (c) If leakage rates for cylinders are higher than values in Table 13-15, do the Right Side Blocked Cylinder Test 35 (paragraph g, following).
- (d) If leakage rates for control valves are higher than values in Table 13-15, adjust the tilt relief valve (page 13-15) or repair or replace the bulldozer control valve (page 13-15).

g. Right Side Blocked Cylinder Test

NOTE

This test will tell you if the left cylinder, right cylinder, or both cylinders are leaking. Perform this test for machines equipped with ripper.

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 13-18. HYDRAULIC SYSTEM - TEST (Cont'd)
 

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## (1) Preparation

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 WARNING
 

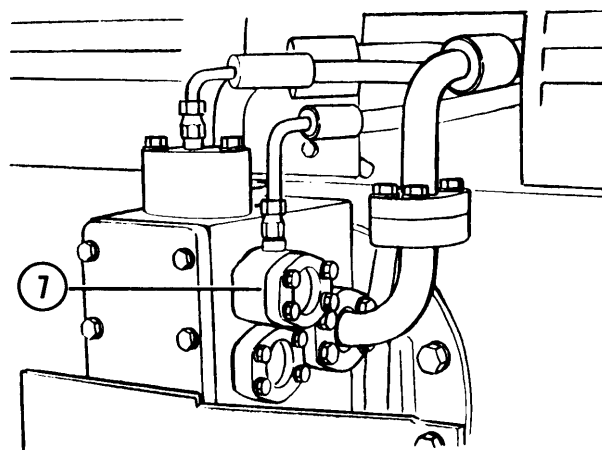
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Move the control levers through the OPERATE and HOLD positions to release pressure from the cylinder lines. Personal injury and damage to equipment can result when disconnecting lines to remove flow blocking devices. The blade and ripper can move and pressure oil can be released.

- (a) Place all control levers in HOLD position.
- (b) Fully open the manual load valve.
- (c) Remove blocking plates installed in paragraph f, above. Leave the head end of the right ripper lift cylinder blocked (7).

## NOTE

Record test results as shown in Table 13-15.



## (2) Test 34 (System Oil Temperature)

- (a) Start the diesel engine. run the engine at any rpm with the system pressure at 0 to 100 psi.
- (b) Move ripper control lever to LOWER position.
- (c) Write down oil temperature.

## (3) Test 35 (Lift Lower Flow Rate)

- (a) Start with the manual load valve in the fully open position.
- (b) Move the ripper control lever to LOWER position.

13-18. HYDRAULIC SYSTEM - TEST (Cont'd)

---

- (c) Slowly close the manual load valve to get 1000 psi.
  - (d) Write down the flow rate.
- (4) Test 37 (Tilt Valve Flow Rate)
- (a) Move the tilt control lever to TILT RIGHT position.
  - (b) Run the engine at full load rpm with the pressure at 1000 psi.
  - (c) Write down the flow rate of the oil.
- (5) Test 38 (System Oil Temperature)
- (a) With the engine at any rpm and the system pressure at 0 to 100 psi, fully open the manual load valve.
  - (b) Move the ripper control lever to the LOWER position.
  - (c) Write down the oil temperature.
- (6) Finding the Leakage Rates for the Lift Cylinders.
- (a) Find the leakage rates for the right and left cylinders by subtracting the leakage rates for the indicated tests in Table 13-15.
  - (b) Perform all leakage calculations and record as illustrated in Table 13-10.
  - (c) Repair defective lift cylinder if indicated by test results (page 13-93).
  - (d) Repair tilt control valve if indicated by test results (page 13-15).

## 13-18. HYDRAULIC SYSTEM -TEST (Cont'd)

<p>Example: Find the right cylinder leakage rate.</p> <p>Solution: Tests 35 and 6 check the same components except the right cylinder. The difference between the two test values will be the leakage in the right cylinder. Using the same values in Tables 13-10 and 13-15.</p> <p>Cylinder leakage rate</p> $= \text{Test 35} - \text{Test 6}$ $= (48.0 \text{ to } 49.0) - 48.0 \text{ gpm}$ $= 0 \text{ to } 1.0 \text{ gpm}$	<p>Example: Find the left cylinder leakage rate.</p> <p>Solution: Tests 27 and 35 check the same components except the left cylinder. Using the same values in Table 13-15.</p> <p>Cylinder leakage rate</p> $= \text{Test 27} - \text{Test 35}$ $= 49.0 \text{ gpm} - (49.0 \text{ to } 48.0 \text{ gpm})$ $= 0 \text{ to } 1.0 \text{ gpm}$
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h. Restoring Equipment

## NOTE

Return the equipment to operating condition after repairs have been made and tests repeated to make sure problems have been corrected.

- (1) Shut down the engine.

WARNING

Personal injury and equipment damage can result when disconnecting lines to remove flow blocking devices or test equipment. Set the flow control valve to the fully open position and move the control levers through all positions and set in the HOLD positions.

13-18. HYDRAULIC SYSTEM - TEST (Cont'd)

(2) Remove any cylinder or valve blocking devices installed during the tests.

(3) Disconnect the tachometer-generator from the drive (3). Disconnect the tachometer-generator cable from the circuit tester.

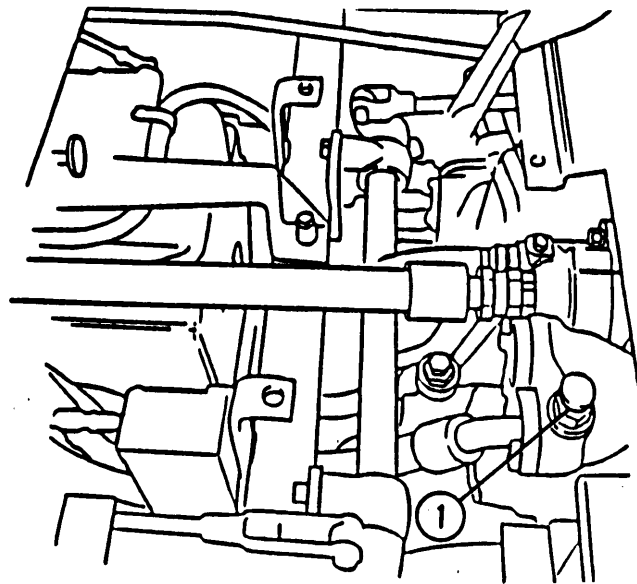
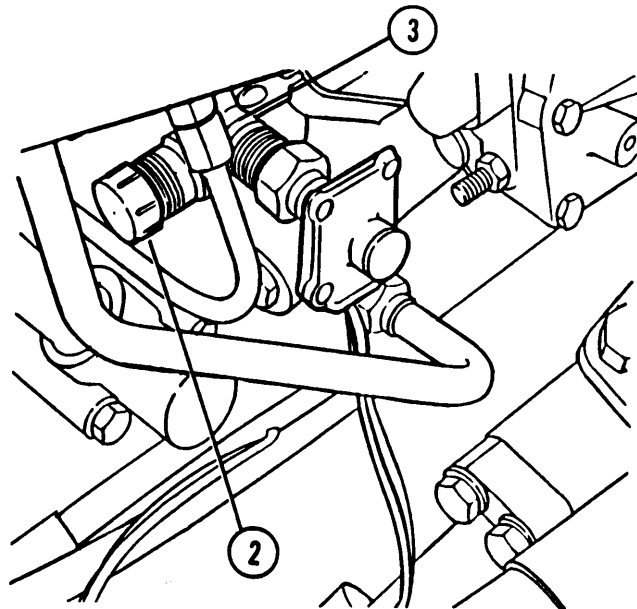
(4) Disconnect the hydraulic circuit tester and install plug (1) in main hydraulic pump.

(5) Remove the hydraulic return line between the hydraulic tank and the circuit tester. Install screen and filler cap.

(6) Start the engine and operate the blade and ripper through several cycles. Check for proper operation.

(7) Shut down the engine. Inspect all cylinders, lines and fittings for leaks.

(8) Check hydraulic fluid level and fill if required (L05-2410-237-12).



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**13-19. QUICK DROP VALVES - REPLACE/REPAIR**


---

This task covers:

- a. Removal
  - b. Disassembly
  - c. Assembly
  - d. Installation
  - e. Place In Service
- 

**INITIAL SETUP**
Applicable Configurations

All

Common Tools

Shop Equipment, General Purpose Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894

Materials/Parts

**Preformed packings (10, 11, 12 and 13)**

Lubricating Oil OE/HDO-10 (Refer to L05-2410-237-12)

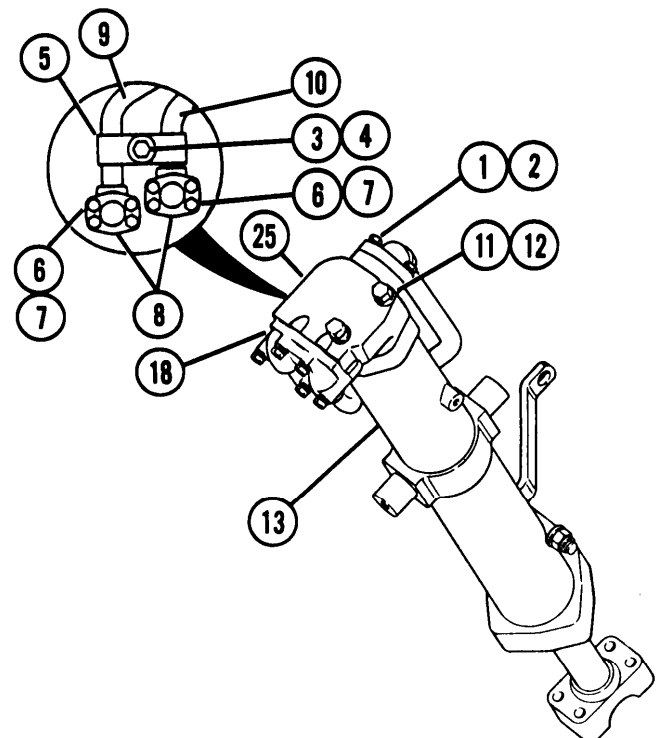
Equipment Condition

Tractor parked on level ground.  
Engine off.

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**a. Removal**

- (1) Use a wrench to remove two capscrews (1) and lockwashers (2).
- (2) Use a wrench to remove capscrew (3) and lockwasher (4), and clamp (5).
- (3) Remove eight capscrews (6), eight washers (7), and four half flanges (8) securing cylinder hydraulic lines (9 and 10).
- (4) Remove two capscrews (11) and lockwashers (12) and lift quick drop valve (25) and manifold (18) from cylinder (13).
- (5) Use a wrench to remove two capscrews and lockwashers (7) and lift quick drop valve (8) from cylinder (9).





13-19. QUICK DROP VALVES - REPLACE/REPAIR (Cont'd)

b. Disassembly

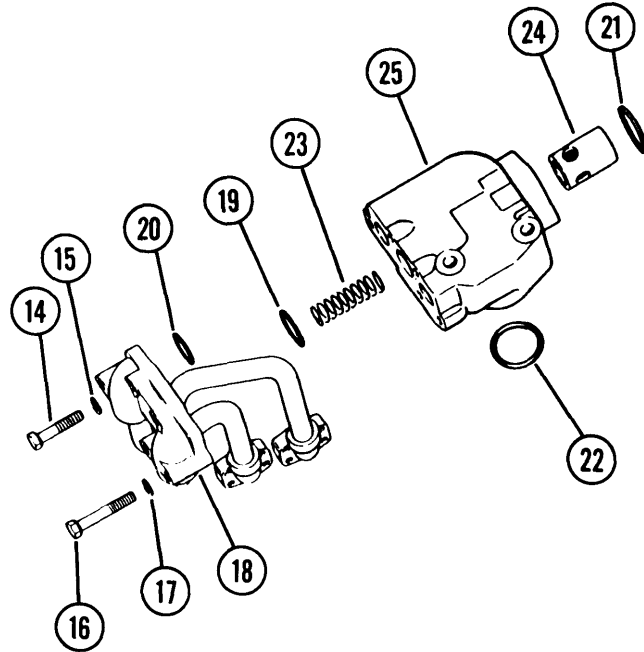
- (1) Use a wrench to remove two short capscrews (14), two washers (15), three long capscrews (16), three washers (17), and manifold (18).
- (2) Remove and discard preformed packings (19) and two preformed packings (20).
- (3) Remove and discard preformed packing (21).
- (4) Remove and discard preformed packing (22).
- (5) Remove spring (23) and plunger (24) from valve body (25).

c. Assembly

NOTE

Apply clean hydraulic oil on spring, plunger, and preformed packings during assembly.

- (1) Install plunger (24) and spring (23) into valve body (25).
- (2) Install new preformed packings (19, 21 and 22).
- (3) Install two new preformed packings (20).
- (4) Assemble manifold (18) to quick drop valve (25). Install three long capscrews (16), three washers (17), two short capscrews (14), and two washers (15) using a socket. Tighten capscrews to  $60 \pm 3$  lb. ft., using a torque wrench.



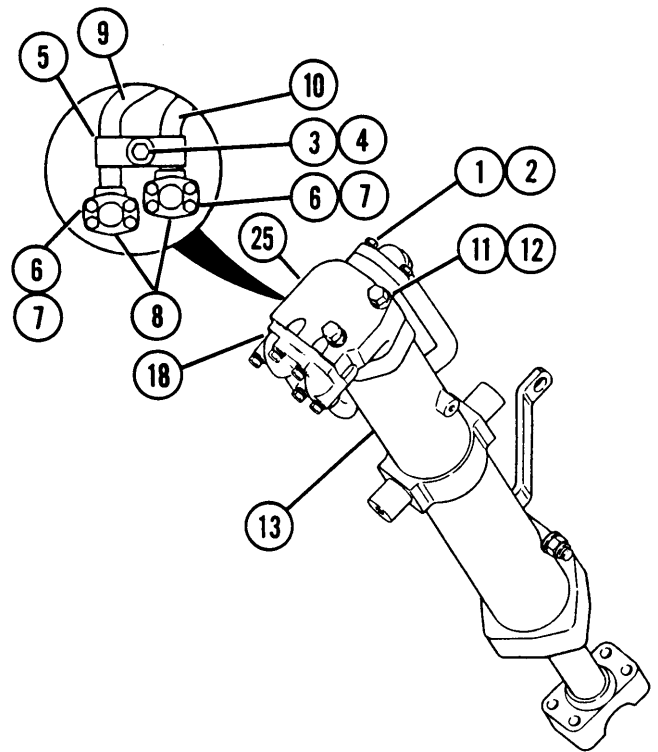
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 13-19. QUICK DROP VALVES - REPLACE/REPAIR (Cont'd)
 

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d. Installation

- (1) Place quick drop valve (25) and manifold (18) on cylinder (13) and install two capscrews (11) and lockwashers (12) using a socket. Tighten capscrews to  $118 \pm 4$  lb. ft. torque using a torque wrench.
- (2) Check movement of plunger (24) to make sure it moves freely.
- (3) Connect hydraulic lines (9 and 10) using four half flanges (8), eight washers (7), and eight capscrews (6).
- (4) Place clamp (5) in position and install capscrew (3) and lockwasher (4) using a wrench.
- (5) Install two capscrews (1) and lockwashers (2) using a socket. Tighten capscrews to  $60 \pm 3$  lb. ft. torque using a torque wrench.

e. Place In Service

Check quick drop valves for proper operation.

CHAPTER 14

EARTH MOVING EQUIPMENT MAINTENANCE

Section I. DESCRIPTION AND DATA

14-1. GENERAL

Earth moving equipment maintenance procedures not covered in this chapter can be found in TM5-2410-237-20.

14-2. DESCRIPTION AND DATA

Refer to TM5-2410-237-20 for complete description and data regarding earth moving equipment components-

Section II. EARTH MOVING EQUIPMENT MAINTENANCE PROCEDURES

14-3. EARTH MOVING EQUIPMENT MAINTENANCE TASK SUMMARY

TASK PARA.	PROCEDURES	PAGE NO.
14-4	Blade and Pusharm Assembly - Repair	14-2
14-5	Ripper Assembly - Replace/Repair	14-8

---

## 14-4. BLADE AND PUSHARM ASSEMBLY - REPAIR

---

This task covers:

- a. Disassembly
- b. Assembly
- c. Place In Service

---

### INITIAL SETUP

#### Applicable Configurations

Tractor with blade assembly

#### Common Tools

Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Lifting Equipment 3,500 lbs.

#### Materials/Parts

##### **Blocking 1' X 4" X4" as required**

Cotter pin (3), (5), (14), (16)  
Grease (App. B, Item 6)

#### Equipment Condition

Blade adjustable brace removed.  
See TM5-2410-237-20.  
Blade tilt cylinder removed.  
See TM5-2410-237-20.  
Bulldozer and pusharm removed.  
See TM5-2410-237-20.

- 
- a. Disassembly

#### **WARNING**

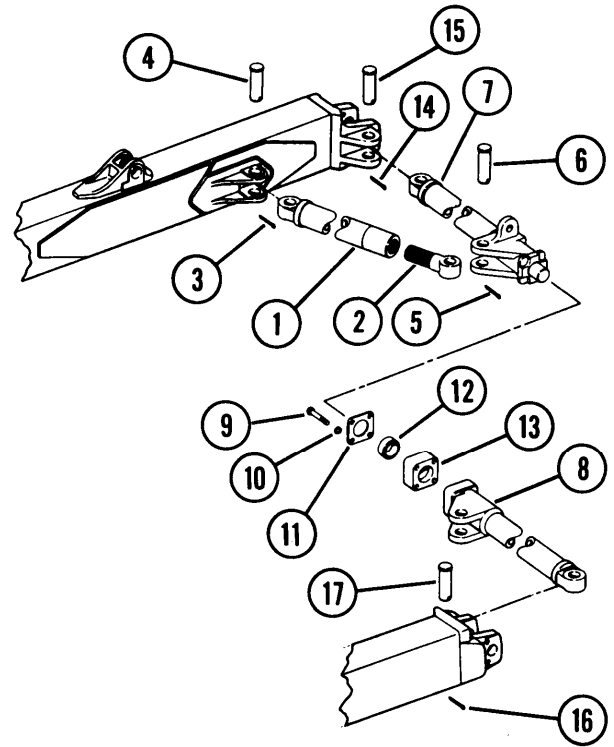
Use blocking during disassembly to prevent heavy parts from falling or tipping. Use lifting equipment to lift heavy parts. Failure to follow these precautions could result in serious injury.

#### **WARNING**

Before disassembly, attach lifting equipment near center of heavy part to be lifted or make two attachments (one near each end). Raise lifting equipment which will assist in removal of pins, capscrews, and will avoid dropping of parts which could result in personal injury.

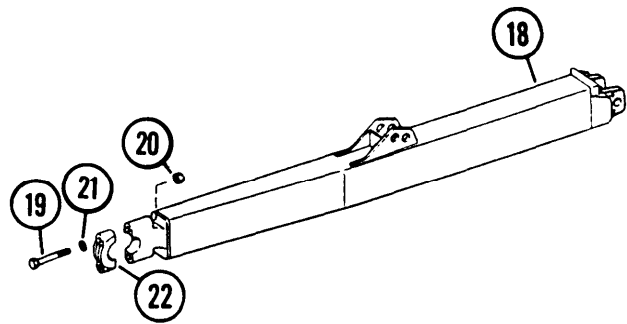
## 14-4. BLADE AND PUSHARM ASSEMBLY - REPAIR (Cont'd)

- (1) Attach lifting equipment to one brace (1) and screw (2) as an assembly.
- (2) Remove cotter pin (3) and pin (4) at one end of brace. Discard cotter pin (3).
- (3) Remove cotter pin (5) and pin (6) at other end of brace. Use lifting equipment to remove brace. Discard cotter pin (5).
- (4) Put brace (1) in a vise and remove eyebolt (2).
- (5) Repeat STEPS 1-4 for other brace.
- (6) Attach lifting equipment to the strut assembly which consists of a left hand strut (7), a right hand strut (8), screws (9), lockwashers (10), retainer (11), bearing (12) and cage (13).
- (7) Remove cotter pin (14) and pin (15) at one end of strut assembly.
- (8) Remove cotter pin (16) and pin (17) at other end of strut assembly. Use lifting equipment to remove strut assembly. Discard cotter pin (16).
- (9) Disassemble left hand strut (7) from right hand strut (8).
- (10) Use a wrench to remove four capscrews (9), four lockwashers (10), one retainer (11), and bearing (12) and cage (13) as a unit from right hand strut.
- (11) Use a bearing puller to remove bearing (12) from cage (13).



14-4. BLADE AND PUSHARM ASSEMBLY - REPAIR (Cont' d)

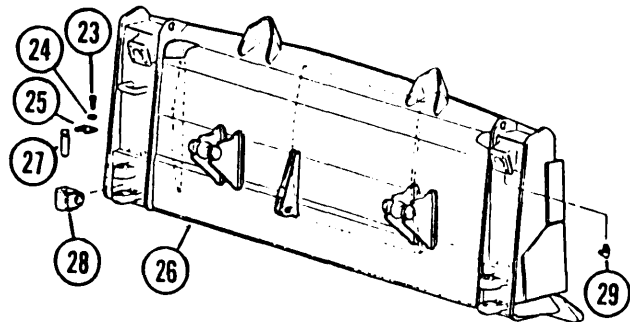
- (12) Attach lifting equipment near each end of one pusharm (18).
- (13) Use two wrenches to remove two capscrews (19), two nuts (20), two washers (21) and one cap (22) from pusharm.
- (14) Use lifting equipment to remove pusharm from one side of tractor.
- (15) Repeat STEPS 12-14 at other push-arm.



NOTE

If blade is laying front side up, do STEPS 21 and 22, then turn blade over to complete STEPS 16-20.

- (16) Use a wrench to remove two capscrews (23), two lockwashers (24) and retainer (25) at one end of blade (26).
- (17) Remove pin (27) and connector (28).
- (18) Remove grease fitting (29).
- (19) Repeat STEPS 16-18 for other end of blade.
- (20) Attach lifting equipment to blade and turn it to front side. Block cutting edge up 6".
- (21) Remove blade end bits. See TM5-2410-237-20.
- (22) Remove blade cutting edge. See TM5-2410-237-20.



---

## 14-4. BLADE AND PUSHARM ASSEMBLY - REPAIR (Cont'd)

---

### b. Assembly

---

#### WARNING

---

Use blocking during assembly to prevent heavy parts from falling or tipping. Use lifting equipment to lift heavy parts. Failure to follow these precautions could result in serious injury.

---

#### WARNING

---

Before assembly, attach lifting equipment near center of heavy part to be lifted or make two attachments (one near each end). Use lifting equipment to line up holes for pins and capscrews.

#### NOTE

If blade is laying front side down, do STEPS 4-7, then turn blade over to complete STEPS 1-3.

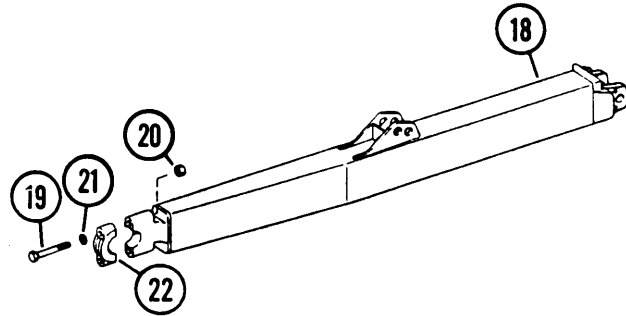
- (1) Install blade cutting edge. See TM5-2410-237-20.
- (2) Install blade end bits. See TM5-2410-237-20.
- (3) Attach lifting equipment to blade (26) and turn it to front side down.
- (4) Install grease fitting (29).  
Apply grease.
- (5) Install connector (28) and secure with pin (27) at one end of blade.
- (6) Install retainer (25) and secure with two capscrews (23) and two lockwashers (24) at one end of blade. Use a wrench to tighten capscrews.

14-4. BLADE AND PUSHARM ASSEMBLY - REPAIR (Cont'd)

(7) Repeat STEPS 4-6 for other end of blade.

(8) Attach lifting equipment to pusharm (18) and install it to one side of tractor.

(9) Install cap (22), two washers (21), two capscrews (19) and two nuts (20) which secure pusharm to trunnion. Use two wrenches to tighten capscrews and nuts.

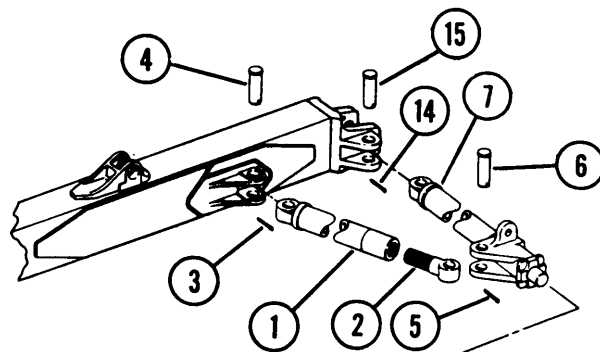


(10) Repeat STEPS 8 and 9 at other pusharm.

(11) Install blade adjustable brace. See TM5-2410-237-20. Do not adjust.

(12) Install bearing (12) into cage (13)

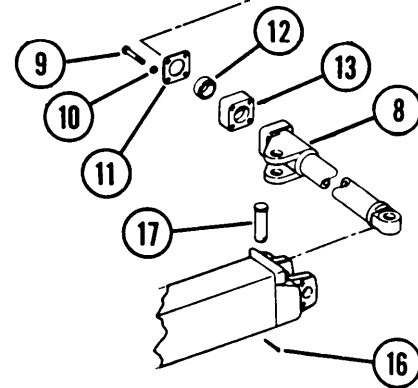
(13) Use a wrench to install four capscrews (9), four lockwashers (10), one retainer (11) and cage (13) to right hand strut (8).



(14) Assemble right hand strut (8) to left hand strut (7). This assembly is referred to as the strut assembly.

(15) Use lifting equipment to install strut assembly into position between pusharms.

(16) Install pin (17) and new cotter pin (16) to connect one end of strut assembly to pusharm.



(17) Install pin (15) and new cotter pin (14) to connect other end of strut assembly to pusharm.

(18) Put brace (1) in vise and install eyebolt (2).



---

#### 14-4. BLADE AND PUSHARM ASSEMBLY - REPAIR (Cont'd)

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- (19) Attach lifting equipment to one brace and screw assembly. Use lifting equipment to install assembly into position on pusharm and strut assembly.
- (20) Install pin (4) and new cotter pin (3) to connect one end of brace to pusharm.
- (21) Install pin (6) and new cotter pin (5) to connect other end of brace to strut assembly.
- (22) Repeat STEPS 17-20 for other brace.
- (23) Install bulldozer and pusharm. See TM5-2410-237-20.
- (24)** Install and adjust blade tilt cylinder. See TM5-2410-237-20.
- (25) Adjust blade adjustable brace. See TM5-2410-237-20.

#### c. Place In Service

Run tractor and check blade and pusharm for proper operation.

14-5. RIPPER ASSEMBLY -REPLACE/REPAIR

This task covers:

- a. Removal
- b. Installation
- c. Place In Service

INITIAL SETUP

Applicable Configurations  
Tractor with Ripper

Personnel Required  
MOS62B (3)

Common Tools  
Shop Equipment, General Purpose  
Repair, Semi-Trailer Mounted  
NSN 4940-00-287-4894  
Lifting Equipment 1,000 lbs.

Materials/Parts  
Preformed Packing (13)  
Blocks, 2' X8" X8"  
Bar, 30" Lg. X 1" Dia.  
Chains  
Lifting Eyes

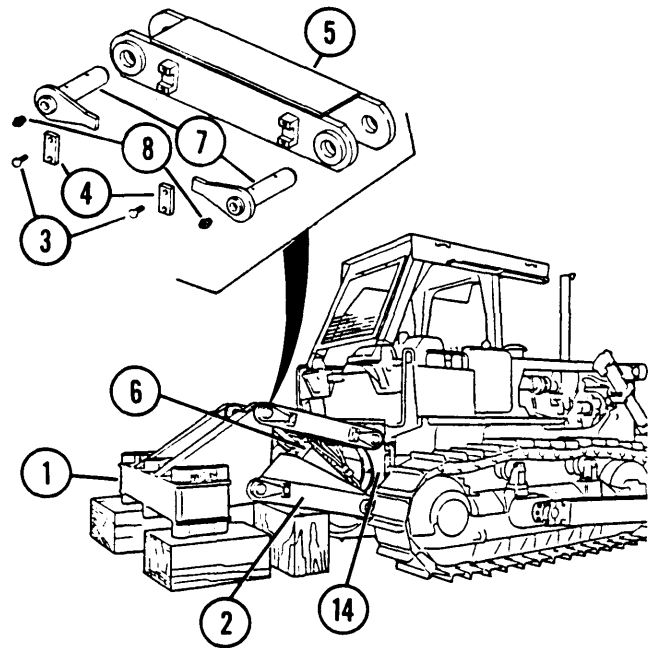
Equipment Condition  
Tractor parked on level ground.  
Engine cool.  
Ripper control valve removed. See page 13-51.  
Ripper shanks removed. See TM5-2410-237-20.

a. Removal

NOTE

Mark all pins for installation.

- (1) Place blocks underneath beam assembly (1) and frame assembly (2).
- (2) Use a wrench to remove two capscrews (3) and one plate (4) from one end of link (5).
- (3) Repeat STEP 1 at other end of same link (5).
- (4) Attach lifting equipment to link (5).



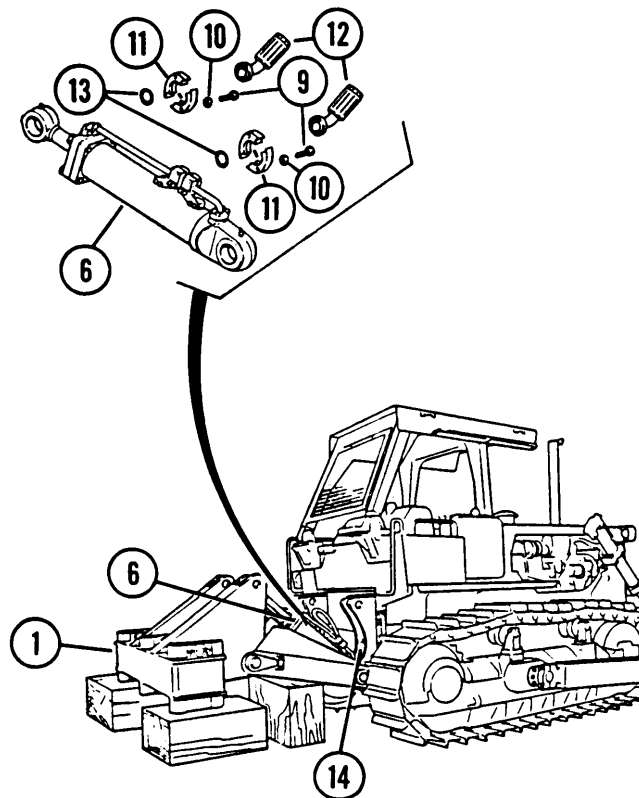
## 14-5. RIPPER ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (5) Place a bar between ripper lift cylinder (6) and frame assembly (2). The bar will prevent damage and movement of the ripper lift cylinder during removal of the pin assembly (7).

CAUTION

Be careful not to damage cylinder or valve hoses and fitting with pry bar.

- (6) Use a pry bar to remove two pin assemblies (7) from link (5).
- (7) Remove two fittings (8) from each pin assembly (7).
- (8) Mark link (5) to indicate sides, front, rear, up, down and use hoist to remove link.
- (9) Repeat STEPS 2-8 for link at other side of ripper.
- (10) Mark hoses and connections on the ripper lift cylinders (6).
- (11) Use a wrench to remove four capscrews (9), four washers (10), two flanges (11) and disconnect hose assembly (12) from tube on ripper lift cylinder.
- (12) Remove and discard preformed packing (13) from hose assembly (12). Plug end of hose.
- (13) Repeat STEPS 11 and 12 for the other hose assembly on the same ripper lift cylinder (6).
- (14) Repeat STEPS 11-13 for hose assemblies on the other ripper lift cylinder.



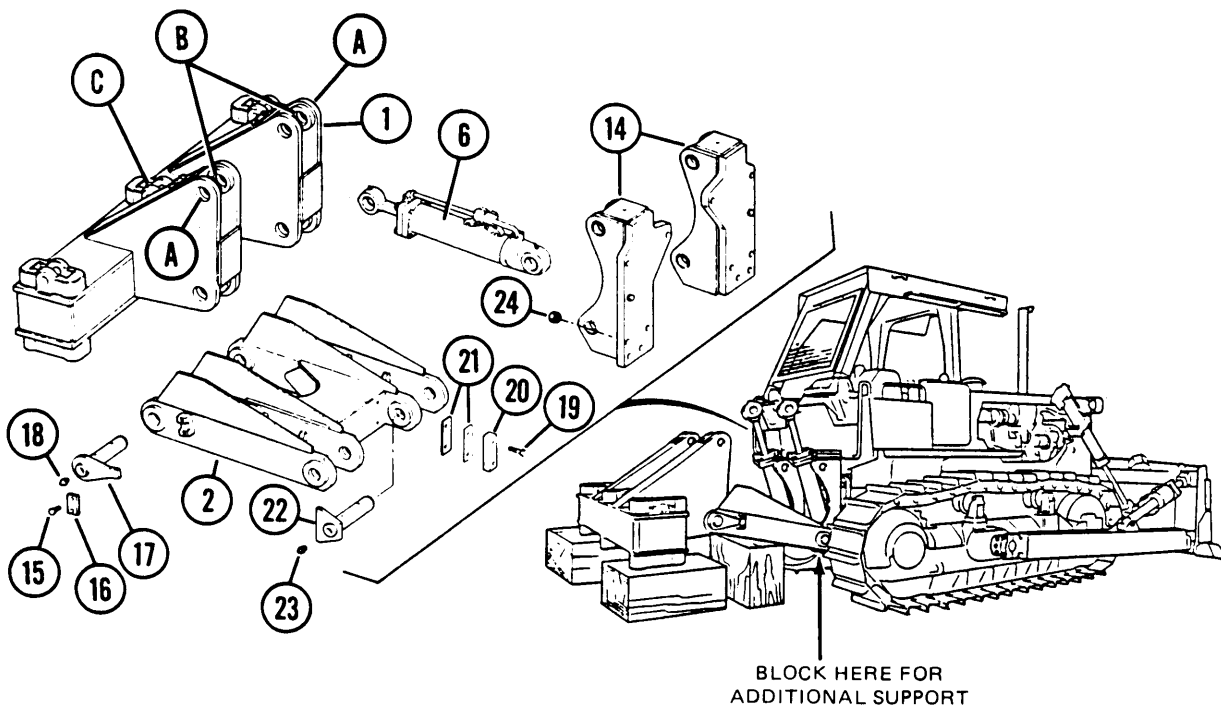
14-5. RIPPER ASSEMBLY - REPLACE/REPAIR (Cont'd)

- (15) Attach lifting equipment to ripper lift cylinder (6). Use lifting equipment to move ripper lift cylinder up and toward the bracket (14). Use chains to secure cylinder to bracket. Repeat for other ripper lift cylinder.
- (16) Install a bar through front pin assembly holes A of beam assembly (1). Attach lifting equipment at point B to beam assembly and bar
- (17) Use a wrench to remove two capscrews (15) and one retainer (16) from over each pin assembly (17) that secure frame assembly (2) to beam assembly (1).
- (18) Use a pry bar to remove a pin assembly (17) from each side of frame assembly (2).
- (19) Remove two fittings (18) from each pin assembly (17).

NOTE

Put slack in slings before attaching chains.

- (20) Place a bar through bore at c. Attach chain to bar and lifting equipment. Use lifting equipment to remove beam assembly (1) from frame assembly (2).
- (21) Attach lifting equipment to frame assembly (2). Use lifting equipment to lift frame so it is level with tractor. Place additional blocks underneath frame assembly, if necessary. Remove lifting equipment.
- (22) Attach lifting equipment to one ripper lift cylinder (6).
- (23) Label ripper lift cylinders (6) as left and right.



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 14-5. RIPPER ASSEMBLY - REPLACE/REPAIR (Cont'd)
 

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- |   |  |
|---|--|
| <p>(24) Use a wrench to remove two capscrews (19), plate (20) and shims (21) from each side of frame assembly (2).</p> <p>(25) Remove pin assembly (22) from side of frame assembly (2) that retains ripper lift cylinder (6) to frame.</p> <p>(26) Remove two fittings (23) from pin assembly (22).</p> <p>(27) Use a pry bar and hoist to remove both ripper lift cylinders (6) from frame assembly (2).</p> <p>(28) Repeat STEPS 22 through 27 for other lift cylinder.</p> <p>(29) Attach lifting equipment to frame assembly (2). Use lifting equipment to remove frame assembly from back of tractor.</p> <p>(30) Install lifting eyes on mounting brackets (14). Attach lifting equipment to mounting brackets.</p> <p>(31) Use a drive socket with extension and breaker bar to remove seven nuts (24) from studs which secure each mounting bracket (14) to back of tractor.</p> <p>(32) Use lifting equipment to remove two mounting brackets (14).</p> | <p>(2) Use lifting equipment to install two mounting brackets (14) into position on back of tractor.</p> <p>(3) Use a drive socket with extension and torque wrench. Wet threads with oil and install seven nuts (24) on studs which secure each mounting bracket (14) to back of tractor. Torque to 1800±180 lb. ft. Remove lifting eyes from brackets.</p> |
|---|--|

## NOTE

It may be necessary to temporarily install lower pins to achieve proper alignment of frame and brackets.

- (4) Attach lifting equipment to frame assembly (2). Use lifting equipment to align frame assembly. Place blocks underneath frame assembly. Remove lifting equipment.

## NOTE

Install with cylinder eye toward machine and port tubing up.

- (5) Use lifting equipment to position one ripper lift cylinder (6) in frame assembly (2).
- (6) Install two fittings (23) in each pin (22). Apply multi purpose grease to pin.
- (7) Use a hammer, if necessary, to install pin (22) through the inside of frame assembly (2) which retains lift cylinder (6) and frame to brackets. Place a block underneath cylinder and lower lift cylinder on block. Remove lifting equipment.

b. Installation

## NOTE

Clean all pins and bores thoroughly.

- (1) Install ripper control valve. See page 13-51. Attach lifting equipment to mounting brackets (14) |

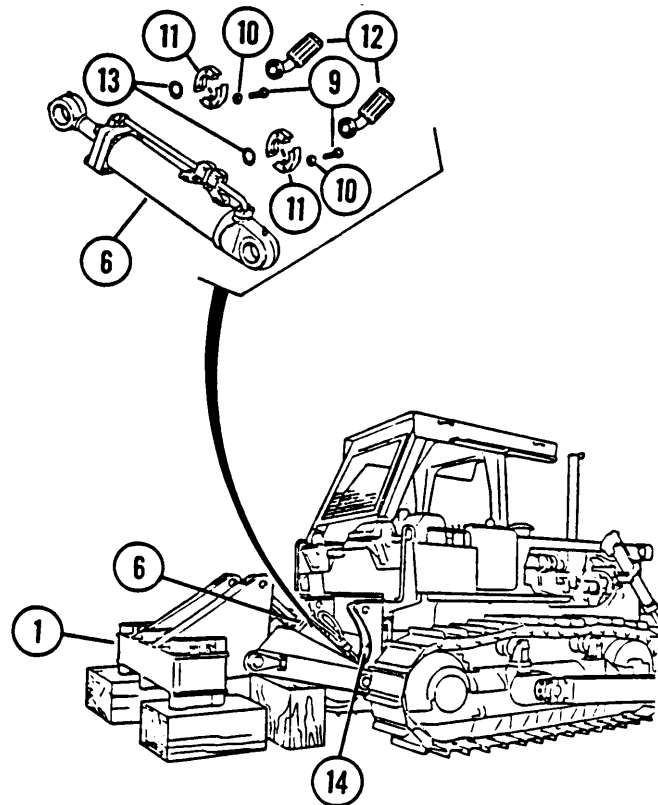
14-5. RIPPER ASSEMBLY - REPLACE/REPAIR (Cont' d)

- (8) Repeat STEPS 4, 5 and 6 for other lift cylinder.

NOTE

Place shims between pin and frame.

- (9) Use a wrench to install two capscrews (19), plate (20) and shims 21 to each side of frame assembly (2).
- (10) Remove plug from end of hose assembly (12). Install a new preformed packing (13) in hose.
- (11) Connect hose assembly (12) to tube on ripper lift cylinder (6). Install two flanges (11), four washers (10) and four capscrews (9) to secure hose. Use a wrench to tighten capscrews.
- (12) Repeat STEPS 10 and 11 for the other hose assembly on the same ripper lift cylinder (6).
- (13) Repeat STEPS 10, 11 and 12 for hose assemblies on the other ripper lift cylinder.
- (14) Install a bar through front pin assembly holes of beam assembly (1). Attach lifting equipment to beam assembly and bar.
- (15) Use lifting equipment to align beam assembly (1) into position on frame assembly (5).
- (16) Install two fittings (18) in each pin assembly (17). Apply multi-purpose grease to pin.
- (17) Use a hammer, if necessary, to install pin (17) in the outside of frame assembly (2) and through beam assembly (1).
- (18) Repeat STEPS 16 and 17 for other pin.



14-5. RIPPER ASSEMBLY - REPLACE/REPAIR (Cont'd)

(19) Use a wrench to install two capscrews (15) and one retainer (16) over each pin assembly (17) on sides of frame assembly (2).

(20) Place a jack at center and underneath back end of beam assembly (1). Remove lifting equipment.

(21) Attach lifting equipment to links (5). Use hoist to install each link.

(22) Install two fittings (8) in each pin assembly (7).

(23) Use a hammer to install front pin (7) through link (5) and mounting bracket (14).

(24) Use a wrench to install two capscrews (3) and one plate (4) over end of link (5).

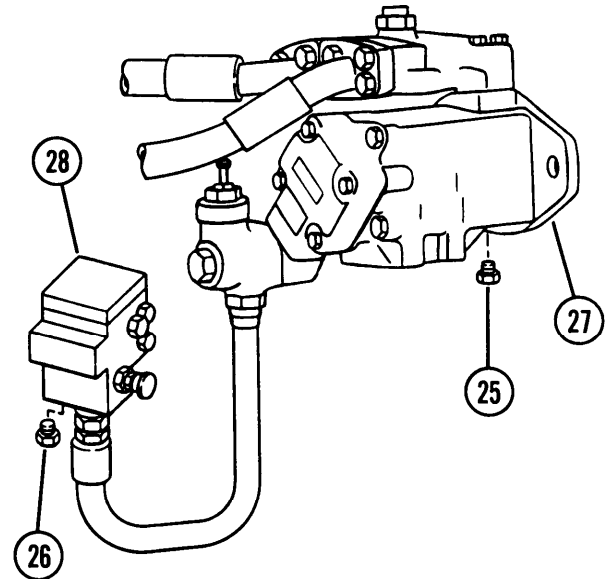
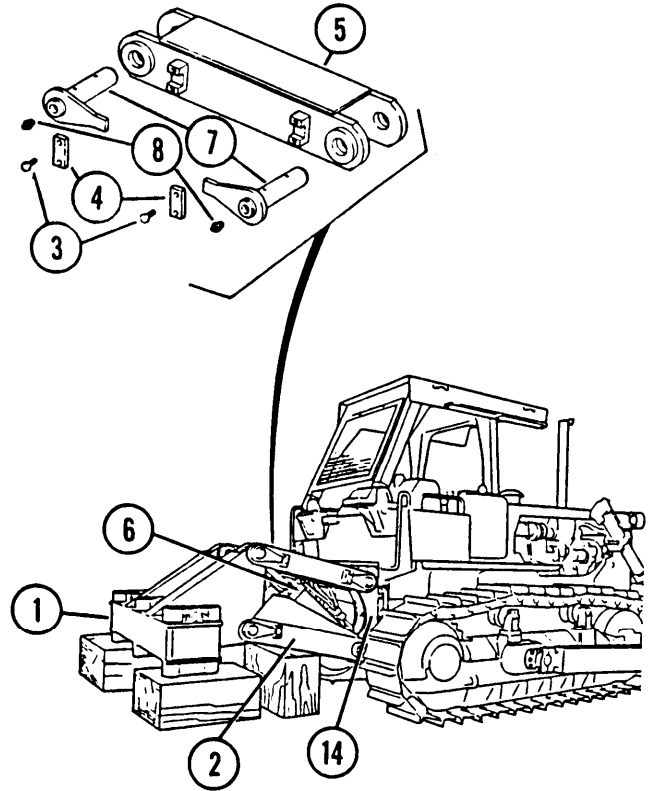
(25) Use lifting equipment on the link (5) and jack underneath the beam assembly (1) to align rear pin holes. Use a hammer to install pin (7) through link and 1" into beam assembly.

(26) Repeat STEPS 20 through 25 for other link.

(27) Use a pry bar to align cylinder (6) eye with link and beam bores. Start engine and extend cylinder to proper length; adjust jack as needed.

(28) Use a hammer to completely install pin assembly (7) through ripper lift cylinder rod (6).

(29) Use a wrench to install two capscrews (3) and one plate (4) over end of link (5).



14-5. RIPPER ASSEMBLY - REPLACE/REPAIR (Cont'd)

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- (30) Repeat STEPS 27 through 29 for the other ripper lift cylinder rod.
- (31) Install ripper teeth. See TM5-2410-237-20.
- (32) Fill hydraulic tank as needed. See TM5-2410-237-20.
- (33) Lubricate ripper. See L05-2410-237-12.

c. Place In Service

Check ripper for proper operation.



**APPENDIX A**

**REFERENCES**

**A-1. SCOPE**

This appendix lists forms, field manuals, technical manuals, and other publications referenced in this manual and which apply to intermediate direct support and general support maintenance of the D7G tractor.

**A-2. DEPARTMENT OF THE ARMY PAMPHLETS**

Consolidated Index of Army Publications and Blank Forms . . . . . DA Pam 25-30  
 The Army Maintenance Management System (TAMMS) . . . . . DA Pam 738-750

**A-3 . FORMS**

Recommended Changes to Equipment Technical Publications . . . . . DA Form 2028-2  
 Organizational Control Record for Equipment . . . . . DA Form 2401  
 Equipment Inspection and Maintenance Worksheet . . . . . DA Form 2404  
 Maintenance Request . . . . . DA Form 2407  
 Preventive Maintenance Schedule and Record 1. . . . . DD Form 314  
 Processing and Reprocessing Record for Shipment, Storage, and  
 Issue of Vehicles and spare Engines . . . . . DD Form 1397  
 Product Quality Deficiency Report (NSN 7540-00-105-0078) . . . . . SF 368

**A-4 . FIELD MANUALS**

Camouflage . . . . . FM 5-20  
 First Aid for Soldiers . . . . . FM 21-11  
 Basic cold Weather Manual . . . . . FM 31-70  
 Northern Operations . . . . . FM 31-71  
 Mountain Operations (How to Fight) 1 . . . . . FM 90-6

**A-5. LUBRICATION ORDER**

Tractor, Full Tracked, Low Speed: DED,  
 Medium Drawbar Pull, D7G . . . . . LO 5-2410-237-12

**A-6. TECHNICAL BULLETINS**

- Warranty Program for Tractor, Full Tracked,  
Low Speed: DED, Medium Drawbar Pull, D7G . . . . . TB 5-2410-237-15
- Occupational and Environmental Health: Hearing Conservation . . . . . TB MED 501
- Equipment Improvement Report and Maintenance  
Digest (US Army Tank-Automotive Command)  
Tank-Automotive Equipment . . . . . TB 43-0001-39 series
- Nonaeronautical Equipment Army Oil Analysis Program (AOAP) . . . . . TB 43-0210

**A-7. TECHNICAL MANUALS**

- Operator's Manual for Tractor, Full Tracked,  
Low Speed: DED, Medium Drawbar Pull, D7G . . . . . TM 5-2410-237-10
- Hand Receipt for Components of End Item (COEI),  
Basic Issue Items (BII), and Additional  
Authorized List (AAL) for Tractor, Full  
Tracked, Low Speed: DED, Medium Drawbar  
Pull, D7G . . . . . TM 5-2410-237-10HR
- Unit Maintenance Manual for Tractor, Full Tracked,  
Low Speed: DED, Medium Drawbar Pull, D7G . . . . . TM 5-2410-237-20
- Unit Maintenance, Intermediate Direct Support, and  
Intermediate General Support Maintenance Repair Parts  
and Special Tools List (Including Depot Maintenance  
Repair Parts and Special Tools List) for Tractor,  
Full Tracked, Low Speed: DED, Medium Drawbar Pull, D7G . . . . . TM 5-2410-237-24P
- Inspection, Care, and Maintenance of Antifriction Bearings . . . . . TM 9-214
- Operator's Manual for Welding Theory and Application . . . . . TM 9-237
- Materials Used for Cleaning, Preserving, Abrading, and  
Cementing Ordnance Materiel and Related Materiels  
Including Chemicals . . . . . TM 9-247
- Operator and Organizational Maintenance Manual Including  
Repair Parts and Special Tools List Simplified Test  
Equipment for Internal Combustion Engines (STE-ICE)  
(4910-00-124-2554) . . . . . TM 9-4910-571-12&P
- Operator's Organizational, Direct Support,  
and General Support Maintenance Manual for  
Lead-Acid Storage Batteries; 4HN, 24v,  
(NSN 6140-00-069-3528) MS75047-1; 2HN,  
12 V (6140-00-057-2553) MS 35000-1; 6TN,  
12 V (6140-00-057-2554) MS 35000-3 . . . . . TM 9-6140-200-14
- Painting Instructions for Field Use . . . . . TM 43-0139

Procedures for Destruction of Equipment to Prevent  
Enemy Use (Mobility Equipment Command) . . . . . TM 750-244-3

**A-8. SPECIFICATIONS AND STANDARDS**

Dry Cleaning Solvent . . . . . Fed Spec P-D-680

Methyl Ethyl Ketone, Technical . . . . . TT-M-261

Inspection, Liquid Penetrant Methods . . . . . MIL-I-6866

Inspection Process, Magnetic Particles . . . . . MIL-I-6868

Human Engineering Design Criteria for Military Systems,  
Equipment and Facilities . . . . . MIL-STD-1472

**A-9 . OTHER PUBLICATIONS**

Expendable\Durable Items (Except Medical,  
Class V, Repair Parts, and Heraldic  
Items) . . . . . CTA 50-970

Army Medical Department Expendable/Durable Items . . . . . CTA 8-100

**APPENDIX B**

**EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LISTS**

**Section I. INTRODUCTION**

**B-1. SCOPE**

This appendix lists expendable supplies and materials you will need to operate and maintain the D7G tractor. This listing is for informational purposes only and is not authorized to requisition the needed items. These items are authorized to you by CTA 50-970, Expendable/Durable Items (except Medical, Class V, Repair Parts, and Heraldic Items) or CTA 8-100, Army Medical Department Expendable/Durable Items.

**B-2 . EXPLANATION OF COLUMNS**

a. Item Number, Column 1. This number is assigned to the entry in the listing.

b. Level, Column 2. This column identifies the lowest level of maintenance that requires the listed item. The symbol designations for the various maintenance categories are as follows:

- C. . . . .Operator/Crew
- O . . . . .Organizational Maintenance
- H. . . . .General Support Maintenance
- F. . . . .Direct Support Maintenance
- D. . . . .Depot Maintenance

c. National Stock Number Column 3. This is the National Stock Number (NSN) assigned to the item; use it to request or requisition the item.

d. Description, Column 4. Indicates the Federal item name and, if required~ a description to identify the item. The last line for each item indicates the part number followed by the Federal Supply Code for Manufacturer (FSCM) in parentheses, if applicable.

e. Unit of Measure (U/M), Column 5. Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea in., pr) . If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
1	0	8040-00-0664-4134	Cement, Gasket,	pt.
2	0	8030-00-0251-3980	Compound, Anti -Sei ze,	lb.
3	0	8030-00-25-2391	Gasket, Li qui d,	oz l
			Grease, Automotive and Artillery GAA, (MI L-G-10924)	
4	0	9150-00-065-0029	2-1/4 oz. Tube	oz .
5	0	9150-00-935-1017	14 oz. Cartridge	Oz.
6	0	9150-00-190-0904	1-3/4 lb. Can	lb.
7	0	9150-00-190-0905	6-1/2 lb. Can	lb.
8	0	9150-00-190-0907	35 lb. Can	lb.
9	0	9150-00-530-7369	120 lb. Drum	lb.
9a	F	9150-01-145-1259	Grease, High Temperature	oz .
9b	o	8010-00-145-0312	Primer, Quick Cure	02•
10	0	8010-00-551-0128	Prussi an Bl ue, Red Lead or Paint,	oz l
11	0	8010-00-410-8463	Putty, Epoxy	ki t
12	0	7920-00-205-3570	Rags, Wi pi ng, A-A-531, (58536)	lb.
			Seal ing Compound	
13	0	8030-01-142-3131		cc.
14	0	8030-00-246-0931	Seal ant, Thread	oz .

## Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST (Cont'd)

(1) Item Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
15	0	5330-00-479-2847	Gasket Material, Liquid (non-hardening)	tu
16	0		Soap, Liquid	
17	0	3439-01-074-9983	Solder	lb.
			Solvent, Dry Cleaning, P-D-680, (81348)	
18	0	6850-00-664-5685	1 qt. Container	qt l
19	0	6850-00-281-1985	1 gal. Container	gal.
20	0	6850-00-285-8011	55 gal. Drum	gal.
21	F	8030-00-889-3535	Tape, Antiseizing, MIL-T-27730	dis.
22	0	6810-00-476-5612	Trichloroethane	gal.

## APPENDIX C

## ILLUSTRATED LIST OF MANUFACTURED ITEM

## SECTION I. INTRODUCTION

## C-1. SCOPE

This appendix includes complete instructions for making items authorized to be manufactured or fabricated at direct support and general support maintenance levels.

## Section II. MANUFACTURED ITEMS ILLUSTRATIONS

## C-2. PART NUMBER INDEX

A part number index in alphanumeric order is provided for cross-referencing the part number of the item to be manufactured to the figure which covers fabrication criteria. See table E-1.

## C-3. MANUFACTURED ITEMS

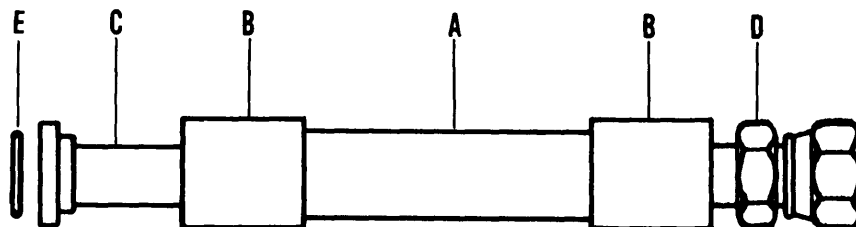
All bulk materials needed for manufacture of an item are listed by part number or specification number in a tabular list on the illustration.

Table C-1. Part Number to Figure Cross Reference

PART NUMBER	FIGURE	PART NUMBER	FIGURE
2P6434	c-1	5R6250	C-12
3P4825	c-7	5R6251	C-8
3P4833	C-11	5R6252	C-8
3P5724	C-7	5R6253	C-4
3P5725	C-5	5R6254	C-4
3P6022	C-5	5R6255	C-5
3P6146	C-3	5R6256	C-5
4S6825	C-14	5R6257	C-7
5P0580-44	C-14	5R6258	C-7
5P1262-5	C-14	5R6259	C-9
5P1262-6	C-14	5R7249	C-10
5P1263	C-14	5R7250	C-8
5P1442	C-14	7G7106	C-6
5P7760-51	C-14	8P2685	C-5
5P7760-150	C-14	9D5988	C-9
5R6247	C-12	9G1951	C-2
5R6248	C-9	9L1794	C-14
5R6249	C-12	9P2895	C-13

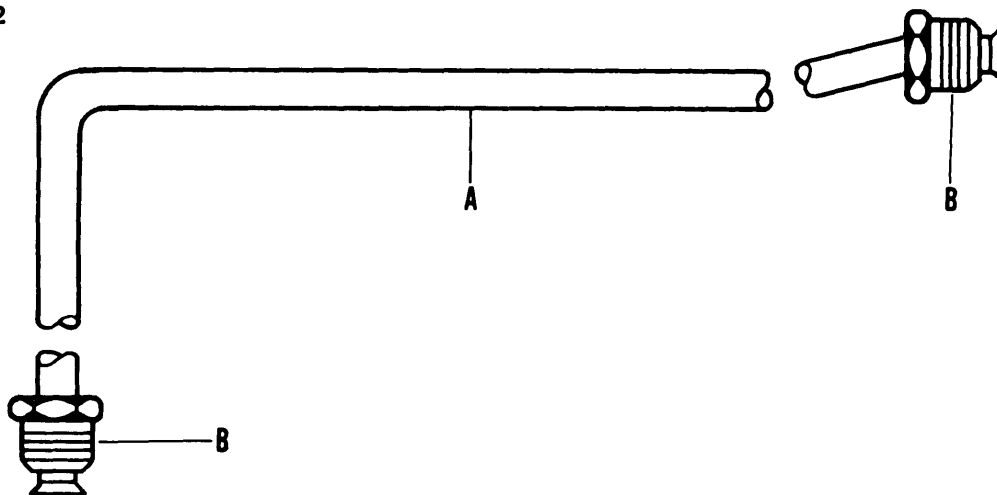
Section II. MANUFACTURED ITEMS ILLUSTRATIONS

Figure C-1



	A		B		C	D	E
HOSE ASSEMBLY	BULK HOSE NO.	HOSE LENGTH	SLEEVE/PLUNGER NO. (QTY)	STEM ASSEMBLY	STEM ASSEMBLY	PACKING	
2P6434	8S9348	61.02 in.	3S7116 (2)	5S3779	2P0988	4J0524	

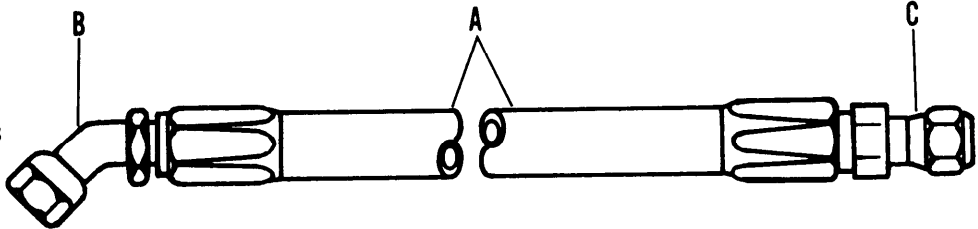
Figure C-2



	A		B
HOSE ASSEMBLY	BULK TUBE NO.	TUBE LENGTH	NUT (QTY)
9G1951	5P0193	26.38 in.	4B8756 (2)

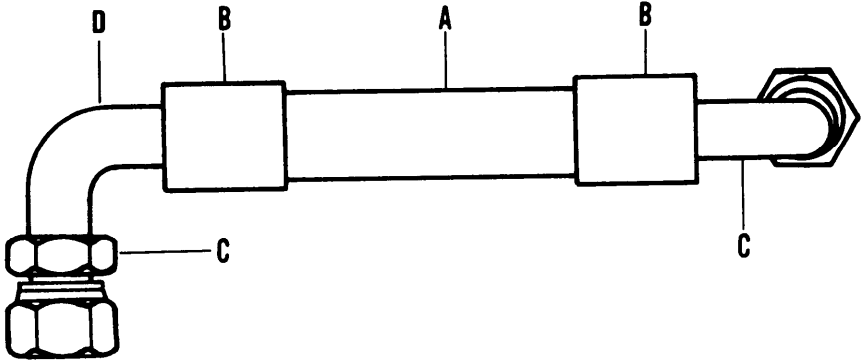


Figure C-3



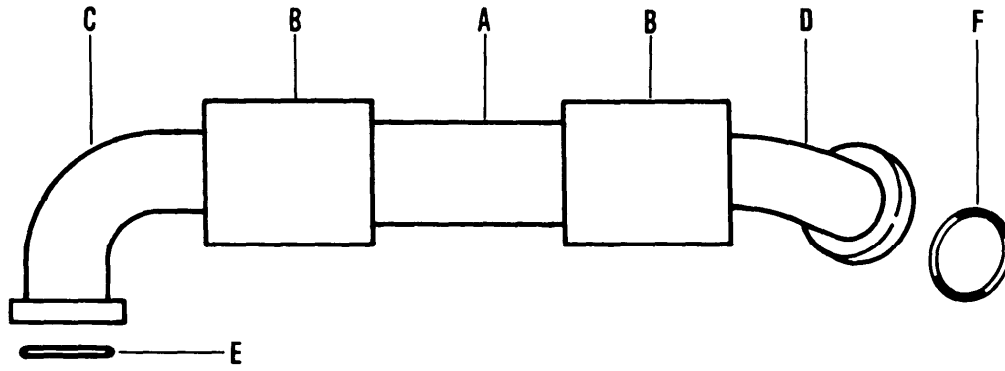
A		B		C
HOSE ASSEMBLY	BULK HOSE NO.	HOSE LENGTH	STEM ASSEMBLY	STEM ASSEMBLY
3P6146	5P0734	37.60 in.	30000-6-65	BT05-06NJ

Figure C-4



A		B		C	D
HOSE ASSEMBLY	BULK HOSE NO.	HOSE LENGTH	SLEEVE/PLUNGER NO. (QTY)	STEM ASSEMBLY	STEM ASSEMBLY
5R6254	2P5943	74.02 in.	4S5414 (2)	8S6393	8S6393
5R6253	2P5943	55.51 in.	8S5414 (2)	8S6393	8S6393

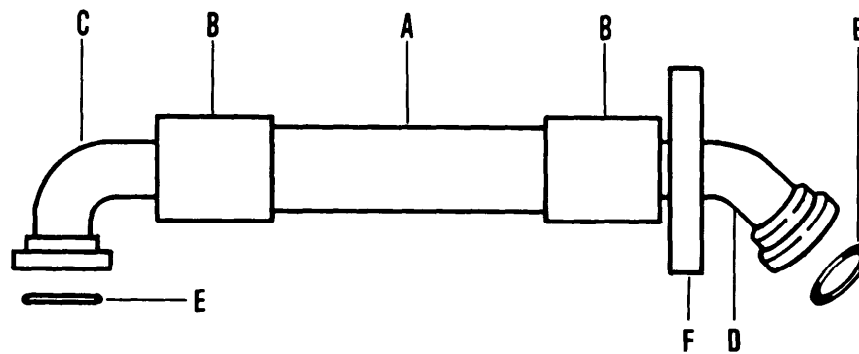
Figure C-5



	A	B	C	D	E	F	
HOSE ASSEMBLY	BULK HOSE NO.	HOSE LENGTH	SLEEVE/PLUNGER NO. (QTY)	STEM ASSEMBLY	STEM ASSEMBLY	PACKING	PACKING
3P5725	8S9355	17.13 in.	3S7252 (2)	6D9961	5P0922	4J0520	4J0522
8P2685	8S9355	10.63 in.	3S7252 (2)	3S8503	3S8497	4J0520	4J0520
3P6022	8S9355	67.91 in.	3S7252 (2)	2P4813	3S8497	4J0522	4J0520
5R6256	9S0247	34.65 in.	3S7166 (2)	6V4676	6V4664	N/A*	N/A*
5R6255	9S0247	29.53 in.	3S7166 (2)	6V4679	6V4664	N/A*	N/A*

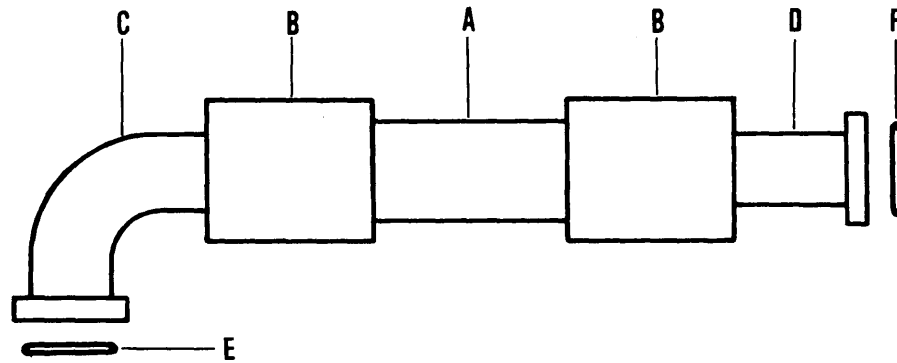
\* NOT APPLICABLE

Figure C-6



	A	B	C	D	E	F	
HOSE ASSEMBLY	BULK HOSE NO.	HOSE LENGTH	SLEEVE/PLUNGER NO. (QTY)	STEM ASSEMBLY	STEM ASSEMBLY	PACKING NO. (QTY)	FLANGE
7G7106	9S247	29.13 in.	3S7166 (2)	6V4676	6V4672	4J0520 (2)	2M5762

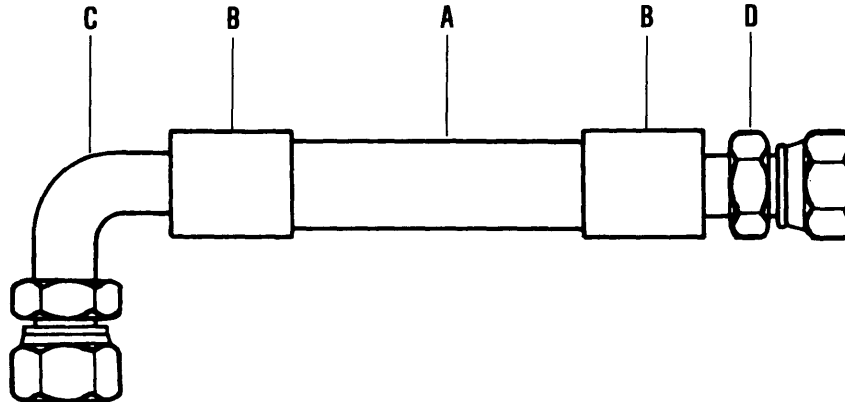
Figure C-7



A		B		C	D	E	F
HOSE ASSEMBLY	BULK HOSE NO.	HOSE LENGTH	SLEEVE/PLUNGER NO.	STEM ASSEMBLY	STEM ASSEMBLY	PACKING	PACKING
3P5724	8S9355	13.27 in.	3S7252 (2)	5S2105	7S0570	4J0520	4J0522
3P4825	8S9355	109.72 in.	3S7252 (2)	7S0574	3S8496	4J0522	Z-219N709-90
5R6258	5P0179	178.74 in.	3S8606 (2)	5S9593	3S8617	N/A*	N/A*
5R6257	5P0179	167.71 in.	3S8606 (2)	3S8975	3S8617	N/A*	N/A*

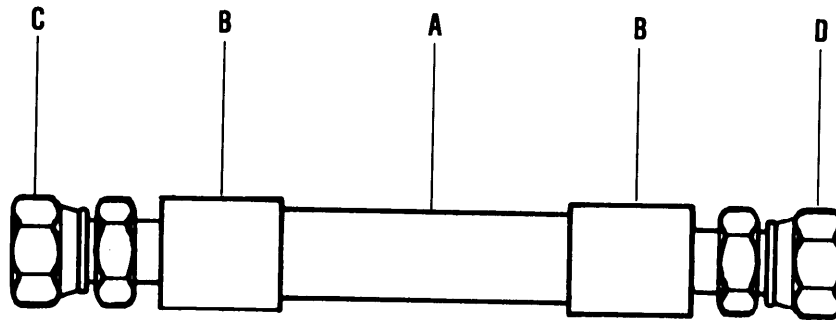
\* NOT APPLICABLE

Figure C-8



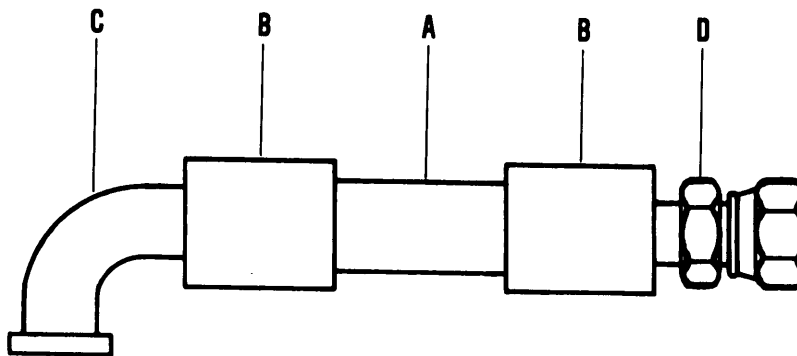
A		B		C	D
HOSE ASSEMBLY	BULK HOSE NO.	HOSE LENGTH	SLEEVE/PLUNGER NO.	STEM ASSEMBLY	STEM ASSEMBLY
5R7250	9S0671	19.29 in.	3S8606 (2)	8S6391	8S4055
5R6252	2P5943	19.68 in.	4S5414 (2)	8S6393	8S6417
5R6251	2P5943	62.99 in.	4S5414 (2)	8S6392	8S6417

**Figure C-9**



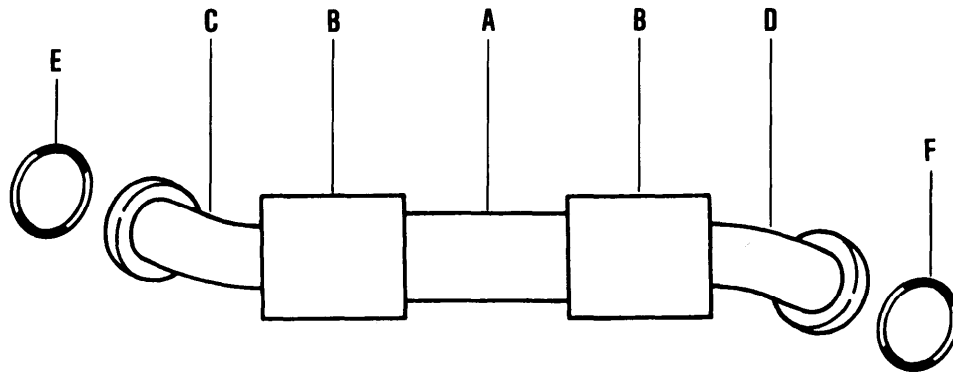
	A		B		C	D
HOSE ASSEMBLY	BULK HOSE NO.	HOSE LENGTH	SLEEVE/PLUNGER NO.	(QTY)	STEM ASSEMBLY	STEM ASSEMBLY
5R6248	9S0247	23.39 in.	3S7166	(2)	6V4657	6V4657
5R6259	2P5943	16.14 in.	4S5414	(2)	8S6417	8S6417
9D5988	2P5943	11.42 in.	4S5414	(2)	8S6417	8S6417

**Figure C-10**



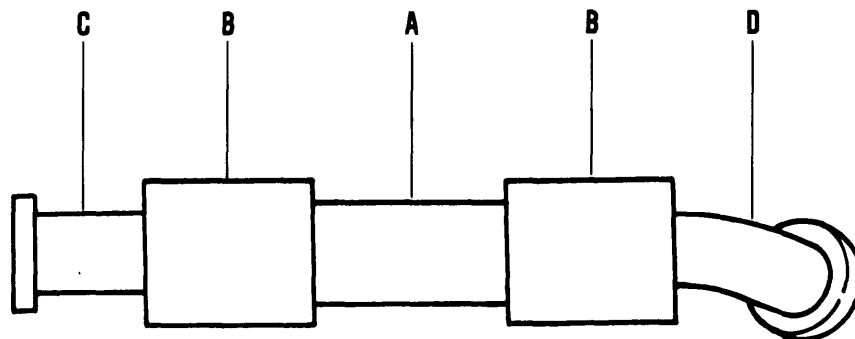
	A		B		C	D
HOSE ASSEMBLY	BULK HOSE NO.	HOSE LENGTH	SLEEVE/PLUNGER NO.	(QTY)	STEM ASSEMBLY	STEM ASSEMBLY
5R7249	9S0247	15.75 in.	3S7166	(2)	6V4676	6V4657

Figure C-11



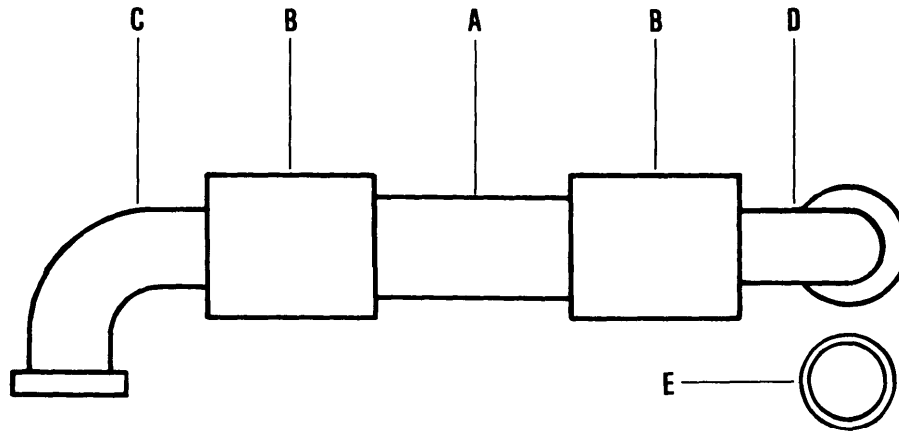
A		B		C	D	E	F	
HOSE ASSEMBLY	BULK HOSE NO.	HOSE LENGTH	SLEEVE/PLUNGER NO.	(QTY)	STEM ASSEMBLY	STEM ASSEMBLY	PACKING	PACKING
3P4833	8S9355	36.42 in.	3S7252	(2)	7S0574	3S8501	4J0522	Z-219N709-90

Figure C-12



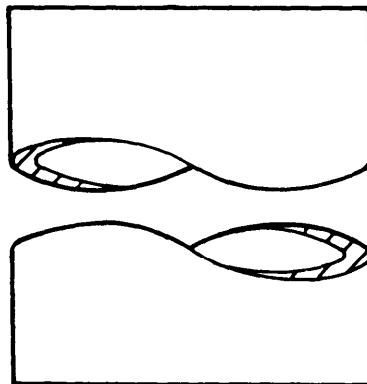
A		B		C	D	
HOSE ASSEMBLY	BULK HOSE NO.	HOSE LENGTH	SLEEVE/PLUNGER NO.	(QTY)	STEM ASSEMBLY	STEM ASSEMBLY
5R6247	9S0247	24.60 in.	3S7166	(2)	6V4651	6V4658
5R6250	9S0671	213.38 in.	3S8606	(2)	3S8617	5S9614
5R6249	9S0671	222.83 in.	3S8606	(2)	3S8617	5S9614

**Figure C-13**



	A		B		C	D	E
HOSE ASSEMBLY	BULK HOSE NO.	HOSE LENGTH	SLEEVE/PLUNGER NO.	(QTY)	STEM ASSEMBLY	STEM ASSEMBLY	PACKING
9P2895	8S9355	44.88 in.	3S7252	(2)	2P4813	2P4813	4J0522

**Figure C-14**



BULK HOSE

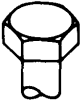



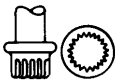




HOSE PART NO.	HOSE LENGTH
5P1442	27.55 in.
5P1263	8.27 in.
5P1262-5	4.34 in.
5P1262-6	4.73 in.
9L1794	3.00 in.
4S6825	4.5 in.
5P7760-51	20.08 in.
5P7760-150	59.06 in.
5P0580-44	44 in.

**APPENDIX D**  
**TORQUE LIMITS**

**D-1. SCOPE**

Table D-1 gives the standard torque values for capscrews, nuts and taperlock studs used on the D7G tractor of SAE Grade 1 and better. Exceptions to the following values are given in the maintenance task w-here appropriate.

**D-2 . CAPSREW MARKING**

Current Usage	Much Used	Much Used	Used at Times	Used at Times
Quality of Material	Indeterminate	Minimum Commercial	Medium Commercial	Best Commercial
SAE Grade Number	1 or 2	5	6 or 7	8
Capscrew Head Markings			6  7 	 
Manufacturer's marks may vary				
These are all SAE Grade 5 (3 line)	  			

**D-3 . STANDARD TORQUE VALUES**

**CAUTION**

If replacement capscrews are of a higher grade than originally supplied, use torque specifications for that replacement, not for the grade. This will prevent equipment damage due to overtorquing.

Always use the torque values listed when specific torque values are not available.

Do not use values in place of those specified in other sections of this manual; special attention should be observed when using SAE Grade 6, 7 and 8 capscrews.

Reduce torque by 10 percent when engine oil is used as a lubricant.

Reduce torque by 20 percent if new plated capscrews are used.

Capscrews threaded into aluminum may require reductions in torque of 30 percent or more of Grade 5 capscrews torque and must attain two capscrew diameters of thread engagement.

Table D-1. Standard Torque Limits

Capscrew Body Size Diameter TPI	Grade 1/2 Torque lb. ft. (N.m)	Grade 5 Torque lb. ft. (N.m)	Grade 6/7 Torque lb. ft. (N.m)	Grade 8 Torque lb. ft. (N.m)
------------------------------------	--------------------------------------	------------------------------------	--------------------------------------	------------------------------------

**NOTE**

Use these torques for standard capscrews and nuts with clean, dry threads.

1/4	20	5 (7)	8 (11)	10 (14)	12 (16)
	28	6 (8)	10 (14)		14 (19)
5/16	18	11 (15)	17 (23)	19 (26)	24 (33)
	24	13 (18)	19 (26)		27 (37)
3/8	16	18 (24)	31 (42)	34 (46)	44 (60)
	24	20 (27)	35 (47)		49 (66)
7/16	14	28 (38)	49 (66)	55 (75)	70 (95)
	20	30 (41)	55 (75)		78 (106)
1/2	13	39 (53)	75 (102)	85 (115)	105 (142)
	20	41 (56)	85 (115)		120 (163)
9/16	12	51 (69)	110 (149)	120 (163)	155 (210)
	18	55 (75)	120 (163)		170 (231)
5/8	11	83 (113)	150 (203)	167 (226)	210 (285)
	18	95 (129)	170 (231)		240 (325)
3/4	10	105 (142)	270 (366)	280 (380)	375 (508)
	16	115 (156)	295 (400)		420 (569)
7/8	9	160 (217)	395 (536)	440 (597)	605 (820)
	14	175 (237)	435 (590)		675 (915)
1	8	235 (319)	590 (800)	660 (895)	910 (1234)
	14	250 (339)	660 (895)		990 (1342)

**NOTE**

Use these torques for capscrews and nuts on hydraulic valve bodies with clean, dry threads.

5/16	18	-	14 (19)	-	-
3/8	16	-	25 (34)	-	-
7/16	14	-	40 (54)	-	-
1/2	13	-	61 (82)	-	-
5/8	11	-	120 (162)	-	-



Table D-1. Standard Torque Limits (Cont'd)

Capscrew Body Size		Grade 1/2 Torque		Grade 5 Torque		Grade 6/7 Torque		Grade 8 Torque	
Diameter	TPI	lb. ft.	(N.m)	lb. ft.	(N.m)	lb. ft.	(N.m)	lb. ft.	(N.m)
<b>NOTE</b>									
Use these torques for studs with clean, dry taperlock threads.									
1/4	20	-	-	6	(8)	-	-	-	-
5/16	18	-	-	11	(16)	-	-	-	-
3/8	16	-	-	21	(29)	-	-	-	-
7/16	14	-	-	32	(43)	-	-	-	-
1/2	13	-	-	42	(58)	-	-	-	-
9/16	12	-	-	65	(87)	-	-	-	-
5/8	11	-	-	80	(107)	-	-	-	-
3/4	10	-	-	117	(160)	-	-	-	-
7/8	9	-	-	180	(242)	-	-	-	-
1	8	-	-	275	(375)	-	-	-	-
1-1/8	8	-	-	335	(455)	-	-	-	-
1-1/4	8	-	-	420	(565)	-	-	-	-
1-3/8	8	-	-	500	(675)	-	-	-	-
1-1/2	6	-	-	575	(780)	-	-	-	-

## GLOSSARY

## Section I. ABBREVIATIONS

STE/ICE .....	Simplified test equipment for internal combustion engines
gpm .....	Gallons per minute
psi .....	Pounds per square inch
ROPS .....	Rollover protective structure
RPM .....	Revolutions per minute
TDC .....	Top dead center
kPa .....	Kilo pascals
DC .....	Direct current
V .....	Volts
AC .....	Alternating current
A .....	Amperes or Amps
SAE .....	Society of Automotive Engineers
lg .....	long
PTO .....	Power take-off
dia. ....	diameter

## Section II. DEFINITIONS OF UNUSUAL TERMS

Pusharm - One on each side of dozer; attaches blade to roller frame.

Transducer - A device that transmits power from one system to another.

Electrolyte - A substance when introduced to liquid is capable of conducting electric current.

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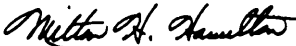
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By Order of the Secretary of the Army:

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

Official:

  
MILTON H. HAMILTON  
*Administrative Assistant to the*  
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PAGE NO	PARA-GRAPH	FIGURE NO	TABLE NO
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IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

Item 10. Change illustration. Reason: Tube end shown assembled on wrong side of lever cam.

Item 3. The NSN and P/N are not listed on the AMDF nor the MCRL. Request correct NSN and P/N be furnished.

Preventive Maintenance Checks and Services. Item 7 under "Items to be inspected" should be changed to read as follows: Firing linkage and firing mechanism pawl.

Since there are both 20- and 30- round magazines for this rifle, data on both should be listed.

SAMPLE

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DEPARTMENT OF THE ARMY

TEAR ALONG PERFORATED LINE

Commander  
US Army Tank-Automotive Command  
ATTN: AMSTA-MB  
Warren, Michigan 48397-5000

**THE METRIC SYSTEM AND EQUIVALENTS**

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches  
 1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches  
 1 Kilometer = 1000 Meters = 0.621 Miles

SQUARE MEASURE

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inches  
 1 Sq Meter = 10,000 Sq Centimeters = 10.76 Sq Feet  
 1 Sq Kilometer = 1,000,000 Sq Meters = 0.386 Sq Miles

WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces  
 1 Kilogram = 1000 Grams = 2.2 Lb  
 1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

CUBIC MEASURE

1 Cu Centimeter = 1000 Cu Millimeters = 0.06 Cu Inches  
 1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces  
 1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

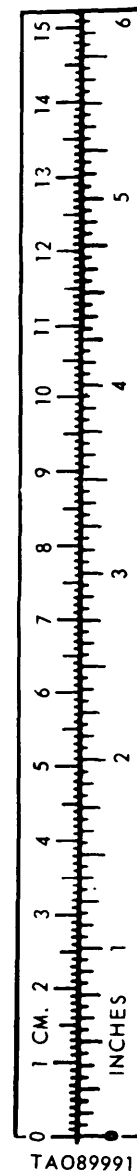
TEMPERATURE

$5 \text{ } ^\circ\text{F} - 32 = ^\circ\text{C}$   
 212<sup>o</sup> Fahrenheit is equivalent to 100<sup>o</sup> Celsius  
 90<sup>o</sup> Fahrenheit is equivalent to 32.2<sup>o</sup> Celsius  
 32<sup>o</sup> Fahrenheit is equivalent to 0<sup>o</sup> Celsius  
 $9 \text{ } ^\circ\text{C} + 32 = ^\circ\text{F}$

APPROXIMATE CONVERSION FACTORS

<u>TO CHANGE</u>	<u>TO</u>	<u>MULTIPLY BY</u>
Inches . . . . .	Centimeters . . . . .	2.540
Feet . . . . .	Meters . . . . .	0.305
Yards . . . . .	Meters . . . . .	0.914
Miles . . . . .	Kilometers . . . . .	1.609
Square Inches . . . . .	Square Centimeters . . . . .	6.451
Square Feet . . . . .	Square Meters . . . . .	0.093
Square Yards . . . . .	Square Meters . . . . .	0.836
Square Miles . . . . .	Square Kilometers . . . . .	2.590
Acres . . . . .	Square Hectometers . . . . .	0.405
Cubic Feet . . . . .	Cubic Meters . . . . .	0.028
Cubic Yards . . . . .	Cubic Meters . . . . .	0.765
Fluid Ounces . . . . .	Milliliters . . . . .	29.573
Pints . . . . .	Liters . . . . .	0.473
Quarts . . . . .	Liters . . . . .	0.946
Gallons . . . . .	Liters . . . . .	3.785
Ounces . . . . .	Grams . . . . .	28.349
Pounds . . . . .	Kilograms . . . . .	0.454
Short Tons . . . . .	Metric Tons . . . . .	0.907
Pound-Feet . . . . .	Newton-Meters . . . . .	1.356
Pounds per Square Inch . . . . .	Kilopascals . . . . .	6.895
Miles per Gallon . . . . .	Kilometers per Liter . . . . .	0.425
Miles per Hour . . . . .	Kilometers per Hour . . . . .	1.609

<u>TO CHANGE</u>	<u>TO</u>	<u>MULTIPLY BY</u>
Centimeters . . . . .	Inches . . . . .	0.394
Meters . . . . .	Feet . . . . .	3.280
Meters . . . . .	Yards . . . . .	1.094
Kilometers . . . . .	Miles . . . . .	0.621
Square Centimeters . . . . .	Square Inches . . . . .	0.155
Square Meters . . . . .	Square Feet . . . . .	10.764
Square Meters . . . . .	Square Yards . . . . .	1.196
Square Kilometers . . . . .	Square Miles . . . . .	0.386
Square Hectometers . . . . .	Acres . . . . .	2.471
Cubic Meters . . . . .	Cubic Feet . . . . .	35.315
Cubic Meters . . . . .	Cubic Yards . . . . .	1.308
Milliliters . . . . .	Fluid Ounces . . . . .	0.034
Liters . . . . .	Pints . . . . .	2.113
Liters . . . . .	Quarts . . . . .	1.057
Liters . . . . .	Gallons . . . . .	0.264
Grams . . . . .	Ounces . . . . .	0.035
Kilograms . . . . .	Pounds . . . . .	2.205
Metric Tons . . . . .	Short Tons . . . . .	1.102
Newton-Meters . . . . .	Pound-Feet . . . . .	0.738
Kilopascals . . . . .	Pounds per Square Inch . . . . .	0.145
Kilometers per Liter . . . . .	Miles per Gallon . . . . .	2.354
Kilometers per Hour . . . . .	Miles per Hour . . . . .	0.621





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