

TECHNICAL MANUAL
DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

FOR

**CONTAINER CRANE, 40-TON,
ROUGH TERRAIN, MODEL RT875CC
NSN 3810-01-205-2716**

This manual shall be used in place of the Direct Support and General Support maintenance portions of the GROVE Manufacturing Company Commercial Maintenance Manual No. 7-187-000004-2 dated 1 Feb 89, the PAT Equipment Corp. Troubleshooting Manual DS350M dated January 1989 and the Cummins Engine C Series Shop Manual dated 1986, originally overpacked with the crane.

Approved for public release; distribution is unlimited.

HEADQUARTERS, DEPARTMENT OF THE ARMY

25 FEBRUARY 1993

WARNING**CARBON MONOXIDE (EXHAUST GAS) CAN KILL YOU**

Carbon monoxide is without color or smell, but can kill you. Breathing air with carbon monoxide produces symptoms of headache, dizziness, loss of muscular control, a sleepy feeling, and coma. Brain damage or death can result from heavy exposure. Carbon monoxide occurs in the exhaust fumes of fuel-burning heaters and internal combustion engines. Carbon monoxide can become dangerously concentrated under conditions of no air movement. Precautions must be followed to insure crew safety when the personnel heater, main or auxiliary engine of any vehicle is operated for any purpose.

1. DO NOT operate personnel heater or engine of vehicle in a closed place unless the place has a lot of moving air.
2. DO NOT idle engine for long periods without ventilator blower operating. If tactical situation permits, open hatches.
3. DO NOT drive any vehicle with inspection plates, cover plates, or engine compartment doors removed unless necessary for maintenance purposes.
4. BE ALERT at all times during vehicle operation for exhaust odors and exposure symptoms. If either is present, IMMEDIATELY VENTILATE personnel compartments. If symptoms persist, remove affected crew to fresh air; keep warm; DO NOT PERMIT PHYSICAL EXERCISE; if necessary, give artificial respiration.

FOR ARTIFICIAL RESPIRATION, REFER TO FM21-11.

5. BE AWARE; the field protective mask for chemical-biological-radiological (CBR) protection will not protect you from carbon monoxide poisoning.

THE BEST DEFENSE AGAINST CARBON MONOXIDE POISONING IS GOOD VENTILATION.

WARNING**DRY CLEANING SOLVENT P-D-680 IS TOXIC AND FLAMMABLE**

1. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and don't breath vapors.
2. Do not use near open flame or excessive heat. Flash point is 100° F 1380 F (380 590 C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

CAUTION**COMPRESSED AIR USED FOR CLEANING PURPOSES WILL NOT EXCEED 30 PSI**

1. Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).

WARNING

DISCONNECT BATTERIES BEFORE PERFORMING ANY MAINTENANCE ON THE ELECTRICAL SYSTEM

1. Serious burns may result from accidental shorting or grounding of live circuits.
2. If it should become necessary to perform electrical maintenance on live or hot circuits, remove all rings, watches, and other jewelry before performing maintenance as serious burns result from accidental grounding or shorting circuits.

WARNING

EYE CONTACT WITH SILICONE RTV MATERIALS MAY CAUSE IRRITATION

1. If eye contact takes place, flush the eyes with water for 15 minutes and have eyes examined by a doctor.

WARNING

EXERCISE EXTREME CARE AROUND PRESSURIZED HYDRAULIC SYSTEMS

1. Do not work on a hydraulic system while it is in operation or until all pressure is released.

WARNING

DO NOT ATTEMPT TO DEMOUNT OR MOUNT TIRES WITHOUT PROPER TRAINING

1. Tire and wheel assembly shall be placed in a tire cage. High pressure involved can cause tire and rim parts and tools to fly with explosive force, causing severe injury or death to personnel and damage to the crane and surrounding area.
2. When separating tire bead and flange, stand to side of tire bead separator to ensure that if tool slips off, the operator will not be injured.

CHANGE

NO. 2

TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

FOR

**CONTAINER CRANE, 40-TON,
ROUGH TERRAIN, MODEL RT875CC
NSN 3810-01-205-2716**

TM 5-3810-306-34, 25 February 1993 is changed as follows:

1. Remove old pages and insert new pages as indicated below.
2. New or changed material is indicated by a vertical bar in the margin.
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JOEL B. HUDSON
Administrative Assistant to the
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DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

**FOR
CONTAINER CRANE, 40TON
ROUGH TERRAIN, MODEL RT875CC
NSN 381001-2052716**

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Official:


MILTON H. HAMILTON
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FOR**

**CONTAINER CRANE, 40-TON
ROUGH TERRAIN, MODEL RT875CC
NSN 381001-205-2716**

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: US Army Tank Automotive Command, ATTN: AMSTA-MB, Warren, MI 48090-5000. A reply will be furnished to you.

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CHAPTER 1
INTRODUCTION

Section I. GENERAL INFORMATION

SCOPE

Type of Manual: Direct Support and General Support Maintenance

Model Number and Equipment Name:

RT875CC - Container Crane, Rough Terrain
Wheel Mounted, Hydraulic, Diesel Powered

Purpose of Equipment: Provides for 360 degree boom travel and 80,000 lbs (40 Tons) lifting capacity in rough terrain conditions.

MAINTENANCE FORMS, RECORDS, AND REPORTS

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.

Accidents involving injury to personnel or damage to materiel will be reported on DA Form 285 (Accident Report) in accordance with AR385-40.

Explosives and ammunition malfunctions will be reported in accordance with AR75-1.

DESTRUCTION OF ARMY MATERIEL TO PREVENT ENEMY USE

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

PREPARATION FOR STORAGE OR SHIPMENT

Before the Container Crane is stored for a long period of time, shipped to a distant location, or returned to service after a period of time, certain guidelines/procedures must be followed. Refer to Chapter 18, Preparation for Storage and Shipment in TM 5-3810-306-20.

REPORTING EQUIPMENT IMPROVEMENT RECOMMENDATIONS (EIR)

If your RT875CC Container Crane 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. Put it on an SF 368 (Quality Deficiency Report). Mail it to us at U.S. Army Tank Automotive Command, Attn: AMSTA-QRT, Warren, MI 48090. We'll send you a reply.

WARRANTY INFORMATION

The RT875CC Rough Terrain Container Crane is warranted by Grove Manufacturing Company for 18 months. Warranty starts on the date found on DA Form 2410 or DA Form 2408-16 in the logbook. Report all defects in materiel or workmanship to your supervisor who will take appropriate action. Refer to Warranty Technical Bulletin TB 5-3810-306-14.

Section II. EQUIPMENT DESCRIPTION AND DATA

EQUIPMENT CHARACTERISTICS, CAPABILITIES, AND FEATURES

RT875CC Rough Terrain Container Crane

- Axle steering accomplished by utilizing hydraulic steer cylinders
- Welded steel frame
- Engine mounted at rear of crane
- Superstructure
- Sliding beam outriggers are integral with carrier frame
- Remote mounted six speed transmission
- Four-wheel drive

Capability and Features

- Automatic axle oscillation when superstructure travels more than 5 degrees from travel position.
- All crane functions controlled from cab.
- Superstructure capable of 360 degree rotation in either direction.
- Lifting is provided by main and auxiliary hoists.
- Equipped with two section, trapezoidal boom.
- Integral fifth wheel, to which rear axle is mounted, provides axle oscillation.

LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

Counterweight. Bolted onto turntable to be part of turntable assembly. Weighs 12,500 pounds.

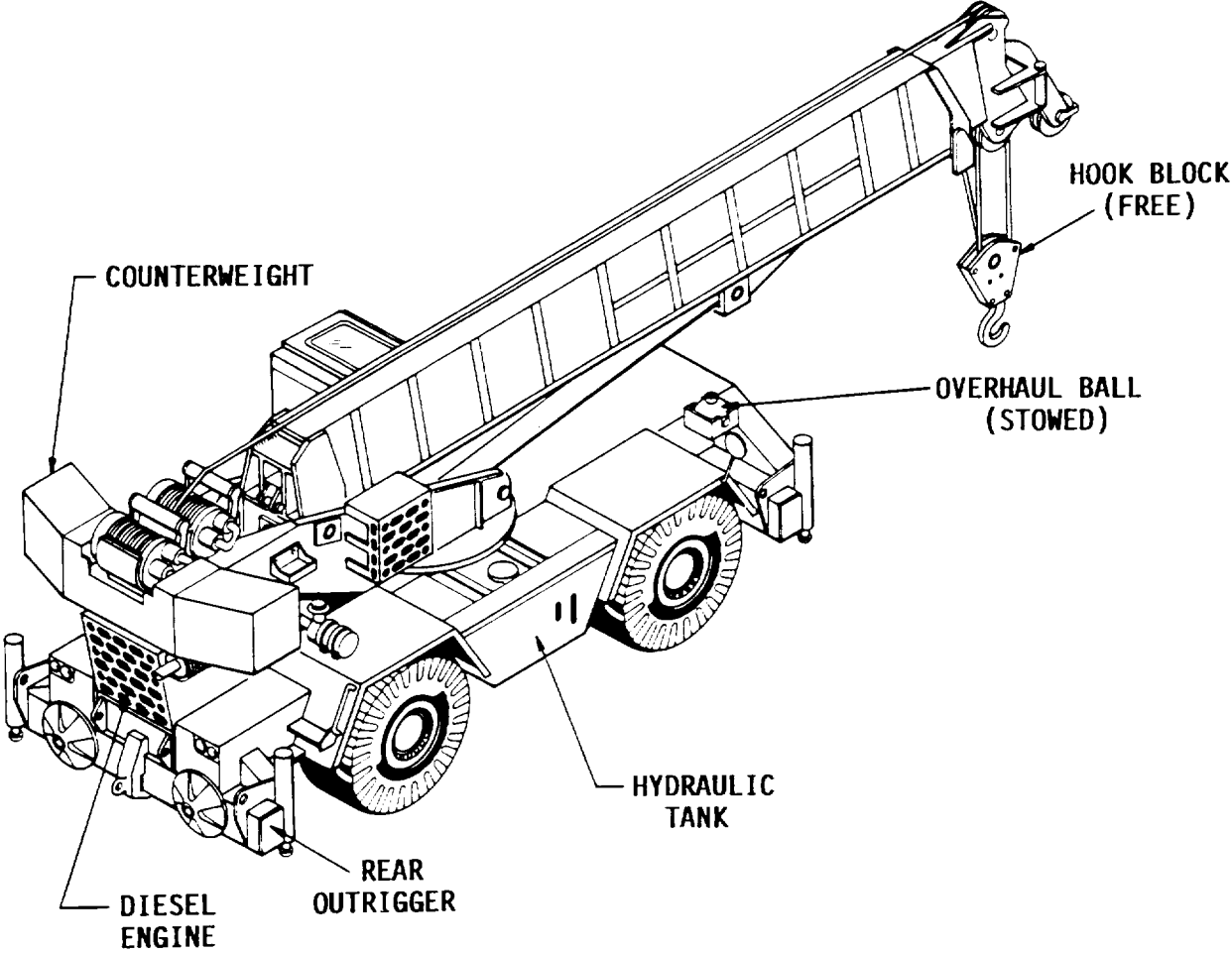
Hookblock. Provides lifting capability while boom is retracted. Capable of lifting 40 tons and utilizes one-piece pivot block with a safety latch.

Overball Ball. Mounted on the auxiliary boom-nose. Ball can be stored during travel. Capable of lifting 5 tons.

Hydraulic Tank. 165 gallon capacity. Supplies hydraulic oil to hydraulic valve banks. Located on right side of carrier frame. Uses a magnetized drain plug to collect metal particles in tank and a sight gauge to indicate oil level.

Rear Outrigger. Mounted on rear stabilizer box. Extends when selector valve in outrigger control panel is operated. Stabilizes rear portion of crane during lifting operations.

Diesel Engine. Cummins 6CTA8.3 turbo-charged diesel engine. Speed is controlled by a foot operated air throttle valve. Access to engine is gained through two side doors in hood assembly.



LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

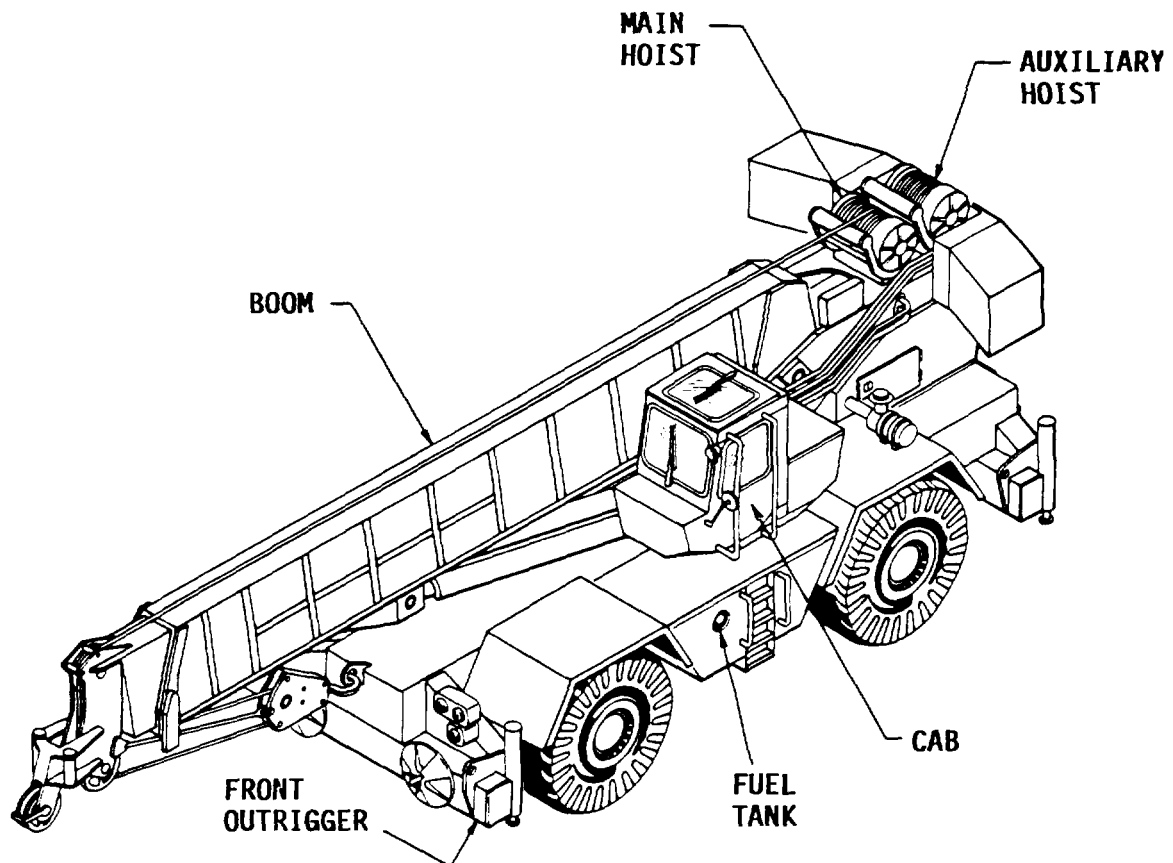
Boom. Extends from 34 to 60 feet with one full powered telescoping section. Trapezoidal in design and uses one 6.50-inch telescope cylinder to extend and retract boom. Boom elevation is from -4° degrees (below horizontal) to $+80^{\circ}$ degrees. Supports main and auxiliary boom nose.

Main/Auxiliary Hoists. The hoists provide power for all load raising and lowering operations. Two hydraulic motors drive each hoist drum by means of a planetary gear reduction system. A metallic disc brake is also an integral part of the hoist assembly, and operates automatically when the control lever is in neutral.

Cab. Contains controls and indicators for roading and crane operations. Enclosed in an all steel, acoustically treated enclosure, surrounded with tinted safety glass.

Fuel Tank. Is a steel cylinder-type tank located below the left fender. Two connections on top of tank provide for fuel supply to engine and return of surplus form engine. Equipped with a lock type filter cap and fuel quantity sender. Fuel tank has a draw capacity of 100 gallons.

Outriggers. The outriggers, part of the carrier frame, are controlled and operated from the cab. They are full hydraulic, double box type. When positioned they provide a rigid four-point platform (fully extended and set) capable of supporting the machine and its maximum load capacity. Integral holding valves and floats are provided.



EQUIPMENT DATA

General

Grove Manufacturing Co. Model No..... RT875CC
 Drive 4 x 4
 Gross Weight 94,500 lbs. (42,865 kg)

NOTE

Dimensions listed are for a crane with all components fully retracted and in the travel mode.

Dimensions

Wheel Base 170 inches (431.8 cm)
 Overall Crane Length 46.3 feet (14.1 cm)
 Overall Crane Width 144 inches (365.76 cm)
 Overall Crane Height..... 156.75 inches (398.15 cm)
 Tail-swing 171 inches (434.43 cm)
 Curb Clearance Circle (4W Steer Mode)50.2 feet (15.3 m)

Capacities

Fuel Tank 100 gallons (378.50 liters)
 Hydraulic Tank 165 gallons (624.52 liters)
 Coolant System 44 quarts (41.6 liters)
 Engine Lubrication System..... 23.7 quarts (22.42 liters)
 Hoists (each) 10 quarts (9.46 liters)
 Swing Gearbox..... 15 quarts (14.2 liters)
 Axle Planetary Ends 58 pints (27.45 liters)
 Axle Drive Unit..... 30 pints (14.2 liters)
 Transmission 8.6 gallons (32.6 liters)

Fire Extinguisher

Manufacturer Walter Kidde
 Model..... 897213-10BC-23/4
 Type.....Dry
 Rating 10 BC
 Weight 2.75 pounds (1.2 kg)

Engine

Manufacturer Cummins
 Model..... 6CTA8.3
 Type.....6 cyl. OHV, diesel
 Combustion 4 cycle, turbo-charged, after-cooled
 Bore and Stroke 4.49 in. x 5.32 in. (114 mm x 135 mm)
 Displacement..... 504.5 cu. in. (8.27 liters)
 Horsepower (Gross)..... 250
 Torque (Gross) 650 ft. lb. @ 1800 RPM
 Cooling System 44 quarts (41.6 liters)
 Air Cleaner..... 2 stage, dry type

Air Compressor

Manufacturer Cummins
Model..... 3051041
Number of Cylinders..... 1
Piston Displacement @ 1250 rpm..... 13.2 cfm (6230 cm /sec)

Hydraulic Pumps

Manufacturer Commercial Shearing
Model - 3-section..... 313-9632-002
2-section..... 313-9320-536
Type..... Gear
Sections..... 1 - two section and 1 - three section
GPM3 - 50 gpm and 2 - 27 gpm
@ 2400 rpm

Swing Motor

Manufacturer Char-Lynn
Model..... 101-1086
Type..... Genotor
Displacement..... 17.9 cu. in./rev. (293 cu. cm)

Swing Gearbox

Manufacturer Grove
Model..... GB-200A
Type..... Gear Reduction
Reduction Ratio..... 20.2 : 1

Boom

Manufacturer Grove
Model..... 2-187-900028
Length..... 34.4 - 64.4 feet
(10.5 - 18.4 M)
Elevation..... -4 to +80 degrees

Main and Auxiliary Hoists

Manufacturer Grove
Model..... HO 30E-16
Drum Dimensions
Diameter 16 inch (40.64 cm)
Length 16 inch (40.64 cm)
Cable Capacity With Cable Dia. of 0.75 inch (19mm)
16 inch (40.64 cm) Drum 525 feet (160 m)
Permissible Line Pull Refer to the Line Pulls
and Reeving Info Chart in the Cab

Counterweight

Manufacturer Grove
Model.....2-187-200063
Type..... Fixed-Bolted On
Weight 12,500 lbs. (5,670 kgm)

Outriggers

Manufacturer Grove
Model.....2-187-100108
Type..... Double box beam and jack
Extended Length 288 inches (731.52 cm)
Retracted Length 133 inches (337.82 cm)

Hydraulic Swivel

Manufacturer Grove
Model.....6-364-001428
Ports 11 with dual ports on 11

Air/Hydraulic Swivel

Manufacturer Grove
Model.....6-364-001600
Air Ports..... 5
Oil Ports..... 7

Electrical System

Type..... Single wire ground return (chassis)
System Voltage 24
Starting Voltage 24
Batteries
Number(4)
Rating..... 610 CCA @ 0° F
Alternator 65 AMP, 24 Volt

Emergency Steer Pump

Manufacturer John S. Barnes
Model..... 1380004
Type..... Gear
Capacity.....5.3 gpm (20.1 lpm)
RPM..... 2400
Voltage24 volts

Cab Heater

ManufacturerWebasto
Model..... 468-657
Type..... Internal Combustion
Voltage 24 Volts
Fuel..... Diesel
Heat Output15,000 Btu/hr

SAFETY, CARE AND HANDLING

Safety

Your safety and that of others is always the number one consideration when working around machines. Safety is a matter of thoroughly understanding the job to be done and the application of good common sense. It is not just a matter of do's and don'ts. Stay clear of all moving parts.

Care and Handling

When performing maintenance, do not attempt to manually lift heavy parts when hoisting equipment should be used. Never locate or leave heavy parts in an unstable position. When raising a portion of a crane or a complete crane, ensure the crane is blocked securely and the weight is supported by blocks rather than by lifting equipment.

When using hoisting equipment, follow the hoist manufacturers recommendations and use lifting devices that will allow you to achieve the proper balance of the assemblies being lifted and to ensure safe handling.

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

Section III. PRINCIPLES OF OPERATION

INTRODUCTION

This section explains how major components in the RT875CC Container Crane work by providing a functional description and the theory of operation for each system's organizational level component.

ENGINE LUBRICATING SYSTEM

Gerotor

Oil flow begins as the gerotor type oil pump pulls oil from the oil pan through the rigid, internally mounted suction tube. The oil pump then delivers the oil through an internal drilling in the cylinder block to the oil pressure regulator, which is located in the oil cooler cover.

Pressure Regulating Valve

The pressure regulating valve relieves oil pressure during cold starting and regulates oil pressure after the oil is warm. The regulator valve remains closed until the oil pressure is approximately 315 kPa (45 PSI). When the oil pressure is greater than 315 kPa (45 PSI), the valve begins to open and pressure is relieved by allowing some of the oil to return to the pan. The valve plunger has a tapered shoulder which creates a variable opening to regulate the pressure.

Oil Cooler

From the regulator cavity, the oil flows through the cooler cover and cooler element. Coolant flowing past the plates of the element cools the oil.

Filter Bypass Valve

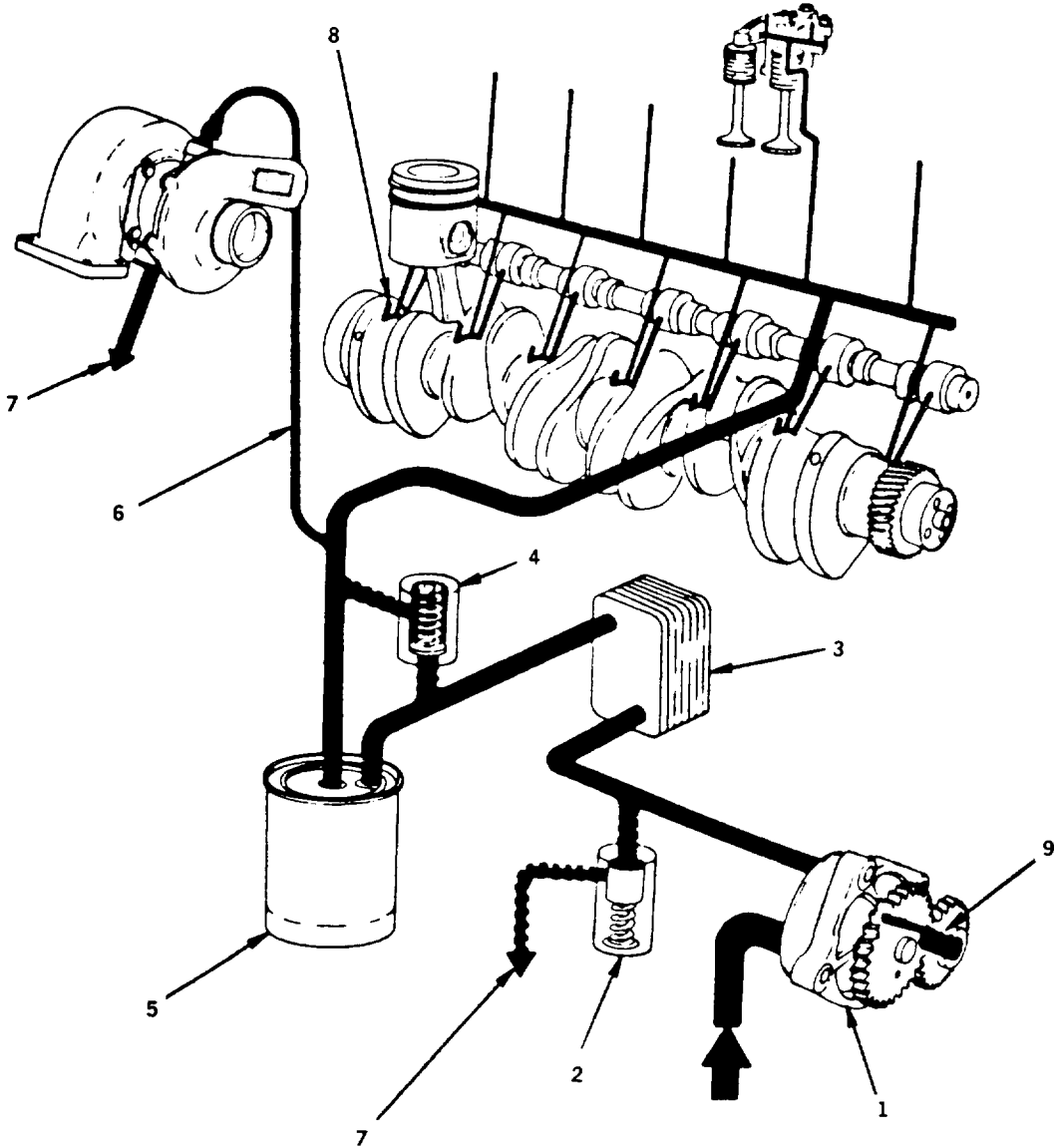
The oil cooler cover contains a bypass valve that will let the oil flow bypass a plugged oil filter. If the pressure drop across the oil filter exceeds 138 kPa (20 PSI), the bypass valve will open, allowing the oil to continue through the engine.

Oil Filter

From the cooler, the oil flows through a passage in the cooler cover to the oil filter. The filtered oil flows up to the center of the filter to the filter head.

Turbocharger and Cylinder Block

At the filter head, the oil flow is divided: A portion flows to the turbocharger; the rest flows down a passage in the cylinder block that connects to a cross drilling over the number 3 main bearing.



LEGEND

- 1. LUBRICATING OIL PUMP
- 2. PRESSURE REGULATING VALVE
- 3. OIL COOLER
- 4. FILTER BYPASS VALVE
- 5. OIL FILTER
- 6. TURBOCHARGER OIL SUPPLY
- 7. OIL RETURN TO PAN
- 8. PISTON COOLING NOZZLE
- 9. OIL PUMP IDLER GEAR

ENGINE LUBRICATION SYSTEM

FUEL SYSTEM

General

The function of the fuel system is to inject a metered quantity of clean, atomized fuel into the engine cylinders at a precise time near the end of the compression stroke of each piston. The components of the system contribute to the delivery of fuel to the cylinders.

The fuel system consists of the fuel tank, fuel-filters, strainer, water separator, fuel pump, and the fuel injectors. All components except the fuel tank are installed on the engine.

Fuel Tank

The fuel tank is a steel cylinder-type tank located on the left side of the crane. The fuel tank has a draw capacity of 100 gallons (379 liters). Two connections on top of the tank provide for fuel supply to the engine and return of surplus fuel from the engine. The tank is equipped with a locktype filler cap and a fuel quantity sender unit which provides a signal to a fuel gauge on the instrument panel in the cab.

Fuel Filter and Strainer (Pre-filter)

A replaceable spin-on type fuel filter is used in the fuel system to remove impurities. The filter is adjacent to the water separator.

The fuel strainer is mounted on the carrier frame rail on the right side of the engine. The unit includes a removable sediment bowl.

Fuel Pump

The engine has a positive displacement gear-type metering fuel pump driven by an engine power take-off. The pump supplies fuel at low pressure to the injectors, where the high pressure necessary for atomization of the fuel is created.

The fuel oil is finely atomized as it is injected into the cylinder and ignited by the heat of the compression. It is metered before injection, to meet the load requirements imposed upon the engine.

Fuel Filter-Water Separator

The replaceable spin-on type fuel filter-water separator removes water from the fuel before it reaches the engine. It is mounted on the right side of the engine.

The fuel mixture passes through the outer wrap of the first stage of the filter paper, where large droplets of water are formed as it is stripped from the fuel. The water falls out into the void between the two paper elements and goes to a reservoir in the bottom of the housing, where it can be drained through a petcock (knurled knob) at bottom of the shell.

Injection Pump

Low pressure fuel from the fuel filter and head is sent to the injection pump at 140 kPa the injection pump builds the high injection pressures required for combustion and routes the fuel through high pressure fuel lines to each injector. The injector pump is equipped with an emergency fuel shutoff solenoid.

Fuel Injectors

The engine uses a 17 mm closed-nozzle, hole-type injector. When the high-pressure fuel reaches the injector, the pressure lifts the needle valve against the spring tension to allow fuel to enter the combustion chamber.

Any leakage past the needle valve enters the fuel drain manifold. The manifold routes leakage from the injectors to the injection pump vent fitting. Fuel from the fitting is returned to the supply tank.

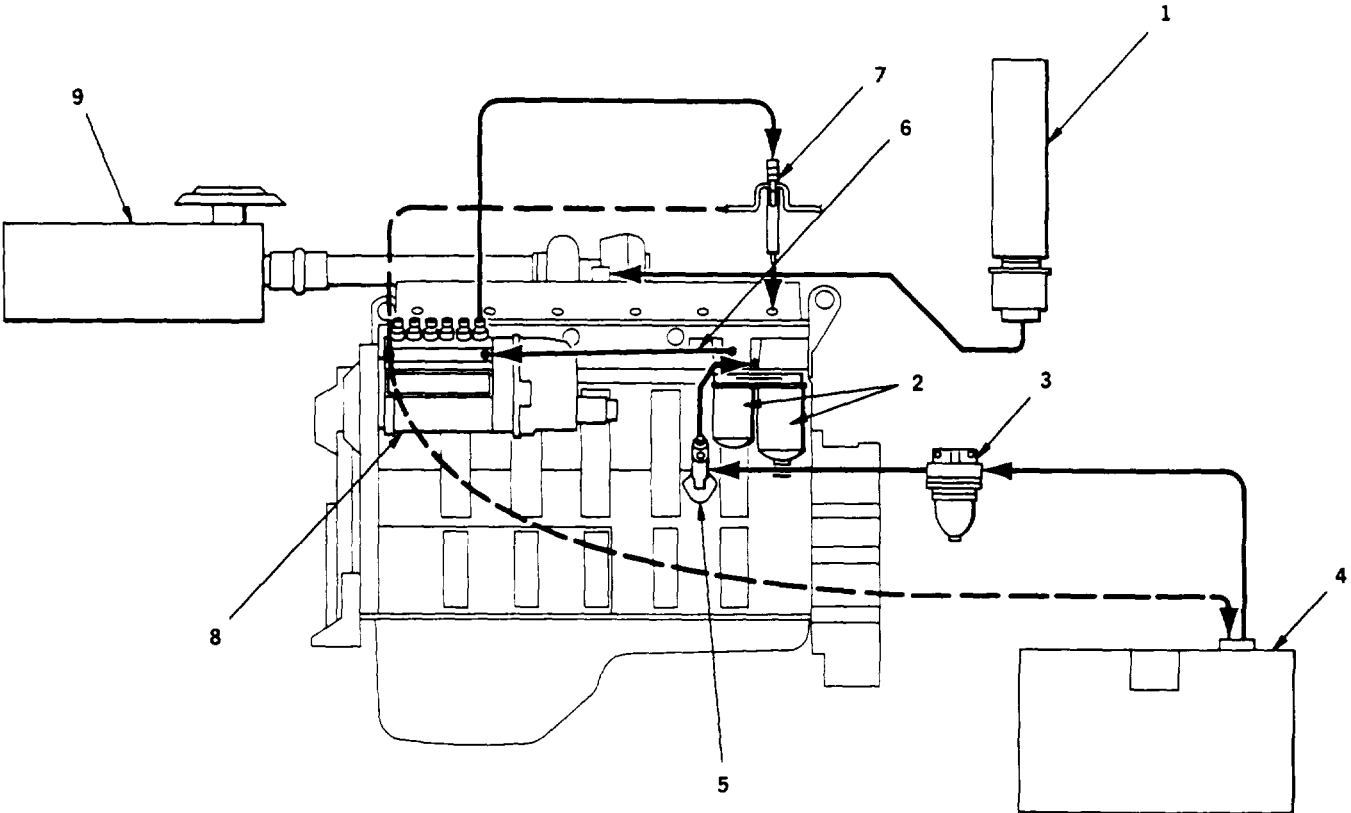
Quick Starting Kit

The quick starting system consists of an atomizer, valve assembly, starting aid bottle and temperature control. The quick start system is normally used during cold weather operations to facilitate engine starting. When the quick start system is used, starting aid from the bottle is passed through the atomizer into the air intake manifold where it mixes with the intake air to facilitate engine combustion. Temperature control prevents a hot engine being primed with the starting aid.

Air Cleaner

The engine air intake system consists of two air cleaners: one on each side of the engine hood assembly. The intake pipe also includes a restriction indicator to indicate a dirty air cleaner.

The air cleaners are the dry-type with replaceable primary and safety elements. Air is drawn through the air cleaner into the compressor side of the turbocharger. Intake air from the turbocharger flows through the cooling fins of the aftercooler before entering the intake manifold. The cooled air becomes more dense and contains more oxygen which allows more fuel to be injected increasing power output from the engine.



LEGEND

- 1. QUICK START AID
- 2. FUEL/WATER SEPARATOR
- 3. FUEL PRE-FILTER
- 4. FUEL TANK
- 5. LIFT PUMP
- 6. LOW PRESSURE SUPPLY LINE
- 7. INJECTOR
- 8. INJECTION PUMP
- 9. AIR CLEANER

————— FUEL FLOW
- - - - - FUEL RETURN LINE

FUEL SYSTEM

COOLING SYSTEM

General

The cooling system consists of the radiator, engine cooling circuit, thermostats, water pump, turbocharger aftercooler filter, and the connecting hoses. The temperature is controlled by two 180 degree F (82 degrees C) thermostats located between the top of the engine and the top of the radiator.

The function of the cooling system is to maintain a specific operating temperature for the engine. Some of the heat generated by the engine is absorbed by the coolant flowing through the passages in the cylinder block and head. Then, heat is removed from the coolant as it flows through the radiator.

Radiator

The radiator has a capacity of 44 quarts and contains a mix of 50/50 antifreeze coolant and water. Coolant is stored in the radiator and is drawn by an integrally mounted water pump. Air forced through the fins of the radiator by a fan cools the coolant pumped through the radiator.

Water Pump

The water pump pulls coolant from the bottom of the radiator and pumps it through the engine back to the top of the radiator for cooling. Reduced or interrupted flow will result in the engine running hot. The pump is belt driven from the crankshaft pulley.

Coolant Overflow Tank

A coolant overflow tank is installed on the inside of the engine hood assembly. The tank collects excess coolant overflowing from the radiator.

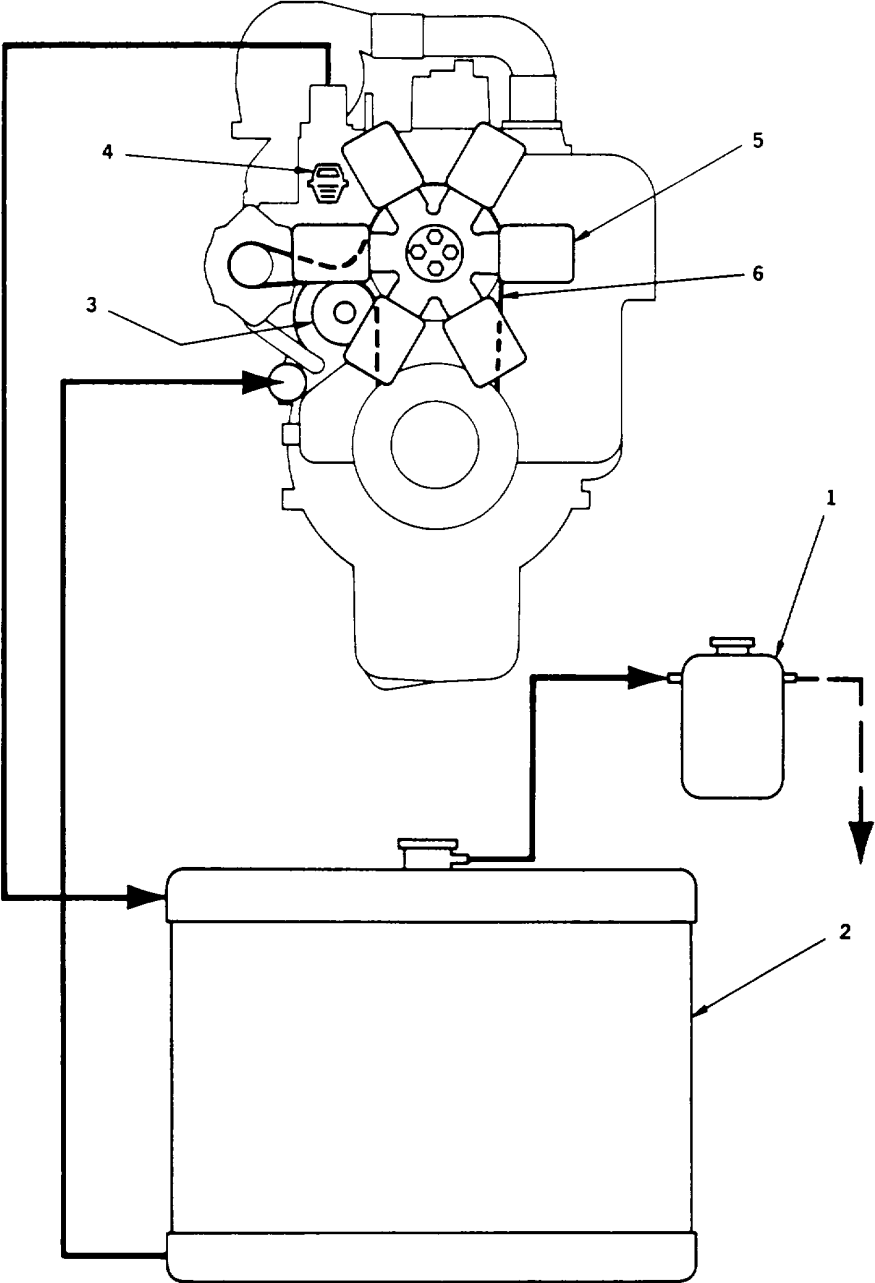
Fan Drive Belt

The fan drive belt is used to drive the fan, alternator, and water pump pulleys. An automatic belt tensioner is used to prevent belt slippage. A malfunction in the belt tensioner reduces pump impeller speed, coolant flow, and prevents the battery from charging properly.

Thermostats

From the liner cavities, the coolant flows through cast openings into the lower manifold, and into the thermostat cavity.

Thermostats control coolant temperature. When the coolant temperature is below operating temperature, the thermostats are closed, and coolant is bypassed to the water pump inlet. As coolant temperature increases to the intermediate range, both thermostats open, and coolant flow to the bypass will be partially restricted. At engine operating temperature the thermostats are open and the bypass is closed.



LEGEND

- 1. COOLANT OVERFLOW TANK
- 2. RADIATOR
- 3. WATER PUMP
- 4. THERMOSTATS
- 5. RADIATOR FAN
- 6. DRIVE BELT

————— COOLANT FLOW
- - - - - COOLANT OVERFLOW

COOLING SYSTEM

ELECTRICAL SYSTEM

General

The electrical system is 24-volt operation, consisting of an alternator and four lead-acid batteries, series-parallel connected. The system is the single wire ground return, utilizing the crane's superstructure as ground.

Batteries

The 12-volt batteries are located in a box on the left side of the machine behind the rear axle. Two batteries are connected in parallel to make two parallel sets. Both parallel sets are connected in series to provide the necessary 24-volts for the system.

Starter

When the start button is depressed, the coils in the solenoid are energized creating a magnetic field. This field pulls in the plunger which causes the shift lever to push the drive assembly in mesh with the ring gear in the engine. At this time the plunger closes the circuit between the "BATTERY" terminal and the field coil.

The current passes through the field coil, then through the brushes until it reaches the armature. The current forms counteracting magnetic fields around the field coil and the armature, causing the armature to turn. The armature turns the drive assembly which cranks the engine through the ring gear.

When the engine starts, the start button is released. This causes the magnetic field in the solenoid to collapse and a return spring forces the plunger back to its original position. As this happens, the shift lever disengages the drive assembly from the ring gear teeth. The contact from the "BATTERY" to the field coil is also broken by the returning plunger, which causes the armature to stop turning.

Alternator

The alternator is mounted on the engine and is belt driven. It is a 65 amperage alternator with a 24-volt output terminal. The 24 volts from the alternator is supplied by a transformer - rectifier unit mounted on the end frame of the alternator. When the engine is running, the 24-volt terminal supplies the voltage to recharge the batteries and maintain them at a full state of charge.

Electrical Swivel

The electrical swivel center or collector ring assembly is secured by setscrews to a center post which is bolted to the spool of the air/transmission swivel. This allows the collector ring assembly to remain stationary with the chassis. The outer portion or brush assembly is spring mounted on two pins which are located on a mounting plate welded to the air/transmission swivel barrel. This allows the brush assembly to rotate with the superstructure. The springs on the mounting plate pins allow the swivel to float and not bind when the superstructure rotates.

Electrical power is transferred to and from the carrier and superstructure through the electrical swivel. The swivel has 42 slip rings.

SUPERSTRUCTURE

Distribution Panel

All electrical circuits are protected, and some controlled, from the printed circuit board (circuit breakers) located in the cab right side panel. The printed circuit board consists of a harness with four connectors, six relays, nine circuit breakers, and a flasher. The relays are energized to close their contacts any time the ignition switch is in the ON or ACC position.

Instrument Panel

The instrument panel is located in the cab section of the crane. It contains all of the controls and indicators that the operator will use during crane operation. Additional information on the instrument panel and its controls and indicators can be found in the Operator's Manual TM 5-3810-306-10.

Alarms

The backup alarm is located above the pintle hook on the carrier. It serves as a warning to personnel that the crane is traveling in reverse.

Superstructure Lighting

Two lights mounted in the crane's superstructure are the cab floodlight and boom floodlight. The cab floodlight is located on the outside of the cab and is controlled by the operator by a swivel handle inside the cab. The boom floodlight is mounted on the telescoping boom and is used to illuminate the work area and hook block during night operations.

CARRIER FRAME

Sending Units and Switches

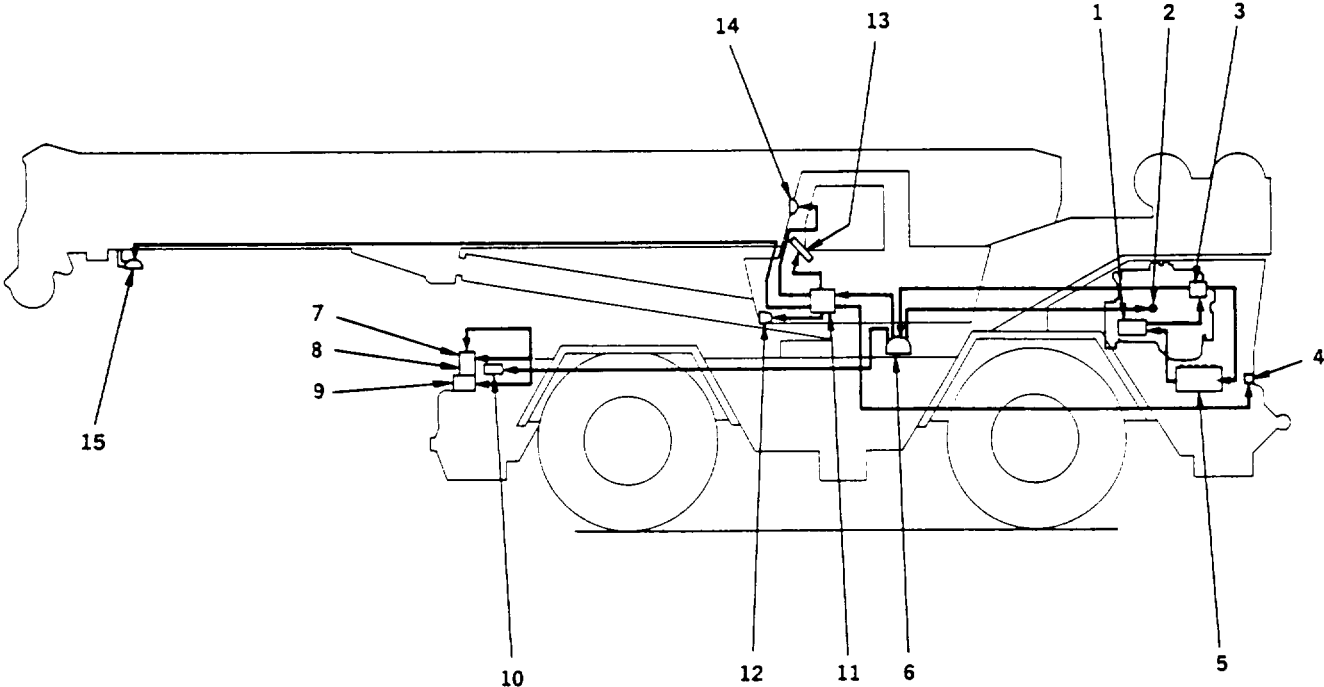
The electrical system provides electrical power to a variety of sending units and switches that monitor the systems in which they are installed. These sending units and switches transmit signals to indicators and warning lights in the operator's cab, allowing the operator to monitor the system and warn him of impending problems.

Carrier Frame Lighting

The operator controls lighting on the Carrier frame within the cab. All switches and indicators are located on the instrument panel. External carrier frame lighting include; headlights, turn signals, clearance lights, and blackout lights.

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LEGEND

CARRIER FRAME

- 1. STARTER
- 2. SENDING UNIT
- 3. ALTERNATOR
- 4. BACKUP ALARM
- 5. BATTERY
- 6. ELECTRICAL SWIVEL
- 7. TURN SIGNAL
- 8. HEADLIGHT
- 9. BLACKOUT LIGHT
- 10. CLEARANCE LIGHT

SUPERSTRUCTURE

- 11. DISTRIBUTION PANEL
- 12. HORN
- 13. INSTRUMENT PANEL
- 14. CAB FLOODLIGHT
- 15. BOOM FLOODLIGHT

ELECTRICAL SYSTEM

AIR SYSTEM

General

The air system provides the air supply to operate the service brakes, the parking brake, the engine throttle, the transmission range shift and rear axle disconnect.

The air system is pressurized by an engine-mounted air compressor and this pressure is stored in three air reservoirs installed underneath the frame to the rear of the front axle. From these reservoirs, air is provided for operation of the above mentioned components.

An air pressure gauge is provided in the cab on the front console. The green arrow indicates primary air pressure, while the red arrow indicates secondary pressure.

Air Compressor and Air Governor

The compressor, mounted on and driven by the engine, is regulated by an air governor which vents the compressor when a pressure of 120 psi (827.4 kPa/8.27 bar) is sensed in the air system. When pressure drops to 100 psi (689.5 kPa/6.895 bar), the governor will allow the compressor to supply the air system to maintain proper system pressure.

Through reciprocating motion, the piston in the compressor compresses air with every cycle.

Air Dryer

The air dryer removes moisture from the air system by using a desiccant cartridge. Water is drained from the air dryer via the automatic drain valve.

Supply Reservoir

Compressed air passes through the air dryer to the supply reservoir. The supply reservoir helps cool heated air and contains an automatic drain valve to vent off condensed water from the cooling air. A 150 psi (1034.25 kPa/10.34 bar) safety valve is installed on the supply reservoir for excess pressure protection (from the supply reservoir, pressurized air flows to the primary and secondary reservoirs).

Automatic Drain Valve

The automatic drain valve is designed to eject moisture and contaminants from the air system reservoir upon a slight reduction in reservoir pressure. It operates automatically from ascending and descending reservoir pressures, has only one moving part, and requires no manual assistance of control lines from other sources. The valve has a die cast aluminum body and cover.

With no air pressure in the system, the inlet and exhaust valves are closed. Upon charging the system, a slight pressure opens the inlet valve which permits air and contaminants to collect in the sump. The inlet valve remains open when pressure is ascending in the system until maximum (governor cut-out) pressure is reached. The spring action of the valve guide in the sump cavity closes the inlet valve. The valve and the exhaust valve are now closed.

When the reservoir pressure drops slightly (approximately 2 psi [13.8 kPa/.14 bar]), air pressure in the sump cavity opens the exhaust valve and ejects moisture and contaminants from the sump cavity until pressure in the sump cavity drops sufficiently to close the exhaust valve.

The length of time the exhaust valve remains open and the amount of moisture and contaminants ejected depends upon the sump pressure and the reservoir pressure drop that occurs each time air is used from the system.

Manual draining from the valve can be accomplished by using a tool to move the wire in the exhaust port upwards, holding it until draining is completed.

Single Check Valve

Inline single check valves are designed to allow air flow in one direction only, preventing the flow of air in the reverse direction. Inline single check valves are used in the air system to prevent air pressure in the supply reservoir from bleeding back into the dryer when the compressor is unloaded or shut down, or to prevent air pressure from bleeding back into the supply reservoir in the event of a major malfunction of the air system. An arrow indicating the direction of air flow is cast into the body of the check valve and should be pointed toward the reservoir supply tank.

Safety Valve

A safety valve is installed in the top of the supply reservoir to protect the air system against excessive air pressure buildup. The valve consists of a spring loaded ball valve subjected to reservoir pressure which permits air to exhaust from the reservoir to the atmosphere if the pressure rises above 150 psi (1034.3 kPa/10.3 bar). This pressure setting is nonadjustable and is determined by the force of the spring.

When the reservoir pressure decreases to approximately 135 psi (930.8 kPa/9.30 bar), the spring force will seat the ball check valve, sealing off reservoir pressure. The pressure setting of the safety valve is determined by the governor cut-out pressure.

Safety Valve

Normally the safety valve remains inoperative and only functions if reservoir pressure exceeds 150 psi (1034.3 kPa/10.3 bar). Constant exhausting of air from the safety valve can be caused by a faulty safety valve, governor, compressor unloading mechanism, or a combination of any of these.

Primary Reservoir

The primary reservoir provides the supply for the dual brake valve, the parking brake valve, the transmission shift valve, and the R12 relay valve for the spring or parking brake release.

Pressure Protection Valves

Three pressure protection valves are used in this air system. Two of the pressure protection valves are set at 85 psi (586 kPa/5.86 bar) while the third is set at 75 psi (517.12 kPa/5.17 bar). The pressure protection valves are essentially check valves. They open approximately 10 to 15 psi (68.95 to 103.42 kPa/.689 to 1.03 bar) above their closing pressure. The 75 psi (517.12 kPa/5.17 bar) pressure protection valve for example, will open at approximately 85 to 90 psi (586 to 620.55 kPa/5.86 to 6.2 bar) and will close when pressure drops to 75 psi (517.12 kPa/5.17 bar). These valves protect a circuit if a line is ruptured and ensure a priority supply to the brakes.

Air entering the supply port is initially prevented from flowing out the delivery port by the inlet valve which is held closed by the pressure regulating spring above the piston. When sufficient air pressure builds beneath the piston to overcome the setting of the regulating spring, the piston will move, causing the inlet valve to unseat (open), and allow air to flow out the delivery port. As long as air pressure at the supply port and beneath the piston remains above the specified closing pressure, the inlet valve will remain open. Closing pressure is noted on the label affixed to the valve.

If for any reason system air pressure is decreased below the specified closing pressure, the regulating spring will move the piston closing the inlet valve. The remaining air pressure at either the supply or delivery side, (depending upon where the pressure drop has occurred) will be retained.

Swivel

The spool of the air/transmission swivel is attached by setscrews to a spool mounting plate which is bolted to the spool of the hydraulic swivel. This permits the air/transmission swivel spool to remain stationary with the chassis. The air/transmission swivel barrel is attached to the hydraulic swivel barrel by means of a slotted arm which secures it to a keying lug welded to the hydraulic swivel barrel. This permits both barrels to turn with the superstructure.

Foot Throttle Valve (Accelerator Control Valve)

The foot throttle valve is a treadle operated air valve mounted on the cab floor. The valve controls the air pressure to the throttle cylinder mounted on the engine which controls engine speed. Air pressure is supplied from the air swivel to the foot throttle valve.

Throttle Cylinder

The throttle cylinder is bracket mounted on the engine and connected to the engine throttle linkage. It moves the throttle lever in response to an air pressure from the foot throttle valve in the cab. The push tube adapter is threaded to permit connection to the throttle lever.

When the reservoir air pressure is below the pressure protection valve setting the push tube extends to the fast idle position. When the pressure protection valve opens, the push tube returns to the slow idle position in which the adapter shoulder is in contact with the cylinder bushing.

At normal system pressures, control of the throttle cylinder is through the throttle valve and connecting line. When the foot throttle is depressed, air pressure is supplied through the throttle valve port and acts on the effective area of the throttle piston. When the force developed by the air pressure is greater than the force developed by the graduating spring on the opposite side of the throttle position, the push tube is extended toward the full throttle position to the extent of the air pressure delivered by the throttle valve.

As pressure is reduced or completely exhausted from the throttle cylinder through the throttle valve, the push tube is moved toward the idle position " by the graduating spring.

Secondary Reservoir

The secondary reservoir provides the supply for the R12 relay valve for the service brakes application and the supply for the dual brake valve (pedal) in the cab.

R-12 Relay Valve

The relay valve functions as a relay station to speed up the application, modulation, and release of the service brakes. It can be considered to be a remote mounted, air controlled brake valve that releases or delivers air to the actuators in response to the signals received from the parking brake valve or the dual brake valve.

The rapid reaction of the relay valve to changes in control pressures is in part due to the relatively small volume of air required between the valve cover and the relay piston. The area of the relay piston and the pressure of the quick release also contribute greatly to the fast application and release of the actuators.

When the dual brake valve is actuated, air pressure is delivered to the service port of the relay valve. Air pressure delivered to the service port enters the small cavity above the piston and moves the piston down. The exhaust seat moves down with the piston and seats on the inner or exhaust portion of the inlet and exhaust valve, sealing off the exhaust passage. At the same time, the outer or inlet portion of the inlet and exhaust valve moves off its seat, permitting supply air to flow from the reservoir, past the open inlet valve and into the actuator.

The air pressure being delivered by the open inlet valve also is effective on the bottom area of the relay piston. When this air pressure beneath the piston reaches that being delivered above, the piston moves up slightly and the inlet spring returns the inlet valve to its seat. The exhaust remains closed as the service line pressure balances the relay valve delivery pressure.

When air pressure is released from the service port and air pressure in the cavity above the relay piston is exhausted, air pressure beneath the piston lifts the relay piston and the exhaust seat moves away from the exhaust valve, opening the exhaust passage. With the exhaust passage open, the air pressure in the air actuators exhausts out the exhaust port to the atmosphere.

Foot Brake Valve

The foot brake valve is mounted to the cab floor. It is a treadle-operated type brake valve with two separate supply and delivery circuits. The valve provides the driver with a graduated control for applying and releasing the vehicle brakes.

The circuits in the foot brake valve are identified as follows. The No. 1 circuit portion is that portion of the valve between the spring seat which contacts the plunger and the relay piston. The No. 2 circuit portion is that portion between the relay-piston and the exhaust cavity.

The No. 1 circuit portion of the valve is similar in operation to standard single-circuit air brake valve and under normal operating conditions the No. 2 circuit portion is similar in operation to a relay valve.

Both the No. 1 and No. 2 circuit portions of the dual brake valve use a common exhaust protected by an exhaust diaphragm.

For explaining the operation of the foot brake valve, the valve is divided into a No. 1 circuit portion and a No. 2 circuit portion.

Applying - Normal Operation of No. 2 Circuit Portion

When the brake treadle is depressed, the plunger exerts force on the spring seat, rubber graduating spring, and No. 1 piston. The No. 1 piston which contains the exhaust valve seat, closes the No. 1 exhaust valve. As the exhaust valve closes, the No. 1 inlet valve is moved off its seat allowing No. 1 air to flow out the No. 1 delivery port.

Applying - Normal Operation of No. 1 Circuit Portion

When the No. 1 inlet valve is moved off its seat, air is permitted to pass through the bleed passage and enters the relay piston cavity. The air pressure moves the relay piston, which contains the exhaust seat and closes the No. 2 exhaust valve. As the No. 2 exhaust valve closes, the No. 2 inlet valve is moved off its seat allowing the No. 2 air to flow out the No. 2 delivery port. Because of the small volume of air required to move the relay piston, action of the No. 2 circuit portion of the valve is almost simultaneous with the No. 1 circuit portion.

Applying - Loss of Air in the No. 2 Circuit

Should air be lost in the No. 2 circuit, the No. 1 circuit portion will continue to function as described under Normal Operation of No. 1 Circuit Portion.

Applying - Loss of Air in the No. 1 Circuit

Should air be lost in the NO. 1 circuit, the function will be as follows. As the brake treadle is depressed and no air is present in the No. 1 circuit supply and delivery ports, the No. 1 piston will mechanically move the No. 2 exhaust valve open the No. 2 inlet valve and allow air to flow out the No. 2 delivery port.

Balanced - No. 1 Circuit Portion

When the No. 1 delivery pressure acting on the piston equals the mechanical force of the brake pedal application, the No. 1 piston will move and the No. 1 inlet valve will close, stopping the further flow of air from the No. 1 supply line through the valve. The exhaust valve remains closed preventing any escape of air through the exhaust port.

Balanced - No. 2 Circuit Portion

When the air pressure on the No. 2 side of the relay piston approached that being delivered on the No. 1 side of the relay piston, the relay piston moves closing the No. 2 inlet valve and stopping further flow of air from the supply line through the valve. The exhaust remains closed as the No. 2 delivery pressure balances the No. 1 delivery pressure.

When applications in the graduating range are made, a balanced position in the No. 1 portion is reached as the air pressure on the delivery side of the No. 1 piston equals the effort exerted by the operator's foot on the treadle. A balanced position in the No. 2 position is reached when air pressure on the No. 2 side of the relay piston closely approaches the air pressure on the No. 1 side of the relay piston.

When the brake treadle is fully depressed, both the No. 1 and No. 2 inlet valves remain open and full reservoir pressure is delivered to the actuators.

Releasing - No. 1 Circuit Portion

With the brake treadle released, mechanical force is removed from the spring seat, rubber graduating spring, and No. 1 piston. Air pressure and spring load moves the No. 1 piston, opening the No. 1 exhaust valve allowing air pressure in the No. 1 delivery line to exhaust out the exhaust port.

Releasing - No. 2 Circuit Portion

With the treadle released, air is exhausted from the No. 1 circuit side of the relay piston. Air pressure and spring load move the relay piston, opening the No. 2 exhaust valve allowing air pressure in the No. 2 delivery line to exhaust out the exhaust port.

Low Pressure Indicating Switch

The Low pressure indicating switch is designed to provide a warning to the operator that one or both air systems are at a low pressure. The switch is electrically connected to a buzzer and a LED indicator light. The switch has a die cast body with a nylon cover, and employs a spring loaded O-ring diaphragm and piston. A gasket is used between the cover and body. The switch is provided with electrical contacts and a single terminal from connection to the electrical system. The contacts remain closed by spring force until the air pressure below the diaphragm is great enough to overcome the spring force. This pressure setting is approximately 75 psi (517 kPa/5.17 bar) and should be marked on a label affixed to the valve body.

When air pressure at the supply port and under the diaphragm is above 75 psi (517 kPa/5.17 bar), the electrical contacts remain open because the force exerted by air pressure underneath the diaphragm overcomes the force exerted by the spring above the diaphragm.

When air pressure below the diaphragm drops below 75 psi (517 kPa/5.17 bar), the spring exerts a force which is greater than the force exerted by the air pressure below the diaphragm. This causes the diaphragm and piston to move and allow the electrical contacts to close. This completes or closes the electrical circuit to the warning buzzer and the indicator light.

Stop Light Switch

A stop light switch is installed in the No. 1 circuit of the dual brake valve. The switch senses the pressure in the brake air lines. Electrically, the switch is connected to illuminate the service stop lights on the rear of the machine with the MS51113 switch in the SERVICE Mode, when the brake pedal is pressed. With the MS51113 switch in the BLACKOUT Mode, the stop light illuminates the blackout stop lights when the brake pedal is pressed. The switch is an electro-pneumatic switch and is not a serviceable item. It must be replaced as a complete assembly.

When a brake application is made, air pressure from the brake valve enters the cavity below the diaphragm. The air pressure below the diaphragm moves the piston until it contacts the leaf spring. The leaf spring travels past a fulcrum at which point the leaf spring snaps a shorting bar which mates with the contact strips. The stop light electrical circuit is completed, lighting the stop lights before the brake applications pressure reaches 6 psi (41 kPa/0.41 bar).

Parking and Service Brakes

The top priority of the air system is to provide braking. Each wheel has two spring brake chambers and two service brake chambers. The spring brake is spring actuated and must be released by pressurized air. The spring brakes on all four wheels are released by the parking brake push-pull knob on the right hand console in the cab. Pushing down on the parking brake causes air pressure to enter the spring brake chamber on each wheel and compress the spring, releasing the brakes. At least 40 psi (275.8 kPa/2.75 bar) is required to keep the parking brake valve engaged. If supply pressure to the valve drops below 40 psi (275.8 kPa/2.75 bar), the valve will release, applying the brakes.

The service brakes are applied by air pressure. Depressing the foot brake pedal on the cab floor causes pressurized air to enter the service brake chamber on each wheel, applying the brakes. In the event of a loss of supply pressure to the service brakes, the spring brake valve will allow the operator to release or bleed off the air pressure in the spring brake chamber by depressing the foot brake pedal to apply the brakes.

Dual Brake Valve

The dual brake valve is used in the air system when a single function or component must be controlled by either of two sources of pressure. The dual brake valve transmits the higher of the two pressure sources to the outlet port.

As air pressure enters either end of the dual brake valve (inlet port), the movable shuttle responds to the air pressure and seals the line on the opposite inlet port, but permits air pressure to flow out the outlet port. The same action will take place if the air pressure on one side of the shuttle is higher than the air pressure on the other side. It is not necessary for the cavity, one side of the disc or shuttle, to be exhausted for the valve to operate.

Dual brake valves are designed so that it is impossible for the shuttle to block off the outlet port.

Spring Brake Valve

The function of the spring brake valve is to supply a specific, limited hold-off pressure to the spring brakes, and in the event of loss of service pressure, to modulate the spring brakes through the use of the dual brake

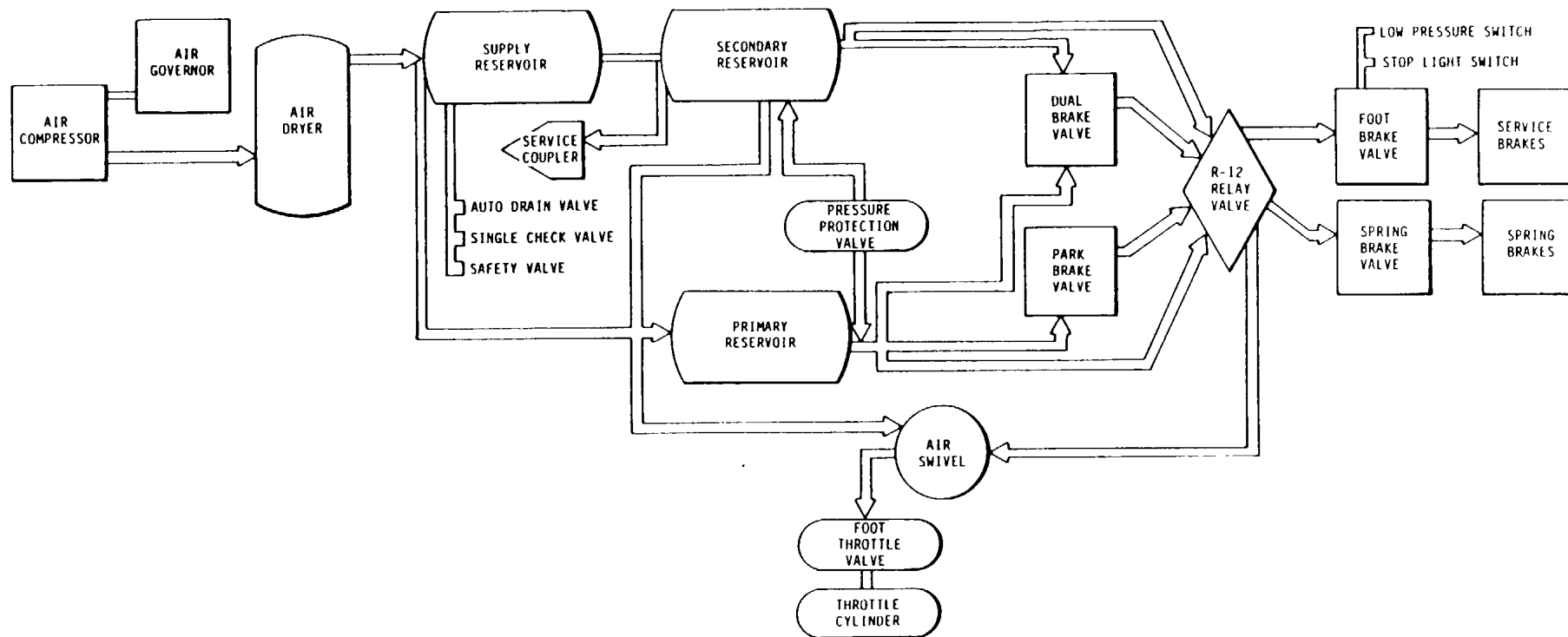
The valve has four air connected ports and a diaphragm protected exhaust port. Each air connection port is labeled with embossed letters to identify the ports.

Initial charge air, from primary and secondary reservoirs flow through the park control valve and enters the spring brake valve supply port. Air entering the supply port flows past inlet and exhaust valve B to the under side of piston B and out the delivery port of the spring brake valve to the emergency air connection at the spring brake actuator. Air flowing from the primary reservoir only enters the reservoir port of the spring brake valve. This air remains under piston A as system pressure builds. With primary reservoir pressure below approximately 55 psi (379 kPa/3.79 bar), the spring above piston A forces it into contact with inlet and exhaust valve A causing the exhaust to seal and the inlet to open.

With air system pressure above approximately 55 psi (379 kPa/3.80 bar) in the primary and secondary reservoirs, piston A has moved against the force of the spring above it, allowing the inlet of valve A to close and opening the hollow exhaust passage through piston A. When air pressure beneath piston B is approximately 95 psi (655 kPa/6.55 bar), piston B rises slightly against the force of the springs above it, allowing the inlet of valve B to close. The exhaust through valve B remains closed. The closing of the inlet portion of valve B traps approximately 95 psi (655 kPa/6.55 bar) in the hold-off cavity of the spring brake actuators while allowing full air system pressure to build elsewhere.

When a service application is made by actuating the dual brake valve, air from the No. 2 delivery circuit is delivered from the brake valve to the control port, and is stopped at the closed inlet of valve A. No movement of the internal components of the spring brake valve takes place. Air from the No. 1 delivery circuit of the dual brake valve actuates the service section of the spring brake actuators.

With both system No. 1 and No. 2 intact when the park control valve is placed in the park or exhaust position, the spring brake valve supply of air pressure and the air pressure in the spring brake actuator cavities is exhausted. The single check valve in the spring brake valve assists this exhaust of air pressure from the spring brake by allowing the air below piston B to flow back out the open exhaust of the park control valve. When air pressure below piston B has dropped sufficiently, piston B moves down opening the inlet of valve B thus providing an additional exhaust passage for air exhausting through the spring brake valve from the spring brakes.



AIR BRAKE SYSTEM

HYDRAULIC SYSTEM

General

Each hydraulic valve bank is tapped with a pressure test port for checking the relief valve settings. The pressure settings can be checked by removing the appropriate test port plug and installing a flexible hose and pressure gauge.

The supply pressure and return circuit is made up of four (4) separate circuits which route oil from the two hydraulic pumps to the directional control valves for the individual operating circuits. The supply pressure and return circuit consists of the reservoir, hydraulic pumps, pump disconnects, oil cooler, oil filter, and an 11 port hydraulic swivel. The operating circuits description and components begin with the circuit's directional control valve.

The supply pressure and return circuit uses ports 7, 8, 9, and 10 for pump supply and the dual port 11 for return.

Hydraulic Reservoir

The reservoir, attached to the right side of the carrier frame, has a useable capacity of 165 U.S. gallons (624.52 liters). The all-steel reservoir has an internally mounted full-flow filter and integral baffles that help cool the oil and prevent oil foaming.

Oil flows through hoses from the back of the reservoir to each hydraulic pump. The return oil also flows to the back of the reservoir, but on the opposite side of a baffle plate which acts to separate return and supply oil. Five return lines are connected to the back of the reservoir, three of them go directly into the reservoir and the other two go directly into the filter case inside the reservoir. The three lines that go directly into the reservoir are from the No. 1 port of the swivel and the drain from the integrated outrigger valve, steering relief valve, steer flow divider, and hand pump.

A magnetized drain plug is located in the bottom of the reservoir to collect metal particles from the oil should the oil become contaminated.

A sight gauge is located on the front of the reservoir to indicate oil level. A breather cap (vent) is located on the top of the reservoir to allow air to enter or exhaust from the reservoir. It is most important that the breather be kept clean to prevent damage to the reservoir. A large round access cover on the top of the reservoir provides access for cleaning. This opening may also be used to fill the reservoir after it has been completely drained.

Oil Filter

The oil filter assembly is located in the reservoir. The assembly housing contains a replaceable 10 micron filter element through which most of the oil returning to the reservoir is directed. From a box manifold inside the reservoir, return oil enters the outer annular passage in the filter body assembly and flows upward into the head assembly and down into the center of the element. During normal operation, oil passes outward through, and is filtered by, the element and is exhausted into the annular housing surrounding it and downward through a tube into the reservoir.

With a clogged filter, pressure builds inside the filter element and head assembly forcing the spring loaded valve in the upper housing to unseat and bypass oil directly to the exhaust annulus. The white indicator post, normally visible in the head assembly window, moves downward with the bypass valve providing visual indication, from outside, of the degree of element blockage. Element bypass begins when internal pressure reaches 25 psi (172.4 kPa/1.72 bar). Total bypass is indicated by the top of the white indicator bar reaching the halfway mark on the window.

Three Section Pump

Section one of the hydraulic pump supplies the valve bank housing the main hoist boost, auxiliary hoist, and lift boost directional control valves. Oil flowing from the valve bank returns to the reservoir filter through the return manifold.

Section two of the hydraulic pump supplies the valve bank housing the main hoist and auxiliary hoist boost directional control valves. Oil flowing from the valve bank returns to the reservoir filter through the return manifold.

Section three of the hydraulic pump supplies the valve bank housing the lift, rear steer, and telescope directional control valves. Oil flowing from the valve bank returns to the reservoir control filter through the return manifold.

Two Section Pump

Section one of the hydraulic pump supplies the integrated outrigger valve, and subsequently the outrigger circuit. Pressure beyond flow from the integrated outrigger valve supplies the swing valve bank which controls the rotation of the crane superstructure.

Section two of the hydraulic pump supplies the rear axle lockout valve and the front steering control valve. Oil flowing from the valves returns to the reservoir filter through the return manifold.

Oil Cooler

An air cooled hydraulic oil cooler is mounted on the right side of the superstructure. The oil cooler consists of a hydraulic radiator, a hydraulic motor, a fan, and a fan guard. The fan is driven by the motor which receives its oil flow from the pressure-beyond of the tele/rear steer/lift valve bank. The fan blows air through the cooling fins on the cooler. All of the hydraulic oil returns (from the major crane functions) through the dual return lines via swivel port No. 11. This line has a 15 psi (103.4 kPa/1.03 bar) in line check valve which is normally closed and does not permit flow. Normally all oil is routed to the return manifold, through the oil cooler, and on to the hydraulic filter in the reservoir.

When several hydraulic functions are being used at one time (i.e., hoisting, lifting, and telescoping), more oil has to flow through this one line causing a pressure buildup in the dual port return system. When this pressure reaches 15 psi (103.4 kPa/1.03 bar), the normally closed check valve will open and permit some oil to bypass the oil cooler and flow directly into the reservoir filter. When fewer functions are being used, the pressure in the system will decrease below 15 psi (103.4 kPa/1.03 bar) and the check valve will close.

As mentioned above, the oil cooler fan motor is driven by oil from the tele/rear steer/lift circuit when the control valve is in neutral. If any of the three functions is activated, the oil exhausts directly into the return manifold and the fan motor stops running. In addition, if the temperature of the oil in the return manifold falls below 111 degrees F (44 degrees C), an oil bypass valve will direct oil around the motor, causing the motor to stop. The motor will restart when the oil temperature reaches 120 degrees (49 degrees C).

Oil Cooler Motor

The hydraulic motor consists of two meshed gears in a closely fitted housing with inlet and outlet ports opposite each other. The two gears mesh and rotate together with only one gear coupled to the drive shaft. The motor torque is developed through pressure on the surfaces of the gear teeth. Oil enters the inlet exerting pressure on the gear teeth causing them to rotate. Oil is carried to the outlet port in chambers formed between the gear teeth and housing.

Hydraulic Pump Disconnect

This disconnect assembly is provided for cold weather starting and consists of a housing, lever, movable collar, and a sliding splined sleeve. Moving the lever actuates the movable collar within the housing which in turn slides the splined sleeve on the splined pump shaft to engage the sleeve with the splined shaft of the torque converter drive. The disconnect housing is initially filled with one pint of transmission fluid and during operation the torque converter will spray transmission fluid into the housing to lubricate the disconnect.

Relief Valve

Relief valves are used to protect a component, a circuit, or a system from overpressurization. Most of the relief valves are located in the directional control valves, while others are part of a component.

Relief valves are checked and adjusted by causing a given circuit to reach its prescribed pressure limit (stall). At this point the relief valve opens, returning oil to the reservoir. Hydraulic motor circuits may be stalled by preventing rotation of the motor shaft prior to actuating the control valve. Cylinder circuits may be stalled by extending or retracting a cylinder to its limit of travel.

By placing a pressure gauge in the proper line or port, a pressure reading will indicate the point at which the relief valve opens. The needle on the meter face will climb until it reaches the relief valve setting. At that point the needle will stop climbing and fluctuate, indicating the relief valve is open and returning oil to the reservoir.

Correct relief valve adjustment is mandatory if any hydraulic circuit is to function properly. Settings must be within tolerances. Therefore, adjustment should be performed only by qualified technicians using the correct equipment, after the need for adjustment has established.

The hydraulic system utilizes four valve banks. Each valve bank has one main relief valve limiting maximum operating pressure of the component(s) in that circuit. In addition, circuit relief valves further limit operating pressures as required by circuit design.

Directional Control Valves

The directional control valves are located within the valve compartment behind the operator's cab. Access to the directional control valves is gained by lifting the access cover over the valve compartment and locking in place.

The directional control valves are four-way, three-position valves with either an open or closed spool. Whether a valve has an open or closed spool is determined by whether, with the spool in the neutral position, the work ports are open to the reservoir return passage. If the work ports are open to the reservoir return passage, the valve is classified as an open spool type: if they are not, the valve is a closed spool type. Additionally, the valve spool is spring loaded to the neutral position.

The open spool directional control valve is constructed with a through passage to allow flow to pass to the next valve(s) in the bank and on the reservoir, when the valve spool is in the neutral position. By positioning the valve spool to a work position, the through passage is blocked and flow is diverted to the dead end parallel passage. This causes flow to be directed to the component's open supply work port. Return flow is routed from the return work port to the reservoir return passage by the opposite end of the valve spool. This flow pattern is applicable in either direction the valve may be positioned. If it is necessary to open more than one

directional control valve in the same valve bank, it may be required to partially close or feather the valves that are located in the bank first, in regards to flow from the pump, in order to provide sufficient flow to the valves located last in the bank.

The closed spool directional control valve functions basically the same way as the open spool directional control valve in that the through passage of the valve must be blocked off by the valves' spool to divert flow to the dead end parallel passage. With flow diverted to the parallel passage, pressure then must unseat the load check valve to allow the flow to reach the open work port. The load check valve is provided to prevent back sliding of components which support heavy loads as is evidence by the circuits this valve is used in. Return flow from the component is through the return work port to the reservoir return passage.

Integrated Outrigger Valve

The integrated outrigger valve is mounted near the center of the carrier frame in front of the front axle and is used for the control of the outrigger circuit. The valve consists of five subassemblies; two solenoid valves, an inlet section, an outlet section, and a working section.

The integrated outrigger valve consists of five subassemblies; two solenoid valves, an inlet section, an outlet section, and a working section.

The solenoid valves are normally closed. They are used to control a pilot pressure that positions the spool within the working section. When the solenoid valves are de-energized, the springs maintain the spool in a centered position permitting oil to flow to the pressure beyond circuit.

The inlet section contains two inlet ports and a pressure gauge port. It also contains an adjustable main relief valve set at 2500 psi (17, 238 kPa/72.38 bar). This relief valve is an adjustable pilot operated type valve and relieves back to the reservoir through the exhaust (EX) port.

The working section is the open center type and contains a spring centered spool which allows oil to flow through the center to the pressure beyond circuit when the spool is centered. Work port A is cylinder spooled, or the oil is trapped in the function while the spool is in neutral. Work port B is open to the reservoir (when the spool is in neutral) due to the fact that there are two flats ground into the end land of the spool. These flats act as an orifice preventing the complete blockage of oil in this circuit. This prevents an unwanted pressure buildup in this circuit when the spool is in neutral. The flats are so small that when the circuit is being energized, the oil passing by these flats is negligible compared to the total volume of oil. The working section also contains two nonadjustable relief valves and a check valve. The port A relief valve is set at 300 to 400 psi (2069 to 2758 kPa/20.69 to 27.58 bar). The port B relief valve has full flow capability and is set to relieve at 2000 psi (13.791 kPa/137.91 bar). The check valve in the bottom of the working section, prevents a reverse flow of oil if the oil pressure in the working circuit is greater than the supply pressure.

The outlet section has two ports. One port, offset to the side is the return from the circuit supplied by ports A and B. The other port is for the power beyond circuit as long as the working section spool is in neutral.

Outrigger Control Valve Assembly

The solenoid valve stack assembly consists of four valve sections, four solenoid assemblies, and an assembly kit. By using the four valves assembled together, four separate components can be controlled by a single hydraulic source.

The valve is held in its normally closed position by a spring. When the solenoid is energized, the plunger assembly forces the spool to shift which opens the valve. De-energizing the solenoid causes spring pressure to shift the spool to its normally closed position.

Pilot Operated Check Valve

The pilot operated check valve is located in the port block on the outrigger stabilizer cylinder. The valve is normally closed and is opened by pilot pressure.

Hoist Motor Control Valve

The hoist motor control valve is designed to provide an even flow of oil to the hoist motors in both directions.

To drive the hoist motor in the raise direction, hydraulic oil flows through the in port and pushes to the free flow poppet off its seat. The oil then flows to the out port and onto the hoist drive motors.

When driving the hoist motors in the lower direction, oil from the directional control valve enters the out port. The pilot operated poppet is held shut by the adjustment spring until pilot pressure of sufficient force is secured at the pilot pressure port to move the pilot operated poppet off its seat. This allows flow to the return reservoir through the directional control valve.

An orifice plug is installed in the pilot pressure port to restrict back flow when the directional control valve is closed. The restriction prevents the pilot operated poppet from chattering on its seat.

A vent is provided that vents the area between the pilot piston seal and the free flow poppet and pilot operated poppet seals to prevent a hydraulic lock should weepage around the seals occur.

Swing Brake Valve

The glide swing brake valve is a proportionate valve. Pressing the brake pedal causes hydraulic oil to be transmitted to the top of the swing brake where pressure and spring tension proportionately apply the brake. The total force overcomes the brake release pressure and applies the brake.

When the brake valve is in the neutral position, oil from the top of the swing brake is allowed to pass through the center of the spool. The oil escapes from the spool through two pilot holes to the drain port. When the foot brake pedal is proportionately pressed, oil is routed around the groove on the spool through the pilot holes and is routed to the brake. When pressure builds to apply the brake, pressure also builds against the spool of the brake valve. This pressure will act against the greater surface area between the port end and the spool and tend to cut off the pressure port and compress the spring proportionate to the pressure applied to the pedal.

When the foot pedal is fully pressed, the pressure is routed directly to the brake. Since the spool is completely against the ported end cap there is no surface area to act upon, therefore full system pressure is available.

HOLDING VALVES

Cylinder Holding Valves

Three different holding valves are utilized on the crane, one in each lift cylinder and one in the telescope cylinder. The valves are installed in the port block of their respective cylinder.

Overcenter Valve

The overcenter valve is a normally closed valve used in the boom lift circuit to act as a fourth holding valve and to provide smooth operation during circuit activation. This valve provides static overload relief and thermal expansion relief as the control valves in the lift circuit have open centers.

An overcenter valve is basically a counterbalance valve with a pilot override, or assist, on the relief valve section. The load is raised by a free flow of oil through the check section. With the control valve centered, the load is locked (relief must be set at least 1.3 times higher than the maximum load induced pressure).

To lower the load, pilot pressure is required which effectively reduces the relief valve setting. This allows the load to be safely and smoothly controlled with minimum energy loss. If the load tries to run ahead of the pump, the relief section will throttle or close to prevent runaway.

Two Position Selector Valve

The two position selector valve is used to direct a regulated flow of pressure. When in the disengaged (knob pulled out) position, the flow is routed in a port A through the valve and out the IN port. In the engaged (knob pushed in) position the flow of oil is allowed to enter the IN port and exit through the B port.

Selector Valve

The valve is held in the normally closed position by a spring. When the solenoid is energized, the plunger assembly forces the spool to shift which opens the valve. De-energizing the solenoid causes the spring pressure to shift the spool to its normally closed position.

The selector valve, is located at the center of the carrier frame just forward of the rear axle. At crane start-up in travel mode, with boom-over-front, the valve solenoids are energized, allowing rear axle oscillation, by an electrical circuit controlled by a cam actuated roller switch mounted on the swivel. As the superstructure is rotated more than five degrees either direction from boom-over-front-position, the switch roller rides off a cam, opening the circuit, de-energizing the solenoids, and allowing cartridge springs to close the valve, blocking through flow and locking out rear axle oscillation.

The system is designed so that with the loss of power rear axle oscillation lockout is automatic.

Steering Relief Valve

A pressure relief valve is provided on the discharge of the steering pump to relief the pressure in the power steering system when the pressure reaches 2500 psi (17, 238/172.3). The relief valve is mounted on the front face of the frame cross-member to rear of centerline of rotation. When the pressure in the power steering system exceeds the setpoint, the relief valve opens to relieve hydraulic oil to the hydraulic return system.

The relief valve protects the system if pressure exceeds the designated setting. The relief valve can be pressure adjusted. The poppet assembly is constructed with the spool area being larger than the poppet area. When pressure against the spool reaches the pre-determined setting, the poppet assembly shifts against the springs. This opens the relief port to the reservoir, and oil flows to the reservoir. When pressure decreases, the spring forces the poppet assembly to the neutral position. This closes the relief port to the reservoir. A passage in the relief valve prevents a vacuum buildup within the relief valve.

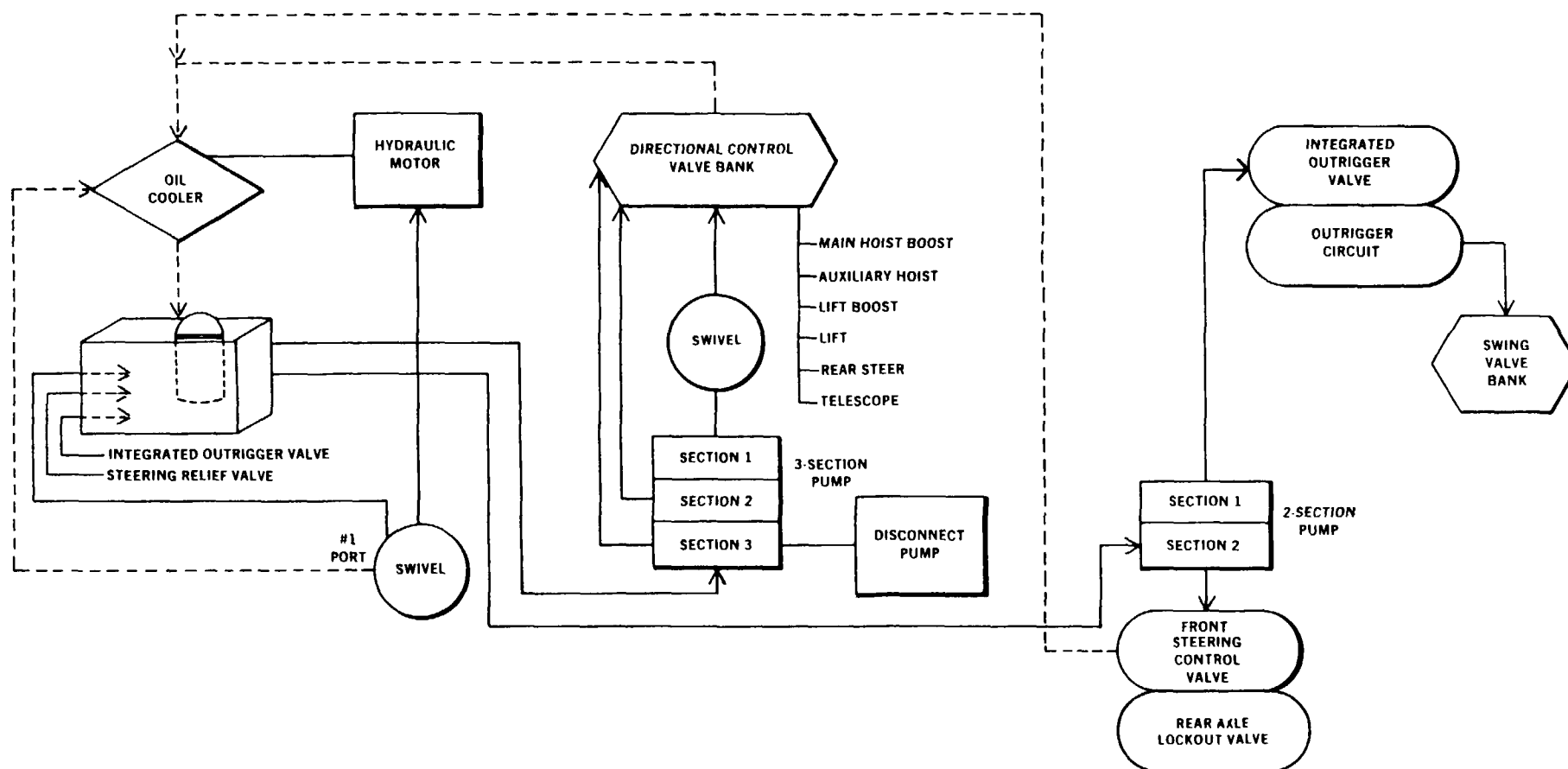
Bypass Valve Assembly

The bypass valve assembly consists of a single selector valve, air cylinder, and a three way air solenoid valve. This assembly, controlled by a temperature switch mounted in the return manifold, allows hydraulic oil to bypass the superstructure oil cooler fan motor when the hydraulic oil temperature is less than 111 degrees F (44 degrees C).

When the oil temperature is 120 degrees F (49 degrees C) the bypass valve is closed and the oil flows through the oil cooler fan motor. When the temperature drops to 111 degrees F (44 degrees C), sensed by the temperature switch, the 3-way air solenoid valve is energized to move the valve spool to allow air pressure on the cylinder moves it's piston rod against the single selector valve to open the valve, bypassing the oil cooler fan motor.

Hydraulic Swivel

The spool portion of the hydraulic swivel is attached to lugs inside the corner frame rails by means of a spool mounting plate bolted to a swivel mount channel. The barrel portion is attached by two rotation links to the turntable base plates. This allows the barrel portion of the swivel to rotate around the stationary spool as the superstructure rotates.



HYDRAULIC SYSTEM

CHAPTER 2**CRANE MAINTENANCE INSTRUCTIONS**

Section I. REPAIR PARTS, SPECIAL TOOLS, TMDE, AND SUPPORT EQUIPMENT**COMMON TOOLS AND EQUIPMENT**

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

SPECIAL TOOLS, REPAIR PARTS, TMDE AND SUPPORT EQUIPMENT

Reference Section III in the Maintenance Allocation Chart (MAC) for a list of all special tools, test and equipment needed to maintain the container crane. Repair parts and special tools are listed and illustrated in the Repair Parts and Special Tools List (TM 5-3810-306-24P) covering direct and general support maintenance for this equipment.

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CHAPTER 3
TROUBLESHOOTING

INTRODUCTION

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the container crane and its components. Malfunctions which may occur are listed in Table 3-1. Each malfunction is followed by a listing of probable causes. The corresponding corrective actions suggest applicable maintenance actions for correcting the malfunction.

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TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING

Malfunction	Test or Inspection	Corrective Action
1. <u>ENGINE CRANKS SLOWLY</u>		
Step 1.	Crankshaft rotation restricted.	a. Bar engine to check for rotational resistance. If OK, repair starter. (Refer to page 4-33.)
2. <u>ENGINE HARD TO START OR WILL NOT START - EXHAUST SMOKE PRESENT</u>		
Step 1.	Injection pump timing not correct.	a. Check injection pump timing. (Refer to page 5-4.) If OK, do Step 2. b. Time fuel injection pump.
Step 2.	One or more injectors worn or malfunctioning.	a. Remove and test injectors. (Refer to page 5-2.) b. Replace defective injector(s).
3. <u>ENGINE CRANKS, BUT WILL NOT START - NO SMOKE FROM EXHAUST</u>		
Step 1.	Worn or malfunctioning fuel injection pump.	a. Loosen high pressure line at two injectors and visually check fuel delivery while cranking engine. If OK, do Step 2. b. Replace fuel injection pump. (Refer to page 5-4.)
Step 2.	Fuel injection pump timing incorrect.	a. Check fuel injection pump timing. (Refer to page 5-4.) If OK, do Step 3. b. Time fuel injection pump.

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
Step 3.	Camshaft timing incorrect.	<ul style="list-style-type: none"> a. Check gear train timing alignment. (Refer to page 4-24.) b. Correct gear train timing alignment.
4. <u>ENGINE STARTS BUT WILL NOT KEEP RUNNING</u>		
Step 1.	Fuel injection pump timing incorrect.	<ul style="list-style-type: none"> a. Check fuel injection pump timing. (Refer to page 5-4.) If OK, do Step 2. b. Time fuel injection pump.
Step 2.	Camshaft out of time.	<ul style="list-style-type: none"> a. Check/correct gear train timing. (Refer to page 4-24.)
5. <u>ROUGH IDLE, WARM ENGINE</u>		
Step 1.	Fuel injection pump timing incorrect.	<ul style="list-style-type: none"> a. Check fuel injection pump timing. (Refer to page 5-4.) If OK, do Step 2. b. Correct fuel injection pump timing.
Step 2.	Injector nozzles plugged or inoperative.	<ul style="list-style-type: none"> a. Remove and test/inspect fuel injectors. (Refer to page 5-2.) If OK, do Step 3. b. Replace injectors.
Step 3.	Broken engine mounts.	<ul style="list-style-type: none"> a. Inspect engine mounts. If OK, do Step 4. b. Replace engine mounts. (Refer to page 4-2.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
Step 4.	Wrong high pressure fuel lines.	<ul style="list-style-type: none"> a. Inspect high pressure fuel lines. If OK, do Step 5. b. Replace high pressure fuel lines. (Refer to TM 5-3810-306-20.)
Step 5.	Defective fuel injection pump.	<ul style="list-style-type: none"> a. Remove and test fuel injection pump. (Refer to page 5-4.) b. Replace fuel injection pump.

6. ENGINE SURGES AT IDLE

- Step 1. Defective fuel injection pump.
 - a. Remove and test fuel injection pump. (Refer to page 5-4.) If OK, do Step 2.
 - b. Replace fuel injection pump.
- Step 2. One or more injectors malfunctioning.
 - a. Remove and test fuel injectors. (Refer to page 5-2.)
 - b. Replace defective fuel injector(s).

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
7. <u>LOW LUBRICATING OIL PRESSURE</u>		
Step 1.	Oil diluted with fuel accompanied by rough engine operation or low power.	<ul style="list-style-type: none"> a. Remove and check for stuck fuel injector nozzle. (Refer to page 5-2.) If OK, replace fuel injection pump. (Refer to page 5-4.) b. Replace defective fuel injector.
Step 2.	Oil diluted with coolant.	<ul style="list-style-type: none"> a. Check core plugs, cylinder liner, head gasket, and cracked passages in block and head for leaks. If OK, do Step 3. b. Replace defective engine component. Change engine lubrication oil.
Step 3.	Oil pressure regulating valve stuck open or broken spring.	<ul style="list-style-type: none"> a. Remove and inspect oil pressure regulating valve. (Refer to page 4-62.) If OK, do Step 4. b. Clean or replace oil pressure regulating valve.
Step 4.	Internal leak from oil rifle cup plug.	<ul style="list-style-type: none"> a. Check oil rifle cup plugs, cup plug in front and rear face of block. If OK, do Step 5. b. Replace oil rifle cup plugs.
Step 5.	Oil pump suction tube loose or seal leaking.	<ul style="list-style-type: none"> a. Inspect oil pump suction tube. If OK, do Step 6. b. Replace seal and tighten oil pump suction tube. (Refer to page 4-57.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
Step 6.	Defective lube oil pump.	a. Remove and inspect lube oil pump. (Refer to page 4-59.) If OK, do Step 7. b. Replace lube oil pump.
Step 7.	Loose main bearing cap.	a. Check main bearings and caps. If OK, do Step 8. b. Install new main bearings and tighten caps. (Refer to page 4-24.)
Step 8.	Worn crankshaft bearings.	a. Check crankshaft bearings for wear. b. Replace crankshaft bearings. (Refer to page 4-24.) Check and replace piston cooling nozzles if damaged. (Refer to page 4-24.)

8. LUBRICATING OIL PRESSURE TOO HIGH

- | | | |
|---------|---|--|
| Step 1. | Oil pressure relief valve stuck closed. | a. Remove and inspect oil pressure relief valve. (Refer to page 4-62.)
b. Clean or replace valve. |
|---------|---|--|

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
9. <u>ENGINE OIL LOSS</u>		
Step 1.	Air compressor pumping oil.	<ul style="list-style-type: none"> a. Inspect air compressor output for engine oil. If OK, do Step 2. b. Replace air compressor. (Refer to page 9-2.)
Step 2.	High blowby forcing oil out breather.	<ul style="list-style-type: none"> a. Inspect breather tube area for signs of oil loss. If OK, do Step 3. b. Measure blowby. Connect open straight port of engine blowby tool (3375788) to crank case breather tube. Connect water manometer to 90° port of engine blowby tool and measure blowby with engine running at rated speed. Maximum blowby 18 inches of water (226 liters/minute). c. Perform required repairs.
Step 3.	Turbocharger leaking oil to the air intake or exhaust.	<ul style="list-style-type: none"> a. Inspect turbocharger inlet and outlet for evidence of oil transfer. If OK, do Step 4. b. Replace turbocharger. (Refer to page 5-10.)
Step 4.	Worn valve seals.	<ul style="list-style-type: none"> a. Inspect valve seals for wear. b. Replace worn valve seals. (Refer to page 4-8.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
10. CONTAMINATED ENGINE OIL		
Step 1.	Fuel injector needle valves not sealing.	<ul style="list-style-type: none"> a. Remove and test fuel injectors. (Refer to page 5-2.) If OK, do Step 2. b. Replace fuel injector(s).
Step 2.	Coolant in the oil, internal engine component leaks.	<ul style="list-style-type: none"> a. Refer to troubleshooting logic for COOLANT LOSS.
Step 3.	Fuel in the oil, engine operating too cold.	<ul style="list-style-type: none"> a. Review operation for excessive idling resulting in the engine running below normal temperature.
Step 4.	Defective fuel injection pump.	<ul style="list-style-type: none"> a. Replace fuel injection pump. (Refer to page 5-4.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
11. EXHAUST SMOKE EXCESSIVE UNDER LOAD		
Step 1.	Fuel injection pump timing incorrect.	a. Check fuel injection pump timing. (Refer to page 5-4.) If OK, do Step 2. b. Correct fuel injection pump timing.
Step 2.	Air leak between turbocharger and intake or exhaust manifold.	a. Inspect housing and gaskets for leaks and damage. If OK, do Step 3. b. Replace and tighten components.
Step 3.	Defective fuel injector nozzle.	a. Remove and test fuel injectors. (Refer to page 5-2.) If OK, do Step 4. b. Replace fuel injector(s).
Step 4.	Defective turbocharger.	a. Remove and inspect turbocharger. (Refer to page 5-10.) If OK, do Step 5. b. Replace turbocharger.
Step 5.	Piston rings not sealing.	a. Perform a compression check using STE/ICE, VTM test No. 14. If OK, do Step 6. b. Repair engine as required.
Step 6.	Defective fuel injection pump.	a. Replace fuel injection pump. (Refer to page 5-4.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
12. <u>ENGINE WILL NOT REACH RATED SPEED WHEN LOADED</u>		
Step 1.	Defective fuel injection pump.	a. Replace fuel injection pump. (Refer to page 5-4.)
13. <u>LOW POWER</u>		
Step 1.	Air leak between turbocharger and intake manifold.	a. Inspect turbocharger, air inlet manifold and connections. If OK, do Step 2. b. Replace components and tighten attaching hardware. (Refer to page 5-10.)
Step 2.	Exhaust leak between turbocharger and exhaust manifold.	a. Inspect turbocharger exhaust manifold and connections. If OK, do Step 3. b. Replace gasket and tighten attaching hardware. (Refer to page 5-10.)
Step 3.	Fuel injection pump timing incorrect.	a. Check fuel injection pump timing. (Refer to page 5-4.) If OK, do Step 4. b. Correct fuel injection pump timing.
Step 4.	Defective turbocharger.	a. Remove and inspect turbocharger. If OK, do Step 5. b. Replace turbocharger. (Refer to page 5-10.)
Step 5.	Valves out of adjustment.	a. Check valve adjustment. (Refer to TM 5-3810-306-20.) If OK, do Step 6. b. Adjust valves.

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
Step 6.	Defective fuel injector nozzles.	a. Remove and test fuel injectors. (Refer to page 5-2.) If OK, do Step 7. b. Replace fuel injector(s).
Step 7.	Low engine compression.	a. Perform compression check to identify malfunction. (Refer to TM 5-3810-306-20.) If OK, do Step 8. b. Repair engine as required.
Step 8.	Defective fuel injection pump.	a. Replace fuel injection pump. (Refer to page 5-4.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
14. ENGINE MISFIRING		
Step 1.	Fuel injector nozzles plugged or inoperative.	a. Remove and test fuel injectors. (Refer to page 5-2.) If OK, do Step 2. b. Replace fuel injector(s).
Step 2.	Fuel injection pump timing incorrect.	a. Check fuel injection pump timing. (Refer to page 5-4.) If OK, do Step 3. b. Correct fuel injection pump timing.
Step 3.	Low compression on one or more cylinders.	a. Perform compression check to identify cause (piston rings, head gasket or valves). (Use STE/ICE, VTM test No. 14.) If OK, do Step 4. b. Repair engine as required.
Step 4.	Camshaft timing incorrect.	a. Check gear train timing. (Refer to page 4-41.) If OK, do Step 5. b. Correct gear train timing.
Step 5.	Damaged camshaft, tappets or push rods.	a. Inspect camshaft, tappets and push rods. b. Replace camshaft, tappets and push rods. (Refer to page 4-41.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
15. FUEL KNOCK		
Step 1.	Incorrect fuel injection pump timing.	<ul style="list-style-type: none"> a. Check fuel injection pump timing. (Refer to page 5-4.) If OK, do Step 2. b. Correct fuel injection pump timing.
Step 2.	Defective fuel injector nozzles.	<ul style="list-style-type: none"> a. Remove and test fuel injectors. (Refer to page 5-2.) b. Replace fuel injector(s).
16. EXCESSIVE FUEL CONSUMPTION		
Step 1.	Fuel injection pump timing incorrect.	<ul style="list-style-type: none"> a. Check fuel injection pump timing. (Refer to page 5-4.) If OK, do Step 2. b. Correct fuel injection pump timing.
Step 2.	Defective fuel injectors.	<ul style="list-style-type: none"> a. Remove and test fuel injectors. (Refer to page 5-2.) If OK, do Step 3. b. Replace fuel injector(s).
Step 3.	Malfunctioning base engine components.	<ul style="list-style-type: none"> a. Inspect engine base components. b. Repair engine as required.

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
17. EXCESSIVE VIBRATION		
Step 1.	Defective vibration bearing.	<ul style="list-style-type: none"> a. Inspect vibration damper. If OK, do Step 2. b. Replace defective vibration damper. (Refer to page 4-45.)
Step 2.	Flywheel misaligned.	<ul style="list-style-type: none"> a. Disassemble engine and using a dial indicator, check concentricity of flywheel housing to crankshaft. If OK, do Step 3. b. Replace flywheel. (Refer to page 4-32.)
Step 3.	Loose or broken power component.	<ul style="list-style-type: none"> a. Disassemble engine and inspect crankshaft and rods for damage that cause unbalance. b. Replace defective engine components.

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
18. EXCESSIVE ENGINE NOISES		
Step 1.	Defective vibration damper.	<ul style="list-style-type: none"> a. Inspect vibration damper. If OK, do Step 2. b. Replace vibration damper. (Refer to page 4-45.)
Step 2.	Excessive valve noise.	<ul style="list-style-type: none"> a. Inspect push rods and rocker levers for damage and wear. If OK, do Step 3. b. Replace push rods and/or rocker levers.
Step 3.	Defective turbocharger.	<ul style="list-style-type: none"> a. Remove and inspect turbocharger impeller and wheel for housing contact. (Refer to page 5-10.) If OK, do Step 4. b. Replace turbocharger.
Step 4.	Gear train noise.	<ul style="list-style-type: none"> a. Inspect and measure gear backlash. (Refer to page 4-41.) If OK, do Step 5. b. Replace damaged gears as required.
Step 5.	Defective connecting rods and bearings.	<ul style="list-style-type: none"> a. Disassemble engine and inspect connecting rods and bearings. (Refer to page 4-24.) b. Replace connecting rods and bearings as required.

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
19. FUEL OR OIL LEAKING FROM EXHAUST MANIFOLD		
Step 1.	Defective fuel injector nozzles.	<ul style="list-style-type: none"> a. Remove and test fuel injectors. (Refer to page 5-2.) If OK, do Step 2. b. Replace fuel injector(s).
Step 2.	Defective turbocharger seals leaking oil.	<ul style="list-style-type: none"> a. Remove and inspect turbocharger oil seals. (Refer to page 5-10.) b. Replace turbocharger seals.
20. COOLANT TEMPERATURE ABOVE NORMAL		
Step 1.	Defective fuel injection pump.	<ul style="list-style-type: none"> a. Remove and test fuel injection pump. (Refer to page 5-2.) If OK, do Step 2. b. Replace fuel injection pump.
Step 2.	Compression leak through cylinder head gasket.	<ul style="list-style-type: none"> a. Check for compression leak through cylinder head gasket. (Use STE/ICE, VTM test No. 14.) b. If necessary, remove cylinder head and replace cylinder head gasket. (Refer to page 4-8.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
<u>21. COOLANT LOSS</u>		
Step 1.	Expansion plugs leaking.	<ul style="list-style-type: none"> a. Inspect expansion plugs for leaks. If OK, do Step 2. b. Replace expansion plugs.
Step 2.	Leak in cylinder block coolant passages.	<ul style="list-style-type: none"> a. Disassemble engine and check cylinder block coolant passages. b. Replace cylinder block.
<u>22. CONTAMINATED COOLANT</u>		
Step 1.	Oil leaks from engine oil cooler, head gasket, head and cylinder block.	<ul style="list-style-type: none"> a. Disassemble engine and check engine oil cooler, cylinder head and cylinder block for damage. b. Repair or replace components as required.
<u>23. ALTERNATOR NOT CHARGING OR INSUFFICIENT CHARGING</u>		
Step 1.	Defective/malfunctioning alternator.	<ul style="list-style-type: none"> a. Remove and test alternator. (Refer to page 6-2.) b. Repair alternator as required.

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
24. LOW TRANSMISSION CLUTCH PRESSURE		
Step 1.	Clutch pressure regulating valve spool stuck open.	<ul style="list-style-type: none"> a. Remove and inspect valve spool housing. (Refer to page 7-5.) If OK, do Step 2. b. Clean and repair pressure regulating valve.
Step 2.	Faulty charging pump.	<ul style="list-style-type: none"> a. Install pressure gauge in pump outlet and check for pressure of 300 psi. If OK, do Step 3. b. Replace pump. (Refer to page 7-5.)
Step 3.	Broken or worn clutch shaft or piston sealing rings.	<ul style="list-style-type: none"> a. Disassemble transmission and inspect sealing rings. (Refer to page 7-23.) If OK, do Step 4. b. Replace sealing rings.
Step 4.	Clutch piston bleed valve stuck open.	<ul style="list-style-type: none"> a. Disassemble transmission and clean bleed valves. (Refer to page 7-23.) If OK, do Step 5.
Step 5.	Transmission malfunctioning.	<ul style="list-style-type: none"> a. Close pressure line to transmission control valve. If clutch pressure returns to normal, transmission is faulty. b. Repair or replace transmission. (Refer to page 7-23.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
25. <u>LOW TORQUE CONVERTER CHARGING PUMP OUTPUT</u>		
Step 1.	Suction screen plugged.	a. Remove and clean suction screen. (Refer to page 7-23.)
Step 2.	Air leaks at pump intake hose and connections or collapsed hose.	a. Inspect hoses and connections. If OK, do Step 3. b. Tighten all connections or replace hose if necessary.
Step 3.	Defective charging pump.	a. Replace pump. (Refer to page 7-5.)
26. <u>TORQUE CONVERTER OVERHEATING</u>		
Step 1.	Pump suction line taking in air.	a. Check oil line connections. If OK, do Step 2. b. Tighten oil line connections.
Step 2.	Worn charging pump.	a. Remove and test charging pump. (Refer to page 7-5.) If OK, do Step 3. b. Replace pump.
Step 3.	Restricted oil cooler.	a. Check oil cooler for restriction. b. Clean oil cooler. (Refer to page 7-61.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
27. <u>NOISY TORQUE CONVERTER</u>		
Step 1.	Worn coupling gears.	<ul style="list-style-type: none"> a. Disassemble torque converter and inspect gears. If OK, do Step 2. b. Replace gears. (Refer to page 7-5.)
Step 2.	Worn charging pump.	<ul style="list-style-type: none"> a. Remove and test pump. (Refer to page 7-5.) If OK, do Step 3. b. Replace pump.
Step 3.	Worn or damaged bearings.	<ul style="list-style-type: none"> a. Disassemble torque converter and inspect bearings. If OK, do Step 4. b. Replace bearings. (Refer to page 7-5.)
Step 4.	Worn Drive gears.	<ul style="list-style-type: none"> a. Replace drive gears. (Refer to page 7-5.)
28. <u>TORQUE CONVERTER SUCTION LINE IS TAKING AIR</u>		
Step 1.	The suction line connections are taking air.	<ul style="list-style-type: none"> a. Check oil line connections. If OK, do Step 2. b. Tighten oil line connections.
Step 2.	Defective charging pump.	<ul style="list-style-type: none"> a. Replace pump. (Refer to page 7-5.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
29. HIGH TORQUE CONVERTER PRESSURE.		
Step 1.	The oil cooler or oil lines are restricted.	<ul style="list-style-type: none"> a. Check oil cooler lines and oil cooler for restrictions. If OK, do Step 2. b. Clean or replace oil cooler and lines . (Refer to TM 5-3810-306-20.)
Step 2.	Transmission oil is cold.	<ul style="list-style-type: none"> a. Converter pressure in cold weather will-vary. As soon as converter gets hot, pressure should drop.
30. HIGH CLUTCH PRESSURE		
Step 1.	Pressure regulator valve is stuck closed.	<ul style="list-style-type: none"> a. Clean and check valve for worn or dirty parts and replace if necessary. (Refer to page 7-5.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
31. <u>OIL IN ENGINE FLYWHEEL HOUSING</u>		
Step 1.	Preformed packing between impeller cover and impeller is damaged.	<ul style="list-style-type: none"> a. Remove and inspect preformed packing. (Refer to page 7-5.) If OK, do Step 2. b. Replace preformed packing.
Step 2.	Oil baffle preformed packing is damaged.	<ul style="list-style-type: none"> a. Remove and inspect preformed packing. (Refer to page 7-5.) If OK, do Step 3. b. Replace preformed packing.
Step 3.	Oil baffle oil seal is damaged.	<ul style="list-style-type: none"> a. Replace the oil seal. (Refer to page 7-5.)
32. <u>LACK OF POWER</u>		
Step 1.	Low engine rpm at converter stall.	<ul style="list-style-type: none"> a. Refer to troubleshooting logic, engine LOW POWER.

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
33. <u>UNEVEN BRAKING OR LINING WEAR</u>		
Step 1.	Grease on brake shoes.	<ul style="list-style-type: none"> a. Inspect brake linings. If OK, do Step 2. b. Replace the brake lining. (Refer to page 9-18.)
Step 2.	Glazed brake lining.	<ul style="list-style-type: none"> a. Inspect brake linings. If OK do Step 3. b. Replace brake lining. (Refer to page 9-18.)
Step 3.	Corroded or frozen plungers.	<ul style="list-style-type: none"> a. Remove, clean and free-up plungers. (Refer to page 9-18.)
34. <u>HARD TO STEER LEFT AND RIGHT</u>		
Step 1.	Defective two-section pump.	<ul style="list-style-type: none"> a. Connect flow meter to output of pump and do a flow check (16 GPM). If OK, do Step 2. b. Replace pump. (Refer to page 13-24.)
Step 2.	Defective steering control valve.	<ul style="list-style-type: none"> a. Replace steering control valve. (Refer to page 10-2.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
35. SLOW OR ERRATIC OPERATION OF OUTRIGGER EXTENSION CYLINDERS		
Step 1.	Electrical collector ring dirty or glazed.	a. Remove electrical collector ring and clean and deglaze collector ring. (Refer to page 15-95.)
Step 2.	Weak brush springs on electrical collector ring.	a. Replace brush springs. (Refer to page 15-100.)
Step 3.	Defective extension cylinder.	a. Remove extension cylinder and inspect internal parts for damage. (Refer to page 11-8.) If OK, do Step 4. b. Repair extension cylinder.
Step 4.	Binding outrigger beam.	a. Inspect outrigger beam for damage. If OK, do Step 5. b. Repair or replace outrigger beam. (Refer to page 11-2.)
Step 5.	Partially shifted hydraulic selector spool.	a. Disassemble, clean, and polish spool and valve housing with very fine emery cloth. (Refer to page 13-52.)
NOTE		
Solenoids require a minimum of 19 volts to energize.		
Step 6.	Insufficient voltage for operation of solenoid valve.	a. Check outrigger wiring and electrical swivel coupling collector rings.

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
36. <u>STICKING OUTRIGGER CONTROL VALVE</u>		
Step 1.	Distortion caused by tie bolts being overtorqued.	<ul style="list-style-type: none"> a. Check torque on the bolts. (Refer to page 13-72.) If OK, do Step 2. b. Retorque tie bolts.
Step 2.	Flow in excess of valve rating.	<ul style="list-style-type: none"> a. Install flow meter in exhaust line of pump. Under moderate load check for proper output (27 GPM at 2400 rpm).
Step 3.	Pressure in excess of valve rating.	<ul style="list-style-type: none"> a. Check relief valve setting with that recommended. (Refer to TM 5-3810-306-20.) If OK, do Step 4.
Step 4.	Electrical failure.	<ul style="list-style-type: none"> a. Check wiring and solenoids.
37. <u>EXTERNAL LEAKAGE AT CONTROL VALVE</u>		
Step 1.	Damage preformed packings or quad rings.	<ul style="list-style-type: none"> a. Inspect for chipped packings and replace. (Refer to page 13-72.) If OK, do Step 2. b. Repair valve. (Refer to page 13-72.)
Step 2.	Loose tie bolts.	<ul style="list-style-type: none"> a. Retorque tie bolts. (Refer to page 13-72.) If OK, do Step 3.
Step 3.	Damaged solenoid.	<ul style="list-style-type: none"> a. Replace damaged parts. (Refer to page 13-72.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
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38. OUTRIGGER CONTROL VALVE SOLENOID FAILURE

Step 1.	No current.	a. Check power source of at least 85% of coil rating. If OK, do Step 2.
Step 2.	Damaged solenoid assembly.	a. Check solenoid for obvious damage. If OK, do Step 3.
Step 3.	Short in solenoid.	a. Check solenoid. b. Replace coil. (Refer to page 13-72.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
39. OUTRIGGER VERTICAL JACK CYLINDER SLOW OR ERRATIC		
Step 1.	Defective jack cylinder.	a. Remove and disassemble jack cylinder. (Refer to page 11-17.) If OK, do Step 2. b. Repair jack cylinder.
Step 2.	Bent outrigger housing.	a. Inspect outrigger housing. If OK, do Step 3. b. Repair outrigger housing.
Step 3.	Sticking solenoid valve spool.	a. Repair or replace valve spool. (Refer to page 13-72.)
Step 4.	Damaged wiring to solenoid.	a. Repair or replace wiring.
Step 5.	Weak electrical collector brush springs.	a. Replace brush springs. (Refer to page 15-100.)
Step 6.	Electrical collector ring dirty or glazed.	a. Clean or deglaze collector ring.
Step 7.	Directional selector switch sticking.	a. Replace switch. (Refer to TM 5-3810-306-20.)
Step 8.	Defective two-section hydraulic pump.	a. Remove and repair hydraulic pump. (Refer to pages 13-24 & 13-26.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
40. <u>OUTRIGGER JACK CYLINDER RETRACTS UNDER LOAD</u>		
Step 1.	Defective jack cylinder.	<ul style="list-style-type: none"> a. Remove and disassemble jack cylinder. (Refer to page 11-17.) Replace all preformed packings. b. Inspect all parts for damage. c. Repair jack cylinder.
41. <u>JACK CYLINDER EXTENDS WITHOUT ANY SYSTEM ACTIVATION</u>		
Step 1.	Defective jack cylinder.	<ul style="list-style-type: none"> a. Remove and disassemble jack cylinder. (Refer to page 11-17.) Replace all preformed packings. b. Inspect all parts for damage. c. Repair jack cylinder.
42. <u>OUTRIGGER SYSTEM OPERATES, BUT SELECTED OUTRIGGER WILL NOT RETRACT OR EXTEND</u>		
Step 1.	Defective cylinder.	<ul style="list-style-type: none"> a. Remove and disassemble cylinder. (Refer to pages 11-11 or 11-17.) Replace all preformed packings. b. Inspect all parts for damage. c. Repair cylinder.

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
43. <u>BOOM RAISES ERRATICALLY</u>		
Step 1.	Defective lift cylinder.	<ul style="list-style-type: none"> a. Remove and disassemble lift cylinder. (Refer to page 13-94.) b. Inspect all parts for damage. c. Repair cylinder.
Step 2.	Bent boom pivot shaft.	<ul style="list-style-type: none"> a. Replace boom pivot shaft. (Refer to page 15-5.)
44. <u>BOOM LOWERS ERRATICALLY</u>		
Step 1.	Damaged hydraulic pump section.	<ul style="list-style-type: none"> a. Repair or replace hydraulic pump. (Refer to page 13-12.)
45. <u>BOOM RAISES SLOWLY</u>		
Step 1.	Defective lift cylinder(s).	<ul style="list-style-type: none"> a. Remove and disassemble lift cylinders. (Refer to page 13-94.) If OK, do Step 2. b. Repair hydraulic cylinder.
Step 2.	Defective hydraulic pump section.	<ul style="list-style-type: none"> a. Repair or replace hydraulic pump section. (Refer to page 13-12.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
46. <u>BOOM LOWERS SLOWLY</u>		
Step 1.	Defective lift cylinder(s).	<ul style="list-style-type: none"> a. Remove and disassemble lift cylinder(s). (Refer to page 13-94.) If OK, do Step 2. b. Repair hydraulic cylinder.
Step 2.	Defective hydraulic pump.	<ul style="list-style-type: none"> a. Repair or replace hydraulic pump. (Refer to page 13-12.)
47. <u>BOOM WILL NOT RAISE</u>		
Step 1.	Broken pump shaft.	<ul style="list-style-type: none"> a. Inspect pump shaft. If OK, do Step 2. b. Replace pump shaft and seals. (Refer to page 13-12.)
Step 2.	Broken pump drive coupling.	<ul style="list-style-type: none"> a. Inspect drive coupling. If OK, do Step 3. b. Replace drive coupling. (Refer to page 13-10.)
Step 3.	Defective hydraulic pump section.	<ul style="list-style-type: none"> a. Repair or replace pump section. (Refer to page 13-12.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
48. <u>BOOM WILL NOT LOWER</u>		
Step 1.	Broken pump shaft.	<ul style="list-style-type: none"> a. Inspect pump shaft. If OK, do Step 2. b. Replace pump shaft and seals. (Refer to page 13-12.)
Step 2.	Broken pump drive coupling.	<ul style="list-style-type: none"> a. Inspect pump drive coupling. If OK, do Step 3. b. Replace drive coupling. (Refer to page 13-10.)
Step 3.	Defective hydraulic pump.	<ul style="list-style-type: none"> a. Repair or replace hydraulic pump. (Refer to page 13-12.)
49. <u>ERRATIC OPERATION OF EXTENDING TELESCOPING CYLINDER</u>		
Step 1.	Worn boom wear pads.	<ul style="list-style-type: none"> a. Replace wear pads. (Refer to page 15-8.)
Step 2.	Distorted boom section.	<ul style="list-style-type: none"> a. Inspect boom. If OK, do Step 3. b. Replace distorted section. (Refer to page 15-8.)
Step 3.	Damaged telescope cylinder.	<ul style="list-style-type: none"> a. Repair or replace cylinder. (Refer to page 13-108.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
50. <u>ERRATIC OPERATION OF RETRACTING TELESCOPING CYLINDER</u>		
	Step 1. Worn boom wear pads.	a. Replace wear pads. (Refer to page 15-8.)
	Step 2. Distorted boom section.	a. Inspect boom. If OK, do Step 3. b. Replace distorted section. (Refer to page 15-8.)
	Step 3. Defective telescope cylinder.	a. Repair or replace cylinder. (Refer to page 13-108.)
51. <u>TELESCOPE CYLINDER WILL NOT EXTEND</u>		
	Step 1. Broken hydraulic pump coupling.	a. Inspect hydraulic pump coupling. If OK, do Step 2. b. Replace broken hydraulic pump coupling. (Refer to page 13-10.)
	Step 2. Defective hydraulic pump.	a. Repair or replace pump section. (Refer to page 13-12.)
	Step 3. Bent boom section.	a. Inspect boom. If OK, do Step 4. b. Replace damaged boom section. (Refer to page 15-8.)
	Step 4. Defective telescope cylinder.	a. Repair or replace cylinder. (Refer to page 13-108.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
52. <u>TELESCOPE CYLINDER WILL NOT RETRACT</u>		
	Step 1. Broken hydraulic pump coupling.	<ul style="list-style-type: none"> a. Inspect hydraulic pump coupling. If OK, do Step 2. b. Replace broken hydraulic pump coupling. (Refer to page 13-10.)
	Step 2. Defective hydraulic pump.	<ul style="list-style-type: none"> a. Repair or replace pump section. (Refer to page 13-12.)
	Step 3. Bent boom section.	<ul style="list-style-type: none"> a. Inspect boom. If OK, do Step 4. b. Replace damaged boom section. (Refer to page 15-8.)
	Step 4. Defective telescope cylinder.	<ul style="list-style-type: none"> a. Repair or replace cylinder. (Refer to page 13-108.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
53. <u>HOIST WILL NOT RAISE LOAD</u>	Step 1. Defective hoist motor control valve.	<ul style="list-style-type: none"> a. Remove and inspect valve. (Refer to page 15-60.) If OK, do Step 2. b. Replace valve.
	Step 2. Damaged primary drive assembly.	<ul style="list-style-type: none"> a. Repair or replace primary drive assembly. (Refer to page 15-36.)
	Step 3. Damaged overrunning clutch.	<ul style="list-style-type: none"> a. Remove brake housing and associated lines from the primary housing. The clutch assembly is keyed and bolted to the brake pinion. The clutch assembly should turn freely in the counterclockwise direction. Repair or replace if damaged. (Refer to page 15-64.)
	Step 4. Sheared shaft on pump or damaged pump.	<ul style="list-style-type: none"> a. Install a 0 to 5000 psi (0 to 34,475 kPa/344.8 bar) gauge in the inlet line of the hoist valve bank activate the system. No pressure or excessively low pressure indicates a damaged pump or drive shaft. Repair or replace. (Refer to page 13-12.)
54. <u>HOIST WILL NOT LOWER</u>	Step 1. Damaged primary drive assembly.	<ul style="list-style-type: none"> a. Repair or replace primary drive assembly. (Refer to page 15-36.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
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55. **SLOW HOIST OPERATION DOWN**

Step 1. Defective three-section hydraulic pump.

- a. Install flow meter in exhaust line of the pump. Under moderate load, check for proper output (50 GPM at 2400 RPM).
- b. Damaged pumps normally build heat. By hand, carefully check the temperature of the pump in relation to the other hydraulic pumps.
- c. Replace pump. (Refer to page 13-10.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
56. <u>SLOW HOIST OPERATION UP</u>		
Step 1. Damaged hydraulic pump disconnect.		
	a. Check speed of other hydraulic functions under load. If all operations are slow, repair or adjust pump disconnect. (Refer to page 13-42.)	
Step 2. Defective three-section hydraulic pump.		
	a. Install flow meter in exhaust line of pump. Under moderate load, check for proper output (50 GPM at 2400 RPM).	
	b. Damaged pumps normally build heat. By hand, carefully check temperature of pump in relation to other hydraulic pumps.	
	c. Replace pump. (Refer to page 13-10.)	
Step 3. Damaged O-rings in brake piston.		
	a. Install a 0 to 5000 psi (0 to 34,475 kPa/344.8 bar) pressure gauge in pipe plug in line going into center of brake housing. Inability to build or hold pressure at 500 psi (3447.5 kPa/34.48 bar) in this line indicates defective preformed packing. Replace if damaged. (Refer to page 15-64.)	
Step 4. Warped brake piston.		
	a. Replace piston. (Refer to page 15-64.)	

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
57. <u>ERRATIC HOIST OPERATION UP</u>		
	Step 1. Defective hoist motor.	
		<ul style="list-style-type: none"> a. Disconnect line to brake release port. Plug and cap line. Disconnect exhaust (for the down circuit) lines from each motor and cap lines. Pressurize line and examine exhaust port for excessive leakage. b. Replace defective motor. (Refer to page 15-50.)
58. <u>LEAKING HOIST MOTOR CONTROL VALVE SEALS</u>		
	Step 1. Paint on or under seal.	
		<ul style="list-style-type: none"> a. Remove and clean, as necessary. (Refer to page 15- 60.)
	Step 2. Dirt under seal.	
		<ul style="list-style-type: none"> a. Remove and clean, as necessary. (Refer to page 15- 60.)
	Step 3. Scored spool.	
		<ul style="list-style-type: none"> a. Replace valve. (Refer to page 15-60.)
	Step 4. Loose seal plates.	
		<ul style="list-style-type: none"> a. Clean and tighten plates.
	Step 5. Cut or scored seal.	
		<ul style="list-style-type: none"> a. Replace faulty parts.

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
59. <u>UNABLE TO MOVE HOIST MOTOR CONTROL VALVE SPOOL IN OR OUT</u>	Step 1. Dirt in valve.	a. Clean and flush out valve assembly.
	Step 2. Spool cap full of oil.	a. Replace seals. (Refer to page 15-60.)
	Step 3. Bind in linkage.	a. Free linkage.
60. <u>POOR HYDRAULIC SYSTEM PERFORMANCE OR FAILURE</u>	Step 1. Defective three-section hydraulic pump.	a. Check pump output (50 GPM at 2400 RPM). If OK, do Step 2. b. Repair or replace pump. (Refer to page 13-12.)
	Step 2. Worn hoist motor.	a. Repair or replace damaged components. (Refer to page 15-54.)
61. <u>EXTERNAL HOIST MOTOR LEAKAGE</u>	Step 1. Seal failure.	a. Replace seal. (Refer to page 15-50.)
	Step 2. Defective casting.	a. Replace casting. (Refer to page 15-54.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
62. <u>LEAKAGE AT HOIST MOTOR FITTINGS</u>		
	Step 1. Cracked casting.	a. Replace casting. (Refer to page 15-54.)
	Step 2. Defective threads.	a. Replace fittings or casting. (Refer to page 15-54.)
	Step 3. Damaged preformed packings.	a. Replace packings. (Refer to page 15-54.)
	Step 4. Burrs on casting or fittings.	a. Stone or file to remove burrs.
63. <u>LOSS OF HOIST SPEED UNDER LOAD</u>		
	Step 1. Low hoist motor inlet pressure.	a. Check pressure (2700 + 100 PSI at 2400 RPM). b. Adjust hoist relief valve. (Refer to TM 5-3810-306-20.)
	Step 2. Excessive back-pressure at hoist motor outlet.	a. Check pressure (50 + 5 PSI) increase line size.
	Step 3. Scored port plate or end cap.	a. Relap to remove scored surfaces.
64. <u>POOR HOIST SPEED CONTROL</u>		
	Step 1. Worn cam ring assembly.	a. Repair hoist motor. (Refer to page 15-54.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
65. <u>HOIST MOTOR FAILS TO START TURNING</u>		
	Step 1. Excessive motor leakage.	<ul style="list-style-type: none"> a. Install flow meter in motor outlet and check flow. If 50 gpm check shuttle valve in front port plate. Pressure not loading plate causing plate to move away from cam ring. b. Repair hoist motor. (Refer to page 15-54.)
	Step 2. Worn port plates.	<ul style="list-style-type: none"> a. Repair hoist motor. (Refer to page 15-54.)
	Step 3. Worn cam ring assembly.	<ul style="list-style-type: none"> a. Repair hoist motor. (Refer to page 15-54.)
	Step 4. Defective preformed packing on OD of front port plate.	<ul style="list-style-type: none"> a. Replace preformed packing. (Refer to page 15-54.)
	Step 5. Defective hoist motor.	<ul style="list-style-type: none"> a. Replace hoist motor. (Refer to page 15-50.)
66. <u>HOIST MOTOR SHAFT PLAY</u>		
	Step 1. Worn bearings.	<ul style="list-style-type: none"> a. Disassemble hoist motor and replace bearings. (Refer to page 15-54.)
	Step 2. Hammering coupling on shaft.	<ul style="list-style-type: none"> a. Coupling bore should be slip fit on shaft.

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
67. <u>EXCESSIVE HOIST MOTOR NOISE</u>	Step 1. Worn or damaged internal parts.	<ul style="list-style-type: none"> a. Disassemble to remove rotor, vane, cam ring assembly. (Refer to page 15-54.) b. Inspect for excessive wear. c. Check condition of faces of port plate and end cap. d. Rework (lap) or replace if scuffed.
68. <u>BOOM SWING OPERATION ERRATIC IN EITHER DIRECTION</u>	Step 1. Defective swing motor.	<ul style="list-style-type: none"> a. Repair or replace swing motor. (Refer to page 15-133.)
	Step 2. Improperly torqued swing motor attachment bolts.	<ul style="list-style-type: none"> a. Check torque on bolts. (Refer to TM 5-3810-306-20.) If OK, do Step 3. b. Torque swing motor attachment bolts.
	Step 3. Defective swing box.	<ul style="list-style-type: none"> a. Remove swing box and make necessary repairs. (Refer to page 15-116.)
	Step 4. Defective two-section hydraulic pump section.	<ul style="list-style-type: none"> a. Repair or replace damaged section. (Refer to page 13-26.)
69. <u>BOOM SWING OPERATION ERRATIC IN ONE DIRECTION ONLY</u>	Step 1. Damaged swing pinion.	<ul style="list-style-type: none"> a. Replace swing pinion. (Refer to page 15-116.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
70. <u>BOOM WILL NOT SWING IN EITHER DIRECTION</u>		
	Step 1. Defective swing motor.	a. Repair or replace swing motor. (Refer to page 15-133.)
	Step 2. Swing brake not releasing properly.	a. Repair as necessary. (Refer to page 15-126.)
	Step 3. Defective swing box.	a. Remove swing box and repair. (Refer to page 15-116.)
	Step 4. Defective two-section hydraulic pump.	a. Repair or replace pump. (Refer to page 13-26.)
71. <u>SWING OPERATION SLOW IN EITHER DIRECTION</u>		
	Step 1. Worn or damaged output shaft bearings.	a. Remove and disassemble swing box. (Refer to page 15-116.) Inspect bearings. If OK, do Step 2.
		b. Replace bearings.
	Step 2. Defective swing motor.	a. Remove and repair swing motor. (Refer to page 15- 133.)
	Step 3. Defective two-section hydraulic pump.	a. Repair or replace hydraulic pump. (Refer to page 13-26.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
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72. SWING BRAKE SYSTEM WILL NOT OPERATE

Step 1. Defective swing brake valve.

- a. Replace swing brake valve. (Refer to TM 5-3810-306-20.)

Step 2. Defective swing brake assembly.

- a. Remove and repair swing brake. (Refer to page 15-126.)

73. BOOM SWINGS SLOWLY

Step 1. Defective swing motor.

- a. Repair or replace swing motor. (Refer to page 15-133.)

74. SWING MOTOR NOISY

Step 1. Swing motor binding.

- a. Repair or replace swing motor. (Refer to page 15-133.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
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75. <u>CAB HEATER STARTS AFTER SWITCHING ON SEVERAL TIMES</u>		
	Step 1. Defective glow plug.	
	a. Check glow plug. If OK, do Step 2.	
	b. Replace glow plug. (Refer to page 12-2.)	
	Step 2. Fuel (Dosing) pump failure.	
	a. Check fuel (dosing) pump deliver rate. (Refer to page 12-8.)	
	b. Replace pump. (Refer to page 12-8.)	
76. <u>NO CAB HEATER IGNITION VOLTAGE</u>		
	Step 1. Defective glow plug.	
	a. Check glow plug.	
	b. Replace glow plug. (Refer to page 12-2.)	
77. <u>CAB HEATER MOTOR DOES NOT START</u>		
	Step 1. Motor drive assembly failure.	
	a. Replace motor drive assembly. (Refer to page 12-2.)	

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
78. <u>CAB HEATER COMBUSTION DOES NOT START</u>		
	Step 1. Overheat thermostat failure.	<ul style="list-style-type: none"> a. Inspect thermostat. If OK, do Step 2. b. Replace thermostat. (Refer to page 12-2.)
	Step 2. Defective glow plug.	<ul style="list-style-type: none"> a. Check glow plug. If OK, do Step 3. b. Replace glow plug. (Refer to page 12-2.)
	Step 3. Fuel (dosing) pump failure.	<ul style="list-style-type: none"> a. Check fuel (dosing) pump delivery rate. (Refer to page 12-8.) If OK, do Step 4. b. Replace dosing pump. (Refer to page 12-8.)
	Step 4. Switch (safety switch) failure.	<ul style="list-style-type: none"> a. Remove and test safety switch. b. Replace switch. (Refer to page 12-2.)
79. <u>CAB HEATER COMBUSTION STOPS</u>		
	Step 1. Overheat thermostat failure.	<ul style="list-style-type: none"> a. Inspect thermostat. If OK, do Step 2. b. Replace thermostat. (Refer to page 12-2.)
	Step 2. Fuel (dosing) pump failure.	<ul style="list-style-type: none"> a. Check fuel (dosing) pump delivery rate. (Refer to page 12-8.) If OK, do Step 3. b. Replace dosing pump. (Refer to page 12-8.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
Step 3. Switch (safety switch) failure.	a. Remove and test safety switch.	b. Replace safety switch. (Refer to page 12-2.)
80. <u>CAB HEATER COMBUSTION PRODUCES BLACK SMOKE</u>		
Step 1. Motor drive assembly failure.	a. Replace motor drive assembly. (Refer to page 12-2.)	
81. <u>CAB HEATER DOSING PUMP TICKING NOT AUDIBLE</u>		
Step 1. Overheat thermostat failure.	a. Inspect thermostat. If OK, do Step 2.	b. Replace thermostat. (Refer to page 12-2.)
Step 2. Fuel (dosing) pump failure.	a. Check fuel (dosing) pump delivery rate. (Refer to page 12-8.) If OK, do Step 3.	b. Replace dosing pump. (Refer to page 12-8.)
Step 3. Switch (safety switch) failure.	a. Replace safety switch. (Refer to page 12-2.)	

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
82. <u>LEVER LOCKOUT SYSTEM ACTIVATED. (CRANE NOT IN OVERLOAD OR TWO-BLOCK CONDITION).</u>	Step 1. Hold HORN OFF/CLL-OVERRIDE switch to OVERRIDE position. If OK go to Step 2.	<ul style="list-style-type: none"> a. Check crane electric or air system. (Refer to TM 5-3810-306-20.) Repair as needed. b. Check lever lockout system. (Refer to page 12-9.) Repair as needed.
	Step 2. Fault in LMI system, cables, wiring or fuses.	<ul style="list-style-type: none"> a. Refer to Malfunction No. 83.
	Step 3. Fault in Anti-Two-Block System.	<ul style="list-style-type: none"> a. Refer to Malfunction No. 84.
83. <u>NO DISPLAY (LEVER LOCKOUT SYSTEM ACTIVATED).</u>	Step 1. Check circuit breaker on Central Processor Unit (CPU). If OK go to Step 2.	<ul style="list-style-type: none"> a. Reset Circuit breaker.
	Step 2. Check voltage between Pin 2 and Pin 4 on CPU terminal board, terminal block X1; (Refer to page 3-64.) voltage should be 24 Vdc. If OK go to Step 3.	<ul style="list-style-type: none"> a. Check crane electrical system. (Refer to TM 5-3810-306-20.) Repair as necessary.
	Step 3. Check voltage between Pin 2 and Pin 3 (ground) on CPU terminal board, terminal block X4; (Refer to page 3-65.) voltage should be 24 Vdc. If OK go to Step 4.	<ul style="list-style-type: none"> a. Replace/defective CPU. (Refer to page 14-4.)
	Step 4. Check voltage between Pin 1 and Pin 2 on CPU main board, terminal block X1; (Refer to page 3-66.) voltage should be 24 Vdc. If OK go to Step 5.	

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
	a.	Replace/defective CPU. (Refer to page 14-4.)
	Step 5.	Disconnect ribbon cables from CPU main board, terminal blocks X2 and X3. Check voltages between following test points on Main board: (Refer to page 3-67.)
		MP15 and MP1 = + 5 Vdc
		MP15 and MP2 = - 5 Vdc
		MP13 and MP12 = + 5 Vdc
		MP15 and MP18 = + 5 Vdc
		MP15 and MP19 = - 5 Vdc
		If OK go to Step 6.
	a.	Replace/defective CPU. (Refer to page 14-4.)
	Step 6.	Reconnect ribbon cable to CPU main board, terminal blocks X2 and X3. Check voltages between following test points on main board: (Refer to page 3-67.)
		MP15 and MP1 = + 5 Vdc
		MP15 and MP2 = - 5 Vdc
		MP13 and MP12 = + 5 Vdc
		MP15 and MP18 = + 5 Vdc
		MP15 and MP19 = - 5 Vdc
		If OK go to Step 7.
	a.	Repair short circuit in external wiring of load moment indicator.
	Step 7.	Check voltage at console terminal block between Pin 1 and Pin 2; (Refer to page 3-68.) voltage should be 24 Vdc. If OK go to Step 8.
	a.	Repair wiring between terminal block X1 in CPU and console terminal block.
	Step 8.	Defective Console.
	a.	Replace console. (Refer to page 14-2.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
84. <u>MALFUNCTION OF ANTI-TWO-BLOCK SYSTEM</u>	Step 1. Check if jumper/dummy plug in receptacle at boom nose is plugged in. If OK go to Step 2.	a. Plug in jumper/dummy plug.
	Step 2. Remove jumper/dummy plug from receptacle at boom nose and check ohm reading between terminals 23 and 24 of Anti-Two Block switch. (Refer to page 3-69.) Readings should be:	Safe condition = 0 ohm Block-to-Block = greater than 1 megaohm
	If OK go to Step 3.	
	Step 3. Disconnect wire from CPU terminal board, terminal block X1, Pin 35. Check ohm reading between Pin 1 and Pin 6 of receptacle at boom nose. (Refer to page 3-70.) Readings should be:	Anti-Two-Block Switch Closed = 0 ohm Anti-Two-Block Switch Open = greater than 1 megaohm
	If OK go to Step 4.	
	a. Fault in wiring cable from Anti-Two-Block switch to junction box at boom nose. Repair as necessary.	
	b. Short circuit in length cable. Repair as necessary.	
	Step 4. Reconnect jumper/dummy plug in receptacle at boom nose. Disconnect length cable from slip rings terminals 17 and 18 in cable reel. (Refer to page 3-71.) Check ohm reading between center and shield of length cable. Readings should be:	Anti-Two-Block Switch Closed = 4700 ohms + 500 ohms Anti-Two-Block Switch Open = greater than 1 megaohm
	If OK go to Step 5.	
	a. Faulty wiring between receptacle at boom nose and cable reel. Repair as necessary.	

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
		<ul style="list-style-type: none"> b. Damaged length cable. Replace length cable. (Refer to page 14-16.)
	<p>Step 5. Check ohm reading between wire disconnected from Pin 35 and Pin 34 at CPU terminal board, terminal block X1. (Refer to page 3-72.) Readings should be:</p> <p style="padding-left: 40px;">Anti-Two-Block Switch Closed = 4700 ohms + 500 ohms Anti-Two-Block Switch Open = greater than 1 megaohm</p> <p>If OK go to Step 6.</p>	<ul style="list-style-type: none"> a. Faulty wire between cable reel and CPU. Repair as necessary.
	<p>Step 6. Check CPU main board function by installing a temporary resistor (4700 Ohm) at terminal block X1 between Pin 35 and Pin 34. (Refer to page 3-73.) With resistor connected, alarm should be inactive. If OK go to Step 7.</p>	<ul style="list-style-type: none"> a. Defective CPU. Replace CPU. (Refer to page 14-4.)
	<p>Step 7. Bad data transfer between CPU and console.</p>	<ul style="list-style-type: none"> a. Refer to malfunction No. 87.

85. LENGTH READING INCORRECT

- Step 1. Check that length potentiometer in cable reel, with boom fully retracted, is adjusted counterclockwise to stop. (Refer to page 3-74.) If OK go to Step 2.
- a. Adjust length potentiometer counterclockwise to stop.
 - b. Replace length/angle cable reel. (Refer to page 14-10.)
- Step 2. Extend and retract boom to ensure clutch in big gear wheel of length transducer is not slipping on potentiometer axle in cable reel. (Refer to page 3-74.) If OK go to Step 3.
- a. Replace length/angle cable reel. (Refer to page 14-10.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
Step 3. Check voltage between Pin 8 and Pin 11 on CPU terminal board, terminal block X1. (Refer to page 3-75.) Reading should be: -5 Vdc. If OK go to Step 4.	a. Replace CPU. (Refer to page 14-4.)	
Step 4. Check voltage between Pin 1 and Pin 3 on terminal block in cable reel. (Refer to page 3-76.) Reading should be: -5 Vdc. If OK go to Step 5.	a. Faulty wiring between CPU and length transducer. Repair as necessary.	
Step 5. Check voltage between Pin 2 and Pin 1 on terminal block in cable reel. (Refer to page 3-77.) Readings should be:	Boom retracted = - 0.5 Vdc Boom extended = -2.27 Vdc	
If OK go to Step 6.	a. Replace length angle cable reel. (Refer to page 14-10.)	
Step 6. Check voltage between Pin 8 and Pin 10 on CPU terminal board, terminal block X1. (Refer to page 3-78.) Readings should be:	Boom retracted = - 0.5 Vdc Boom extended = -2.27 Vdc	
If OK go to Step 7.	a. Faulty wiring between CPU and length transducer. Repair as necessary.	
Step 7. Check voltage between test points MP15 and MP6 on CPU main board. (Refer to page 3-79.) Reading should be: +0.5 Vdc. If OK go to Step 8.	a. Replace CPU if reading is not as above. (Refer to page 14-4.)	

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
Step 8. Bad data transfer between CPU and console.	a. Refer to Malfunction No. 87.	
86. <u>LOAD READING INCORRECT</u>		
Step 1. Measure boom length and check with reading on display. If OK go to Step 2.	a. Adjust length potentiometer. (Refer to page 14-14.)	
Step 2. Measure boom radius and check with console display. If OK go to Step 3.	a. Adjust angle sensor. (Refer to page 14-14.)	
Step 3. Unplug transducer cables (rod and piston) from transducers and check voltages on CPU terminal board at terminal block X1. (Refer to page 3-80.) Readings should be:	Between Pin 14 and Pin 15 = -5 Vdc Between Pin 14 and Pin 13 = +5 Vdc Between Pin 19 and Pin 20 = -5 Vdc Between Pin 19 and Pin 18 = +5 Vdc	
If OK go to Step 4.	a. Replace defective CPU. (Refer to page 14-4.)	
Step 4. Check voltage at transducer plugs (rod and piston). (Refer to page 3-81.) Readings should be:	Between receptacles B and A = +5 Vdc Between receptacles B and C = -5 Vdc	
If OK go to Step 5.	a. Faulty wiring between CPU and pressure transducer. Repair as necessary.	

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
Step 5. Reconnect plugs (rod and piston) to pressure transducers and check voltages on CPU terminal board at terminal block X1. (Refer to page 3-82.) Readings should be:	Boom fully retracted: Between Pin 19 and Pin 21 = 0 Vdc + 20 mV Between Pin 14 and Pin 16 = 0 Vdc + 20 mV	Boom fully extended: Between Pin 19 and Pin 21 = Maximum -1 Vdc Between Pin 14 and Pin 16 = Maximum -1 Vdc
If OK go to Step 6.	a. Faulty wiring between CPU and pressure transducer. Repair as necessary. b. Replace defective transducer. (Refer to page 14-20.)	
Step 6. Disconnect hydraulic pipes from pressure transducers (rod and piston) and check voltages on CPU main board. (Refer to pages 3-83 and 3-84.) Readings should be:	Between test points MP15 and MP4 = 500 mV Between test points MP15 and MP5 = 500 mV	
If OK go to Step 7.	a. Adjust voltage readings as follows: Adjust reading between MP15 and MP4 by turning adjustment screw at P4. Adjust reading between MP15 and MP5 by turning adjustment screw at P5. b. If unable to adjust, replace defective transducer. (Refer to page 14-20.)	
Step 7. Bad data transfer between CPU and console.	a. Refer to Malfunction No. 87.	

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
87. <u>ERROR IN DATA OR NO DATA TRANSFER BETWEEN CENTRAL PROCESSING UNIT AND CONSOLE (ERROR CODES E91, E92, E93 OR E94)</u>		
	Step 1. Check that Data EPROM is plugged into CPU main board socket D5 and System EPROM is plugged into CPU main board socket D4. Ensure that notch on EPROMs match notch on sockets. (Refer to page 3-85.) If OK go to Step 2.	a. Position and insert EPROMs correctly.
	Step 2. Check voltage supply for console between Pin 33 and Pin 30 on CPU terminal board, terminal block XI. (Refer to page 3-86.) Reading should be 24 Vdc. If OK go to Step 3.	a. Check crane electric system. (Refer to TM 5-3810-306- 20.) Repair as n ecessary.
	Step 3. Check that CPU external and internal power supply is correct. (Refer to Malfunction No. 83.) If OK go to Step 4.	a. Replace defective CPU. (Refer to page 14-4.)
	Step 4. Check power supply to console between terminal No. 2 and terminal No. 1 on console board. (Refer to page 3-88.) Reading should be: 24 Vdc. If OK go to Step 5.	a. Replace defective cable between CPU and console.
	Step 5. Ensure that wires are properly connected between CPU terminal board, terminal block X1, Pin 31 and Console terminal Pin 4 and between CPU terminal board, terminal block X1, Pin 32 and Console terminal Pin 3. If OK go to Step 6.	a. Connect wires properly (position, clean, tight, etc.).
	Step 6. Defective Central Processor Unit and/or Console.	a. Replace Console. (Refer to page 14-2.) b. Replace CPU. (Refer to page 14-4.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
88. <u>INTERFERENCE PROBLEM (ERROR CODES E91, E92, E93 OR E94 INTERMITTENT)</u>	<p>Step 1. Check data transfer between CPU and Console (Refer to Malfunction No. 87). If OK go to Step 2.</p> <p>a. Repair or replace defective part(s).</p> <p>Step 2. Check that additional ground link between CPU main board terminal X9/1 and CPU mounting bracket is in place. If OK go to Step 3.</p> <p>a. Install 2ground link (single cable minimum of AWG14 (2.0 mm²)).</p> <p>Step 3. Ensure that cable shields are connected properly. (Refer to pages 3-87, 3-88 and 3-89.) If OK go to Step 4.</p> <p>a. Connect cable shields correctly.</p> <p>Step 4. Determine which component of crane electric system is spiking out (e.g. dump valve, outrigger relay).</p> <p>a. Install diode or varistor across terminals of spiking component. Diode type such as IN4001 can be used (watch + and - connection for diode).</p>	
89. <u>ERROR CODE E05 DISPLAYED ON CONSOLE</u>	<p>Step 1. Boom length range exceeded.</p> <p>a. Length sensor adjustment changed. (Refer to Malfunction No. 85.)</p>	
90. <u>ERROR CODE E07 DISPLAYED ON CONSOLE</u>	<p>Step 1. No acknowledgment signal from overload relay (K1).</p> <p>a. Replace defective CPU. (Refer to page 14-4.)</p>	

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
91. <u>ERROR CODE E08 DISPLAYED ON CONSOLE</u>	Step 1. No acknowledgment signal from Anti-Two-Block switch relay (K2).	a. Replace defective CPU. (Refer to Page 14-4.)
92. <u>ERROR CODE E11 DISPLAYED ON CONSOLE</u>	Step 1. Fallen below lower limiting value for measuring channel (length).	<ul style="list-style-type: none"> a. Check for defective cable from CPU to length sensor. (Refer to Malfunction No. 85.) Replace cable if necessary. b. Replace defective length/angle cable reel. (Refer to page 14-10.) c. Replace defective CPU. (Refer to Page 14-4.)
93. <u>ERROR CODE E12 DISPLAYED ON CONSOLE</u>	Step 1. Fallen below lower limiting value for measuring channel (pressure-piston side).	<ul style="list-style-type: none"> a. Check cable and plug from CPU to pressure transducer. (Refer to Malfunction No. 86.) Replace as necessary. b. Replace defective pressure transducer (piston side). (Refer to page 14-20.) c. Replace defective CPU. (Refer to page 14-4.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
94. <u>ERROR CODE E13 DISPLAYED ON CONSOLE</u>	Step 1. Fallen below lower limiting value for measuring channel (pressure - rod side).	<ul style="list-style-type: none"> a. Check cable and plug from CPU to pressure transducer. (Refer to Malfunction No. 86.) Replace as necessary. b. Replace defective pressure transducer (rod side). (Refer to page 14-20.) c. Replace defective CPU. (Refer to page 14-4.)
95. <u>ERROR CODE E15 DISPLAYED ON CONSOLE</u>	Step 1. Fallen below lower limiting value for the measuring channel (angle - main boom).	<ul style="list-style-type: none"> a. Check cable from CPU to length/angle sensor. (Refer to Malfunction No. 85.) Replace as necessary. b. Replace defective length/angle cable reel. (Refer to page 14-10.) c. Replace defective CPU. (Refer to page 14-4.)
96. <u>ERROR CODE E19 DISPLAYED ON CONSOLE</u>	Step 1. Error in reference voltage.	<ul style="list-style-type: none"> a. Replace defective CPU. (Refer to page 14-4.) b. Check external load moment indicator wiring for short circuit. Repair as necessary.

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

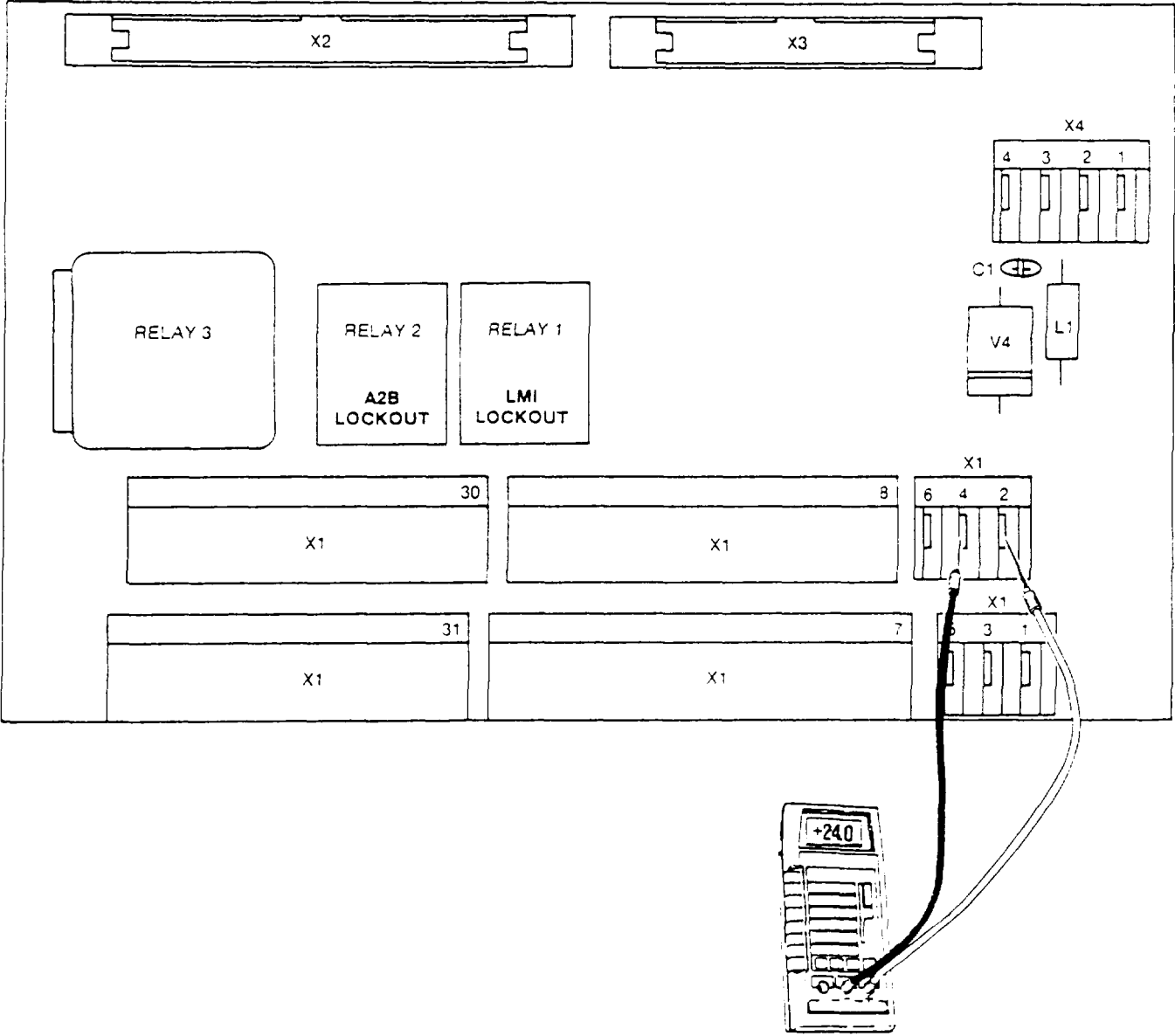
Malfunction	Test or Inspection	Corrective Action
97. <u>ERROR CODE E21 DISPLAYED ON CONSOLE</u>	Step 1. Upper limiting value for the measuring channel (length) exceeded.	<ul style="list-style-type: none"> a. Check for defective or loose cable between CPU and length/angle sensor. (Refer to Malfunction No. 85.) Repair or replace as necessary. b. Replace defective length/angle cable reel. (Refer to page 14-10.) c. Replace defective CPU. (Refer to page 14-4.)
98. <u>ERROR CODE E22 DISPLAYED ON CONSOLE</u>	Step 1. Upper limiting value for the measuring channel (pressure -piston side) exceeded.	<ul style="list-style-type: none"> a. Check for defective or loose cable between CPU and pressure transmitter. (Refer to Malfunction No. 86.) Repair or replace as necessary. b. Replace defective piston side pressure trans mitter. (Refer to page 14-20.) c. Replace defective CPU. (Refer to Page 14-4.)
99. <u>ERROR CODE E23 DISPLAYED ON CONSOLE</u>	Step 1. Upper limiting value for the measuring channel (pressure -rod side) exceeded.	<ul style="list-style-type: none"> a. Check for defective or loose cable between CPU and pressure transmitter. (Refer to Malfunction No. 86.) Repair or replace as necessary. b. Replace defective rod side pressure transmitter. (Refer to page 14-20.) c. Replace defective CPU. (Refer to page 14-4.)

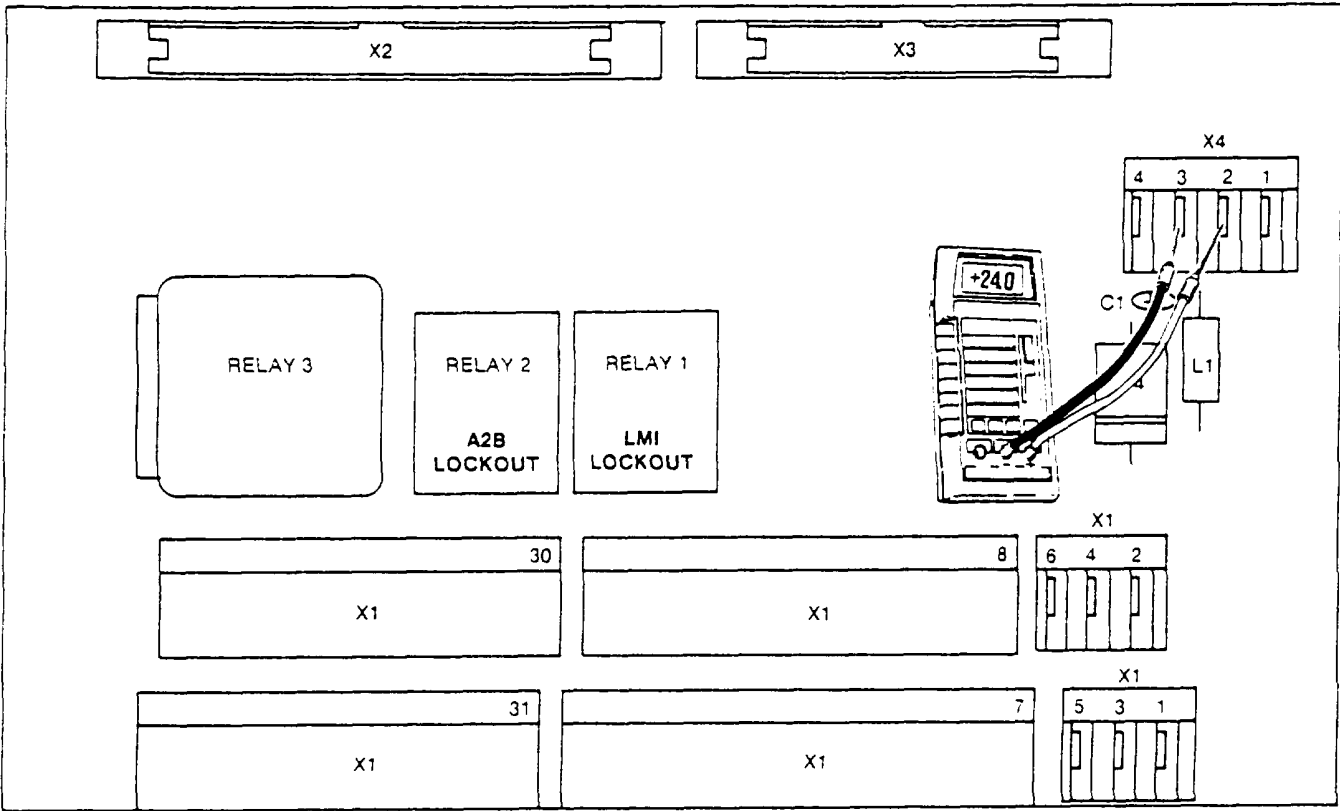
TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

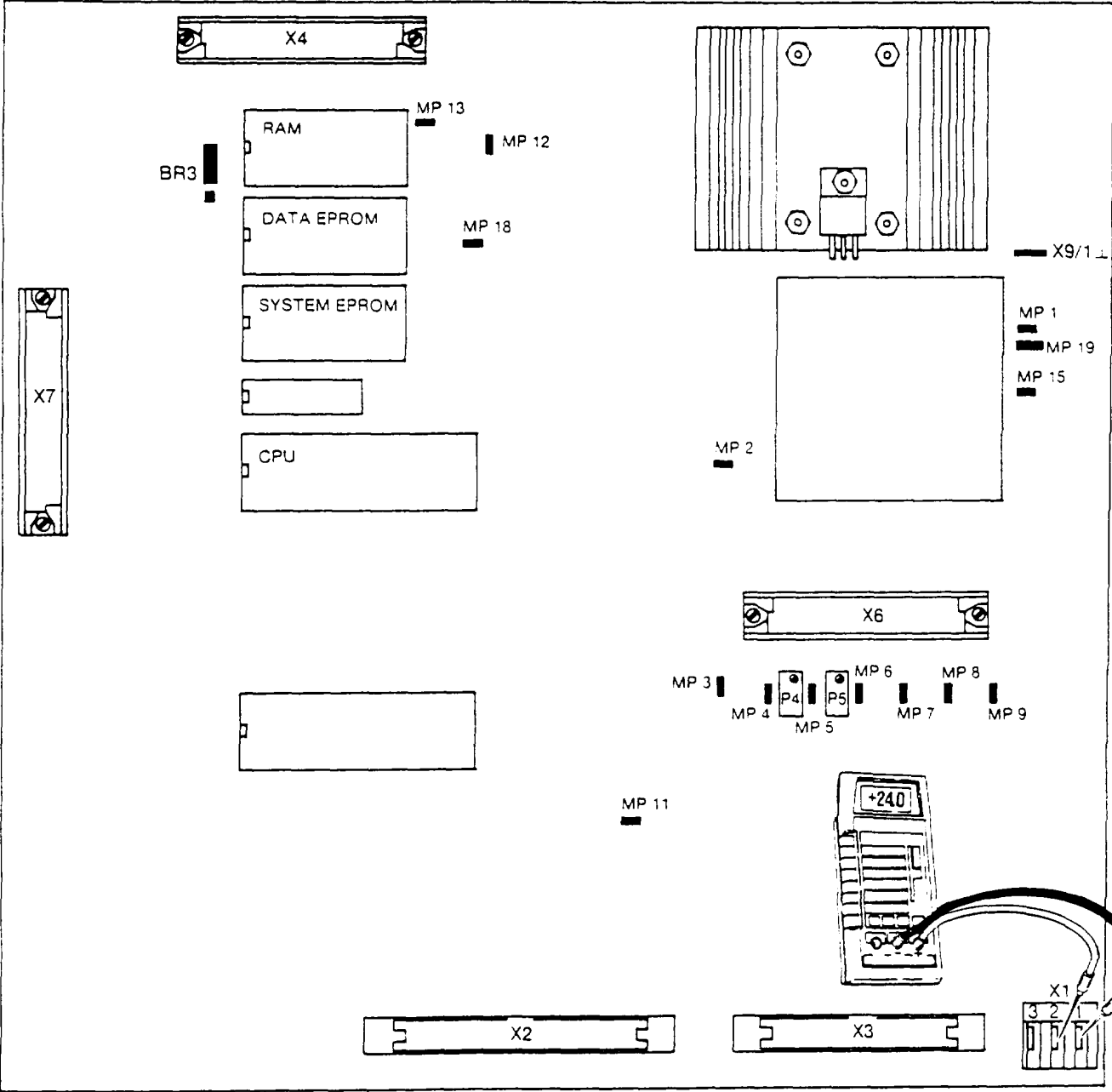
Malfunction	Test or Inspection	Corrective Action
100. <u>ERROR CODE E25 DISPLAYED ON CONSOLE</u>	Step 1. Upper limiting value for the measuring channel (main boom angle) exceeded.	<ul style="list-style-type: none"> a. Check for defective or loose cable between CPU and length/angle sensor. (Refer to Malfunction No. 85.) Repair or replace as necessary. b. Replace defective length/angle cable reel. (Refer to page 14-10.) c. Replace defective CPU. (Refer to Page 14-4.)
101. <u>ERROR CODE E29 DISPLAYED ON CONSOLE</u>	Step 1. Error in reference voltage.	<ul style="list-style-type: none"> a. Replace defective CPU. (Refer to page 14-4.)
102. <u>ERROR CODE E31 DISPLAYED ON CONSOLE</u>	Step 1. Error in system program	<ul style="list-style-type: none"> a. Replace defective CPU. (Refer to page 14-4.)
103. <u>ERROR CODE E38 DISPLAYED ON CONSOLE</u>	Step 1. Incorrect system program.	<ul style="list-style-type: none"> a. Replace defective CPU. (Refer to page 14-4.)
104. <u>ERROR CODE E41 DISPLAYED ON CONSOLE</u>	Step 1. Error in external RAM.	<ul style="list-style-type: none"> a. Replace defective CPU. (Refer to page 14-4.)

TABLE 3-1. DIRECT AND GENERAL SUPPORT TROUBLESHOOTING (CONTD)

Malfunction	Test or Inspection	Corrective Action
<hr/>		
105. <u>ERROR CODE E42 DISPLAYED ON CONSOLE</u>		
	Step 1. Error in external write/read memory (RAM).	
		a. Replace defective CPU. (Refer to page 14-4.)
<hr/>		
106. <u>ERROR CODE E45 DISPLAYED ON CONSOLE</u>		
	Step 1. Error in internal communications.	
		a. Replace defective CPU. (Refer to page 14-4.)
<hr/>		
107. <u>ERROR CODE E47 DISPLAYED ON CONSOLE</u>		
	Step 1. Malfunction in the monitored write/read memory.	
		a. Replace defective CPU. (Refer to page 14-4.)
<hr/>		
108. <u>ERROR CODE E51 DISPLAYED ON CONSOLE</u>		
	Step 1. Error in data memory.	
		a. Check that BR3 is installed in CPU main board. Install if missing.
		b. Replace defective CPU. (Refer to page 14-4.)





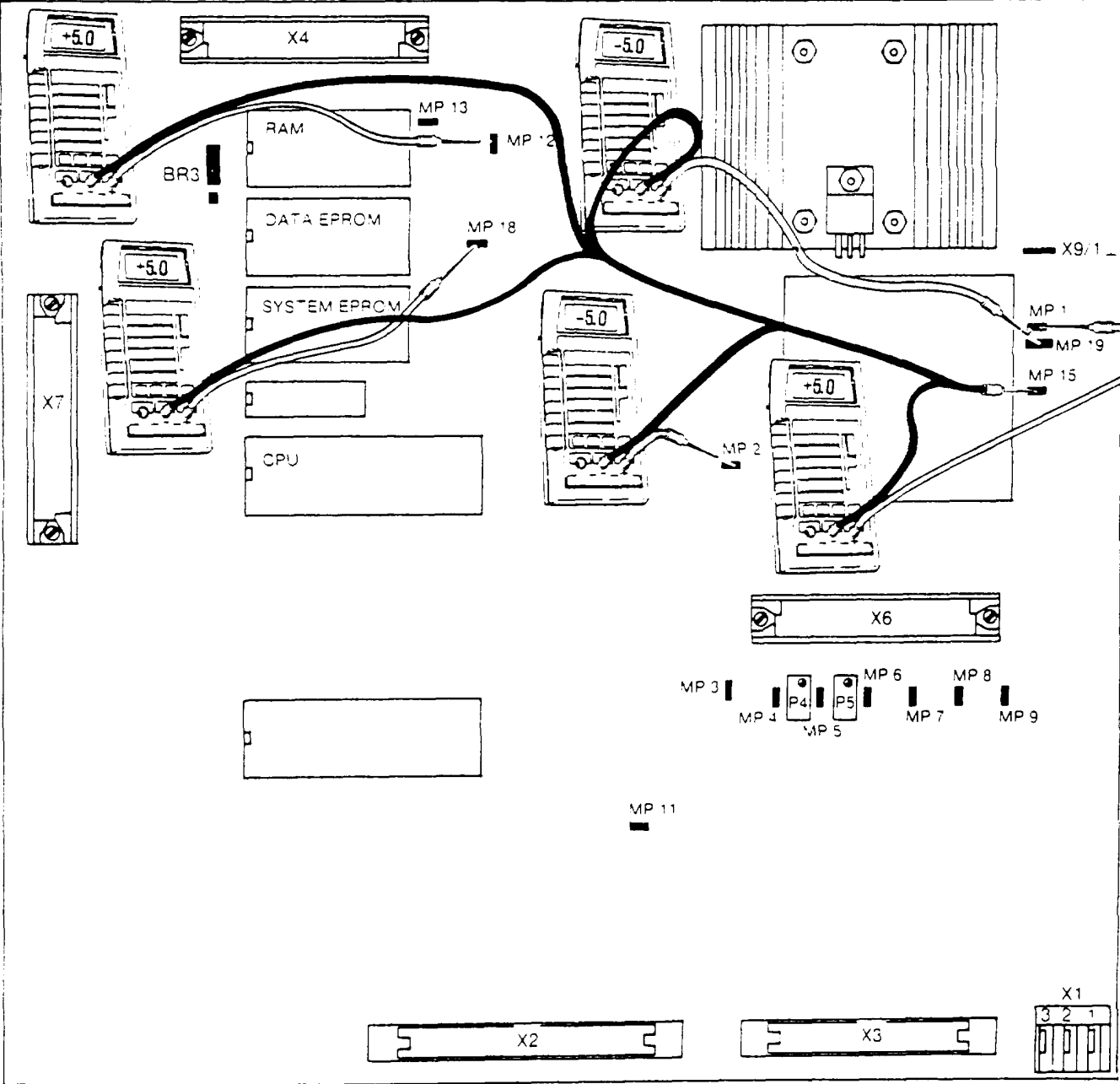


Power Supply Test Points

- MP 1 = + 5V
- MP 2 = - 5V
- MP 11 = Ground
- MP 12 = + 5V
- MP 13 = Digital Ground
- MP 15 = Analog Ground
- MP 19 = - 5V

Analog Measuring Channels/Test Points

- Ch. 1 Boom Length - MP 6/P6 - Do Not Adjust
- Ch. 2 Piston Pressure - MP 4/P4
- Ch. 3 Rod Pressure - MP 5/P5
- Ch. 4 Force Transducer - MP 3/P3 - Do Not Adjust
- Ch. 5 Boom Angle - MP 8/P8 - Do Not Adjust
- Ch. 6 Jib Angle - MP 9/P9 - Do Not Adjust

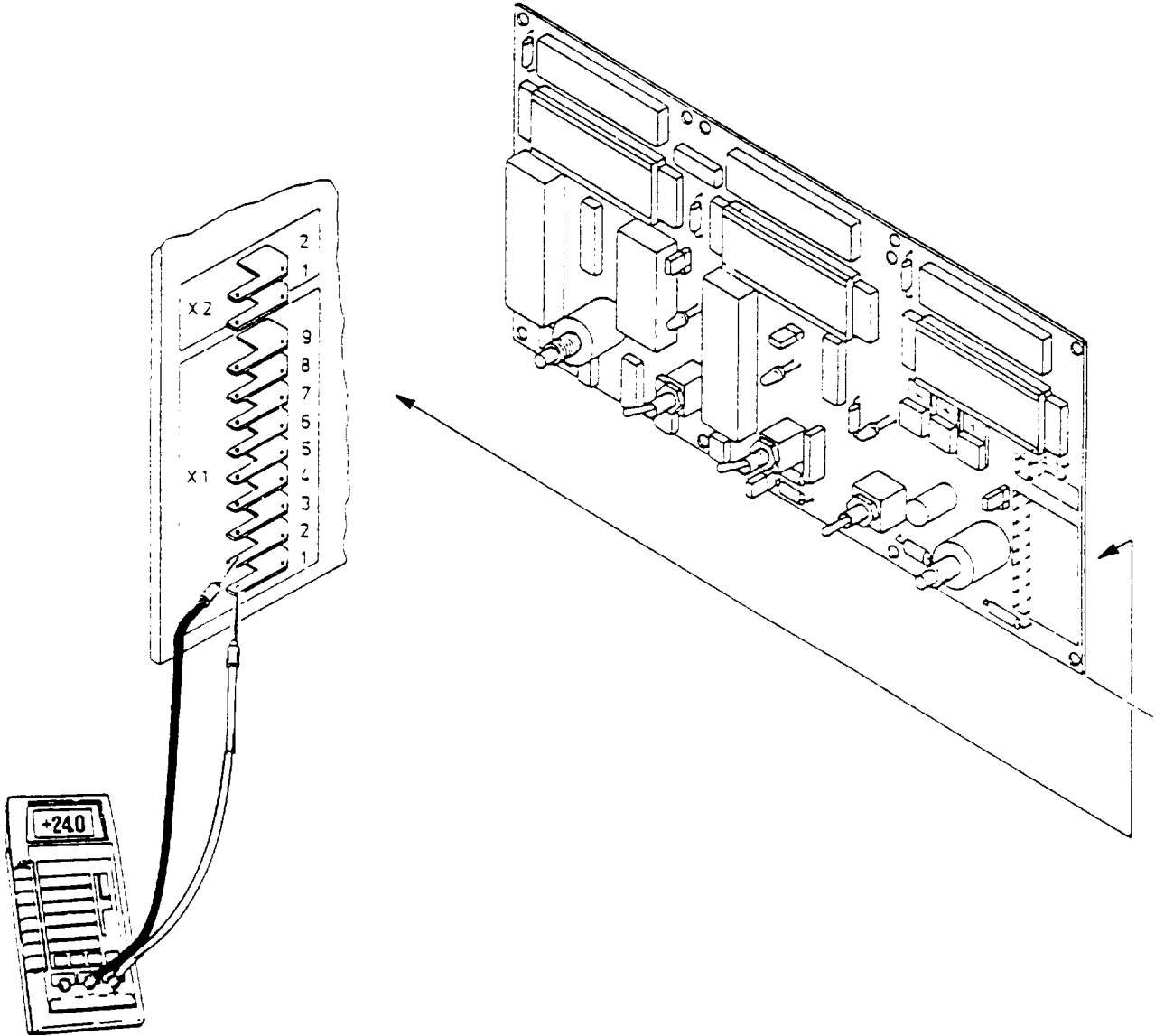


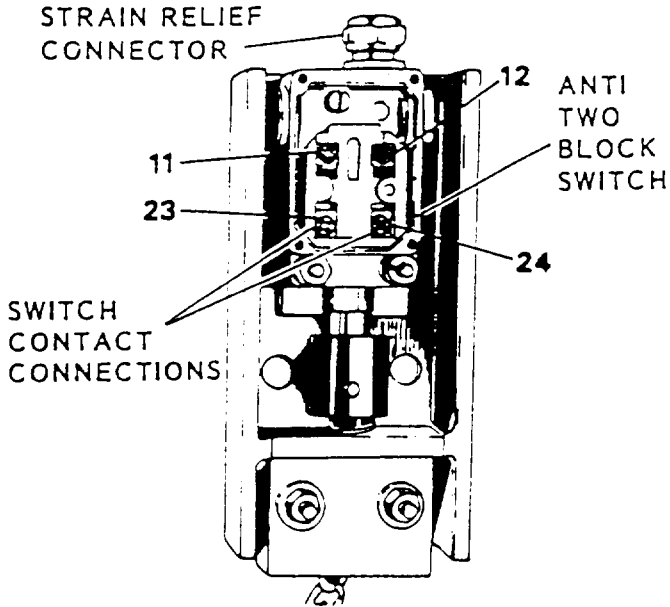
Power Supply Test Points

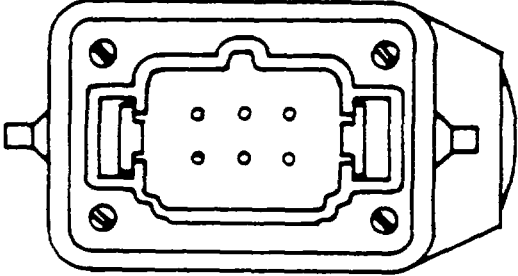
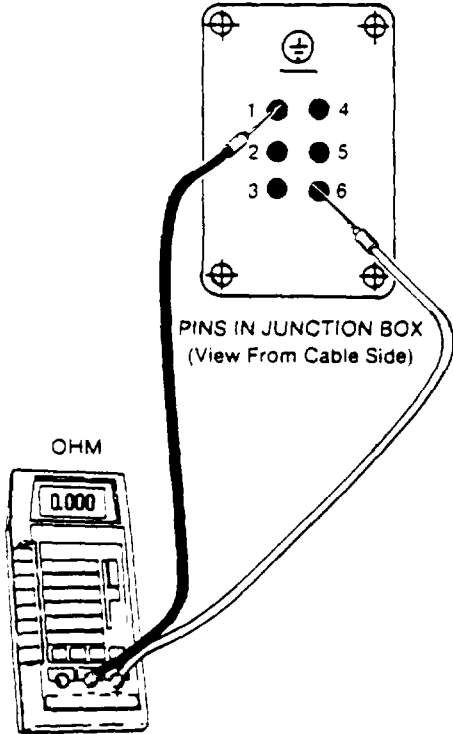
- MP 1 = + 5V
- MP 2 = - 5V
- MP 11 = Ground
- MP 12 = + 5V
- MP 13 = Digital Ground
- MP 15 = Analog Ground
- MP 19 = - 5V

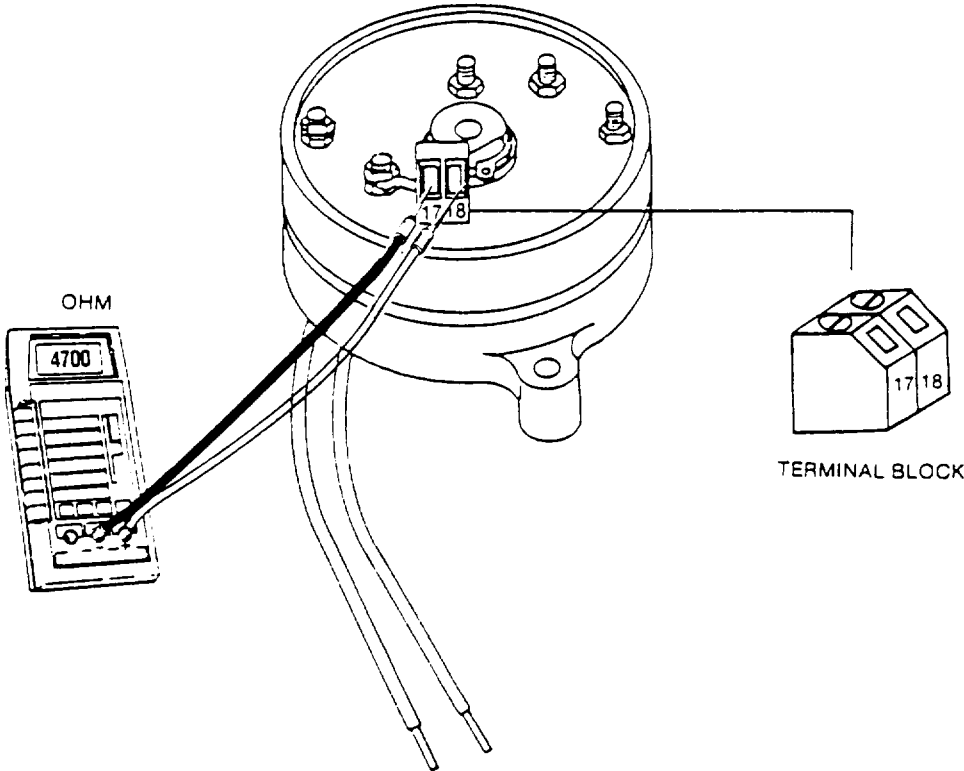
Analog Measuring Channels/Test Points

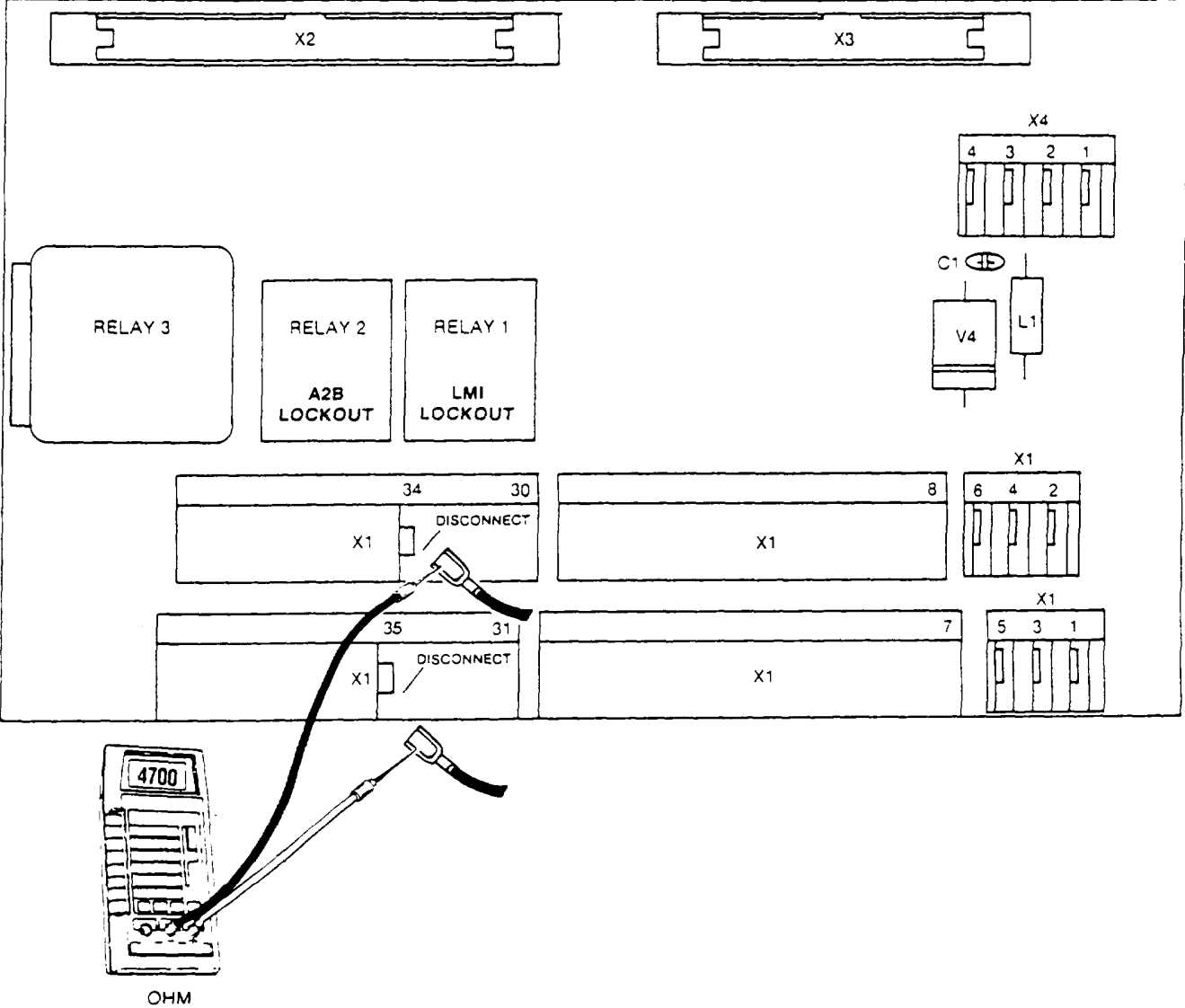
- Ch. 1 Boom Length - MP 6/P6 - Do Not Adjust
- Ch. 2 Piston Pressure - MP 4/P4
- Ch. 3 Rod Pressure - MP 5/P5
- Ch. 4 Force Transducer - MP 3/P3 - Do Not Adjust
- Ch. 5 Boom Angle - MP 8/P8 - Do Not Adjust
- Ch. 6 Jib Angle - MP 9/P9 - Do Not Adjust

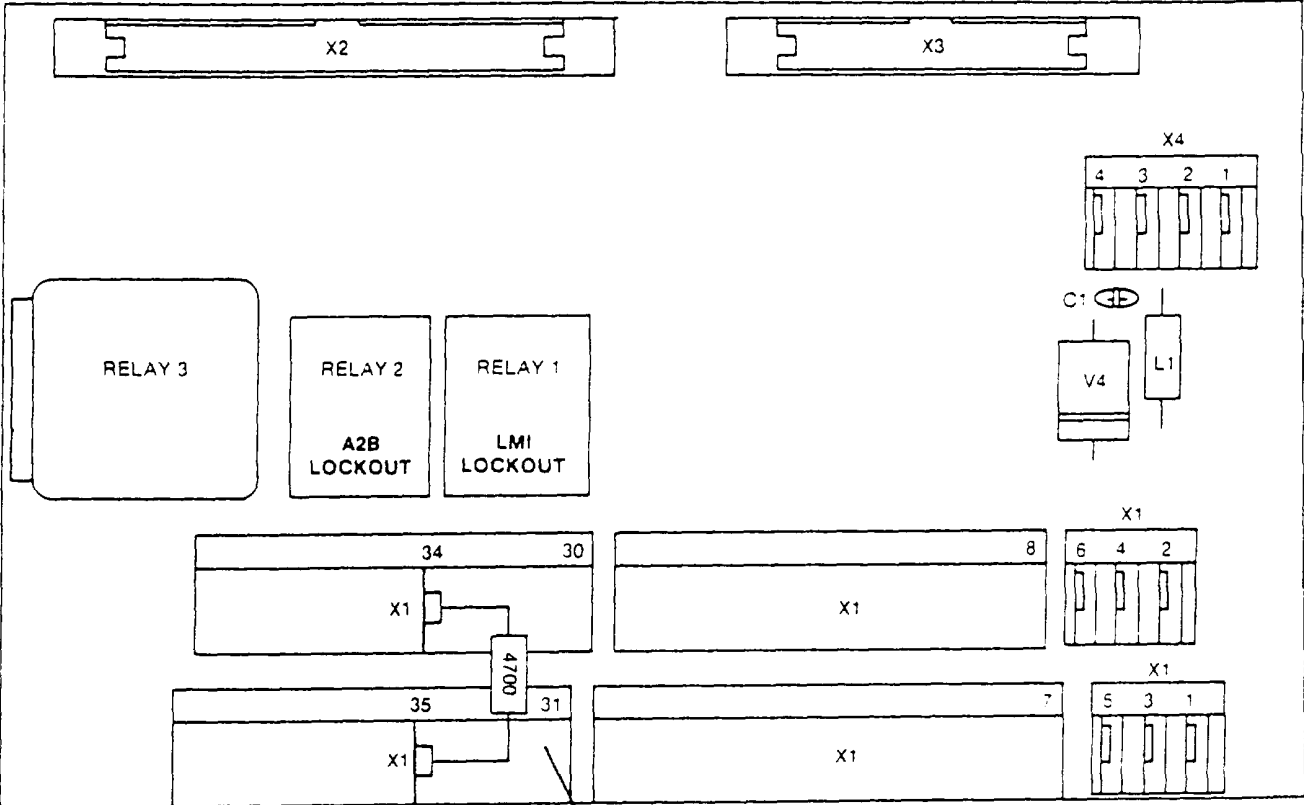




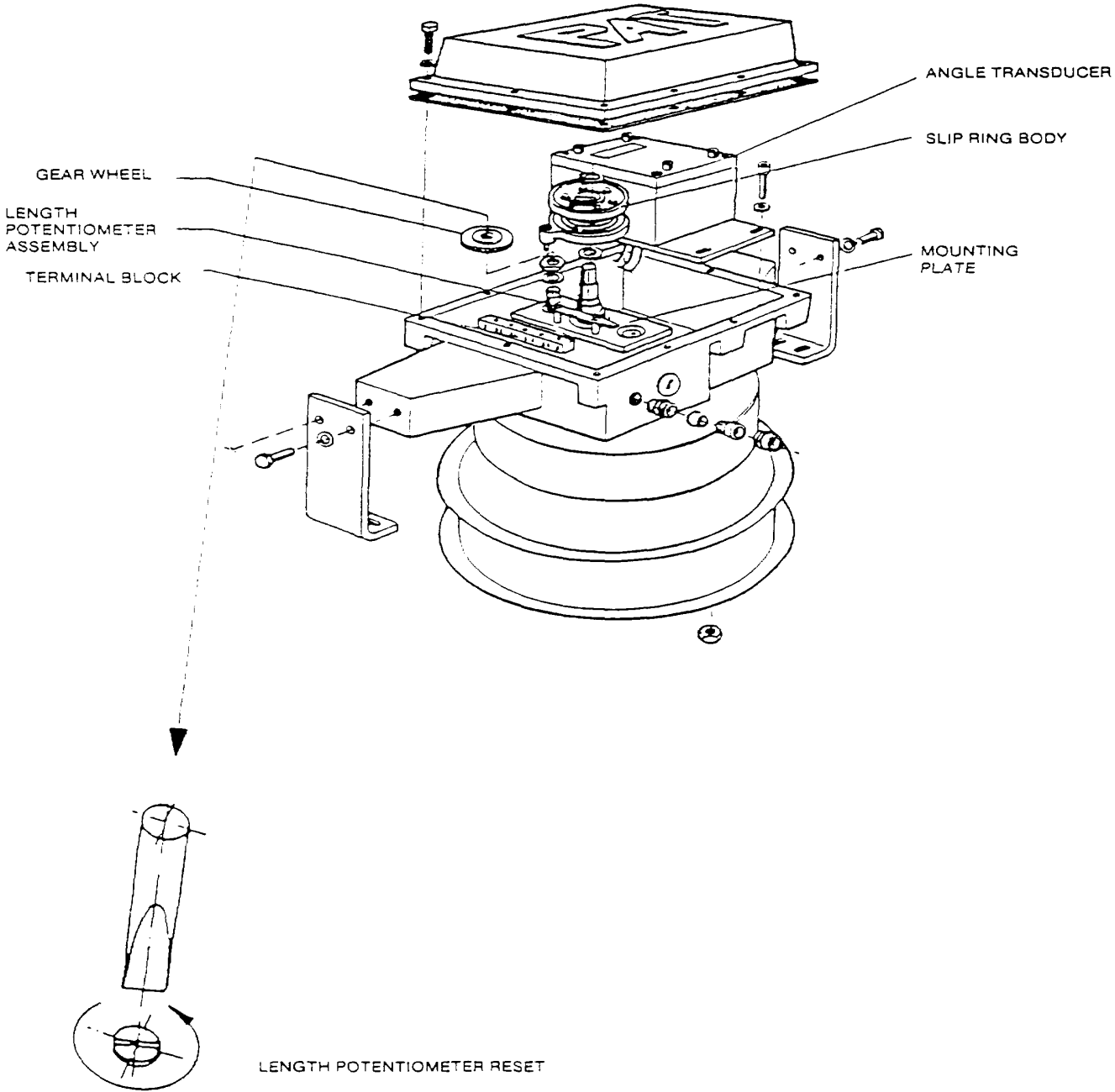


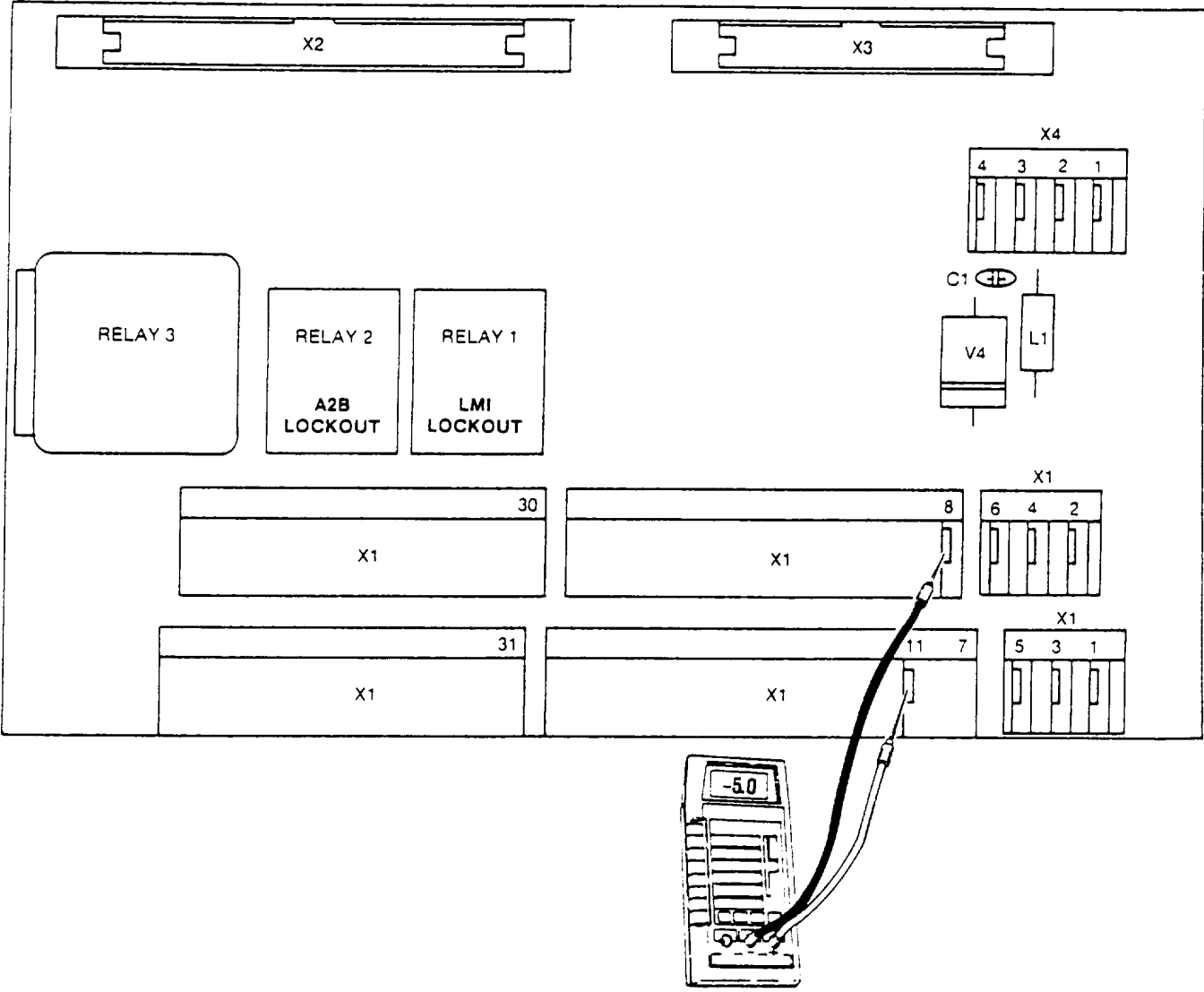


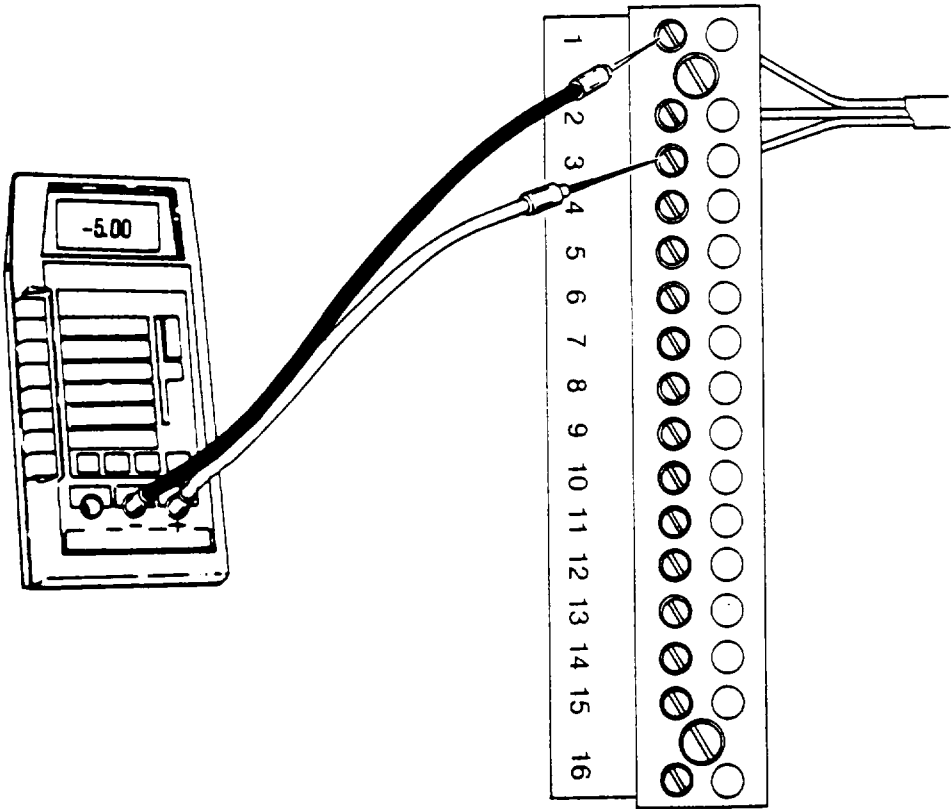




INSTALL TEMPORARY RESISTOR

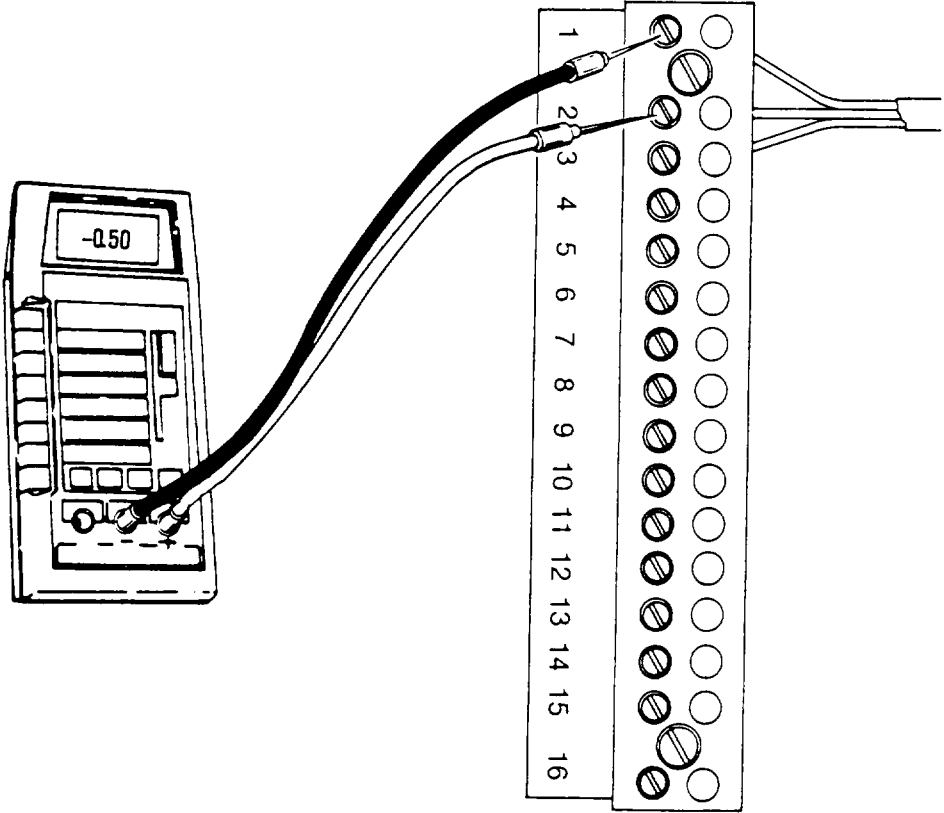






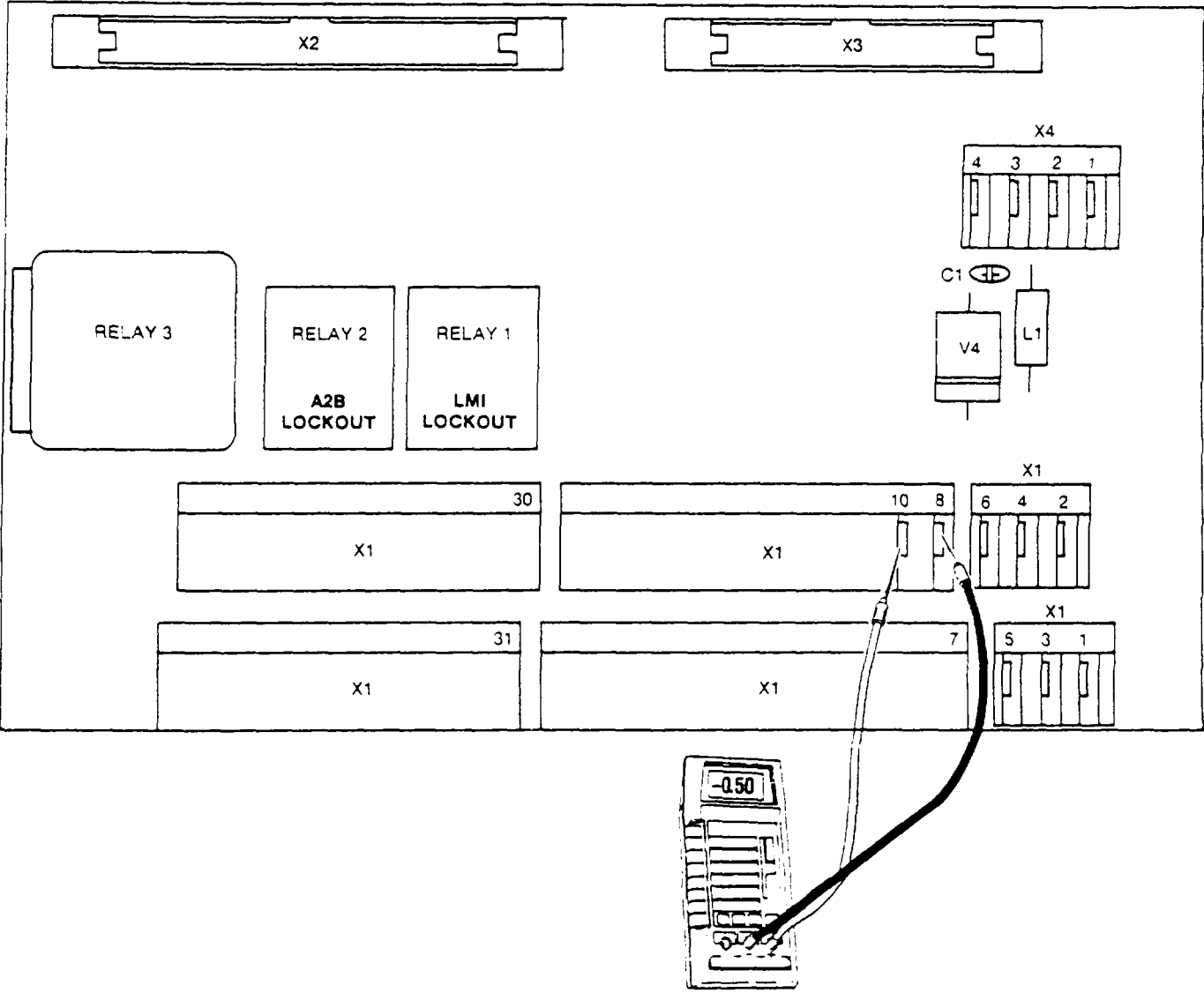
CABLE FROM CENTRAL
PROCESSING UNIT

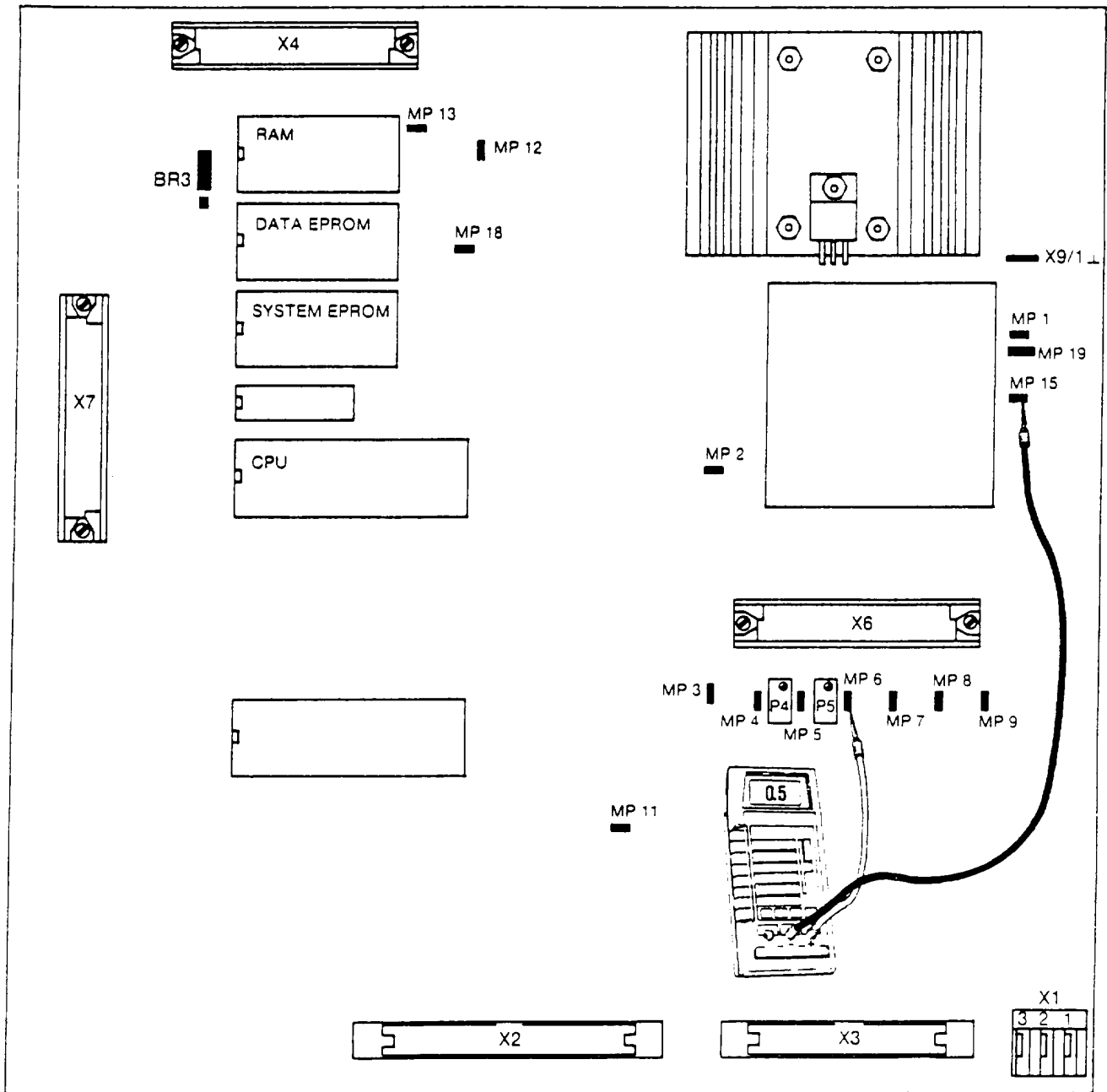
CABLE REEL
TERMINAL



CABLE FROM CENTRAL
PROCESSING UNIT

CABLE REEL
TERMINAL



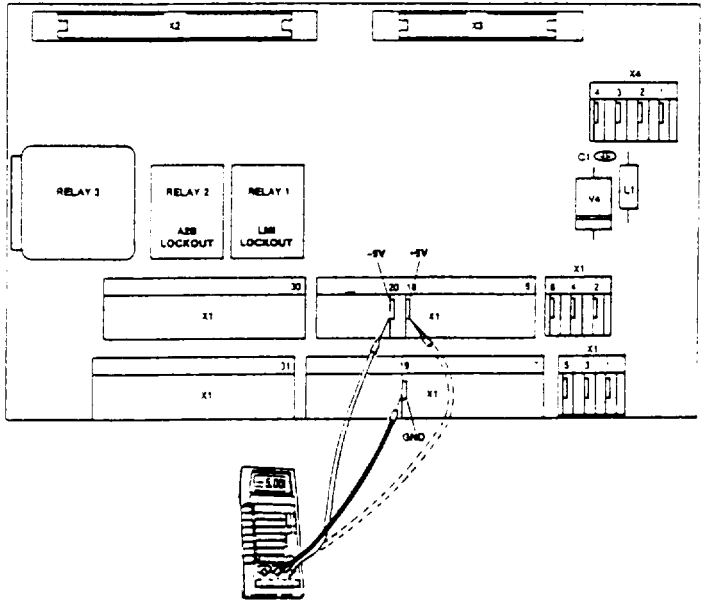
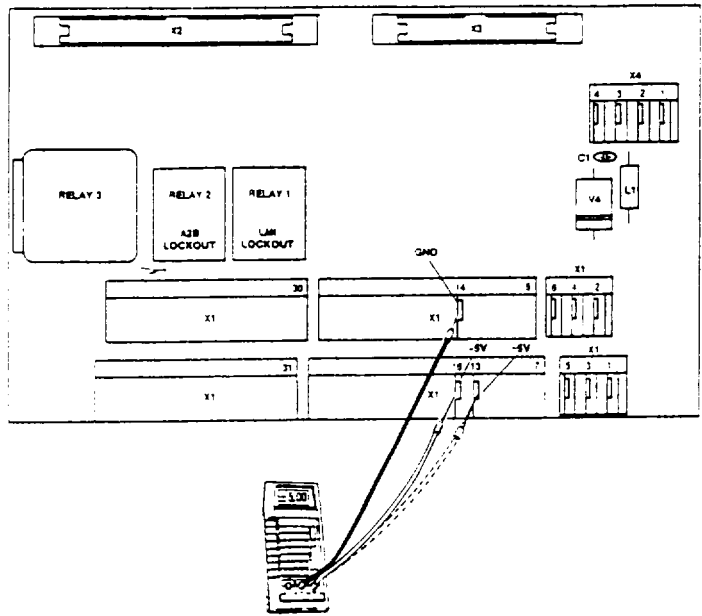


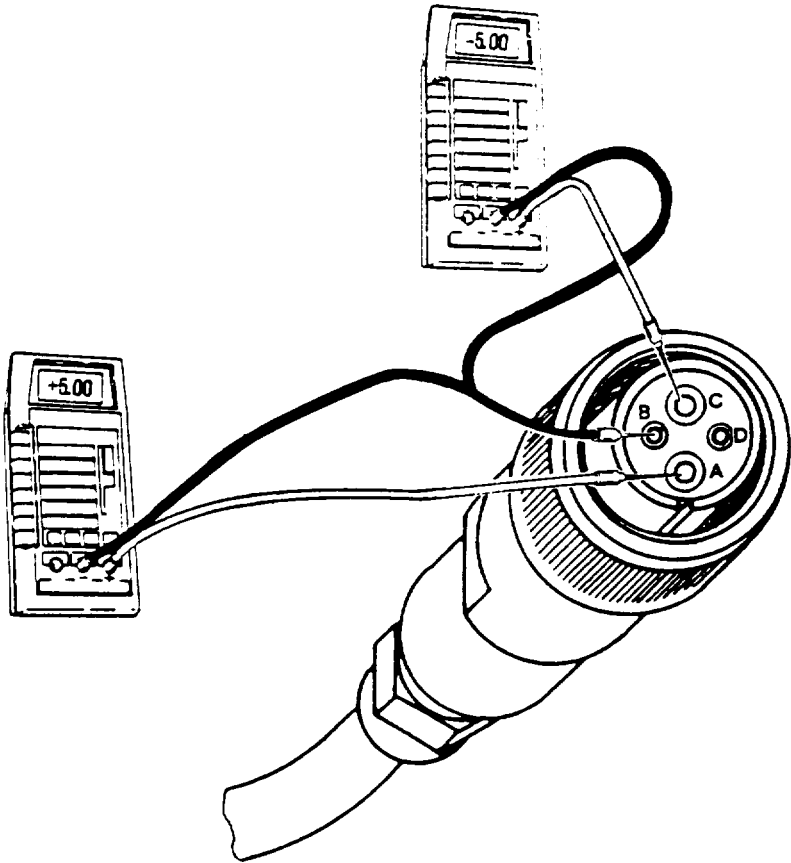
Power Supply Test Points

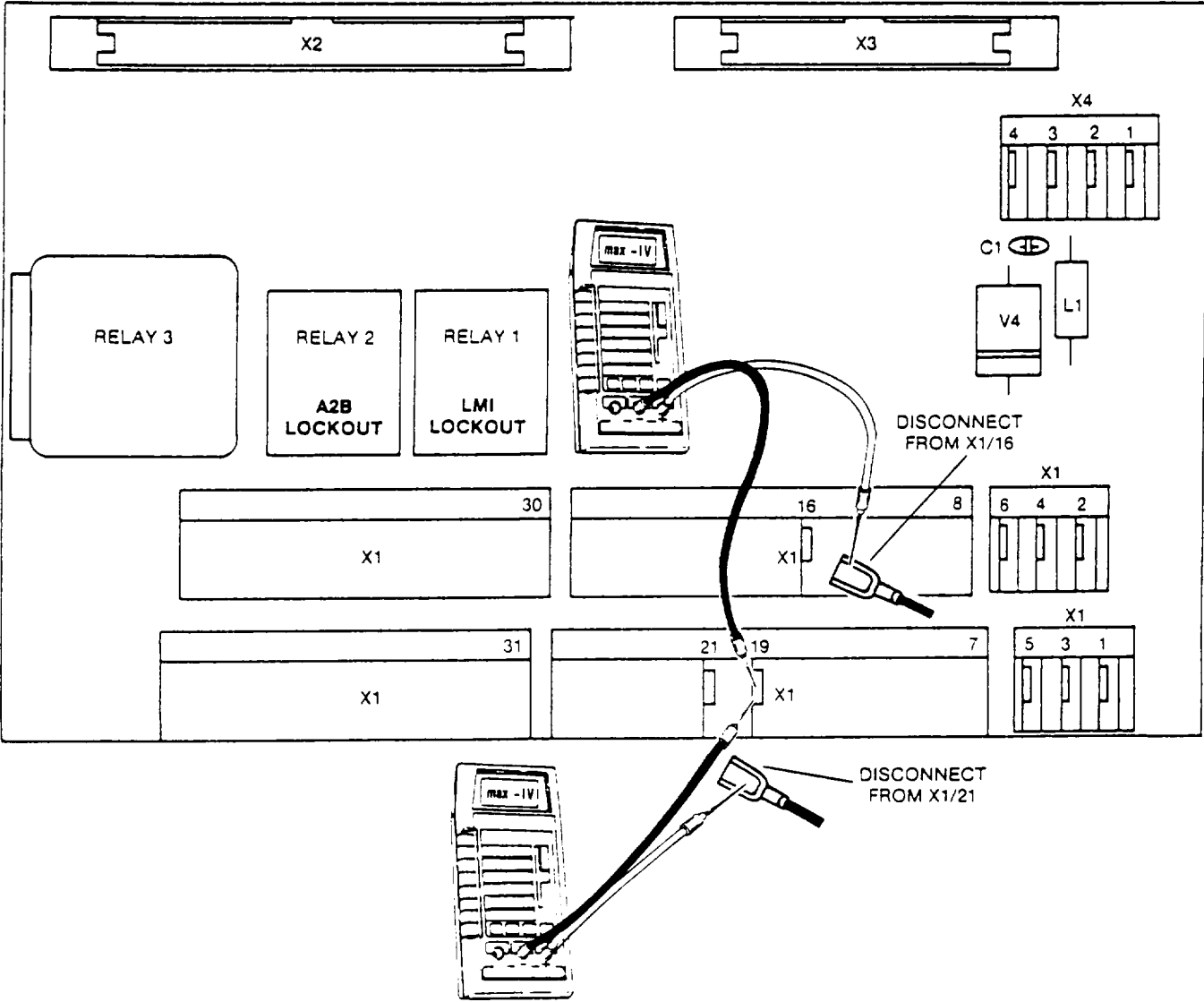
- MP 1 = + 5V
- MP 2 = - 5V
- MP 11 = Ground
- MP 12 = + 5V
- MP-13 = Digital Ground
- MP 15 = Analog Ground
- MP 19 = - 5V

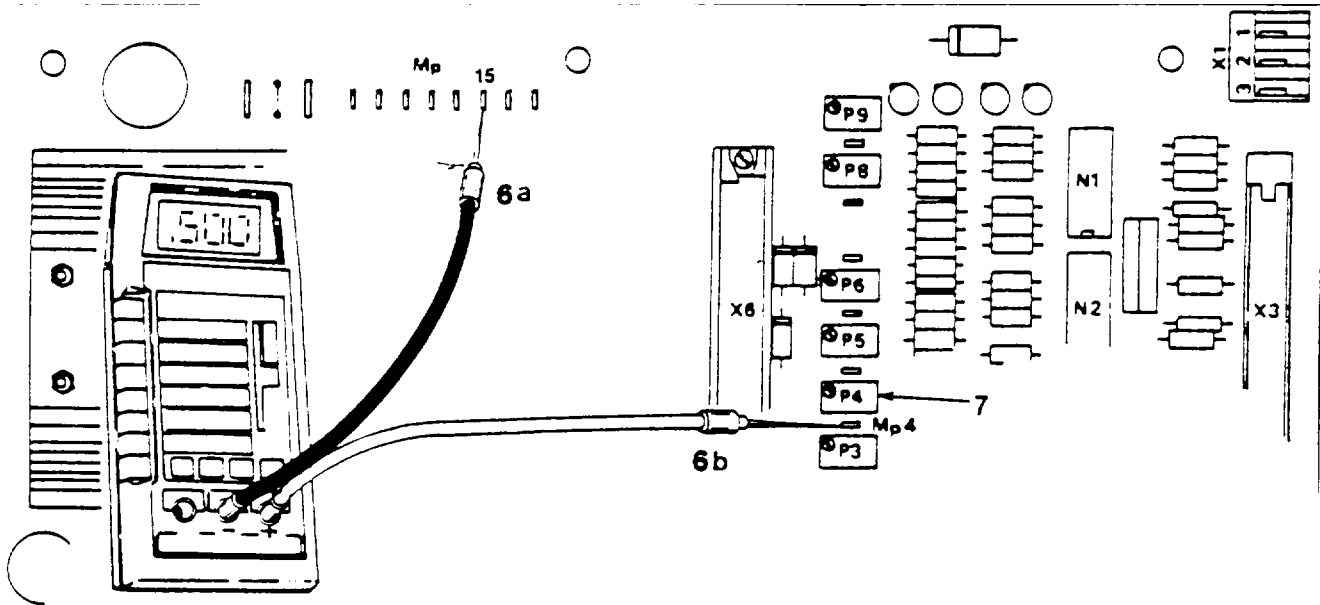
Analog Measuring Channels/Test Points

- Ch. 1 Boom Length - MP 6/P6 - Do Not Adjust
- Ch. 2 Piston Pressure - MP 4/P4
- Ch. 3 Rod Pressure - MP 5/P5
- Ch. 4 Force Transducer - MP 3/P3 - Do Not Adjust
- Ch. 5 Boom Angle - MP 8/P8 - Do Not Adjust
- Ch. 6 Jib Angle - MP 9/P9 - Do Not Adjust



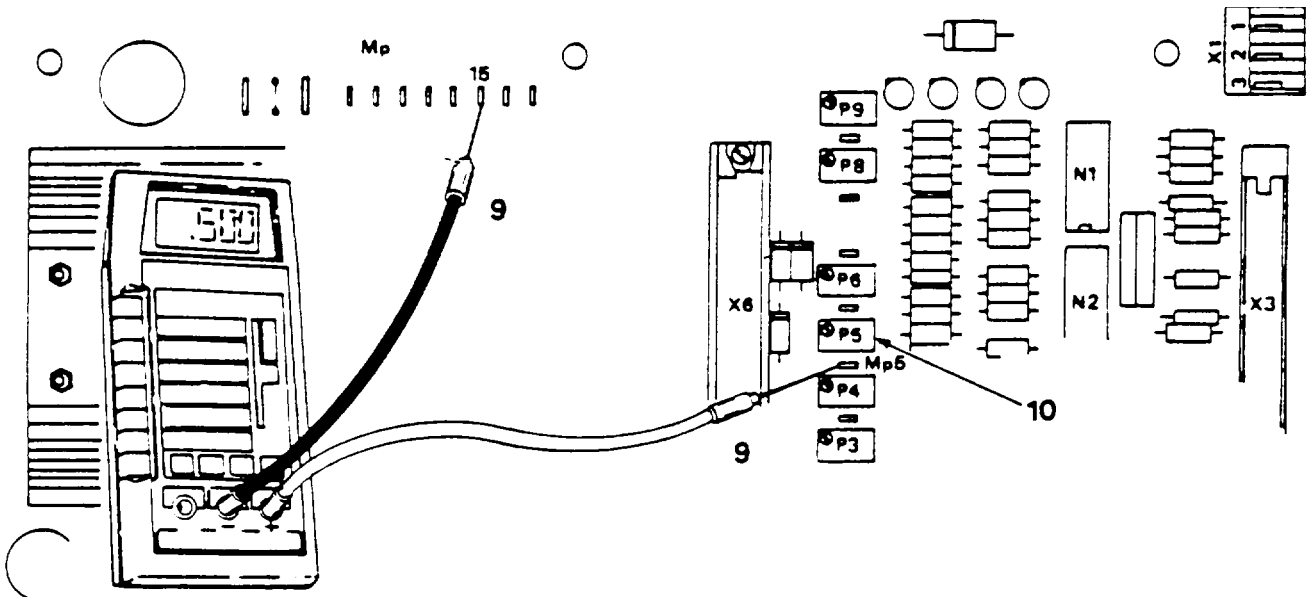






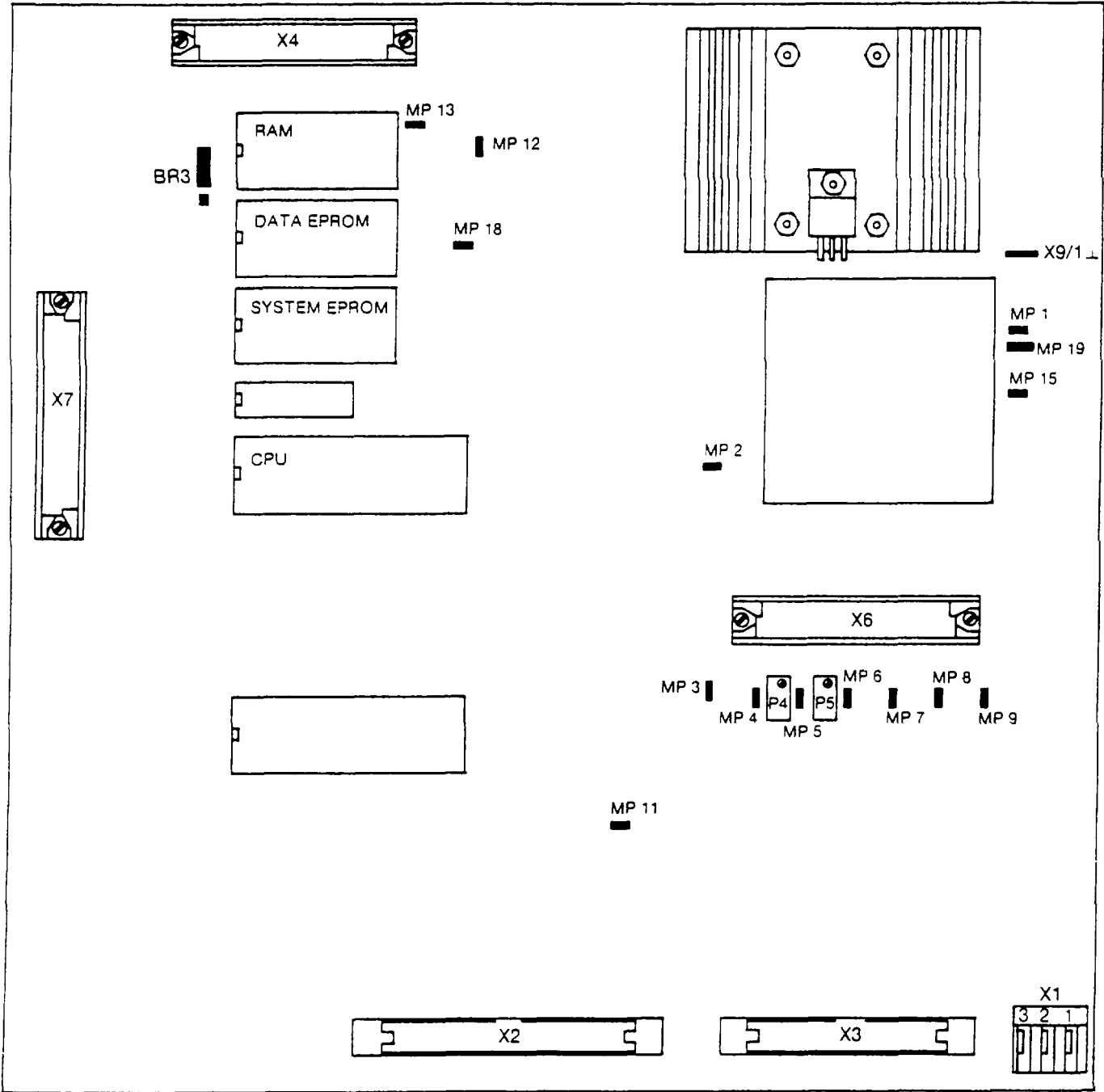
PISTON PRESSURE CHANNEL
ZERO POINT ADJUSTMENT

5. LOWER BOOM ALL THE WAY DOWN, SHUT THE ENGINE OFF THEN DISCONNECT HYDRAULIC HOSE FROM THE PISTON SIDE PRESSURE TRANSDUCER.
6. CONNECT A DIGITAL VOLTMETER TO MAIN P.C. BOARD
 - a) BLACK (-) LEAD TO Mp15
 - b) RED (+) LEAD TO Mp 4
7. ADJUST P4 TO OBTAIN A READING OF .500 VOLTS (500mv) ON METER.



ROD PRESSURE CHANNEL
ZERO POINT ADJUSTMENT

8. DISCONNECT HYDRAULIC HOSE FROM THE ROD SIDE PRESSURE TRANSDUCER.
9. LEAVE BLACK (-) LEAD CONNECTED TO Mp15 MOVE RED (+) LEAD TO Mp 5.
10. ADJUST P5 TO OBTAIN A READING OF .500 VOLTS (500mv) ON METER.
11. RECONNECT HYDRAULIC HOSES TO PRESSURE TRANSDUCERS, THEN BLEED AIR FROM HYDRAULIC LINES.
12. PUT THE OUTSIDE COVER BACK INTO PLACE, SECURE WITH THE (8) SCREWS TAKEN OUT DURING THE DISASSEMBLY PROCEDURE, REPLACE WIRE SEAL.

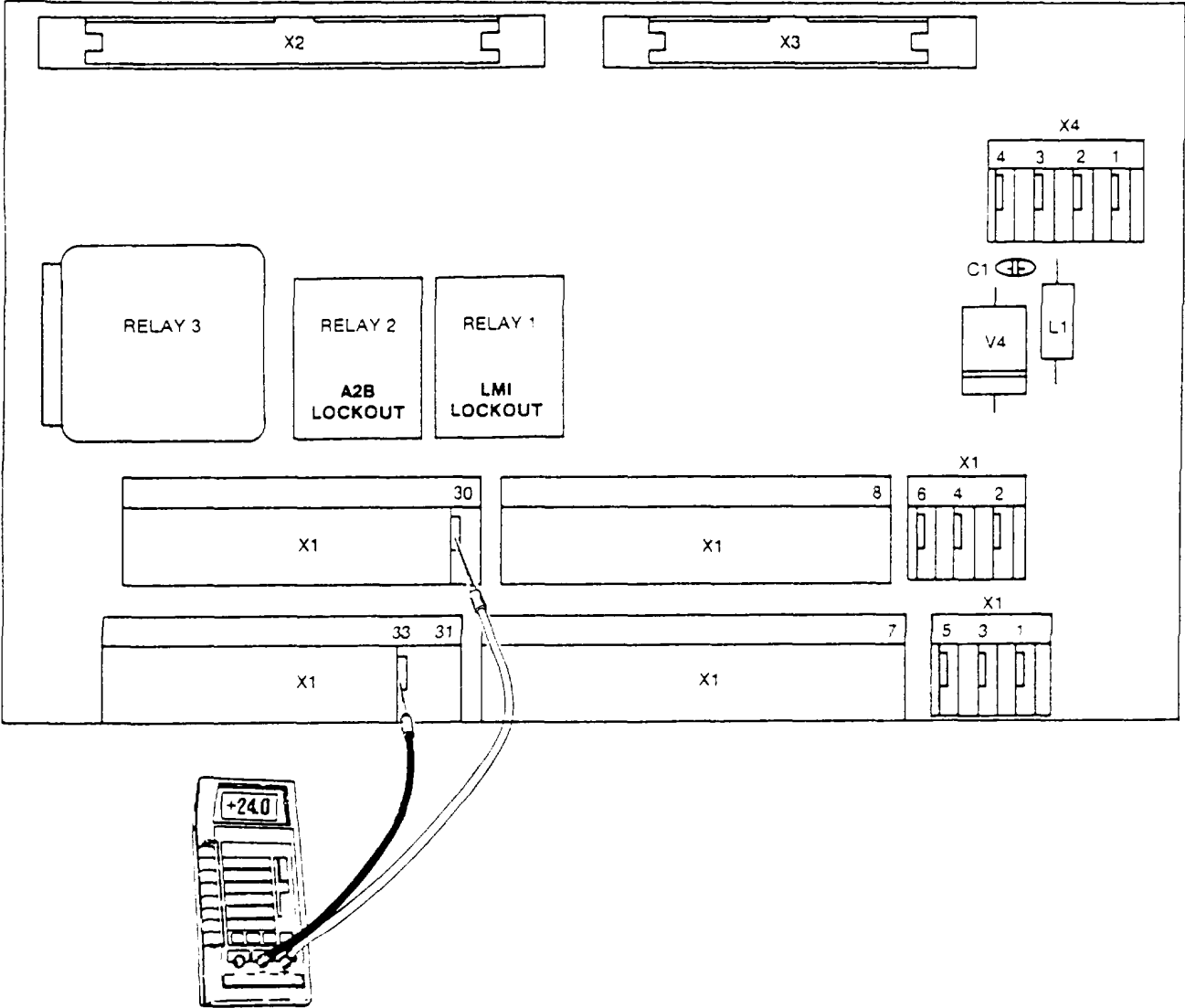


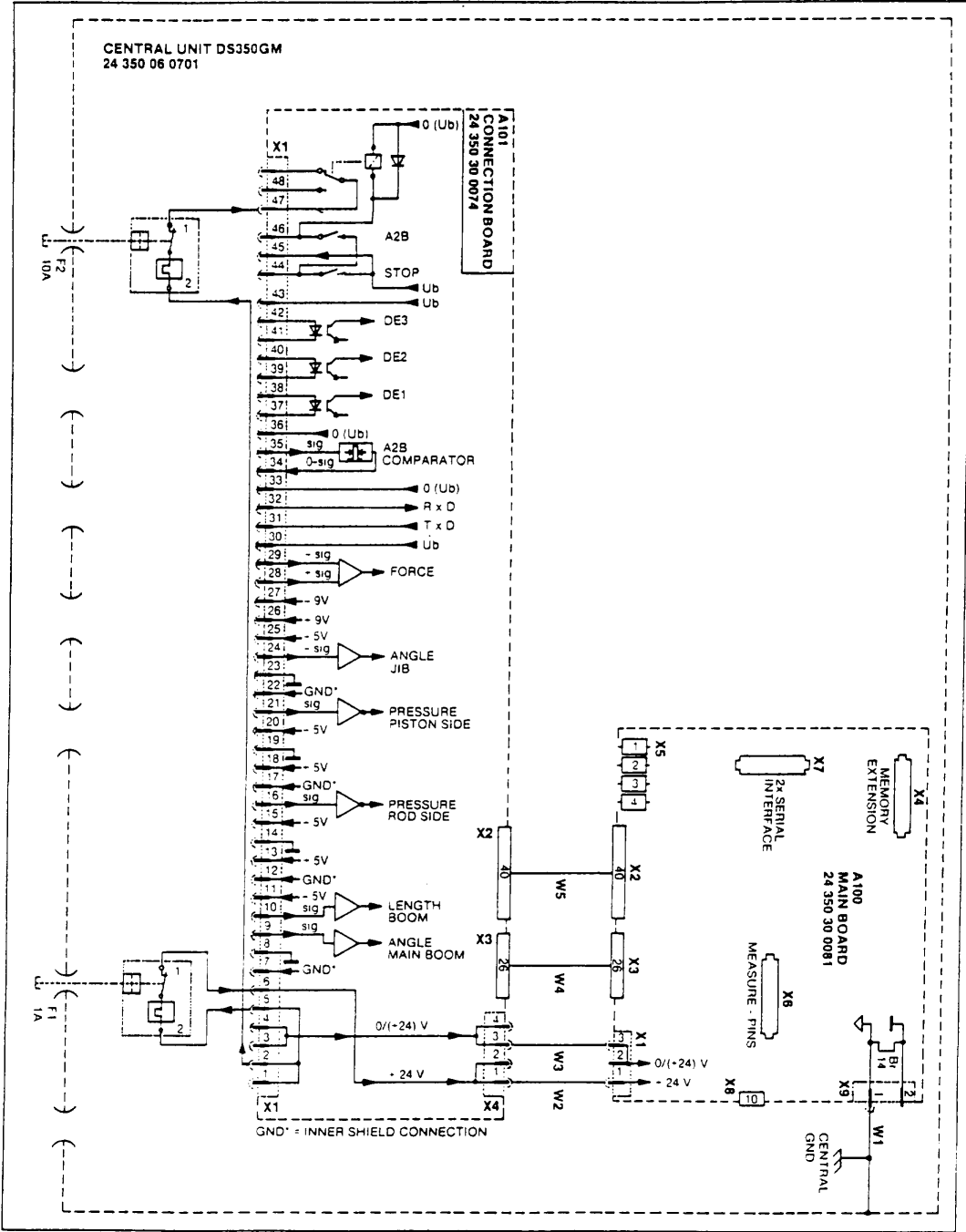
Power Supply Test Points

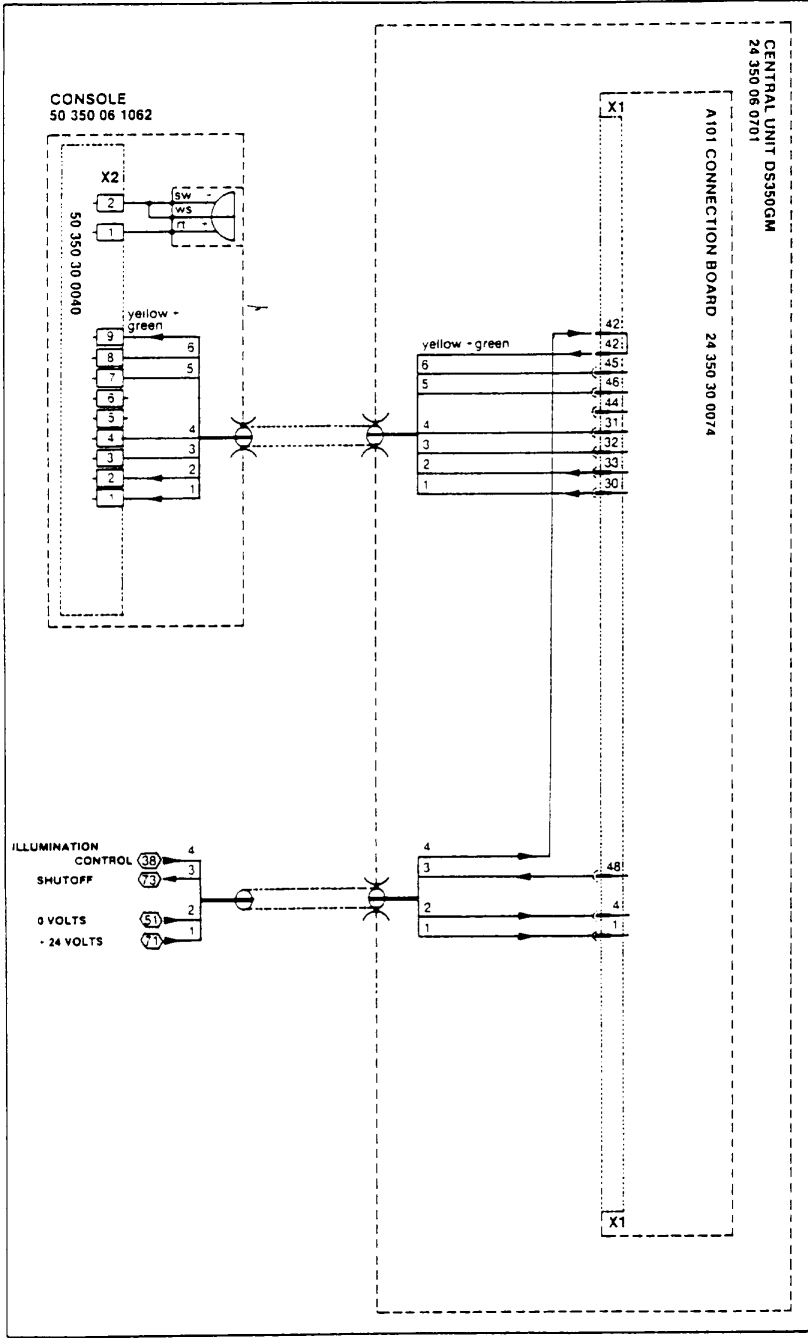
- MP 1 = + 5V
- MP 2 = - 5V
- MP 11 = Ground
- MP 12 = + 5V
- MP 13 = Digital Ground
- MP 15 = Analog Ground
- MP 19 = - 5V

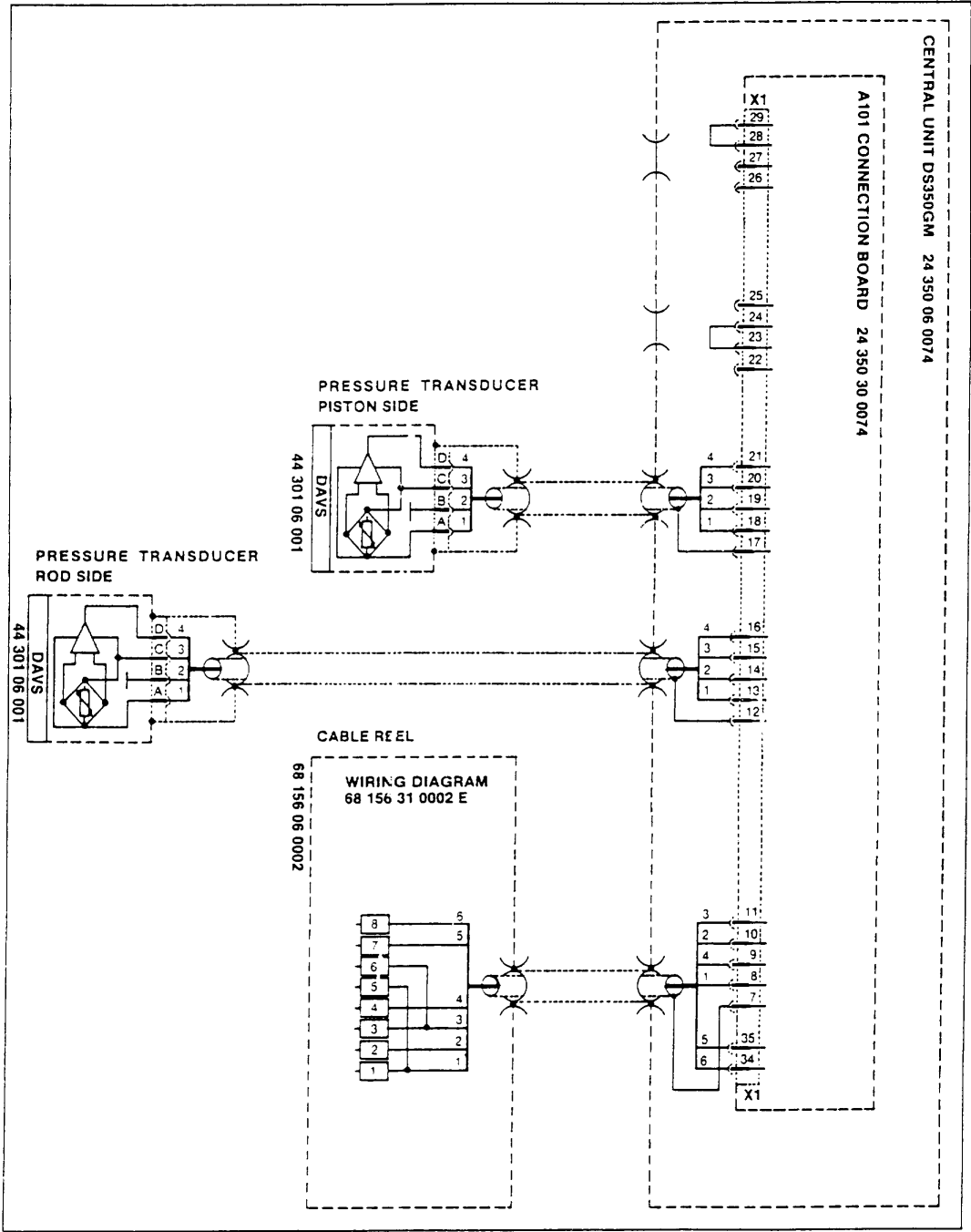
Analog Measuring Channels/Test Points

- Ch. 1 Boom Length - MP 6/P6 - Do Not Adjust
- Ch. 2 Piston Pressure - MP 4/P4
- Ch. 3 Rod Pressure - MP 5/P5
- Ch. 4 Force Transducer - MP 3/P3 - Do Not Adjust
- Ch. 5 Boom Angle - MP 8/P8 - Do Not Adjust
- Ch. 6 Jib Angle - MP 9/P9 - Do Not Adjust









CHAPTER 4
ENGINE MAINTENANCE

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Section I. ENGINE MAINTENANCE

ENGINE INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Overhead hoist (1500 lbs. capacity)

SUPPLIES: None

EQUIPMENT CONDITIONS: Outrigger fully extended and lowered.
(Refer to TM 5-3810-306-10.)
Boom positioned over the side.
(Refer to TM 5-3810-306-10.)
Negative battery cable disconnected at shunt.
(Refer to TM 5-3810-306-20.)
Engine hood removed. (Refer to TM 5-3810-306-20.)
Radiator and shroud removed.
(Refer to TM 5-3810-306-20.)
Hydraulic pressure relieved from lines. (Refer to TM 5-3810-306-20.)
Air system purged. (Refer to TM 5-3810-306-20.)
Rear deck removed. (Refer to TM 5-3810-306-20.)

REMOVAL:

CAUTION

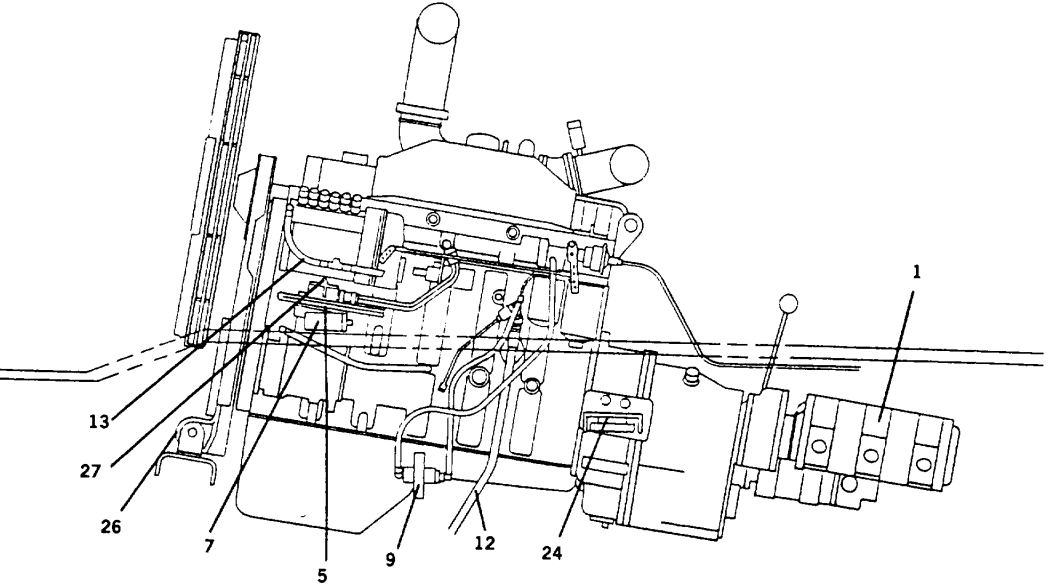
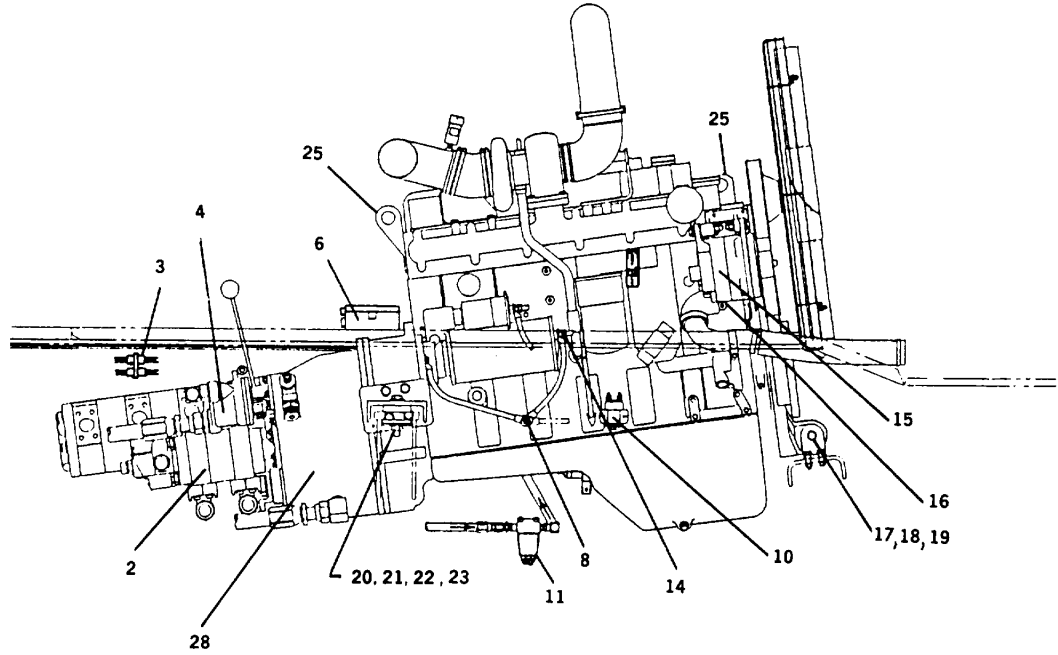
NOTE

Cover exhaust and intake openings to prevent any parts or debris from entering engine.

1. TAG AND DISCONNECT SIX HYDRAULIC LINES FROM THREE SECTION PUMP (1). PLUG OR CAP ALL OPENINGS.
2. TAG AND DISCONNECT TWO HYDRAULIC LINES TO TORQUE CONVERTER CHARGING PUMP (4). PLUG OR CAP ALL OPENINGS.
3. TAG AND DISCONNECT FIVE HYDRAULIC LINES FROM TWO SECTION PUMP (2). PLUG OR CAP ALL OPENINGS.
4. TAG AND DISCONNECT TWO WIRING HARNESS ELECTRICAL CONNECTORS (3) ON RIGHT SIDE WALL IN ENGINE COMPARTMENT.

Mark the universal(s) so they can be assembled as taken apart. Otherwise severe drive line vibration can occur.

5. REMOVE PROPELLER SHAFT BETWEEN TORQUE CONVERTER (28) AND TRANSMISSION.
6. TAG AND DISCONNECT FOUR HYDRAULIC LINES TO TORQUE CONVERTER (28). PLUG OR CAP ALL OPENINGS.
7. REMOVE BRAIDED STEEL LINE (5) FROM AIR COMPRESSOR. POSITION AWAY FROM ENGINE.
8. TAG AND DISCONNECT ALL ELECTRICAL CONNECTORS TO ENGINE COMING FROM DCA BOX (6).
9. REMOVE AIR LINE AT AIR COMPRESSOR (27) FROM AIR GOVERNOR (7).



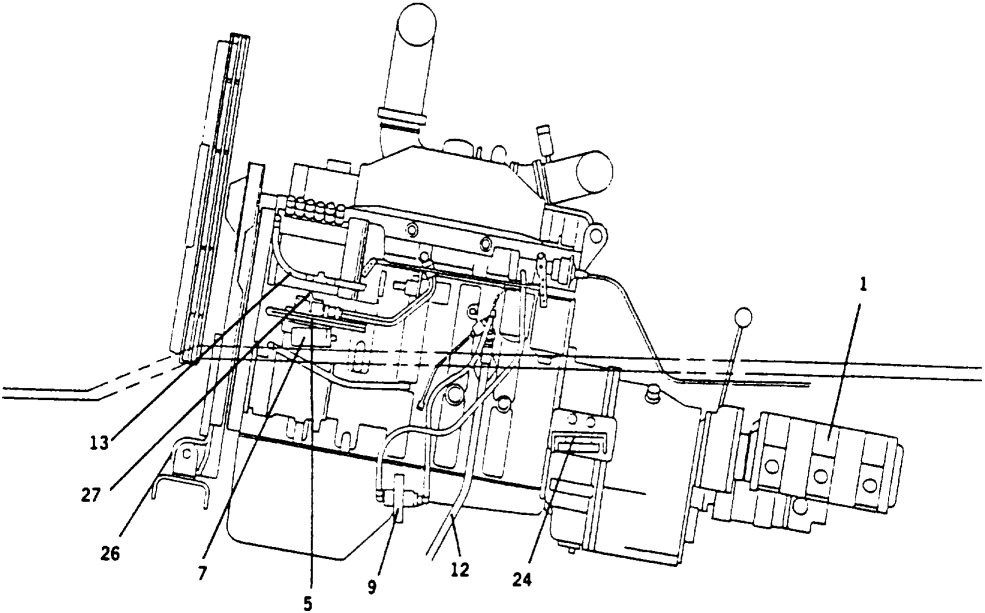
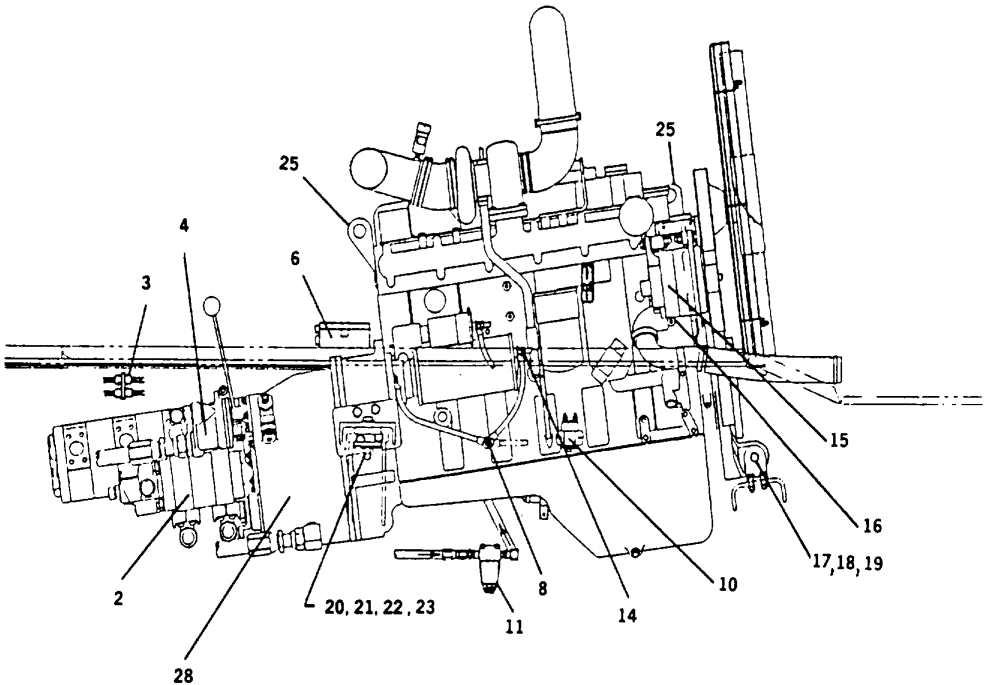
WARNING

The engine/torque converter weighs approximately 1985 pounds (900 kg). Use care when lifting the engine.

10. REMOVE TWO NUTS AND LOCKWASHERS FROM AIR GOVERNOR FRAME MOUNTING STUDS. REMOVE AIR GOVERNOR (7) AND RELOCATE OUT OF WAY OF ENGINE.
11. REMOVE GROUNDING CABLE FROM LEFT SIDE WALL TO STARTER (8).
12. REMOVE FUEL PRESSURE DIFFERENTIAL SWITCH (9) FROM FRAME MOUNTING STUDS ON RIGHT SIDE WALL.
13. REMOVE STARTER RELAY (10) FROM FRAME MOUNTING STUDS ON LEFT SIDE WALL..
14. CLOSE PETCOCKS TO SHUT OFF FUEL FLOW AT FUEL FILTER (11). REMOVE FUEL LINE TO FUEL PUMP (12).
15. LOOSEN CLAMP AND REMOVE FUEL RETURN LINE (13) TO FUEL INJECTION PUMP.
16. TAG AND REMOVE BATTERY CABLE TO STARTER (14).
17. TAG AND DISCONNECT THREE WIRES 671, 676 AND 677 TO STARTER (14).
18. TAG AND DISCONNECT THREE WIRES 672, 673 AND 674 TO ALTERNATOR (15).
19. TAG AND DISCONNECT TWO WIRES TO TEMPERATURE SENSOR (16).
20. REMOVE LOCKNUT (17), CAPSCREW (18) AND LOCK WASHER (19) SECURING FRONT ENGINE MOUNT (26) TO MOUNTING BRACKET.
21. REMOVE TWO LOCKNUTS (20), LARGE WASHERS (21), CAPSCREWS (22) AND WASHERS (23) FROM SIDE MOTOR MOUNTS.
22. USING SUITABLE LIFTING DEVICE ATTACHED TO ENGINE LIFTING EYES (25) AND THREE SECTION PUMP (1), REMOVE ENGINE FROM CRANE.
23. REMOVE SHOCK MOUNTS (24) FROM ENGINE SIDE MOUNTS. REPLACE AS NECESSARY.
24. IF A NEW ENGINE IS TO BE INSTALLED, REMOVE ALL COMPONENTS, FITTINGS, ETC., FROM OLD ENGINE AND INSTALL THEM ON NEW ENGINE IN SAME LOCATIONS. ENSURE THAT SAME GRADE HARDWARE, TORQUE VALUES, AND LOCTITE AS WERE INSTALLED BY FACTORY ARE USED.

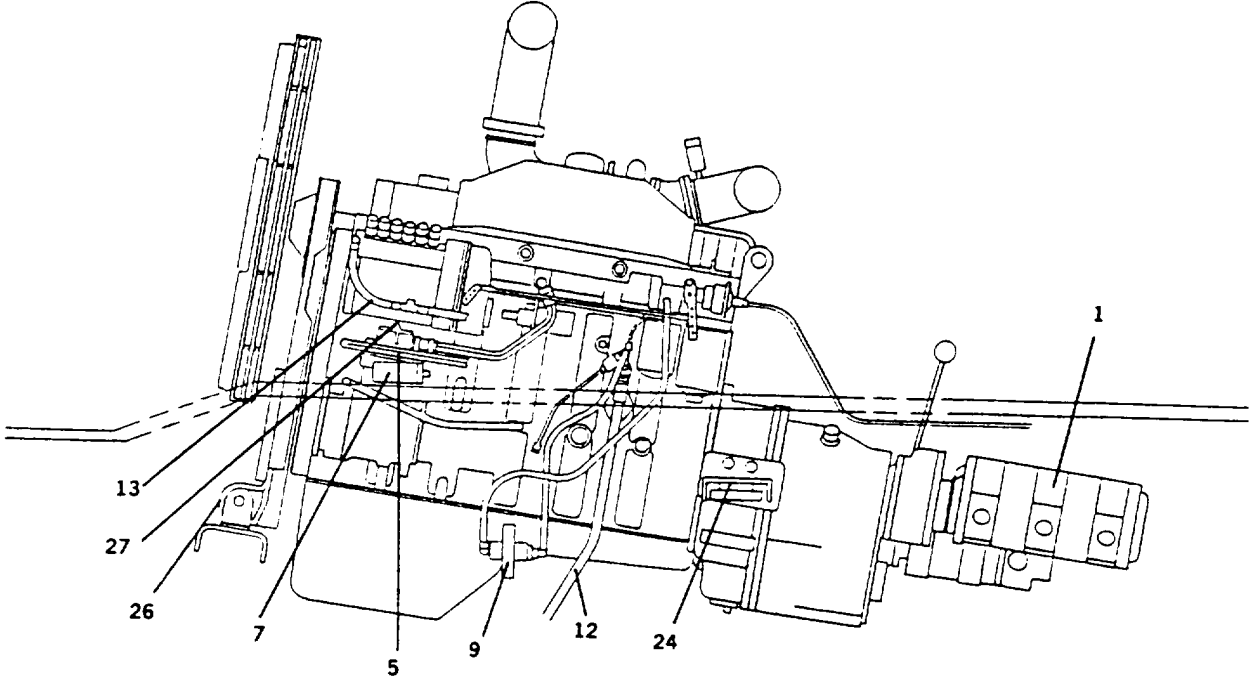
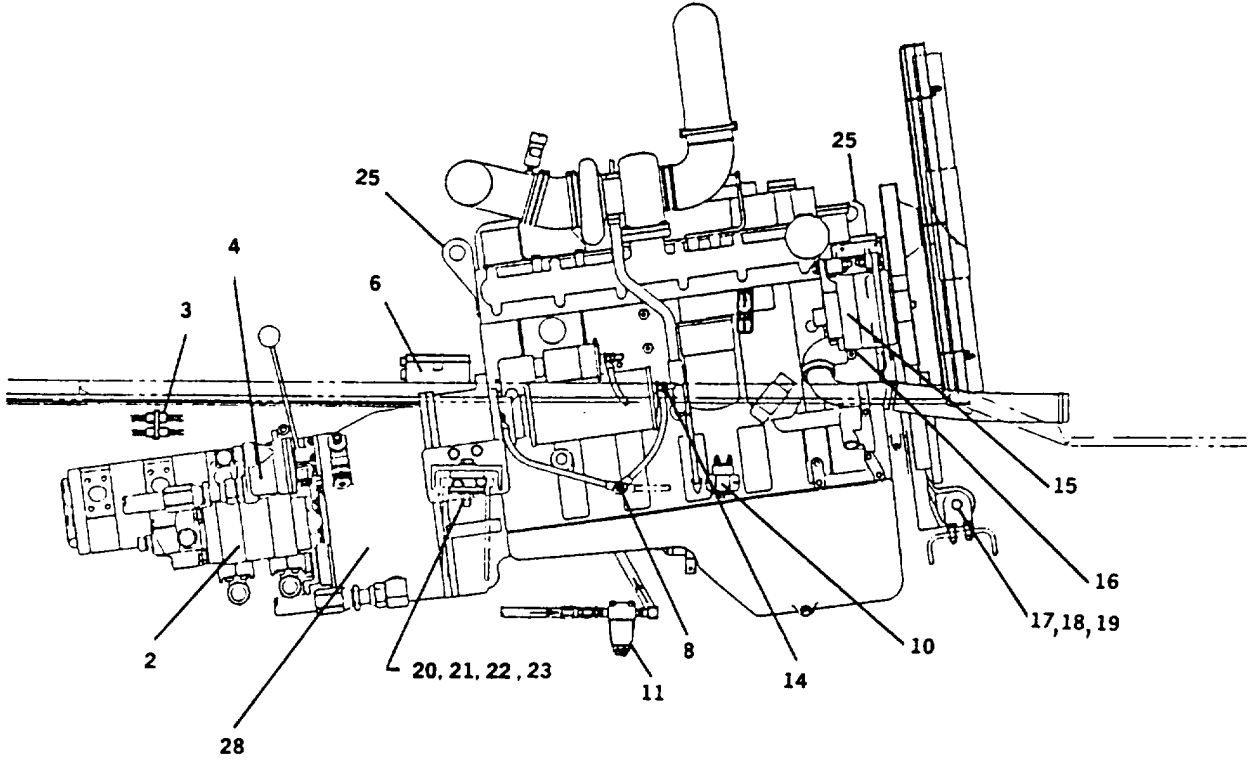
INSTALLATION:

1. INSTALL SHOCK MOUNTS (24) IN HOLES ON ENGINE SIDE MOUNTING BRACKETS.
2. USING SUITABLE LIFTING DEVICE ATTACHED TO ENGINE LIFTING EYES (25) AND THREE SECTION PUMP (1), INSTALL ENGINE.
3. INSTALL TWO CAPSCREWS (22), WASHERS (23), LARGE WASHERS (21) AND LOCKNUTS (20) IN ENGINE SIDE MOUNTS. TORQUE BOLTS TO 150 FT-LBS (200 Nm).
4. INSTALL CAPSCREW (18), NUT (17) AND LOCK WASHER (19) SECURING FRONT ENGINE MOUNT (26). TORQUE CAPSCREW (18) TO 250 FT-LBS (333 Nm).



5. CONNECT TWO TAGGED WIRES TO TEMPERATURE SENSOR (16).
6. CONNECT THREE TAGGED WIRES 672, 673 AND 674 TO ALTERNATOR (15).
7. CONNECT THREE TAGGED WIRES 671, 676 AND 677 TO STARTER (14).
8. INSTALL BATTERY CABLE TO STARTER (14).
9. INSTALL FUEL RETURN LINE (13) TO FUEL INJECTION PUMP. SECURE WITH CLAMP.
10. INSTALL FUEL LINE TO FUEL PUMP (12). OPEN PETCOCKS AT FUEL FILTER.
11. MOUNT STARTER RELAY (10) ON FRAME STUDS AND SECURE WITH ATTACHING HARDWARE.
12. INSTALL FUEL PRESSURE DIFFERENTIAL SWITCH (9) ON FRAME STUDS AND SECURE WITH ATTACHING HARDWARE.
13. CONNECT GROUNDING CABLE (8) FROM STARTER TO LEFT SIDE WALL.
14. MOUNT AIR GOVERNOR (7) ON FRAME STUDS AND SECURE WITH NUTS AND LOCKWASHERS.
15. CONNECT AIR LINE FROM AIR GOVERNOR (7) TO AIR COMPRESSOR (27).
16. CONNECT TAGGED ELECTRICAL CONNECTORS TO ENGINE FROM DCA BOX (6).
17. CONNECT BRAIDED STEEL LINE (5) TO AIR COMPRESSOR (27).
18. CONNECT FOUR TAGGED HYDRAULIC LINES TO TORQUE CONVERTER.
19. INSTALL PROPELLER SHAFT BETWEEN TORQUE CONVERTER AND TRANSMISSION.
20. REMOVE CAPS OR PLUGS AND CONNECT TWO HYDRAULIC LINES TO TORQUE CONVERTER CHARGING PUMP (4).
21. CONNECT TWO WIRING HARNESS ELECTRICAL CONNECTORS (3) ON RIGHT SIDE WALL IN ENGINE COMPARTMENT.
22. CONNECT FIVE HYDRAULIC LINES TO TWO SECTION PUMP (4).
23. CONNECT SIX HYDRAULIC LINES TO THREE SECTION PUMP (1).
24. INSTALL RADIATOR AND SHROUD ASSEMBLY. (REFER TO TM 5-3810-306-20.)
25. INSTALL ENGINE HOOD. (REFER TO TM 5-3810-306-20.)
26. INSTALL REAR DECK. (REFER TO TM 5-3810-306-20.)
27. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
28. INSPECT ALL ENGINE/TORQUE CONVERTER FLUID LEVELS. START ENGINE AND CHECK FOR LEAKS. (REFER TO TM 5-3810-306-10.)
29. BLEED HIGH PRESSURE FUEL LINES. (REFER TO PAGE 5-8.)

END OF TASK



Section II. CYLINDER HEAD AND BLOCK MAINTENANCE

CYLINDER HEAD INSTALLATION AND ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Lifting device (225 lbs. capacity)

SUPPLIES: Clean rags (Item 2, Appendix B)
Gasket (Item 220, Appendix B)
Cleaning pad, non metallic (Item 228, Appendix B)
Solvent P-D-680 (Item 1, Appendix B)

EQUIPMENT CONDITIONS: Outriggers set and boom positioned over-the-side.
(Refer to TM 5-3810-306-10.)
Negative battery cable disconnected at shunt.
(Refer to TM 5-3810-306-20.)
Engine hood removed. (Refer to TM 5-3810-306-20.)
Coolant drained from radiator.
(Refer to TM 5-3810-306-20.)
Valve cover removed. (Refer to TM 5-3810-306-20.)
Thermostat housing removed.
(Refer to TM 5-3810-306-20.)
Aftercooler removed. (Refer to TM 5-3810-306-20.)
Turbocharger removed. (Refer to page 5-10.)
Exhaust manifold removed. (Refer to page 5-10.)
Fuel injection lines removed. (Refer to TM 5-3810-306-20.)
Rocker Lever Assembly removed. (Refer to page 4-53.)
Fuel Injectors removed. (Refer to page 5-2.)

REMOVAL:

1. REMOVE CYLINDER HEAD (1).
 - a. Remove cylinder head capscrews (2) and (3).
2. IF A NEW CYLINDER HEAD IS TO BE INSTALLED, TRANSFER ANY HARDWARE FROM REPLACED CYLINDER HEAD.

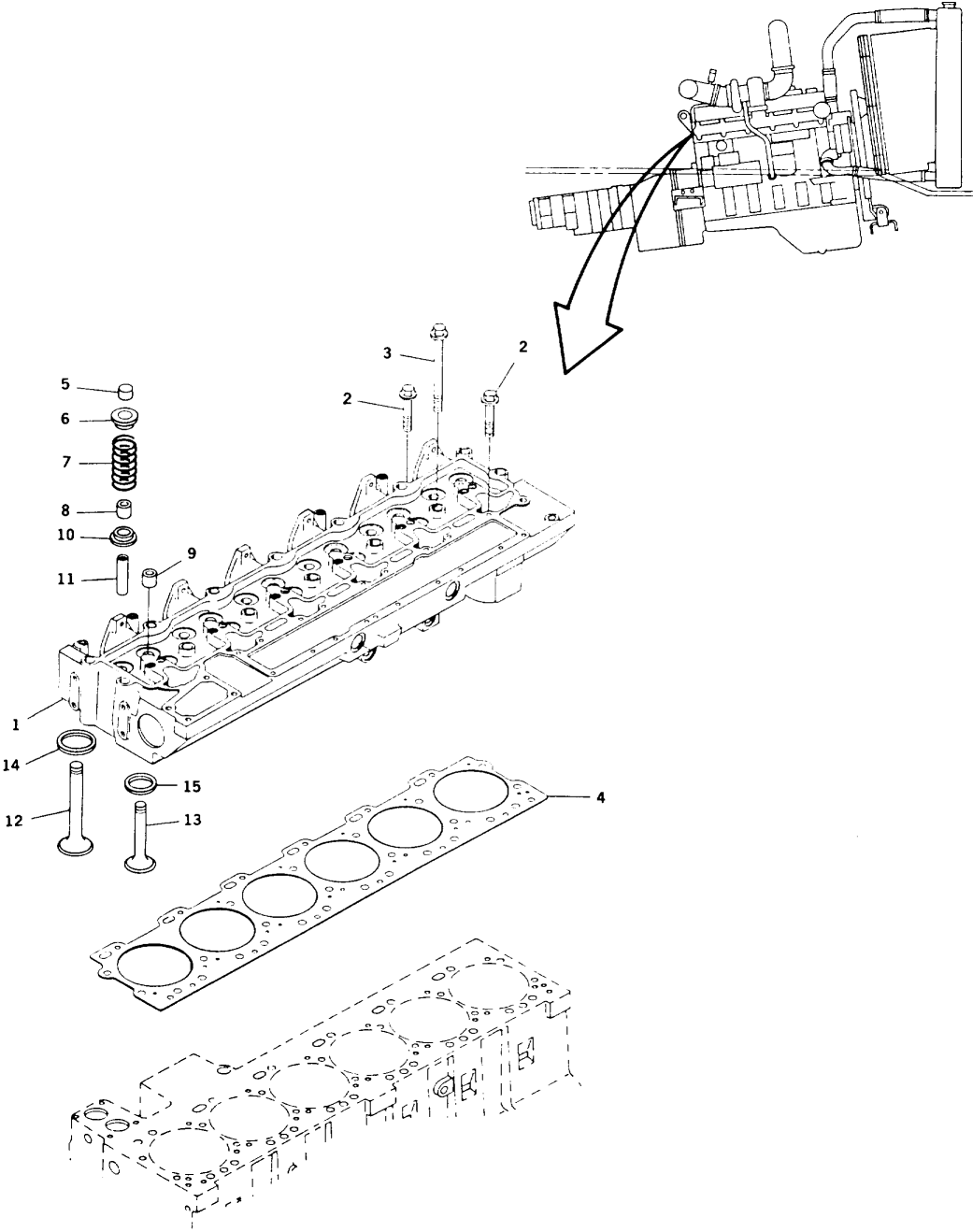
CAUTION

Failure to remove cylinder head cleanly from block can result in damage to head.

- b. Attach suitable lifting device to lifting brackets and remove cylinder head (1) in a direct upward motion.
- c. Remove gasket (4) and discard.

DISASSEMBLY:

1. REMOVE VALVES (12) AND (13).
 - a. Mark valves to identify position in cylinder head.
 - b. For each valve, compress valve spring (7) and remove valve spring lock (5) using a magnet.
 - c. Release valve spring (7) and remove retainer (6), spring (7) and valve (12) or (13) accordingly.



2. REMOVE VALVE STEM SEALS (8) AND (9) AND VALVE SPRING GUIDES (10). DISCARD VALVE STEM SEALS (8) AND (9).

NOTE

The remaining disassembly steps shall be performed only as deemed necessary after inspection.

3. USING AN APPROPRIATE DRIVER, REMOVE VALVE STEM GUIDES (11).
4. REMOVE VALVE SEATS (14) AND (15).

CAUTION

Make sure tool only cuts the valve seats and not the machined valve pockets of the cylinder head.

CAUTION

Shavings or debris between the cutter motor base and the head deck can cause serious damage to cylinder head.

- a. Using Router and Cutter, set the cutter depth 1.0 to 1.5 mm (.03937 to 0.59 in.) from the bottom of the valve seat pocket.
- b. Cut a groove in valve seats (14) and (15) making sure the cutter motor base remains flat against the cylinder head while rotating the cutter motor in a circular motion. Make sure groove is deep enough for the expanding seat extractor to catch in when expanded.
- c. Using slide hammer and appropriate seat extractor, remove valve seats (14) and (15).

CLEANING:

1. USING INJECTOR BORE BRUSH, CLEAN CARBON FROM INJECTOR NOZZLE SEATS.
2. SCRAPE GASKET MATERIAL AWAY FROM ALL GASKET SURFACES.
3. CLEAN DEPOSITS FROM COOLANT PASSAGES.

WARNING

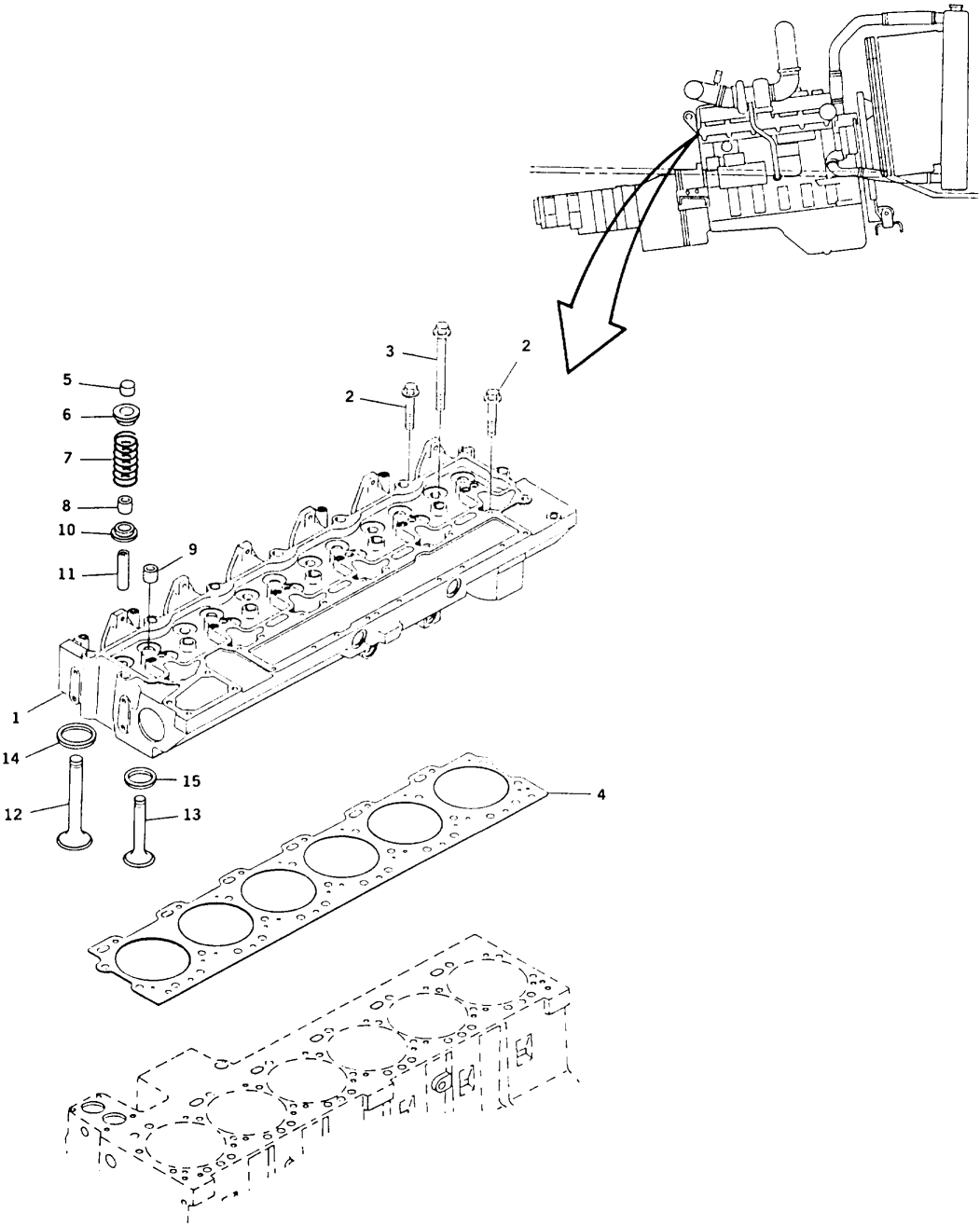
Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (380-590C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

4. CLEAN THE COMBUSTION DECK WITH A NONMETALLIC CLEANING PAD AND DIESEL FUEL OR SOLVENT.

CAUTION

Wear eye protective goggles when using rotating tools for cleaning purposes.

5. CLEAN CARBON DEPOSITS FROM THE VALVE POCKETS WITH A HIGH QUALITY STEEL WIRE WHEEL INSTALLED IN A DRILL OR DIE GRINDER.



NOTE

An inferior quality wire wheel will lose steel bristles during operation, causing additional contamination.

CAUTION

Use only clean low pressure (30 psi max) compressed air for drying parts. If unavailable, allow parts to air dry or wipe with clean, lint-free cloth.

6. WASH CYLINDER HEAD IN HOT SOAPY WATER SOLUTION 88°C (190°F). AFTER RINSING, USE COMPRESSED AIR TO DRY CYLINDER HEAD.

CAUTION

Wear eye protective goggles when using rotating tools for cleaning purposes.

7. CLEAN VALVE HEADS WITH A SOFT WIRE WHEEL INSTALLED IN A DRILL OR BENCH GRINDER.

NOTE

Keep valves in a labeled rack to prevent mixing.

8. POLISH VALVE STEMS WITH CROCUS CLOTH AND DIESEL FUEL.

INSPECTION:

1. INSPECT VALVES.
 - a. Inspect for abnormal wear on heads and stems, and bent valves. Replace damaged or worn valves.

- b. Measure diameter of valve stems in at least three equally spaced places. Minimum diameter .3724 in. (9.46 mm). Maximum diameter .3740 in. (9.50 mm). Replace valves if out of limits.
- c. Check valve stem tips for flatness and measure valve head rim thickness. Minimum thickness of rim .0591 in. (1.50 mm). Valve stem tips and valve head rims may be resurfaced if determined suitable.

2. INSPECT VALVE GUIDES.

- a. Inspect valve guides for scuffing or scoring.
- b. Measure valve guide bores. Minimum diameter .3756 in. (9.539 mm). Maximum diameter .3763 in. (9.559 mm).
- c. Replace damaged valve guides.

3. INSPECT CYLINDER HEAD DECK.

- a. Measure cylinder head deck for distortion. Maximum distortion is 0.003 in. (0.075 mm) overall end to end or side to side.
- b. If distortion exceeds limits, a maximum of 0.040 in. (1.0 mm) can be machined from combustion surface of cylinder head or cylinder head must be replaced.
- d. If cylinder head is machined, place valve in respective bore and check valve depth dimension. Minimum depth is 0.043 in. (1.09 mm), maximum is 0.064 in. (1.62 mm).
- d. If valve depth is less than minimum, machine valve seat. (Refer to page 4-13.)

4. INSPECT VALVE SEATS.

- a. Inspect valve seats for cracks or burnt spots. Replace damaged seats.
- b. Install valves in their respective bores, and using gauge block, measure depth of valve from cylinder head deck. Minimum valve depth .035 in. (.89 mm). Maximum valve depth .056 in. (1.42 mm).

NOTE

Make sure seats are clean before measuring valve depth.

- c. If the valve depth is out-of-limits, before replacing the valve seat, try replacing the old valve with a new valve. If the depth is in limits with the new valve, proceed with the seat grinding procedure using the new valve with the old seat. If the valve depth is still out-of-limits, even with the new valve, replace the valve seat. After replacing the seat, recheck the valve depth with the old valve to determine if it can be reused. If not, replace valve.

5. INSPECT VALVE SPRINGS.

- a. Inspect springs for breaks and distortion. Replace damaged springs.
- b. Measure valve springs. Approximate free length 2.585 in. (65.66 mm). Minimum inclination .039 in. (1.0 mm). Replace springs out-of-limits.

- c. Check valve spring tension. A load of 101.2 to 115.5 lbs (450 to 513.5 N) is required to compress spring to a height of 2 in. (50.8 mm). Replace springs out-of-limits.

6. INSPECT COMBUSTION FACE FOR CRACKS.

- a. Cracks that extend from the injector bores, away from the valve seats and are not over .3937 in. (10 mm) long are acceptable.
- b. Cracks that extend from the injector bores toward the valve seats or cracks between the valves are unacceptable. Replace cylinder head.

REPAIR:

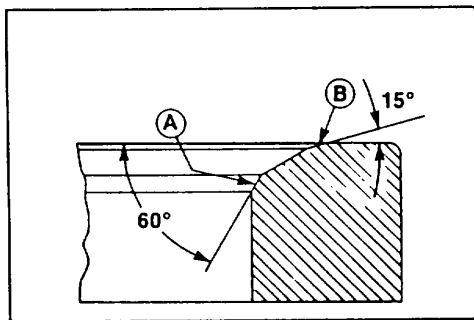
1. REFACE ALL REUSED VALVES.

- a. Valve seat angle Intake: 30 degrees Exhaust: 45 degrees
- b. Minimum valve head rim thickness .0591 in. (1.50 mm)
- c. Valve stem tips as required for flatness

2. GRIND VALVE SEATS.

- a. Grind valve seats to remove all scores, scratches and burns. Seat angle: Intake (30 degrees). Exhaust (45 degrees).
- b. Measure valve depth.
- c. Apply a coat of valve lapping compound to each valve and lap each valve to its corresponding seat.
- d. Remove valves and clean compound from valves and seats.

- e. Reinstall valves in their corresponding bores. The valve seat should seat in the center of the valve face.
- f. Measure the valve seat width indicated by the lapped surface. Minimum seat width .060 in. (1.5 mm). Maximum seat width .080 in. (2.0 mm).
- g. If valve seat width limits are not met or the seat is not centered, grind area (A) with a 60 degree stone and area (B) with a 15 degree stone to center the seat on the valve face and obtain the valve seat width limits.



- h. After reaching limits above, coat each valve face with "Dykem Steel Blue" and allow to dry.
- i. Apply a coat of valve lapping compound to each valve and lap the valve to its corresponding seat.
- j. Remove valves and clean compound from valve faces and seats.

NOTE

Keep valves in a labeled rack to prevent mixing.

ASSEMBLY:

- 1. IF REMOVED, INSTALL NEW VALVE GUIDES (11).
 - a. Fabricate two spacers (Items 12 and 13, Appendix C) for controlling installation depth of new valve guides (11).

NOTE

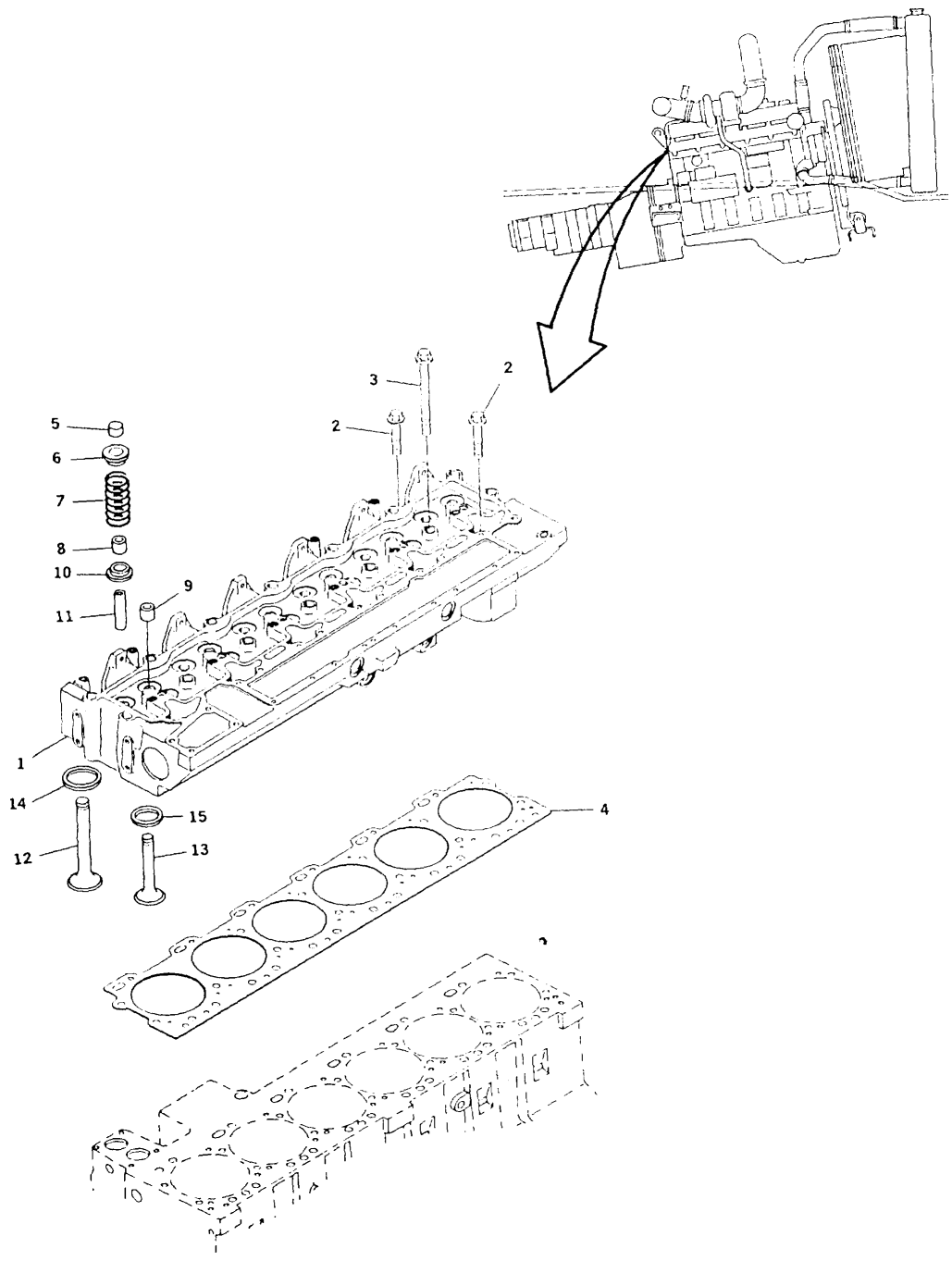
Valve guide depth is very important and care should be taken to machine spacers to correct dimensions.

- b. Using universal valve guide driver, start guides (11) into head. Make sure guides start straight.
- c. Install the proper spacer over guide. If required, install a flat washer on driver o contact spacer.
- d. Drive guide (11) in, until driver contacts spacer.
- e. Using a .3750 in. (9.525 mm) reamer, ream valve guides (11) with no lubricant and in one direction only.

NOTE

Damage to valve guide can result from pulling reamer back through guide.

- f. Lubricate reamer with clean engine oil and run through a second time in one direction only.



WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (380-590C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

- g. Clean the valve guide bore with cleaning solvent.
- 2. IF REMOVED, INSTALL NEW VALVE SEATS (14) AND (15).
 - a. Freeze new valve seats at 0°F (18°C) for 30 minutes before attempting to install.
 - b. Remove new seats (14) and (15) from freezer one at a time and position in valve pocket. Using a hardwood board and a lead hammer, place hardwood board on valve seat (14) or (15) and drive seat into valve pocket until bottomed.

NOTE

Intake and exhaust valve seats are different. Be sure to use correct seat.

- c. Lap corresponding valve (12) or (13) to each seat (14) or (15) and grind as necessary. (Refer to page 4-13.)

- 3. INSTALL VALVE SPRING GUIDES (10).
- 4. INSTALL NEW VALVE STEM SEALS (8) AND (9).

NOTE

Intake and exhaust seals are different. Be sure to use correct seal.

- 5. INSTALL VALVES (12) AND (13).

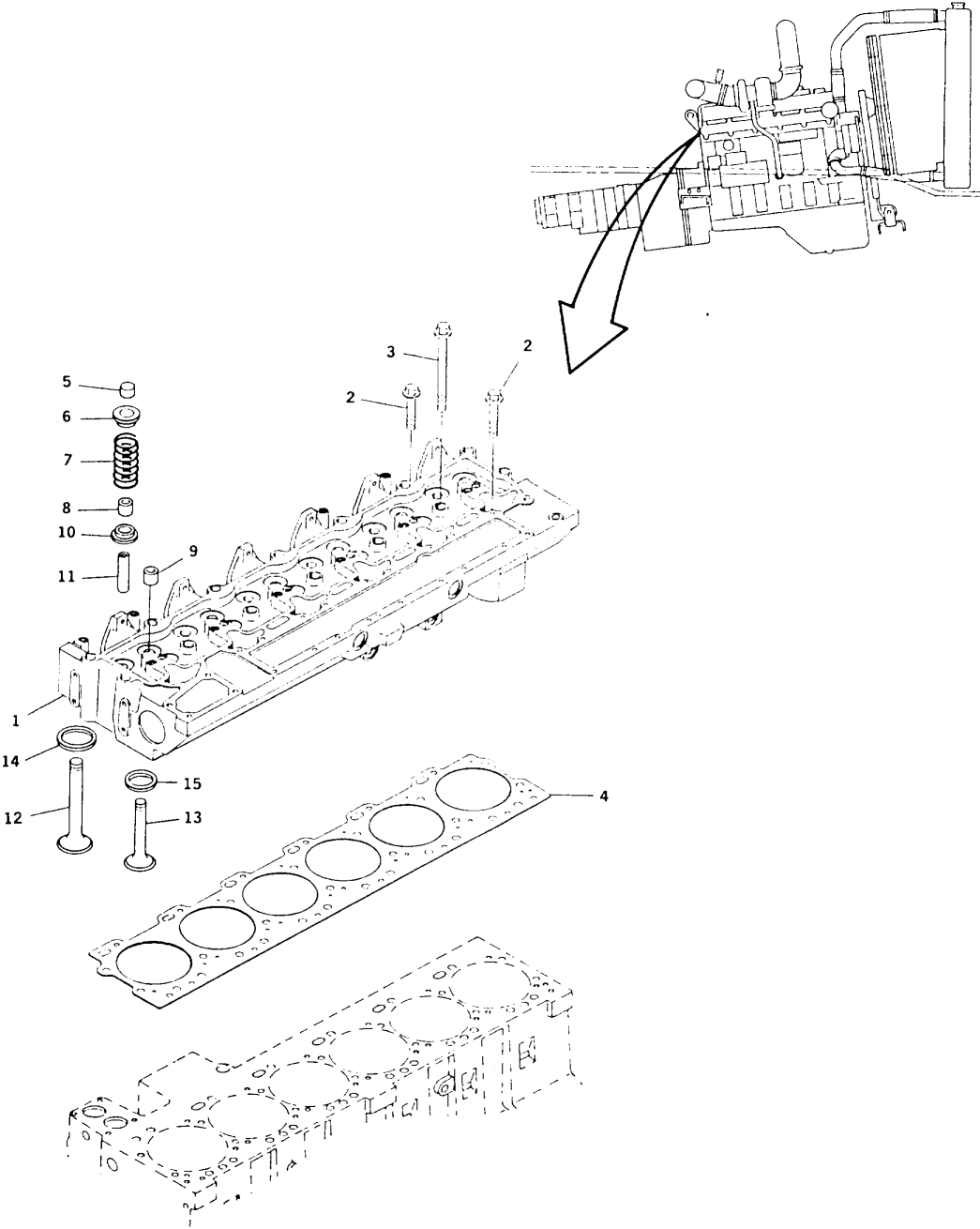
CAUTION

Be sure valves (12) and (13) are installed in corresponding valve bores as removed and/or lapped.

- a. Lubricate valve stems with SAE 90W engine oil and insert valves (12) and (13) in corresponding valve bores.
- b. Position valve springs (7) and valve spring retainers (6) over valve stems.
- c. Compress valve springs (7) and install valve spring locks (5). Release spring tension.

CAUTION

Wear eye protective goggles. If valve spring locks (5) are not correctly installed, they can fly out when hit with a hammer.



- d. After assembly, hit valve stems with a plastic hammer to ensure valve spring locks (5) are seated.

- d. Torque capscrews (2) and (3) first time to 27 ft-lbs (36 Nm) in sequence shown. Repeat in same sequence to torque of 110 ft-lbs (146 Nm). Finally torque capscrews in same sequence to 148 ft-lbs (197 Nm).

INSTALLATION:

1. INSTALL CYLINDER HEAD (1).
 - a. Position new gasket (4) onto cylinder block dowels.

NOTE

Cylinder block and cylinder head must be clean and dry.

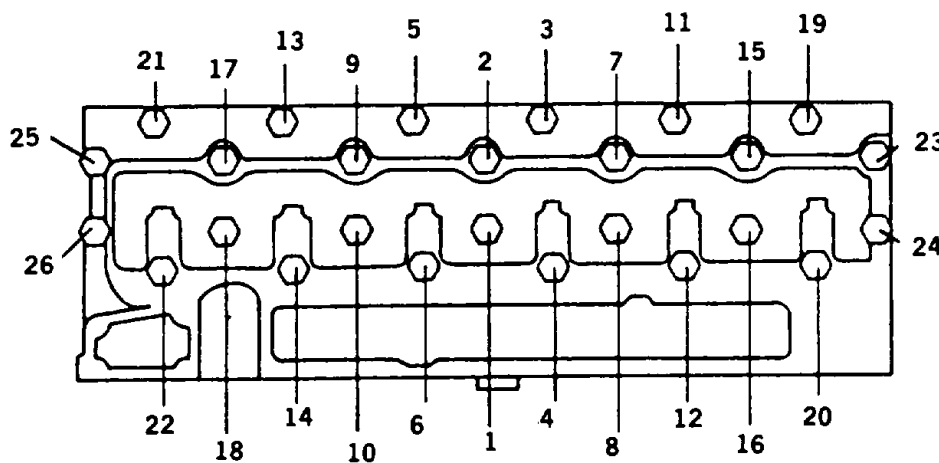
- b. Carefully place cylinder head (1) onto gasket (4) on cylinder block. Make sure cylinder head (1) is aligned on dowels.

CAUTION

Do not install capscrews with painted heads in the center rows which will be covered by the valve cover.

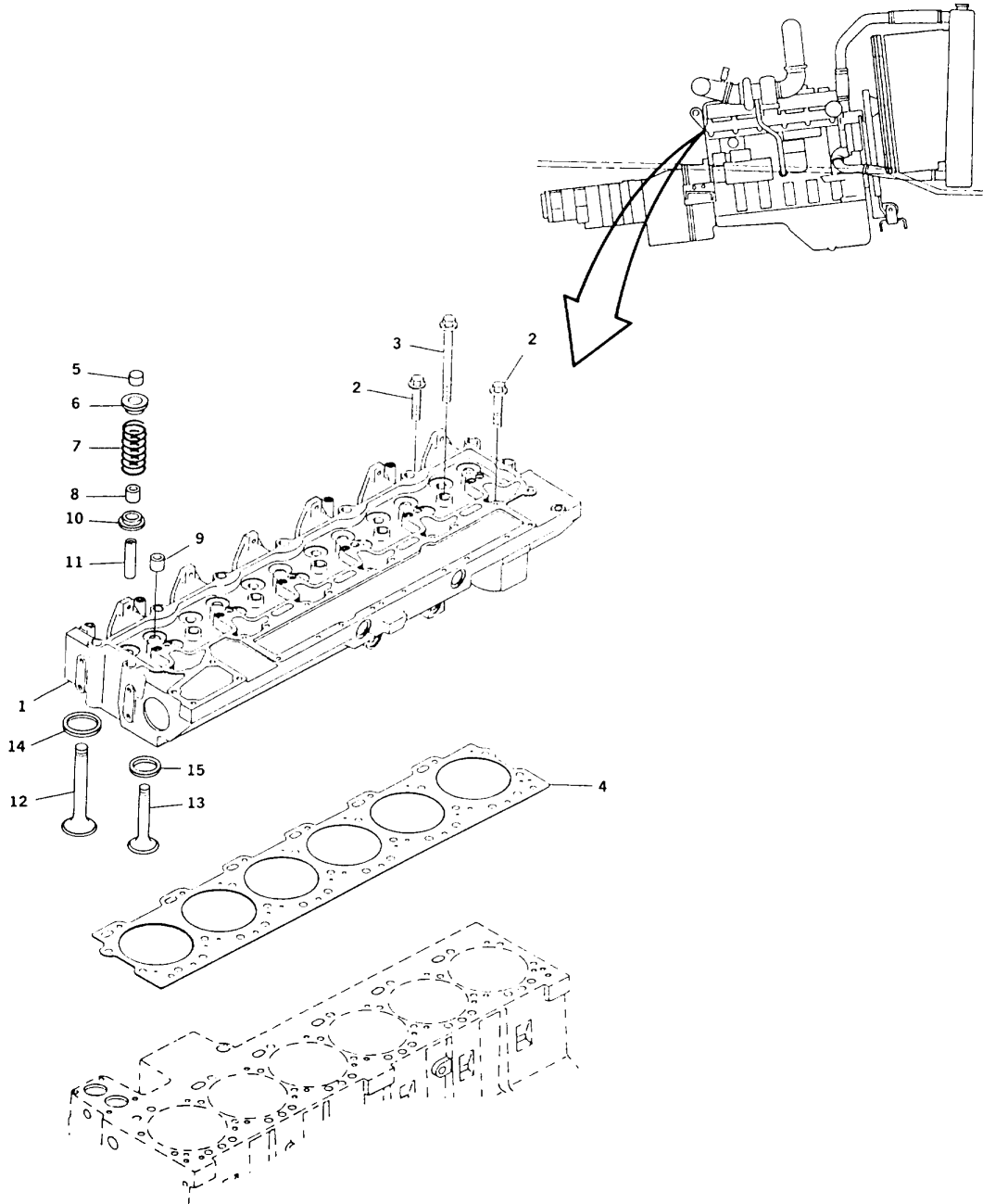
- c. Install lubricated cylinder head capscrews (2) and (3).

2. INSTALL ROCKER LEVER ASSEMBLIES. (REFER TO PAGE 4-53.)
3. ADJUST VALVES. (REFER TO TM 5-3810-306-20.)
4. INSTALL VALVE COVER. (REFER TO TM 5-3810-306-20.)
5. INSTALL FUEL INJECTORS AND LINES. (REFER TO PAGE 5-2.)
6. INSTALL THERMOSTAT HOUSING. (REFER TO TM 5-3810-306-20.)
7. INSTALL EXHAUST MANIFOLD. (REFER TO PAGE 5-10.)
8. INSTALL TURBOCHARGER. (REFER TO PAGE 5-10.)
9. INSTALL ENGINE HOOD. (REFER TO TM 5-3810-306-20.)
10. SERVICE RADIATOR. (REFER TO LO 5-3810-306-12.)
11. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)



TORQUE SEQUENCE

END OF TASK



CYLINDER LINER INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Liner Puller (3376015)
Liner Driver (ST-1299)
Liner protrusion gauge (ST-18547)
Liner clamps (3376944)

SUPPLIES: Ring seals (Item 3, Appendix B)
Clean rags (Item 2, Appendix B)

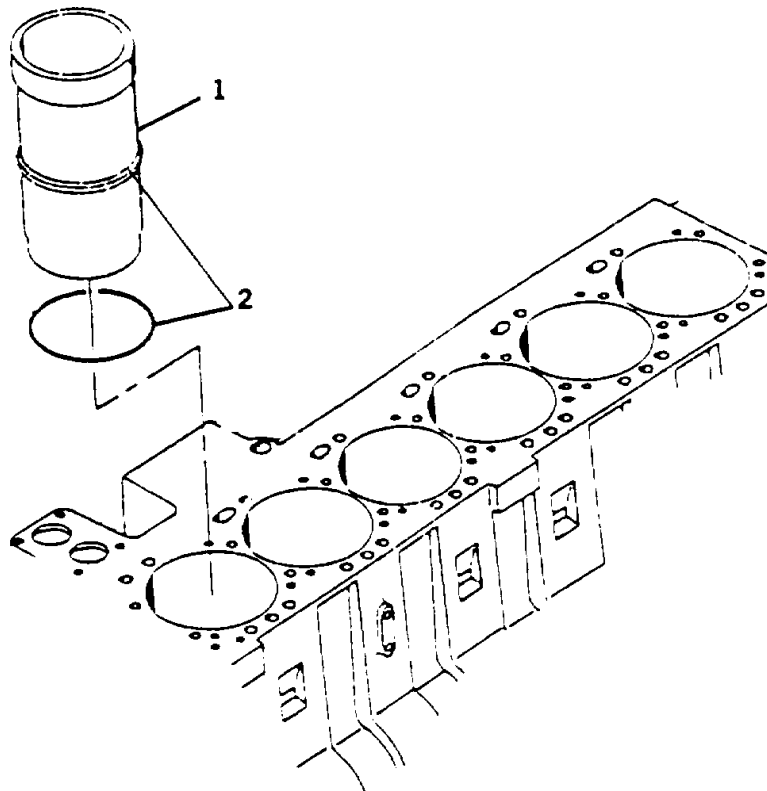
EQUIPMENT CONDITIONS: Engine removed. (Refer to page 4-2.)
Pistons and connecting rods removed.
(Refer to page 4-34.)

REMOVAL:

1. USE CLEAN RAGS TO COVER HOLE IN BOTTOM OF CYLINDER TO BLOCK DEBRIS FROM FALLING INTO CONNECTING ROD JOURNAL OIL HOLE.

CAUTION

- Make sure liner puller does not catch on any of the four liner stops.**
2. USING LINER PULLER, PULL LINER (1) AND SEALS (2). MARK LINERS FOR INSTALLATION.



CLEANING AND INSPECTION:

WARNING

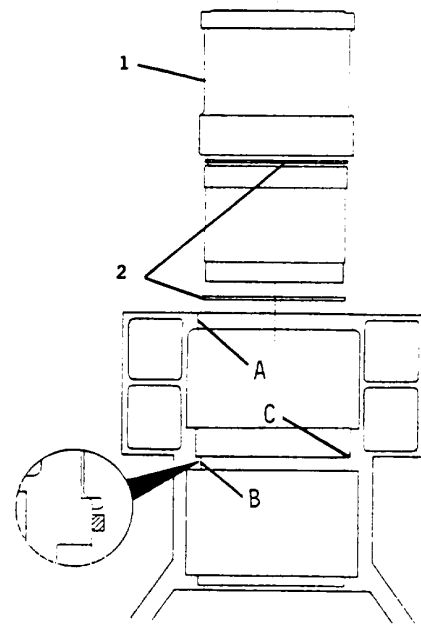
Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (380-590C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

1. CLEAN SEALING SURFACES.
 - a. Clean all deposits and debris from sealing surfaces A, B and C.

NOTE

A fine grit sandpaper and cleaning solvent can be used to polish surfaces. However, due to critical machined tolerances, care should be taken not to remove any stock.



2. INSPECT SEALING SURFACES.
 - a. If surface C has cracks or signs of extreme wear, engine block must be replaced.
3. CLEAN WATER PASSAGES AND INSPECT FOR DEBRIS IN WATER JACKET.
4. CLEAN CYLINDER BORE.
 - a. Thoroughly flush block with cleaning solvent.
 - b. Remove shop rags and clean crankshaft with cleaning solvent.
 - c. Blow cylinder bores and crankshaft dry and wipe them clean with a lint free cloth.

INSTALLATION:

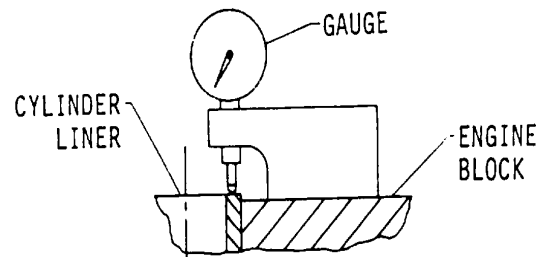
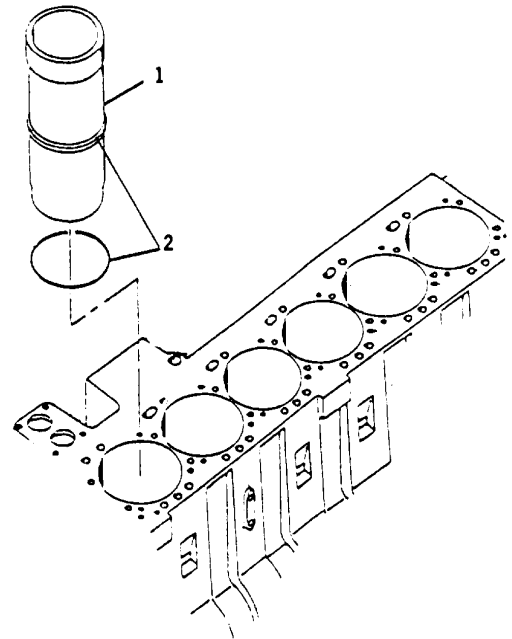
1. INSTALL CYLINDER LINERS (1) AND SEALS (2).
 - a. Lubricate surfaces A and B with clean engine oil.
 - b. Install new seals (2) on liners (1) as illustrated. Lubricate with clean engine oil.
 - c. Position marked liner (1) in proper cylinder bore. Using liner driver, drive liner in until it is fully seated.

NOTE

Liner clamps may also be used to install liner. Install liner clamping plate over liner, secure with capscrews and spacers. Torque capscrews to 50 ft-lbs (68 Nm). Repeat for each liner.

2. INSPECT LINER PROTRUSION.

Limits: .0005 - .0043 in.
(.013 - .109 mm)



3. INSTALL PISTON AND ROD ASSEMBLIES.
(REFER TO PAGE 4-34.)

5. TEST FOR PROPER OPERATION. INSPECT FOR
LEAKS AND LOOSE PARTS. (REFER TO TM 5-
3810-306-10.)

4. INSTALL ENGINE. (REFER TO PAGE 4-2.)

END OF TASK

Section III. CRANKSHAFT MAINTENANCE

CRANKSHAFT INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Shop equipment general purpose repair, semi-trailer mtd (4930-01-006-3229)
 Shop equipment machine shop; fm heavy less power (3470-00-754-0738)
 Shop equipment machine shop; fm heavy suppl no. 1 (3470-00-754-0739)
 Shop equipment auto-maintenance and repair, fm basic (4910-00-754-0705)
 Shop equipment auto-maintenance and repair, fm suppl no. 1
 (4910-00-754-0706)
 Lifting device (150 lbs capacity)

SUPPLIES: Oil (Item 11, Appendix B)
 Lubriplate 105 (Item 4, Appendix C)

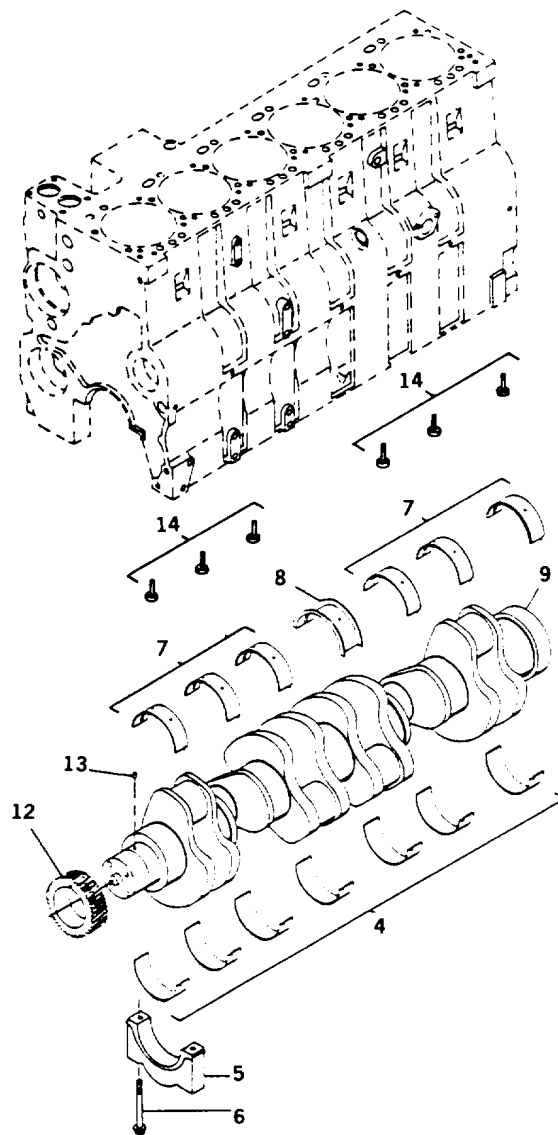
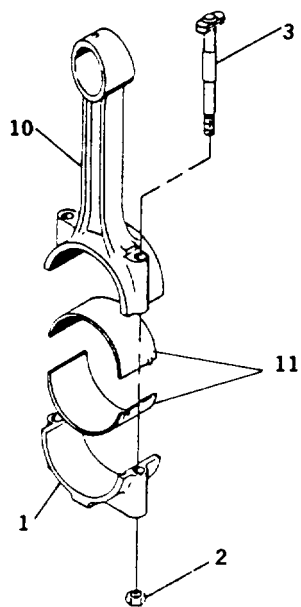
EQUIPMENT CONDITIONS: Engine removed. (Refer to page 4-2.)
 Flywheel housing and rear seal cover removed.
 (Refer to page 4-29.)
 Front gear cover removed. (Refer to page 4-45.)
 Oil pan and suction tube removed. (Refer to page 4-57.)

REMOVAL:

1. WITH ENGINE ON MAINTENANCE STAND, ROTATE ENGINE BOTTOM SIDE UP.
2. DISCONNECT CONNECTING RODS (10).
 - a. Mark each rod cap (1) according to cylinder number.
 - b. Remove two nuts (2) from connecting rod bolts (3).
 - c. Tap bolts (3) with plastic hammer to loosen rod cap (1).
 - d. Slide each piston assembly away from crankshaft.
3. REMOVE BEARINGS (4) AND CAPS (5).
 - a. Mark each bearing cap to assure that each is installed in same position at assembly.
 - b. Remove fourteen hex capscrews (6) from seven main bearing caps (5).

CAUTION

- Do not pry on main bearing caps to free them from cylinder block.**
- c. Use two hex capscrews (6) to work main cap loose.
 - d. Remove main bearing caps (5).
 4. REMOVE CRANKSHAFT (9) AND BEARINGS (7), (8) AND (11).
 - a. Using suitable lifting device, remove crankshaft (9) from cylinder block in direct upward motion.
 - b. Remove and discard main bearings (4) from seven bearing caps (5).
 - c. Remove and discard main bearings (7) and (8) from cylinder block.
 - d. If necessary, using a 3/16 in. pin punch, drive piston cooling nozzles (14) from bearing saddles in block.



- e. Remove and discard rod bearings (11) from rods (10) and caps (1).
- f. Reinstall main bearing caps (5) in their corresponding positions. Note, #1 cap is to front of block.

5. REMOVE CRANK SHAFT GEAR (12).

- a. Using a suitable puller, remove crankshaft gear (12) from crankshaft (9).
- b. Remove alignment pin (13) from crankshaft (9).
- c. If crankshaft is to be reused, remove all burrs to make sure gear and bearing surfaces on end of crankshaft are smooth.

- b. Heat crankshaft gear (12) for 45 minutes at 2500F (121°C).

INSTALLATION

1. INSTALL CRANKSHAFT GEAR (12).

- a. Install alignment pin (13) in crankshaft (9).

CAUTION

Crank case gear (12) will be permanently distorted if overheated.

CAUTION

Wear protective gloves to prevent personal injury from hot gear.

- c. Install hot crankshaft gear (12), with timing mark out, up to shoulder on crankshaft (9) aligning slot in gear with alignment pin (13).

2. INSTALL BEARINGS (7), (8) AND (11),
 - a. If removed, using a 1/2 in. center punch, install piston cooling nozzles even with or below bearing saddle surfaces in block.

NOTE

Upper bearings (7) and (8) contain an oil hole. Lower bearings (4) do not.

NOTE

All bearings are marked on back to indicate either standard (STD) or oversize (OS). Use only appropriate size required.

- b. Install new bearings (7) in bearing saddles. Make sure tang of bearings are in slot of bearing saddle.
- c. Install new combination thrust/main bearing (8) in center journal saddle.

CAUTION

Prevent dirt from mixing with lubricant. (Dirty lubricant will accelerate bearing wear.)

- d. Lubricate bearings (7) and (8) with Lubriplate 105. Do not lubricate back of bearings.
- e. Clean crankshaft (9) bearing surfaces using a lint free cloth.
- f. Install bearings (11) in rods (10) and caps (1). Apply light film of Lubriplate 105 to bearing surfaces.

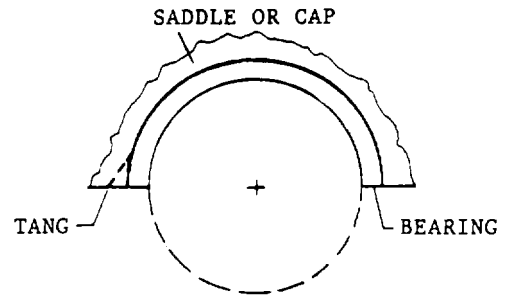
3. INSTALL CRANKSHAFT (9)

- a. Using lifting strap that will not damage crankshaft (9) lower into position avoiding not to

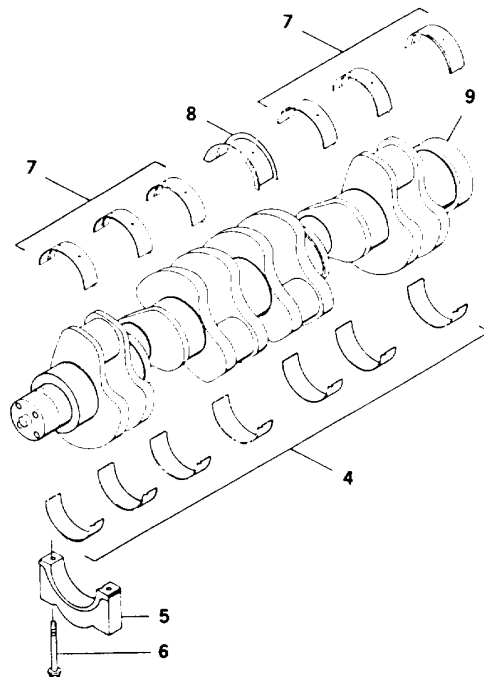
drop crankshaft on bearing.

- b. Install crankshaft (9) taking care not to damage thrust/main bearing (8).

4. INSTALL LOWER BEARINGS (4) AND (8) AND CAPS (5).



- a. Install new lower main bearings (4) and (8) into caps (5). Make sure tang of bearing shell is in slot of cap.
- b. Lubricate bearings (4) and (8) with Lubriplate 105. Do not lubricate back of bearings.



NOTE

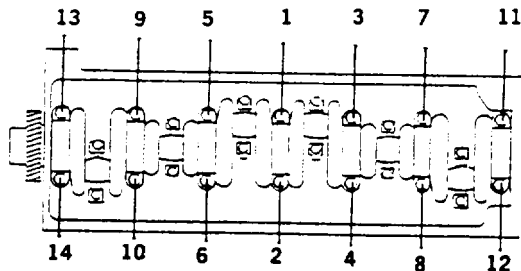
The main bearing caps (5) are numbered for location. Number one starts at front of block, and numbers face the camshaft side of engine. When installed the tangs should both be on the same side.

- c. Install bearing caps (5).

NOTE

Thrust journal bearing (8) does not have tang or slot. Ensure the number stamped on main bearing cap (5) is positioned to the camshaft side of engine.

- d. Lubricate main bearing hex capscrew threads and underside of head with clean engine oil.
- e. Using plastic rubber mallet, tap main bearing caps (5) gently into position. When in place, hex capscrews (6) can be threaded in by hand (6).
- f. Torque hex capscrews (6) evenly in three steps in order shown.
 First step to 37 ft-lbs (49 Nm)
 Second step to 70 ft-lbs (93 Nm)
 Third step to 110 ft-lbs (146 Nm)



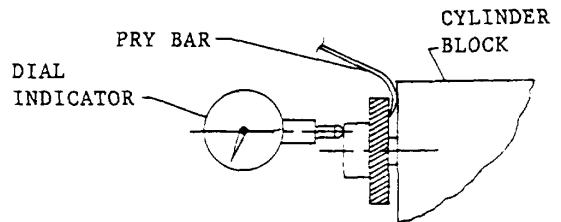
NOTE

Crankshaft should rotate freely. If crankshaft does not rotate freely check bearing installations and sizes.

- 5. CHECK CRANKSHAFT END PLAY.

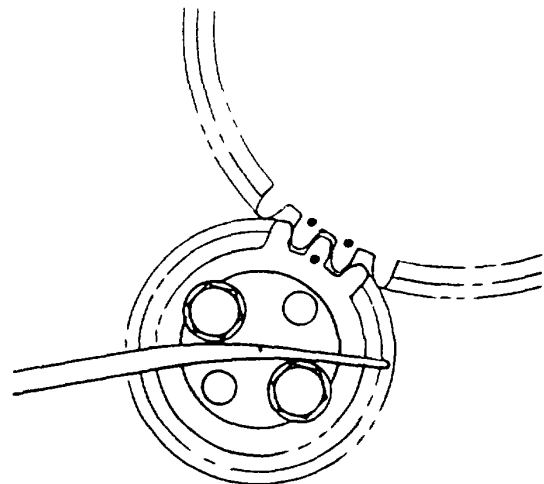
- a. Position dial indicator as shown and measure crankshaft (9) end play.

Tolerance: min .006 (.15 mm)
 max .013 (.33 mm)



- 6. CONNECT PISTON RODS (10).

- a. Bar crankshaft (9) so rod journal for piston to be installed is at bottom dead center.



- b. Pull connecting rod (10) onto crankshaft (9) journal.
- c. Apply clean engine oil to lubricate threads of bolts (3) of connecting rod (10).

NOTE

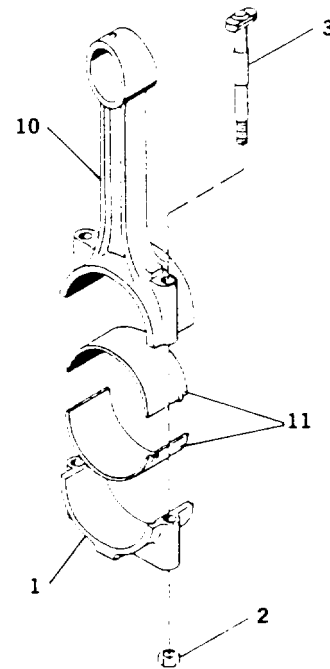
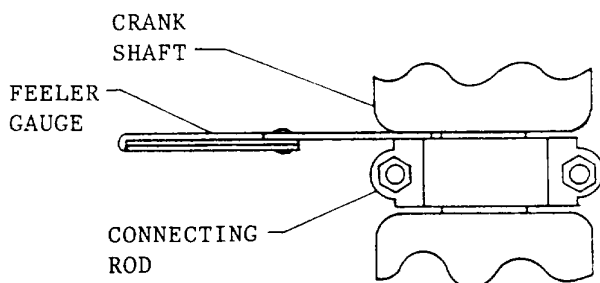
The number stamped on rod (10) and cap (1) at parting line must match and be installed on camshaft side of engine.

- d. Install rod cap (1) and start connecting rod nuts (2).
- e. Lubricate under connecting rod nuts (2) with clean engine oil.
- f. Alternately tighten rod nuts (2) to pull rod cap (1) into position.
- g. Torque rod nuts (2) evenly in three steps.

First to 30 ft-lbs (40 Nm)
 Second to 60 ft-lbs (80 Nm)
 Final torque to 88 ft-lbs (117 Nm)

- h. Shake connecting rod (10) and cap (1) to verify side clearance.
- i. Measure total side clearance with a feeler gauge between crankshaft and connecting rod.

min .004 (.1 mm)
 max .012 (.3 mm)



- j. Check crankshaft for freedom of rotation as caps (1) are installed one at a time. If crankshaft does not rotate freely check bearing installation and size.
 - k. Install all six caps (1).
7. INSTALL OIL PAN AND SUCTION TUBE. (REFER TO PAGE 4-57.)
 8. INSTALL FRONT COVER. (REFER TO PAGE 4-45.)
 9. INSTALL FLYWHEEL HOUSING AND REAR SEAL. (REFER TO PAGE 4-29.)
 10. INSTALL ENGINE. (REFER TO PAGE 4-2.)
 11. INSTALL ENGINE HOOD. (REFER TO TM 5-3810-306-20.)
 12. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

END OF TASK

Section IV. FLYWHEEL MAINTENANCE

FLYWHEEL HOUSING AND REAR SEAL INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Pneumatic or electric drill
1/8 in. drill bit

SUPPLIES: Preformed packing (Item 221, Appendix B)
Seal (Item 222, Appendix B)
Clean rags (Item 2, Appendix B)
Lubriplate 105 (Item 102, Appendix B)

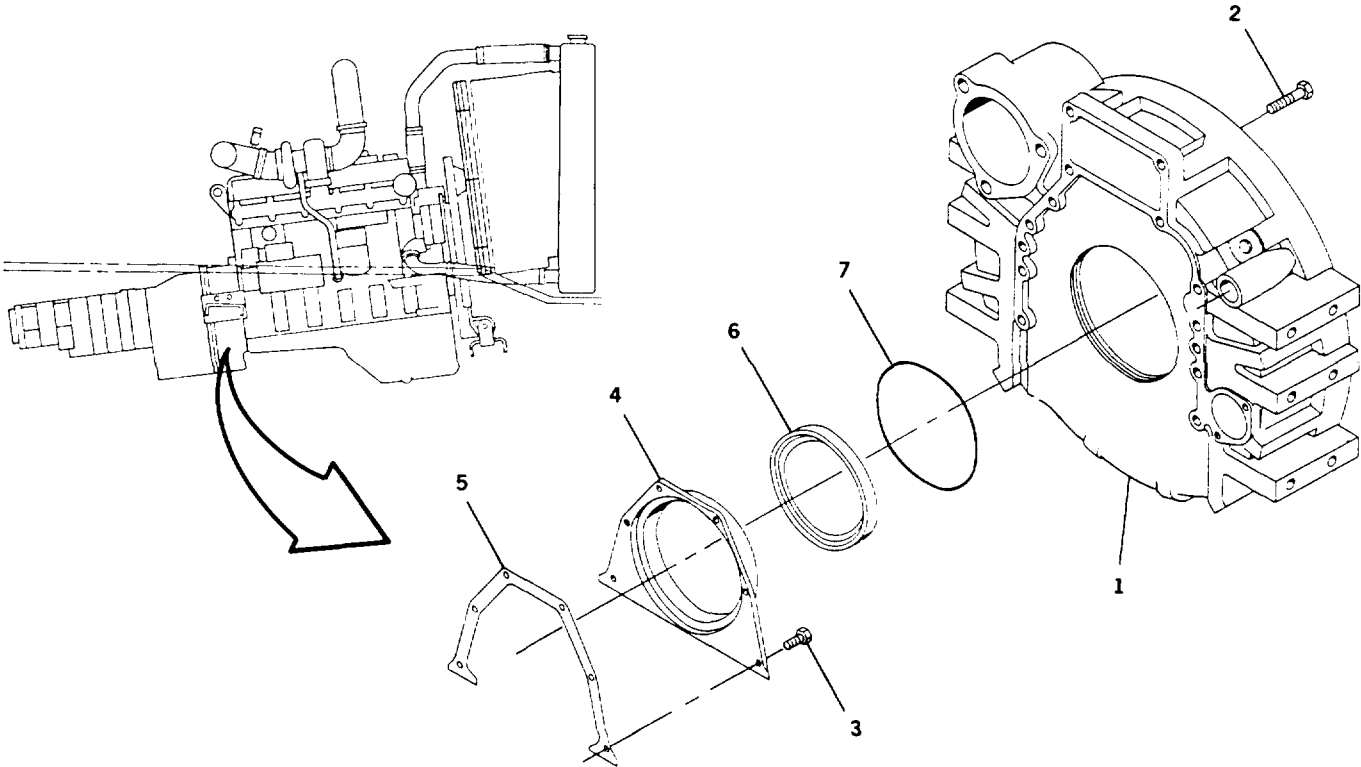
EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
(Refer to TM 5-3810-306-20.)
Engine removed. (Refer to page 4-2.)
Torque Converter Removed. (Refer to page 7-2.)
Starter removed. (Refer to TM 5-3810-306-20.)
Flywheel removed; (Refer to page 4-32.)

REMOVAL:

NOTE

If only rear seal needs replacement. Step 2 outlines procedure for removal without removing flywheel housing or seal cover.

1. REMOVE FLYWHEEL HOUSING (1) AND REAR SEAL (6).
- a. Remove twelve cap screws (2) from flywheel housing (1). Remove housing (1).



- b. Remove and discard packing seal (7).
- c. If oil pan has not been removed, remove four capscrews attaching oil pan to rear seal cover (4).
- d. Remove six capscrews (3) from rear seal cover (4) and remove with gasket (5).
- e. Drive out and discard seal (6) from rear seal cover (4).

2. REMOVE REAR SEAL (6) FROM SEAL COVER (4).

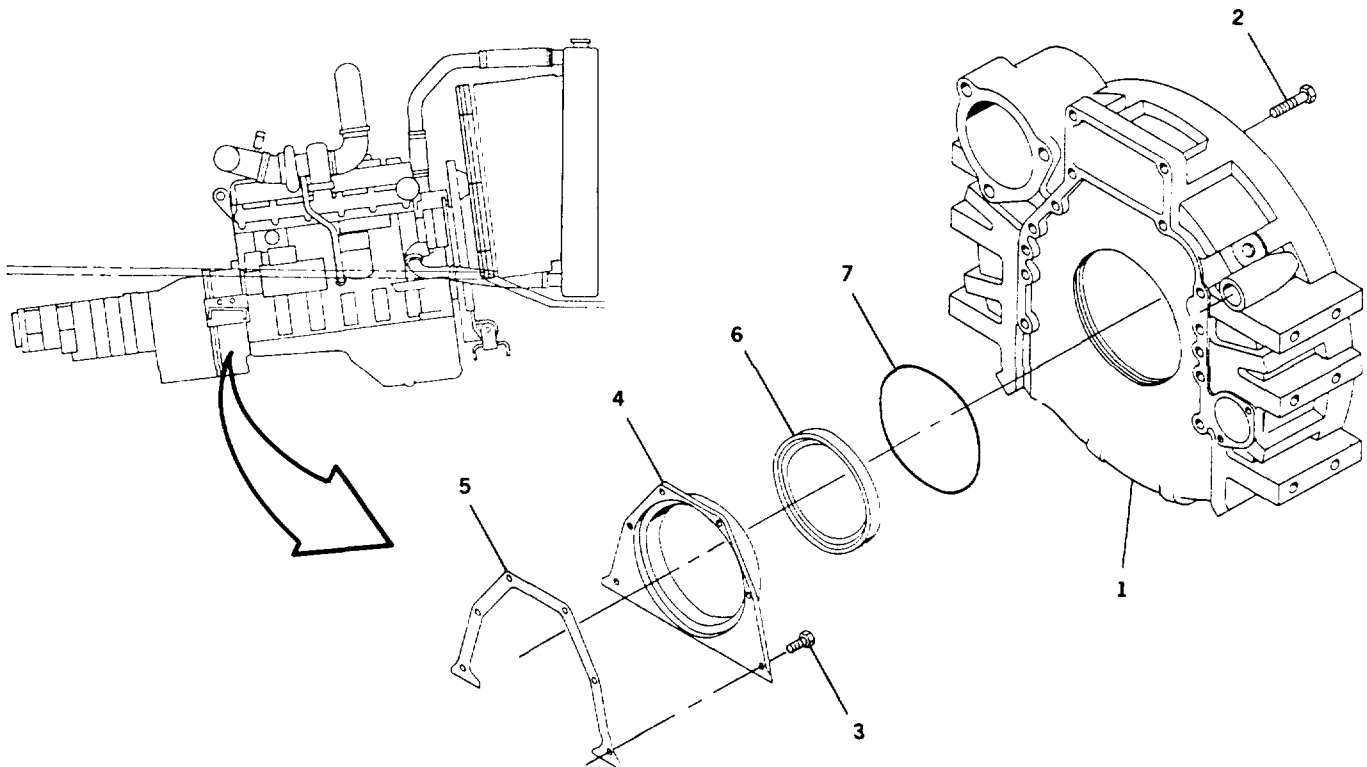
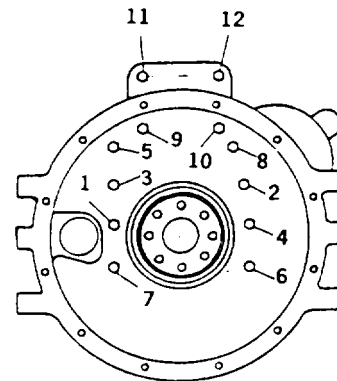
- a. Drill two 1/8 in. holes 180 degrees apart in seal (6).
- b. Install slide hammer with No. 10 sheet metal screw into holes and remove seal (6).

INSTALLATION:

1. INSTALL REAR SEAL (6) (COVER

- a. Install new seal (6) into rear seal cover (4).
- b. Mount rear seal cover (4) and new gasket (5) with six capscrews (3).
- c. Position new packing seal (7) on seal cover (4) and lubricate with Lubriplate 105.

2. INSTALL REAR SEAL (6) (COVER INSTALLED).



- a. Clean and dry crankshaft sealing surface.
 - b. Install seal pilot from seal kit, over crankshaft. Push new seal (6) over pilot, into position. Remove pilot.
 - c. Tap seal with alignment tool until tool stops against housing
3. INSTALL FLYWHEEL HOUSING (1).

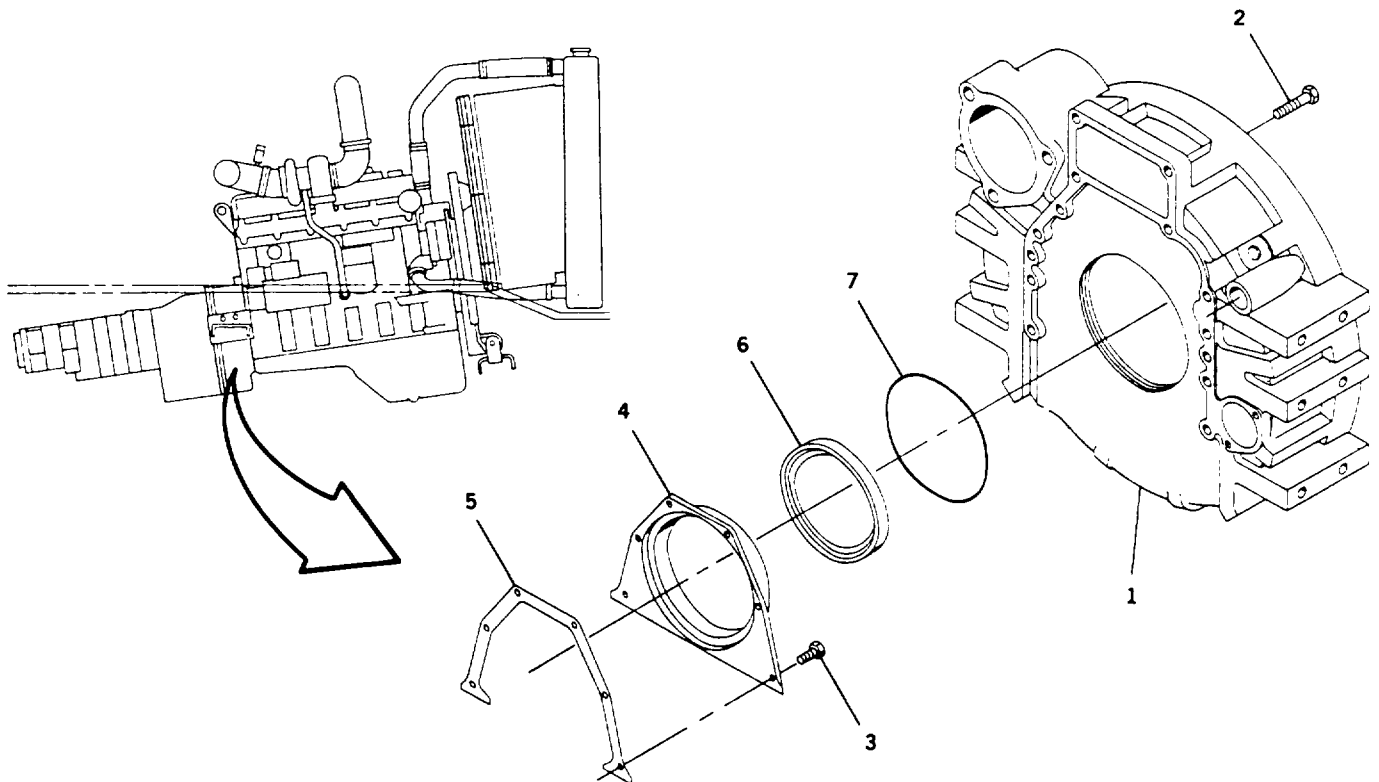
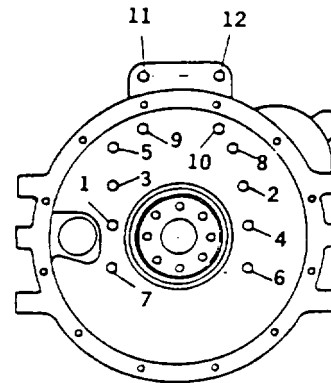
CAUTION

Make sure flywheel housing is positioned onto the alignment dowels and packing seal (7) is not cut or damaged.

- a. Mount flywheel housing (1) with twelve capscrews (2). Torque capscrews (2) to 45 ft-lbs (60 Nm) in sequence shown.
4. INSTALL FLYWHEEL. (REFER TO PAGE 4-32.)

5. INSTALL STARTER. (REFER TO TM 5-3810-306-20.)
6. INSTALL TORQUE CONVERTER. (REFER TO PAGE 7-2.)
7. INSTALL ENGINE. (REFER TO PAGE 4-2.)
8. INSTALL ENGINE HOOD. (REFER TO TM 5-3810-306-20.)
9. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

END OF TASK



FLYWHEEL INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Shop Equipment Machine Shop; FM Basic (3470-00-754-0708)
 Shop Equipment Welding, Field Maintenance (4940-00-357-7268)
 Tool Outfit Hyd System; Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784)
 Shop Equipment Fuel and Electric System Engine FM Basic(4940-00-754-0714)
 Engine barring tool (3377371)

SUPPLIES: None

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)
 Torque converter removed. (Refer to page 7-2.)

REMOVAL:

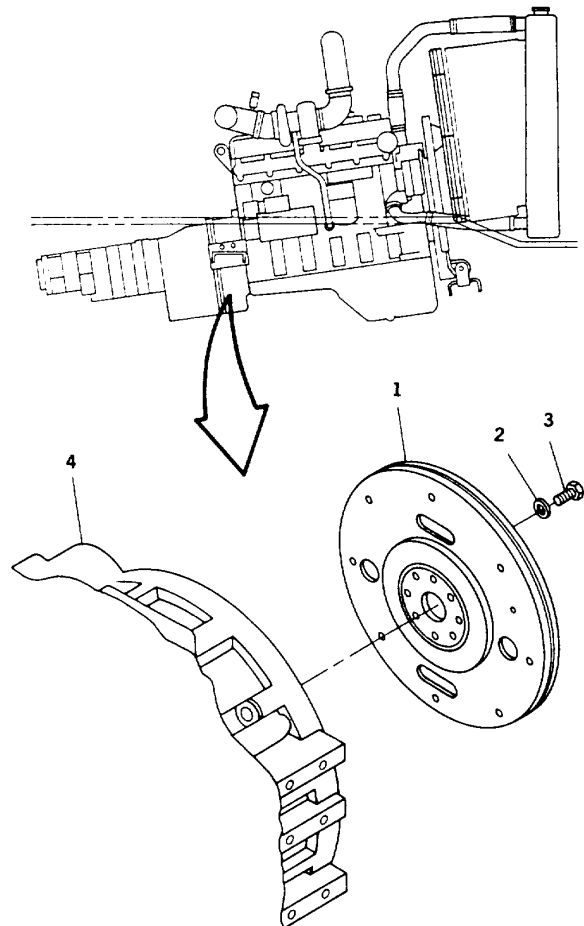
1. REMOVE FLYWHEEL (1).
 - a. Remove eight capscrews (3) and washers (2) from crankshaft.
 - b. Remove flywheel (1) from flywheel housing (4).

INSTALLATION:

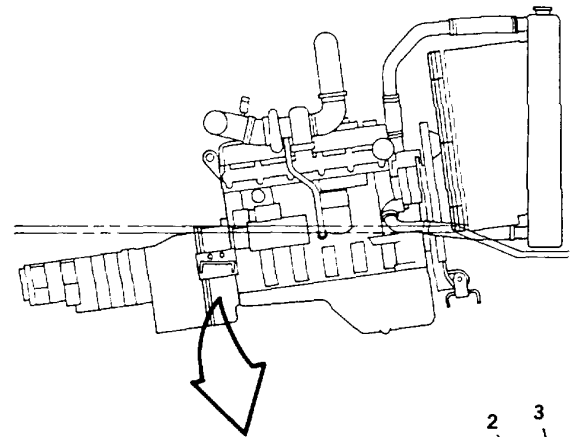
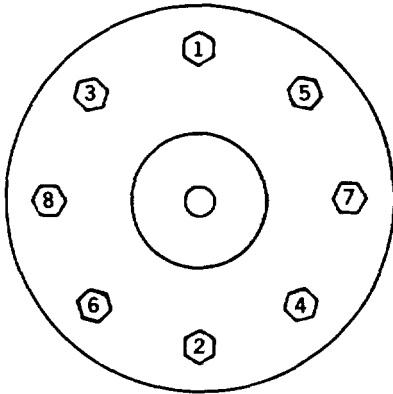
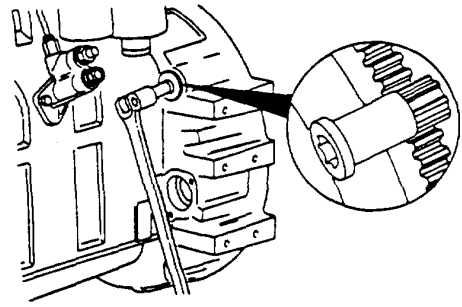
1. INSTALL FLYWHEEL (1).
 - a. Lubricate capscrews (3) and washers (2) with clean engine 4 oil.
 - b. Install flywheel (1), into flywheel housing (4), onto crankshaft with eight capscrews (3) and washers (2).

CAUTION

Do not use timing pin to lock engine.

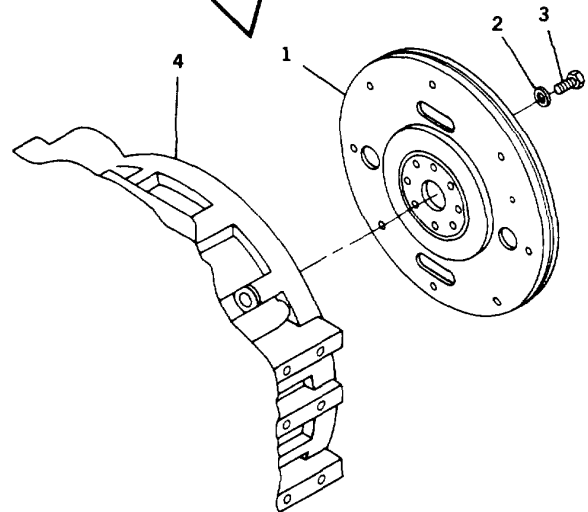


- c. Install engine barring tool TM 5-3810-306-34 through flywheel housing (4) and into flywheel (1).
- d. Hold flywheel (1) from turning with engine barring tool and J torque capscrews (3) in sequence shown to 101 ft-lbs (134 Nm).



- e. Remove engine barring tool from flywheel housing (4).

- 2. INSTALL TORQUE CONVERTER. (REFER TO PAGE 7-2.)
- 3. INSTALL REAR DECKING. (REFER TO TM 5-3810-306-20.)
- 4. INSTALL ENGINE HOOD. (REFER TO TM 5-3810-306-20.)
- 5. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)



END OF TASK

Section V. PISTONS AND CONNECTING RODS MAINTENANCE

PISTON AND CONNECTING ROD ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Ring compressor
 Engine barring tool (3377371)

SUPPLIES: Piston ring set (Item 5, Appendix B)
 Lubriplate 105 (Item 4, Appendix B)

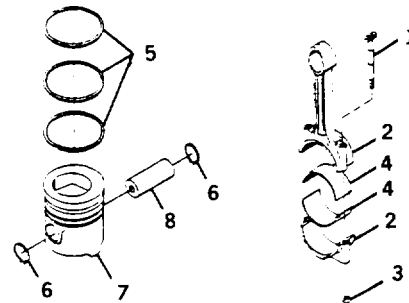
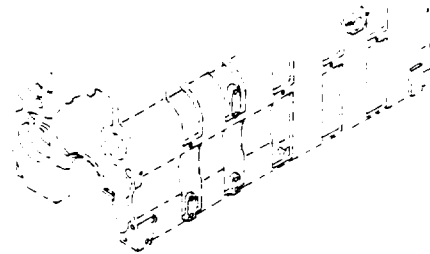
EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)
 Engine removed. (Refer to page 4-2.)
 Cylinder head removed. (Refer to page 4-8.)
 Oil pan and suction tube removed.
 (Refer to page 4-57.)

REMOVAL:

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (380-590C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

1. USE SCRAPER OR 240 GRIT EMERY CLOTH AND SOLVENT TO REMOVE CARBON BUILD UP AT TOP OF CYLINDERS.
2. USING NUMBER STAMPS, MARK EACH CYLINDER NUMBER ON EACH CONNECTING ROD CAP AND PISTON.
3. REMOVE TWELVE CONNECTING ROD NUTS (3).



NOTE

Only scrape or sand above piston travel area.

4. REMOVE ROD CAPS (2) AND SLEEVE BEARINGS (4).
 - a. Tap rod bolts (1) to loosen rod caps (2).

5. PUSH PISTONS (7) AND CONNECTING RODS (2) UP THROUGH CYLINDER BORE. SET ASSEMBLIES IN RACK.

WARNING

Take care not to damage cylinder bore or connecting rod.

DISASSEMBLY:

1. DISASSEMBLE PISTON (7).
 - a. Remove retaining rings (6).
 - b. Remove piston pin (8) and separate connecting rod (2) from piston (7).
 - c. Remove piston rings (5) from piston (7).

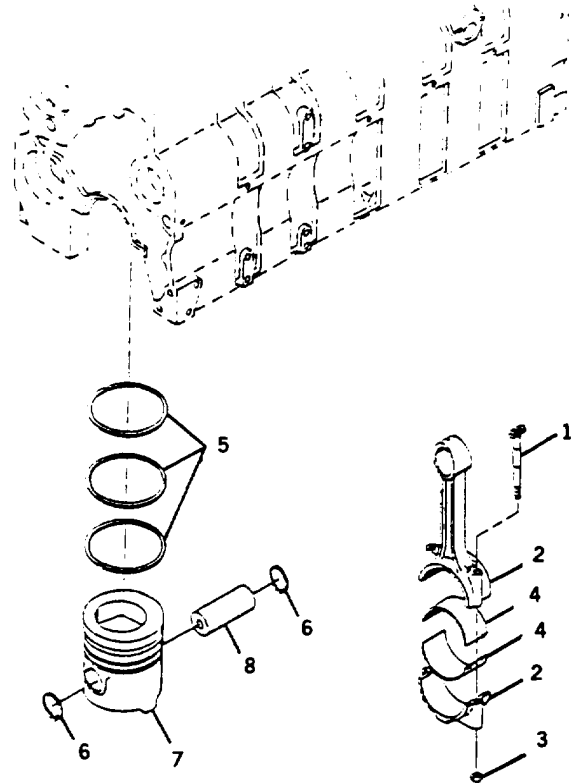
CLEANING:

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).



1. SOAK PISTONS OVERNIGHT TO LOOSEN CARBON DEPOSITS.

CAUTION

Do not use bead blast to clean pistons.

2. WASH PISTONS (7) AND RODS (2) IN STRONG SOLUTION OF LAUNDRY DETERGENT.

CAUTION

Do not clean components in an acid bath.

- 3. CLEAN REMAINING DEPOSITS FROM RING GROOVES WITH SQUARE END OF A BROKEN RING.

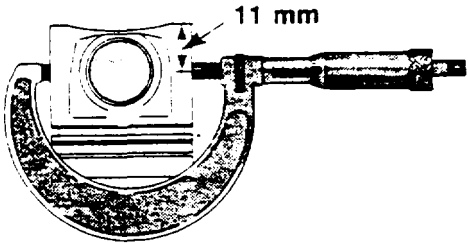
CAUTION

Do not use a ring groove cleaner. Ensure sealing surface in piston groove does not get scratched.

- 4. WASH PISTONS AGAIN IN DETERGENT SOLUTION AND BLOW DRY WITH COMPRESSED AIR.

INSPECTION:

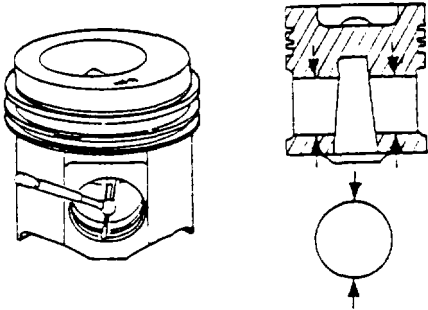
- 1. INSPECT PISTON, PISTON PIN AND CONNECTING ROD FOR DAMAGE AND EXCESSIVE WEAR. CHECK PISTON TOP, RING GROOVES, SKIRT AND PIN BORE.
- 2. MEASURE PISTON SKIRT DIAMETER AND RECORD.



Diameter = 4.4794 in. (113.776 mm)

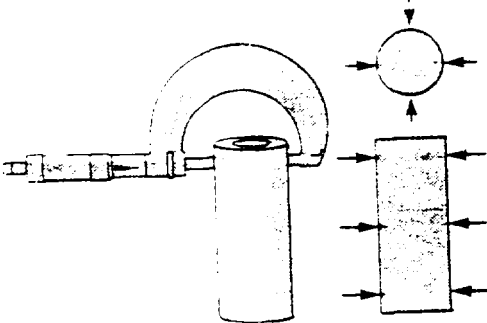
- 3. MEASURE RING TO GROOVE CLEARANCE.
 - a. Use a new piston ring inserted in appropriate groove to measure clearance.
 - Top = Use keystone gauge
 - Intermediate = .006 in. (.150 mm)
 - Oil control = .005 in. (.130 mm)

- 4. MEASURE PISTON BORE.



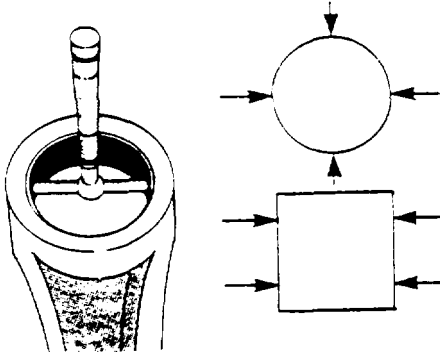
Max. dia. = 1.7726 in. (45.025 mm)

- 5. MEASURE PISTON PIN.



Min. dia. = 1.7712 in. (44.989 mm)

- 6. MEASURE CONNECTING ROD PIN BORE.



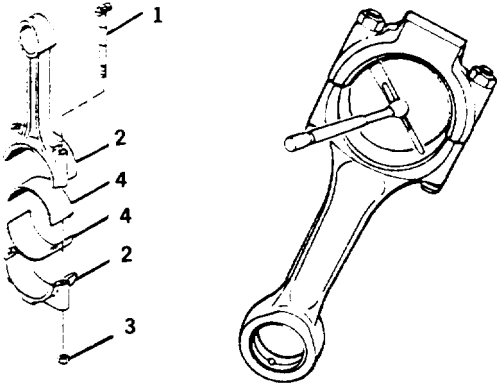
Max. dia. = 1.773 in. (45.035 mm)

7. DETERMINE ROD BEARING CLEARANCE.

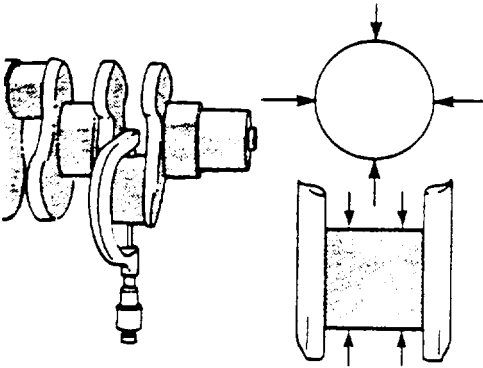
NOTE

Bearing clearance can also be determined using Plastigage during engine assembly.

- a. Install bearings (4) and rod caps (2). Install nuts (3) and tighten to 73 ft-lbs (99 Nm). Measure and record smallest diameter.



- b. Measure and record maximum diameter of appropriate rod journal on crankshaft.



Min. dia. = 2.9906 in. (75.962)
 Max. dia. = 2.9921 in. (76.000)
 Out-of-roundness = .002 in.
 (.050 mm)
 Tapers = .0005 in. (.013 mm)

- c. Bearing clearance = Rod inside diameter minus crankshaft journal diameter.

Clearance = .0035 in. (.009 mm)

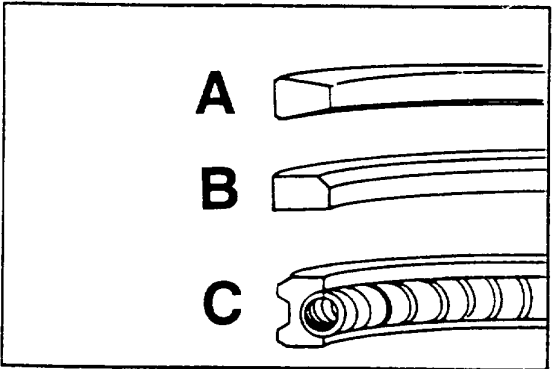
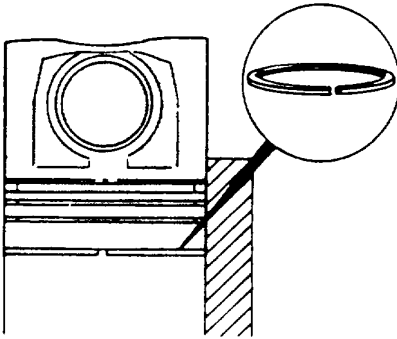
8. CHECK PISTON RING GAP.

- a. Determine proper ring set according to piston diameter measurement taken in step 2.

NOTE

Rings for a turbocharged engine are same as rings for a naturally aspirated engine.

- b. Position each ring in cylinder and use a piston to square it in bore 3.5 in. (89 mm) from top of block. Use feeler gauge to measure ring gap.



Top (A)

Max. = .0275 in. (.70 mm)
 Min. = .0157 in. (.40 mm)

Intermediate (B)

Max. = .0275 in. (.70 mm)
 Min. = .0157 in. (.40 mm)

Oil Control (C)

Max. = .0236 in. (.60 mm)
 Min. = .0118 in. (.30 mm)

NOTE

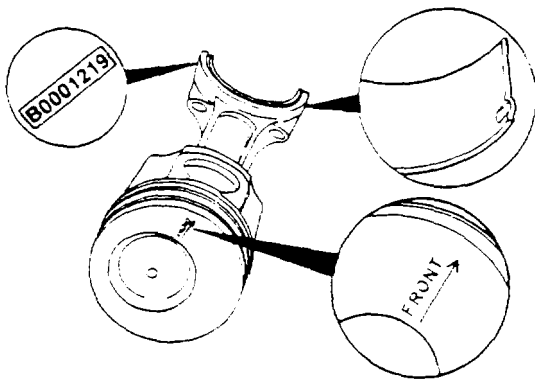
If ring gap exceeds maximum limit, cylinder liner is worn and must be replaced.

REASSEMBLY:

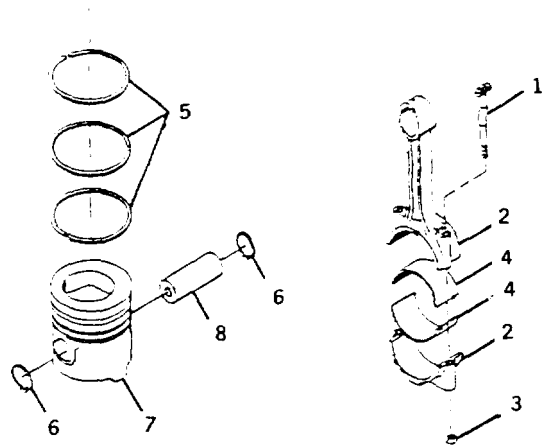
1. INSTALL PISTON (7) ON CONNECTING ROD (2).

CAUTION

Ensure "front" marking on piston and numbers on rod and cap are oriented as shown.



- a. Install retaining ring (6) in pin groove on "front" side of piston.
- b. Lubricate piston pin (8) and pin bores with clean engine oil. Position connecting rod (2) and install pin (8).
- c. Install second retaining ring (6).

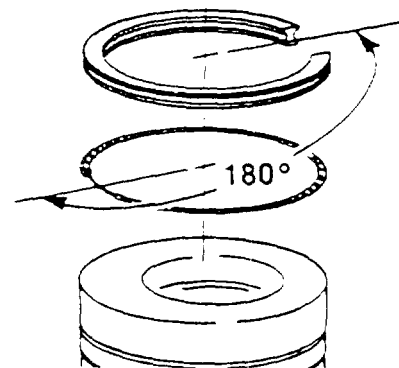


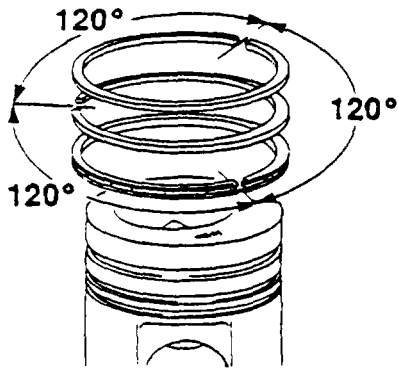
2. INSTALL PISTON RINGS (5).

NOTE

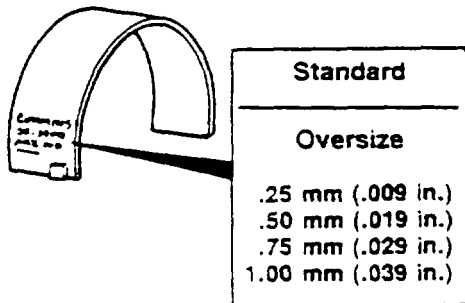
The top surface of all of the rings are identified: Assemble with the word "Top" or the supplier mark up.

- a. Install oil ring expander in oil control ring groove.



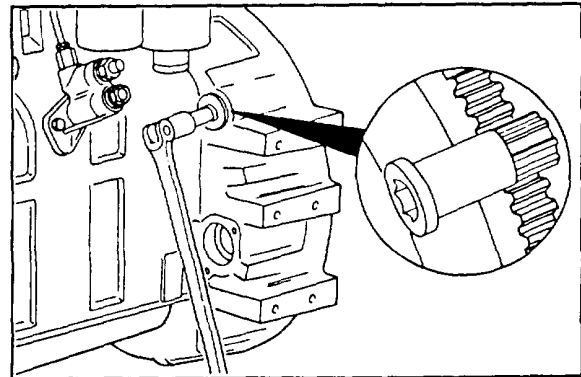


- b. Install oil control ring with end gap opposite end gap on oil ring expander.
 - c. Install intermediate ring.
 - d. Install top ring.
 - e. Position rings.
3. IF REMOVED, TAP CONNECTION ROD BOLTS (1) IN CONNECTING ROD (2) UNTIL HEAD IS SEATED ON FLAT OF ROD.
4. INSTALL ROD BEARINGS (4).
- a. Obtain a set of rod bearings same size as bearings removed which were measured and recorded previously.



- b. Install new bearings (4) in rods and caps (2) and lubricate with Lubriplate 105.
5. INSTALL PISTON AND ROD ASSEMBLIES.
- a. Lubricate cylinder bore, rings and piston skirt with clean engine oil.

- b. Compress rings with a suitable ring compressor, taking care not to damage rings.
- c. Using engine barring tool, bar crankshaft so rod journal for piston to be installed is at bottom dead center (BDC).



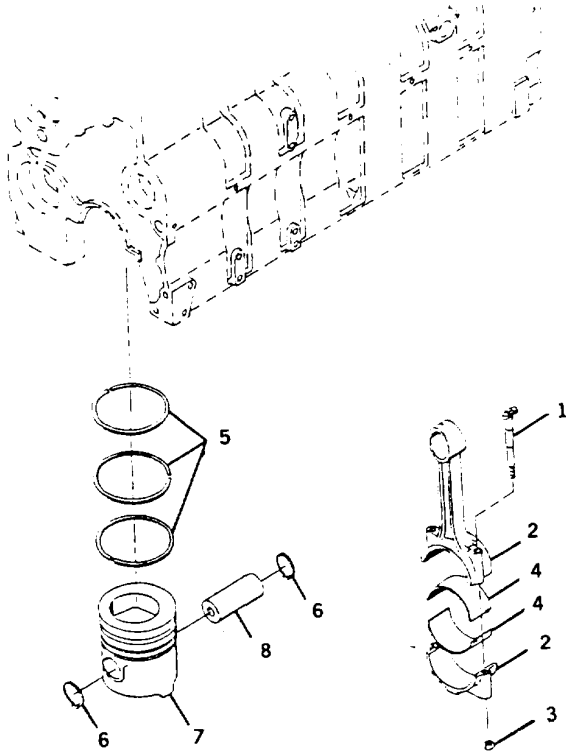
- d. Install piston and rod assembly into appropriate cylinder bore taking care not to damage cylinder bore.

CAUTION

The word "front" on top of piston must face front of engine.

- e. Push piston into bore approximately 2 in. (50 mm), then pull connecting rod onto crankshaft journal.
- f. Lubricate connecting rod capscrews with clean engine oil.
- g. Install rod caps (2) and start connecting rod nuts (3).

6. DETERMINE SIDE CLEARANCE BETWEEN CONNECTING ROD AND CRANKSHAFT.



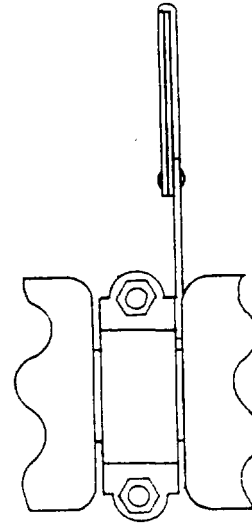
CAUTION

Number stamped on rod and cap at parting line must match and be installed towards camshaft side of engine.

- h. Alternately tighten rod nuts (3) to pull rod cap (2) into position.

- i. Torque rod nuts using the following steps:

- Step 1 = 30 ft-lbs (40 Nm)
- Step 2 = 60 ft-lbs (80 Nm)
- Step 3 = 88 ft-lbs (120 Nm)



Limit .004 - .012 in. (.1 to .3 mm)

NOTE

Throughout piston and connecting rod reassembly check for freedom of rotation of the crankshaft. If crankshaft does not move freely recheck bearing size and installation.

- 7. INSTALL SUCTION TUBE AND OIL PAN. (REFER TO PAGE 4-57.)
- 8. INSTALL CYLINDER HEAD. (REFER TO PAGE 4-8.)
- 9. INSTALL ENGINE. (REFER TO PAGE 4-2.)
- 10. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

END OF TASK

Section VI. VALVES AND CAMSHAFT MAINTENANCE

CAMSHAFT AND TAPPET INSTALLATION

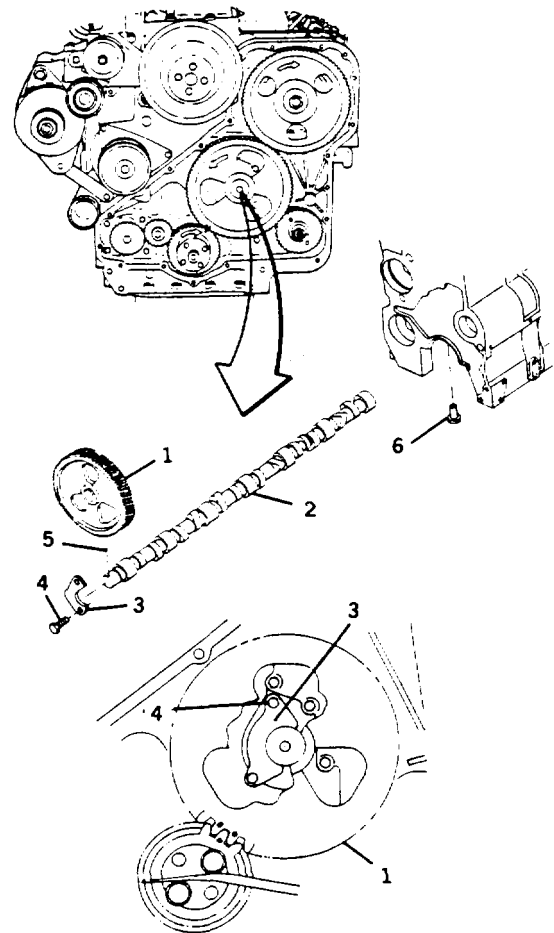
TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: 1/2 in. x 18 in. Wooden dowel rods (Item 104, Appendix C)
 (12 Required)
 Lubriplate 105 (Item 102, Appendix C)
 Rubber bands (Item 103, Appendix C)

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)
 Engine removed. (Refer to page 4-2.)
 Valve cover removed. (Refer to TM 5-3810-306-20.)
 Rocker levers and push rods removed.
 (Refer to page 4-53.)
 Oil pan removed. (Refer to page 4-57.)
 Fuel Injection pump removed. (Refer to page 5-4.)
 Front gear cover removed. (Refer to page 4-45.)

REMOVAL:

1. POSITION TAPPETS (6) AWAY FROM CAMSHAFT (2).
 - a. Cut a slot in each dowel rod .75 in. (19 mm) deep using a hacksaw.
 - b. Insert dowels through push rod holes and into top of each tappet securely. When properly installed, dowels can be used to pull tappets up and should not be able to be pulled out without considerable effort.
 - c. Pull tappets (6) up and wrap a rubber band around top of dowel rods. This will prevent tappets from dropping down.
2. REMOVE CAMSHAFT (2).
 - a. Rotate engine to align crankshaft to camshaft timing marks.



- b. Remove capscrews (4) securing thrust plate (3). Remove thrust plate (3).
 - c. Carefully remove camshaft (2) from engine.
 - d. Remove gear (1) and pin (5) from camshaft using suitable puller.
3. REMOVE TAPPETS (6).
- a. Rotate crankshaft to allow access to tappets (6).

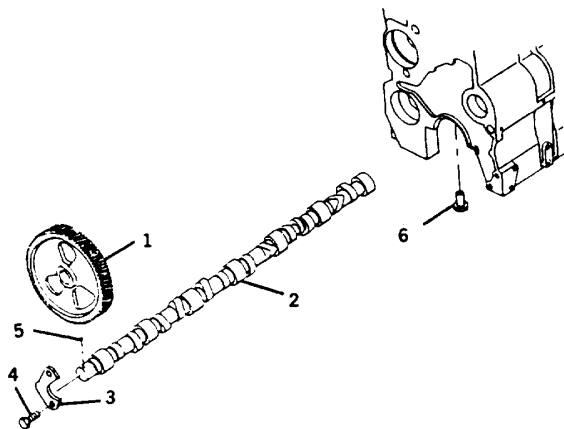
NOTE

Only four tappets will be accessible at one time. Crankshaft must be rotated three times to access all tappets.

- b. Remove rubber bands from dowels securing only accessible tappets. Remove tappets (6) from block and dowel from tappet.

CAUTION

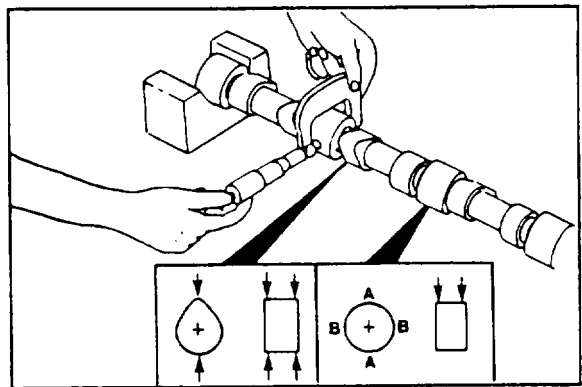
When reusing camshaft (2) and tappets (6), tappets must be matched to their companion lobe on camshaft to prevent accelerated camshaft wear.



- c. Repeat steps a and b for remaining tappets.

INSPECTION:

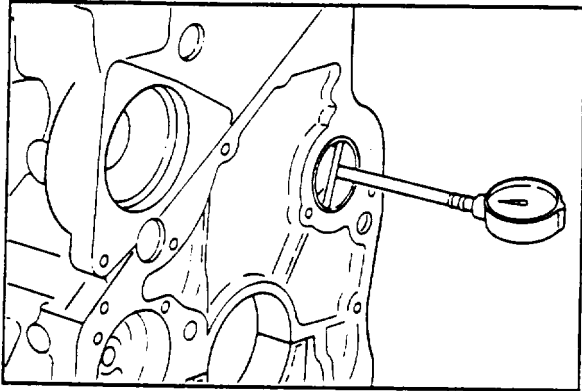
1. INSPECT THE FUEL PUMP LOBE, VALVE LOBES AND BEARING JOURNALS FOR WEAR, CRACKING, PITTING AND OTHER DAMAGE.
2. INSPECT GEAR (1) TEETH FOR WEAR AND DAMAGE. LOOK FOR CRACKS AT ROOT OF TEETH.
3. MEASURE BEARING JOURNALS AND VALVE LOBES.
 - a. Bearing journal
Min. dia. = 2.3607 in.
(59.962 mm)
 - b. Valve lobes
(Min. dia. at peak of lobe)
Intake min. height = 2.0383 in.
(51.774 mm)
Exhaust min. height = 2.0313 in.
(51.596 mm)
 - c. Fuel pump lobe
Min. dia. = 1.626 in. (41.31 mm)



4. INSPECT CAMSHAFT BORES FOR DAMAGE OR EXCESSIVE WEAR.

NOTE

Only four tappets will be accessible at one time. Crankshaft must be rotated three times to access all tappets.



5. MEASURE CAMSHAFT BUSHING BORE.

Max. dia. = 2.367 in. (60.122 mm)

NOTE

If bushings are worn beyond the specified limit, replacement is necessary.

6. INSPECT TAPPET SOCKET, STEM AND FACE FOR EXCESSIVE WEAR, CRACKS AND OTHER DAMAGE.

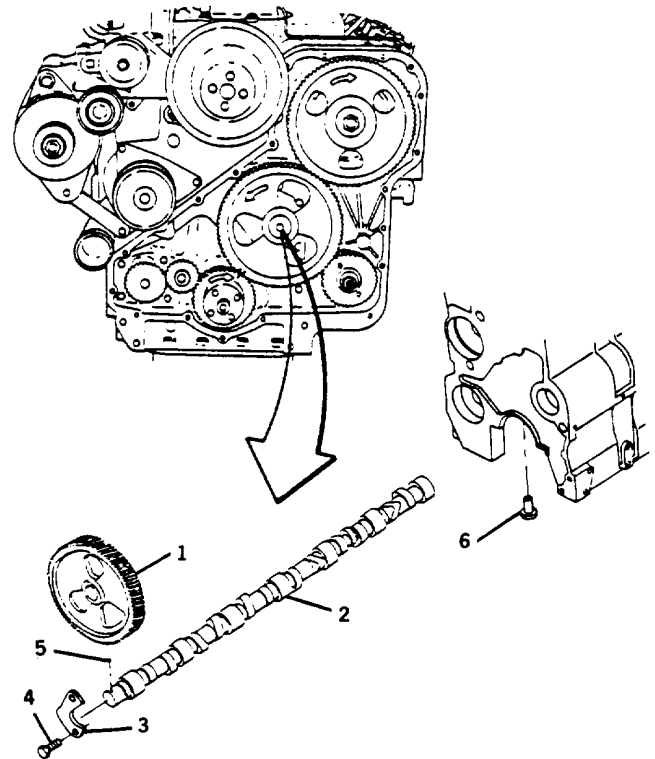
7. MEASURE TAPPET STEM.

Min. dia. = .628 in. (15.9 mm)

INSTALLATION:

1. INSTALL TAPPETS (6).

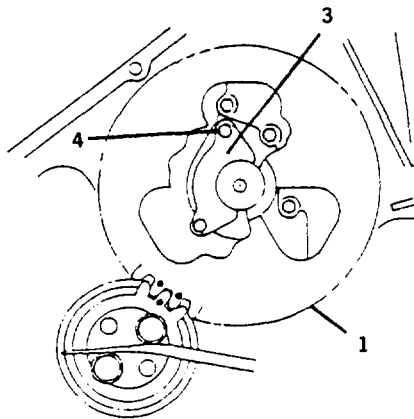
- a. Insert wooden dowels used during removal into tappets.
- b. Lubricate tappets with Lubriplate 105.
- c. Insert dowel and tappet into push rod hole until tappet is seated. Secure wooden dowel with rubber bands.



2. INSTALL CAMSHAFT (2).

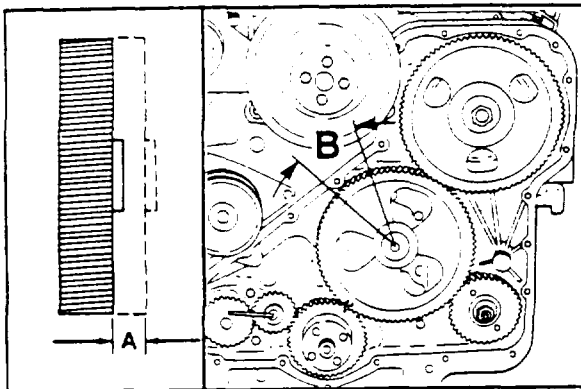
- a. Install dowel pin (5) and gear (1) on camshaft (2).
- b. Lubricate camshaft lobes, journals and thrust washer with Lubriplate 105.

- c. Install camshaft (2) and thrust washer (3). Align timing marks.



- d. Install thrust washer cap screws (4) and tighten to 18 ft-lbs (24 Nm)

3. CHECK CAMSHAFT BACK LASH AND END PLAY.



- a. End play (A) = .006 - .010 in.
(.152 - .254 mm)
- b. Backlash (B) = .005 - .013 in.
(.12 - .33 mm)

4. REMOVE DOWELS FROM TAPPETS (6).
5. INSTALL PUSH RODS AND ROCKER LEVERS. (REFER TO PAGE 4-53.)
6. INSTALL OIL PAN. (REFER TO PAGE 4-57.)
7. INSTALL FRONT COVER. (REFER TO PAGE 4-45.)
8. INSTALL FUEL INJECTION PUMP. (REFER TO PAGE 5-4.)
9. INSTALL ENGINE. (REFER TO PAGE 4-2.)
10. INSTALL RADIATOR. (REFER TO TM 5-3810-306-20.)
11. INSTALL ENGINE HOOD. (REFER TO TM 5-3810-306-20.)
12. SERVICE ENGINE FLUID LEVELS. (REFER TO LO 5-3810-306-12.)
13. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
14. TEST FOR PROPER OPERATIONS. INSPECT FOR LEAKS AND LOOSE PARTS. (REFER TO TM 5-3810-306-10.)

END OF TASK

FRONT GEAR COVER INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Loctite 277 (Item 164, Appendix B)
 Gasket (Item 165, Appendix B)
 Copper coat gasket sealer (Item 32, Appendix B)

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)
 Radiator fan and fan guard removed.
 (Refer to TM 5-3810-306-20.)
 Radiator shroud removed. (Refer to TM 5-3810-306-20.)
 Tachometer angle drive removed. (Refer to page 4-56.)

REMOVAL:

1. REMOVE VIBRATION DAMPER (1).
 - a. Remove four capscrews (2) securing damper to crankshaft. Do not allow crankshaft to turn.
 - b. Remove vibration damper (1).
2. REMOVE FRONT GEAR COVER.

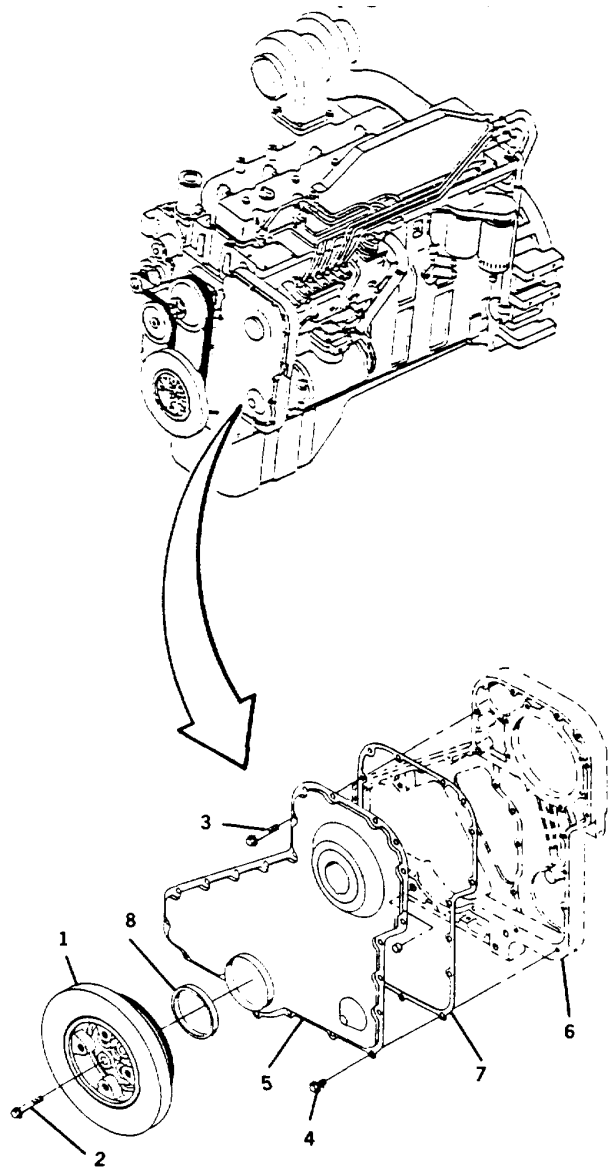
NOTE

Front cover does not have to be removed in order to change front seal. Proceed to Step C to remove front seal (8) only.

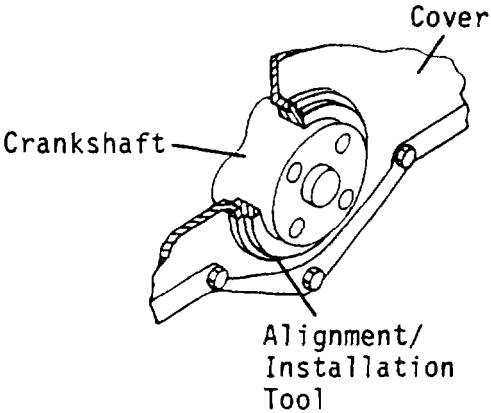
- a. Remove capscrews (3) and (4) securing cover (5) to gear cover housing (6).
- b. Remove cover (5) and gasket (7). Discard gasket (7).
- c. Remove front crankshaft seal (8) from front cover, if necessary.

INSTALLATION:

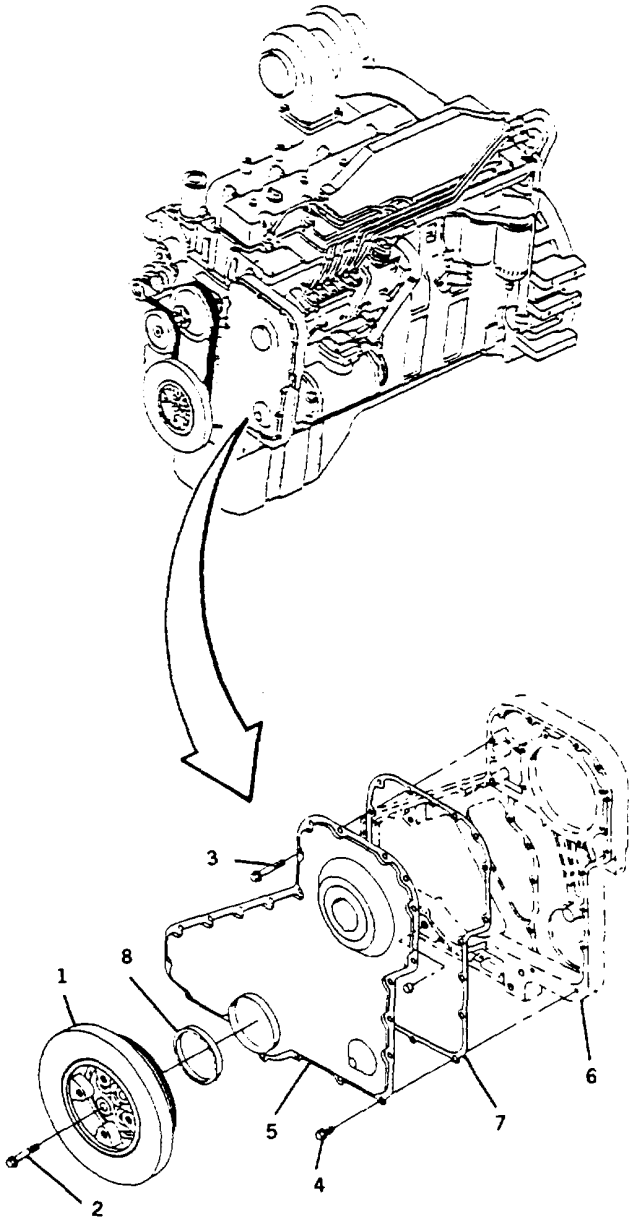
1. CLEAN ANY GASKET MATERIAL OFF OF COVER (5) AND HOUSING (6) MATING SURFACES.



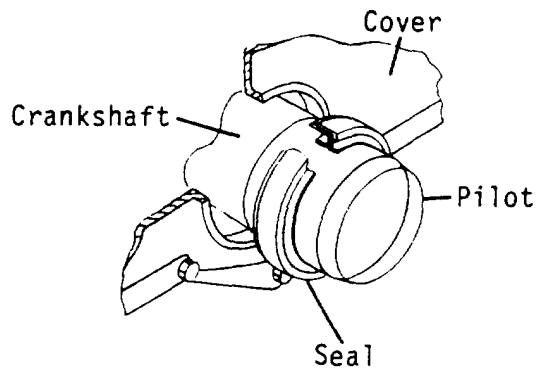
- 2. APPLY COPPER COAT TO BOTH SIDES OF GASKET (7).
- 3. INSTALL FRONT GEAR COVER (5).
 - a. Install new gasket (7) and cover (5). Secure loosely with capscrews (3) and (4).
 - b. Clean crankshaft sealing surface and install alignment/installation tool from seal kit to align front cover (5) to crankshaft.



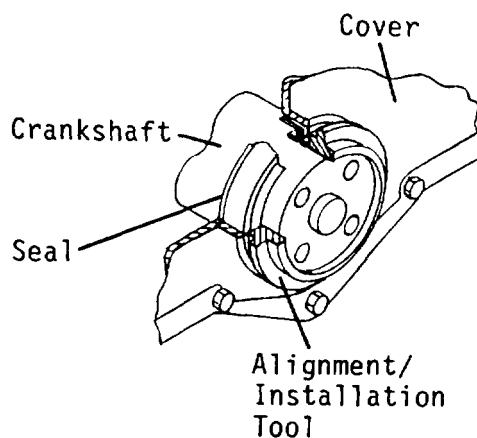
- c. Torque capscrews (3) and (4) to 18 ft-lbs (24 Nm).
 - d. Remove alignment/installation tool.
- 4. IF REMOVED, INSTALL FRONT CRANKSHAFT SEAL (8).
 - a. Apply a coat of Loctite 277 to outside diameter of crankshaft seal.



- b. Install pilot from seal kit over crankshaft and slide on crankshaft seal over pilot. Remove pilot.



- c. Using alignment/installation tool, tap seal until outer edge is even with cover. Remove alignment/installation tool.



- d. Connect tagged electrical connector to pulse tachometer.

5. INSTALL VIBRATION DAMPER (1) AND SECURE WITH FOUR CAPSCREWS (2).
6. INSTALL TACHOMETER ANGLE DRIVE. (REFER TO PAGE 4-56.)
7. INSTALL DRIVE BELT, RADIATOR FAN AND FAN GUARD. (REFER TO TM 5-3810-306-20.)
8. INSTALL RADIATOR SHROUD. (REFER TO TM 5-3810-306-20.)
9. INSTALL ENGINE HOOD ASSEMBLY. (REFER TO TM 5-3810-306-20.)
10. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
11. TEST FOR PROPER OPERATION AND INSPECT FOR LEAKS. (REFER TO TM 5-3810-306-10.)

END OF TASK

FRONT GEAR HOUSING INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Gasket (Item 225, Appendix B)

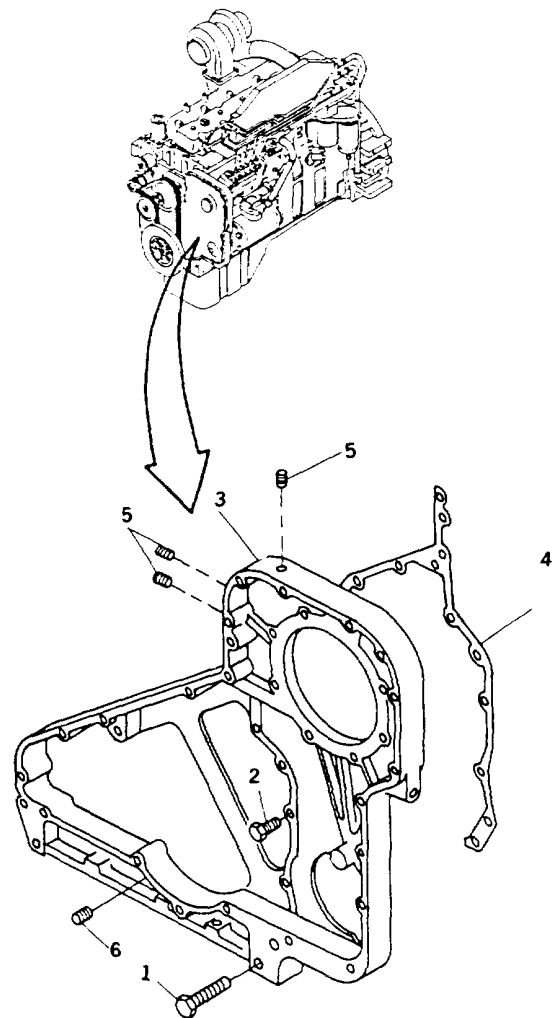
EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)
 Engine removed. (Refer to page 4-2.)
 Front gear cover removed. (Refer to page 4-45.)
 Fuel Injector pump removed. (Refer to page 5-4.)
 Cam shaft removed. (Refer to page 4-41.)
 Oil pump removed. (Refer to page 4-59.)
 Oil pan removed. (Refer to page 4-57.)

REMOVAL:

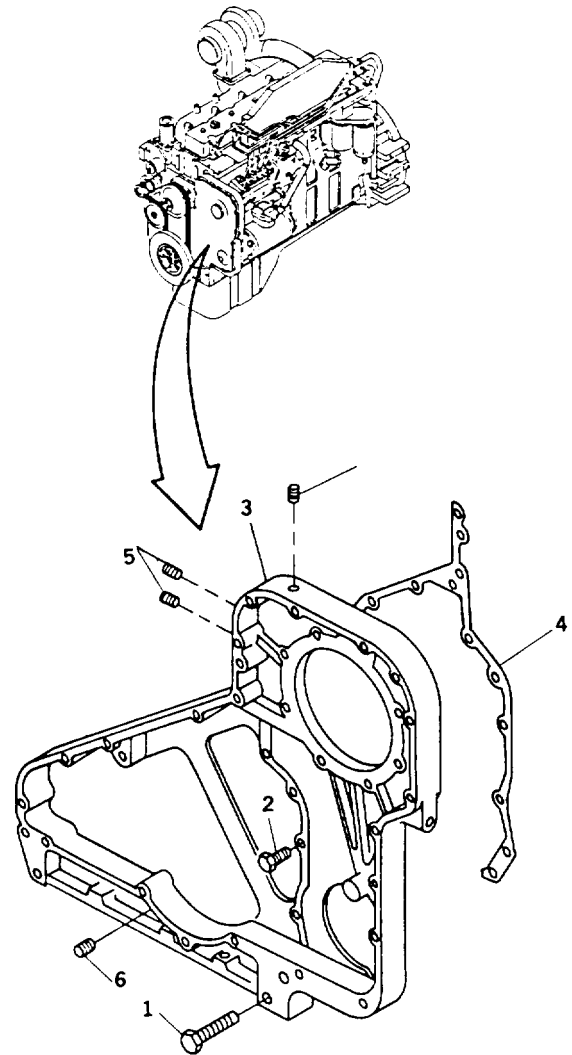
1. REMOVE FRONT GEAR HOUSING (3).
 - a. Remove capscrews (1) and (2).
 - b. Remove front gear housing (3) from cylinder block.
2. REMOVE AND DISCARD GASKET (4) FROM CYLINDER BLOCK.
3. IF NECESSARY, REMOVE PLUGS (5) AND (6) FROM GEAR HOUSING (3).
4. IF FRONT GEAR HOUSING IS BEING REPLACED, REMOVE TIMING PIN ASSEMBLY (13). (REFER TO PAGE 4-50.)

INSTALLATION:

1. IF REMOVED, INSTALL PLUGS (5) AND (6) IN GEAR HOUSING (3).
2. INSTALL FRONT GEAR HOUSING (3).
 - a. Install new gasket (4), front gear housing (3) and capscrews (1) and (2). Torque capscrews (1) and (2) to 18 ft-lbs (24 Nm).
 - b. Trim gasket (4) flush with oil pan rail.



3. INSTALL OIL PUMP. (REFER TO PAGE 4-59.)
4. INSTALL OIL PAN. (REFER TO PAGE 4-57.)
5. INSTALL CAMSHAFT. (REFER TO PAGE 4-41.)
6. IF REMOVED, INSTALL TIMING PIN ASSEMBLY (13). (REFER TO PAGE 4-50.)
7. INSTALL FUEL INJECTOR PUMP. (REFER TO PAGE 5-4.)
8. INSTALL FRONT GEAR COVER. (REFER TO PAGE 4-45.)
9. INSTALL ENGINE. (REFER TO PAGE 4-2.)
10. INSTALL RADIATOR. (REFER TO TM 53810-306-20.)
11. INSTALL ENGINE HOOD. (REFER TO TM 5-3810-306-20.)
12. SERVICE ENGINE FLUID LEVELS. (REFER TO LO 5-3810-306-12.)
13. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
14. TEST FOR PROPER OPERATION. INSPECT FOR LEAKS AND LOOSE PARTS. (REFER TO TM 5-3810-306-10.)



END OF TASK

TIMING PIN ASSEMBLY INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Cylinder liner clamp (3376944) 2 required

SUPPLIES: Gasket (Item 223, Appendix B)
 Preformed packing (Item 224, Appendix B)

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE TORX SCREWS (1) AND TIMING PIN ASSEMBLY (2) FROM FRONT GEAR HOUSING.
2. REMOVE AND DISCARD GASKET (3).

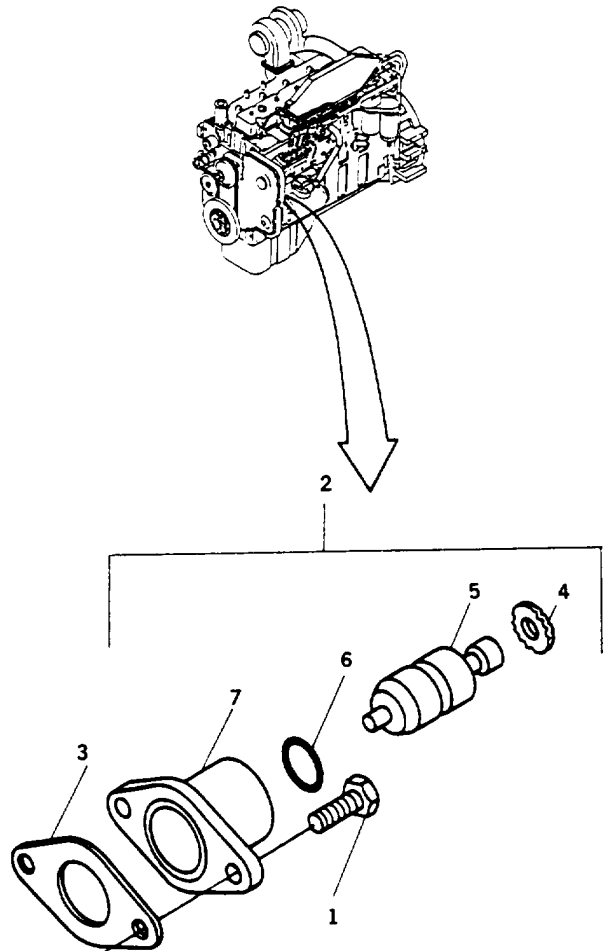
DISASSEMBLY:

1. REMOVE RETAINING RING (4) FROM TIMING PIN ASSEMBLY (2).
2. REMOVE TIMING PIN (5) AND PREFORMED PACKING (6) FROM HOUSING (7). DISCARD PACKING (6).

ASSEMBLY:

1. INSTALL NEW PREFORMED PACKING (6) ON TIMING PIN (5).
2. INSERT TIMING PIN (5) AND PREFORMED PACKING (6) INTO HOUSING (7).
3. INSTALL RETAINING RING (4) SECURING TIMING PIN ASSEMBLY (2) TOGETHER.

INSTALLATION:

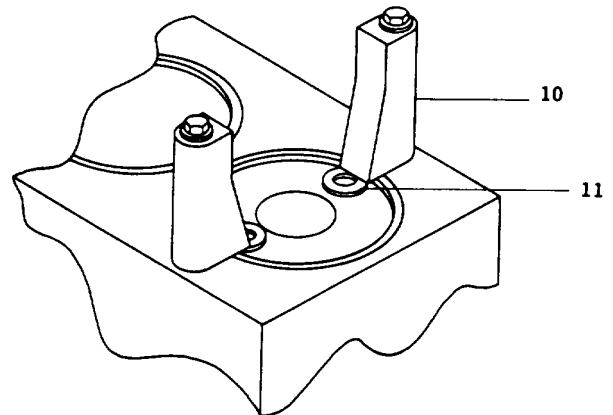
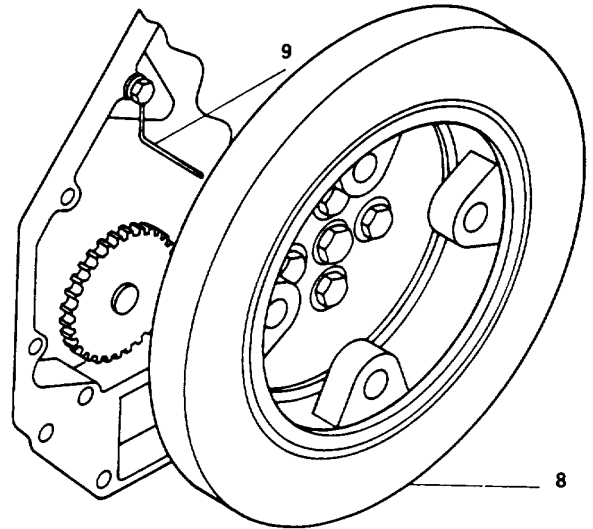


NOTE

The timing pin assembly (2) must be relocated if front gear housing has been replaced. Perform Step 1 before cylinder head and front gear cover are installed. Otherwise proceed to Step 2.

1. RELOCATE TIMING PIN ASSEMBLY (2).

- a. Temporarily install vibration damper (8) on end of crankshaft, and a fabricated wire pointer (9) on front gear housing. Put a flat washer between wire and gear housing to prevent damage to gear housing.
- b. Assemble two liner clamps (10) or equivalent, over No. 1 cylinder bore. Torque clamps to 50 ft-lbs (68 Nm).
- c. Position two flat washers (11) on the piston so they will contact the liner clamps (10).
- d. Rotate crankshaft until washers (11) on piston contact liner clamps (10). Mark vibration damper (8) as indicated by pointer (9).
- e. Rotate crankshaft in opposite direction until washers (11) contact liner clamps (10) again. Mark vibration damper (8) as indicated by pointer (9).
- f. Using a steel rule, measure and mark vibration damper (8) one-half the distance between the first two marks. This mark indicates TDC of the No. 1 cylinder.
- g. Remove clamps (10) and washers (11) and rotate crankshaft until the pointer aligns with the TDC mark.

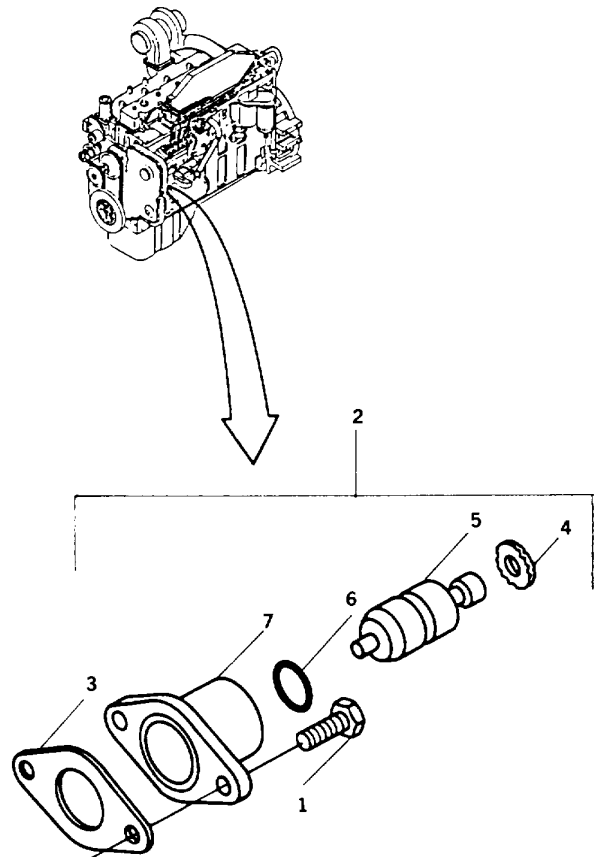


- h. Look for timing pin hole in camshaft gear by looking through timing pin assembly hole in front gear cover. If it is not visible, rotate the crankshaft one complete turn.
- i. Remove wire pointer (9) and vibration damper (8).

2. INSTALL TIMING PIN ASSEMBLY (2).

- a. Install new gasket (3), timing pin assembly (2) and torx screws (1). Do not tighten screws.
- b. Push pin (5) into hole in cam gear to align housing (7).
- c. Hold pin (5) in and torque torx screws (1) to 4 ft-lbs (5 Nm).

3. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (Refer to TM 5-3810-306-20.)



END OF TASK

ROCKER LEVER INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Clean motor oil (Item 11, Appendix B)
 Loctite 601 (Item 12, Appendix B)

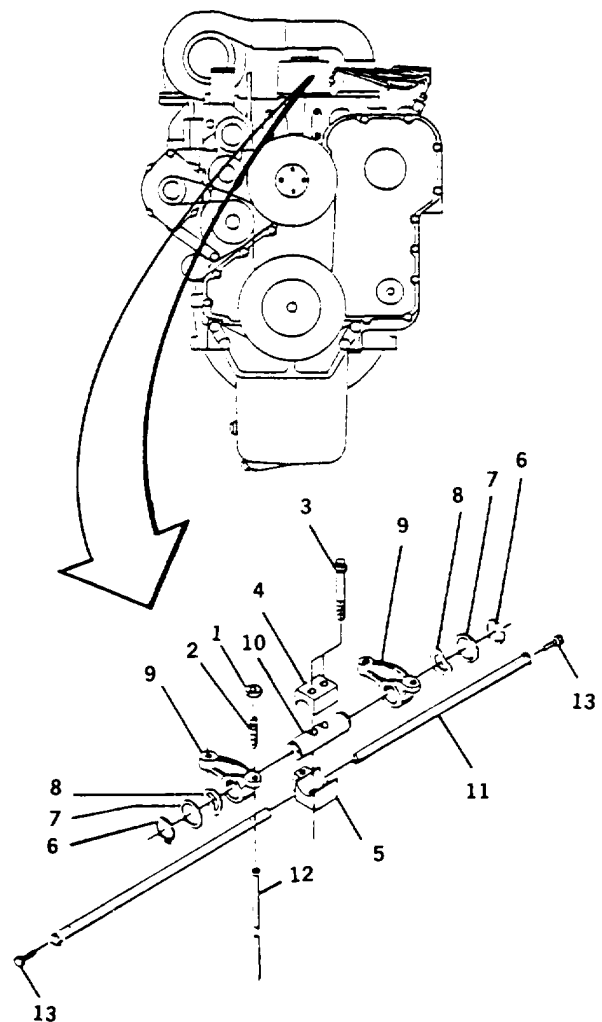
EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)
 Engine hood assembly removed.
 (Refer to TM 5-3810-306-20.)
 Engine cool to touch.
 Valve cover removed. (Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE ROCKER LEVER ASSEMBLY.
 - a. Loosen locknuts (1) and loosen adjusting screws (2) until they stop.
 - b. Remove twelve capscrews (3) rocker lever clamps (4), rocker lever assemblies and rocker lever support (5).
 - c. Remove oil transfer tube (11).
 - d. Remove push rods (12).

DISASSEMBLY:

1. DISASSEMBLE ROCKER LEVER ASSEMBLY.
 - a. Remove retaining rings (6), thrust washers (7), wave washers (8) and rocker levers (9) from rocker shaft (10).
 - b. Remove locknut (1) and adjusting screw (2) from rocker levers (9).
2. REMOVE SCREWS (13) FROM OIL TRANSFER TUBE (11) ENDS.



NOTE

The two self tapping screws (13) in each end of oil transfer tube (11) are not interchangeable. Note which end they are removed from for reassembly.

CLEANING:

- a. Clean all parts in a strong solution of laundry detergent in hot water.

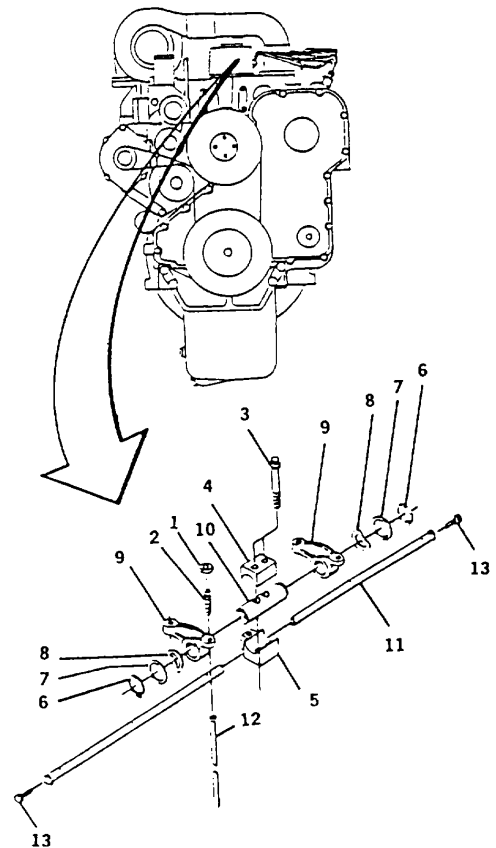
WARNING

Use only clean low pressure compressed air. If available, allow parts to air dry or wipe with clean lint-free cloth.

- b. Use compressed air to dry the parts after rinsing in clean hot water.

INSPECTION:

1. INSPECT ROCKER LEVER COMPONENTS.
 - a. Inspect rocker lever for cracks and excessive wear in bore and contact surfaces.
 - b. Measure rocker lever bore.
Max. dia. .878 in. (22.301 mm)
 - c. Measure rocker lever shaft diameter.
Min. dia. .874 in. (22.199 mm)
 - d. Inspect pushrod ball and socket for signs of scoring. Inspect for cracks where the ball and socket are pressed into the tube.
 - e. Inspect oil transfer tube for cracks and debris.



REASSEMBLY:

1. ASSEMBLE ROCKER LEVER ASSEMBLY.
 - a. Screw adjusting screw (2) into rocker lever and locknut (1) onto adjusting screw.
 - b. Place retaining ring (6), thrust washer (7) and wave washer (8) on one side of rocker shaft (10).
 - c. Lubricate shaft with motor oil.
 - d. Position levers on rocker shaft.
 - e. Install remaining washers and retaining clips on rocker shaft.
 - f. Compress wave washers and thrust washers and install rocker lever support (5).

2. INSTALL SCREWS (13) IN OIL TRANSFER TUBE (11).

- a. Apply Loctite 601 to threads of screws (13).
- b. Install screws (13) in proper ends of oil transfer tube (11) and tighten until flats of screws align with bottom of oil transfer tube.

INSTALLATION:

- 1. INSTALL OIL TRANSFER TUBE (11).
- 2. INSTALL PUSH RODS (12).
- 3. INSTALL ROCKER LEVER ASSEMBLY.

- a. Ensure adjusting screws (2) are completely backed out.
- b. Install rocker lever assembly over oil transfer tube.

NOTE

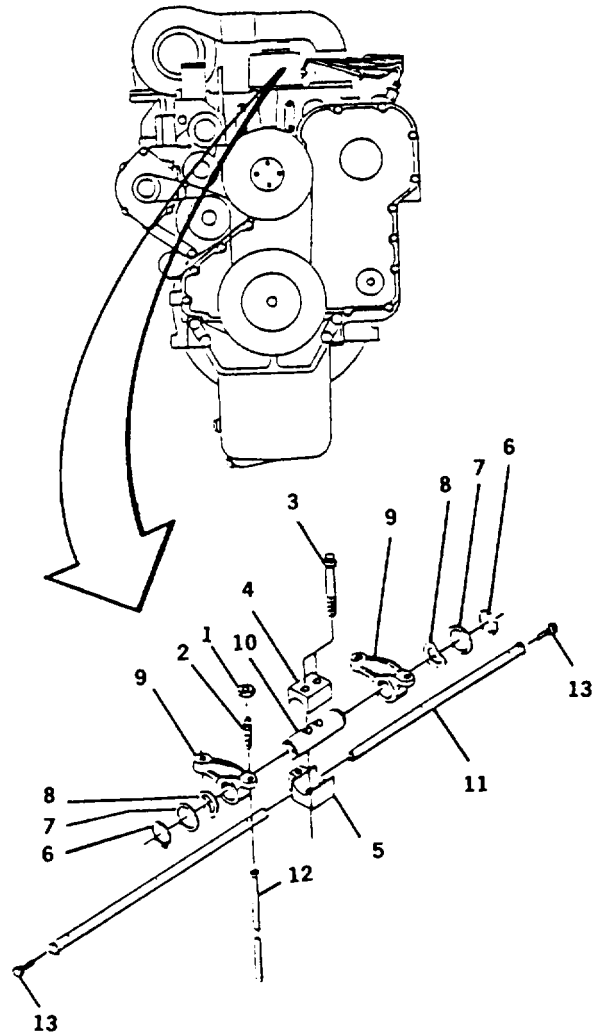
Make sure dowel rings in rocker lever support (5) are installed into the dowel bores.

- c. Lubricate capscrew (3) threads with clean motor oil.
- d. Install rocker lever clamps (4) and secure with capscrews (3).

NOTE

To prevent damage to rocker lever or push rod make sure adjusting screw ball is positioned in the socket of push rod when tightening.

- e. Torque capscrews to 32 ft-lbs (43 Nm).



- 4. ADJUST VALVES. (REFER TO TM 5-3810306-20.)
- 5. INSTALL VALVE COVER. (REFER TO TM 5-3810-306-20.)
- 6. INSTALL ENGINE HOOD. (REFER TO TM 5-3810-306-20.)
- 7. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

END OF TASK

TACHOMETER ANGLE DRIVE ADAPTER

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Gasket (Item 213, Appendix B)
Gasket (Item 214, Appendix B)

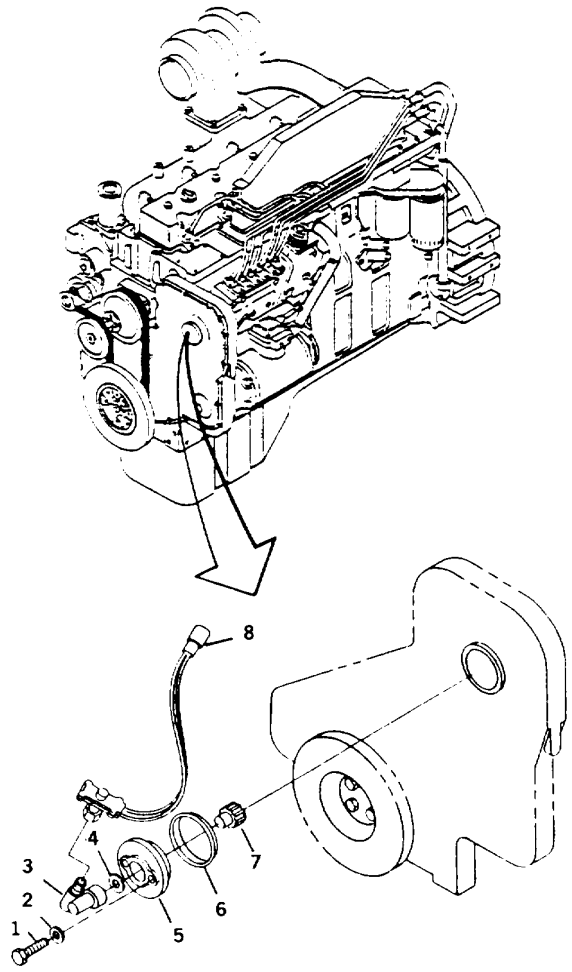
EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
(Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE FRONT GEAR TRAIN.
 - a. Note or mark position of angle drive adapter (3).
 - b. Tag and disconnect electrical lead (8).
 - c. Remove two capscrews (1) and washers (2).
 - d. Remove angle drive adapter (3) and gasket (4). Discard gasket (4).
 - e. Remove cover (5) and gasket (6). Discard gasket (6).
 - f. Remove coupling hub (7).
2. INSPECT ALL PARTS FOR DAMAGE. REPLACE PARTS AS REQUIRED.

INSTALLATION:

1. INSTALL FRONT GEAR TRAIN.
 - a. Attach coupling hub (7) to engine.
 - b. Install cover (5) and new gasket (6).
 - c. Install angle drive adapter (3) and new gasket (4).
 - d. Clamp angle drive adapter (3) in position noted or marked and



secure with capscrews (1) and washers (2).

2. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

Section VII. ENGINE LUBRICATION SYSTEM MAINTENANCE

OIL PAN AND SUCTION TUBE INSTALLATION

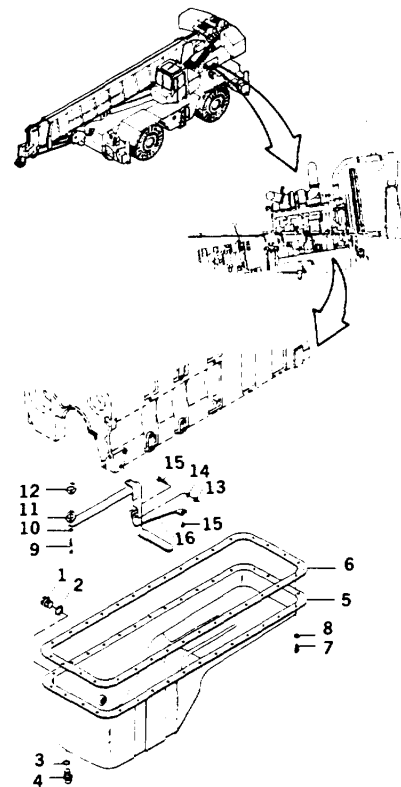
TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Clean rags (Item 2, Appendix B)
 Copper coat (Item 32, Appendix B)
 No. 2 Permatex (Item 31, Appendix B)
 Washer, flat sealing (Item 29, Appendix B)
 Washer, flat sealing (Item 30, Appendix B)
 Gasket (Item 226, Appendix B)
 Gasket (Item 227, Appendix B)

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)
 Outriggers set and boom positioned over-the-side.
 (Refer to TM 5-3810-306-10.)
 Lube oil drained from engine. (Refer to LO 5-3810-306-12.)
 Engine removed. (Refer to page 4-2.)

REMOVAL:

1. REMOVE OIL PAN (5).
 - a. Support oil pan (5) and remove bolts (7) and washers (8).
 - b. Remove oil pan (5) and gasket (6). Discard gasket (6).
2. REMOVE PLUGS (1) AND (4) AND SEALS (2) AND (3). DISCARD SEALS (2) AND (3).
3. REMOVE SUCTION TUBE (11) AND GASKET (12).
 - a. Remove two capscrews (9) and washers (10) securing suction tube (11).
 - b. Remove nut (13), washer (14) and capscrew (15) securing suction tube (11) to brace (16).
 - c. Remove suction tube (11) and gasket (12). Discard gasket (12).



4. INSPECT ALL PARTS FOR DAMAGE. REPLACE PARTS AS REQUIRED.

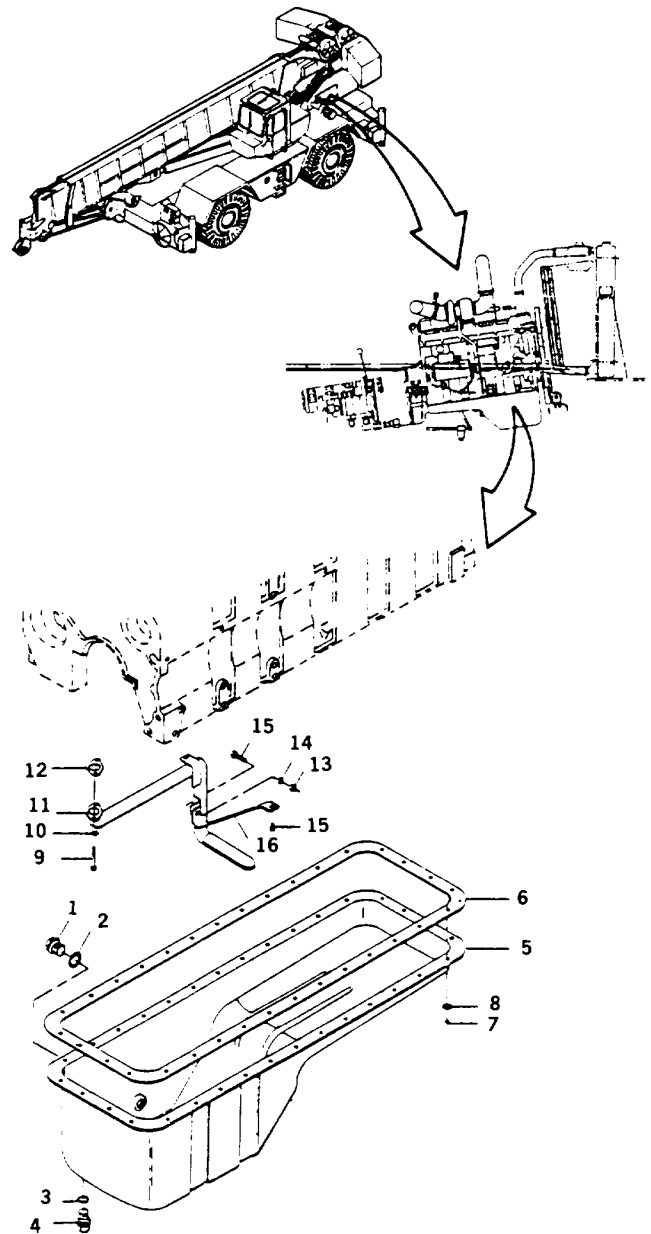
INSTALLATION:

1. CLEAN GASKET MOUNTING SURFACE ON OIL PAN (3) AND BLOCK.
2. INSTALL SUCTION TUBE (11) AND GASKET (12).
 - a. Position suction tube (11) and new gasket (12). Secure with two capscrews (9) and washers (10).
 - b. Secure suction tube (11) to brace (16) with capscrew (15), washer (14) and nut (13).
3. COAT BOTH SIDES OF NEW GASKET (6) WITH COPPER COAT AND APPLY TO OIL PAN. APPLY NUMBER 2 PERMATEX TO JOINTS BETWEEN PAN RAIL, GEAR HOUSING AND REAR COVER.

NOTE

Ensure raised bead on gasket faces pan.

4. INSTALL OIL (6) PAN (3).
 - a. Install oil pan (3) to engine block with bolts (4) and washers (5). Torque bolts to 18 ft-lbs (24 Nm).
5. INSTALL PLUGS WITH NEW SEALS (2) AND (3). TORQUE PLUGS TO 60 FT-LBS (80 Nm).
6. INSTALL ENGINE. (REFER TO PAGE 4-2.)
7. FILL CRANKCASE WITH NEW OIL TO CAPACITY. (REFER TO LO 5-3810-30612.)
8. INSTALL ENGINE HOOD. (REFER TO TM 5-3810-306-20.)



9. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

OIL PUMP INSTALLATION

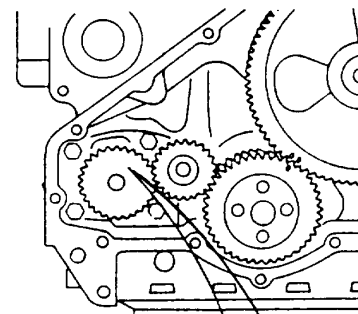
TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Clean rags (Item 2, Appendix B)
 Motor oil (Item 11, Appendix B)
 Solvent P-D-680 (Item 1, Appendix B)

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)
 Front gear cover removed. (Refer to page 4-45.)

REMOVAL:

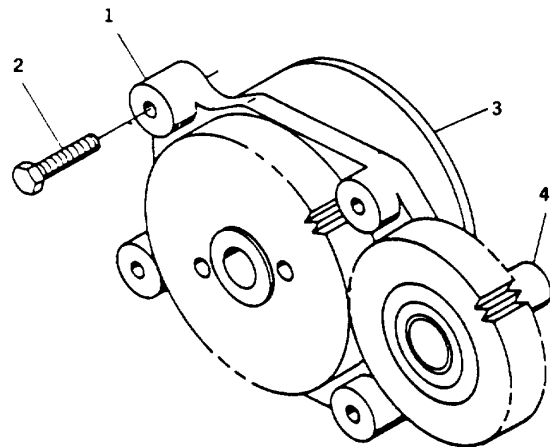
1. REMOVE LUBE OIL PUMP.
 - a. Remove four capscrews (2).
 - b. Remove lube oil pump (1).
2. REMOVE BACK PLATE (3).
3. MARK "TOP" ON GEROTOR PLANETARY (5) AND REMOVE.



CLEANING AND INSPECTION

WARNING

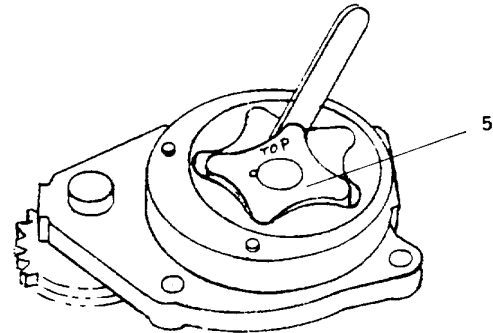
Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (380-590C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.



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.).

1. CLEAN ALL PARTS WITH SOLVENT P-D-680 AND BLOW DRY WITH COMPRESSED AIR.
2. VISUALLY INSPECT PUMP GEARS, GEROTOR DRIVE AND HOUSING FOR DAMAGE, CHIPS, CRACKS OR EXCESSIVE WEAR.
3. INSTALL GEROTOR PLANETARY IN ORIGINAL POSITION.



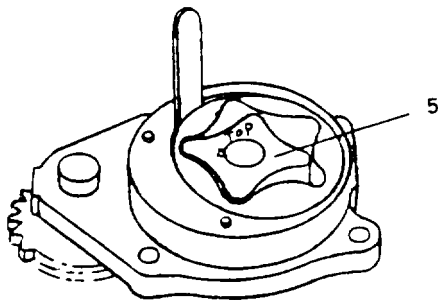
6. MEASURE CLEARANCE OF GEROTOR PLANETARY TO BODY BORE.

Max. clearance = .015 in. (.381 mm).

7. MEASURE GEAR BACKLASH. LIMIT (USED PUMP) .003 TO .015 IN. (.08 TO .38 MM). LIMIT (NEW PUMP) .003 TO .013 IN. (.08 TO .33 MM).

NOTE

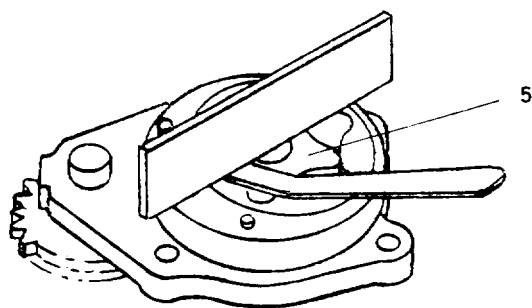
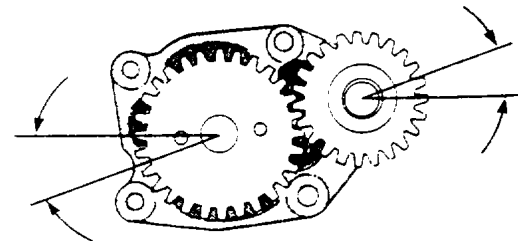
If clearances exceed limits, oil pump replacement is necessary.



4. MEASURE TIP CLEARANCE.

Max. clearance = .007 in. (.1778 mm).

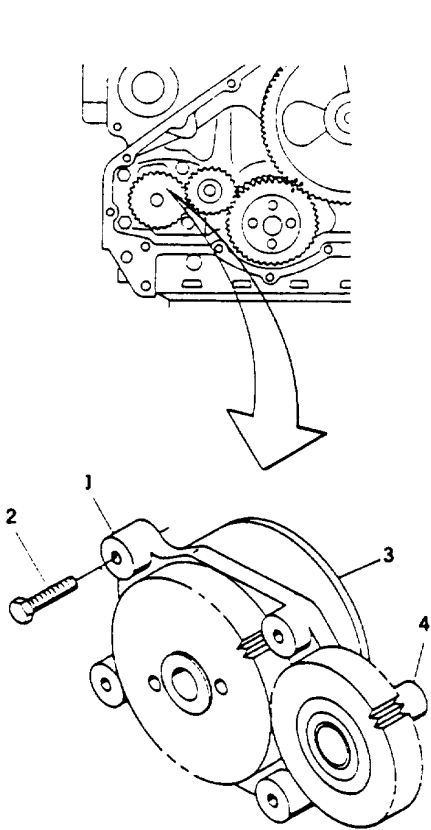
5. MEASURE CLEARANCE OF GEROTOR DRIVE/ GEROTOR PLANETARY TO PORT PLATE.



Max. clearance = .005 in. (.127 mm).

INSTALLATION:

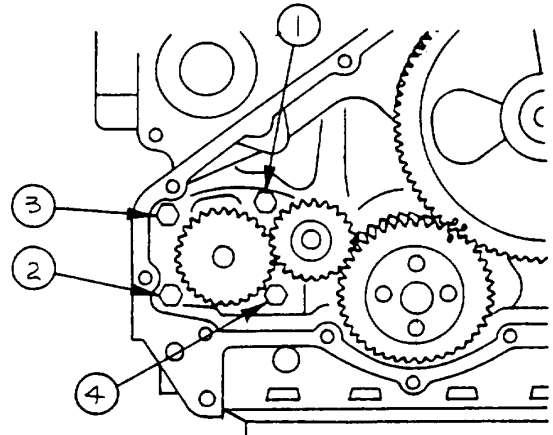
1. INSTALL BACK PLATE (3) AND TAP LIGHTLY WITH HAMMER UNTIL SEATED.
2. LUBRICATE LUBE PUMP (1) WITH CLEAN ENGINE OIL.
3. INSTALL LUBE OIL PUMP (1).
 - a. Install lube pump (1) locating idler gear pin (4) into locating bore in cylinder block.



NOTE

Sealing plate on back of lube pump (1) will seat on cylinder block, but capscrews (2) will not draw flange up tight to the block.

- b. Install capscrews (2) and torque first time to 4 ft-lbs (5 Nm) in sequence shown.
 - c. Repeat torquing capscrews (2) in same sequence to 18 ft-lbs (24 Nm).
 - d. Lubricate geartrain with clean engine oil.
4. INSTALL FRONT GEAR COVER. (REFER TO PAGE 4-45.)



- 5. INSTALL DRIVEBELT, RADIATOR FAN AND FAN GUARD. (REFER TO TM 5-3810-306-20.)
- 6. INSTALL RADIATOR, MOORING BRACKETS AND SHROUD. (REFER TO TM 5-3810-306-20.)
- 7. INSTALL ENGINE HOOD. (REFER TO TM 5-3810-306-20.)
- 8. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

END OF TASK

OIL COOLER INSTALLATION

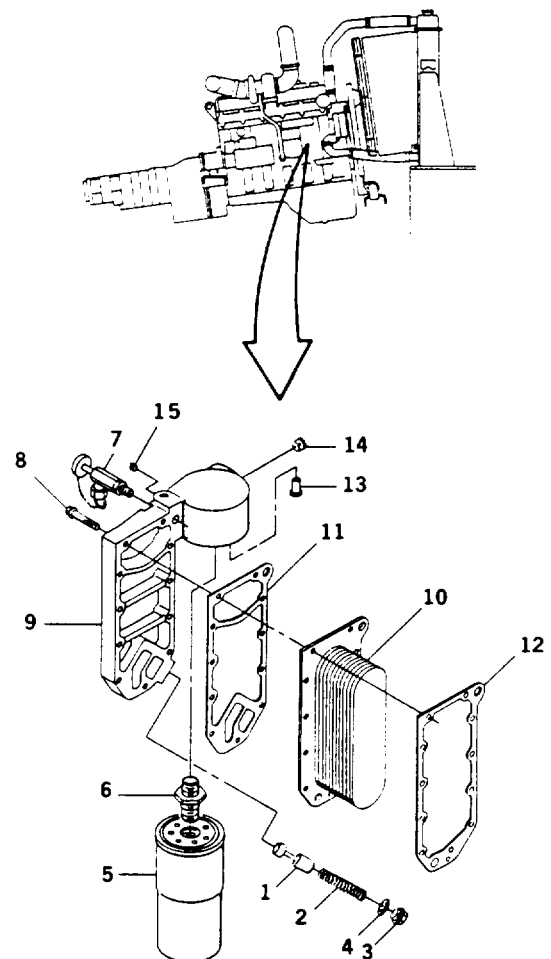
TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Clean rags (Item 1, Appendix C)
 Copper washer (Item 53, Appendix C)
 Gasket (Item 55, Appendix C)
 Gasket (Item 54, Appendix C)
 Oil filter element (Item 56, Appendix C)

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)
 Radiator coolant drained. (Refer to LO 5-3810-306-12.)
 Engine cool to touch.
 All debris cleaned from oil cooler area.

REMOVAL:

1. REMOVE OIL COOLER ASSEMBLY.
 - a. Remove retainer plug (3), copper washer (4), retaining spring (2) and regulating valve (1). Remove spring and valve. Discard copper washer (4).
 - b. Remove oil filter element (5) and discard. Keep adapter (6) for installation.
 - c. Remove oil sampling valve (7). Keep for installation.
 - d. Remove turbocharger oil supply line from oil cooler head. (Refer to TM 5-3810-306-20.)
 - e. Remove eleven capscrews (8), cover (9), core (10) and gaskets (11) and (12). Discard gaskets (11) and (12).
 - f. Remove bypass valve (13) from cover and replace as necessary.
 - g. If necessary, remove plugs (14) and (15).



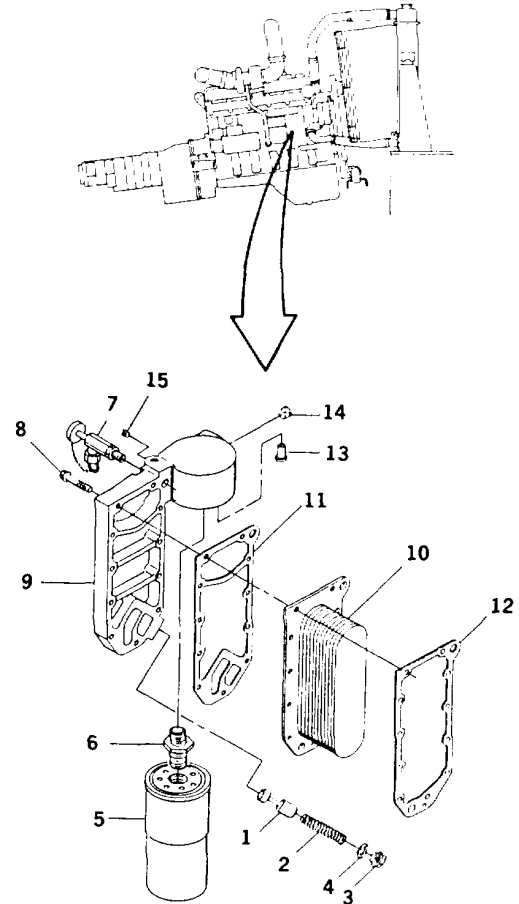
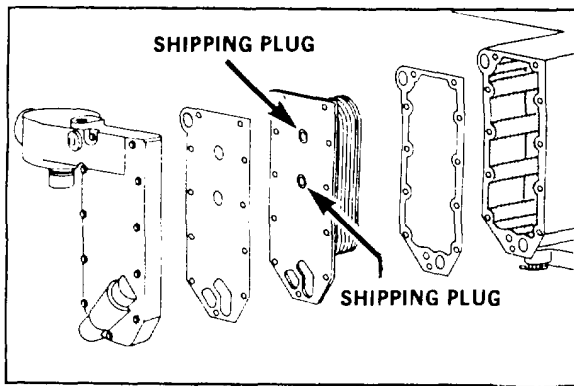
2. INSPECT ALL PARTS FOR DAMAGE AND REPLACE AS NECESSARY.

- a. Apply 70 lbs psi (483 kPa) air pressure to core (10) and check for leaks with element in water tank.

INSTALLATION:

NOTE

If a new oil cooler core is to be installed. Be sure to remove shipping plugs from new core.



1. CLEAN ALL SEALING SURFACES.
2. INSTALL OIL COOLER ASSEMBLY.
 - a. If removed, install plugs (14) and (15).
 - b. Install new gaskets (11) and (12), core (10) and cover (9). Secure with eleven capscrews (8).
 - c. Install bypass valve (13).

CAUTION

Mechanical overtightening may distort the threads or damage the filter element (5) seal.

- d. Install new oil filter element (5). Follow manufacturer's instruction for tightening.

- e. Install oil sampling valve (7).
 - f. Install turbocharger oil supply line.
 - g. Install regulator valve (1) into bore and ensure it moves freely.
 - h. Install spring (2) and secure with new copper washer (4) and retainer plug (3).
3. SERVICE RADIATOR. (REFER TO LO 53810-306-12.)
 4. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
 5. START ENGINE AND INSPECT FOR LEAKS. (REFER TO TM 5-3810-306-10.)

END OF TASK

CHAPTER 5
FUEL SYSTEM MAINTENANCE

CHAPTER INDEX

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	Fuel Injector Replacement.....	5-2
Section II	Fuel Injection Pump Maintenance	5-4
	Fuel Injection Pump Installation.....	5-4
Section III	Turbocharger Maintenance.....	5-10
	Turbocharger and Exhaust Manifold Replacement	5-10

Section I. FUEL INJECTOR MAINTENANCE

FUEL INJECTOR REPLACEMENT

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Fuel injector tester (3376946)

SUPPLIES: Clean rags (Item 2, Appendix B)
 Injector sleeve (Item 229, Appendix B)
 Injector washer (Item 20, Appendix B)

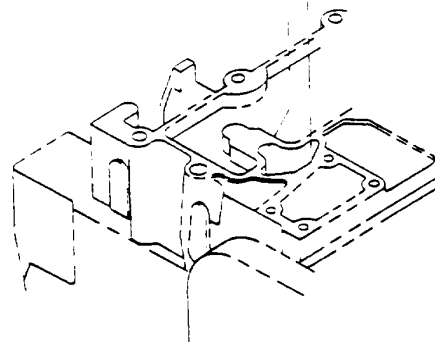
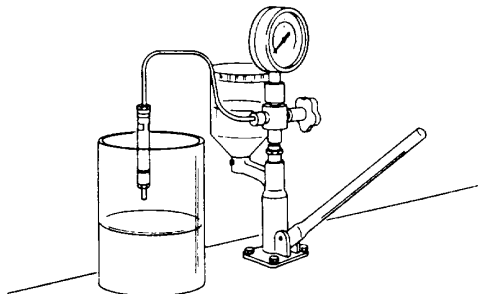
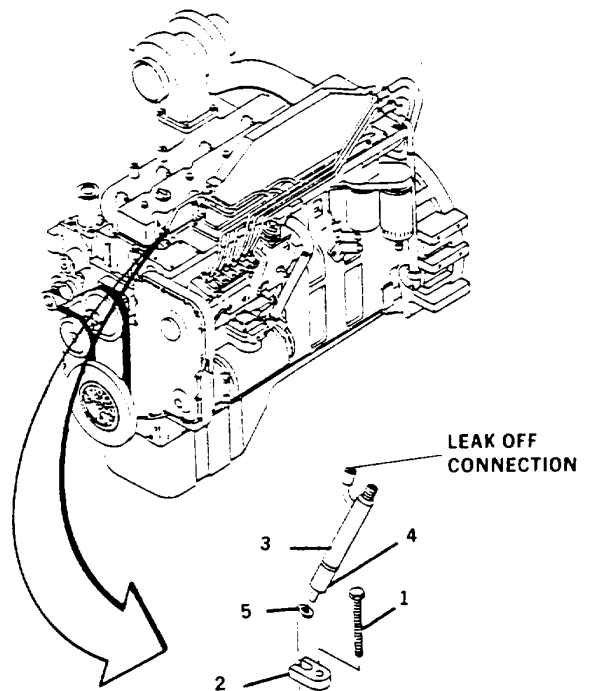
EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)
 Fuel injector lines and fuel manifold removed.
 (Refer to TM 5-3810-306-20.)
 Turbocharger aftercooler removed.
 (Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE FUEL INJECTOR(S).
 - a. Remove capscrew (1) and clamp (2) from injector (3).
 - b. Remove injectors (3' with sealing sleeves (4). Discard sleeves (4).
2. REMOVE AND DISCARD SEALING WASHERS (5).
3. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

TESTING:

1. ATTACH FUEL INJECTOR TO FUEL INJECTOR TESTER. POINT FUEL INJECTOR INTO A CLEAR CONTAINER.



2. FUEL INJECTOR OPENING PRESSURE TEST.

WARNING

Keep body clear of test spray. Fluid can be injected into bloodstream causing blood poisoning and possible death.

- a. Open valve on fuel injector tester and operate lever at one stroke per second.
- b. Spray should start at 205 bar (2973 psi).
- c. Check for well atomized spray pattern.

2. FUEL INJECTOR LEAKAGE TEST.

- a. Open valve on fuel injector tester and operate lever to hold pressure 20 bar (290 psi) below opening pressure.
- b. No drops should fall from fuel injector tip within 10 seconds.

INSTALLATION:

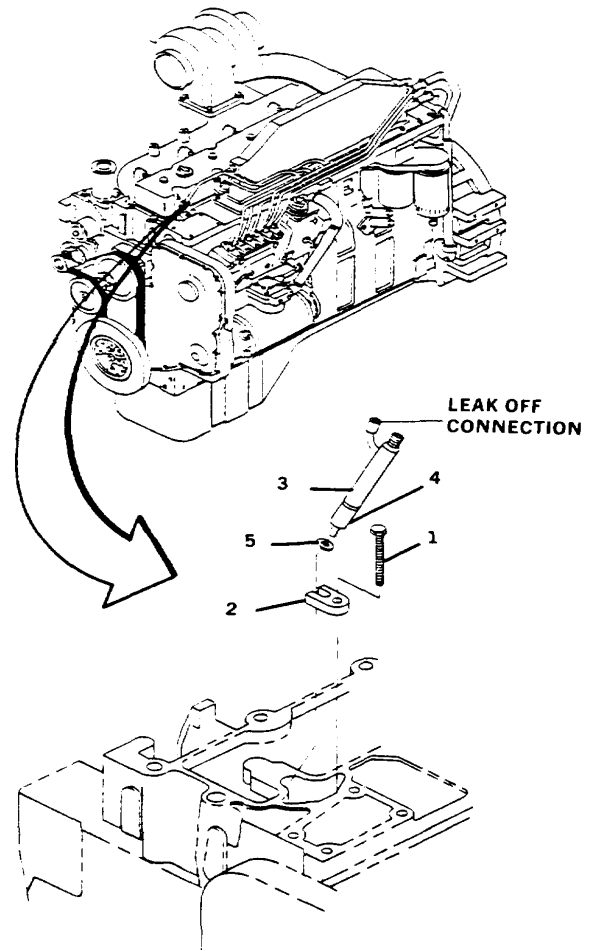
1. INSTALL FUEL INJECTOR(S).

- a. Lubricate injectors with clean engine oil and install new sealing sleeves (4) on injectors (3).
- b. Lubricate sealing lips of sleeve (4) with anti-seize compound.

NOTE

A light coat of clean 15W40 engine oil between the washer (5) and injector (3) can help to keep the washer from falling during installation.

- c. Assemble injector (3), sealing sleeve (4), new copper sealing washer (5) and holddown clamp (2). Use only one washer (5).



- d. Install injector assembly into injector bore. Injector leak-off connection must be toward valve cover.
- e. Tighten holddown capscrew (1). Torque to 18 ft-lbs (24 Nm).

2. INSTALL FUEL INJECTION LINES. (REFER TO TM 5-3810-306-20.)

3. INSTALL TURBOCHARGER AFTERCOOLER. (REFER TO TM 5-3810-306-20.)

4. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

END OF TASK

Section II. FUEL INJECTION PUMP MAINTENANCE

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Tool Kit Auto-Fuel and Electric System Repair (5180-00-754-0655)
 Shop Equipment Auto-Maintenance and Repair; Common No. 1 (4910-00-754-0654)
 Shop Equipment Auto-Maintenance and Repair; Org Suppl No. 1 (4910-00-754-0653)

SUPPLIES: Clean rags (Item 2, Appendix B)
 Preformed packing (Item 190, Appendix B)
 Preformed packing (Item 191, Appendix B)
 Flat washer (Item 192, Appendix B)

EQUIPMENT CONDITIONS: Outriggers set and boom positioned over-the-side.
 (Refer to TM 5-3810-306-10.)
 Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)
 Radiator fan and fan guard removed.
 (Refer to TM 5-3810-306-20.)
 Front gear cover removed. (Refer to page 4-45.)
 Fuel shutoff solenoid removed.
 (Refer to TM 5-3810-306-20.)
 Throttle linkage removed. (Refer to TM 5-3810-306-20.)
 Fuel petcocks closed at filter/strainer.

REMOVAL:

1. CHECK BACKLASH OF DRIVE GEAR (1).

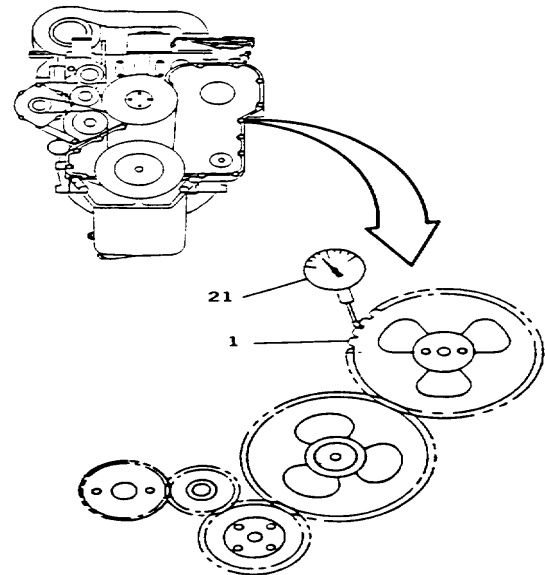
NOTE

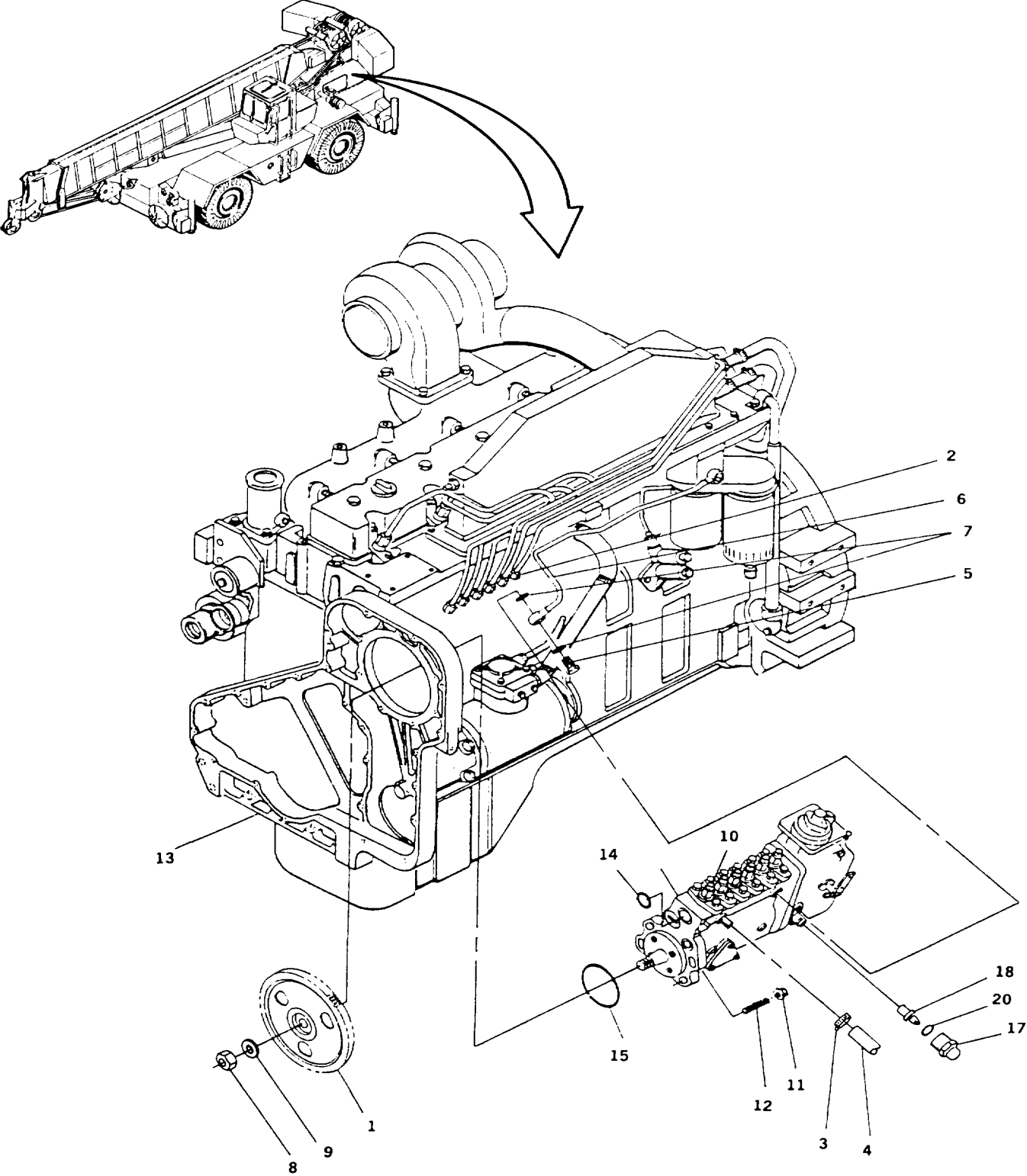
Hold adjoining gear from moving when checking backlash, or readings will be for the total of both gears.

- a. Position dial indicator (21) on a tooth of injector pump drive gear (1).
- b. Note total indicator travel. Backlash limits
 MIN .006 - MAX .010

2. TAG AND DISCONNECT ALL FUEL LINES.

- a. Disconnect six fuel lines (2).





- b. Cover high pressure outlets on fuel injection pump to avoid contamination.
- c. Remove clamp (3) and fuel hose (4).
- d. Loosen screw (5) and disconnect fuel supply tube (6). Discard washers (7).

3. REMOVE DRIVE GEAR (1).

- a. Remove nut (8) and washer (9) from fuel pump shaft and remove gear (1) using a suitable puller.

4. REMOVE FUEL INJECTION PUMP (10).

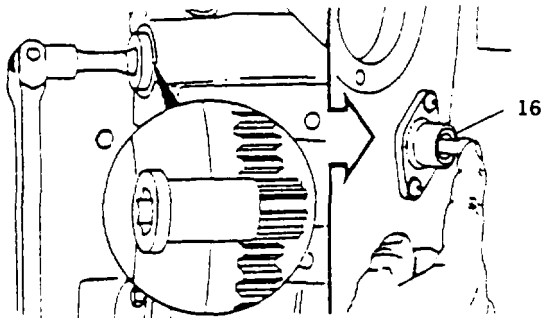
- a. Remove four nuts (11) from studs (12) in front gear housing (13).
- b. Remove fuel pump (10).
- c. Discard preformed packings (14) and (15).

5. INSPECT ALL PARTS FOR DAMAGE.
REPLACE PARTS AS REQUIRED.

INSTALLATION:

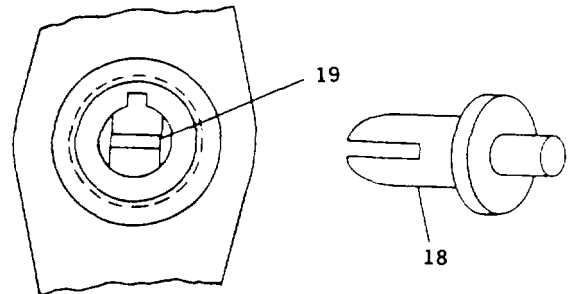
1. ENGINE NO. 1 CYLINDER AT TDC.

- a. Bar engine at flywheel housing until engine timing pin (16) at rear of front gear housing engages camshaft gear.



2. INSTALL FUEL INJECTION PUMP.

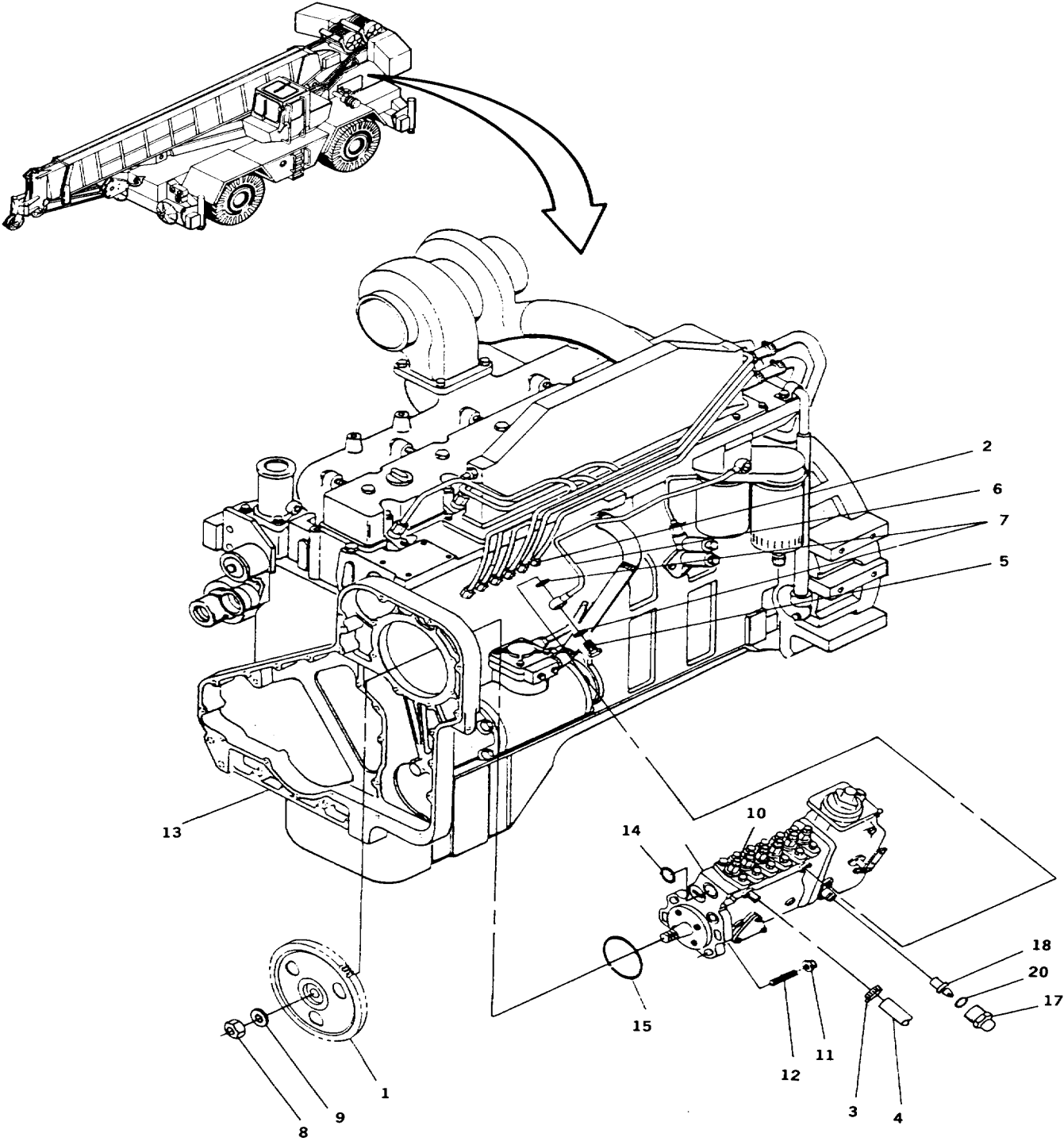
- a. Remove access plug (17) and timing pin (18).
- b. Rotate fuel injection pump shaft until timing tooth (19) is aligned with timing pin hole.
- c. Reverse position of pin (18) so slot of pin (18) will fit over timing tooth (19) in pump.



- d. Install and secure pin (18) with access plug (17).
- e. Make sure new preformed packings (14) and (15) are correctly installed and not damaged.
- f. Lubricate mounting flange with clean engine oil.
- g. Position fuel injection pump (10) flange onto mounting studs.
- h. Install four nuts (11). Torque to 32 ft-lbs (43 Nm).

3. INSTALL FUEL INJECTION PUMP DRIVE GEAR (1).

- a. Install fuel injection pump drive gear (1) washer (9) and nut (8). Torque nut (8) to 7-11 ft-lbs (9-15 •m).



- b. Disengage engine timing pin (16).
- c. Remove fuel pump timing pin plug (17). Reverse position of pin (18) and install pin (18), plug (17) and sealing washer (20).
- d. Final torque drive gear retaining nut (8) to 77 ft-lbs (102 Nm).

4. INSTALL FUEL SHUTOFF SOLENOID. (REFER TO TM 5-3810-306-20.)

5. CONNECT FUEL LINES.

- a. Connect fuel drain manifold hose (4) and secure with clamp (3).
- b. Connect fuel supply tube (6) with two new washers (7) and screw (5).
- c. Connect six fuel lines (2) to fuel injection pump (10).

6. INSTALL THROTTLE LINKAGE. (REFER TO TM 5-3810-306-20.)

7. INSTALL FRONT GEAR COVER. (REFER TO PAGE 4-45.)

8. INSTALL RADIATOR FAN AND FAN GUARD. (REFER TO TM 5-3810-306-20.)

9. INSTALL RADIATOR, MOORING BRACKET AND SHROUD. (REFER TO TM 5-3810-306-20.)

10. INSTALL ENGINE HOOD. (REFER TO TM 5-3810-306-20.)

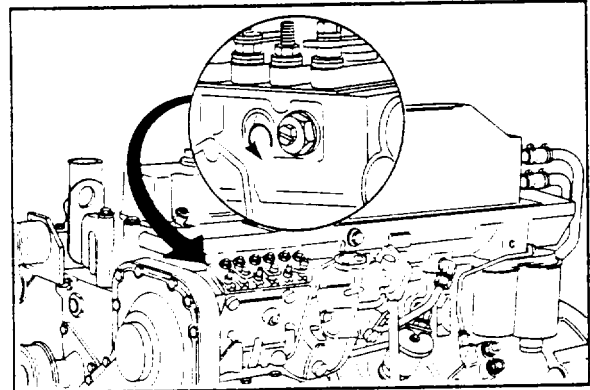
11. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-30620.)

12. VENT FUEL INJECTION PUMP AND FUEL LINES.

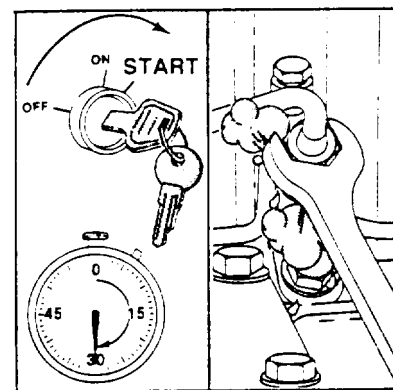
- a. Loosen vent screw.
- b. Place fuel control in run position.

c. Crank engine and allow air to bleed from pump.

d. Close vent screw.



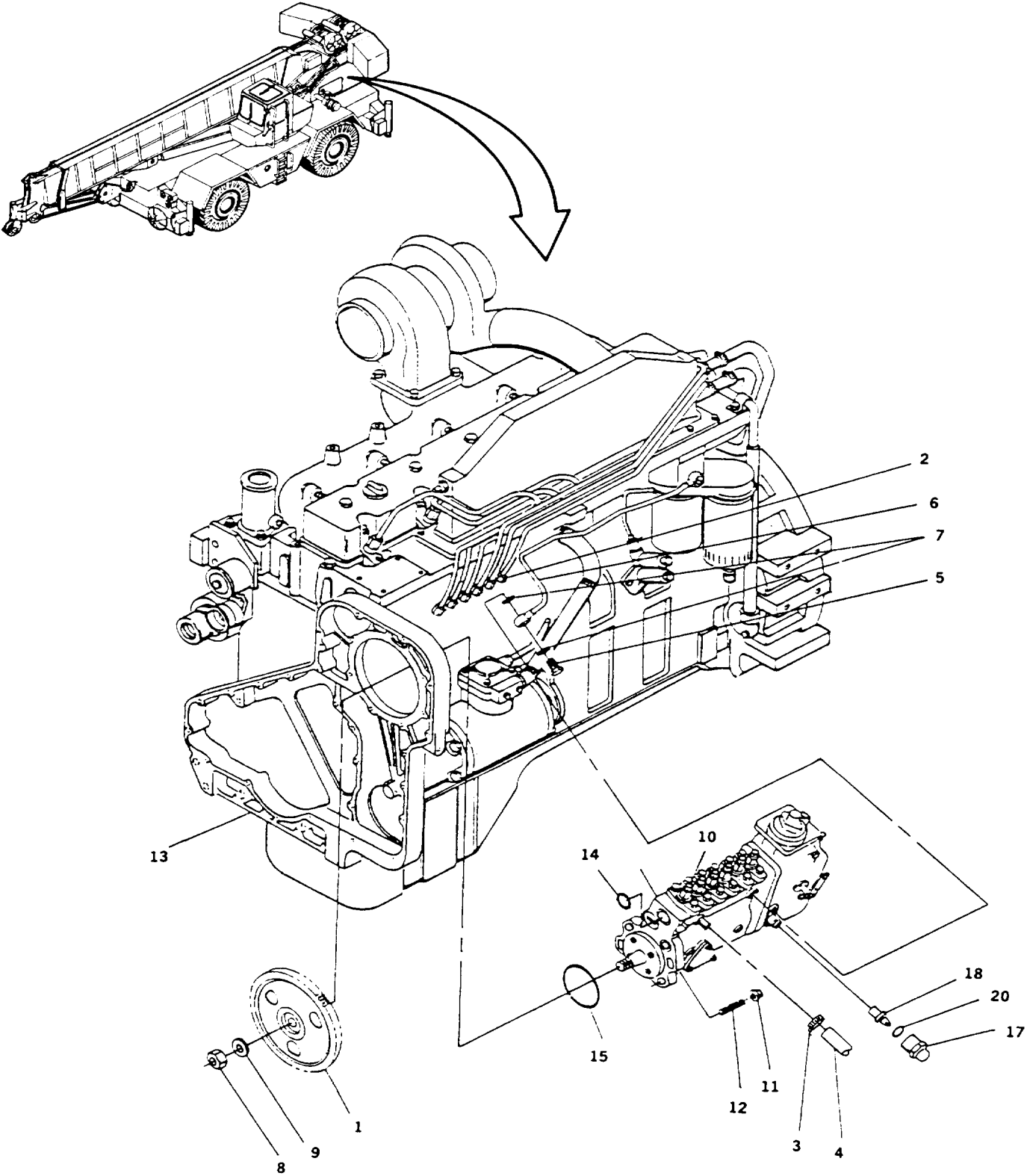
e. Loosen each high pressure line one at a time starting at number 1 injector. Crank engine to allow air to bleed from lines then tighten lines.



f. Continue until engine runs smoothly.

13. ADJUST IDLE AS NECESSARY AT THROTTLE LINKAGE. (REFER TO TM 5-3810-306-20.)

END OF TASK



Section III. TURBOCHARGER MAINTENANCE

TURBOCHARGER AND EXHAUST MANIFOLD REPLACEMENT

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Oil (Item 11, Appendix B)
 Gasket (Item 111, Appendix B)
 Gasket (Item 112, Appendix B)
 Gasket (Item 113, Appendix B)
 NEVER-SEEZ (Item 24, Appendix B)
 Lockwasher (Item 273, Appendix B)

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)
 Engine oil filter removed. (Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE HOSES AND CLAMPS TO TURBOCHARGER.
 - a. Disconnect clamps (1) and remove hose (2) from turbocharger (3).
 - b. Remove turbocharger oil supply line hose (4).
 - c. Remove two capscrews (5) from oil tube connection (6) to turbocharger (3).
 - d. Remove two clamps (7) and remove tube (6) and gasket (8) and hose (9). Discard gasket (8).
 - e. Remove tube (10) from block.
 - f. Loosen clamp (18) on exhaust connection (17).
 - g. Remove two capscrews (19) from bracket (20) and move exhaust connection (17) and bracket (20) away from turbocharger (3).
 - h. Loosen clamps (21) and hose (22).
2. REMOVE TURBOCHARGER (3).
 - a. Remove four nuts (11) from studs (12).
 - b. Lift turbocharger (3) and gasket (13) away from exhaust manifold (15) while separating it from hose (22). Discard gasket (13).
3. REMOVE EXHAUST MANIFOLD (15).
 - a. Remove two capscrews (19), exhaust connection (17) and brace (20).
 - b. Remove two cap screws (23), lockwashers (24) and flat washers (25) securing air inlet "T" (26) to exhaust manifold (15). Discard lockwashers.
 - c. Remove twelve capscrews (14) from exhaust manifold (15).
 - d. Remove exhaust manifold (15) and gaskets (16). Discard gaskets (16).
 - e. Clean gasket surfaces.
4. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

INSTALLATION:

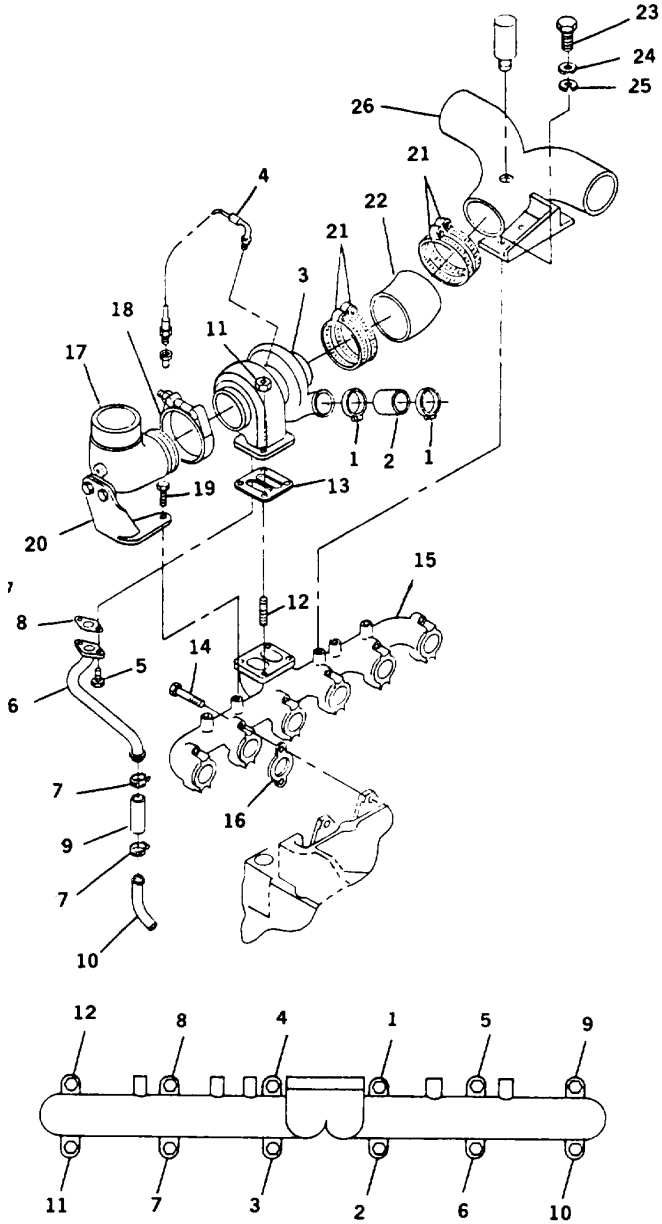
1. INSTALL EXHAUST MANIFOLD (15).

- a. Assemble exhaust manifold (15) capscrews (14) and new gaskets (16).
- b. Apply NEVER-SEEZ compound to the capscrews (14). The bead on gaskets (16) can be installed either direction.
- c. Install manifold (15) and gaskets (16) to block.
- d. Torque capscrews (14) to 32 ft-lbs (43 Nm) in sequence shown. After tightening, follow same sequence and retighten to same value.
- e. Install air inlet "T" (26) on exhaust manifold (15) with two capscrews (23), new lockwashers (24) and flat washers (25).

2. INSTALL TURBOCHARGER (3).

- a. Install new turbocharger gasket (13) and apply NEVER-SEEZ compound to studs (12).
- b. Position turbocharger (3) on exhaust manifold (15) and into hose (22). Secure turbocharger (3) using nuts (11). Torque nuts (11) to 24 ft-lbs (32 Nm).
- c. Tighten clamps (21) on hose (22).

3. INSTALL HOSES AND CLAMPS TO TURBOCHARGER.



- a. Install exhaust connection (17) and mount (20) on exhaust manifold (15) using capscrews (19).
- b. Connect exhaust connection (17) to turbocharger (3) with clamp (18).

NOTE

If required, bend lockplates back and loosen the turbine housing capscrews to better position bearing housing to install the turbocharger drain tube.

- c. Install drain tube (6) and new gasket (8) with two bolts (5) torque to 18 ft-lbs (24 Nm).

NOTE

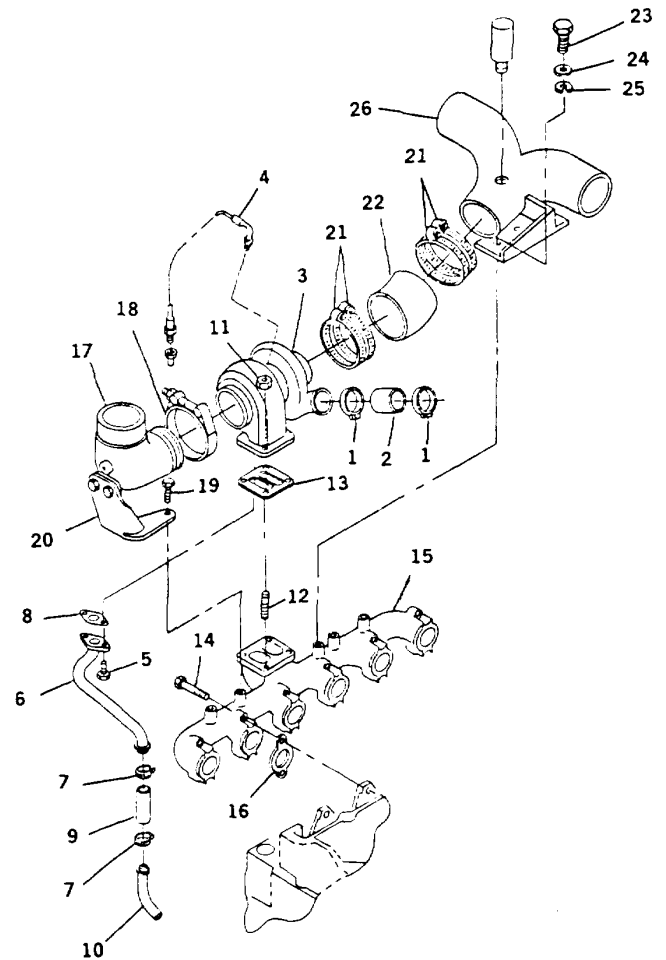
If Note above was used, reposition turbine housing and torque nuts to 100 in-lbs (11 Nm).

- d. Install tube (10) in cylinder block.
- e. Connect tubes (6) and (10) with hose (9) using clamps (7).

CAUTION

Failure to prelubricate the turbocharger could result in damage to the turbocharger upon engine startup.

- f. Pour 2 to 3 oz of clean engine oil into oil inlet fitting on the top of turbocharger (3) while spinning turbocharger impeller to distribute oil in bearing.
- g. Install oil supply line (4). Tighten fittings securely. Torque to 18 ft-lbs (24 Nm).
- h. Install hose (2) to turbocharger (3) using clamps (1).



- 4. INSTALL ENGINE OIL FILTER. (REFER TO TM 5-3810-306-20.)
- 5. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
- 6. TEST FOR PROPER OPERATION AND INSPECT FOR LEAKS. (REFER TO TM 5-3810-306-10.)

END OF TASK

CHAPTER 6
ELECTRICAL SYSTEM MAINTENANCE

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Section I. ALTERNATOR MAINTENANCE

ALTERNATOR ASSEMBLY

- TOOLS:
- Ohmmeter
 - Battery
 - Carbon pile
 - Ammeter
 - Analyzer, Set Engine; STE/ICE (4910-00-124-2554)
 - Shop Equipment Contact Maintenance Truck Mtd (4930-00-294-9518)
 - Shop Equipment Electrical Repair Semitrailer Mtd (4940-01-150-3113)
 - Shop Equipment Fuel and Electric System Engine FM Basic (4940-00-754-0714)
 - Test Standard Auto-Generator and Starter, Floor Mtd 500 AMP (4910-00-767-0218)
 - Tool Kit Auto-Fuel and Electric System Repair (5180-00-754-0655)

SUPPLIES: Clean rags (Item 2, Appendix B)

EQUIPMENT CONDITIONS: Alternator removed from engine. (Refer to TM 5-3810-306-20.)

DISASSEMBLY:

1. DISASSEMBLE ALTERNATOR.

NOTE

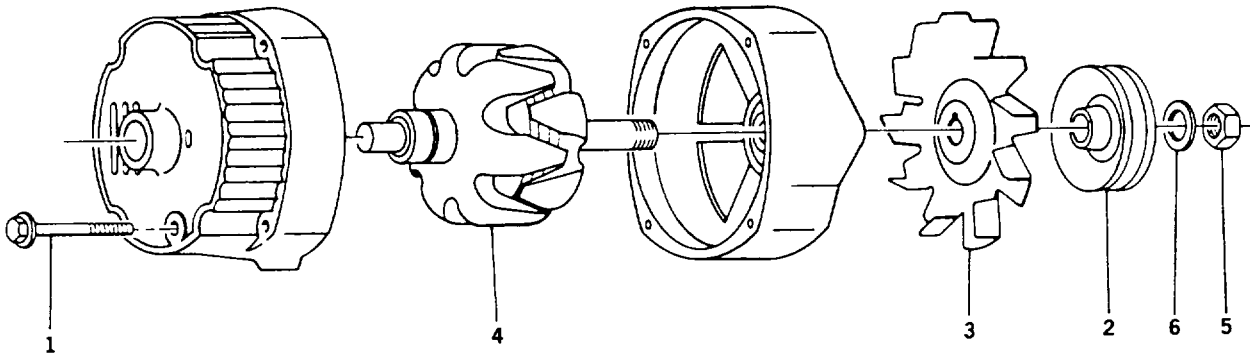
Scribe a locating mark on frames to aid positioning during assembly.

- a. Remove thru-bolts (1) and separate the drive end frame with rotor assembly from the slip ring end frame with stator assembly by prying apart with a screwdriver at the stator slot.

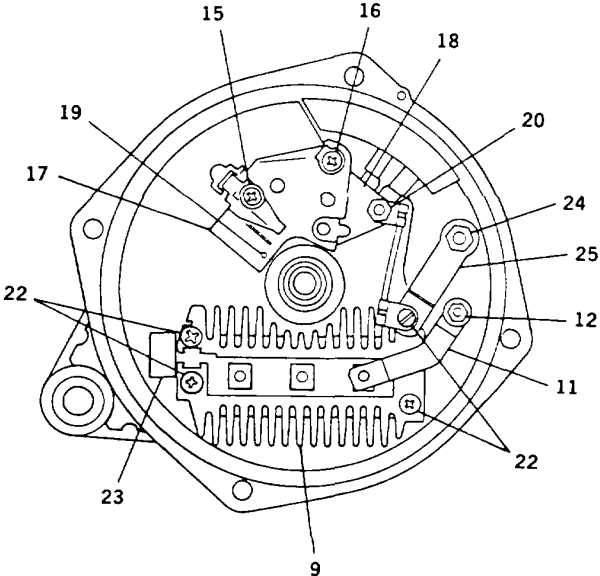
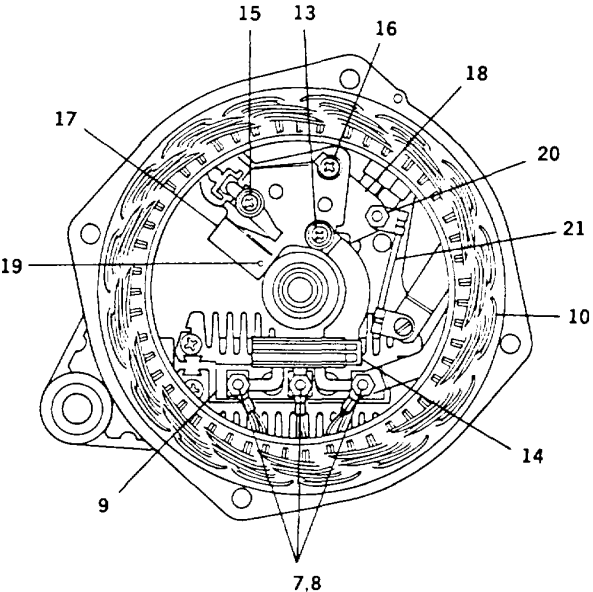
- b. If necessary, remove pulley (2) fan (3) and rotor (4) by removing nut (5) and washer (6).
- c. Remove three nuts (7) securing stator leads (8) to rectifier assembly (9). Remove stator (10).

NOTE

Perform rectifier check and stator check as described under INSPECTION prior to further disassembly.



- d. Remove nut (12) securing strap (11) to housing. Remove strap (11). Retain nut (12) and connecting hardware for assembly.
- e. Remove insulated screw (13) securing diode (14). Remove diode (14).
- f. Remove insulated screw (15) and ground screw (16) securing brush holder (17) and regulator (18). Remove brush holder (17). Remove brushes (19) from brush holder.
- g. Remove nut (20) securing wire (21) to regulator (18). Remove regulator (18).
- h. Remove four screws (22) securing rectifier assembly (9) and capacitor (23). Remove rectifier assembly (9), capacitor (23) and wire (21).
- i. Remove nut (24) securing battery terminal strap (25). Remove strap (25). Retain nut (24) and connecting hardware for assembly.



CLEANING:

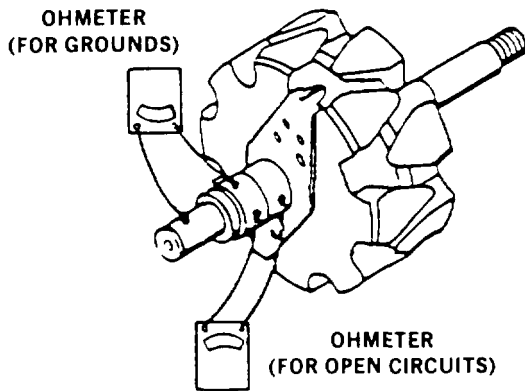
- 1. WIPE OFF ALL PARTS WITH CLEAN LINT-FREE CLOTHS.

INSPECTION:

1. INSPECT ALTERNATOR COMPONENTS.

- a. Inspect pulley for cracks and wear.
- b. Inspect fan for wear and damaged vanes.
- c. Inspect rotor for corrosion and wear.
- d. Inspect brushes for wear.
- e. Check rotor assembly as follows:

- (1) Connect ohmmeter to each slip ring.
- (2) If ohmmeter reading is high (infinite), then rotor winding is open.
- (3) Connect ohmmeter from one slip ring to shaft.
- (4) If ohmmeter is low, then rotor winding is grounded.



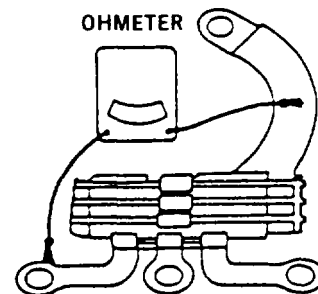
- (5) Check rotor winding for short-circuit by connecting ohmmeter to each slip ring.

- (6) If ohmmeter reading is above 3.0, rotor winding has excessive resistance.
- (7) If ohmmeter reading is below 2.4, rotor winding is shorted.

NOTE

If the rotor assembly is not defective but the generator fails to supply rated output, then defect is in diode, rectifier, stator, or voltage regulator.

- f. Check diodes as follows:
 - (1) Connect ohmmeter (having a 1-1/2 volt cell) to single side connector and one of three connectors.
 - (2) Observe and record reading on lowest range scale and reverse leads to same two connectors.



- (3) Observe ohmmeter reading.
- (4) If readings are the same, replace diode. A good diode will give one high and one low reading.

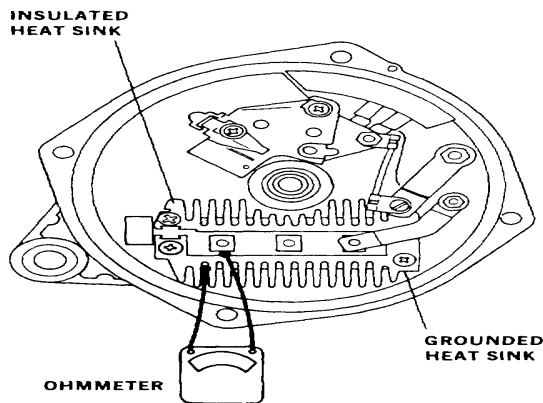
- (5) Repeat steps (1) thru (4) for the other two short connectors.
- (6) Connect ohmmeter to each pair of three connectors.
- (7) If any reading is zero, replace diode.

g. Check rectifier as follows:

CAUTION

Do not use high voltage such as 110 volt test lamp to check rectifier.

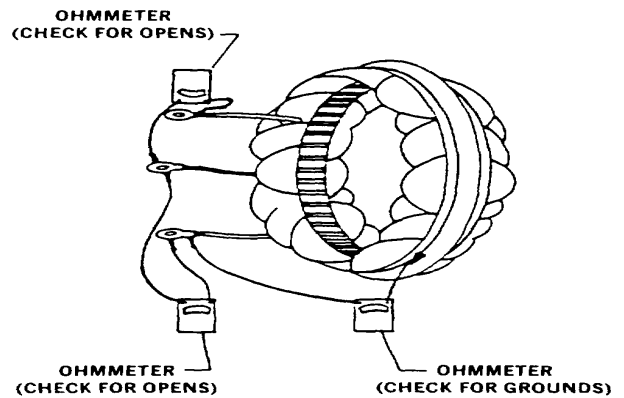
- (1) Connect ohmmeter to grounded heat sink and one of three terminals on rectifier.
- (2) Press down firmly on flat metal connector of rectifier then reverse leads to heat sink and same terminal.



- (3) If both readings are same, replace rectifier.
- (4) Repeat steps (1) thru (3) for the other two terminals on rectifier.

h. Check stator as follows:

- (1) Connect ohmmeter from any stator lead to frame.
- (2) If ohmmeter reading is low, then windings are grounded. Replace alternator.
- (3) Connect ohmmeter leads from each set of stator leads.
- (4) If ohmmeter readings are high, then windings are open. Replace alternator.



- i. Inspect battery terminal insulator for cracks. Replace if damaged.

ASSEMBLY:

1. ASSEMBLE ALTERNATOR.

CAUTION

Be certain slip ring end frame is clean prior to assembly.

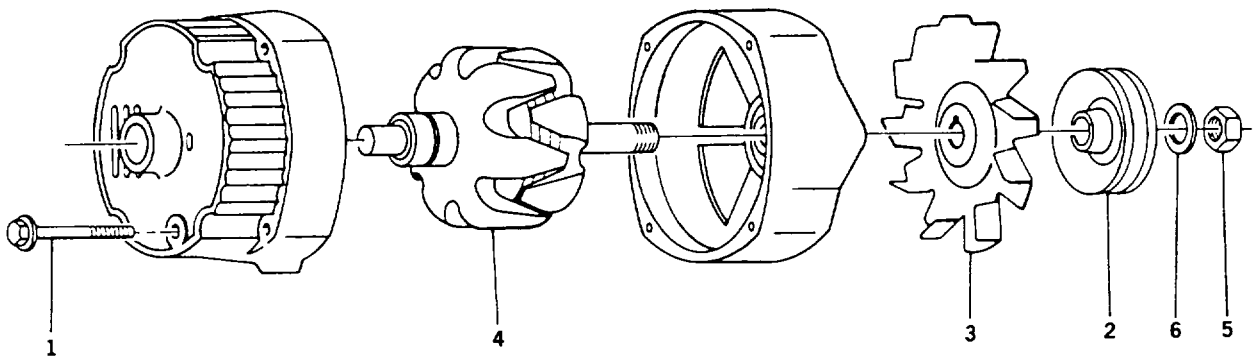
- a. Install battery terminal strap (25) and secure one end with nut (24) and attaching hardware.
- b. Install capacitor (23), rectifier assembly (9) (Under end of battery terminal strap (25) and one end of wire (21). Secure all four items using four screws (22).
- c. Install regulator (18) and other end of wire (21) and secure both with nut (20).
- d. Install brushes (19) in brush holder (17).
- e. Install brush holder (17), insulated screw (15) and ground screw (16).
- f. Install diode (14) and insulated screw (13).

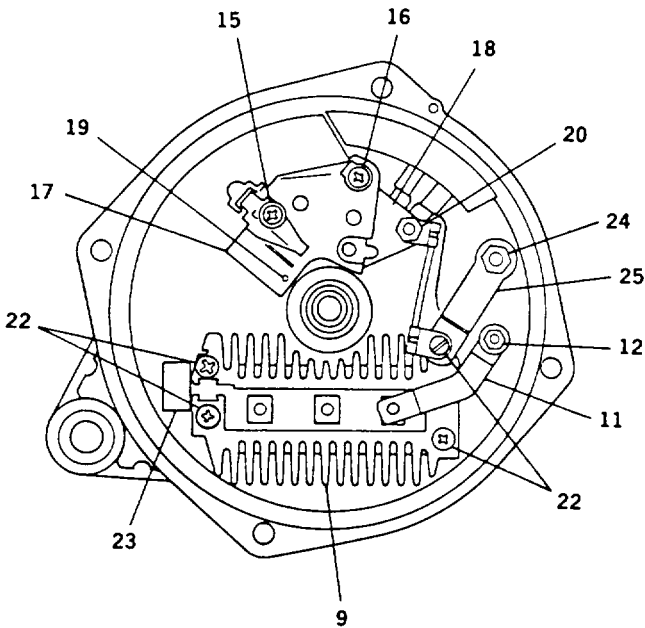
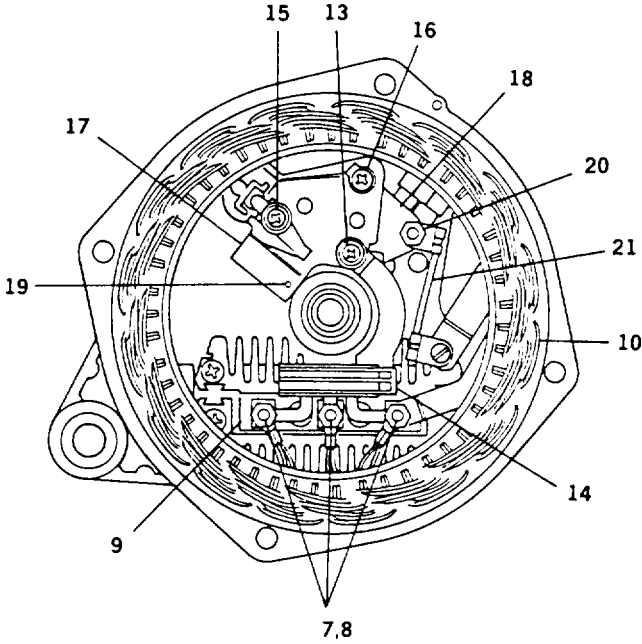
- g. Install strap (11) and secure one end to housing using nut (12) and attaching hardware.
- h. Install stator (10), stator leads (8) and nuts (7).
- i. If removed, install rotor (4), fan (3), pulley (2), washer (6), and nut (5). Torque nut (5) to 70-80 ft-lbs (95-108 Nm).

NOTE

Make sure rotor (4) shaft is clean. Insert pin through hole in end frame to hold brushes and springs up in brush holder during assembly. Remove pin after thru-bolts (1) are tightened to allow brushes to contact slip rings.

- j. Assemble slip ring end frame to drive end frame. Align scribe mark on frames and install thru-bolts (1).





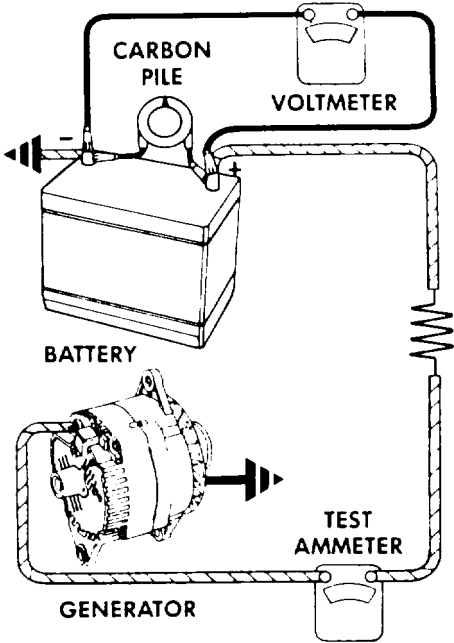
TESTING:

1. BENCH TEST ALTERNATOR.

NOTE

Battery used for bench check must be fully charged.

- a. Connect ammeter, voltmeter, resistor (10 ohms at 6 watts), alternator, and fully charged battery as shown. Do not connect carbon pile at this time.



- b. Slowly increase alternator speed and observe voltage.
- c. If voltage is uncontrolled with speed and increases above 31.0 volts, test voltage regulator and recheck field winding.
- d. If voltage is below 31.0 volts, connect carbon pile as shown.
- e. Operate alternator at moderate speed and adjust carbon pile as required to obtain maximum current output.
- f. If output is within 10 amperes of 65 amperes, then alternator is good.
- g. If output is not within 10 amperes of 65 amperes keep battery loaded with carbon pile and insert screwdriver into end frame hole to ground tab to end frame. Note that tab is within 3/4-inch of casting surface, therefore, do not force the screwdriver deeper than 1-inch into end frame.

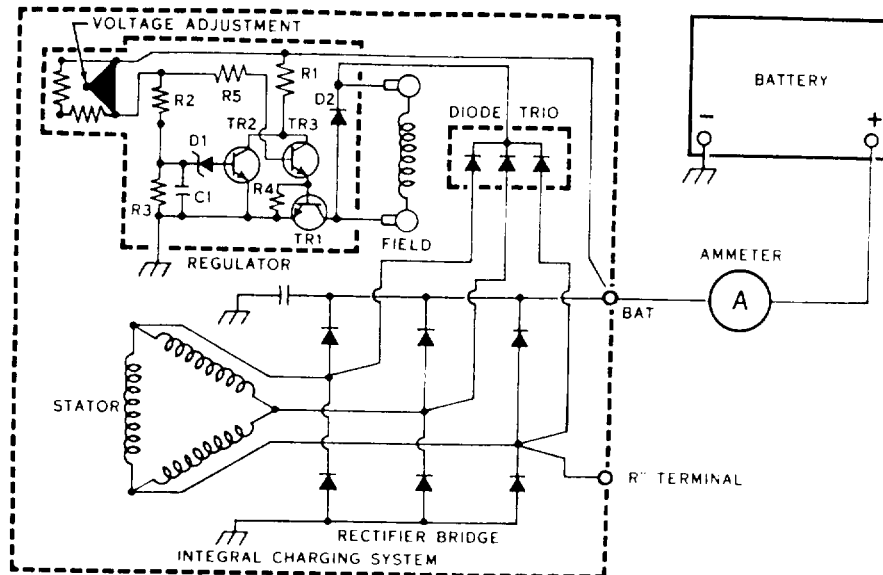
- h. Operate the alternator at a moderate speed and adjust carbon pile to obtain maximum current output.
- i. If output is within 10 amperes of 65, disassemble the alternator and replace the regulator.

Recheck alternator after repair.

- j. If output is not within 10 amperes of 65, disassemble the alternator and check winding, diode, rectifier, and stator. Recheck alternator after repair.
- k. Remove ammeter and turn accessories off.

2. MOUNT ALTERNATOR ON ENGINE. (REFER TO TM 5-3810-306-20.)

END OF TASK



Section II. STARTING MOTOR MAINTENANCE

ENGINE STARTER ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Multimeter

SUPPLIES: Emery cloth (Item 95, Appendix B) (1 Required)
Preformed packing (Item 92, Appendix B) (2 Required)
Preformed packing (Item 93, Appendix B)
Solvent P-D-680, Type II (Item 1, Appendix B)
Oil, lubricating SAE 10 (Item 94, Appendix B)
Loctite #2114 (Item 100, Appendix B)

EQUIPMENT CONDITIONS: Starting motor removed. (Refer to TM 5-3810-306-20.)

DISASSEMBLY:

1. REMOVE SOLENOID SWITCH (4).

- a. Remove ground jumper wire from terminal #4 on switch (4).

NOTE

If terminal is not heated the plastic base may be damaged during disassembly.

- b. Using soldering iron or gun, pre-heat terminal #3 on switch (4) enough to soften loctite. Remove terminal nut.

CAUTION

Use an open wrench to hold the bottom nut while removing the top nut. Failure to do this may damage the field coil.

- c. Remove nut (1) and jumper strap (2) from field coil stud on field ring (49).
d. Remove two hex head screws (3) from switch bracket.

- e. Lift switch (4) up, turn 180° and pull out of shift lever (40), removing switch from shift housing (29).

CAUTION

Push back on boot (5) to expose plunger on switch (4). Wrap strip of emery cloth twice around plunger to avoid nicks.

- f. Grip plunger on switch (4) with channel lock pliers and unscrew link spool (6) with wrench.

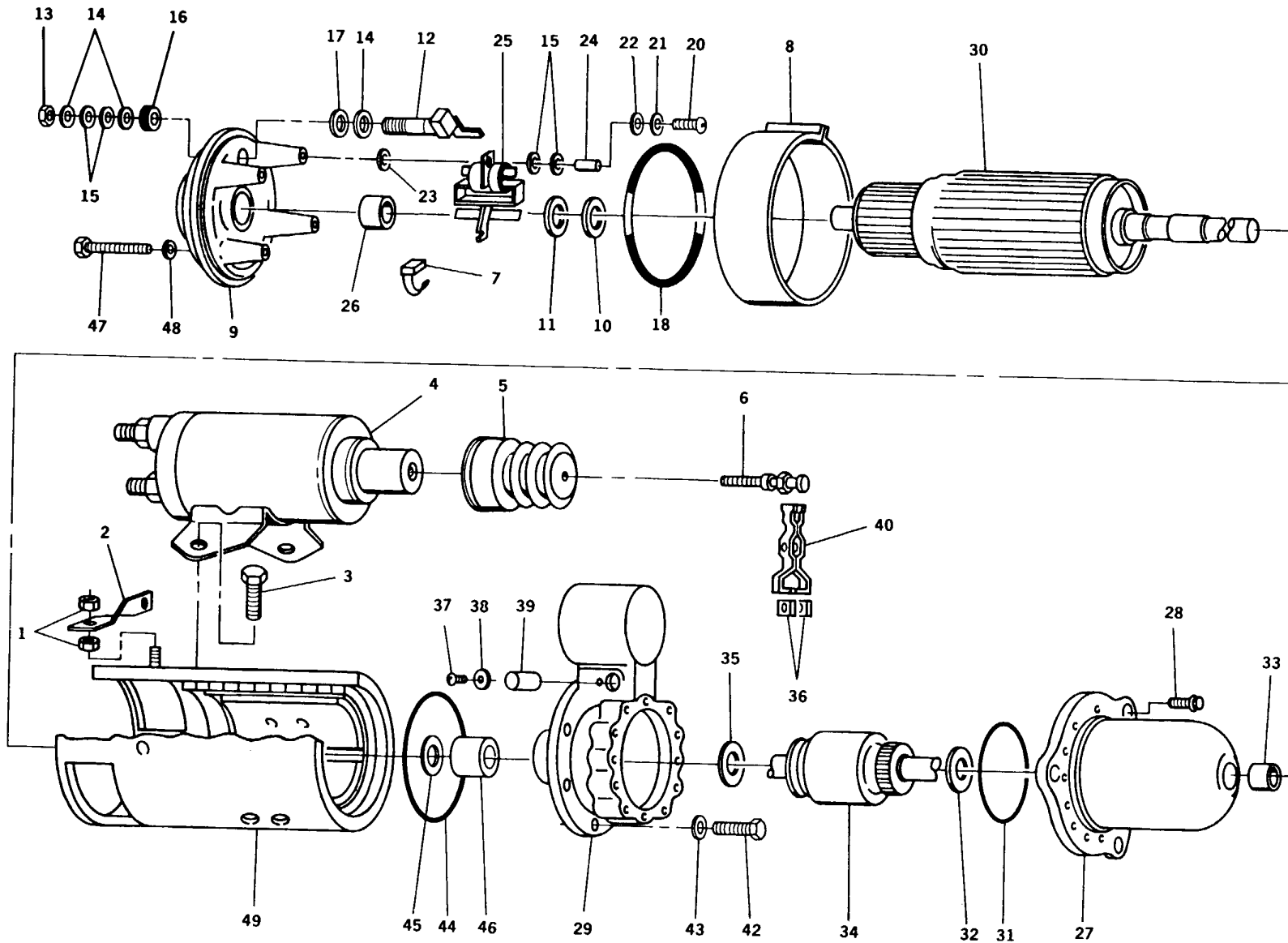
- g. Inspect boot (5) for cracks or damage. Replace if damaged.

2. REMOVE BRUSHES (7).

CAUTION

Do not pull brush leads while springs exert pressure on the brushes.

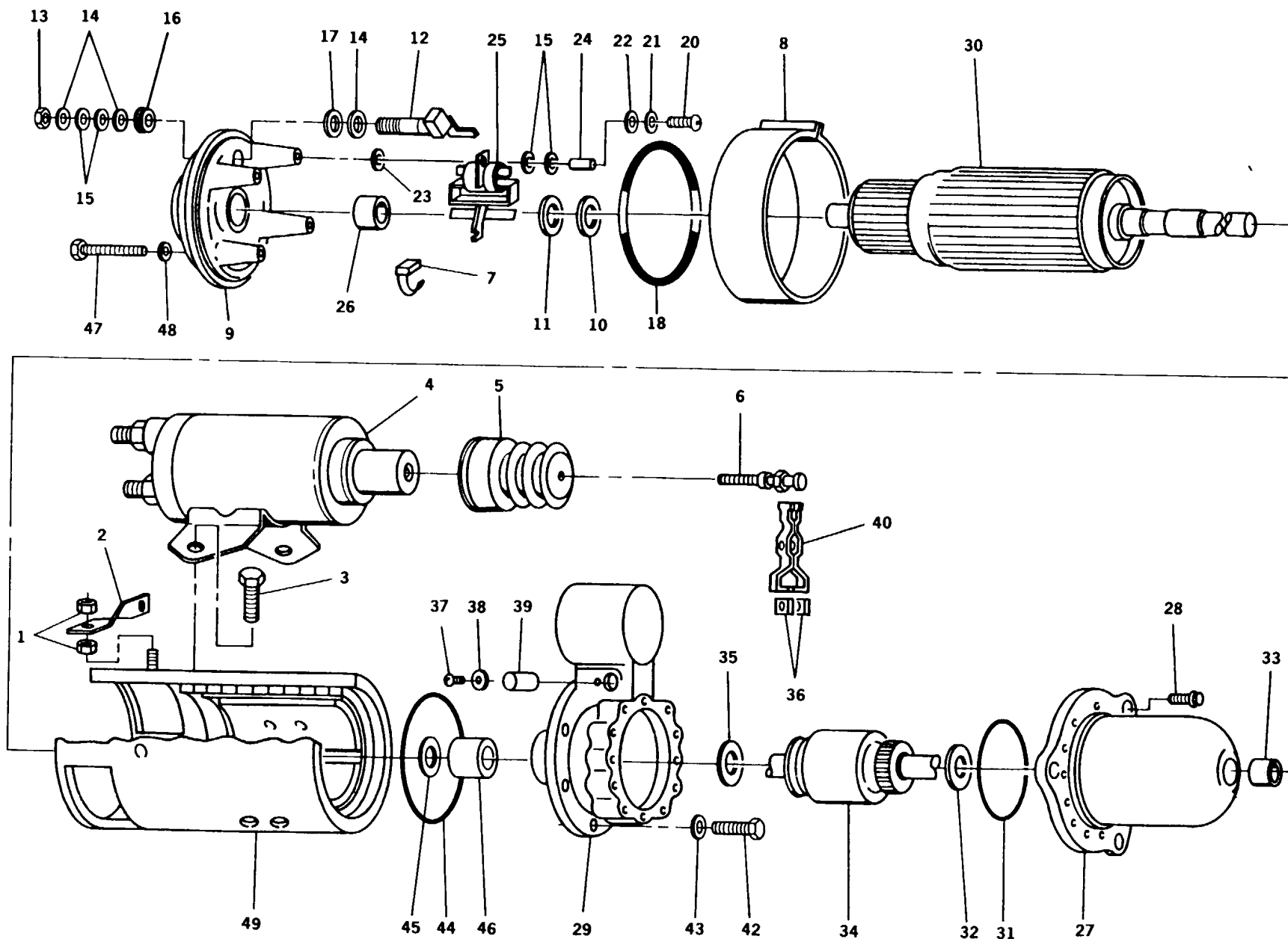
- a. Remove access cover (8) and brushes (7).



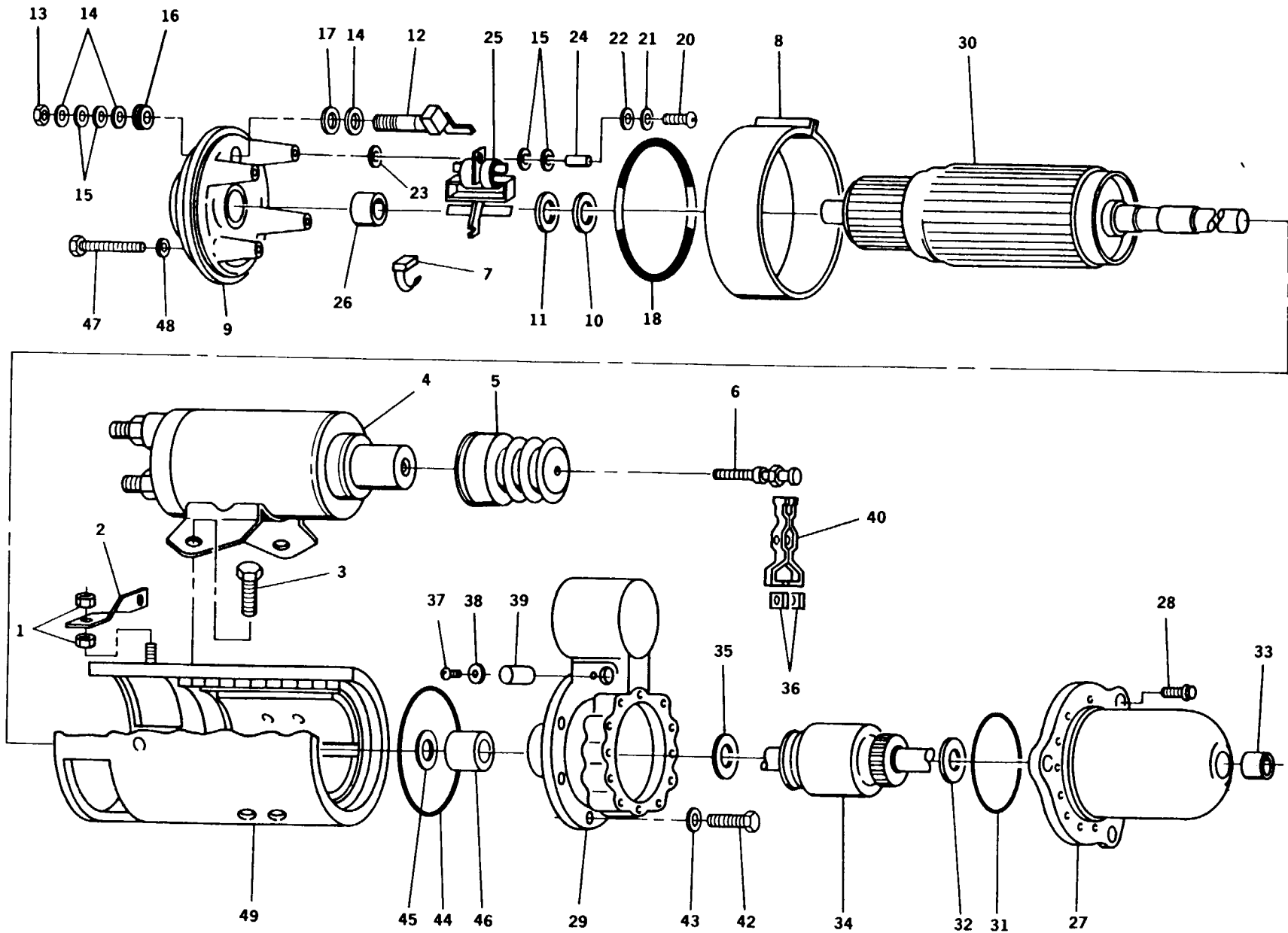
- b. Inspect brushes (7) for wear. Brushes less than 5/8" in length must be replaced.
3. REMOVE HOUSING (9).
 - a. Remove ground jumper wire from housing (9).
 - b. Mark housing (9) in relation to the field ring (49) with a punch.
 - c. Remove four hex head screws (47), lockwashers (48) and housing (9). Remove and discard preformed packing (18) and lockwashers.
 - d. Remove fiber washer (10) and steel washer (11) from armature (30).
 - e. Match mark jumper and screw assembly (12) to housing (9). Remove nut (13), washer guards (14), belleville washers (15), insulator (16), insulator washer (17) and jumper and screw assembly (12). Note position of hardware and retain for assembly.
 - f. Remove screws (20), lockwashers (21), washer guards (22), insulation washers (23), insulation bushings (24) and brush holders (25). Discard lockwashers.
 - g. If necessary, using a suitable puller, remove bushing (26) from housing (9).
 4. REMOVE ARMATURE (30).
 5. REMOVE ENGINE DRIVE HOUSING (27).
 - a. Match mark shift housing (29) engine drive housing (27) and field ring (49).
 - b. Remove six socket head capscrews (28).
 - c. Tap flange of engine drive housing (27) and separate housing (27) from shift housing (29).
 - d. Remove packing (31) and steel washer (32). Discard packing (31).
 - e. If necessary, remove bushing (33) from housing (27) using a suitable driver.
 6. REMOVE ENGINE DRIVE (34).
 - a. Remove engine drive (34) and washer (35).
 - b. Remove cams (36).
 - c. Remove socket head screw (37) and washer (38) from shift housing (29). Remove shift lever shaft (39) and shift lever (40).
 7. REMOVE SHIFT HOUSING (29).
 - a. Remove socket head screws (42), lockwashers (43) and shift housing (29). Discard lockwashers (43).
 - b. Remove and discard packing (44) and seal (45).
 - c. If necessary, using a suitable driver, remove bushing (46) from housing (29).

INSPECTION:

1. INSPECT BRUSH HOLDERS (25) FOR DAMAGE.
 - a. Insert new brush (7) in each brush slot in each of the four brush holders (25). If brush does not move freely in one of slots, then that brush holder (25) must be replaced.



- b. Inspect each of four brush holders (25). Discoloration, burns or signals of high temperatures indicates defective or improperly assembled insulators.
2. TEST BRUSH HOLDER (25) INSULATION.
 - a. Connect multimeter test leads to two brush holders that share a common mounting post.
 - b. A LOW resistance reading indicates that an insulator bushing (24) or washer (23) is defective and must be replaced. Repeat this test at each of four pounting posts.
3. TEST BRUSH HOLDER (25) GROUND.
 - a. Connect one multimeter test lead to a bare metal surface on housing (9) and second test lead to each of four brush holders (25).
 - b. LOW resistance indicates a grounded brush holder caused by defective insulator(s).
4. INSPECT INSULATOR BUSHINGS (24) FOR DAMAGE.
 - a. Inspect each insulator bushing (24) for breaks, cracks or burns.
 - b. Remove damaged insulator bushings (24).
5. TEST JUMPER AND SCREW ASSEMBLY (12).
 - a. Connect multimeter test leads to a bare metal surface on housing and jumper and screw assembly (12).
 - b. LOW resistance indicates defective insulation bushing(s) or washer(s).
6. INSPECT BUSHINGS (26) and (33) FOR WEAR.
 - a. Measure inside diameter of each bushing (26) and (33).
 - b. Remove bushings (26) and (33) if measurement is greater than .753 inch.
7. INSPECT ENGINE DRIVE (34) FOR DAMAGE.
 - a. Rotate engine drive (34) in both directions. If drive does not move freely (in and out) replace drive.
 - b. Inspect engine drive (34) splines for damage and wear. Replace drive if worn or damaged.
8. INSPECT ARMATURE (30) FOR DAMAGE.
 - a. Inspect armature (30) shaft splines for damage and wear.
 - b. Replace engine starter if armature is worn or damaged.
9. PERFORM ARMATURE (30) GROUND TEST.
 - a. Connect one multimeter test lead to armature (30) shaft (on spline end) and run second test lead across all commutator contacts.
 - b. LOW resistance indicates a ground and engine starter must be replaced.
10. PERFORM ARMATURE GROWLER TEST.
 - a. If armature (30) is grounded, replace entire engine starter.
11. INSPECT COMMUTATOR END OF ARMATURE (30) FOR DAMAGE.
 - a. Inspect commutator end for pits, scoring, excessive carbon and oil.



- b. Turn armature (30) (commutator end) if necessary in a lathe to remove surface pits, scoring and contamination. Minimum diameter after turning must be 2-1/16 inch. Maximum runout should be .003 inch TIR.

12. TEST FIELD COIL FOR GROUND.

- a. Connect one multimeter test lead to a bare metal surface on the field ring (49) and the second test lead to each of the two field coil jumpers.
- b. LOW resistance indicates a ground. If grounded, engine starter must be replaced.

13. INSPECT FIELD RING (49) FOR DAMAGE.

- a. Inspect field ring (49) for burn marks.
- b. Inspect pole pieces for wear. If other field pieces and armature show wear, replace bushings (26) and (33).

CLEANING:

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If

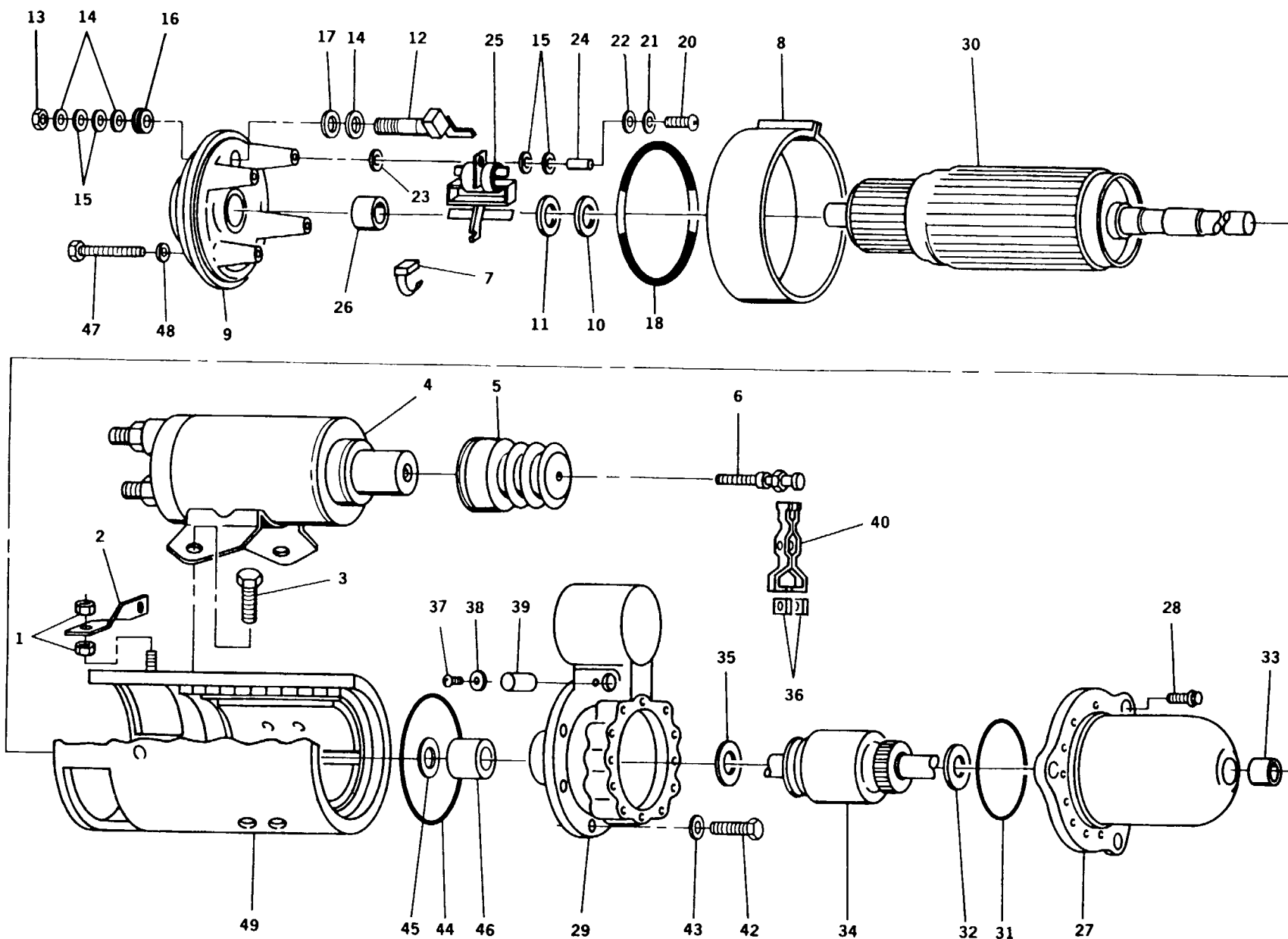
contact with eyes is made, wash your eyes with water and get medical aid immediately.

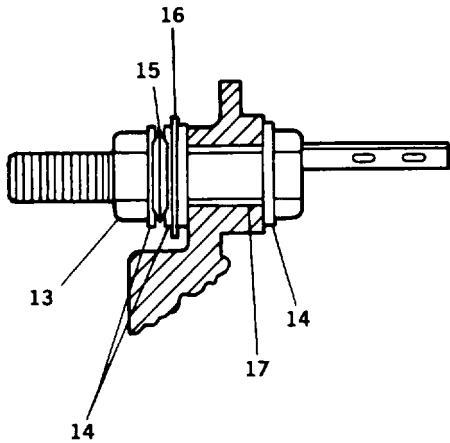
Compressed air used for cleaning purposes will not exceed 30 psi. Use only with effective chip guarding and personal protective equipment (goggles/ shield, gloves, etc.).

- 1. CLEAN ALL METAL PARTS IN SOLVENT P-D-680.
- 2. USE LOW-PRESSURE COMPRESSED AIR TO DRY PARTS.

REASSEMBLY:

- 1. IF REMOVED, INSTALL BUSHING (26) IN HOUSING (9).
 - a. Ream bushing (26) ID to .754-inch.
 - b. Press bushing (26) into housing (9).
- 2. INSTALL JUMPER AND SCREW ASSEMBLY (12).
 - a. Slide washer guard (14) and insulation washer (17) on assembly and insert into housing (9).
 - b. Align jumper and screw assembly with markings made at disassembly.
 - c. Install insulation washer (16), guard washer (14), two belleville washers (15) (face-to-face) and guard washer (14).
 - d. Install hex nut (13) and torque to 33-37 ft-lbs (44-49 Nm).



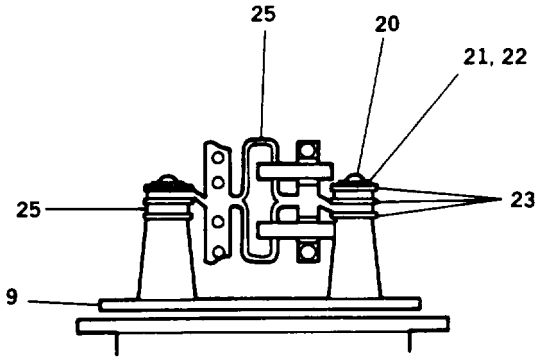


3. INSTALL BRUSH HOLDERS (25).

NOTE

Insulation bushings (24) must be installed so they pass through washers (23) and fit flush against the mounting posts.

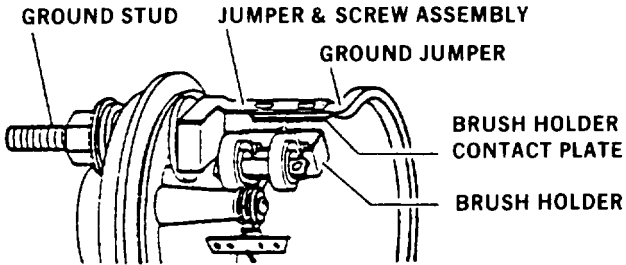
- a. Insert four guide pins in each of four housing mounting posts and slide an insulation bushing (24) and an insulation washer (23) on each of the four guide pins.
- b. Match one of four brush holders (25) to jumper and screw assembly (12) tab so two holes in tab are aligned with two tapped holes in brush holder contact plate.



- c. Mount brush holders (25) on the mounting posts with insulation washers (23), washer guards (22), new lockwashers (21) and screws (20).
4. TEST BRUSH HOLDER (25) INSULATION.
- a. Connect multimeter test leads to two brush holders (25) that share a common mounting post.
 - b. A LOW resistance reading indicates an insulator bushing (24) or washer (23) is defective or misaligned.
 - c. If necessary, remove and reinstall insulator bushings (24) and washers (23).

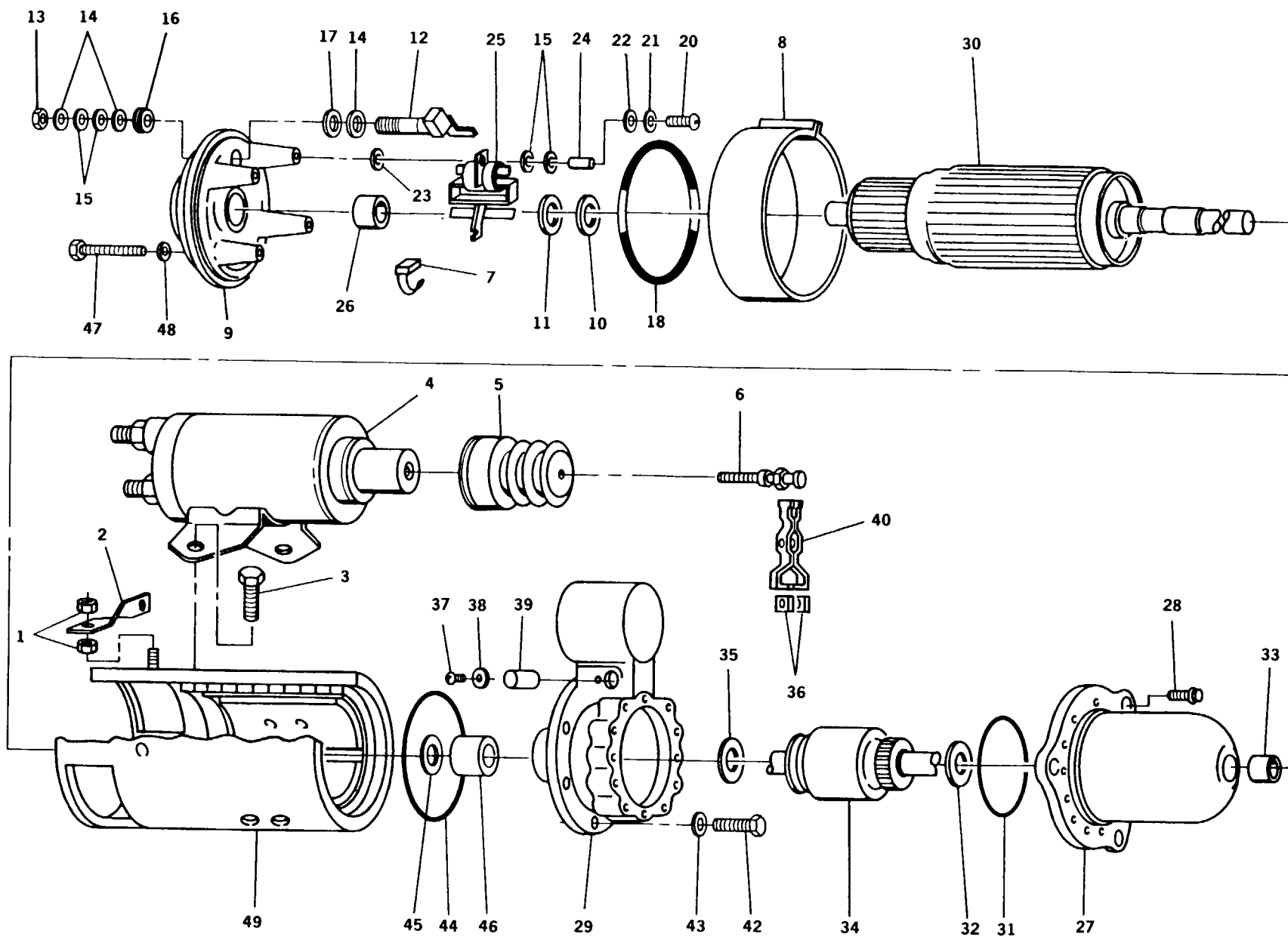
5. TEST BRUSH HOLDER GROUND.

- a. Connect one multimeter lead to bare surface on housing (9) and second test lead to each of four brush holders (25).
- b. A LOW resistance reading at any brush holder indicates a grounded brush holder.
- c. If necessary, remove and reinstall insulator bushings (24) and washers (23).

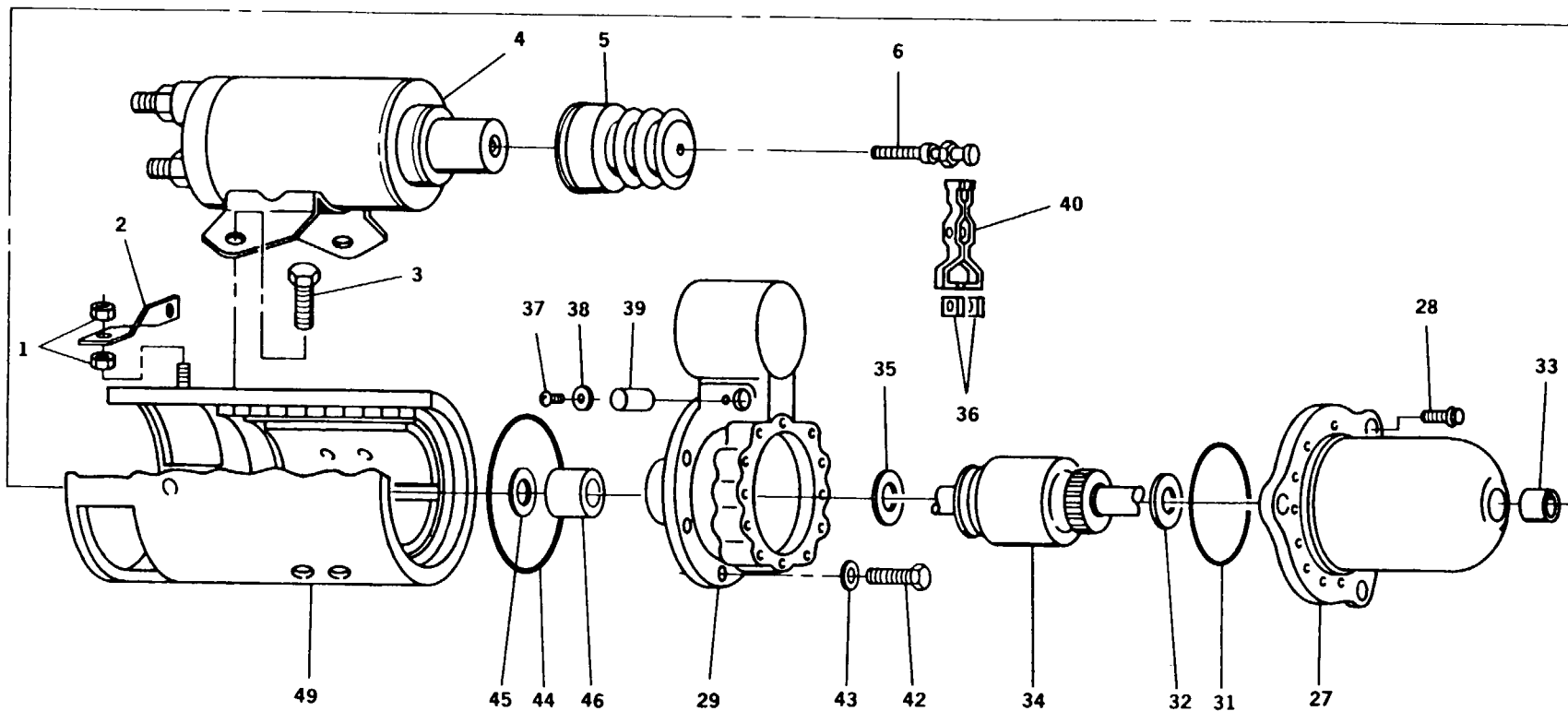
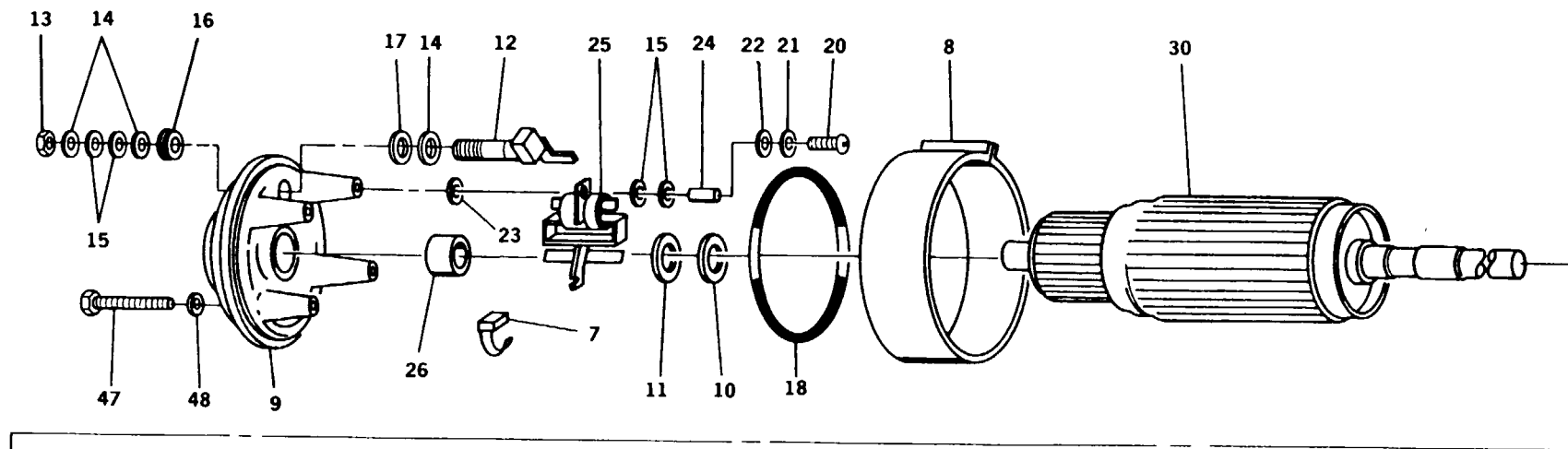


6. ASSEMBLE HOUSING (9) AND FIELD RING (49).

- a. Install new preformed packing (18).



- b. Match housing (9) to field ring (49) according to marks made at disassembly and align jumper and screw assembly (12) with ground jumper tab.
 - c. Press housing (9) flush with field ring (49). Insure that ground jumper tab meshes with jumper and screw assembly (12) and brush holder (25) contact plate.
 - d. Apply 1-2 drops of Loctite #2114 on four hex head screws (47). Use these screws plus new lock-washers (48) to secure housing (9) to field ring (49). Torque capscrews (48) to 62-66 in-lbs (7-8 Nm).
 - e. Install ground jumper wire.
7. INSTALL ARMATURE (30).
- a. Install fiber washer (10) and steel washer (11) on armature (30).
 - b. Apply film of SAE-10 grade oil on armature (30) shaft.
 - c. Slide armature (30) into field ring (49) and housing (9).
8. INSTALL BUSHING (46) AND SEAL (45).
- a. Using a suitable driver, install bushing (46) in shift housing (29).
 - b. Install seal (45) in shift housing (29).
9. INSTALL SHIFT LEVER (40).
- a. Position shift lever (40) in shift housing (29).
 - b. Secure shift lever (40) with lever shaft (39), socket head screw (37) and washer (38).
10. INSTALL ENGINE DRIVE (34).
- a. Apply film of SAE-10 grade oil on armature shaft (30) and splines.
 - b. Clamp field ring (49) with armature (30) installed in a vise.
 - c. Install new packing (44) on shift housing (29).
 - d. Slide shift housing (29) on armature shaft (30) so that shaft sticks out one inch on shift lever side of housing (29).
 - e. Install fiber washer (35) on armature (30). Washer (35) should be against shift housing (29).
 - f. Apply small amount of bearing grease to holes in shift lever cams (36) and to long sides of cams. Install cams (36) on shift lever (40).
 - g. Insert a finger in shift housing (29) and pull top of the shift lever (40) to swivel cams out of housing (29).
 - h. Adjust the angle of cams (36) so both point in same direction. Slide engine drive (34) on cams (36) so cams are riding in engine drive (34) channel. Slide engine drive (34) on armature (30) shaft and push shift housing (29) and engine drive (34) toward field ring (49) so that armature (30) shaft passes through drive assembly (34).
11. ASSEMBLE SHIFT HOUSING (29) AND FIELD RING (49).
- a. Press shift housing (29) against field ring (49). Insure that housing and field ring are aligned according to the marks made at disassembly.



- b. Apply 1-2 drops of Loctite #2114 to threads of five socket head capscrews (42).
- c. Install capscrews (42) and washers (43). Torque capscrews (42) to 108-132 in-lbs (12-15 Nm).

- c. Pull inside brush holder spring up and insert brush (7) in slot. Repeat this step to install outer brush.
- d. Install remaining brushes.

12. INSTALL ENGINE DRIVE HOUSING (27).

- a. If removed, install bushing (33) in engine drive housing (27) using a suitable driver.
- b. Install new packing (31) on engine drive housing (27).
- c. Slide bearing washer (32) on armature (30) shaft and place it against engine drive (34).
- d. Press engine drive housing (27) on armature (30) shaft and match alignment markings made at disassembly.
- e. Apply 1-2 drops of Loctite #2114 to threads of six socket head screws (28) and fasten engine drive housing to shift housing. Torque sockethead screws to 13-17 ft-lbs (17-23 Nm).
- f. Install rubber plugs in six engine drive housing holes not used.

13. INSTALL BRUSHES (7).

- a. Pass two screws through a lockplate and slide a brush terminal on each of two screws.
- b. Fasten brushes (7) to brush holder contact plate.

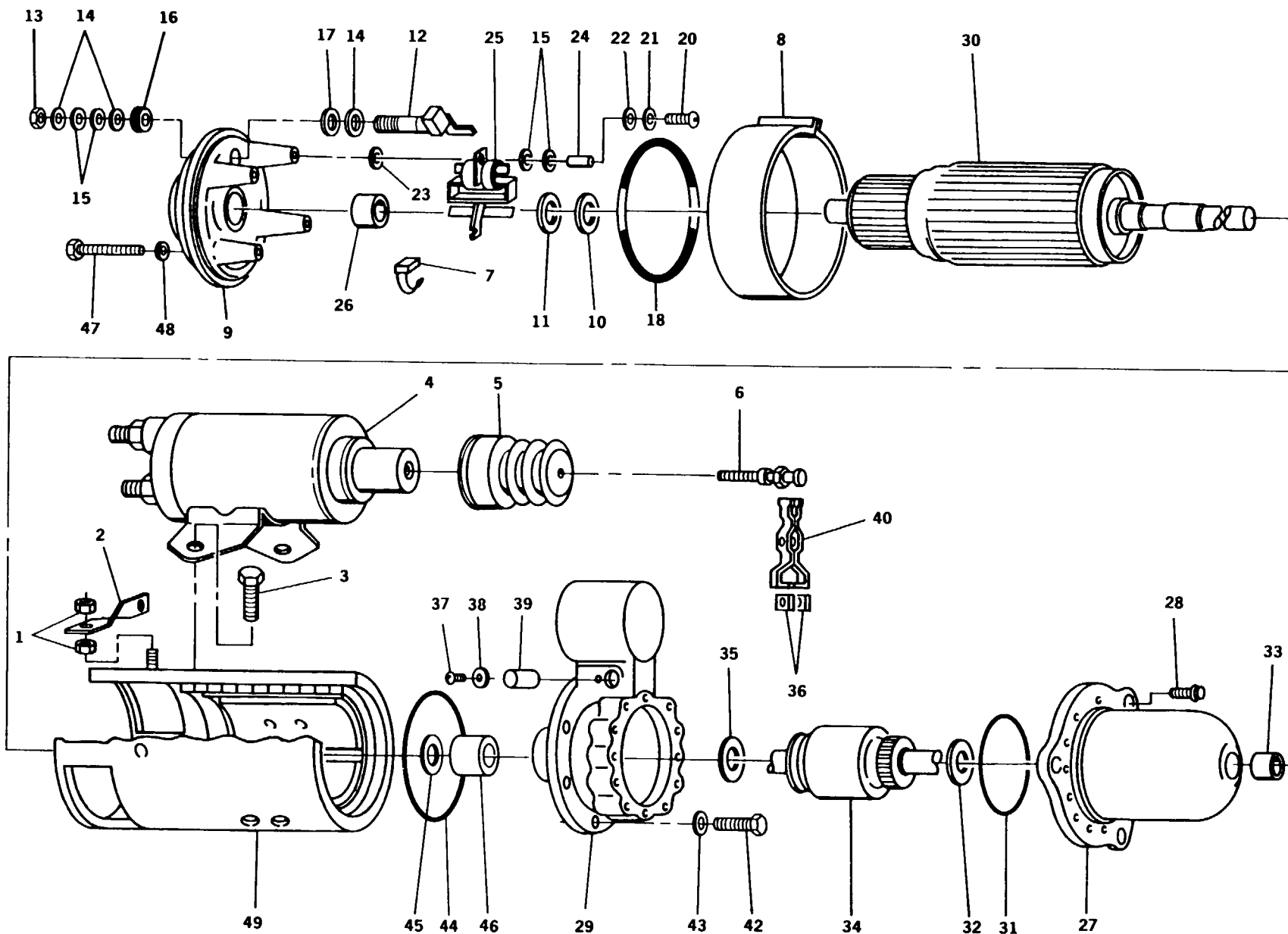
NOTE

Before installing band (8) insure that dirt, oil, or any other foreign matter is removed from the brush opening areas to insure proper sealing.

- e. Wrap access band (8) around four brush openings according to paint outline. Secure band with two screws and nuts.

14. INSTALL SOLENOID SWITCH (4).

- a. Slide closed end of boot (5) on link spool (6) up to hex shoulder.
- b. Wrap a strip of emery cloth around plunger of switch (4) twice to avoid nicks.
- c. Grip plunger with channel lock pliers and turn link spool (6) into switch (4) plunger. Torque link spool (6) to 27-33 in-lbs. (3-4 Nm).
- d. Install boot (5) into channel on switch (4).
- e. Turn solenoid switch (4) such that two mounting legs face away from field ring (49) and insert link spool (6) in shift housing (29).
- f. Hook link spool (6) in fork of shift lever (40).
- g. Turn solenoid switch (4) so that mounting legs rest on field ring



and press switch flush in shift housing.

- h. Apply 1-2 drops of Loctite #2114 to threads of two hex head screws (3) and secure solenoid switch (4) to field ring (49).

NOTE

Use an open wrench to support the bottom nut while tightening the top nut.

- i. Apply two drops of Loctite #2114 to the last 1/4" of switch (4), #3 terminal and field coil stud on field ring (49).

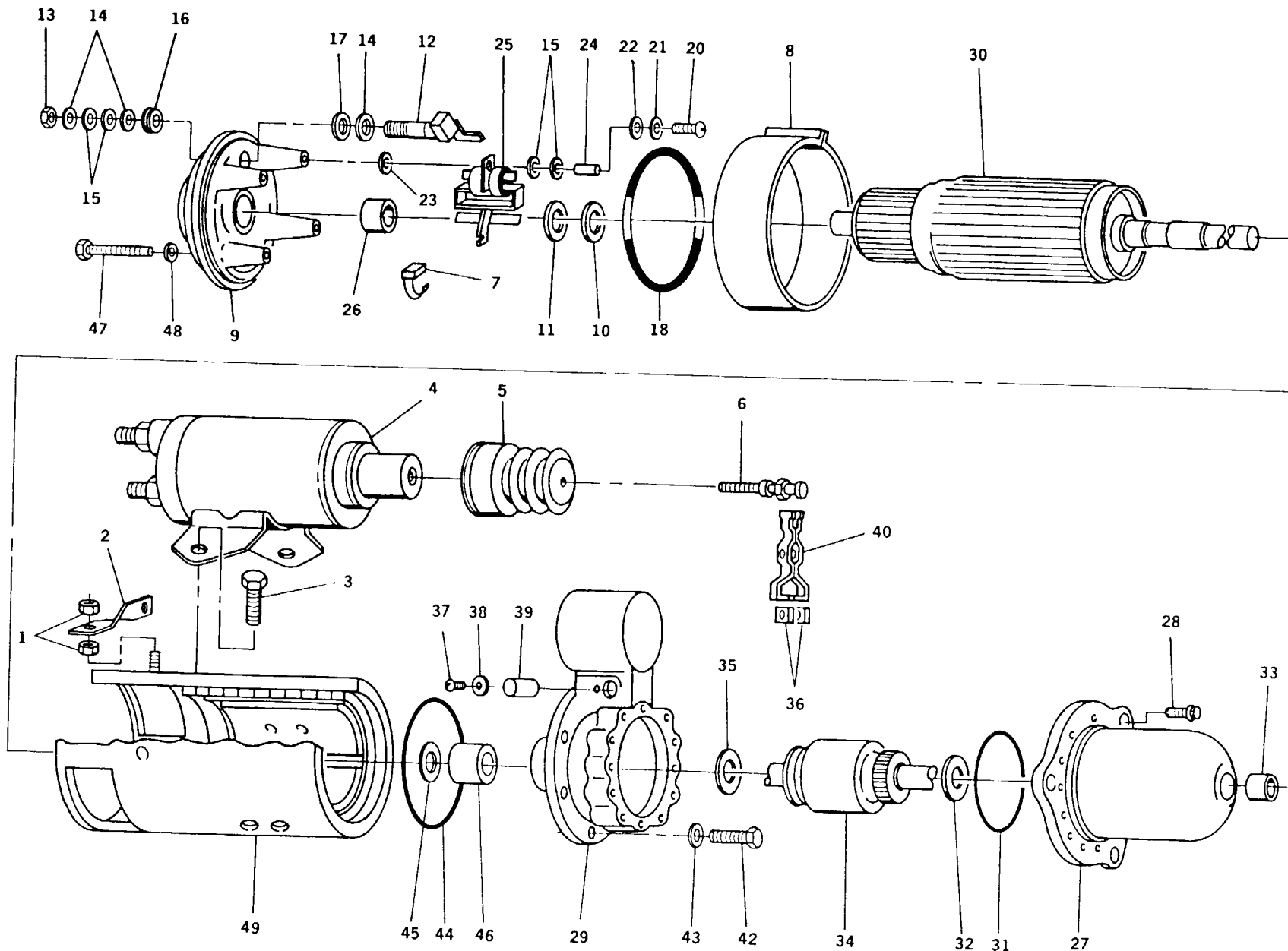
- j. Secure jumper strap (2) with nuts (1). Torque #3 terminal nut to 33-37 ft. lbs. (44-49 Nm) and field coil nut to 18-22 ft. lbs (24-29 Nm).
- k. Install ground wire to switch (4) terminal #4 and to ground stud on housing (9). Torque terminal #4 connection to 43-47 in lbs (5-6 Nm).

NOTE

Ground stud connection is made finger-tight only.

- l. Install rubber plug in plastic end base access hole.

END OF TASK



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CHAPTER 7
TRANSMISSION MAINTENANCE

CHAPTER INDEX

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Section I. TORQUE CONVERTER MAINTENANCE

TORQUE CONVERTER INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Lifting device (275 lbs. capacity)

SUPPLIES: Loctite #242 (Item 6, Appendix B)
Loctite #545 (Item 18, Appendix B)
Screw, self-locking (Item 231, Appendix B)

EQUIPMENT CONDITIONS: Outriggers fully extended and lowered. (Refer to TM 5-3810-306-10.)
Boom positioned over side. (Refer to TM 5-3810-306-10.)
Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)
Engine top hood and rear decking removed. (Refer to TM 5-3810-306-20.)
Transmission oil drained. (Refer to LO 5-3810-306-12.)
Propeller shaft to torque converter removed. (Refer to TM 5-3810-306-20).

REMOVAL:

1. TAG AND DISCONNECT ELECTRICAL WIRES TO TORQUE CONVERTER (1).
2. TAG AND REMOVE HYDRAULIC LINES TO TWO HYDRAULIC PUMPS (7) AND (8) AND CONVERTER CHARGING PUMP (11). PLUG OR CAP OPENINGS.

NOTE

Tie lines up to prevent leakage.

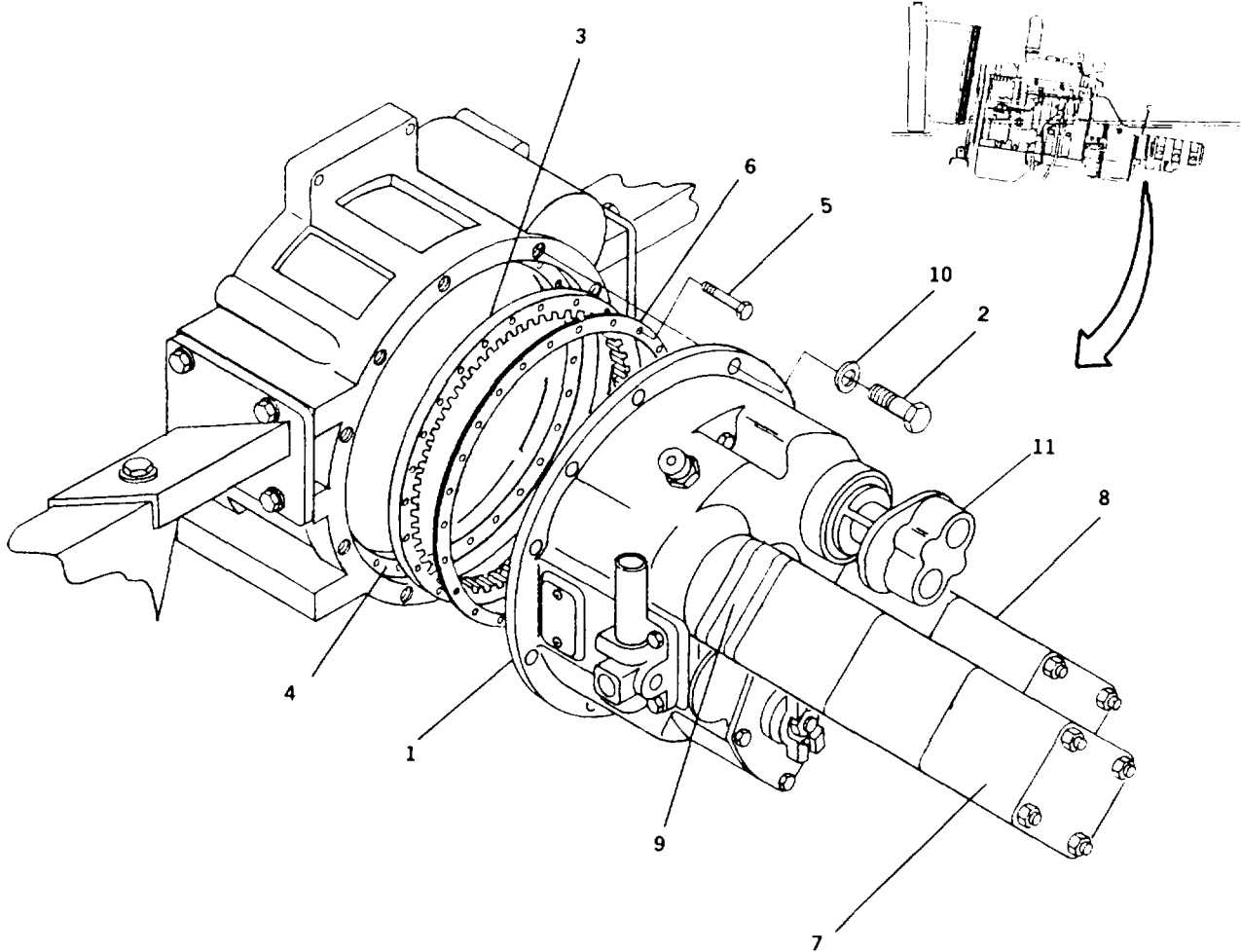
3. REMOVE TORQUE CONVERTER (1).

NOTE

Torque converter weighs approximately 267.50 pounds (121.34 kg) dry.

- a. Attach an adequate lifting strap around torque converter and take up any slack.
- b. Remove twelve bolts (2) and washers (10) securing torque converter housing to engine flywheel housing.

- c. Remove torque converter from crane and move it to a clean work area.
4. REMOVE RING GEAR (3) FROM FLYWHEEL (4) IF NECESSARY.
 - a. Remove thirty two bolts (5) securing ring gear (3) to flywheel (4). Discard bolts (5).
 - b. Remove ring gear (3) and back-up ring (6).
5. REMOVE TWO HYDRAULIC PUMPS (7) AND (8) AND PUMP DISCONNECT (9), IF NECESSARY. (REFER TO CHAPTER 13.)
6. IF NEW TORQUE CONVERTER IS TO BE INSTALLED, REMOVE ALL COMPONENTS AND INSTALL THEM ON NEW TORQUE CONVERTER IN SAME LOCATION.



INSTALLATION

NOTE

The torque converter weighs approximately 267.50 pounds (121.34 kg) dry.

1. IF NEW CONVERTER IS TO BE INSTALLED, ENSURE ALL COMPONENTS FROM OLD ONE ARE INSTALLED ON NEW ONE.
2. INSTALL PUMP DISCONNECT (9), IF REMOVED, AND BOTH HYDRAULIC PUMPS (7) AND (8). (REFER TO CHAPTER 13.)
3. IF REMOVED, INSTALL RING GEAR (3) ON FLYWHEEL (4).
 - a. Remove all burrs from flywheel mounting face and pilot bores. Clean torque converter ring gear flywheel mounting surface and

ring gear screw tapped holes with solvent. Dry thoroughly, being certain ring gear screw holes are dry and clean.

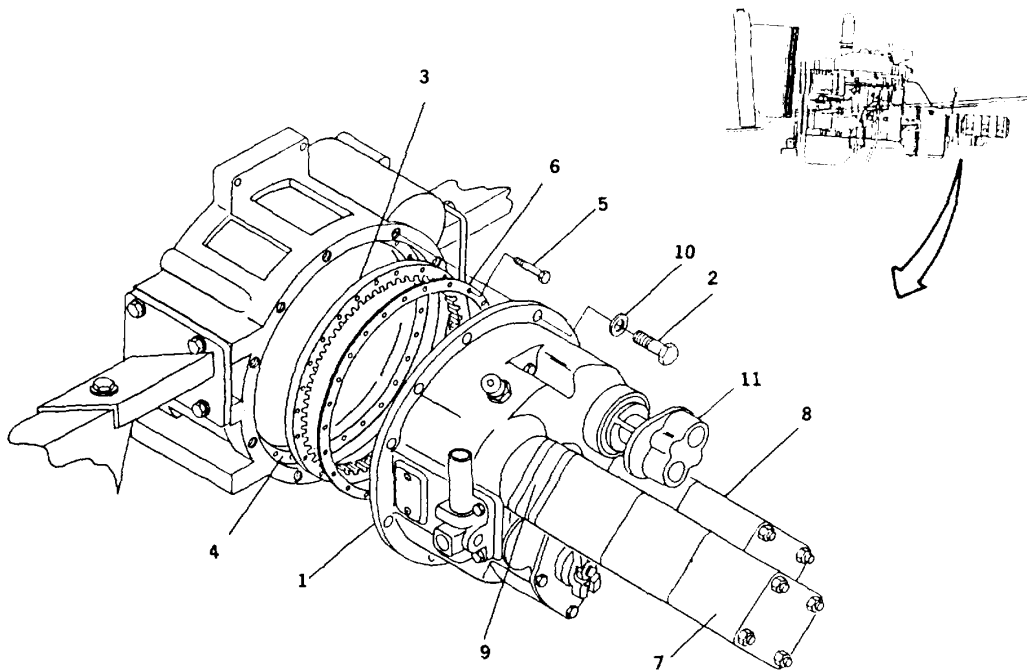
- b. Install torque converter ring gear (3) as shown.

NOTE

Apply Loctite #242 to mounting bolts (5).

NOTE

Assembly of ring gear must be completed within a fifteen minute period from start of screw installation.



- c. Install backing ring (6) and thirty-two special screws (5). Tighten screws to 23-25 ft-lbs (30-33 Nm). The special screws are to be used for ONE installation only. If screws are removed for any reason, they **MUST BE REPLACED**. Remove epoxy left in flywheel hole with the proper tap and clean with solvent. Dry hole thoroughly and use a **NEW** screw for reinstallation.
4. USING AN ADEQUATE LIFTING STRAP AROUND TORQUE CONVERTER. LIFT AND MOUNT TORQUE CONVERTER TO FLYWHEEL HOUSING. SECURE WITH TWELVE BOLTS (2) AND WASHERS (10).
 - a. Measure and record engine crankshaft end play at flywheel.
 - b. Assembly torque converter to engine flywheel by sliding converter into position by hand before fastening housing attachment screws. This may require more than one trial to match drive gear teeth. Pulling converter into position with housing attachment bolts is not recommended.
 - c. Install twelve bolts (2) and washers (10) securing torque converter to flywheel housing.
 - d. Measure engine crankshaft end play after assembly of torque converter. This value must be within one thousandth (.001) of an inch of end play recorded (Step a) before assembly of torque converter.
 5. CONNECT TAGGED ELECTRICAL WIRES TO TORQUE CONVERTER.
 6. REMOVE CAPS AND PLUGS, INSTALL HYDRAULIC LINES TO TWO HYDRAULIC PUMPS (7) AND (8) AND CONVERTER CHARGING PUMP (11).
 7. INSTALL PROPELLER SHAFT. (REFER TO TM 5-3810-306-20.)
 8. INSTALL REAR DECKING AND HOOD. (REFER TO TM 5-3810-306-20.)
 9. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
 10. SERVICE THE TRANSMISSION HYDRAULIC SYSTEM. (REFER TO PAGE 7-61.)
 11. SERVICE CRANE HYDRAULIC SYSTEM. (REFER TO LO 5-3810-306-12.)
 12. TEST FOR PROPER OPERATION AND INSPECT FOR LEAKS.

END OF TASK

TORQUE CONVERTER ASSEMBLY

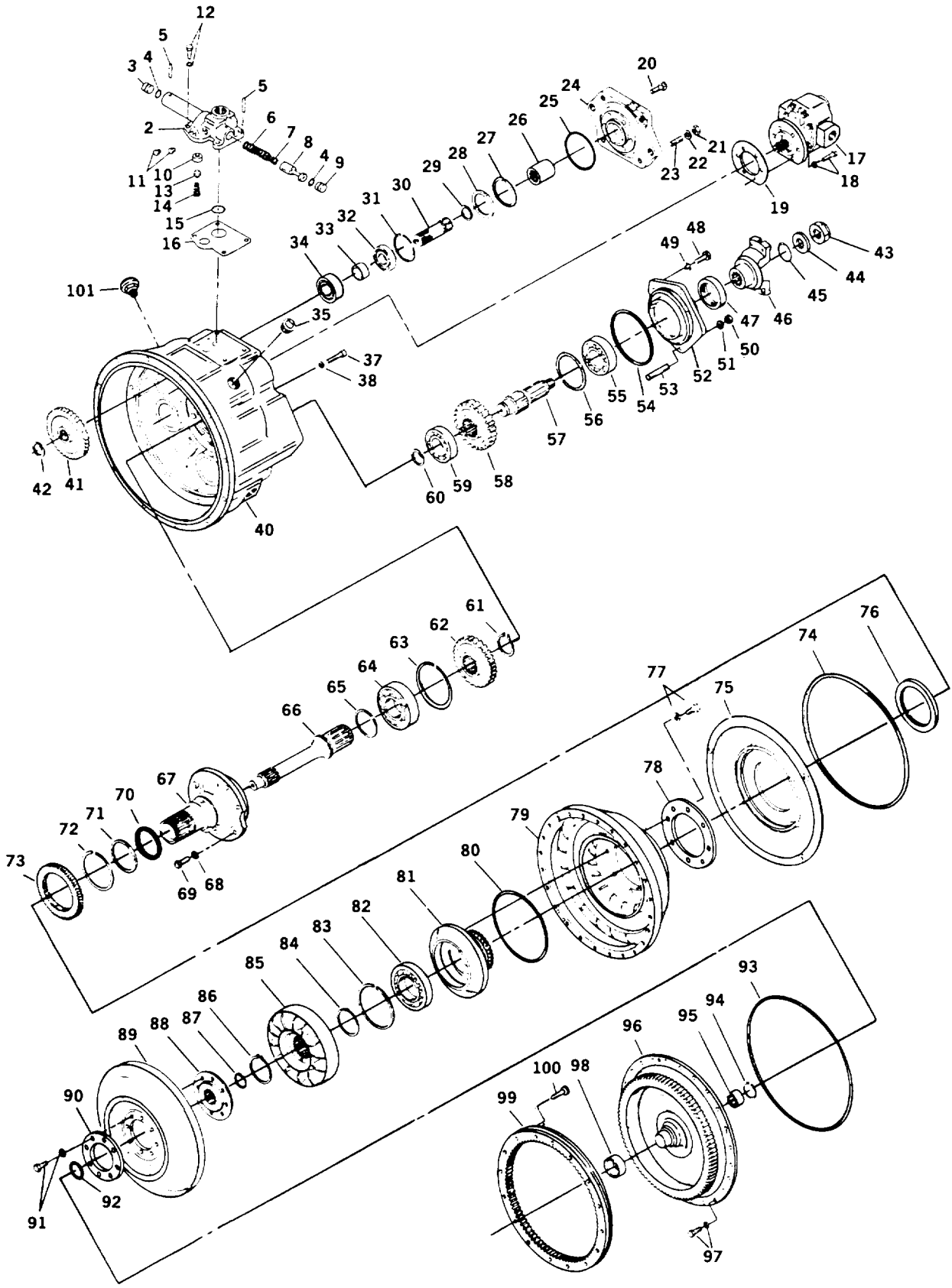
TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Lubrication Service, Unit Trailer Mtd (49300-00-107-9167)
 Shop Equipment Contact Maintenance Truck Mtd (4930-00-294-9518)
 Shop Equipment Electrical Repair Semi-trailer Mtd (4940-01-150-3113)
 Shop Equipment Machine Shop, FM Heavy Less Power (3470-00-754-0738)
 Shop Equipment Machine Shop; FM Heavy Suppl No. 1 (3470-00-754-0739)
 Shop Equipment Machine Shop; FM Basic (3470-00-754-0708)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1
 (4910-00-754-0706)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 2
 (4910-00-754-0707)
 Tool Outfit Hyd System; Test and Repair, 3/4 Ton Trailer Mtd.
 (4940-01-036-5784)

SUPPLIES: Oil MIL-L-2104 SAE 10 (Item 94, Appendix B)
 Solvent, P-D-680 Type II (Item 1, Appendix B)
 Permatex No. 2 (Item 31, Appendix B)
 Preformed packing (Item 166, Appendix B) (2 Required)
 Safety valve seat (Item 167, Appendix B)
 Preformed packing (Item 168, Appendix B)
 Gasket (Item 169, Appendix B)
 Gasket (Item 170, Appendix B)
 Lockwasher (Item 171, Appendix B) (4 Required)
 Preformed packing (Item 172, Appendix B)
 Retaining ring (Item 173, Appendix B)
 Retaining ring (Item 174, Appendix B)
 Retaining ring (Item 175, Appendix B)
 Retaining ring (Item 176, Appendix B)
 Preformed packing (Item 177, Appendix B)
 Lockwasher (Item 25, Appendix B) (5 Required)
 Preformed packing (Item 178, Appendix B)
 Retaining ring (Item 153, Appendix B)
 Retaining ring (Item 122, Appendix B)
 Retaining ring (Item 179, Appendix B)
 Lockwasher (Item 180, Appendix B) (6 Required)
 Retaining ring (Item 181, Appendix B)
 Preformed packing (Item 182, Appendix B)
 Plain encased seal (Item 183, Appendix B)
 Preformed packing (Item 184, Appendix B)
 Retaining ring (Item 185, Appendix B)
 Retaining ring (Item 186, Appendix B)
 Retaining ring (Item 187, Appendix B) (2 Required)
 Preformed packing (Item 188, Appendix B)
 Retaining ring (Item 189, Appendix B)

EQUIPMENT CONDITION: Torque converter removed. (Refer to page 7-2)

DISASSEMBLY:

1. REMOVE PUMP (17).
 - a. Remove capscrews (18) and pump (17).
 - b. Remove and discard gasket (19).
2. REMOVE IMPELLER COVER (96).
 - a. Remove twenty-four capscrews (97).
 - b. Locate slots in impeller (79) and using two prybars, remove impeller cover (96).
 - c. If necessary, use puller to remove sleeve (98).
 - d. Using snap ring pliers remove retaining ring (94).
 - e. Using small inside bearing puller remove bearing (95).
3. REMOVE TURBINE (89).
 - a. Remove retaining ring (92).
 - b. Remove turbine (89) with hub (88).
 - c. If necessary, remove capscrews (91), spacer (90) and separate hub (88) and turbine (89).
4. REMOVE REACTION MEMBER (85).
 - a. Remove retaining ring (86).
 - b. Remove retaining ring (87).
 - c. Remove reaction member (85).
 - d. Remove spacer (84).
5. REMOVE OIL BAFFLE (75).
 - a. Remove three screws (37) and lockwashers (38) part way.
 - b. Lightly tap each screw to unseat oil baffle (75).
 - c. Remove screws (37) and lockwashers (38). Discard lockwashers (38).
 - d. Remove oil baffle (75) with impeller (79) from housing (40).
 - e. Separate oil baffle (75) from impeller (79).
 - f. Remove retaining ring (72) and gear (73) from hub (81).
 - g. Remove and discard seal (76) and packing (74) from oil baffle (75).
6. REMOVE HUB (81).
 - a. Remove twelve bolts (77) and spacer plate (78).
 - b. Separate impeller (79) and hub (81).
 - c. Remove and discard preformed packing (80).
7. REMOVE BEARING (82).
 - a. Remove retaining ring (83).
 - b. Press bearing (82) from hub (81).
8. REMOVE THREE SPUR GEARS (41).
 - a. Remove retaining rings (42).
 - b. Remove spur gears (41).
9. REMOVE STATOR SUPPORT (67).
 - a. Remove six capscrews (69) and lockwashers (68). Discard lock-washers (68).
 - b. Remove stator support (67).



10. REMOVE SPUR GEAR (62).

- a. Remove retaining ring (61).
- b. Remove spur gear (62).

11. REMOVE SHAFT (66).

- a. Remove retaining ring (63).
- b. Press shaft (66) from stator support (67).
- c. Remove bearing (64).
- d. Remove and discard ring seal (65) and piston rings (70) and (71).

12. REMOVE RETAINER (52).

- a. Remove three machine bolts (48) and lockwashers (49).
- b. Remove two nuts (50) and lockwashers (51).
- c. Remove retainer (52) and preformed packing (54). Discard packing (54).
- d. Remove seal (47).

13. REMOVE YOKE (46).

- a. Secure shaft (57) in vise with protected jaws.
- b. Remove nut (43), washer (44) and preformed packing (45). Discard packing (45).
- c. Remove yoke (46).

14. REMOVE SHAFT (57).

- a. Expand special ring (56) and remove shaft (57) with bearings (55) and (59).
- b. Remove retaining ring (60), bearing (59), spur gear (58) and bearing (55).

NOTE

Special ring (56) remains in housing (52).

15. REMOVE RETAINING PLATE (24).

- a. Remove six screws (20), nut (21) and lockwasher (22).
- b. Remove retaining plate (24) and packing (25). Discard packing (25).

16. REMOVE THREE COUPLINGS (26).

NOTE

Remove couplings (26) if not removed with pump.

17. REMOVE THREE GEARSHAFTS (30).

- a. Remove retaining rings (27) and spacer rings (28).

NOTE

Mark location of longer gearshaft for reassembly.

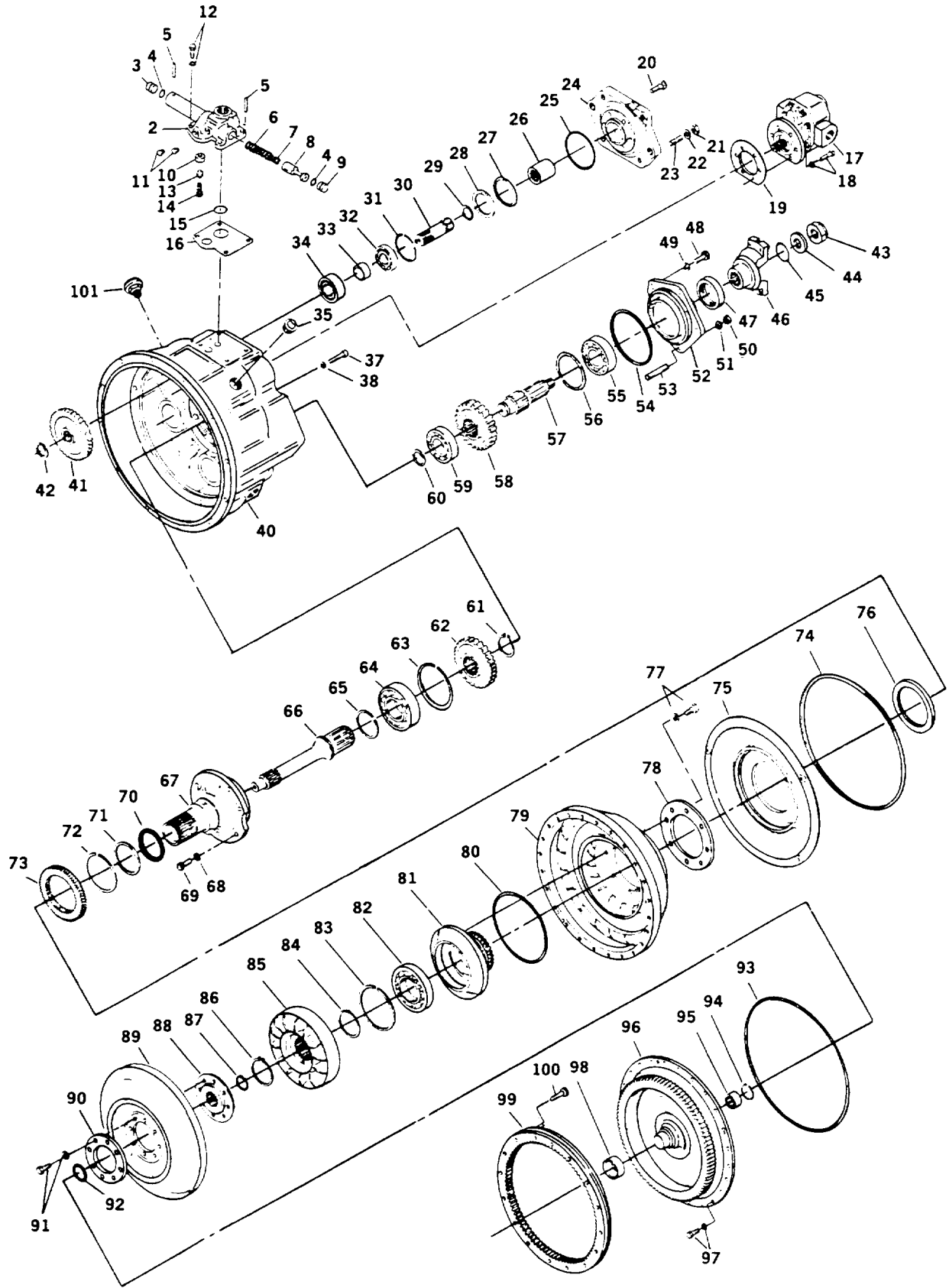
- b. Remove gearshafts (30).
- c. Remove retaining rings (29) and (31).
- d. Press bearings (32) and (34) and spacers (33) from gearshafts (30).

18. REMOVE VALVE (2).

NOTE

Use care to avoid losing seat (10), plunger (13) and spring (14) when removing valve (2).

- a. Remove four capscrews with washers (12) and valve (2).
- b. Remove and discard preformed packing (15) and gasket (16).



- c. Depress stop (9) and remove pin (5).
- d. Remove piston (8) and springs (6) and (7).
- e. Remove opposite side pin (5) and stop (3).
- f. Remove and discard two preformed packings (4).

19. IF NECESSARY, REMOVE VACUUM VALVE (101).

CLEANING:

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

- 1. CLEAN ALL PARTS THOROUGHLY.
 - a. Immerse all parts in dry cleaning fluid P-D-680 Type II.

- b. Agitate parts up and down to remove all old lubricant and foreign material.

2. CLEAN BEARINGS.

- a. Remove bearings from dry cleaning fluid.
- b. Gently strike bearings against a block of wood to remove solid lubricant particles.
- c. Immerse bearings in dry cleaning fluid.
- d. Repeat steps a. thru c. Until bearings are clean.
- e. Dry bearings using dry compressed air.

CAUTION

Do not direct air stream across bearing surfaces causing bearings to spin. Otherwise bearing damage could result.

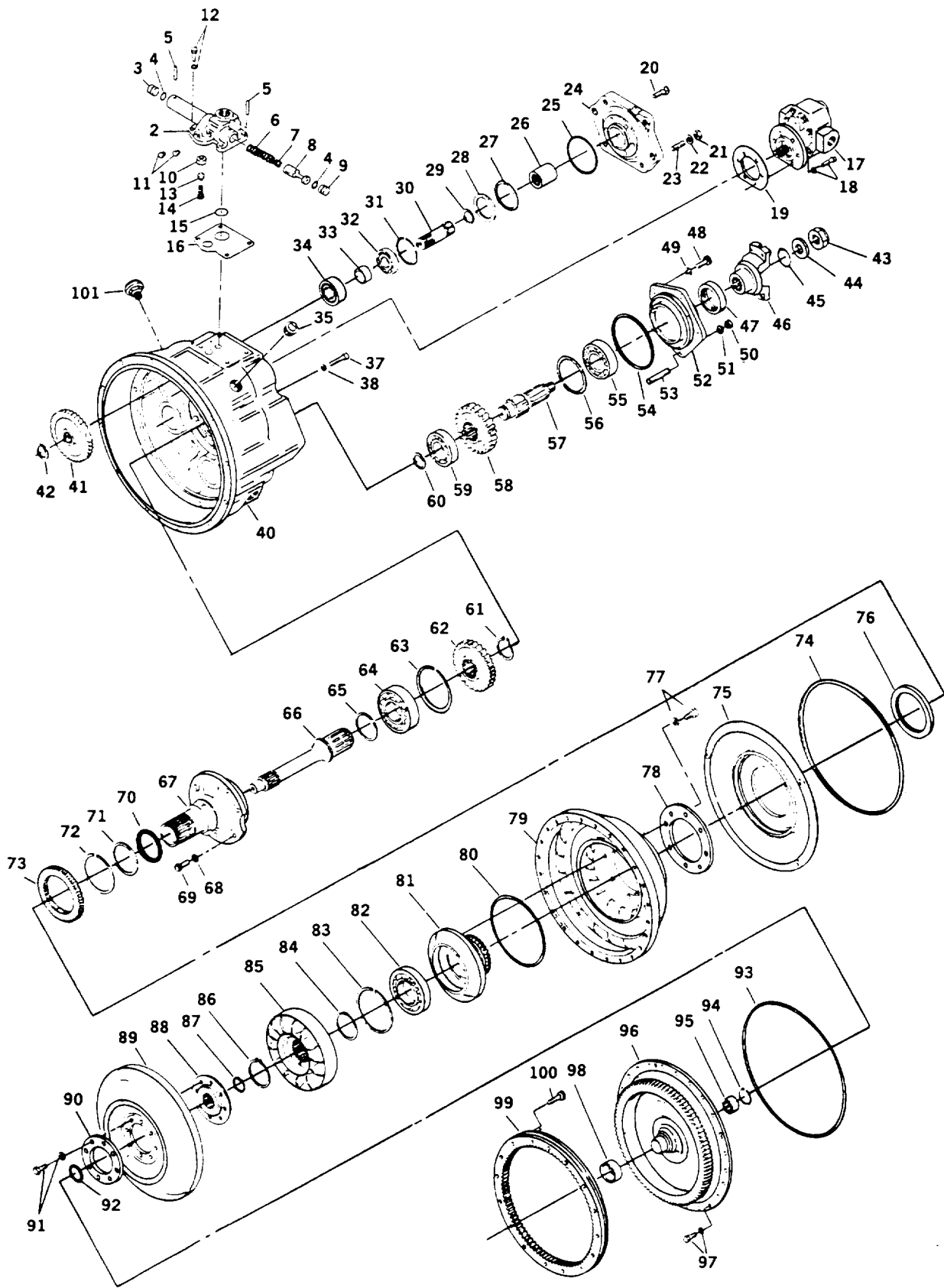
- f. Rotate bearings slowly by hand to aid in drying.

4. CLEAN HOUSINGS.

WARNING

Care should be exercised to avoid skin rashes and the inhalation of vapors when using alkali cleaners.

- a. Clean interior and exterior housings, bearing Caps, etc.
- b. Cast parts (without polished or ground surfaces) can be cleaned in hot solution tank with mild alkali solution.
- c. Ensure parts are thoroughly cleaned and heated.



- d. Rinse parts thoroughly with clean water to remove all traces of alkali.
- e. Thoroughly dry all parts with dry, compressed air and dry, lint-free cloths.

INSPECTION:

1. BEARINGS.

- a. Inspect rollers, cages and cups for wear, nicks and chips.

NOTE

Replace bearing cones and cups in matched sets.

- b. Dip bearings in oil MIL-L-2104 SAE 10 and wrap each in clean lint-free cloth.

2. GEARS AND SHAFTS.

- a. Using Magna-flux process, check all gears and shafts for cracks and damage.
- b. Examine teeth on all gears for wear, pitting, chipping, nicks, cracks or scores.
- c. Replace gears if case hardening is worn through.
- d. Remove small nicks with suitable hone.
- e. Inspect shafts and quills to ensure that they are not sprung, bent or twisted.

3. HOUSINGS AND COVERS.

- a. Inspect housings, covers and bearing caps for damage.
- b. Inspect mating surfaces for nicks or burrs.

ASSEMBLY:

1. PREPARE SEALS AND PACKINGS.

- a. Coat all preformed packings with oil MIL-L-2104 SAE 10.
- b. Coat all seals with oil MIL-L-2104 SAE 10.
- c. Apply thin coat of Permatex No. 2 on outside diameter of oil seal (47).

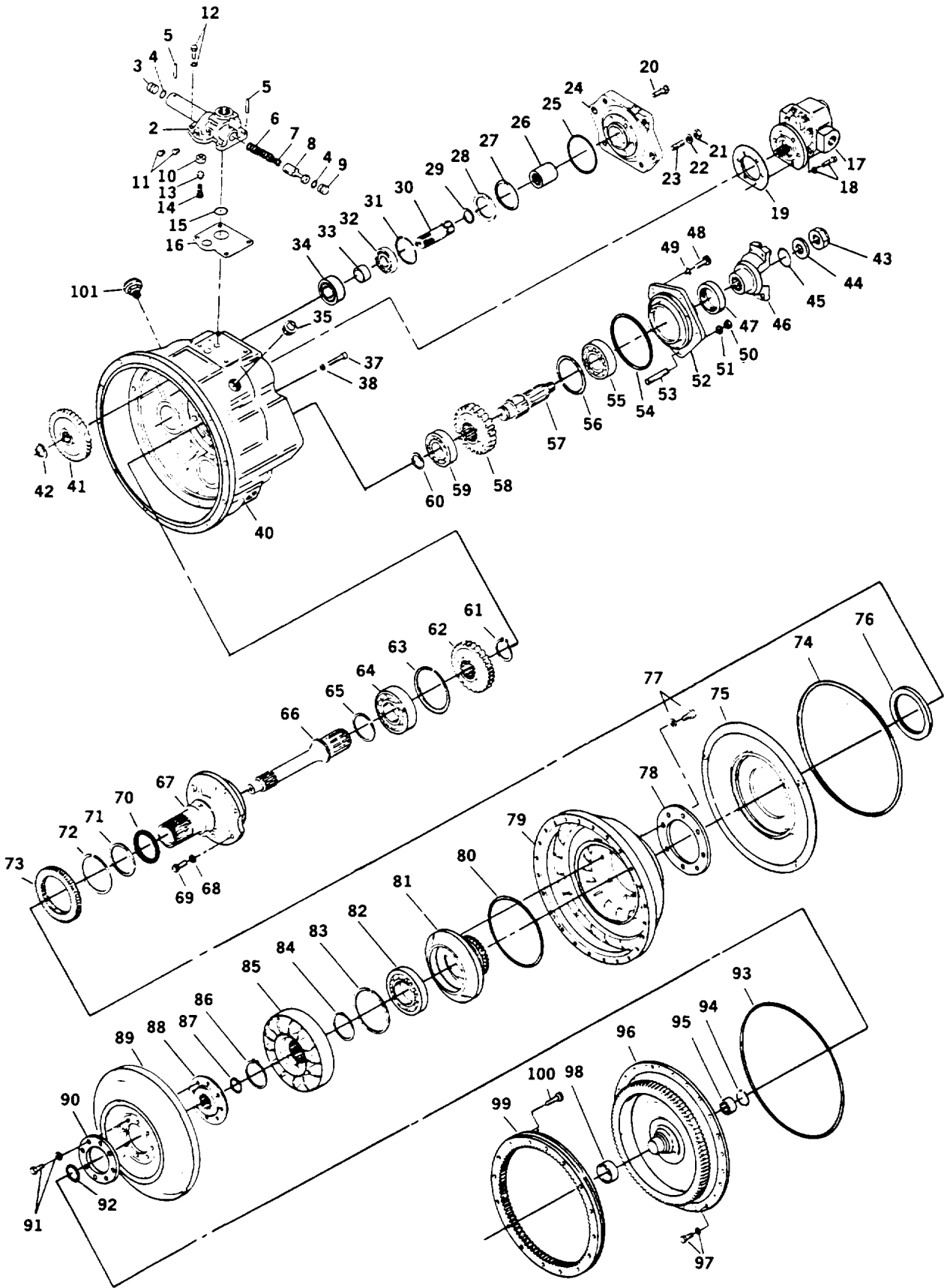
2. ASSEMBLE VALVE (2).

- a. Install springs (6) and (7) and piston (8) in housing (2).
- b. Install new preformed packings (4) in valve stops (3) and (9).
- c. Install new preformed packing (15) in housing (2).
- d. Install valve stop (9) and pin (5).
- e. Install valve stop (3).
- f. Depress valve stop (3) and install pin (5).

3. INSTALL THREE GEARSHAFTS (30).

Install longer shaft in location noted during disassembly.

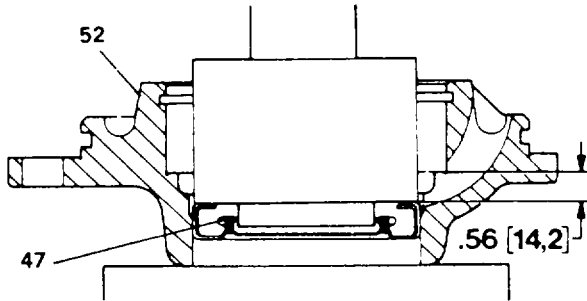
- a. Install retaining rings (29) toward rear of gearshafts (30).
- b. Press bearings (32) with retaining rings (31) on gearshafts (30).
- c. Install spacers (33) and press bearings (34) on gearshafts (30) until they shoulder against spacers (33).
- d. Install gearshafts (30) in housing (40).



- e. Tap gearshafts (30) until retaining rings (29) shoulder against bearing bore.
- f. Install spacer ring (28) and retaining ring (27).

4. INSTALL SHAFT (57).

- a. Press oil seal (47) into retainer (52). Press seal from inside of retainer to dimension shown.



- b. Press bearing (55) on shaft (57) and special ring (56).

CAUTION

Use care to avoid damage to oil seal (47).

- c. Press shaft (57) into retainer (52).
- d. Install spur gear (58) on shaft (57).
- e. Press bearing (59) on shaft (57) and install retaining ring (60).

5. INSTALL RETAINER (52).

- a. Secure shaft (57) in vise equipped with soft jaws.
- b. Install yoke (46), new preformed packing (45), washer (44) and nut (43).
- c. Torque nut (43) to 200-250 ft-lbs (271-338 Nm).

- d. Install new preformed packing (54) in retainer (52).
- e. Install retainer assembly (52) in converter housing (40).
- f. Install three machine bolts (48) with new lockwashers (49).
- g. Install two nuts (50) with new lockwashers (51).
- h. Torque machine bolts (48) and nuts (50) to 37-41 ft-lbs. (49-55 Nm).

6. INSTALL SHAFT (66).

- a. Press bearing (64) on shaft (66).

CAUTION

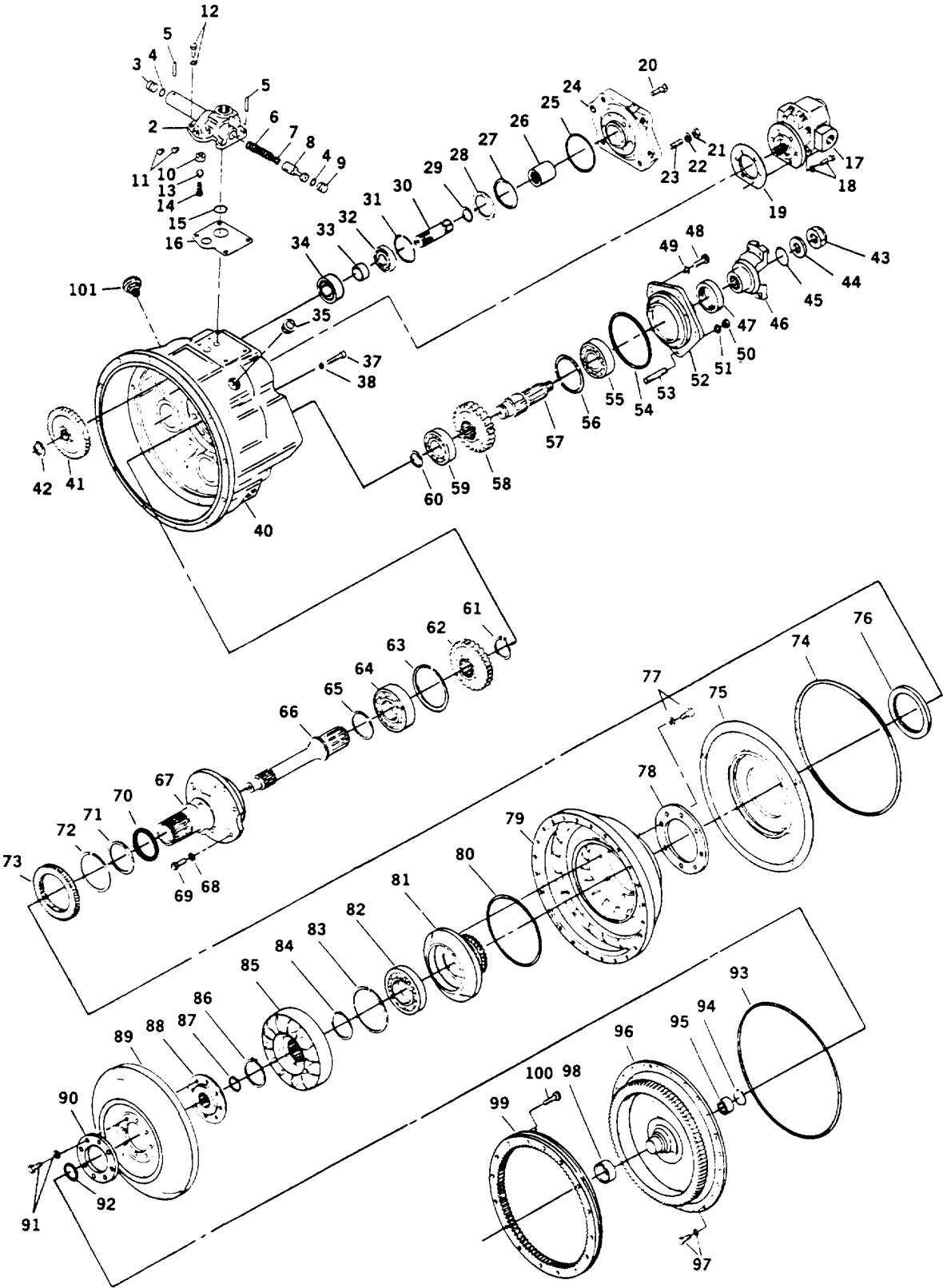
Use care to avoid damage to seal ring (65).

- b. Install new seal ring (65).
 - c. Press shaft (66) into stator support (67).
 - d. Install retaining ring (63).
7. INSTALL SPUR GEAR (62).
- a. Install spur gear (62) on shaft (66) with large shoulder toward bearing.
 - b. Install retaining ring (61).
8. INSTALL STATOR SUPPORT (67).

CAUTION

Spring gap on piston rings (70) and (71) should be 180° from piston ring hook joint.

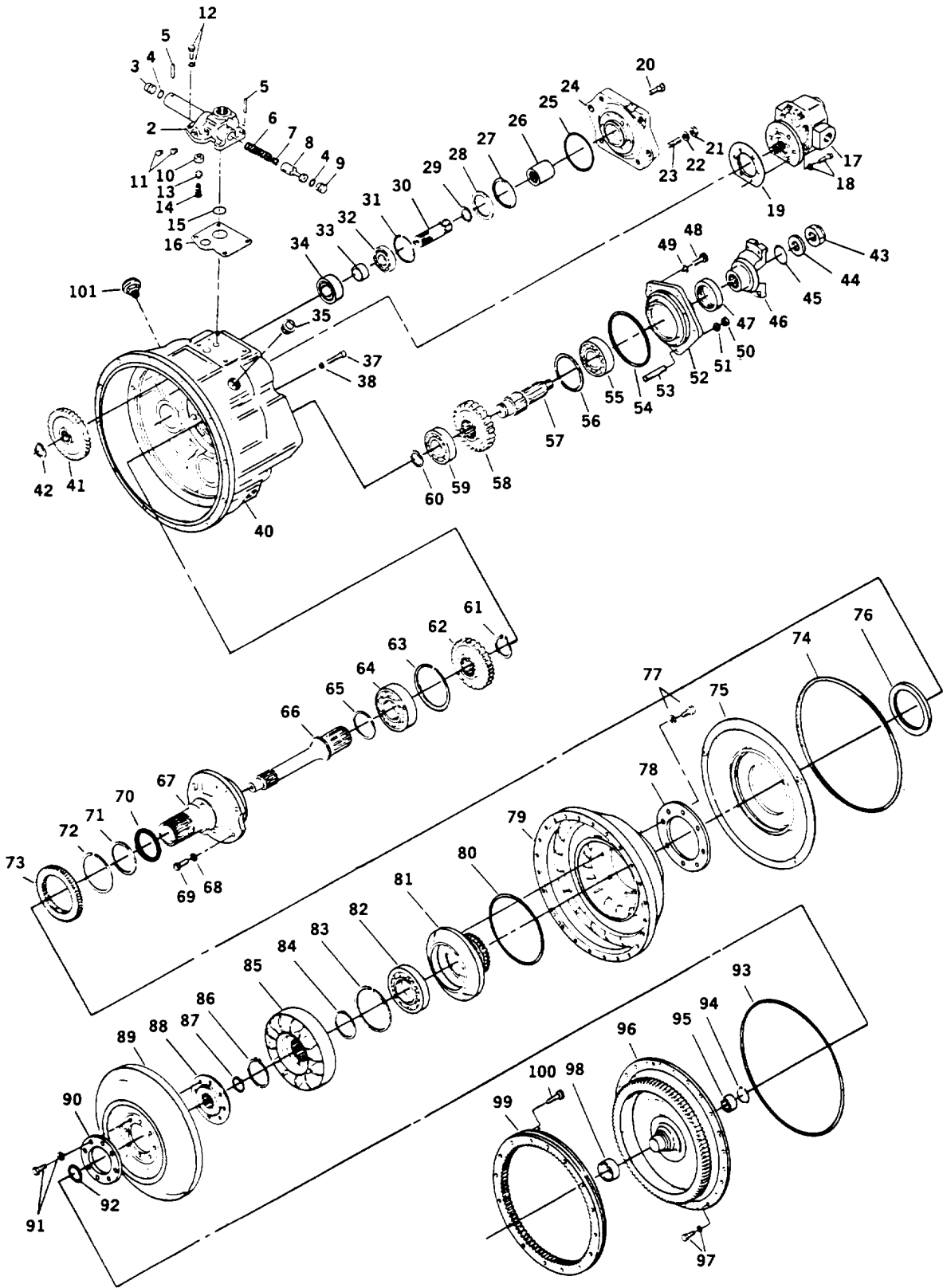
- a. Install piston rings (70) and (71) on stator support (67).



- b. Install stator support (67) in housing (40).
 - c. Install six capscrews (69) with lockwashers (68).
 - d. Torque capscrews to 57-63 ft-lbs. (76-84 Nm).
9. INSTALL THREE SPUR GEARS (41).
- a. Install spur gears (41) with P/N facing away from inner housing (40).
 - b. Install retaining rings (42).
10. ASSEMBLE OIL BAFFLE (75) AND IMPELLER (79).
- a. Press seal (76) in oil baffle (75) with lip of seal away from impeller (79).
 - b. Press bearing (82) in hub (81).
 - c. Install retaining ring (83).
 - d. Install new preformed packing (80) on hub (81).
 - e. Apply locktite to twelve bolts (77). Position hub (81) in impeller (79), position spacer plate (78) and secure with twelve bolts (77). Torque bolts (77) to 40 in-lbs. (4 Nm).
 - f. Install oil baffle (75) on impeller (79).
 - g. Install gear (73) and retaining ring (72).
 - h. Set impeller (79) and oil baffle (75) in housing (40), aligning three bolt holes in baffle with holes in housing.
 - i. Start three bolts (37) with new lockwashers (38) thru housing (40) into oil baffle (75).

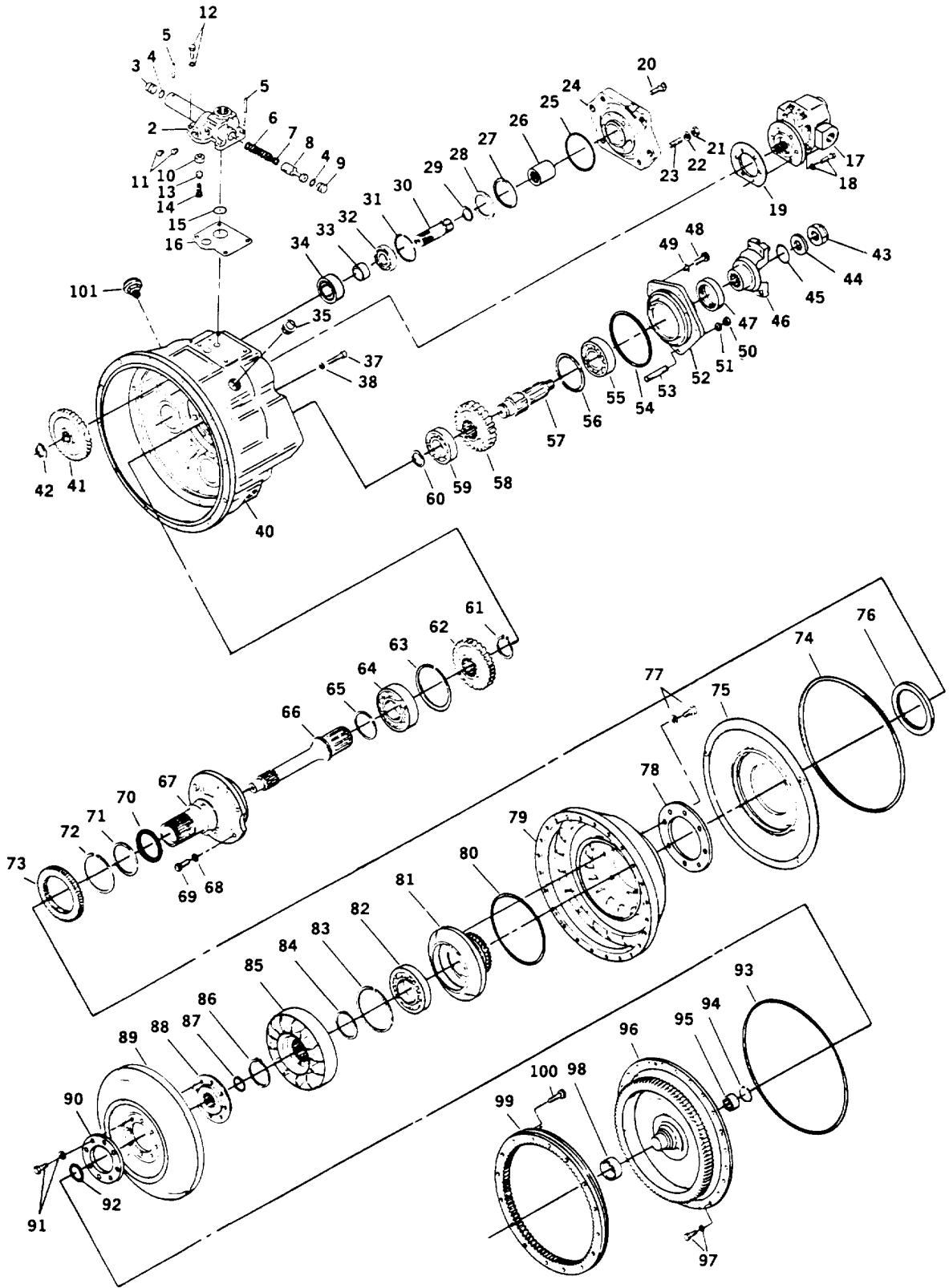
NOTE**Do not tighten bolts (37).**

- j. Rotate long gear shaft (30) to align gears (41) and (73).
 - k. Tighten bolts (37) in alternate pattern using care to evenly seat oil baffle (75). Torque bolts (37) to 23-25 ft-lbs. (3033 Nm).
11. INSTALL REACTION MEMBER (85).
- a. Install spacer (84).
 - b. Install reaction member (85) on impeller (79).
 - c. Install retaining ring (86).
 - d. Install retaining ring (87).
12. INSTALL TURBINE (89).
- a. Apply locktite to capscrews (91). Assemble turbine (89) and hub (88). Position spacer plate (90) and secure with capscrews (91). Torque capscrews (91) to 40 in-lbs. (4 Nm). Lockwire capscrews (91) in pairs.
 - b. Install turbine (89) with hub (88).
 - c. Install retaining ring (92).
13. ASSEMBLE IMPELLER COVER (96).
- a. Press bearing (95) into impeller cover (96).
 - b. Install retaining ring (94).
 - c. Heat sleeve (98) to 200°F (93°C) and press on impeller cover (96).
14. INSTALL IMPELLER COVER (96).
- a. Install new preformed packing (93) on impeller cover (96).



- b. Align holes in impeller cover (96) with holes in impeller (79).
 - c. Install impeller cover (96).
 - d. Install twenty-four capscrews and lockwashers (97). Torque capscrews (97) to 23-25 ft-lbs (30-33 Nm).
15. INSTALL VALVE (2).
- a. Install spring (14), plunger (13) and seat (10).
 - b. Install new gasket (16), packing (15) and valve (2).
 - c. Secure valve (2) with capscrews (12). Torque capscrews (12) to 23-25 ft-lbs (30-33 Nm).
16. INSTALL COUPLING (26).
17. INSTALL RETAINING PLATE (24).
- a. Install new preformed packing (25) on retaining plate (24).
 - b. Install retaining plate (24) on housing (40) and secure with six capscrews (20), nut (21) and lockwashers (22). Torque capscrews (20) to 23-25 ft-lbs (30-33 Nm) and nut (21) to 37-41 ft-lbs (50-55 Nm).
18. INSTALL PUMP (17).
- a. Install pump (17) and new gasket (19).
 - b. Install capscrews (18). Torque capscrews (18) to 23-25 ft-lbs (30-33 Nm).
19. IF REMOVED, INSTALL VACUUM VALVE (101).

END OF TASK



Section II. TRANSMISSION MAINTENANCE

TRANSMISSION AND RANGE SHIFTER ASSEMBLY INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Transmission Jack (800 lbs. capacity)

SUPPLIES: Loctite #545 (Item 18, Appendix B)
Hydraulic oil (Item 8, Appendix B)
Cotter pin (Item 105, Appendix B) (2 Required)
Preformed packing (Item 106, Appendix B) (4 Required)
Preformed packing (Item 107, Appendix B)
Preformed packing (Item 189, Appendix B) (3 Required)

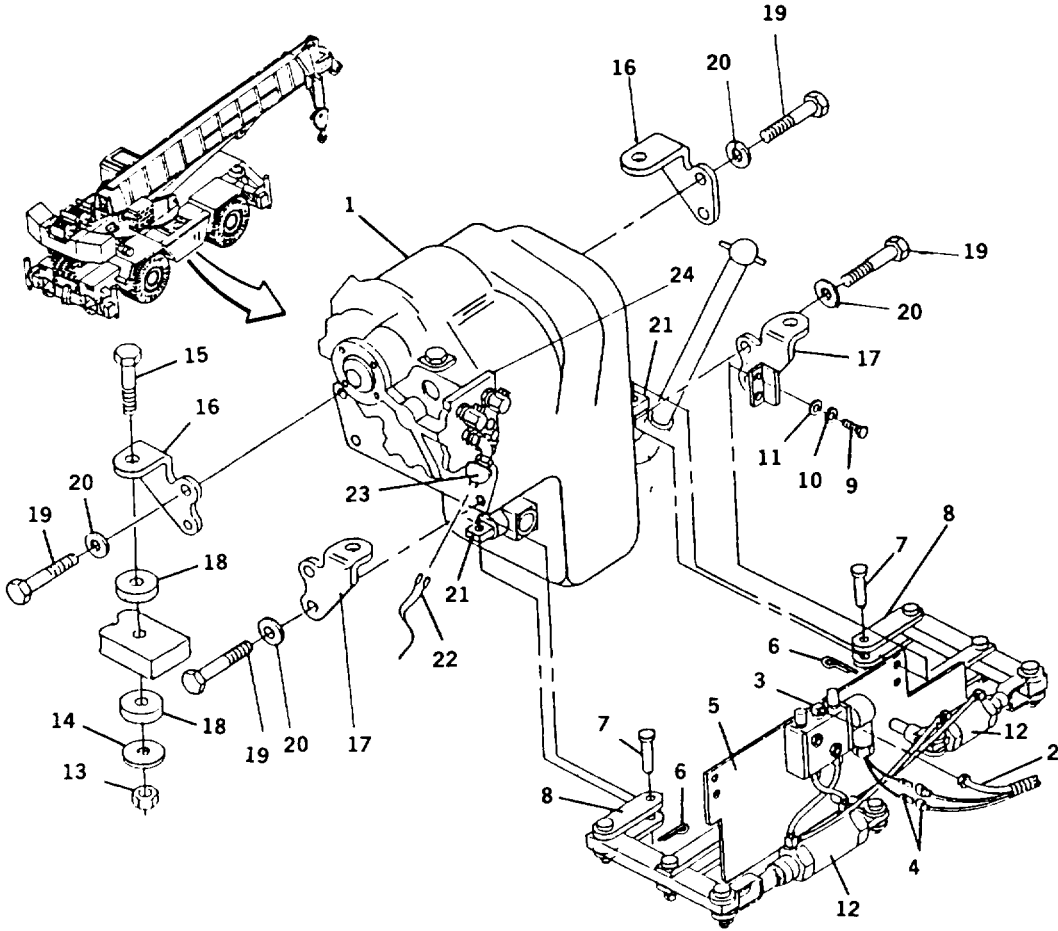
EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20).
Propeller shafts with top universal removed. (Refer to TM 5-3810-306-20.)
Transmission oil drained. (Refer to L05-3810-306-12). Air system purged. (Refer to TM 5-3810-306-20.)

REMOVAL:

1. TAG AND DISCONNECT AIR LINE (2) TO 4-WAY AIR VALVE (3).
2. TAG AND DISCONNECT TWO ELECTRICAL CONNECTORS (4).
3. TAG AND DISCONNECT ELECTRICAL CONNECTORS (22) TO BACK-UP SWITCH (23).
4. DISCONNECT RANGE SHIFT ACTUATOR RODS (21).
 - a. Remove cotter pins (6) and clevis pin (7) securing linkage bars (8) to rear axle disconnect and range shift actuator rods (21) in transmission (1). Discard cotter pins (6).
 - b. Remove the four bolts (9), lockwashers (10) and washers (11) securing shifter assembly mounting plate (5). Remove mounting plate with air cylinders (12) and linkage (8) attached. Discard lockwashers (10).
5. TAG AND DISCONNECT ALL TRANSMISSION OIL LINES FROM TRANSMISSION (1).

NOTE

- Tag and remove fittings, as necessary from adapter plate (24) to gain access to upper transmission lines.**
6. REMOVE TRANSMISSION MOUNTS (16) AND (17) AND TRANSMISSION (1).
 - a. Remove four locknuts (13), washers (14), and bolts (15) that secure front and rear mounts (16) and (17) to frame attachments. Remove four lower bonded mounting centers (18).
 - b. Position a transmission jack or some other means of support, capable of supporting weight of transmission (780 pounds - 354 Kg), under transmission.
 - c. With weight of transmission on supporting device, remove eight bolts (19) and washers (20) securing front and rear mounts (16) and (17) to transmission (1).
 - d. Remove front and rear mounts (16) and (17) and upper bonded mounting centers (18) as required.



NOTE

It may be necessary to remove upper left elbow to lower transmission.

- 7. USING SUPPORTING DEVICE, LOWER AND REMOVE TRANSMISSION.

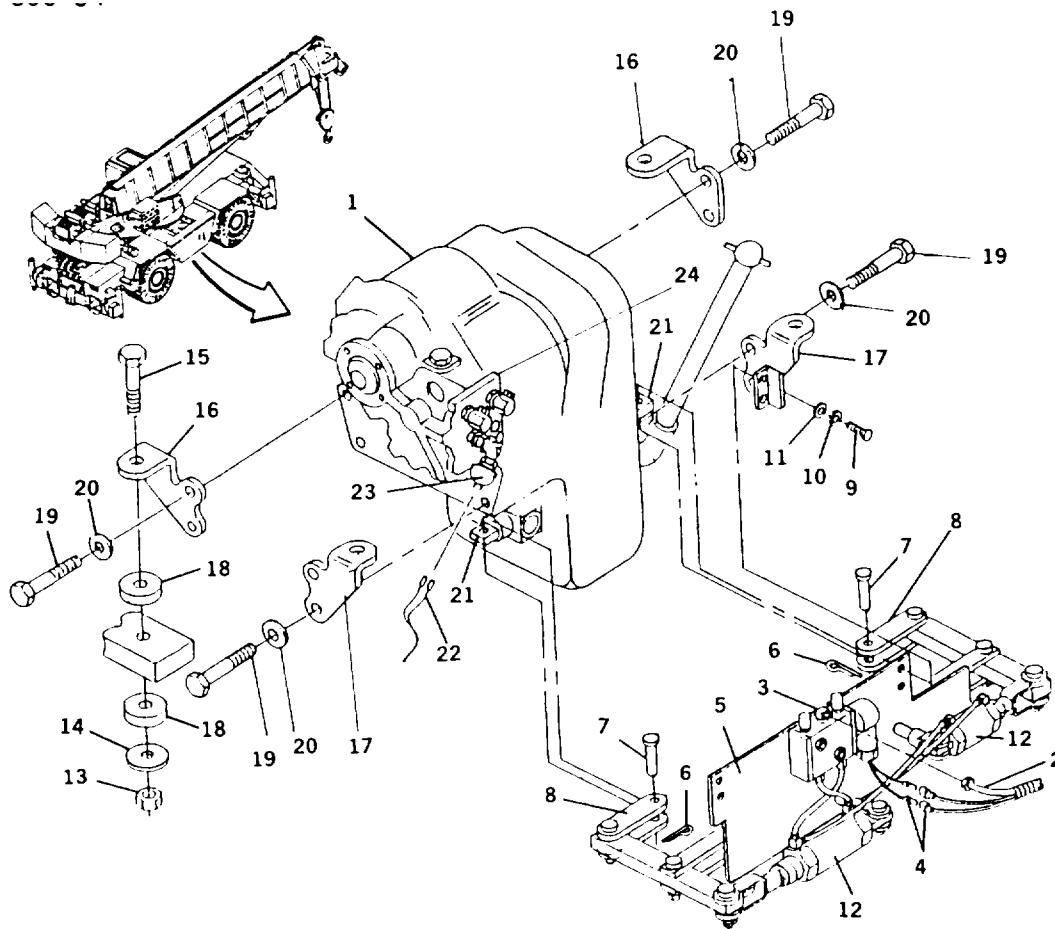
INSTALLATION:

- 1. IF A NEW TRANSMISSION IS TO BE INSTALLED, REMOVE ALL FITTINGS FROM OLD ONE AND INSTALL THEM IN SAME LOCATIONS ON NEW TRANSMISSION.

NOTE

Apply clean hydraulic oil to new O-rings and coat threads of fittings with Loctite #545.

- 2. USING A TRANSMISSION JACK OR SUITABLE DEVICE CAPABLE OF SUPPORTING TRANSMISSION WEIGHT (780 POUNDS - 354 KG), POSITION TRANSMISSION (1) UNDER FRAME AND RAISE IT INTO POSITION.
- 3. INSTALL FRONT AND REAR TRANSMISSION MOUNTS
 - a. Secure front and rear mounts (16 and 17) to transmission using eight bolts (19) and washers (20). Torque bolts to 250 ft-lbs (333 Nm).
 - b. Place four upper bonded mounting centers (18) in place between mounts and frame brackets and install four bolts (15).
 - c. Lower supporting device until transmission is supported. Remove supporting device.



- d. Install four lower bonded mounting centers (18), washers (14) and locknuts (13). Torque bolts to 150 ft-lbs (200 Nm).
- 4. CONNECT ALL TRANSMISSION OIL LINES TO APPROPRIATE FITTINGS ON TRANSMISSION IN ACCORDANCE WITH IDENTIFICATION MARKS MADE DURING REMOVAL.
- 5. INSTALL SHIFTER ASSEMBLY MOUNTING PLATE (5).
 - a. Position shifter assembly mounting plate (5) with air cylinders and linkage attached on side of transmission mounts and secure with four bolts (9), new lockwashers (10), and washers (11).
 - b. Align linkage bars (8) with actuator rods (21) on transmission and secure with clevis pins (7) and new cotter pins (6).
- 6. INSTALL TAGGED ELECTRICAL CONNECTORS (4).
- 7. CONNECT TAGGED AIR LINE (2) TO 4-WAY AIR VALVE (3).
- 8. SERVICE TRANSMISSION OIL. (REFER TO PAGE 7-61.)
- 9. INSTALL PROPELLER SHAFTS. (REFER TO TM 5-3810-306-20.)
- 10. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

END OF TASK

TRANSMISSION ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Overhead hoist (1-ton capacity)
 Clutch spring tool (Item 9, Appendix C)
 Lubrication Service, Unit Trailer Mtd (4930-00-107-9167)
 Shop Equipment Contact Maintenance Truck Mtd (4930-00-294-9518)
 Shop Equipment General Purpose Repair, Semi-trailer Mtd (4930-01-006-3229)
 Shop Equipment Machine Shop; FM Heavy Less Power (3470-00-754-0738)
 Shop Equipment Machine Shop; FM Heavy Suppl No. 1 (3470-00-754-0739)
 Shop Equipment Machine Shop; FM Basic (3470-00-754-0708)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1 (4910-00-754-0706)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 2 (4910-00-754-0707)
 Tool Outfit Hyd System; Test and Repair, 3/4 Ton Trailer Mtd. (4940-01-036-5784)

SUPPLIES: Oil (MIL-L-2104; SAE10) (Item 94, Appendix B)
 Grease (MIL-L-10924) (Item 37, Appendix B)
 Solvent P-D-680 Type II (Item 1, Appendix B)
 Retaining ring (Item 119, Appendix B) (2 Required)
 Preformed packing (Item 120, Appendix B) (2 Required)
 Lockwasher (Item 121, Appendix B) (4 Required)
 Retaining ring (Item 122, Appendix B)
 Lockwasher (Item 25, Appendix B) (33 Required)
 Preformed packing (Item 123, Appendix B)
 Preformed packing (Item 124, Appendix B) (2 Required)
 Gasket (Item 125, Appendix B)
 Gasket (Item 126, Appendix B)
 Retaining ring (Item 127, Appendix B) (5 Required)
 Locating ring (Item 128, Appendix B)
 Retaining ring (Item 129, Appendix B)
 Gasket (Item 130, Appendix B)
 Lockwasher (Item 131, Appendix B) (12 Required)
 Inner ring bearing (Item 132, Appendix B) (2 Required)
 Preformed packing (Item 133, Appendix B)
 Preformed packing (Item 134, Appendix B)
 Preformed packing (Item 135, Appendix B)
 Retaining ring (Item 136, Appendix B) (2 Required)
 Preformed packing (Item 137, Appendix B) (2 Required)
 Nut (Item 138, Appendix B)
 Flat washer (Item 139, Appendix B)
 Self-locking nut (Item 140, Appendix B) (2 Required)
 Flat washer (Item 141, Appendix B) (2 Required)
 Preformed packing (Item 142, Appendix B) (2 Required)
 Piston ring (Item 143, Appendix B) (6 Required)
 Special ring (Item 144, Appendix B) (4 Required)
 Retaining ring (Item 145, Appendix B) (5 Required)
 Retaining ring (Item 146, Appendix B) (5 Required)
 Piston ring (Item 147, Appendix B) (5 Required)

- Preformed packing (Item 148, Appendix B) (5 Required)
- Retaining ring (Item 149, Appendix B) (4 Required)
- Retaining ring (Item 150, Appendix B) (6 Required)
- Retaining ring (Item 151, Appendix B) (2 Required)
- Retaining ring (Item 152, Appendix B)
- Special ring (Item 153, Appendix B)
- Retaining ring (Item 154, Appendix B)
- Gasket (Item 155, Appendix B)
- Retaining ring (Item 156, Appendix B)
- Retaining ring (Item 157, Appendix B)

EQUIPMENT CONDITIONS: Transmission removed. (Refer to page 7-20.)

DISASSEMBLY:

CAUTION

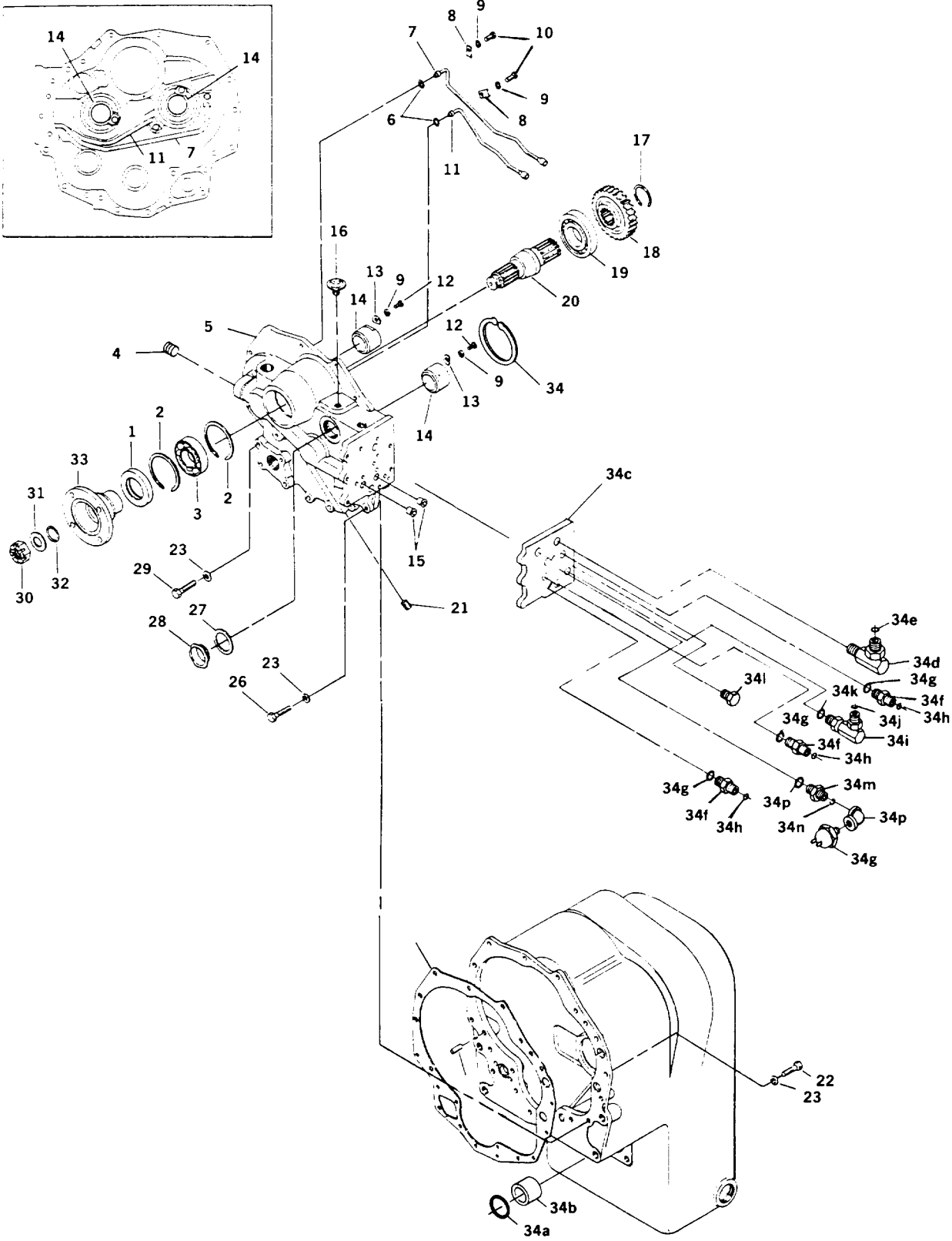
WARNING

Dry cleaning solvent P-D- 680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

The entire transmission exterior should be cleaned prior to disassembly in order to reduce the amount of dirt and contaminants entering the interior.

1. CLEAN TRANSMISSION EXTERIOR SURFACES.
2. REMOVE TRANSMISSION COVER (5).
 - a. Remove nut (30), washer (31), preformed packing (32) and flange (33). Discard packing (32).
 - b. Remove pipe plug (28) and gasket (27). Discard gasket (27).
 - c. Remove eighteen capscrews (22), (26) and (29) and lockwashers (23). Discard lockwashers (23).
 - d. Support transmission cover (5) with overhead hoist.
 - e. Using spreading-type snap ring pliers, hold special ring (34) open while prying transmission cover (5) free.



NOTE

If forward and second clutch comes out with the transmission cover, spread ears on front bearing special ring (34) and separate clutch and cover.

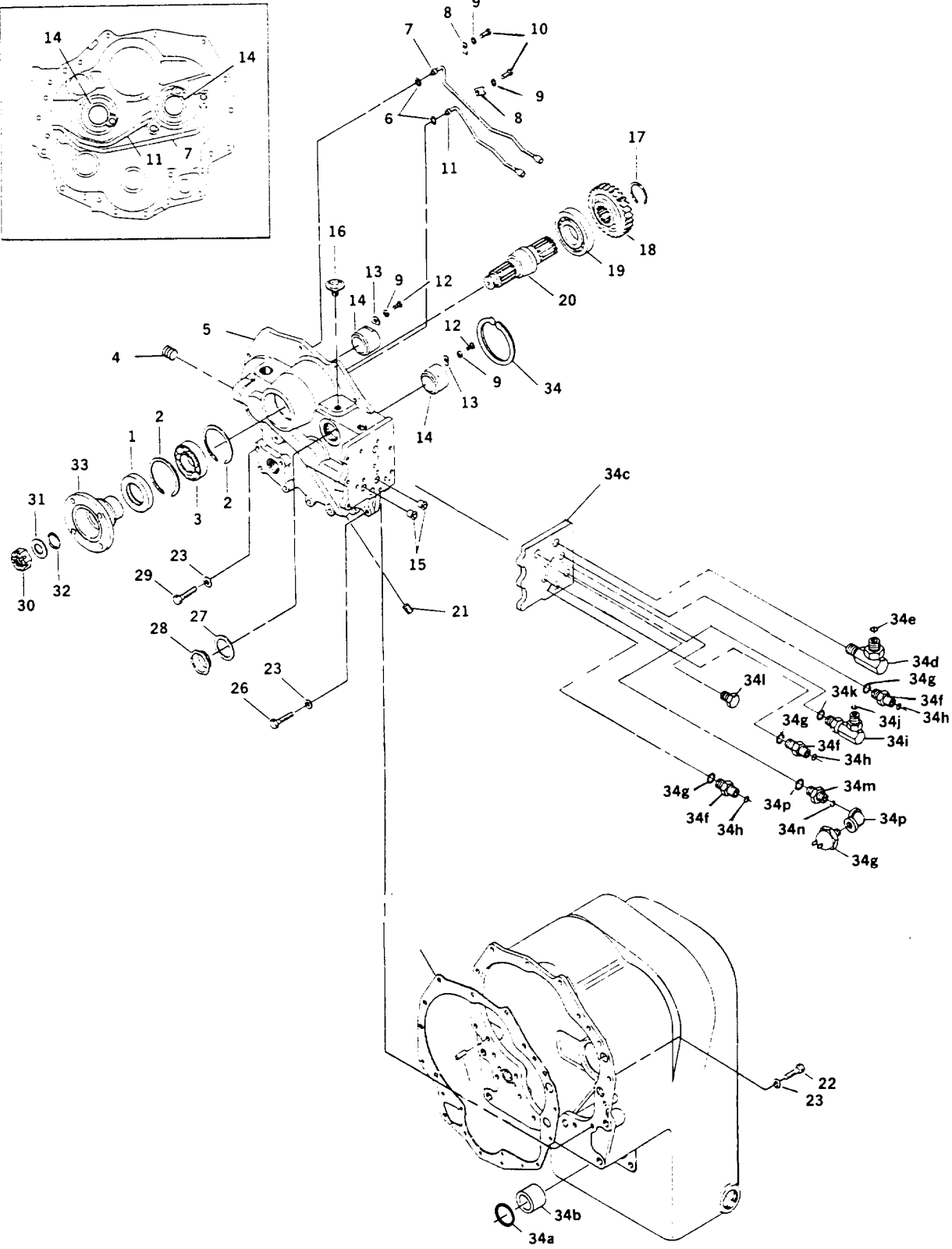
- f. Remove sleeve (34a) and packing (34b). Discard packing (34b).
- 3. REMOVE GEARSHAFT (20).
 - a. Tap on threaded end of gearshaft (20) with soft mallet.
 - b. Remove gearshaft (20).
- 4. REMOVE BEARING (3).
 - a. Remove and discard seal (1).
 - b. Remove retaining rings (2) and bearing (3).
- 5. REMOVE ADAPTER PLATE (34c).
 - a. Remove fitting (34d) and preformed packing (34e). Discard packing (34e).
 - b. Remove fittings (34f) and preformed packings (34g) and (34h). Discard packings (34g) and (34h).
 - c. Remove fitting (34i) and preformed packings (34j) and (34k). Discard packings (34j) and (34k).

- d. Remove plug (341).
- e. Remove fitting (34m) and preformed packing (34p) with switch (34q) and elbow (34r). Discard packing (34p).
- f. Remove adapter plate (34c) from cover (5).
- g. If necessary, remove switch (34q), elbow (34r) and packing (34n) from fitting (34m). Discard packing (34n).
- 6. REMOVE TUBES (7) AND (11).
 - a. Remove two bolts (10), lockwashers (9) and clips (8). Discard lockwashers (9).

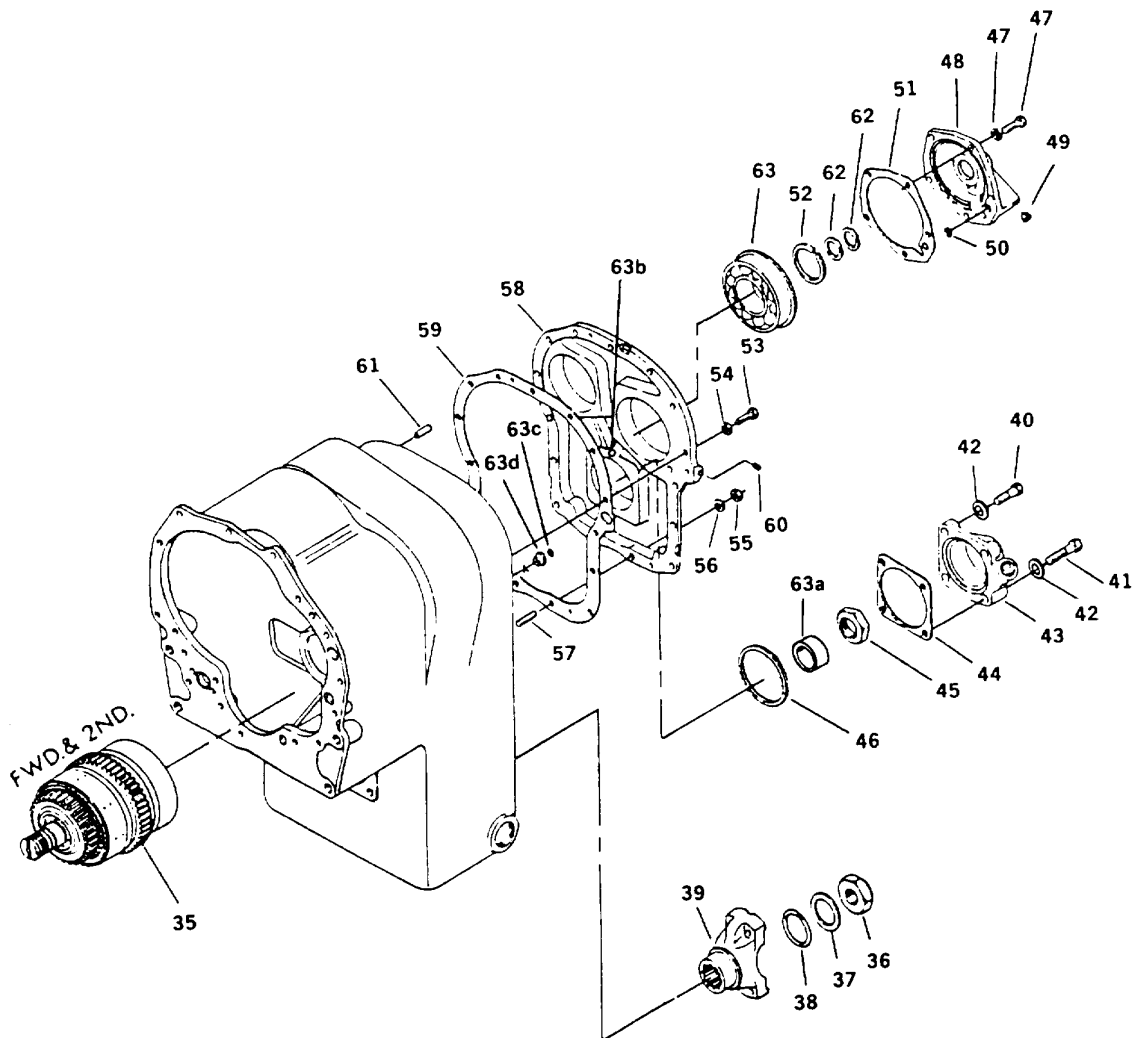
CAUTION

Sleeves (15) must be removed while removing tubes (7) and (11) to prevent tubes from bending.

- b. Remove tubes (7) and (11), sleeves (15) and preformed packings (6). Discard preformed packings (6).
- 7. REMOVE BUSHINGS (14).
 - a. Remove two bolts (12), lockwashers (9) and sleeves (13). Discard lockwashers (9).
 - b. Press bushings (14) out of transmission cover (5).



8. REMOVE FORWARD AND SECOND CLUTCH (35).
9. REMOVE FLANGE (39).
 - a. Remove nut (36), washer (37) and preformed packing (38). Discard packing (38).
 - b. Remove flange (39).
10. REMOVE BEARING HOUSING (43).
 - a. Remove four capscrews (40) and (41) and lockwashers (42). Discard lockwashers (42).
 - b. Remove bearing housing (43) and gasket (44). Discard gasket (44).
11. REMOVE NUT (45), SPACER (63a) AND RETAINING RING (46).
12. REMOVE GREASE CAP (48).
 - a. Remove five bolts and washers (47).
 - b. Remove grease cap (48) and gasket (51). Discard gasket (51).
13. REMOVE RETAINING RING (52).

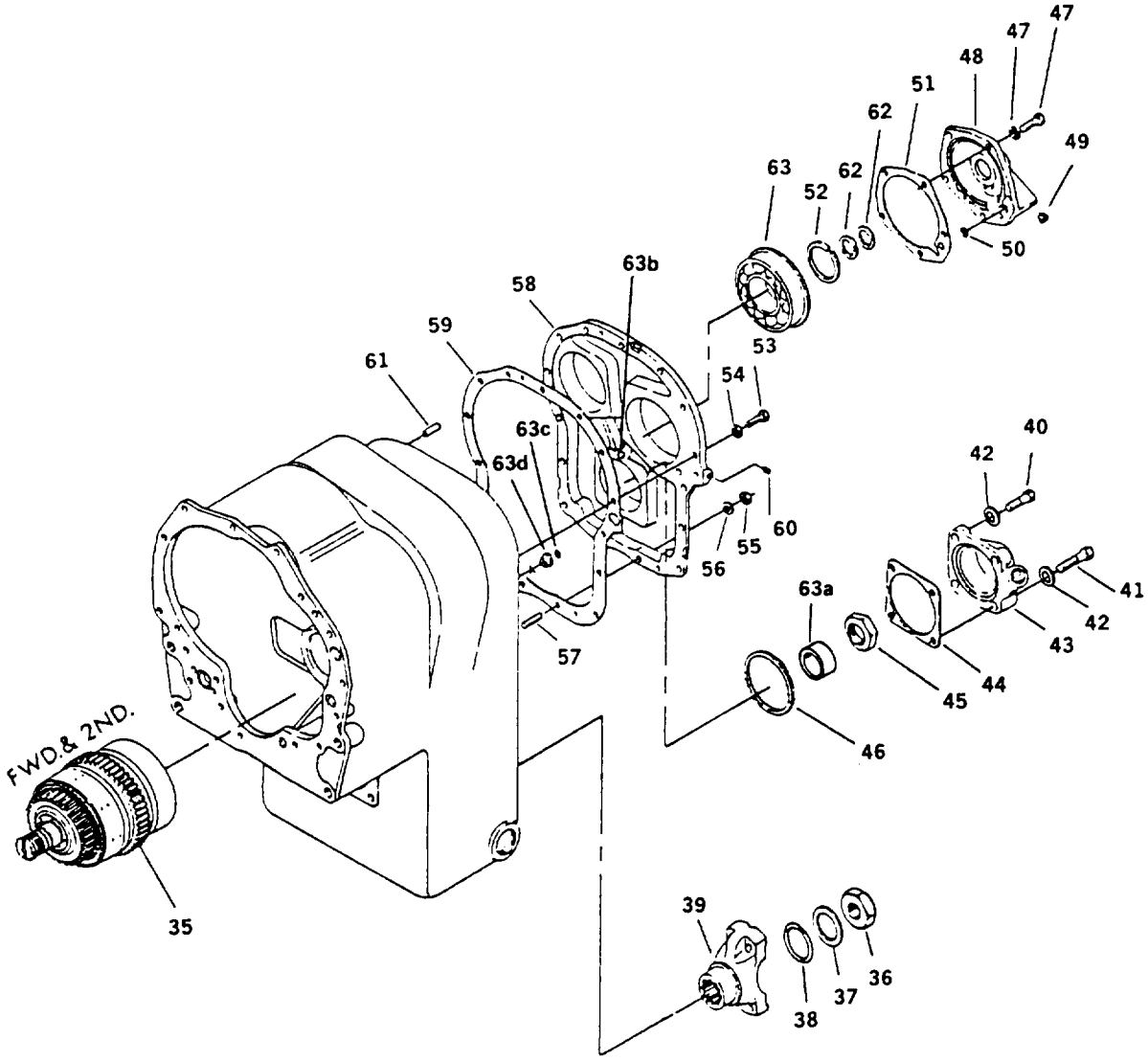


- 14. REMOVE TRANSMISSION COVER (58).
 - a. Remove thirteen capscrews (53) and lockwashers (54). Discard lockwashers (54).
 - b. Remove two nuts (55) and lockwashers (56). Discard lockwashers (56).
 - c. Using pry slots provided, pry transmission cover (58) while tapping low clutch/idler shaft (71).

- d. Remove transmission cover (58) and gasket (59). Discard gasket (59).
 - e. Inspect studs (57) for damage. If damaged, remove stud(s).
 - f. Remove packing (63c) and sleeve (63d). Discard packing (63c).
15. REMOVE BEARING (63).

NOTE
Do not lose rear bearing lock ball (63b).

- a. Remove piston rings (62).
- b. Using bearing puller, remove bearing kb3).



16. REMOVE SIX SPEED IDLER SHAFT AND GEAR (64).

17. REMOVE CLUTCH ASSEMBLIES (70) AND (71).

a. Remove retaining ring (65).

b. Remove spur gear (66).

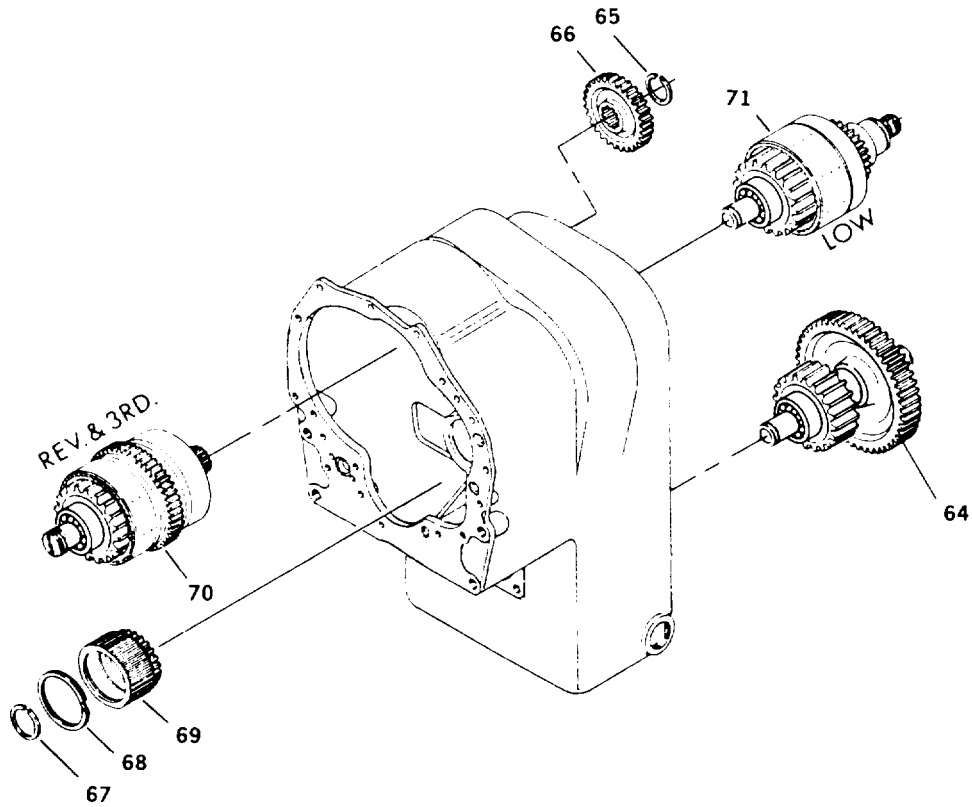
c. Remove retaining ring (67).

d. Remove retaining ring (68), if required.

e. Remove second gear (69).

f. Remove clutch (70).

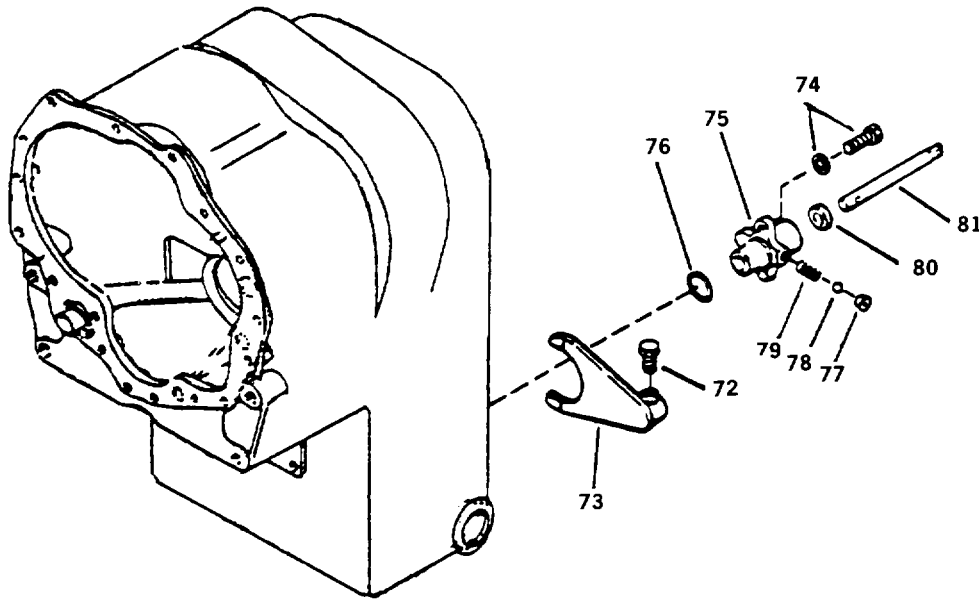
g. Remove clutch (71).



18. REMOVE SHIFT COUPLING (75).

- a. Cut lockwire on setscrew (72).
- b. Remove setscrew (72) and shifter fork (73).

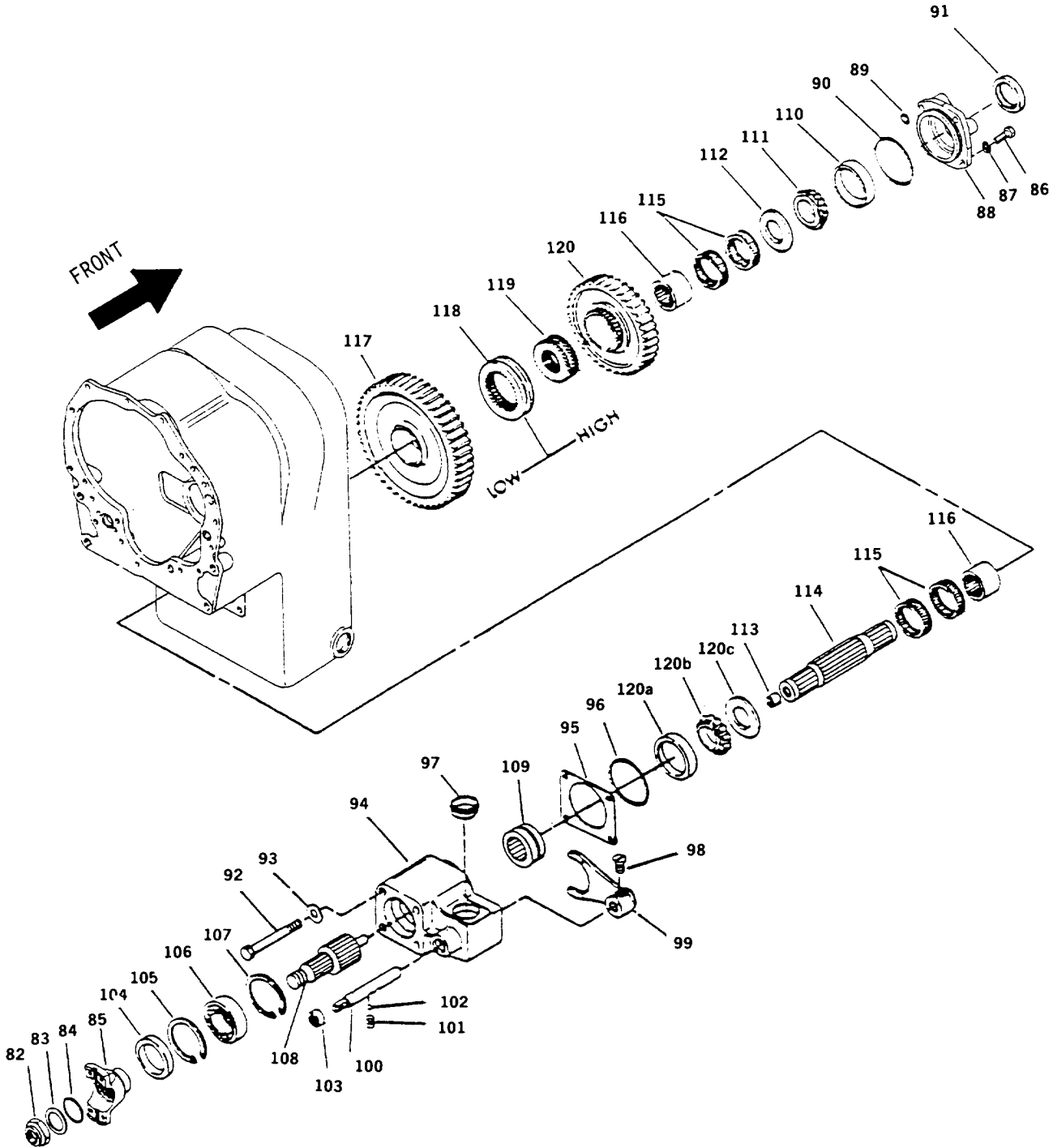
- c. Remove two bolts (74), shift coupling (75) and preformed packing (76). Discard packing (76).
- d. If necessary, remove pipe plug (77), ball (78), spring (79), seal (80) and shaft (81).



19. REMOVE FLANGE (85).
 - a. Remove nut (82), lockwasher (83) and preformed packing (84). Discard packing (84) and lockwasher (83).
 - b. Remove flange (85).
20. REMOVE BEARING HOUSING (88).
 - a. Remove four capscrews (86) and lockwashers (87). Discard lockwashers (87).
 - b. Remove bearing housing (88).
 - c. Remove cup (110) and preformed packings (89) and (90). Discard packings (89) and (90).
 - d. If necessary, remove seal (91).
21. REMOVE REAR AXLE DISCONNECT HOUSING (94).
 - a. Remove four capscrews (92) and lockwashers (93). Discard lockwashers (93).
 - b. Remove housing (94) pulling it straight out.
 - c. Remove shims (95). Note number and size of shims (95).
 - d. Remove and discard preformed packing (96).
22. REMOVE OUTPUT SHAFT (114).
 - a. Support gears (117) and (120).
 - b. Using press, push straight shaft (114) from front through gears (117) and (120).
 - c. Remove cup (120a), taper bearing (120b) and washer (120c).
 - d. Using press, remove taper bearing (111) and washer (112).
23. REMOVE OUTPUT GEARS (117) AND (120).
 - a. Remove sleeve bushing (113), four retainers and rollers (115), two rings (116) and gears (117) and (120).
 - b. Remove gear hub (118) and sleeve bearing (119).
24. DISASSEMBLE REAR AXLE DISCONNECT (94).
 - a. Remove plug (97) and setscrew (98).
 - b. Remove shift rail (100) with spring (101) and ball bearing (102).
 - c. Remove seals (103) and (104). Discard seals (103) and (104).
 - d. Remove retaining ring (105) and gearshaft (108) with bearing (106).
 - e. Remove bearing (106), hub shaft (109) and fork shift (99).

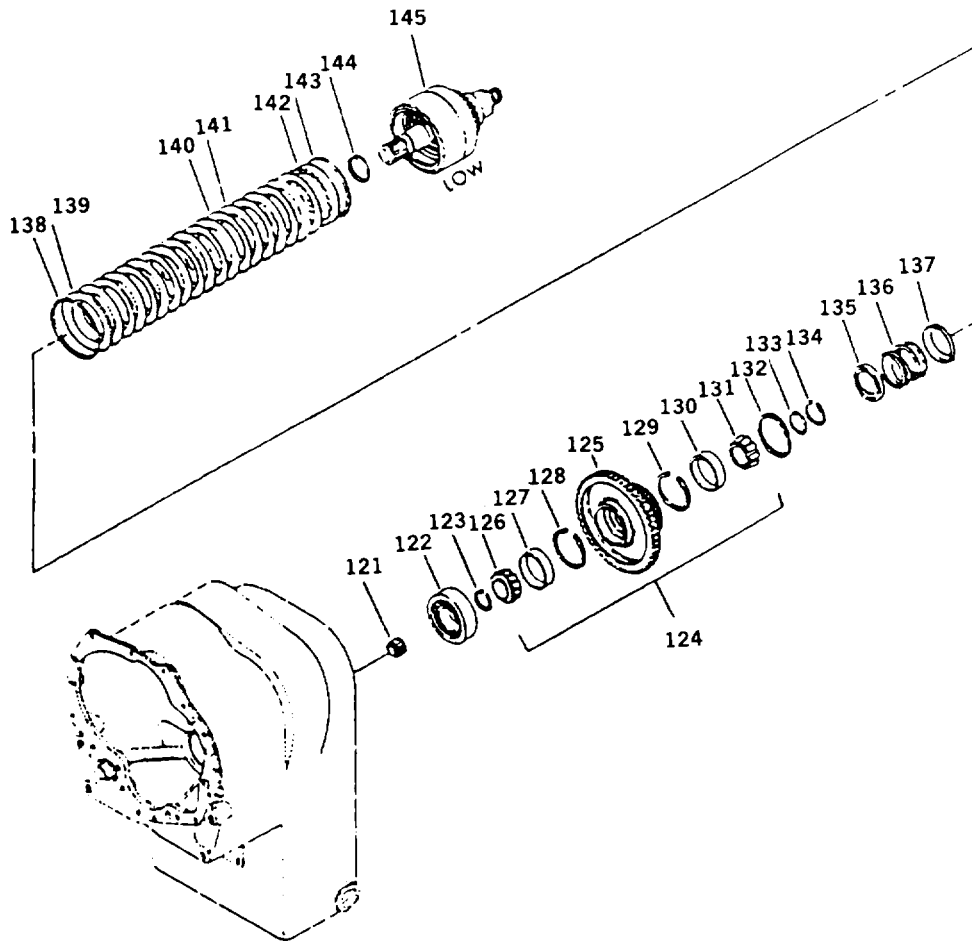
NOTE

Do not mix clutch discs among the clutch packs.



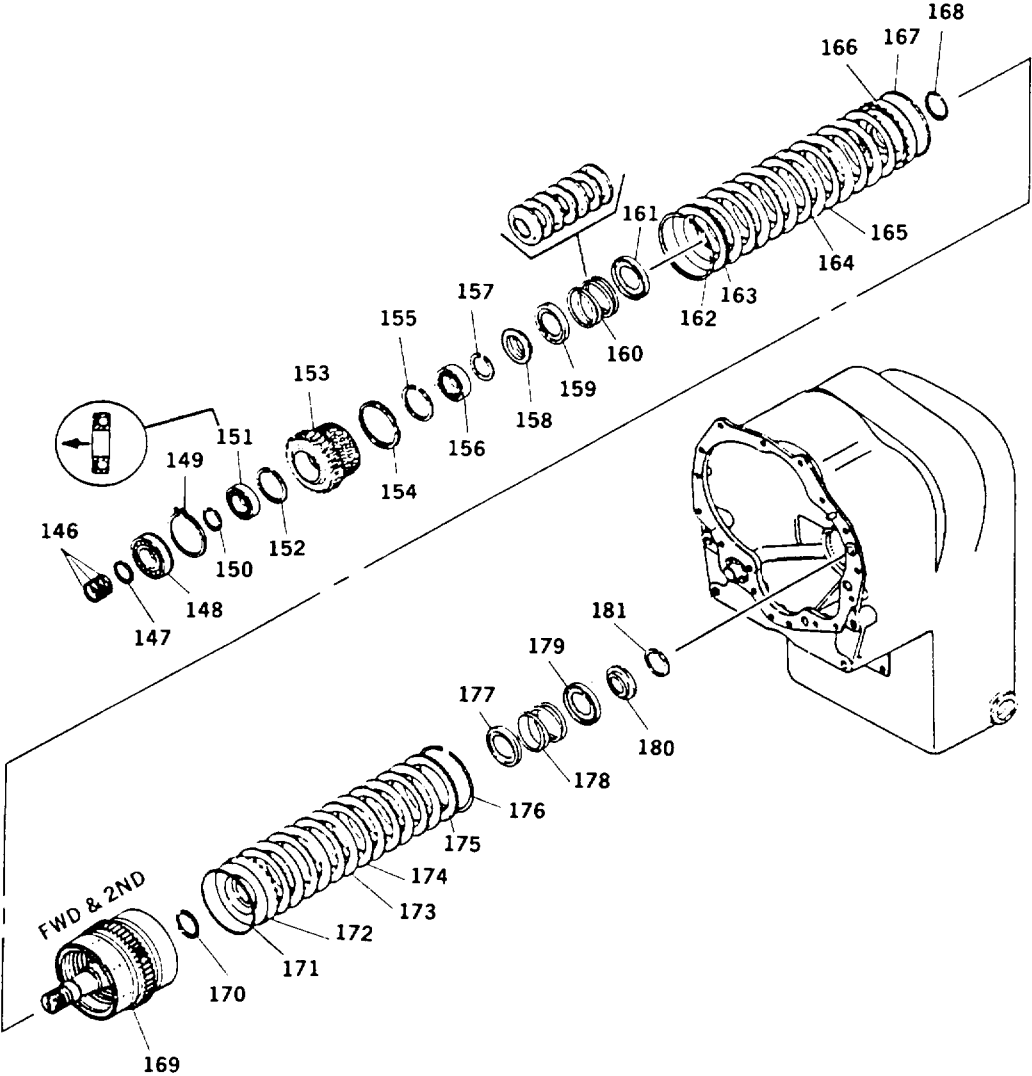
25. DISASSEMBLE LOW CLUTCH (71).

- a. Remove roller (121).
- b. Using puller, remove bearing (122).
- c. Remove retaining ring (123).
- d. Using puller, remove gear (124) with bearing (126).
- e. Remove retaining rings (132) and (138).
- f. Remove clutch plate (139) and clutch discs (140) and (141).
- g. Using puller, remove bearing (131) and retaining ring (133).
- h. Using clutch spring tool (Item 9, Appendix C), compress retainer (135).
- i. Accessing retaining ring (134) through opening in tool, remove retaining ring (134).
- j. Release tension on retainer (135). Remove clutch spring tool, retainers (135) and (137) and spring (136).
- k. Turn over housing (145) resting it on a block of wood. Remove piston (142), piston ring (143) and preformed packing (144). Discard packing (144).

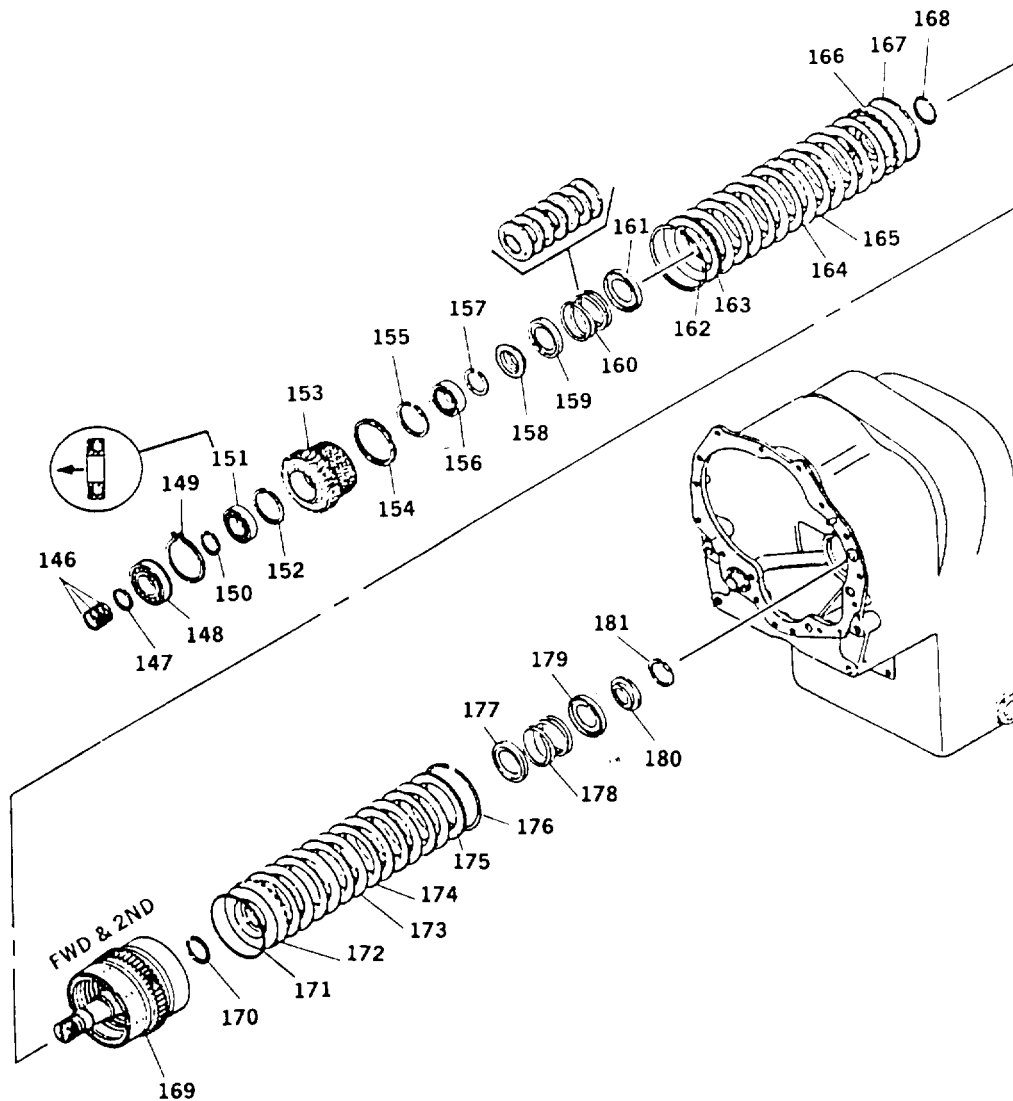


26. DISASSEMBLE FORWARD AND 2ND CLUTCH (169).

- a. Remove three piston rings (146).
- b. Remove retaining ring (147).
- c. Using puller remove bearing (148).
- d. Remove special ring (149).
- e. Using puller, remove gear (153) with bearing (151).
- f. Using puller, remove bearing (156).
- g. Remove retaining ring (162).
- h. Remove clutch plate (163).
- i. Using clutch spring tool (Item 9, Appendix C), compress retaining ring (158) and remove retaining ring (157).
- j. Relieve pressure on retaining ring (158) and remove retaining ring (158), spring retainer (159), spring (160) and spring retainer (161).

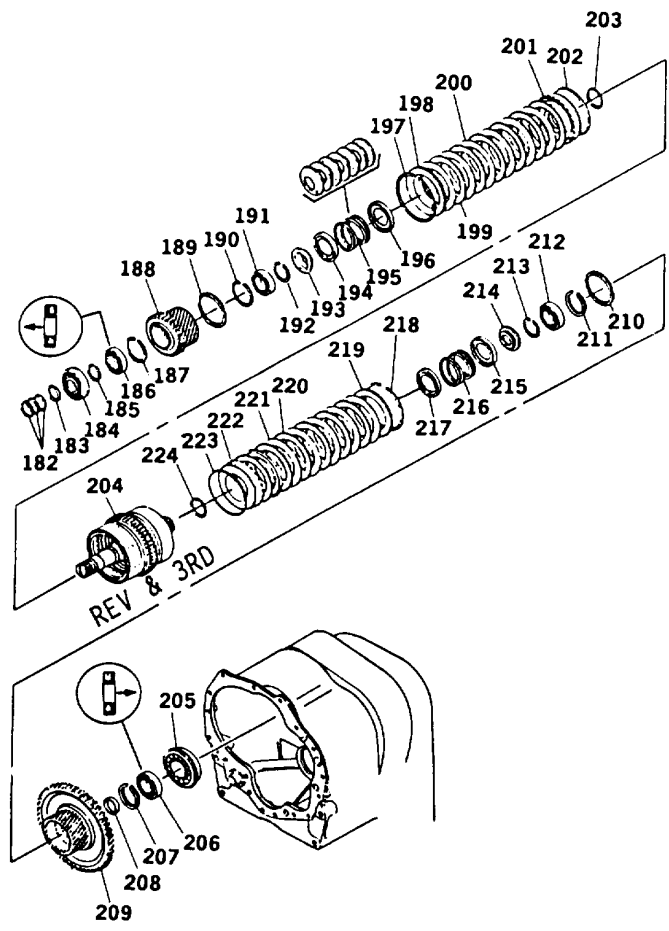


- k. Remove clutch discs (164 and 165).
- l. Turn over housing (169) resting it on a block of wood. Remove piston (166), piston ring (167) and preformed packing (168). Discard packing (168).
- m. Remove retaining ring (176) and clutch plate (175).
- n. Using clutch spring tool (Item 9, Appendix C), compress retaining ring (180) and remove retaining ring (181).
- o. Relieve pressure on retaining ring (180) and remove retaining ring (180), spring retainer (179), spring (178) and spring retainer (177).
- p. Remove clutch disks (173) and (174).
- q. Turn over housing (169) resting it on a wood block. Remove piston (172), piston ring (171) and preformed packing (170). Discard packing (170).

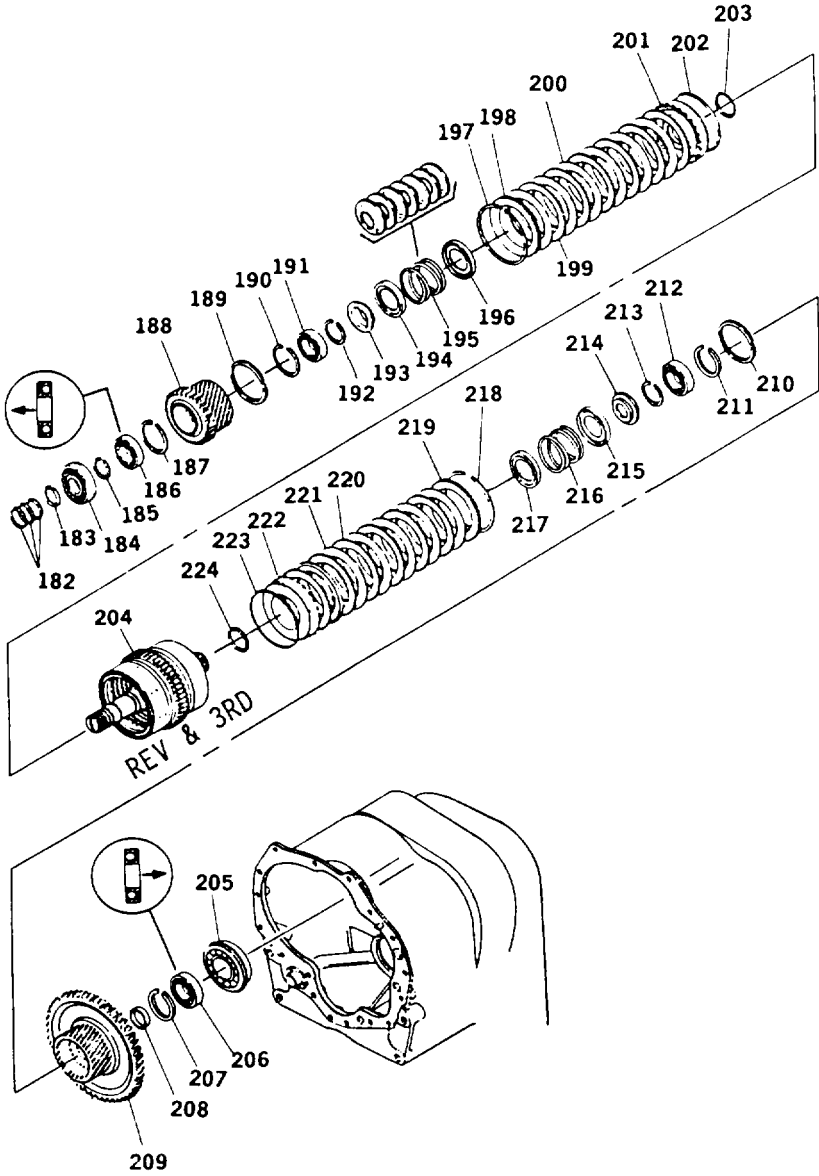


27. DISASSEMBLE REVERSE AND 3RD CLUTCH (204).

- a. Remove three piston rings (182).
- b. Remove retaining ring (183).
- c. Using puller remove bearing (183).
- d. Using puller remove gear (188) with bearing (186).
- e. Using puller remove bearing (191).
- f. Remove retaining ring (197) and clutch plate (198).
- g. Using clutch spring tool (Item 9, Appendix C), compress retaining ring (193) and remove retaining ring (192).
- h. Relieve pressure on retaining ring (193) and remove retaining ring (193), spring retainer (194), spring (195) and spring retainer (196).
- i. Remove clutch discs (199 and 200).
- j. Turn housing (204) over on a block of wood and remove piston (201), piston ring (202) and preformed packing (203). Discard packing (203).
- k. Using puller remove bearing (205).
- l. Using puller remove gear (209) with bearing (206).
- m. Remove retaining ring (207) and spacer (208).
- n. Remove retaining rings (210) and (218).
- o. Remove clutch plate (219) and clutch discs (220 and (221).



- p. Using puller remove bearing (212).
- q. Using clutch spring tool (Item 9, Appendix C), compress retaining ring (214) and remove retaining ring (213).
- r. Relieve pressure on retaining ring (214) and remove retaining ring (214), spring retainer (215), spring (216) and spring retainer (217).
- s. Turn housing (204) over on a block of wood and remove piston (222), piston ring (223) and preformed packing (224). Discard packing (224).



28. DISASSEMBLE SIX SPEED IDLER SHAFT ASSEMBLY (64).

CAUTION

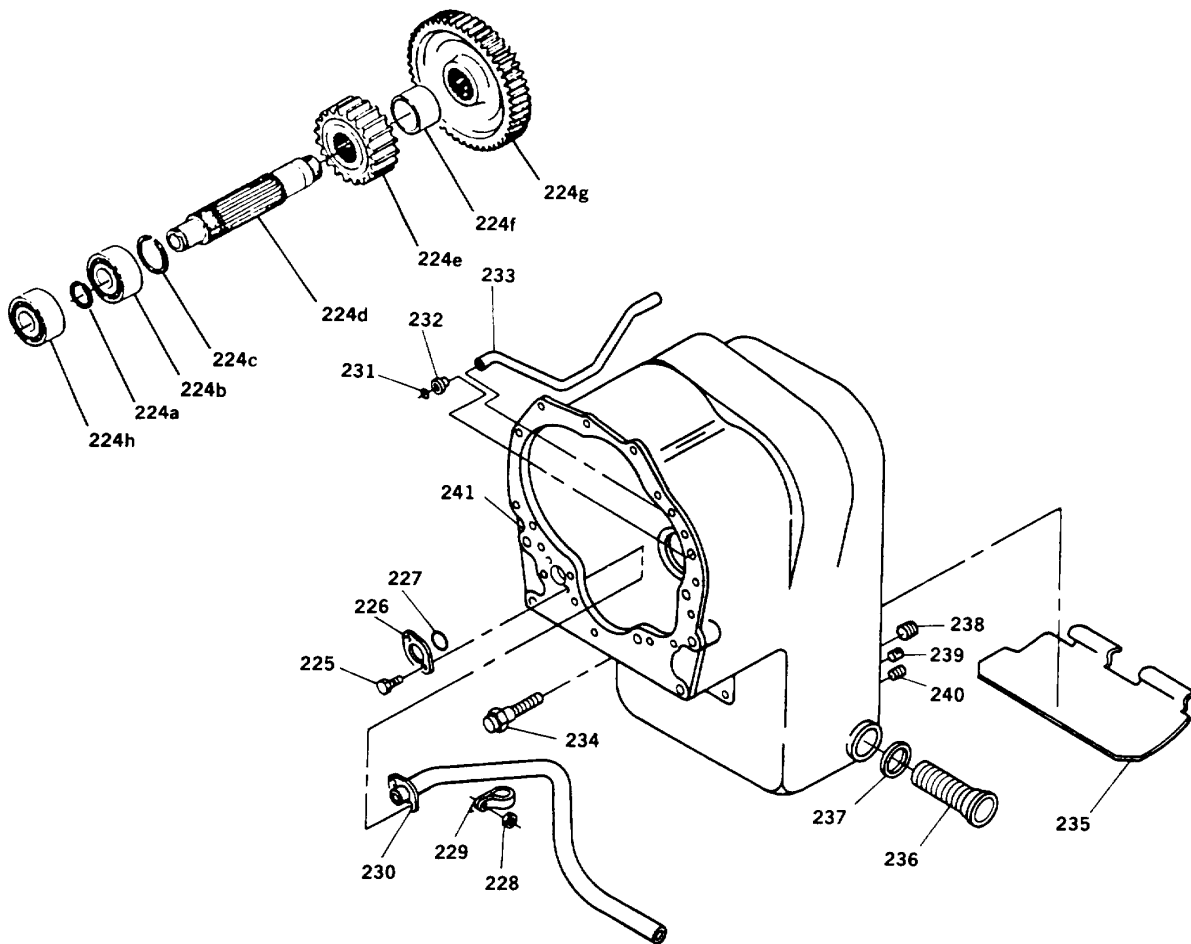
Use care to prevent damage to bearing cage (224h).

- a. Using a suitable bearing puller, remove bearing (224h).
- b. Remove gear (224g).
- c. Remove spacer (224f).
- d. Remove retaining ring (224a).

- e. Using a suitable bearing puller, remove bearing (224b).
- f. Remove locating ring (224c).
- g. Using a suitable press, remove gear (224e).

29. REMOVE OIL TUBES (230) AND (233).

- a. Remove two capscrews (225), spacer (226) and preformed packing (227). Discard packing (227).
- b. Remove nut (228), clamp (229) and tube (230).
- c. Remove two sleeves (232), preformed packings (231) and tube (233). Discard packing (231).
- d. Remove strainer (236) and gasket (237). Discard gasket (237).
- e. Remove oil baffle (235).



CLEANING:

WARNING

Dry cleaning solvent P-D- 680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F/138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

1. CLEAN ALL PARTS WITH CLEANING FLUID P-D-680 TYPE II.
 - a. Immerse parts in cleaning fluid tank.
 - b. Agitate parts up and down to remove old lubricant and foreign material.
2. CLEAN ALL BEARINGS.
 - a. Remove bearings from cleaning fluid and gently strike bearings against block of wood to dislodge lubricant particles.
 - b. Immerse in cleaning fluid again.

- c. Repeat steps a. and b. until bearings are thoroughly clean.

CAUTION

Do not direct air stream across bearing surfaces causing bearings to spin. Spinning unlubricated bearings could cause premature wear.

- d. Dry bearings using low pressure compressed air. Spin bearings slowly by hand to aid in drying.
3. CLEAN TRANSMISSION HOUSINGS AND CAPS.

WARNING

Use care when cleaning parts with alkali cleaners. Avoid breathing in vapors or contact with bare skin. Otherwise skin rash and dizziness could result.

CAUTION

Do not clean parts which have machined or polished surfaces in alkali solution.

- a. Clean all housings and bearing caps, etc. in hot, mild alkali solution. Allow parts to be thoroughly heated and cleaned.
- b. Rinse parts thoroughly to remove all traces of alkali.
- c. Dry parts immediately with low pressure compressed air.
- d. Wipe all parts dry with clean, lint-free cloths.

INSPECTION:

1. INSPECT BEARINGS.

- a. Inspect all bearings, cages and cups for wear, nicks and chips.

NOTE

Bearing cones and cups are matched sets. Replace both if one is bad.

- b. Dip cleaned bearings in clean oil MIL-L-21-4 SAE 10.
 - c. Wrap each clean and lubed bearing in a clean, lint-free cloth until installed.
2. INSPECT ALL GEARS AND SHAFTS.
- a. Using a Magna-flux process, inspect all gears and shafts for damage and cracks.

- b. Inspect gear teeth for wear, pits, nicks, cracks and scores. Replace gear(s) if hardening is worn or cracked. Remove minor damage with suitable hone.

- c. Inspect all shafts, insuring each is true, not sprung or bent.

3. INSPECT HOUSINGS AND COVERS.

- a. Inspect all mating surfaces for nicks and burrs.
- b. Inspect all parts for cracks and damage.
- c. Ensure all parts are clean.

7-41/7-42 Blank

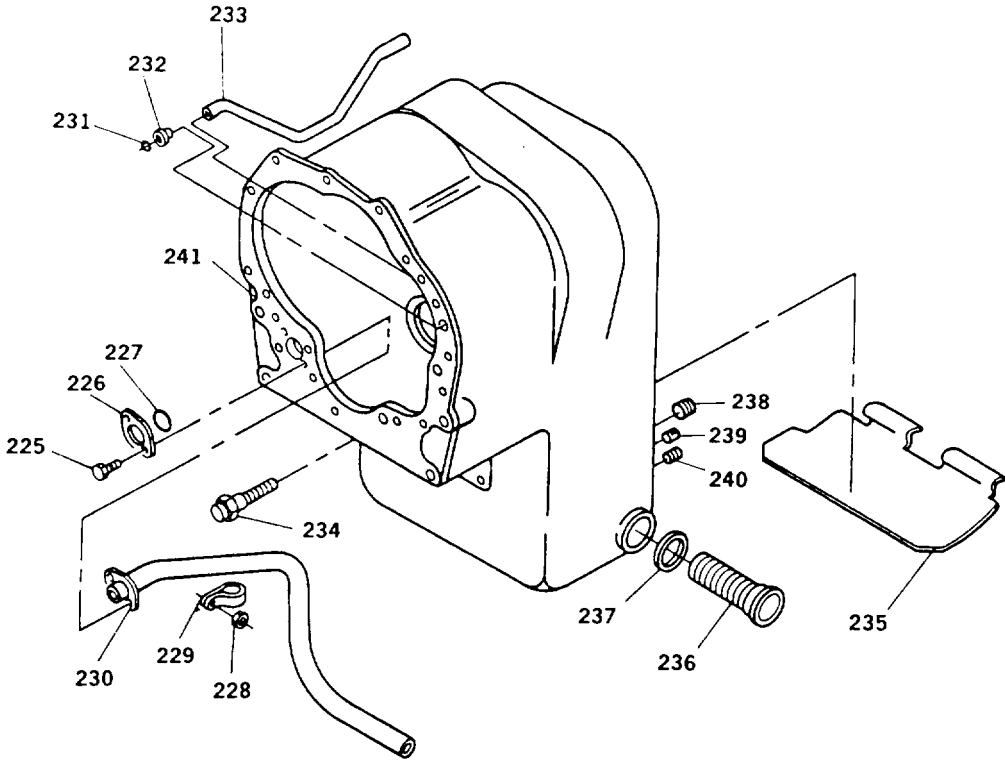
ASSEMBLY:

NOTE

Lubricate all preformed packings and seals with clean oil MIL-L-2104 SAE 10 prior to installation. Apply this coat of Permatex No. 2 on outer diameter of oil seals to assure tight fit.

Coat metal-type sealing rings with a light coat of grease MIL-G-10924.

1. INSTALL OIL TUBES (230) AND (233).
 - a. Install oil baffle (235).
 - b. Install strainer (236) and new gasket (237).
 - c. Install tube (233) with sleeves (232) and new preformed packings (231).
 - d. Install tube (230) and secure with clamp (229) and nut (228).
 - e. Install new preformed packing (227), spacer (226) and two capscrews (225).



2. ASSEMBLE REVERSE AND 3RD CLUTCH (204).

- a. Install new preformed packing (224) and new piston ring (223) in piston (222).

CAUTION

Do not damage preformed packing (224) and piston ring (223).

- b. Install piston (222) in housing (204).
- c. Install spring retainer (217), spring (216), spring retainer (215), and retaining ring (214). Using clutch spring tool (Item 9, Appendix C), install retaining ring (213).
- d. Install one steel clutch disc (220).
- e. Install one friction clutch disc (221). Alternate one steel clutch disc (220) and one friction clutch disc (221) until all have been installed.
- f. Install clutch plate (219) and retaining ring (218).
- g. Install retaining ring (210).
- h. Press bearing (212) onto housing shaft (204).
- i. Install gear (209) into housing shaft (204). Align gear splines with internal teeth of friction discs and tap gear into position.

NOTE

Gear (209) splines must be aligned with internal teeth of all friction discs.

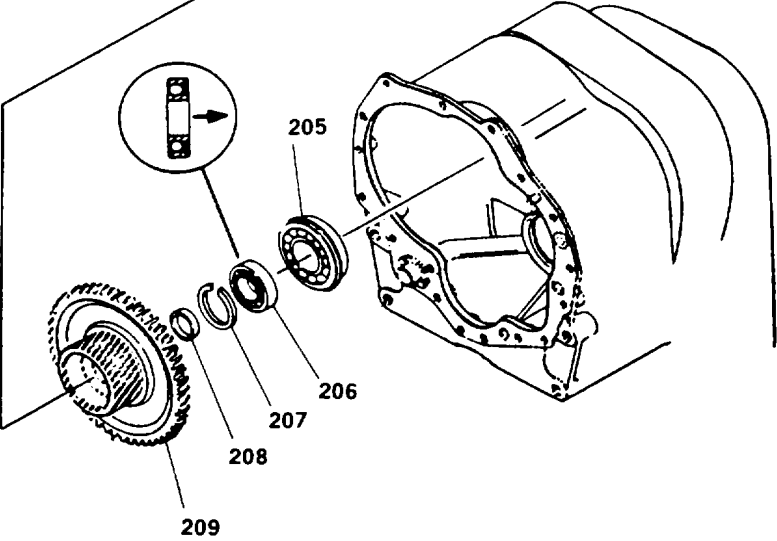
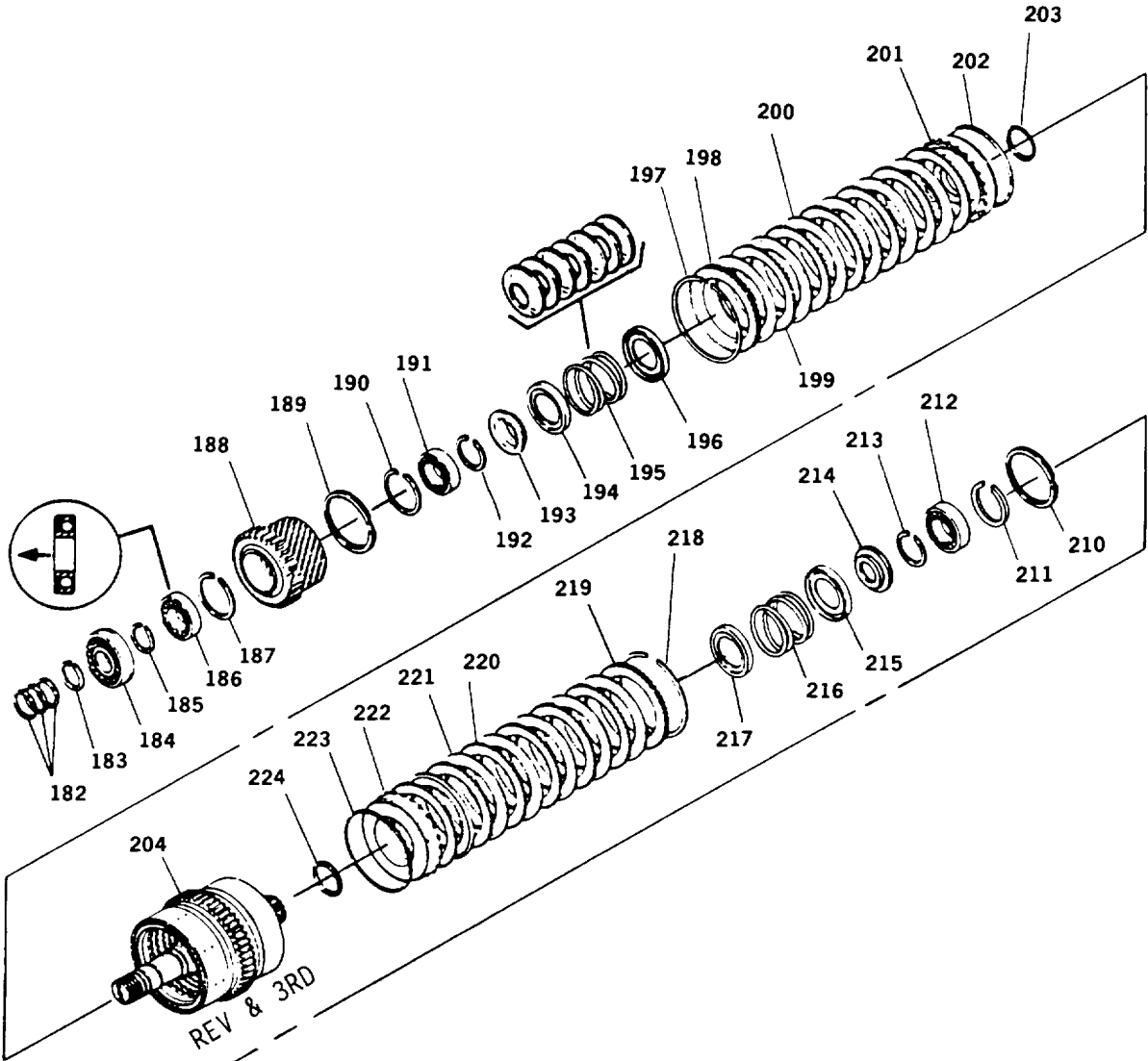
- j. Install spacer (208) and retaining ring (207).
- k. Press bearing (206) into position.
- l. Press bearing (205) into position.

- m. Install new preformed packing (203) and piston ring (202) on piston (201).

CAUTION

Do not damage preformed packing (203) and piston ring (202).

- n. Install piston (201) in housing (204).
- o. Install spring retainer (196), spring (195), spring retainer (194), and retaining ring (193). Using clutch spring tool (Item 9, Appendix C), install retaining ring (192).
- p. Install one steel clutch disc (199).
- q. Install one friction clutch disc (200). Alternate one steel clutch disc (199) and one friction disc (200) until all have been installed.
- r. Install clutch plate (198) and retaining ring (197).
- s. Install retaining ring (189).
- t. Press bearing (191) into position.
- u. Install gear (188) onto housing shaft (204). Align gear splines with internal teeth of friction discs and tap gear into position.
- v. Press bearing (186) into position and install retaining ring (185).
- w. Press bearing (184) into position and install retaining ring (183).
- x. Apply grease MIL-L-10924 to piston rings (182). Install piston rings (182).



3. ASSEMBLE FORWARD AND 2ND CLUTCH (169).

- a. Install new preformed packing (170) and new piston ring (171) in piston (172).

CAUTION

Do not damage preformed packing (170) and piston ring (171).

- b. Install piston (172) in housing (169).
- c. Install spring retainer (177), spring (178), spring retainer (179) and retaining spring (180). Using clutch spring tool (Item 9, Appendix C), install retaining ring (181).
- d. Install one steel clutch disc (173).
- e. Install one friction clutch disc (221). Alternate one steel clutch disc (220) and one friction clutch disc (221) until all have been installed.
- f. Install clutch plate (175) and retaining ring (176).
- g. Install new preformed packing (168) and new piston ring (167) in piston (166).
- h. Install piston (166) in housing (169).
- i. Install spring retainer (161), spring (160), spring retainer (159) and retaining spring (158). Using clutch spring tool (Item 9, Appendix C), install retainer ring (157).
- j. Install one steel clutch disc (164).
- k. Install one friction clutch disc (165). Alternate one steel

clutch disc (164) and one friction clutch disc (165) until all have been installed.

- l. Install clutch plate (163) and retaining ring (162).
- m. Install retaining ring (154)
- n. Press bearing (156) into position.

NOTE

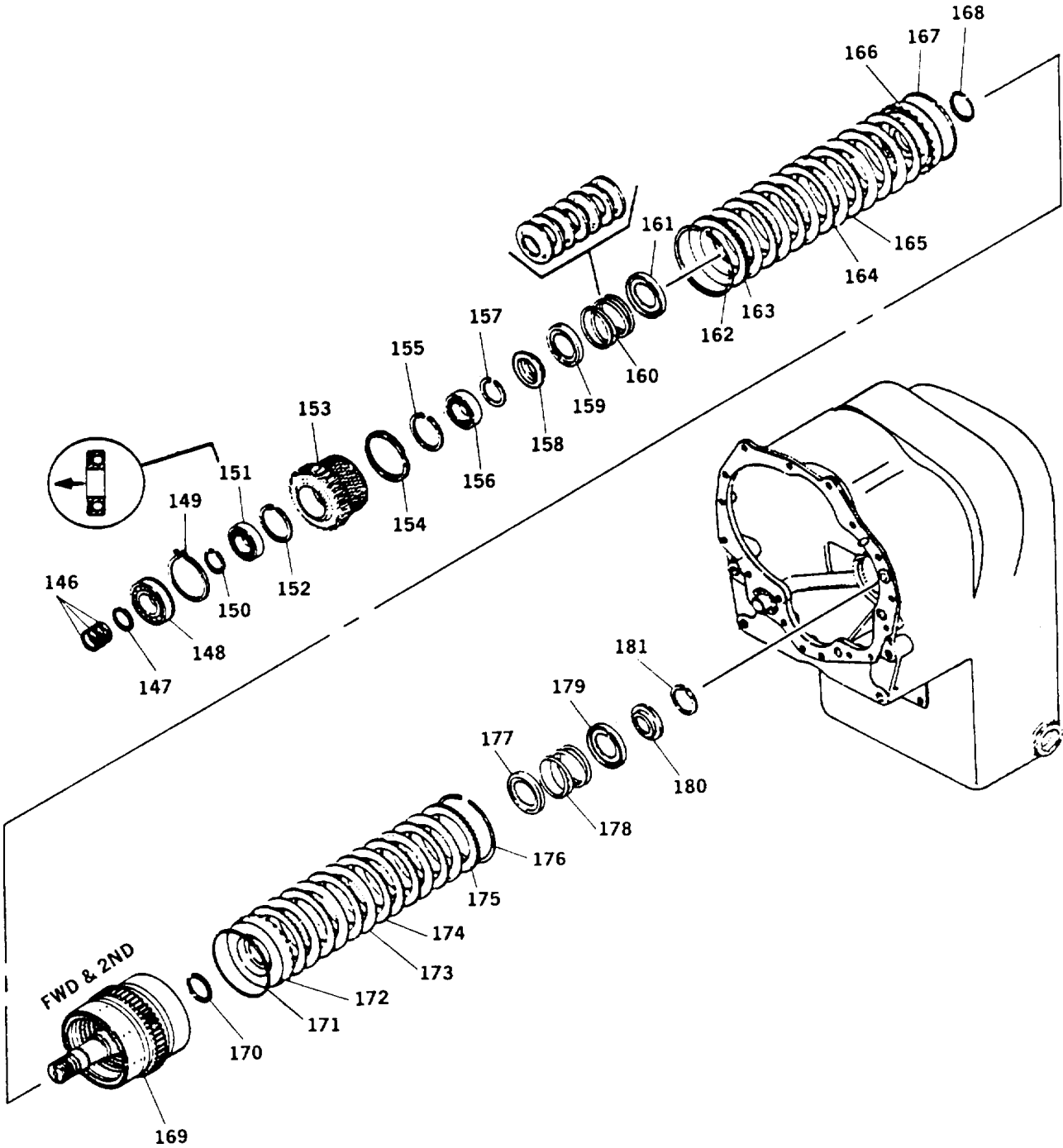
Gear (153) must be in full position. Do not force this operation.

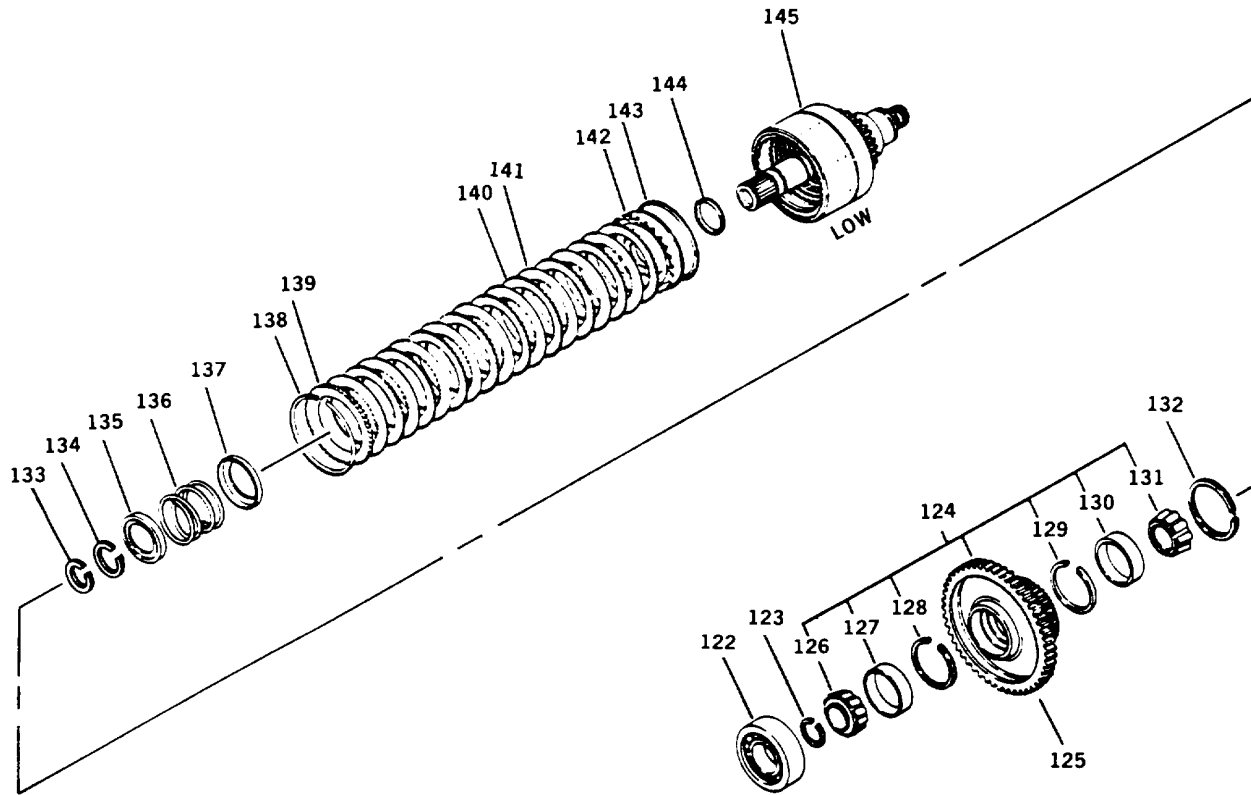
- o. Install gear (153) onto housing shaft (169). Align gear splines with external teeth of friction discs and tap gear into position.
 - p. Press bearing (151) into position and install retaining ring (150).
 - q. Install special ring (149).
 - r. Press bearing (148) into position and install retaining ring (147).
 - s. Apply grease MIL-L-10924 to piston rings (146). Install piston rings (146).
4. ASSEMBLE LOW CLUTCH (71).
- a. Install new preformed packing (144) and new piston ring (143) in piston (142).

CAUTION

Do not damage preformed packing (144) and piston ring (143).

- b. Install piston (142) in housing (145).
- c. Install spring retainer (137), spring (136) and spring retainer (135). Using clutch spring tool (Item 9, Appendix C), install retaining ring (134).

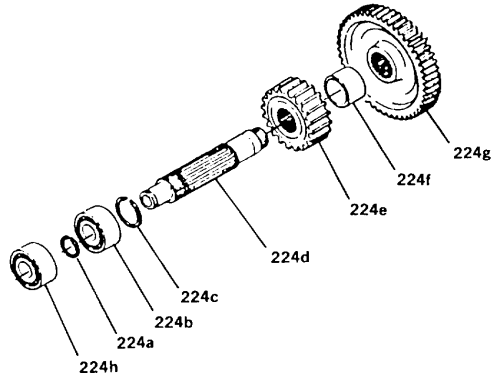




NOTE

The friction discs in the low clutch have a higher coefficient rating than the friction discs in the other clutches, therefore the discs must not be mixed. The low clutch inner disc can be identified by an X stamped on one side of the inner teeth. The low clutch inner disc also has a strip of non-soluble yellow paint sprayed on the outer edge of the disc.

- d. Install one steel clutch disc (140).
- e. Install one friction clutch disc (141). Alternate one steel clutch disc (140) and one friction clutch disc (141) until all have been installed.
- f. Install clutch plate (139) and retaining ring (138).
- g. Install retaining rings (133 and 132).
- h. Press bearing (131) into position. Install cup (130).
- i. Install gear (125) onto housing shaft (145). Align splines on gear with internal teeth of friction discs and top gear into position.
- j. Install retaining ring (123).
- k. Press bearing (122) into position.



5. ASSEMBLE SIX SPEED IDLER SHAFT ASSEMBLY (64).

- a. Using a suitable press, install gear (224e).
- b. Install locating ring (224c).
- c. Using a suitable press, install bearing (224b).
- d. Install retaining ring (224a).
- e. Install spacer (224f).
- f. Install gear (224g).

NOTE

Retaining ring groove on bearing (224h) must face away from gear (224g).

- g. Using a suitable press, install bearing (224h).

6. ASSEMBLE REAR AXLE DISCONNECT (94).

- a. Install fork shift (99), hub shaft (109) and retaining ring (107) if removed.
- b. Press bearing (106) onto gearshaft (108).
- c. Install gearshaft (108) and retaining ring (105).
- d. Press new seal (104) into disconnect (94).

- e. Install shift rail (100) with spring (101) and ball bearing (102). Press in new seal (103).
- f. Install setscrew (99) and plug (97).

7. INSTALL OUTPUT GEARS (117) AND (120).

- a. Assemble and install two retainer rollers (115), ring (116), gear (120), gear hub (118) and sleeve bearing (119) in housing.
- b. Assemble and install two retainer rollers (115), ring (116) and gear (117) in housing.

8. INSTALL OUTPUT SHAFT (114).

- a. Using press, install front bearing (111) and washer (112) on output shaft (114).
- b. Insert output shaft (114) through output gears from front of transmission housing.
- c. Install front bearing cup (110) and bearing housing (88) with new preformed packings (89 and 90). Ensure lube opening in bearing housing (88) is aligned with lube opening in transmission housing.
- d. Install four capscrews (86) and new lockwashers (87). Torque capscrews to 82-90 ft-lbs (109-120 N•m).
- e. Install rear cup (120a).
- f. Position rear washer (120c) and bearing (120d) on output shaft (114).
- g. Press rear bearing (120b) into place.
- h. Install seal (91) if required.

9. INSTALL REAR AXLE DISCONNECT (94).

- a. Install sleeve bushing (113) and cup (110).

- b. Install new preformed packing (96), shims (95) and rear axle disconnect housing (94). Install capscrews (92) and new lockwashers (93). Torque capscrews (92) 115-127 ft-lbs (153-169 N•m).
- c. Tap output shaft (114) front and rear to seat bearings (111).

10. CHECK ROLLING TORQUE.

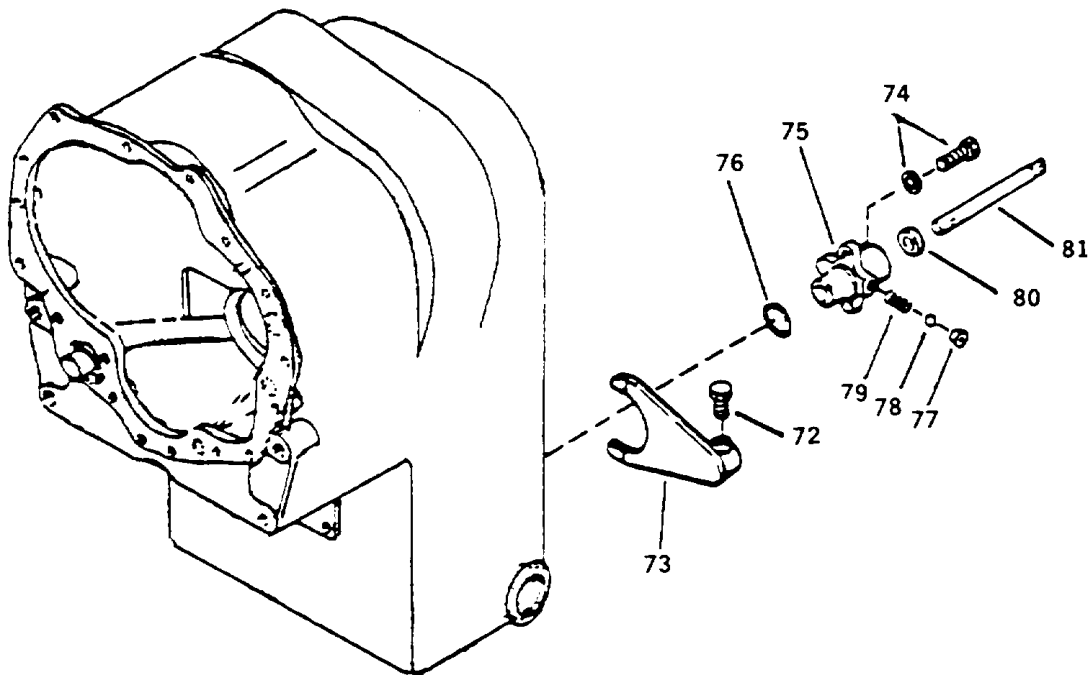
- a. Loosen capscrews (92).
- b. Using pound-inch torque wrench, determine and record rolling torque of output shaft.
- c. Tighten capscrews (92) to 115-127 ft-lbs (153-169 N•m).
- d. Determine and record rolling torque of output shaft.
- e. Compare recorded torque from step b. and step d. If value recorded in step d. is between 6 and 8 pound-inches (8-11 N•m) greater than that recorded in step b, bearing preload is correct. Otherwise add or subtract shims (95) as required to achieve proper bearing preload.

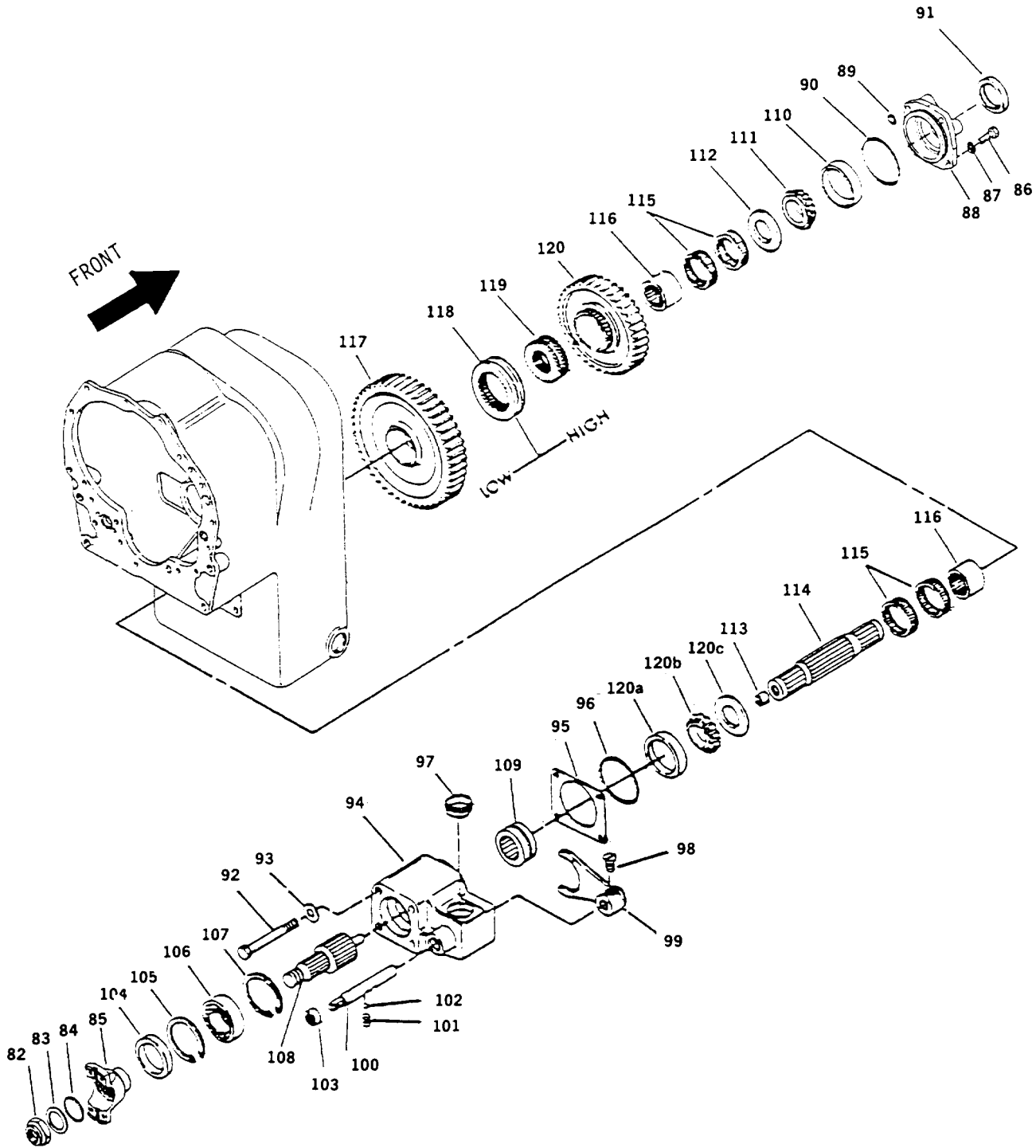
11. INSTALL SHIFT COUPLING (75).

- a. Locate shifter fork (73) in gear hub (118) with offset of fork toward front of transmission.
- b. Assemble shaft (81), seal (80), spring (79), ball (78), and pipe plug (77).
- c. Install shaft coupling (75) with new preformed packing (76).
- d. Install and torque two bolts (74) to 23-25 ft-lbs (31-33 N•m).
- e. Locate setscrew hole in shaft (81) and shift fork (73). Install setscrew (72) and lockwire to prevent loosening.

12. INSTALL FLANGE (85).

- a. Install flange (85).
- b. Install new preformed packing (84), new lockwasher (83) and nut (82).
- c. Torque nut (82) 200-250 ft-lbs (266-333 N•m).





13. INSTALL CLUTCH ASSEMBLIES (70) AND (71).

- a. Install clutch (71) into front of transmission housing.
- b. Install clutch (70) into rear of transmission housing.
- c. Install second gear (69).
- d. If removed, install retaining ring (68).
- e. Install retaining ring (67).
- f. Install spur gear (66) and retaining ring (65).

14. INSTALL SIX SPEED IDLER SHAFT AND GEAR (64).

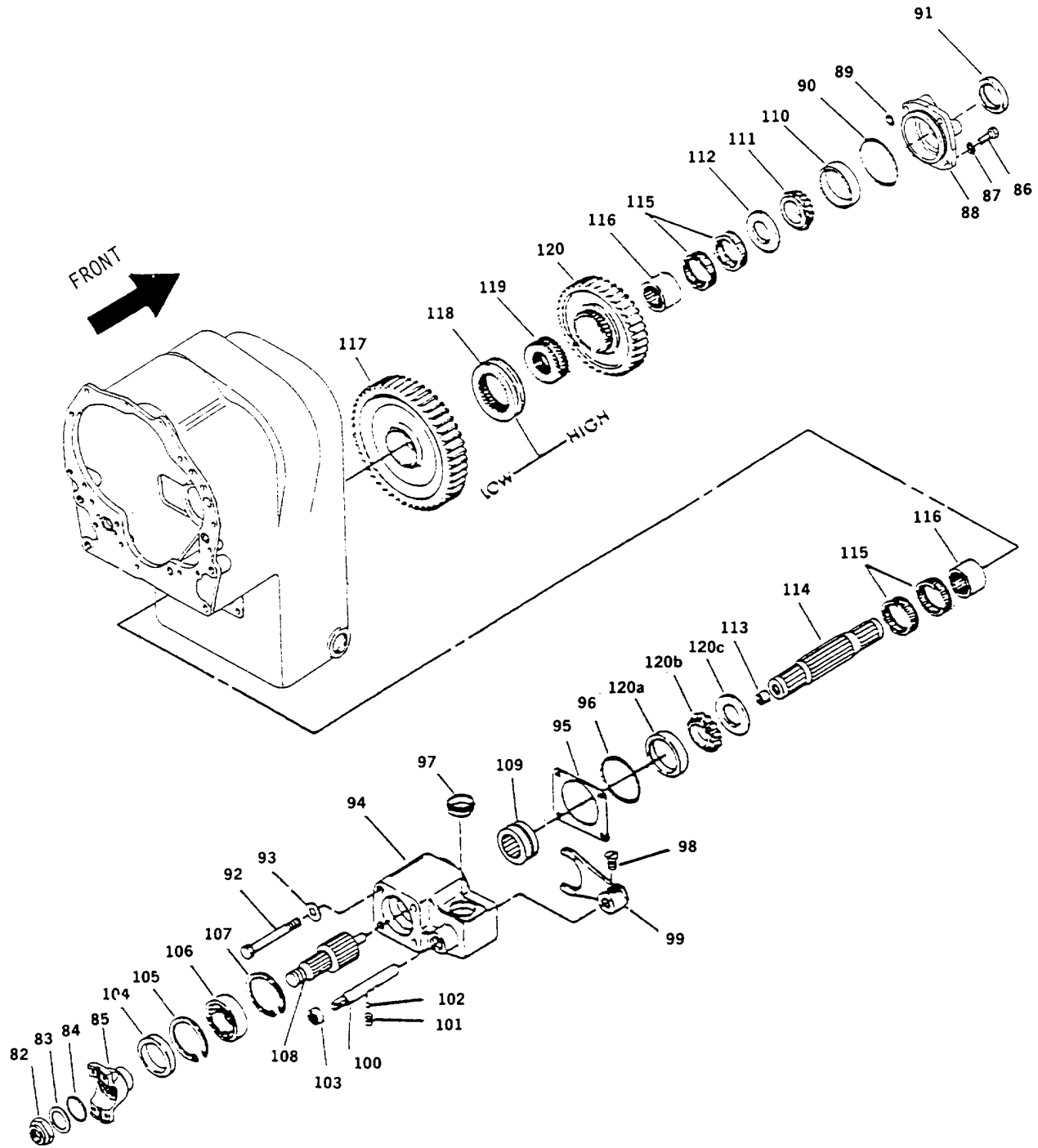
15. INSTALL BEARING (63).

- a. Press bearing (63) onto clutch (71) with ring groove to front.

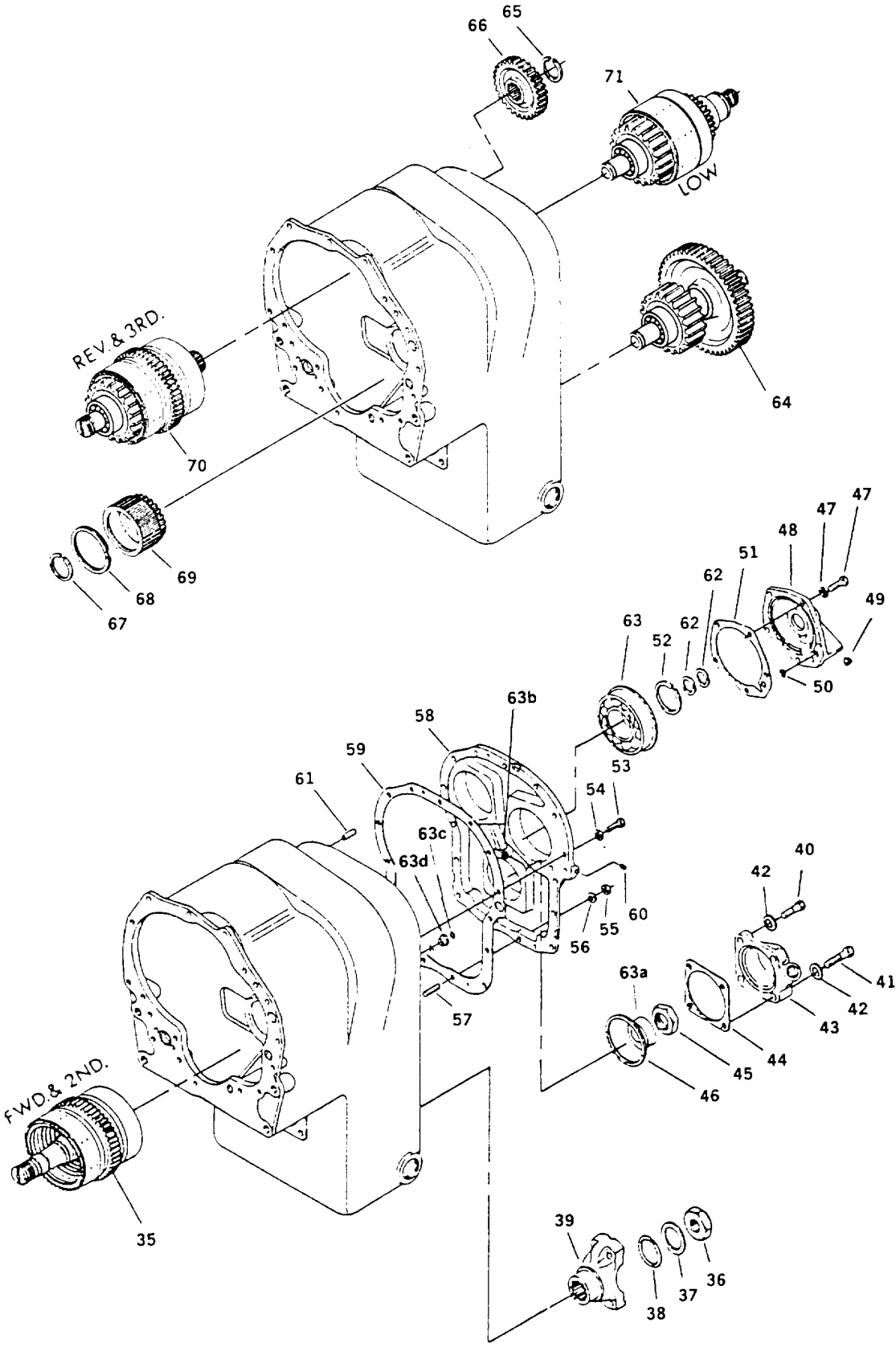
- b. Install retaining ring (52).

16. INSTALL TRANSMISSION COVER (58).

- a. Position new gasket (59) on front of transmission housing.
- b. Install new preformed packing (63c) and sleeve (63d).
- c. Align lock ball (63b) in idler shaft (64) bearing with notch in transmission cover (58).
- d. Tap transmission cover (58) into place and secure with thirteen capscrew (53) and new lockwashers (54).
- e. Install two nuts (55) and new lockwashers (56).
- f. Torque capscrews (53) to 52-57 ft-lbs (69-76 N•m).



- g. From rear of transmission, tap low clutch (71) and six speed idler shaft (64). This will allow clearance for installing retaining ring (46).
 - h. Install piston rings (62).
17. INSTALL GREASE CAP (48).
- a. Install new gasket (51) on grease cap (48).
 - b. Install grease caps (48) and secure with five bolts and washers (47).
 - c. Torque bolts and washers (47) to 23-25 ft-lbs (31-33 N•m).
18. INSTALL RETAINING RING (46) AND SPACER (63a).
19. INSTALL NUT (45).
- a. Install nut (45) on six speed idler shaft and gear (64).
 - b. Block idler gear and torque nut 400-450 ft-lbs (532-600 N•m).
20. INSTALL BEARING HOUSING (43).
- a. Position new gasket (44) on bearing housing (43).
 - b. Install bearing housing (43) and secure with four capscrews (40) and (41) and new lockwashers (42).
 - c. Torque capscrews (40)and(41) to 82-90 ft-lbs (109-120 N•m).
21. INSTALL FLANGE (39).
- a. Install flange (39) with new preformed packing (38).
 - b. Secure with washer (37) and nut (36).
 - c. Block output shaft.
 - d. Torque nut (36) 200-250 lbs-ft (266-333 N•m).
22. INSTALL FORWARD AND SECOND CLUTCH ROLLER (71a).
- a. Install roller (71a) in rear of forward and second clutch shaft (35).



23. INSTALL BUSHINGS (14).

- a. Press bushings (14) into transmission cover (5).
- b. Install sleeve (13), two bolts (12) and new lockwashers (9).

24. INSTALL TUBES (7) AND (11).

CAUTION

Sleeves (15) and tubes (7) and (11) must be installed together, lightly tapping sleeves (15) to seat.

- a. Install new preformed packings (6), sleeves (15) and tubes (7) and (11).
- b. Install two clips (8), new lockwashers (9) and bolts (10).

25. INSTALL BEARING (3).

- a. Install bearing (3) and retaining rings (2).
- b. Press new seal (1) into transmission cover (5).

26. INSTALL GEARSHAFT (20) INTO TRANSMISSION COVER (5).

27. INSTALL TRANSMISSION COVER (5).

- a. Install front bearing special ring (33).
- b. Support transmission cover (5) with overhead hoist.
- c. Using snap ring pliers, hold special ring (34) open.
- d. Position transmission cover (5) to transmission housing.

CAUTION

Do not damage piston rings.

- e. Install eight capscrews (22), (26) and (29).
- f. Tighten capscrews 37-41 ft-lbs (49-55 N•m).
- g. Install pipe plug (28).

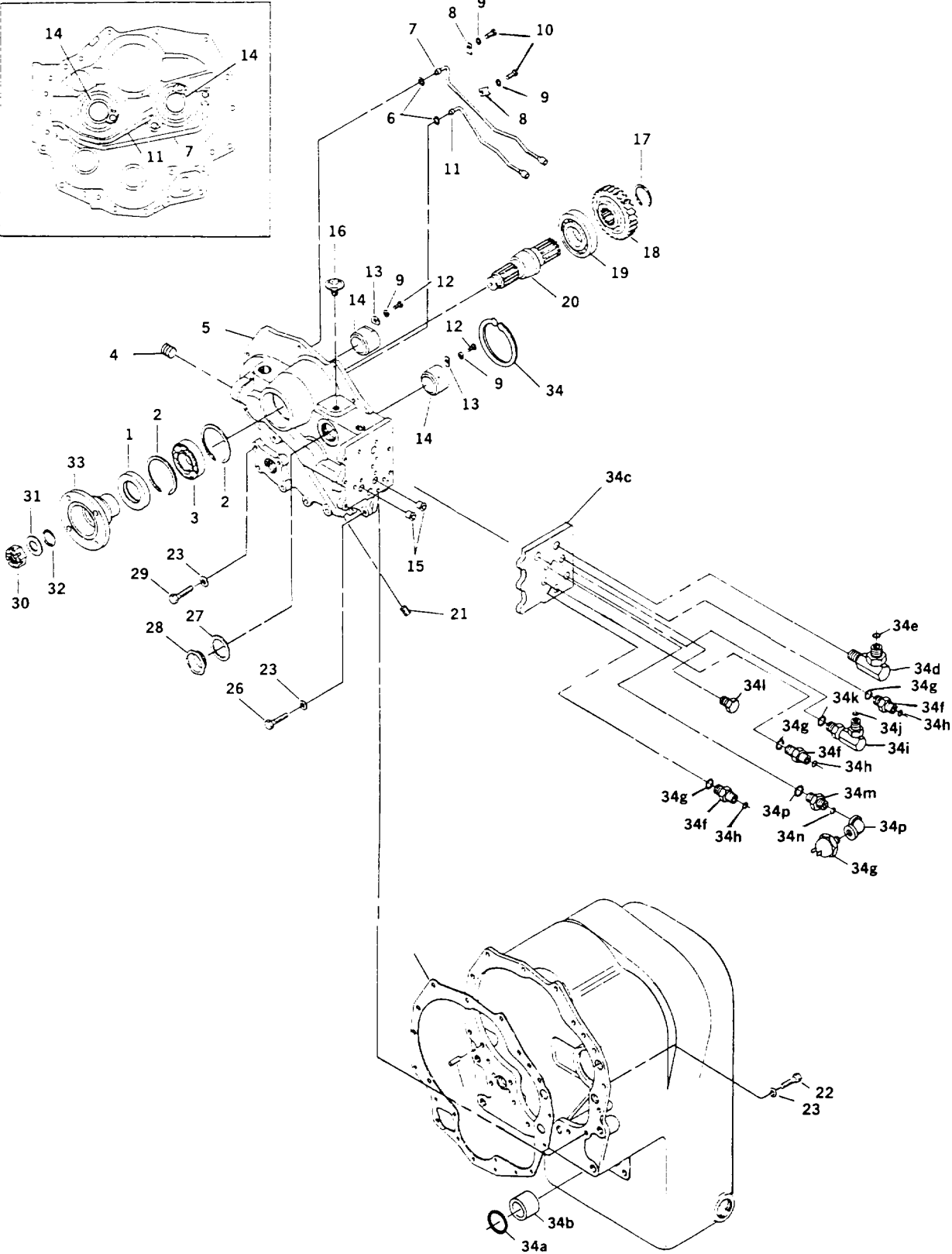
28. INSTALL FLANGE (33).

- a. Install flange (33) with new preformed packing (32), washer (31) and nut (30).
- b. Torque nut (30) to 150-200 ft-lbs (200-265 N•m).

29. INSTALL ADAPTER PLATE (34c).

- a. If removed, install new packing (34n), elbow (34r) and switch (34g) in fitting (34m).
- b. Position adapter plate (34c) on cover (5).
- c. Install new packing (34p) and fitting (34m).
- d. Install plug (341).
- e. Install new packings (34k) and (34j), and fitting (34i).
- f. Install new packings (34h) and (34g), and fittings (34g).
- g. Install new packing (34e) and fitting (34d).

END OF TASK



RANGE SHIFTER ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Cotter pin (Item 105, Appendix B) (6 Required)
 Cotter pin (Item 232, Appendix B) (2 Required)
 Lockwasher (Item 233, Appendix B) (2 Required)

EQUIPMENT CONDITIONS: Range shifter assembly removed. (Refer to page 7-20.)

DISASSEMBLY:

1. REMOVE 4-WAY AIR VALVE (1).

- a. Disconnect and remove air lines (2) and (3) from air valve (1) and air cylinder (4).
- b. Remove nuts (5) and lockwashers (6). Discard lockwashers (6).

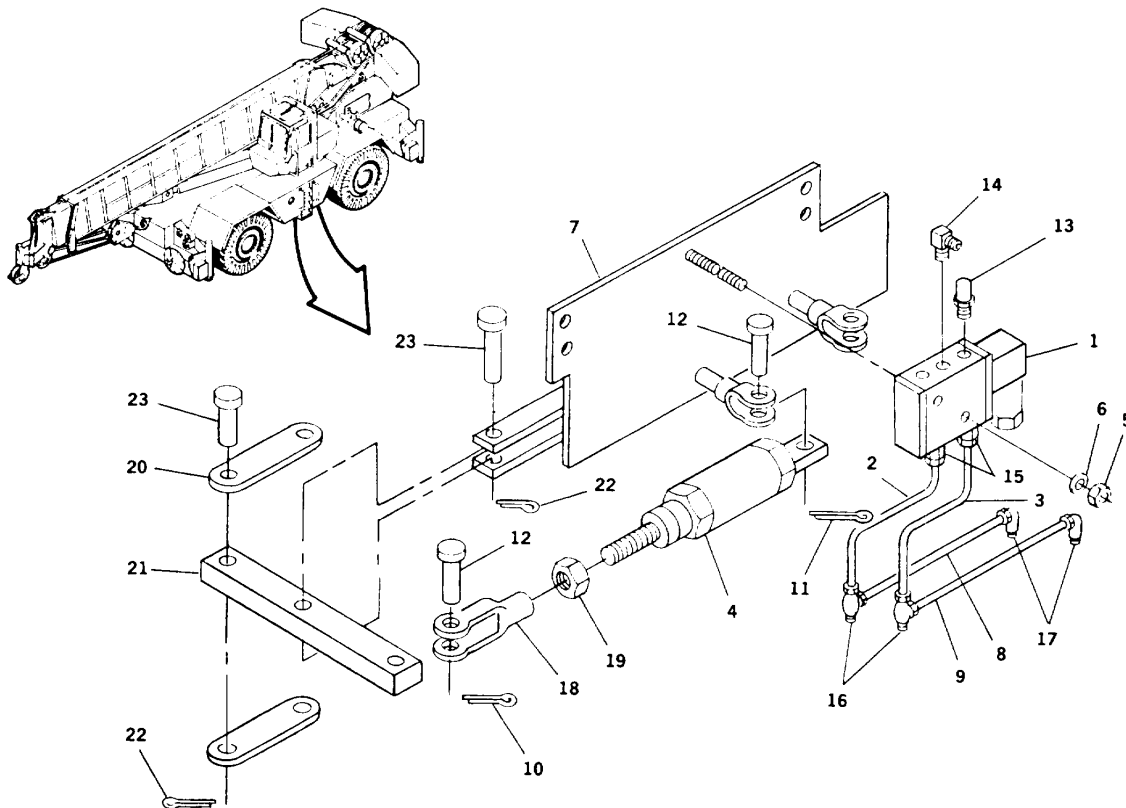
c. Remove air valve (1) from mounting plate (7).

d. If necessary, remove air mufflers (13), elbow (14) and unions (15) from air valve (1).

2. REMOVE AIR CYLINDERS (4).

a. Disconnect and remove air lines (8) and (9) from air cylinders (4).

b. Remove cotter pins (10) and (11), and clevis pins (12) from air cylinders (4). Discard cotter pins (10) and (11).



- c. Remove air cylinder (4).

NOTE

Count number of turns when removing clevis rod ends (18) from air cylinders (4) for reassembly.

- d. If necessary remove tee fittings (16), elbows (17), clevis rod ends (18) and nuts (19) from air cylinders (4).

3. REMOVE LINKAGE BARS (20) AND (21).

- a. Remove cotter pins (22) and clevis pins (23). Discard cotter pins (22).

- b. Remove linkage bars (20) and (21) from mounting plate (7) linkage bars.

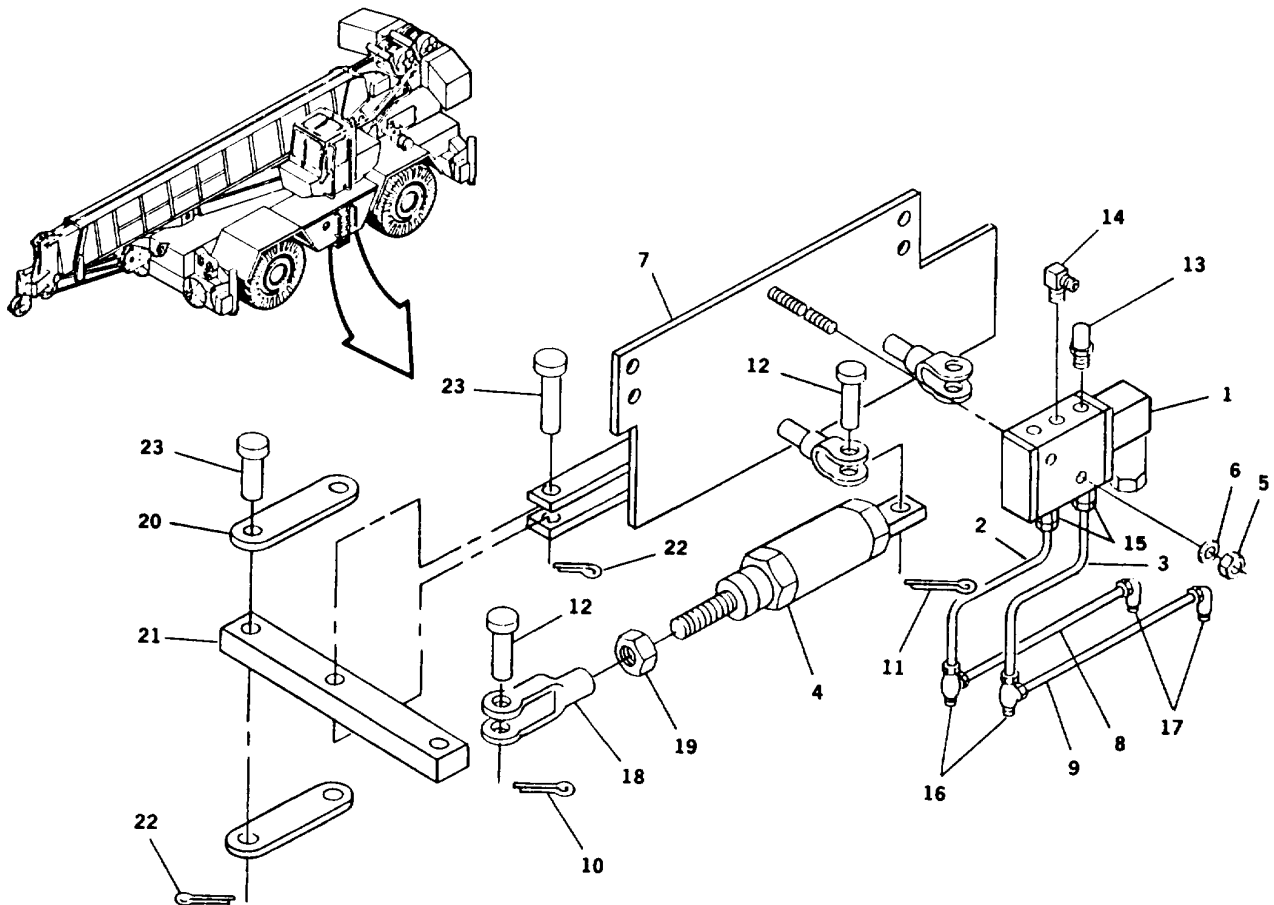
ASSEMBLY:

1. INSTALL LINKAGE BARS (20) AND (21).

- a. Position linkage bars (21) in mounting plate (7) linkage bars, and linkage bars (20) on linkage bars (21).
- b. Secure linkage bars (20) and (21) with clevis pins (23) and new cotter pins (22).

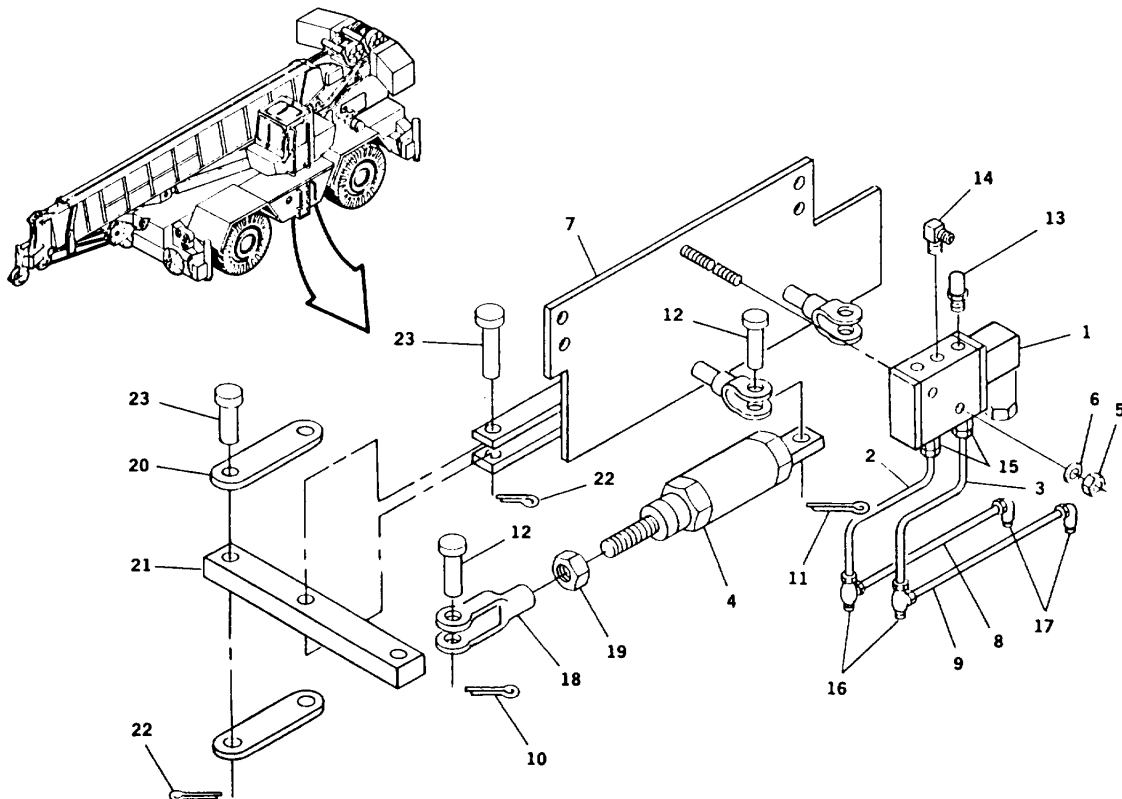
2. INSTALL AIR CYLINDERS (4).

- a. If removed, install nuts (19), clevis rod ends (18) (same number of turns noted on disassembly), elbows (17) and tee fittings (16).



- b. Position air cylinders (4) in mounting plate (7) clevis ends and on linkage bars (21).
 - c. Secure air cylinders (4) with clevis pins (12) and new cotter pins (10) and (11).
 - d. Position and connect air lines (8) and (9) to air cylinders (4).
3. INSTALL 4-WAY AIR VALVE (1).
- a. If removed, install unions (15), elbow (14) and air mufflers (13).
- b. Secure air valve (1) to mounting plate (7) studs with new lockwashers (6) and nuts (5).
 - c. Position and connect air lines (3) and (2) to air valve (1) and air cylinder (4).
4. INSTALL RANGE SHIFTER ASSEMBLY. (REFER TO PAGE 7-20.)

END OF TASK



Section III. HYDRAULIC SYSTEM SERVICE**HYDRAULIC SYSTEM SERVICE**

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Oil as recommended (Refer to LO 5-3810-306-12)

EQUIPMENT CONDITIONS: None

1. SERVICE HYDRAULIC SYSTEM.

The transmission, torque converter, and its allied hydraulic system are important links in drive line between engine and wheels. The proper operation of either unit depends greatly on condition and operation of other; therefore, whenever repair or overhaul of one unit is performed, the balance of system must be considered before job can be considered completed.

- a. Replace oil filter elements, cleaning out filter cases thoroughly.
- b. The oil cooler must be thoroughly cleaned. The cooler should be back flushed with oil and compressed air until all foreign material has been removed. Flushing in direction of normal oil flow will not adequately clean cooler. If necessary, cooler assembly should be removed for cleaning, using oil, compressed air and a steam cleaner for that purpose.
- c. Drain transmission/ converter lubricant from transmission drain plug. If presence of considerable foreign material is noted, it will be necessary that transmission be removed, disassembled, and cleaned thoroughly.
- d. Assemble all components and use only type oil recommended. Fill converter/transmission through the fill pipe until fluid is at the top of the fill pipe. Run the engine two minutes at 500 to 600 rpm to prime the torque converter and hydraulic lines. Recheck the level of oil in the transmission with the engine running at idle (500 to 600 rpm). Add oil as necessary to bring the level above the ADD mark on the dipstick. After the oil temperature reaches 180 to 200 degrees F (82.2 to 93.3 degrees C), add oil to bring the level to the FULL mark on the dipstick.

CAUTION

Do not use flushing compounds for cleaning purposes.

END OF TASK

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CHAPTER 8

AXLE MAINTENANCE

CHAPTER INDEX

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Section I. AXLE ASSEMBLY MAINTENANCE

AXLE, PROPELLER SHAFT, SPINDLE AND TIE ROD ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Grease MIL-G-10924 (Item 37, Appendix B)
 Sleeve bushing (Item 212, Appendix B) (2 Required)
 Sleeve bushing (Item 213, Appendix B) (2 Required)
 Cotter pin (Item 214, Appendix B)

EQUIPMENT CONDITIONS: Planetary ends removed. (Refer to page 8-50.)
 Steering cylinders disconnected. (Refer to TM 5-3810-306-20.)

DISASSEMBLY

CAUTION

Use care when removing propeller shaft (4) to avoid damage to bushing (3).

1. REMOVE PROPELLER SHAFT (4).
2. REMOVE TIE ROD (8).
 - a. Remove pin (6).
 - b. Remove two cotter pins (14), nuts (5) and bolts (13).
 - c. Remove tie rod (8).
 - d. Mark position of tie rod ends (9) in relation to tie rod (8).
 - e. Remove nuts (11), lockwashers (10), capscrews (7) and tie rod ends (9).
 - f. Remove bushing (12).
 - g. Repeat steps a thru e for opposite side.
3. REMOVE DUST SHIELDS.

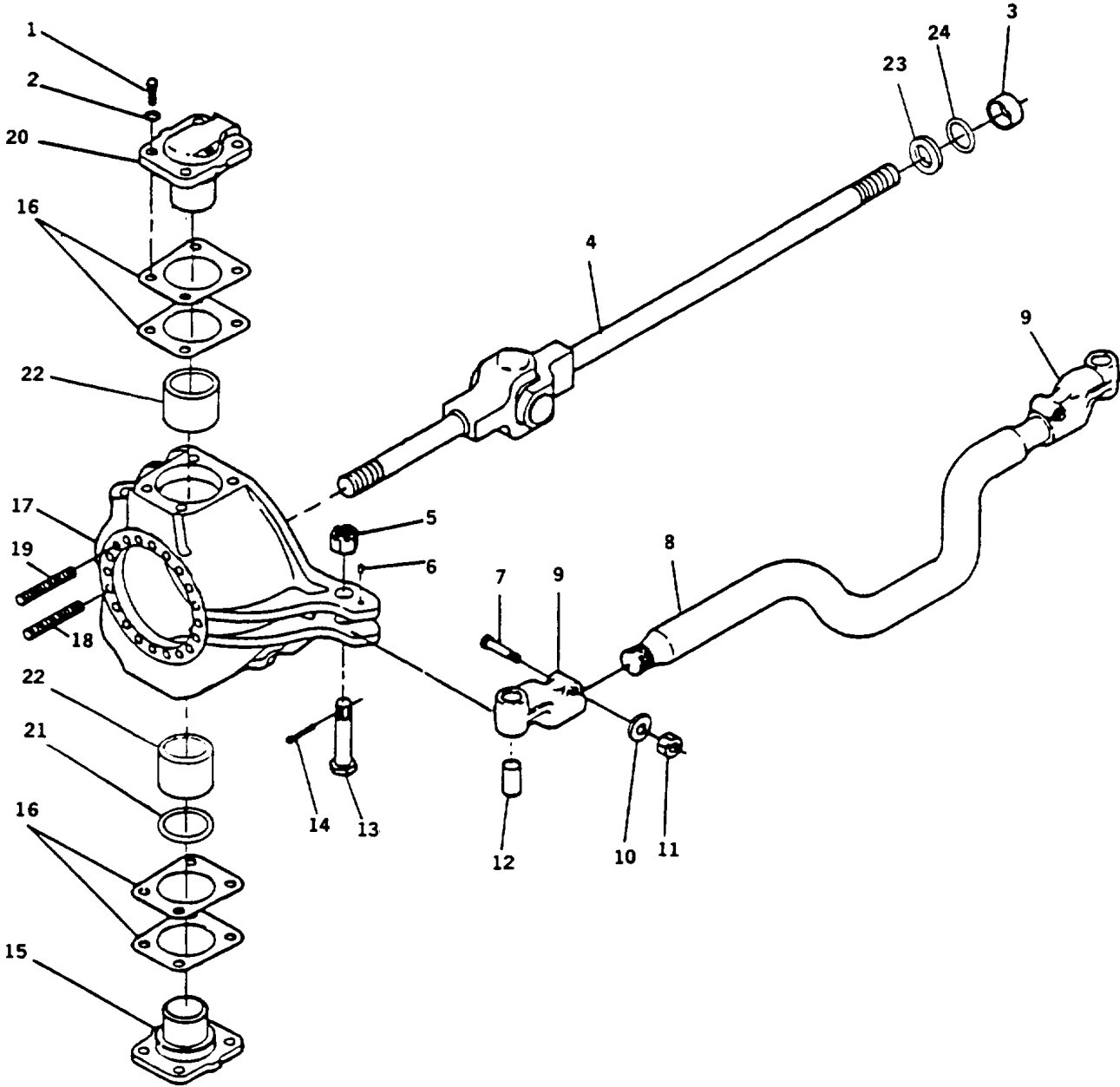
4. REMOVE WHEEL SPINDLE (17).

- a. Remove eight capscrews (1) and washers (2).

CAUTION

Do not mix upper and lower shims (16).

- b. Remove retaining plate (15), shims (16) and thrust washer (21).
- c. Remove retaining plate (20) and shims (16).
- d. Remove wheel spindle (17). Tip wheel spindle (17) to clear axle knuckle.
- e. Repeat steps a thru d for opposite side wheel spindle.
5. REMOVE BUSHINGS (22) AS REQUIRED.
6. REMOVE OIL SEAL (23), RETAINER (24) AND BUSHING (3) FROM END OF AXLE HOUSING.



INSPECTION**WARNING**

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°C-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

1. CLEAN ALL PARTS WITH CLEANING FLUID P-D-680 TYPE II.
2. INSPECT ALL PARTS FOR WEAR AND DAMAGE.
 - a. Inspect propeller shaft universal joints for looseness or wear.
 - b. Inspect splines on yoke for cracks or broken teeth.
 - c. Replace driveshaft if previous conditions exist.
 - d. Inspect all bushings and replace as necessary.

ASSEMBLY

1. INSTALL BUSHINGS (12) AND (22).

WARNING

Do not strike hardened steel parts directly with a hammer. Personal injury from chips or splinters may result.

NOTE

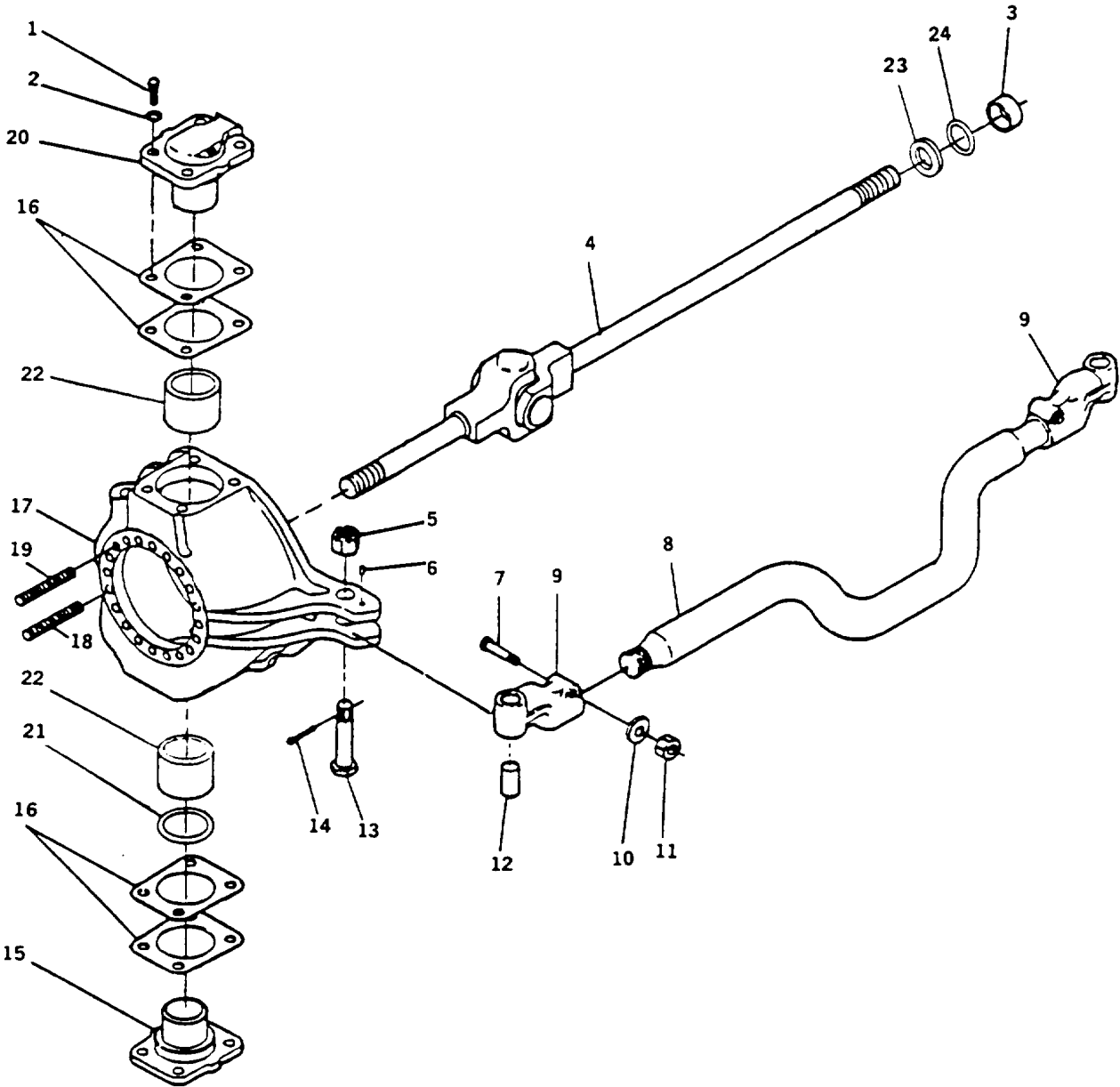
Ream bushings as necessary.

- a. If used, install axle shaft guide plate with mallet.
 - b. Using suitable driver, install bushing (12).
 - c. Using suitable driver, install bushings (22).
2. INSTALL BUSHING (3), RETAINER (24) AND OIL SEAL (23) IN END OF AXLE HOUSING. REAM BUSHING AS NECESSARY.
 3. INSTALL WHEEL SPINDLES (17).
 - a. Lubricate retaining plate bores (two places) in wheel spindle (17).
 - b. Install wheel spindle (17) on axle socket.
 - c. Install retaining plate (20) with original shims (16).

CAUTION

Insure retaining plate (20) is square with spindle bore while tightening capscrews (1).

- d. Install four capscrews (1) and washers (2). Tighten each capscrew (1) alternately in small increments.



- e. Apply grease MIL-L-10924 to grooved face on thrust washer (21).
- f. Install retaining plate (15) and thrust washer (21) with original shims (16).
- g. Insure tangs of thrust washer engage slots in wheel spindle (17).

CAUTION

Insure retaining plate (15) is square with spindle bore while tightening capscrews (1).

- h. Install four capscrews (1) and washers (2). Tighten each capscrew (1) alternately in small increments.
- i. Repeat steps a thru h for opposite side wheel spindle.

4. ADJUST WHEEL SPINDLE.

NOTE

Wheel spindle adjustment is accomplished by the shims (16). Vertical end play should be 0.005 to 0.013 in. (0.127 to 0.330 mm).

- a. Using hydraulic jack or pry bar, force wheel spindle upward.
- b. Measure and record vertical end play of wheel spindle (17) by using a feeler gauge inserted between plate retainer (20) and wheel spindle (17).

NOTE

If recorded end play is 0.013 in. (0.330 mm) or less, no adjustment is required. If end play exceeds 0.013 in. 0.333 mm) continue with steps c thru h.

- c. Remove retaining plates (15) and (20).
- d. Measure total shim pack (16) thickness (i.e., upper pack plus lower pack).
- e. Subtract actual end play recorded in step b. Divide the result by two.
- f. Assemble new lower shim pack (16) thickness using same value calculated in step e. If shim pack thickness cannot be met exactly, choose nearest shim pack thickness.
- g. Assemble new upper shim pack (16) thickness using same value calculated in step e plus 0.005 in. (0.127 mm). If shim pack thickness cannot meet exactly, choose nearest shim pack thickness.
- h. Install retaining plates (15) and (20) with new shim pack (16).

5. INSTALL PROPELLER SHAFT (4).

- a. Apply film of grease MIL-L-10924 to bushing lips (3), housing oil seal lips and oil seal journal on propeller shaft (4).

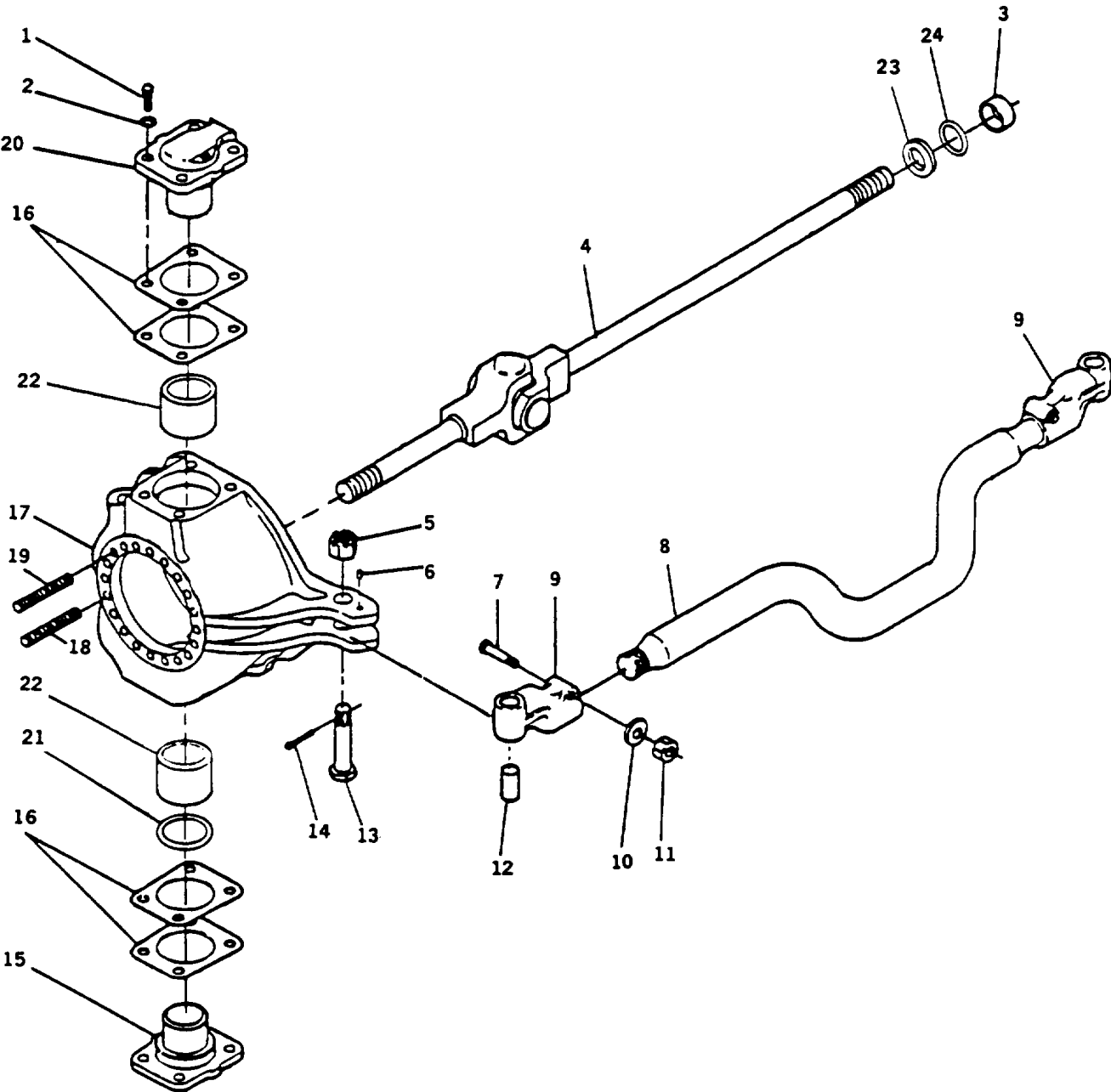
CAUTION

Use care to avoid damaging bushing (3) and oil seal (23) when installing propeller shaft (4).

- b. Insert propeller shaft (4) through housing and into side gear of planetary carrier.

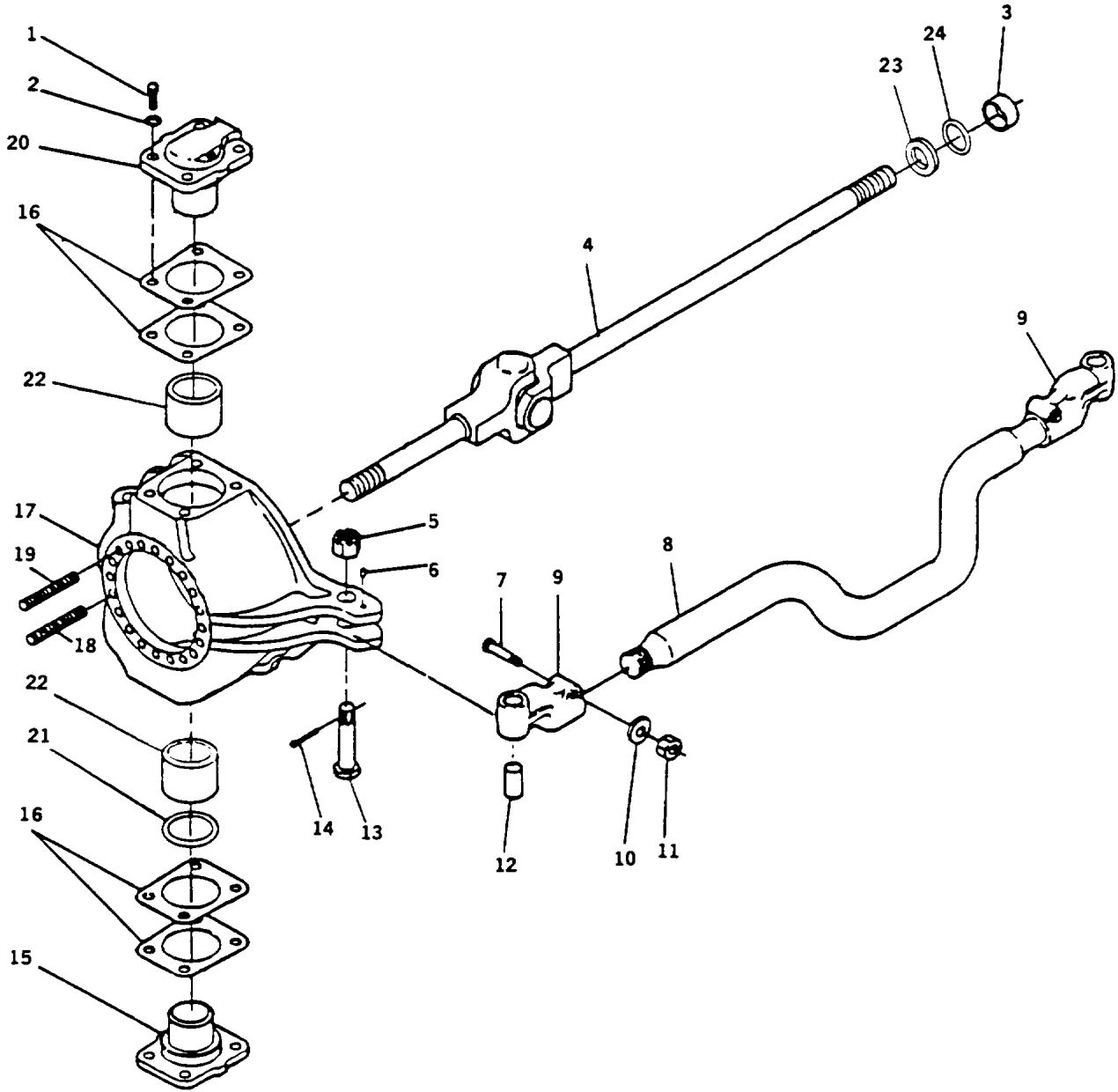
6. INSTALL TIE ROD (8).

- a. Press two bushings (12) into tie rod ends (9).



- b. Install two tie rod ends (9) to original position and secure with nuts (11), washers (10) and capscrews (7).
 - c. Install tie rod (8) and secure with bolts (13) and nuts (5). Install cotter pin (14).
 - d. Install two pins (6).
- 7. INSTALL PLANETARY ENDS. (Refer to page 8-50.)
 - 8. CONNECT STEERING CYLINDERS. (REFER TO TM 5-3810-306-20.)
 - 9. INSTALL TIRE AND WHEEL ASSEMBLIES. (REFER TO TM 5-3810-306-20.)

END OF TASK



REAR AXLE REMOVAL

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: None

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)
 Outrigger fully extended and lowered. (Refer to TM 5-3810-306-10.)
 Drive lines removed. (Refer to TM 5-3810-306-20.)
 Hydraulic systems shut down. (Refer to TM 5-3810-306-10.)
 Air systems purged. (Refer to TM 5-3810-306-20.)
 Brake chamber lines disconnected and capped. (Refer to TM 5-3810-306-20.)
 Steer cylinders removed. (Refer to TM 5-3810-306-20.)
 Wheels removed. (Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE REAR AXLE.

NOTE

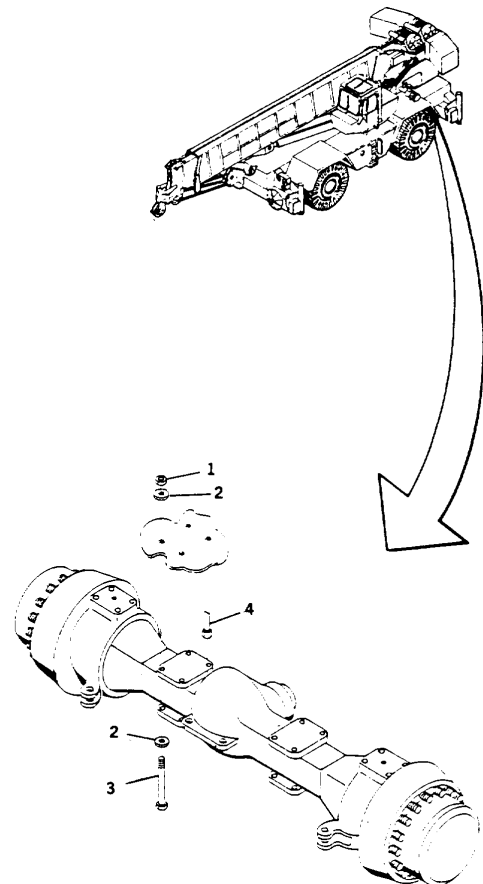
Axle weighs approximately 4085 lbs (1985 kg).

- a. Position jacks which are capable of handling weight of axle, under axle and support axle.
- b. Remove breather line (4) from axle housing.
- c. Remove eight nuts (1), washers (2) and bolts (3) securing axle.
- d. Lower axle to ground.

INSTALLATION:

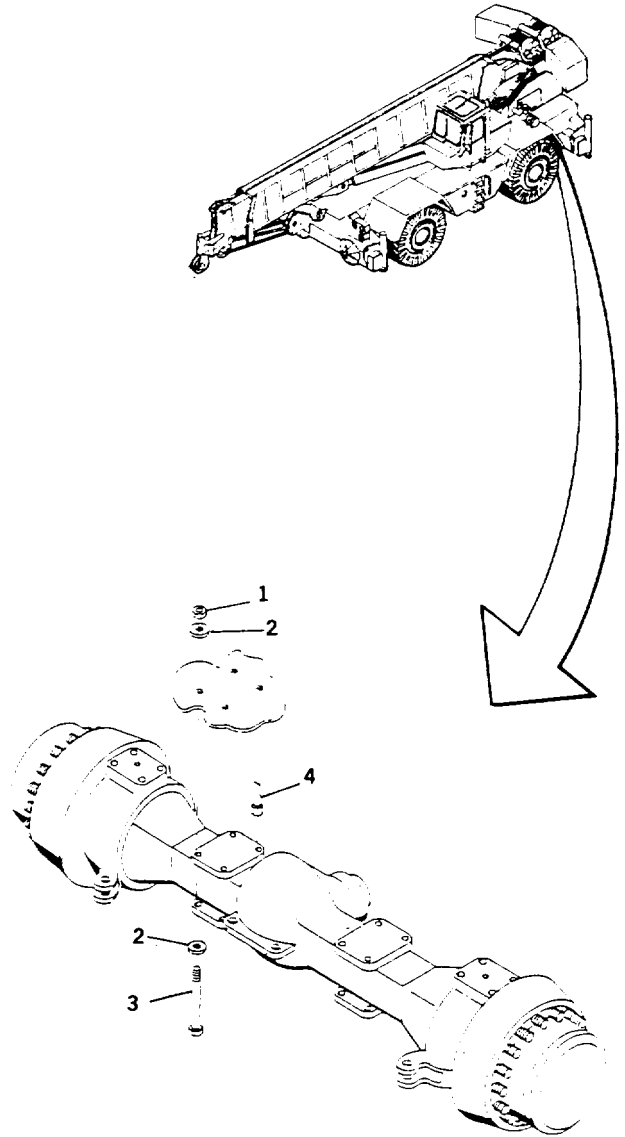
1. INSTALL REAR AXLE.

- a. Position jacks which are capable of handling weight of axle under axle and support axle.
- b. Raise axle into place and secure with bolts (3), washers (2) and nuts (1).



- c. Install breather line (4) at axle housing.
2. INSTALL STEER CYLINDERS. (REFER TO TM 5-3810-306-20.)
3. CONNECT BRAKE CHAMBERS. (REFER TO TM 5-3810-306-20.)
4. INSTALL DRIVE LINES. (REFER TO TM 5-3810-306-20.)
5. INSTALL WHEELS. (REFER TO TM 53810-306-20.)
6. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
7. RETRACT AND RAISE OUTRIGGERS TO LOWER THE WHEELS TO THE GROUND. (REFER TO TM 5-3810-306-10.)
8. ALIGN WHEELS STRAIGHT WITH NO TOE IN OR OUT.
9. TEST FOR PROPER OPERATION.

END OF TASK



FRONT AXLE REMOVAL

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: None

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)
 Outrigger fully extended and lowered. (Refer to TM 5-3810-306-10.)
 Drive lines removed. (Refer to TM 5-3810-306-20.)
 Hydraulic systems shut down. (Refer to TM 5-3810-306-10.)
 Air systems purged. (Refer to TM 5-3810-306-20.)
 Brake chamber lines disconnected and capped. (Refer to TM 5-3810-306-20.)
 Steer cylinders removed. (Refer to TM 5-3810-306-20.)
 Wheels removed. (Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE FRONT AXLE.

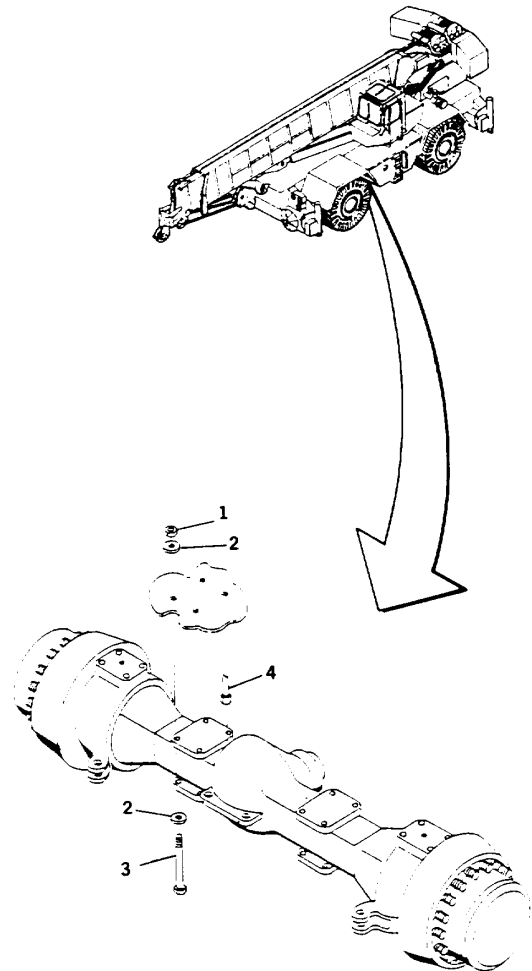
NOTE

Axle weighs approximately 4085 lbs (1985 kg).

- a. Position jacks which are capable of handling weight of axle, under axle and support axle.
- b. Remove breather line (4) from axle housing.
- c. Remove eight nuts (1), washers (2) and bolts (3) securing axle.
- d. Lower axle to ground.

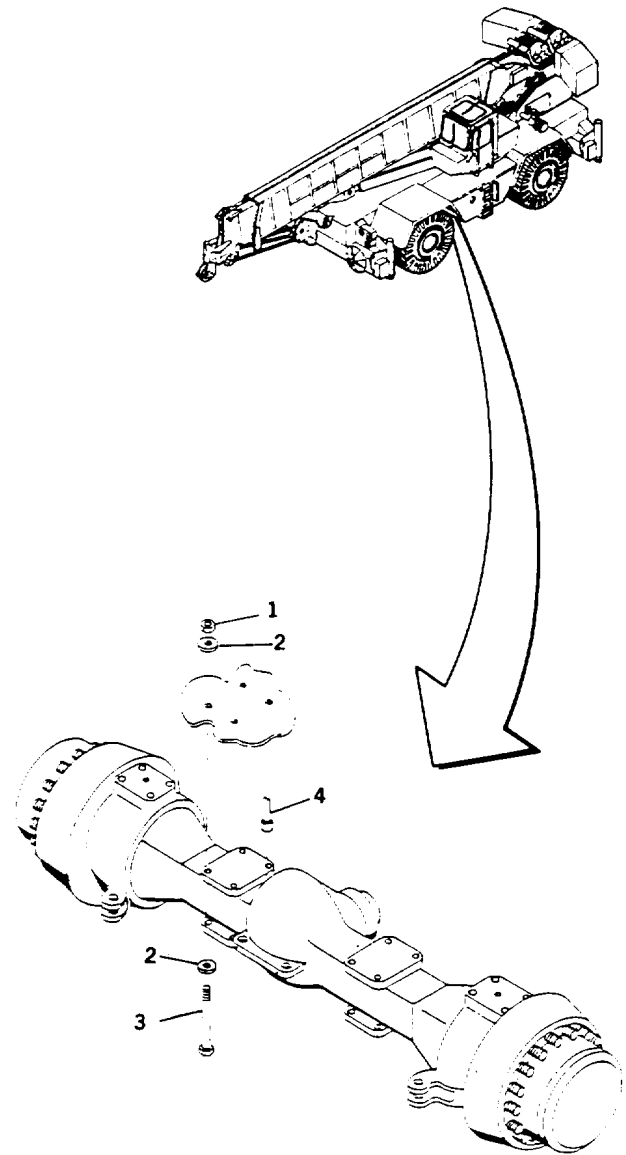
INSTALLATION:

1. INSTALL FRONT AXLE.
 - a. Position jacks which are capable of handling weight of axle under axle and support axle.
 - b. Raise axle into place and secure with bolts (3), washers (2) and nuts (1).



- c. Install breather line (4) at axle housing.
2. INSTALL STEER CYLINDERS. (REFER TO TM 5-3810-306-20.)
3. CONNECT BRAKE CHAMBERS. (REFER TO TM 5-3810-306-20.)
4. INSTALL DRIVE LINES. (REFER TO TM 5-3810-306-20.)
5. INSTALL WHEELS. (REFER TO TM 5-3810-306-20.)
6. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
7. RETRACT AND RAISE OUTRIGGERS TO LOWER THE WHEELS TO THE GROUND. (REFER TO TM 5-3810-306-10.)
8. ALIGN WHEELS STRAIGHT WITH NO TOE IN OR OUT.
9. TEST FOR PROPER OPERATION.

END OF TASK



Section II. DIFFERENTIAL MAINTENANCE

DIFFERENTIAL CARRIER

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Holding fixture
 Checking tool (Item 11, Appendix C)
 Roller jack
 Yoke three-piece installation tool (Item 10, Appendix C)
 T-bar (Item 15, Appendix C)
 Dial indicator

SUPPLIES: Lint-free cloths (Item 91, Appendix B)
 Gear oil MIL-L-2105 (Item 195, Appendix B)
 Grease, automotive MIL-G-10924 (Item 37, Appendix B)
 Cleaning fluid P-D-680 Type II (Item 1, Appendix B)
 Lubriplate (Item 102, Appendix B)
 Rockwell adhesive (Item 215, Appendix B)
 Gear marking compound (Item 216, Appendix B)
 Retaining ring (Item 217, Appendix B)
 Gasket (Item 218, Appendix B)
 Cotter pin (Item 219, Appendix B) (2 Required)

EQUIPMENT CONDITIONS: Planetary ends removed. (Refer to page 8-50.)
 Axle propeller shafts removed. (Refer to TM 5-3810-306-20.)
 Propeller (drive) shaft disconnected. (Refer to TM 5-3810-306-20.)
 Tie rods removed. (Refer to page 8-2.)

DISASSEMBLY

1. DRAIN GEAR OIL.

- a. Place suitable container under axle drain plug (40).
- b. Remove drain plug (40).

2. REMOVE DIFFERENTIAL CARRIER.

CAUTION

Loosen two top nuts (41) but do not remove them. Otherwise differential carrier could fall.

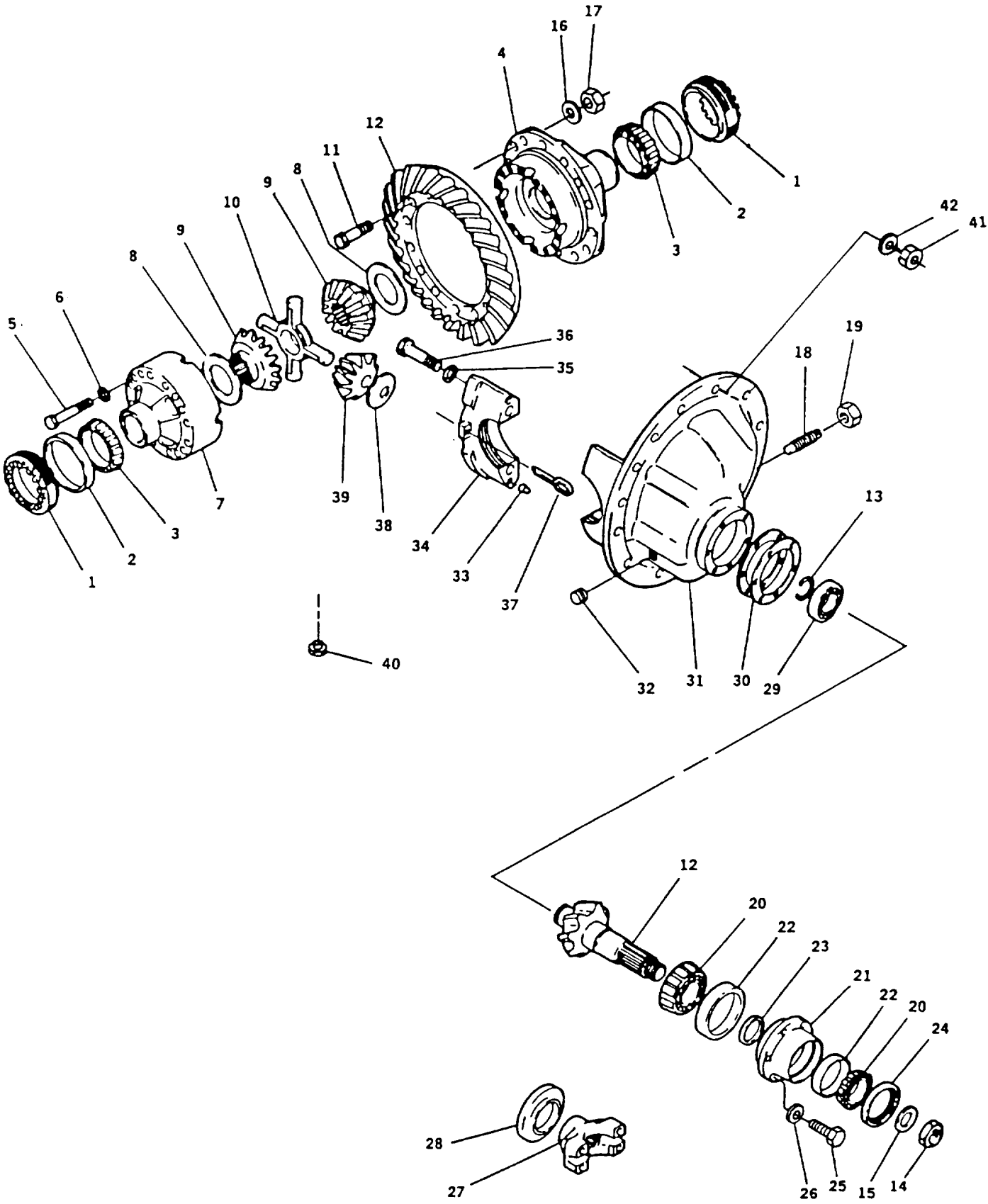
- a. Remove nuts (41) and washers (42).

- b. Break differential carrier loose from axle housing using rawhide mallet.
- c. Place roller jack under differential carrier housing (31).
- d. Remove remaining two nuts (41) and washers (42).

CAUTION

Use rounded pry bar to prevent damage to housing (31).

- e. Work differential carrier free. A small pry bar can be used to straighten housing (31) in axle housing bore.



3. INSPECT BEVEL GEAR (12).

- a. Inspect bevel gear (12), drive and pinion for worn, cracked and chipped teeth.
- b. If bevel gear (12) will not be replaced, measure and record existing backlash to be used at assembly.

4. REMOVE RETAINING RINGS (1) AND CAPS (34).

- a. Center punch one bearing cap (34) and carrier leg to identify each at assembly.
- b. Remove and discard two cotter pins (37).
- c. Remove four capscrews (36) and washers (35).
- d. Remove two retaining rings (1) and caps (34).

5. REMOVE DIFFERENTIAL AND GEAR ASSEMBLY.

- a. Loosen jam nut (19) on screw (18). Remove screw (18) and jam nut (19).
- b. Lift out pinion and retainer assembly.

6. DISASSEMBLE DIFFERENTIAL AND GEAR.

- a. Match mark differential case (7) and housing (4) for correct alignment at assembly.
- b. Remove sixteen capscrews (5) and washers (6).

WARNING

Wear safety goggles to prevent eye injury.

Do not hit steel parts with a steel hammer. Parts can break or splinter causing injury.

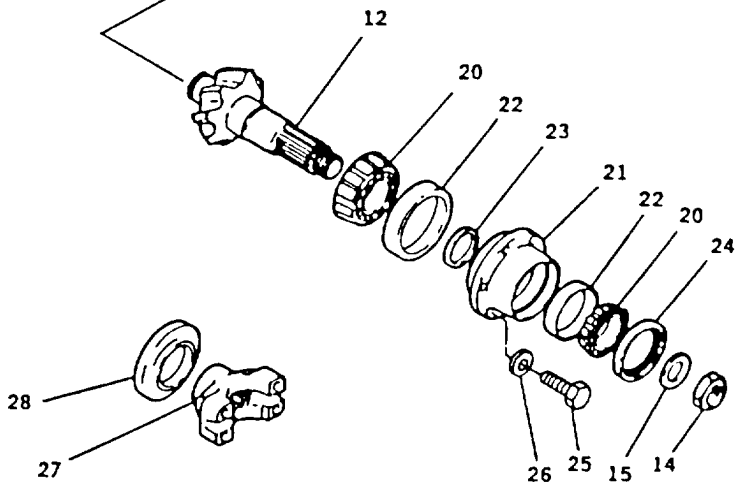
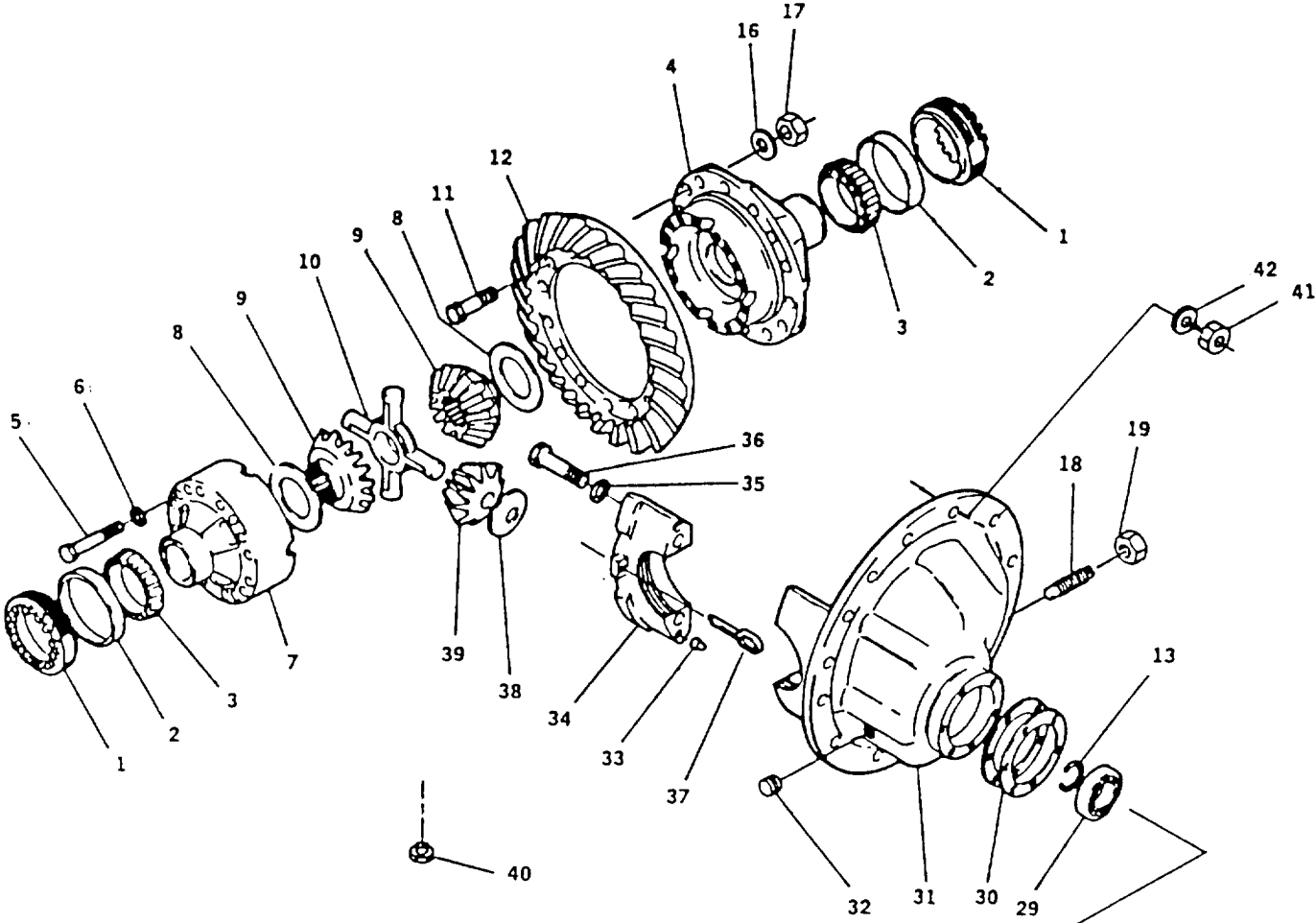
- c. Separate housing (4) and case (7).
- d. Remove spider (10) with four pinion gears (39) and thrust washers (38). Remove two bevel gears (9) and lugs (8).
- e. If necessary, separate bevel gear (12) and housing (4) by removing twelve capscrews (11), nuts (17) and washers (16). Use blocks of wood to support bevel gear (12) and press housing (4) through bevel gear (12).
- f. If necessary, use puller to remove cups (2) and bearings (3).

7. REMOVE PINION (12) AND RETAINER (21).

- a. Holding yoke (27), remove nut (14) and washer (15).

CAUTION

Do not use a hammer or mallet to remove yoke (27). Otherwise parts will be damaged.



- b. Remove yoke (27) and deflector (28). If necessary, use puller.
- c. Remove eight capscrews (25) and washers (26).

CAUTION

Do not use a pry bar to remove the retainer (21). Otherwise damage to the retainer could result.

NOTE

The pinion gasket (24) is mounted in the outer bore of the retainer (21). Remove the gasket (24) after the pinion (12) has been removed.

- d. Remove retainer (21), drive pinion (12) and shims (30) from housing (31). If retainer (21) will not loosen, tap retainer with leather, plastic or rubber mallet.

NOTE

If shims (30) are in good condition, retain shims for later use in assembly. If shims are damaged, first measure and record thickness of shims (30). This dimension will be used to calculate depth of drive pinion.

- 8. DISASSEMBLE PINION (12) AND RETAINER (21).
 - a. Place pinion (12) and retainer (21) in press. Pinion shaft should be pointed up.
 - b. Support retainer (21) under flange area with wood blocks.
 - c. Press pinion through retainer (21).

NOTE

The inner bearing (20) will stay on the pinion shaft.

CAUTION

Be careful when using pry bar or screwdriver to remove gasket (24). Otherwise damage to the bore wall could result.

- d. Remove gasket (24).

NOTE

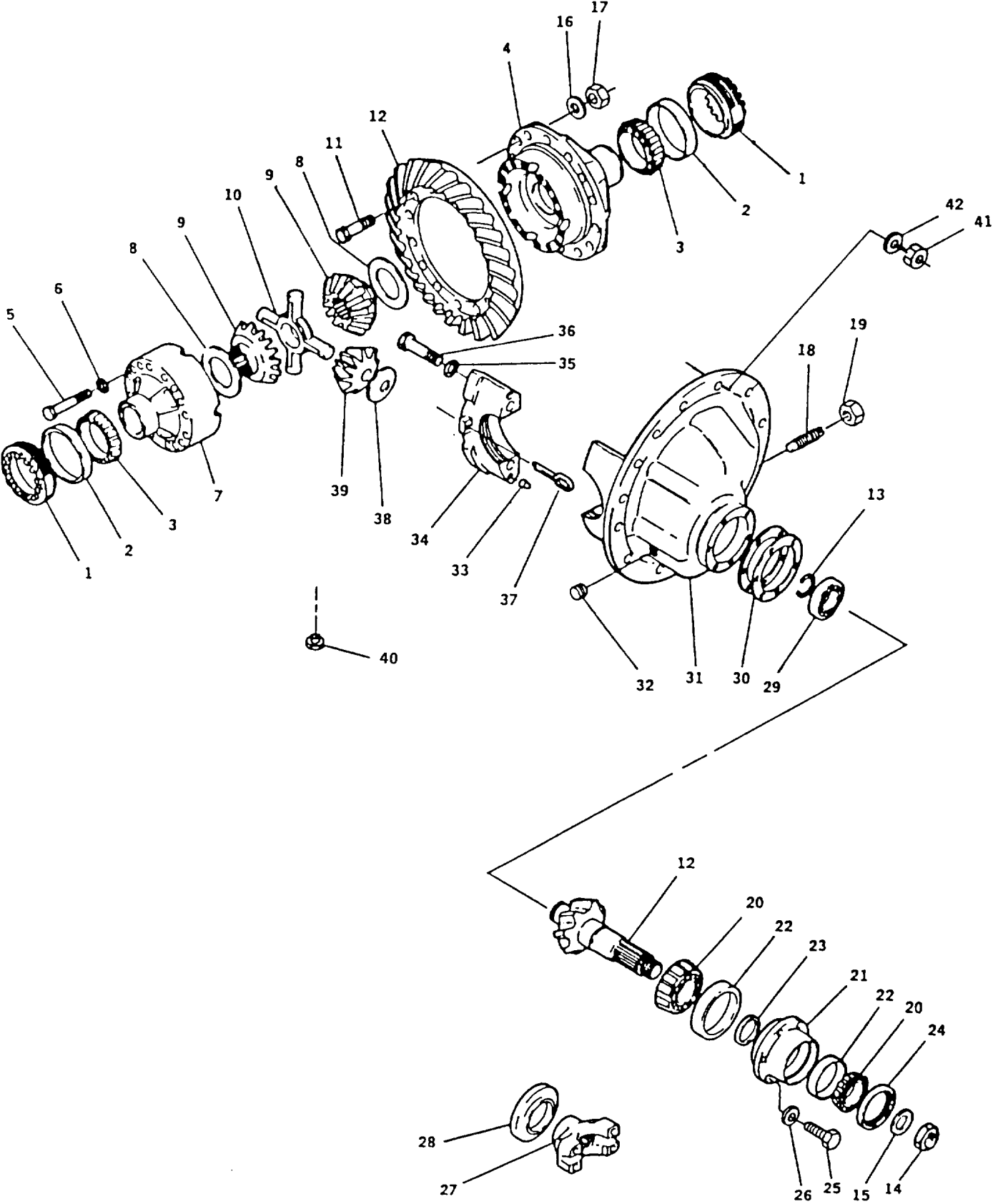
If gasket (24) is a one-piece design discard gasket. If gasket has a triple lip (with flange), inspect gasket for wear or damage. If OK, reuse the gasket, otherwise discard the gasket.

- 9. REMOVE BEARINGS (20) AND (29).
 - a. Remove cups (22).
 - b. Using press remove bearing (20) in retainer (21) by supporting retainer flange with wood blocks and driving bearing (20) out of retainer (21).
 - c. Place pinion (12) in soft-faced vise.

CAUTION

The bearing puller must fit under the inner race of the bearing (20). Otherwise damage to the bearing could result.

- d. Remove spacer (23) and using puller remove bearing (20) on pinion (12).
- e. Remove snap ring (13).
- f. Using puller remove bearing (29)



CLEANING AND INSPECTION**WARNING**

Dry cleaning solvent P-D680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately. 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.).

1. CLEAN ALL PARTS.
 - a. Clean all parts with cleaning solvent P-D-680 Type II.
 - b. Clean bearings in both of solvent moving bearings up and down to dissolve hardened lubricant.

CAUTION

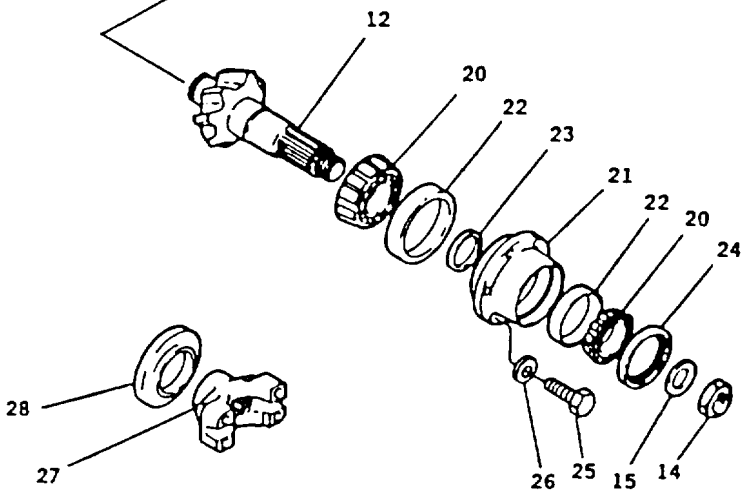
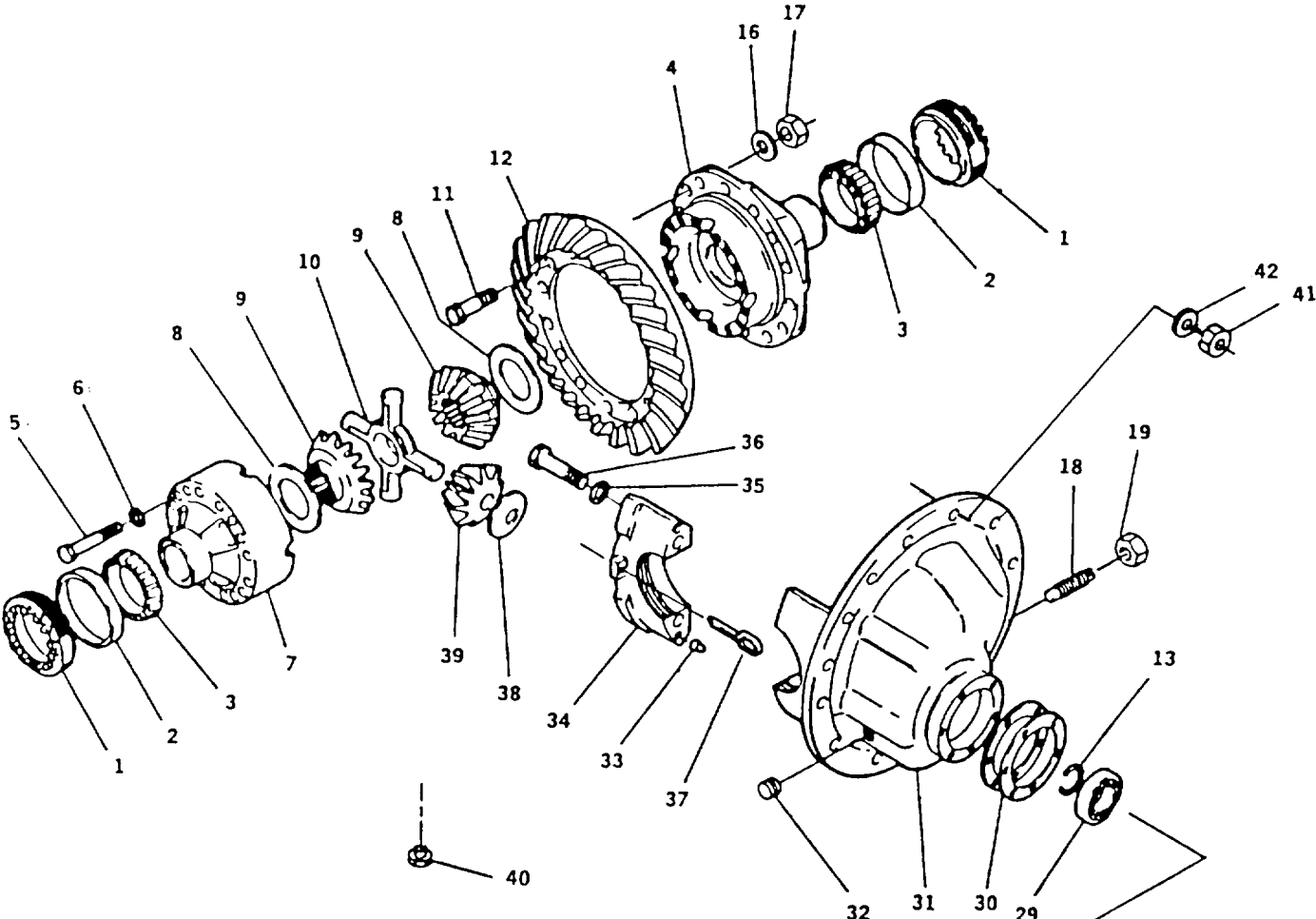
Direct compressed air across bearing face to avoid roller spinning. Otherwise bearing wear could result from high speed spinning without lubrication.

- c. Dry all parts with clean, low pressure air.
- d. Repeat steps b and c until bearings are thoroughly clean.

- e. Wipe all parts with clean, lint-free cloth.
- f. Wrap bearings in clean lint-free cloth until ready for assembly.
- g. Inspect all parts for wear and damage.

ASSEMBLY

1. ASSEMBLY RETAINER (21) AND PINION (12).
 - a. Place retainer (21) in press.
 - b. Support flange of retainer (21) with wood blocks.
 - c. Press two bearing cups (22) into retainer (21) using sleeve of correct size.
 - d. Place pinion (12) in press with gear head down.
 - e. Press inner bearing (20) on pinion (12) until core is flat against gear head of pinion (12). Use sleeve of correct size against bearing inner race.
 - f. Place pinion (12) in press with gear head up.
 - g. Press bearing (29) in pinion (12) until bearing is flat against gear head of pinion (12). Use correct size against bearing inner race.
 - h. Install snap ring (13).
 - i. Apply lubricant MIL-L-2105 on bearing cups (22) and bearings (20) and (29).
 - j. Install pinion (12) in retainer (21)



- k. Install spacer (23) on pinion (12) against inner bearing (20).

NOTE

Spacer (23) controls preload adjustment of pinion bearings (20).

- l. Install outer bearing (20) on pinion shaft (12) until bearing is flat against spacer (23).

NOTE

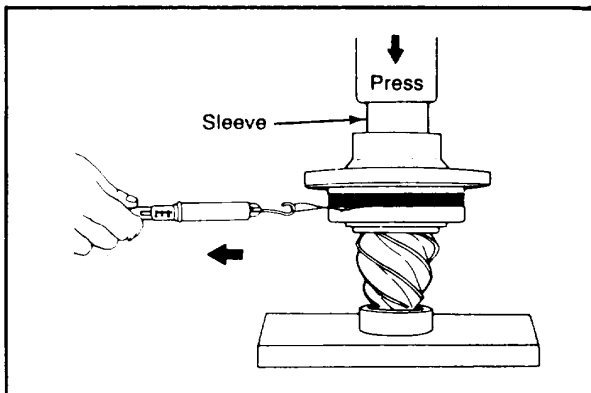
Do not install gasket (24) until bearing preload is set.

2. ADJUST BEARING PRELOAD.

NOTE

New bearings should have a rolling torque of 5 to 45 in-lbs (5.76 to 51.8 kgcm). Used pinion bearings in good condition should have a rolling torque of 10 to 30 in-lbs (11.5 to 34.6 kgcm).

PRESS METHOD.



NOTE

If press is not available, or if press does not have a pressure gauge, use yoke or flange method to adjust preload.

- a. Place pinion (12) and retainer (21) in press, gear head down.
- b. Install sleeve of correct size against inner race of outer bearing (20).
- c. Apply and hold correct amount of pressure to pinion bearings. See table.

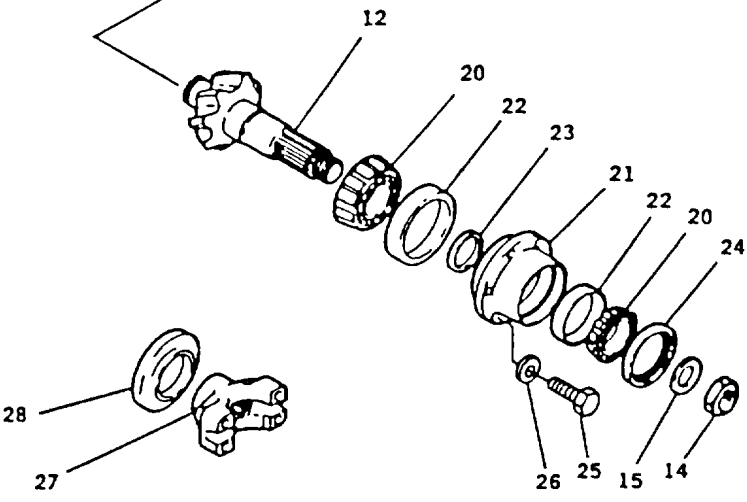
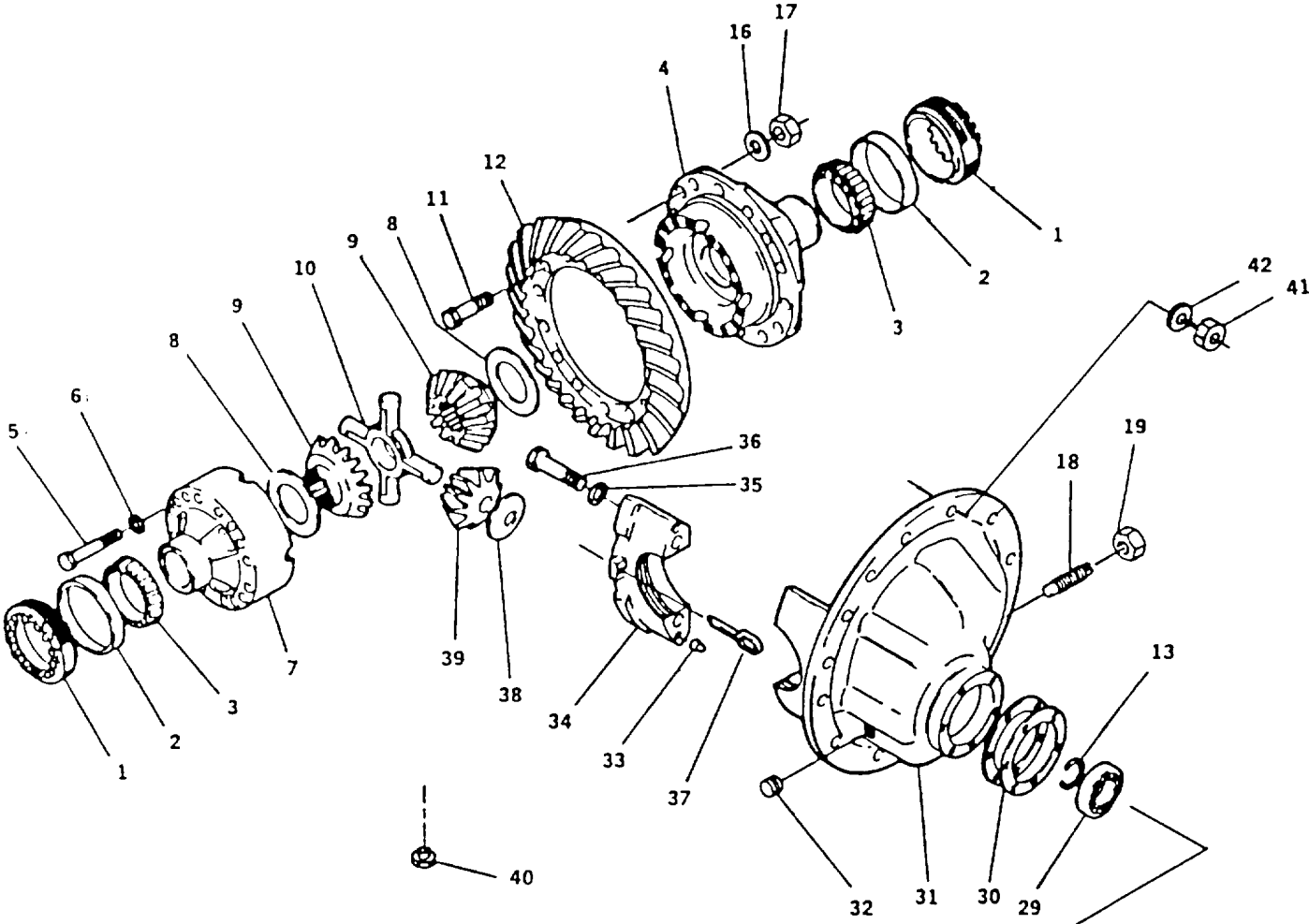
Pinion Shaft Thread Size		Press Load	
		FT-LBS	KGM
7/8	- 20	22,000	10,000
1	- 20	30,000	13,500
1-1/4	- 12	54,000	24,500
1-1/2	- 12	54,000	24,500
1-1/2	- 18	54,000	24,500
1-3/4	- 12	54,000	24,500
2	- 12	50,000	22,700

- d. As pressure is applied, rotate retainer (21) several times so that bearings make normal contact.
- e. With pressure being held, wrap a cord around retainer (21) several times.
- f. Attach spring seals to end of cord.

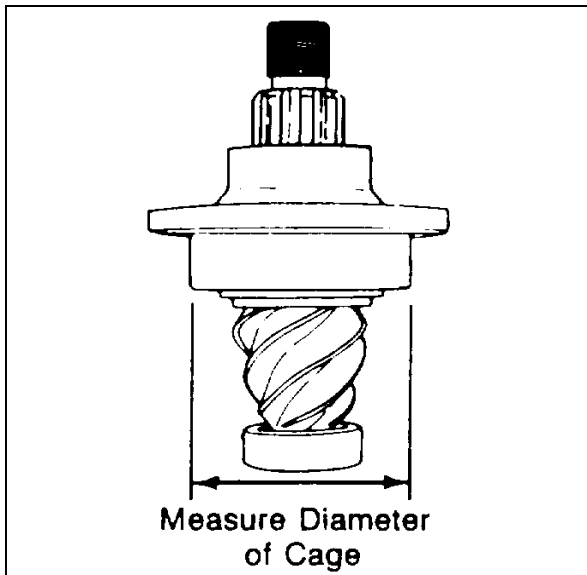
NOTE

Do not record the starting torque. Record only the torque value after retainer starts to rotate. Starting torque gives a false reading.

- g. Pull end with scale on horizontal line. As retainer (21) rotates, read and record value indicated on scale.



h. Measure and record diameter of retainer where cord was wound. Measurement can be inches or centimeters.



- i. Calculate radius by dividing diameter by 2.
- j. Calculate bearing preload as follows:
Pounds pulled x radius = preload

NOTE

Calculated preload will be in in-lbs if value recorded in step g is in in-lbs. Likewise, preload will be in kg-cm if recorded value is in kg-cm.

- k. If calculated preload is not within 5 to 45 in-lbs (5.76 to 51.8 kgcm) for new bearings or 10 to 30 in-lbs (11.5 to 34.6 kgcm) for used bearings, increase preload by installing thinner bearing spacer (23). Decrease preload by installing thicker bearing spacer (23).
- l. Recheck bearing preload by performing steps a thru j.

YOKE METHOD

CAUTION

Do not install tight fitting yoke on shaft using a hammer or mallet. Otherwise damage to yoke will result.

- a. Install yoke (27), washer (15) and nut (14) on pinion (12). Yoke (27) must be against outer bearing (20).

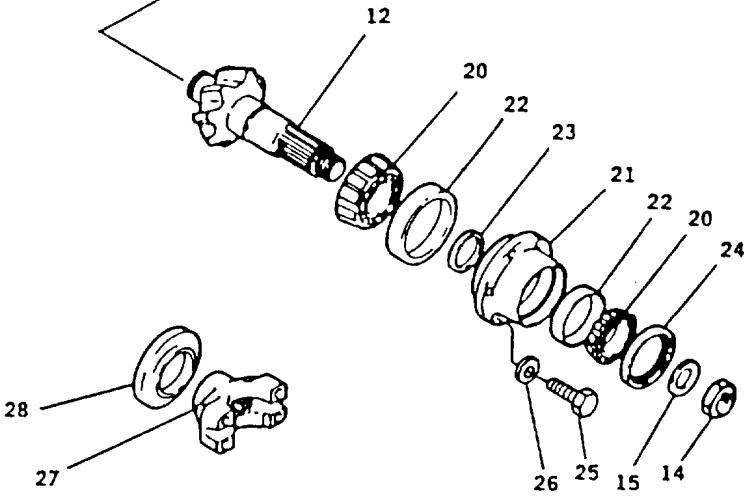
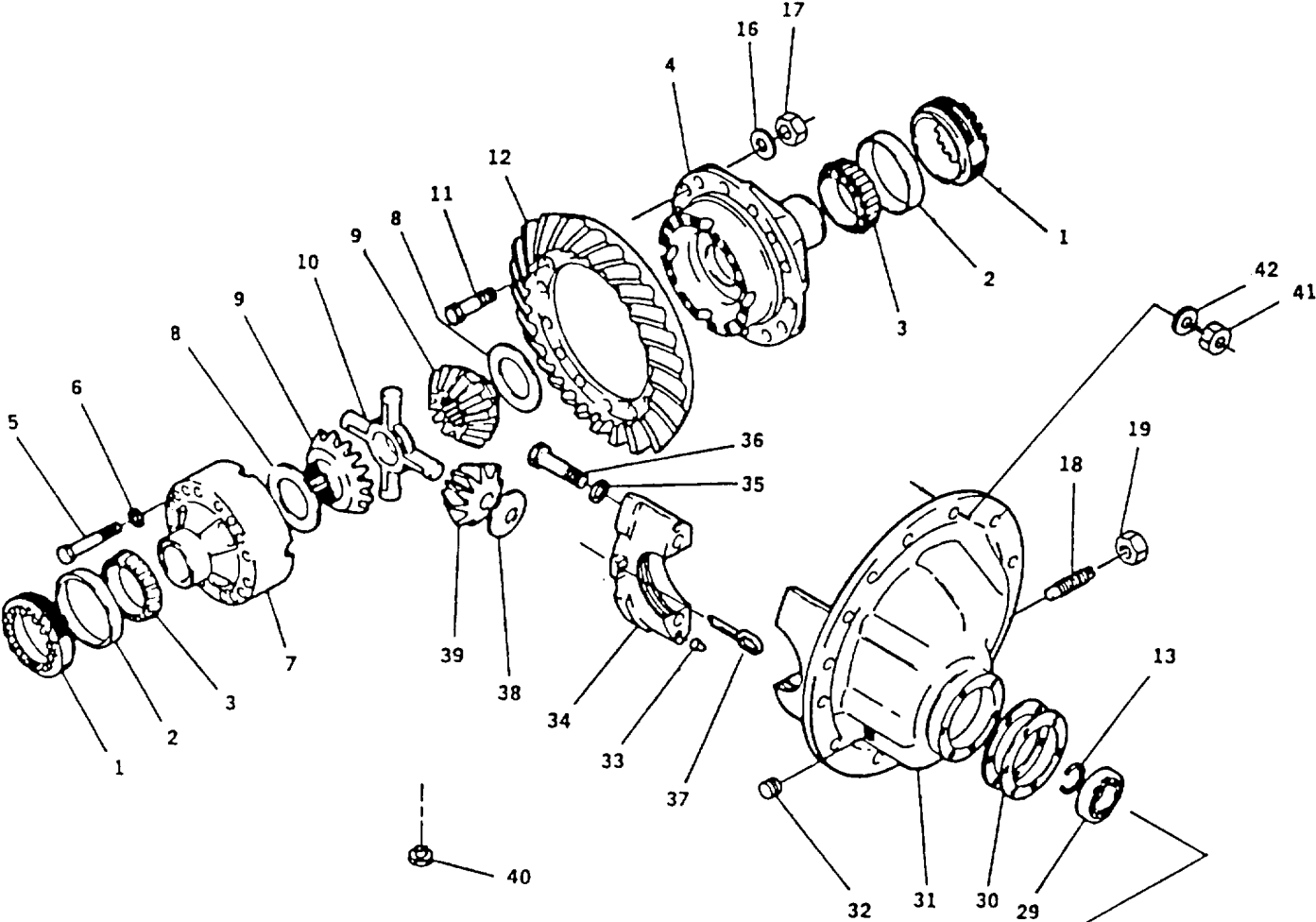
NOTE

If required, use a press to install yoke (27).

- b. Install pinion (12) and retainer (21) in housing (31) without shims (30).
- c. Install eight capscrews (25) without washers (26). Tighten capscrews hand tight.
- d. Attach yoke bar to yoke (27). Bar will hold pinion (12) in position when nut (14) is tightened.
- e. Tighten nut (4) to correct torque value as follows:

Nut Size	Correct Torque	
	LB-FT	KGM
7/8 - 20	200- 175	27.6- 38.0
1 - 20	300- 400	41.4- 55.3
1-1/4 - 20	700- 900	96.8-124.4
1-1/4 - 18	700- 900	96.8-124.4
1-1/2 - 12	800-1100	1100.6-152.1
1-1/2 - 18	800-1100	1110.6-152.1
1-3/4 - 12	900-1200	1124.4-165.9
2 - 12	1200-1500	1165.9-207.4

- f. Remove yoke bar.
- g. Attach torque wrench to nut (14).



- h. Rotate pinion (12) and read value indicated on torque wrench.
 - i. If preload is not within 5 to 45 in-lbs (5.76 to 51.8 kgcm) for new bearings or 10 to 30 in-lbs (11.5 to 34.6 kgcm) for used bearings, increase preload by installing thinner bearing spacer (23). Decrease preload by installing thicker spacer (23).
 - j. Recheck bearing preload by performing steps a thru i.
 - k. Remove capscrews (25) and pinion (12) with retainer (21).
3. INSTALL GASKET (24).

CAUTION

Insure gasket lips are clean and free of dirt or particles. Otherwise, leaks could occur at gasket.

NOTE

An old three-lipped gasket (24) can be installed if not worn or damaged.

NOTE

On used gaskets, apply Lubriplate or green MILG-10924 to gasket lips.

- a. Apply lubricant MIL-L-2105 to outer surface of gasket (24) and gasket bore in retainer (27).
- b. Place pinion (12) and retainer (21) in a press with gasket bore up.

CAUTION

The diameter of the driver must be larger than the diameter of the gasket (24). Otherwise damage to the gasket (24) could occur.

- c. Using a correct size driver, press gasket (24) into retainer (21) until flange of gasket is against top of retainer (21).

WARNING

Wear eye protection. Do not hit steel parts with a steel hammer. Part or tools can break causing injury.

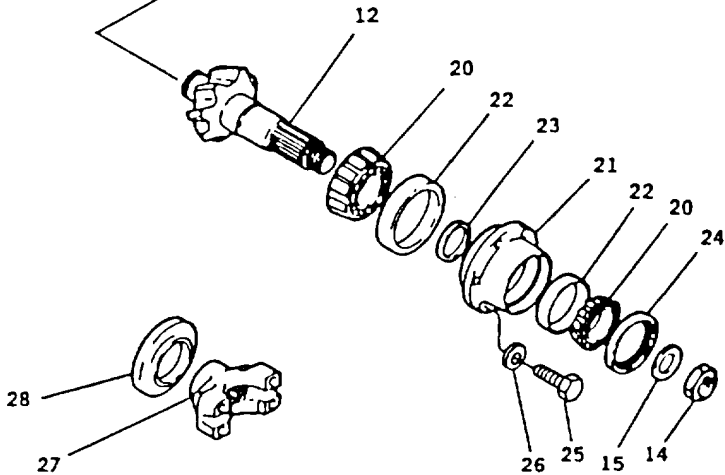
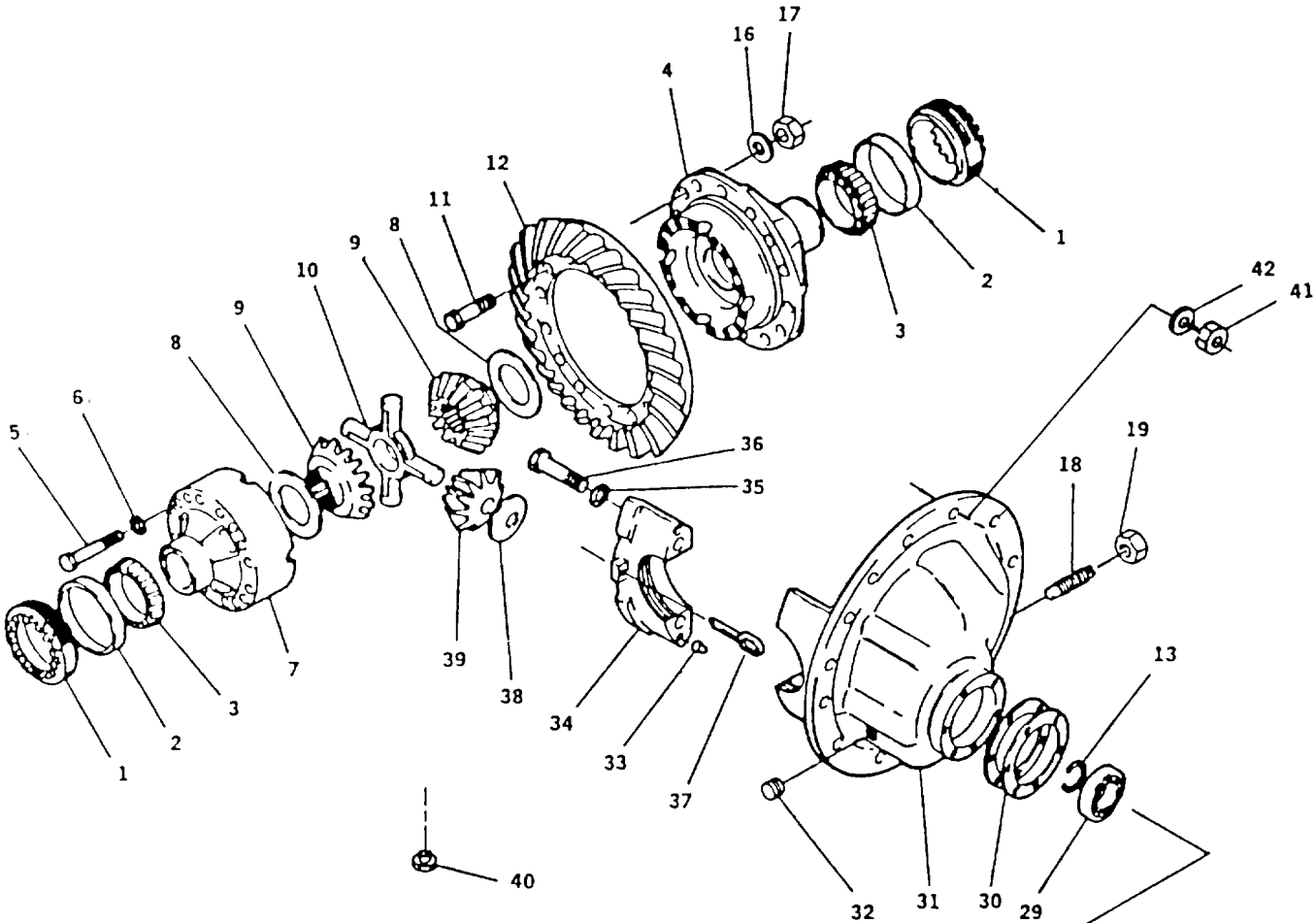
- d. If press is not available, use mallet and driver to install gasket (24).
- e. Using feeler gauge, check gap at several points around gasket (24). Gap must be from 0.015 to 0.030 in. (0.38 to 0.76 mm). Difference between largest and smallest gap should not exceed 0.010 in. (0.25 mm).

4. ADJUST SHIM PACK THICKNESS.

NOTE

Use this procedure only if new bevel gear (12) and pinion set are being installed.

- a. Measure and record thickness of old shim pack (30).
- b. Check and record pinion core (PC) variation number on old pinion being replaced.



NOTE

The PC variation number can be in 1,000-ths of an in. or 100-ths of a mm. See the following examples:

PC + 3, PC -3, +3 or -3 = .003 in.

PC +.03, PC -.03, +.03 or -.03 = .03 mm

- c. If old pinion (12) PC variation number is prefixed with "+", subtract the PC number from old shim pack thickness recorded in step a.
- d. If old pinion (12) PC variation number is prefixed with "-", add the PC number to old shim pack thickness recorded in step a.

NOTE

The value calculated in step c or d is the thickness of a standard shim pack (i.e., without variation).

- e. Check and record PC variation of new pinion (12).
- f. If new pinion (12) PC variation is prefixed with a "+", add the PC number to standard shim pack thickness.
- g. If new pinion (12) PC variation is prefixed with a "-", subtract the PC number from the standard shim pack thickness.

NOTE

The value calculated in steps f or g will be the thickness of the new shim pack (30).

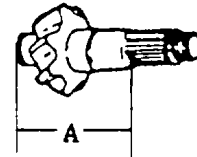
NOTE

The bevel gear (12) and pinion must be replaced as a matched set.

NOTE

If no PC variation number is visible perform the following step.

- h. Measure and record difference between old pinion and new pinion (Dimension A) add or subtract PC number from the standard shim pack thickness.



- 5. INSTALL PINION (12) AND RETAINER (21).

NOTE

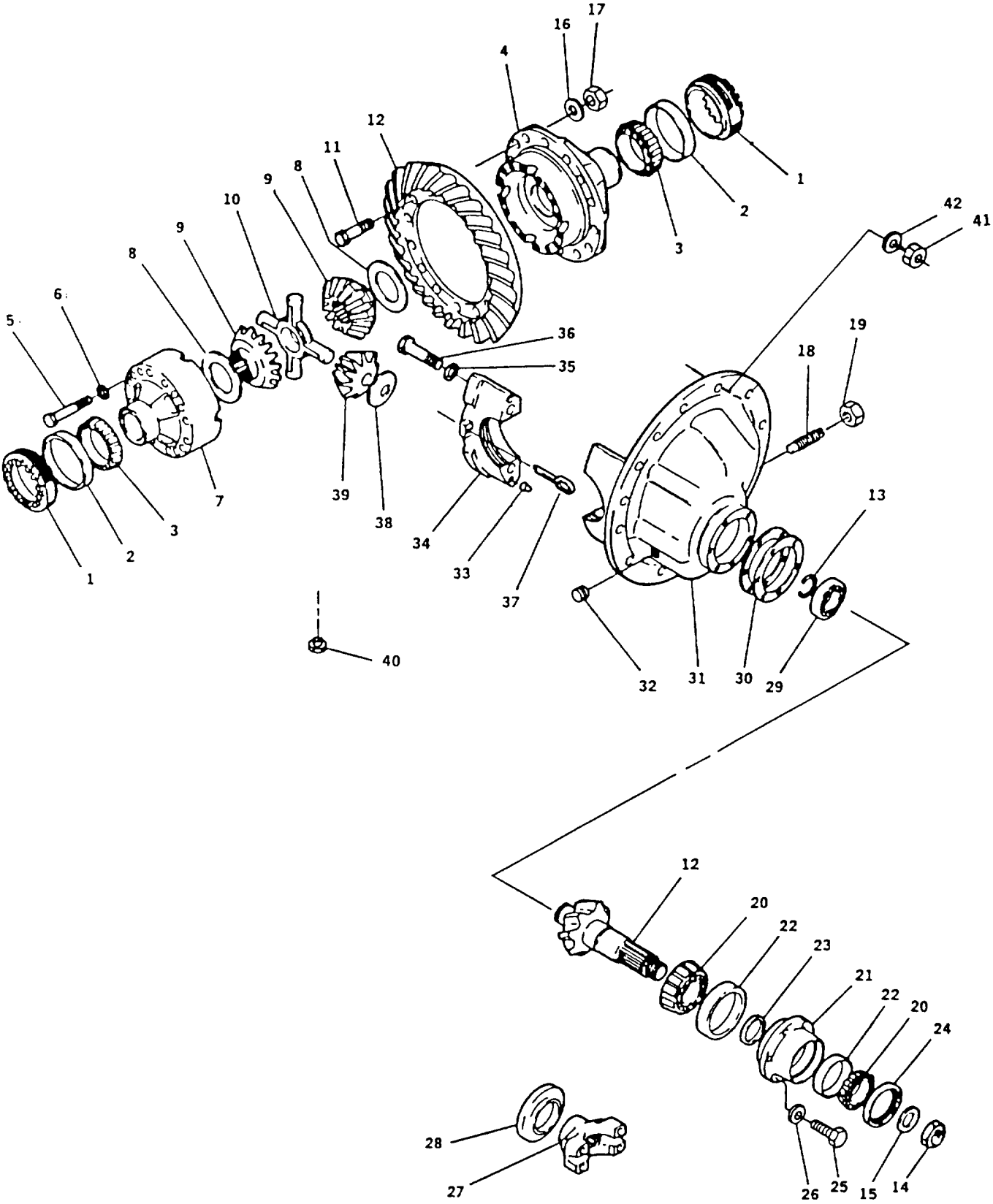
Install a minimum of three shims in a pack. If the pack is made up of different thicknesses, install thinnest shims on both sides of pack for maximum sealing.

- a. Install correct shim pack (30). Insure oil slots in shims (30) align with oil slots in retainer (21) and housing (31).

WARNING

Wear eye protection. Do not hit steel parts with a hammer. Parts can break and cause injury.

- b. Install pinion (12) and retainer (21) into housing (31). If required use rubber, plastic or leather mallet.



- c. Install eight capscrews (25) and washers (26). Torque capscrews to 85-115 ft-lbs (113-153 Nm).

6. INSTALL YOKE (27).

CAUTION

Do not install tight fitting yoke (27) with a hammer or mallet. Otherwise damage to the yoke could result.

- a. Install deflector (28), yoke (27), washer (15) and nut (14). Yoke (27) must be against outer bearing (20).

NOTE

If yoke fit is tight, use three piece yoke installation tool.

7. ASSEMBLE BEVEL GEAR (12) TO HOUSING (4).

WARNING

Wear protective clothing and gloves to protect you from hot bevel gear (12).

CAUTION

Do not press cold bevel gear (12) to housing (4). A cold bevel gear will damage the housing due to tight fit. Metal particles trapped between the parts will cause excessive gear runout.

- a. Place bevel gear (12) in tank of hot water (160° to 180°F <71° to 81°C>) for fifteen minutes.
- b. Safely lift bevel gear (12) from water using lifting tool.

- c. Install bevel gear (12) on housing (4) immediately. If bevel gear does not fit easily on housing, repeat step a.

- d. Align holes in bevel gear (12) with those in housing (4).

- e. Install twelve nuts (17), washers (16) and capscrews (11). Insure screw heads are on gear side of assembly and heads are against gear.

- f. Torque nuts (17) to 180-230 ft-lbs (239-306 Nm).

8. INSTALL BEARINGS (3).

- a. Using press and sleeve install bearings (3) on housing (4) and case (7).

9. ASSEMBLY HOUSING (4) AND CASE (7).

- a. Apply lubricant MIL-L-2105 to inside surfaces of housing (4) and case (7), lugs (8), spider (10), thrust washers (38) and gears (9) and (39).

- b. Place housing (4) on bench with bevel gear (12) up.

CAUTION

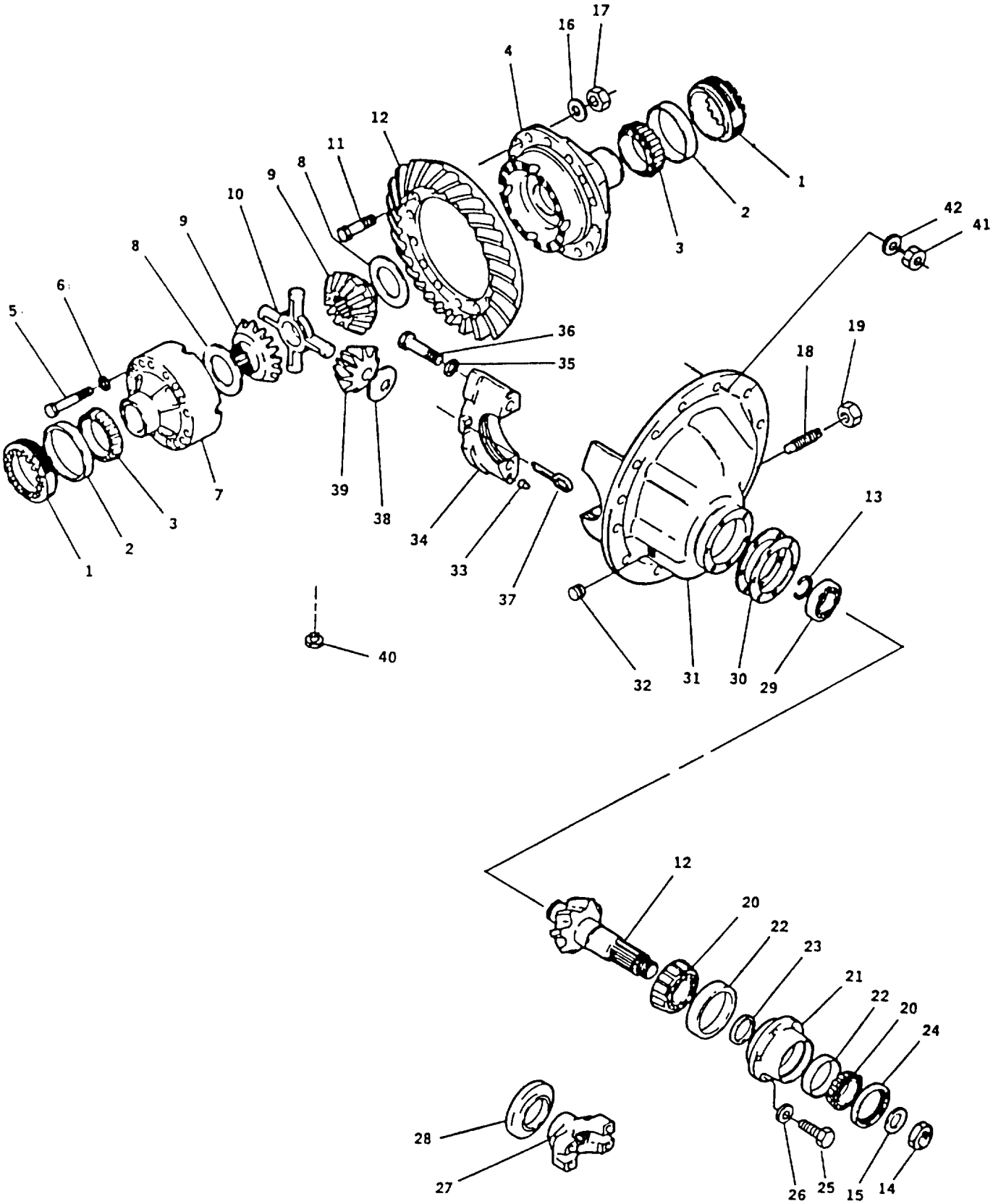
Side gears (9) on some models have hubs of differing lengths.

- c. Install one lug (8) and insert length side gear (9) in housing (4).

- d. Install spider (10) with four pinion gears (39) and thrust washers (38) into housing (4).

- e. Install second side gear (9) and lug (9) over spider (10).

- f. Install case (7) over housing (4) and gears. Rotate case as needed to align match marks.



NOTE

The housing (4) and case (7) are held together with dri-loc fasteners.

- g. Install four capscrews (5) and washers (6). Each capscrew should be spaced evenly around case (7). Torque each capscrew (5) in a pattern opposite each other to 85-115 ft-lbs (113-153 Nm).
- h. Install and torque sixteen remaining capscrews (5) and washers (6) to 85-115 ft-lbs (113-153 Nm).

10. CHECK ROLLING RESISTANCE OF DIFFERENTIAL NEST.

CAUTION

Use soft metal covers over vise jaws to protect bevel gear (12).

- a. Place differential and bevel gear (12) in a vise. Clamp at bevel gear (12).
- b. Insert checking tool into case (7). Checking tool can be made by cutting an axle drive shaft to an appropriate length and welding a nut on end to accept wrench socket.
- c. Using socket and torque wrench, rotate differential nest while observing torque wrench scale. Correct rolling resistance is 50 ft-lbs (67 Nm) torque applied to one side gear.

11. INSTALL CUPS (2).

- a. Clean and dry cups (2) and bores of carrier legs and caps (34).
- b. Apply grease MIL-G-10924 to inner diameter of cups (2) and on bearings (3).

- c. Apply Rockwell adhesive in bearing bores of carrier legs and caps (34).
- d. Install cups (2) over bearings (3).

12. INSTALL DIFFERENTIAL AND BEVEL GEAR (12).

- a. Safely lift differential and bevel gear (12) into housing (31). Bearing cups (2) must be flat against bores between carrier legs.
- b. Install two retaining rings (1). Turn each retaining ring by hand until each is tight against bearing cups (2).
- c. Install caps (34) over bearings and retaining rings as marked during assembly.

WARNING

Wear eye protection. Do not hit steel parts with a steel hammer. Parts can break and cause injury.

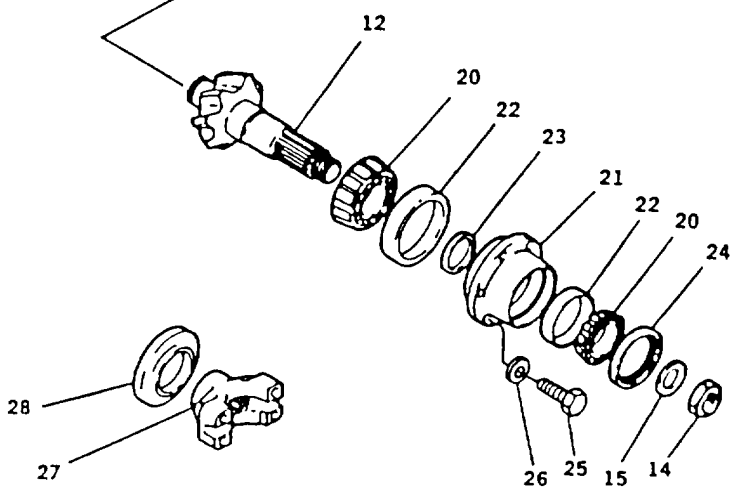
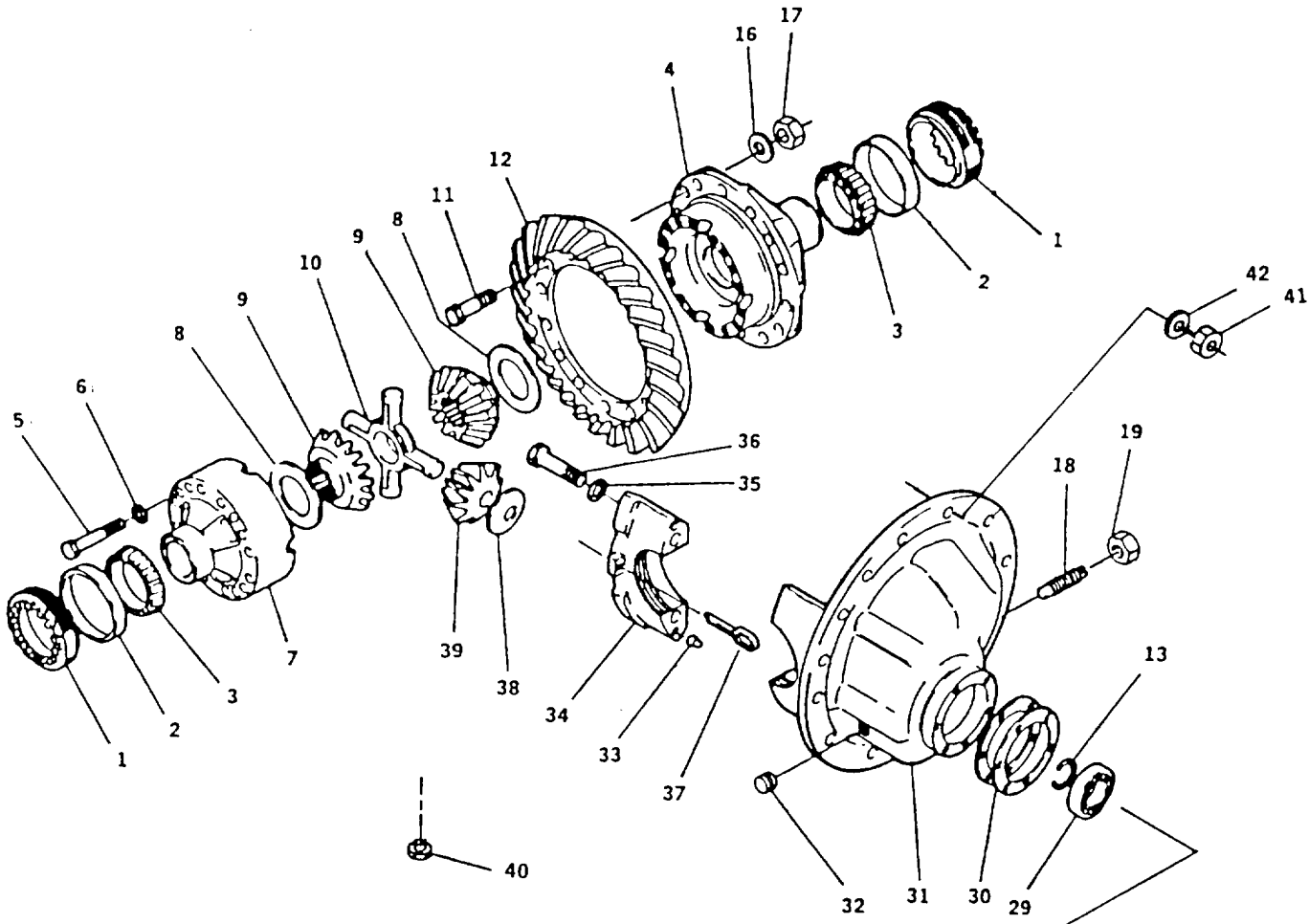
NOTE

The caps (34) must fit easily against bearings (3) retaining rings (1) and housing (31). Do not force caps (34) into position.

- d. Strike each cap (34) with a light leather, plastic or rubber mallet.

CAUTION

If caps (34) are not installed in correct locations, the bores and threads will not match the housing (31).



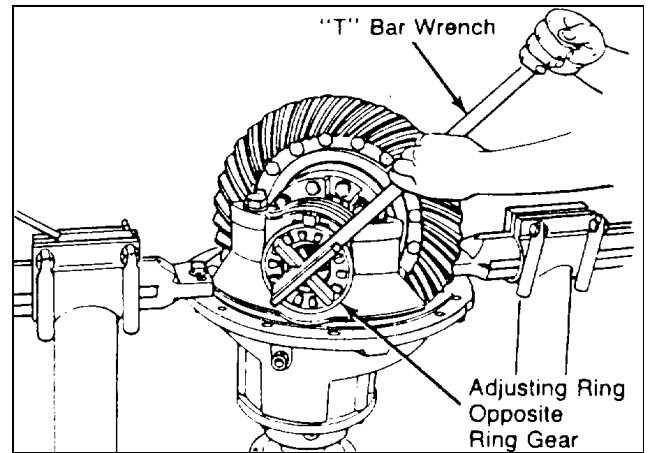
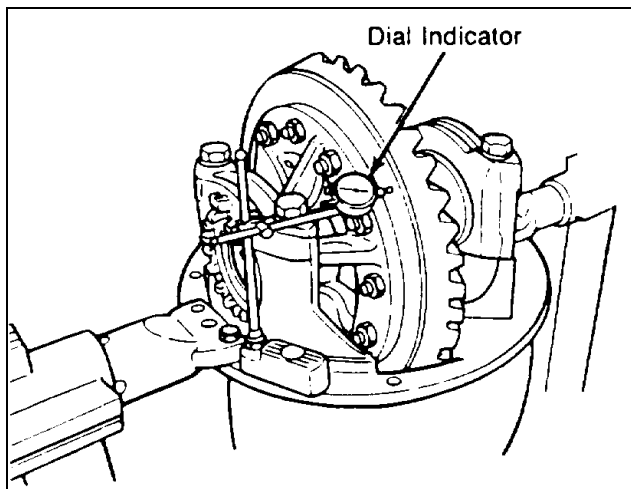
- e. If caps (34) do not fit correctly, recheck alignment marks. Remove caps (34) and repeat steps c and d.
- f. Install two capscrews (36) and washers (35) for each cap (34). Tighten capscrews (36) four to six turns then tighten capscrews (36) to 270-350 ft-lbs (360-465 Nm).

13. ADJUST BEARING PRELOAD.

NOTE

The preload of the differential bearing is 15 to 35 in-lbs (17.3 to 40.3 kgcm) torque. The expansion between bearing cups is 0.006 to 0.013 in. (0.15 to 0.33 mm).

- a. Attach dial indicator on mounting flange of housing (31).
- b. Adjust dial indicator so that plunger or pointer is against back surface of bevel gear.



CAUTION

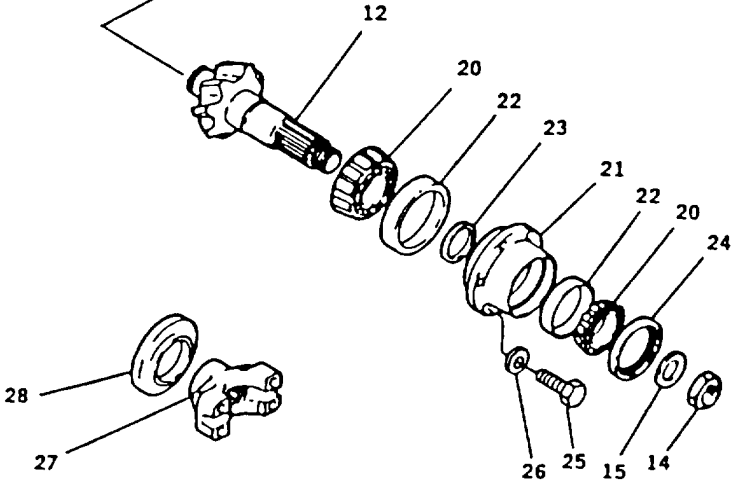
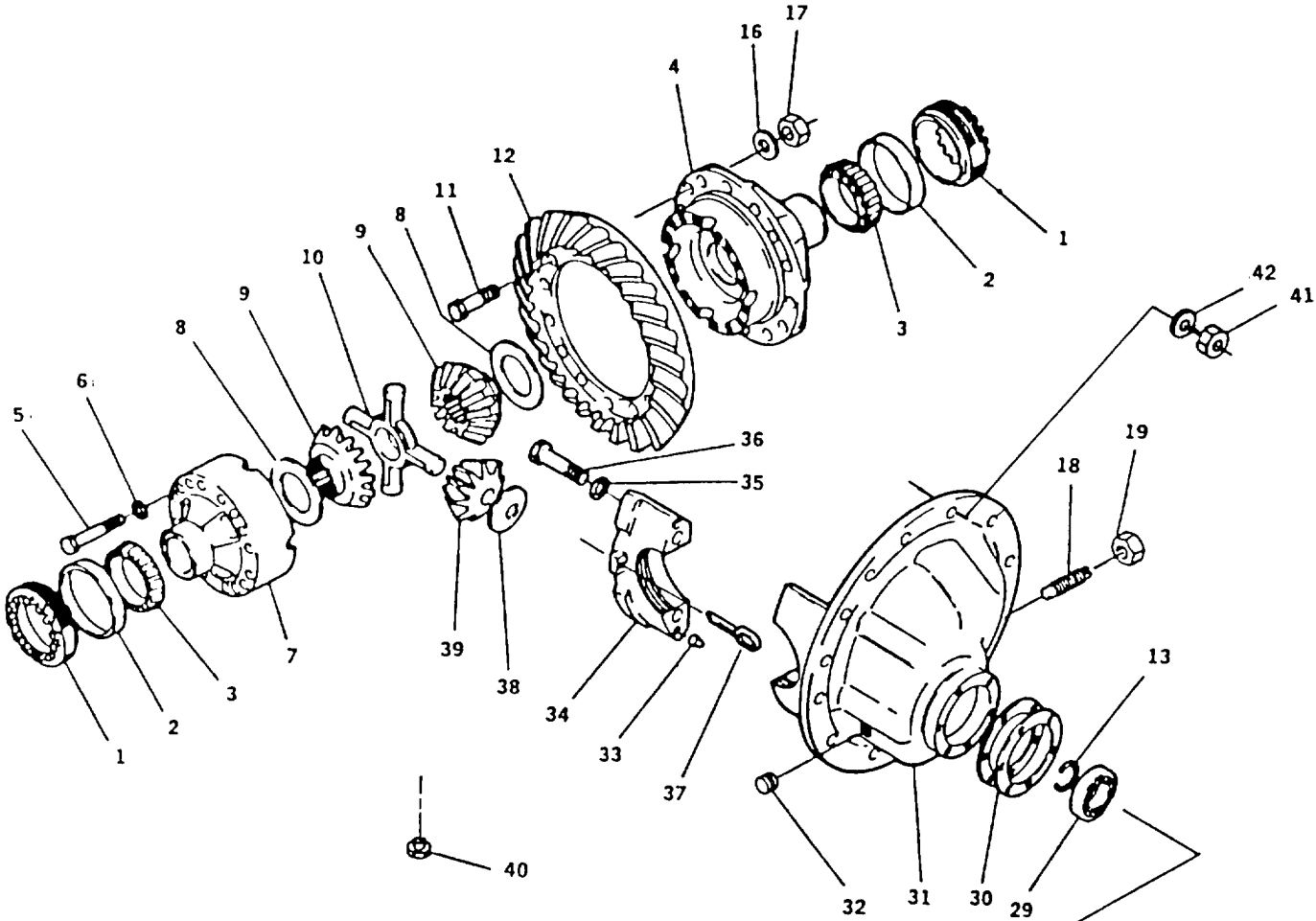
When turning retaining rings (1) always use a tool that engages two or more opposite notches in ring. A "T" bar wrench can be used. If tool does not correctly fit into notches, damage to lugs could occur.

- c. Loosen adjusting ring (1) opposite bevel gear (12) such that a small amount of end play shows on dial indicator.

CAUTION

Pry bars must not touch bearings (3).

- d. Move differential and bevel gear (12) to left and right with pry bars while reading dial indicator. Insert pry bars between retaining rings and housing ends.
- e. Insert pry bars at locations other than those noted in step d and move differential and bevel gear (12) left and right.
- f. Tighten same adjusting ring (1) (loosened in step c) until no end play shows on dial indicator.



- g. Repeat step d and e.
- h. Turn each adjusting ring (1) one notch from zero end play measured in step f to preload differential bearings.

Range of backlash setting - .010 to .020 in. (.25 to .51 mm). Backlash setting for new gear sets .005 - .015 in. (.13 - .38 mm).

NOTE

14. CHECK BEVEL GEAR RUNOUT.

Measure the outer diameter of bevel gear (12) for approximate pitch diameter.

- a. Attach dial indicator to mounting flange of housing (31).
- b. Adjust indicator so that plunger or pointer is against back surface bevel gear.
- c. Adjust dial indicator to zero (0).
- d. Rotate differential and bevel gear while reading dial indicator. Runout of bevel gear should not exceed 0.008 in. (0.20 mm).
- e. If bevel gear runout exceeds 0.008 in. (0.20 mm) remove differential and bevel gear (12) and perform steps f thru h.
- f. Inspect all parts for wear. Replace parts as required.
- g. Install differential and bevel gear (12) in housing (31).
- h. Perform steps a thru d.

NOTE

If the old bevel gear set is installed, adjust the backlash to the setting that was measured before the carrier was disassembled.

NOTE

If a new bevel gear set is installed, adjust the backlash to the correct specification for new gear sets.

NOTE

During the check of tooth contact patterns, the backlash can be adjusted within specification limits, if needed, to change the location of the pattern.

15. ADJUST BEVEL GEAR BACKLASH.

Specifications:

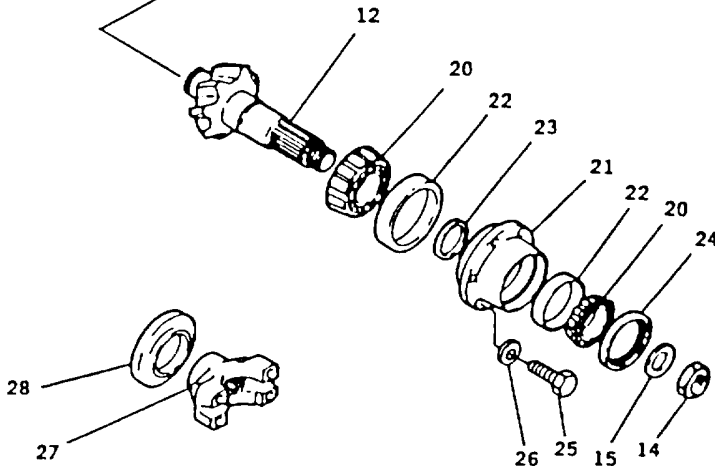
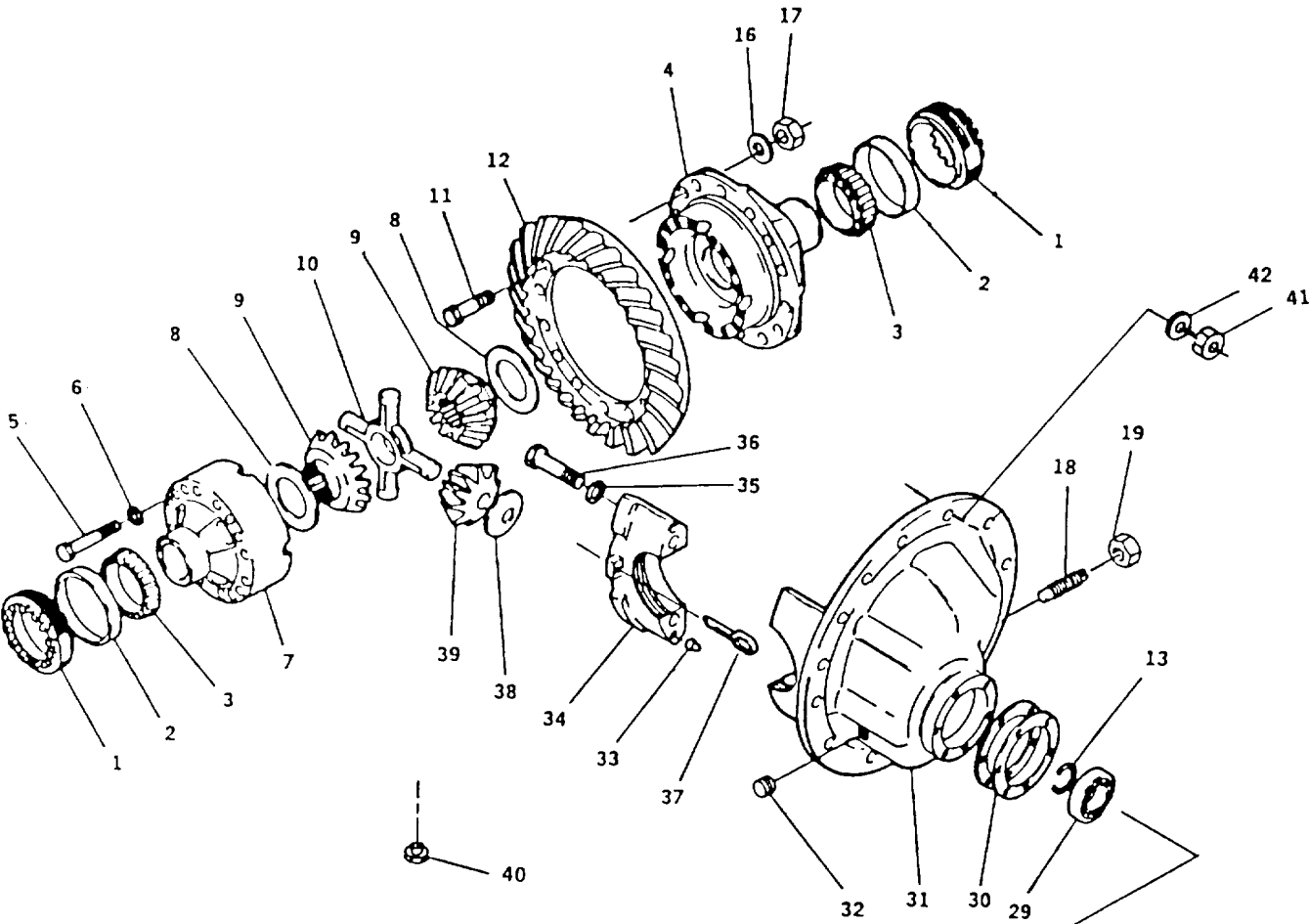
Bevel gears that have a pitch diameter of less than 17 in. (431.8 mm).

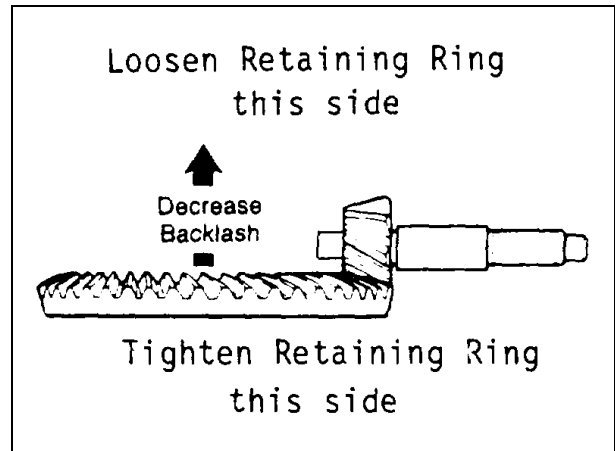
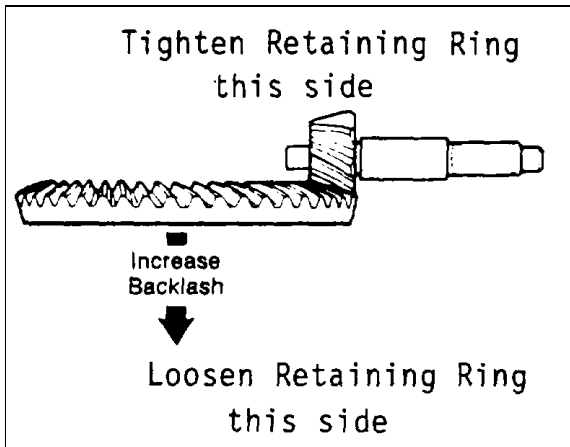
Range of backlash setting - .008 to 0.18 in. (.20 to .46 mm).

Backlash setting for new gears .012 in. (.30 mm).

Bevel gears that have a pitch diameter of 17 in. (431.8 mm) or greater than 17 in.

- a. Attach a dial indicator on mounting flange of housing (31).
- b. Adjust dial indicator so that plunger or pointer is against tooth surface of bevel gear (12).
- c. Adjust dial of indicator to zero (0).
- d. Hold pinion in position.





- e While reading dial indicator, rotate differential and bevel gear a small amount in both directions, against teeth of drive pinion. If backlash reading is within specification, continue by checking tooth contact patterns. If backlash reading is not within specifications, adjust backlash as needed by following steps f and g.

NOTE

Backlash is increased by moving the bevel gear away from the drive pinion. Backlash is decreased by moving the bevel gear toward the pinion.

- f Loosen one bearing retaining ring (1) one notch then tighten opposite ring same amount.

NOTE

When you adjust backlash, move the bevel gear **ONLY**. **DO NOT** move the drive pinion.

- g Repeat steps b thru f until backlash is within specifications.

1 . CHECK TOOTH CONTACT PATTERNS.

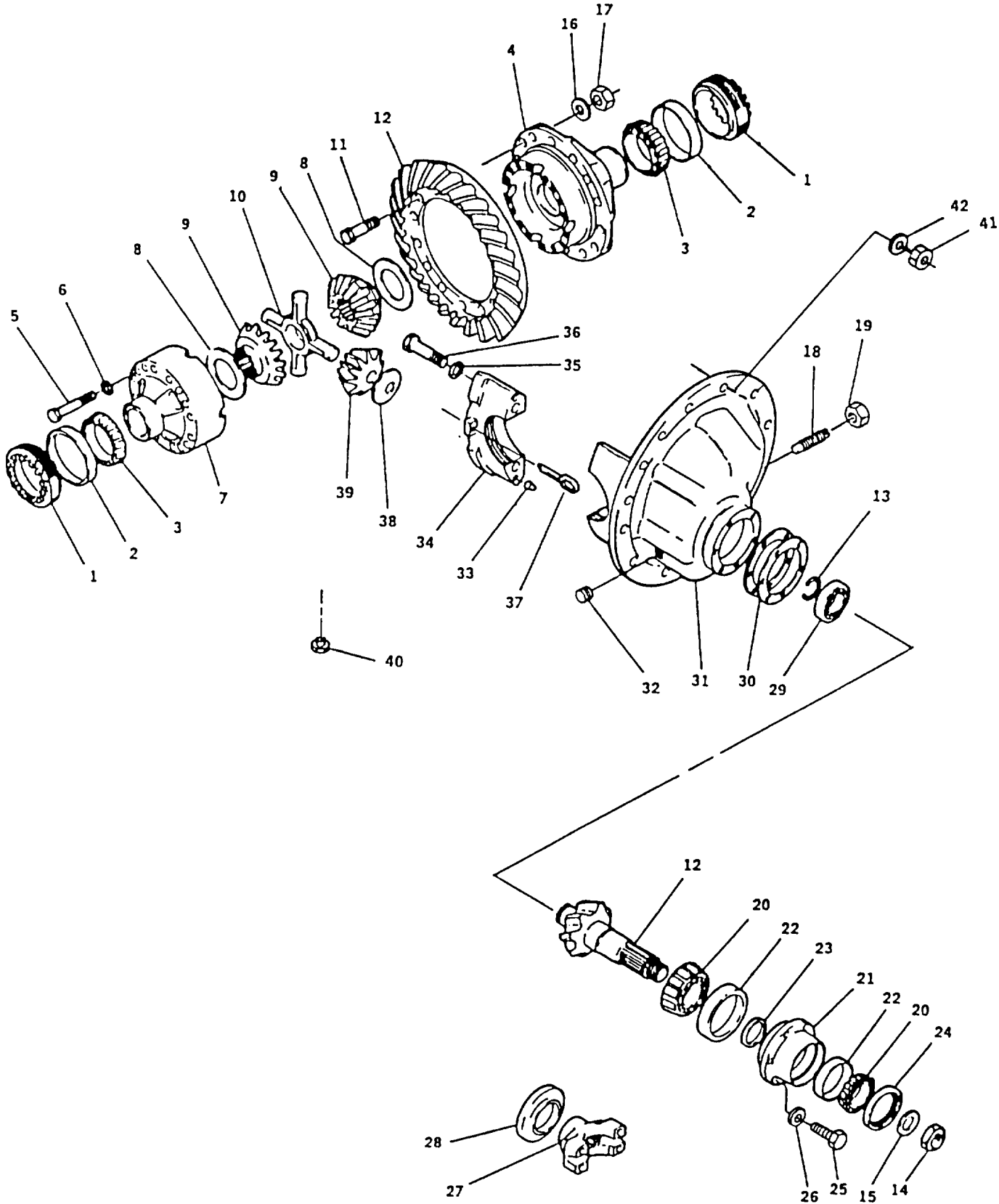
NOTE

In the following procedures, movement of the contact pattern in the length of the tooth is indicated as, toward the "heel" or "toe" of the bevel gear (12).

NOTE

Always check tooth contact patterns on the drive side of the gear teeth.

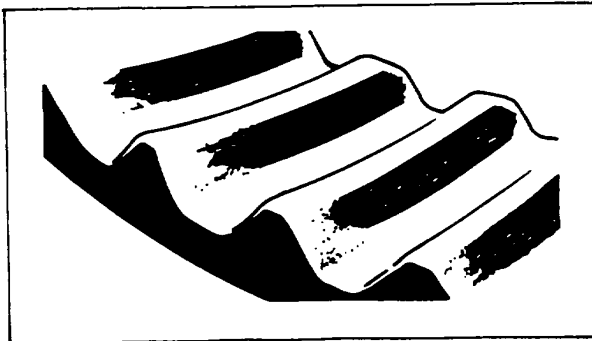
- a Adjust backlash of a new gear set to either 0.012 in. (.30 mm) or 0.015 in. (.38 mm). Adjust backlash of old gear set to setting that was measured before carrier was disassembled.
- b Apply a marking compound to approximately 12 gear teeth of the bevel gear (12). Rotate bevel gear so that 12 gear teeth are next to drive pinion.
- c Rotate bevel gear (12) forward and backward so that 12 gear teeth go past drive pinion six times to get contact patterns. Repeat if needed to get a more clear pattern.



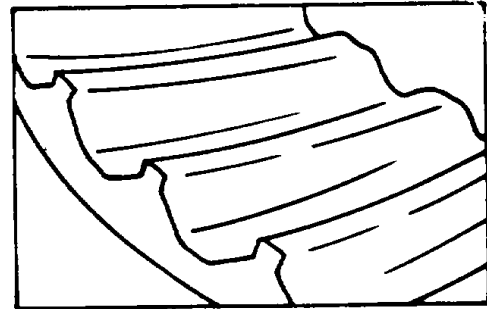
d Look at contact patterns on the ring gear teeth. Compare patterns to the following:



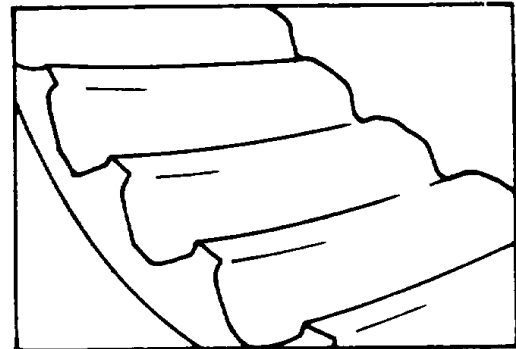
- (1) The location of a good hand rolled contact pattern should be between center and toe of tooth and in center between top and bottom of tooth.
- (2) When carrier is being operated, a good pattern will extend approximately full length of gear tooth. The top of pattern will be near top of gear tooth.



- (3) The location of a good hand rolled contact pattern for an old gear set MUST match wear pattern in bevel gear. The contact pattern will be smaller in area than wear pattern.



High Pattern



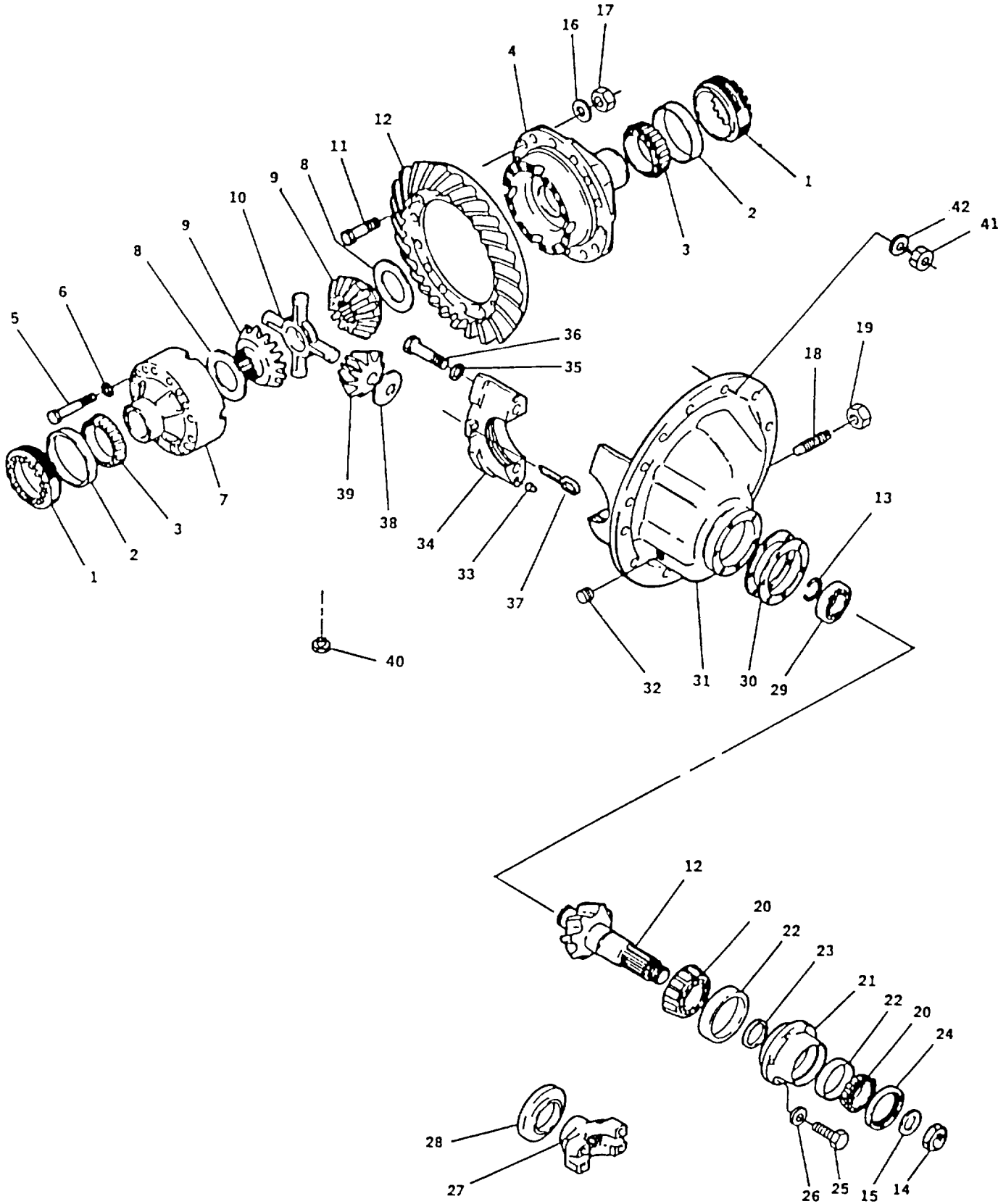
Low Pattern

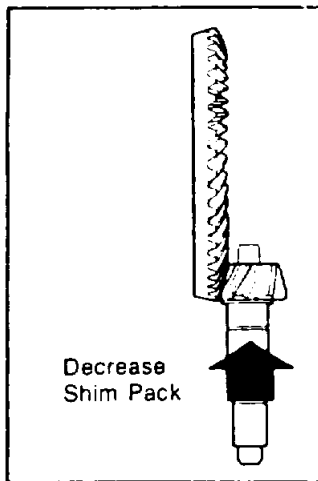
- (4) If contact patterns require adjustment, continue by following step 3 to move contact patterns between top and bottom of gear teeth. If contact patterns are in center of gear teeth, continue by following step f.
- e Change thickness of shim pack (30) under retainer (21) to move the contact patterns between top and bottom of gear teeth. Use following procedure.

NOTE

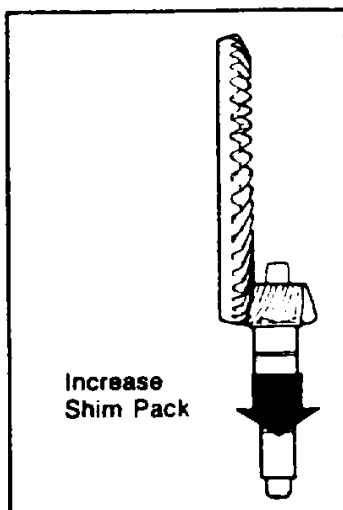
A high contact pattern indicates that the drive pinion was not installed deep enough into the carrier. A low contact pattern indicates that the drive pinion was installed too deep in the carrier.

- (1) Remove drive pinion and retainer (21) from carrier.



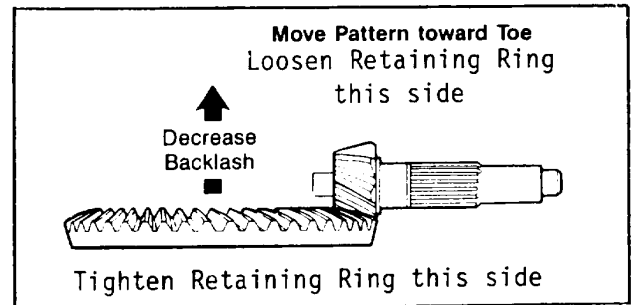


- (2) To correct a high contact pattern, decrease thickness of the shim pack (30) under retainer (21). When you decrease the thickness of the shim pack, the drive pinion will move toward the bevel gear.

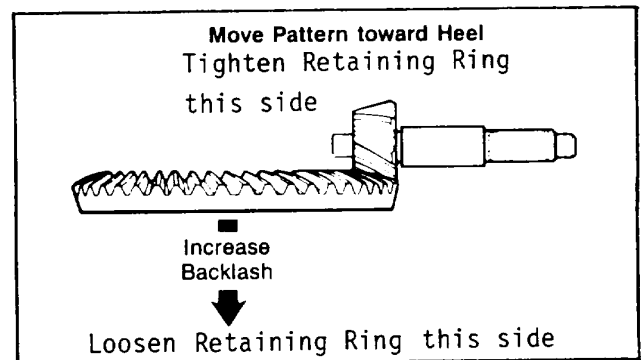


- (3) To correct a low contact pattern increase thickness of shim pack (30) under retainer (21). When you increase the thickness of the shim pack, the drive pinion will move away from the bevel gear.
- (4) Install drive pinion (12), retainer (21) and shims (30) into carrier.
- (5) Repeat steps b, c, and d until the contact patterns are in center between the top and bottom of gear teeth.

- f. Adjust backlash of the bevel gear within specification range to move contact patterns to correct location in length of gear teeth.



- (1) Decrease backlash to move contact patterns toward toe of the bevel gear teeth.

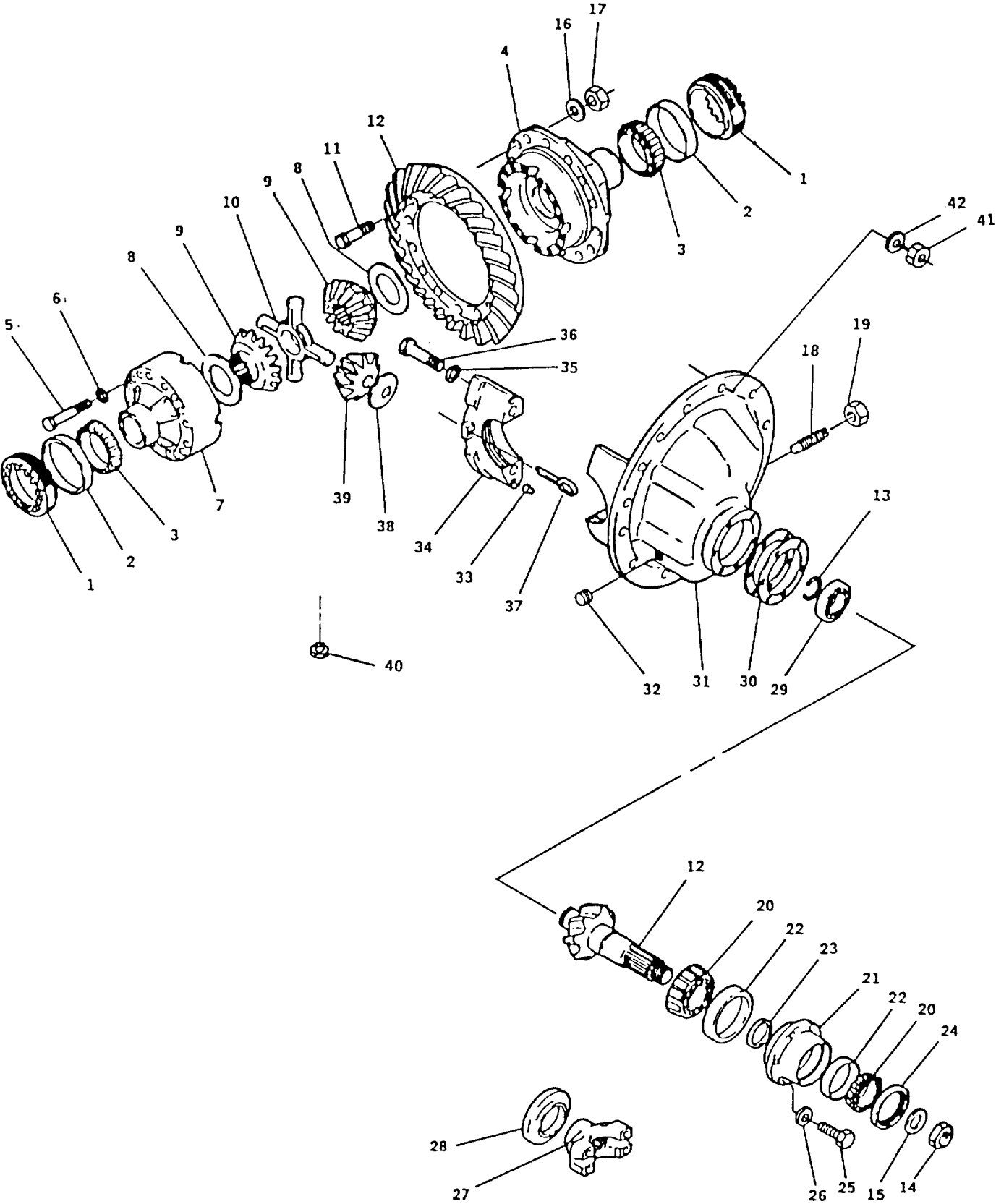


- (2) Increase backlash to move contact patterns toward the heel of the bevel gear teeth.
- (3) Repeat steps b, c, d, and f until contact patterns are at correct location in length of gear teeth.

- g. Install cotter pins (37) between lugs of retaining rings (1) and boss of caps (34). Bend ends of cotter pins around boss.

17. INSTALL THRUST SCREW (18).

- a. Rotate carrier in stand and position it with bevel gear up.



- b. Install jam nut (19) on thrust screw (18) one half distance between both ends.
- c. Install thrust screw (18) and tighten firmly against bevel gear (12).
- d. Loosen thrust screw (18) 1/2 turn to obtain correct adjustment of 0.025 to 0.045 in. (.635 to 1.143 mm) clearance.
- e. Tighten jam nut (19) to 150-190 ft-lbs (200-253 Nm).

18. INSTALL DIFFERENTIAL CARRIER INTO AXLE HOUSING.

WARNING

Dry cleaning solvent P-D680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F/138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately. 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.).

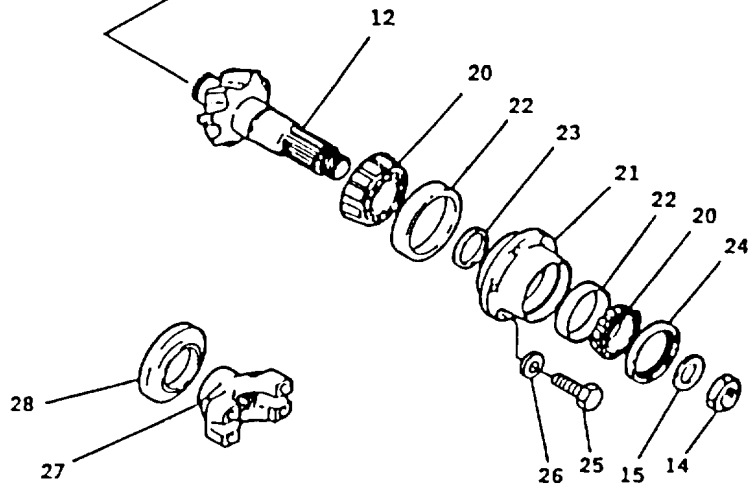
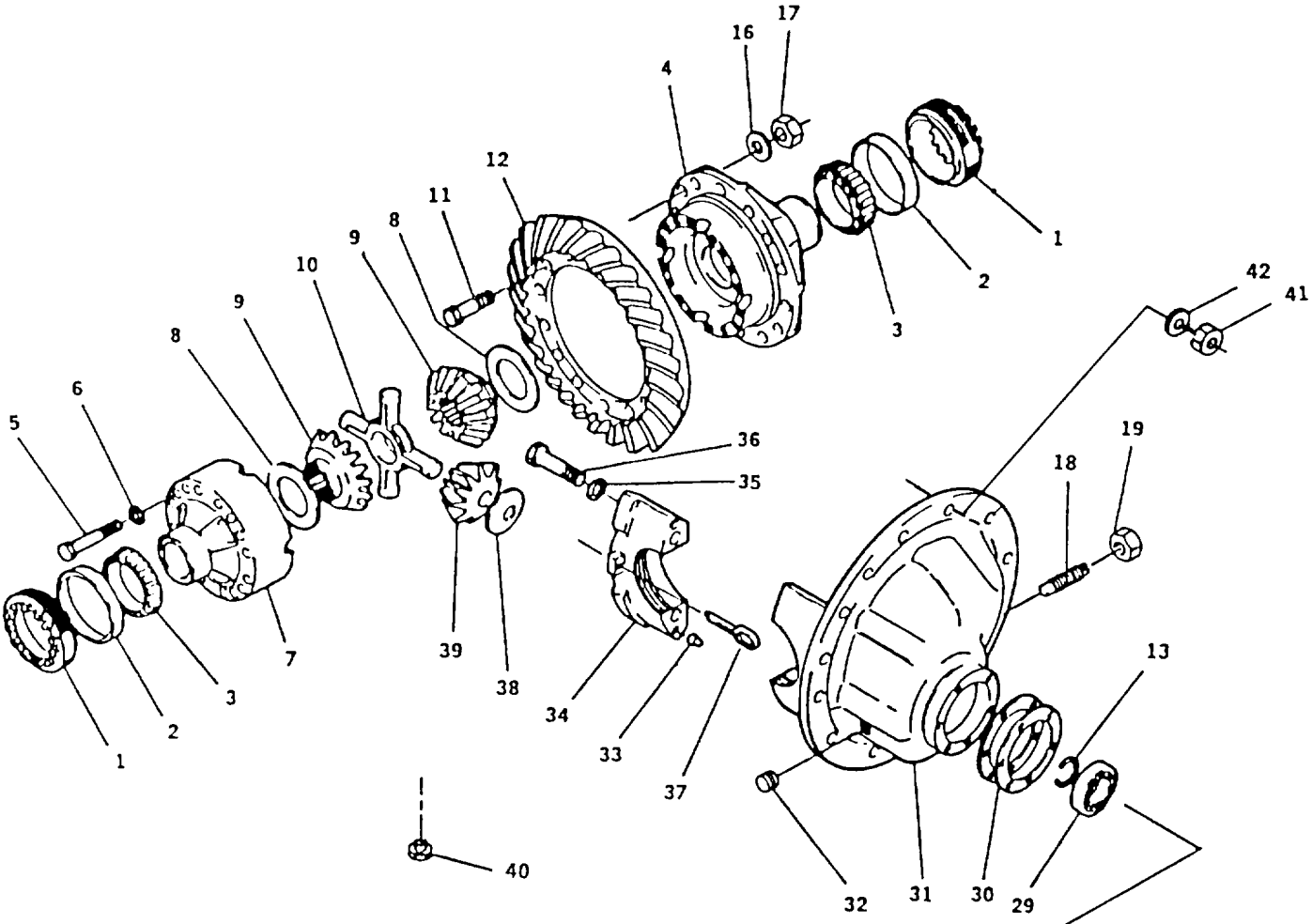
- a. Clean inside of axle housing and mounting surface where carrier fastens. Use cleaning solvent and clean, lint-free cloths. Dry with low pressure compressed air.

- b. Inspect axle housing for damage. Repair or replace axle housing.
- c. Check for loose or damaged studs (43).
- d. Apply liquid adhesive (Item 215, Appendix B) and install studs (43) if removed.
- e. Apply silicone gasket material to mounting surface of housing where carrier fastens.

CAUTION

Do not use hammer or mallet to install carrier. Otherwise, damage to mounting flange and seals could occur.

- f. Using roller jack, align and carefully push carrier into axle housing (31).
 - g. Install four nuts (41) and washers (42). Tighten nuts hand tight.
 - h. Tighten four nuts (41) two or three turns in a pattern opposite each other.
 - i. Repeat step h until four nuts (41) are tightened to 150-230 ft-lbs (200-306 Nm).
 - j. Install remaining nuts (41) and washers (42). Torque nuts (41) to 150-230 ft-lbs (200-306 Nm).
 - k. Install drain plug (40).
19. INSTALL AXLE PROPELLER SHAFTS. (REFER TO TM 5-3810-306-20.)
20. INSTALL PLANETARY ENDS. (REFER TO PAGE 8-50.)
21. INSTALL PROPELLER (DRIVE) SHAFTS. (REFER TO TM5 -3810-306-20.)
22. SERVICE AXLE WITH LUBRICANT. (REFER TO LO 5-3810-306-12.)



DRIVE UNIT TORQUE VALUES

FASTENER	THREAD SIZE	TORQUE VALUE FT-LB (Nm)	
Plug, Oil Drain (40)	50-14	25 minimum (34 minimum)	
Capscrew, Differential Case (5)	.38-16	35-50	(48-68)
	.44-14	60-75	(81-102)
	.50-13	85-115	(115-156)
	.56-12	1130-165	(176-224)
	.62-11	1180-120	(244-312)
	Flange Head M12 x 1.75	185-103	(115-140)
	Standard Hex Head M12 x 1.75	175-95	(100-130)
	M16 x 2	1203-251	(275-340)
Nut, Bevel Gear Bolt (17)	.50-13	175-100	(102-136)
	.50-20	185-115	(115-156)
	.62-11	1150-190	(203-258)
	.62-18	1180-230	(244-312)
	M12 x 1.25	166-81	(90-110)
	M12 x 1.75	177-85	(104-115)
	Flange Head M16 x 1.5	1192-214	(260-290)
Standard Hex Head M16 x 1.5	1190-225	(260-305)	
Capscrew, Bearing Cap (36)	.56-12	1110-145	(149-197)
	.62-11	1150-190	(203-258)
	.75-10	1270-350	(366-475)
	.88-14	1360-470	(488-637)
	.88-9	1425-550	(576-746)
	M16 x 2	1181-221	(245-300)
	M20 x 2.5	1347-431	(470-585)
	M22 x 2.5	1479-597	(650-810)
Nut, Housing to Carrier Stud (41)	.44-20	150-75	(68-102)
	.50-20	175-115	(102-156)
	.56-18	1110-165	(149-224)
	.62-18	1150-230	(203-312)
Jam Nut, Thrust Screw (44)	.75-16	1150-190	(203-258)
	.88-14	1150-300	(203-407)
	1.12-16	1150-190	(203-258)
	M22 x 1.5	1148-210	(200-285)
	M30 x 1.5	1236-295	(320-400)
Nut, Drive Pinion (14)	.88-20	1200-275	(271-373)
	1.0-20	1300=400	(407-542)
	1.25-12	1700-900	(949-1220)
	1.25-18	1700-900	(949-1220)
	1.50-12	1800-1100	(1085-1491)
	1.50-18	1800-1100	(1085-1491)
	1.75-12	1900-1200	(1220-1627)
	M32 x 1.5	1738-918	(1000-1245)
	M39 x 1.5	1922-1132	(1250-1535)
	M45 x 1.5	1996-1232	(1350-1670)
Capscrew, Retainer (25)	.38-16	130-50	(41-68)
	.44-14	150-75	(68-102)
	.50-13	175-115	(102-156)
	.56-12	1110-165	(149-224)
	.62-11	1150-230	(203-312)
	M12 x 1.75	174-96	(100-130)

END OF TASK

UNIVERSAL JOINT ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033) TM 5-3810-306-34

SUPPLIES: None

EQUIPMENT CONDITIONS: Wheel ends removed. (Refer to page 8-50.)

REMOVAL:

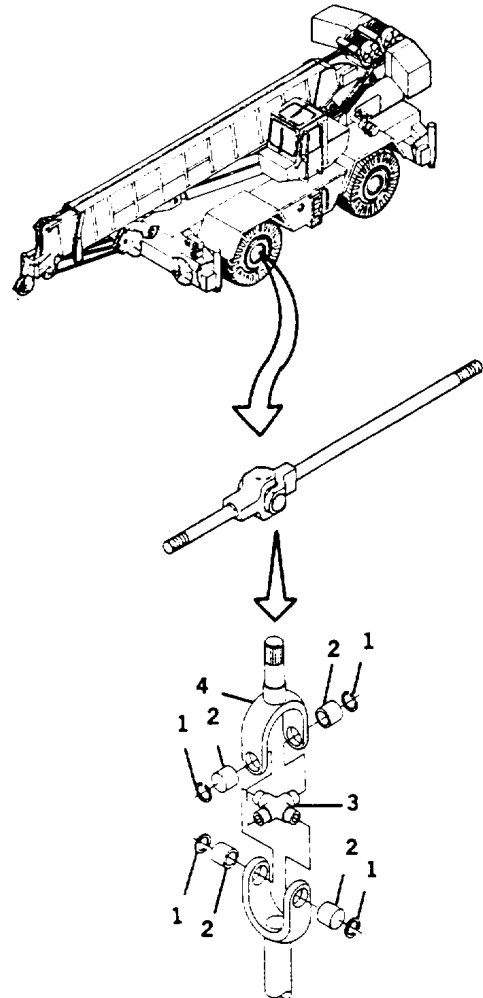
1. REMOVE AXLE SHAFT AND UNIVERSAL JOINT FROM HOUSING.

NOTE

Avoid damaging oil seal in housing.

2. REMOVE UNIVERSAL JOINT.

- a. Remove the snap rings (1) from the two ears in each yoke. Use a suitable tool.
- b. Position joint assembly in an open vise with one yoke horizontal and resting on top of vise jaws. (Do not tighten vise).
- c. With a suitable soft hammer, tap upper ear of the vertical yoke several times. This will drive the vertical yoke down and push out upper needle bearing and cap (2). Bearing cap has a highly polished surface and care should be exercised not to mar or scratch surface during removal operation).
- d. If metal retainers have worked free from bearing caps, remove them from arms of cross (3), through hole in yokes.
- e. Turn vertical yoke upside down and remove needle bearing and retainer on opposite side following procedure outlined in Steps c and d.



- f. Remove vertical yoke by gently working yoke off arms of cross.
- g. To complete disassembly, hold remaining yoke in a vertical position and rest cross (3) arms on top of open vise. Repeat Steps c, d and e.
- h. Remove cross from yoke by gently working cross free.

INSPECTION:

1. CLEAN AND INSPECT ALL PARTS.

- a. When inspecting bearings, keep needles, caps, and retainers together.
- b. Replace parts that show excessive wear or damage. If it is necessary to use a new cross, needle bearings should also be replaced. Do not mix new and used bearings together. Replacement should be made in sets of four.

INSTALLATION:

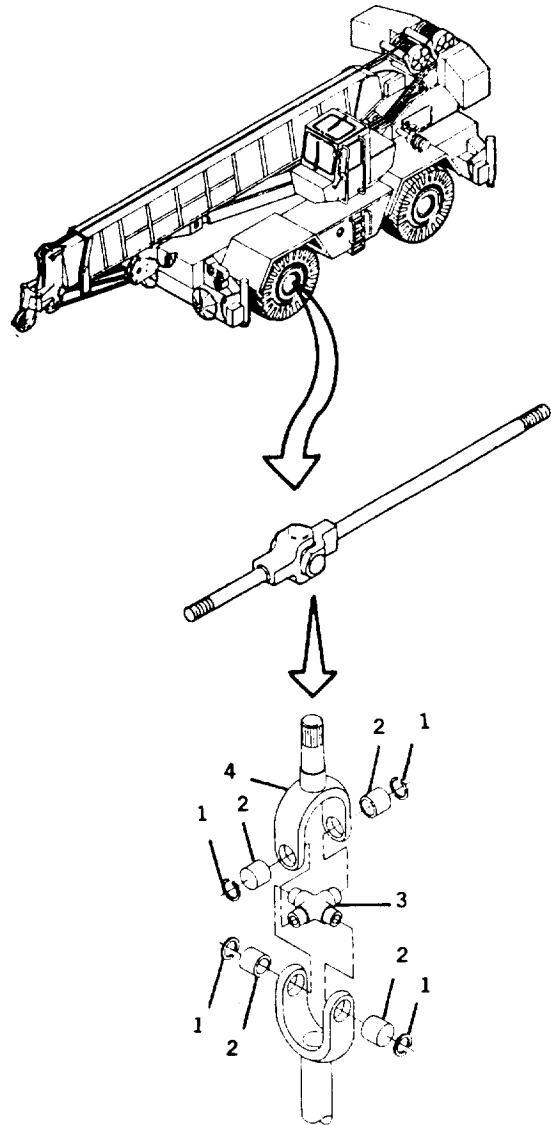
1. INSTALL UNIVERSAL JOINT.

- a. Insert needle bearing cap (1) into ear of yoke.
- b. Place yoke in a vise and press needle bearing cap into proper position. (The bearing cap has a highly polished surface and care should be exercised not to mar or scratch surface during installation operations).
- c. Remove yoke from vise and gently work one arm of cross (3) into yoke (4) and bearing cap (1).
- d. Install opposite bearing cap (1) by hand and line up cross (3) arm.
- e. Place yoke in a vise and press needle bearing cap (2) into yoke (4) and onto arm of cross (3).

CAUTION

The cross must move freely in both caps. If the cross should bind, remove the cap and check for upset needles.

- f. With aid of a short plug, move the bearing caps past snap ring groove, and insert snap rings (1) into grooves. (One with each bearing cap).



- g. Repeat procedures outlined in Steps a through f for installing remaining caps and yokes.

2. INSTALL AXLE SHAFT AND UNIVERSAL JOINT IN HOUSING.

3. INSTALL WHEEL ENDS. (REFER TO PAGE 8-50.)

4. INSTALL WHEEL AND TIRE ASSEMBLIES. (REFER TO TM 5-3810-306-20.)

5. TEST FOR PROPER OPERATION.

END OF TASK

Section III. PLANETARY DRIVE MAINTENANCE

PLANETARY WHEEL END ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Axle wheel nut wrench (Item 14, Appendix C)

SUPPLIES: Preformed Packing (Item 196, Appendix B)
Gear oil (Item 195, Appendix B)
Grease MIL-G-10924 (Item 37, Appendix B)

EQUIPMENT CONDITIONS: Outriggers fully extended and lowered. (Refer to TM 5-3810-306-10.)
Wheel assemblies removed. (Refer to TM 5-3810-306-20.)
Spring in air brake chambers caged. (Refer to TM 5-3810-306-20.)

REMOVAL:

1. DRAIN LUBRICANT FROM HUB.

- a. Rotate hub assembly so DRAIN/FILL plug (1) is at bottom.
- b. Drain lubricant.
- c. Clean magnetic drain plug.

2. REMOVE PLANETARY ASSEMBLY.

- a. Match mark both spider (2) and wheel hub (21) for identification of correct alignment when reassembling unit.
- b. Remove thirty planetary spider capscrews (18) and lockwashers (34).

CAUTION

Planetary axles employ a floating ring gear. Care should be taken to prevent this gear from accidentally falling out when planetary spider is removed. Two screws (18) should be left slightly threaded to prevent planetary spider assembly from falling out while prying.

NOTE

The adhesive effect of liquid gasket material may require using the pry bar slots provided.

- c. Separate and remove planetary spider assembly (2) from wheel hub assembly (21).
- d. Remove setscrews (17).
- e. Support planetary spider (2) in a press, flange side down.

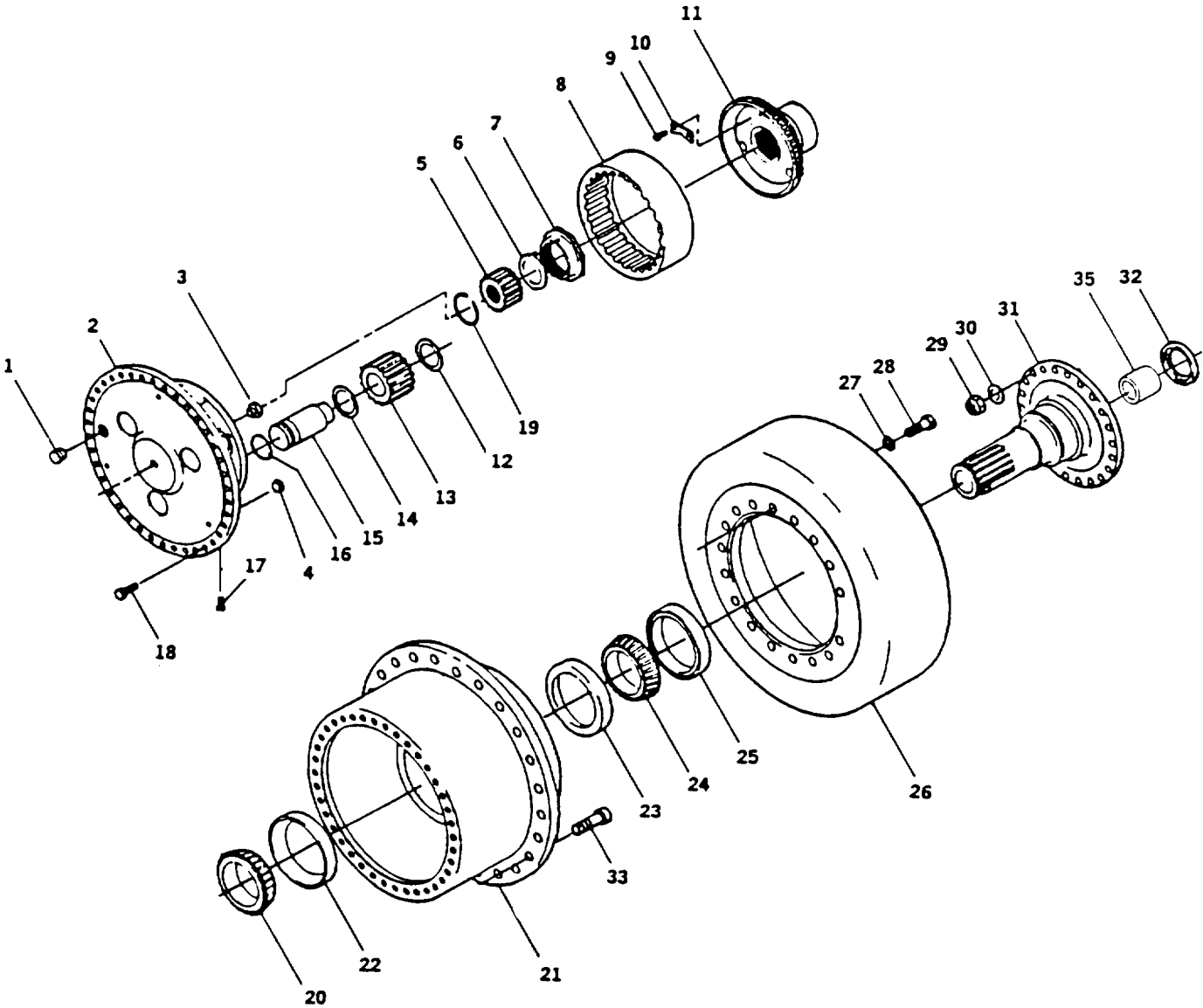
WARNING

Do not strike planet gear shafts (15) directly with a hammer. Personal injury from chips or splinters may result.

NOTE

Place block of wood under press to cushion gear shafts as they are pressed out.

- f. Using press, press out planet gear shafts (15) and packing (16). Remove packing (16) and discard.



- g. Remove spur gears (13) and their respective thrust washers (12) and (14).

NOTE

Thrust washers (12) and (14) are designed for opposite sides of the planet shafts and can only be installed in their correct locations.

3. REMOVE FLOATING RING GEAR ASSEMBLY.

- a. Remove retaining ring (19) from end of spindle (31).
- b. Remove axle shaft spur gear (5).
- c. Remove key washer (6).
- d. Remove two capscrews (9) and wheel bearing nut strip (10).
- e. Using axle wheel nut wrench (Item 14, Appendix C) remove wheel bearing nut (7).

CAUTION

Provide support to prevent spur gear (11) from dropping.

- f. Remove spur gear (11) and gear (8).
- g. If necessary, remove bearing (20) using suitable puller.

4. REMOVE WHEEL HUB AND DRUM ASSEMBLY.

- a. Lift hub (21) and drum (26) slightly to relieve hub weight and brake shoe drag. Remove assembly from spindle (31).

NOTE

The oil seal (25) is located in hub against hub rear bearing cup and wipes spindle (31).

- b. Remove oil seal (25) from hub with a suitable puller. Remove bearing (24).
- c. If necessary, remove outer bearing rings (22) and cup (23) from wheel hub with a suitable puller.
- d. Match mark drum (26) and hub (21) and remove eighteen capscrews (28) and washers (27). Separate drum (26) and hub (21).

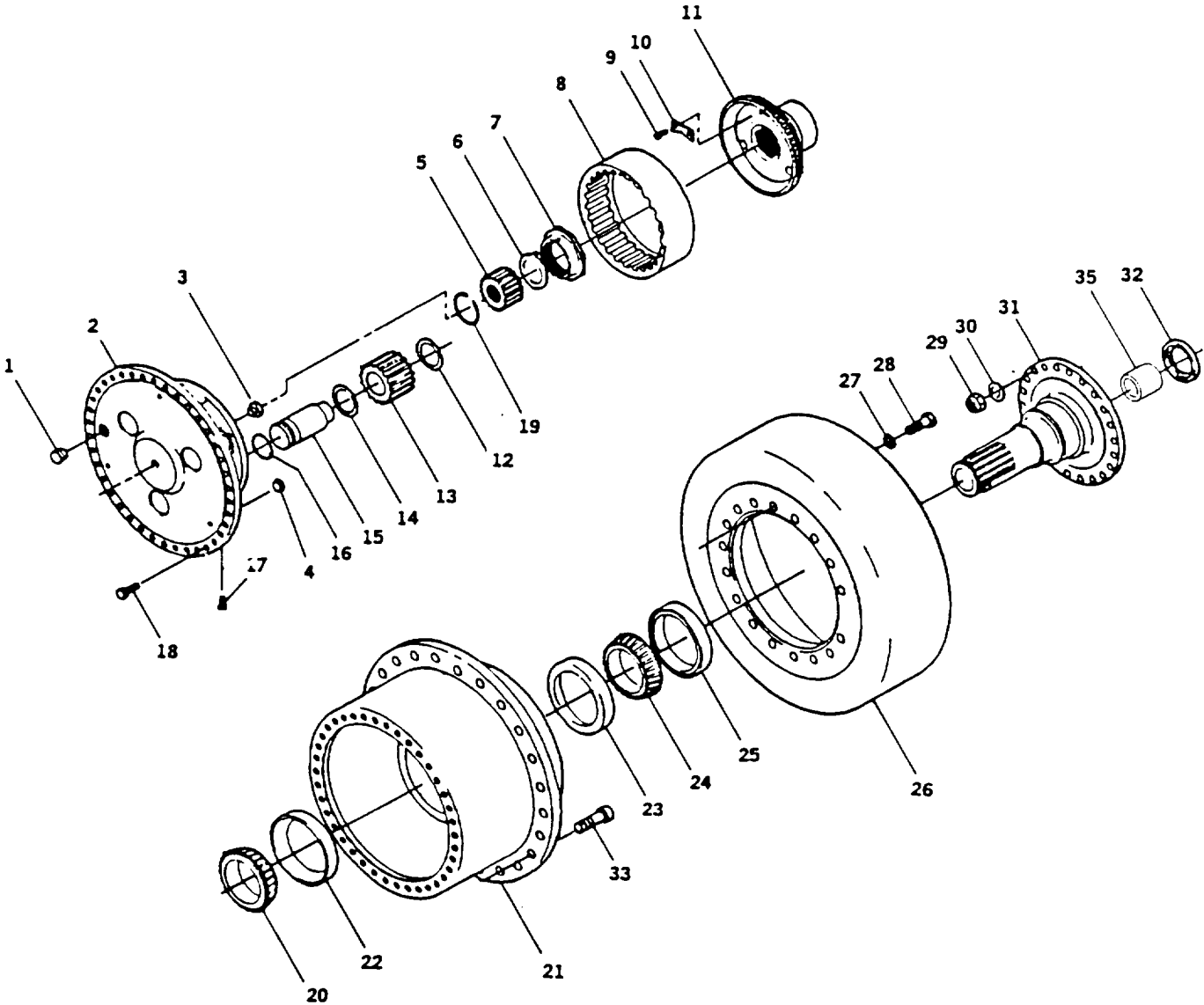
5. REMOVE SPINDLE.

- a. Tag and disconnect air lines at both air brake chambers.
- b. Disconnect air line mounting plate on top of wheel spindle and move to side.
- c. Remove air brake chambers.
- d. Remove spindle nuts (29) and washers (30).
- e. Remove brake spider assembly.

CAUTION

Use care when removing spindle (31) to avoid damage to oil seal (32).

- f. Install wheel bearing nut (7) on spindle. Using rubber mallet, tap and remove spindle (31).
- g. Remove inner oil seal (32) and bushing (35). Discard seal (32).



INSPECTION:

1. INSPECT WHEEL END COMPONENTS.

CAUTION

Avoid use of drifts and hammers. They may easily mutilate or distort component parts.

- a. Inspect all bearings, cups and cones, including those not removed from parts of drive unit, and replace if rollers or cups are worn, pitted, or damaged in any way. If necessary, remove parts with a suitable puller or in a press with sleeves.
- b. Inspect planetary reduction, spur gears, and ring gear assembly for wear or damage. Gears which are scored, pitted, ridged, or worn should be replaced.
- c. Inspect for pitted, scored, or worn thrust washers.
- d. Inspect for worn or ridged planet shafts.
- e. Remove nicks, marks, and burrs, from machined or ground surfaces. Threads must be clean and free of dirt to obtain accurate adjustment and correct torque. A fine mill file or India stone is suitable for this purpose. Studs must be tight prior to assembling parts.
- f. Burrs caused by lockwashers at spot face of stud holes of knuckle flanges, spider flange, or hub cover should be removed to assure easy assembly of these parts.

INSTALLATION:

1. INSTALL SPINDLE.

- a. Apply film of waterproof grease to lips of seal (32), bronze bushing (35) (in spindle 31) and oil seal journal of axle shaft.
- b. Install bushing (35) and a new seal (32) from inner end of spindle (31) with a suitable driver.
- c. Install bearing (24) on spindle (31).

NOTE

Be careful not to damage inner seal (32) as it passes over axle shaft.

- d. Install spindle (31) by carefully sliding it over axle shaft.
- e. Secure spindle with twenty washers (29) and nuts (30).

2. INSTALL BEARING (20).

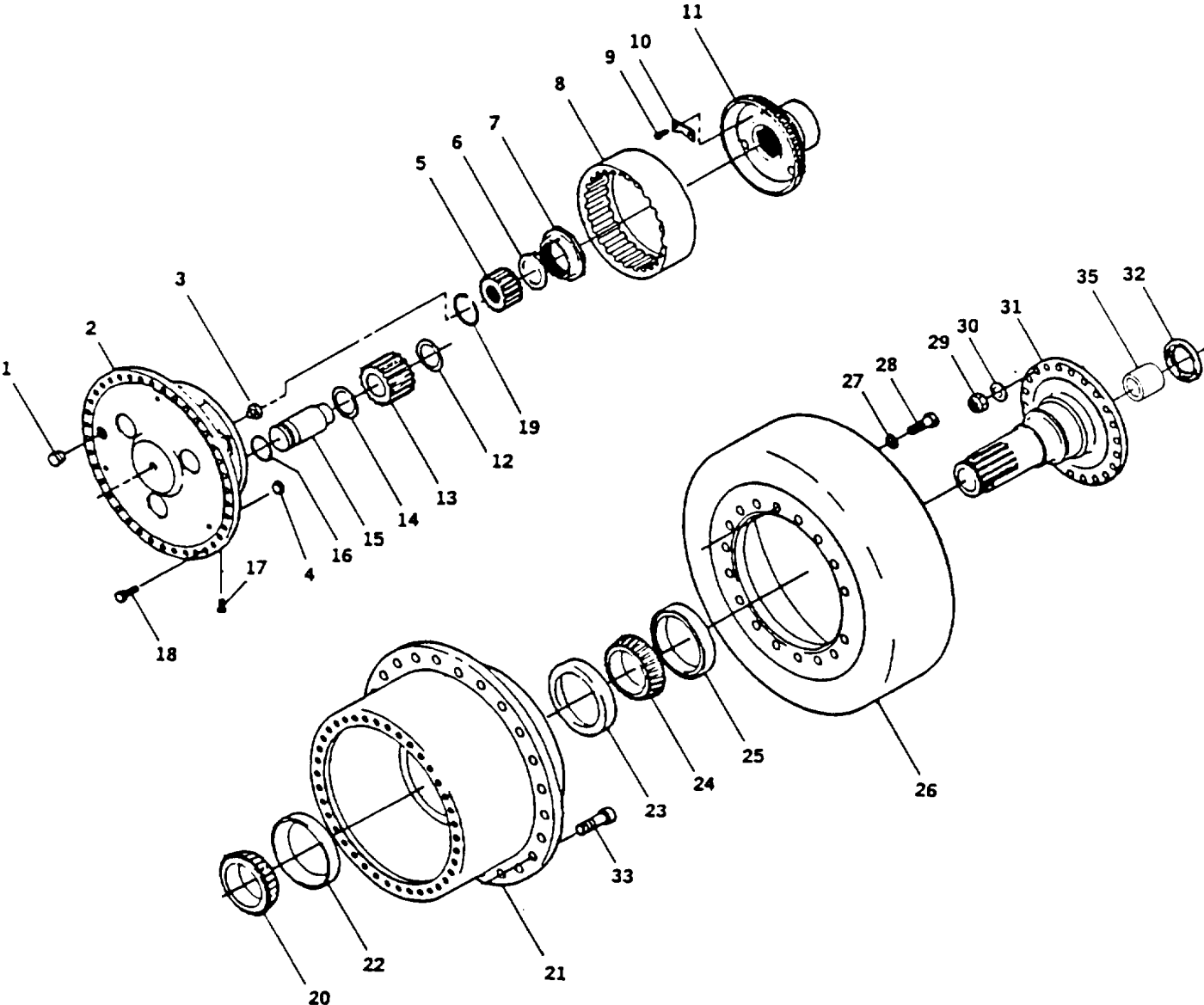
- a. Install bearing (20) on spur gear journal (11).
- b. Apply grease MIL-G-10924 to bearing (20).

NOTE

Inner race of bearing (20) is slip fit over spindle journal.

3. ASSEMBLE WHEEL HUB AND DRUM ASSEMBLY.

- a. Install cup (23) and outer ring (22) with suitable driver.
- b. Install new oil seal (25) with proper driver. Seal (25) must be driven to its original location.



- c. Lubricate lips of seal (25) and oil seal journal of spindle (31) with grease MIL-L-10924.
- d. Mount brake drum (26) to wheel hub (21) as marked and secure with eighteen capscrews (28) and washers (27). Torque capscrews (28) to 310-400 ft-lbs (412-532 Nm).

- c. Back off adjusting nut to relieve reload on bearings. Torque on nut should be 0 ft-lbs (0 Nm)
- d. Tighten bearing nut (7) to 350 ft-lbs (466 Nm) while hub (21) is being rotated. Increase torque as required to install nut strip (10).

4. ASSEMBLE SPUR GEAR (11) AND HUB (21).

- a. Place hub (21) on floor with drum (26) down.
- b. Align puller holes in spur gear (11) with threaded holes in hub (21).
- c. Install temporary capscrews to hold spur gear (11) and hub (21) together.
- d. Using overhead hoist, locate hub (21) on spindle splines.
- e. Install bearing nut (7) and draw assembly into place.
- f. Remove temporary capscrews installed in spur gear (11).

5. ADJUST WHEEL BEARINGS.

- a. Seat bearings and related components by tightening nut (7) to 400 ft-lbs (532 Nm) while hub is rotated in both directions. Rap hub several times with a brass or plastic mallet then re-torque to 400 ft-lbs (532 Nm).
- b. Repeat step a until bearing nut (7) will not advance under application of 400 ft-lbs.

NOTE

The capscrews (9) are Dri-Loc fasteners. Refer to general maintenance procedures for use of these.

- e. Install nut strip (10) and capscrews (9). Torque capscrews to 60-75 ft-lbs (80-100 Nm).

6. INSTALL PLANETARY RING AND SUN GEARS.

- a. Apply grease MIL-L-10924 to key washers (6).

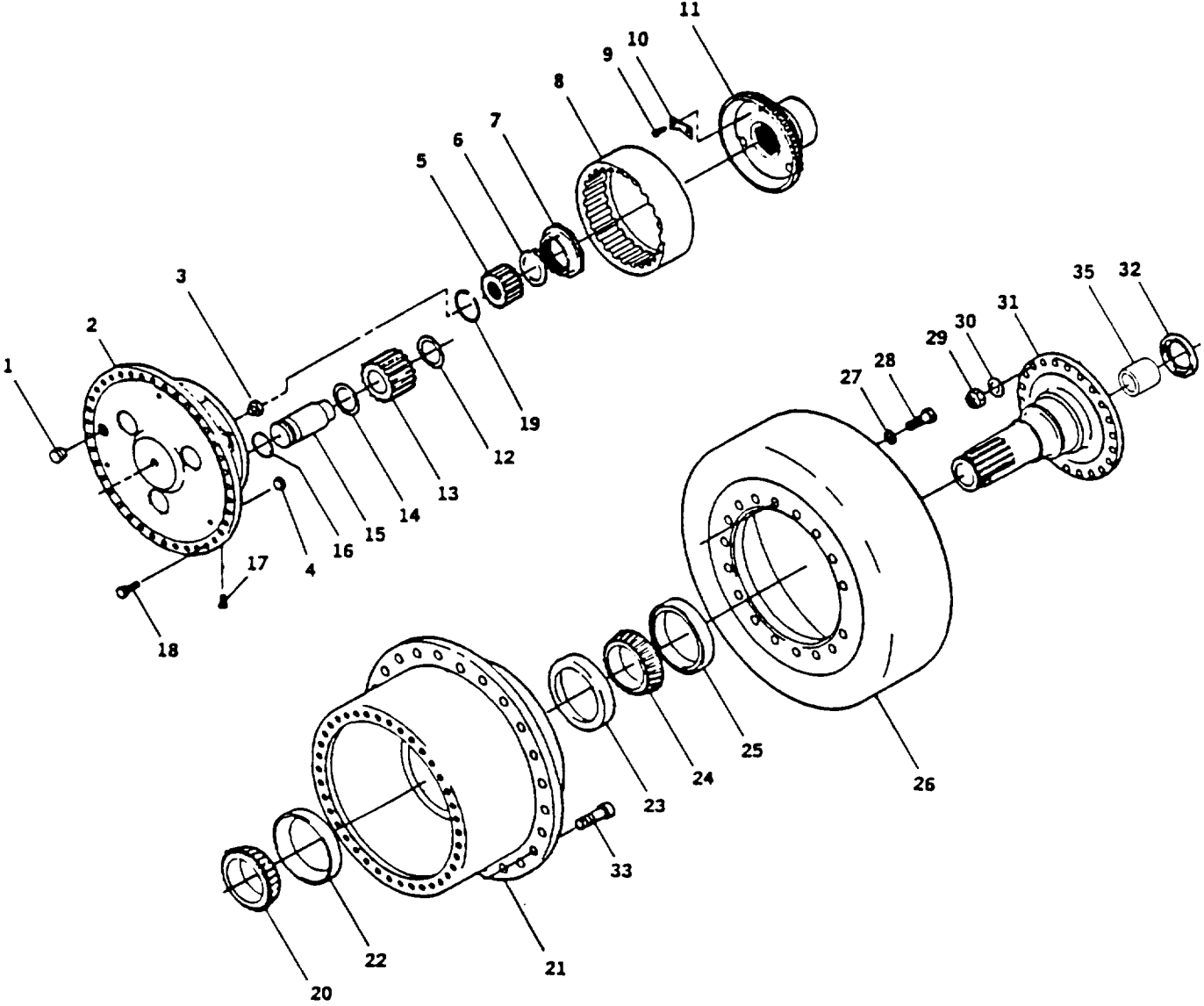
NOTE

Key washer (6) tangs must engage slots in spindle (31) or bearing nut (7).

- b. Install key washer (6), spur gear (5) and retaining ring (19).
- c. Install gear (8) onto spur gear.

7. INSTALL SPUR GEARS AND SHAFTS INTO SPIDER ASSEMBLY.

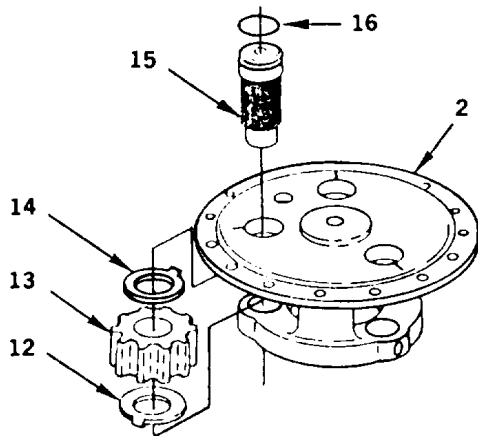
- a. Inspect bores of spur gears (13). Do not reuse spur gears with bore surface roughness. Smooth bore is essential.



CAUTION

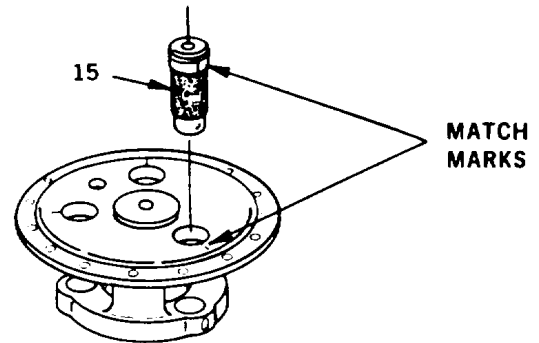
Chamfers on large bores must be smooth. Use emery cloth to remove surface blemishes. Failure to follow this caution could result in damage to shaft (15) and preformed packing (16).

- b. Install new preformed packing (16) on each shaft (15). Ensure preformed packing (16) is not twisted.
- c. Place spider (2) in press with the flange side up. Block up as required.



- d. Install inner washer (12) with washer tab engaged in spider indent and washer bore aligned with spider bore.
- e. Coat bore of the spur gear (13) with a film of MIL-L-2105 gear oil. Slide spur gear and outer flat washer (14) into spider. Align bores of parts and engage outer flat washer (14) tab in spider indent.
- f. Install flat shaft (15) into spider and through the spur gear and flat washers by hand. The large end of the shaft will bind in the spider bore due to an interference fit.

- g. On axle models with one-piece integral spider and cover align match-mark on large diameter of shaft with match-mark on spider.



NOTE

These match-marks provide proper alignment of the set screw hole in the small end of the shaft and the tapped set screw hole in the spider boss.

- h. Apply film of non-hardening sealant (Permatex 51 or equivalent) to preformed packing (16) and large end of shaft.

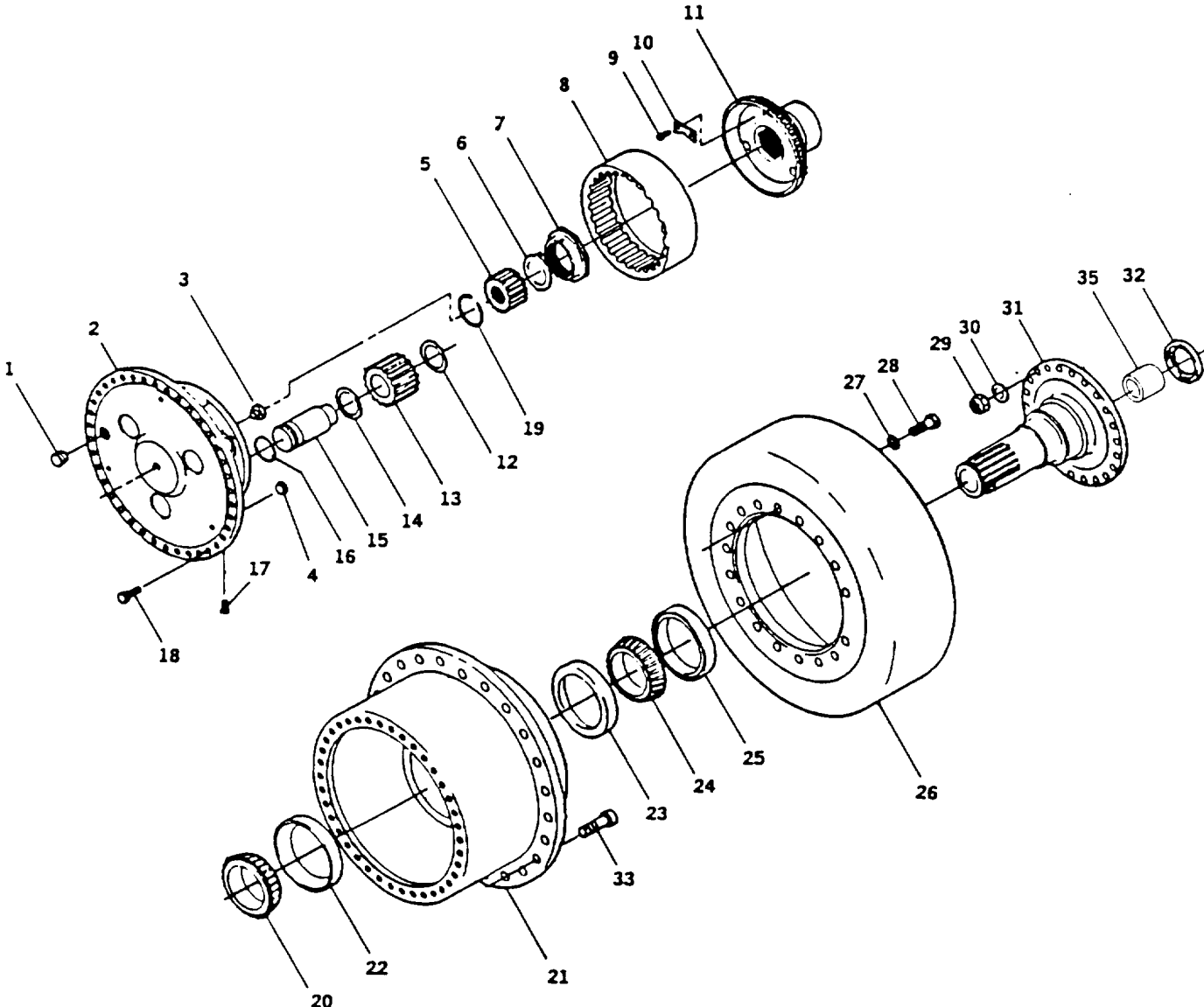
CAUTION

Do not strike shafts (15) directly with a steel hammer. Personal injury from chips or splinters may result.

NOTE

If a press is not available use a brass drift and mallet to tap the shaft (15) through the spider and spur gear.

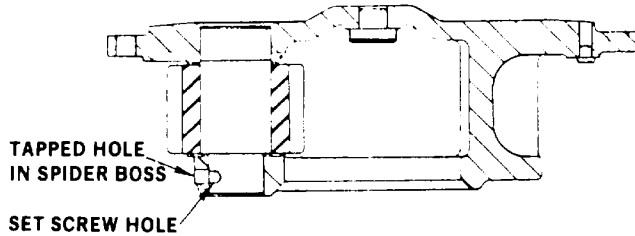
- i. Being careful to keep shaft (15) aligned, press shaft into spider until shoulder of the shaft bottoms against inner flat washer (12).



NOTE

The set screws are Dri-Loc fasteners. Refer to General Procedures for use of these.

- j. Install set screw (17) into spider and shaft (15). Torque screw 15 to 25 ft-lbs (20-33 Nm).



- k. Repeat steps d thru j for each of two remaining spur gears (13) and shafts (15).

8. INSTALL SPIDER.

WARNING

Eye contact with these silicone RTV materials may cause irritation. If eye contact takes place, flush the eyes with water for 15 minutes and have the eyes examined by a doctor.

WARNING

Minor concentrations of acetic acid vapor may be produced during application. Adequate ventilation should be provided when silicone RTV is applied in confined areas.

- a. Apply silicone gasket material (RTV) to cover flange on spider to hub mating surface.
- b. Start spider and pinion assembly, aligning teeth of spur gear (13) and gear teeth (8). Line up match-marks.
- c. Align hub holes with spider holes and push spider assembly against hub.
- d. Install thirty washers (34) and capscrews (18). Torque capscrews (18) to 85-115 ft-lbs (113-153 Nm).

9. FILL WHEEL END ASSEMBLIES WITH MULTIPURPOSE GEAR OIL MIL-L-2105.

- a. Turn hub and drum assembly so the DRAIN/FILL plug (1) 900 from bottom.
- b. Fill each housing until lubricant appears at drain plug hole. Replace all plugs and tighten them securely.

10. ADJUST BRAKES. (REFER TO TM 5-3810306-20.)

11. UNCAGE SPRING IN AIR BRAKE CHAMBER. (REFER TO TM 5-3810-306-20.)

12. INSTALL WHEEL AND TIRE ASSEMBLIES. (REFER TO TM 5-3810-306-20.)

13. TEST FOR PROPER OPERATION.

END OF TASK

CHAPTER 9

BRAKE SYSTEM

CHAPTER INDEX

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Section I. AIR COMPRESSOR MAINTENANCE

AIR COMPRESSOR INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Shop Equipment Contact Maintenance Truck Mtd (4930-00-294-9518)
 Shop Equipment General Purpose Repair, Semi-trailer Mtd (4930-01-006-3229)
 Shop Equipment Machine Shop; FM Basic (3470-00-754-0708)
 Shop Equipment Auto-Maintenance and Repair Common No. 1 (4910-00-754-0650)
 Shop Equipment Auto-Maintenance and Repair; Org Suppl No. 1 (4910-00-754-0653)

SUPPLIES: Gasket (Item 98, Appendix B)
 Gasket (Item 99, Appendix B)

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)
 Radiator drained. (Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE TUBES AND LINES.

- a. Loosen clamps (6) and remove compressor inlet tube (7), molded hose (8) and compressor inlet hose (9). Replace as required.
- b. Tag and remove water inlet (4) and water outlet (5) tubes and fittings (19) and (20) from compressor (2). Replace as required.
- c. Remove air lines (3).
- d. Remove lube oil supply tube (1) from compressor (2).
- e. Remove capscrews (16), inlet connector (17) and gasket (18). Discard gasket (18).

2. REMOVE AIR COMPRESSOR (2).

- a. Remove capscrews (10) securing compressor mounting brace (11) to engine.
- b. Remove nuts (12) and washers (13) from mounting studs (15).

c. Remove compressor (2).

d. Remove gasket (14) and discard.

e. Remove capscrews (21) and brace (11).

3. INSPECT PARTS FOR DAMAGE. REPLACE AS REQUIRED.

INSTALLATION:

1. INSTALL AIR COMPRESSOR (2).

- a. Position new gasket (14) on front gear cover.
- b. Mount air compressor (2) on studs (9) and retain with washers (8) and lock nuts (7).

2. INSTALL TUBES AND LINES.

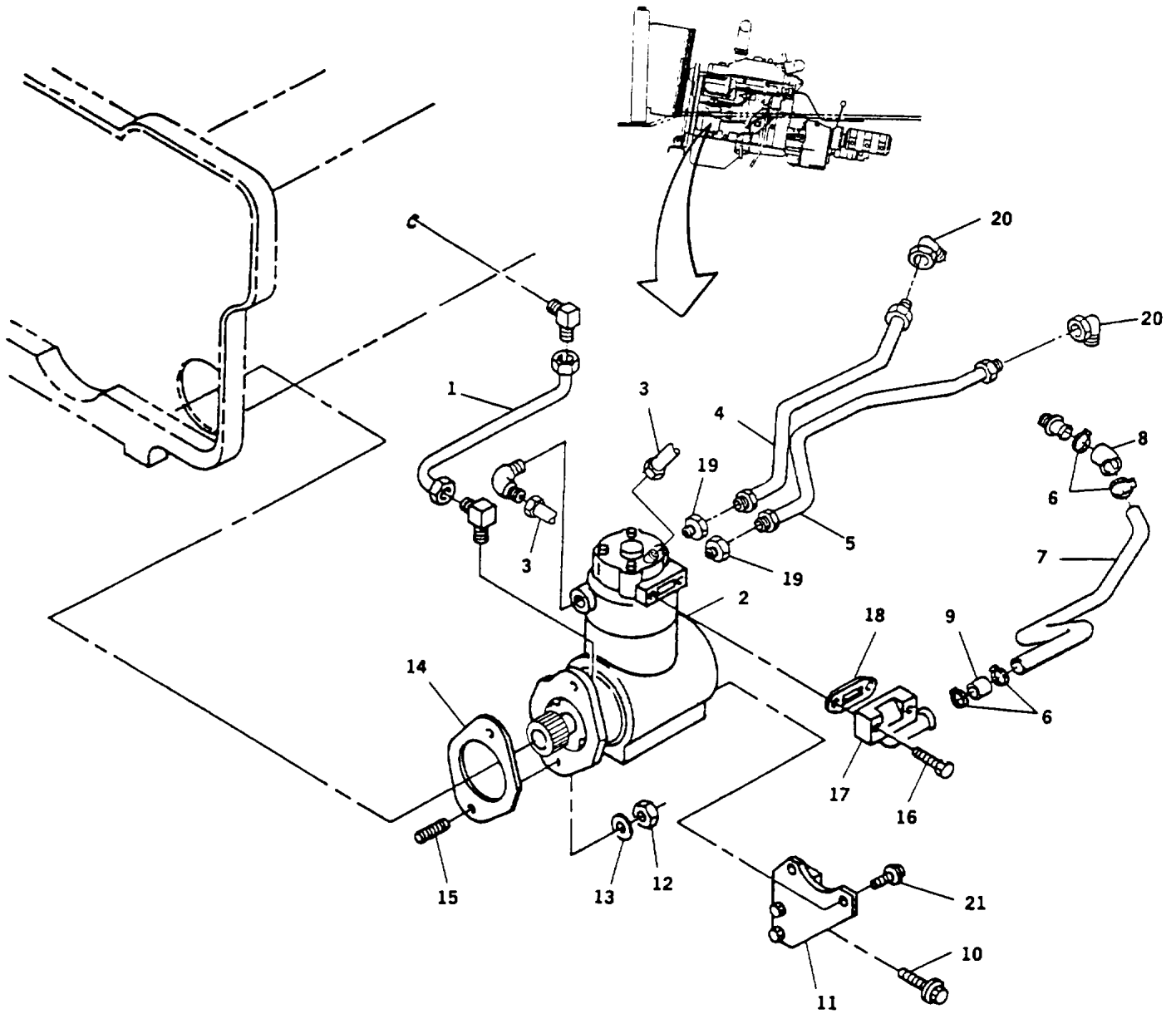
- a. Install fittings (19) and (20), water inlet (4) and water outlet (5) tubes.
- b. Install inlet connector (17) and new gasket (18). Secure with capscrews (16).

- c. Install compressor inlet hose (9), molded hose (8) and inlet tube (7). Secure with clamps (6).
- d. Install oil supply tube (1).
- e. Install air lines (3).

3. SERVICE RADIATOR. (REFER TO TM 5-3810-306-20.)

4. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

END OF TASK



AIR COMPRESSOR ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Seat removal tool (NSN)
 Air compressor seat installation tool (NSN)

SUPPLIES:

Gasket (Item 199, Appendix B)
 Fuel pump gasket (Item 200, Appendix B)
 Retaining ring (Item 201, Appendix B)
 Oil ring (Item 202, Appendix B)
 Piston ring (Item 203, Appendix B)
 Piston ring (Item 204, Appendix B)
 Gasket (Item 205, Appendix B)
 Preformed packing (Item 206, Appendix B)
 Preformed packing (Item 207, Appendix B)
 Preformed packing (Item 208, Appendix B)
 Preformed packing (Item 209, Appendix B)
 Lockwasher (Item 210, Appendix B)
 Gasket (Item 211, Appendix B)
 Solvent P-D-680 (Item 1, Appendix B)
 NEVER-SEEZ compound (Item 24, Appendix B)
 Machinist's bluing

EQUIPMENT CONDITIONS: Air compressor removed from engine. (Refer to page 9-2.)

DISASSEMBLY:**1. DISASSEMBLE UNLOADER VALVE (29).**

- a. Loosen captive washer bolts (27).

WARNING

The unloader valve (29) is spring loaded. Use care when removing valve to avoid personal injury.

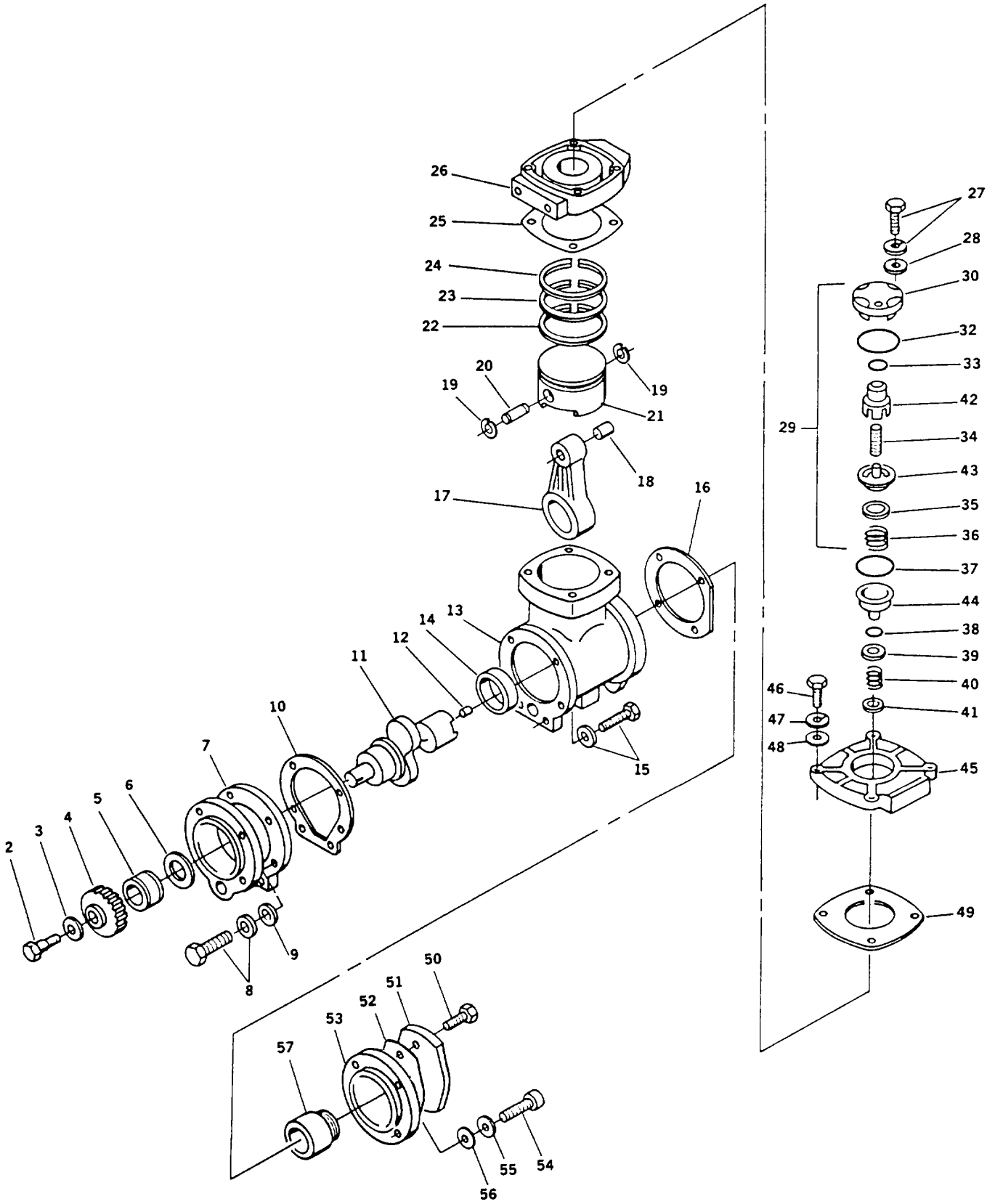
- b. Holding down body (30), remove captive washer bolts (27) and washers (28). Remove body (30).
- c. Remove and discard preformed packings (32) and (33).
- d. Remove cap (42), spring (34) and cover (43).
- e. Remove intake valve (35) and valve spring (36).

2. REMOVE COVER (45) AND HEAD (26).

- a. Remove capscrews (46), lockwashers (47) and washers (48). Remove cover (45) and discard gasket (49).
- b. Remove head (26) and discard gasket (25).

3. REMOVE EXHAUST VALVE (39) AND EXHAUST VALVE SEAT (44).

- a. Using press and seat removal tools, remove exhaust valve seat (44) and packing (37). Discard packing (37).
- b. Remove preformed packing (38), exhaust valve (39), compression spring (40) and wear plate (41). Discard packing (38)



4. REMOVE ADAPTER (53).

- a. Remove two capscrews (50), coverplate (51) and discard gasket (52).
- b. Remove four socket head screws (54), washers (55), lockwashers (56) securing adapter (53). Discard gasket (16).
- c. Using puller, remove splined adapter (57) from crankshaft (11), if required.

5. REMOVE SUPPORT (7).

- a. Remove capscrew (2), washer (3) and using puller, remove drive gear (4).
- b. Remove spacer (5) and thrust bearing (6).
- c. Remove captive washer capscrews (8) and (15), washers (9) and support (7). Discard gasket (10).

6. REMOVE CRANKSHAFT (11).

- a. Rotate crankshaft (11) until piston (21) is approximately 90° before or after top-dead-center. Remove crankshaft (11)
- b. Remove pipe plug (12).

7. REMOVE AND DISASSEMBLE PISTON ASSEMBLY.

- a. Remove piston (21) with connecting rod (17).
- b. Install connecting rod (17) in a soft-jawed vise.
- c. Remove piston ring (24), piston ring (23) and oil ring (22).
- d. Remove retaining rings (19).

CAUTION

Do not drive out piston pin (20). This could damage piston.

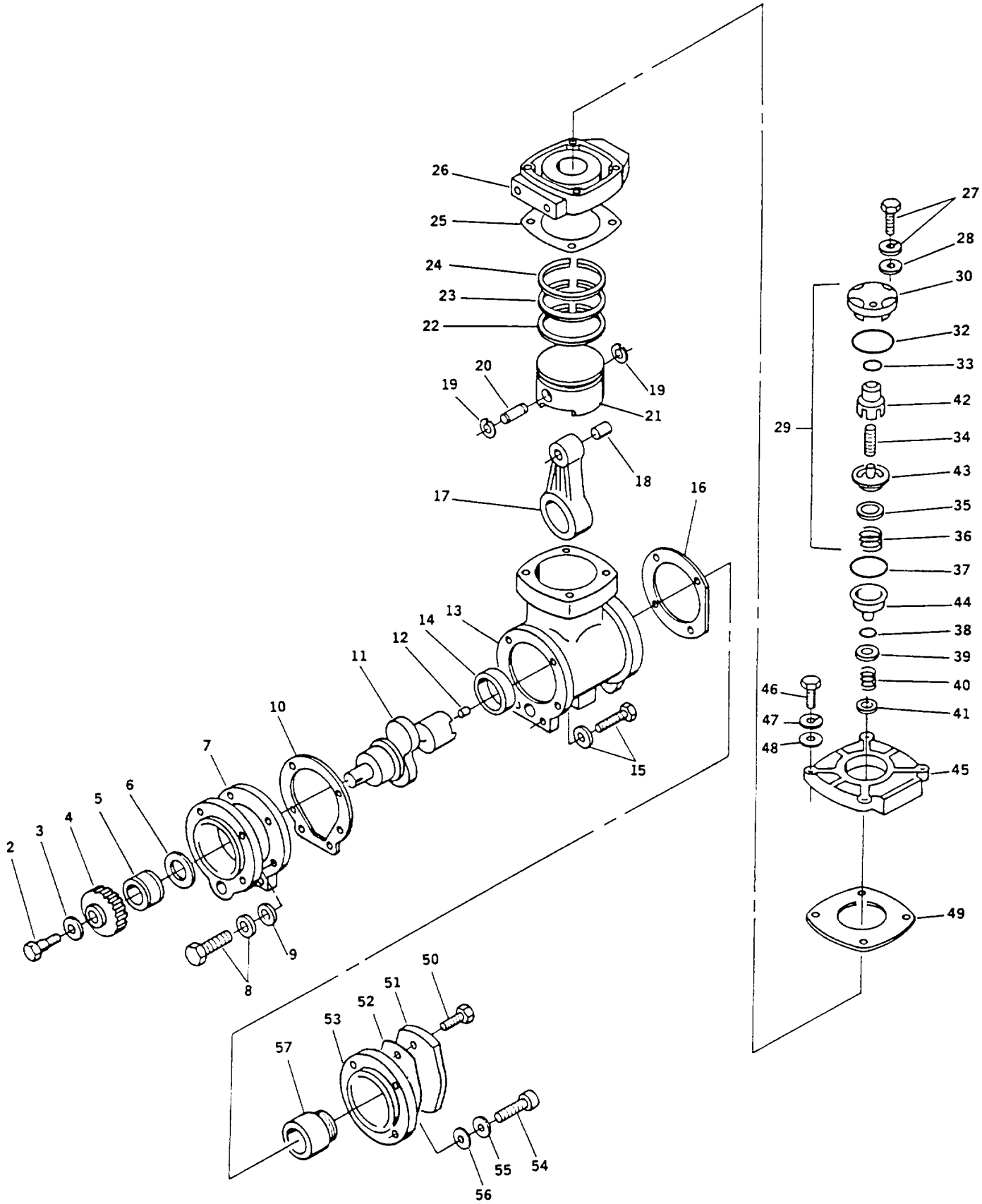
- e. Push out piston pin (20) using finger pressure. If necessary place piston in boiling water for five minutes to expand piston pin bore.
- f. Separate piston (21) and connecting rod (17).

CLEANING:

1. CLEAN AIR COMPRESSOR COMPONENTS.

WARNING

Dry cleaning solvent P-D680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F - 138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately. 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.).



- a. Clean all metal parts with solvent. Use low-pressure compressed air to dry parts.

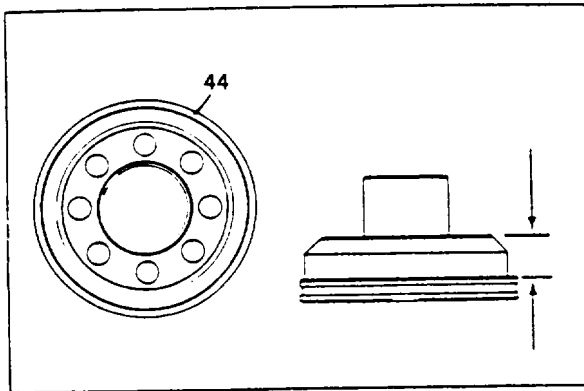
CAUTION

Do not use scraper to remove carbon or scale. Damage to sealing surfaces could result.

INSPECTION:

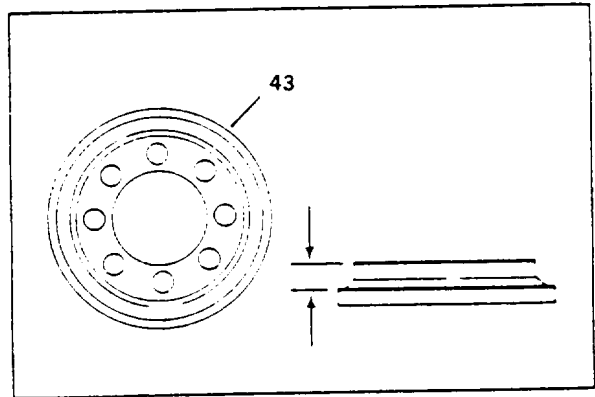
1. INSPECT AIR COMPRESSOR COMPONENTS.

- a. Inspect exhaust valve seat (44). Use bluing to check seating surface. If not 1000 true, replace seat.
- b. Measure exhaust valve seat (44) height as shown. If height is less than 0.485 in. (12.32 mm), replace seat.



- c. Inspect cover (43). Use bluing to check seating surface. If not 100° true, replace seat.

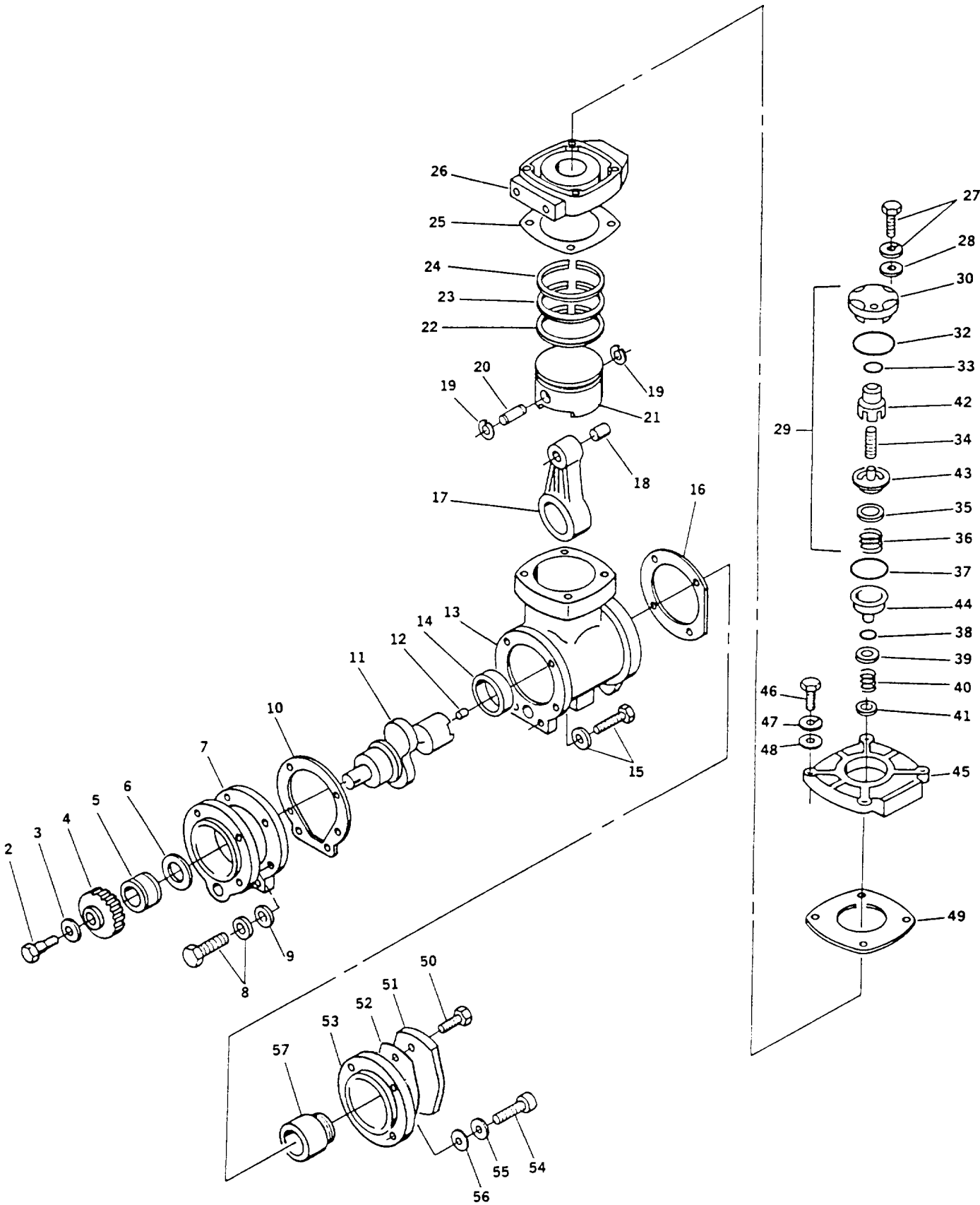
- d. Measure cover (43) height as shown. If height is less than 0.270 in. (6.86 mm), replace cover.



- e. Inspect exhaust valve (39) and intake valve (35) for cracks or damage. Measure valve flatness. Valves must be flat within 0.in. (0.03 mm).
- f. Using spring tester, check springs (34), (36) and (40). Use chart shown.

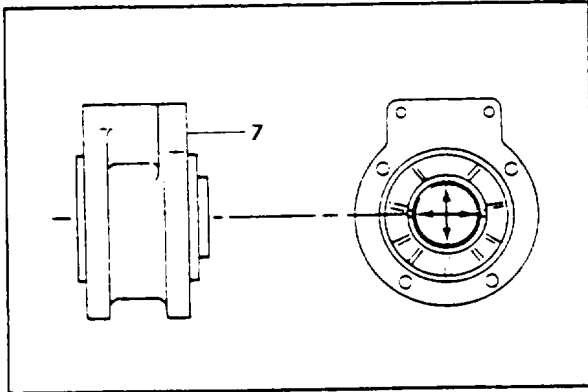
SPRING FORCE (LB.)						
SPRING	FREE LENGTH (IN.)	TEST # COILS	LENGTH (IN.)	NEW (MIN.)	NEW (MAX.)	WORN
34	1.650	10.8	0.980	13.00	17.00	12.00
36	0.500	2.8	0.280	0.65	1.10	0.55
40	0.670	3.0	0.280	8.50	10.40	8.00

- g. Inspect unloader cap (42) for scoring. Replace if damaged.
- h. Inspect thrust bearing (6). Replace if compressed.



- i. Measure inside diameter of support (7).
Use following criteria.

Min = 1.8740 in. (47.600 mm)
Max = 1.8760 in. (47.650 mm)
Worn = 1.8775 in. (47.688 mm)



- j. Inspect connecting rod (17) for damaged bushing (18).
- k. Measure inside diameter of crankshaft end of connecting rod (17). Replace if I.D. exceeds 1.9355 in. (49.263 mm).
- l. Measure inside diameter of piston end of connecting rod (17). Replace if I.D. exceeds 0.6895 in. (17.513 mm).
- m. Measure piston pin (20) outside diameter.
- Min = 0.6875 in. (17.462 mm)
Max = 0.6876 in. (17.465 mm)
Worn = 0.6872 in. (17.455 mm)
- n. Inspect piston (21) for cracks and scoring.
Replace if damaged.

- o. Measure outside diameter of piston (21). Measure 0.250 in. (6.35 mm) above bottom piston skirt at right angle to piston pin bore. Measurement should be

Min = 3.619 in. (91.92 mm)
Max = 3.620 in. (91.95 mm)
Worn = 3.617 in. (91.87 mm)

- p. Using new piston rings (22), (23) and (24) measure ring to groove clearance. Install piston rings (22), (23) and (24).

Piston rings (23) and (24) to groove clearance should be:

Min = 0.002 in. (0.05 mm)
Max = 0.0035 in. (0.089 mm)
Worn = 0.0045 in. (0.114 mm)

Oil ring (22) to groove clearance should be:

Min = 0.0015 in. (0.038 mm)
Max = 0.003 in. (0.08 mm)
Worn = 0.004 in. (0.10 mm)

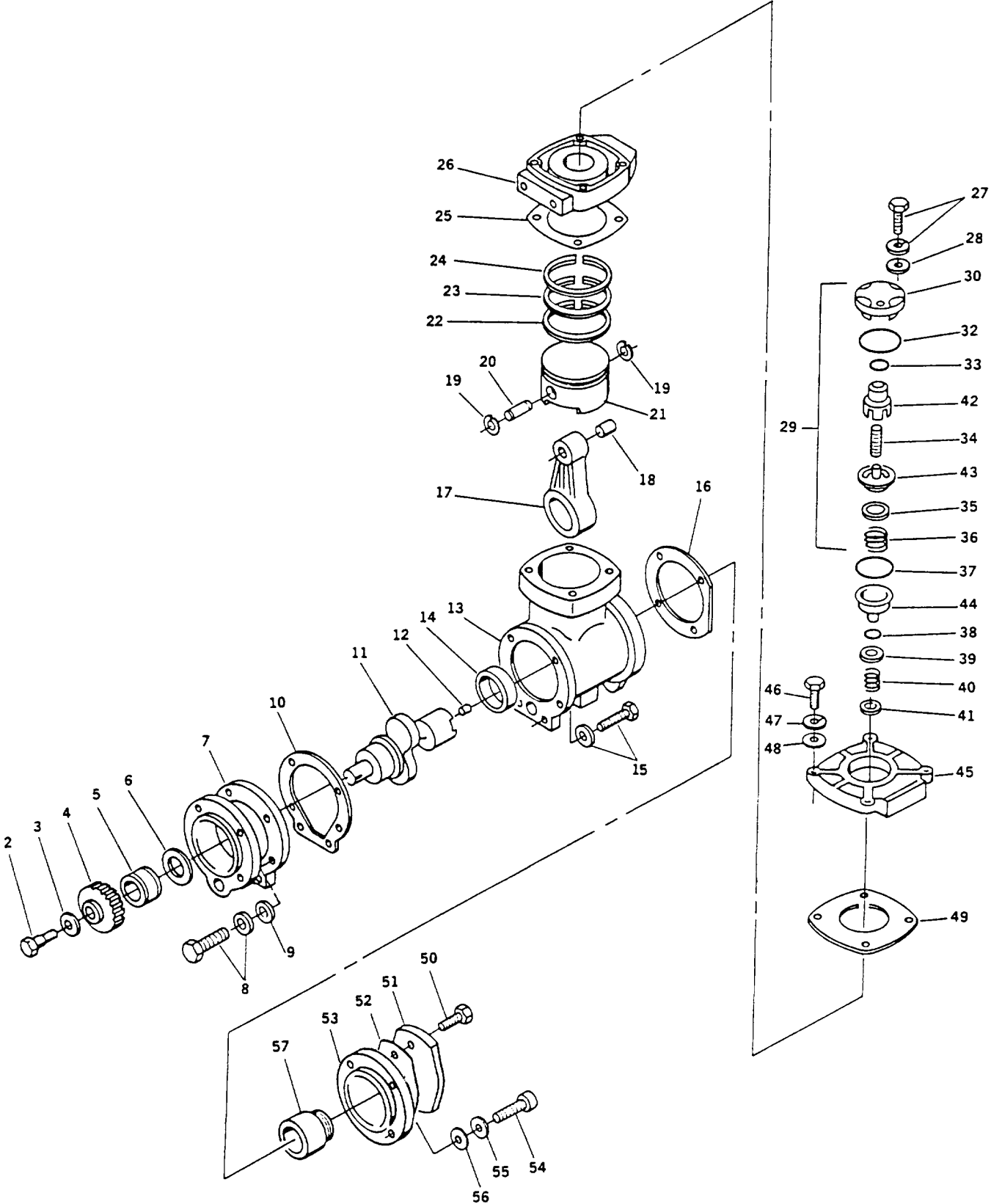
- q. Measure piston pin bore on piston (21).

Min = 0.6880 in. (17.475 mm)
Max = 0.6885 in. (17.488 mm)
Worn = 0.6890 in. (17.501 mm)

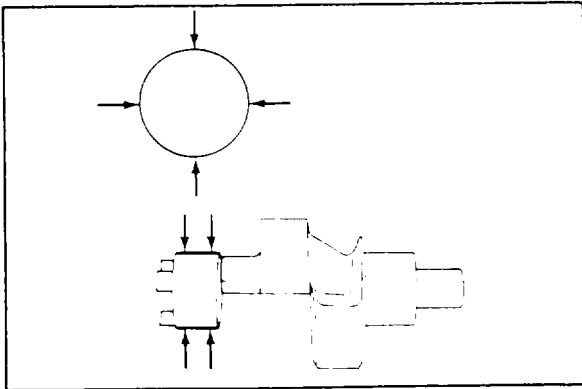
- r. Inspect crankcase (13) for cracks and scoring.

- s. Measure cylinder bore diameter on crankcase (13). Measure bore diameter at 1.0 in. (25.00 mm) below top of crankcase. Maximum out-of-round is 0.0015 in. (0.038 mm). Cylinder bore should be:

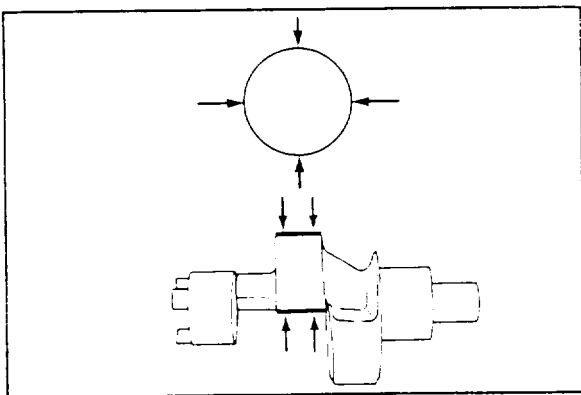
Min = 3.625 in. (92.08 mm)
Max = 3.626 in. (92.10 mm)
Worn = 3.6285 in. (92.164 mm)



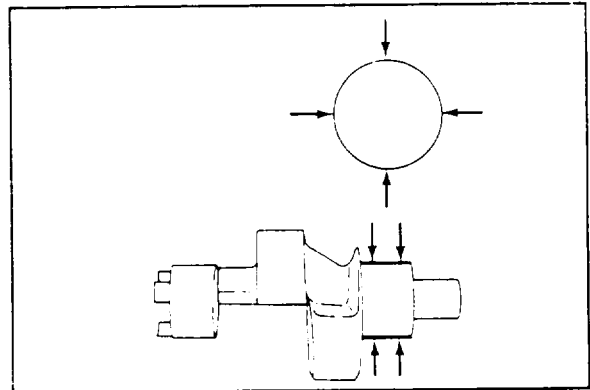
- t. Inspect bushing (14) in crankcase (13). If scored, replace bushing.
- u. Measure inside diameter of bushing (14). Replace if worn larger than 1.8780 in. (47.701 mm). Support crankcase when removing bushing (14). Using clean oil to lubricate bushing bore, press new bushing until flush with bore surface.
- v. Inspect crankshaft (11) for scoring and scratches.
- w. Measure outside diameter of rear coupling journal on crankshaft (11) as shown. Replace if worn beyond 1.872 in. (47.55 mm).



- x. Measure outside diameter of connecting rod journal on crankshaft (11) as shown. Replace if worn beyond 1.9345 in. (49.136 mm).

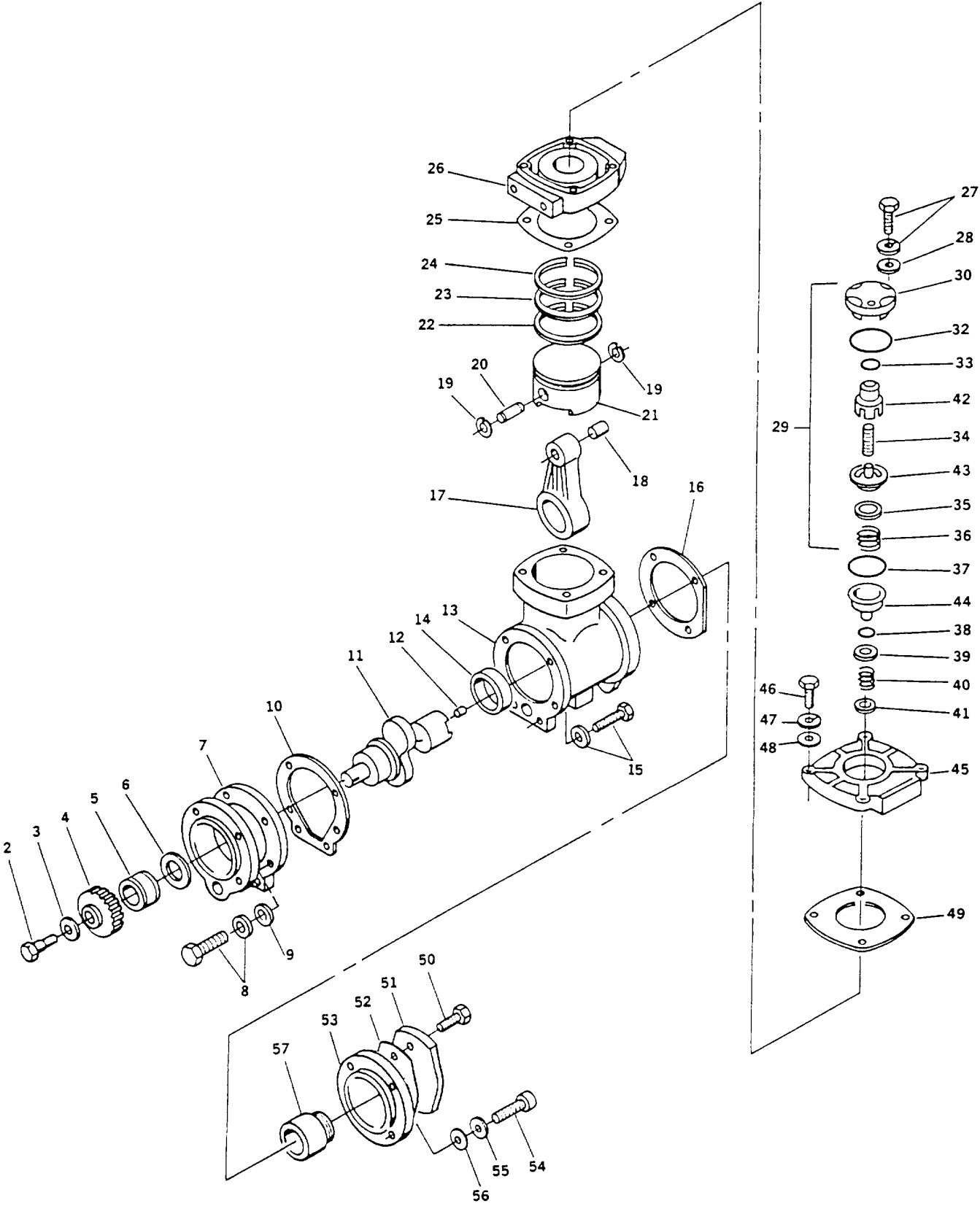


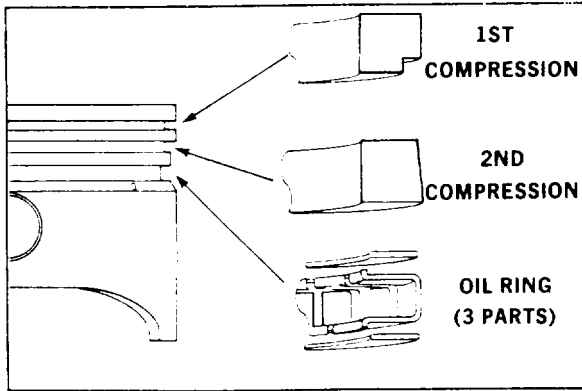
- y. Measure outside diameter of front support journal on crankshaft (11) as shown. Replace if worn beyond 1.872 in. (47.55 mm).



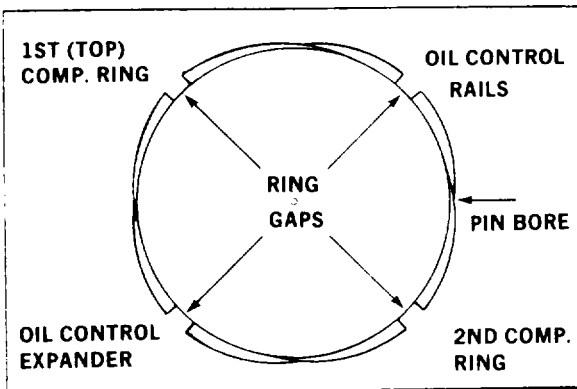
REASSEMBLY:

1. REASSEMBLE PISTON ASSEMBLY.
 - a. Install one retaining ring (19) and lubricate piston pin bore with clean engine oil.
 - b. With connecting rod (17) in soft-jawed vice, position piston (21) and insert piston pin (20). If piston pin cannot be installed by hand, place piston (21) into boiling water for five minutes.
 - c. Install second retaining ring (19).
 - d. If not installed, install oil ring (22), piston ring (23) and piston ring (24). Ensure that piston rings are installed with part number or top side pointed up.





- e. Position piston oil ring and piston ring gaps so that they are not over piston pin bore.

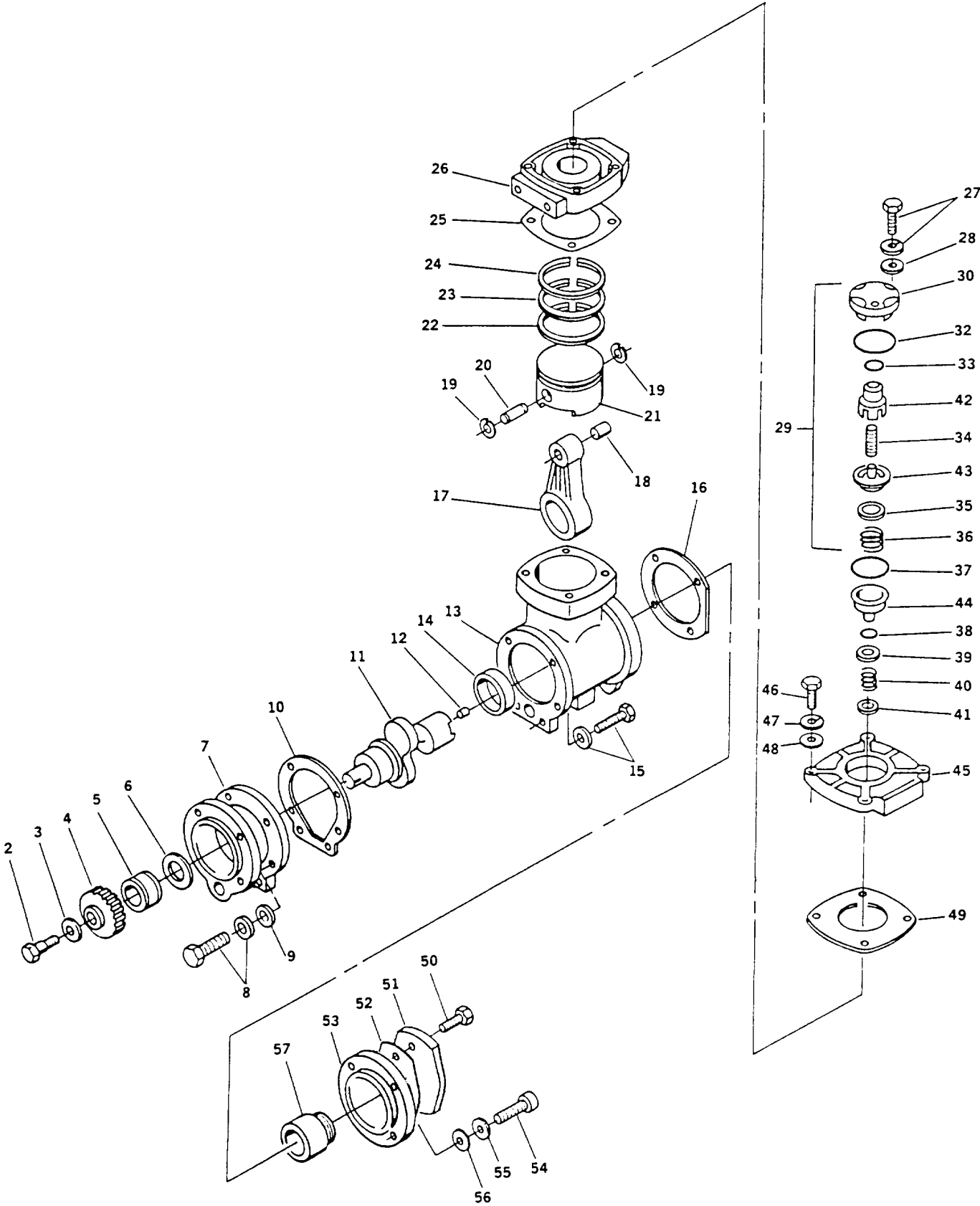


2. INSTALL PISTON (21) AND CONNECTING ROD (17).

- a. Use clean engine oil to lubricate piston rings, compress piston rings and install piston (21) and connecting rod (17).
- b. If removed, install pipe plug (12) and tighten 3-6 ft-lb (4-8 Nm).
- c. If removed, using press, install adapter (57) on crankshaft (11).

3. INSTALL CRANKSHAFT (11) AND SUPPORT (7).

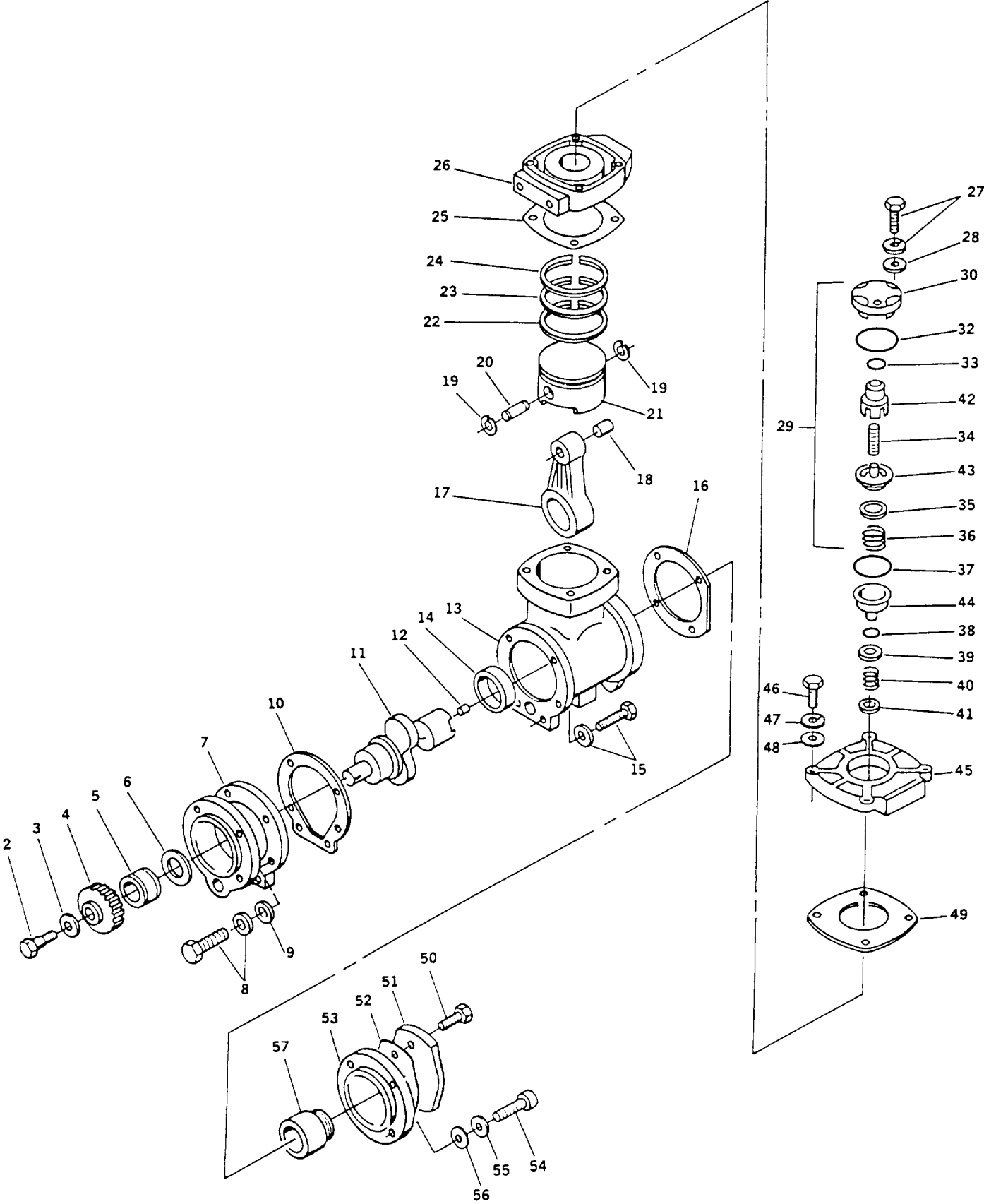
- a. Use clean engine oil to lubricate bore in support (7). Install support (7) over crankshaft.
- b. Use clean engine oil to lubricate thrust bearing (6) and install it with part number side out (or grooved side facing in).
- c. Use clean engine oil to lubricate spacer (5) and gear (4). Install spacer (5) and using press, install gear (4) until spacer contacts thrust bearing. Install capscrew (2) with washer (3). Torque capscrew (2) to 93 ft-lbs (124 Nm).
- d. Measure distance between support (7) and crankshaft (11) mating surfaces. This measurement should be:
 Min = .004 in. (.102 mm)
 Max = .009 in. (.229 mm)
 Worn = .012 in. (.305 mm)
- e. Install new gasket (10) on support (7).
- f. Position piston at 90° before or after top-dead-center and install crankshaft (11) with support (7) into crankcase (13).
- g. Install captive washer capscrews (15).
- h. Install captive washer capscrews (8) and washers (9). Torque capscrews (8) and (15) to 30-35 ft-lbs (41-47 Nm).



4. INSTALL ADAPTER (53).
 - a. Install new gasket (16) and adapter (53). Secure with washers (55), lockwashers (56) and socket head screws (54). Torque screws (54) to 45 ft-lbs (60 Nm).
 - b. Install new gasket (52) and cover plate (51) using screws (50).
5. INSTALL EXHAUST VALVE (39) AND EXHAUST VALVE SEAT.
 - a. Install wear plate (41), valve spring (40), exhaust valve (39) and new preformed packing (38).
 - b. Install new packing (37) on exhaust valve seat (44).
 - c. Using air compressor seat installation tool, install exhaust valve seat (44).
6. INSTALL HEAD (26) AND COVER (45).
 - a. Dip new gasket (25) in clean engine oil and install new gasket (25) and head (26).
 - b. Dip new gasket (49) in clean engine oil and install new gasket (49) and cover (45).
 - c. Install washers (48), lockwashers (47) and capscrews (46). Torque capscrews to final value of 20 ft-lb (27 Nm) in four steps:

Step 1	5 ft-lb (7 Nm)
Step 2	10 ft-lb (14 Nm)
Step 3	15 ft-lb (20 Nm)
Step 4	20 ft-lb (27 Nm)
7. INSTALL UNLOADER VALVE.
 - a. Install valve spring (36) with tang down, intake valve (35), cover (43) with flange side up, spring (34) and cap (42).
 - b. Lubricate outside diameter of cap (42) with NEVER-SEIZE (paste type) compound.
 - c. Install new preformed packing (33) with grooved side up. Lubricate preformed packing (32) with clean engine oil.
 - d. Install new preformed packing (32).
 - e. Install body (30). Press body (30) and ensure that tangs of cap (42) are in three slots of cover (43).
 - f. Holding down body (30), install washers (28), capscrews and washers (27). Torque capscrews to 8-11 ft-lbs (11-15 Nm).
8. INSTALL AIR COMPRESSOR. (REFER TO PAGE 9-2.)
9. TEST FOR PROPER OPERATION.

END OF TASK



Section II. BRAKE MAINTENANCE

BRAKE ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Grease (Item 37, Appendix B)
 Adjusting plunger seal (Item 267, Appendix B)
 Anchor plunger seal (Item 268, Appendix B)

EQUIPMENT CONDITIONS: Outriggers fully extended and lowered.
 (Refer to TM5-3810-306-10.)
 Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)
 Spring brake chambers removed.
 (Refer to TM5-3810-306-20.)
 Planetary wheel end removed. (Refer to page 8-50.)

REMOVAL:

- b. Remove brake shoes (2).

WARNING

Parts of the brake assembly may be coated with asbestos dust; breathing this dust can harm you.

- Use filter mask approved for use against asbestos dust.
- Never use compressed air or dry brush to clean these assemblies.
- Use an industrial type vacuum cleaner with a high efficiency filter system to remove dust.
- Use water and a soft bristle brush or cloth to remove dirt or mud.

- 1. REMOVE BRAKE SHOES.

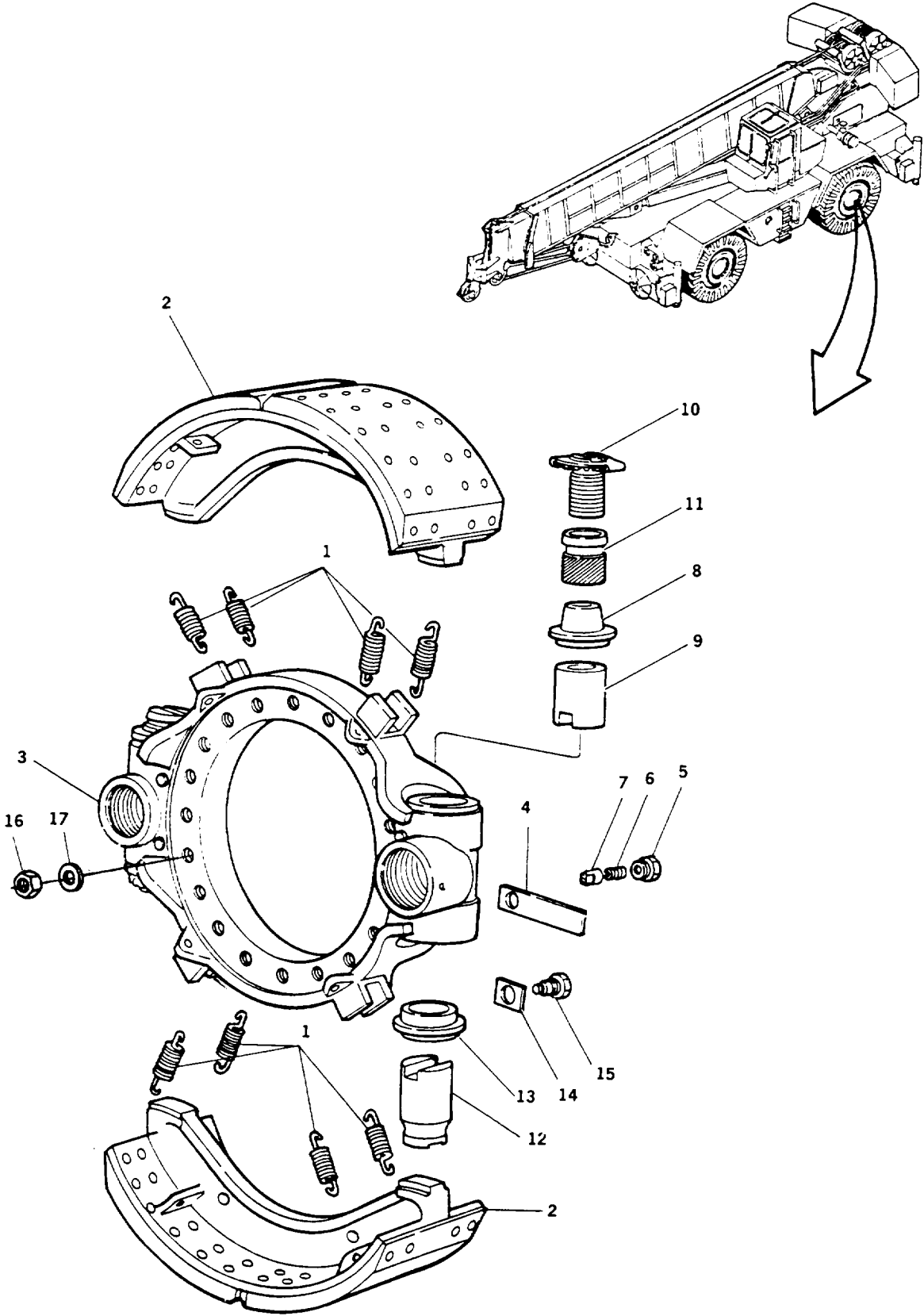
WARNING

Do not use a screwdriver to remove the return springs.

- a. Using brake spring removal tool, remove four springs (1) per shoe (2) from brake spider (3).

DISASSEMBLY:

- 1. DISASSEMBLE ADJUSTABLE PLUNGER (9).
 - a. Bend tabs on instruction tag (4). Remove cap (5), spring (6) and guide (7) from plunger housing.
 - b. Pry plunger seal (8) loose and remove plunger (9) along with plunger seal (8), adjusting bolt (10) and adjusting actuator (11). Discard adjusting plunger seal (8).
 - c. Remove adjusting actuator (11) and adjusting bolt (10) from plunger (9).
 - d. Unthread adjusting bolt (10) from adjusting actuator (11).
 - e. Remove plunger seal (8) from adjusting bolt (10).



2. DISASSEMBLE ANCHOR PLUNGER (12).
 - a. Pry anchor plunger seal (13) loose and remove from anchor plunger (12). Discard anchor plunger seal (13).
 - b. Bend tabs on lock plate (14) and remove guide screw (15).
 - c. Remove anchor plunger (12) from plunger housing.

NOTE

It is not necessary to remove brake spider to service plunger housing. However, if replacement is required, remove brake chamber assemblies and twenty nuts (16) and washers (17) from mounting studs and remove brake spider. Removing brake spider will also allow access to spindle.

CLEANING:

1. CLEAN ALL PARTS IN SUITABLE SOLVENT AND BLOW DRY WITH COMPRESSED AIR.

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If

WARNING (CON'T)

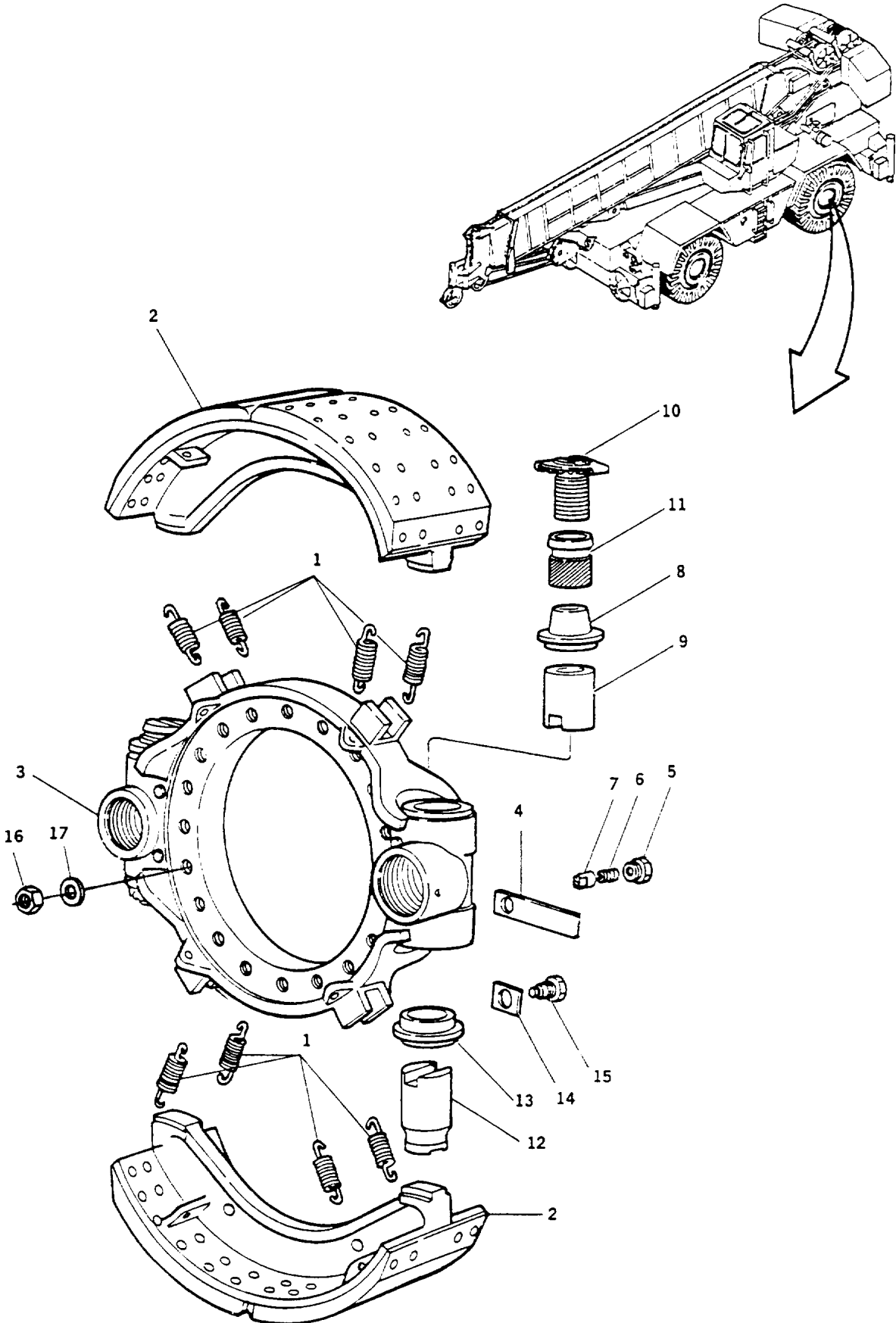
contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

2. WIRE BRUSH PLUNGER PARTS AND ADJUSTING BOLT THREADS TO REMOVE CAKED-ON DIRT AND CORROSION.

INSPECTION:

1. INSPECT ALL PARTS FOR ANY SIGNS OF WEAR OR DAMAGE. REPLACE ANY PART THAT SHOWS WEAR OR DAMAGE.
 - a. Inspect threads in plunger (9) or actuator (11) and on adjusting bolt for wear or damage. Bolt must move freely in and out of plunger. Clean threads or replace parts.
 - b. Inspect the teeth on pawl and actuator. Replace the parts that are worn or damaged.
 - c. Inspect slot in-plunger (9) and (12) that touches wedge assembly. Be sure area is free of nicks, pits, scratches or corrosion. If damaged, replace plunger.
 - d. Inspect brake shoe linings (2) for wear. Each end of brake shoe is chamfered. Brake shoes should be replaced anytime shoes are worn to the point that a chamfer is no longer visible or when thickness of shoe anywhere is less than 0.23 in. (5.84 mm).



- e. Polish bore of plunger housing (3) with crocus cloth. If bore has nicks, scratches or corrosion, replace spider.

INSTALLATION:

1. INSTALL BRAKE SPIDER (3) IF REMOVED. SECURE WITH TWENTY NUTS (16) AND WASHERS (17).
2. INSTALL ANCHOR PLUNGER (12).
 - a. Apply a thin film of grease to a new anchor plunger seal (13).
 - b. Carefully push double lip seal (13) onto anchor plunger (12), stretching outer seal lip over plunger nose end until inner seal lip is completely in second plunger groove and outer seal lip is in first plunger groove.
 - c. Coat entire anchor plunger (12) with grease, packing cavity behind seal.

NOTE

Brake assemblies have one adjusting plunger and one anchor (solid) plunger per plunger housing. Anchor plungers are marked on shoe slot end, R for right hand brakes and L for left hand brakes. DO NOT mix at assembly.

- d. Insert anchor plunger (12) and seal (13) into plunger housing with anchor plunger key-way slot aligned with guide screw hole. Ensure anchor plunger goes all the way into plunger bore and seats at bottom.

NOTE

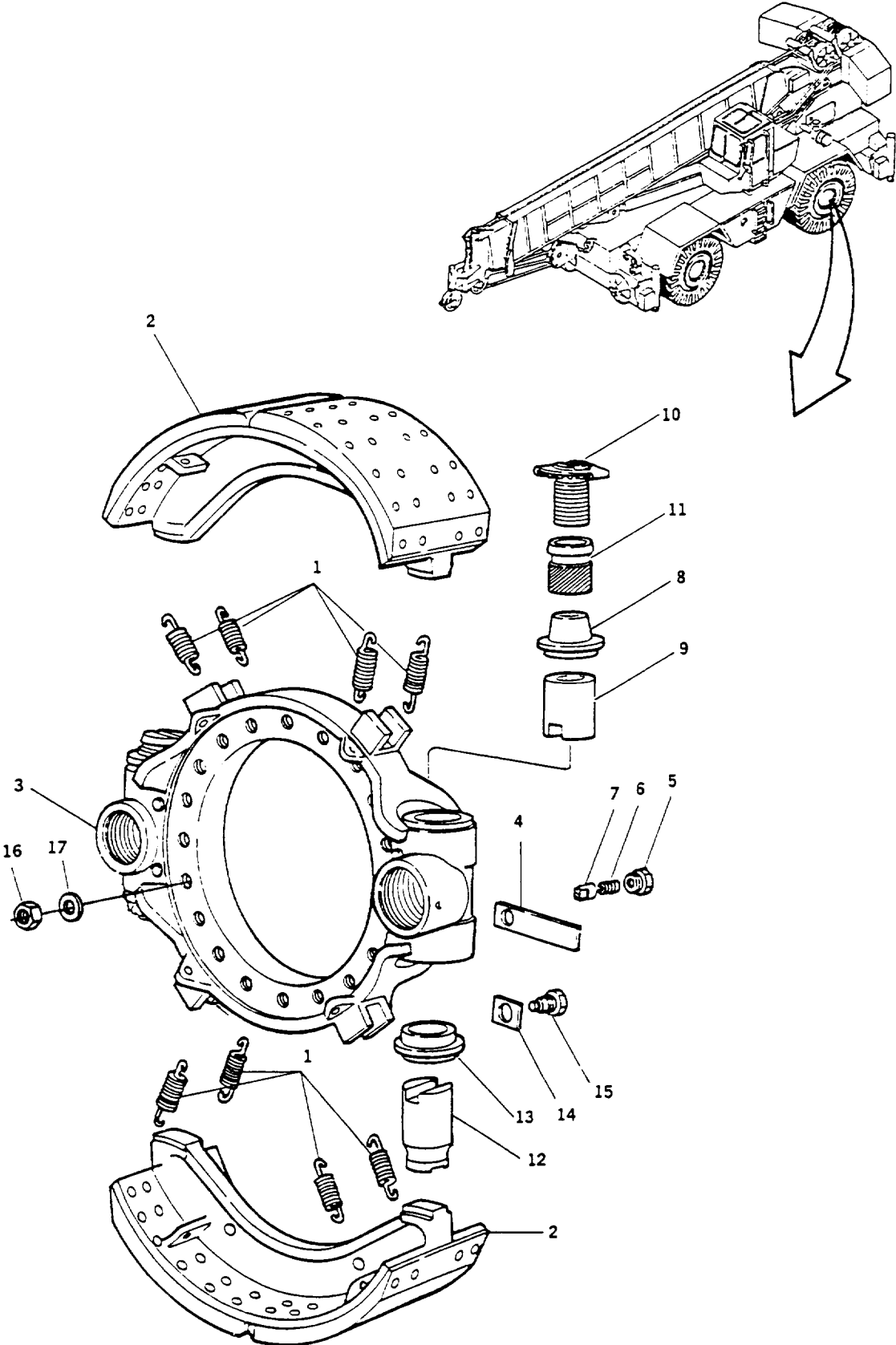
If a seal driver is not available, a 1-3/4 in. socket can be used.

- e. Seat anchor plunger seal (8) into plunger housing with suitable seal driver tool.
 - f. Install lock plate (14) onto guide screw (15). Install guide screw into plunger housing. Ensure end of guide screw enters the anchor plunger key-way slot so that anchor plunger can slide freely in housing bore. Torque guide screw to 15-20 ft-lbs (20-27 Nm). Bend tabs on lock plate to secure nuts.
3. INSTALL ADJUSTABLE PLUNGER.
 - a. Apply a thin coating of grease to inside and outside surfaces of adjusting plunger (9). Place adjusting plunger into bore in plunger housing aligning key-way slot with guide hole.
 - b. Grease a new seal (8) and threads of adjusting bolt (10). Carefully install new seal onto bolt. Grease adjusting actuator (11) and thread it onto bolt.

CAUTION

The adjusting actuator (9) must bottom out on shoulder inside adjusting plunger. If bolt is threaded too far into the adjusting sleeve, bolt will bottom out inside adjusting plunger and the automatic adjuster will not function.

- c. Install actuator (11), adjusting bolt (10), and seal (8) into adjusting plunger (9) already in housing.



- d. Coat guide (7) with grease and install it into plunger housing. Install spring (6), instruction tag (4) and cap (5) into plunger housing. Torque cap to 15-25 ft-lbs (20-33 Nm). Bend tabs on lock plate to secure cap.
- e. Using suitable seal driver tool, seat adjusting bolt seal (8).

CAUTION

Do not reline shoes with combination linings.

- 4. APPLY GREASE TO SHOE REST PADS AND PLUNGERS.
- 5. INSTALT BRAKE SHOES (2).
 - a. Apply grease to tops of plungers, inside of guide plates and bases of shoes where they contact plungers and guide plates.
 - b. Position brake shoes so long radius of shoe web fits into slots on adjacent bolt retainer and web stamped with an arrow stamp points to anchor plunger in a forward wheel rotation.
 - c. Secure brake shoes (2) with springs (1) installed using brake spring pliers.
- 6. INSTALL PLANETARY WHEEL END ASSEMBLY. (REFER TO PAGE 8-50.)
- 7. INSTALL BRAKE CHAMBERS. (REFER TO TM 5-3810-306-20.)
- 8. ADJUST BRAKES.

NOTE

If brakes shoes (2) were not replaced, do steps a. and b. in addition to the following procedure.

WARNING

Elevate both rear wheels when adjusting brakes. If one wheel remains on the ground, the crane may move when the other wheel is turned.

- a. Cage spring brake manually or build up air pressure and release the parking brake.
- b. Using outriggers, raise wheels off ground. (Refer to TM 5-3810-306-10.)

NOTE

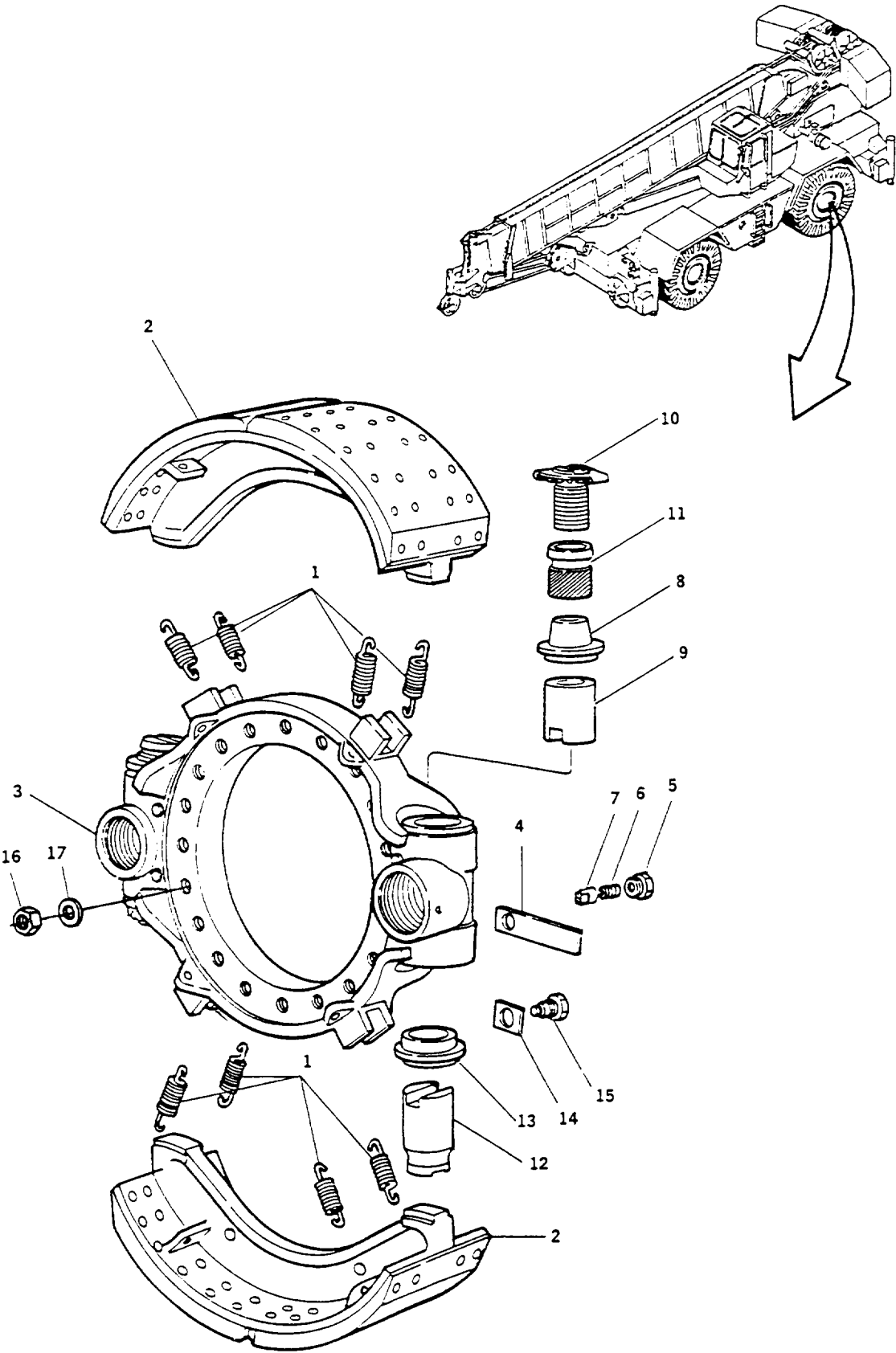
Do not check the clearance at the ends of the linings.

- c. Use feeler gauge to check clearance between center of linings and the drum. The clearance must be 0.020-0.040 in. (0.5-1.0 mm).

CAUTION

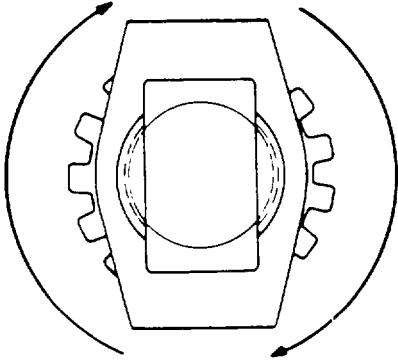
Do not damage the seals (8) and (13) when you adjust the brake. If you damage the seals, replace the damaged seal with a new one.

- d. Work on one brake shoe at a time. Use an adjusting spoon or a screwdriver to turn star wheel on the adjuster (10) in direction shown to move the linings against the drum. Turn adjuster (10) until you feel a heavy drag on the drum when you rotate wheel.



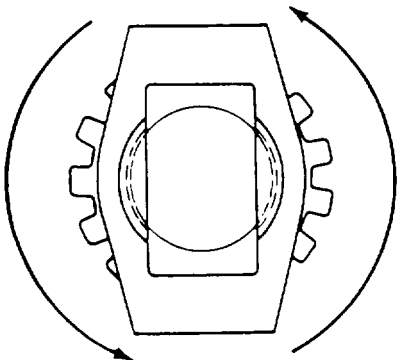
- e. Turn the star wheel in direction shown until you feel a very light drag on drum when you turn wheel. Turning the star wheel in this direction moves linings away from the drum.

TURN STAR WHEEL IN THIS DIRECTION TO MOVE LININGS AWAY FROM DRUM



TOP VIEW OF STAR WHEEL

TURN STAR WHEEL IN THIS DIRECTION TO MOVE LININGS AGAINST THE DRUM



TOP VIEW OF STAR WHEEL

- f. Use a feeler gauge to check clearance between center of lining and drum. The clearance must be 0.020-0.040 in. (0.5-1.0 mm). Continue to adjust clearance until correct.
- g. Repeat the above procedure for each brake shoe on the brake.
- 9. UNCAGE BRAKE CHAMBERS. (REFER TO TM 5-3810-306-20.)

END OF TASK

CHAPTER 10
STEERING SYSTEM

CHAPTER INDEX

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	Steering Control Valve Installation	10-2
	Steering Control Valve Assembly	10-4
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	Steer Cylinder Assembly	10-9

Section I. STEERING CONTROL VALVE ASSEMBLY MAINTENANCE

STEERING CONTROL VALVE INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Clean rags (Item 2, Appendix B)
 Lockwashers (Item 26, Appendix B) (4 required)
 Hydraulic oil (Item 8, Appendix B)
 Loctite #545 (Item 18, Appendix B)
 Preformed packing (Item 118, Appendix B) (4 Required)
 Preformed packing (Item 107, Appendix B) (2 Required)
 Preformed packing (Item 106, Appendix B) (2 Required)

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)
 Cover at front of cab removed. (Refer to TM 5-3810-306-20.)
 Right and left front consoles removed. (Refer to TM 5-3810-306-20.)

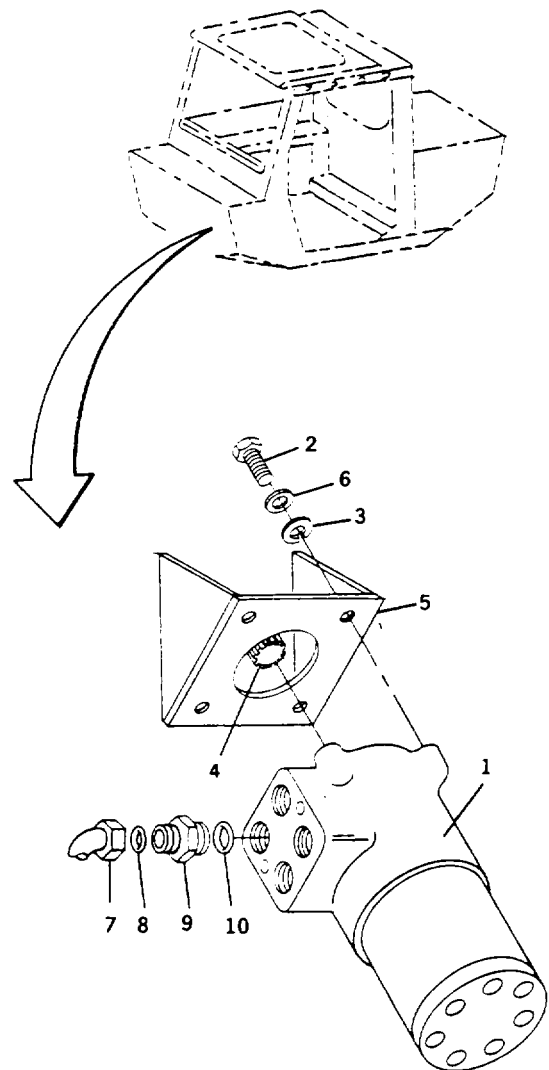
REMOVAL:

1. TAG AND DISCONNECT HYDRAULIC HOSES.
 - a. Thoroughly clean steering control valve and surrounding area of all dirt and contamination before disconnecting hydraulic hoses from valve (1).

NOTE

It may be necessary to disconnect automatic control lever lock out linkage to access all hydraulic hoses.

- b. Tag and disconnect four hydraulic hoses (7) from steering control valve (1). Cap or plug each hose. Remove and discard packings (8).
- c. Remove fittings (9) and preformed packings (10) from ports and retain for installation. Cap or plug ports. Discard packings (10).



2. REMOVE STEERING CONTROL VALVE (1).
 - a. Working through front console in cab, remove four bolts (2), washers (6) and lockwashers (3) securing valve (1) to bracket (5) and steering column.
 - b. Remove control valve (1) leaving steering column (4) in cab.
3. INSPECT ALL PARTS FOR DAMAGE. REPLACE AS REQUIRED.

INSTALLATION:

1. INSTALL STEERING CONTROL VALVE (1).
 - a. Position control valve (1) to bracket (5) and steering column and install four lockwashers (3), washers (6) and bolts (2).

NOTE

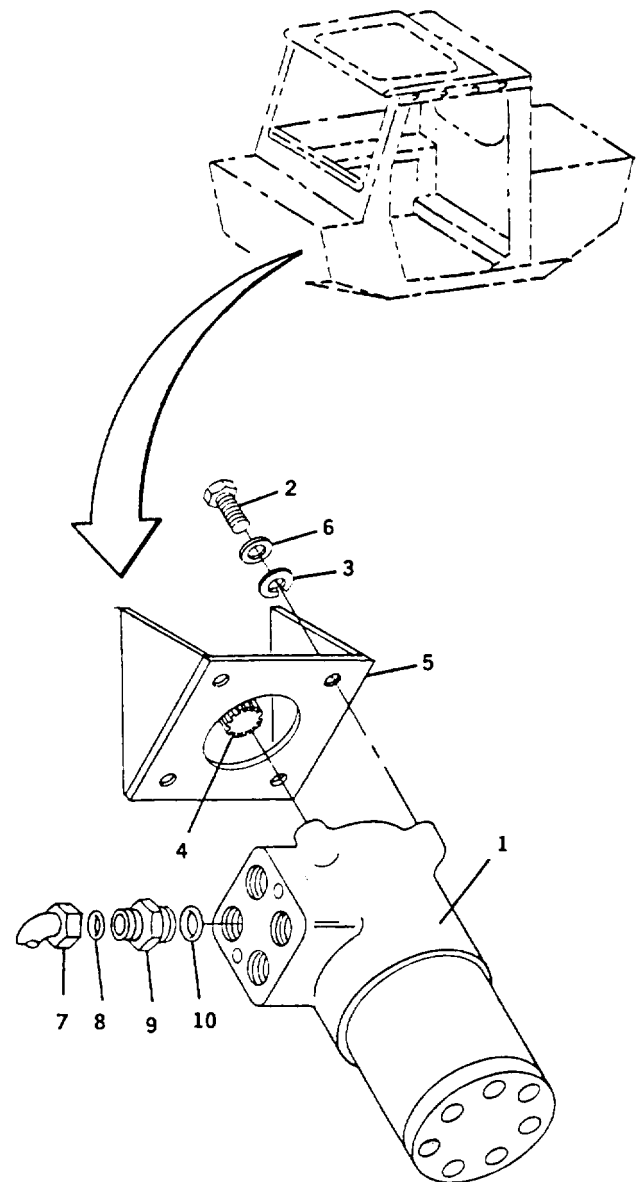
Use new preformed packing when installing hoses and fittings. Coat preformed packings with clean hydraulic oil and threads with Loctite #545.

2. REMOVE TAGS AND INSTALL HYDRAULIC HOSES TO STEERING CONTROL VALVE (1).
 - a. Install fittings in ports.
 - b. Connect four hydraulic hoses to control valve (1) as tagged during removal.

NOTE

Connect lock out control linkage if required.

3. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER to TM 5-3810-306-20.)
4. TEST STEERING CONTROL VALVE FOR PROPER OPERATION.



- a. Prior to securing cover to front of crane cab, start engine and check for proper operation and any leaks.
5. INSTALL CAB FRONT COVER. (REFER to TM 5-3810-306-20.)
6. INSTALL RIGHT AND LEFT FRONT CONSOLES. (REFER TO TM 5-3810-306-20.)

END OF TASK

STEERING CONTROL VALVE ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Lubrication Service, Unit Trailer Mounted (4930-00-017-9167)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1
 (4910-00-754-0706)
 Shop Equipment Auto-Maintenance and Repair; Common No. 2 (4910-00-754-0653)
 Spring installation tool (NSN)

SUPPLIES: Packing Assortment (Item 161, Appendix B)
 Retaining Ring (Item 160, Appendix B)
 Machine screw, 1/8-24 x 1-1/2 in. (Item 159, Appendix B)
 Petroleum Jelly (Item 158, Appendix B)

EQUIPMENT CONDITIONS: Steering control valve assembly removed. (Refer to page 10-2.)

DISASSEMBLY:

1. CLEAN ALL SURFACE CONTAMINATION FROM VALVE ASSEMBLY PRIOR TO DISASSEMBLY.

2. DISASSEMBLE GEROTOR END.

- a. Remove seven capscrews (27), end cap (26) and packing (21). Discard packing (21).
- b. Remove gerotor (24) and packing (21). Discard packing (21).
- c. Remove drive spacer(s) (25).
- d. Remove drive (23), spacer plate (22) and packing (21). Discard packing (21).

3. DISASSEMBLE CONTROL END.

- a. Remove retaining ring (4).
- b. Rotate spool (18) until pin (19) is horizontal. Push spool (18) forward until seal gland bushing (5) is free of housing (16). Remove bushing (5).
- c. Remove oil seal (3) and quad ring (7) from bushing (5). Discard seal (3).

- d. Remove needle bearing set (8).
- e. Remove sleeve (17) and spool (18) from housing (16).

CAUTION

Do not bind the spool and sleeve in the housing. Rotate the spool and sleeve assembly slowly when removing it from the housing.

- f. Remove pin (19) from spool (18) and sleeve (17).

4. REMOVE SIX CENTERING SPRINGS (20) FROM SPOOL (18) AND SLEEVE (17).

- a. Push spool (18) partially from sleeve (17) and remove six centering springs (20).
- b. Remove spool (18) from sleeve (17) while rotating slowly.

5. REMOVE AND DISCARD SEAL (6) FROM HOUSING (16).

6. REMOVE CHECK BALL (13) AND SEAT (11).

- a. Remove setscrew (9) from housing (16).
- b. Screw 1/8" -24 machine screw into end of check ball seat (11). Pull screw and seat (11) out with pliers.
- c. Remove and discard seals (10) and (12) from seat (11).
- d. Tip housing (16) and remove check ball (13) and check ball retainer (14).

WARNING (CONT'D)

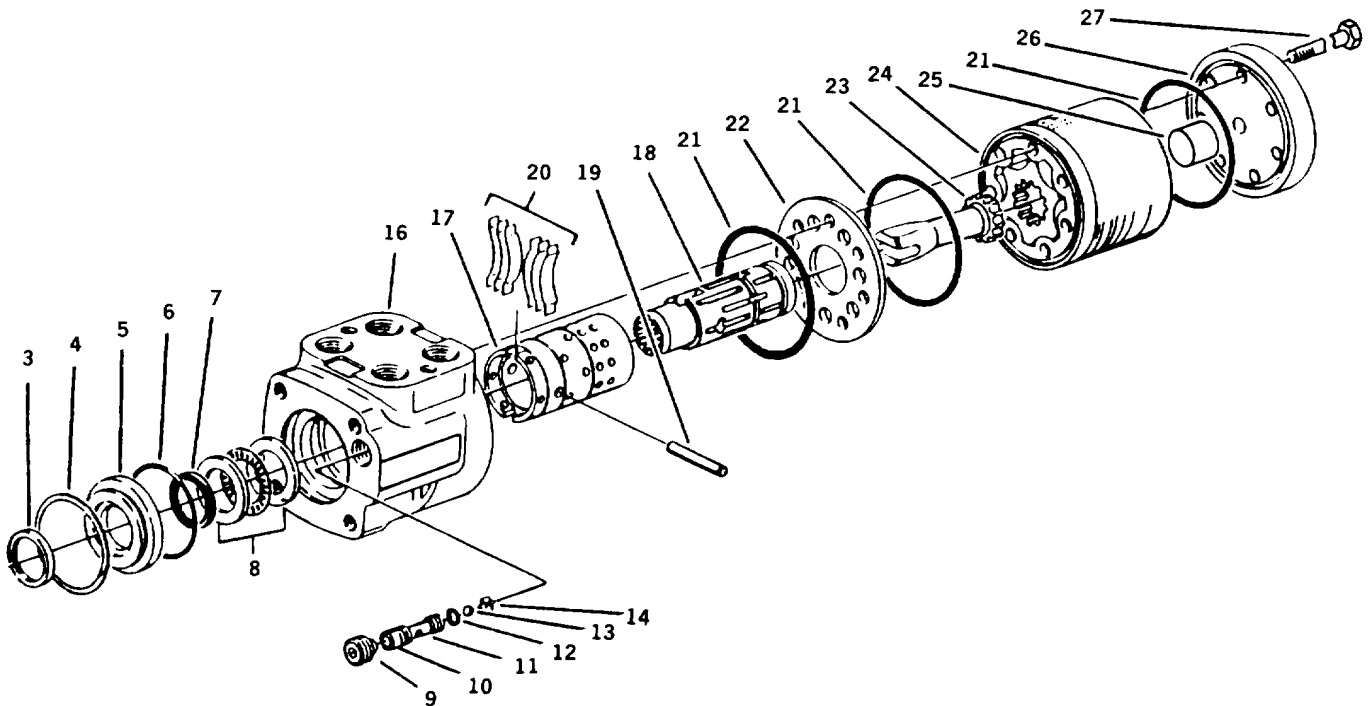
flash point is 100°F-138°F (38°-59° C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately. Dry parts with compressed air. Do not wipe dry with cloth or paper towel because lint or other matter can get into hydraulic system and cause damage. 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.).

CLEANING:

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The

1. CLEAN ALL PARTS WITH SOLVENT P-D-680 AND BLOW DRY WITH COMPRESSED AIR.



INSPECTION:

1. INSPECT ALL PARTS AND REPLACE AS NECESSARY.
 - a. Inspect parts for scratches and burrs. Minor scratches may be removed with fine crocus cloth. Do not use coarse grit or grind.
 - b. Inspect all mating surfaces.

REASSEMBLY:

NOTE

Lubricate all seals (with the exception of the quad ring seal) with a petroleum jelly, such as Vaseline. Do not use excessive lubricant on the seals for the gerotor section.

1. INSTALL CHECK BALL (13) AND SEAT (11).
 - a. Insert check ball retainer (14) into housing using needle nose pliers. Ensure retainer sits flat.
 - b. Install check ball (13).
 - c. Lubricate and install new seals (10) and (12) onto check ball seat (11). Install check ball seat (11) in housing (16).
 - d. Install setscrew (9). Torque to 100 in.-lbs (11 Nm). Ensure top of setscrew is below mating surface to avoid interference upon installation.

2. ASSEMBLY AND INSTALL SPOOL (18), SLEEVE (17) AND SPRINGS (20).
 - a. Install spool (18) into sleeve (17). Ensure spool (18) moves freely. Rotate spool (18) so spring slots are aligned.

NOTE

Some spool and sleeve sets have identification marks, aligning these marks will line up spring slots.

- b. Bring spring slots of both parts in line and stand parts on end of bench. Insert spring installation tool through spring slots of both parts. Position three pairs of centering springs (20) (two sets of three each) on bench so extended edge is down and arched center section is together. In this position, enter one end of entire spring set into spring installation tool.
- c. Compress the extended end of centering spring set and push it into spool sleeve assembly, withdrawing installation tool at same time.
- d. Center spring set in parts so they push down evenly and are flush with upper surface of the spool and sleeve.
- e. Install pin (19) through spool (18) and sleeve (17) until ends are flush with both sides of sleeve.
- f. Install spool and sleeve assembly into housing (16).

CAUTION

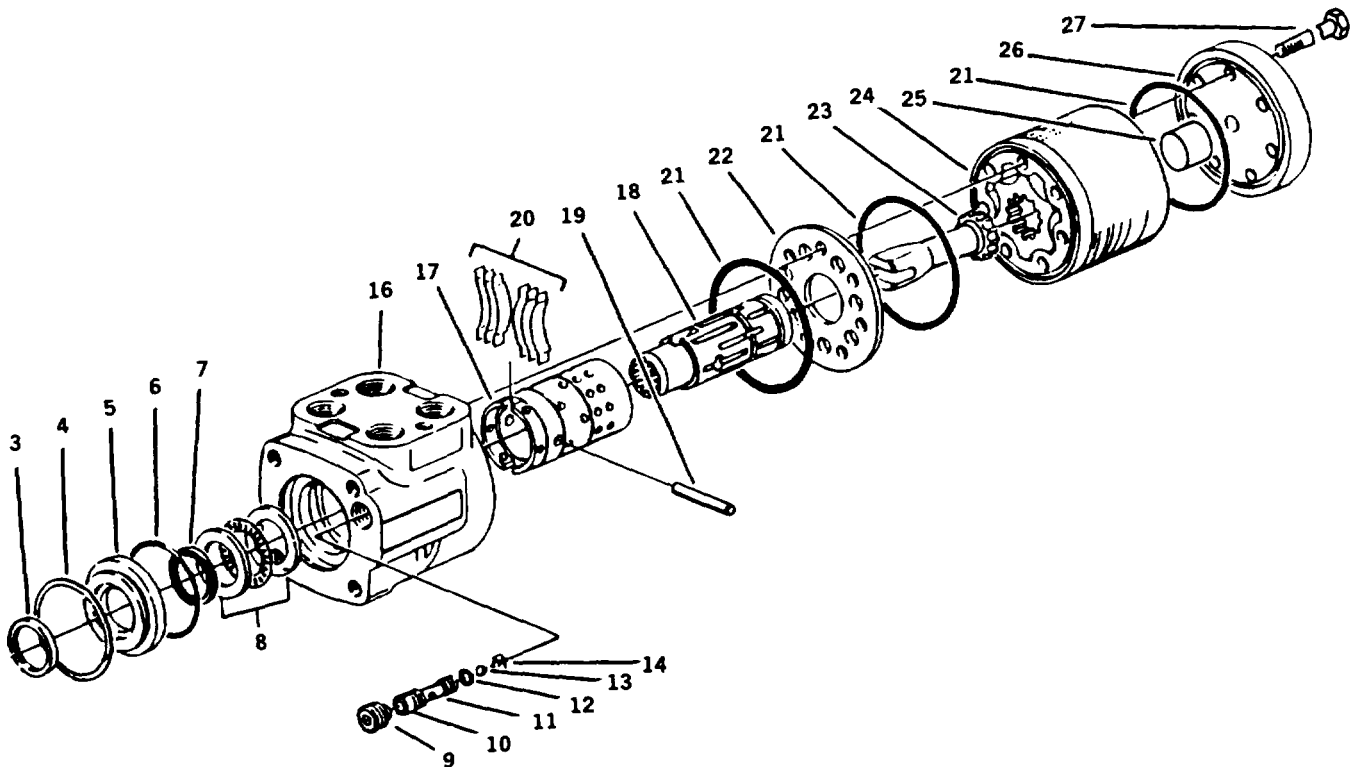
Be extremely careful that parts do not tilt out of position while entering. Push parts gently into place with a slight rotating action. Keep the pin (19) nearly horizontal. Bring spool assembly entirely within housing (16) bore until parts are flush at meter end or fourteen hole end of housing. Do not pull spool assembly beyond this point to prevent the cross pin from dropping into discharge groove of housing. With spool assembly in this flush position, check for free rotation within housing by turning with light fingertip force at splined end.

3. REASSEMBLE CONTROL END.

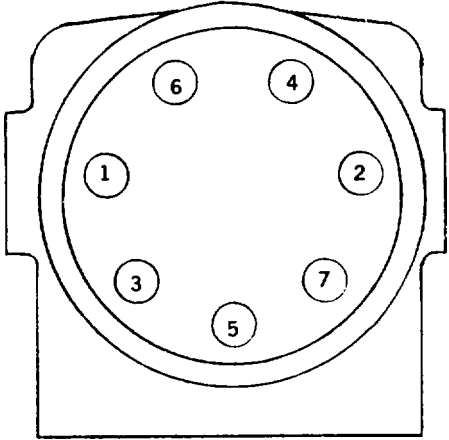
- a. Install new seal (6) into housing (16).
- b. Lubricate and install needle bearing set (8) on spool (18) in housing (16).
- c. Install new oil seal (3) into bushing (5). Flat or smooth side of oil seal (3) must face in towards bushing (5).
- d. Install quad ring (7) in bushing (5). Install bushing over spool end until seated on bearing (8).
- e. Secure assembled part with retaining ring (4).

4. REASSEMBLE GEROTOR END.

- a. Install new packing (21) and spacer plate (22). Align holes in spacer plate (22) with those in housing (16).

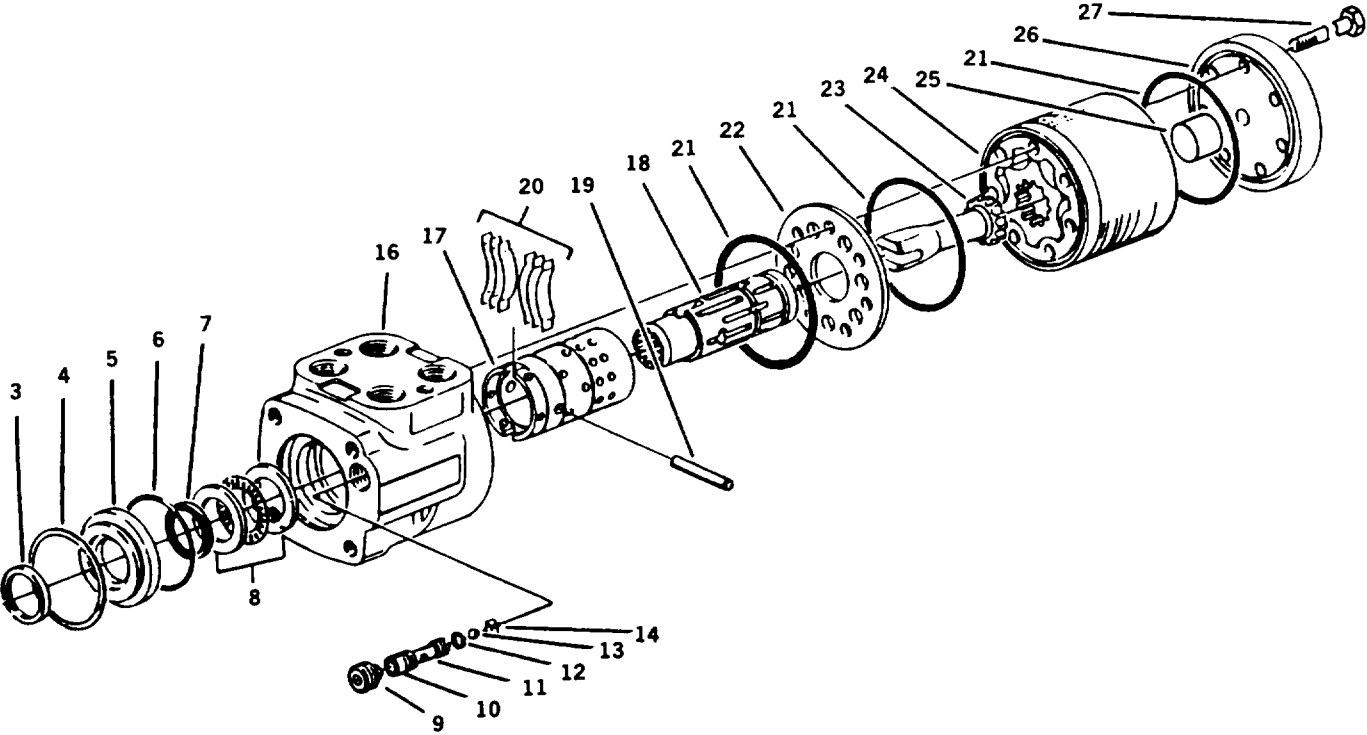


- b. Ensure pin (19) is parallel with port face and install drive (23) until fully seated against pin (19).
- c. Install new packing (21) and gerotor (24) on housing (16).
- d. Install spacer(s) (25).
- e. Install new packing (21) and end cap (26). Secure with seven capscrews (27).
- f. Pre-tighten capscrews (27) to 150 in.-lbs (17 Nm) then torque screws to 275 in.-lbs (30 Nm) in sequence shown.



5. INSTALL STEERING CONTROL VALVE. (REFER TO PAGE 10-2.)

END OF TASK



Section II. HYDRAULIC STEERING CYLINDER MAINTENANCE

STEER CYLINDER ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1 (4910-00-754-0706)
Tool Outfit Hyd System, Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784)

SUPPLIES: Parts kit (Item 266, Appendix B)
Loctite # 271 (Item 23, Appendix B)
Hydraulic oil (Item 8, Appendix B)
Solvent (Item 1, Appendix B)
NEVER-SEEZ (Item 24, Appendix B)

EQUIPMENT CONDITIONS: Steer cylinder assembly removed. (Refer to TM 5-3810-306-20.)

DISASSEMBLY:

NOTE

Any maintenance requiring disassembly of the cylinder should include replacement of all cylinder seals.

- 1. REMOVE CYLINDER ROD ASSEMBLY (3), SEALS AND PISTON (7).

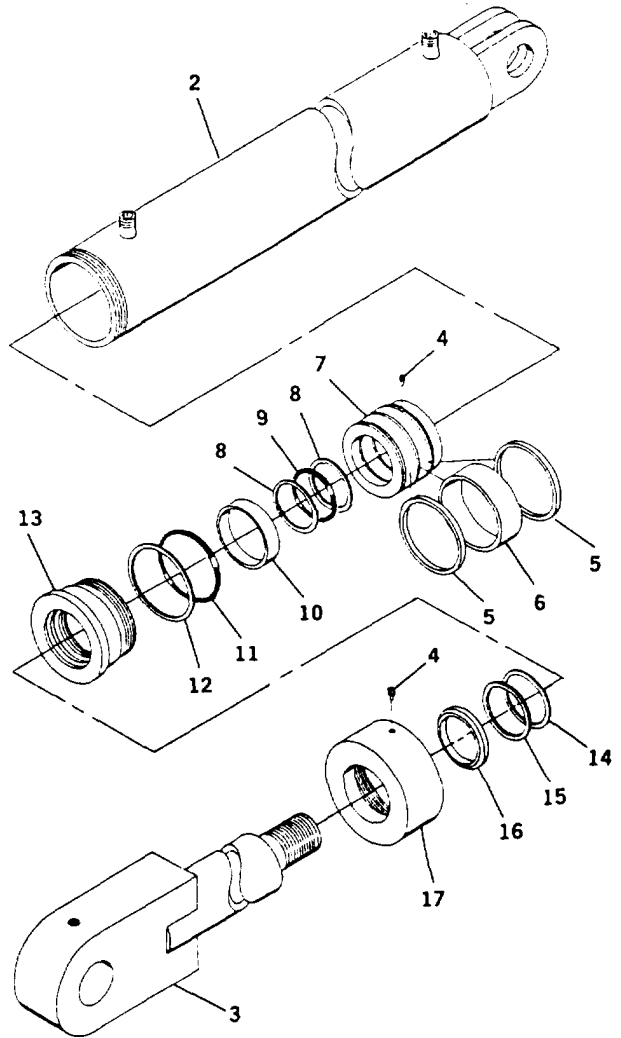
 - a. Loosen and remove setscrew (4) that attaches lock ring (17) to rod end of barrel (2).

WARNING

Do not use air pressure to remove cylinder rod assembly. Use only a source of controlled hydraulic oil pressure if rod assembly is hard to remove.

CAUTION

Exercise extreme care when handling or setting down cylinder rod.



CAUTION

When removing seals and rings, avoid scratching grooved and gland surfaces.

- b. Remove rod (3) with components, from barrel (2) and place rod assembly on a clean workbench for disassembly. Cover barrel opening.

NOTE

Aligning discarded seals and rings in order of disassembly will facilitate installation of new items.

- c. Remove and discard seal (6) and rings (5) from outside of piston (7).
 - d. Loosen and remove setscrew (4) from rod (3).
 - e. Unscrew piston (7) from rod (3).
 - f. Remove and discard two backup rings (8) and packing (9) from inside of piston (7).
2. REMOVE HEAD (13) AND SEALS FROM ROD (18).
- a. Slide head (13) from rod (3).
 - b. Remove and discard wear ring (10), buffer seal (14) and rod seal (15) from inside of head (13).
 - c. Remove and discard packing (11) and back-up ring (12) from outside of head (13).
3. SIDE LOCK RING (17) FROM ROD (3). REMOVE AND DISCARD WIPER SEAL (16) FROM LOCK RING.

CLEANING AND INSPECTION:**WARNING**

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

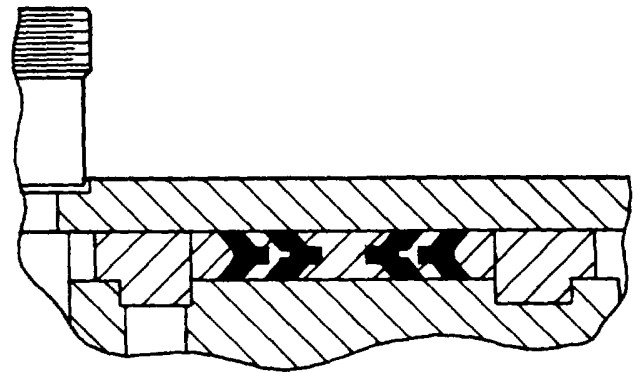
Compressed air used for cleaning purposes will not exceed 30 psi. Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).

- 1. CLEAN ALL PARTS WITH SOLVENT AND DRY WITH COMPRESSED AIR. INSPECT ALL PARTS FOR SERVICEABILITY.

CAUTION

Before installing new seals and rings, clean all surfaces and carefully remove burrs and nicks. Parts displaying excessive wear or damage should be replaced.

2. STONE OUT MINOR BLEMISHES AND POLISH WITH A FINE CROCUS CLOTH.
3. CLEAN WITH SOLVENT AND DRY WITH COMPRESSED AIR ANY PARTS THAT HAVE BEEN STONED AND POLISHED.
4. INSPECT BARREL CAREFULLY FOR SCORING.



REASSEMBLY:

WARNING

When installing new seals and rings, avoid stretching seals or scratching grooved or gland surfaces.

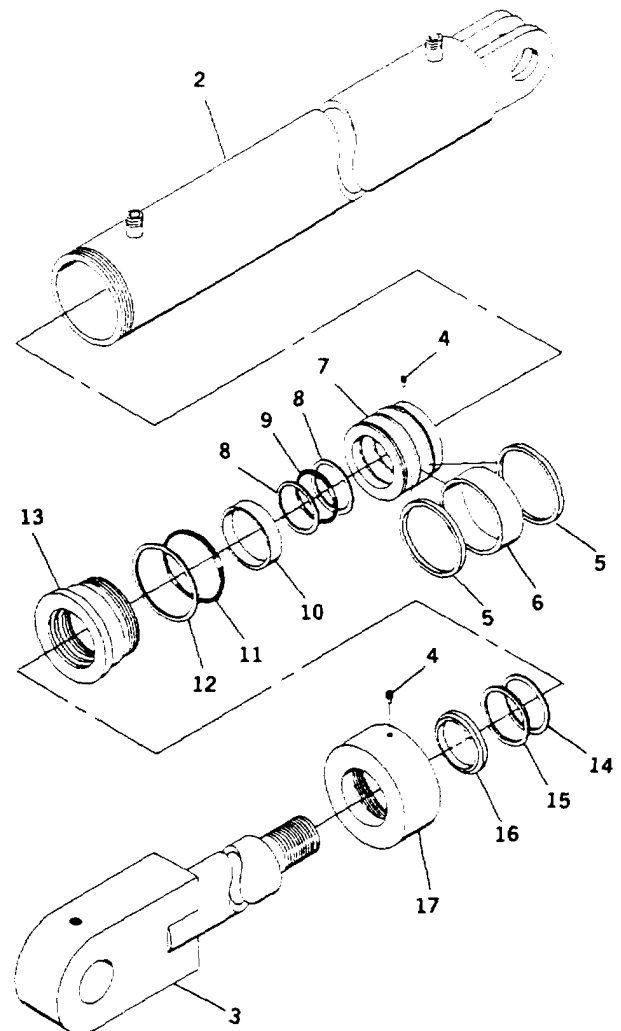
NOTE

Lubricate new seals and rings with clean hydraulic oil.

4. IF EXISTING PISTON (7) AND ROD (3) ARE TO BE USED, PROCEED AS FOLLOWS:

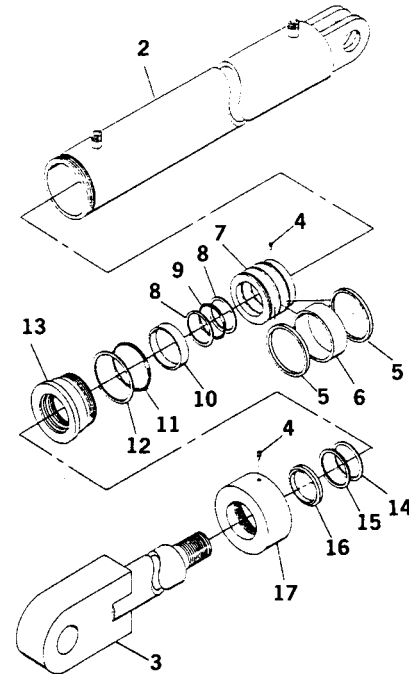
- a. Install piston (7) onto rod (3).

1. LUBRICATE AND INSTALL A NEW WIPER SEAL (16) INTO INSIDE OF LOCK RING (17) AND SLIDE LOCK RING ONTO ROD (3).
2. INSTALL HEAD (13) AND NEW SEALS ON ROD (3).
 - a. Lubricate and install a new packing (11) and backup ring (12) onto outside of head (13).
 - b. Lubricate and install a new wear ring (10) on inside of head.
 - c. Lubricate and install a new rod seal (15), grooved end first, into inside of head (13). Lubricate and install a new buffer seal (14).
 - d. Slide head onto rod (3).
3. INSTALL NEW SEALS AND BACKUP RINGS ON PISTON (7).
 - a. Lubricate and install new ring (6) and seals (5) onto outside of piston (7). Ensure the seal assembly is installed as shown.
 - b. Lubricate and install two new back-up rings (8) and new packing (9) on inside of piston (7).



- b. Using strap wrench, tighten piston securely until setscrew holes align.
 - c. Apply Loctite # 271 to setscrew (4) and install setscrew.
5. IF NEW PISTON (7) OR ROD (3) ARE TO BE USED, PROCEED AS FOLLOWS:
- a. Install piston (7) onto rod (3).
 - b. Using strap wrench, tighten piston securely.
 - c. If necessary, drill 0.265-inch diameter hole 3/16-inch (minimum) deep in rod (3).
 - d. Clean drilled hole of chips and debris.
 - e. Apply Loctite # 271 to setscrew (4) and install setscrew.
6. SLIDE CYLINDER ROD (3) WITH HEAD (13) AND PISTON (7) INTO CYLINDER BARREL WITH A TWISTING MOTION.
7. CLEAN OIL FROM THREADS OF LOCK RING (17). COAT THREAD WITH NEVER-SEEZ (PASTE-TYPE) LUBRICANT.
8. IF EXISTING LOCK RING (17) AND BARREL (2) ARE TO BE USED, PROCEED AS FOLLOWS:
- a. Screw lock ring (17) onto barrel (2).
 - b. Using strap wrench, tighten lock ring securely until setscrew holes align.
 - c. Apply Loctite # 271 to setscrew (4) and install setscrew.
9. IF NEW LOCK RING (17) OR BARREL (2) IS TO BE USED, PROCEED AS FOLLOWS:
- a. Screw lock ring (17) onto barrel (2).

- b. Using strap wrench, tighten lock ring (17) securely.
- c. If necessary, drill 0.265-inch diameter hole 3/16-inch (maximum) deep in barrel (2).



NOTE

Setscrew (4) when installed should be flush with lock ring (17).

- d. Clean drilled hole of chips and debris.
- e. Apply Loctite # 271 to setscrew (4) and install setscrew.

WARNING

Do not use air pressure to cycle or pressurize the cylinder.

10. PRESSURIZE AND CYCLE TEST CYLINDER. CHECK FOR PROPER OPERATION AND ANY LEAKAGE.

END OF TASK

CHAPTER 11
OUTRIGGER MAINTENANCE

CHAPTER INDEX

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Section I. OUTRIGGER ASSEMBLY MAINTENANCE

OUTRIGGER BEAM INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Shop Equipment Auto-Maintenance and Repair Common No 1 (4910-00-754-0655)
 Shop Equipment Auto-Maintenance and Repair; Org Suppl No 1 (4910-00-754-0653)
 Lifting device (1 ton capacity)

SUPPLIES: Cotter pins (Item 64, Appendix B)
 Hydraulic oil (Item 8, Appendix B)
 Loctite #545 (Item 18, Appendix B)
 Preformed packing (Item 67, Appendix B) (2 Required)
 Preformed packing (Item 68, Appendix B) (2 Required)
 Grease (Item 9, Appendix B)
 NEVER-SEEZ (Item 24, Appendix B)

EQUIPMENT CONDITION: None

REMOVAL:

NOTE

WARNING

Outrigger beam assembly weighs approximately 1520 lbs (690 Kg). Use care when removing outrigger beam assembly.

1. EXTEND OUTRIGGER SLIGHTLY TO FACILITATE ATTACHING A LIFTING DEVICE TO OUTRIGGER BEAM.
2. DISCONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
3. REMOVE OUTRIGGER HOUSING COVER (1).
 - a. On opposite side of outrigger housing, remove two screws (2) securing cover (1) to housing. Disconnect side marker light electrical connector and remove cover.
4. TAG AND DISCONNECT THREE HYDRAULIC LINES (3) AT CYLINDER END OF EXTENSION CYLINDER. CAP ALL LINES AND FITTINGS.
5. REMOVE EXTENSION CYLINDER MOUNTING SHAFT (4).

Do not allow end of outrigger extension cylinder to fall when cylinder mounting shaft is removed. Use an adequate blocking to support cylinder.

- a. Remove cotter pins (5) securing cylinder mounting shaft (4) and remove shaft.
6. REMOVE OUTRIGGER BEAM (6).
 - a. Attach a suitable lifting device to outrigger beam.
 - b. Pull outrigger beam out of outrigger box, readjusting lifting attachment to maintain equal balance.

WARNING

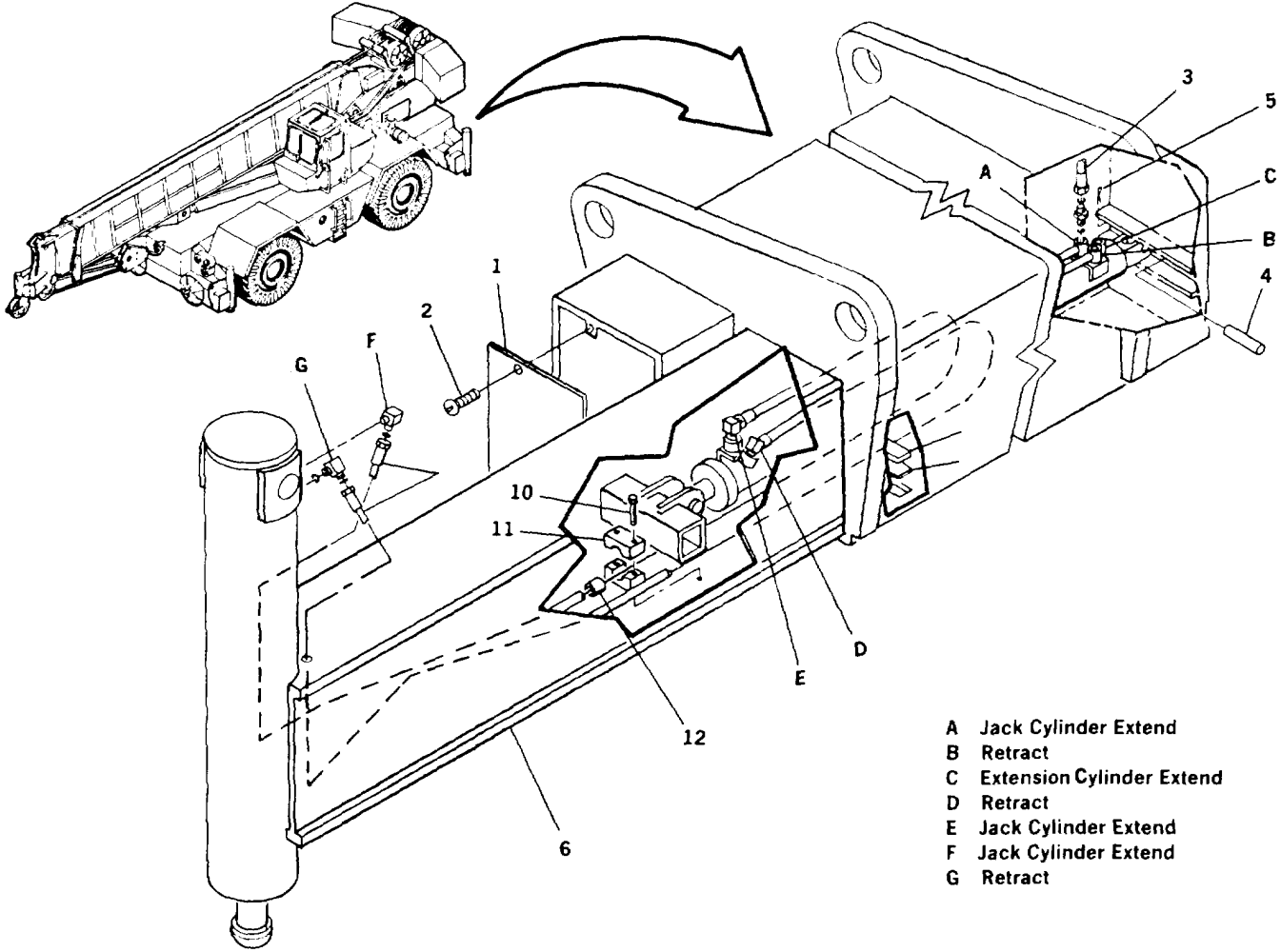
Ensure any blocking material used is capable of supporting weight of outrigger beam. Do not allow it to tilt or slide.

- c. Position outrigger beam (6) on blocking material.
- 7. REMOVE WEAR PAD (7) AND SHIM (8) FROM POCKET AT BOTTOM OF OUTRIGGER BOX.
- 8. IF NECESSARY, REMOVE JACK CYLINDER AND/OR EXTENSION CYLINDER.
- 9. IF NECESSARY REMOVE JACK CYLINDER HYDRAULIC HOSES FROM BEAM AS FOLLOWS:
 - a. If not disconnected, tag and disconnect hoses (9) from jack cylinder.
 - b. If not removed, remove extension cylinder.

- c. Remove two capscrews (10) securing pipe clamps (11), hoses (9) and rubber insert (12). Remove items.
- d. Pass hoses through holes in top of beam and remove from beam.

INSPECTION:

- 1. INSPECT OUTRIGGER BEAMS FOR BENDS, EVIDENCE OF CRACKS, OR OTHER DAMAGE. CHECK OUTRIGGER BEAM INTERNALLY FOR HYDRAULIC FLUID, WHICH MAY INDICATE A LEAKING CYLINDER, LOOSE CONNECTION, OR DAMAGED HYDRAULIC LINE.



INSTALLATION:

1. IF REMOVED, INSTALL JACK CYLINDER HOSES AS FOLLOWS:
 - a. Slide hoses (9) into beam ensuring they pass through hose retainer bracket.
 - b. Feed hose ends through holes in top of beam.

NOTE

Extend hose through inward hole, retract hose through outward hole.

- c. Install hose clamps (11) and rubber insert (12) and secure with two capscrews (10).
2. IF REMOVED, INSTALL JACK CYLINDER AND/OR EXTENSION CYLINDER.
3. APPLY GREASE TO SHIM (8) AND WEAR PAD (7). INSTALL IN POCKET IN BOTTOM OF BOX.
4. APPLY GREASE TO TOP AND BOTTOM SIDE RAILS OF BEAM.
5. INSTALL OUTRIGGER BEAM (10).
 - a. Attach a suitable lifting device to outrigger beam (6).
 - b. Slide beam (10) into outrigger housing and align cylinder bushing with mounting lug.

NOTE

Coat the cylinder mounting shaft (33) with NEVER-SEEZ.

- c. Secure cylinder barrel to housing with shaft (4) and two new cotter pins (5). Remove blocking under cylinder.

CAUTION

Ensure piston side (extend) of all outrigger cylinders is connected to solenoid valves. Reversal of port connections of rod (retract) and piston (extend) could result in damage to cylinders as very high pressures will occur.

NOTE

Coat new preformed packing with clean hydraulic oil and threads of fittings with Loctite #545.

6. CONNECT HYDRAULIC LINES AS TAGGED PRIOR TO REMOVAL.
7. INSTALL OUTRIGGER HOUSING COVER (1).
 - a. Connect marker light electrical connector and position end cover (1) on housing. Secure cover with two screws (2).
8. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
9. CHECK FOR PROPER OPERATION OF AFFECTED BEAM AS FOLLOWS:

CAUTION

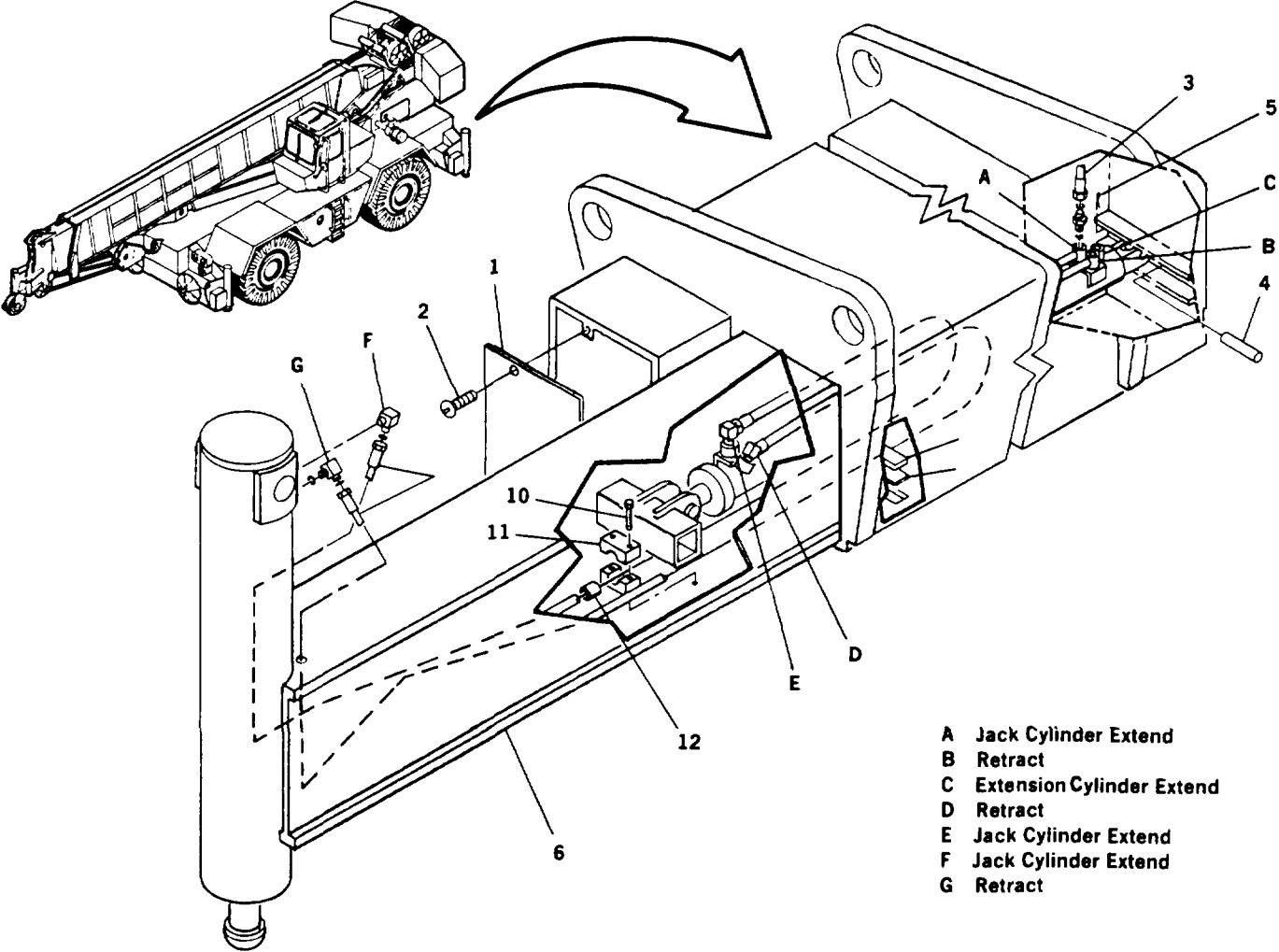
Be sure to use this sequence of operation. If hydraulic lines are reversed, this will prevent damage to cylinders until the situation can be corrected.

- a. Position applicable extensions switch to proper position.

- b. Position EXTEND/RETRACT switch to EXTEND.
- c. Observe that proper beam extends.
- d. Release both switches.
- e. Position applicable STABILIZERS switch to proper position.

- f. Position EXTEND/RETRACT switch to EXTEND.
- g. Observe that proper jack cylinder extends.
- h. Release both switches.
- i. Retract cylinders in same manner using RETRACT position.

END OF TASK



OUTRIGGER CHECK VALVE INSTALLATION

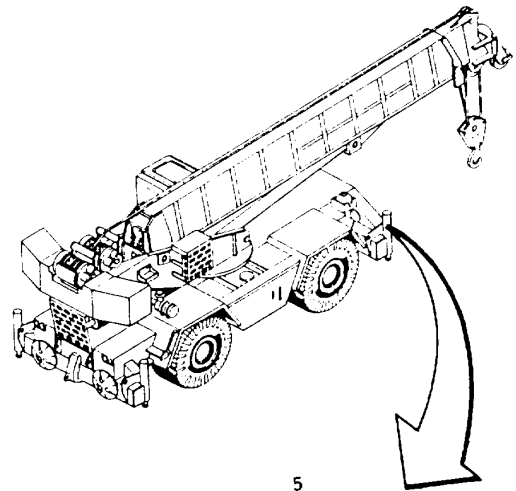
TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Cotter pins (Item 10, Appendix B)

EQUIPMENT CONDITION: Hydraulic pressure relieved from system.
 (Refer to TM 5-3810-306-20.)
 Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)

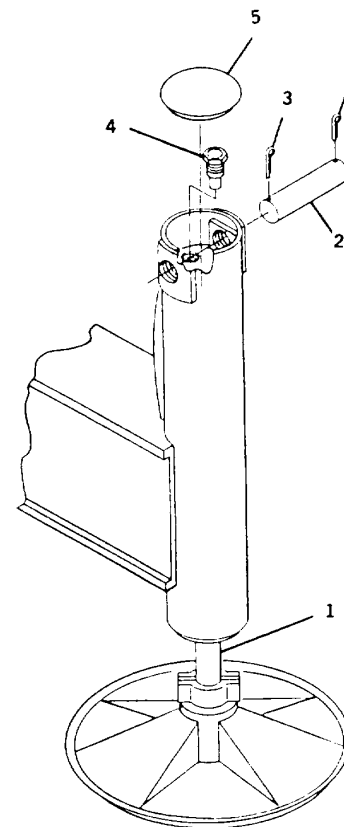
REMOVAL:

1. REMOVE OUTRIGGER CHECK VALVE (4).
 - a. Position a suitable jack under jack cylinder and raise to relieve pressure from pin (2).
 - b. Remove cap (5).
 - c. Remove two cotter pins (3) and remove pin (2) securing jack cylinder (1). Discard cotter pins (3).
 - d. Loosen outrigger check valve (4) slowly to relieve hydraulic pressure. Remove outrigger check valve (4).



INSTALLATION:

1. INSTALL OUTRIGGER CHECK VALVE (4).
 - a. Install outrigger check valve (4) in jack cylinder (1).
 - b. Install jack cylinder pin (2) through outrigger body and jack cylinder (4). Secure with two new cotter pins (3).
 - c. Install cap (5).
2. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
3. TEST FOR PROPER OPERATION.



END OF TASK

OUTRIGGER CHECK VALVE ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Parts kit (Item 36, Appendix B)
Hydraulic oil (Item 8, Appendix B)

EQUIPMENT CONDITION: Outrigger check valve removed. (Refer to page 11-7.)

DISASSEMBLY:

1. DISASSEMBLE OUTRIGGER CHECK VALVE (4).

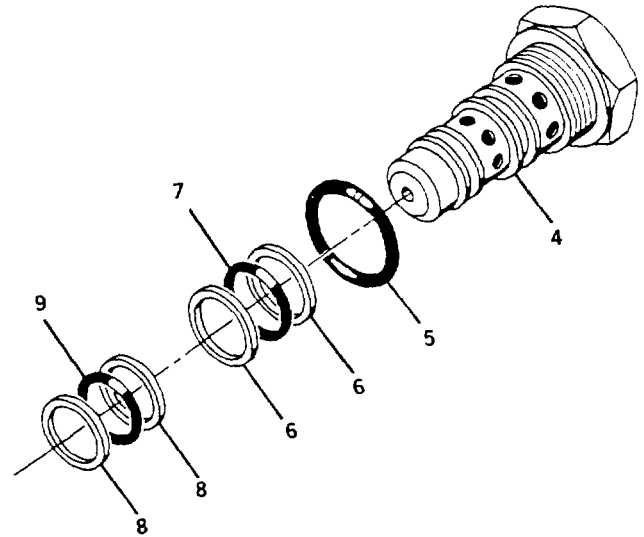
NOTE

Disassembly of outrigger check valve is limited to replacement of packings and backup rings.

- a. Remove packing (5) from check valve (4).
- b. Remove packings (9) and (7) and backup rings (6) and (8).

REASSEMBLY:

1. REPLACE ALL PACKINGS (5), (7) AND (9) AND BACKUP RINGS (6) AND (8). COAT WITH CLEAN HYDRAULIC OIL PRIOR TO INSTALLATION.



END OF TASK

OUTRIGGER EXTENSION CYLINDER INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Loctite #545 (Item 18, Appendix B)
 Hydraulic oil (Item 8, Appendix B)
 Preformed packing (Item 67, Appendix B) (2 Required)
 Preformed packing (Item 68, Appendix B) (2 Required)
 Lockwasher (Item 13, Appendix B)
 Cotter pin (Item 71, Appendix B)

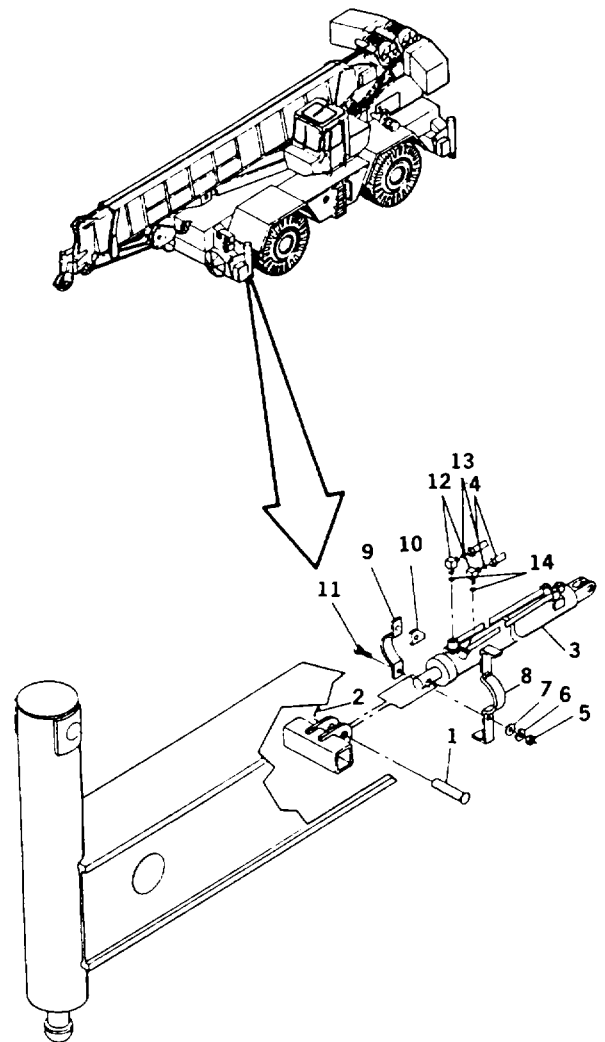
EQUIPMENT CONDITION: Outrigger beam removed. (Refer to page 11-2.)

REMOVAL:

1. REMOVE CLEVIS PIN (1) AND EXTENSION CYLINDER (3).
 - a. Remove cotter pins (2) and pin (1) securing rod end of extension cylinder (3) to outrigger beam. Discard cotter pins (2).
 - b. Withdraw cylinder until rod end is exposed.
 - c. Tag and disconnect hydraulic lines (4) on rod end of extension cylinder. Remove and discard packings (13). Cap lines.
 - d. Remove extension cylinder (3).
 - e. Remove capscrews (11), lockwashers (6), washers (7), nuts (5), spacer (10) and clamps (8) and (9).
 - f. If necessary, remove fittings (12) from end of cylinder. Remove and discard packings (14). Plug ports.

INSTALLATION:

1. INSTALL FITTINGS (12) AND CLAMPS (8) AND (9) ONTO EXTENSION CYLINDER (3).



NOTE

Prior to installation, coat new preformed packings with clean hydraulic oil and fitting threads with Loctite #545.

- a. If removed, install hydraulic fittings (12) and new packings (14) on end of cylinder.
- b. Install clamps (8) and (9) and spacer (10) and secure them with two capscrews (11), washers (7), lockwashers (6) and nuts (5).

NOTE

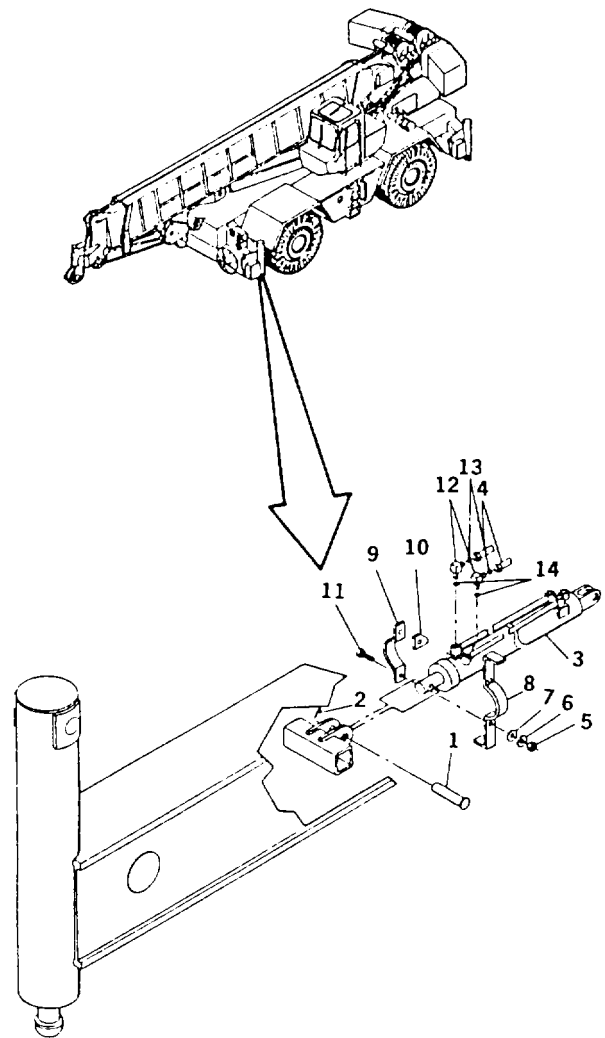
The wedge shape spacer (10) is located between two top halves of clamps and goes between hydraulic port bosses on rod end of cylinder to prevent clamp from rotating.

NOTE

The top leg of longer clamp should face toward outside of the beam (toward hoses).

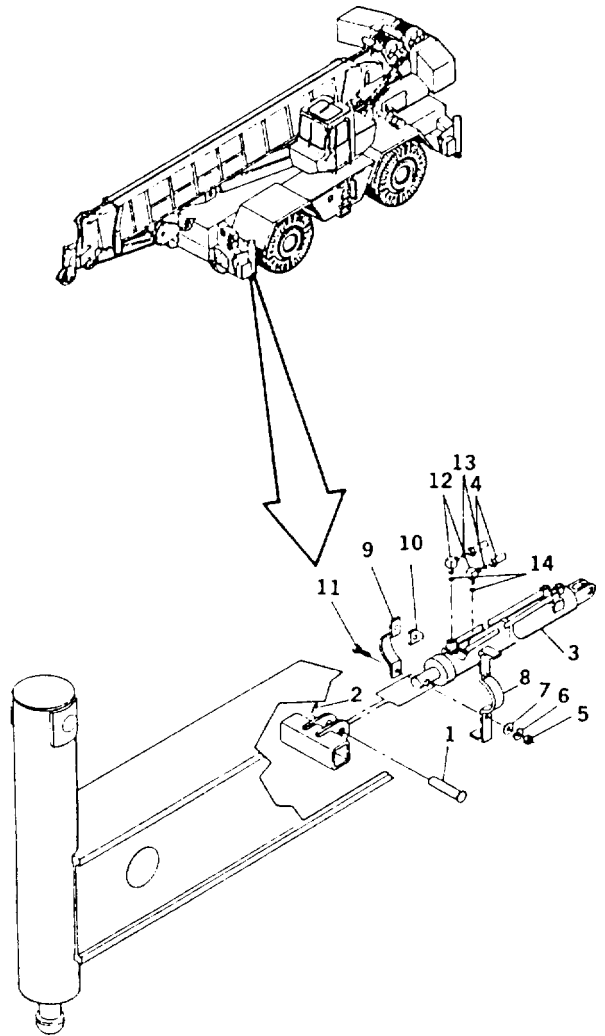
CAUTION

Ensure piston side (extend) of cylinder is connected to the solenoid valve. Reversal of port connections of rod (retract) and piston (extend) could result in damage to cylinder as very high pressure will occur.



2. INSTALL EXTENSION CYLINDER (3).
 - a. Start cylinder into beam and connect hydraulic hoses (4) with new packings (13) to fittings (12) as marked during removal.
 - b. Push cylinder into beam until rod end aligns with mounting lugs.
 - c. Coat clevis pin (1) with Never-Seeze and install pin and new cotter pin (2) securing extension cylinder (3) rod.
3. INSTALL OUTRIGGER BEAM. (REFER TO PAGE 11-2.)
4. EXTEND AND RETRACT EXTENSION CYLINDER AS DESCRIBED UNDER OUTRIGGER BEAM INSTALLATION.

END OF TASK



OUTRIGGER EXTENSION CYLINDER ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1 (4910-00-754-0706)
 Tool Outfit Hyd System, Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784)

SUPPLIES: Parts kit (Item 58, Appendix B)
 Loctite # 271 (Item 23, Appendix B)
 NEVER SEEZ (Item 24, Appendix B)
 Hydraulic oil (Item 8, Appendix B)
 Solvent (Item 1, Appendix B)

EQUIPMENT CONDITION: Outrigger extension cylinder assembly removed.
 (Refer to page 11-8.)

DISASSEMBLY:

NOTE

Any maintenance requiring disassembly of cylinders should be accompanied by replacement of all cylinder seals.

1. DRAIN THE OIL FROM THE CYLINDER.
2. REMOVE CYLINDER ROD ASSEMBLY FROM BARREL (14).
 - a. Remove setscrew (3) securing lock ring (5) to barrel (14).

WARNING

Do not use air pressure to remove cylinder rod assembly. Use only a source of controlled hydraulic oil pressure if rod assembly is hard to move.

CAUTION

Exercise extreme care when handling or setting down cylinder rod. Damage to rod surface may cause unnecessary maintenance and expense.

- b. Unscrew lock ring (5) and withdraw cylinder rod assembly from barrel.

NOTE

Cover cylinder barrel opening to preclude contamination from dust and dirt.

3. DISASSEMBLE ROD ASSEMBLY.

CAUTION

When removing seals (12) and rings, avoid scratching grooved and gland surfaces.

- a. Remove the seals from the piston (2).

NOTE

Aligning discarded seals and rings in order of disassembly will facilitate installation of new seals and rings.

- b. Remove lock ring (5) from rod (2). Remove wiper seal (4) from inside of the lock ring (5).

- c. Remove head (9) from rod. Remove packing (8) and back-up ring (7) from outside of head. Remove wear ring (11), rod seal (6) and buffer seal (10) from inside of head.

CLANING AND INSPECTION:

WARNING

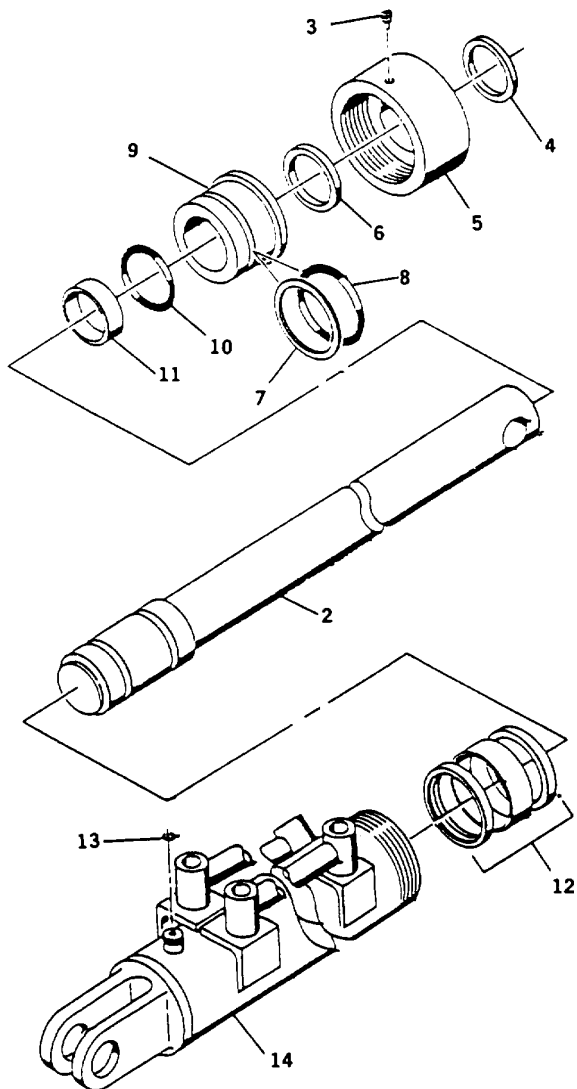
Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (380-590C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

1. CLEAN ALL PARTS WITH SOLVENT AND DRY WITH COMPRESSED AIR. INSPECT ALL PARTS FOR SERVICEABILITY.

CAUTION

Before installing new seals and rings, clean all surfaces and carefully remove burrs and nicks. Parts displaying excessive wear or damage should be replaced.



2. STONE OUT MINOR BLEMISHES AND POLISH WITH A FINE CROCUS CLOTH.
3. CLEAN WITH SOLVENT AND DRY WITH COMPRESSED AIR ANY PARTS THAT HAVE BEEN STONED AND POLISHED.
4. INSPECT BARREL CAREFULLY FOR SCORING.

REASSEMBLY:

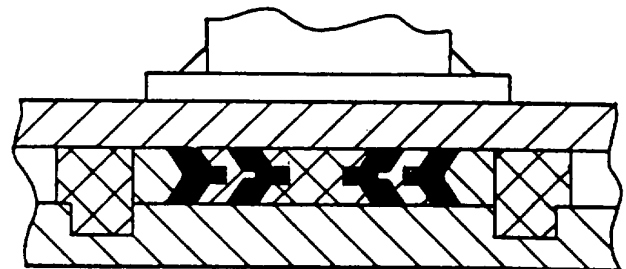
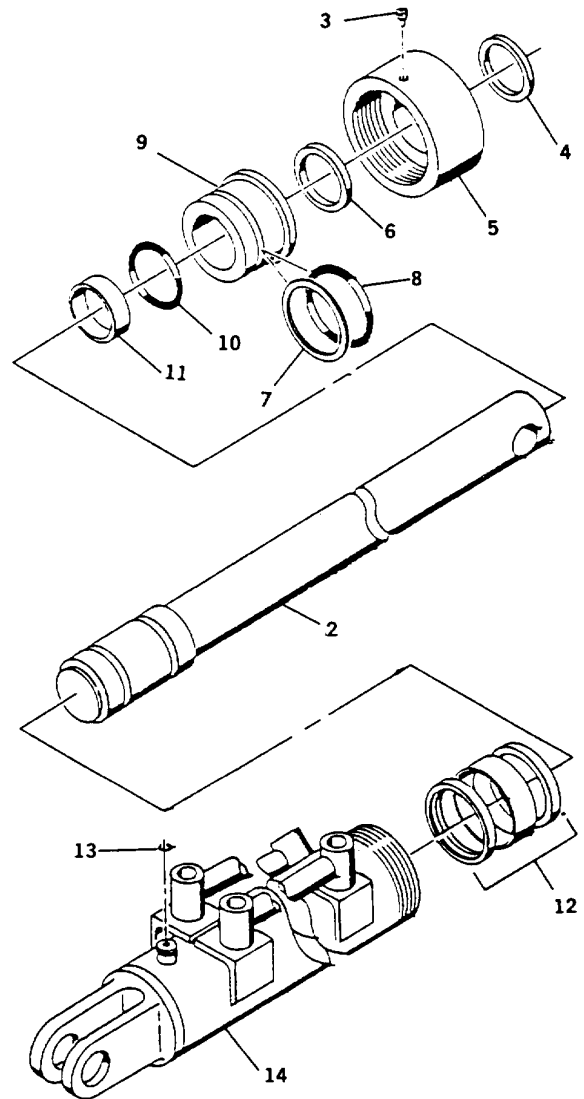
CAUTION

When installing new seals and rings, avoid scratching the grooved and gland surfaces. Scratches cause seal wear resulting in leakage.

NOTE

Before installation, lubricate all parts and surfaces freely with clean hydraulic oil. Ensure packing portion of rod seal is installed forward as head (9) would enter barrel (14).

1. INSTALL NEW SEALS AND BACK-UP RINGS ON HEAD AND INSTALL ON ROD (2).
 - a. Install wear ring (11), rod seal (6) and buffer seal (10) on inside of head (9). Install packing (8) and back-up ring (7) on outside of head.
 - b. Install head (9) on rod (2).
 - c. Install wiper seal (4) in lock ring (5).
2. INSTALL ROD SEALS. ENSURE SEAL ASSEMBLY (12) IS INSTALLED AS SHOWN.



CAUTION

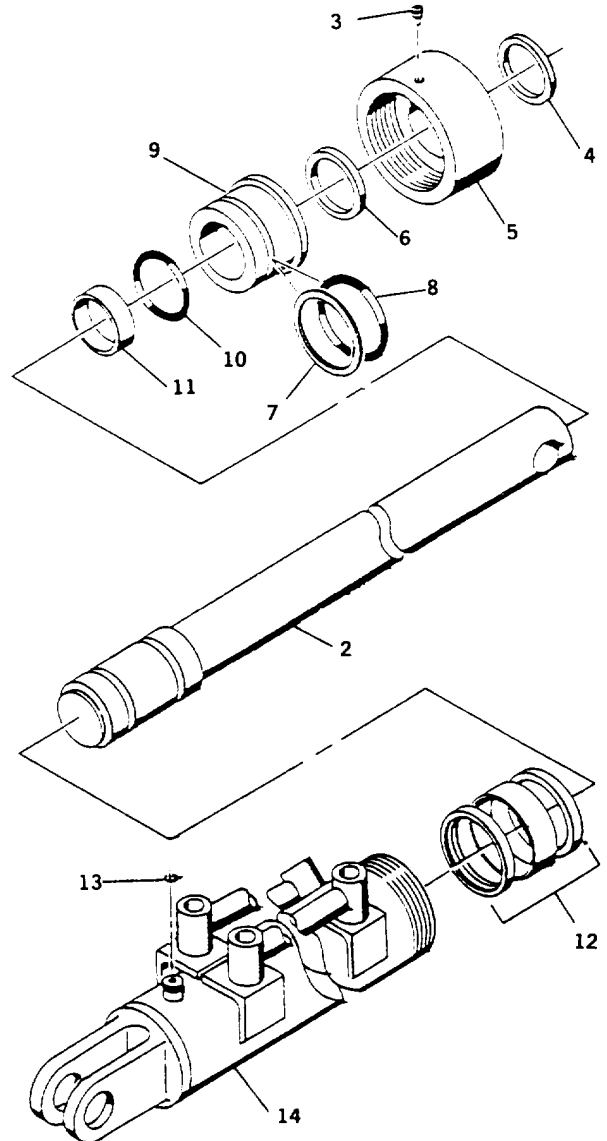
Exercise extreme care when handling or setting down cylinder rod. Damage to rod surface may cause unnecessary maintenance and expense.

3. INSTALL CYLINDER ROD ASSEMBLY INTO CYLINDER BARREL WITH A TWISTING MOTION. SEAT HEAD IN CYLINDER BARREL.
4. CLEAN OIL FROM THREADS OF LOCK RING (5). COAT THREADS WITH NEVER-SEEZ (PASTE TYPE) LUBRICANT.
5. IF EXISTING LOCK RING (5) AND BARREL (14) ARE TO BE USED, PROCEED AS FOLLOWS:
 - a. Screw lock ring (5) onto barrel (14).
 - b. Using strap wrench, tighten lock ring securely until the setscrew holes align.
 - c. Apply Loctite # 271 to setscrew (3) and install setscrew.
6. IF NEW LOCK-RING (5) OR BARREL (14) IS TO BE USED, PROCEED AS FOLLOWS:
 - a. Screw lock ring onto barrel.
 - b. Using a strap wrench, tighten lock ring securely.
 - c. If necessary, drill 0.265-in. dia. hole 3/16-in. (maximum) deep in barrel.

NOTE

Setscrew when installed should be flush with lock ring.

- d. Clean drilled hole of chips and debris.



- e. Apply Loctite # 271 to setscrew and install setscrew (3).

WARNING

Do not use air pressure to cycle or pressurize cylinder.

7. PRESSURIZE AND CYCLE CYLINDER. CHECK PROPER OPERATION AND ANY LEAKAGE.

END OF TASK

OUTRIGGER JACK CYLINDER INSTALLATION

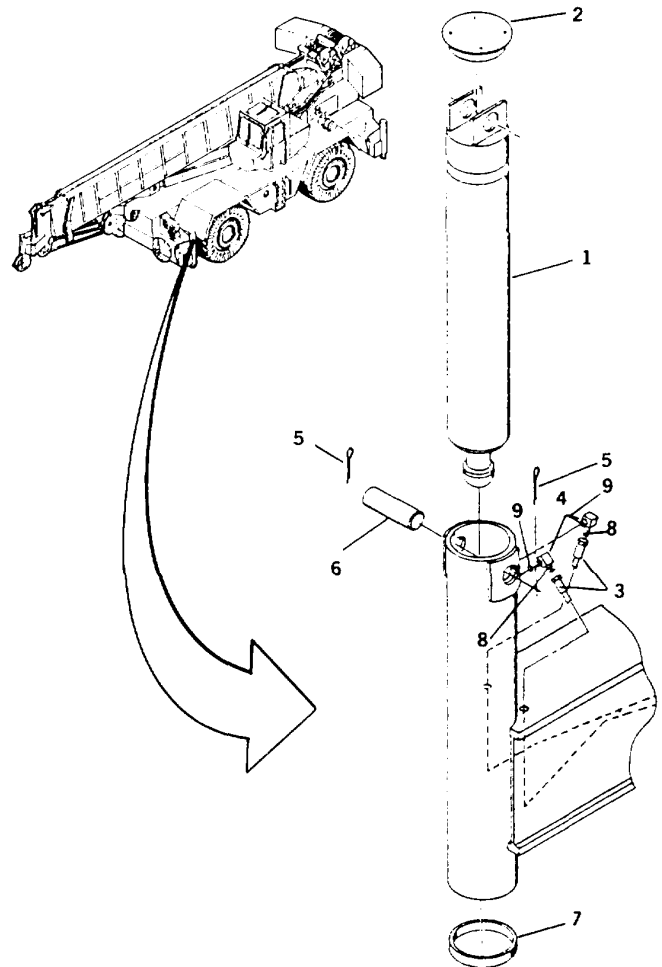
TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Tool Outfit Hyd System, Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784)
 Tool Kit Auto-Fuel and Electric System Repair (5180-00-754-0655)
 Shop Equipment Auto-Maintenance and Repair; Org Suppl No 1 (4910-00-754-0653)
 Lifting device (500 lbs capacity)

SUPPLIES: Preformed packing (Item 67, Appendix B) (2 Required)
 Preformed packing (Item 68, Appendix B) (2 Required)
 Wear ring (Item 69, Appendix B)
 Weatherstrip adhesive (Item 70, Appendix B)
 Cotter pin (Item 10, Appendix B) (2 Required)

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE JACK CYLINDER (1).
 - a. Remove jack cylinder access cap (2).
 - b. Tag and disconnect hydraulic lines (3) from jack cylinder. Remove and discard packings (8). Cap or plug lines.
 - c. Remove two fittings (4) from jack cylinder ports. Remove and discard packings (9). Plug cylinder ports.
 - d. Place a hydraulic jack under jack cylinder. Raise jack cylinder to relieve weight from pin (6).
 - e. Remove cotter pins (5) and pin (6) securing jack cylinder (1). Discard cotter pins (5).
 - f. Using hydraulic jack, raise cylinder up until a lifting device can be attached to cylinder (1).
 - g. Using lifting device, remove cylinder from beam.
 - h. In bottom of cylinder tubes remove and discard wear ring (7).



INSTALLATION:

1. INSTALL JACK CYLINDER (1).
 - a. Install new wear ring (7) in groove in bottom of cylinder tube.
 - b. Place a hydraulic jack under cylinder tube.
 - c. Using a lifting device, lower jack cylinder into tube aligning ports with cut-out in tube.
 - d. Raise hydraulic jack to take up weight of cylinder and remove lifting device.
 - e. Lower cylinder (1) into tube until pin (6) can be installed. Use care not to damage wear ring (7) or dislodge it.
 - f. Coat pin with Never-Seeze and install pin (6) and two new cotter pins (5) securing cylinder (1) to tube.
 - g. Remove the hydraulic jack.

NOTE

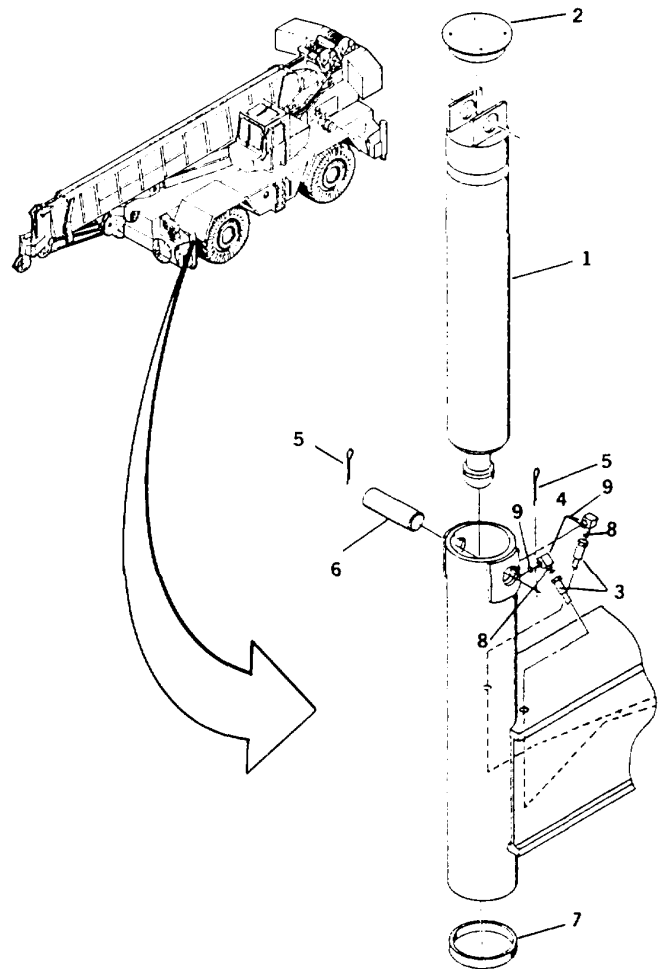
Coat new performed packing with clean hydraulic oil and fittings threads with Loctite #545.

- h. Install hydraulic fittings (4) and new packings (9) in ports of cylinder.

CAUTION

Ensure piston side (extend) of cylinder is connected to solenoid valve. Reversal of port connection of rod (retract) and piston (extend) could result in damage to cylinder as very high pressure will occur.

- i. Connect hydraulic lines (3) And new packings (8) to fittings as tagged during removal.
- j. Install jack cylinder access cap (2) with weatherstrip cement applied in three beads approximately 120° apart.



2. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
3. ACTIVATE HYDRAULIC SYSTEM. (REFER TO TM 5-3810-306-10.)
4. EXTEND AND RETRACT JACK CYLINDER AS DESCRIBED UNDER OUTRIGGER BEAM INSTALLATION.
5. CHECK FOR SMOOTH OPERATION OF CYLINDER.
6. CHECK ALL HYDRAULIC CONNECTIONS AND HOSES FOR EVIDENCE OF LEAKAGE.

END OF TASK

OUTRIGGER JACK CYLINDER ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1 (4910-00-754-0706)
 Tool Outfit Hyd System, Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784)

SUPPLIES: Parts kit, seal repl (Item 57, Appendix B)
 Parts kit, check valve (Item 36, Appendix B)
 Solvent (Item 1, Appendix B)
 Loctite #271 (Item 23, Appendix B)
 Hydraulic oil (Item 8, Appendix B)
 NEVER-SEEZ (Item 24, Appendix B)

EQUIPMENT CONDITION: Outrigger jack cylinder assembly removed.
 (Refer to page 11-15.)

DISASSEMBLY:

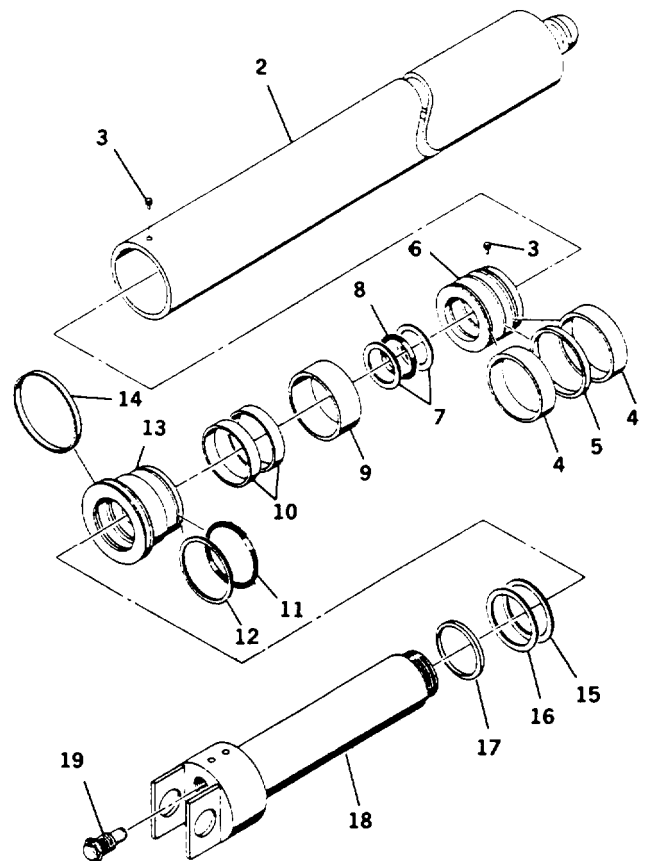
NOTE

Any maintenance requiring disassembly of cylinder should include replacement of all cylinder seals.

1. REMOVE THE CHECK VALVE (19) FROM PORT BLOCK.
2. DRAIN ALL OIL FROM HYDRAULIC CYLINDER.
3. REMOVE CYLINDER ROD ASSEMBLY.
 - a. Remove ring (14) from outside of hood (13).
 - b. Remove setscrew (3) securing head (13) to barrel (2).

WARNING

Do not use air pressure to remove cylinder rod assembly. Use only a source of controlled hydraulic oil pressure if rod assembly is hard to remove.



CAUTION

Exercise extreme care when handling or setting down cylinder rod. Do not damage rod surface.

- c. Remove cylinder rod assembly from cylinder barrel (2) and set it on a suitable surface. Cover cylinder barrel opening.

4. REMOVE PISTON (6), RINGS AND SEALS.

- a. Secure cylinder rod from moving.

CAUTION

When removing seals and rings, avoid scratching grooved and gland surfaces.

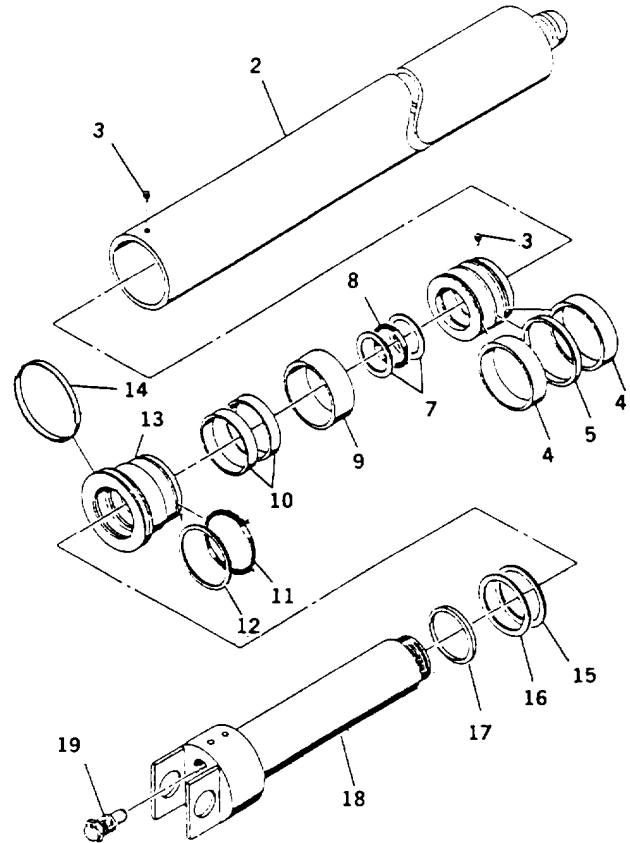
- b. Remove ring (5) and seals (4) from piston external surface.
- c. Remove the setscrew (3) from piston (6). Unscrew piston and remove it.
- d. Remove two back-up rings (7) and packing (8) from inside of piston (6).

NOTE

Aligning discarded seals and rings in order of disassembly will facilitate installation of new items.

5. REMOVE HEAD (13) FROM ROD (18).

- a. Remove spacer (9) and head (13) from rod.
- b. Remove wiper seal from threaded head (13).
- c. Remove two wear rings (10), rod seal (16) and buffer seal (15) from inside of head (13).



- d. Remove packing (11) and back-up ring (12) from outside of head.

CLEANING AND INSPECTION:

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

1. CLEAN ALL PARTS WITH SOLVENT AND DRY WITH COMPRESSED AIR. INSPECT ALL PARTS FOR SERVICEABILITY.

CAUTION

Before installing new seals and rings, clean all surfaces and carefully remove burrs and nicks. Parts displaying excessive wear or damage should be replaced.

2. STONE OUT MINOR BLEMISHES AND POLISH WITH A FINE CROCUS CLOTH.
3. CLEAN WITH SOLVENT AND DRY WITH COMPRESSED AIR ANY PARTS THAT HAVE BEEN STONED AND POLISHED.
4. INSPECT BARREL CAREFULLY FOR SCORING.

REASSEMBLY:

CAUTION

When installing new seals and rings, avoid stretching seals or scratching grooved and gland surfaces.

NOTE

Lubricate new seals and rings with clean hydraulic oil.

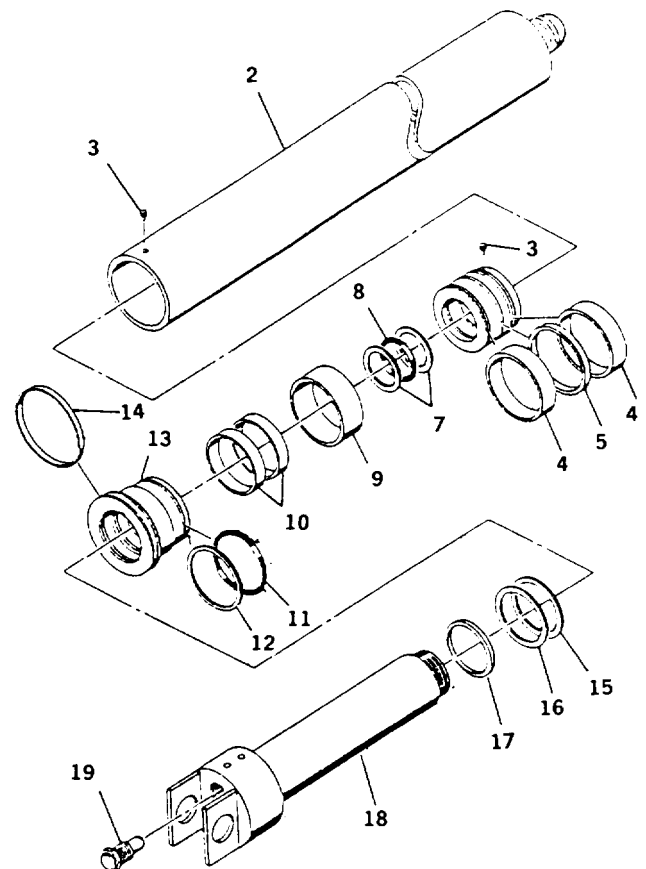
NOTE

Locate the gap of each wear ring 180° apart.

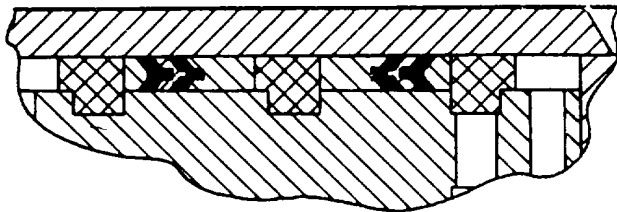
NOTE

The packing must be assembled forward of backup ring of rod seal as head would enter barrel.

1. ASSEMBLE HEAD (13) WITH NEW SEALS AND INSTALL ON ROD (18).
 - a. Install two wear rings (10), rod seal (16), buffer seal (15) and wiper seal (17) on inside of head (13). Install packing (11) and back-up ring (12) on outside of head (13).
2. LUBRICATE ROD (18) WITH CLEAN HYDRAULIC OIL.



3. INSTALL HEAD (13) ONTO ROD (18).
4. INSTALL SPACER (9) ON ROD (18).
5. ASSEMBLE PISTON (6) WITH NEW SEALS AND INSTALL ONTO ROD (18).
 - a. Install seals (4) and ring (5) on outside of piston. Ensure seal assembly is installed as shown.



NOTE

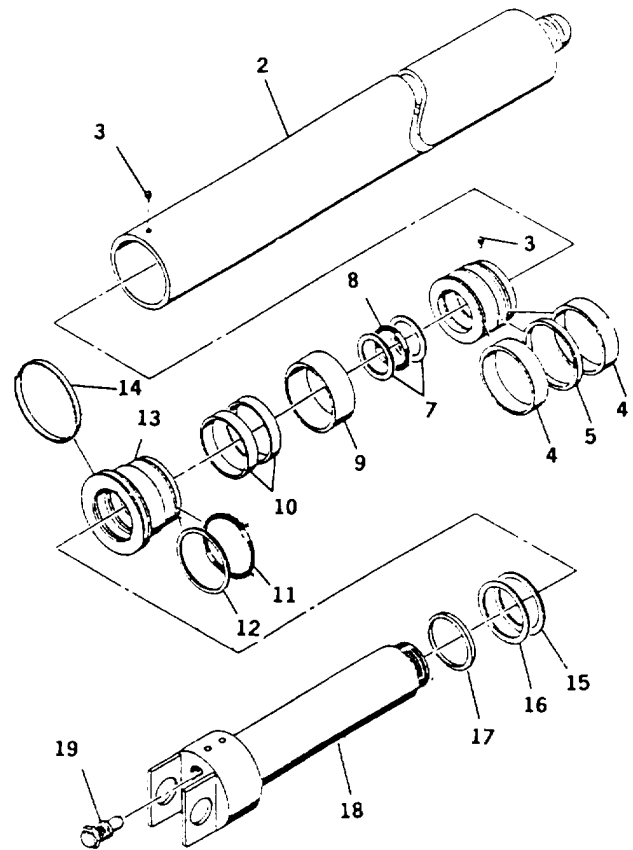
The packing is centered between two backup rings in piston.

- b. Install the two backup rings (7) and the packing (8) into inside of piston (6).

CAUTION

Do not damage back-up rings and packing when installing piston over threaded rod.

6. IF EXISTING PISTON AND ROD ARE TO BE USED, PROCEED AS FOLLOWS:
 - a. Install piston (6) onto rod.
 - b. Using strap wrench, tighten piston securely until setscrew holes align.
 - c. Apply Loctite #271 to setscrew (3) and install setscrew.
7. IF NEW PISTON OR ROD IS TO BE USED, PROCEED AS FOLLOWS:
 - a. Install piston (6) onto rod.

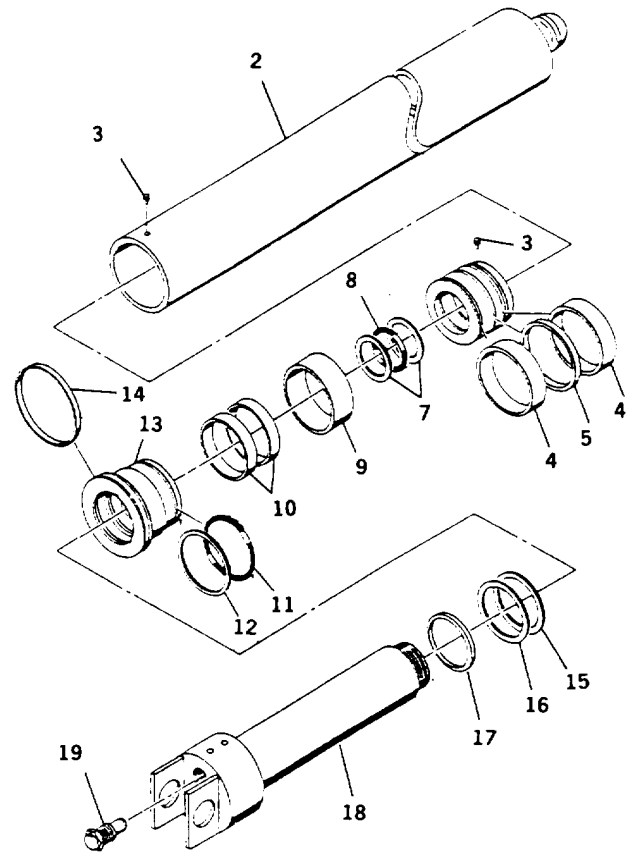


- b. Using strap wrench, tighten piston securely.
 - c. If necessary, drill 0.265-in. dia. hole 3/16-in. (min.) deep in rod.
 - d. Clean drilled hole of chips and debris.
 - e. Apply Loctite #271 to setscrew (3) and install setscrew.
8. INSTALL BARREL (2) OVER ROD ASSEMBLY.
 - a. Remove cover from barrel opening.
 - b. Lubricate piston, head, and inside of barrel opening.

CAUTION

Do not damage packing (11) or back-up ring (12) when installing head into threaded barrel.

- c. Install rod assembly into barrel (2) with a slight twisting motion.
 - d. Wipe any oil from threads of barrel and head. Coat threads with NEVER-SEEZ (paste type) lubricant.
9. IF EXISTING HEAD (13) AND BARREL (2) ARE TO BE USED, PROCEED AS FOLLOWS:
- a. Screw head (13) into barrel (2).
 - b. Using strap wrench, tighten head securely until the setscrew holes align.
 - c. Apply Loctite # 271 to setscrew (3) and install setscrew.
10. IF NEW HEAD (13) OR BARREL (2) IS TO BE USED, PROCEED AS FOLLOWS:
- a. Screw head (13) into barrel (2).
 - b. Using strap wrench, tighten head securely.
 - c. If necessary, drill 0.265-in. dia. hole 3/16-in. (max.) deep in head (13).



11. INSTALL CHECK VALVE (19).

- a. Check inside of port block for any sharp edges or burrs and remove as necessary with emery cloth.
- b. Install new external packing onto check valve (19).
- c. Lubricate check valve and packings with clean hydraulic oil.

CAUTION

Do not damage packings during installation of check valve. If check valve turns freely then gets hard to turn, then easy to turn; remove check valve and check packings. They have probably been damaged by a sharp edge of a port.

NOTE

Setscrew when installed should be flush with barrel.

- d. Clean drilled hole of chips and debris.
- e. Apply Loctite #271 to setscrew and install setscrew.

NOTE

Check valve should turn by hand until compression of the packings begins.

- d. Carefully install check valve into port block until fully seated.

WARNING

Do not use air pressure to cycle or pressurize cylinder.

- 12. PRESSURIZE AND CYCLE CYLINDER. CHECK FOR PROPER OPERATION AND ANY LEAKAGE.

END OF TASK

CHAPTER 12

BODY CHASSIS AND ACCESSORY ITEM MAINTENANCE

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Section I. CAB HEATER MAINTENANCE

CAB HEATER ASSEMBLY

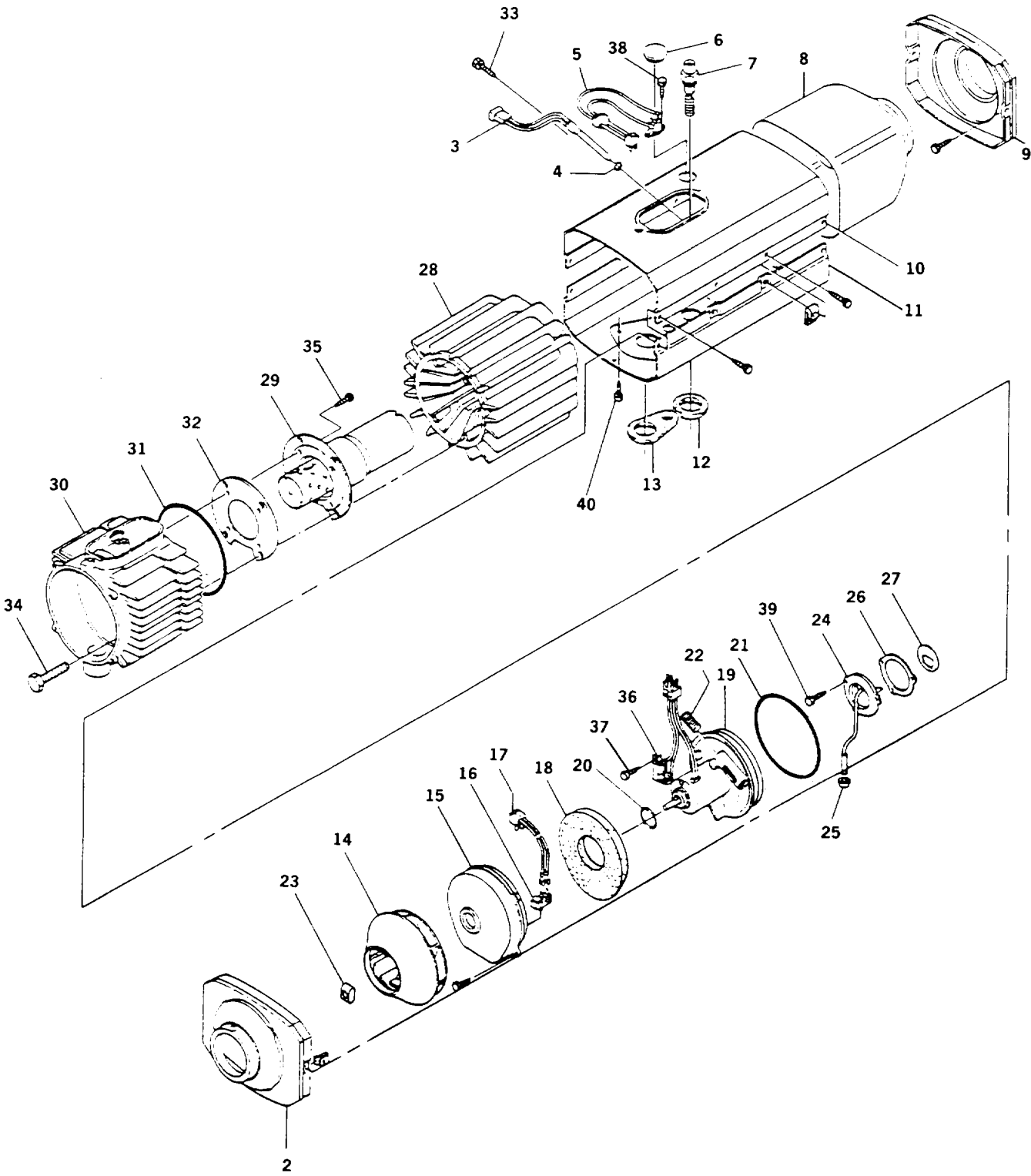
TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Packing, preformed (Item 235, Appendix B)
 Gasket (Item 236, Appendix B)
 Gasket (Item 237, Appendix B)
 Packing, preformed (Item 238, Appendix B)
 Packing, preformed (Item 239, Appendix B)
 Gasket (Item 240, Appendix B)
 Matting (Item 241, Appendix B)
 Packing, preformed (Item 242, Appendix B)
 Gasket (Item 243, Appendix B)

EQUIPMENT CONDITIONS: Cab heater removed. (Refer to TM 5-3810-306-20.)

DISASSEMBLY:

1. REMOVE GLOW PLUG (7).
2. REMOVE FLAME DETECTOR (3).
 - a. Remove Phillips head screw (33) securing flame detector and packing (4) in housing. Discard packing (4).
3. SEPARATE UPPER AND LOWER CASES HALVES (10) AND (11).
 - a. Remove upper case (10) by removing eight Phillips head screws from sides of cover and one screw on top. Remove top cover (10).
 - b. Remove end hoods (2) and (9).
 - c. Remove and discard gaskets (12) and (13).
 - d. Remove screws (40) and lower cover (11) from housing (30).
 - e. Remove foil heat protector (8).
4. REMOVE OVERHEAT SWITCH.
 - a. Remove two Phillips head screws (38) and overheat switch (5) from outside of housing (10).
 - b. Remove rubber grommet (6) and wire harness from housing (10).
5. REMOVE HEATER DRIVE (19).
 - a. Remove retainer (23) securing rotor (14) to motor shaft. Remove rotor (14).
 - b. Remove four Phillips head screws securing motor cap (15) and switch (16) to housing (30).
 - c. Tag and disconnect two electrical wires (17) from switch (16) and remove switch from motor cap (15).
 - d. Remove packing (20) and sound proof mat (18). Discard packing (20).
 - e. Remove heater drive assembly (19) and packing (21). Discard packing (21).



6. REMOVE RESISTOR (36).
 - a. Remove Phillips head screw (37) and resistor (36) from drive assembly.
 - b. Tag and unsolder two electrical wires to resistor.
7. REMOVE FUEL SUPPLY TUBE (24).
 - a. Remove three Phillips head screws (39) securing fuel supply tube (24), gasket (25), gasket (26) and fleece (27) in housing. Remove components. Discard gaskets (25) and (26) and fleece (27).
8. REMOVE HEAT EXCHANGER (28).
 - a. Separate heat exchanger (28) from housing by removing four capscrews (34).
 - b. Remove and discard packing (31) from housing (30).
9. REMOVE BURNER TUBE (29).
 - a. Remove four Phillips head screws (35). Remove burner tube (29) and gasket (32) from housing. Discard gasket (32).

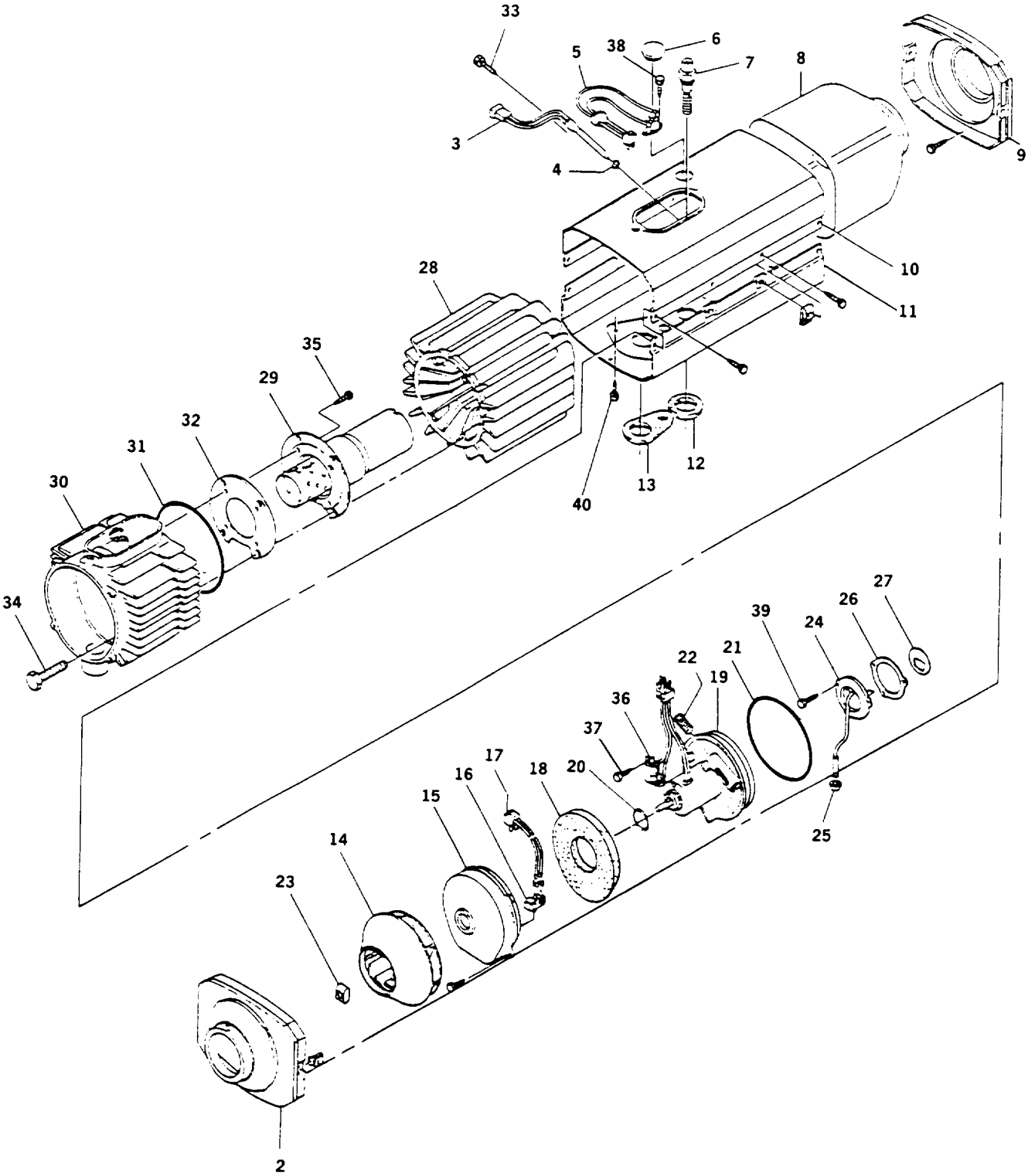
INSPECTION:

1. INSPECT PARTS AND REPLACE AS NECESSARY.

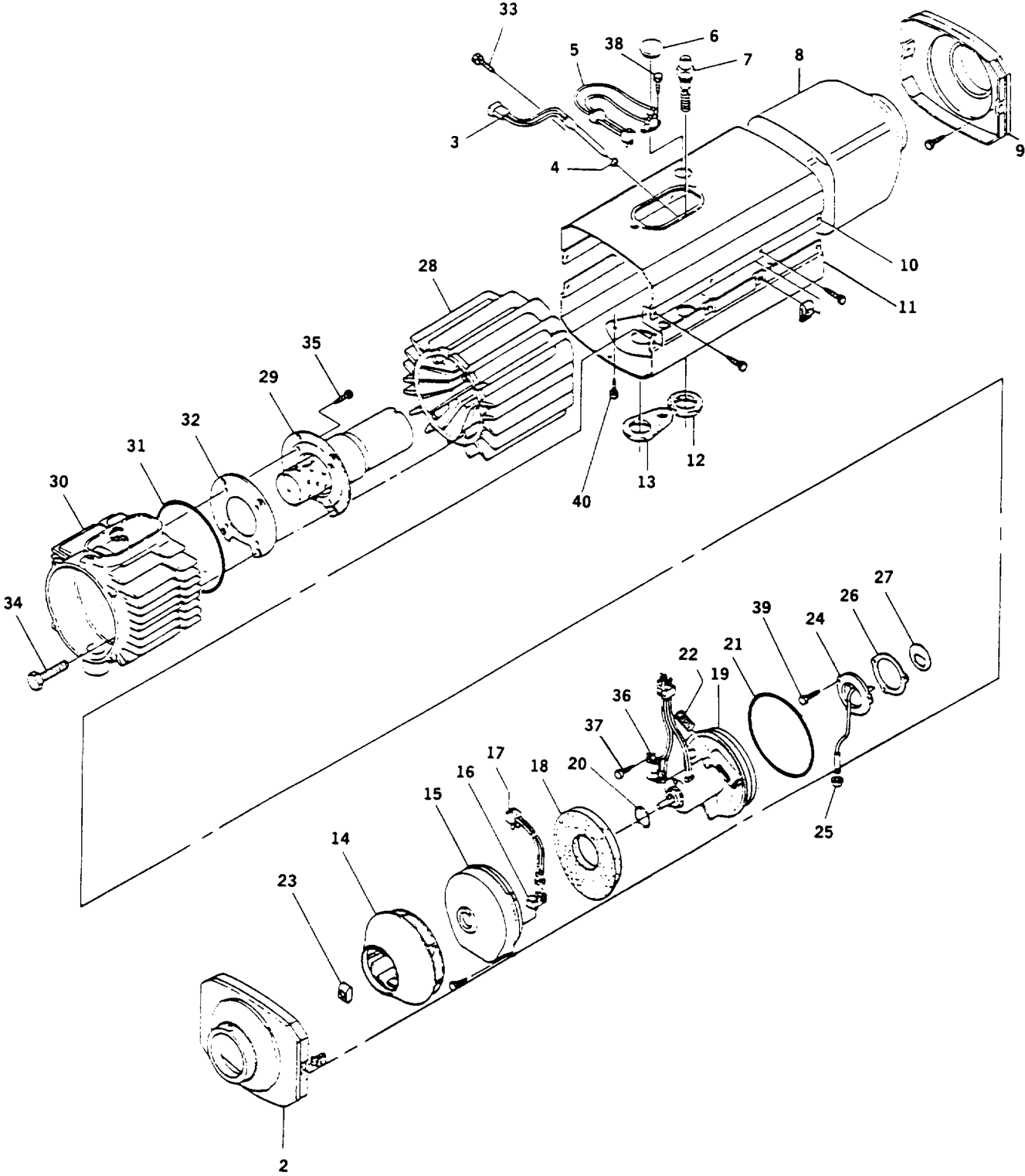
ASSEMBLY:

1. INSTALL BURNER TUBE (29).
 - a. Position new gasket (32) and burner tube (29) on housing (30) and secure with four Phillips head screws (35).

2. INSTALL HEAT EXCHANGER (28).
 - a. Install new packing (31) in groove on housing (30) and install heat exchanger (28). Secure with four capscrews.
3. INSTALL FUEL SUPPLY TUBE (24).
 - a. Install new fleece (27), gasket (26) and fuel supply tube in housing and secure with three Phillips head screws (39).
 - b. Position new gasket (25) over tube and slide into housing until seated.
4. INSTALL RESISTOR (36).
 - a. Solder tagged electrical wires directly to resistor and mount on heater drive assembly (19) using Phillips head screw.
5. INSTALL HEATER DRIVE (19).
 - a. Place new packing (21) on heater drive assembly (19) and install in housing.
 - b. Install sound proof mat (18) over heater drive (19).
 - c. Install new packing (20) on front of heater drive (19).
 - d. Install switch (16) in motor cap (15) and connect tagged wires (17). Secure motor cap to housing with four Phillips head screws.
 - e. Place rotor (14) on motor shaft insuring small pin seats in slot. Secure with retainer (23).



6. INSTALL OVERHEAT SWITCH (5).
 - a. Position overheat switch (5) on housing and secure with two Phillips head screws (38).
 - b. Route overheat switch wiring harness through hole in housing and secure rubber grommet (6) in hole.
 7. PLACE FOIL HEAT PROTECTOR (8) OVER HEAT EXCHANGER.
 8. INSTALL TWO HOODS (2) AND (9), UPPER AND BOTTOM CASE HALVES (10) AND (11).
 - a. Turn heater assembly upside down and install bottom case. Secure with four Phillips head screws (40). Install new gaskets (12) and (13).
 - b. Turn heater right side up and install both hoods (2) and (9) and upper case ensuring wires are routed through hole in top case. Secure with eight Phillips head screws along side and one on top.
 9. INSTALL FLAME DETECTOR (3).
 - a. Place new packing (4) on flame detector (3) and insert in housing. Secure with Phillips head screw.
 10. INSTALL GLOW PLUG (7).
 11. INSTALL HEATER IN CAB. (REFER TO TM 5-3810-306-20.)
- END OF TASK



FUEL (DOSING) PUMP INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

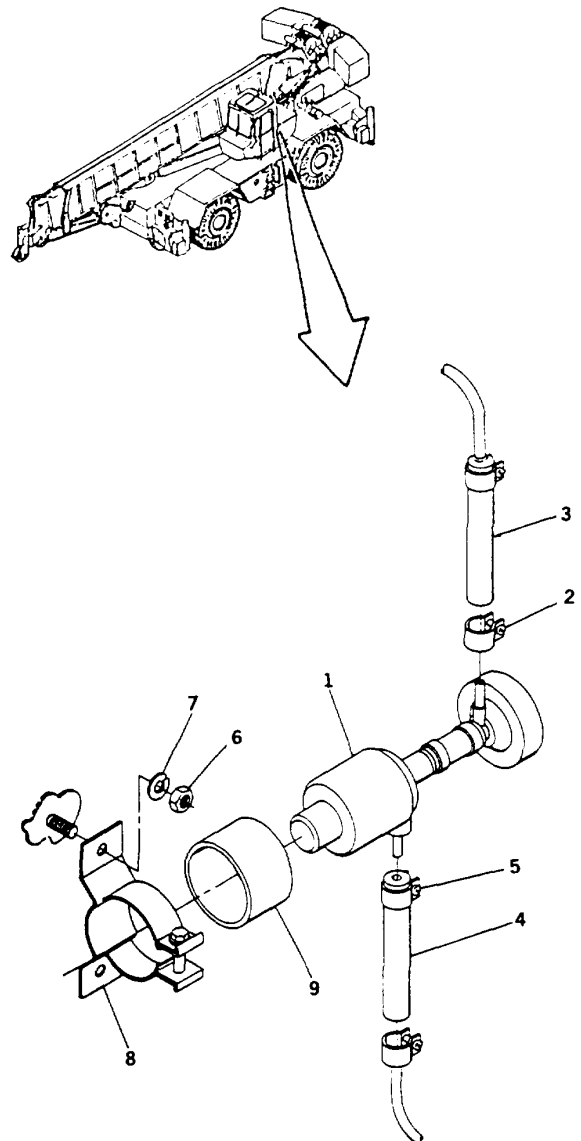
SUPPLIES: Lockwasher (Item 274, Appendix B)

EQUIPMENT CONDITIONS: Disconnect ground cable at shunt.
(Refer to TM 5-3810-306-20.)
Valve compartment access lid open.

REMOVAL:**WARNING**

Fuel is flammable. Keep fuel away from heat and open flame. Catch any fuel that may come out of hoses in a suitable container.

1. SHUT OFF FUEL AT PETCOCK ON BOTTOM OF HEATER FUEL TANK.
2. REMOVE FUEL (DOSING) PUMP (1).
 - a. Tag and disconnect electrical leads from fuel pump (1).
 - b. Loosen hose clamp (2) and disconnect hose (3) from fuel pump (1). Plug hose.
 - c. Loosen hose clamp (4) and disconnect hose (5) from fuel pump (1). Plug hose.
 - d. Loosen clamp (8) and remove bumper (9) and fuel pump (1) from clamp.
 - e. In necessary remove two nuts (6) and lockwashers (7) securing clamp (8) and remove clamp. Discard lockwashers (7).



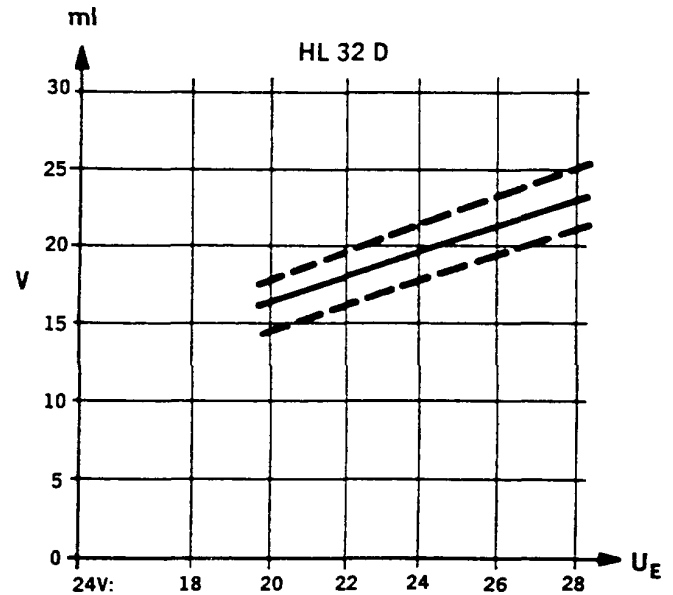
INSTALLATION:

1. INSTALL FUEL (DOSING) PUMP (1).
 - a. If removed, position clamp (8) on mounting studs and secure with two new lockwashers (7) and nuts (6).
 - b. Slide bumper (9) and pump (1) into clamp (8) and tighten.
 - c. Slip hose (5) over fitting on pump and secure with hose clamp (4).
 - d. Slip hose (3) over fitting on pump and secure with hose clamp (2).
 - e. Connect electrical leads to pump and marked during removal.
2. OPEN PETCOCK ON BOTTOM OF HEATER FUEL TANK.
3. CONNECT GROUND CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
4. CHECK CAB HEATER OPERATION. (REFER TO TM 5-3810-306-10.)

CHECKING PUMP FLOW RATE:

1. CHECK FLOW RATE AS FOLLOWS:
 - a. Remove wiring harness cap from top of heater and disconnect glow plug.
 - b. Detach the fuel line from the heater and place the end of it in a measuring cylinder such as a 100 ml graduated burette.
 - c. Turn on heater. After 90 seconds, the heater automatically goes to fault lock-out with subsequent repeat start. Repeat this procedure until fuel emerges from fuel line.

- d. To make the measurements, turn on the heater again and measure the increase in fuel volume for two 90 second periods. At the same time, measure the electrical voltage at the control unit terminals B3 (+) and C2 (-).
- e. Take the data recorded in step d and apply it to the following graph. The point of intersection must lie within the shaded area.



Delivery volume V (ml) of the dosing pump after 180 seconds pumping time plotted against the input voltage U (V) at the electronic control unit. Temperature $T = +20 \pm 2$ ($^{\circ}\text{C}$).

Section II. **AUTOMATIC CONTROL LEVER LOCKOUT CYLINDER AND LINKAGE MAINTENANCE****AUTOMATIC CONTROL LEVER LOCKOUT CYLINDER AND LINKAGE INSTALLATION**

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: "E" clip (Item 193, Appendix B) (2 Required)
Lockwasher (Item 234, Appendix B) (4 Required)

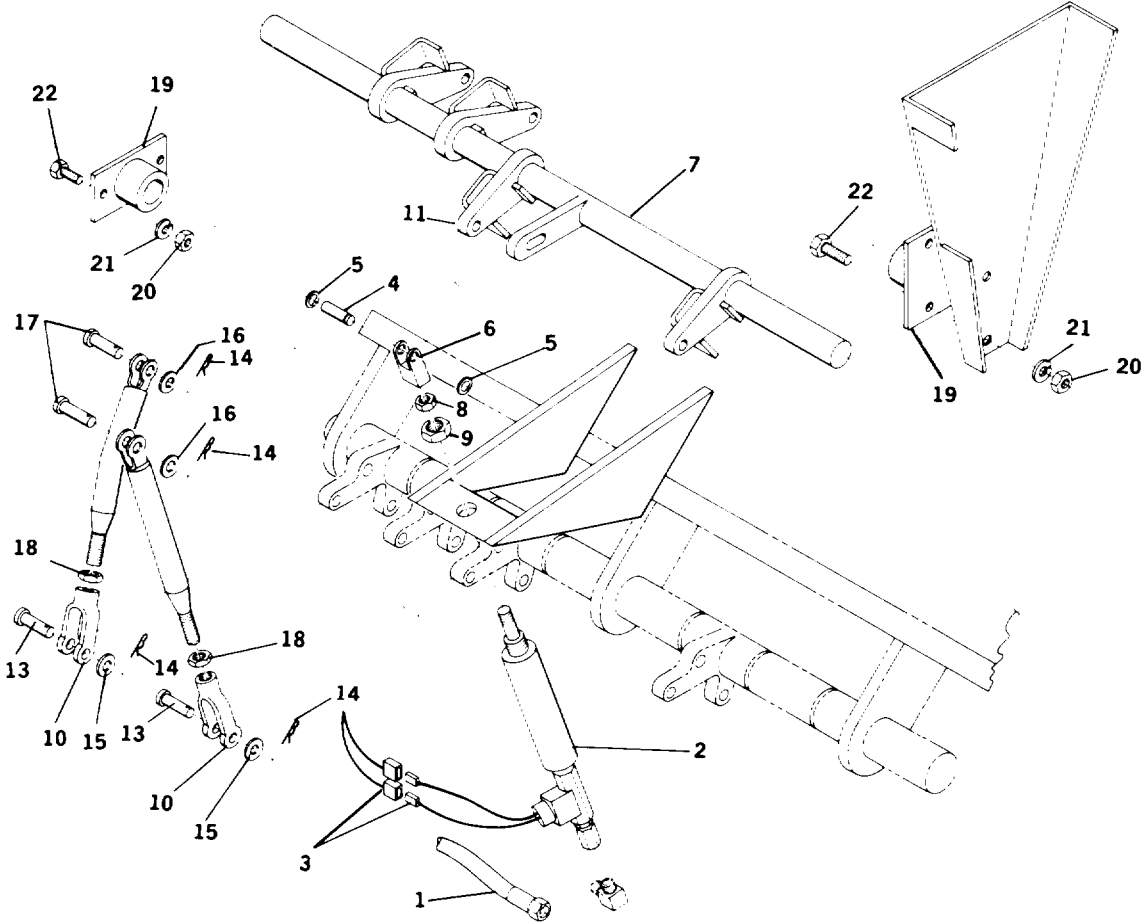
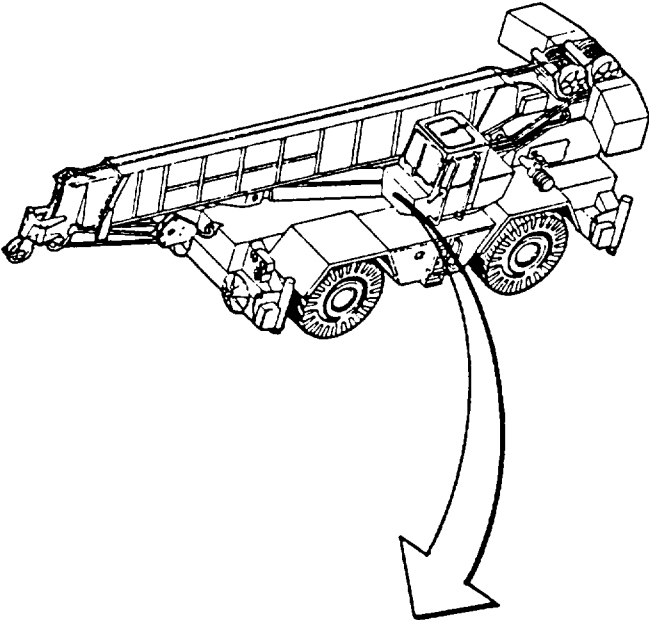
EQUIPMENT CONDITION: Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)
Air system purged. Refer to TM 5-3810-306-20.)
Cab front cover removed. (Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE AUTOMATIC CONTROL LEVER LOCKOUT CYLINDER (2).
 - a. Tag and disconnect air line (1) to automatic control lever lockout (2).
 - b. Remove fitting and retain for reassembly.
 - c. Tag and disconnect two electrical connectors (3).
 - d. Remove two "E" clips (5), from clevis pin (4) securing clevis (6) to lockout shaft (7). Replace clips (5) if damaged.
 - e. Loosen clevis lock nut (8) and remove clevis (6) and lock nut (8) from automatic control lever lockout cylinder (2).
 - f. Remove nut (9) and automatic control lever lockout cylinder (2) from mounting bracket.
2. REMOVE CONTROL RODS (11) AND (12).
 - a. Remove lock pins (14) and washers (15) and (16).
 - b. Remove clevis pins (13) and (17) and control rods (11) and (12).
 - c. If necessary, remove clevis rod ends (10) and jam nuts (18) from control rods (11) and (12).
3. REMOVE SHAFT ASSEMBLY (7) AND BEARING UNITS (19).
 - a. Remove nuts (20) and lockwashers (21) from bolts (22). Discard lockwashers (21).
 - b. Remove bolts (22) and lower shaft (7) and bearing units (19) from frame.
 - c. Slide bearing units (19) from ends of shaft (7).

INSTALLATION:

1. INSTALL SHAFT ASSEMBLY (7) AND BEARING UNITS (19).
 - a. Slide bearing units (19) on ends of shaft (7) and position assembly in frame.
 - b. Install bolts (22), new lockwashers (21) and nuts (20).
2. INSTALL CONTROL RODS (11) AND (12).
 - a. If removed, install jam nuts (18) and clevis rod ends (10) on control rods (11) and (12).



- b. Install control rods (11) and (12) with clevis pins (13) and (17), washers (15) and (16) and lock pins (14).
3. INSTALL AUTOMATIC CONTROL LEVER LOCKOUT CYLINDER (2).
- a. Place lockout cylinder (2) shaft through hole in mounting bracket and secure with nut (9).
 - b. Install locknut (8) and clevis (6) on lockout cylinder (2) shaft.
 - c. Align slotted hole in lockout shaft (7) with hole in clevis (6). Install clevis pin (4) and secure with two "E" clips (5).
 - d. Tighten clevis locknut (8).
 - e. Remove tags and connect two electrical connectors (3).

- f. Install fitting and connect air line (1) to automatic control lever lockout (2).

4. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

5. TEST FOR PROPER OPERATION.

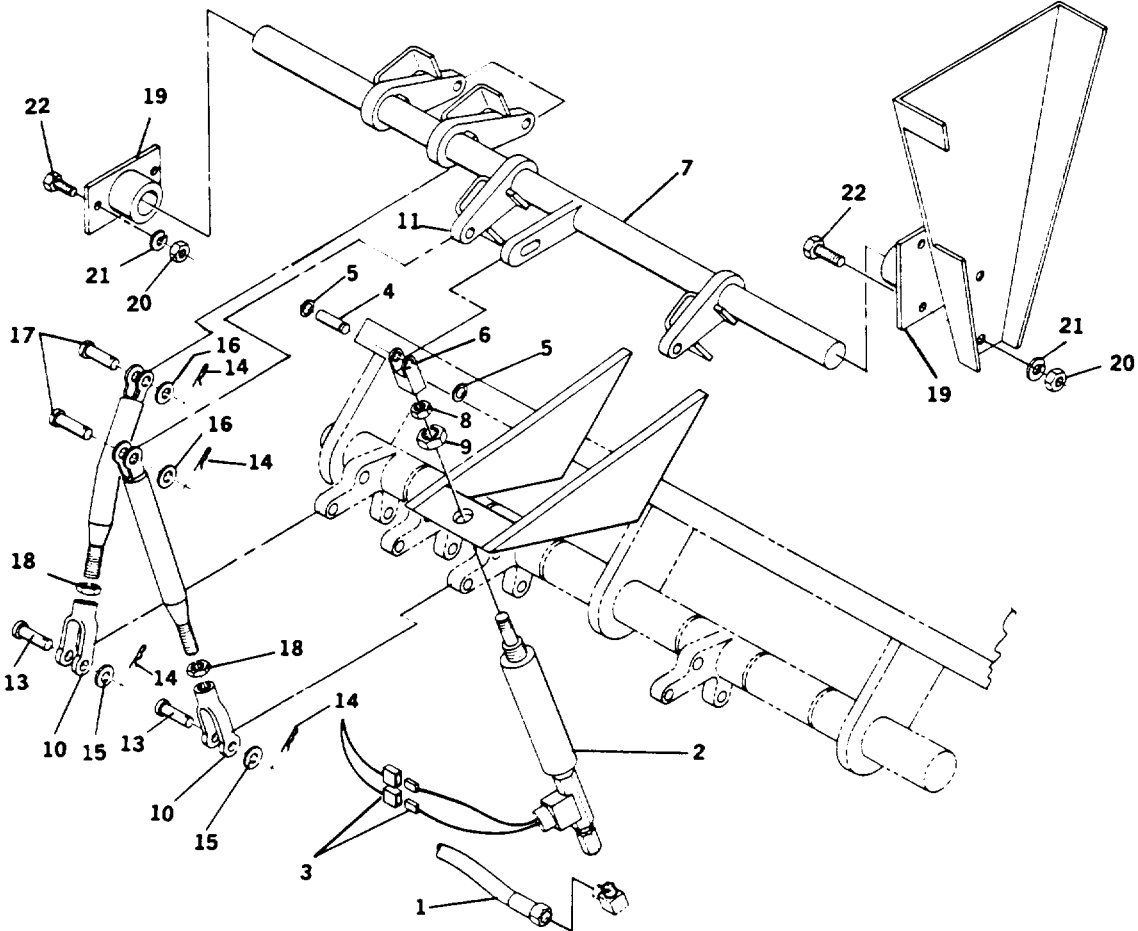
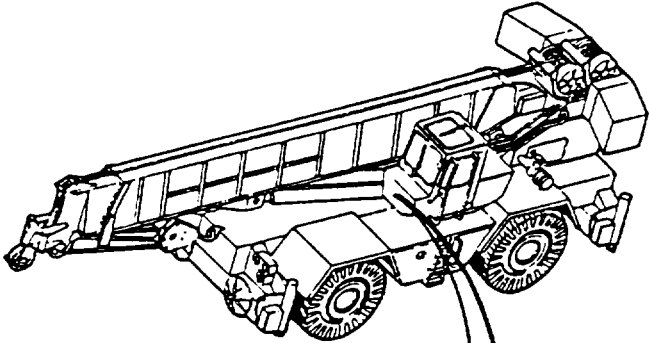
ADJUSTMENT:

1. ADJUST AUTOMATIC CONTROL LEVER LOCKOUT CYLINDER (2).

- a. With control valves centered and lockout cylinder (2) fully extended, adjust clevis (10) until stops on shaft (7) contact free rotating lugs (11) on shaft.

2. INSTALL FRONT COVER ON CAB. (REFER TO TM 5-3810-306-20.)

END OF TASK



Section III. 5TH WHEEL MAINTENANCE**5TH WHEEL INSTALLATION**

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Lifting device (1000 pound capacity)

EQUIPMENT CONDITIONS: Rear axle removed. (Refer to page 8-10.)
Rear axle not centered proximity switch removed. (Refer to TM 5-3810-306-20.)
Lockout cylinders disconnected at 5th wheel. (Refer to page 13-86.)

REMOVAL:

1. REMOVE 5TH WHEEL (1).
 - a. Using a suitable jack, support 5th wheel (1) in carrier frame.
 - b. Remove nuts (3), bolts (2) and pivot pins (4).
 - c. Lower 5th wheel (1) from carrier frame.
 - b. Install pivot pins (4), bolts (2), and nuts (3).
2. CONNECT LOCKOUT CYLINDERS TO 5TH WHEEL. (REFER TO PAGE 13-86.)
3. INSTALL REAR AXLE. (REFER TO PAGE 8-10.)
4. INSTALL REAR AXLE NOT CENTERED PROXIMITY SWITCH. (REFER TO TM 53810-306-20.)

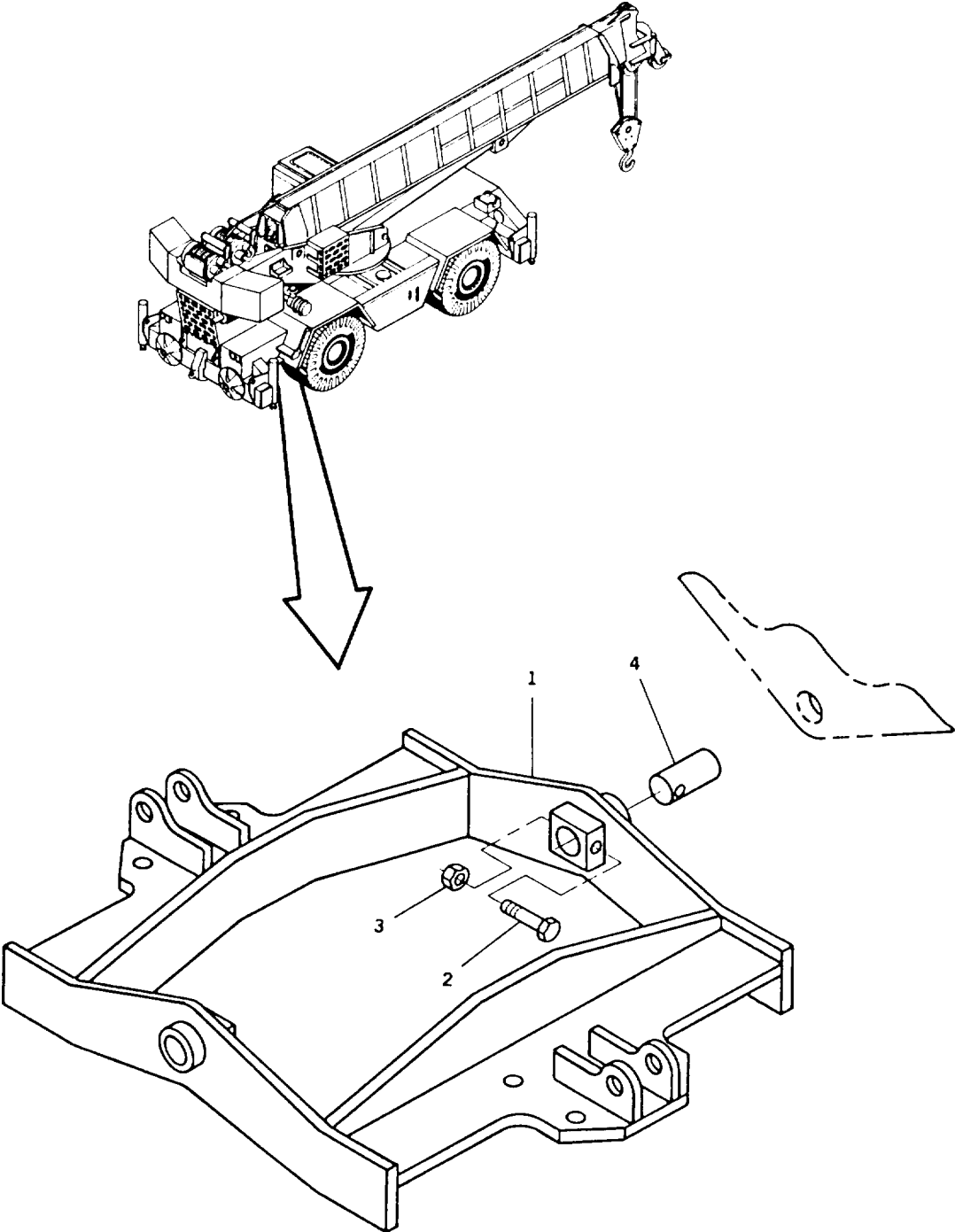
INSPECTION:

1. INSPECT 5TH WHEEL (1) FOR CRACKS AND OBVIOUS DAMAGE. REPLACE IF DAMAGED.

INSTALLATION:

1. INSTALL 5TH WHEEL (1).
 - a. Using a suitable jack, raise and position 5th wheel (1) in carrier frame.

END OF TASK



12-15/12-16 Blank

CHAPTER 13

HYDRAULIC AND FLUID SYSTEM MAINTENANCE

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Section I. HYDRAULIC PUMP MAINTENANCE

OIL COOLER HYDRAULIC MOTOR ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1 (4910-00-754-0706)
 Tool Outfit Hyd System, Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784)
 Check valve tool (Item 4, Appendix C)
 Sleeve (Item 5, Appendix C)
 Carborundum stone
 Seal removal tool (Item 3, Appendix C)
 Lip seal installer (Item 7, Appendix C)

SUPPLIES : Grease (Item 9, Appendix B)
 Aviation Form-A-Gasket No. 3 (Item 75, Appendix B)
 Gasket (Item 72, Appendix B) (2 Required)
 Gasket (Item 73, Appendix B) (2 Required)
 Seal (Item 74, Appendix B)

EQUIPMENT CONDITIONS: Hydraulic motor removed. (Refer to page 13-48.)

DISASSEMBLY:

CAUTION

Disassemble in dust-free work area.

1. POSITION MOTOR ASSEMBLY IN SOFT JAWED VISE WITH SHAFT END DOWN.
2. INDEX MARK HOUSINGS.
 - a. Index mark port end housing (4), gear housing (5), and shaft end housing (16) to facilitate reassembly.
3. REMOVE PORT END HOUSING (4).
 - a. Remove the four capscrews (2) and washers (3) from port end housing (4).

CAUTION

If end cover (4) will not lift off, pry it off using care to avoid damaging machined surfaces.

- b. Remove port end housing (4) from gear housing (5).

4. REMOVE THRUST PLATE (9).

NOTE

If thrust plate (9) remains in gear housing (5) it will be removed later.

CAUTION

Avoid distorting the thrust plate.

- a. Pry thrust plate (9) from port end housing (4) carefully. Remove and discard six pocket seals (12).

NOTE

To replace ring seal (8) pull integral shaft and gear bearing (6) with suitable bearing puller and remove ring seal (8) from bottom of bearing bore.

- b. Check ring seals (8) for wear and replace if necessary.

5. REMOVE GEAR HOUSING (5).

CAUTION

If gear housing (5) will not lift off, pry it off using care to avoid damaging machined surfaces.

- a. Remove integral shaft and gear (11), gear (10), and gear housing (5) from shaft end housing (16). Keep gears together as they are a matched set.

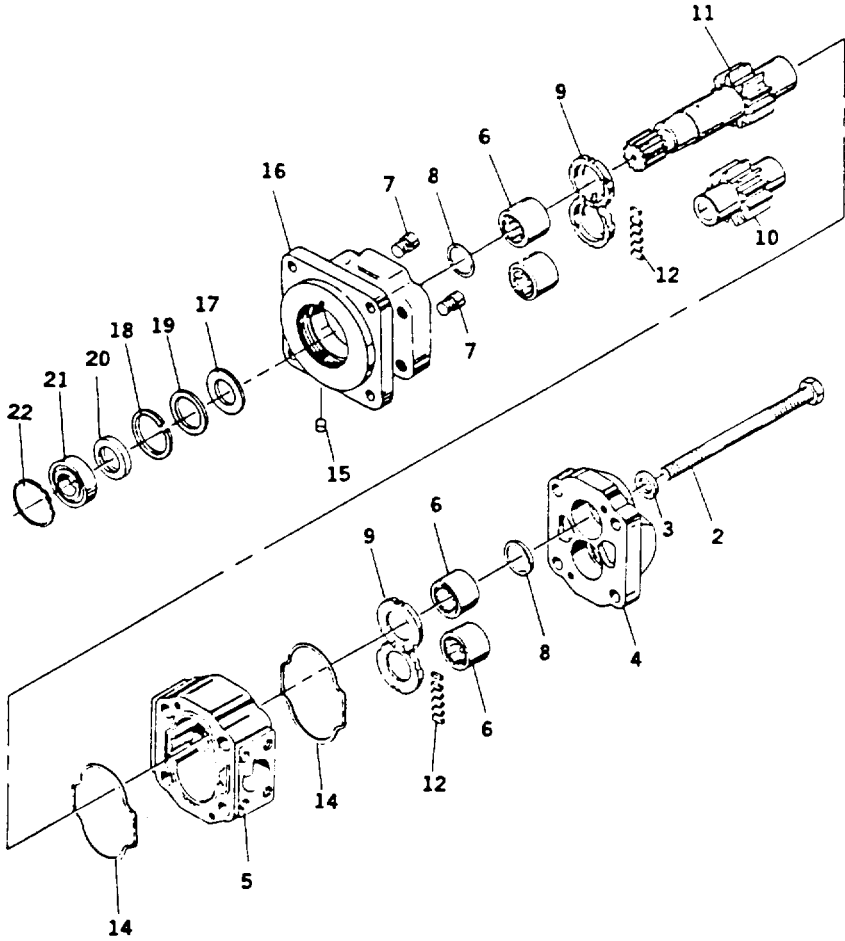
NOTE

Gears are a matched set, therefore both gears must be replaced even if only one was found damaged.

CAUTION

Avoid distorting thrust plates.

- b. If thrust plates (9) remained in gear housing (5), tap them out with a wooden hammer handle.
- c. Remove and discard packings (14) from grooves in housing (5).



6. REMOVE THRUST PLATE (9).

CAUTION

Avoid distorting thrust plate.

- a. Pry thrust plate (9) from shaft end cover (16) with a thin bladed screwdriver. Remove and discard pocket seals (12).

NOTE

To replace ring seal (8) pull integral shaft and gear bearing (6) with suitable bearing puller and remove ring seal (8) from bottom of bearing bore.

- b. Check ring seals (8) for wear and replace if necessary.

7. REMOVE SHAFT END BEARING AND SEALS.

- a. Remove the outboard bearing snap ring (22) with a small screwdriver or awl.
- b. Pull outboard bearing (21) from shaft end cover (16) with a bearing puller.
- c. Remove spacer bearing (20) and retaining ring (18) from shaft end cover (16).
- d. Remove seal retainer (19) and using seal removal tool (Item 3, Appendix C), remove lip seal (17) from shaft end housing (16).
- e. If necessary remove check assemblies (7) from shaft end cover (16) using check valve tool (Item 4, Appendix C).
- f. If necessary, remove plug (15) from shaft end cover (16). Stone off all machined surfaces with a medium grit carborundum stone.

CLEANING:**WARNING**

Dry cleaning solvent P-D680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F/38°C. If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

1. CLEAN ALL PARTS IN SOLVENT P-D-680 AND DRY WITH COMPRESSED AIR.

INSPECTION:

1. INSPECT HOUSINGS.

NOTE

Wear in excess of 0.005in. (0.127 mm) cutout justifies replacement of housing.

- a. Place a straight edge across housing bore. If a 0.005-in. (0.127 mm) feeler gauge will slip between straight edge and housing, replace housing.

2. INSPECT GEAR HUBS AND GEARS.

NOTE

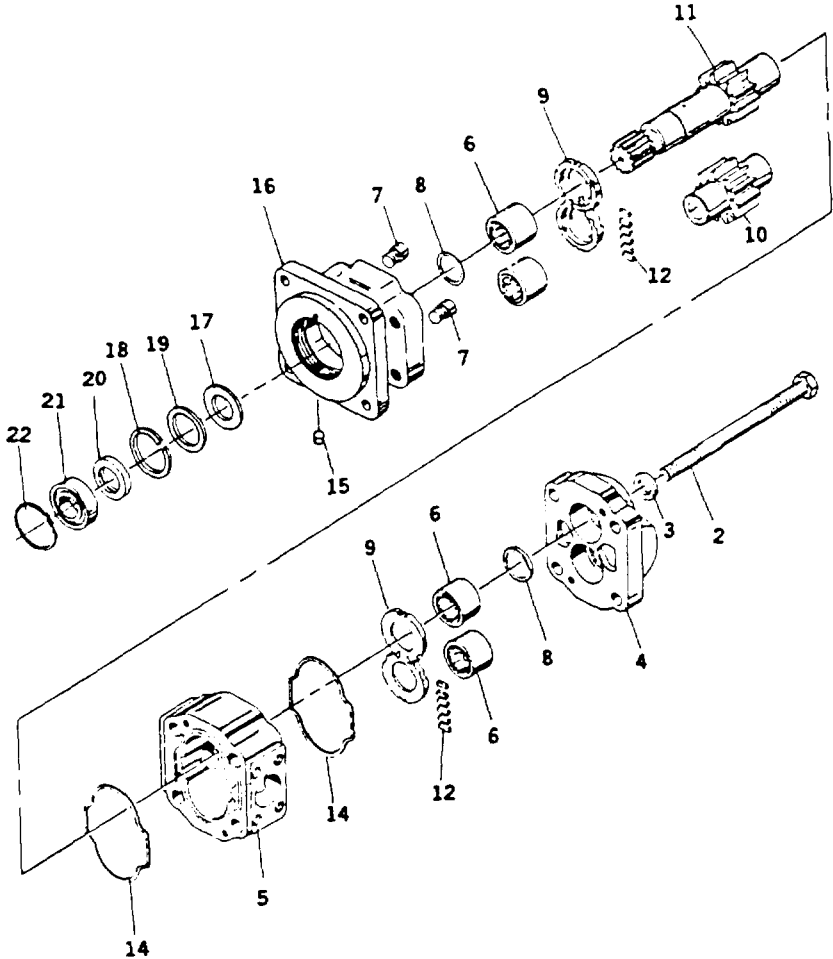
Gears are a matched set, therefore both gears must be replaced even if only one was found damaged.

- a. Any wear on gear hubs that is detectable by touch, or exceeding 0.002-in. (0.051 mm) justifies replacement. Scoring, grooving, or burring of the outside diameter of the gear teeth, as well as nicking, grooving, or fretting of teeth surfaces necessitates replacement.

- b. Replace the integral shaft and gear if any wear is detectable visibly or by touch in the seal areas or at the drive coupling. A maximum of 0.002-in. (0.051 mm) wear is allowable. Wear or damage to key or keyway justifies replacement. Wear in shaft seal areas indicates oil contamination.

3. INSPECT THRUST PLATES.

- a. Thrust plates seal the gear section at sides of gears. Wear in this area will allow internal slippage, resulting in oil bypassing within motor. Maximum allowable wear is 0.002-in. (0.051 mm). Replace thrust plates if they are scored, eroded, or pitted.



- b. Check the center area of thrust plates where the gears mesh. Erosion in this area indicates oil contamination. Pitted thrust plates indicate cavitation or oil aeration. Discoloration of plates would indicate overheating, probably as a result of insufficient oil.

- a. Peen edge of check valve holes 1/32 to 1/16 in. using a 1-1/2 in. diameter steel ball.

3. INSTALL SHAFT END BEARING AND SEALS.

NOTE

Coat outer edge of new lip seal (17) with Aviation Form-A-Gasket No. 3 non-hardening sealant or equivalent prior to installation.

- a. With metal side up press new lip seal (17) in shaft end cover (16) using suitable press and lip seal installer (Item 7, Appendix C). Ensure seal is fully seated in bore.
- b. Install seal retainer (19) in shaft end cover (16).
- c. Install spacer bearing (20) and retaining ring (18) in shaft end cover (16).
- d. Using a press install outboard bearing (21) into shaft end cover.
- e. Install snap ring (22) into shaft end cover groove to retain outboard bearing.

4. INSPECT BEARINGS.

CAUTION

If the gears are replaced, bearings must be replaced also.

- a. Examine roller bearings (6) for spalling and pitting. If replacement is necessary, pull bearings with a bearing puller.
- b. If bearings have been removed, deburr bearing bores. Clean all parts in a suitable solvent and dry them with compressed air.
- c. Bearings should fit into bore with a light press fit, however, a neat hand fit is allowable. If the bearings tend to fall from bore, bore is probably oversize.

4. INSTALL RING SEALS (8) IF REMOVED.

NOTE

The notch in ring seal (8) must be visible to ensure notched side is next to bearing.

- 1. IF REMOVED, INSTALL PLUG (15) IN SHAFT END HOUSING (16). TORQUE PLUG TO 240 IN-LBS (27 Nm).
- 2. IF REMOVED, INSTALL CHECK ASSEMBLIES (7) IN SHAFT END COVER (16) USING CHECK VALVE TOOL (ITEM 4, APPENDIX C).

- a. Install new ring seals (8) into bottom of integral shaft and gear bearing bore on both shaft end cover (16) and port end cover (4).

5. INSTALL BEARINGS (6).

- a. Replace any bearings that have been removed from shaft end cover (16) and port end cover (4). Install bearings with an arbor press.

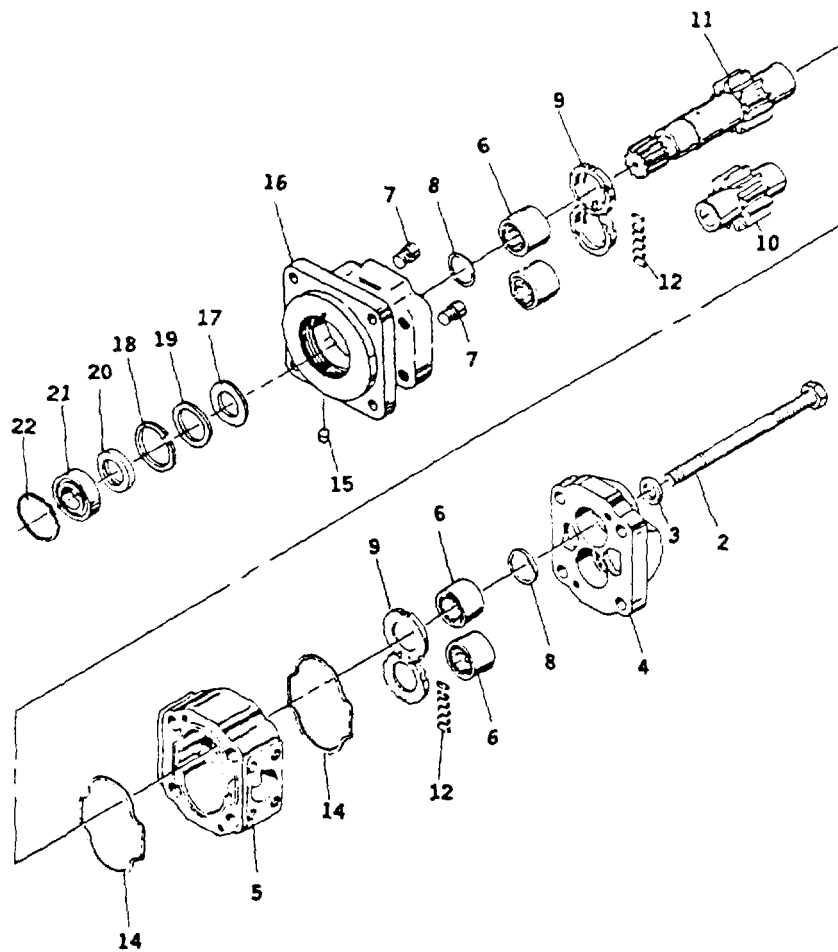
6. INSTALL THRUST PLATES (9).

- a. Cut two pocket seals for each thrust plate 0.219 in. (5.56 mm) long from pocket seal strip.
- b. Place a small amount of heavy grease into two middle slots in open face of thrust plates (9) and insert pocket seals (13).
- c. With pocket seals down, place thrust plates (9) over bearings (6) in shaft end cover (16) and port end cover (4). Tap thrust plates with a soft hammer to about 0.031-in. (0.794 mm) from machined surface.

- d. Cut four pocket seals for each thrust plates (9) approximately 0.25-in. (6.35 mm) long from pocket seal strip. Insert one pocket seal into each slot in thrust plate. Push each pocket seal all the way in so that they touch roller bearings. Tap thrust plates down firmly against machined surface with a soft hammer. Using a sharp razor blade, trim exposed end of pocket seal square and flush with thrust plate.

7. INSTALL GEAR HOUSING (5).

- a. Grease the new packings (14) and install them into grooves in both sides of gear housing (5).



- b. Insert keyed end of integral shaft and gear (11) into special steel sleeve (Item 5, Appendix C). Lightly grease driveshaft and sleeve. Insert shaft with sleeve into shaft end cover with twisting motion. Be careful not to damage shaft seal (17). Push down carefully until gear rests against thrust plate (9). Remove steel sleeve.
- c. Install drive gear (10) into the shaft end cover roller bearing bores.

- d. Slide gear housing (5) over gears and tap with a soft hammer until housing rests tightly against the shaft end cover (16).

NOTE

Oil the gears to provide initial lubrication when the motor is started.

- 8. INSTALL PORT END COVER (4).

CAUTION

Avoid pinching the gasket seal (14).

CAUTION

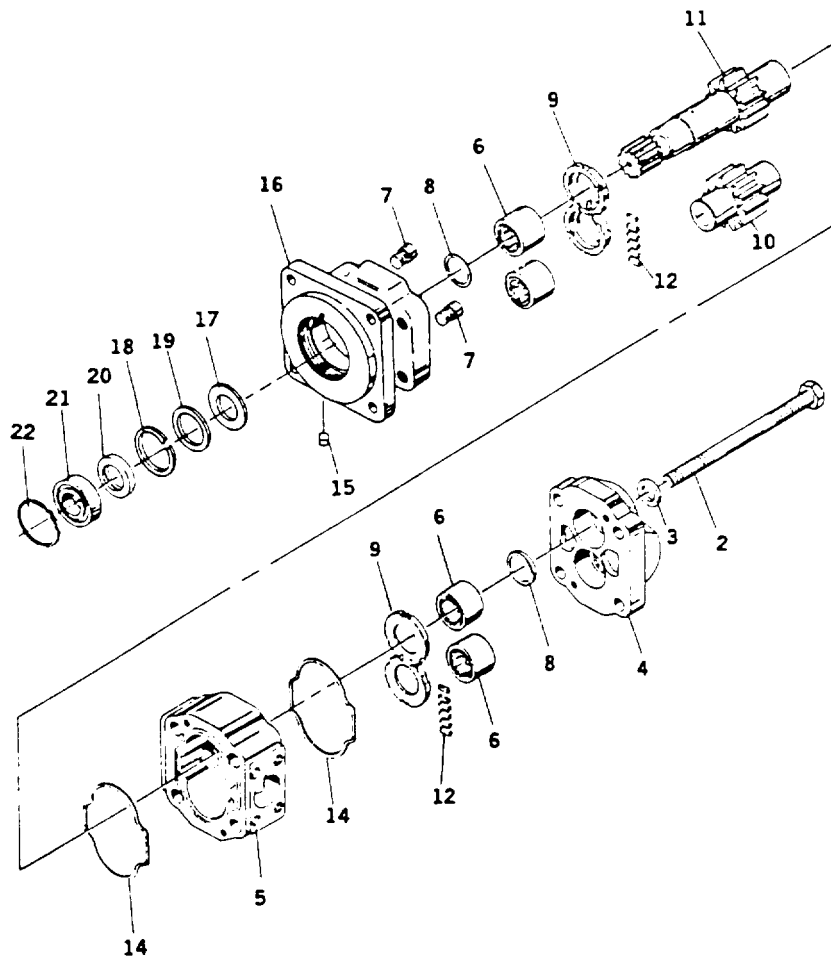
Ensure index marks are properly aligned.

CAUTION

Avoid pinching gasket seal (14).

CAUTION

Ensure index marks are properly aligned.



- a. Install port end cover (4) over gear hubs and tap with a soft hammer until cover (4) rests tightly against gear housing (5).
 - b. Thread four capscrews (2) with washers (3) into shaft end cover (4). Tighten diagonally opposed capscrews (2).
 - c. Using 6-in. wrench rotate the drive shaft to ensure there is no binding in motor.
 - d. Torque diagonally opposed capscrews (2) to 200 ft-lbs (266 Nm).
9. INSTALL HYDRAULIC MOTOR. (REFER TO PAGE 13-48.)
 10. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
 11. DRAIN AND FLUSH HYDRAULIC SYSTEM. (REFER TO PAGE 13-115.)
 12. BLEED AIR FROM HYDRAULIC SYSTEM. (REFER TO PAGE 13-117.) OBSERVE FOR LEAKS AND PROPER OPERATION.

END OF TASK

3-SECTION HYDRAULIC PUMP INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1 (4910-00-754-0706)
 Tool Outfit Hyd System, Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784)

SUPPLIES: Lockwashers (Item 26, Appendix B) (6 Required)
 Gasket (Item 28, Appendix B)
 Hydraulic oil (Item 8, Appendix B)
 Silicone sealant (Item 27, Appendix B)

EQUIPMENT CONDITIONS: Outriggers fully extended and lowered. (Refer to TM 5-3810-306-10.)
 Boom positioned over-the-side.
 Engine hood top cover removed. (Refer to TM 5-3810-306-20.)
 Rear decking removed. (Refer to TM 5-3810-306-20.)
 Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)

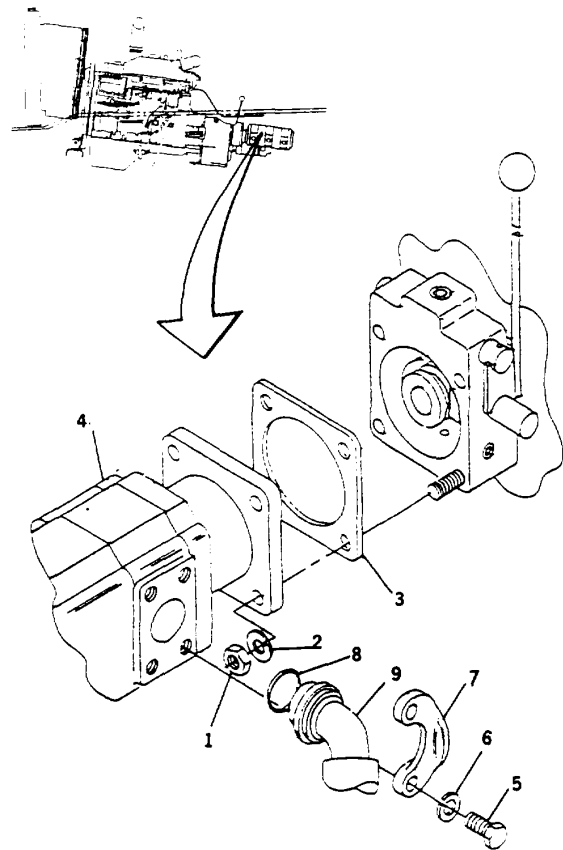
REMOVAL:

1. REMOVE 3-SECTION HYDRAULIC PUMP (4).
 - a. Tag and disconnect hydraulic hoses (9) from pump (4) by removing capscrews (5), lockwashers (6) and split flanges (7). Remove hoses and discard preformed packing (8). Cap all lines and openings.
 - b. Remove nuts (1) and Lockwashers (2) securing hydraulic pump.

NOTE

Leave pump disconnect on studs unless necessary to remove it. If gasket between pump drive pad and disconnect is broken, it must be replaced.

- c. Remove pump and if necessary, remove drive sleeve.
- d. Cover opening to prevent dirt from getting into pump drive opening.



INSTALLATION:**NOTE**

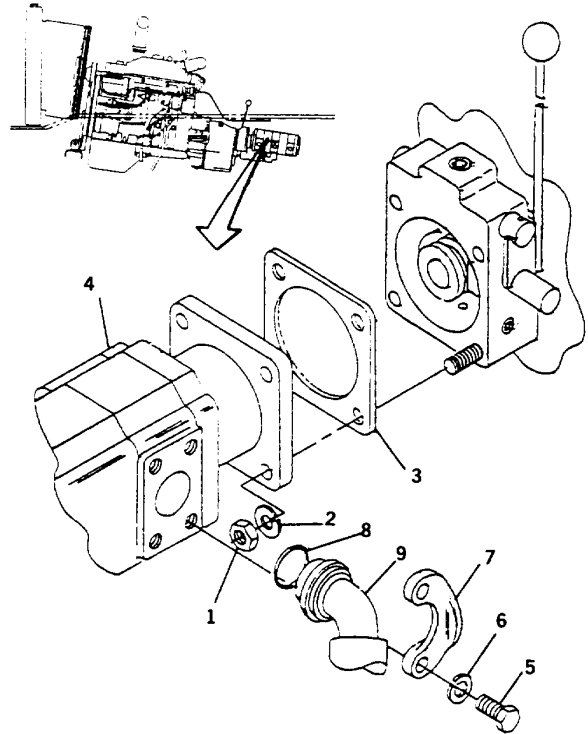
If pump is being installed on new torque converter it will be necessary to install new studs in pump drive flanges. Studs must be 4.5 in. (11.4 cm) long as measured from the mounting flange. Using a prick punch,peen studs at mounting flange holes.

1. INSTALL THREE-SECTION HYDRAULIC PUMP (4).
 - a. Uncover pump opening.
 - b. If pump disconnect was removed install new gasket with silicone sealant and install pump disconnect.
 - c. If removed, install pump drive sleeve.
 - d. Install a new gasket (3) between pump (4) and pump drive mounting. Apply silicone sealant to gasket.
 - e. Install the pump (4) using nuts (1) and lockwashers (2).

NOTE

Coat new preformed packing with clean hydraulic oil prior to assembly.

- f. Connect hydraulic hoses (9) with new preformed packing (8) to pump as tagged during removal using split flanges (7), lockwashers (6) and capscrews (5).



2. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

CAUTION

Hot oil must not be fed into a cold pump. It may cause pump to seize.

3. DRAIN AND FLUSH HYDRAULIC SYSTEM. (REFER TO PAGE 13-115.)
4. BLEED AIR FROM HYDRAULIC SYSTEM. (REFER TO PAGE 13-117.) OBSERVE FOR LEAKS AND PROPER OPERATION.
5. INSTALL REAR DECKING. (REFER TO TM 5-3810-306-20.)
6. INSTALL ENGINE HOOD TOP COVER. (REFER TO TM 5-3810-306-20.)

END OF TASK

THREE-SECTION HYDRAULIC PUMP ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1 (4910-00-754-0706)
 Tool Outfit Hyd System, Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784)
 Seal removal tool (Item 3, Appendix C)
 Carborundum stone
 Sleeve (Item 6, Appendix C)
 Lip seal Installer (Item 8, Appendix C)

SUPPLIES: Preformed packing (Item 96, Appendix B) (4 Required)
 Parts kit, seal repl (Item 97, Appendix B)
 Lint free cloth (Item 91, Appendix B)
 Solvent, P-D-680 (Item 1, Appendix B)
 Form-a-gasket (Item 75, Appendix B)

EQUIPMENT CONDITIONS: Three-Section hydraulic pump assembly removed. (Refer to page 13-10.)

DISASSEMBLY:

NOTE

CAUTION

When securing pump in a vise, do not grip on or near machined surfaces.

1. REMOVE PORT END COVER (5).
 - a. Place pump in a vise with shaft pointing down. Index mark all sections with a prick punch for proper alignment during assembly.
 - b. Remove nuts (2), washers (4) and studs (3) securing port end cover (5).

It will be necessary to pry components off dowel pins (6). Pry from opposite sides.

c. Remove port end cover (5).

2. REMOVE GEAR HOUSING (12).

CAUTION

If it is necessary to pry housing loose, use care to avoid damaging machined surfaces.

a. Remove gear housing (12) from gears (13).

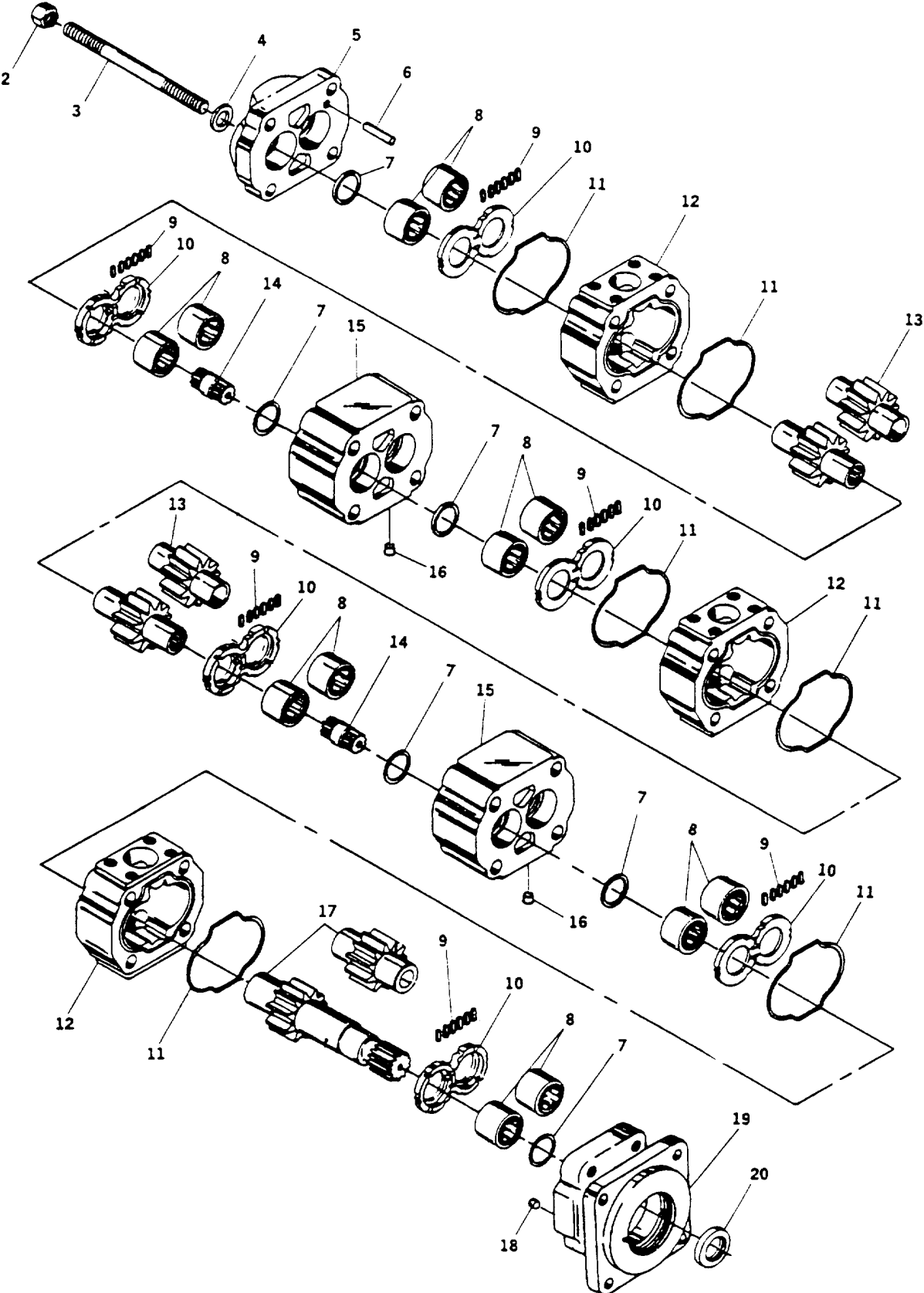
b. Remove and discard performed packings (11).

3. REMOVE DRIVE AND DRIVEN GEARS (13) AND KEEP THEM TOGETHER AS THEY ARE A MATCHED SET.

4. REMOVE CONNECTING SHAFT (14).

NOTE

If thrust plate (10) remains in gear housing (12), tap it out with a wooden hammer handle. Avoid distorting the thrust plate.



CAUTION

If it is necessary to pry bearing carrier loose, use care to avoid damaging machined surfaces.

5. LIFT OFF BEARING CARRIER (15) AND REMOVE PLUG (16) IF NECESSARY.

CAUTION

If it is necessary to pry gear housing loose, use care to avoid damaging machined surfaces.

NOTE

If thrust plate (10) remains in gear housing, tap it out with a wooden hammer handle. Avoid distorting thrust plate.

6. USING STEPS 2 THROUGH 5, REMOVE ADDITIONAL GEAR HOUSINGS (12) AND BEARING CARRIER (15) FROM SHAFT END COVER.
7. REMOVE DRIVE GEAR WITH SHAFT AND DRIVEN GEAR (17), AND KEEP THEM TOGETHER AS THEY ARE A MATCHED SET.

CAUTION

Avoid distorting thrust plate.

8. REMOVE THRUST PLATES (10) AND SEALS (11) AND (9).
 - a. Pry thrust plate from shaft end cover, port end cover or bearing carrier with a screwdriver or similar tool. Remove and discard all rubber seals (9) and gasket seals (11).
9. INSPECT BEARINGS (8) AND RING SEALS (7) AND REPLACE AS REQUIRED.

- a. Examine all roller bearings (8) for spalling or pitting. If replacement is necessary, pull bearings (8) with a bearing puller.

NOTE

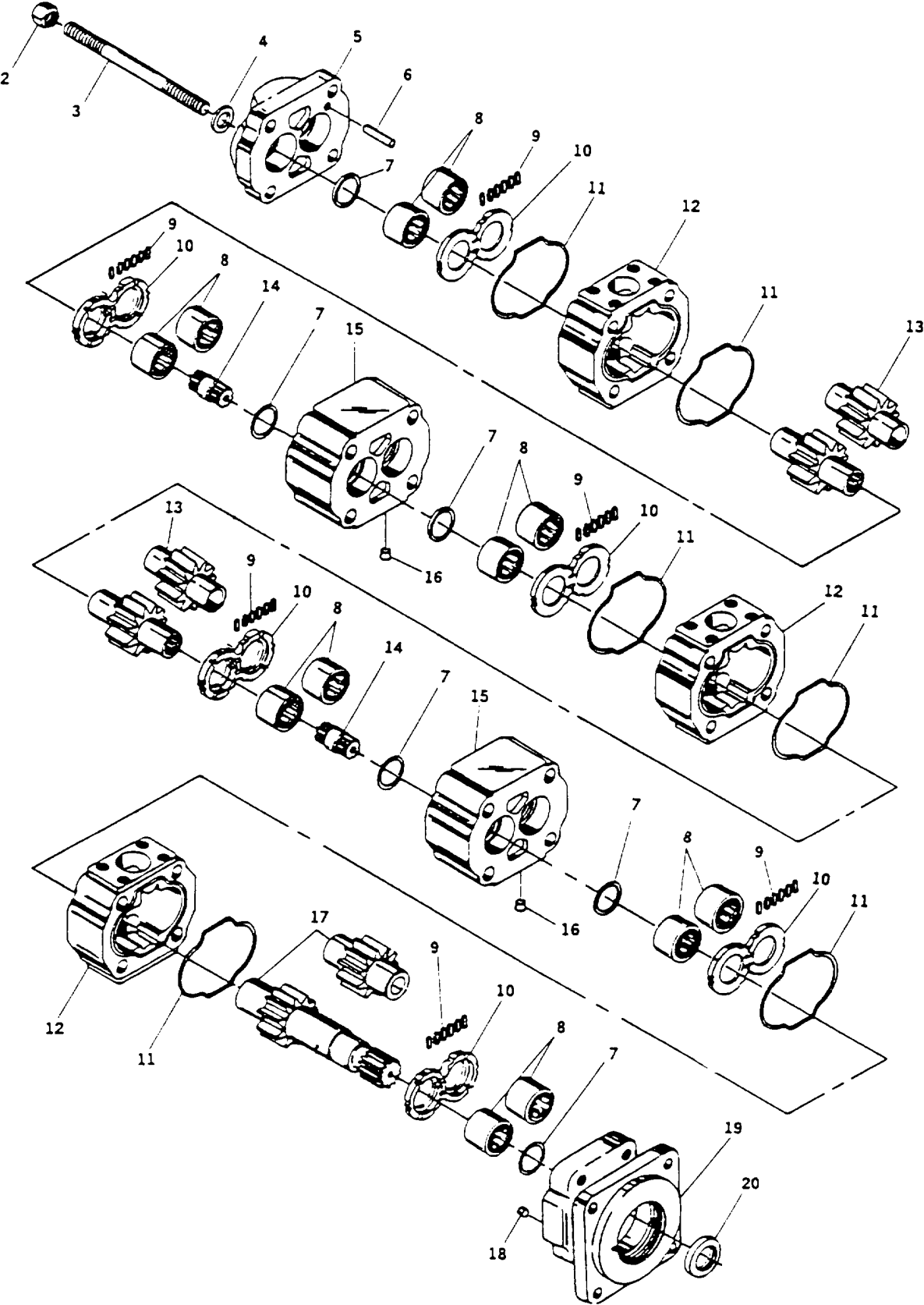
To replace ring seals (7), pull drive gear bearing with a bearing puller and remove ring seal from bottom of bearing bore.

- b. Check ring seals (7) for wear and replace them if necessary.
10. REMOVE LIP SEAL (20) FROM SHAFT END COVER (19).
 - a. Secure shaft end cover in a vise with mounting face down. Remove double lip seal by inserting special seal removal tool (Item 3, Appendix C) into notch between double lip seal and shaft end cover. Tap double lip seal out from shaft end cover and discard seal.
 - b. Stone off all machined surfaces with a medium grit carborundum stone.

CLEANING:

WARNING

Dry cleaning solvent P-D680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat.



WARNING (Cont'd)

The flash point is 100°F/38°C (38°/59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

1. CLEAN ALL PARTS IN SOLVENT P-D-680 AND BLOW DRY WITH COMPRESSED AIR.

INSPECTION:

1. INSPECT GEAR HOUSING.

NOTE

Wear in excess of 0.005in. (0.127 mm) cutout justifies replacement of housing.

- a. Place a straight edge across housing bore. If a 0.005-in. (0.127 mm) feeler gauge will slip between the straight edge and housing, replace housing.
2. INSPECT DRIVE AND DRIVEN GEARS (17).
 - a. Any wear on gear hubs that is detectable by touch, or exceeding 0.002-in. (0.051 mm) justifies replacement. Scoring, grooving, or burring of outside diameter of gear teeth, as well as nicking, grooving, or fretting of teeth surfaces necessitates replacement.

NOTE

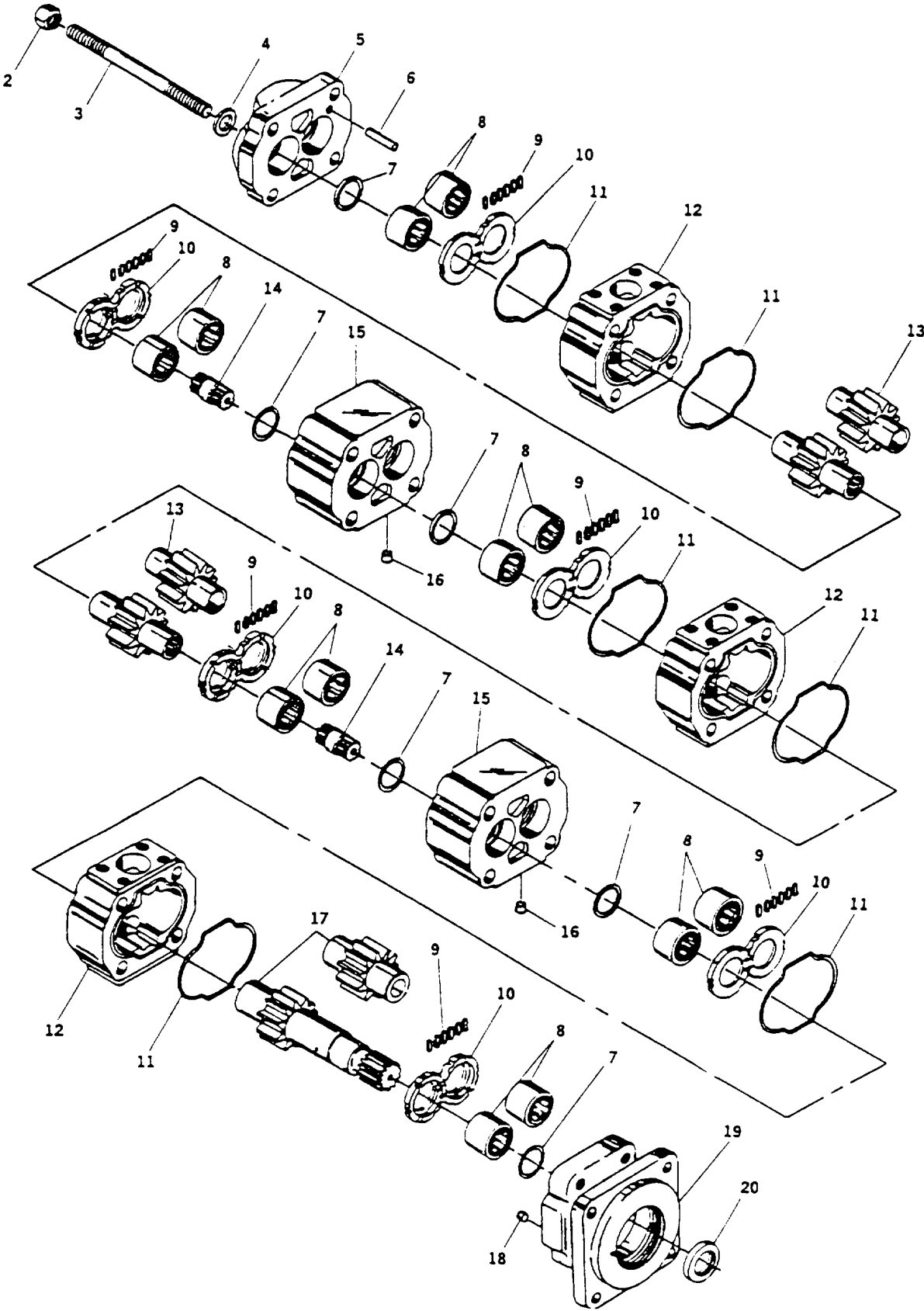
Gears are a matched set, therefore both gears must be replaced even if only one was found damaged.

3. INSPECT DRIVE SHAFT (14).
 - a. Replace drive shaft if any wear is detectable visibly or by touch in seal areas or at drive coupling. A maximum of 0.002in. (0.051 mm) wear is allowable. Wear or damage to splines justifies replacement. Wear in shaft seal areas indicates oil contamination.
4. INSPECT THRUST PLATES (10).
 - a. Thrust plates seal gear section at sides of gears. Wear in this area will allow internal slippage, resulting in oil bypassing within the pump.
 - b. Maximum allowable wear is 0.002in. (0.051 mm). Replace thrust plates if they are scored, eroded, or pitted.
 - c. Check center area of thrust plate where gears mesh. Erosion in this area indicates oil contamination. Pitted thrust plates indicate oil contamination, cavitation or oil aeration. Discoloration of plates would indicate overheating, probably as a result of insufficient oil.
5. INSPECT BEARINGS (8).

CAUTION

If gears are replaced, bearings must be replaced also.

- a. Bearings should fit into bore with a light press fit, however, a neat hand fit is allowable. If bearings tend to fall from bore, bore is probably oversize.



REASSEMBLY:**NOTE**

If either dowel pin (6) or dowel hole is damaged, pin or machined casting, or both, must be replaced. If more than reasonable force is required to seat dowels, cause may be poorly deburred or dirty parts; cocking of dowel in holes or improper pin-to-hole fit.

NOTE

Replace all rubber and polymer seals. Include all packings, pocket seals (9) behind thrust plates (10), shaft seal (20) and gasket seals (11).

CAUTION

When securing pump in a vise, do not grip on or near machined surfaces.

1. IF BEARINGS HAVE BEEN REMOVED, DEBURR BEARING BORES. CLEAN ALL PARTS IN A SUITABLE SOLVENT AND DRY THEM WITH COMPRESSED AIR. WIPE WITH CLEAN LINT FREE CLOTH.

NOTE

If plug (18) is replaced, strike new plug with a prick punch at both ends of screwdriver slot and around edges.

2. EXAMINE PLUG (18) FOR SECURITY. REPLACE ONLY IF IT IS DAMAGED.

CAUTION

Do not attempt to bottomout double lip seal. Press in until seal is flush with face of recess.

NOTE

Wipe off excess sealant.

3. INSTALL LIP SEAL (20).
 - a. Coat outer edge of lip seal and its recess with Permatex Aviation Form-A-Gasket No. 3 Non-hardening Sealant or equivalent. With metal side of lip seal up, press it into mounting flanges side of the shaft and cover (23) with an arbor press and lip seal installer (Item 8, Appendix C).
4. INSTALL RING SEALS (7) AS APPLICABLE.

NOTE

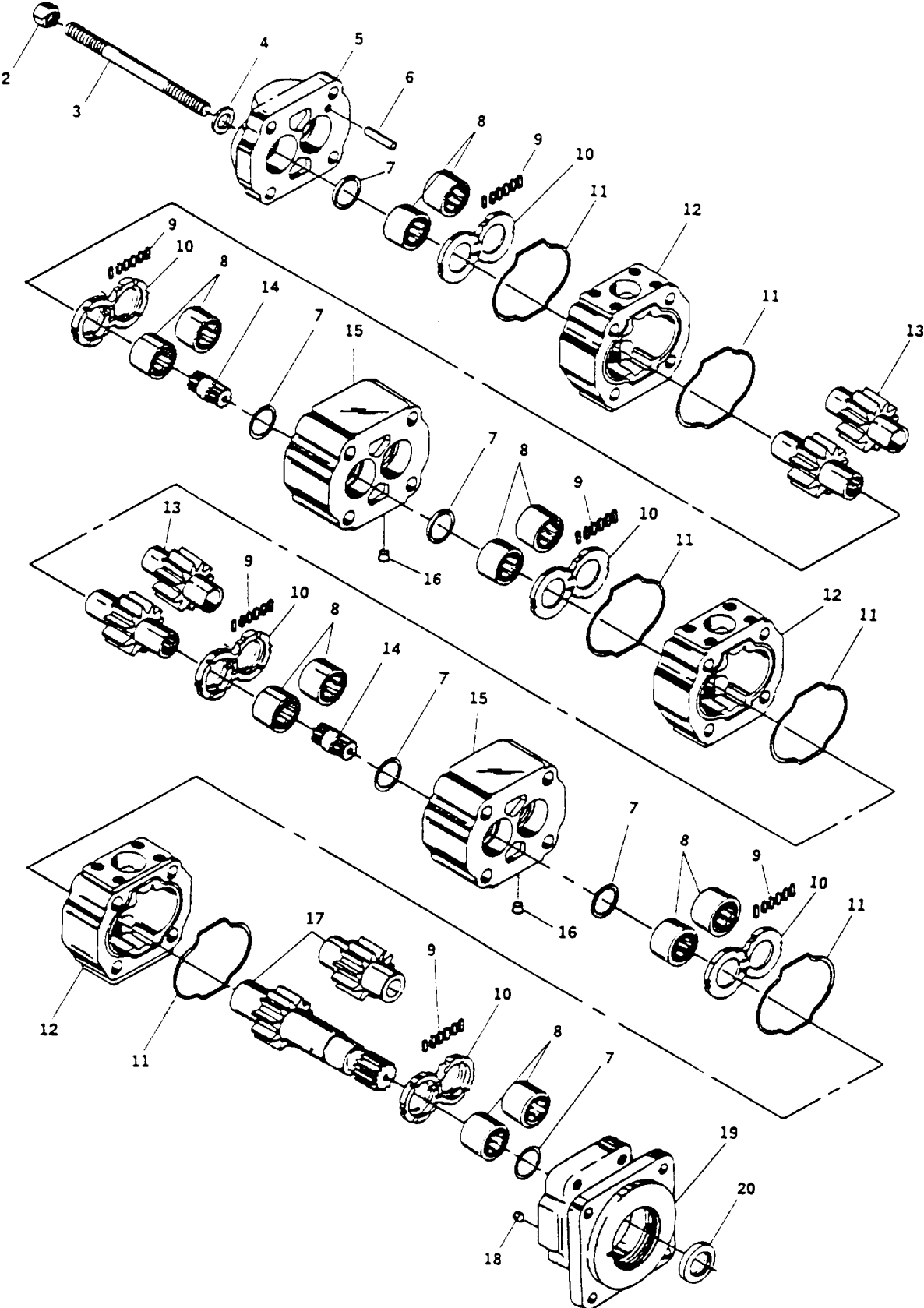
Notch in ring seal must be visible to ensure notched side of seal (7) is next to bearing (8).

- a. If ring seals are being replaced, insert them into bottom of drive gear bearing bore.

CAUTION

Use an arbor press only to install bearings. Do not hammer bearings into place.

5. INSTALL BEARINGS (8) AS APPLICABLE.
 - a. Replace any bearings that have been removed from shaft end cover (19), port end cover (5), or bearing carrier (15). Install bearings with an arbor press.



NOTE

Thrust plates (10) have a single relief pocket and must be installed with this groove on high pressure (outlet) side.

6. REPLACE DAMAGED OR WORN THRUST PLATES (10) AND INSTALL GREASED POCKET SEALS (9).
 - a. Cut two pocket seals (9) 0.219in. (5.556 mm) long from pocket seal strip. Grease seals (9) and insert them into middle slots in thrust plate (10).
 - b. With pocket seals down, place thrust plates (10) over bearings (8) in shaft end cover (19). Tap thrust plate with a soft hammer to about 0.031-in. (0.794 mm) from machined surface.
 - c. Cut four pocket seals approximately 0.25-in. (6.35 mm) long from pocket seal strip. Insert one pocket seal into each slot in thrust plate. Push each pocket seal all the way in so that they touch roller bearing (8). Tap thrust plate (10) down firmly against machined surface with a soft hammer. Using a sharp razor blade, trim exposed end of pocket seal square and flush with thrust plate (13).
 - d. Secure shaft end cover (19) in a vise with mounting face down.

CAUTION

Avoid damaging the double lip seal.

7. INSTALL SHAFTS (17).

- a. Insert splined end of drive shaft (17) into special drive sleeve (Item 6, Appendix C). Lightly grease drive shaft and sleeve. Insert internal gear and drive shaft with sleeve into shaft end cover (19) with a twisting motion. Push down carefully until gear rests against thrust plate (10). Remove steel sleeve. Insert driven gear.

8. INSTALL FIRST SECTION GEAR HOUSING (12) AND GASKETS (11).

- a. Grease new gasket seals (11) and insert them into grooves in both sides of all gear housings (12).
- b. Examine all dowel pins (6). Before inserting a pin, ensure hole is clean and free from burrs. Start pin into hole gently and straight, tapping lightly with a soft hammer.

CAUTION

Avoid pinching gasket seal (11).

NOTE

Oil gears to provide initial lubrication when pump is started.

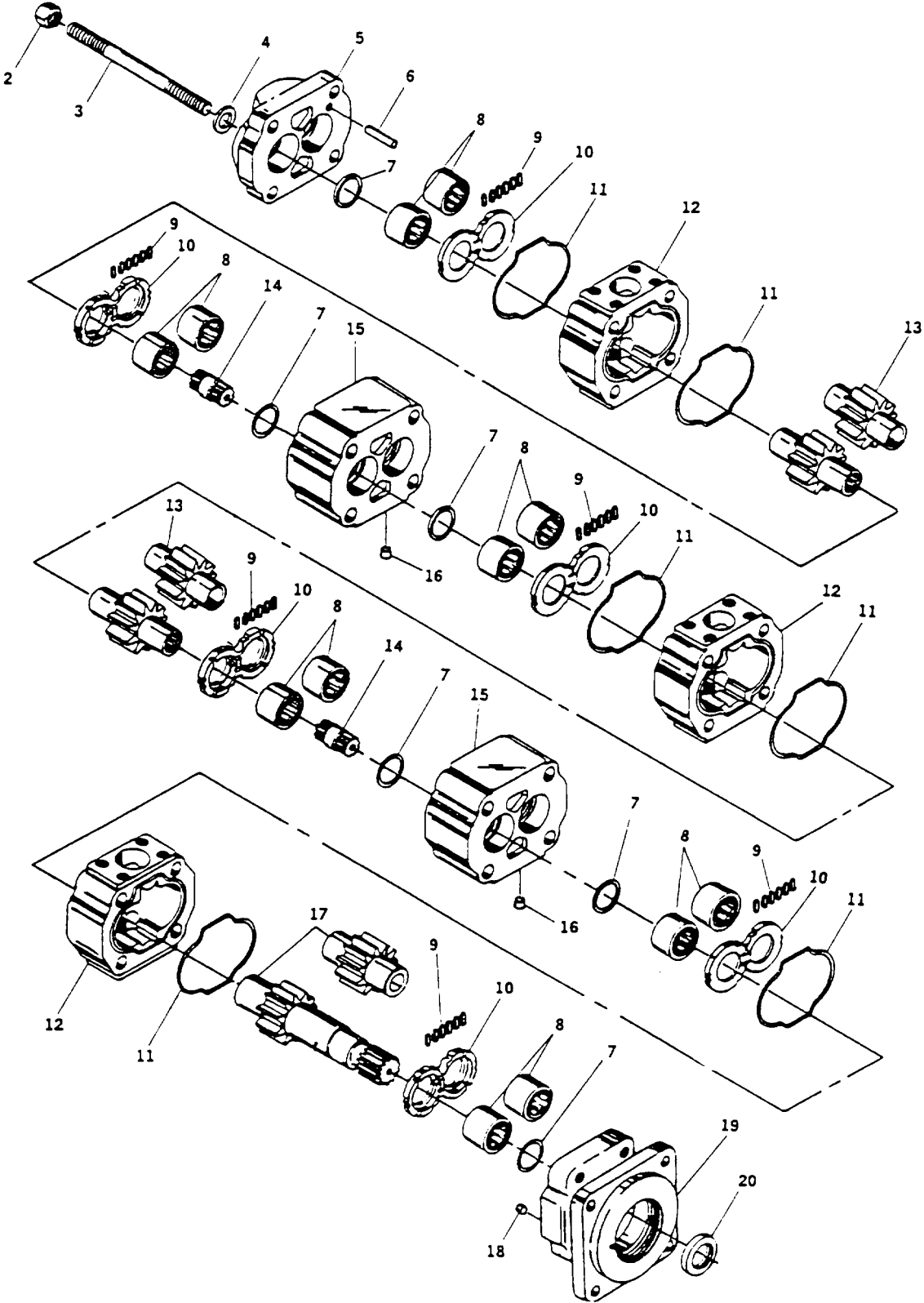
CAUTION

Do not force parts together.

- c. Line up dowels with matching holes. When parts are parallel, squeeze them together or gently tap alternately over dowels with a plastic hammer until parts become parallel and move smoothly together.

CAUTION

Ensure index marks are properly aligned.



9 INSTALL BEARING CARRIER (15).

NOTE

Tap bearing carrier tight with a soft hammer.

- a Position bearing carrier (15) (with thrust plates) on gear housing so that roller bearings receive journal of drive gear (17). Ensure drain port in bearing carrier is on suction or inlet side. If removed, torque plug (16) to 140 in-lbs (16 Nm).

10 INSERT CONNECTING SHAFT (14) INTO SPINE OF DRIVE GEAR (17).

11 INSTALL GEARS (13) AND SECOND SECTION GEAR HOUSING (12) AND GASKETS (11).

- a Insert drive and driven gears (13) of section into proper bearings (8) and push down tightly against thrust plate (10).

CAUTION

Avoid pinching gasket seal (11).

NOTE

Oil gears to provide initial lubrication when pump is started.

CAUTION

Do not force parts together.

- b Line up dowel pins (6) with matching holes. When parts are parallel, squeeze them together or gently tap alternately over dowels with a plastic hammer until parts become parallel and move smoothly together. Install dowel pins as stated in step 8b.

1 REPEAT STEPS 6 THROUGH 11 FOR ADDITIONAL HOUSINGS.

13 INSTALL PORT END COVER (5).

CAUTION

Avoid pinching gasket seal (11).

- a Align dowel pins (6) with holes in port end cover (5). Tap port end cover lightly in center between bearing bores to engage dowels, and to move parts together in final seating.
- b Thread four studs (3), washers (4) and nuts (2) into shaft end cover and a snug up cross-corner.
- c Rotate the drive shaft with a six inch wrench to insure there is no binding in the pump.
- d Torque diagonally opposed nuts to 200 ft-lbs (266 Nm).

14 TEST HYDRAULIC PUMP AFTER REBUILD.

- a Operate pump at least two minutes at zero pressure and at a moderate speed of not over 1500 rpm.

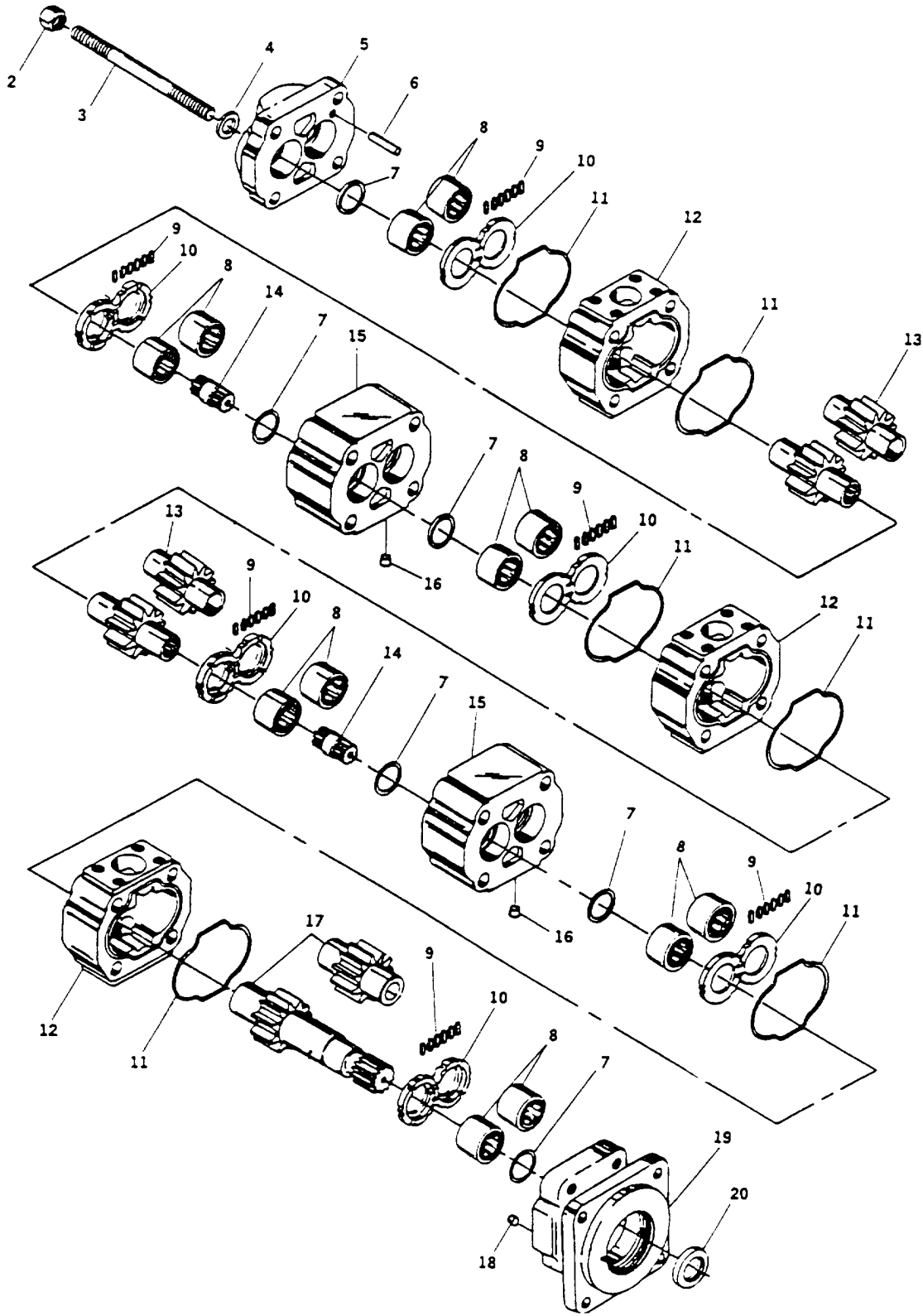
NOTE

If pump becomes hot to touch, it is binding and may seize. Disassemble and ensure freedom from binding.

- b Gradually increase pressure on pump, intermittently, until desired test pressure is reached. This should take about five minutes.
- c Inspect for leakage.

15 INSTALL THREE-SECTION HYDRAULIC PUMP. (REFER TO PAGE 13-10.)

END OF TASK



TWO-SECTION HYDRAULIC PUMP INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Supply No. 1 (4910-00-754-0706)
 Tool Outfit Hyd System, Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784)

SUPPLIES: Lockwasher (Item 13, Appendix B) (4 Required)
 Lockwashers (Item 26, Appendix B) (6 Required)
 Gasket (Item 170, Appendix B)
 Preformed packing (Item 15, Appendix B) (3 Required)
 Preformed packing (Item 76, Appendix B) (3 Required)
 Lockwashers (Item 13, Appendix B)
 Lockwashers (Item 26, Appendix B)
 Hydraulic oil (Item 8, Appendix B)
 Silicone sealant (Item 27, Appendix B)

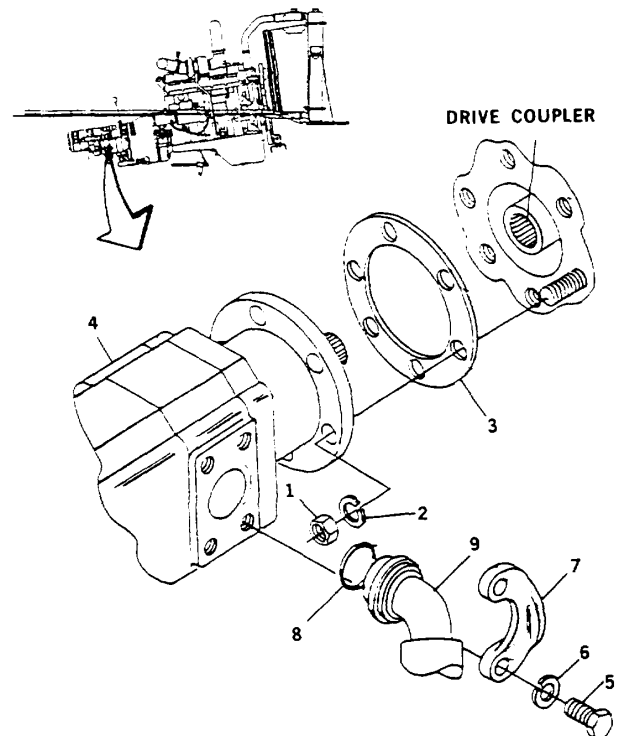
EQUIPMENT CONDITIONS: Outriggers fully extended and lowered. (Refer to TM 5-3810- 306-10.)
 Boom positioned over-the-side. (Refer to TM 5-3810-306-10.)
 Engine hood top cover removed. (Refer to TM 5-3810-306-20.)
 Rear decking removed. (Refer to TM 5-3810-306-20.)
 Torque converter charging pump removed. (Refer to page 7-5.)
 Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)

REMOVAL:

NOTE

Drive coupler to torque converter should remain with torque converter.

- 1 REMOVE TWO-SECTION HYDRAULIC PUMP (4).
 - a Tag and disconnect hydraulic hoses (9) from pump (4) by removing capscrews (5), lockwashers (6) and split flanges (7). Remove hoses and discard preformed packing (8). Cap all lines and openings.
 - b Remove nuts (1) and lockwashers (2) securing hydraulic pump.
 - c Remove pump (4) and gasket (3). Discard gasket (3).



- d Cover opening to prevent dirt from getting into pump drive opening.

INSTALLATION:

NOTE

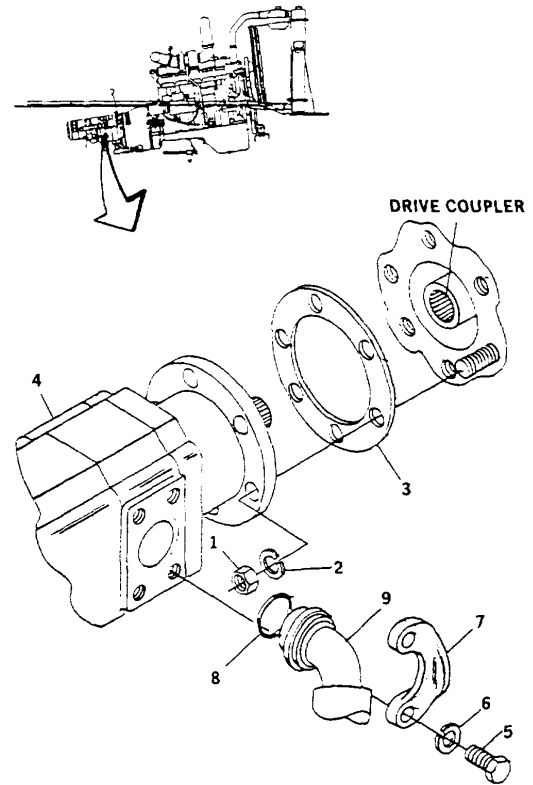
If pump is being installed on new torque converter, it will be necessary to install new studs in pump drive flanges. Using a prick punch,peen studs at mounting flange holes.

- 1 INSTALL TWO-SECTION HYDRAULIC PUMP (4).
 - a Uncover pump opening.
 - b If removed, install pump drive sleeve.
 - c Install a new gasket (3) between pump (4) and pump drive coupling. Apply silicone sealant to gasket.
 - d Install the pump (4) using nuts (1) and lockwashers (2).

NOTE

Coat new preformed packings with clean hydraulic oil prior to assembly.

- e Connect hydraulic hoses (9) with new preformed packing (8) to pump as tagged during removal using split flanges (7), lockwashers (6) and capscrews (5).
- 2 INSTALL TORQUE CONVERTER CHARGING PUMP. (REFER TO PAGE 7-5.)
 - 3 CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)



CAUTION

Hot oil must not be fed into a cold pump. It may cause pump to seize.

- 4 DRAIN AND FLUSH HYDRAULIC SYSTEM. (REFER TO PAGE 13-115.)
- 5 BLEED AIR FROM HYDRAULIC SYSTEM. (REFER TO PAGE 13117.) OBSERVE FOR LEAKS AND PROPER OPERATION.
- 6 INSTALL REAR DECKING. (REFER TO TM 5-3810-306-20.) 7. INSTALL ENGINE TOP COVER. (REFER TO TM 5-3810-306-20.)

END OF TASK

TWO-SECTION HYDRAULIC PUMP ASSEMBLY AND PRIORITY VALVE

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Supply No. 1 (4910-00-754-0706)
 Tool Outfit Hyd System, Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784)
 Seal removal tool (Item 3, Appendix C)
 Carborundum stone
 Lip seal Installer (Item 7, Appendix C)
 Sleeve (Item 5, Appendix C)

SUPPLIES: Preformed packing (Item 89, Appendix B)
 Preformed packing (Item 9, Appendix B)
 Seal (Item 88, Appendix B) (4 Required)
 Parts kit (Item 87, Appendix B)
 Lint free cloth (Item 91, Appendix B)
 Solvent P-D-680 (Item 1, Appendix B)
 Form-a-gasket (Item 75, Appendix B)

EQUIPMENT CONDITIONS: Two-Section hydraulic pump assembly removed. (Refer to page 13-24.)

DISASSEMBLY:

CAUTION

When securing pump in a vise, do not grip on or near machined surfaces.

1. REMOVE PRIORITY VALVE (28) AND PORT END COVER (9).
 - a. Place pump in a vise with shaft pointing down. Index mark all sections with a prick punch for proper alignment during assembly.
 - b. Remove nuts (2) and washers (8) securing priority valve (28) to port end cover (9). Remove priority valve (28).
 - c. Remove nuts (2) and washers (8) from port end cover (9).

CAUTION

If end cover (9) will not lift off, pry it off using care to avoid damaging machined surfaces.

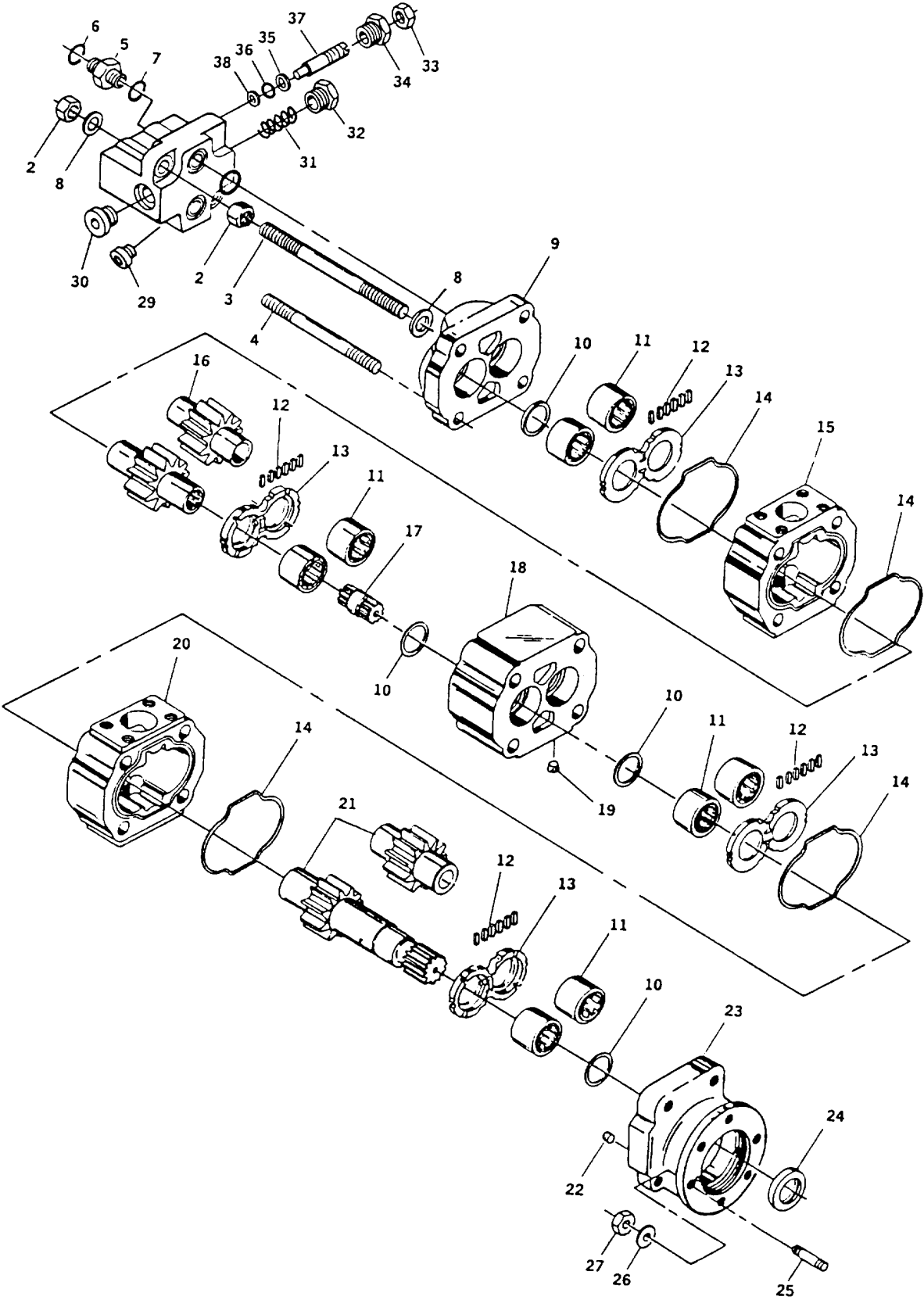
NOTE

If thrust plate (13) remains in gear housing (15), tap it out with a wooden hammer handle. Avoid distorting the thrust plate.

- d. Remove port end cover.
2. REMOVE GEAR HOUSING (15).

CAUTION

If it is necessary to pry housing loose, use care to avoid damaging machined surfaces.



- a. Remove gear housing (15) from gears (16).
- 3. REMOVE DRIVE AND DRIVEN GEARS (16) AND KEEP THEM TOGETHER AS THEY ARE A MATCHED SET.
- 4. REMOVE CONNECTING SHAFT (17).

CAUTION

If it is necessary to pry bearing carrier loose, use care to avoid damaging machined surfaces.

- 5. LIFT OFF BEARING CARRIER (18) AND REMOVE PLUG (19) IF NECESSARY.

CAUTION

If it is necessary to pry gear housing loose, use care to avoid damaging machined surfaces.

NOTE

If thrust plate remains in gear housing, tap it out with a wooden hammer handle. Avoid distorting thrust plate.

- 6. LIFT OFF FIRST SECTION GEAR HOUSING.
- 7. REMOVE DRIVE GEAR WITH SHAFT AND DRIVEN GEAR (21) AND KEEP THEM TOGETHER AS THEY ARE A MATCHED SET.

CAUTION

Avoid distorting thrust plate.

- 8. REMOVE THRUST PLATES (13) AND SEALS (14) AND (12).
 - a. Pry thrust plate from shaft end cover, port end cover or bearing carrier-with a screwdriver or similar tool. Remove and discard all rubber seals (12) and gasket seals (14).

- 9. INSPECT BEARINGS (11) AND RING SEALS (10) AND REPLACE AS REQUIRED.

- a. Examine all roller bearings (11) for spalling or pitting. If replacement is necessary, pull bearings (11) with a bearing puller.

NOTE

To replace ring seals (10), pull drive gear bearing with a bearing puller and remove ring seal from bottom of bearing bore.

- b. Check ring seals (10) for wear and replace them if necessary.

- 10. REMOVE LIP SEAL (24) FROM SHAFT END COVER (23).

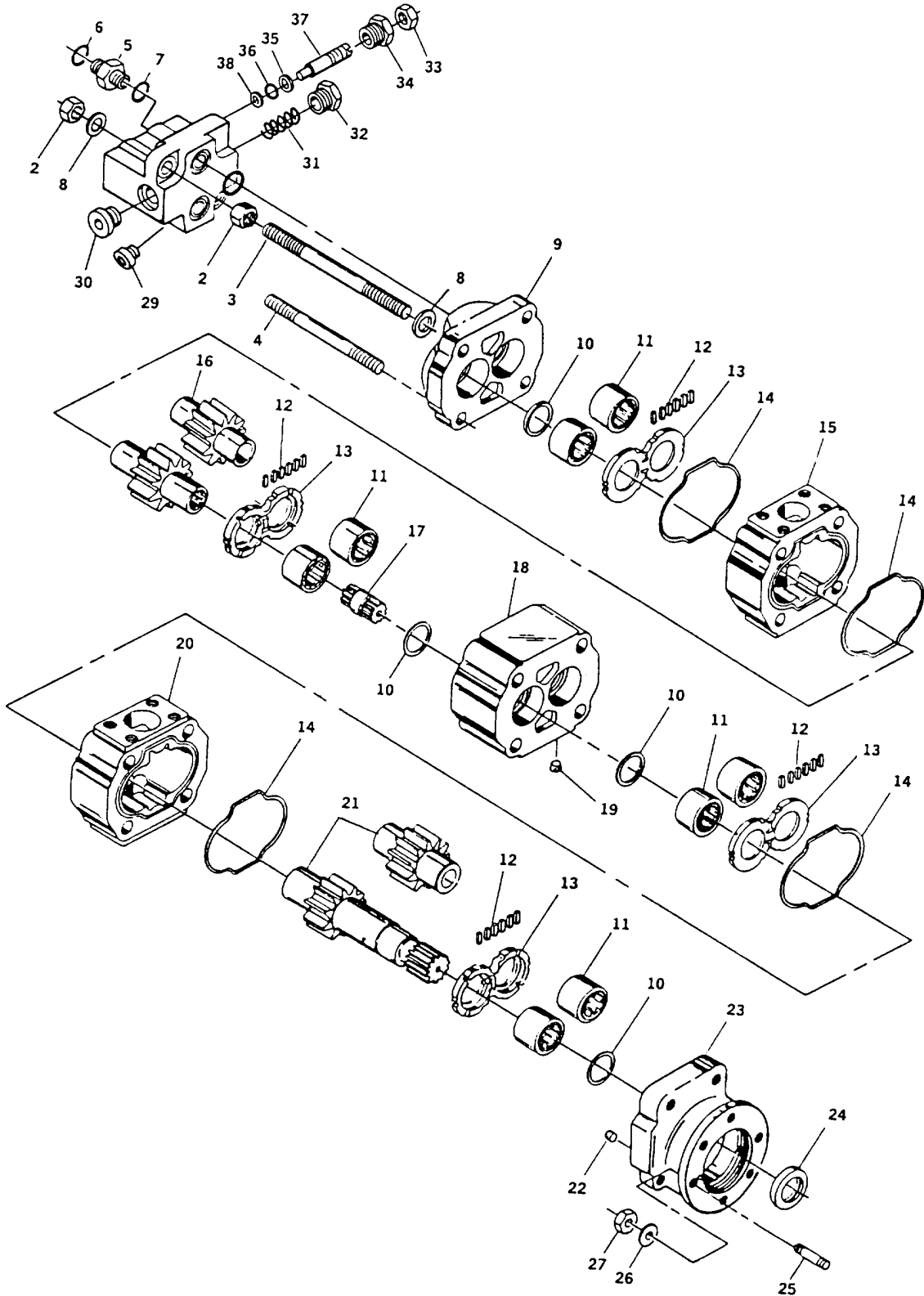
- a. Secure shaft end cover in a vise with mounting face down. Remove double lip seal by inserting special seal removal tool (Item 3, Appendix C) into notch between double lip seal and shaft end cover. Tap double lip seal out from shaft end cover and discard seal.

- b. Stone off all machined surfaces with a medium grit carborundum stone.

- 11. REMOVE STUDS (3) AND (4) FROM END COVER (23).

- 12. DISASSEMBLE PRIORITY VALVE (28).

- a. Remove adapters (5) and packings (6) and (7). Discard packings (6) and (7).
- b. Remove plugs (29) and (30).
- c. Remove plug (31) and spring (32).



NOTE

Count turns on adjusting screw (37) for initial setting on reassembly.

- d. Loosen jam nut (33) and unscrew adjusting screw (37) from cap (34).
- e. Remove jam nut (33), retaining ring (38), packing (36) and back-up ring (35) from adjusting screw (37). Discard back-up ring (35) and packing (36).
- f. Remove cap (34) from valve (28).

1. CLEAN ALL PARTS IN SOLVENT P-D-680 AND BLOW DRY WITH COMPRESSED AIR.

INSPECTION:

- a. Place a straight edge across housing bore. If a 0.005-in. (0.127 mm) feeler gauge will slip between the straight edge and housing replace housing.
2. INSPECT DRIVE AND DRIVEN GEARS (21).
 - a. Any wear on gear hubs that is detectable by touch, or exceeding 0.002-in. (0.051 mm) justifies replacement. Scoring, grooving, or burring of outside diameter of gear teeth, as well as nicking, grooving, or fretting of teeth surfaces necessitates replacement.

CLEANING:**WARNING**

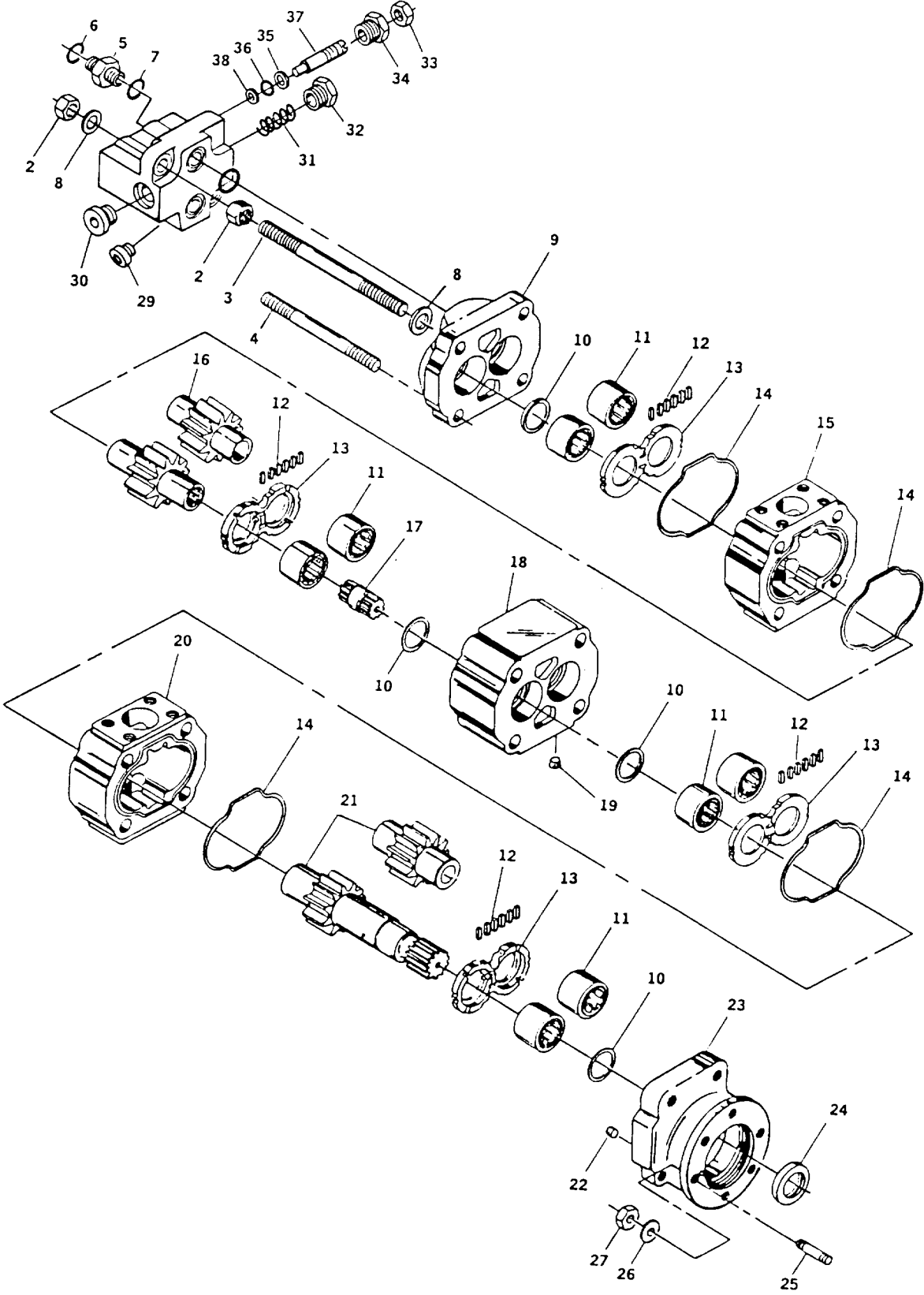
Dry cleaning solvent P-D680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F/138°F (38/59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

NOTE

Gears are a matched set, therefore both gears must be replaced even if only one was found damaged.

3. INSPECT DRIVE SHAFT (17).
 - a. Replace drive shaft if any wear is detectable visibly or by touch in seal areas or at drive coupling. A maximum of 0.002in. (0.051 mm) wear is allowable. Wear or damage to splines justifies replacement. Wear in shaft seal areas indicates oil contamination.
4. INSPECT THRUST PLATES (13).
 - a. Thrust plates seal gear section at sides of gears. Wear in this area will allow internal slippage, resulting in oil bypassing within the pump.



- b. Maximum allowable wear is 0.002in. (0.051 mm). Replace thrust plates if they are scored, eroded, or pitted.
- c. Check center area of thrust plate where gears mesh. Erosion in this area indicates oil contamination. Pitted thrust plates indicate cavitation or oil aeration. Discoloration of plates would indicate overheating, probably as a result of insufficient oil.

5. INSPECT BEARINGS (11).

CAUTION

If gears are replaced, bearings must be replaced also.

- a. Bearings should fit into bore with a light press fit, however, a neat hand fit is allowable. If bearings tend to fall from bore, replace housing.

REASSEMBLY:

NOTE

Replace all rubber and polymer seals. Include all packings, pocket seals (12) behind thrust plates (13), shaft seal (24), back-up ring (35) and gasket seals (14).

CAUTION

When securing pump in a vise, do not grip on or near machined surfaces.

- 1. IF BEARINGS (11) HAVE BEEN REMOVED, DEBURR BEARING BORES. CLEAN ALL PARTS IN A SUITABLE SOLVENT AND DRY THEM WITH COMPRESSED AIR. WIPE WITH CLEAN LINT FREE CLOTH.

NOTE

If plug (22) is replaced, strike new plug with a prick punch at both ends of screwdriver slot and around edges.

- 2. EXAMINE PLUG (22) FOR SECURITY. REPLACE IT ONLY IF IT IS DAMAGED.

CAUTION

Ensure double lip seal is fully seated in recess.

NOTE

Wipe off excess sealant.

- 3. INSTALL LIP SEAL (24).
 - a. Coat outer edge of lip seal and its recess with Permatex Aviation Form-A-Gasket No. 3 Non-hardening Sealant or equivalent. With metal side of lip seal up, press it into mounting flanges side of the shaft and cover (23) with an arbor press and lip seal installer (Item 7, Appendix C).
- 4. INSTALL RING SEALS (10) AS APPLICABLE.

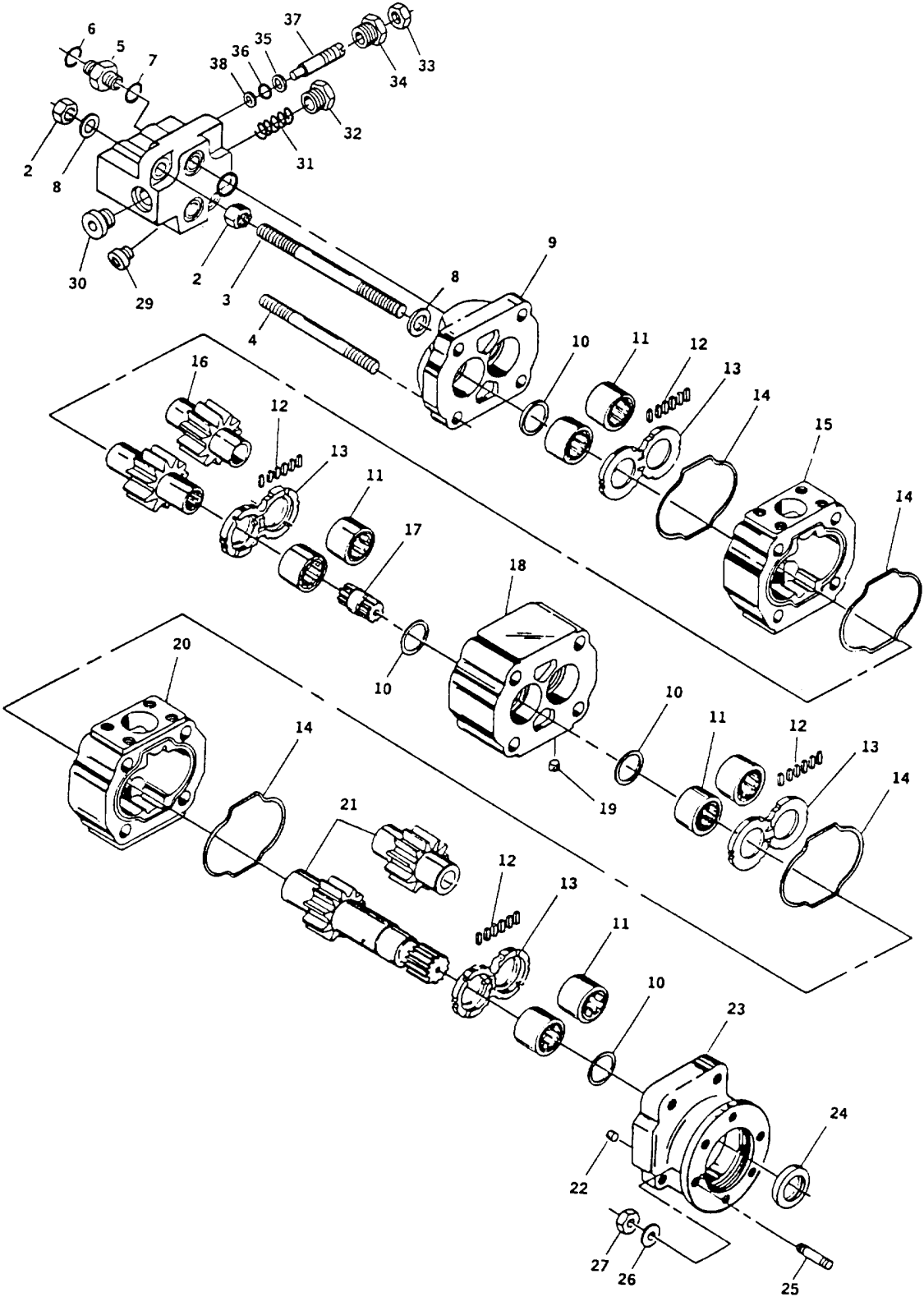
NOTE

Notch in ring seal must be visible to ensure notched side of seal (10) is next to bearing (11).

- a. If ring seals are being replaced, insert them into bottom of drive gear bearing bore.

CAUTION

Use an arbor press only to install bearings. Do not hammer bearings into place.



5. INSTALL BEARINGS (11) AS APPLICABLE.
 - a. Replace any bearings that have been removed from shaft end cover (23), port end cover (9), or bearing carrier (18). Install bearings with an arbor press.
6. REPLACE DAMAGED OR WORN THRUST PLATES (13) AND INSTALL GREASED POCKET SEALS (12).
 - a. Cut two pocket seals (12) 0.219in. (5.556 mm) long from pocket seal strip. Grease seals (12) and insert them into middle slots in thrust plate (13).
 - b. With pocket seals down, place thrust plates (13) over bearings (11) in shaft end cover (23). Tap thrust plate with a soft hammer to about 0.031-in. (0.794 mm) from machined surface.
 - c. Cut four pocket seals approximately 0.25-in. (6.35 mm) long from pocket seal strip. Insert one pocket seal into each slot in thrust plate. Push each pocket seal all the way in so that they touch roller bearing (11). Tap thrust plate (13) down firmly against machined surface with a soft hammer. Using a sharp razor blade, trim exposed end of pocket seal square and flush with thrust plate (13).
 - d. Secure shaft end cover (23) in a vise with mounting face down.

CAUTION

Avoid damaging the double lip seal.

7. INSTALL SHAFTS (21).
 - a. Insert splined end of drive shaft (21) into special drive sleeve (Item 5, Appendix C). Lightly grease drive shaft and sleeve. Insert internal gear and drive shaft with sleeve into shaft end cover (23) with a twisting motion. Push down carefully until gear rests against thrust plate (13). Remove steel sleeve. Insert driven gear.
8. INSTALL FIRST SECTION GEAR HOUSING (20) AND GASKETS (14).
 - a. Grease new gasket seals (14) and insert them into grooves in both sides of all gear housings (15) and (20).

CAUTION

Avoid pinching gasket seal (14).

NOTE

Oil gears to provide initial lubrication when pump is started.

- b. Slide first section gear housing (20) over gears and tap with a soft hammer until housing rests tightly against shaft end cover.

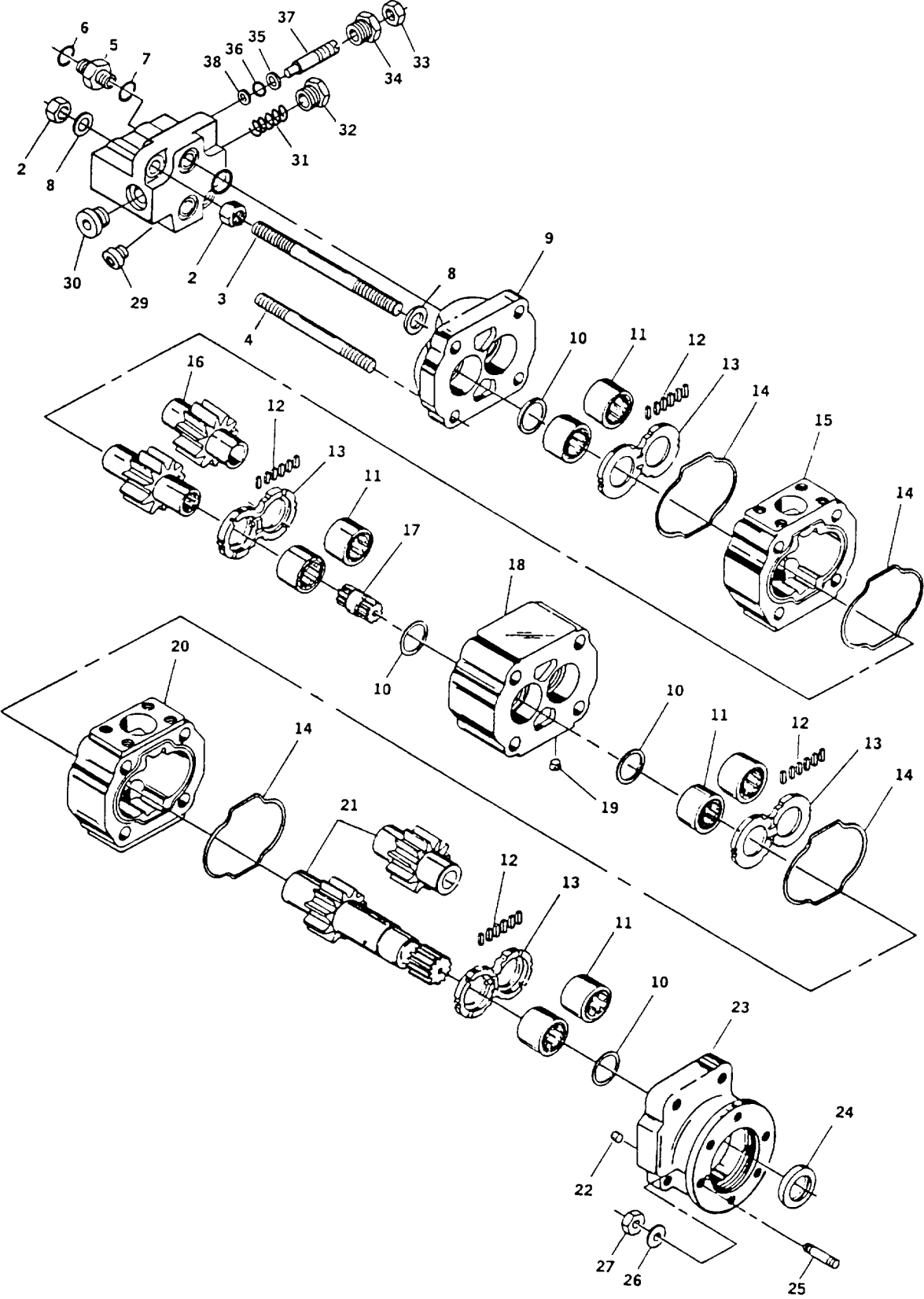
CAUTION

Ensure index marks are properly aligned.

9. INSTALL BEARING CARRIER (18).

NOTE

Tap bearing carrier tight with a soft hammer.



- a. Position bearing carrier (18) (with thrust plates) on gear housing so that roller bearings receive journal of drive gear (21). Ensure drain port in bearing carrier is on suction or inlet side. If removed, torque plug (19) to 140 in-lbs (16 Nm)
10. INSERT CONNECTING SHAFT (17) INTO SPLINE OF DRIVE GEAR (21).
 11. INSTALL GEARS (16) AND SECOND SECTION GEAR HOUSING (15) AND GASKETS (14).
 - a. Insert drive and driven gears (16) of second section into proper bearings (11) and push down tightly against thrust plate (13).

CAUTION

Avoid pinching gasket seal (14).

NOTE

Oil gears to provide initial lubrication when pump is started.

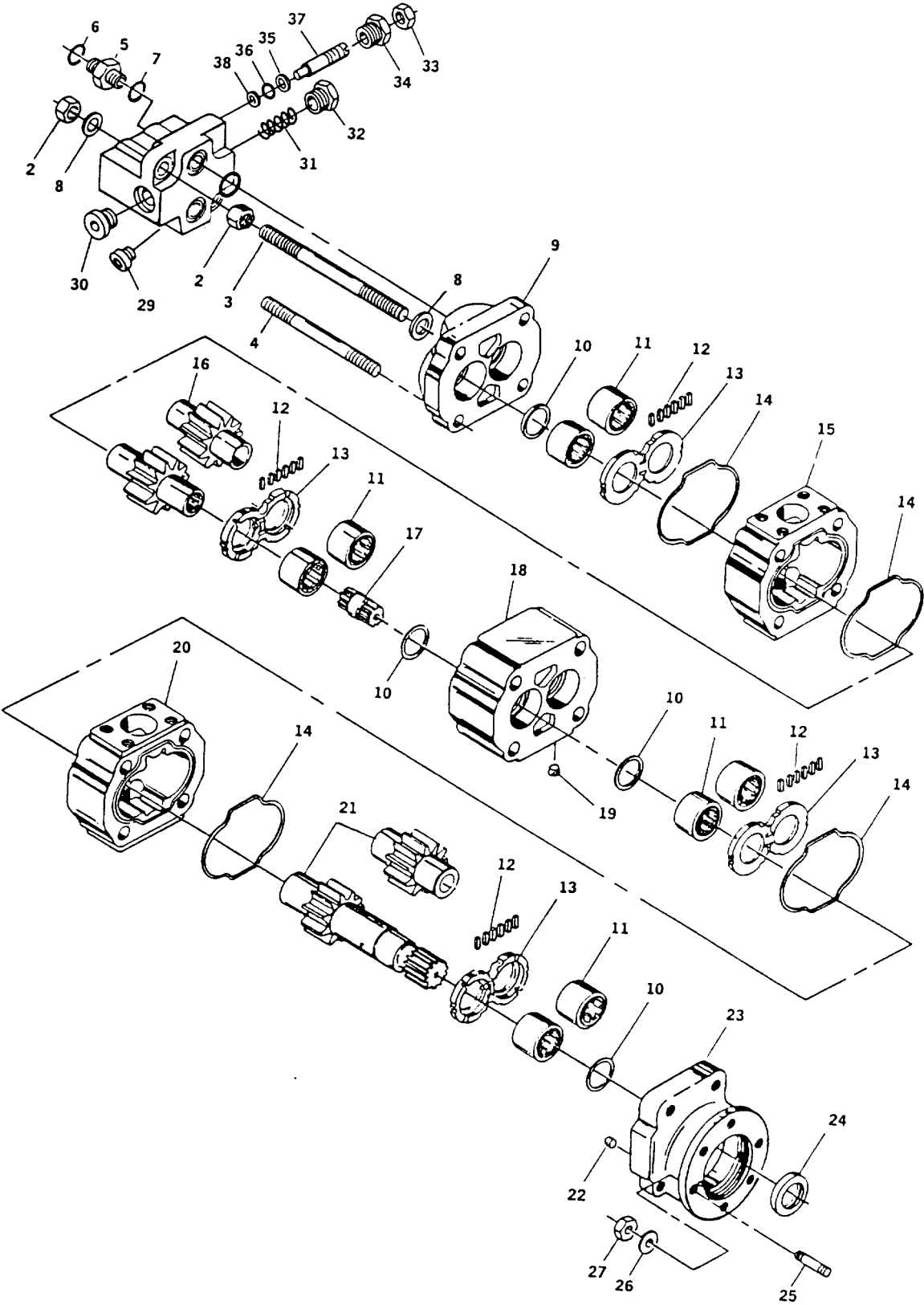
- b. Slide second gear housing (15) over gears (16) and tap in tight against bearing carrier with a soft hammer.
12. INSTALL PORT END COVER (9).

CAUTION

Avoid pinching gasket seal (14).

- a. Place port end cover (9) over gear journals and tap lightly against gear housing (15).
- b. Thread four studs (3) and (4), washers (8) and nuts (2) into shaft end cover and snug up cross-corner.

- c. Rotate the drive shaft with a six inch wrench to insure there is not binding in the pump.
 - d. Torque diagonally opposed nuts to 200 ft-lbs (266 Nm)
13. ASSEMBLE PRIORITY VALVE (28).
 - a. Install jam nut (33), new backup ring (35), new packing (36) and retaining ring (38) on adjusting screw (37).
 - b. Install cap (34) in valve (28).
 - c. Screw adjusting screw (37) into cap (34) the number of turns noted on disassembly and tighten jam nut (33).
 - d. Install spring (32) and plug (31).
 - e. Install new packings (6) and (7) on adapters (5).
 - f. Install adapters (5).
 - g. Install plugs (30) and (29).
 14. INSTALL PRIORITY VALVE (28).
 - a. Install priority valve on two longer studs with nuts (2) and washers (8). Torque nuts to 200 ft-lbs (266 Nm)
 15. TEST HYDRAULIC PUMP AND ADJUST PRIORITY VALVE (28) OUTPUT AFTER REBUILD.
 - a. Install flowmeter (2-30 GPM) between output adapter (5) and output line.
 - b. Operate pump at least two minutes at zero pressure and at a moderate speed of not over 1500 rpm.



NOTE

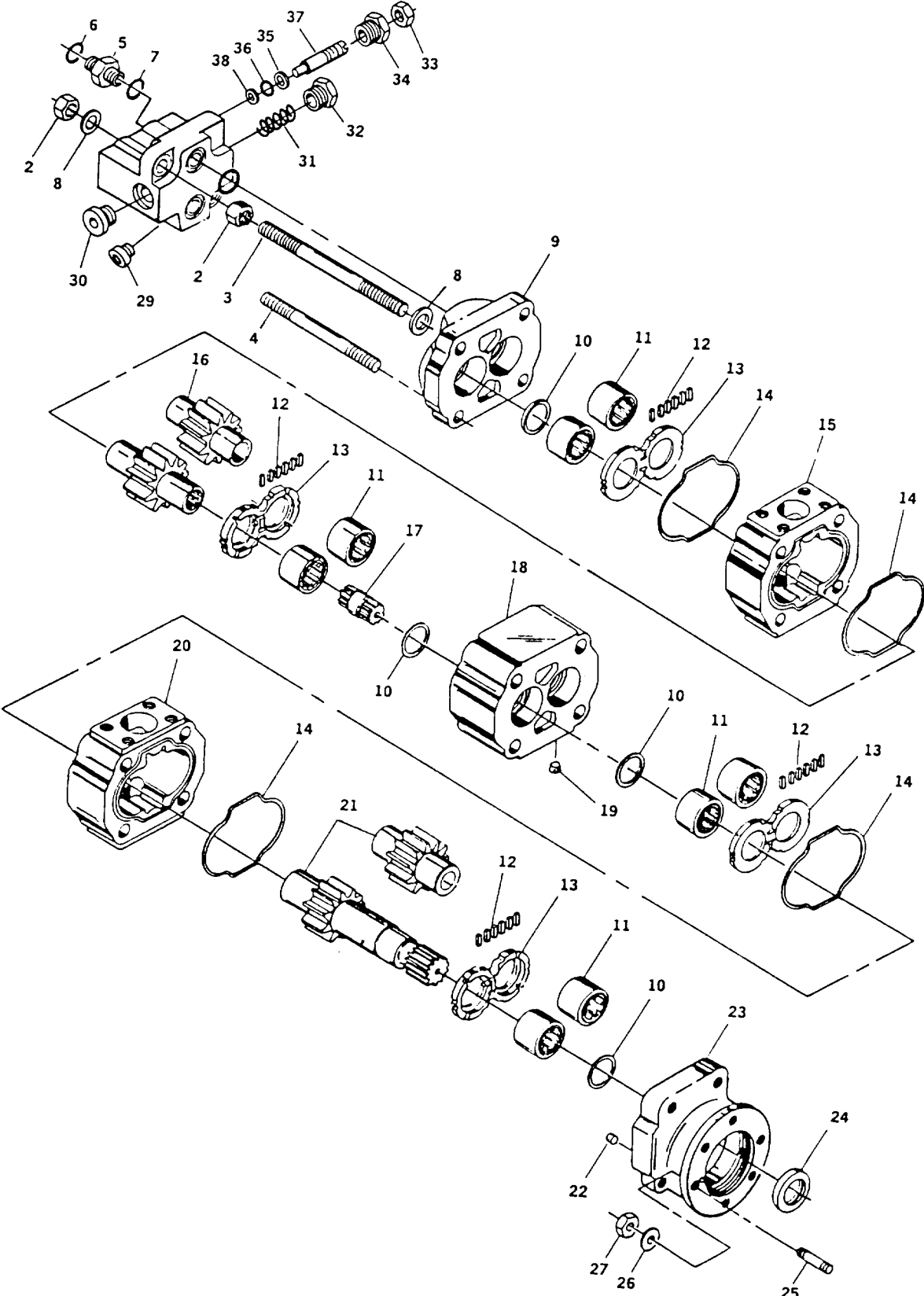
If pump becomes hot to touch, it is binding and may seize. Disassemble and ensure freedom from binding.

- c. Gradually increase pressure on pump, intermittently, until desired test pressure is reached. This should take about five minutes.
- d. Inspect for leakage.

- e. Check flowmeter at output side of priority valve (28). Loosen jam nut (33) and turn adjusting screw (37) as necessary to obtain 15 GPM flow. Tighten jam nut (33).

16. INSTALL TWO-SECTION PUMP. (REFER TO PAGE 13-24.)

END OF TASK



PUMP DISCONNECT INSTALLATION

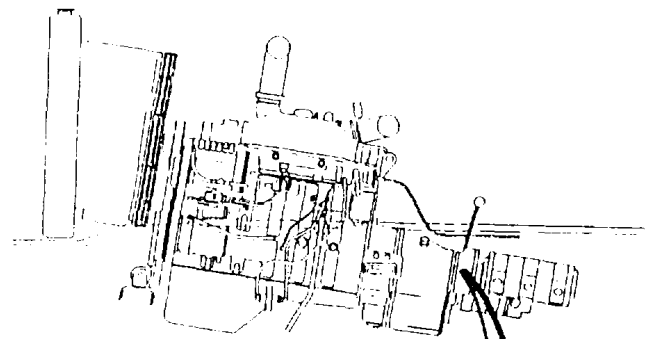
TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Gasket (Item 28, Appendix B)
Silicone sealant (Item 27, Appendix B)

EQUIPMENT CONDITIONS: Rear decking removed. (Refer to TM 5-3810-306-20.)
Three-Section hydraulic pump removed.
(Refer to page 13-10.)
Negative battery cable disconnected at shunt.
(Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE PUMP DISCONNECT (1).
 - a. Pull pump disconnect (1) off studs.
 - b. Remove and discard gasket (2).
 - c. Cover opening to prevent dirt from entering.

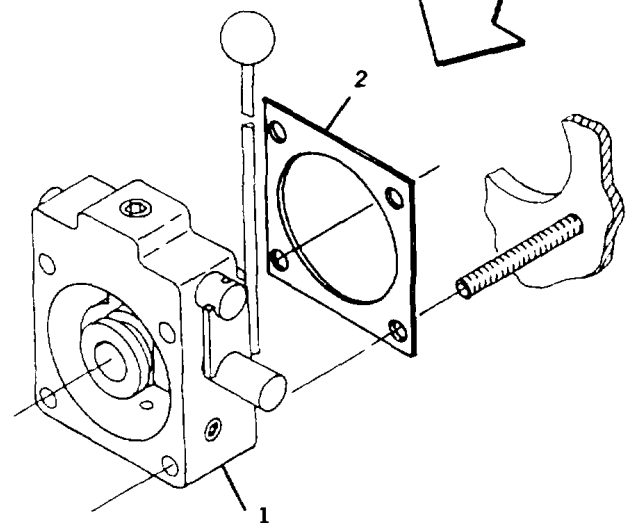
**INSTALLATION:**

1. CLEAN PUMP DISCONNECT MATING SURFACES OF GASKET MATERIAL.
2. INSTALL PUMP DISCONNECT (1).

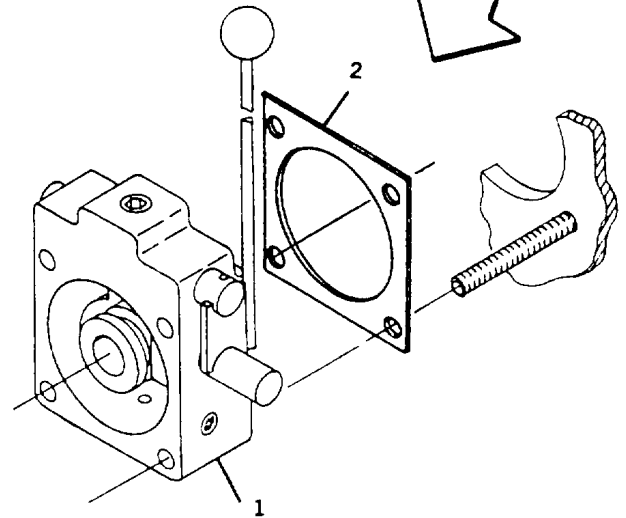
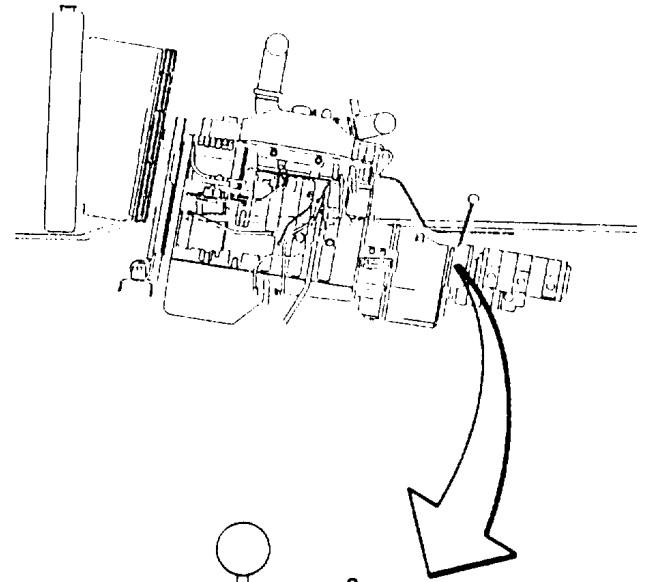
WARNING

Eye contact with silicone RTV materials may cause irritation. If eye contact takes place, flush the eyes with water for 15 minutes and have the eyes examined by a doctor.

- a. Apply silicone sealant to gasket (2).
- b. Position new gasket (2) and pump disconnect (1) on mounting studs.



3. INSTALL THREE-SECTION HYDRAULIC PUMP. (REFER TO PAGE 13-10.)
4. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
5. DRAIN AND FLUSH HYDRAULIC SYSTEM. (REFER TO PAGE 13-115.)
6. BLEED AIR FROM HYDRAULIC SYSTEM. (REFER TO PAGE 13-117.)
7. INSTALL REAR DECKING. (REFER TO TM 5-3810-306-20.)
8. TEST FOR PROPER OPERATION.



END OF TASK

PUMP DISCONNECT ASSEMBLY

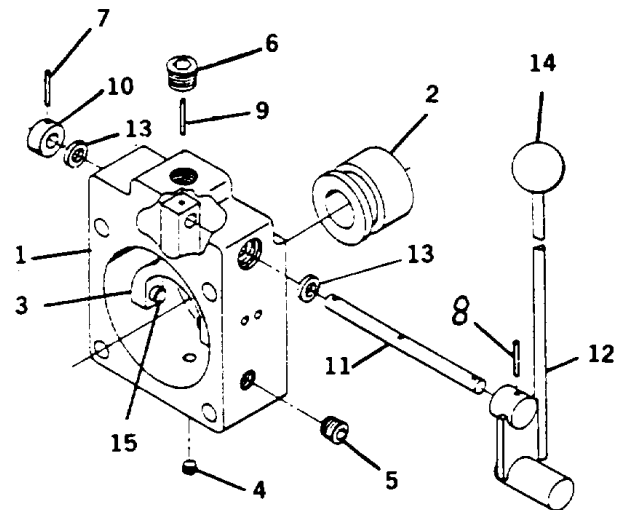
TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Oil seals (Item 33, Appendix B)

EQUIPMENT CONDITIONS: Pump disconnect removed. (Refer to page 13-40.)'

DISASSEMBLY:

1. DISASSEMBLE PUMP DISCONNECT (1).
 - a. Remove drive sleeve (2) from shifter fork (3).
 - b. Remove fittings (4), (5) and (6) from pump disconnect.
 - c. Remove spring pin (7) securing collar (10) to shaft (11). Remove collar (10).
 - d. Remove spring pin (8) securing handle (12) to shaft (11). Remove handle (12).
 - e. Remove spring pin (9) from shifter fork (3).
 - f. Remove shaft (11) and shifter fork (3).
 - g. Remove and discard two seals (13).
 - h. Remove knob (14) from handle.

**CLEANING:****WARNING**

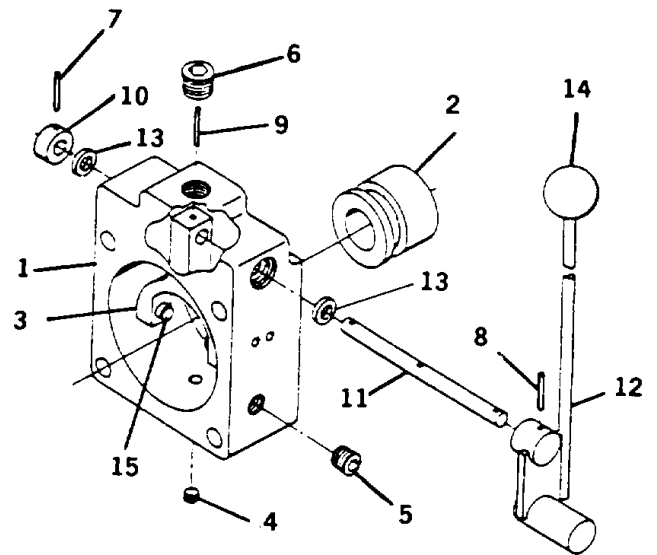
Dry cleaning solvent P-D680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or

WARNING (Cont'd)

excessive heat. The flash point is 100°F/138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

1. CLEAN PARTS WITH SOLVENT P-D-680 AND DRY WITH COMPRESSED AIR.



INSPECTION:

1. INSPECT SHIFTER FORK (3) FOR WEAR AND DISTORTION.
2. INSPECT SHIFTER BUTTONS (15) FOR WEAR.
3. INSPECT SHAFT FOR EXCESSIVE WEAR.
4. INSPECT DRIVE SLEEVE (2) FOR WEAR AND CRACKS.

REASSEMBLY:

1. REASSEMBLE PUMP DISCONNECT (1).
 - a. Install two new oil seals (13).
 - b. Install shifter fork (3) and position so shaft (11) can be installed through shifter fork (3).

- c. Install shaft (11) secure to shifter fork (3) with spring pin (9).
- d. Install fittings (4), (5) and (6) into pump disconnect.
- e. Position collar (10) on shaft (11) and secure with spring pin (7).
- f. Position handle (12) on shaft and secure with spring pin (8).
- g. Install knob (14) on handle (12).

2. INSTALL PUMP DISCONNECT ASSEMBLY. (REFER TO PAGE 13-40.)

END OF TASK

Section II. HYDRAULIC CONTROL VALVE MAINTENANCE

MAIN HOIST BOOST, AUXILIARY HOIST, LIFT BOOST CONTROL VALVE ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Lubrication Service, Unit Trailer Mounted (4930-00-017-9167)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Supply No. 1
 (4910-00-754-0706)
 Tool Outfit Hyd System; Test and Repair, 3/4 Ton Trailer Mtd
 (4940-01-036-5784)

SUPPLIES: Packing assortment (Item 50, Appendix B)
 Parts kit, seal repl. (Item 51, Appendix B)
 Packing assortment (Item 52, Appendix B)
 Parts kit, seal repl. (Item 53, Appendix B)
 Solvent P-D-680 (Item 1, Appendix B)
 Hydraulic oil (Item 8, Appendix B)

EQUIPMENT CONDITION: Control valve removed. (Refer to TM 5-3810-306-20.)

DISASSEMBLY:

NOTE

The following procedure outlines disassembly for one section of the valve bank. All additional valve sections will be identical.

1. REMOVE FITTINGS FROM VALVE BANK AS REQUIRED. SAVE FOR INSTALLATION.
2. REMOVE TIE BOLTS (2) SECURING VALVE SECTIONS TOGETHER. SEPARATE SECTIONS AND REMOVE PREFORMED PACKINGS (21) AND (22).
3. REMOVE RELIEF VALVE (5) FROM INLET SECTION (4).

NOTE

Keeping preformed packings and rings in order during disassembly will aid in reassembly.

4. DISASSEMBLE RELIEF VALVE (5).

- a. Remove preformed packing (18) and washer (9) from cartridge (8).
- b. Remove locknut (20), adjusting screws (19), preformed packing (18), spring (17) and plunger (16).
- c. Remove preformed packing (14) and backup ring (15) from plunger (16).
- d. Remove floating seal (12) and check valve snubber (13) from cartridge.
- e. Remove poppet (11) and retainer (10) from cartridge.
- f. Remove preformed packing (6) and back-up ring (7).

5. DISASSEMBLE VALVE SECTION (33).

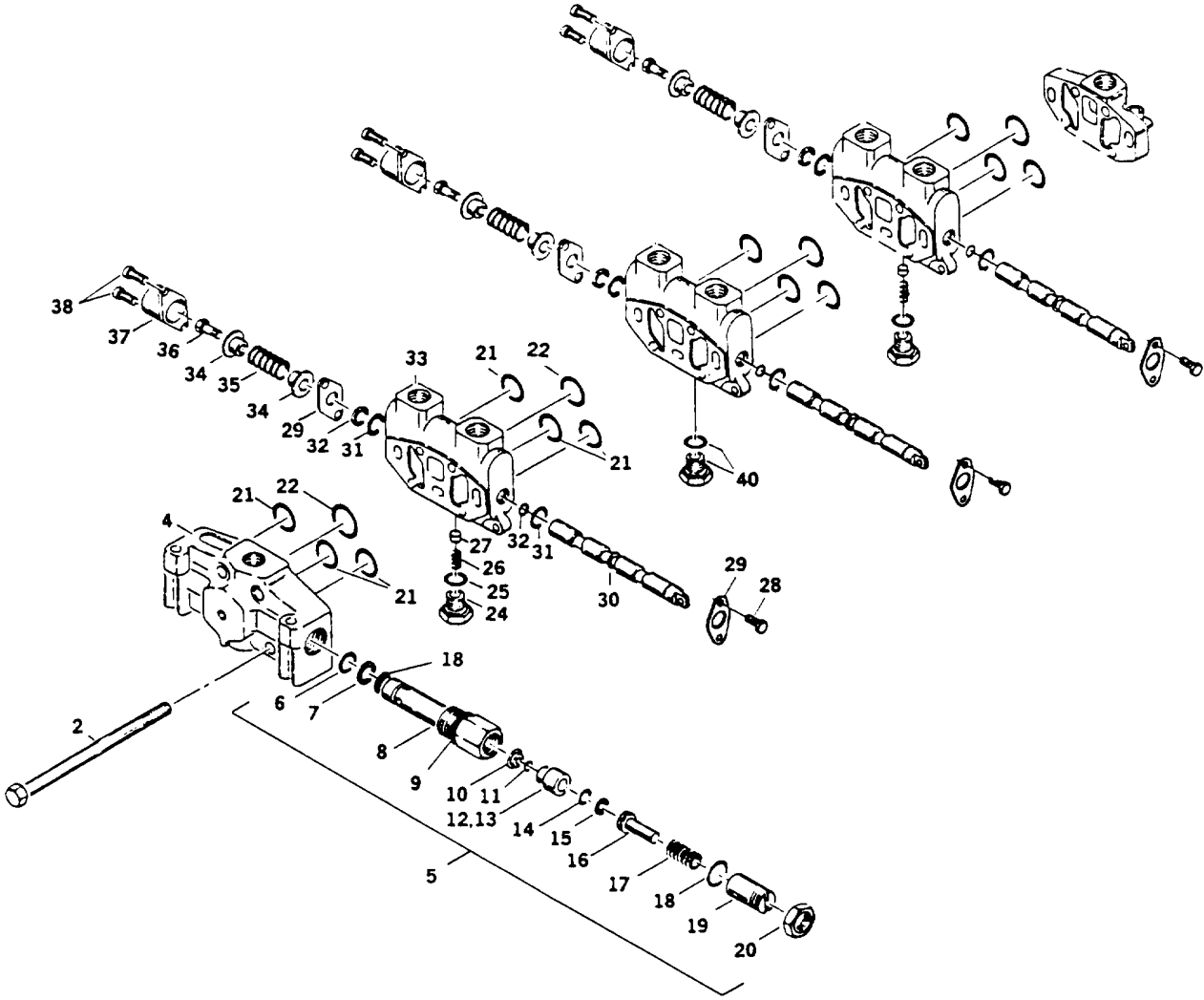
- a. Remove two screws (38) and valve cap (37)

- b. Remove stripper bolt (36), spring guides (34) and spring (35).
- c. Remove two screws (28) and retainer plates (29).
- d. Remove preformed packings (31), back-up rings (32) and spool (30) from valve body.
- e. Remove check cap (24), preformed packing (25), check spring (26) and poppet (27).
- f. Remove plugs and packings (40) from unused ports.

CLEANING:

WARNING

Dry cleaning solvent P-D680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F/138°F (380-590C). If you become dizzy while using



WARNING (Cont'd)

cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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

1. CLEAN PARTS IN SOLVENT P-D-680 AND BLOW DRY WITH COMPRESSED AIR.

INSPECTION:

1. INSPECT SPOOL BORE FOR CRACKS, PITTING SCORING AND WEAR. REPLACE IF NECESSARY.
2. INSPECT SPOOL FOR SCORING AND WEAR. REPLACE IF NECESSARY.

REASSEMBLY:**CAUTION**

Install new packings and seals on or in all component parts. Coat packings and seals with clean hydraulic fluid prior to assembly.

1. REMOVE ANY BURRS FROM FACES OF VALVE SECTIONS AND ENSURE ALL MATING SURFACES ARE CLEAN.
2. REASSEMBLE VALVE SECTION (33).
 - a. Install new packings onto plugs (40).
 - b. Install poppet (27), spring (26), new preformed packing (25) and check cap (24).
 - c. Install spool (30).

- d. Install new preformed packings (31) and back-up rings (32) on both sides of spool. Retain on clevis end of spool with retainer plate (29) and screws (28).
- e. Install retainer plate (29), spring guides (34) and spring (35). Secure with stripper bolt (36).
- f. Install valve cap (37) and screws (38).

3. REASSEMBLE RELIEF VALVE (5).

- a. Install new preformed packing (6) and back-up ring (7) into cartridge (8).
- b. Install poppet (11) and retainer (10) into cartridge (8).
- c. Install new floating seal (12) and check valve snubber (13).
- d. Install new preformed packing (14) and back-up ring (15) on plunger (16).
- e. Install plunger (16), spring (17), adjusting screw (19) with new preformed packing (18) into cartridge (8). Secure with locknut (20).
- f. Install washer (9) and new preformed packing (18) on relief valve cartridge (8). Install relief valve (5) into inlet section (4).

4. POSITION SECTIONS TOGETHER WITH NEW PREFORMED PACKINGS (21) AND (22). SECURE ASSEMBLY WITH TIE BOLTS (2).

NOTE

Do not torque tie bolts at this time.

5. INSTALL CIRCUIT RELIEF VALVES IF APPLICABLE IN THEIR HOUSING.

CAUTION

Ensure that all sections (inlet, housing, and outlet) are aligned prior to applying torque.

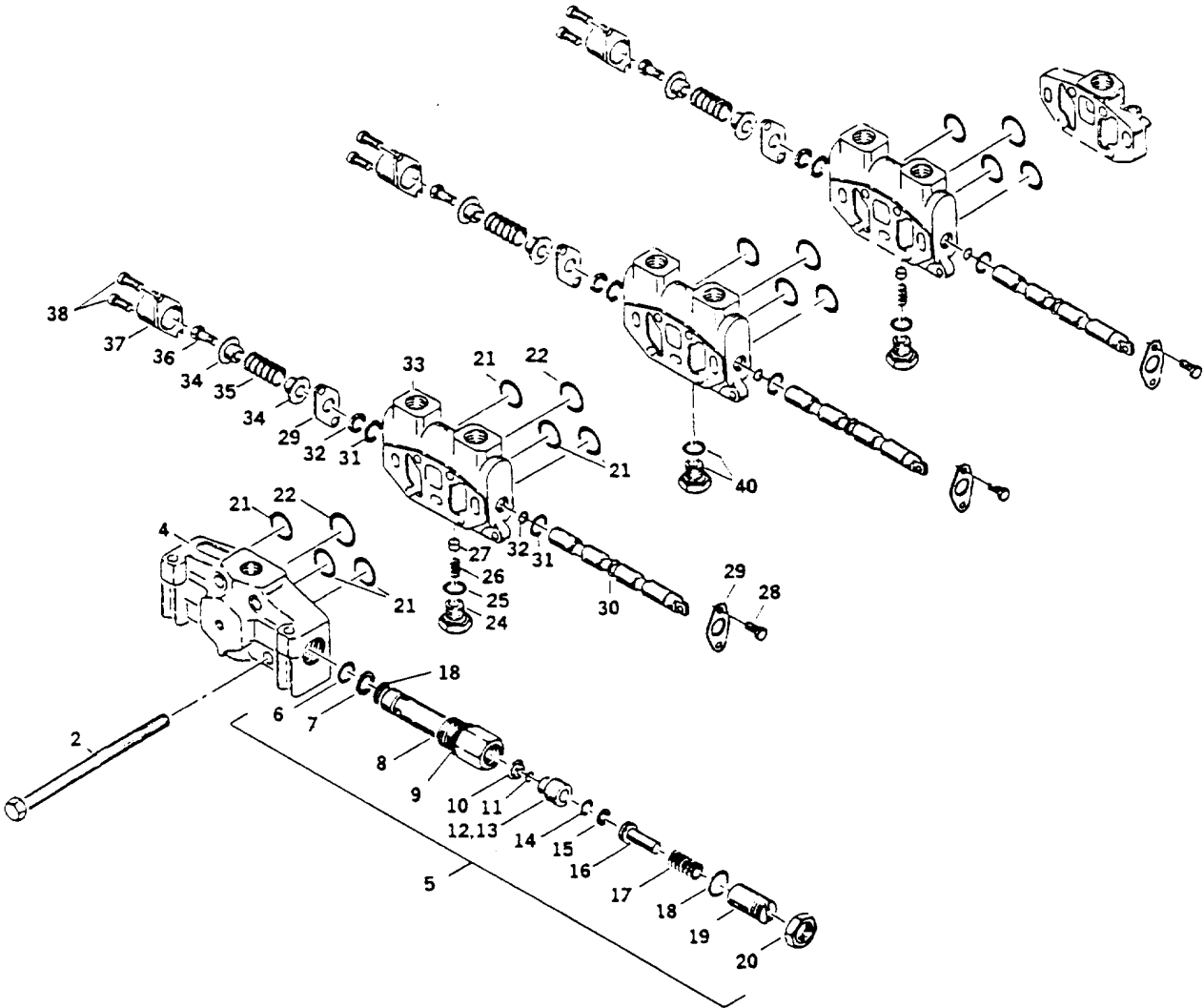
6. USING PROPER TORQUE WRENCH, TORQUE TIE BOLTS (2) TO 350 IN-LBS (39 Nm (A-20 VALVE) AND 400 IN-LBS (44 Nm KGCM) (A-35 VALVE).

7. INSTALL PLUGS (40) AND TIGHTEN UNTIL BOTTOMED.

8. ACTUATE SPOOL TO ENSURE FREE MOVEMENT.

9. INSTALL CONTROL VALVE. (REFER TO TM 5-3810-306-20).

END OF TASK



HYDRAULIC OIL COOLER ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Lifting Device (300 lbs Capacity)

SUPPLIES: Lockwasher (Item 13, Appendix B)
Lockwasher (Item 25, Appendix B)
Lockwasher (Item 26, Appendix B)

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)
Hydraulic system shutdown and pressure relieved from lines.

REMOVAL:**1. REMOVE OIL COOLER COVER (3).**

- a. Remove two nuts (1), lockwashers (2), flatwashers (6) and capscrews (7) securing shroud to superstructure.
- b. Remove eight capscrews (33) securing cover (3) to frame (13).
- c. Remove cover (3).

2. REMOVE OIL COOLER ASSEMBLY.

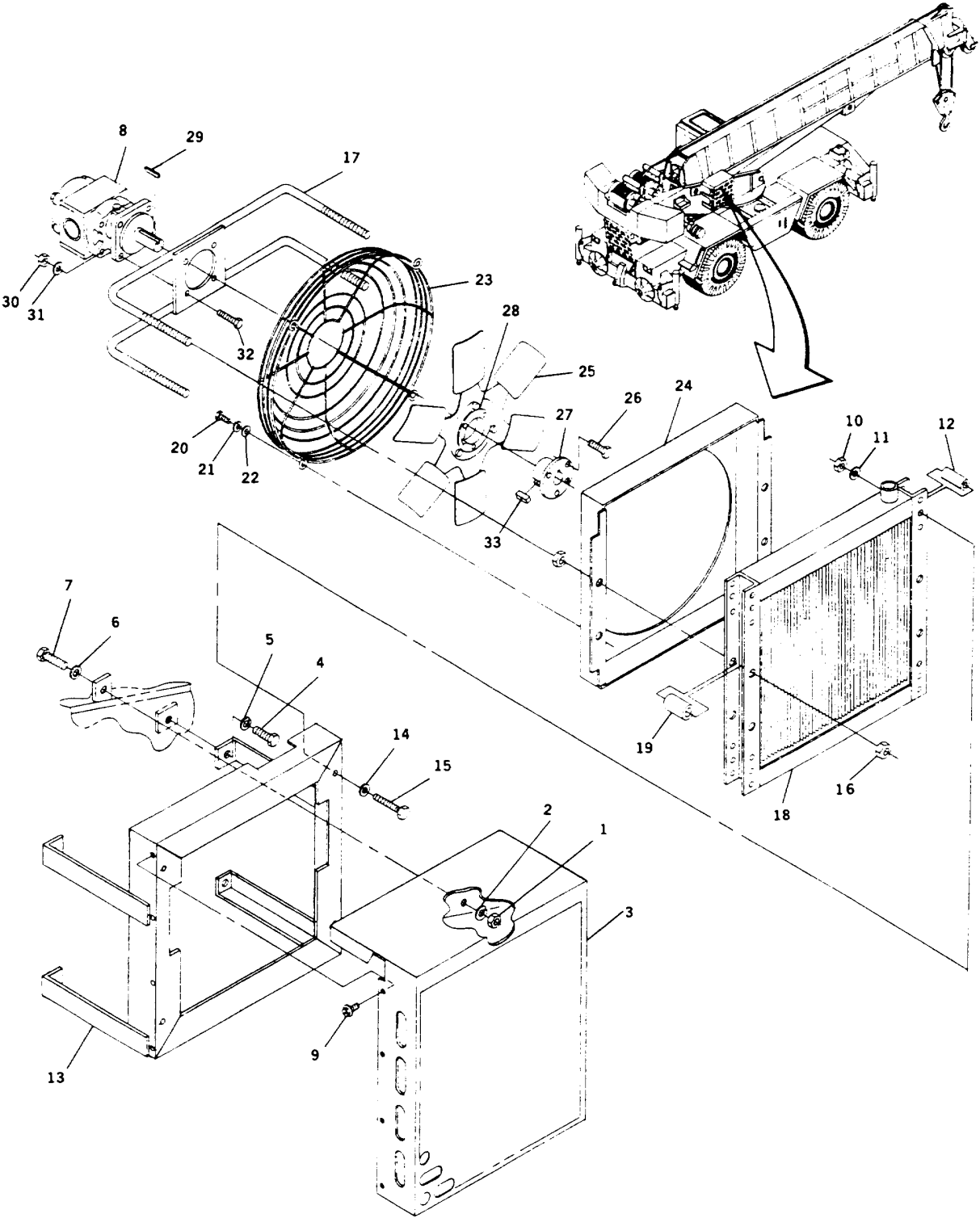
- a. Tag and disconnect four hydraulic hoses from oil cooler motor and oil cooler.
- b. Tag and remove one hydraulic hose between oil cooler and oil cooler motor.
- c. Remove four capscrews (4) and lockwashers (5) and remove oil cooler assembly from superstructure using suitable lifting device.

3. REMOVE OIL COOLER FROM FRAME (13).

- a. Remove eight nuts (10), lockwashers (11), spacers (12), flatwashers (14) and capscrews (15). Remove oil cooler assembly from frame (13).

4. REMOVE OIL COOLER MOTOR FROM OIL COOLER.

- a. Remove four nuts (16) securing fan mount (17) to oil cooler (18). Retain spacers (19) for reassembly.
- b. Remove four capscrews (20), lockwashers (21) and flatwashers (22) securing fan guard (23) to shroud (24).
- c. Remove fan (25), fan guard (23), fan mount (17) and motor (8).
- d. Remove three socket head screw (34) securing fan (25) to fan collar (28). Remove fan (25) and fan guard (23).
- e. Remove three capscrews (26) securing tapered bushing (27) and fan collar (28) to motor shaft. Install capscrew (26) into hole on tapered bushing (27) and tighten to separate bushing and fan collar (28). Remove bushing (27), key (33), and collar (28) from motor shaft.
- f. Remove square key (29) from motor shaft.



- g. Remove four nuts (30), lockwashers (31) and capscrews (32). Remove oil cooler motor (8). Note position of fan mount (17) to oil cooler motor (8) for reassembly.

- e. Position fan shroud (24) on oil cooler, align holes and insert fan mount (17) through holes, ensure spacers (19) are in place.

NOTE

INSTALLATION:

1. INSTALL OIL COOLER MOTOR TO OIL COOLER.

- a. Position oil cooler motor on fan mount bracket (17). Secure with capscrews (32), lockwashers (31) and nuts (30).
- b. Position fan guard (23) over motor shaft. Position square key (29) and fan collar (28) on motor shaft.
- c. Position key (33) and tapered bushing (27) on motor shaft. Ensure that measurement from front of mounting plate (17) to front of tapered bushing (27) is 2 20/32 in. Install and tighten cap screws (26) alternately to draw tapered bushing (27) and fan collar (28) together evenly. Torque cap screws to 15 ft-lbs (20 Nm)

Tee fitting on motor (8) must face boom nose.

- f. Secure fan mount with nuts (16).
- g. Align holes in fan guard (23) with holes in shroud (24) and secure with flatwashers (22), lockwashers (21) and capscrews (20).

NOTE

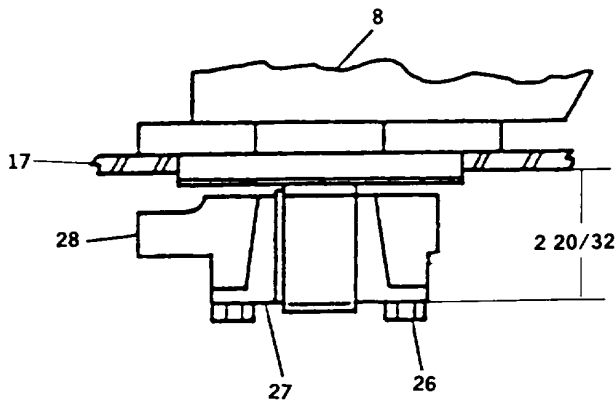
Ensure fan spins freely inside and is centered between fan guard (23) and shroud (24) to eliminate any possible oil cooler damage when motor starts. Adjust by loosening and tightening nuts (16) on fan mount (17).

2. INSTALL OIL COOLER ON FRAME (13).

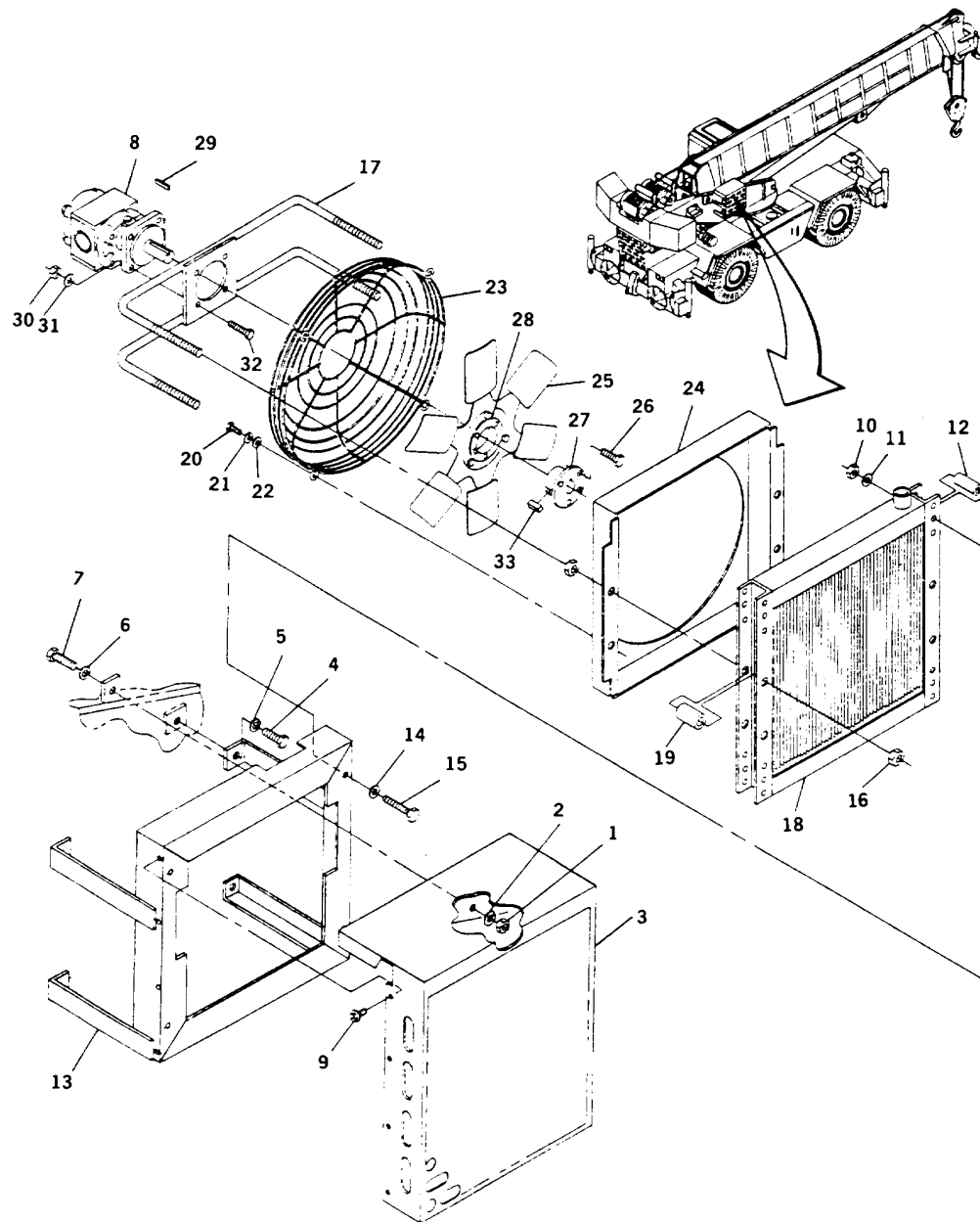
- a. Position oil cooler assembly on frame and secure with eight capscrews (15), flatwashers (14), lockwashers (11) and nuts (10). Ensure spacers (12) are in place.

3. INSTALL OIL COOLER ASSEMBLY.

- a. Using a suitable lifting device, position oil cooler assembly on superstructure and secure with four lockwashers (5) and capscrews (4).
- b. Install tagged hoses on oil cooler and oil cooler motor.



- d. Install fan (25) on fan collar (28) using three socket head screws (34).



4. INSTALL COVER (3).
 - a. Position cover (3) over oil cooler assembly and secure to superstructure using two cap screws (7), flatwashers (6), lockwashers (2) and nuts (1).
 - b. Secure cover (3) sides to frame (13) with eight cap screws (9).
5. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
6. DRAIN AND FLUSH HYDRAULIC SYSTEM. (REFER TO PAGE 13-115.)
7. BLEED AIR FROM HYDRAULIC SYSTEM. (REFER TO PAGE 13-117.)
8. START UP HYDRAULIC SYSTEM AND CHECK FOR PROPER OPERATION AND LEAKS.

END OF TASK

INTEGRATED OUTRIGGER CONTROL VALVE ASSEMBLY

TOOLS: General Mechanic's Tool Kit: automotive (5180-00-177-7033)

SUPPLIES: Parts Kit (Item 256, Appendix B)
 Parts Kit (Item 257, Appendix B)
 Packing, preformed (Item 245, Appendix B)
 Packing, preformed (Item 246, Appendix B)
 Packing, preformed (Item 247, Appendix B)
 Packing, preformed (Item 248, Appendix B) (2 Required)
 Packing, preformed (Item 249, Appendix B) (4 Required)
 Packing, preformed (Item 250, Appendix B)
 Packing, preformed (Item 251, Appendix B) (3 Required)
 Packing, preformed (Item 252, Appendix B) (2 Required)
 Packing, preformed (Item 253, Appendix B)
 Packing, preformed (Item 254, Appendix B)
 Packing, preformed (Item 255, Appendix B)
 Solvent P-D-680 (Item 1, Appendix B)
 Hydraulic Oil (Item 8, Appendix B)

EQUIPMENT CONDITIONS: Integrated outrigger control valve removed. (Refer to TM 5-3810-306-20.)

DISASSEMBLY:

1. REMOVE SOLENOIDS (31).

CAUTION

Remove solenoids (31) slowly. Springs (29) are under tension and can pop out resulting in personal injury.

- a. Remove socket head screws (32) and (33), and remove solenoids (31) from valve body (10).
- b. Remove springs (29), washers (28), packings (23) and valve (21) from valve body (10). Discard packings (23).
- c. Remove and discard packings (30).
- d. Remove valves (15) from solenoids (31).

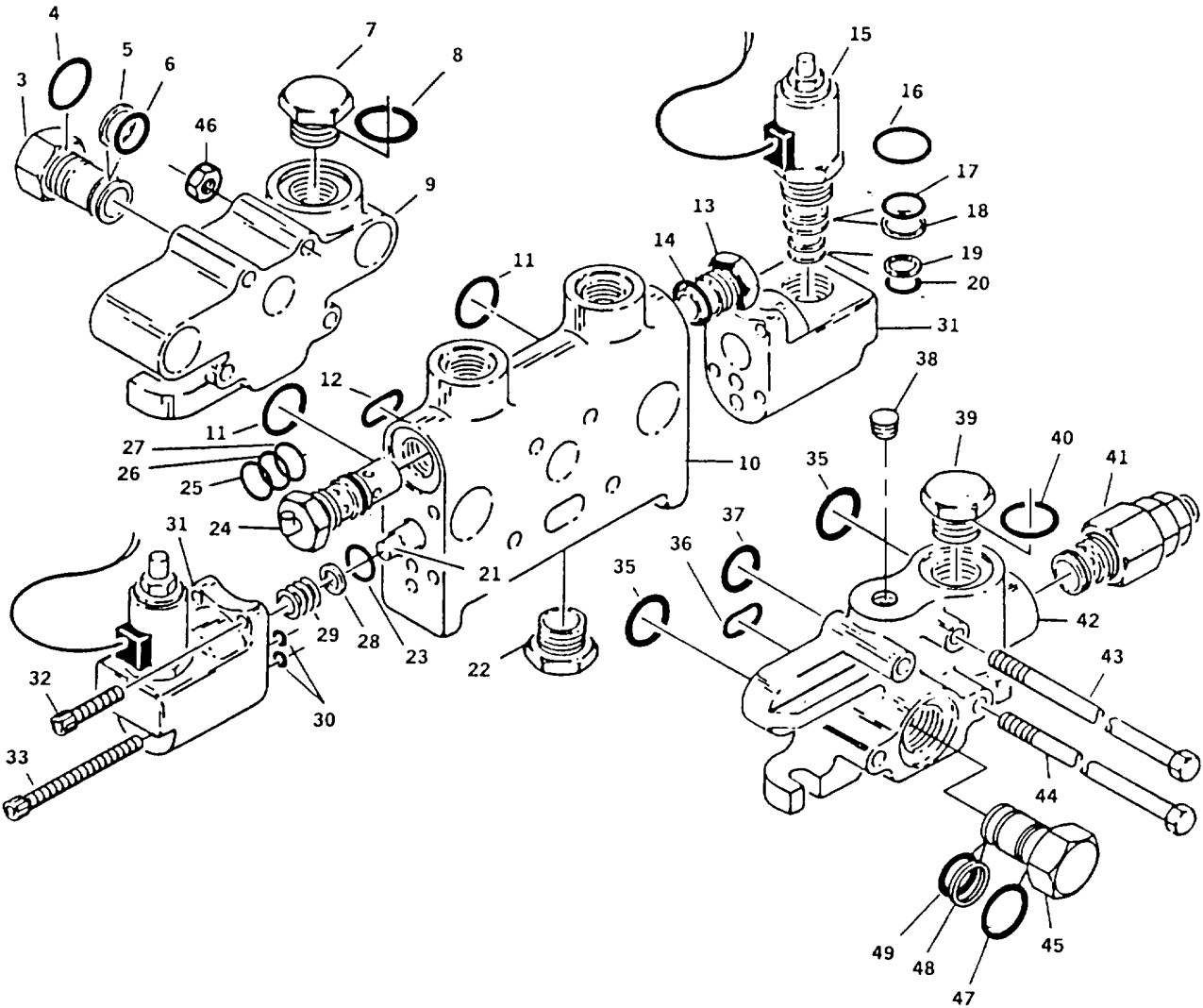
e. Remove and discard packings (16), packings (17), retainers (18), retainers (19) and packings (20).

2. REMOVE SAFETY RELIEF VALVES (13) AND (24).

- a. Remove relief valves (13) and (24) from valve body (10).
- b. Remove and discard packings (25), (26) and (27) from relief valve (24).
- c. Remove and discard packing (14) from relief valve (13).

3. REMOVE VALVE SECTIONS (9) AND (42).

- a. Remove nuts (46) from cap screws (43) and (44) and remove valve section (9) from valve body (10).
- b. Remove and discard packings (11) and (12).



- c. Remove capscrews (43) and (44), and valve section (42) from valve body (10).
 - d. Remove and discard packings (35), (36) and (37).
 - e. Remove plug (7) and packing (8) from valve section (9). Discard packing (8).
 - f. Remove directional sleeve (3) from valve section (9).
 - g. Remove and discard packings (4), (5) and (6).
 - h. Remove relief valve (41) from valve section (42).
 - i. Remove directional sleeve (45) from valve section (42).
 - j. Remove and discard packings (47, (48) and (49) from directional sleeve (45).
 - k. Remove plugs (38) and (39), and packing (40) from valve section (42).
4. IF NECESSARY, REMOVE PLUG (22) FROM VALVE BODY (10).

CLEANING:

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent,

WARNING (CON'T)

get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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

1. CLEAN ALL PARTS IN SOLVENT P-D-680 AND BLOW DRY WITH COMPRESSED AIR.

INSPECTION:

1. INSPECT ALL PARTS FOR WEAR OR OTHER DAMAGE.
2. CHECK THAT ALL ORIFICES ARE CLEAR.

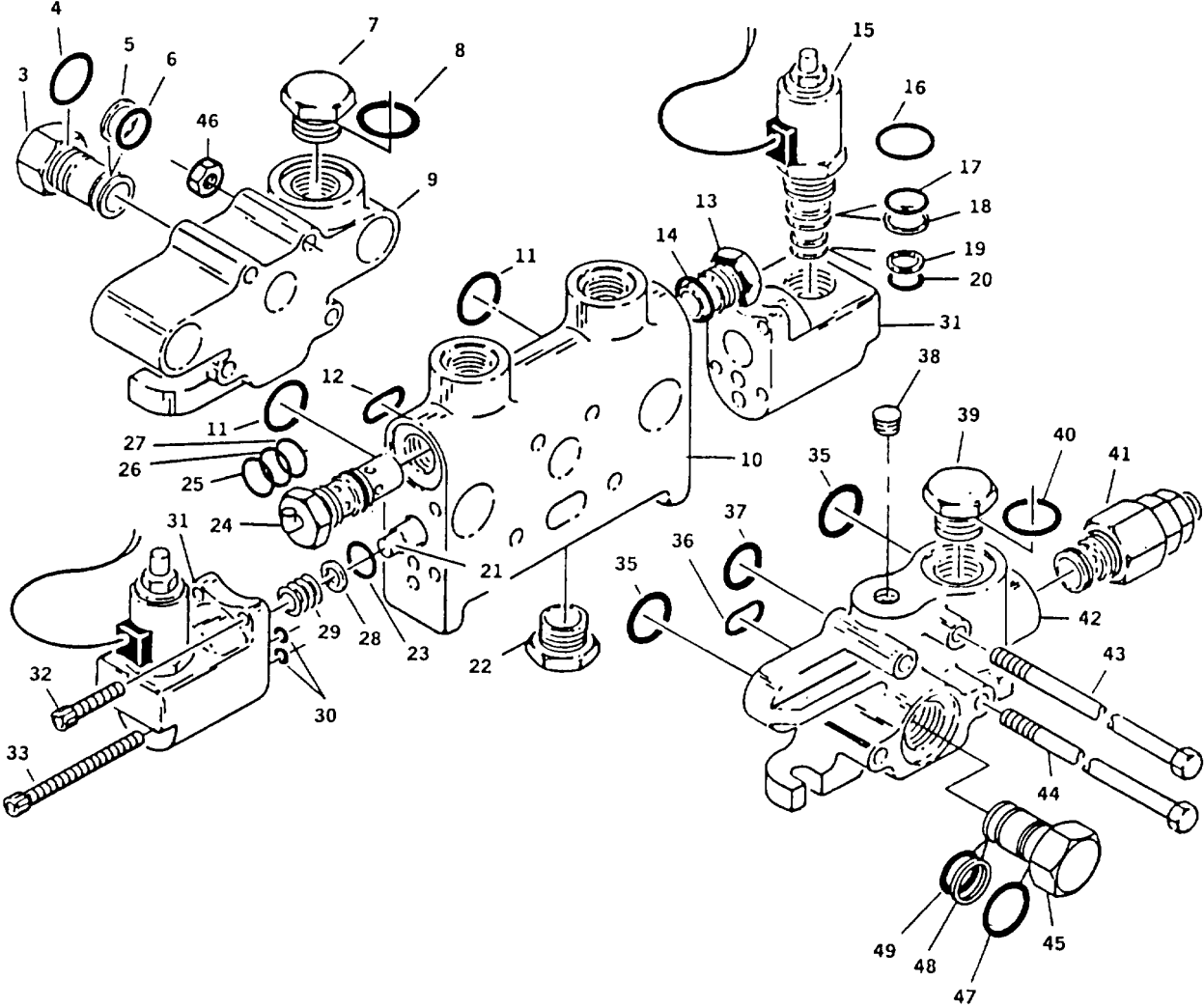
ASSEMBLY:

CAUTION

Install new packings on or in all component parts. Coat packings with clean hydraulic oil prior to assembly.

CAUTION

Do not damage the packings during installation of the valve. If the valve turns freely then gets hard to turn, then easy to turn; remove the valve and check the packings. They have probably been damaged by a sharp edge of a port or thread.

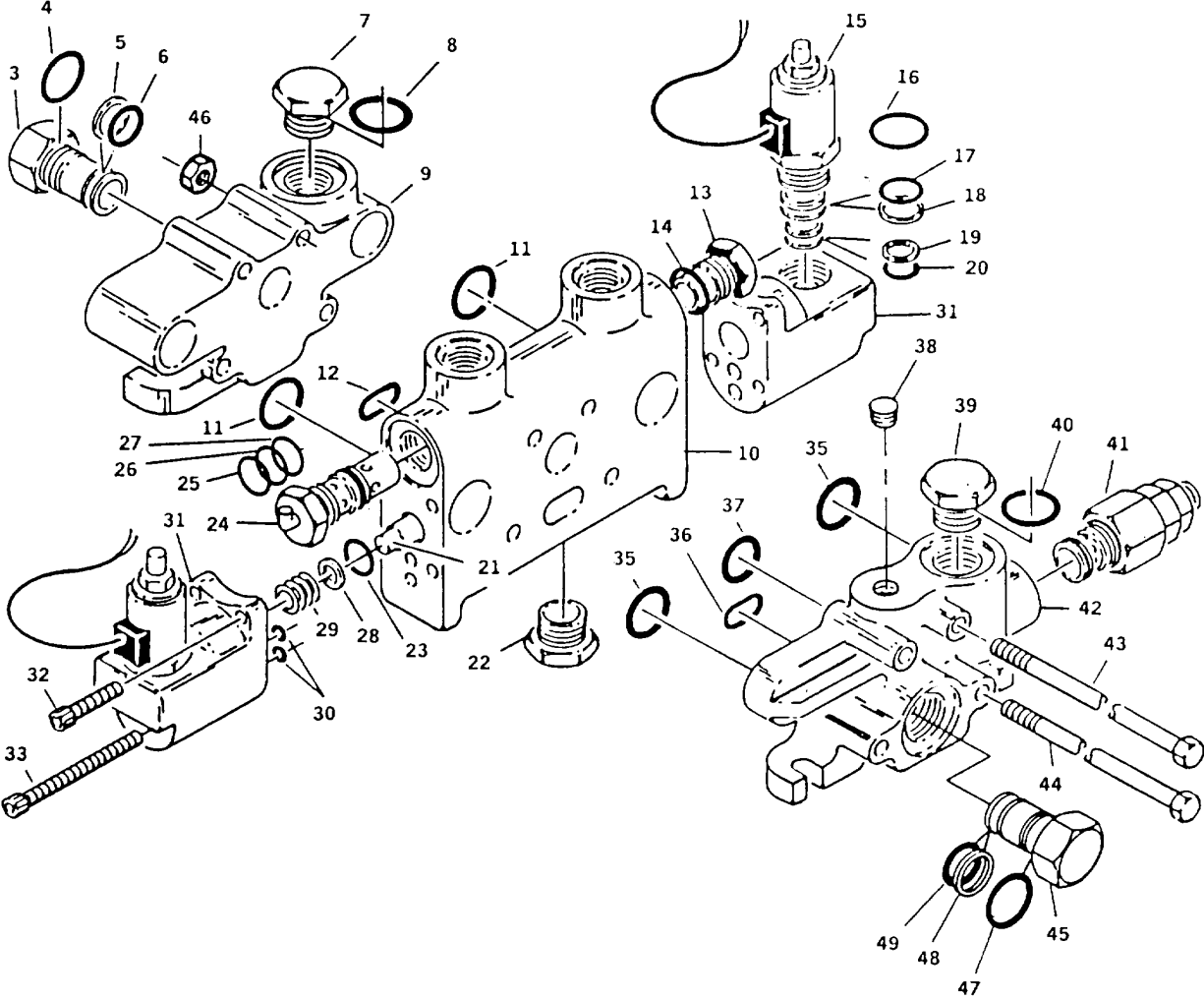


NOTE

The valve should turn by hand until compression of the packings begins.

1. REMOVE ANY BURRS FROM FACES OF VALVE SECTIONS AND ENSURE ALL MATING SURFACES ARE CLEAN.
2. IF REMOVED, INSTALL PLUG (22) IN VALVE BODY (10).
3. ASSEMBLY VALVE SECTION (42).
 - a. Install plugs (38) and (39), and new packing (40).
 - b. Install new packings (47), (48) and (49) on directional sleeve (45).
 - c. Install directional sleeve (45) in valve section (42).
 - d. Install relief valve (41) in valve section (42).
 - e. Install new packings (35), (36) and (37) in valve section (42).
4. ASSEMBLE VALVE SECTION (9).
 - a. Install new packing (8) and plug (7) in valve section (9).
 - b. Install new packings (4), (5) and (6) on directional sleeve (3).
 - c. Install directional sleeve (3) in valve section (9).
 - d. Install new packings (11) and (12) in valve section (9).
5. INSTALL VALVE SECTIONS (9) AND (42).
 - a. Position valve section (42) on valve body (10) and install capscrews (43) and (44) through valve section (42) and valve body (10).
 - b. Install valve section (9) over cap screws (43) and (44), and install nuts (46).
6. INSTALL SAFETY RELIEF VALVES (13) AND (24).
 - a. Install new packings (25), (26) and (27) on relief valve (24).
 - b. Install relief valve (24) in valve body (10).
 - c. Install new packing (14) and relief valve (13) in valve body (10).
7. INSTALL VALVES (15).
 - a. Install new packings (16), (17) and (20), and new retaining rings (18) and (19) on valves (15).
 - b. Install valves (15) in solenoids (31).
8. INSTALL SOLENOIDS (31).
 - a. Install valve (21), new packings (23), washers (28) and springs (29) in valve body (10).
 - b. Install new packings (30) in solenoids (31).
 - c. Install solenoids (31) on valve body (10) with socket head screws (32) and (33).
9. INSTALL INTEGRATED OUTRIGGER CONTROL VALVE. (REFER TO TM 53810-306-20.)

END OF TASK



LIFT, REAR STEER, TELE CONTROL VALVE ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Lubrication Service, Unit Trailer Mounted (4930-00-017-9167)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1 (4910-00-754-0706)
 Tool Outfit Hyd System; Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784)

SUPPLIES: Packing assortment (Item 50, Appendix B)
 Parts kit, seal repl. (Item 51, Appendix B)
 Packing assortment (Item 52, Appendix B)
 Solvent P-D-680 (Item 1, Appendix B)
 Hydraulic oil (Item 8, Appendix B)

EQUIPMENT CONDITION: Control valve-removed. (Refer to TM 5-3810-306-20.)

DISASSEMBLY:**NOTE**

The following procedure outlines disassembly for one section of the valve bank. All additional valve sections will be identical.

1. REMOVE FITTINGS FROM VALVE BANK AS REQUIRED. SAVE FOR INSTALLATION.
2. REMOVE TIE BOLTS (2) SECURING VALVE SECTIONS TOGETHER. SEPARATE SECTIONS AND REMOVE PREFORMED PACKINGS (21) AND (22).
3. REMOVE RELIEF VALVE (5) FROM INLET SECTION (4).

NOTE

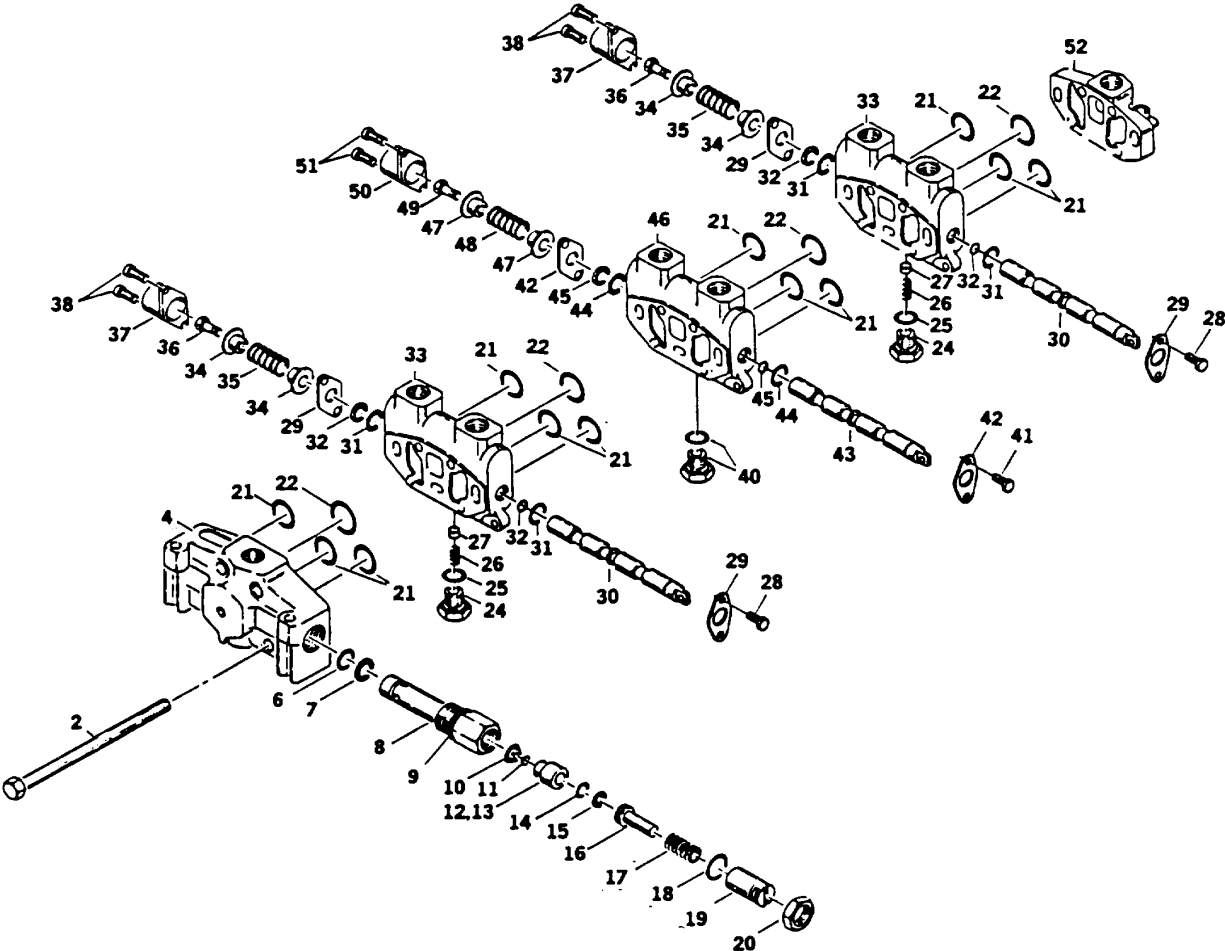
Keeping preformed packings and rings in order during disassembly will aid in reassembly.

4. DISASSEMBLE RELIEF VALVE (5).
 - a. Remove preformed packing (18) and washer (9) from cartridge (8).

- b. Remove locknut (20), adjusting screws (19), preformed packing (18), spring (17), plunger (16).
- c. Remove preformed packing (14) and back-up ring (15) from plunger (16).
- d. Remove floating seal (12) and check valve snubber (13) from cartridge.
- e. Remove poppet (11) and retainer (10) from cartridge.
- f. Remove preformed packing (6) and back-up ring (7).

5. DISASSEMBLE VALVE SECTION (33).

- a. Remove two screws (38) and valve cap (37).
- b. Remove stripper bolt (36), spring guides (34) and spring (35)
- c. Remove two screws (28) and retainer plates (29)
- d. Remove preformed packings (31), backup rings (32) and spool (30) from valve body.



- e. Remove check cap (24), preformed packing (25), check spring (26) and poppet (27).

CLEANING:**WARNING**

Dry cleaning solvent P-D- 680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (380-590C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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

- 1. CLEAN PARTS IN SOLVENT P-D-680 AND BLOW DRY WITH COMPRESSED AIR.

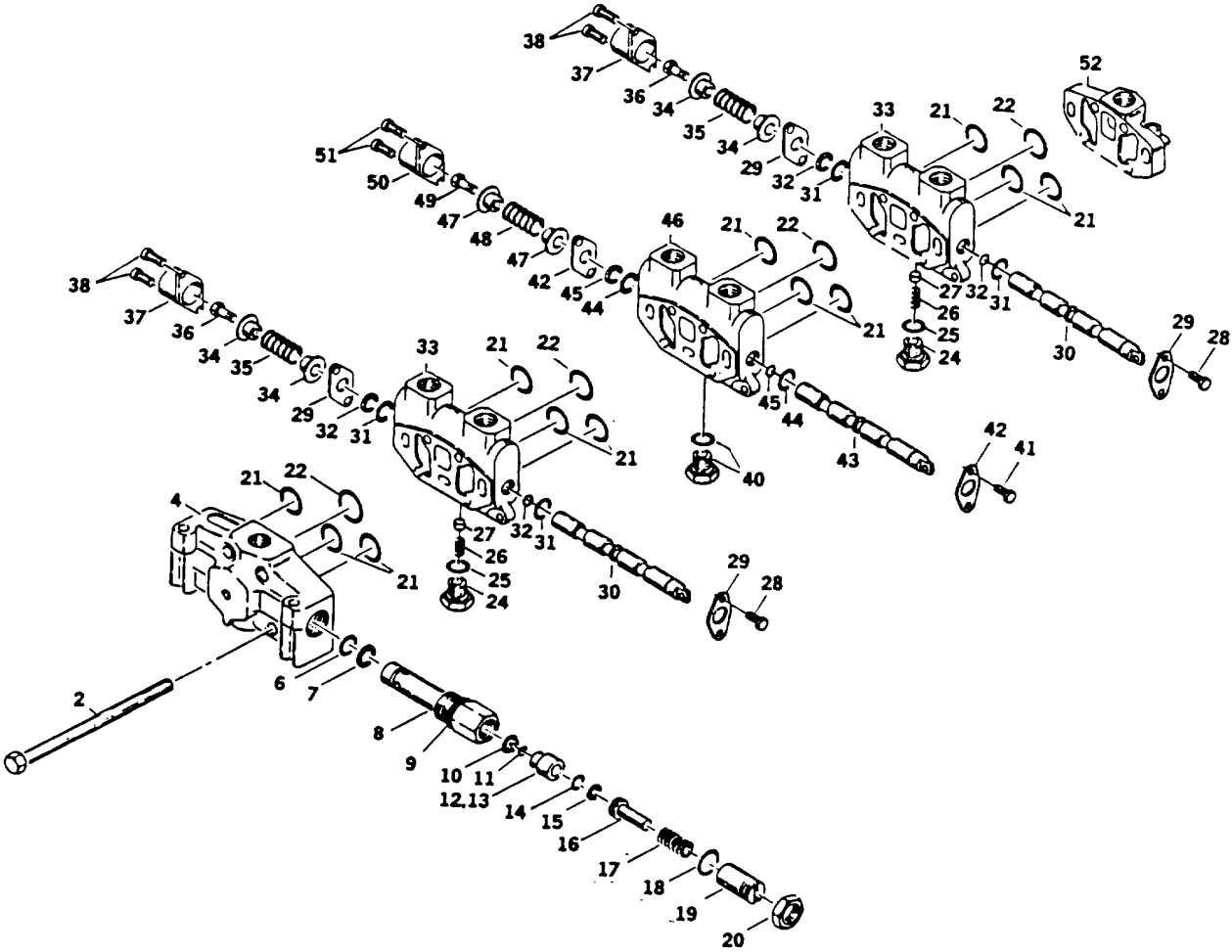
INSPECTION:

- 1. INSPECT SPOOL BORE FOR CRACKS, PITTING SCORING AND WEAR. REPLACE IF NECESSARY.
- 2. INSPECT SPOOL FOR SCORING AND WEAR. REPLACE IF NECESSARY.

REASSEMBLY:**CAUTION**

Install new packings and seals on or in all component parts. Coat packings and seals with clean hydraulic fluid prior to assembly.

- 1. REMOVE ANY BURRS FROM FACES OF VALVE SECTIONS AND ENSURE ALL MATING SURFACES ARE CLEAN.
- 2. REASSEMBLE VALVE SECTION (33).
 - a. Install new packings onto plugs.
 - b. Install poppet (27), spring (26), new preformed packing (25) and check cap (24).
 - c. Install spool (30).
 - d. Install new preformed packings (31) and back-up rings (32) on both sides of spool. Retain on clevis end of spool with retainer plate (29) and screws (28).
 - e. Install retainer plate (29), spring guides (34) and spring (35). Secure with stripper bolt (36).
 - f. Install valve cap (37) and screws (38).
- 3. REASSEMBLE RELIEF VALVE (5).
 - a. Install new preformed packing (6) and back-up ring (7) into cartridge (8).
 - b. Install poppet (11) and retainer (10) into cartridge (8).
 - c. Install new floating seal (12) and check valve snubber (13).



- d. Install new preformed packing (14) and back-up ring (15) on plunger (16).
 - e. Install plunger (16), spring (17), adjusting screw (19) with new preformed packing (18) into cartridge (8). Secure with locknut (20).
 - f. Install washer (9) and new preformed packing (18) on relief valve cartridge (8). Install relief valve (5) into inlet section (4).
4. POSITION SECTIONS TOGETHER WITH NEW PREFORMED PACKINGS (21) AND (22). SECURE ASSEMBLY WITH TIE BOLTS (2).

NOTE

Do not torque tie bolts at this time.

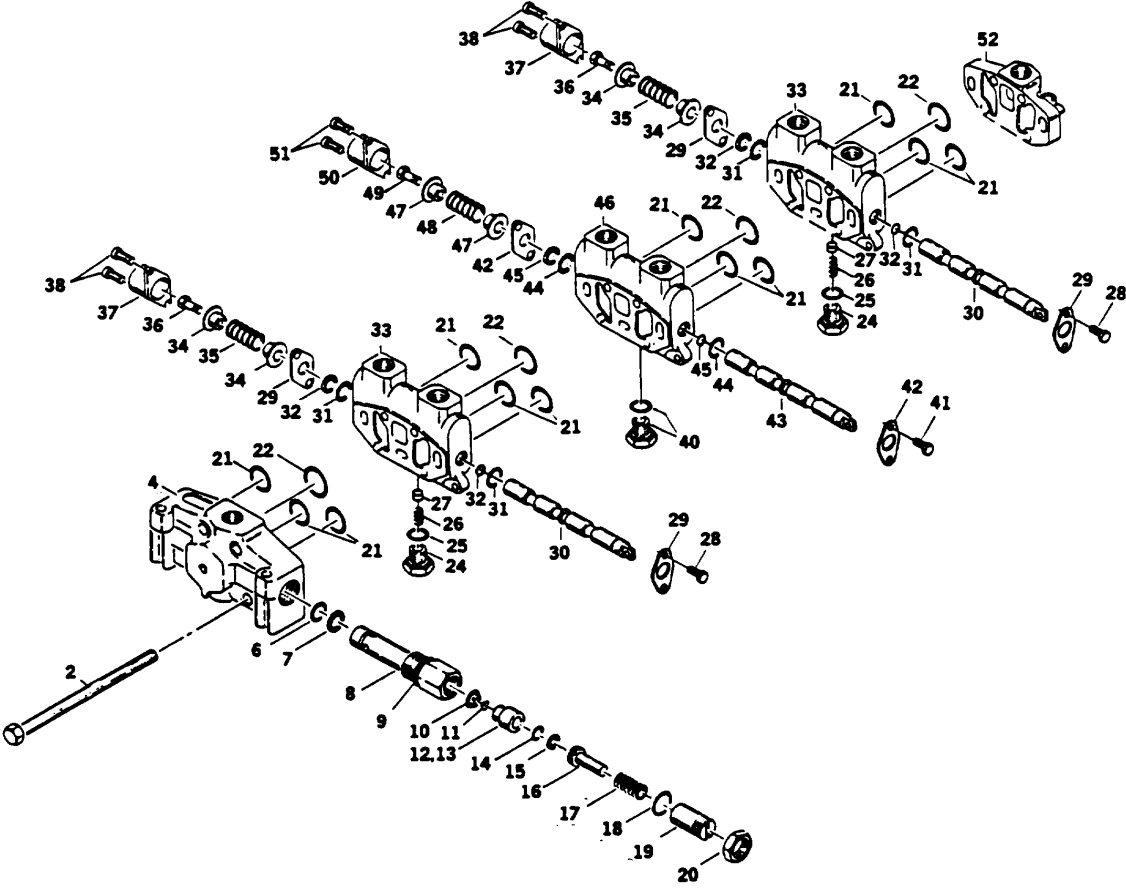
5. INSTALL CIRCUIT RELIEF VALVES IF APPLICABLE IN THEIR HOUSING.

CAUTION

Ensure that all sections (inlet, housing, and outlet) are aligned prior to applying torque.

6. USING PROPER TORQUE WRENCH, TORQUE TIE BOLTS (2) TO 350 IN-LBS (39 Nm) (A-20 VALVE) AND 400 IN-LBS (44 Nm) (A-35 VALVE).
7. ACTUATE SPOOL TO ENSURE FREE MOVEMENT.
8. INSTALL CONTROL VALVE. (REFER TO TM 5-3810-306-20.)

END OF TASK



MAIN HOIST, AUXILIARY HOIST BOOST CONTROL VALVE ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033) Lubrication Service, Unit Trailer Mounted (4930-00-017-9167) Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705) Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1 (4910-00-754-0706)
Tool Outfit Hyd System; Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784)

SUPPLIES: Packing assortment (Item 50, Appendix B)
Parts kit, seal repl. (Item 51, Appendix B)
Packing assortment (Item 52, Appendix B)
Parts kit, seal repl. (Item 53, Appendix B)
Solvent P-D-680 (Item 1, Appendix B)
Hydraulic oil (Item 8, Appendix B)

EQUIPMENT CONDITION: Control valve removed.(Refer to TM 5-3810-306-20.)

DISASSEMBLY:

NOTE

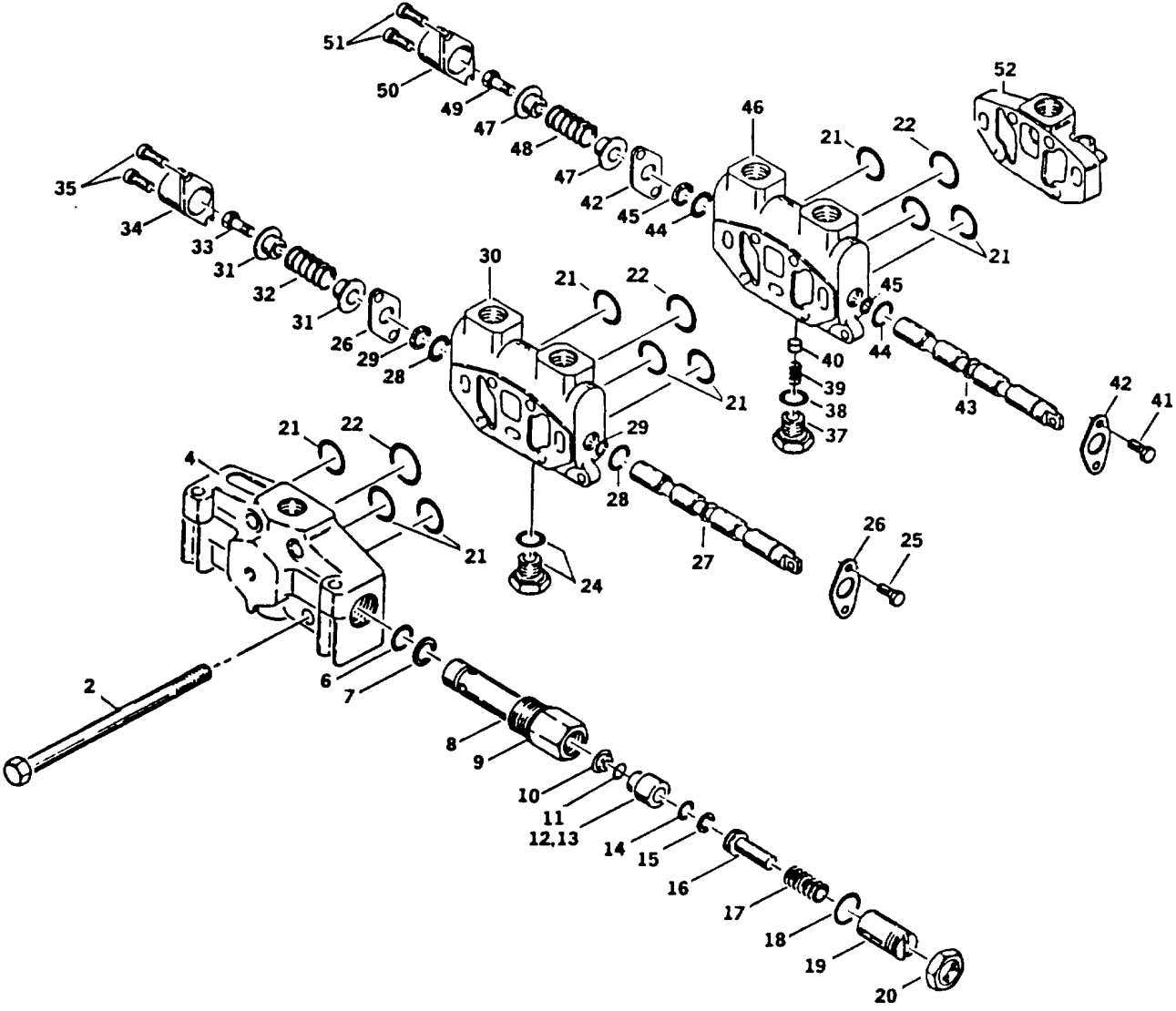
The following procedure outlines disassembly for one section of the valve bank. All additional valve sections will be identical.

1. REMOVE FITTINGS FROM VALVE BANK AS REQUIRED. SAVE FOR INSTALLATION.
2. REMOVE TIE BOLTS (2) SECURING VALVE SECTIONS TOGETHER. SEPARATE SECTIONS AND REMOVE PREFORMED PACKINGS (21) AND (22).
3. REMOVE RELIEF VALVE (5) FROM INLET SECTION (4).

NOTE

Keeping preformed packings and rings in order during disassembly will aid in reassembly.

4. DISASSEMBLE RELIEF VALVE (5).
 - a. Remove preformed packing (18) and washer (9) from cartridge (8).
 - b. Remove locknut (20), adjusting screws (19), preformed packing (18), spring (17) and plunger (16).
 - c. Remove preformed packing (14) and backup ring (15) from plunger (16).
 - d. Remove floating seal (12) and check valve snubber (13) from cartridge.
 - e. Remove poppet (11) and retainer (10) from cartridge.
 - f. Remove preformed packing (6) and back-up ring (7).
5. DISASSEMBLE VALVE SECTION (30).
 - a. Remove two screws (35) and valve cap (34).



- b. Remove stripper bolt (33), spring guides (31) and spring (32).
- c. Remove two screws (25) and retainer plates (26).
- d. Remove preformed packings (28), back-up rings (29) and spool (27) from valve body.
- e. Remove check cap (37), preformed packing (38), check spring (39) and poppet (40).
- f. Remove plugs and preformed packings (24) from unused ports.

1. CLEAN PARTS IN SOLVENT P-D-680 AND BLOW DRY WITH COMPRESSED AIR.

INSPECTION:

1. INSPECT SPOOL BORE FOR CRACKS, PITTING SCORING AND WEAR. REPLACE AS NECESSARY.
2. INSPECT SPOOL FOR SCORING AND WEAR. REPLACE AS NECESSARY.

REASSEMBLY:**CAUTION**

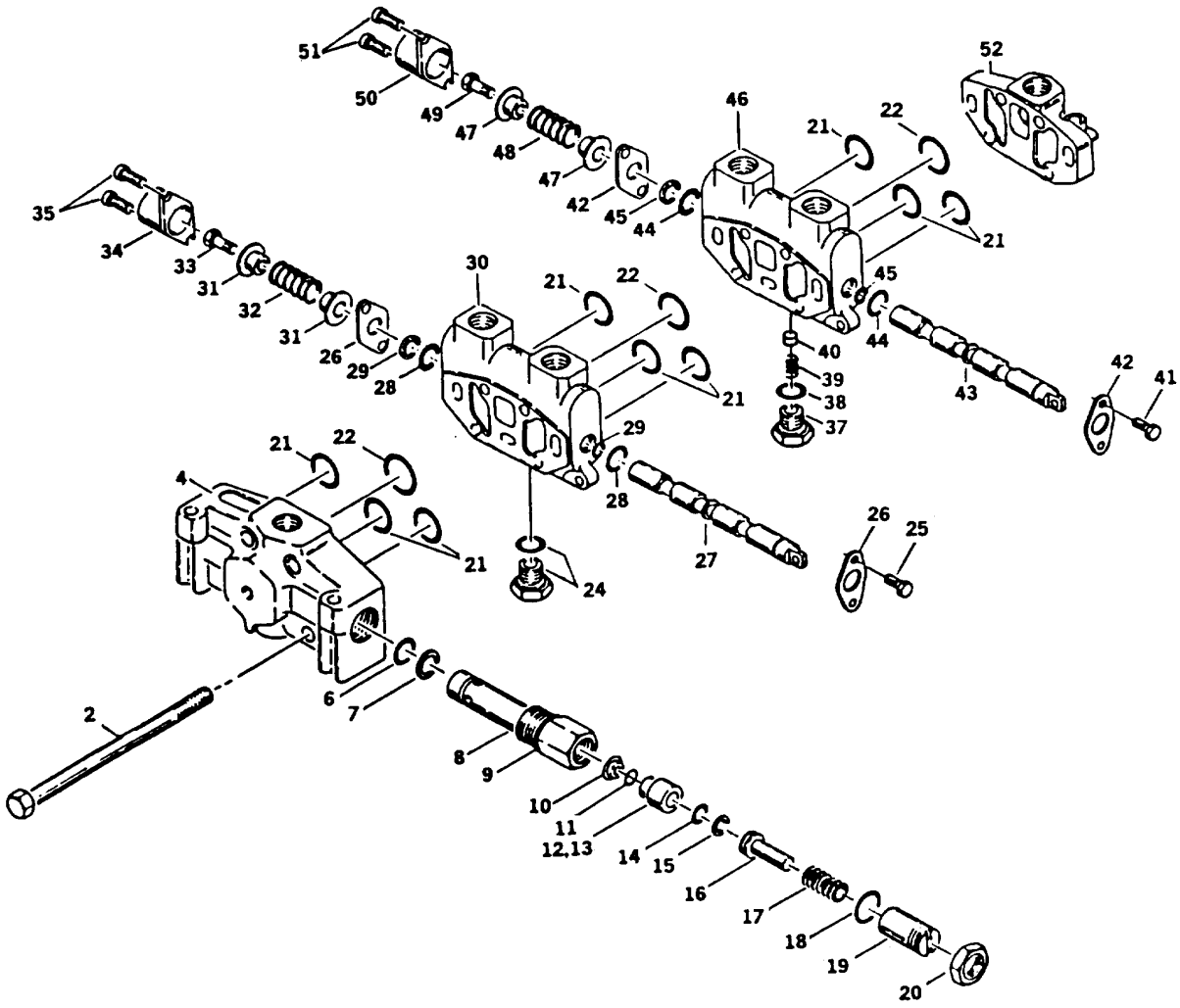
Install new packings and seals on or in all component parts. Coat packings and seals with clean hydraulic fluid prior to assembly.

1. REMOVE ANY BURRS FROM FACES OF VALVE SECTIONS AND ENSURE ALL MATING SURFACES ARE CLEAN.
2. REASSEMBLE VALVE SECTION (30).
 - a. Install new packings onto plugs.
 - b. Install poppet (40), spring (39), new preformed packing (38) and check cap (37).
 - c. Install spool (27).
 - d. Install new preformed packings (28) and back-up rings (29) on both sides of spool. Retain on clevis end of spool with retainer plate (26) and screws (25).
 - e. Install retainer plate (26), spring guides (31) and spring (32). Secure with stripper bolt (33).
 - f. Install valve cap (34) and screws (35).

CLEANING:**WARNING**

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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



3. REASSEMBLE RELIEF VALVE (5).
 - a. Install new preformed packing (6) and back-up ring (7) into cartridge (8).
 - b. Install poppet (11) and retainer (10) into cartridge (8).
 - c. Install new floating seal (12) and check valve snubber (13).
 - d. Install new preformed packing (14) and back-up ring (15) on plunger (16).
 - e. Install plunger (16), spring (17), adjusting screw (19) with new preformed packing (18) into cartridge (8). Secure with locknut (20).
 - f. Install washer (9) and new preformed packing (18) on relief valve cartridge (8). Install relief valve (5) into inlet section (4).
4. POSITION SECTIONS TOGETHER WITH NEW PREFORMED PACKINGS (21) AND (22). SECURE ASSEMBLY WITH TIE BOLTS (2).

NOTE

Do not torque tie bolts at this time.

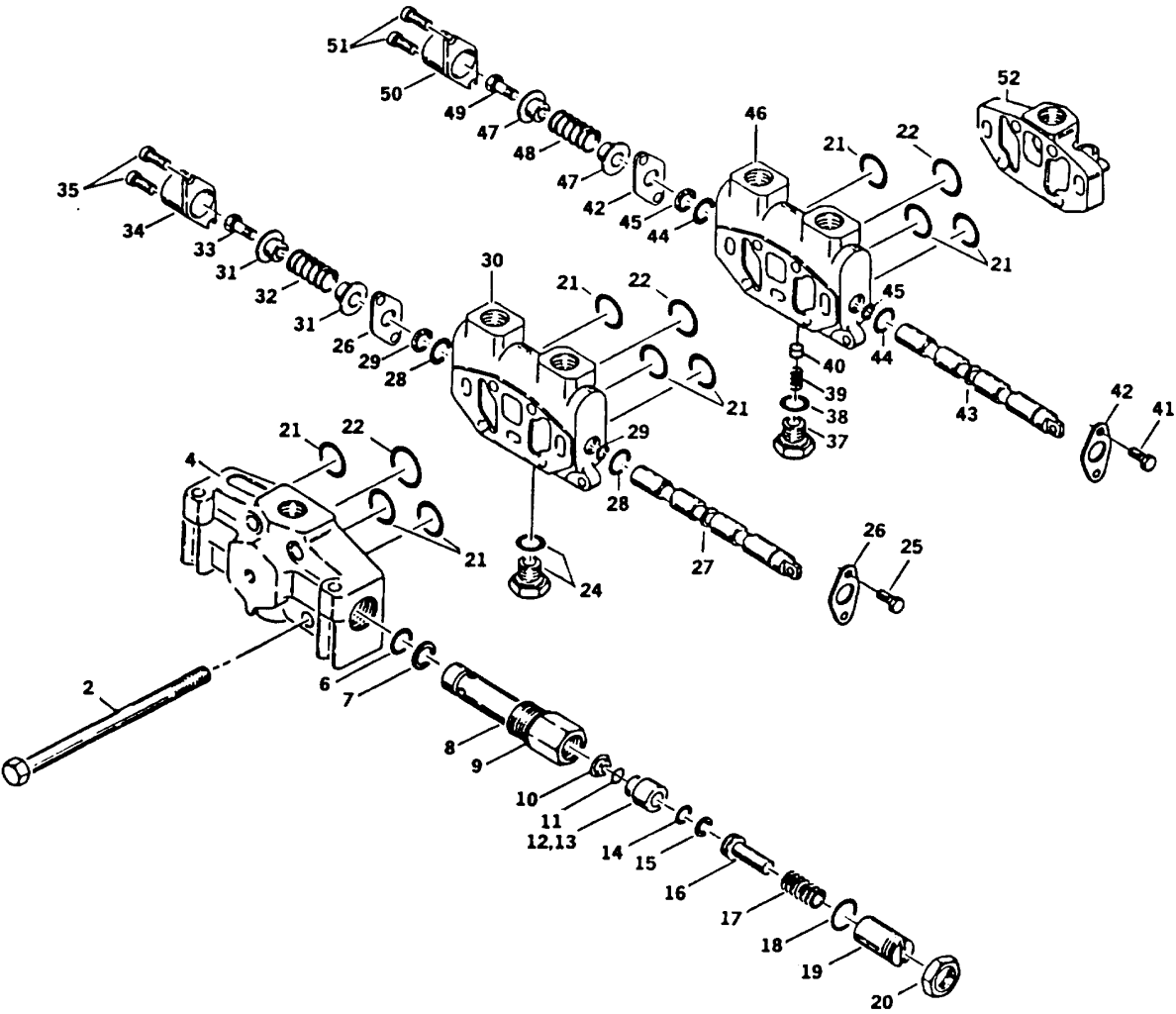
5. INSTALL CIRCUIT RELIEF VALVES IF APPLICABLE IN THEIR HOUSING.

CAUTION

Ensure that all sections (inlet, housing, and outlet) are aligned prior to applying torque.

6. USING PROPER TORQUE WRENCH, TORQUE TIE BOLTS (2) TO 350 IN-LBS (39 Nm) (A-20 VALVE) AND 400 IN-LBS (44 Nm) (A-35 VALVE).
7. ACTUATE SPOOL TO ENSURE FREE MOVEMENT.
8. INSTALL CONTROL VALVE. (REFER TO TM 5-3810-306-20.)

END OF TASK



OIL COOLER BYPASS VALVE INSTALLATION

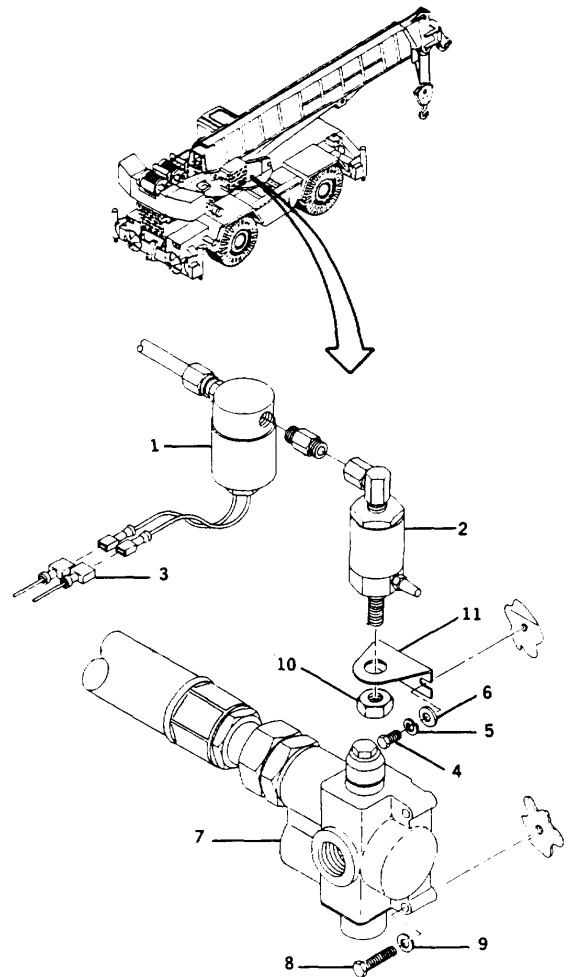
TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033) SR

SUPPLIES: Preformed packing (Item 198, Appendix B) (3 Required)
 Preformed packing (Item 90, Appendix B) (3 Required)
 Lockwashers (Item 38, Appendix B) (2 Required)
 Lockwashers (Item 26, Appendix B) (2 Required)
 Loctite #545 (Item 18, Appendix B)
 Hydraulic oil (Item 8, Appendix B)

EQUIPMENT CONDITIONS: Hydraulic system shutdown and pressure relieved from lines. (Refer to TM 5-3810-306-20.)
 Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE SOLENOID VALVE (1) AND AIR CYLINDER (2).
 - a. Tag and disconnect two electrical connectors (3) to solenoid valve (1).
 - b. Tag and disconnect air line to solenoid valve (1).
 - c. Remove two capscrews (4), lockwashers (5) and flatwashers (6) and remove air cylinder (2), solenoid valve (1) and bracket (11).
 - d. Remove nut (10) and bracket (11) from air cylinder (2).
 - e. Remove fittings and separate valve (1) from air cylinder (2). Retain fittings for installation.
2. REMOVE BYPASS VALVE (7).
 - a. Tag and disconnect three hydraulic lines from bypass valve (7). Remove fittings and preformed packing. Discard preformed packing.
 - b. Remove two capscrews (8) and lockwashers (9). Remove bypass valve (7).



INSTALLATION:

1. INSTALL BYPASS VALVE (7).
 - a. Position bypass valve (7) and secure to superstructure with two capscrews (8) and lockwashers (9).

NOTE

It is recommended that all preformed packing be coated with hydraulic oil prior to installation. Coat threads with Loctite #545.

- b. Connect three tagged hydraulic lines, fittings and new preformed packing to bypass valve (7).

2. INSTALL SOLENOID VALVE (1) AND AIR CYLINDER (2).

- a. Position air cylinder (2) in bracket (11) and secure with nut (10).
 - b. Connect solenoid valve (1) to air cylinder (2) with fittings.
 - c. Position air cylinder (2) above bypass valve (7) and secure bracket (11) to turntable with two capscrews (4), lockwashers (5) and flatwashers (6).
 - d. Connect tagged air line to solenoid valve (1).
 - e. Connect two tagged electrical connectors (3) to solenoid valve (1).

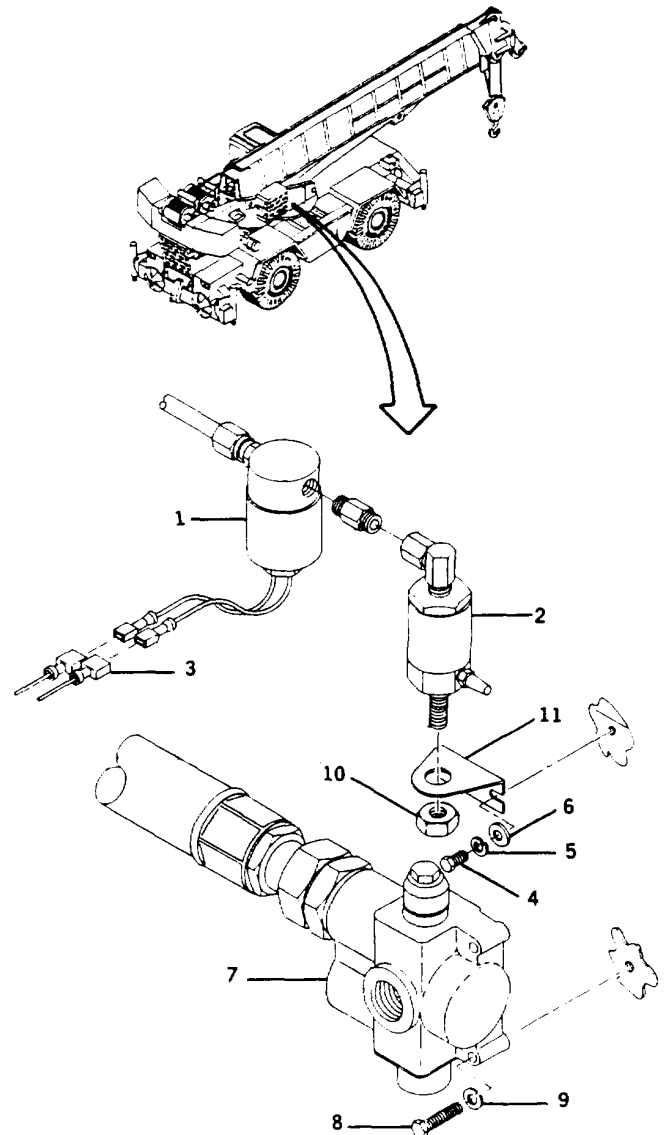
3. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

4. DRAIN AND FLUSH HYDRAULIC SYSTEM. (REFER TO PAGE 13-115.)

5. BLEED AIR FROM HYDRAULIC SYSTEM. (REFER TO PAGE 13-117.)

6. TEST FOR PROPER OPERATION.

END OF TASK



OUTRIGGER CONTROL VALVE ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Lubrication Service, Unit Trailer Mounted (4930-00-017-9167)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1 (4910-00-754-0706)
 Tool Outfit Hyd System; Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784)

SUPPLIES: Solvent, P-D-680 (Item 1, Appendix B)
 Retainer, packing (Item 40, Appendix B) (3 Required)
 Packing, preformed (Item 41, Appendix B)
 Packing, preformed (Item 42, Appendix B)
 Packing, preformed (Item 43, Appendix B)
 Packing, preformed (Item 44, Appendix B)
 Packing, preformed (Item 45, Appendix B)
 Packing, preformed (Item 46, Appendix B) (3 Required)
 Hydraulic oil (Item 8, Appendix B)
 Loctite #545 (Item 18, Appendix B)

EQUIPMENT CONDITION: Outrigger control valve assembly removed. (Refer to TM 5-3810-306-20.)

DISASSEMBLY:

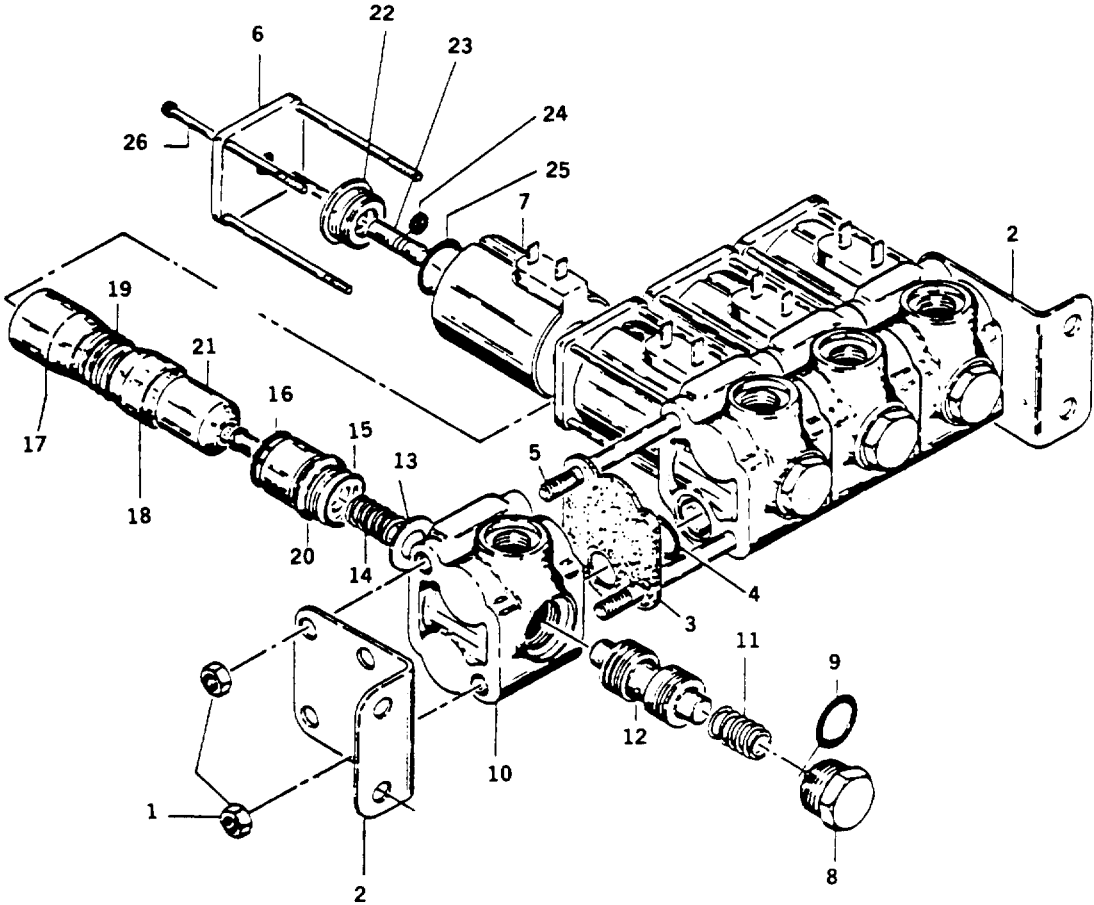
1. DISASSEMBLE OUTRIGGER CONTROL VALVE BANK.

NOTE

The following procedures detail disassembly of one solenoid valve. The outrigger control valve bank consists of four identical solenoid valves. These procedures apply for all valves.

- a. Remove nuts (1) on each end of valve bank securing mounting brackets (2).
- b. Separate valve assemblies and remove three plates (3), three preformed packings (4) and two tie bolts (5). Discard packings (4).
- c. Remove fittings from valve assemblies and retain for reassembly.

- d. Remove four screws (26), plate (6) and solenoid coil (7) from valve assembly.
- e. Remove plug (8) and preformed packing (9) from valve body (10). Discard packing (9).
- f. Remove spring (11), spool (12), washer (13) and spring (14) from valve body (10).
- g. Remove plunger assembly from solenoid coil.
- h. Remove preformed packings (15) and (16), sleeves (17) and (18), spring (19) and cone (20) from plunger (21). Discard packings (15) and (16).
- i. Remove guide (22), pin (23), quad ring (24) and preformed packing (25). Discard packing (25).



CLEANING:

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F/138°F (38°C-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is

WARNING (Cont'd)

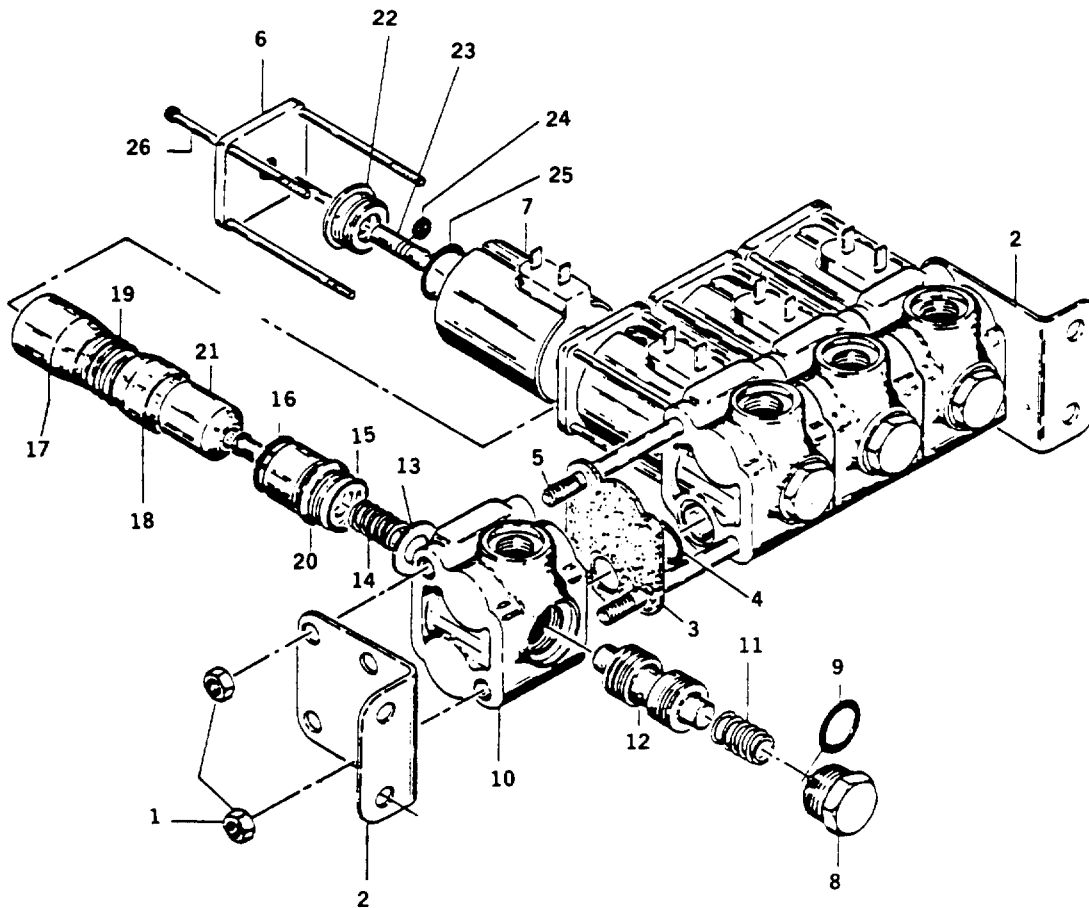
made, wash your eyes with water and get medical aid immediately. Compressed air used for cleaning purposes will not exceed 30 psi. Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).

INSPECTION:

1. INSPECT ALL PARTS FOR NICKS AND SCRATCHES, MINOR NICKS AND SCRATCHES MAY BE REMOVED WITH CROCUS CLOTH.

REASSEMBLY:

1. ASSEMBLE OUTRIGGER CONTROL VALVE.



NOTE

Replace all preformed packings. Coat all parts with hydraulic oil before reassembly.

- a. Install new preformed packings (15) and (16), sleeves (17) and (18), spring (19) and cone (20) on plunger (21) and insert in solenoid coil.
 - b. Install quad ring (24) on pin (23). Install pin (23), guide (22) and new preformed packing (25).
 - c. Install spring (11), washer (13), spool (12) and spring (14) in valve body.
 - d. Install new preformed packing (9) on plug (8) and tighten in end of valve body.
 - e. Position solenoid coil (7) on valve body and secure with plate (6) and four screws (26). Tighten screws.
 - f. Assemble valve bodies, plates (3) and new preformed packings (4) on tie bolts (5).
 - g. Position two mounting brackets (2) on each end of valve bank and secure with nuts (1). Torque nuts (1) to 125 in-lbs (14 Nm).
 - h. Coat threads of fittings with Loctite #545 and install on valves.
2. **INSTALL CONTROL VALVE. (REFER TO TM 5-3810-306-20.)**

END OF TASK

SWING CONTROL VALVE ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Lubrication Service, Unit Trailer Mounted (4930-00-017-9167)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1 (4910-00-754-0706)
 Tool Outfit Hyd System; Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784)

SUPPLIES: Packing assortment (Item 47, Appendix B)
 Quad seal (Item 48, Appendix B) (2 Required)
 Back-up ring (Item 49, Appendix B) (2 Required)
 Solvent P-D-680 (Item 1, Appendix B)
 Hydraulic oil (Item 8, Appendix B)
 Loctite #545 (Item 18, Appendix B)

EQUIPMENT CONDITION: Control valve removed. (Refer to TM 5-3810-306-20.)

DISASSEMBLY:

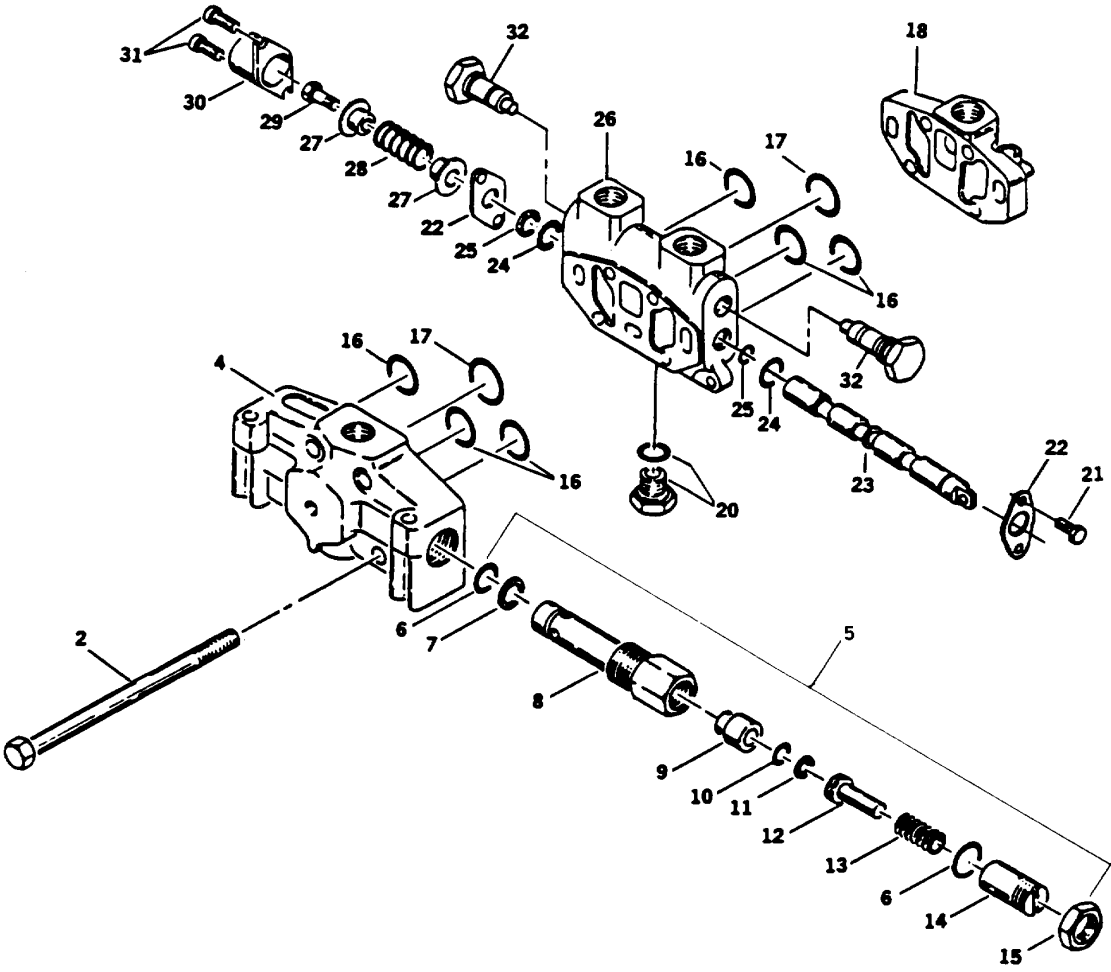
1. REMOVE FITTINGS FROM VALVE BANK AS REQUIRED. SAVE FOR INSTALLATION.
2. REMOVE TIE BOLTS (2) SECURING VALVE SECTIONS TOGETHER. SEPARATE SECTIONS AND REMOVE PREFORMED PACKINGS (16) AND (17).
3. REMOVE RELIEF VALVE (5) FROM INLET SECTION (4).

NOTE

Keeping preformed packings and rings in order during disassembly will aid in reassembly.

4. DISASSEMBLE RELIEF VALVE (5).
 - a. Remove preformed packing (6) and washer (7) from cartridge (8).
 - b. Remove lock nut (15), adjusting screw (14), preformed packing (6), spring (13) and plunger (12).

- c. Remove preformed packing (10) and back-up ring (11) from plunger (16).
- d. Remove seat (9).
5. DISASSEMBLE VALVE SECTION (26).
 - a. Remove two screws (31) and valve cap (30).
 - b. Remove stripper bolt (29), spring guides (27) and spring (28).
 - c. Remove two screws (21) and retainer plates (22).
 - d. Remove quad seals (24), back-up rings (25) and spool (23) from valve body.
 - e. Remove plug and packing (20) from unused port.
 - f. Remove check valves (32).



CLEANING:**WARNING**

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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

1. CLEAN PARTS IN SOLVENT P-D-680 AND BLOW DRY WITH COMPRESSED AIR.

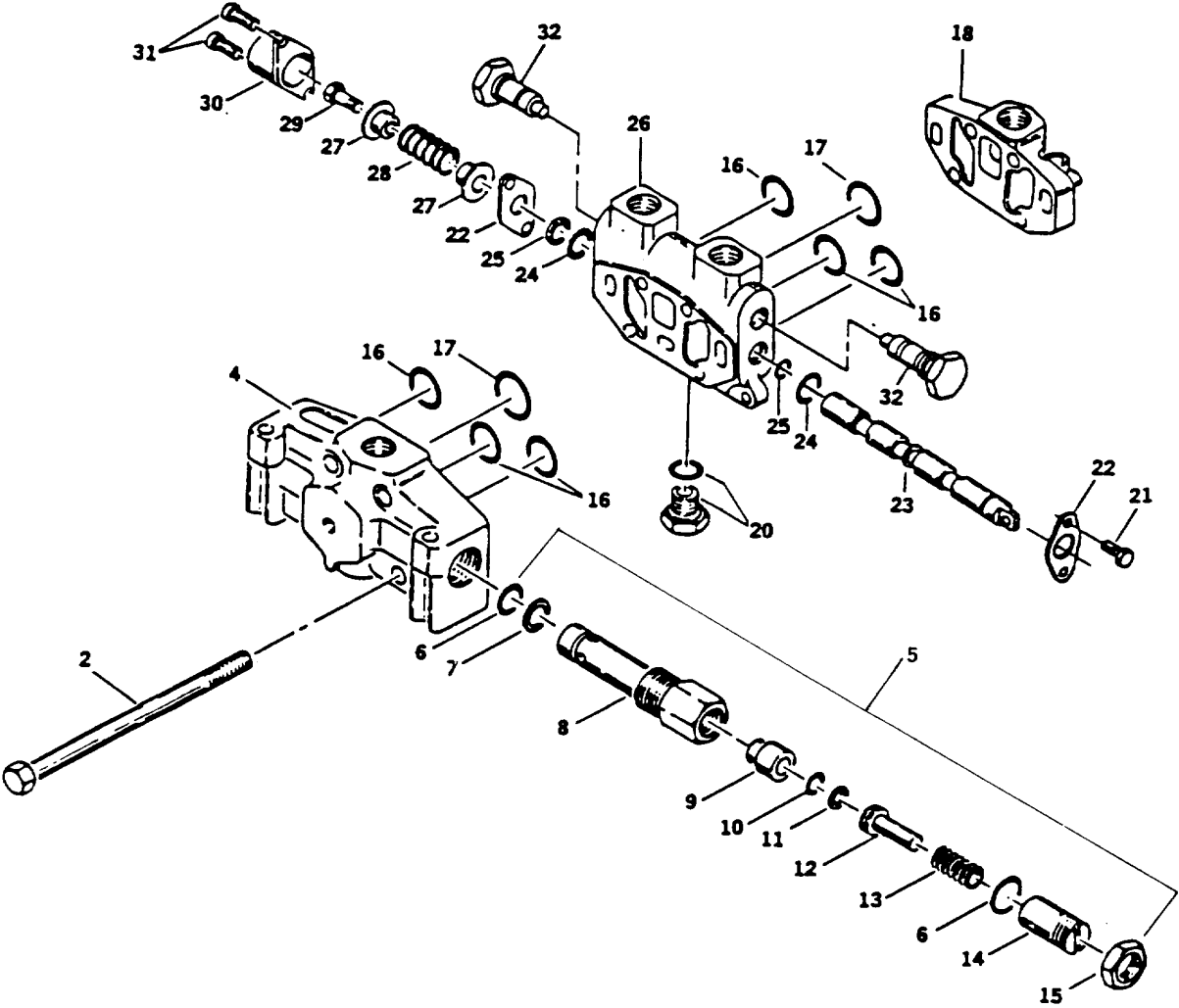
INSPECTION:

1. INSPECT SPOOL BORE FOR CRACKS, PITTING SCORING AND WEAR. REPLACE AS NECESSARY.
2. INSPECT SPOOL FOR SCORING AND WEAR. REPLACE AS NECESSARY.

REASSEMBLY:**CAUTION**

Install new packings and seals on or in all component parts. Coat packings and seals with clean hydraulic fluid prior to assembly.

1. REMOVE ANY BURRS FROM FACES OF VALVE SECTIONS AND ENSURE ALL MATING SURFACES ARE CLEAN.
2. REASSEMBLE VALVE SECTION (26).
 - a. Install new packing onto plug (20).
 - b. Install spool (23).
 - c. Install new preformed packings (31) and back-up rings (32) on both sides of spool. Retain on clevis end of spool with retainer plate (22) and screws (21).
 - d. Install retainer plate (22), spring guides (27) and spring (28). Secure with stripper bolt (29).
 - e. Install valve cap (30) and screws (31).
3. REASSEMBLE RELIEF VALVE (5).
 - a. Install seat (9).
 - b. Install new preformed packing (10) and back-up ring (11) on plunger (12).
 - c. Install plunger (12), spring (13), adjusting screw (14) with new preformed packing (6) into cartridge (8). Secure with locknut (15).



- d. Install washer (7) and new preformed packing (6) on relief valve cartridge (8). Install relief valve (5) into inlet section (4).
- 4. POSITION SECTIONS TOGETHER WITH NEW PREFORMED PACKINGS (16) AND (17). SECURE ASSEMBLY WITH TIE BOLTS (2).

NOTE

Do not torque tie bolts at this time.

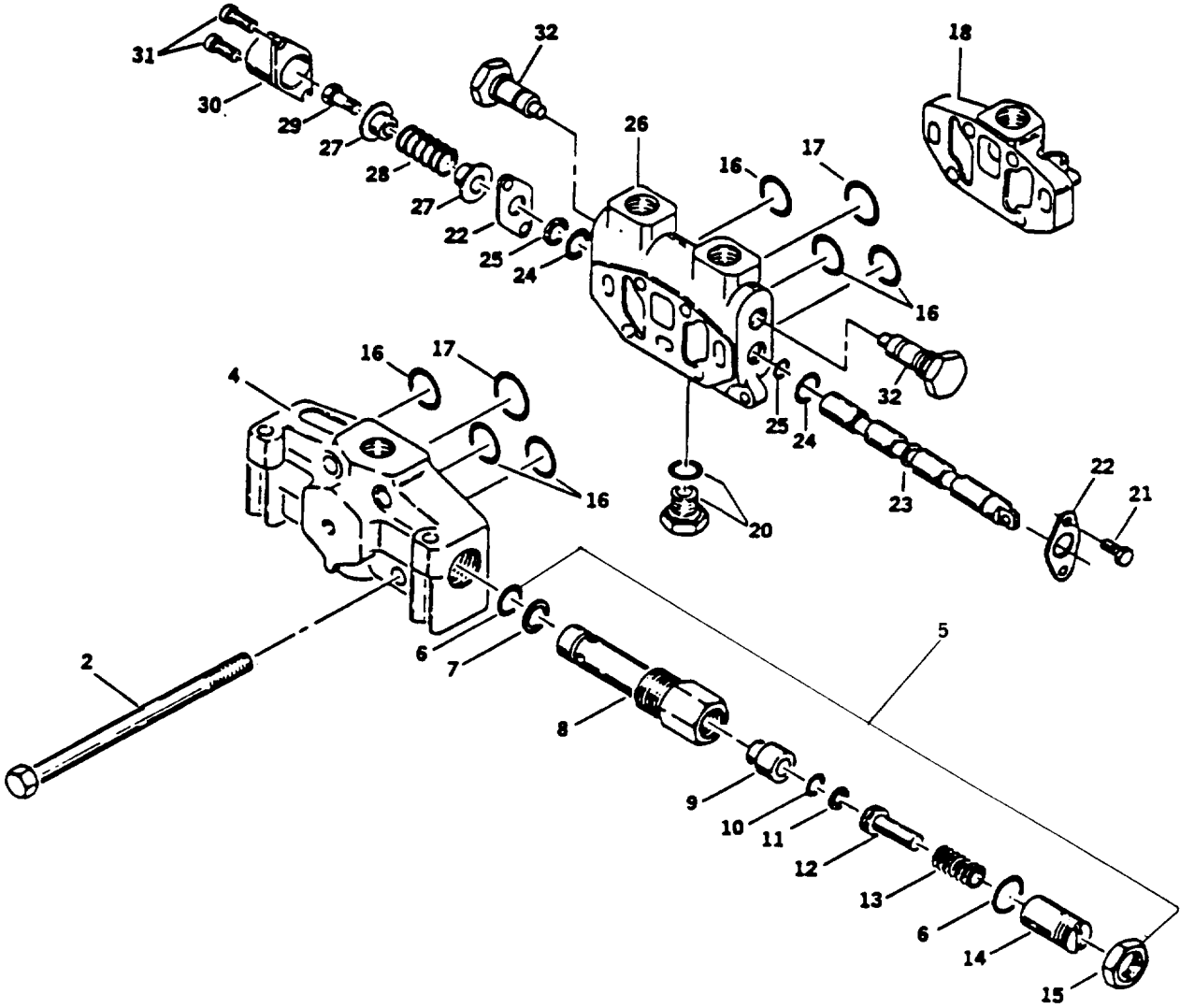
- 5. INSTALL CHECK VALVES (32).

CAUTION

Ensure that all sections are aligned prior to applying torque.

- 6. USING PROPER TORQUE WRENCH, TORQUE TIE BOLTS (2) TO 350 IN-LBS (39 Nm) (A-20 VALVE) AND 400 IN-LBS (44 Nm) (A-35 VALVE).
- 7. APPLY LOCTITE #545 TO THREADS OF FITTINGS AND INSTALL AS REQUIRED.
- 8. INSTALL PLUG (20) AND TIGHTEN UNTIL BOTTOMED.
- 9. ACTUATE SPOOL TO ENSURE FREE MOVEMENT.
- 10. INSTALL CONTROL VALVE. (REFER TO TM 5-3810-306-20.)
- 11. TEST FOR PROPER OPERATION AND INSPECT FOR LEAKS.

END OF TASK



TRANSMISSION CONTROL VALVE ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Hydraulic oil (Item 8, Appendix B)
 Loctite #545 (Item 18, Appendix B)
 Preformed packing (Item 60, Appendix B) (2 Required)
 Seal (Item 59, Appendix B) (2 Required)
 Washer (Item 61, Appendix B)
 Lockwasher (Item 26, Appendix B)
 Gasket (Item 62, Appendix B)

EQUIPMENT CONDITIONS: Transmission control valve removed. (Refer to TM 5-3810-306 - 20.)

DISASSEMBLY:**1. DISASSEMBLE TRANSMISSION CONTROL VALVE.**

- a. Remove fittings from valve and save for installation.
- b. Remove neutral safety switch (13) and ball (12) from valve body (3).
- c. Remove plug (22), washer (21), spring (20) and ball (19) from bolt head side of valve.
- d. Remove nine bolts (23) and lockwashers (24) which secure valve plates (3) together.
- e. Separate plate and remove detent balls (27), springs (28) and gasket (26).
- f. Remove plug (10), packing (11) and spacer (25) from base of valve. Discard packing (11).
- g. Rotate valve body so spools are visible. Remove center plug (14), packing (15), spool (16) and spring (17). Discard packing (15).
- h. Remove and discard oil seals (4 from two spool shafts).
- i. Remove snap ring (5) and washer (6) which secure control spool (7) located near neutral safety switch port. Remove the spool (7).
- j. Remove snap ring (5), washer (6 and spacer 18) from other spool (8) and remove spool (8) and plug (9).

CLEANING:

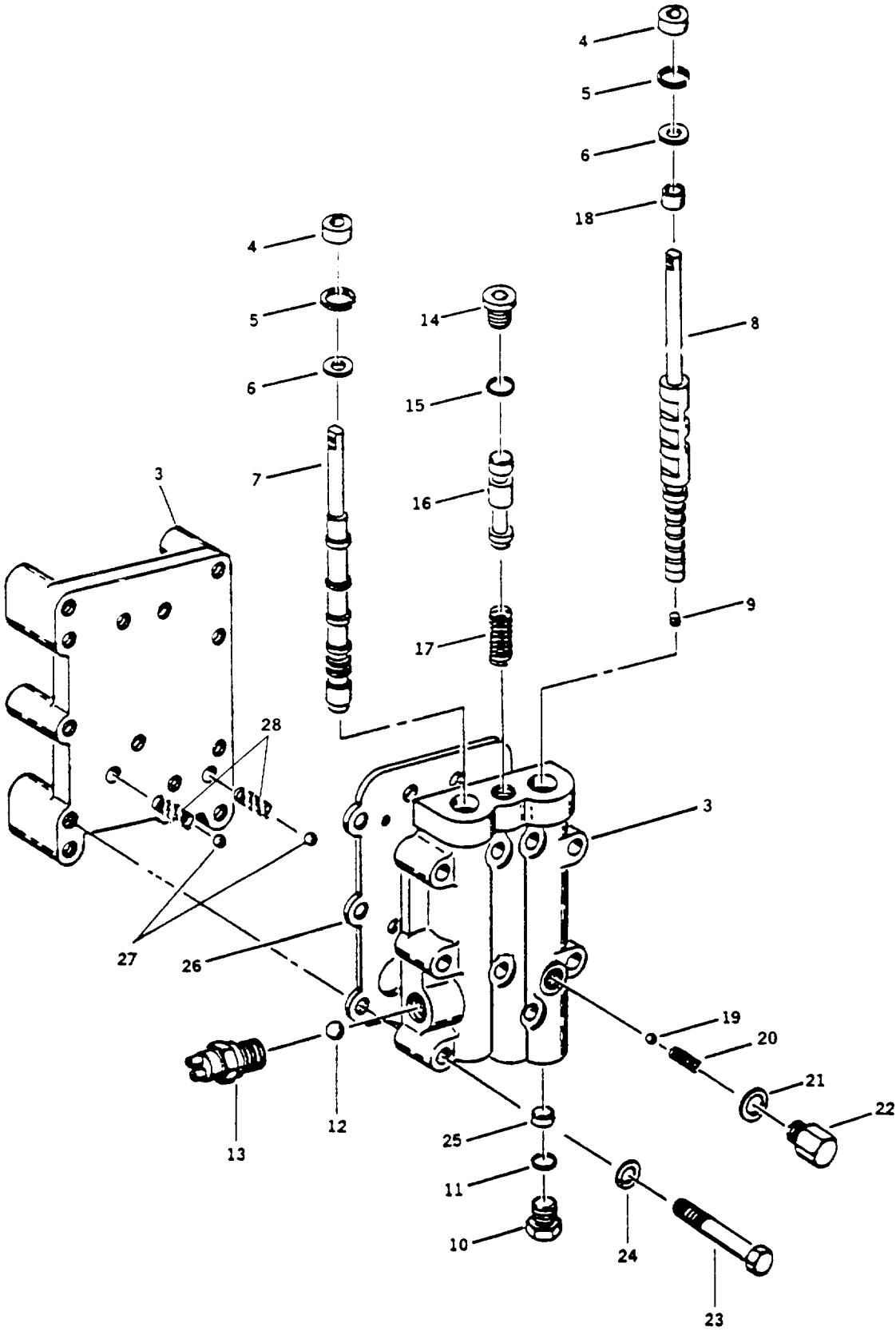
1. CLEAN ALL PARTS IN SOLVENT P-D-680 AND BLOW DRY WITH AIR.

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

NOTE

When separating plates take care not to lose detent balls (27) and springs (28).



WARNING (Cont'd)

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.).

INSPECTION:

1. INSPECT PARTS FOR DAMAGE AND REPLACE AS NECESSARY. MINOR NICKS OR SCRATCHES MAY BE REMOVED WITH CROCUS CLOTH.

REASSEMBLY:

1. REASSEMBLE TRANSMISSION CONTROL VALVE.

NOTE

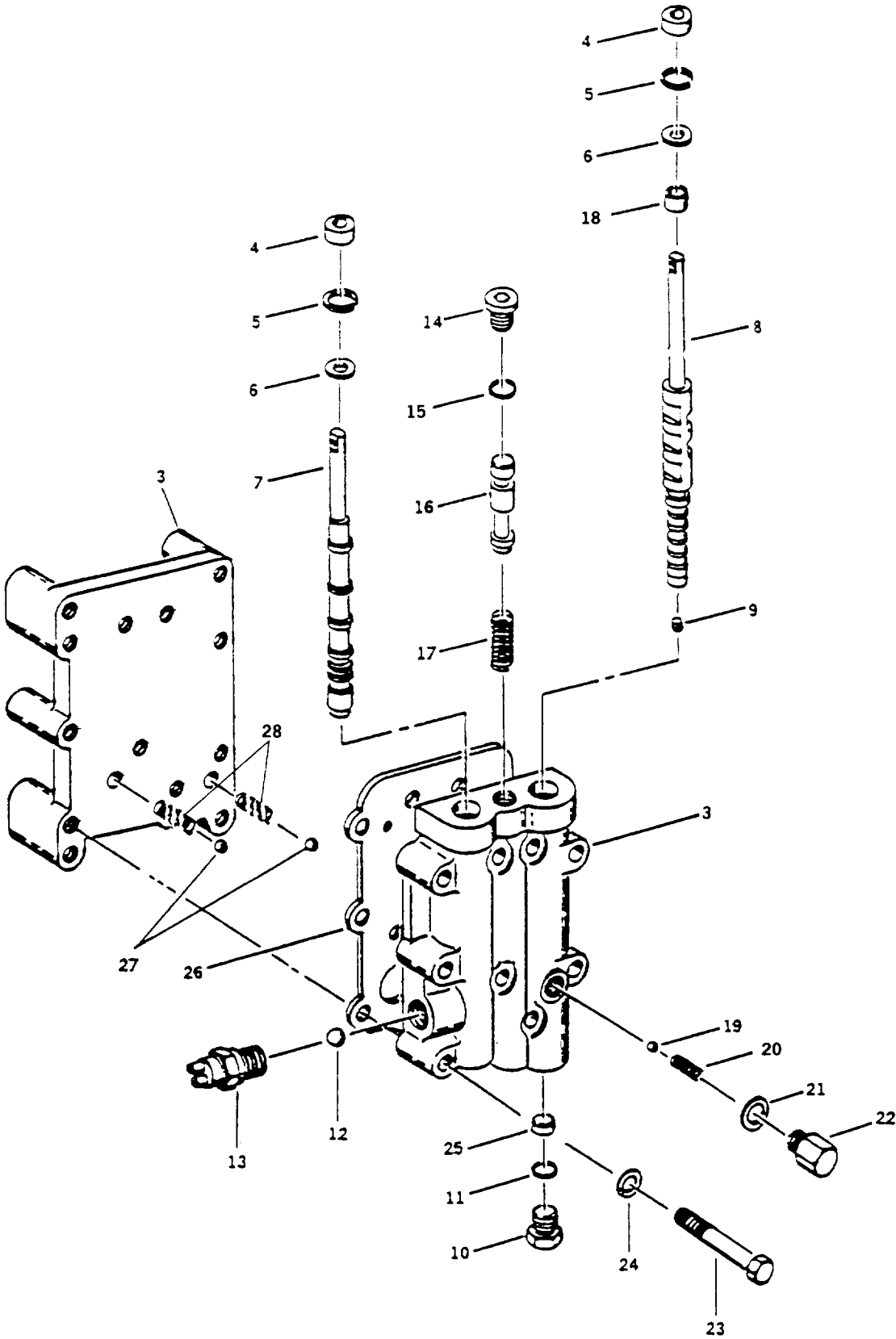
Replace all seals, gaskets, and packings at assembly with new parts. Coat all parts with clean hydraulic oil prior to assembly. Coat threads of fittings with Loctite #545.

- a. Install bottom plug (10), new packing (11) and spacer (25) into bottom of valve.

- b. Install center spool spring (17), center spool (16), new packing (15) and plug (14).
- c. Install spool (7) closest to neutral safety switch port. Secure in place using washer (6) and snap ring (5).
- d. Install other spool (8) by installing plug (9), spool (8), spacer (18), washer (6), and snap ring (5).
- e. Install new oil seals (4) and seat using an oil seal installer or a deep-well socket of appropriate size.
- f. Install gasket (26) on valve body plate.
- g. Install detent balls (27) and springs (28) and place the other plate onto valve body and secure it in place with nine bolts (23) and lockwashers (24).
- h. Install ball (12) and neutral safety switch (13).
- i. Install ball (19), spring (20), washer (21) and plug (22) into bolt head side of valve.
- j. Install fittings in valve.

2. INSTALL TRANSMISSION CONTROL VALVE. (REFER TO TM 5-3810-306-20.)

END OF TASK



Section III. HYDRAULIC CYLINDERS MAINTENANCE

AXLE LOCKOUT CYLINDER INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Cotter pins (Item 56, Appendix B)

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)
Hydraulic system shut down and pressure relieved from lines. (Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE LOCKOUT CYLINDER (1).

- Tag and disconnect two hydraulic lines from lockout cylinder (1). Cap or plug lines and openings.
- Remove locknut (2), capscrew (3), flatwasher (4) and cotter pin (5) securing retaining shaft (6) at base end of lockout cylinder (1). Discard cotter pin (5).
- Tap out retaining shaft (6). Swing lockout cylinder out of mounting gusset.

NOTE

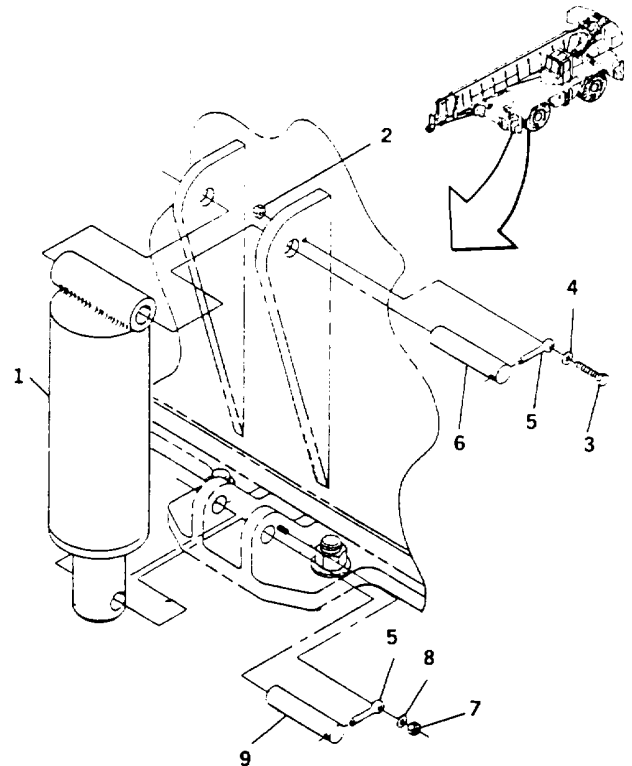
Lockout cylinder weighs 87 lbs (39.5 Kg).

- Remove locknut (7), flatwasher (8) and cotter pin (5) securing retaining shaft at rod end of lockout cylinder. Discard cotter pin (5).
- Tap out retaining shaft (9) and remove lockout cylinder (1).

INSTALLATION:

1. INSTALL LOCKOUT CYLINDER (1).

- Align rod end of lockout cylinder (1) between mounting lugs on fifth wheel and tap in retaining shaft (9).

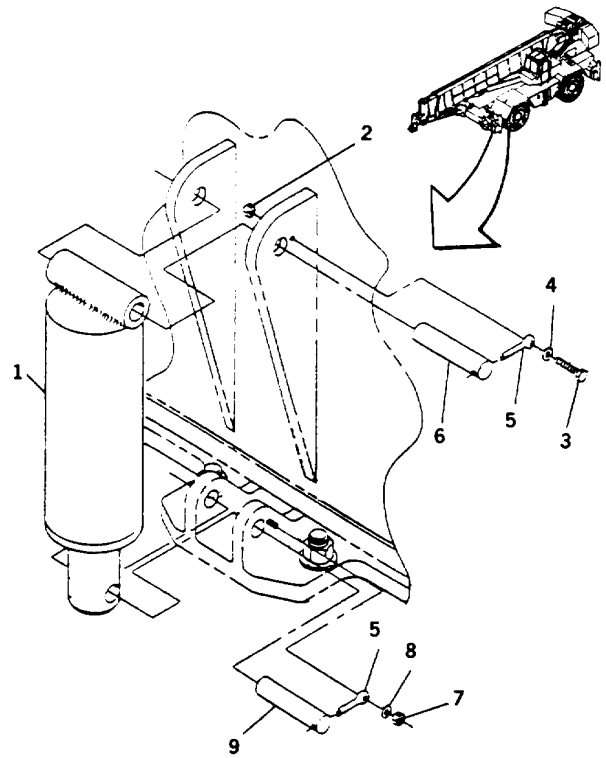


- Install new cotter pin (5) through hole in retaining shaft (6) and secure to the stud with flatwasher (8) and locknut (7).
- Rotate lockout cylinder up and position base end of lockout cylinder between mounting gussets on frame. Tap in retaining shaft (6).

e. Remove tags and caps and connect two hydraulic lines to appropriate ports on lockout cylinder.

2. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
3. DRAIN AND FLUSH HYDRAULIC SYSTEM. (REFER TO PAGE 13-115.)
4. BLEED AIR FROM HYDRAULIC SYSTEM. (REFER TO PAGE 13-117.)
5. TEST FOR PROPER OPERATION AND INSPECT FOR LEAKS.

END OF TASK



AXLE LOCKOUT CYLINDER ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1 (4910-00-754-0706)
 Tool Outfit Hyd System, Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784)

SUPPLIES: Parts kit (Item 63, Appendix B)
 Loctite #271 (Item 23, Appendix B)
 Hydraulic oil (Item 8, Appendix B)
 Solvent (Item 1, Appendix B)
 NEVER-SEEZ (Item 24, Appendix B)

EQUIPMENT CONDITIONS: Axle lockout cylinder assembly removed.
 (Refer to page 13-86.)

DISASSEMBLY:

NOTE

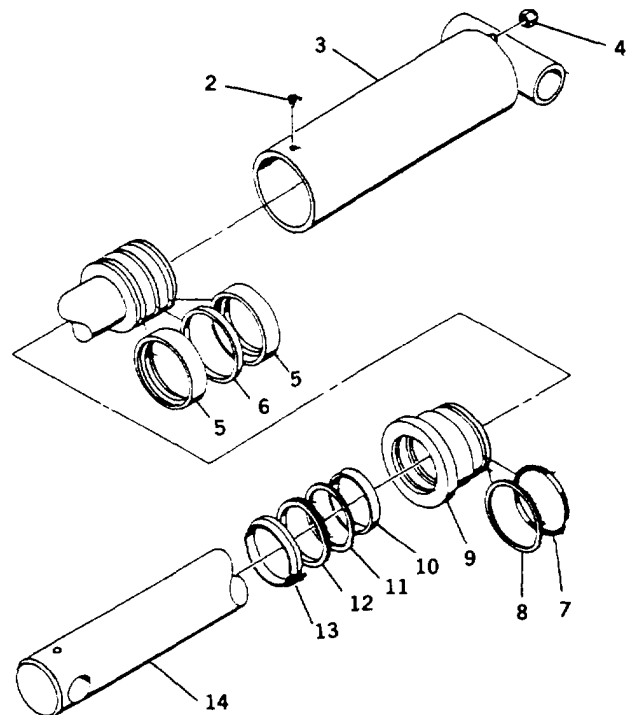
Any maintenance requiring disassembly of cylinder should include replacement of all cylinder seals.

1. REMOVE AND DISASSEMBLE PISTON AND ROD ASSEMBLY (14).
 - a. Remove setscrew (2) at rod end of cylinder.

WARNING

Do not use air pressure to remove cylinder rod assembly. Use only a source of controlled hydraulic oil pressure if rod assembly is hard to remove.

Exercise extreme care when handling or setting down cylinder rod. Do not damage the chrome surface.



- b. Unscrew head (9) and remove cylinder rod assembly from cylinder barrel (3). Cover barrel to avoid contamination.

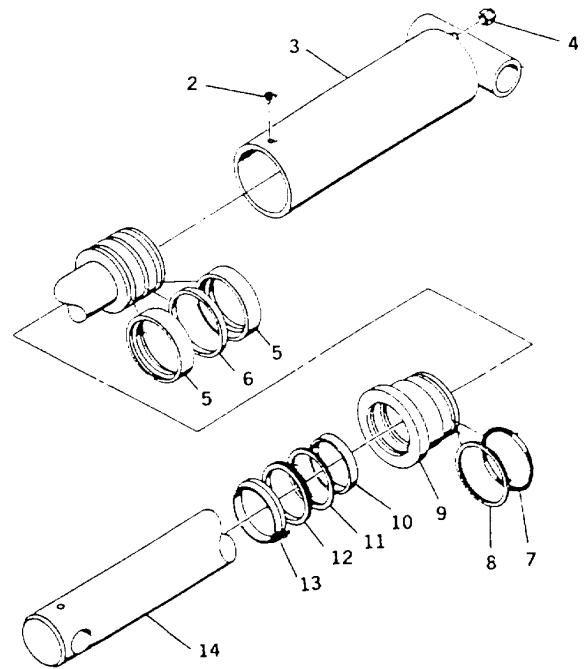
CAUTION

When removing seals and rings, avoid scratching grooved and gland surfaces.

NOTE

Aligning discarded seals and rings in order of disassembly will facilitate installation of new items.

- c. Remove seals (5) and ring (6) from outside of piston.
2. REMOVE HEAD (9) FROM ROD AND PISTON (14). REMOVE SEALS FROM HEAD.
- a. Remove packing (7) and back-up ring (8) from outside of head.
 - b. Remove wear ring (10), rod seal (12) and buffer seal (11) from inside of head.
 - c. Remove wiper seal (13) from head.
 - d. If necessary, remove cap (4).



CLEANING AND INSPECTION:

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (380-590C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

- 1. CLEAN ALL PARTS WITH SOLVENT AND DRY WITH COMPRESSED AIR. INSPECT ALL PARTS FOR SERVICEABILITY.

CAUTION

Before installing new seals and rings, clean all surfaces and carefully remove burrs and nicks. Parts displaying excessive wear or damage should be replaced.

- 2. STONE OUT MINOR BLEMISHES AND POLISH WITH A FINE CROCUS CLOTH.

3. CLEAN WITH SOLVENT AND DRY WITH COMPRESSED AIR ANY PARTS THAT HAVE BEEN STONED AND POLISHED.
4. INSPECT BARREL CAREFULLY FOR SCORING.

REASSEMBLY:

CAUTION

When installing new seals and rings, avoid stretching seals or scratching the grooved or gland surfaces.

NOTE

Lubricate new seals and rings with clean hydraulic oil.

NOTE

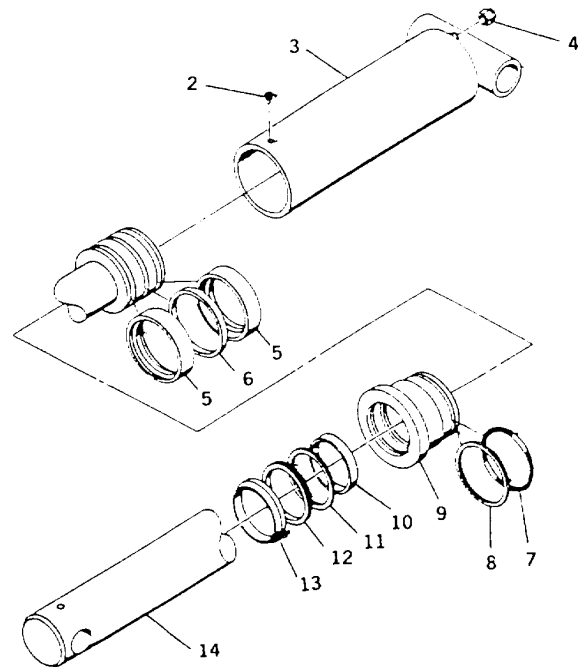
Ensure the packing portion of the rod seal is installed forward as head would enter barrel.

1. INSTALL NEW SEALS ON HEAD (9). INSTALL HEAD.
 - a. Install wear ring (10), rod seal (12), and buffer seal (11) into inside of head (9).
 - b. Fit wiper seal (13) into head.

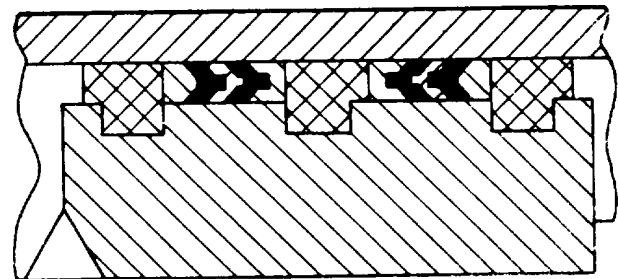
NOTE

Ensure packing is installed forward of back-up ring as head would enter barrel.

- c. Install packing (7) and backup ring (8) onto outside of head.
- d. Lubricate rod (13) with clean hydraulic oil.
- e. Install head (9) onto rod (14).



2. INSTALL NEW SEALS (5) AND RING (6) ON PISTON. ENSURE SEAL ASSEMBLY IS INSTALLED AS SHOWN.



3. INSTALL ROD (14) INTO BARREL (3).
 - a. Remove cover from cylinder barrel.

CAUTION

Avoid scratching or damaging grooved or gland surfaces or rings and seals.

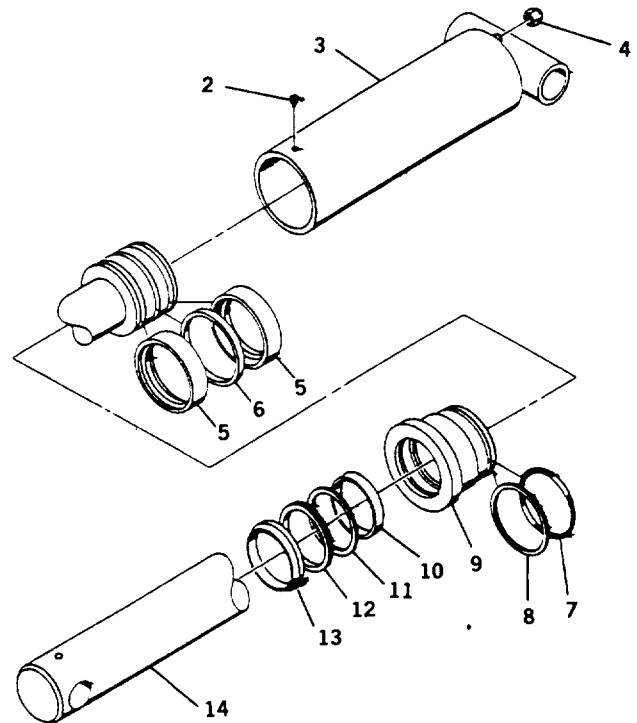
- b. Lubricate cylinder rod assembly with clean hydraulic oil and install rod assembly into cylinder with a light twisting motion.

4. CLEAN OIL FROM THREADS OF HEAD (9). COAT THREADS WITH NEVER-SEEZ (PASTE TYPE) LUBRICANT.
5. IF EXISTING HEAD (9) AND BARREL (3) ARE TO BE USED, PROCEED AS FOLLOWS:
 - a. Screw head (9) into barrel (3).
 - b. Using strap wrench, tighten head securely until the setscrew holes align.
 - c. Apply Loctite #271 to setscrew (2) and install setscrew.
6. IF NEW HEAD (9) OR BARREL (3) IS TO BE USED, PROCEED AS FOLLOWS:
 - a. Screw head (9) into barrel (3).
 - b. Using a strap wrench, tighten head securely.
 - c. If necessary, drill 0.265-in. diameter hole 3/16-in. (max) deep in head.

NOTE

Setscrew (2) when installed should be flush with barrel.

- d. Clean drilled hole of chips and debris.
 - e. Apply Loctite #271 to setscrew (2) and install setscrew.
7. IF REMOVED, INSTALL CAP (4).



WARNING

Do not use air pressure to cycle or pressurize cylinder.

8. PRESSURIZE AND CYCLE CYLINDER. CHECK FOR PROPER OPERATION AND ANY LEAKAGE.
9. INSTALL AXLE LOCKOUT CYLINDER. (REFER TO PAGE 13-86.)

END OF TASK

LIFT CYLINDER INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: None

EQUIPMENT CONDITIONS: Outriggers fully extended and lowered. (Refer to TM 5-3810-306-10.)
Swing lock engaged. (Refer to TM 5-3810-306-10.)

REMOVAL:

1. RAISE AND SUPPORT BOOM.

- a. Raise boom enough so lift cylinder (1) end will be able to be removed from boom mounting bracket.
- b. Support weight of boom with a suitable lifting device, (i.e., another crane or overhead hoist).

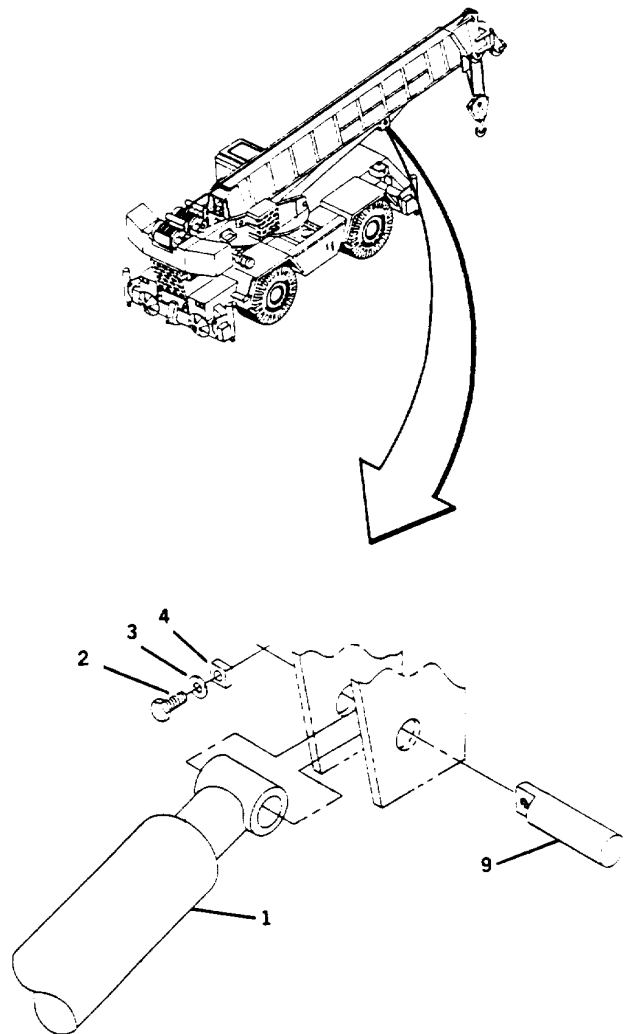
2. REMOVE LIFT CYLINDER.

- a. Remove rod end pivot shaft capscrew (2), hardened washer (3) and retainer block (4).
- b. Block up lift cylinder (1).
- c. Remove shaft (9).
- d. Tag and disconnect small equalizer line from lift cylinder. Plug or cap line and opening.

CAUTION

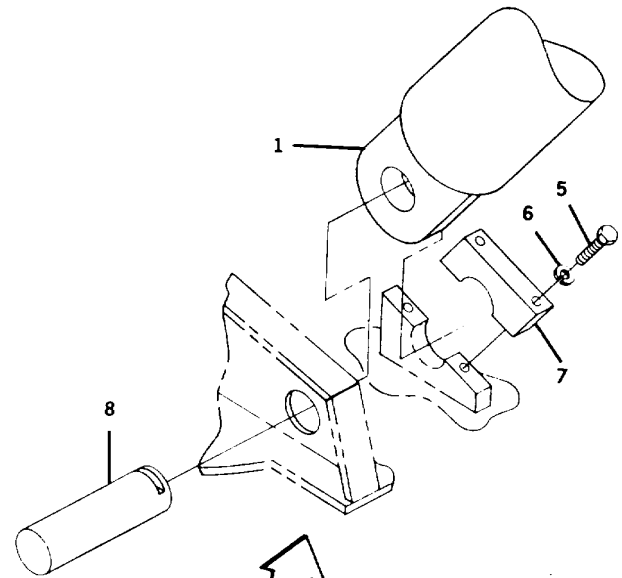
Failure to remove equalizer line from lift cylinder will result in both cylinders retracting. Removing equalizer line will allow only the disconnected lift cylinder to retract.

- e. Start crane and retract lift cylinder from boom mounting.



- f. Disconnect negative battery cable at shunt. (Refer to TM 5-3810-306-20.)

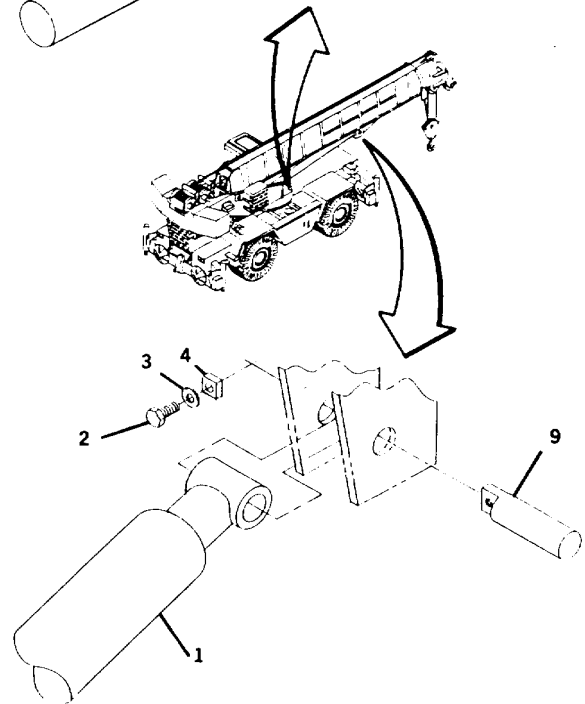
- g. Attach suitable lifting device to lift cylinder.
- h. Remove hydraulic lines from lift cylinder. Remove fittings. Cap or plug all lines and openings.
- i. Remove two capscrews (5) and flatwashers (6) from lift cylinder pivot shaft cap (7).
- j. Slide pivot shaft (8) towards cap end enough to clear hole in superstructure.
- k. Remove lift cylinder (1) and pivot shaft (8).



INSTALLATION:

1. INSTALL LIFT CYLINDER.

- a. Attach suitable lifting device to lift cylinder.
- b. Insert pivot shaft (8) into base end of lift cylinder (1) and position cylinder and shaft into hole in superstructure.
- c. Install pivot shaft cap (7) and secure with flatwashers (6) and capscrews (5).
- d. Block up lift cylinder.
- e. Connect all tagged hydraulic hoses to lift cylinder with exception of equalizer line.
- f. Connect negative battery cable at shunt. (Refer to TM 5-3810-306-20.)
- g. Start crane and extend lift cylinder until rod end holes line up with holes in boom mounting. Shut down crane.
- h. Install pivot shaft (9) and secure with retainer block (4), hardened washer (3) and capscrew (2).
- i. Remove caps and connect equalizer line.



- j. Start crane and extend lift cylinders, remove blocking and boom support.

2. DRAIN AND FLUSH HYDRAULIC SYSTEM. (REFER TO PAGE 13-115.)

3. BLEED AIR FROM HYDRAULIC SYSTEM (REFER TO PAGE 13-117.)

4. TEST FOR PROPER OPERATION AND INSPECT FOR LEAKS.

END OF TASK

LIFT CYLINDER ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Parts kit (Item 21, Appendix B)
 Loctite #271 (Item 23, Appendix B)
 Never-Seez (Item 24, Appendix B)
 Hydraulic oil (Item 8, Appendix B)
 Packing (Item 22, Appendix B)

EQUIPMENT CONDITIONS: Lift cylinder removed. (Refer to page 13-92.)

DISASSEMBLY:

1. REMOVE HOLDING VALVE (1) FROM PORT BLOCK. (REFER TO PAGE 13-100.)
2. REMOVE CYLINDER HEAD (14) AND CYLINDER ROD (18).
 - a. Remove setscrew (2) and unscrew head (14). Slide head clear of barrel. Drain hydraulic oil from cylinder.

WARNING

Do not use air pressure to remove cylinder rod assembly. Use only a source of controlled hydraulic oil pressure if rod assembly is hard to remove.

CAUTION

Exercise extreme care when handling or setting down the cylinder rod (18).

- b. Withdraw cylinder rod (18) assembly from barrel, and move it to a clean work area.

NOTE

It is advisable to cover cylinder barrel opening to avoid contamination.

- c. Secure cylinder rod (18) to prevent it from moving. Remove seals (5) and ring (6) from outside of piston (7). Remove setscrew (2) securing piston (7) to rod (18).
- d. Unscrew piston (7) from rod (18) and remove piston (7), spacer (10) and cylinder head (14).

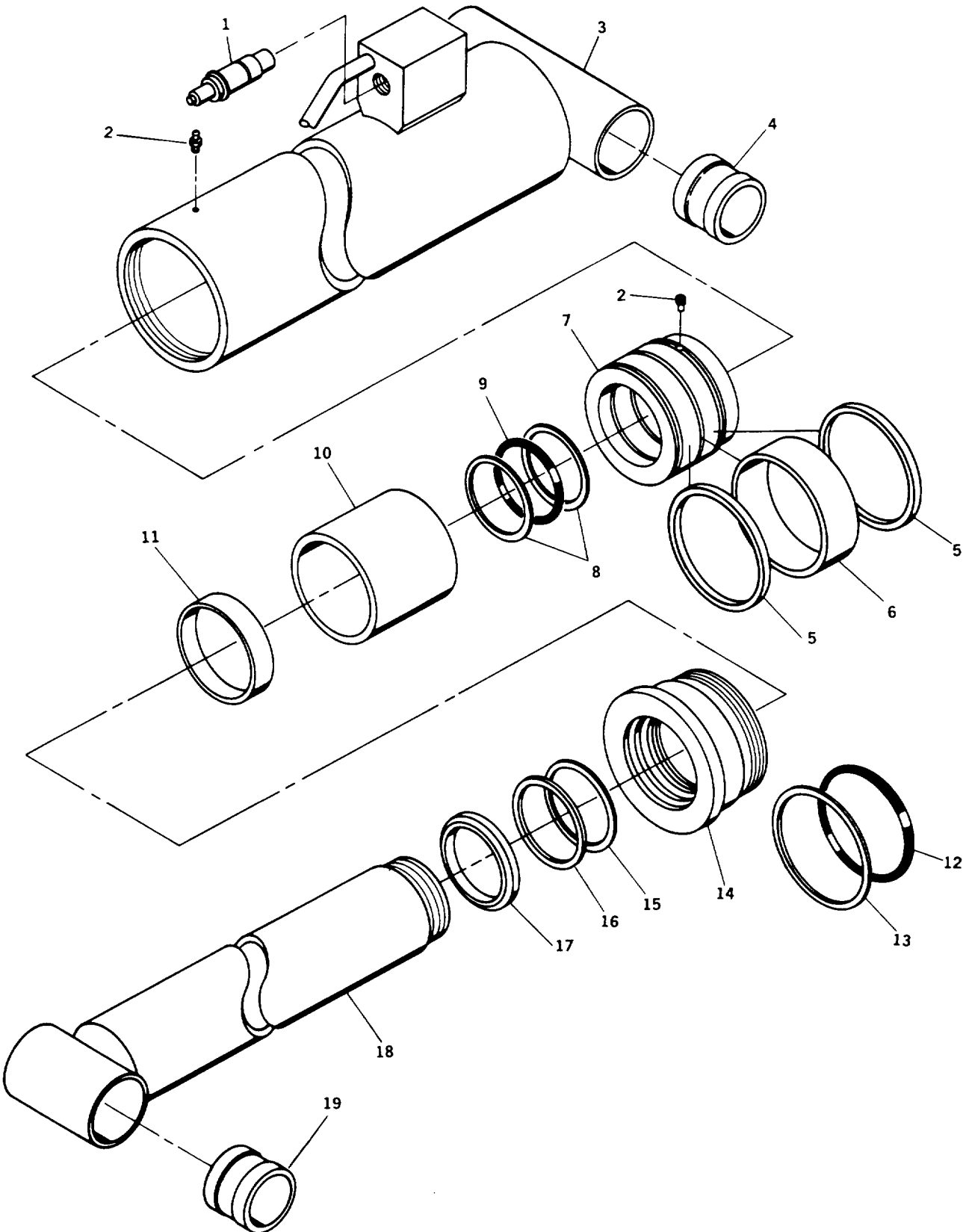
CAUTION

When removing seals and rings, avoid scratching grooved and gland surfaces.

NOTE

Aligning discarded seals and rings in order of disassembly will facilitate installation of new seals and rings.

- e. Remove and discard packing (9) and backup rings (8) from inside of piston.
- f. Remove and discard packing (12) and backup ring (13) from outside of head (14). Remove and discard wear ring (11), seal (15), rod seal (16), and wiper seal (17) from inside of head (14).



CLEANING:**WARNING**

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (380-590C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

1. CLEAN ALL PARTS WITH SOLVENT AND DRY WITH COMPRESSED AIR. INSPECT ALL PARTS FOR SERVICEABILITY.

INSPECTION:**CAUTION**

Before installing new seals and rings, clean all surfaces and carefully remove burrs and nicks. Parts displaying excessive wear or damage should be replaced.

1. STONE OUT MINOR BLEMISHES AND POLISH WITH A FINE CROCUS CLOTH.
2. CLEAN WITH SOLVENT AND DRY WITH COMPRESSED AIR ANY PARTS THAT HAVE

BEEN STONED AND POLISHED.

3. INSPECT BARREL (3) CAREFULLY FOR SCORING.

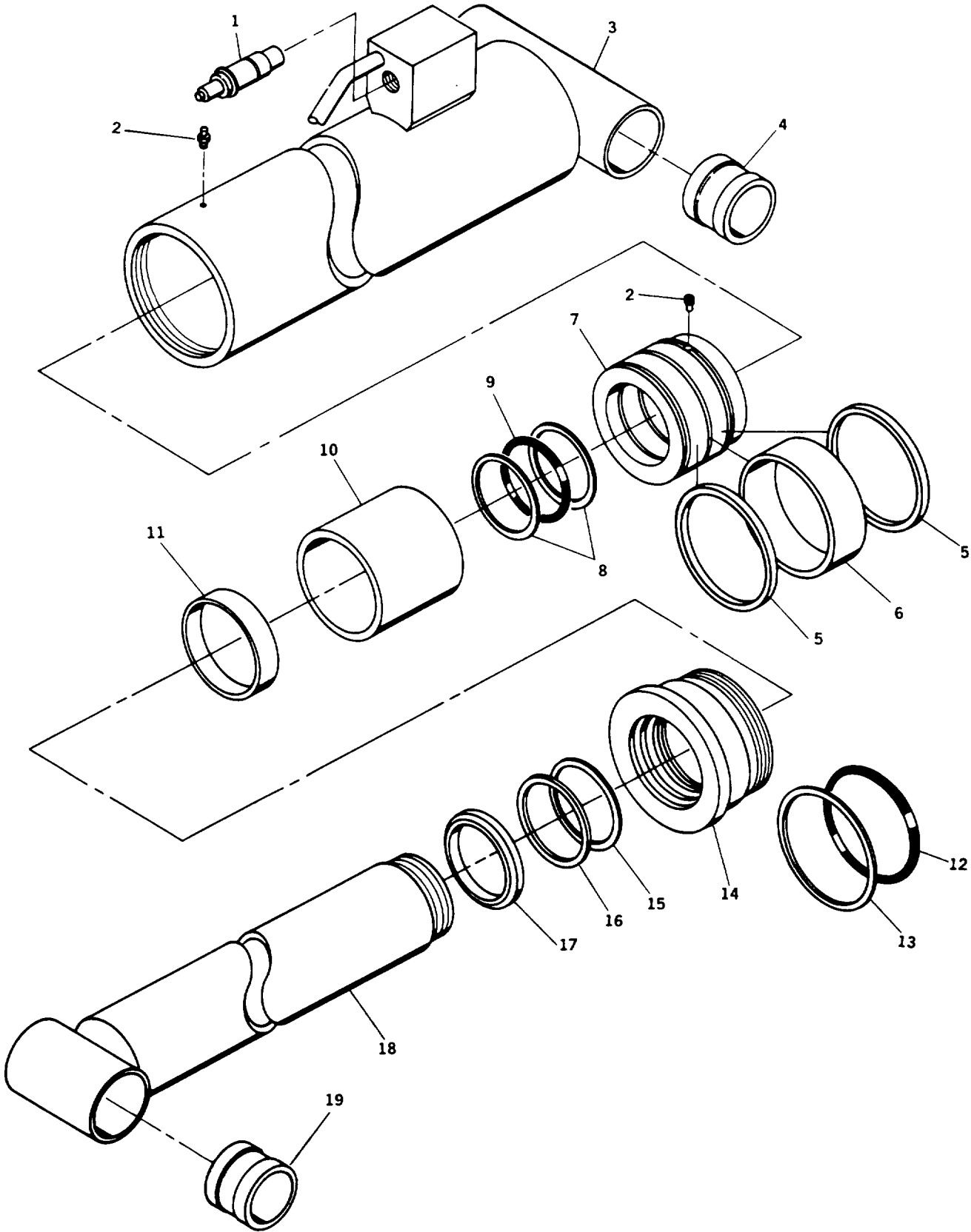
REASSEMBLY:**NOTE**

Coat all seals and rings with clean hydraulic oil.

CAUTION

Avoid stretching the seals and rings. Ensure the seals and rings are installed in the proper order. Ensure all components are clean prior to and during assembly.

1. REASSEMBLE CYLINDER ROD (18).
 - a. Install new wiper ring (17) inside of head (14).
 - b. Install new wear ring (11), rod seal (16), and seal (15) into inside of head. Ensure rod seal is installed with packing portion forward of seal portion as head (14) would enter barrel (3).
 - c. Install new packing (12) and backup ring (13) onto outside of head.
 - d. Install new packing (9) and backup rings (8) on inside of piston (7). Ensure round packing (9) is between the backup rings (8).
 - e. Lubricate bore of head (14) heavily with water pump grease in area between wiper ring and rod seal.
 - f. Install head assembly (14) onto rod (18).
 - g. Install spacer (10) onto rod.



2. IF EXISTING PISTON (7) AND ROD (18) ARE TO BE USED, PROCEED AS FOLLOWS:

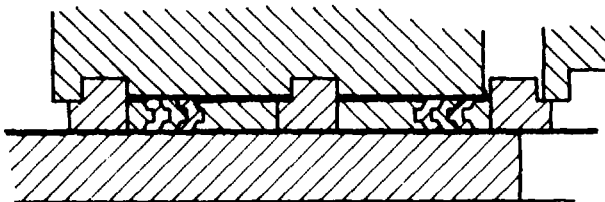
- a. Install piston (7) onto rod (18).
- b. Using strap wrench, tighten piston (7) securely until setscrew holes align.
- c. Apply Loctite #271 to setscrew (2) and install setscrew (2).

3. IF NEW PISTON (7) OR ROD (18) IS TO BE USED PROCEED AS FOLLOWS:

- a. Install piston (7) onto rod (18).
- b. Using strap wrench, tighten pistons securely.
- c. If necessary, drill 0.265 in. diameter hole 3/16-in. (min) deep in the rod (18).
- d. Clean drilled hole of chips and debris.
- e. Apply Loctite #271 to setscrew (2) and install setscrew (2).

4. INSTALL PISTON RING (6) AND SEALS (5).

- a. Install new ring (6) and seals (5) on outside of piston (7). Ensure seals (5) are installed as shown.



- b. Lubricate head (14) and piston (7) with clean hydraulic oil and install rod assembly into barrel with a slight twisting motion.

5. IF EXISTING HEAD (14) AND BARREL (3) ARE TO BE USED, PROCEED AS FOLLOWS:

- a. Clean all oil from threads of head (14).

- b. Coat threads with NEVER-SEIZE (paste type) lubricant and screw head assembly into barrel (3).

- c. Using strap wrench, tighten head (14) securely until setscrew holes align.

- d. Apply Loctite #271 to setscrew (2) and install setscrew (2).

6. IF NEW HEAD (14) OR BARREL (3) IS TO BE USED, PROCEED AS FOLLOWS:

- a. Clean all oil from thread of head (14).

- b. Coat threads with NEVER-SEIZE (paste type) lubricant and screw head assembly into barrel (3).

- c. Using strap wrench, tighten head securely.

- d. If necessary, drill 0.265-in. diameter hole 3/16-in. (max) deep in head.

NOTE

Setscrew when installed should be flush with barrel.

- e. Clean drilled hole of chips and debris.

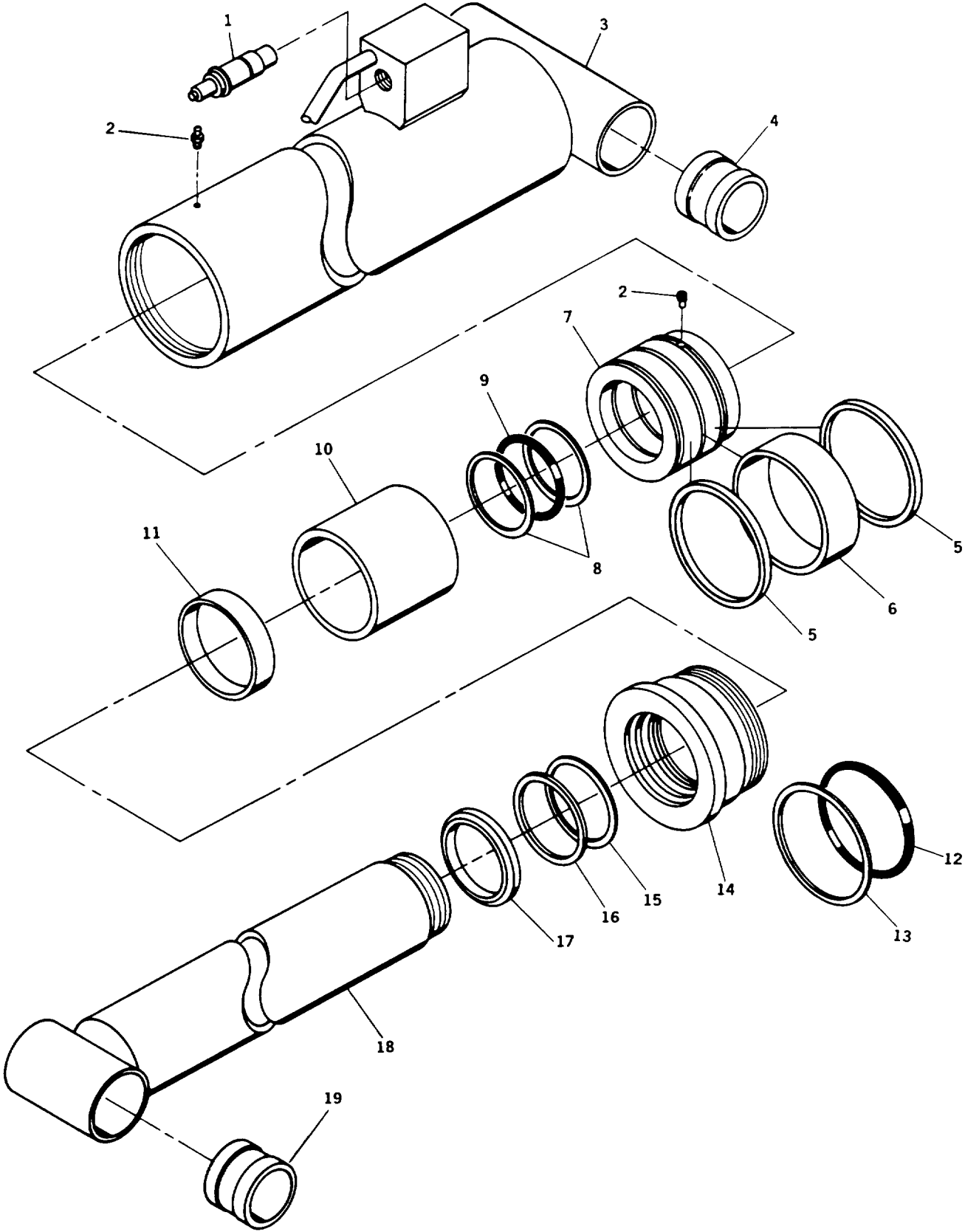
- f. Apply Loctite #271 to setscrew (2) and install setscrew (2).

7. INSTALL HOLDING VALVE (1). (REFER TO PAGE 13-100.)

8. USING A SOURCE OF CONTROLLED HYDRAULIC OIL PRESSURE TEST LIFT CYLINDER FOR PROPER OPERATION AND INSPECT FOR LEAKS.

9. INSTALL LIFT CYLINDER. (REFER TO PAGE 13-92.)

END OF TASK



LIFT CYLINDER HOLDING VALVE INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Seal kit (Item 101, Appendix B)
Hydraulic oil (Item 8, Appendix B)
Loctite #545 (Item 18, Appendix B)

EQUIPMENT CONDITIONS: Hydraulic system shutdown and pressure relieved from lines (Refer to TM 5-3810-306-20.)
Boom fully lowered. (Refer to TM 5-3810-306-10.)
Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE LIFT CYLINDER HOLDING VALVE (1) FROM LIFT CYLINDER (2).
 - a. Tag and remove hydraulic line (8) from plug (9).
 - b. Remove plug (9) and packing (10) from holding valve (1). Discard packing (10).
 - c. Remove lift cylinder holding valve (1).
 - d. Remove and discard packings (3), (4) and (5) and back-up rings (6) and (7).
1. INSTALL NEW EXTERNAL PACKINGS (3), (4) AND (5) AND BACK-UP RINGS (6) AND (7) ONTO VALVE.

CAUTION

Do not damage the packings during installation of the holding valve. If the holding valve turns freely then gets hard to turn, then easy to turn; remove the holding valve and check the packings. They have probably been damaged by a sharp edge of a port.

NOTE

No repair or replacement of valve components is recommended with the exception of outer seals.

NOTE

The holding valve should turn by hand until compression of the packings begins.

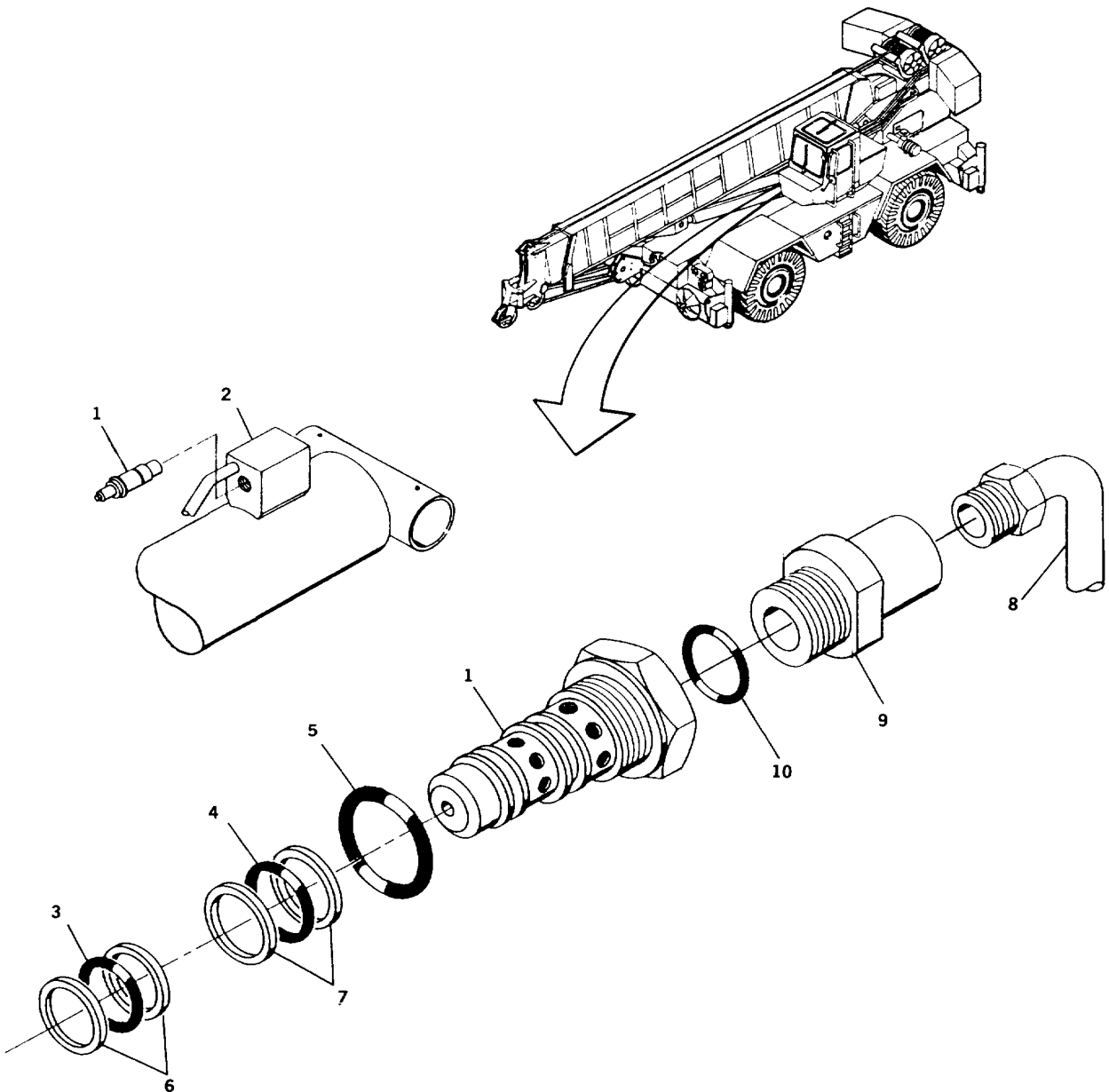
INSTALLATION:**NOTE**

Prior to installing packings and back-up ring, coat components with clean hydraulic oil and threads with Loctite #545.

2. INSTALL LIFT CYLINDER HOLDING VALVE (1) ON LIFT CYLINDER (2).
 - a. Check inside of lift cylinder (2) port block for any sharp edges or burrs and remove as necessary with emery cloth.
 - b. Install lift cylinder holding valve (1) on lift cylinder.

- c. Install new packing (10) on plug (9) and install into holding valve (1).
 - d. Install and tighten hydraulic line (8).
3. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
 4. START UP HYDRAULIC SYSTEM TO NORMAL PRESSURE. (REFER TO TM 5-3810-306-10.)
 5. TEST FOR PROPER OPERATION AND INSPECT FOR LEAKS.

END OF TASK



LIFT CYLINDER OVER CENTER VALVE ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Parts kit (Item 258, Appendix B)
Hydraulic oil (Item 8, Appendix B)
Cleaning Solvent P-D-680 (Item 1, Appendix B)

EQUIPMENT CONDITIONS: Lift cylinder over center valve assembly removed.
(Refer to TM 5-3810-306-20.)

DISASSEMBLY:

1. DISASSEMBLE OVER CENTER VALVE ASSEMBLY (1).

- a. Remove regulating valve assembly (3) from valve body (2).
- b. If necessary, remove fittings (31), (32) and (33) from valve body (2).

2. DISASSEMBLE REGULATING VALVE ASSEMBLY (3).

- d. Remove plug (8) from valve (30).
- e. Remove disk (13), spring (12) and piston (11) from plug (8).
- f. Remove and discard retainers (10) and packing (9) from piston (11).
- g. Remove and discard retainer (7) and packings (5) and (6) from plug (8).
- h. If necessary, remove vent plug (4) from plug (8).
- i. Remove and discard packings (20), (22) and (24), and retainers (21) and (23) from valve (30).

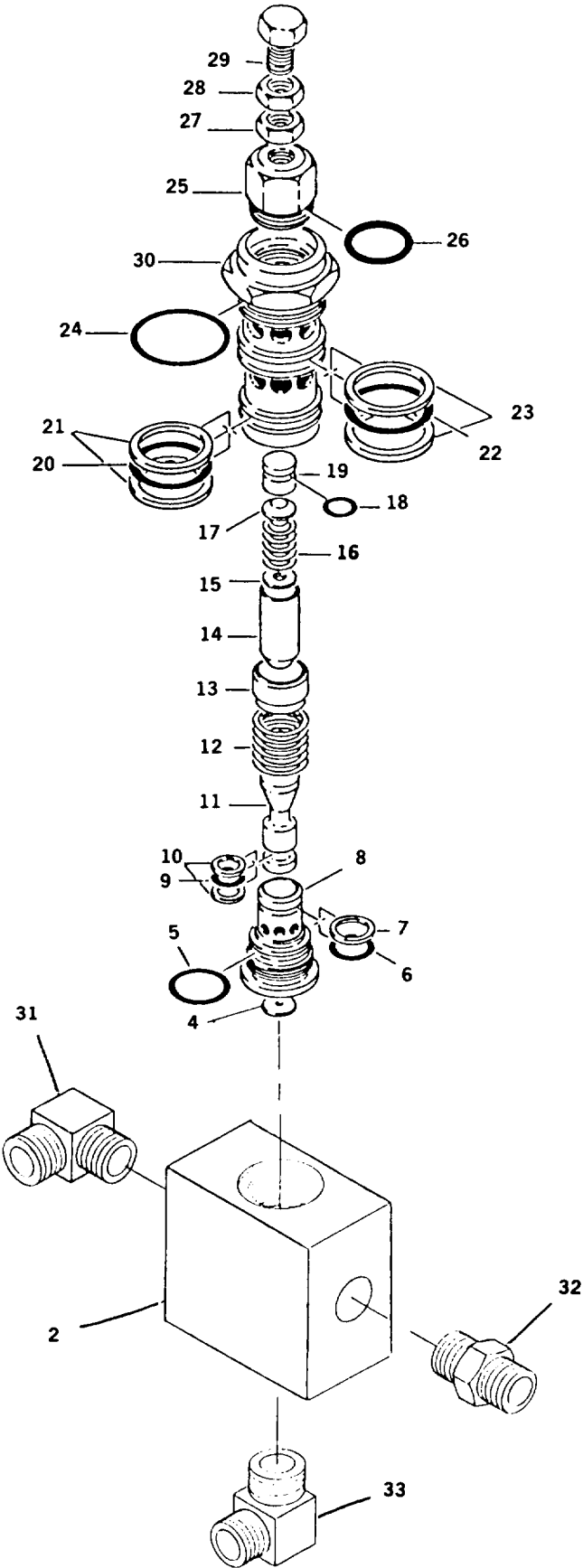
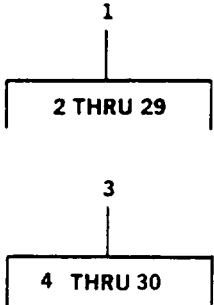
WARNING

Internal parts beneath plug (25) are under spring tension. Remove plug (25) carefully to prevent parts from popping out and causing personal injury.

- a. Remove plug (25), from valve (30).
- b. Remove piston (19), packing (18), spring seats (15) and (17), spring (16) and spring holder (14) from valve assembly (3). Discard packing (18).
- c. Remove bolt (29), nuts (27) and (28), and packing (26) from plug (25). Discard packing (26).

CLEANING:**WARNING**

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air



WARNING (Cont'd)

immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

1. CLEAN ALL PARTS WITH DRY CLEANING SOLVENT P-D-680 AND DRY WITH COMPRESSED AIR.

INSPECTION:

1. INSPECT ALL PARTS FOR OBVIOUS DAMAGE AND REPLACE AS NECESSARY.

ASSEMBLY:

NOTE

Install new packings and retainers on or in all component parts.

Lubricate all new packings and retainers with clean hydraulic oil prior to installation.

1. ASSEMBLE REGULATING VALVE ASSEMBLY (3).
 - a. Install new retainers (10) and packing (9) on piston (11).

- b. Install new packings (5) and (6), and retainer (7) on plug (8).
- c. Install piston (11), spring (12) and disk (13) in plug (8).
- d. Install, new packings (20), (22) and (24), and new retainers (21) and (23) on valve (30).
- e. Install plug (8) in valve (30).
- f. Install new packing (18) on piston (19).
- g. Install spring holder (14), spring seats (15) and (17), spring (16) and piston (19) in valve assembly (3).
- h. Install bolt (29), nuts (27) and (28), and new packing (26) on plug (25).
- i. Install plug (25) in valve assembly (3).

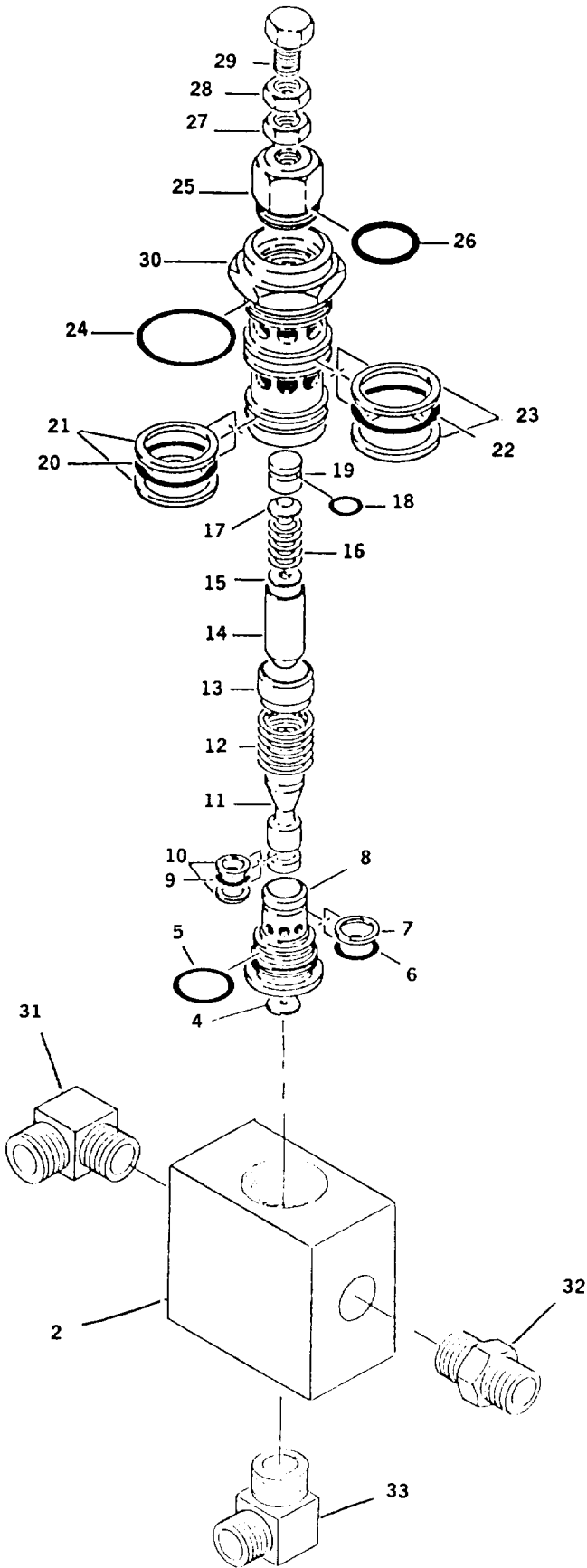
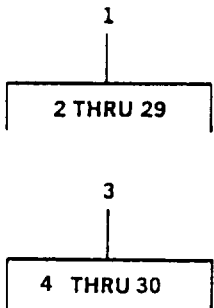
2. ASSEMBLE LIFT CYLINDER OVER CENTER VALVE ASSEMBLY (1).

- a. If removed, install fittings (31), (32) and (33) in valve body (2).
- b. Install regulating valve (3) in valve body (2).

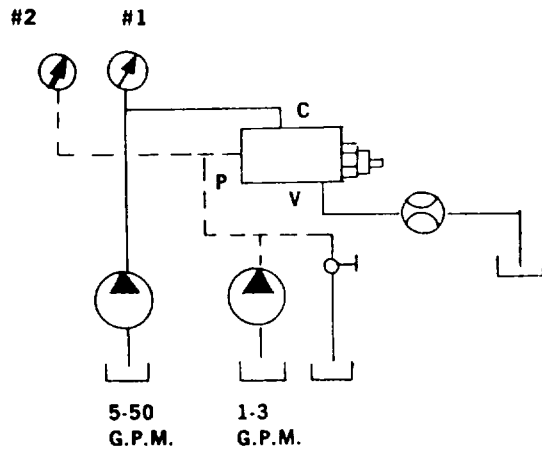
3. BENCH CHECK OVER CENTER VALVE ASSEMBLY (1).

NOTE

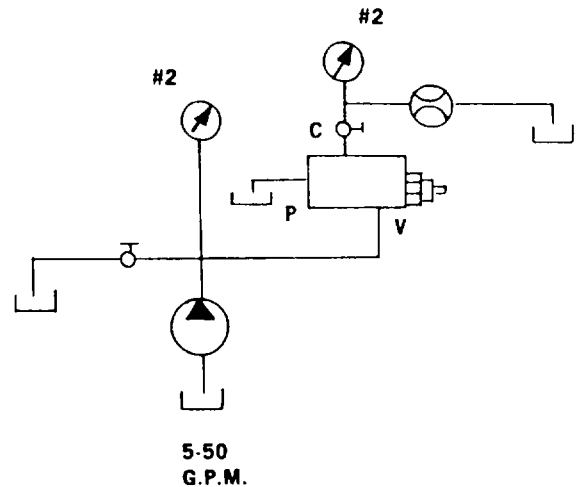
Ensure oil temperature is 120°-130°F (49°-54°C) and all air is purged from test set up before starting checks.



CHECKS a AND b



CHECK c

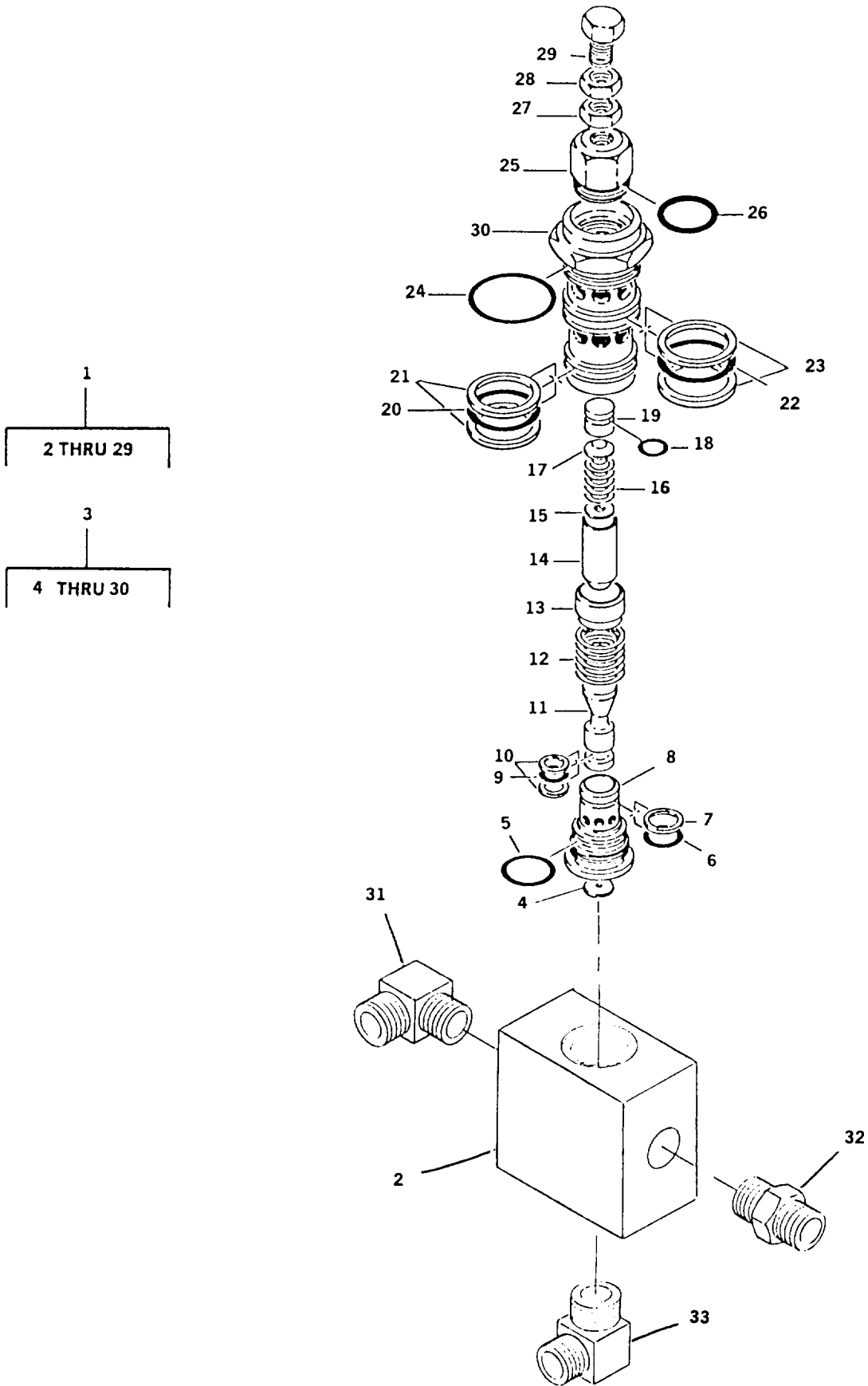


GAUGES
 #1 — 0 to 5000 P.S.I.
 #2 — 0 to 600 P.S.I.

BENCH CHECK SET UP

- a. Pilot pressure adjustment.
 - 1) Induce 2000 psi into "cylinder" port and 375 psi into "pilot pressure" port. Adjust valve with adjusting bolt to allow 1/4 GPM flow \pm 10% out of "valve" port.
 - 2) Vary pilot pressure to open and close valve several times. Recheck valve at 375 psi pilot pressure (and 2000 psi induced into "cylinder" port) to verify proper adjustment.
- b. Leakage test.
 - 1) Induce 2500 psi into "cylinder" port and observe "valve" and "pilot pressure" ports for leakage (5 drops per min. allowed after 2 min.).
 - 2) Apply 20 psi into all ports simultaneously and observe for external leakage. No leakage allowed.
- c. Free flow check test.
 - 1) Pressurize "valve" port to check function of free flow check. Check valve to crack at 25 psi.
 - 2) Induce 25 GPM flow into "valve" port. Pressure drop through valve not to exceed 70 psi.
- 4. INSTALL LIFT CYLINDER OVER CENTER VALVE ASSEMBLY. (REFER TO TM 5-3810-306-20.)

END OF TASK



TELESCOPE CYLINDER ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1 (4910-00-754-0706)
 Tool Outfit Hyd System Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784) <

SUPPLIES: Cylinder parts kit (Item 54, Appendix B)
 Hydraulic oil (Item 8, Appendix B)
 Loctite #271 (Item 23, Appendix B)
 Never-seize (Item 24, Appendix B)
 Packing (Item 22, Appendix B)

EQUIPMENT CONDITIONS: Telescope cylinder removed. (Refer to page 15-8.)

DISASSEMBLY:

NOTE

Any maintenance requiring disassembly of cylinder should include replacement of all cylinder seals.

1. REMOVE HOLDING VALVE (19) FROM PORT BLOCK.
2. REMOVE CYLINDER ROD (18).
 - a. Remove setscrew (3) and unscrew threading ring (17) from barrel (2).

NOTE

It is advisable to cover cylinder barrel opening to prevent contamination.

WARNING

Do not use air pressure to remove cylinder rod assembly. Use only a source of controlled hydraulic oil pressure, if rod is hard to move.

- b. Remove cylinder rod (18) with components, from cylinder barrel (2).

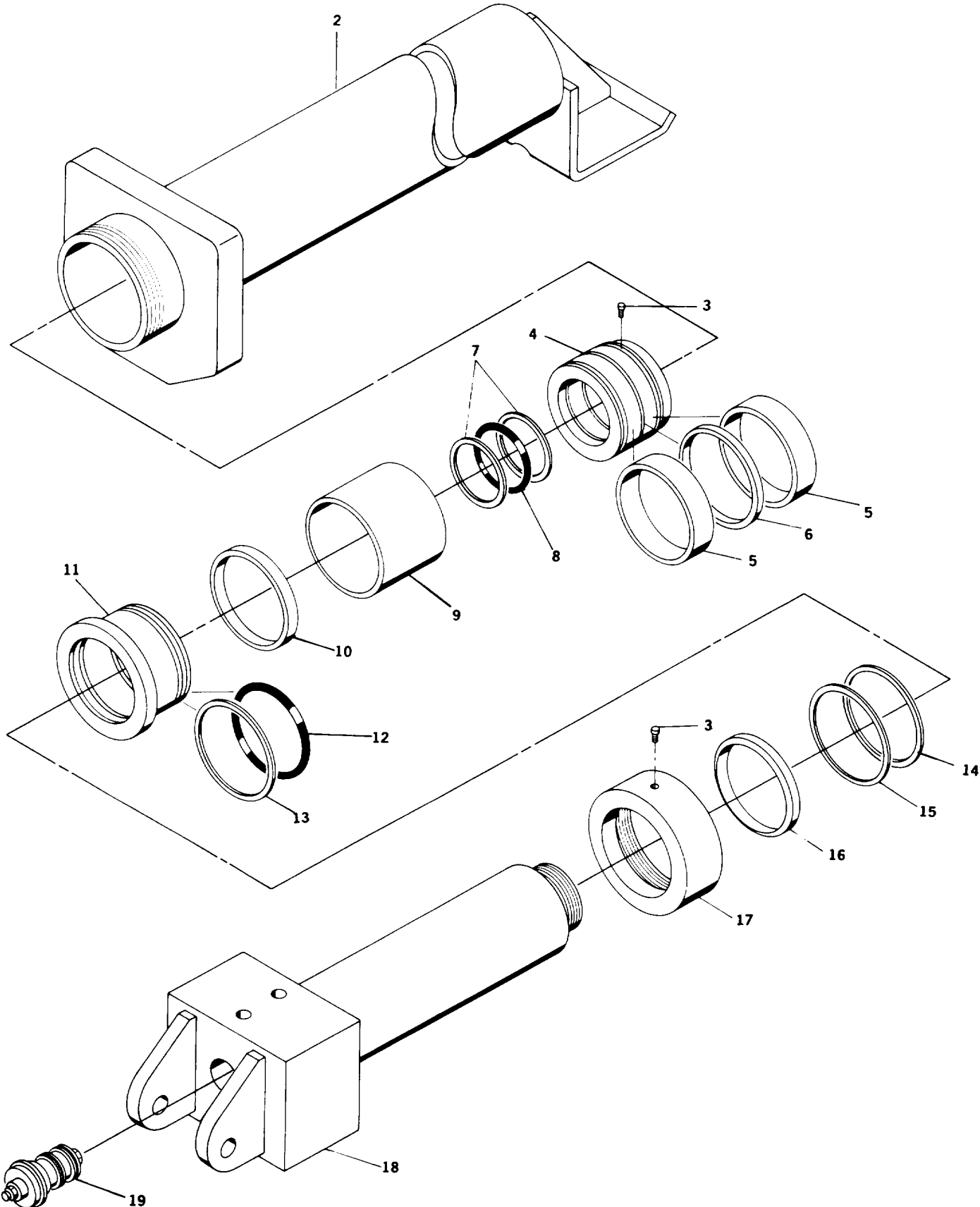
CAUTION

When removing seals and rings, avoid scratching grooved and gland surfaces.

NOTE

Aligning discarded seals and rings in order of disassembly will facilitate installation of new items.

3. REMOVE PISTON (4) AND HEAD (11).
 - a. Remove seals (5) and rings (6) from outside of piston (4). Remove setscrew (3).
 - b. Remove piston (4) spacer (9) and head (11) from rod (18).
 - c. Remove preformed packing (8) and back-up rings (7) from piston rod (18).
 - d. Remove preformed packing (12) and backup ring (13) from outside of head (11).
 - e. Remove wear ring (10), buffer seal (14) and rod seal (15) from inside of head (11).
 - f. Remove threaded ring (17). Remove wiper seal (16).



CLEANING AND INSPECTION:**WARNING**

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

1. CLEAN ALL PARTS WITH SOLVENT AND DRY WITH COMPRESSED AIR. INSPECT ALL PARTS FOR SERVICEABILITY.

CAUTION

Before installing new seals and rings, clean all surfaces and carefully remove burrs and nicks. Parts displaying excessive wear or damage should be replaced.

2. STONE OUT MINOR BLEMISHES AND POLISH WITH A FINE CROCUS CLOTH.
3. CLEAN WITH SOLVENT AND DRY WITH COMPRESSED AIR ANY PARTS THAT HAVE BEEN STONED AND POLISHED.

4. INSPECT THE BARREL CAREFULLY FOR SCORING.

REASSEMBLY:**CAUTION**

When installing new seals and rings, avoid stretching seals or scratching the grooved or gland surfaces.

NOTE

Lubricate new seals and rings with clean hydraulic oil.

1. LUBRICATE CYLINDER ROD (18) WITH CLEAN HYDRAULIC OIL.
2. REASSEMBLE HEAD (11), INSTALL ON ROD (18).
 - a. Install new packing (12) and back-up ring (13) onto the outside of head (11).

NOTE

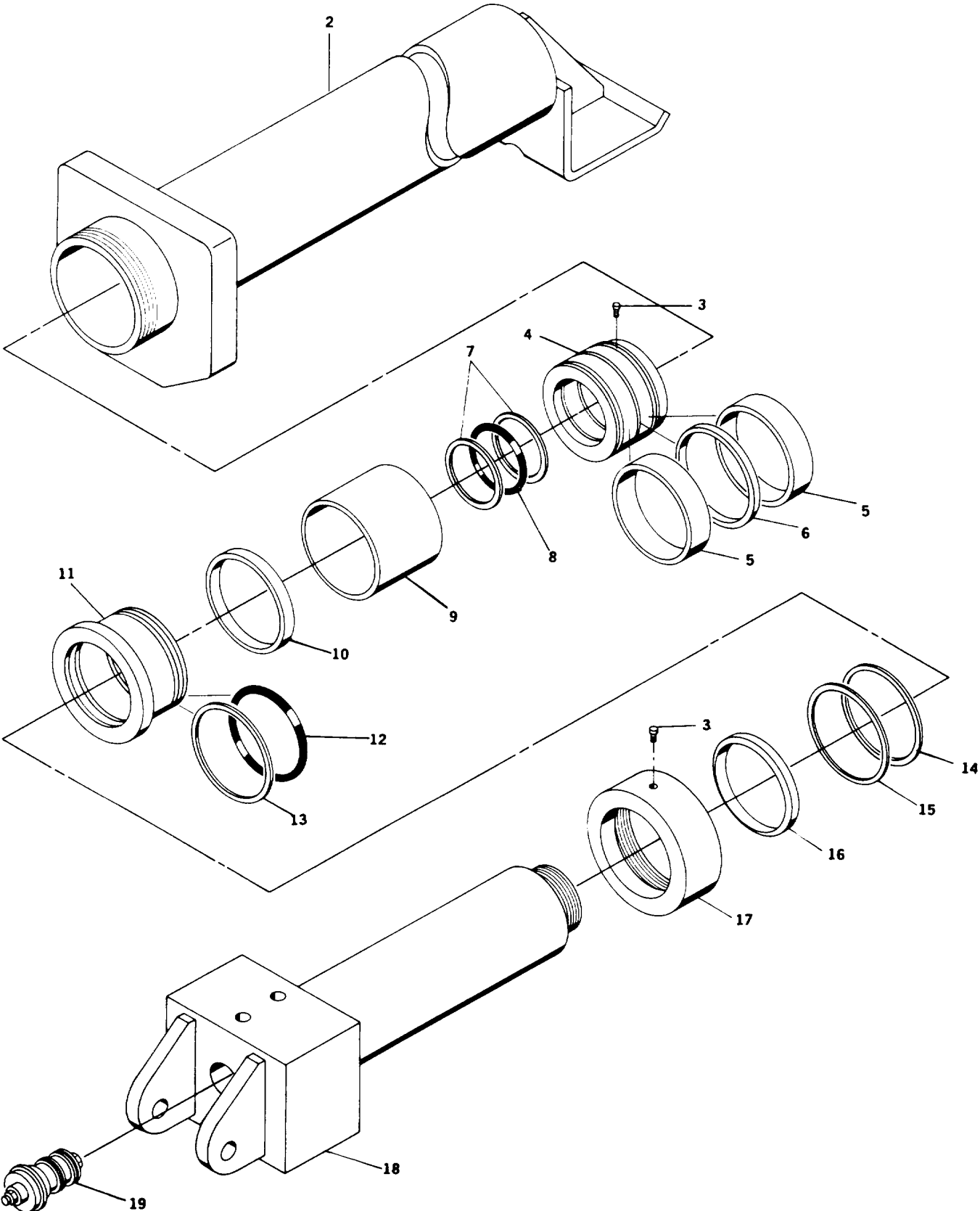
Ensure packing portion of rod seal is installed forward as head would enter barrel.

- b. Install new wear ring (10), buffer seal (14) and rod seal (15) into inside of head (11).
- c. Install new wiper seal (16) into inside of threaded ring (17).

CAUTION

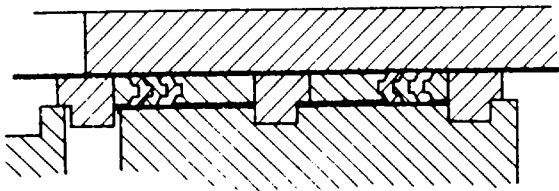
Do not damage rings and seals when installing head (11) and piston (4) onto rod (18).

- d. Install threaded ring (17) and head (11) onto rod (18).
- e. Install spacer (9) (tapered end first) onto the rod (18).



NOTE**Install new performed packing (8) between two backup rings (7).**

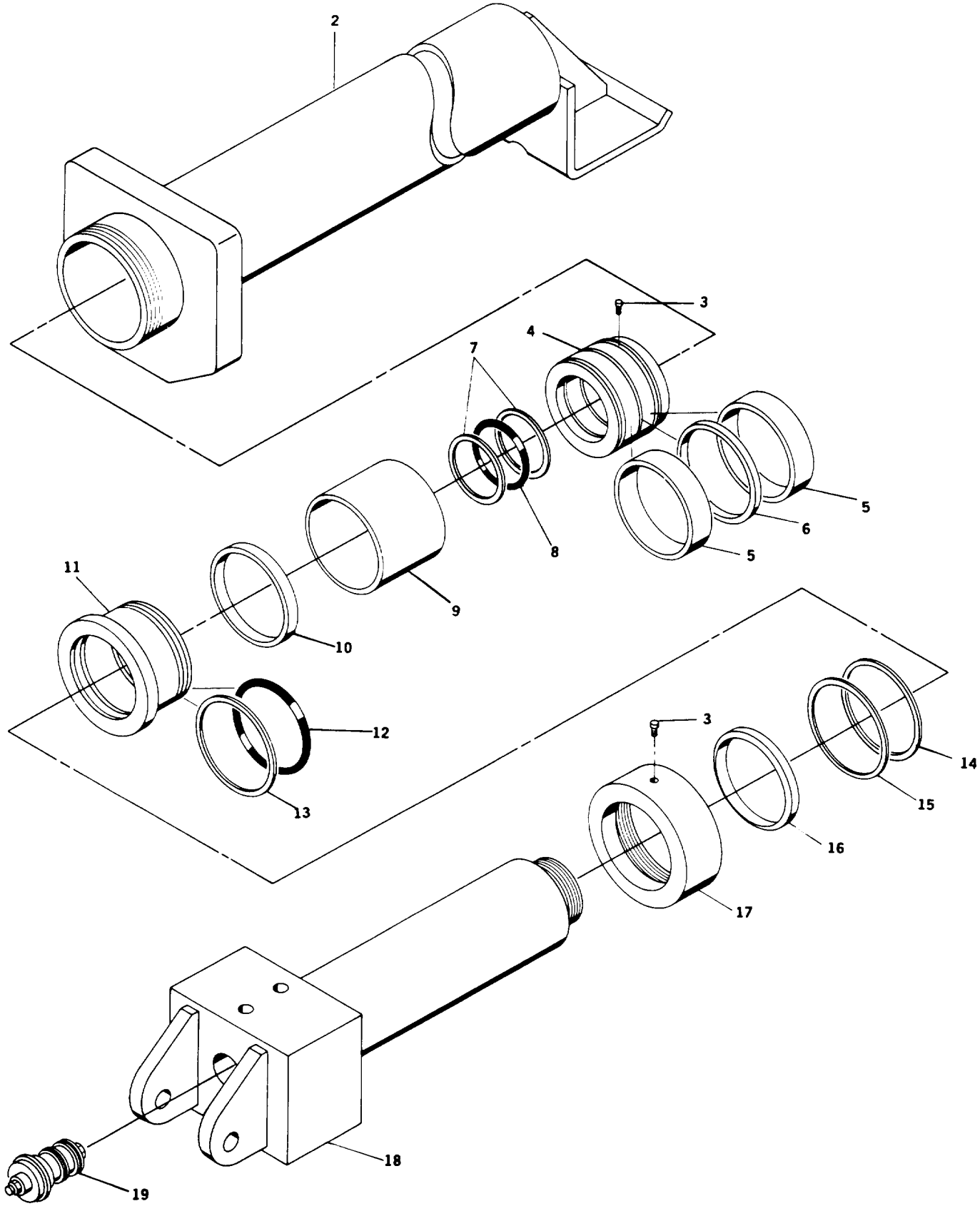
3. INSTALL NEW PREFORMED PACKING (8) AND BACKUP RINGS (7) INTO INSIDE OF PISTON.
4. IF EXISTING PISTON (4) AND ROD (18) ARE TO BE USED, PROCEED AS FOLLOWS:
 - a. Install piston (4) onto rod (18).
 - b. Using strap wrench, tighten piston (4) securely until setscrew holes align.
 - c. Apply Loctite #271 to setscrew (3) and install setscrew.
5. IF NEW PISTON (4) OR ROD (18) IS TO BE USED, PROCEED AS FOLLOWS:
 - a. Install piston (4) onto rod (18).
 - b. Using strap wrench, tighten piston (4) securely.
 - c. If necessary, drill 0.265-in. diameter hole 3/16-in. (min) deep in rod (18).
 - d. Clean drilled hole of chips and debris.
 - e. Apply Loctite #271 to setscrew (3) and install setscrew.
6. INSTALL NEW SEALS (5) AND RING (6) ONTO OUTSIDE OF PISTON (4). ENSURE SEAL ASSEMBLY IS INSTALLED AS SHOWN.



7. INSTALL ROD ASSEMBLY INTO CYLINDER BARREL (2).
 - a. Lubricate all parts freely with clean hydraulic oil.
 - b. Remove cover from cylinder barrel opening.

CAUTION**Avoid scratching or damaging grooved or gland surfaces or rings and seals.**

- c. Carefully slide cylinder rod, with components, in cylinder barrel with a twisting motion.
- d. Clean all oil from threads of threaded ring (17). Coat threads of threaded ring with NEVER-SEIZE (paste type) lubricant.
8. SEAT HEAD (22) ASSEMBLY INTO BARREL (2).
9. IF EXISTING THREADED RING (17) AND BARREL (2) ARE TO BE USED, PROCEED AS FOLLOWS:
 - a. Screw threaded ring onto barrel.
 - b. Using strap wrench, tighten threaded ring securely until the setscrew holes align.
 - c. Apply Loctite #271 to setscrew (3) and install setscrew.
10. IF NEW THREADED RING OR BARREL IS TO BE USED, PROCEED AS FOLLOWS:
 - a. Screw threaded ring onto barrel.
 - b. Using strap wrench, tighten threaded ring securely.
 - c. If necessary, drill 0.265-in. diameter hole 3/16-in. (max) deep in the barrel.



NOTE

Setscrew (3) when installed should be flush with threaded ring (17).

- d. Clean drilled hole of chips and debris.
- e. Apply Loctite #271 to setscrew (3) and install setscrew.

11. INSTALL HOLDING VALVE (19).

- a. Check inside of port block for any sharp edges or burrs and remove as necessary with emery cloth.
- b. Install new external packings onto holding valve.
- c. Lubricate holding valve and the packings with clean hydraulic oil.

CAUTION

Do not damage packings during installation of holding valve. If holding valve turns freely then gets hard to turn, then easy to turn;

remove holding valve and check packings. They have probably been damaged by a sharp edge of a port.

NOTE

The holding valve should turn by hand until compression of the packings begins.

- d. Carefully install holding valve (19) into port block.

WARNING

Do not use air pressure to cycle or pressurize cylinder.

12. PRESSURIZE AND CYCLE CYLINDER. CHECK FOR PROPER OPERATION AND ANY LEAKAGE.

13. INSTALL TELESCOPE CYLINDER. (REFER TO PAGE 15-8.)

END OF TASK

Section IV. HYDRAULIC SYSTEM MAINTENANCE

DRAINING AND FLUSHING HYDRAULIC SYSTEM

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Drain pan

SUPPLIES: Diesel fuel (82 gal (310 L) Required)
 Oil, lubricating, MIL-L-2104 Grade 10 (240 gal (934 L) required)

EQUIPMENT CONDITIONS: None

DRAINING AND FLUSHING:

NOTE

If a component has been changed because of a failure that might allow metal or abrasive particles to enter the system, all systems must be thoroughly checked, drained and flushed.

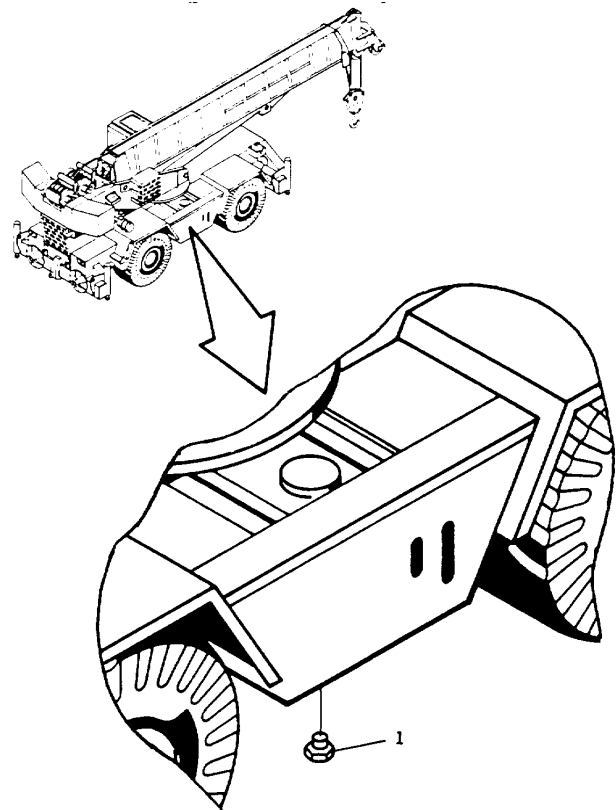
1. DRAIN HYDRAULIC RESERVOIR.

- a. Remove reservoir drain plug (1). Allow approximately three minutes after oil stops flowing from drain port, for side walls to drain.

NOTE

The hydraulic reservoir capacity is 165 gallons (624.5 L)

- b. Clean and install reservoir drain plug and fill reservoir with a 50-50 mixture of diesel fuel and clean hydraulic oil MIL-L-2104, grade 10.
- c. Cycle crane through all functions several times; then return crane to its stowed position and turn front and rear wheels to extreme left. Shut down engine. (Refer to TM 53810-306-10.)



- d. Remove reservoir drain plug (1) and drain reservoir. Clean and install drain plug (1) and fill reservoir with clean oil, MIL-L2104, grade 10.

2. FLUSH HYDRAULIC SYSTEM.

CAUTION

Oil supply lines must be connected to the cylinders when flushing the system.

CAUTION

When oils are changed or added, ensure that oils of different manufacturers are to MIL-L-2104 grade 10.

NOTE

Draining the various components will require connecting a drain line in place of the disconnected return line.

- a. Disconnect return line from lift cylinder and raise boom to maximum elevation.
- b. Connect cylinder return line and lower boom to its stowed position. Refill hydraulic reservoir as required.
- c. Disconnect return line from an outrigger extension cylinder and fully extend outrigger.
- d. Connect outrigger return line and retract outrigger. Refill hydraulic reservoir as required.
- e. Repeat steps c and d for remaining three outriggers.

CAUTION

When draining the jack cylinders, always operate either both front or both rear cylinders together to prevent twisting the crane.

- f. Disconnect return lines from front outrigger jack cylinders and activate cylinders to their maximum down position.
- g. Connect return lines and raise jack cylinders to stowed position. Refill hydraulic reservoir as required.
- h. Repeat steps f and g for rear outrigger jack cylinders.
- i. Disconnect return line from telescope cylinder and fully extend boom.
- j. Connect return line and retract boom. Refill hydraulic reservoir as required.
- k. Disconnect return lines from both front steer cylinders and turn front wheels to extreme right.
- l. Connect return lines and turn front wheels to extreme left and then back to center. Refill hydraulic reservoir as required.
- m. Repeat steps k and l for rear steering cylinders.
- n. Return crane to travel mode (all cylinders retracted and boom over the front).

3. DRAIN AND REFILL HYDRAULIC RESERVOIR WITH FRESH OIL, MIL-L-2104, GRADE 10.
4. START ENGINE AND OPERATE ALL CRANE FUNCTIONS. CHECK AND REFILL RESERVOIR AS REQUIRED.

END OF TASK

BLEEDING AIR FROM HYDRAULIC SYSTEM

TOOLS: None

SUPPLIES: None

EQUIPMENT CONDITIONS: None

GENERAL:

By design, air entering the hydraulic oil will normally be removed automatically by passage of the oil over the baffles in the hydraulic reservoir. However, air can enter the system if a component has been replaced, the reservoir level is too low, or a leak develops in the suction lines to the pumps. If air becomes entrapped in the hydraulic oil, it may be detectable in pumps and motor-operated components such as the swing mechanism and hoist(s) causing these units to become noisy during operation. Should noisy operation occur, first check oil level in hydraulic reservoir and fill as necessary. Then inspect for leaks in suction lines leading to pumps.

Small leaks may be difficult to locate. Should you encounter a leak that is not readily detectable, the following method may be used when checking for such leaks.

1. PRESSURIZE HYDRAULIC SYSTEM.
 - a. Seal all normal openings (vents, etc.) in hydraulic system and reservoir.
 - b. Using a positive means to control pressure (i.e., a regulator), pressurize hydraulic system to 2 to 4 psi (13.79 to 27.6 kPa/0.1379 to 0.276 bar).

NOTE

A soap solution applied to the fittings and joints may also prove helpful in detecting small leaks while the system is pressurized.

- c. Inspect all joints and fittings for evidence of leaks.
 - d. Remove pressure, repair any leaks found and reopen any openings (vents, etc.) closed for inspection.
 - e. Refill reservoir after completing any repairs or service.
 - f. Operate all hydraulic circuits several times in both directions. This action should return any entrapped air to the reservoir where it can be removed from oil by the baffle system provided.
2. REMOVE ENTRAPPED AIR IN CYLINDERS.

CAUTION

Locate crane on a firm supporting surface and position boom in most stable position when extending boom at low angles.

NOTE

Rear outriggers may be used to raise crane in order to lower boom nose slightly below horizontal.

- a. If air in telescope cylinder is not readily removed, lower boom to below horizontal, extend telescope cylinder as far as practicable, and allow boom to remain in this position overnight.

WARNING

Extreme care must be used when removing any plugs or restrictions from a hydraulic system suspected to have entrapped air that may be pressurized.

NOTE

This should allow entrapped air to find its way to holding valve so telescoping boom IN next morning should force air back to reservoir.

NOTE

While allowing boom to remain in extended and lowered position overnight is helpful in removing entrapped air from hydraulic cylinder, ensure boom is first telescoped IN (not OUT) in morning. Telescoping OUT can cause air to be forced back into cylinder.

- b. Entrapped air can be removed from any cylinder by cycling cylinder. On certain cylinders, a plugged port is provided on rod end to bleed-off entrapped air.

WARNING

Do not attempt to loosen fittings in pressurized lines or while hydraulic pumps are in operation.

- c. If pumps and motors are noisy after bleeding cylinders, bleed air by loosening various fittings.

END OF TASK

CHAPTER 14
LOAD MOMENT INDICATOR SYSTEM

CHAPTER INDEX

	Procedure	Page
Section I	Load Moment Indicator System Maintenance	14-2
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	Central Processing Unit Installation	14-4
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	Length Cable Installation.....	14-16
	Main and Auxiliary Boom Nose Anti-Two Block Switch Installation	14-17
	Rod Pressure and Piston Pressure Transducer Installation.....	14-20
	Roller/Cable Guide Installation.....	14-22

SECTION I. LOAD MOMENT INDICATOR SYSTEM MAINTENANCE

DISPLAY CONSOLE INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: None

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
(Refer to TM 5-3810-306-20.)

REMOVAL:

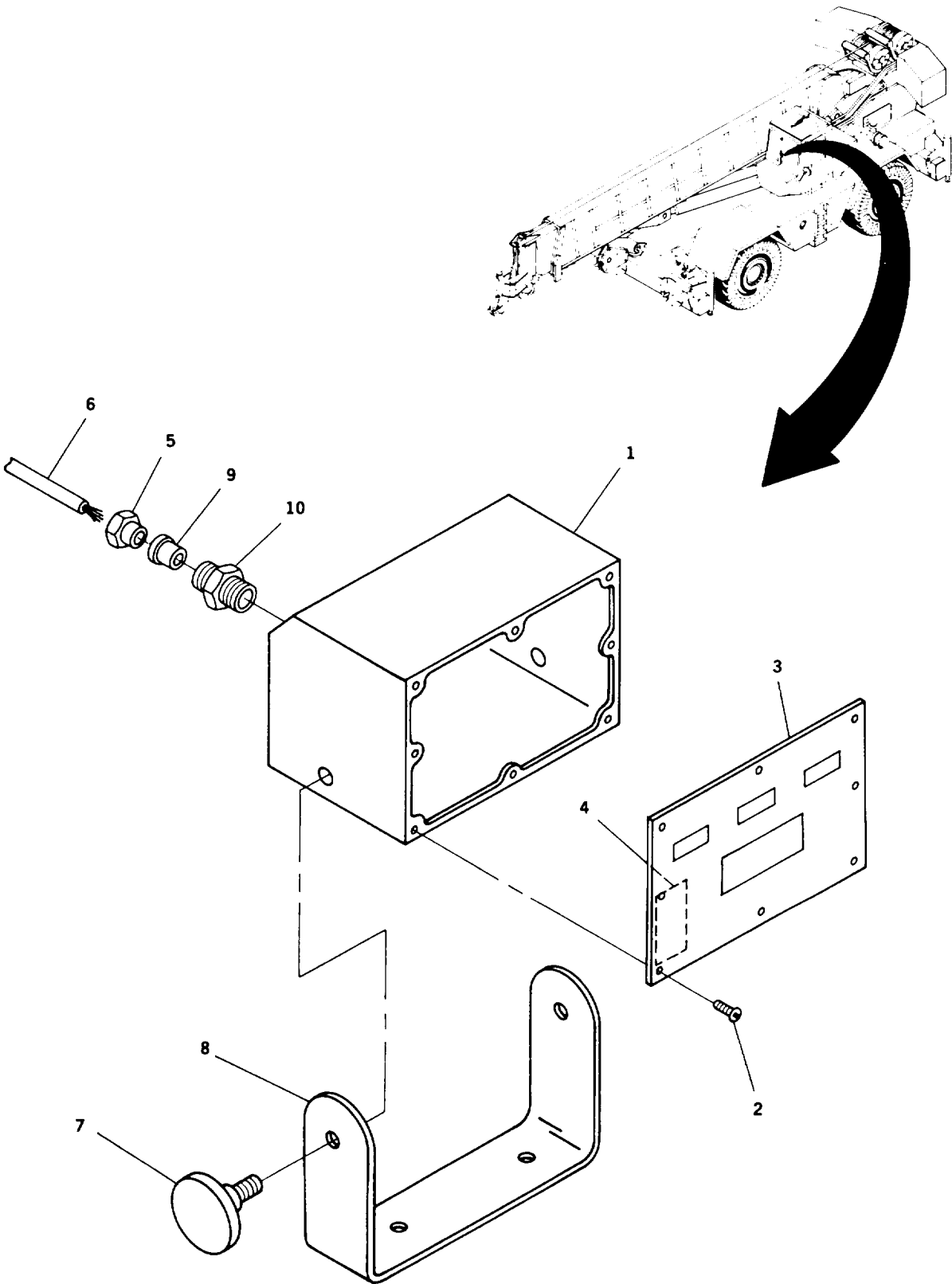
1. REMOVE DISPLAY CONSOLE (1).
 - a. Unscrew self-retaining screws (2) holding console face (3) and separate console face (3) from console (1).
 - b. Tag and disconnect electrical wires of cable (6) from console terminal strip (4) on back of console face (3). Resecure console face (3) to console (1) with screws (2).
 - c. Loosen connector nut (5) and pull cable (6) through connector nut (5) and out of console (1).
 - d. Remove adjusting knobs (7) and remove console (1) from mounting bracket (8).
 - e. Remove connector nut (5) and rubber insert (9) from metal insert (10) and insert cable (6) through connector nut (5) and rubber insert (6). Push both back over outer insulation of cable.
 - f. Insert wires and inner insulation of cable (6) through metal insert (10) and into console (1).

NOTE

Ensure that proper contact is made between outer shield of cable (6) and metal insert (10).

INSTALLATION:

1. INSTALL DISPLAY CONSOLE (1).
 - a. Position console (1) in mounting bracket (8) and secure by installing adjusting knobs (7) through bracket (8) and into sides of console (1).
 - b. Unscrew self-retaining screws (2) holding console face (3) and separate console face (3) from console (1).
 - c. Slide rubber insert (6) and connector nut (5) to metal insert (10) and tighten connector nut (5).
 - d. Reconnect wires of cable (6) to console terminal strip (4) as tagged.
 - e. Secure console face (3) to console (1) by tightening self-retaining screws (2).
 2. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
- END OF TASK



CENTRAL PROCESSING UNIT INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033) As
Digital Voltmeter (6625-00-139-2512)

SUPPLIES: None

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)
Boom hoist cylinder fully retracted. (Refer to TM 5-3810-306-10.)

REMOVAL:

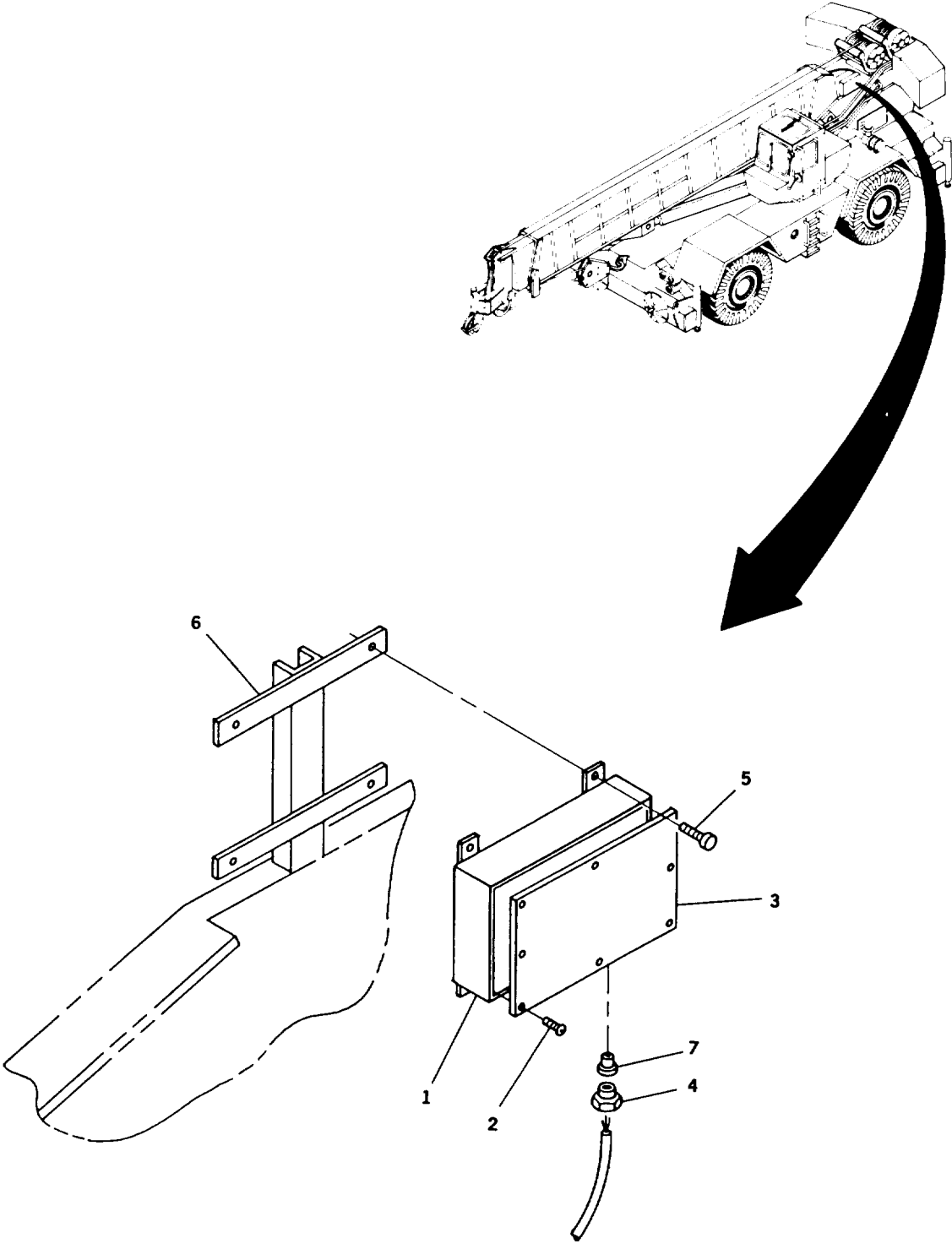
1. REMOVE CENTRAL PROCESSING UNIT (CPU).
 - a. Remove wire seal, screws (2) and cover (3) from housing (1).
 - b. Tag and remove electrical wires of external cables from terminal board in housing (1).
 - c. Loosen connector nuts (4) securing external cables.
 - d. Mark each cable to it's corresponding strain relief connector port on bottom of housing (1) and pull each cable out of housing (1).
 - e. Remove bolts (5) and remove housing (1) from mounting bracket (6).
- b. Remove connecting nuts (4) and rubber inserts (7) from strain relief connectors on bottom of housing (1).
- c. Insert each external cable through a connector nut (4) and rubber insert (7). Push both over outer insulation of cables.
- d. Insert wires and inner insulation of each cable through correct strain relief port and into housing (1) as marked.

NOTE

Ensure proper contact between outer shield of cable (12) and metal insert of strain relief connector.

INSTALLATION:

1. INSTALL CENTRAL PROCESSING UNIT (CPU).
 - a. Position housing (1) in mounting bracket (6) and secure with bolts (5).
- e. Slide each rubber insert (7) and connector nut (4) back onto strain relief connectors and tighten connector nuts (4).
- f. Reconnect electrical wires to terminal board in housing (1) as tagged.
- g. Adjust central processing unit.



ADJUSTMENT:

1. ADJUST CENTRAL PROCESSING UNIT (CPU).

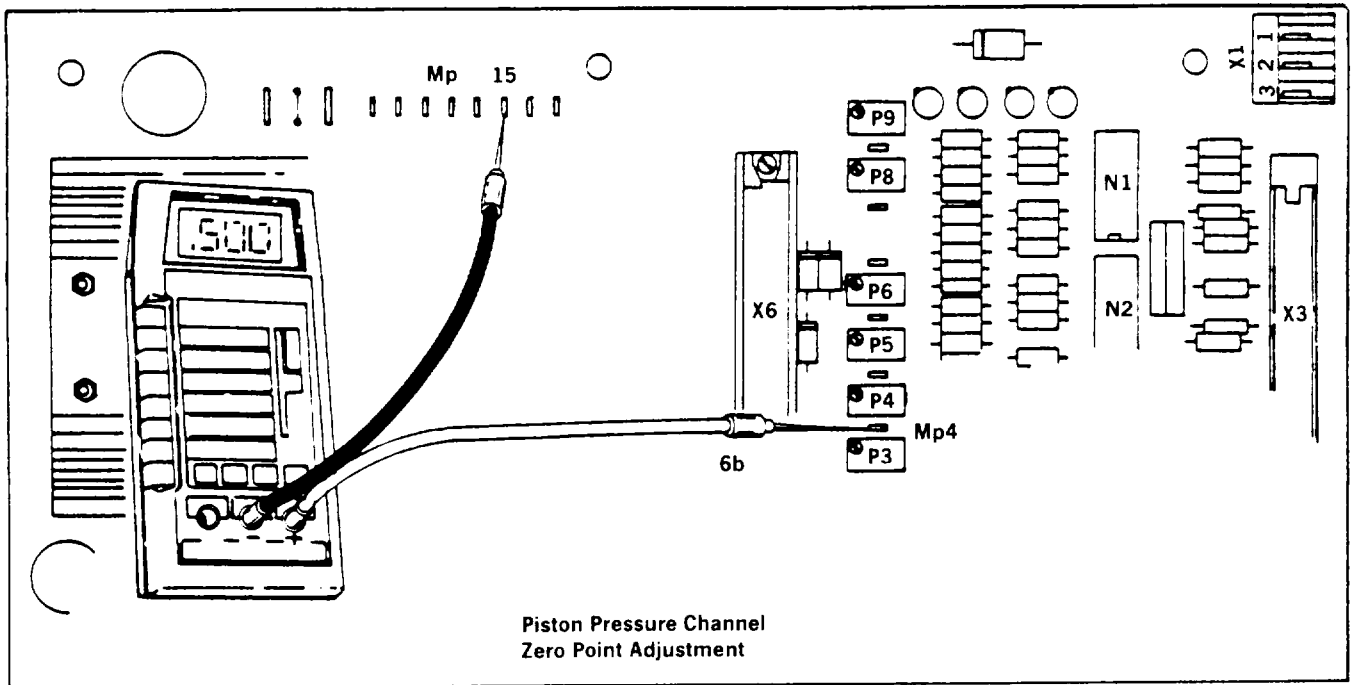
CAUTION

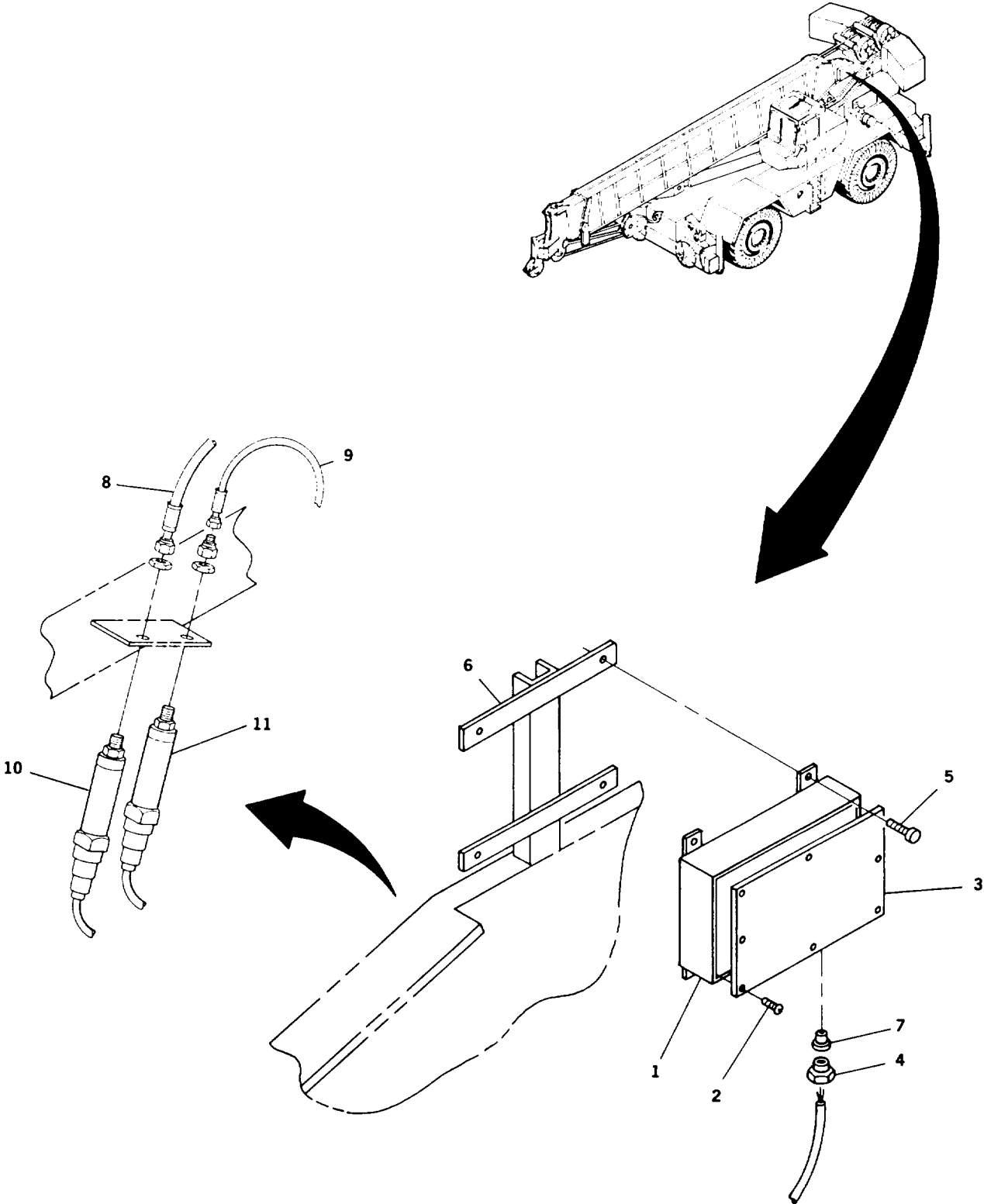
Special care must be taken before disconnecting hydraulic lines from transducers. Make sure lift cylinders are FULLY retracted, otherwise injury and damage can occur.

- a. Disconnect pressure lines (8) and (9) from pressure transducers (10) and (11).

2. ADJUST PISTON PRESSURE CHANNEL.

- a. Connect digital voltmeter to CPU main board.
 - 1) Black (-) lead to test point Mp15.
 - 2) Red (+) lead to test point Mp4.
- b. Adjust P4 to obtain a reading of .500 Vdc (500 mV) on voltmeter.

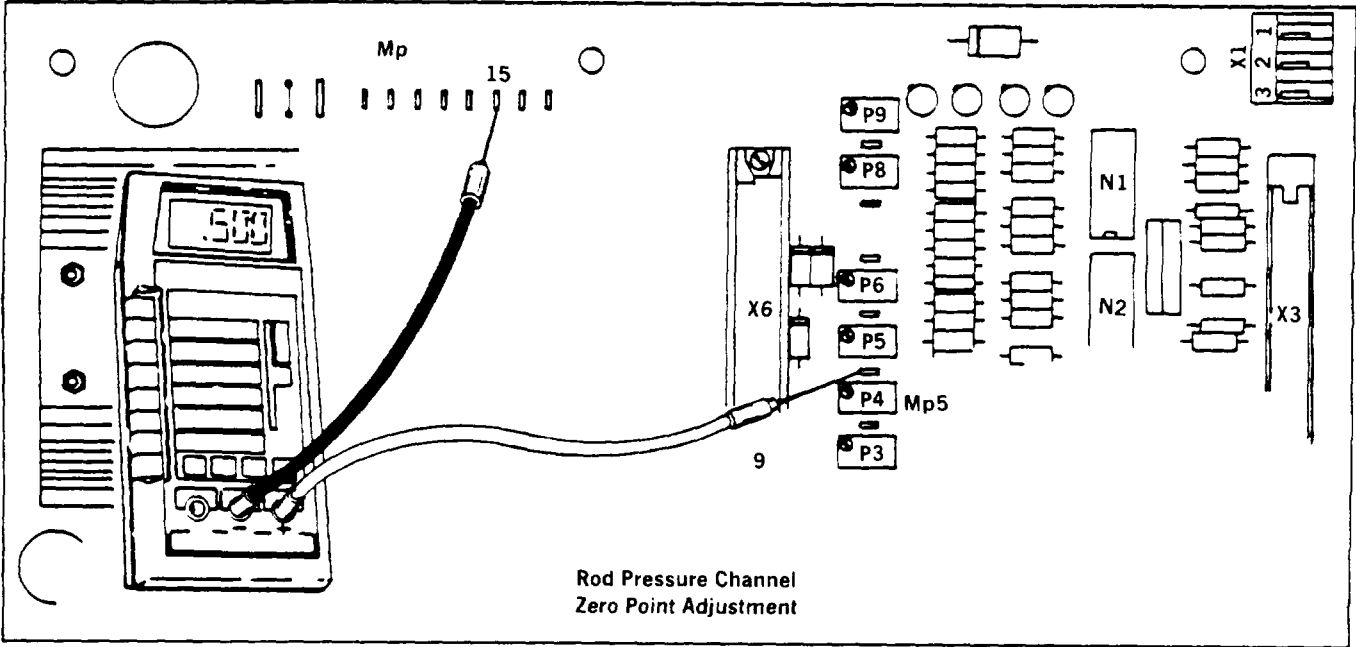


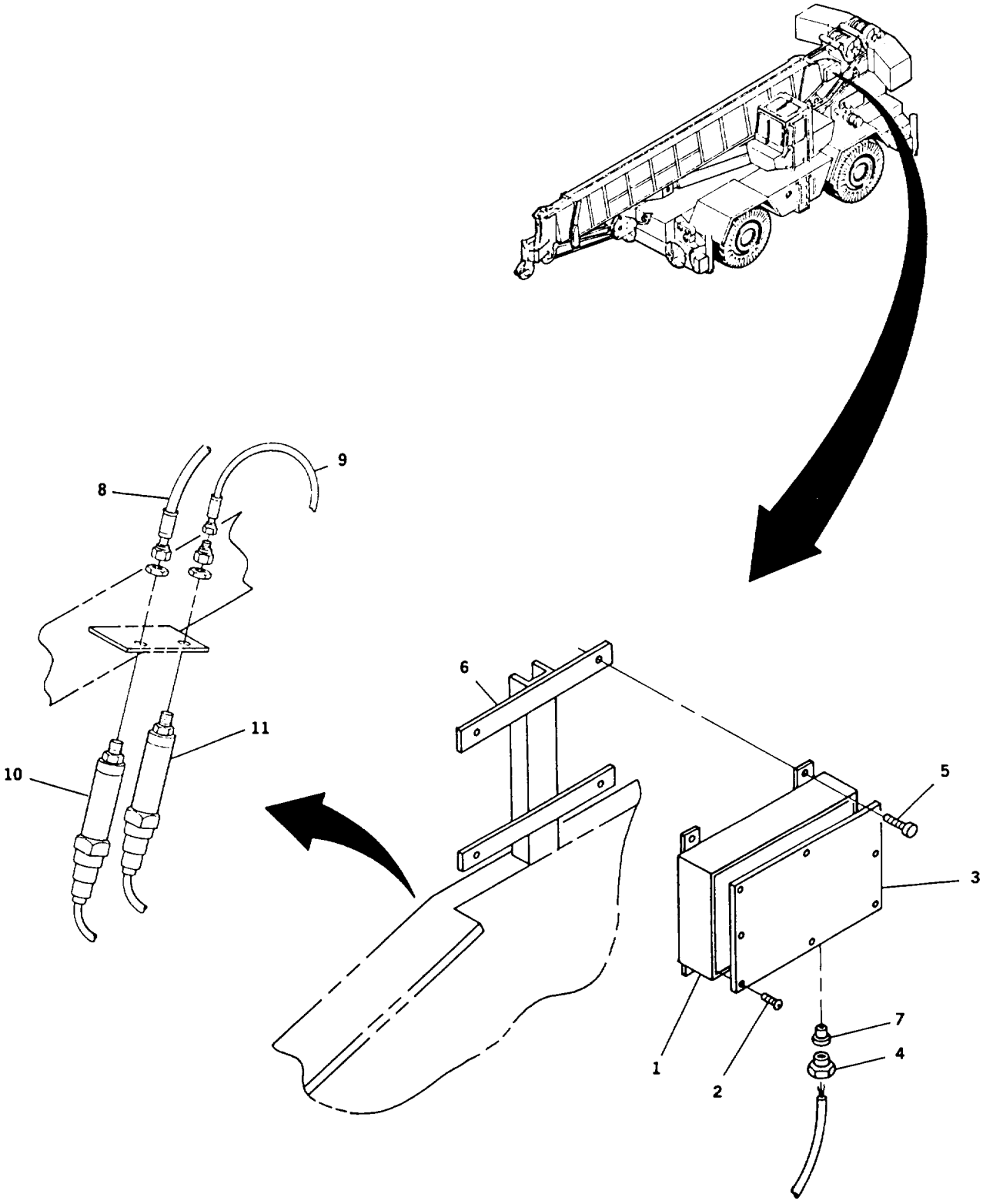


- 3. ADJUST ROD PRESSURE CHANNEL.
 - a. Connect digital voltmeter to CPU main board.
 - 1) Black (-) lead to test point MP15.
 - 2) Red (+) lead to test point MP5.
 - b. Adjust P5 to obtain a reading of .500 Vdc (500 mV) on voltmeter.

- 4. INSTALL COVER (3) WITH SCREWS (2) AND WIRE SEAL.
- 5. RECONNECT PRESSURE LINES (8) AND (9) TO PRESSURE TRANSDUCERS (10) AND (11).
- 6. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

END OF TASK





LENGTH/ANGLE CABLE REEL ASSEMBLY INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Level () 2 required

SUPPLIES: None

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)
Boom fully retracted and lowered. (Refer to TM 5-3810-306-10.)

REMOVAL:

1. CLAMP CABLE DRUM (1) ONTO MOUNTING BRACKET (2) TO PREVENT PREMATURE RETRACTION OF LENGTH CABLE (6).
2. REMOVE LENGTH CABLE (6) FROM BOOM NOSE RECEPTACLE (4).
 - a. Unplug jumper/dummy plug (3) from boom nose receptacle (4).
 - b. Loosen set screws (5) and separate insert (18) from boom nose receptacle (4).
 - c. Disconnect the core wire of length cable (6) from pin 6 and the shield of length cable (6) from ground terminal on insert (18).

NOTE

Do not remove wire No. 2 (A2B Switch) from Pin 6.

- d. Loosen connector nut (7) and pull length cable (6) from boom nose receptacle (4).

NOTE

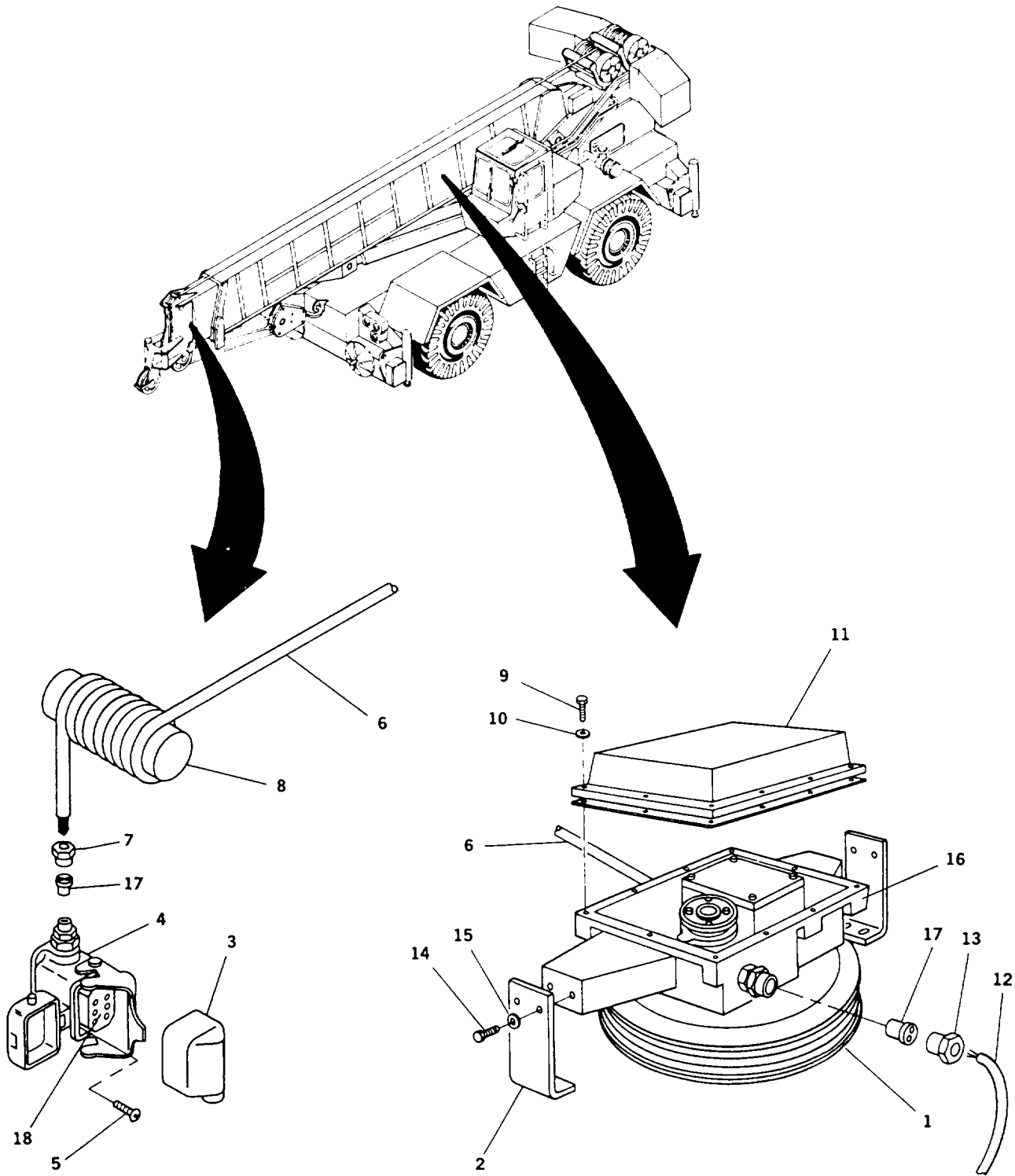
Before cutting tie wraps, make note of how many times length cable (6) is wrapped around tube (8).

- e. Cut tie wraps holding length cable (6) around tube (8). Remove length cable (6).
3. CAREFULLY RELEASE CLAMP ON CABLE DRUM (1) AND RETRACT LENGTH CABLE (6) ONTO DRUM. SECURE FREE END OF LENGTH CABLE (6) TO CABLE DRUM (1) WITH TAPE.

NOTE

Cable drum (1) will still be under tension when length cable (6) is fully retracted. Carefully turn cable drum (1) until tension is gone.

4. REMOVE LENGTH/ANGLE CABLE REEL ASSEMBLY (16).
 - a. Remove hex screws (9), washers (10) and cover (11) from cable reel assembly (16).
 - b. Tag and disconnect wires of cable (12) from terminal block in cable reel assembly (16).
 - c. Loosen connector nut (13) and pull cable (12) from cable reel assembly (16).
 - d. Remove bolts (14), washers (15) and cable reel assembly (16) from mounting brackets (2).



INSTALLATION:

1. INSTALL LENGTH/ANGLE CABLE REEL ASSEMBLY (16).

- a. Position cable reel assembly (16) in mounting brackets (2) and secure with bolts (14) and washers (15).
- b. Remove connector nut (13) and rubber insert (17) from strain relief connector.
- c. Insert cable (12) through connector nut (13) and rubber insert (17). Push both back over outer insulation of cable (12).
- d. Insert wires and inner insulation of cable (12) through strain relief connector and into cable reel assembly (16).

NOTE

Ensure proper contact between outer shield of cable and metal insert of strain relief connector.

- e. Slide rubber insert (17) and connector nut (13) onto strain relief connector and tighten connector nut (13).
- f. Connect wires of cable (12) to terminal block in cable reel assembly (16) as tagged.
- g. Preload cable drum (1) by turning drum 5 to 8 turns counterclockwise. Clamp cable drum (1) to mounting bracket (2) to prevent unwinding.

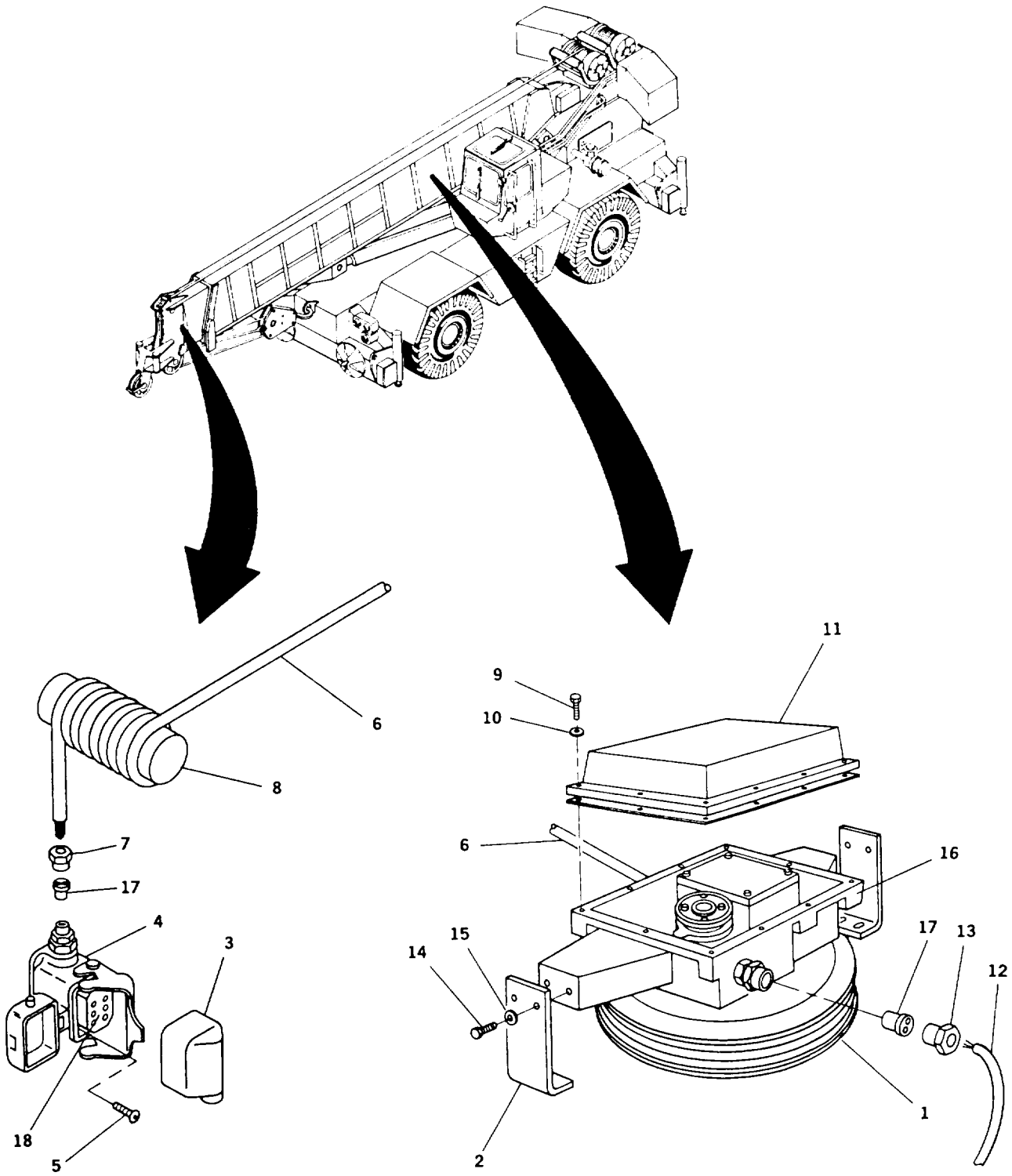
2. INSTALL LENGTH CABLE (6) TO BOOM NOSE RECEPTACLE (4).

- a. Unreel length cable (6) from cable drum (1) and thread through the roller and cable guides along the boom.
- b. Wrap length cable (6) around tube (8) the same number of times as noted on removal and secure with tie wraps.

CAUTION

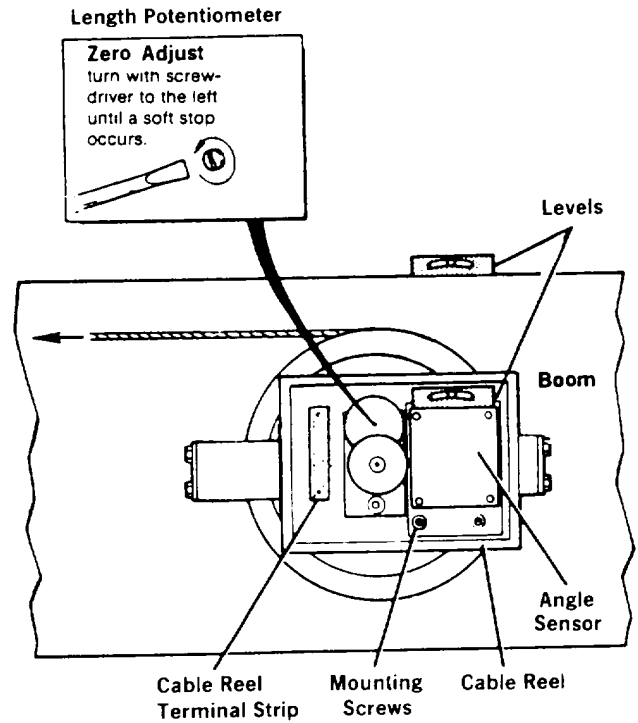
To prevent damage to length cable (6) there should be no slack between tube (8) and cable reel assembly (16).

- c. Remove connector nut (7) and rubber insert (17) from strain relief connector on boom nose receptacle (4).
- d. Insert length cable (6) through connector nut (7) and rubber insert (17). Insert length cable (6) into boom nose receptacle (4). Push rubber insert (17) and connector nut (7) onto strain relief connector and tighten connector nut (7).
- e. Connect core wire to pin 6 and shield wire to ground terminal on insert (18) of boom nose receptacle (4).
- f. Install insert (18) in boom nose receptacle (4) and secure with screws (5).
- g. Plug jumper/dummy plug (3) into boom nose receptacle (4).



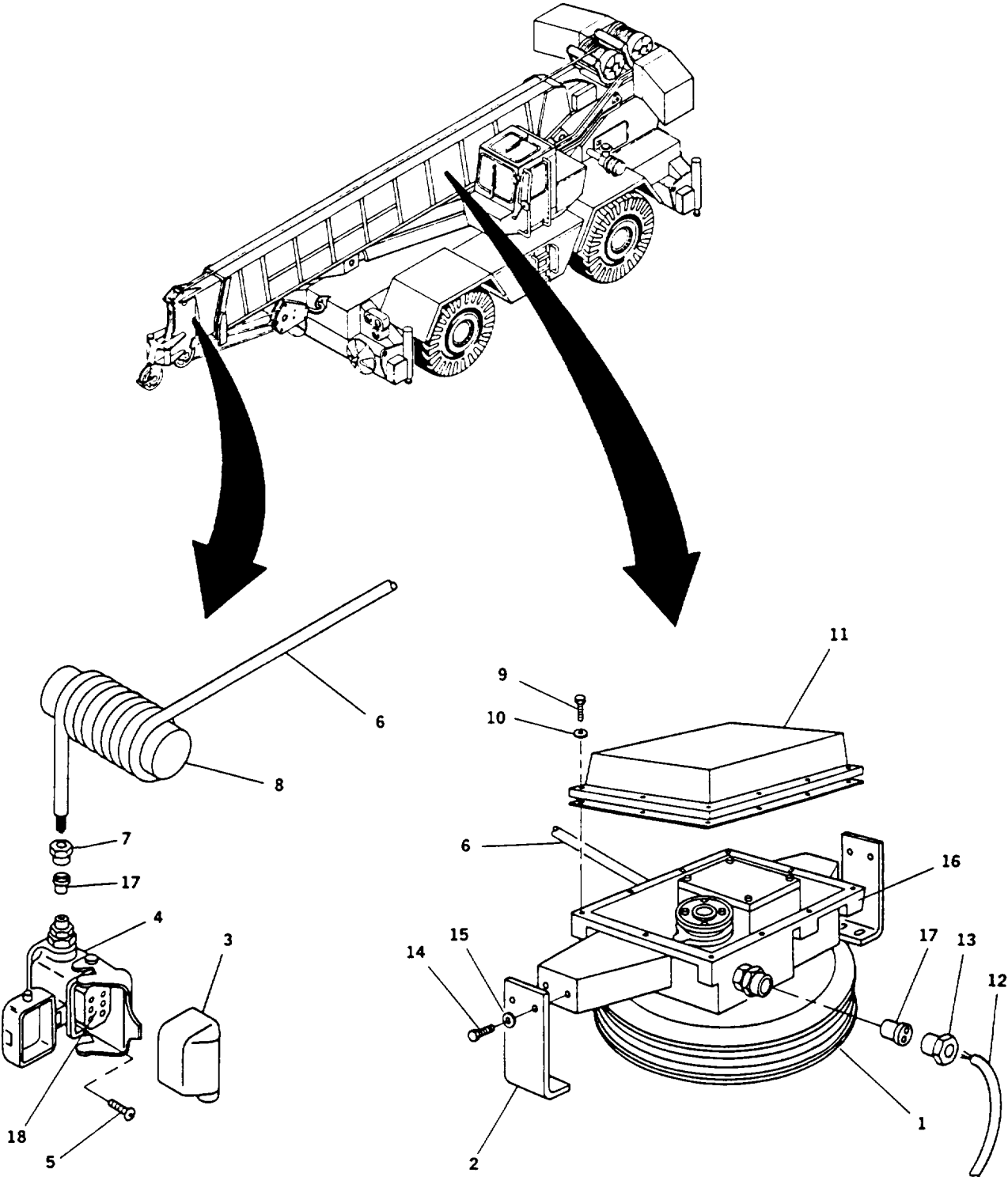
ADJUSTMENT:

1. TURN SCREW (POTENTIOMETER AXLE) IN CENTER OF LARGE NYLON GEAR (INSIDE LENGTH/ANGLE CABLE REEL ASSEMBLY (16) COUNTERCLOCKWISE UNTIL IT STOPS. **DO NOT FORCE SCREW.**
2. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO PAGE TM 5-3810-306-20.)
3. START CRANE AND RAISE BOOM TO 0 DEGREES. PLACE A LEVEL ON TOP OF BOOM BASE SECTION AND ON ANGLE SENSOR INSIDE LENGTH/ANGLE CABLE REEL ASSEMBLY (16).
4. LOOSEN SOCKET HEAD SCREWS ON ANGLE SENSOR AND ADJUST ANGLE SENSOR TO SAME ANGLE AS BOOM BASE SECTION.
5. LUBRICATE HEX HEAD SCREWS (9) WITH OE/HDO ENGINE OIL.
6. INSTALL COVER (11), WASHERS (10) AND HEX HEAD SCREWS (9).
7. COMPARE LOAD MONITOR INDICATOR DISPLAY TO BOOM LENGTH AND ANGLE TO CONFIRM PROPER FUNCTION OF SYSTEM.



Angle/Length Sensor Adjustment

END OF TASK



LENGTH CABLE INSTALLATION

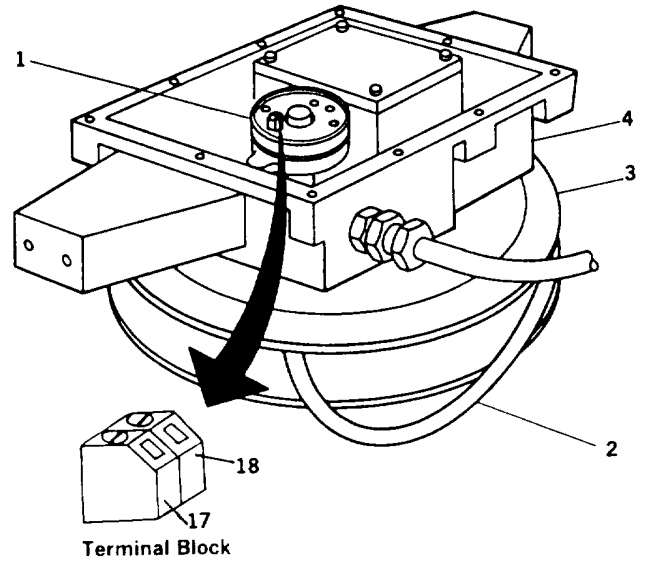
TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: None

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)
Length/angle cable reel assembly removed. (Refer to page 14-10.)

REMOVAL:

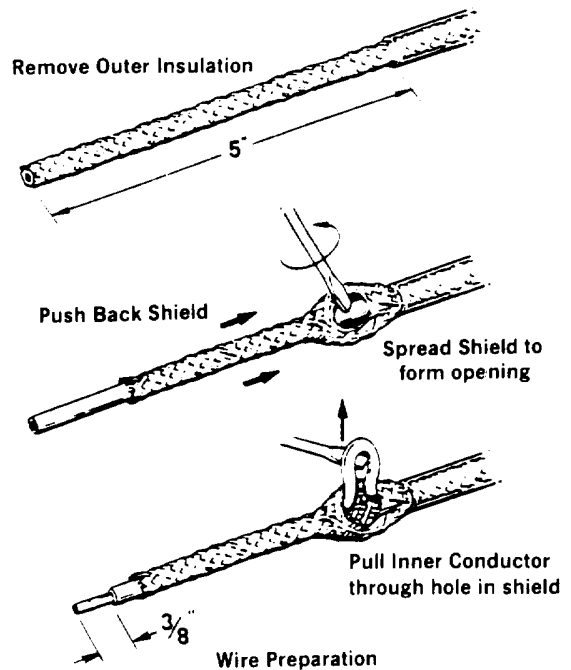
1. DISCONNECT WIRES OF LENGTH CABLE (2) FROM TERMINALS 17 AND 18 ON SLIP RING (1) IN CABLE REEL ASSEMBLY (4).
2. UNWIND LENGTH CABLE (2) AND LOOSEN STRAIN RELIEF CONNECTOR NUT ON AXLE IN CENTER OF CABLE DRUM (3). PULL REMAINDER OF LENGTH CABLE (2) FROM CABLE REEL ASSEMBLY (4).



INSTALLATION:

1. PUSH NEW LENGTH CABLE (2) THROUGH STRAIN RELIEF CONNECTOR ON AXLE OF CABLE DRUM (3), AND UP THROUGH CABLE REEL ASSEMBLY (4) AND SLIP RING (1). TIGHTEN STRAIN RELIEF CONNECTOR NUT.
2. PREPARE BOTH ENDS OF LENGTH CABLE (2) AS SHOWN. TWIST SHIELD INTO A SINGLE CONDUCTOR ONCE SEPARATED.
3. CONNECT LENGTH CABLE (2) TO SLIP RING (1) (SHIELD TO TERMINAL 18 AND CORE TO TERMINAL 17).
4. TURN CABLE DRUM (3) CLOCKWISE (AS MOUNTED) TO WIND LENGTH CABLE (2) ONTO DRUM. SECURE FREE END OF LENGTH CABLE (2) TO CABLE DRUM (3).
5. INSTALL LENGTH/ANGLE CABLE REEL ASSEMBLY. (REFER TO PAGE 14-10).

END OF TASK



MAIN AND AUXILIARY BOOM NOSE ANTI-TWO-BLOCK SWITCH INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

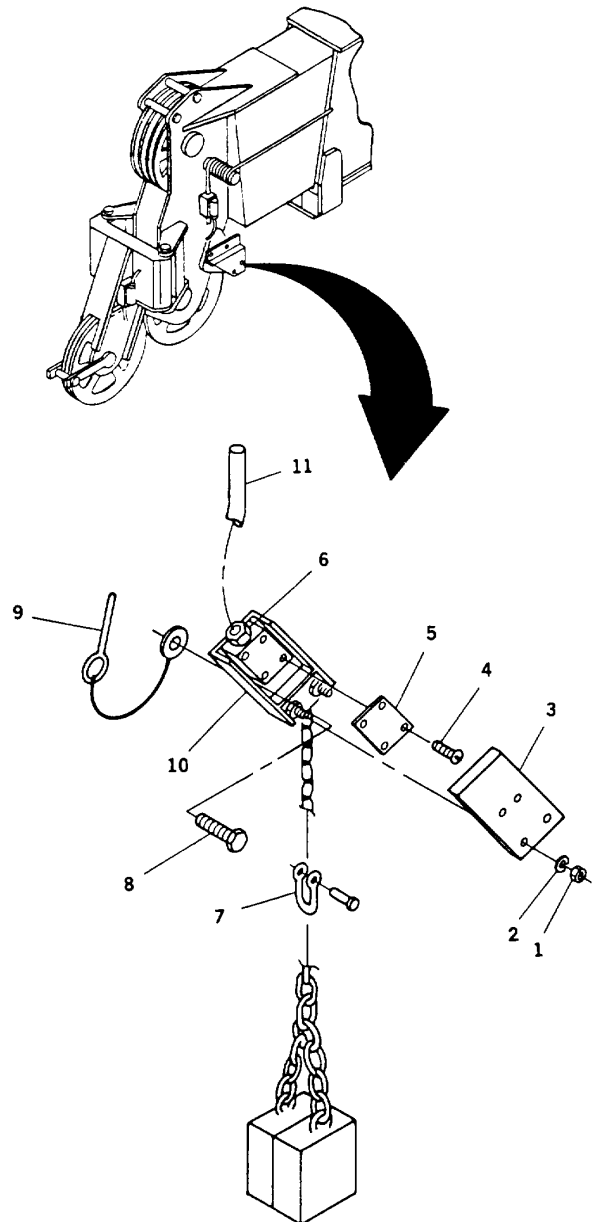
SUPPLIES: None

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
(Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE ANTI-TWO-BLOCK SWITCH (10).

- a. Remove nuts (1), washers (2) and cover (3) from switch (10).
- b. Remove screws (4) and switch contact cover (5).
- c. Tag and disconnect electrical wires from contact terminals.
 - 1) Main Boom: Disconnect wires from terminals 23 and 24.
 - 2) Auxiliary Boom: Disconnect wires from terminals 12 and 23. Remove 4700 ohm resistor from terminals 12 and 24, and retain for installation.
- d. Loosen connector nut (6) and pull cable (11) out of switch (10).
- e. Remove link (7) and disconnect chain and weight from switch (10).
- f. Remove capscrews (8), switch (10) and lock pin (9) from boom.



INSTALLATION:

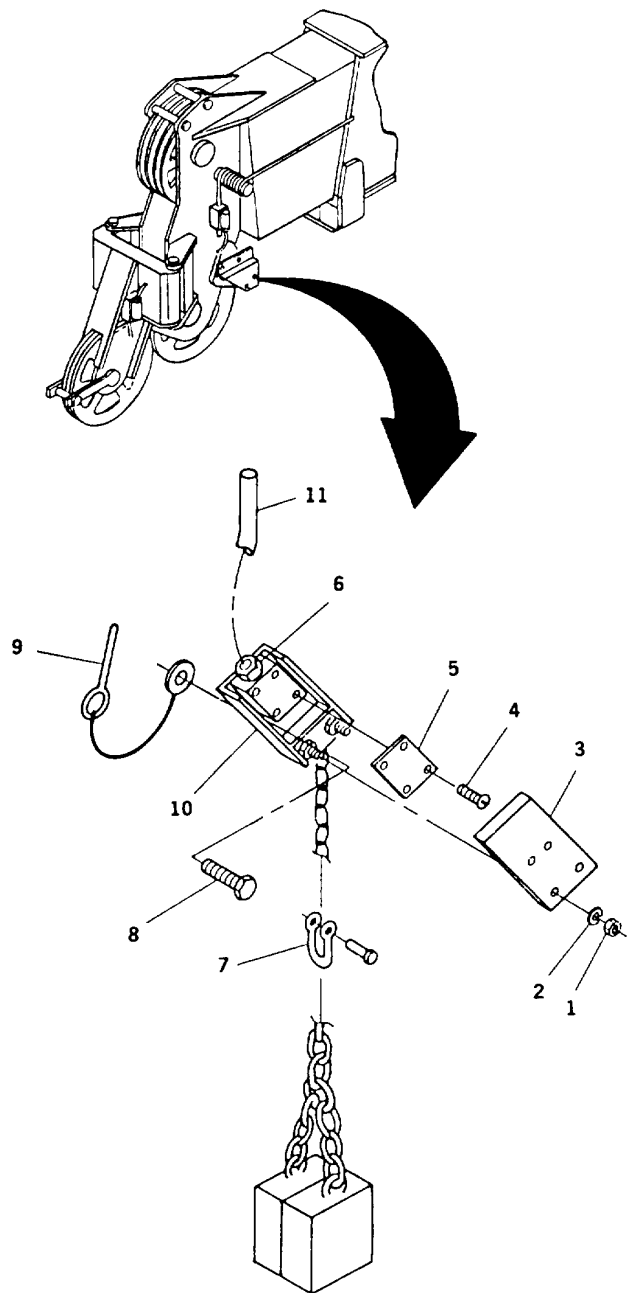
1. INSTALL ANTI-TWO-BLOCK SWITCH (10).

- a. Install lock pin (9) and switch (10) to boom with capscrews (8).

- b. Insert cable (11) into switch (10) and tighten connector nut (6).
- c. Connect electrical wires to contact terminals.
 - 1) Main Boom: Connect wires to terminals 23 and 24 as tagged.
 - 2) Auxiliary Boom: Install 4700 ohm resistor between terminals 12 and 24. Connect wires to terminals 12 and 23 as tagged.
- d. Install switch contact cover (5) with screws (4).
- e. Install cover (3) with nuts (1) and washers (2).
- f. Attach chain and weight to switch (10) by installing link (7).

2. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

END OF TASK



ROD PRESSURE AND PISTON PRESSURE TRANSDUCER INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: None

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)
Boom fully lowered. (Refer to TM 5-3810-306-10.)

REMOVAL:

1. REMOVE PRESSURE TRANSDUCER (2).

- a. Disconnect electrical plug (1) from transducer (2).

WARNING

Special care must be taken before disconnecting hydraulic line (3) from transducer (2). Make sure boom lift cylinder is FULLY retracted, otherwise injury or damage could occur. Even with cylinder fully retracted, some pressure could remain in system. Loosen hydraulic line (3) slowly to bleed any remaining pressure from system.

- b. Disconnect hydraulic line (3) from transducer (2).
- c. Rod pressure transducer only: Remove fitting (4) from transducer (2).

- d. Remove nut (5) and transducer (2) from mounting bracket.

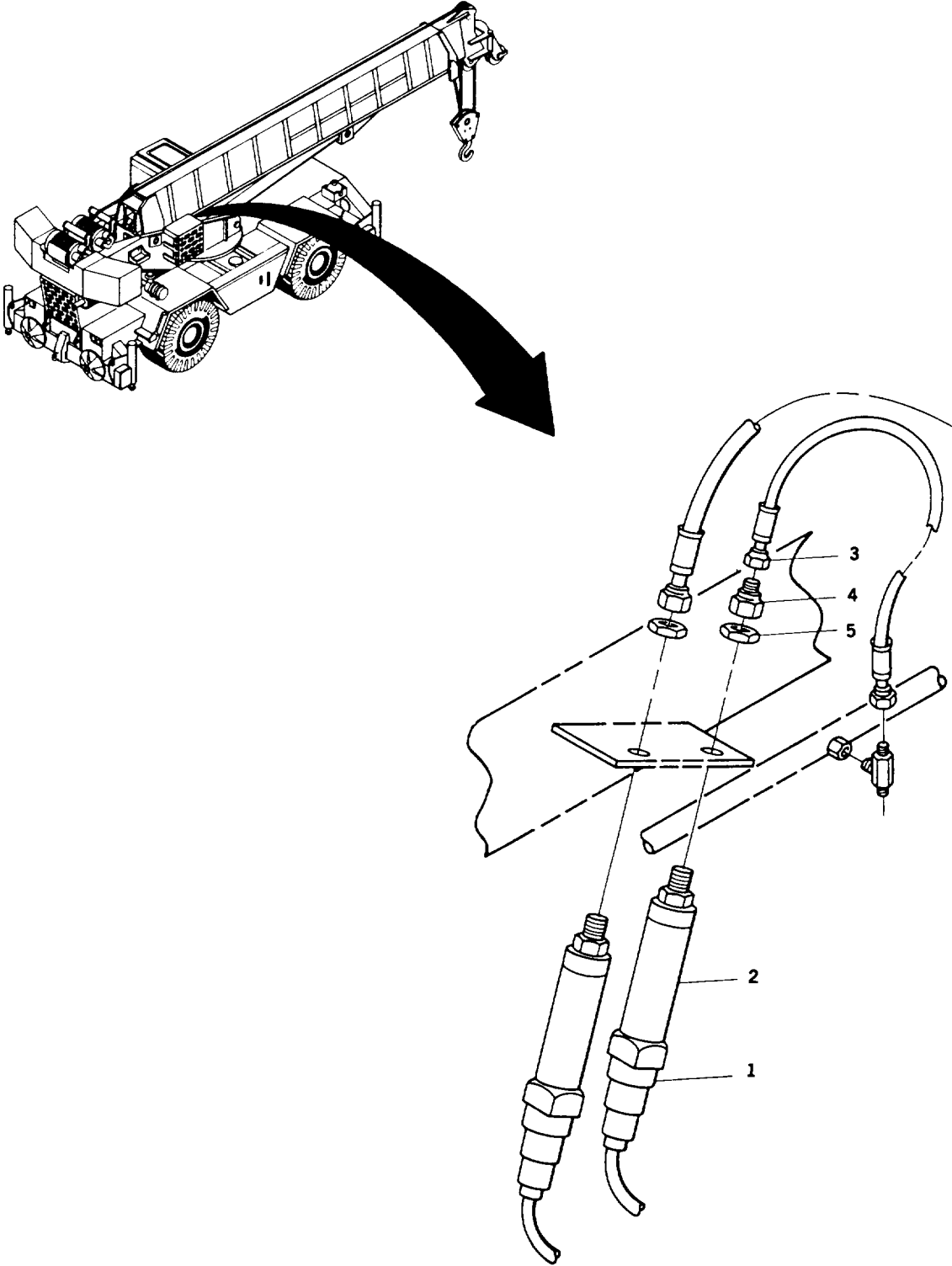
INSTALLATION:

1. INSTALL PRESSURE TRANSDUCER (2).

- a. Install transducer (2) and nut (5) to mounting bracket.
- b. Rod pressure transducer only: Install fitting (4) to transducer (2).
- c. Connect hydraulic line (3) to transducer (2).
- d. Connect electrical plug (1) to transducer (2).

2. ADJUST PRESSURE CHANNEL ON CENTRAL PROCESSING UNIT. (REFER TO PAGE 14-6.) 3. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

END OF TASK



ROLLER/CABLE GUIDE INSTALLATION

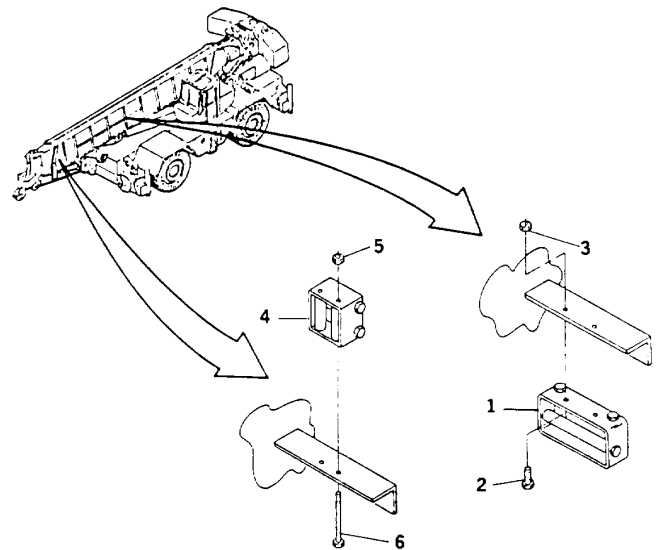
TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: None

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)
Length cable disconnected at boom nose receptacle and retracted into length/angle cable reel. (Refer to page 14-10.)

REMOVAL:

1. REMOVE ROLLER GUIDE (1).
 - a. Remove nuts (2) from capscrews (3).
 - b. Remove capscrews (3) and roller guide (1) from lower boom bracket.
2. REMOVE CABLE GUIDE (4).
 - a. Remove nuts (5) from capscrews (6).
 - b. Remove capscrews (6) and cable guide (4) from upper boom bracket.



INSTALLATION:

1. POSITION CABLE GUIDE (4) ON UPPER BOOM BRACKET AND SECURE WITH BOLTS (6) AND NUTS (5).
2. POSITION ROLLER GUIDE (1) ON LOWER BOOM BRACKET AND SECURE WITH BOLTS (3) AND NUTS (2).
3. REROUTE LENGTH CABLE AND CONNECT AT BOOM NOSE RECEPTACLE. (REFER TO PAGE 14-12.)
4. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
5. LOOSEN NUTS (2) AND (5), AND ADJUST ROLLER/CABLE GUIDES (1) AND (4) FOR SMOOTH OPERATION OF LENGTH CABLE. TIGHTEN NUTS (2) AND (5) AFTER ADJUSTMENT.

END OF TASK

CHAPTER 15
CRANE COMPONENTS MAINTENANCE

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Section I. BOOM MAINTENANCE

AUXILIARY BOOM NOSE ASSEMBLY

TOOLS: General mechanic's tool-kit: automotive (5180-00-177-7033)

SUPPLIES: Lockwashers (Item 26, Appendix B)

EQUIPMENT CONDITIONS: Overhaul ball removed. (Refer to TM 5-3810-306-20.)
Cable unreeved from boom nose sheave.
(Refer to TM 5-3810-306-20.)
Auxiliary boom nose removed. (Refer to TM 5-3810-306-20.)

NOTE

Auxiliary boom nose does not have to be removed to service or replace boom nose sheave.

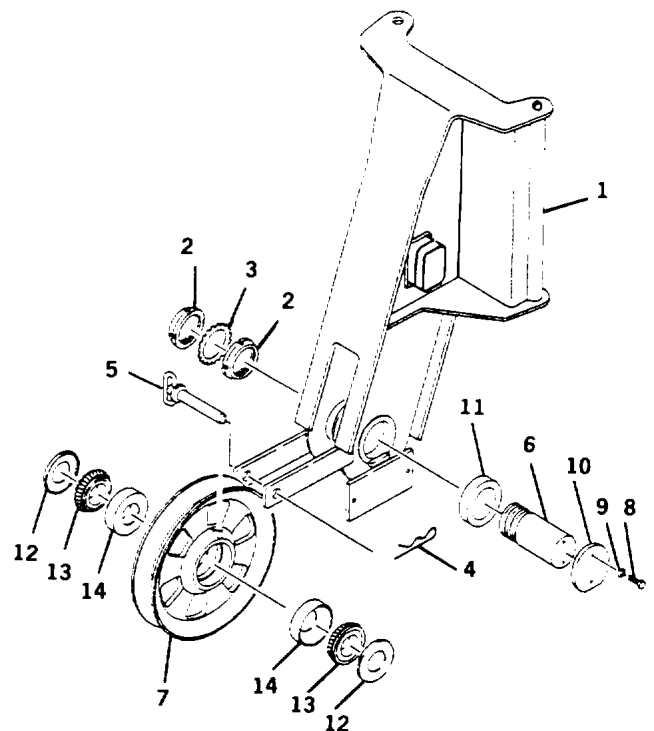
DISASSEMBLE:

1. DISASSEMBLE AUXILIARY BOOM NOSE (1).

- a. Remove pin clip (4) and pin (5).
- b. Remove locknuts (2) and washers (3).
- c. Remove two capscrews (8), lockwashers (9) and end cap (10) from sheave pin (6). Discard lockwashers (9).
- d. Tap out sheave pin (6) and remove sheave (7).
- e. Remove two spacers (11) from auxiliary boom nose (1).

2. DISASSEMBLE SHEAVE (7).

- a. Remove two bearing closures (12) and two bearing cones (13).



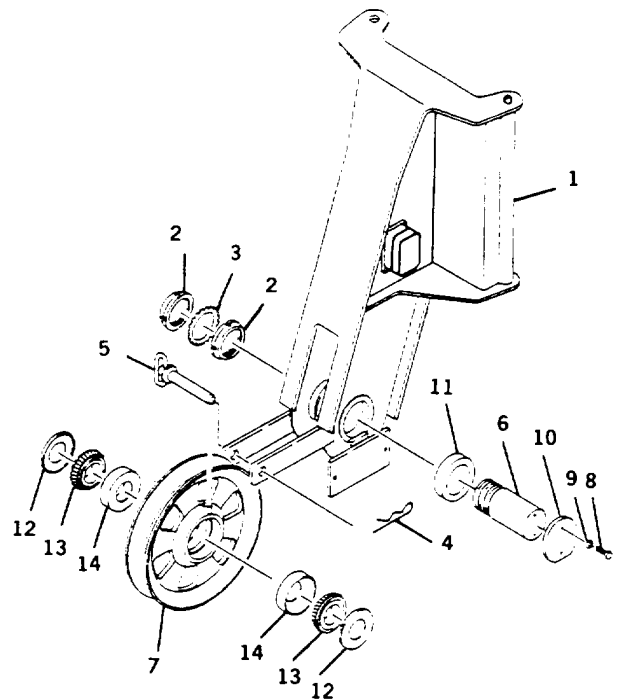
INSPECTION:

1. INSPECT SHEAVE FOR DAMAGE AND DISTORTION.

2. INSPECT BEARING CUP (14) AND CONE (13) FOR WEAR OR SCORING. IF REPLACEMENT IS NECESSARY REMOVE CUP FROM SHEAVE AND REPLACE BEARING ASSEMBLY AS A SET.
3. INSPECT SHEAVE PIN FOR WEAR OR SCORING.

REASSEMBLY:

1. REASSEMBLE AUXILIARY BOOM NOSE (1).
 - a. Install two spacers (11) into auxiliary boom nose (1).
 - b. Replace or clean and repack bearing assemblies as required and install in sheave (7).
 - c. Install two bearing closures (12) and position sheave (7) into auxiliary boom nose (1).
 - d. Install sheave pin (6) through sheave (7) and boom nose (1).
 - e. Install end cap (10) on sheave pin (6) and secure with new lockwashers (9) and capscrews (8).
 - f. Install locknuts (2) and washer (3).
2. INSTALL AUXILIARY BOOM NOSE (1). (REFER TO TM 5-3810-306-20.)
3. REEVE CABLE THROUGH AUXILIARY BOOM NOSE SHEAVE. (REFER TO TM 5-3810-306-20.)
4. INSTALL PIN (5) AND SECURE WITH PIN CLIP (4).
5. INSTALL OVERHAUL BALL OR LIFTING DEVICE TO CABLE. (REFER TO TM 5-3810-306-20.)



END OF TASK

BOOM INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Lifting device (10 ton Capacity)

SUPPLIES: Lockwashers (Item 26, Appendix B) (2 Required)
Grease (Item 37, Appendix B)

EQUIPMENT CONDITIONS: Outriggers fully extended and lowered.
(Refer to TM 5-3810-306-10.)
Auxiliary boom nose removed. (Refer to TM 5-3810-306-20.)
PAT/LMI components removed. (Refer to Chapter 14.)
Boom floodlight and harness removed.
(Refer to TM 5-3810-306-20.)

REMOVAL:

WARNING

Boom weighs approximately 13,135 pounds (5,958 Kg). Ensure that blocking and lifting devices are capable of supporting weight of boom.

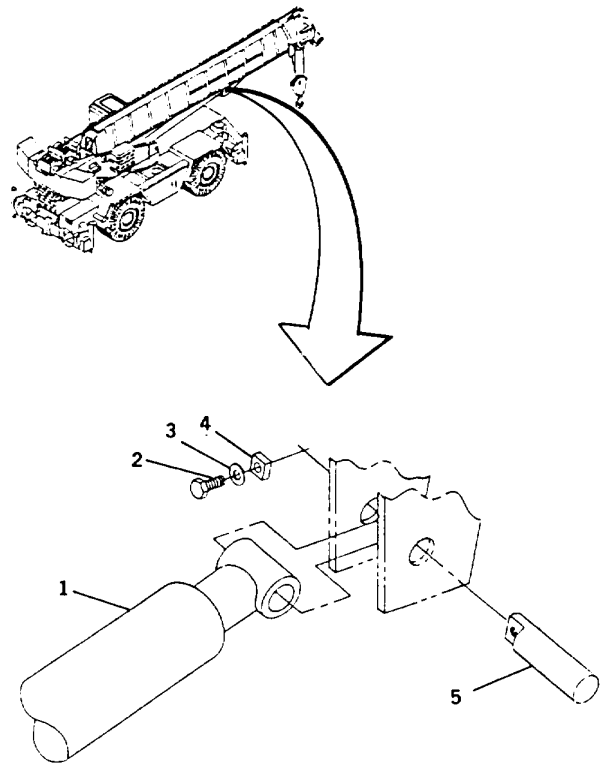
NOTE

Boom can be disassembled without removing boom from crane if base section does not require replacement.

1. ATTACH AN ADEQUATE LIFTING DEVICE BOOM, PROVIDING AN EQUAL WEIGHT DISTRIBUTION.
2. TAG AND DISCONNECT HYDRAULIC LINES TO TELESCOPE CYLINDER, CAP OPEN LINES.
3. ELEVATE BOOM SLIGHTLY TO ALLOW FOR WITHDRAWAL OF LIFT CYLINDER ROD ENDS.

WARNING

Failure to properly support boom lift cylinders could result in injury or death to personnel.



4. REMOVE LIFT CYLINDERS.
 - a. Block lift cylinders.
 - b. Take up any slack in boom lifting device(s).
 - c. Remove capscrew (2), washers (3), and retainer blocks (4) from lift cylinders (1).
 - d. Remove rod end anchor shafts (5)

NOTE

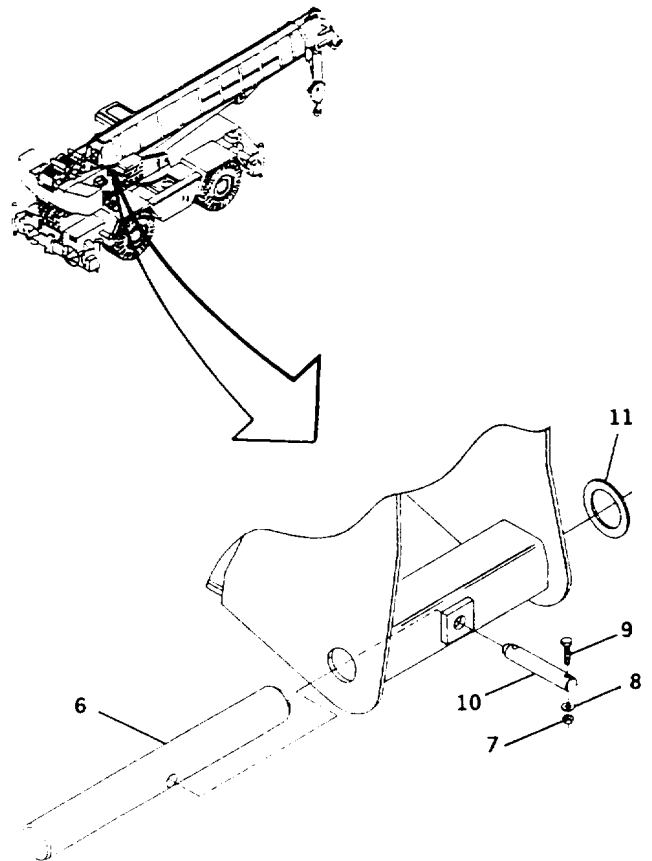
Withdraw lift cylinder rod ends only enough to clear lift cylinder attach fitting.

- e. Retract lift cylinders.

WARNING

Shut down crane before proceeding.

5. DISCONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
6. REMOVE BOOM PIVOT SHAFT (6) AND BOOM ASSEMBLY.
 - a. Remove nuts (7), lockwashers (8) and capscrews (9) securing pivot shaft pin (10) through pivot shaft (6). Discard lockwashers (8).
 - b. Remove pivot shaft pin (10).
 - c. Remove pivot shaft (6) and thrust washer(s) (11).
7. RAISE BOOM CLEAR OF CRANE AND LOWER IT TO GROUND. USE CARE TO AVOID DAMAGING BOOM NOSE.



INSTALLATION:

WARNING

Ensure blocking and lifting devices are capable of supporting the boom assembly.

1. INSTALL BOOM ASSEMBLY.
 - a. Attach boom lifting device to provide equal weight distribution.

- b. Suspend boom over crane.
- c. Lower the boom into position and align the boom pivot shaft mounting holes for installation of the pivot shaft.

NOTE

Add thrust washer (11) as necessary to fill in space between boom and turntable.

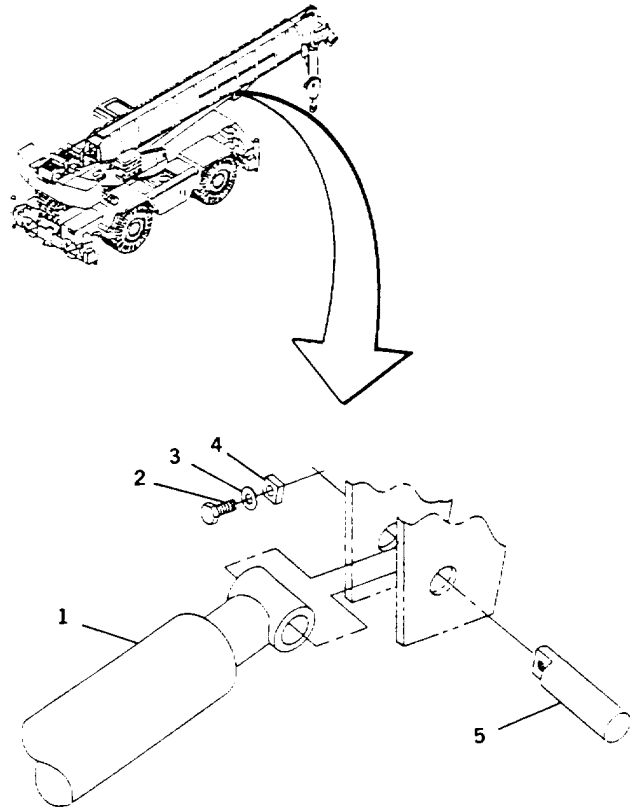
- d. Use extreme pressure multi-purpose grease to lubricate boom pivot shaft (6). Install boom pivot shaft and secure it with the boom pivot shaft retaining pin (10), capscrews (9), new lockwashers (8) and hex nut (7).

2. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

CAUTION

Extend the cylinder rod ends only enough to align them with the holes in the lift cylinder attach fitting.

3. INSTALL LIFT CYLINDERS.
 - a. Extend cylinder rod ends and lower boom until ends align with holes in lift cylinder attach fittings.
 - b. Use extreme pressure multipurpose grease to lubricate rod end anchor shafts (5) and install them.
 - c. Install the retainer blocks (4), washers (3), and capscrews (2) securing rod end anchor shafts to lift cylinder attach fitting.
 - d. Gradually slacken boom lifting device until boom lift cylinders are supporting boom; detach lifting device and rigging from boom.
 - e. Remove lift cylinder blocking device.
4. CONNECT THE HYDRAULIC LINES TO THE TELESCOPE CYLINDER AS TAGGED PRIOR TO REMOVAL.
5. INSTALL PAT/LMI COMPONENTS. (REFER TO CHAPTER 14.)



6. INSTALL THE BOOM FLOODLIGHT AND HARNESS. (REFER TO TM 5-3810-30620.)
7. CONNECT THE ELECTRICAL WIRES AS APPLICABLE.
8. INSTALL THE AUXILIARY BOOM NOSE. (REFER T6 TM 5-3810-306-20.)
9. INSTALL HOOK BLOCK AND OVERHAUL BALL. (REFER TO TM 5-3810-306-20.)
10. TEST FOR PROPER OPERATION.

END OF TASK

BOOM ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Four (4) pieces 1 in. dia. x 3 in. long drill rod or equivalent.
 Two (2) spacers, equal thickness.
 One (1) four ft. level.
 Large square (3 ft. x 4 ft.)
 Measuring tape/scale.
 One (1) three ft. straight edge.
 Chalkline (cord) or equivalent.
 Spanner wrench

SUPPLIES: Cotter pins (Item 64, Appendix B) (2 Required)
 Solvent P-D-680 (Item 1, Appendix B)
 Loctite Primer Grade T (Item 65, Appendix B)
 Loctite # 242 (Item 6, Appendix B)
 NEVER-SEEZ (Item 24, Appendix B)
 Lockwashers (Item 26, Appendix B) (12 Required)
 Retaining clip (Item 66, Appendix B) (3 Required)
 Wear pad (Item 259, Appendix B) (2 Required)
 Wear pad (Item 260, Appendix B) (4 Required)
 Wear pad (Item 261, Appendix B) (2 Required)
 Wear pad (Item 262, Appendix B) (2 Required)

EQUIPMENT CONDITIONS: Boom assembly removed if required. (Refer to page 15-5.)
 Outriggers fully extended and lowered.
 (Refer to TM 5-3810-306-10.)

DISASSEMBLY:

NOTE

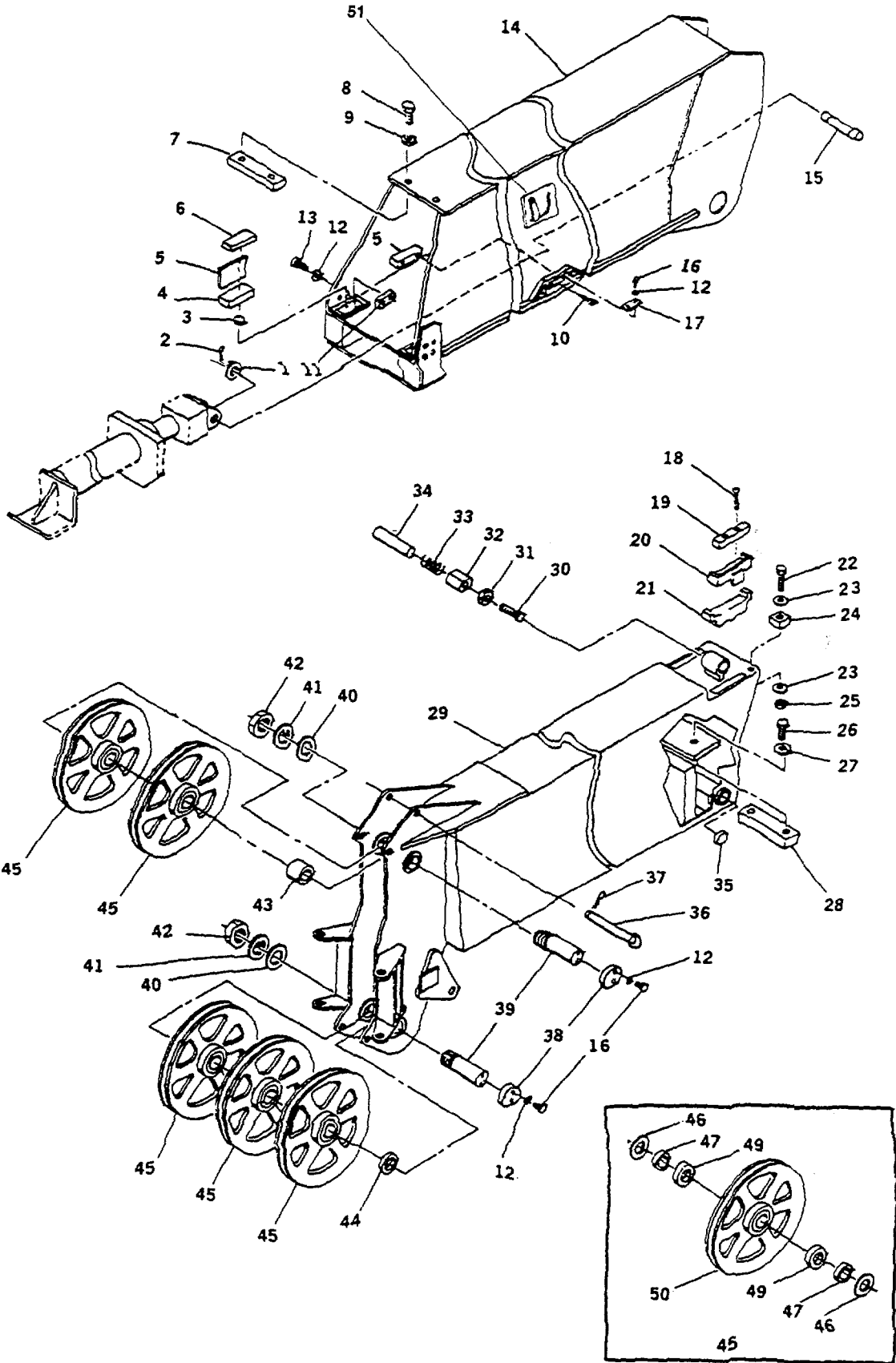
Boom can be disassembled without removing boom from crane if base section does not require replacement.

WARNING

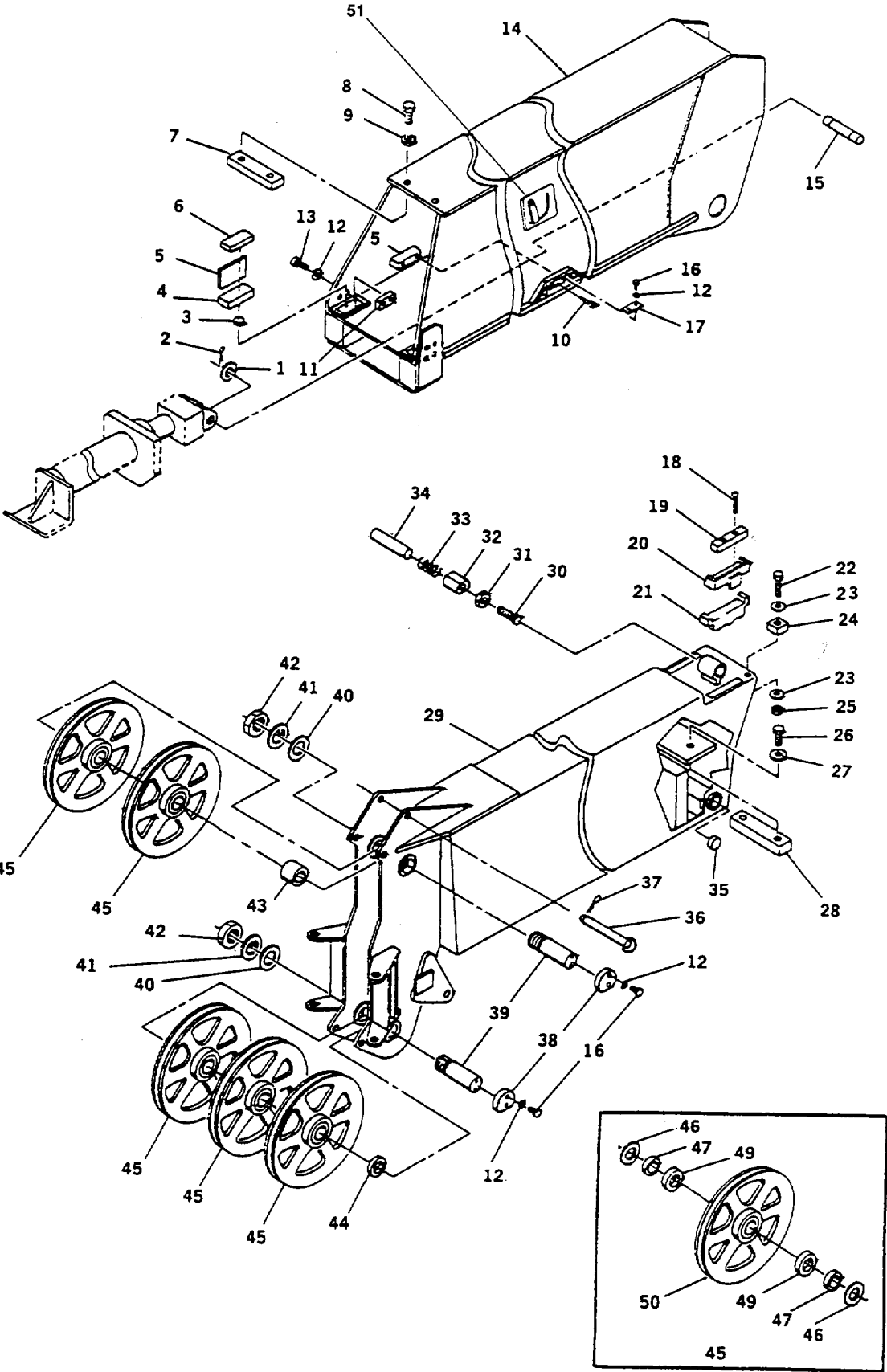
If telescope section is being removed while base section is still attached to crane, ensure lifting device is capable of supporting weight of telescope section and telescope cylinder.

1. REMOVE THE CAPSCREWS (8) AND WASHERS (9) SECURING SPACER (7) TO FRONT OF BOOM BASE SECTION.

2. REMOVE THE CAPSCREWS (16) AND LOCKWASHERS (12) SECURING PLATE (17) ON BOTH SIDE ADJUSTABLE WEAR PADS.
3. REMOVE THE CAPSCREWS (13) AND LOCKWASHERS (12) SECURING KEEPER (11) ON BOTH FRONT ADJUSTABLE WEAR PADS.
4. LOOSEN ADJUSTING SCREWS (1) ON ALL FOUR ADJUSTABLE WEAR PADS (5). REMOVE AND DISCARD WEAR PADS (5).
5. LOOSEN THE ADJUSTING NUT (31) ON THE FLY SECTION ADJUSTABLE WEAR PADS.
6. DISCONNECT TELESCOPE CYLINDER AT BASE SECTION.
 - a. Remove two cotter pins (2), washers (1), and pin (15) securing telescope cylinder to base section.
 - b. Attach suitable lifting device to fly section.



- c. Raise the fly section within base section. Remove and discard two bottom wear pads (6).
7. REMOVE FLY SECTION FROM BASE SECTION OF BOOM.(14) DISASSEMBLE FLY SECTION.
- Using lifting device, remove fly section from base section. Place fly section on suitable blocking.
 - Remove and discard round side wear pads (35) from both sides of fly section.
 - Remove adjustable wear pad supports (20) and pad bases (21) from the fly section.
 - Remove screws (18) securing wear pads (19). Remove and discard wear pads (19).
 - Remove adjusting bolt (30), nut (31), block (32), spring (33) and pin (34) from fly section.
 - Remove capscrew (22), two washers (23) and nut (25) securing each retainer (24). Remove retainers.
 - Remove base (4) and plate (3) from wear pad pockets on front of base section.
 - Remove lockwire, two bolts (26) and washer (27) securing block (28) to fly section, remove block.
- Using lifting device, raise telescope cylinder to clear mounting slot and withdraw telescope cylinder from fly section.
8. DISASSEMBLE BOOM NOSE.
- Remove the three clip pins (37) and hitch pins (36) from boom nose.
 - Remove the nut (42), slotted washer (41) and washer (40) from lower boom nose shaft.
 - Remove the two capscrews (16) and lockwashers (12) securing cap (38) to lower boom nose shaft. Remove cap (38).
 - Repeat steps b and c for the upper boom nose shaft.
- NOTE**
- Each sheave assembly consists of a sheave, grease fitting, two cones (47) two bearings (46) and two cups (49). The cups are a press fit in sheave.**
- Remove each boom nose shaft (39), spacers (44) and (43), and sheave assemblies. Be careful not to drop bearings or cone.
9. BOOM ANGLE INDICATOR
- Remove and Repair as necessary.



CLEANING AND INSPECTION:**WARNING**

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

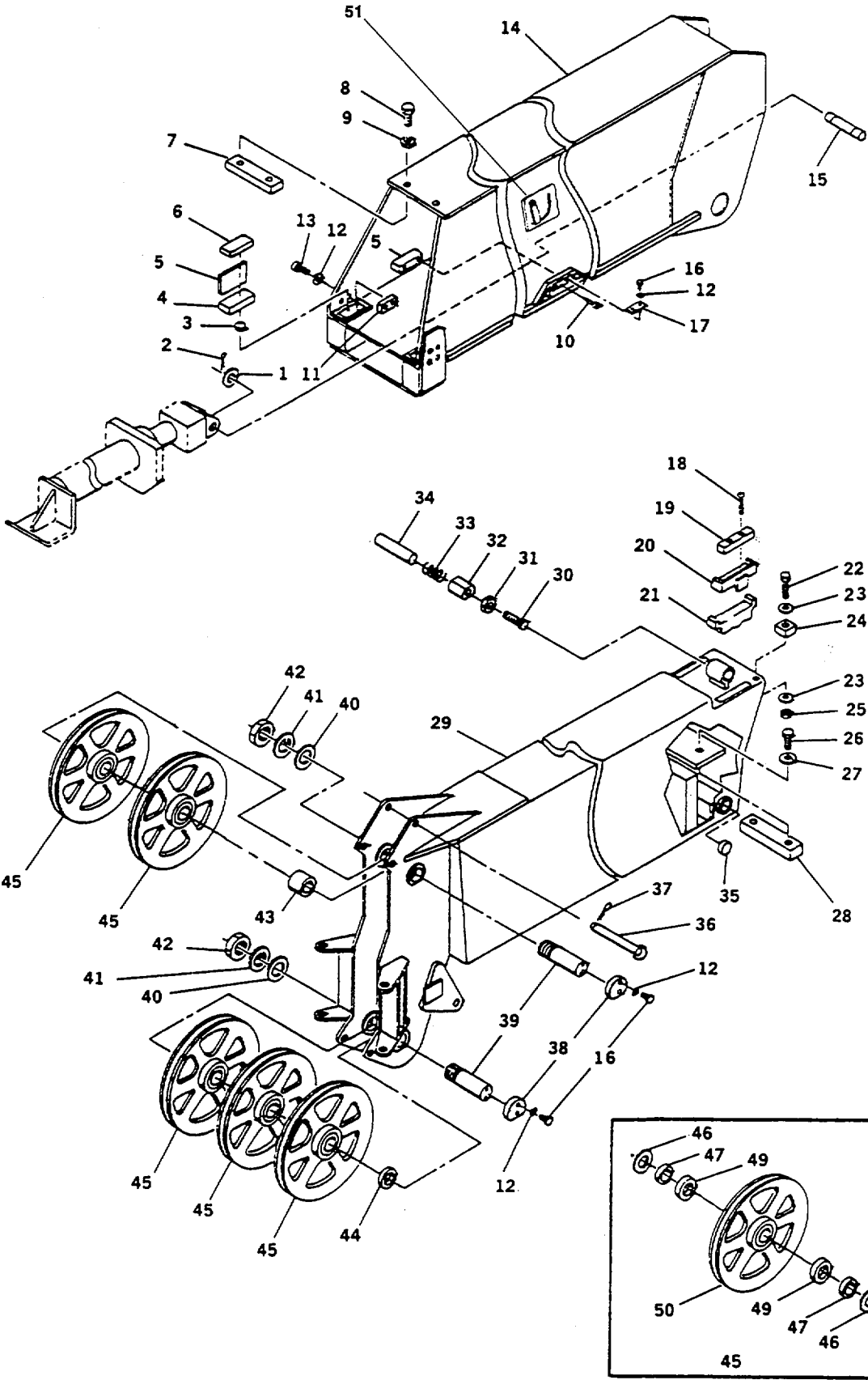
Compressed air used for cleaning purposes will not exceed 30 psi. Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).

1. CLEAN ALL METAL PARTS WITH CLEANING SOLVENT TO REMOVE GREASE AND DIRT. BLOW DRY WITH COMPRESSED AIR.
2. INSPECT SHEAVE WHEELS FOR DAMAGED AND WORN BEARINGS. REPLACE DAMAGED BEARINGS.
3. INSPECT FLY SECTION AND BASE SECTION FOR CRACKS OR DAMAGE.

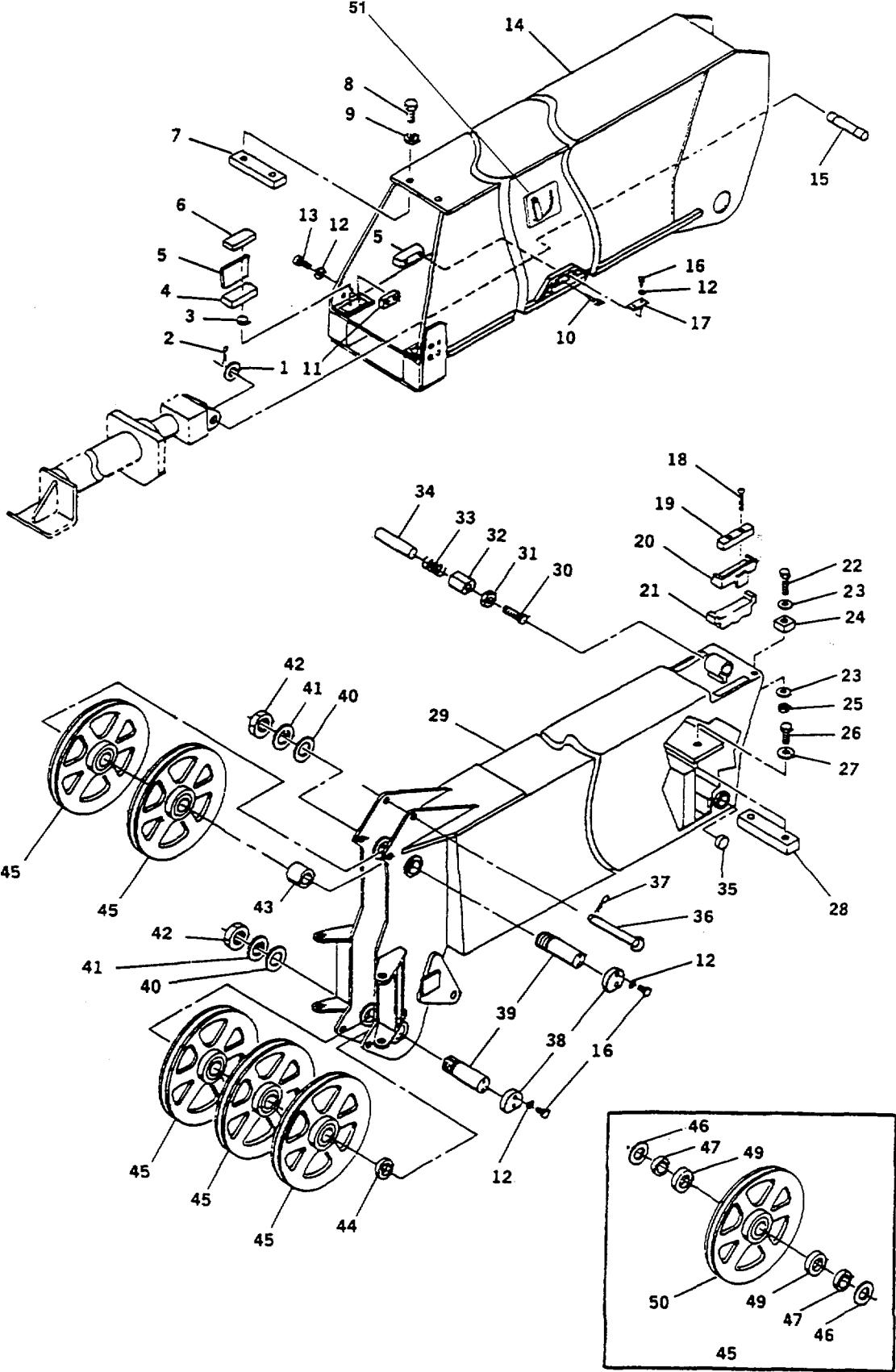
REASSEMBLY:**NOTE**

Apply Loctite Primer Grade T and Loctite Adhesive Sealant Grade 242 to all capscrews and bolts.

1. INSTALL TELESCOPE CYLINDER IN FLY SECTION OF BOOM.
 - a. Using a lifting device, slide telescope cylinder into fly section. Ensure end of barrel aligns in bracket provided. Lower cylinder until collar of barrel rests in slot provided at end of fly section.
 - b. Position block (28) on top of cylinder barrel collar and secure block with two bolts (26) and washers (27). Torque bolts (26) to 370 ft-lbs (492 Nm) and safety with lockwire.
2. INSTALL WEAR PAD AND INSERT FLY SECTION INTO BASE SECTION OF BOOM.
 - a. Position plate (3)(concave side up) and base (4) in wear pad pocket on front of base section.
 - b. Install retainers (24) on each side of fly section with a capscrew (22), two washers (23) and nut (25).
 - c. On rear of fly section, assemble adjusting bolt (30), nut (31), block (32), spring (33), and pin (34).
 - d. Install new wear pads (19) on supports (20) with two screws (18).
 - e. Install adjustable wear pad support (20) and pad base (21) on each side of fly section.
 - f. Coat new round wear pads (35) with grease and install them in pockets on each side of fly section.
 - g. Coat bottom rails of fly section and area of base section where fly section will ride with NEVER-SEEZ.



- h. Using an adequate lifting device, slide fly section into base section. Be careful the round side wear pads (35) and upper adjustable wear pads (19) do not fall out.
 - i. Raise fly section and install two new bottom wear pads (6). Lower fly section and remove lifting device.
3. SECURE THE TELESCOPE CYLINDER TO THE BASE SECTION WITH PIN (15), TWO WASHERS (1) AND TWO COTTER PINS (2).
 4. IF REMOVED, INSTALL ADJUSTING SCREWS (10) IN BOOM BASE SECTION FOUR PLACES.
 5. INSTALL FOUR NEW ADJUSTABLE WEAR PADS (5).
 6. ON FRONT ADJUSTABLE WEAR PADS, INSTALL KEEPER (11) ON INSIDE OF BOOM AND SECURE FROM OUTSIDE WITH TWO CAPSCREWS (13) AND LOCKWASHERS (12).
 7. AT SIDE ADJUSTABLE WEAR PADS, INSTALL PLATE (17) ON WEAR PADS AND SECURE WITH TWO CAPSCREWS (16) AND LOCKWASHERS (12).
 8. AT FRONT OF BASE SECTION, INSTALL SPACER (7) AND SECURE WITH TWO CAPSCREWS (8) AND WASHERS (9).
 9. REASSEMBLE BOOM NOSE.
 - a. Start upper boom nose shaft (39) from right side of boom nose (end with two tapped holes).
 - b. If necessary, press two cups (49) in each of the five sheaves (45).
 - c. Install small spacer (44), on shaft.
 - d. Install cone (47), bearing (46), sheave (48), bearing (46) and cone (47). Install sheave on shaft (39).
 - e. Repeat step d for second sheave assembly.
 - f. Install large spacer (43).
 - g. Align shaft (39) so flat of cap (38) is down. Install cap and secure with two capscrews (16) and lockwashers (12).
 - h. Install washer (40), slotted washer (41), and nut (42) on threaded end of shaft.
 - i. Using spanner wrench, tighten nut (42) while rotating sheave and checking for proper bearing alignment.
 - j. Lock nut (42) by bending tab from slotted washer (41) into slot on nut.
 - k. Repeat steps c thru e for lower boom nose sheaves.
 - l. Repeat step d for third sheave assembly.
 - m. Install small spacer (44).
 - n. Repeat steps a thru j for lower boom nose sheaves.
10. IF REMOVED INSTALL BOOM. (REFER TO PAGE 15-5.)
 11. TEST FOR PROPER OPERATION.



POST-ASSEMBLY INSPECTION:

NOTE

Boom width, height, squareness, sway/sweep, camber, concavity, convexity, and waviness are checked at the factory prior to boom assembly. Boom damage resulting from overloading or other misuse of the crane would be evidenced by binding between the boom sections. Should this occur, the boom should be disassembled and inspected to determine the source of binding and the extent of damage. Contact Grove Manufacturing Company, Service Department, concerning possible repair or replacement of affected parts.

1. MANUALLY INSPECT BOOM OPERATION.

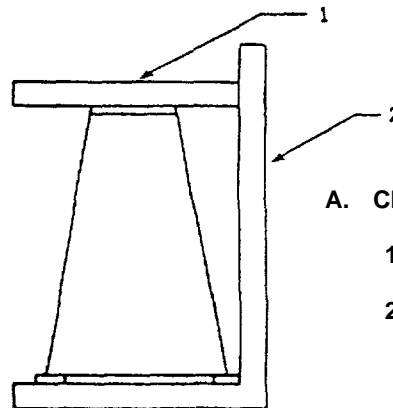
- a. Elevate boom and hold in extended position. Boom should stay in position until retracted by operator.
- b. Extend and retract boom several times at various elevations. Check for smooth operation of telescope cylinder.
- c. Check operation of all electrical/electronic components affected by boom removal.
- d. Visually inspect telescoping section for adequate lubrication of boom plates. Observe extended section for evidence of cracks, warping, or other damage. Periodically check security of boom wear pads. Check boom nose sheave for security and freedom of movement.

NOTE

The following procedure is used to inspect channel and plate trapezoidal boom sections. The procedure ensures proper component clearance and freedom from physical contact and interference.

2. INSPECT CHANNEL AND PLATE TRAPEZOIDAL BOOM SECTIONS.

- a. Check width of boom by measuring across boom plate. This check shall be made at front and rear end and several places along boom section length.
- b. Check height of boom by placing straightedge and square as shown in A. Measure between the edge of square and straight edge, both sides, at 4 foot intervals, maximum.

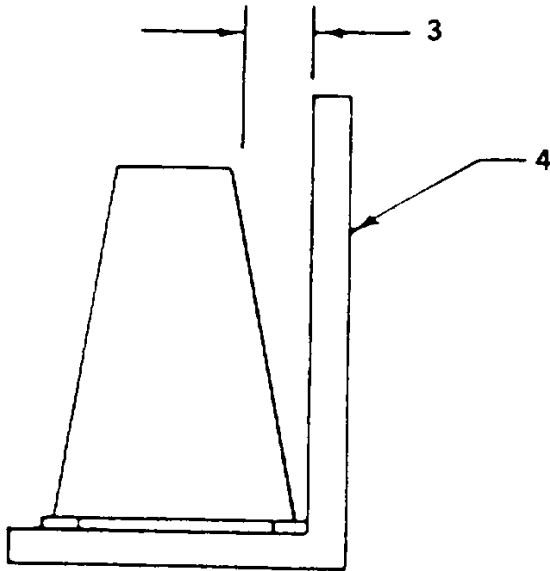


A. CHECKING HEIGHT OF BOOM

- 1. STRAIGHT EDGE**
- 2. SQUARE**

A

- c. Check top width at 4 foot intervals along boom section length.
- d. Check squareness of boom section by placing square as shown in B. Measure dimensions for top plate to square on both sides of section at same interval. The amount boom is out of square is 1/2 of difference between left and right check dimensions.

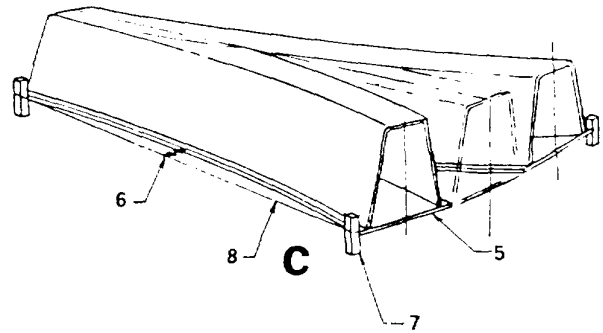


B

B. CHECKING SQUARENESS OF BOOM SECTION

- 3. CHECK DIMENSION
- 4. SQUARE

- e. Check sway/sweep by placing spacers of equal thickness against base plate edge at both ends and draw a cord tightly over them as shown in C. Check distance between cord and top plate at four foot intervals. Record measurements.



C

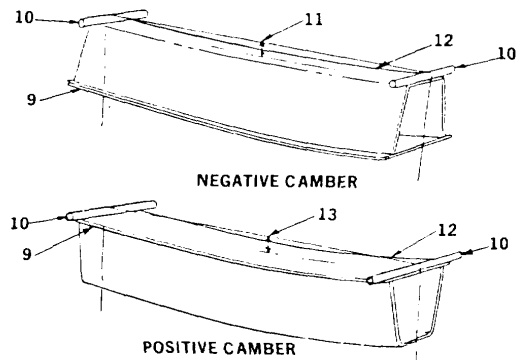
C. CHECKING SWAY/SWEEP OF BOOM SECTION

- 5. BASE PLATE
- 6. CHECK DIMENSION
- 7. SPACERS
- 8. CORD

NOTE

The boom must be in travel position when checked.

- f. Check camber. An upsweep condition is negative camber and a downsweep condition is position camber. Use drill rods and cord as shown in D. Check at four foot intervals.



D

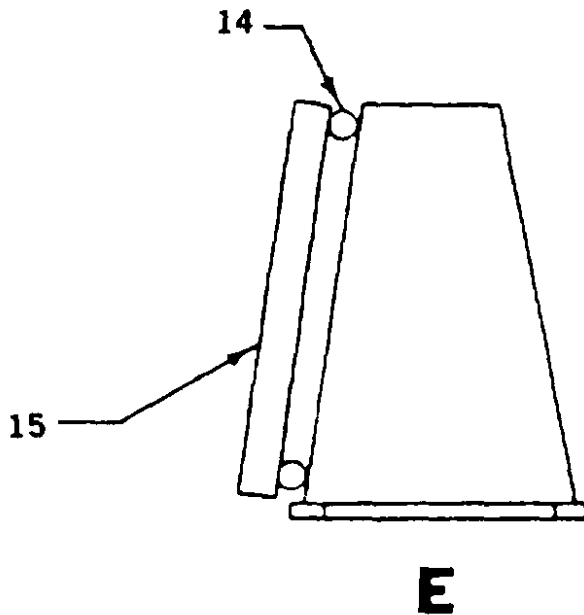
D. CHECKING POSITIVE AND NEGATIVE CAMBER

- 9. BASE
- 10. DRILL ROD
- 11. CHECK NEGATIVE CAMBER
- 12. CORD
- 13. CHECK POSITIVE CAMBER

NOTE

The boom must be in the travel position when checked.

- g. Check concavity and convexity by placing straight edge over rods as shown in E. Measure from straight edge to side plate at mid-point, both sides. Record results. Use straight edge and rods to check lacings and top/bottom plates.



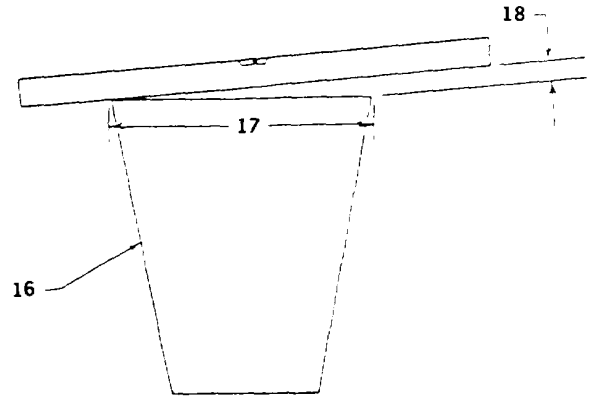
E. CHECKING CONCAVITY AND CONVEXITY

- 14. ROD
- 15. STRAIGHTEDGE

- h. Position boom section with bottom plate facing up. Level rear end of section with respect to bottom plate. Check front of boom section to determine amount of longitudinal twist in bottom plate as shown in F.

NOTE

When telescope section is not twisted, vertical centerline of boom nose shall be located perpendicular to center of bottom plate of section.



F

F. CHECKING BOTTOM PLATE LONGITUDINAL TWIST

- 16. FRONT OF SECTION
- 17. BOTTOM OF PLATE WIDTH
- 18. LONGITUDINAL TWIST

- i. Check longitudinal waviness. Waviness shall be smooth with positive/negative arches (no kinks). Peak to peak waviness shall be based upon peak to valley dimensions as shown in G.



G

G. LONGITUDINAL WAVINESS (PEAK-TO-VALLEY)

- 19. EDGE VIEW OF MEMBER
- 20. PEAK-TO-VALLEY MAXIMUM
- 21. MEAN CENTER LINE

BOOM ALIGNMENT:

CAUTION

The following procedure involves the side thrust pads in checking boom width. Avoid over adjusting the thrust pads to a point where too much binding exists between the pads and the telescope section. Boom damage can occur.

1. CHECK AND ADJUST SIDE THRUST PADS.

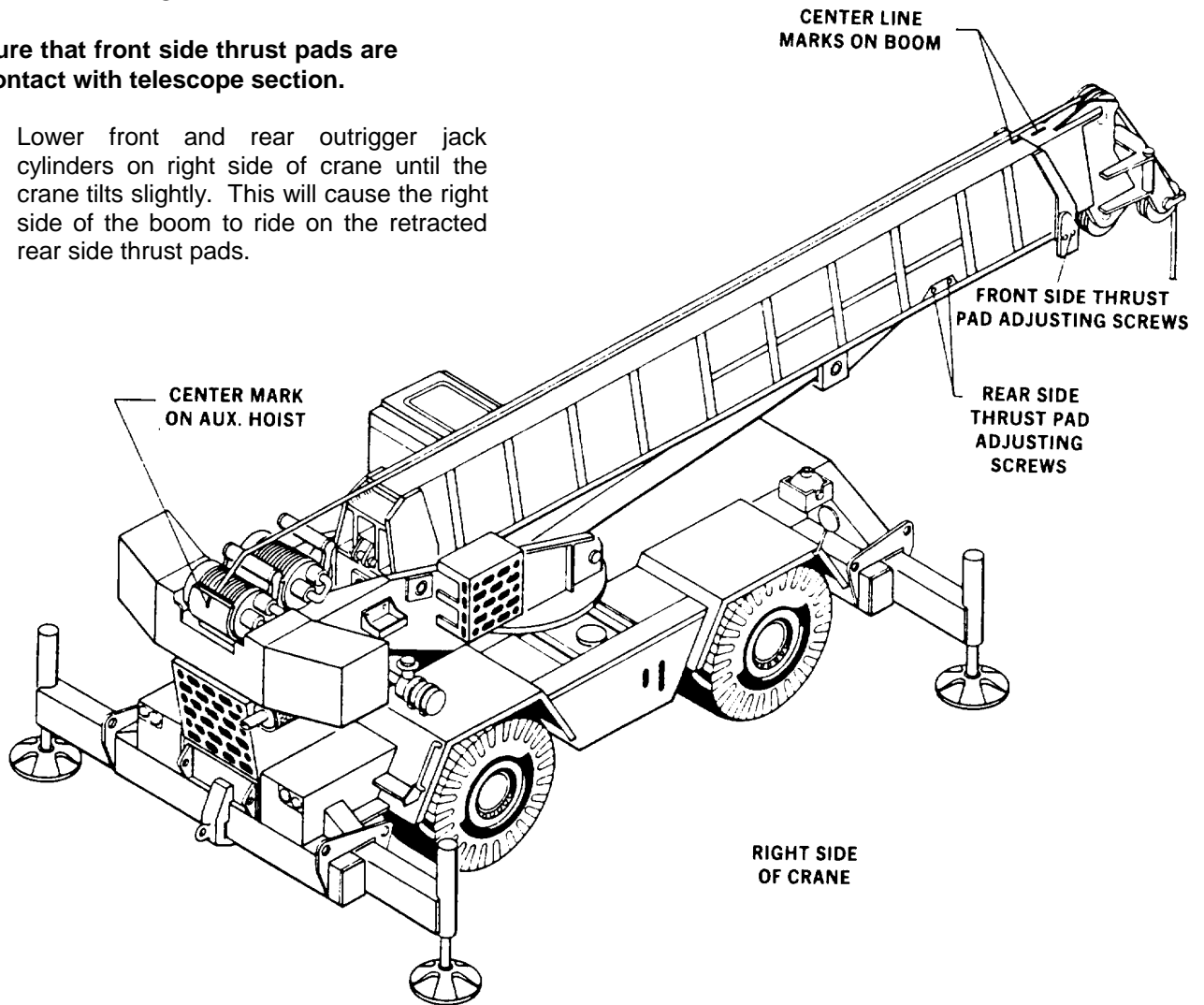
- a. Extend and lower outriggers.
- b. Position fully retracted boom over front of crane and elevate boom slightly to permit complete extension of telescoping section while allowing a maintenance technician to access boom from a maintenance platform.
- c. Back out two rear side thrust pad adjusting screws on right side of crane as shown.

- e. While a crane operator slowly extends telescope section, slowly turn forward adjusting screw of front side thrust pad on left side of the boom. Adjust screw in and out in order to "feel" the changing width of the telescope section. The wide point in telescope section will be indicated when the adjusting screw is backed out furthest.
- f. As the telescope section is extended, mark the locations which "feel" wide.

NOTE

Ensure that front side thrust pads are in contact with telescope section.

- d. Lower front and rear outrigger jack cylinders on right side of crane until the crane tilts slightly. This will cause the right side of the boom to ride on the retracted rear side thrust pads.



- g. Upon full section extension, measure the distance across the bottom of the telescope section at each mark to determine the widest point. Clearly mark the widest point.
- h. Retract the telescope section until the mark is lined up with the front side thrust pads.
- i. Turn left front side thrust pad adjusting screws in snug and back out 1/6 of a turn. When cycled if boom is sluggish or binding, continue to back out screws at 1/6 of a turn increments until smooth cycle operating is achieved. The width between front side thrust pads is now set and will not change.
- j. Measure distance between front and rear side thrust pads. Record this distance.
- k. From mark on telescope section measure distance recorded in step j forward. Make another mark on telescope section.
- l. Retract telescope section until new mark is aligned with front side thrust pads. This will position widest point in line with rear side thrust pads.
- m. Turn left rear side thrust pad adjusting screws in until snug. Do not back off on these screws.
- n. Turn right rear side thrust pad adjusting screws in until, snug and then back off 1/6 of a turn. Distance between rear side thrust pads is now set.

- 2. CHECK AND ADJUST TELESCOPE TO BASE SECTION ALIGNMENT.
 - a. Level crane by raising right front and rear outriggers.
 - b. Measure across the top outer end of the boom base section and telescope section. Mark center point of each section.
 - c. Route auxiliary hoist cable over center sheave on boom nose. Attach a weight to cable to help keep cable taut.
 - d. Elevate boom until cable is suspended (i.e., not resting on top of boom) between boom nose sheave and hoist drum.
 - e. Measure distance across back of auxiliary hoist drum and mark center of drum.
 - f. Lower auxiliary hoist cable until cable lines up with mark.
 - g. Using the auxiliary hoist cable as a point of reference, check telescope and base section alignment. If aligned, auxiliary hoist cable will cover the centerline marks made in step b.

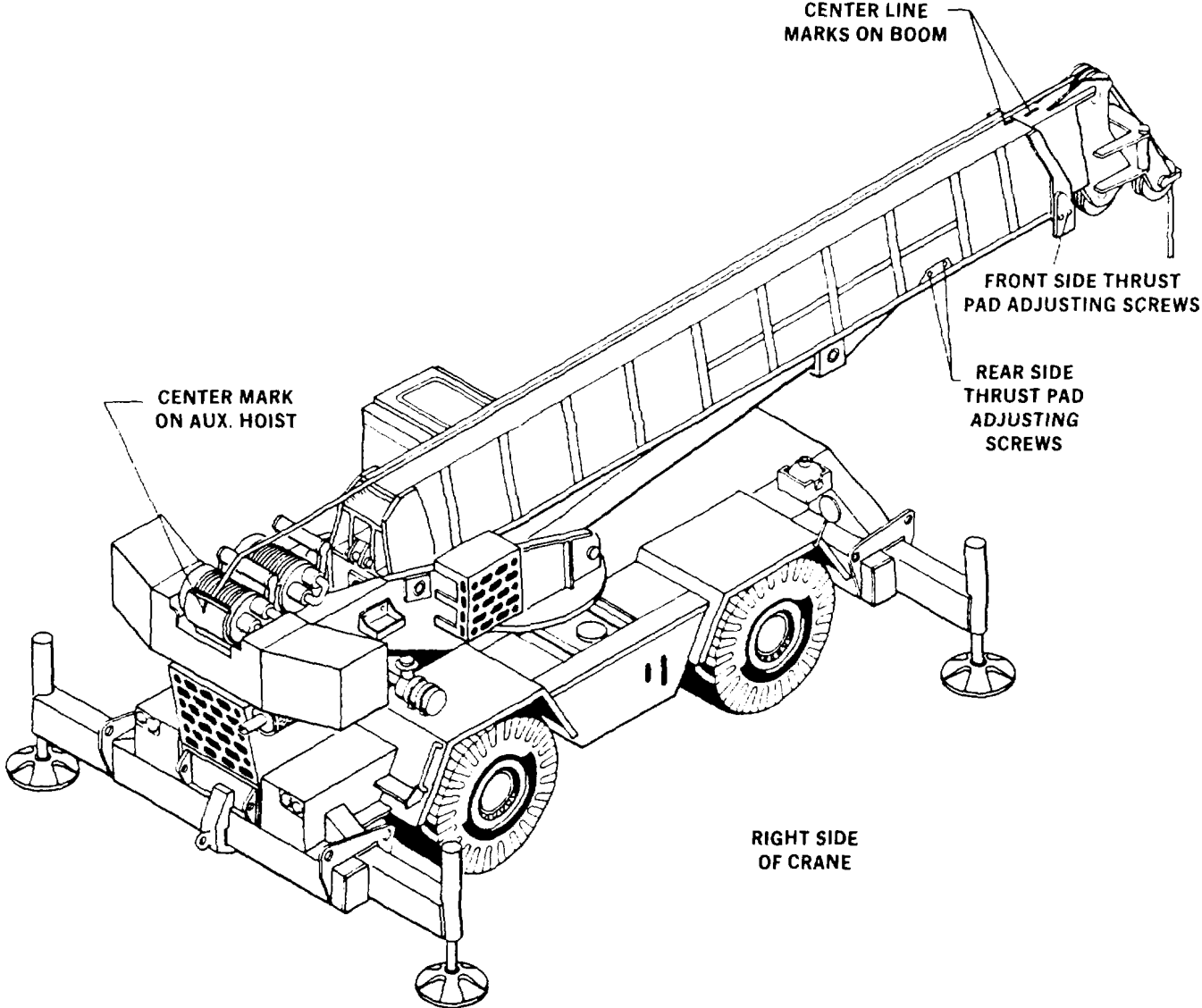
CAUTION

When backing off and tightening opposite side thrust pads be sure to turn screws an equal number of turns in order to maintain previously established optimum width between side thrust pads.

h. If necessary adjust telescope and base section alignment by adjusting side thrust pads. If for example telescope section mark is to left of base section

mark, back off on right side thrust pad adjusting screws and tighten left side thrust pad adjusting screws.

END OF TASK



HOOK BLOCK ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: None

EQUIPMENT CONDITION: Hook block removed. (Refer to TM 5-3810-306-20.)

DISASSEMBLY:

1. DISASSEMBLE HOOK BLOCK.
 - a. Lay hook block on its side and remove nuts (7).
 - b. If necessary remove three grease fittings from center pin (6).
 - c. Remove spirol (-0), setscrew (5) and nut (4).
 - d. Remove side plate (9) and spacers (16).
 - e. Remove first sheave assembly (11), thrust washers (12), and plate (15). Remove remaining sheaves (11), spacers (16), and plates (15) in same manner.
 - f. Remove hook (19) and spacers (28).
 - g. Remove tie bolts (8) and center pin (6).
2. REMOVE ROLLER BEARINGS (13) FROM SHEAVE ASSEMBLIES (14).

CAUTION

Use care when driving out roller bearings (13) to avoid damage to sheaves.

3. DISASSEMBLE HOOK.
 - a. Remove setscrew (18), nut (19), thrust bearing (20) and housing (21).

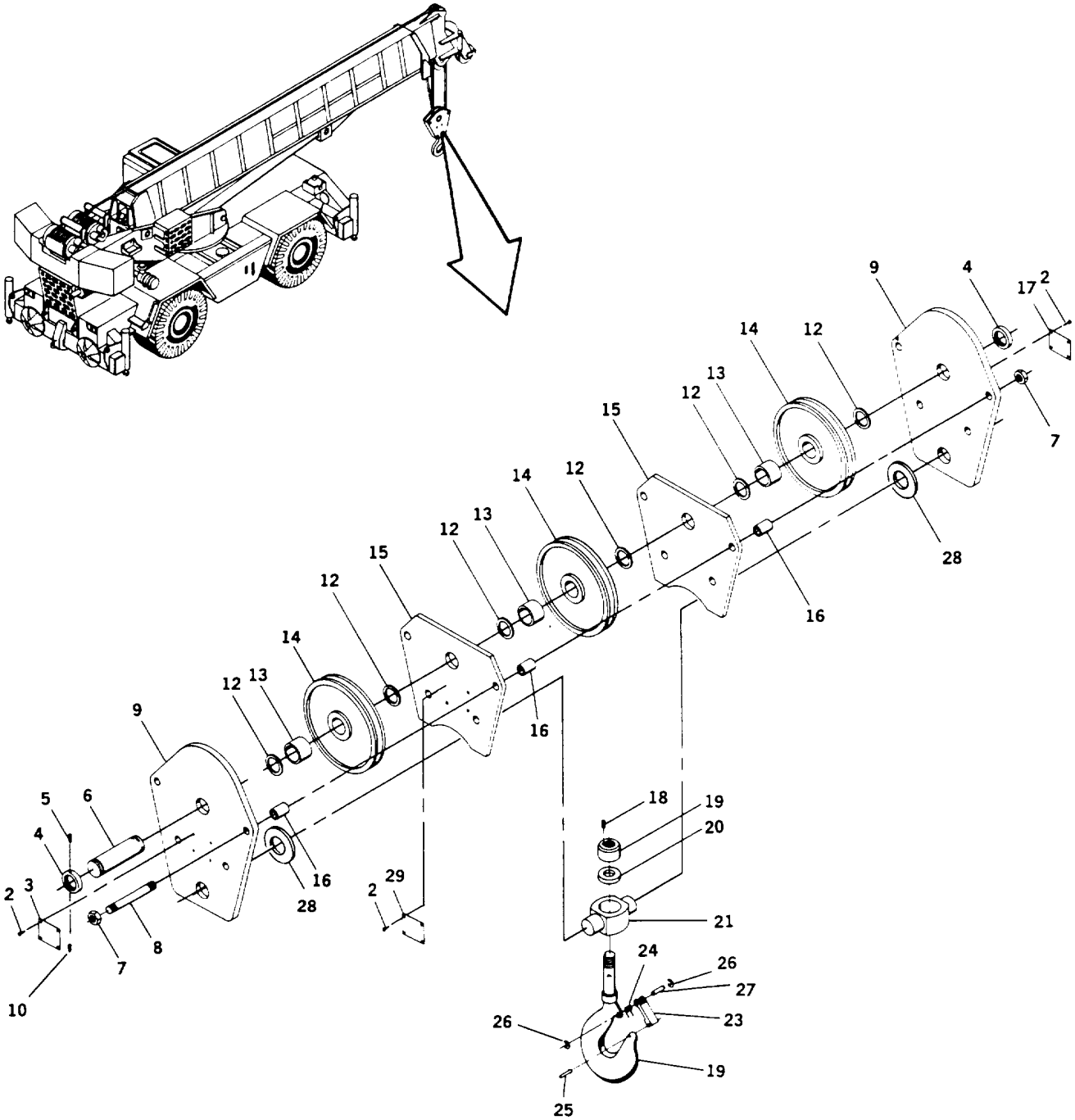
- b. Remove retaining rings (26), grooved pin (27), latch (23) and spring (24). Remove quick release pin (25).
- c. If necessary remove grease fitting from nut (19).

CLEANING:

WARNING

Dry cleaning solvent P-D680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F/138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).



1. CLEAN ALL PARTS WITH SOLVENT AND CLEAN LINT-FREE CLOTH.

INSPECTION:

1. INSPECT HOOK BLOCK COMPONENTS.
 - a. Inspect all sheaves for wear and damaged grooves.
 - b. Inspect internal bearing surfaces for scoring.
 - c. Inspect roller bearings for wear. Repack each bearing with grease MIL-G-10924.
 - d. Inspect hook for distortion and cracks. Perform magnetic-particle inspection to uncover possible fatigue damage. Latch opening must measure 3.43 inches. Any distortion or fatigue is cause for replacement.

REASSEMBLY:

1. ASSEMBLE HOOK.
 - a. Install spring (24), latch (23), and grooved pin (27). Secure with retaining rings (26).
 - b. Install quick release pin (25).

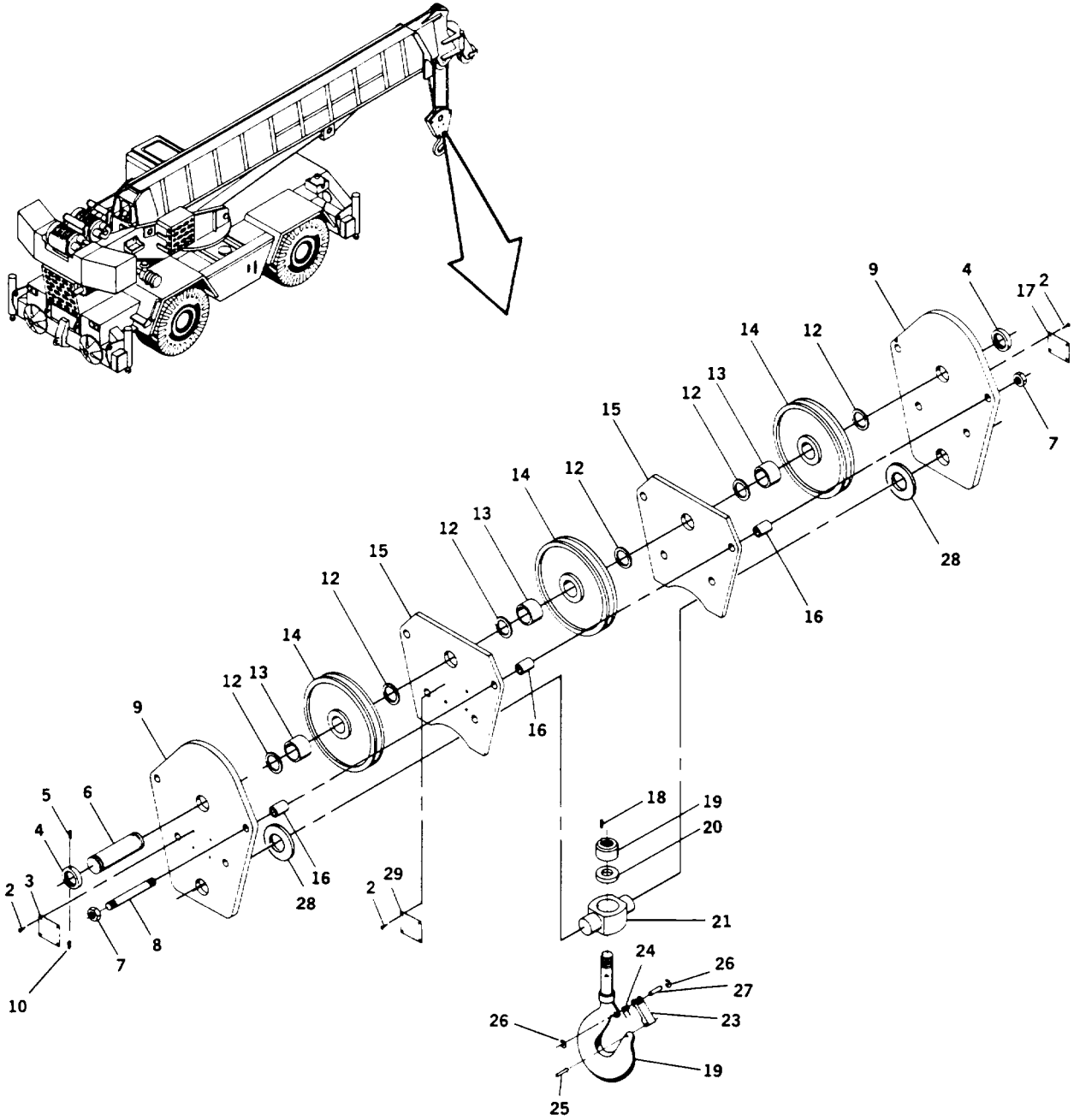
- c. If removed, install grease fitting in nut (19).
- d. Install housing (21) on hook and secure with thrust bearing (20), nut (19) and setscrew (18).

2. ASSEMBLE HOOK BLOCK.

- a. Assemble sheaves (14), roller bearings (13) and thrust washers (12) - 3 places.
- b. Install sheave assemblies (11), thrust washers and plates on center pin (6).
- c. Install hook (19) and spacers (28).
- d. Install side plate (9) over center pin. Install tie bolts (8) ensuring spacers (16) are installed between plates.
- e. Secure center pin with nut (4) and setscrew (5). Install spiro (10). Secure tie bolts (8) with nuts (7).
- f. If removed, install three grease fittings in center pin (6).
- g. Grease lubrication fittings. (Refer to LO 5-3810-306-12.)

3. INSTALL HOOK BLOCK. (REFER TO TM 5-3810-306-20.)

END OF TASK



Section II. HOIST MAINTENANCE

AUXILIARY HOIST INSTALLATION A/

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Torque wrench tool kit (5180-01-284-8747)
Overhead hoist (15,000 lb.)

SUPPLIES: Preformed packing (Item 89, Appendix B)
Preformed packing (Item 163, Appendix B)
Preformed packing (Item 15, Appendix B) (2 Required)
Lockwasher (Item 13, Appendix B) (4 Required)
Loctite #545 (Item 18, Appendix B)
Hydraulic oil (Item 8, Appendix B)

EQUIPMENT CONDITION: Outrigger fully extended and lowered.
(Refer to TM 5-3810-306-10.)
Wire rope removed from hoist drum.
(Refer to TM 5-3810-306-20.)
Negative battery cable disconnected at shunt.
(Refer to TM 5-3810-306-20.)

REMOVAL:

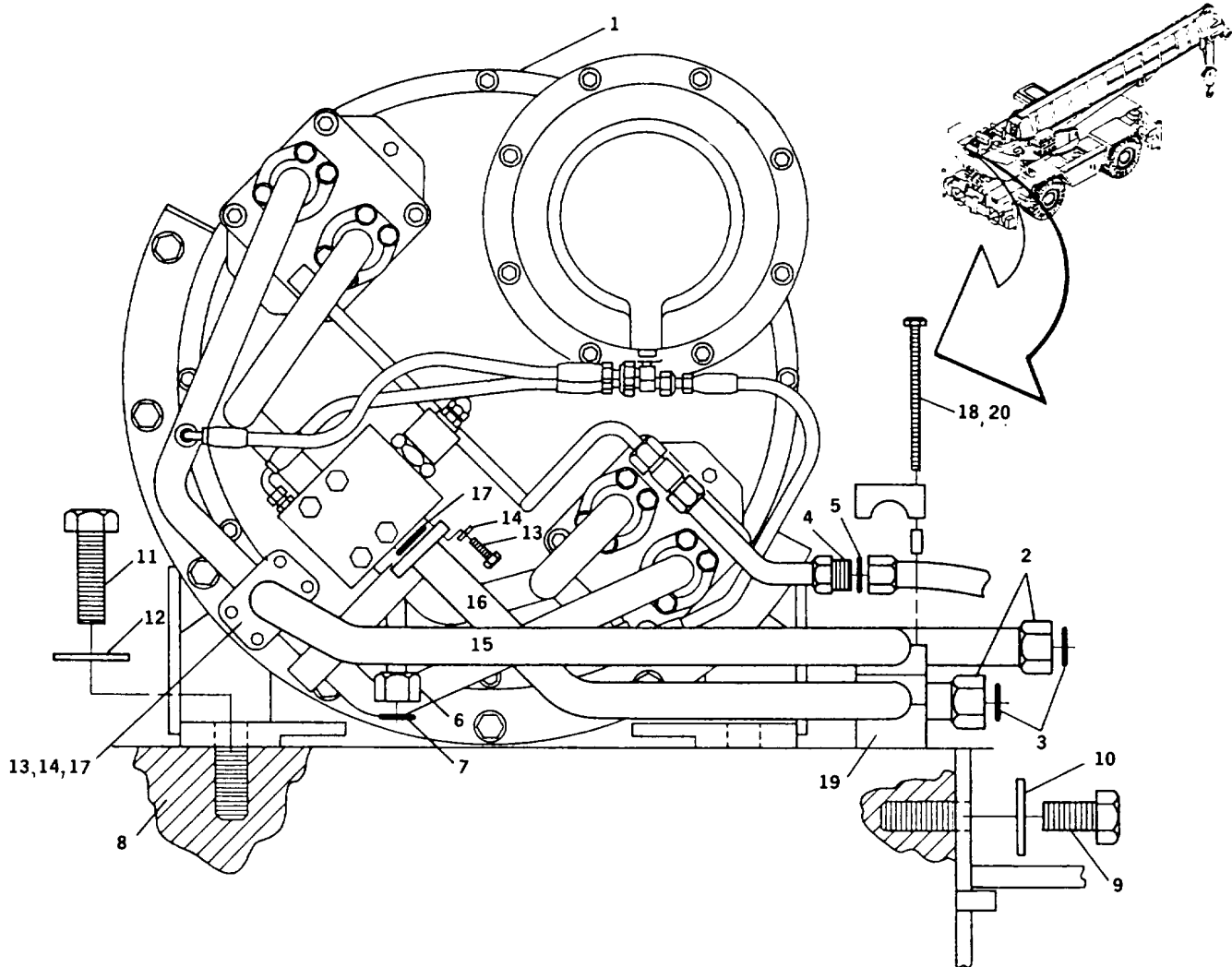
1. TAG AND REMOVE HYDRAULIC LINES TO AUXILIARY HOIST (1).
 - a. Disconnect fittings (2) at steel tubes on left side of auxiliary hoist (1). Discard preformed packing (3).
 - b. Disconnect fitting (4) to motor drain tube. Discard preformed packing (5).
 - c. Disconnect fitting (6) to case drain tube. Discard preformed packing (7).

NOTE

To simplify auxiliary hoist removal, counterweight (8) and auxiliary hoist are removed as an assembly and hoist is removed with counterweight (21) on ground.

WARNING

- Counterweight (8) and hoist weigh approximately 14,300 pounds (6486.37 kg). Use care when lifting and transporting.**
2. REMOVE COUNTERWEIGHT (8) AND AUXILIARY HOIST (1).
 - a. Attach suitable lifting device, capable of supporting weight of counterweight and hoist to counterweight lifting eyes.
 - b. Take up slack in lifting device.
 - c. Remove four capscrews (9) and washers (10) securing counterweight to superstructure.
 - d. Remove counterweight and auxiliary hoist lower to ground.



3. REMOVE AUXILIARY HOIST (1).

- a. Remove eight capscrews (13) and lockwashers (14) securing clamps on hydraulic tubes (15 and 16). Remove tubes and preformed packing (17).
- b. Remove four capscrews (11) and washers (12) securing auxiliary hoist (1) to counterweight.

- c. Attach suitable lifting device to hoist drum and remove from counterweight.
- d. Remove four capscrews (18), four inserts (20) and four pipe clamps (19) securing tubes (15 and 16) to counterweight.

INSTALLATION:

1. INSTALL AUXILIARY HOIST (1) to COUNTERWEIGHT.
 - a. Use suitable lifting device to lift and mount auxiliary hoist on counterweight.
 - b. Install four capscrews (11) and washers (12) and torque to 1100 ft-lbs (1465 Nm) with a suitable torque wrench.
2. INSTALL HYDRAULIC TUBES (15) AND (16) TO HOIST (1).

NOTE

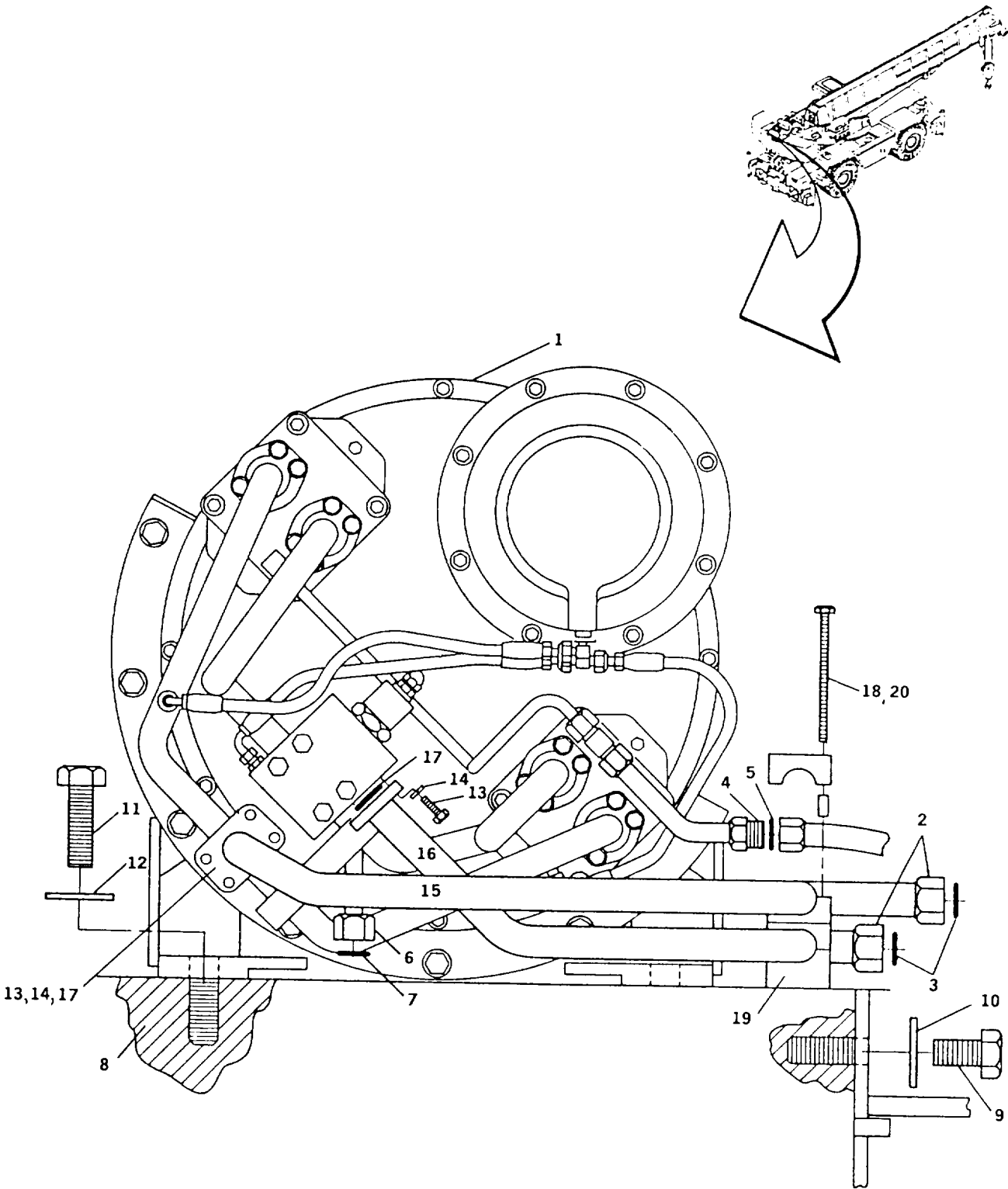
Prior to installing new preformed packings, coat packings with clean hydraulic oil. Coat pipe threads with Loctite #545.

- a. Position hydraulic tubes (15) and (16) in pipe clamps (19) and secure loosely to counterweight using capscrews (18) and inserts (20).
 - b. Position two hydraulic tubes (15) and (16) and new preformed packing (17) and secure with eight capscrews (13) and lockwashers (14).
 - c. Tighten pipe clamps (19).
3. INSTALL COUNTERWEIGHT (8) AND AUXILIARY HOIST (1) TO SUPERSTRUCTURE.
 - a. Attach suitable lifting device to lifting eyes on counterweight (8).

WARNING

Counterweight (8) and hoist weigh approximately 14,300 pounds (6486.37 kg). Use care when lifting and transporting.

- b. Raise and position counterweight on superstructure. Install four capscrews (9) and washers (10).
 - c. Using a suitable torque wrench torque capscrews to 3000 ft-lbs (4000 Nm).
4. CONNECT REMAINING HYDRAULIC LINES.
 - a. Connect fittings (4) and new preformed packing (5) to motor drain tube and tighten to secure.
 - b. Connect fitting (6) and new preformed packing (7) to case drain tube and tighten to secure.
 - c. Install new preformed packing (3) and connect fitting (2) on steel tubes at left side of auxiliary hoist (1).
 5. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
 6. INSTALL WIRE ROPE TO HOIST DRUM. (REFER TO TM 5-3810-306-20.)
 7. TEST FOR PROPER OPERATION.
- END OF TASK



COUNTERWEIGHT INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Torque wrench tool kit (5180-01-284-8747)
Overhead hoist (15,000 LB)

SUPPLIES: Preformed packing (Item 89, Appendix B)
Preformed packing (Item 163, Appendix B)
Preformed packing (Item 15, Appendix B)
Loctite #545 (Item 18, Appendix B)
Hydraulic oil (Item 8, Appendix B)

EQUIPMENT CONDITION: Outrigger fully extended and lowered.
(Refer to TM 5-3810-306-10.)
Wire rope removed from hoist drum.
(Refer to TM 5-3810-306-20.)
Negative battery cable disconnected at shunt.
(Refer to TM 5-3810-306-20.)

NOTE

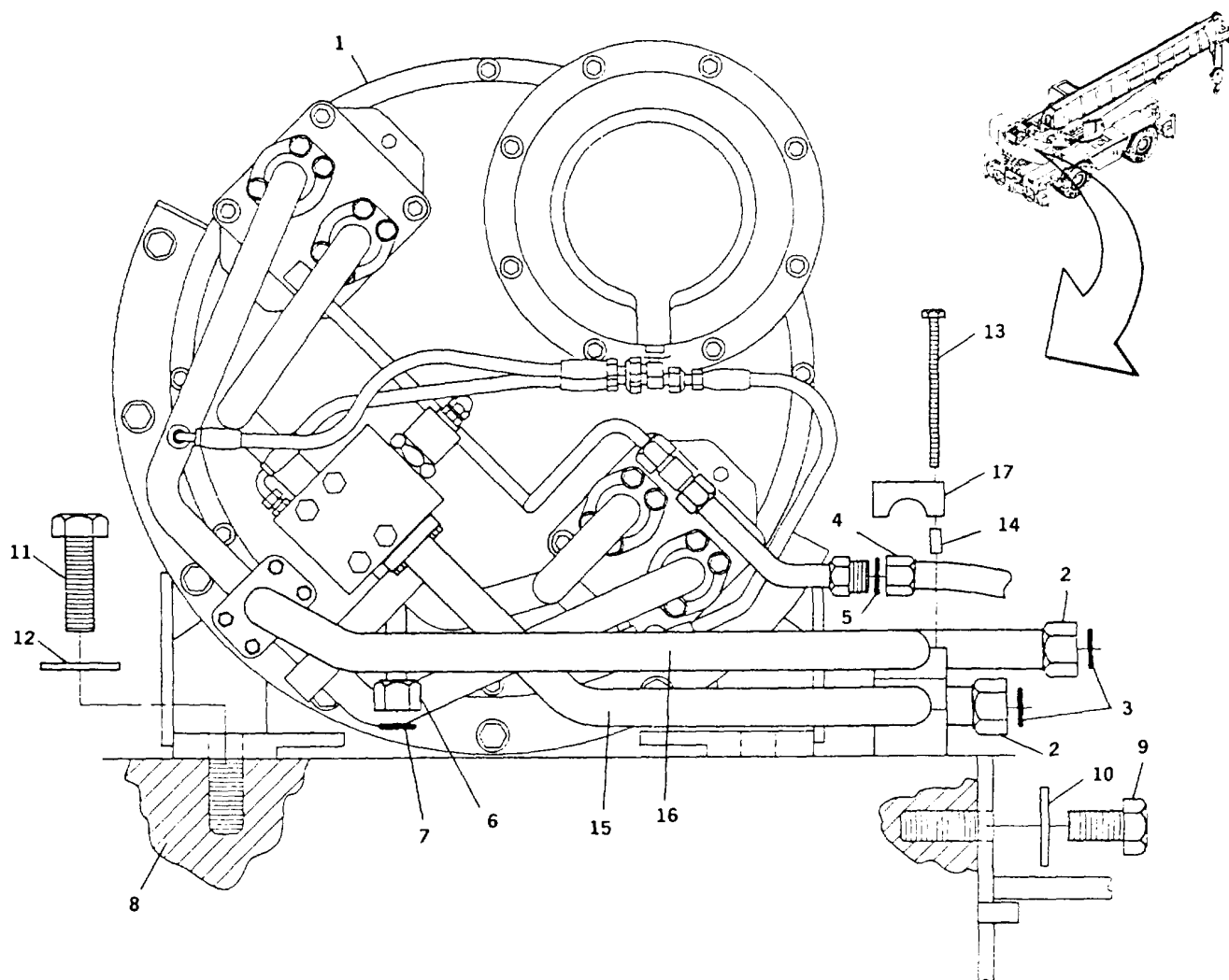
To simplify counterweight removal, auxiliary hoist and counterweight are removed as an assembly. Auxiliary hoist is removed after counterweight is on ground.

REMOVAL:

1. TAG AND REMOVE HYDRAULIC LINES TO AUXILIARY HOIST (1).
 - a. Disconnect fittings (2) at steel tubes on left side of auxiliary hoist (1). Discard preformed packing (3).
 - b. Disconnect fitting (4) to motor drain tube. Discard preformed packing (5).
 - c. Disconnect fitting (6) to case drain tube. Discard preformed packing (7).
2. REMOVE COUNTERWEIGHT (8) AND AUXILIARY HOIST (1).
 - a. Attach suitable lifting device, capable of supporting weight of counterweight and hoist to counterweight lifting eyes.
 - b. Take up slack in lifting device.
 - c. Remove four capscrews (9) and washers (10) securing counterweight to superstructure.
 - d. Remove counterweight and auxiliary hoist and lower to ground.
- 3 REMOVE AUXILIARY HOIST (1).
 - a. Remove four capscrews (13), four inserts (14) and four pipe clamps (17) securing tubes (15 and 16) to counterweight.

WARNING

Counterweight (8) and hoist weigh approximately 14,300 pounds (6486.37 kg). Use care when lifting and transporting.



- b. Remove four capscrews (11) and washers (12) securing auxiliary hoist (1) to counterweight.
- c. Attach suitable lifting device to hoist drum and remove from counterweight.

INSTALLATION:

1. INSTALL AUXILIARY HOIST (1) to COUNTERWEIGHT.
 - a. Use suitable lifting device to lift and mount auxiliary hoist on counterweight.

- b. Install four capscrews (11) and washers (12) and torque to 1100 ft-lbs (1465 Nm) with a suitable torque wrench.
- c. Position hydraulic tubes (15 and 16) in pipe clamps (17) and secure to counterweight using capscrews (13) and inserts (14). Tighten clamps.

2. INSTALL COUNTERWEIGHT (8) AND AUXILIARY HOIST (1) TO SUPERSTRUCTURE.
 - a. Attach suitable lifting device to lifting eyes on counterweight.

WARNING

Counterweight (8) and hoist weigh approximately 14,300 pounds (6486.37 kg). Use care when lifting and transporting.

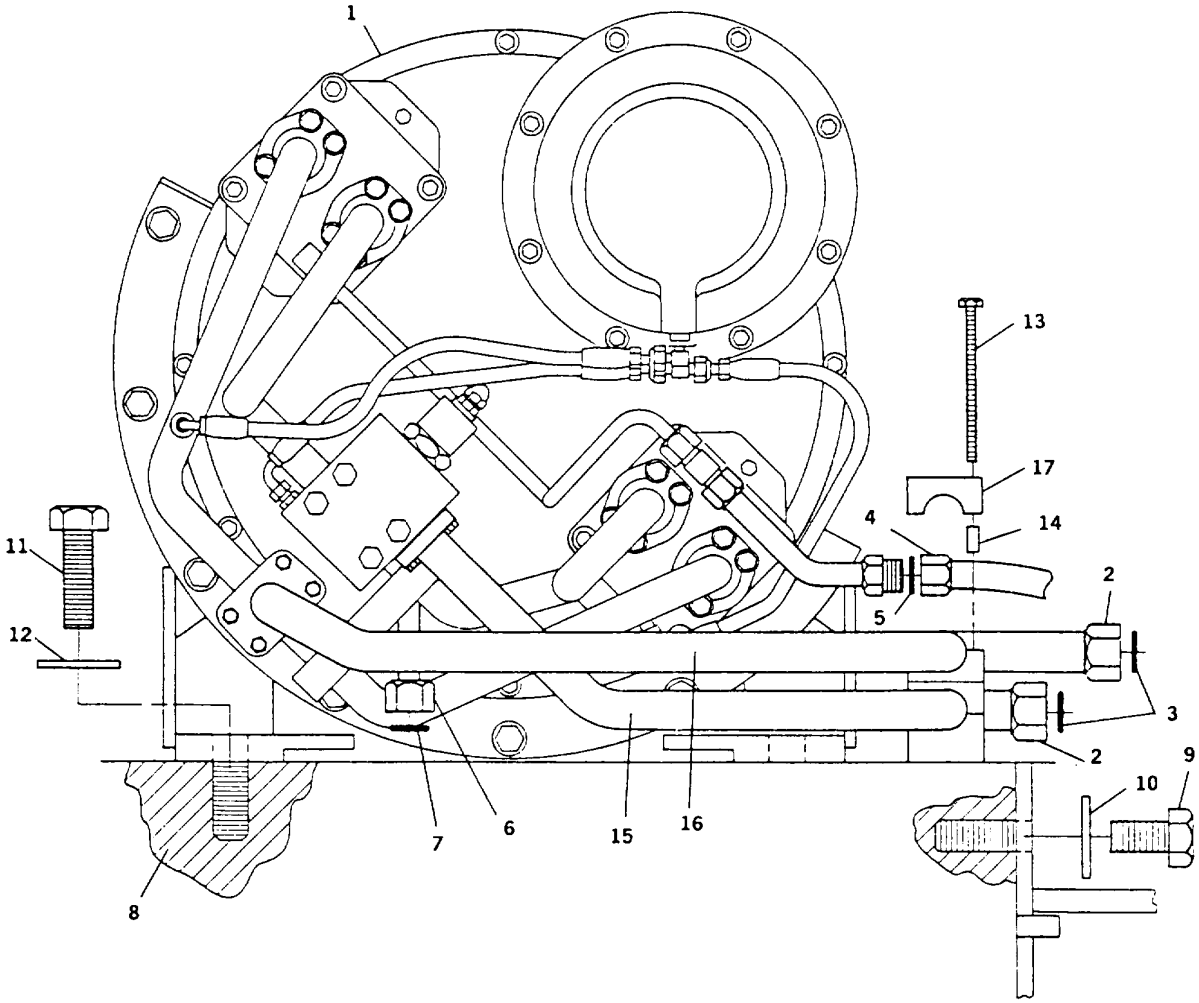
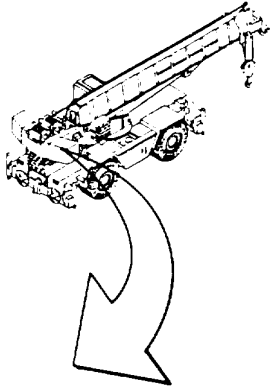
- b. Raise and position counterweight on superstructure. Install four capscrews (9) and washers (10).
 - c. Using a suitable torque wrench, torque capscrews to 3000 ft-lbs (4000 Nm).
3. CONNECT HYDRAULIC LINES.

NOTE

Prior to installing new preformed packings, coat packings with clean hydraulic oil. Coat pipe threads with Loctite 545.

- a. Connect fittings (4) and new preformed packing (5) to motor drain tube and tighten to secure.
 - b. Connect fitting (6) and new preformed packing (7) to case drain tube and tighten to secure.
 - c. Install new preformed packing (3) and connect fittings (2) on steel tubes at left side of auxiliary hoist (1).
4. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
 5. INSTALL WIRE ROPE TO HOIST DRUM. (REFER TO TM 5-3810-306-20.)
 6. TEST FOR PROPER OPERATION.

END OF TASK



MAIN HOIST INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Torque wrench tool kit (5180-01-284-8747)
Overhead hoist (1 ton Capacity)

SUPPLIES: Lockwashers (Item 13, Appendix B)
Preformed packing (Item 89, Appendix B)
Preformed packing (Item 163, Appendix B)
Preformed packing (Item 15, Appendix B) (2 Required)
Loctite #545 (Item 18, Appendix B)
Hydraulic oil (Item 8, Appendix B)

EQUIPMENT CONDITION: Wire rope removed from hoist drum.
(Refer to TM 5-3810-306-20.)
Hydraulic system shutdown and pressure relieved from lines.
(Refer to TM 5-3810-306-20.)
Negative battery cable disconnected at shunt.
(Refer to TM 5-3810-306-20.)

REMOVAL:

1. TAG AND REMOVE HYDRAULIC LINES TO HOIST (1).
 - a. Remove eight capscrews (4) and lockwashers (5) securing clamps on hydraulic tubes (2) and (3). Remove two hydraulic tubes and preformed packings (6). Discard packings (6).
 - b. Disconnect fitting (7) at end of case drain tube. Remove tube and preformed packing (8). Discard packing (8).
 - c. Disconnect fitting (9) at motor drain tube. Remove tube and preformed packing (10). Discard packing (10).
2. REMOVE MAIN HOIST (1).
 - a. Remove four capscrews (11), washers (12) and nuts (13) securing hoist assembly (1) to turntable.

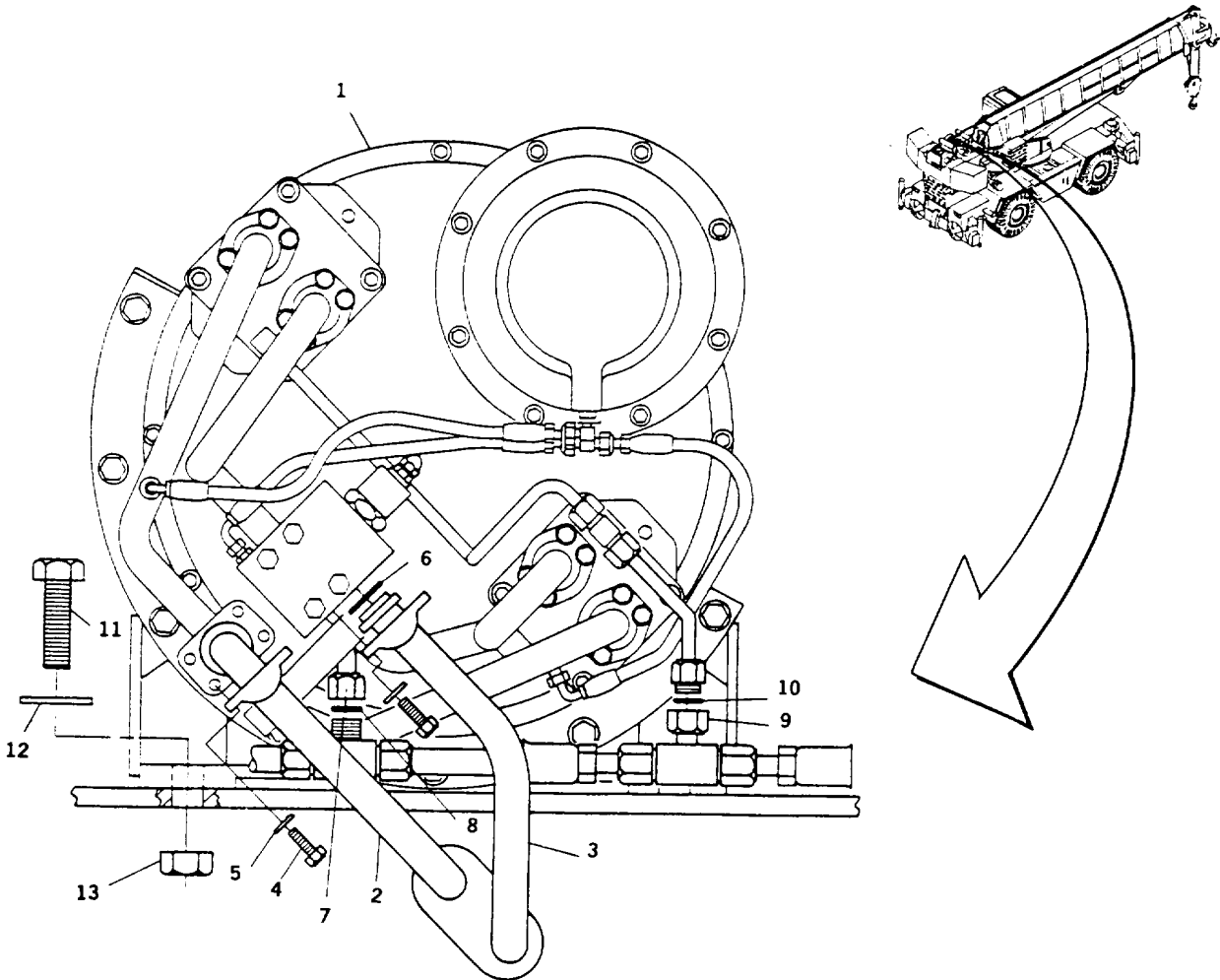
WARNING

Hoist weighs approximately 1800 pounds (818 kg). Use care when lifting and transporting.

- b. Using suitable lifting device, remove hoist from crane.

INSTALLATION:

1. INSTALL MAIN HOIST (1).
 - a. Using suitable lifting device, position main hoist (1) onto turntable.
 - b. Install four capscrews (11), washers (12) and nuts (13) and secure hoist (1) to turntable.
 - c. Using suitable torque wrench, torque nuts (13) to 1100 ft-lbs (1465 Nm).



2. INSTALL HYDRAULIC LINES TO HOIST (1).

- a. Connect fitting (9) and new preformed packing (10) to motor drain tube and tighten.
- b. Connect fitting (7) and new preformed packing (8) to case drain tube and tighten.
- c. Install hydraulic tube (3) and new preformed packing (6) to motor control valve. Secure clamp with four capscrews (4) and lockwashers (5).

- d. Install hydraulic tube (2) and new preformed packing (6). Secure with four capscrews (4) and lockwashers (5).

3. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

4. INSTALL WIRE ROPE TO HOIST DRUM. (REFER TO TM 5-3810-306-20.)

5. TEST FOR PROPER OPERATION.

END OF TASK

HOIST ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Lifting device (200 lbs. Capacity)

SUPPLIES: Kit, repair (Item 77, Appendix B)
Bearing (Item 78, Appendix B) (3 required)
Bearing (Item 79, Appendix B)
Bearing (Item 80, Appendix B) (3 required)
Washer, key (Item 81, Appendix B)
Washer, lock (Item 82, Appendix B) (6 required)
Washer, lock (Item 83, Appendix B) (7 required)
Washer, key (Item 84, Appendix B)
Washer, key (Item 85, Appendix B) (2 required)
Washer, lock (Item 26, Appendix B) (8 required)
Rags, clean (Item 2, Appendix B)
Fluid, dry cleaning P-D-680 Type II (Item 1, Appendix B)
Oil, hydraulic (Item 8, Appendix B)
Loctite 242 (Item 6, Appendix B)
Gear oil, EPGL 90 Wt (Item 86, Appendix B)

EQUIPMENT CONDITIONS: Hoist removed. (Refer to pages 15-26 or 15-34.)
Hoist motors removed. (Refer to page 15-50.)
Hoist brake removed. (Refer to page 15-64.)

DISASSEMBLY:

CAUTION

Any maintenance requiring disassembly of the hoist should be accompanied by replacement of all seals and preformed packings.

NOTE

If the drum (32) is to be removed or replaced, the right side (primary drive) does not have to be disassembled.

2. REMOVE END COVER (5).

- a. Remove bolts (3) from the end cover (5).

NOTE

Leave one or two bolts loosely in place. This will help support the weight of the end cover as it is removed.

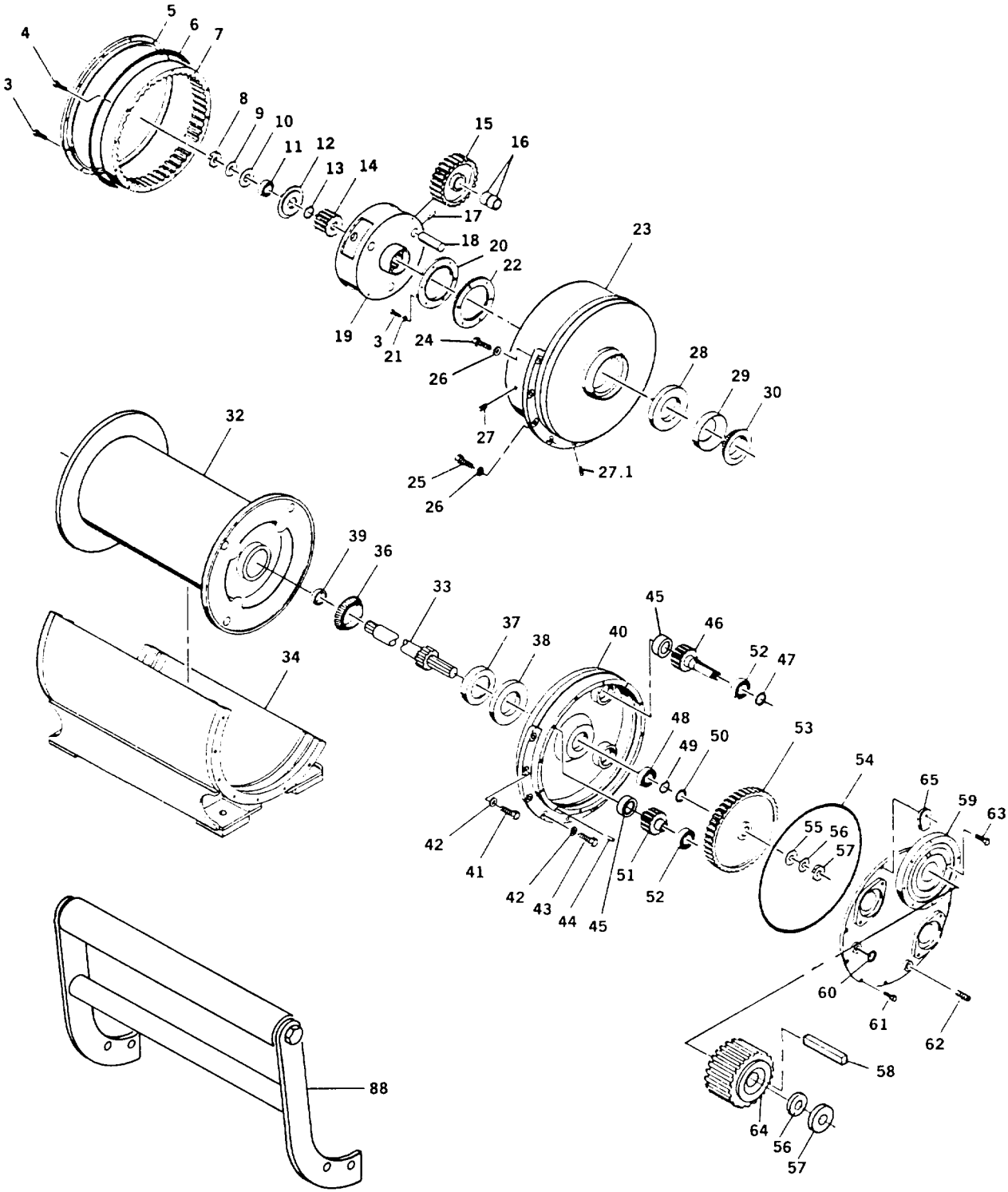
- b. Using pry bar midway between any two bolt holes, loosen end cover (5) and remove it.
- c. Remove and discard the preformed packing (6).

1. DRAIN HOIST (1).

- a. Drain hydraulic oil from the right hand side (primary drive).
- b. Drain gear oil from left hand side (final drive).

3. REMOVE PLANETARY ASSEMBLY (19).

- a. Knock tab of lockwasher (10) from its seat on locknut (8). Remove keywasher (10) and locknut (8).



- b. Remove retaining nut (9).
- c. Remove ball thrust bearing (11) and thrust bearing housing (12).
- d. Remove the snap ring (13) from the main shaft (33).
- e. Install two bolts in threaded holes in planetary assembly (19). Attach lifting device and lift out the entire planetary assembly (19).

4. REMOVE PLANET CAGE HOUSING (23).

- a. Remove pinion gear (14) from planet assembly (19).
- b. Remove bolts (3) and lockwashers (21) securing bearing retainer plate (20) to planet cage housing (23).
- c. Remove bearing retainer plate (20) and shims (22).
- d. Remove bolts (24) and (41) and washers (26) and (42) securing cable reel (88). Remove cable reel (88).
- e. Remove bolts (25) and washers (26) securing planet cage housing (23) to center housing (34).
- f. Using suitable lifting device, remove planet cage housing (23).

5. REMOVE RING GEAR.

- a. Remove bolts (4) securing ring gear (7) to planet cage housing (23).
- b. Remove ring gear (7).

NOTE

Label the bearing (30) and the bearing race (29) to ensure they are mated together.

6. REMOVE DRUM (32).

- a. Pull oil seal (28) and bearing race (29) from planet cage housing (23).

NOTE

The main shaft (33) need not be removed to replace the drum or the drum bearings.

- b. Using suitable lifting device. Remove drum assembly (32).
- c. Pull bearings (30) and (36) from each end of drum (32).
- d. Remove seal (39) from drum (32)

7. DISASSEMBLE PLANET CAGE (5).

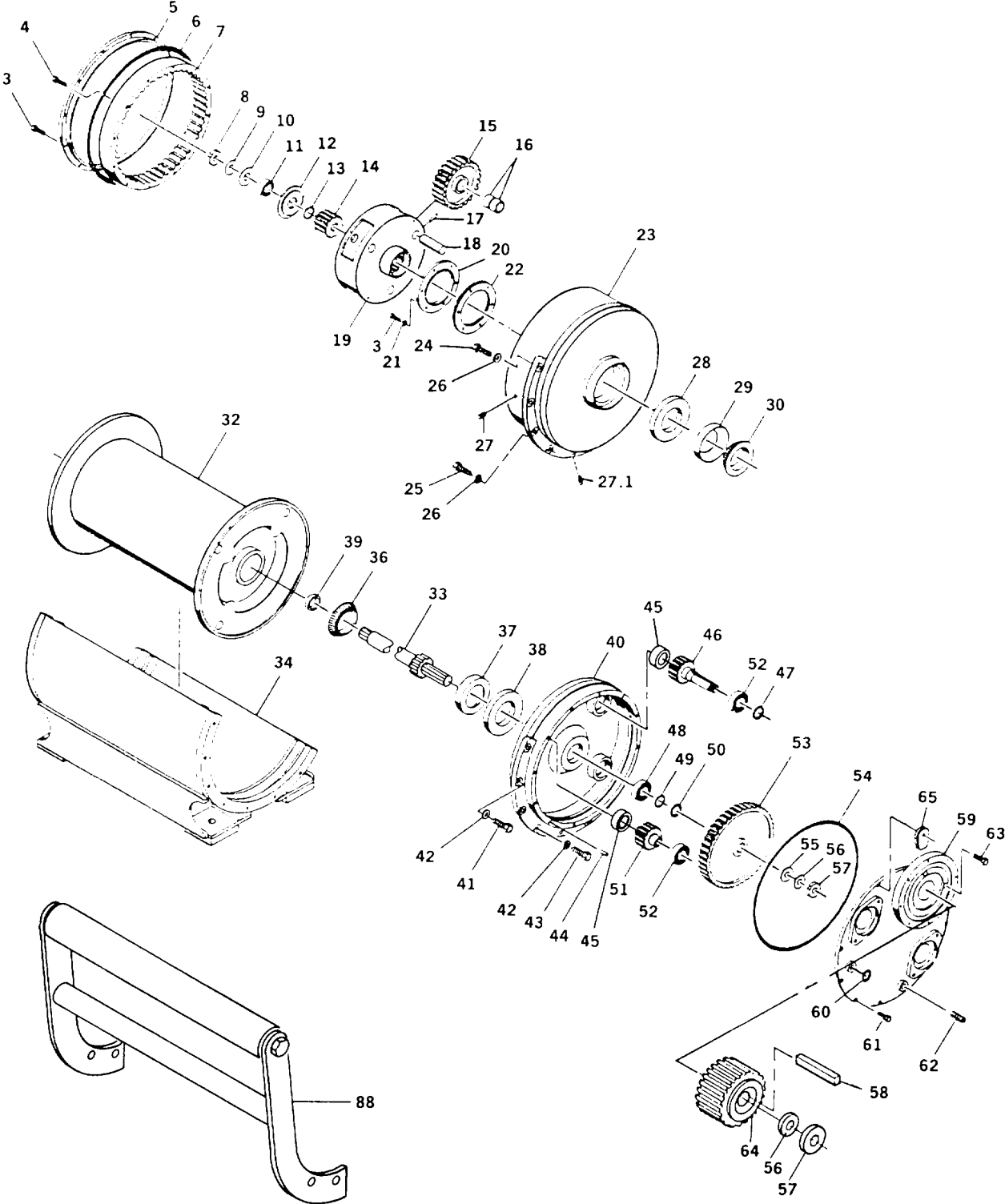
NOTE

Ensure each planet gear, planet gear shaft, and roll pin is labeled as to its position upon disassembly. Mark the planet gears for the direction of rotation.

NOTE

Use Steps a thru e to remove each of the three planet gears.

- a. Using punch, drive roll pin (17: completely into planet gear shaft (18).
- b. Using brass drift, drive planet gear shaft (18) out of planet cage (5).
- c. Remove planet gear (15).
- d. Using punch, remove roll pin (17) from planet gear shaft (18).



- e. Press bearings (2) out of planet gear (15).
8. REMOVE OVERRUNNING CLUTCH (64).
- a. Knock tab of keywasher (56) from its seat on locknut (57).
 - b. Using spanner, remove locknut (57). Remove keywasher (56).
 - c. Remove overrunning clutch (64) and key (58).
 - d. Remove bearing spacer (47) from pinion (46).
9. REMOVE END COVER (59).

NOTE

Leave one or two bolts loosely in place. This will help support the weight of the end cover as it is removed.

- a. Remove bolts (61) and (63) from end cover (59).
 - b. Using pry bar midway between any two bolt holes, loosen end cover (59) and remove it.
 - c. Remove and discard preformed packing (54).
10. REMOVE DRIVEN GEAR (53).
- a. Knock tab of keywasher (56) from its seat on locknut (57).
 - b. Using spanner wrench, remove locknut (57).

- c. Remove keywasher (56) and spacer (55).
 - d. Remove driven gear (53).
 - e. Remove spacer (50).
11. REMOVE DRIVING PINIONS (46) and (51) AND BEARINGS (45) and (52).
- a. Using pry bars remove brake driving pinion (46) and two driving pinions (51).
 - b. Using suitable puller, remove bearings (45) and (52).

12. REMOVE MAIN SHAFT (33).

- a. Remove snap ring (49) from primary drive housing (40).
- b. Remove main shaft (33). Using suitable puller, pull bearing (48) from main shaft.

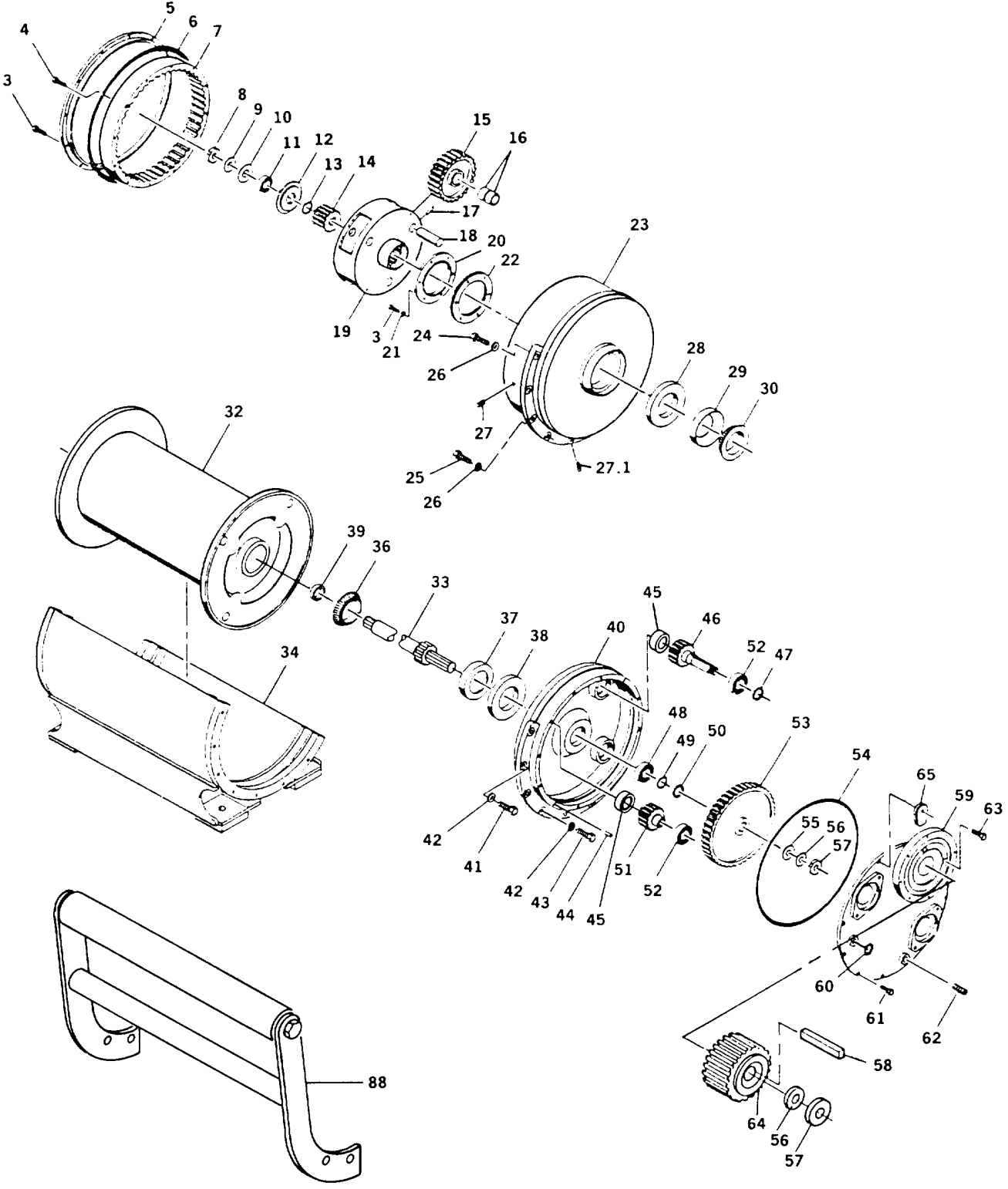
13. REMOVE PRIMARY DRIVE HOUSING (40).

- a. Remove bolts (43) and washers (42) securing primary drive housing (40) to the center housing (34).
- b. Remove the primary drive housing (40).

NOTE

Label bearing (36) and bearing race (37) to ensure they are mated together.

- c. Remove oil seal (38) and bearing race (37).



CLEANING:**WARNING**

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and se only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°C-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

CAUTION

Do not use gasoline as solvent.

1. CLEAN ALL PARTS THOROUGHLY IN SOLVENT AND DRY WITH COMPRESSED AIR.

INSPECTION:

1. INSPECT PARTS FOR WEAR.
 - a. Inspect all bearings and races, including those not removed from parts, and replace if the bearings or cups are worn, pitted or damaged in any way.

- b. Inspect all gears for worn or damaged teeth.
- c. Inspect all splines for wear.

ASSEMBLY:

1. INSTALL PLANET GEARS (15).

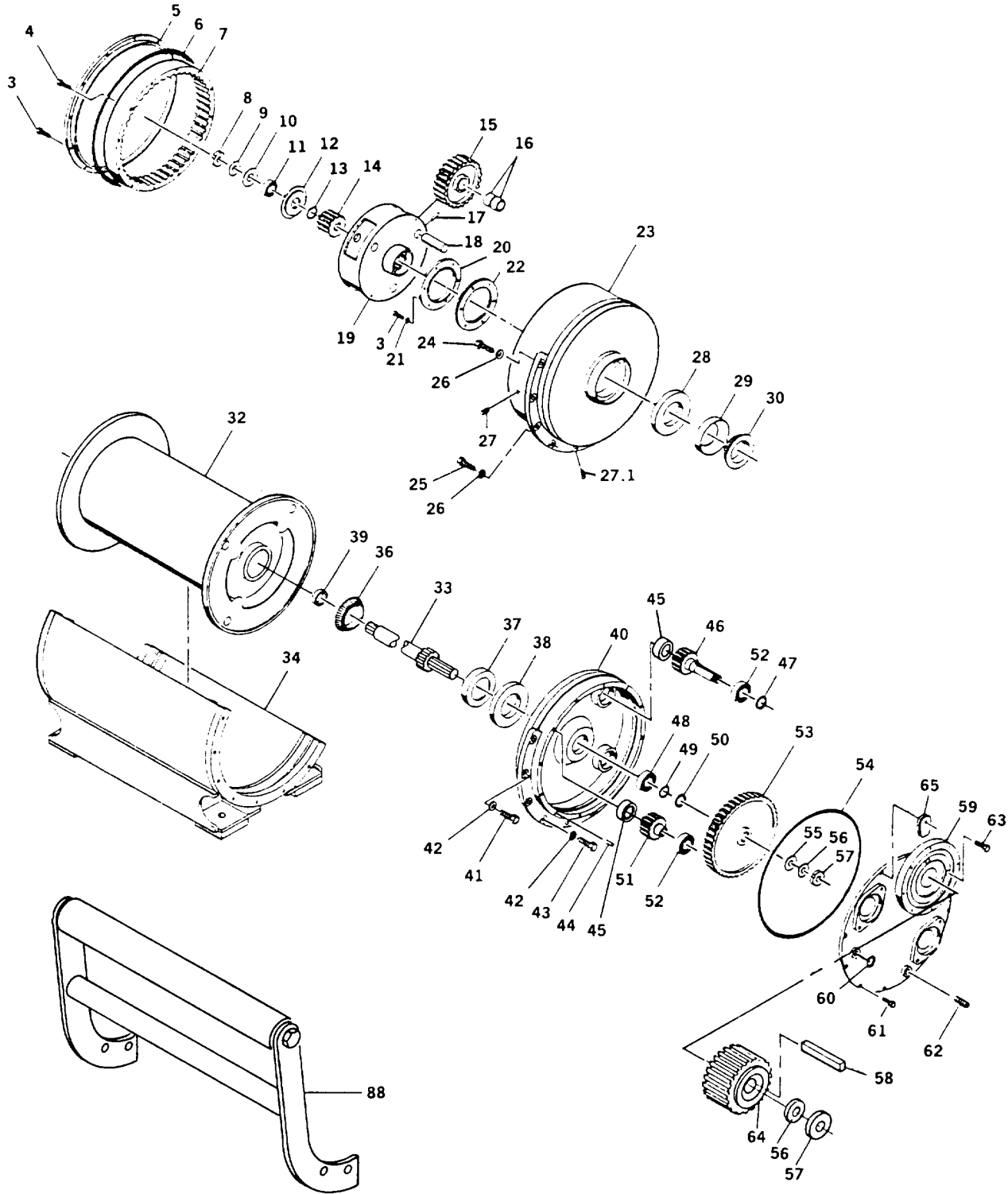
NOTE

Unless replaced, ensure each planet gear, planet gear shaft, and roll pin is used in its position as labeled upon disassembly. Ensure the planet gears are installed so they rotate in the same direction as before disassembly.

NOTE

Lubricate all preformed packings and seals with clean hydraulic oil prior to installation.

- a. Press bearings (16) into planet gear (15).
- b. Start planet gear shaft (18) in correct hole of planet cage (19). Ensure roll pin hole in planet gear shaft (18) is aligned with hole in planet cage (19).
- c. Align planet gear (15) with planet gear shaft (18).
- d. Using brass drift, drive planet gear shaft (18) through planet gear (15) and planet cage (19). Ensure needle bearings are not driven out by planet gear shaft.
- e. Using punch, install roll pin (17) in hole in planet cage.



2. INSTALL PRIMARY DRIVE HOUSING (40).
 - a. Apply Loctite #271 to oil seal (38), and press bearing race (37) and oil seal (38) in drum side of primary drive housing (40).
 - b. Install primary drive housing (40) on center housing (34).
 - c. Apply Loctite #242 to hex head bolt threads (43) and install hex head bolts (43) and washers (42).

NOTE

Ensure alignment of holes for longer bolts (41) installed later.

- d. Torque hex head bolts (43) to 150 ft-lbs (200 Nm).
3. INSTALL BEARINGS (45), (48) AND (52), DRIVING PINIONS (46) AND (51) AND MAIN SHAFT (33).
 - a. Press bearing (48) on main shaft (33) and install main shaft in primary drive housing (40).

NOTE

Bearing (48) has a snap ring. The bearing is installed with the snap ring to the gear side.

- b. Using snap ring pliers, secure bearing (48) in housing (40) with snap ring (49).
- c. Press two new bearings (45) and (52) onto two driving pinions (51) and pinion (46).
- d. Install pinions (51) and (46) in face of primary drive housing (40).
- e. Install spacer (50) on main shaft (33) with recess on shaft shoulder.

4. INSTALL DRIVEN GEAR (53).

NOTE

The gears do not have to be timed.

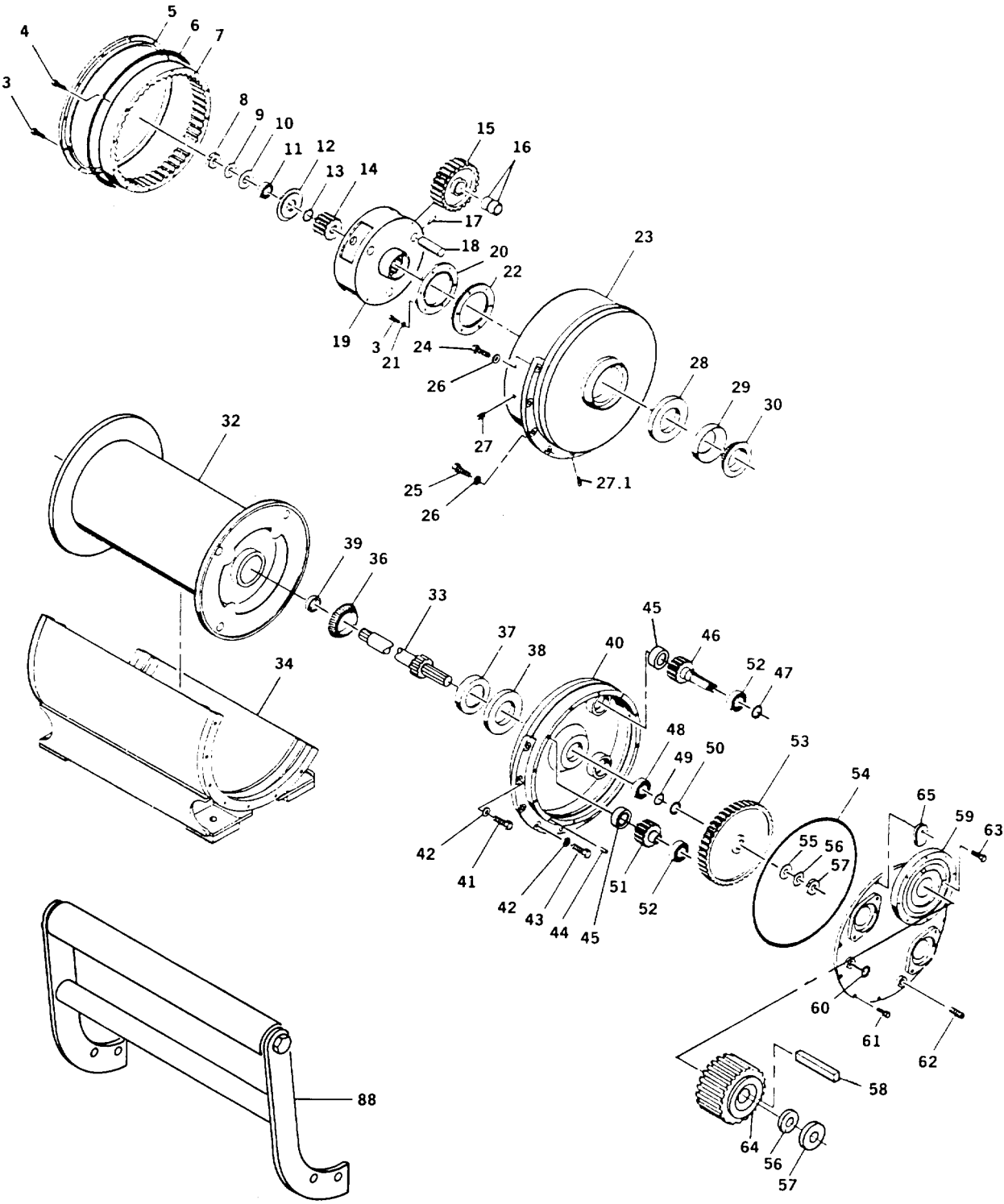
- a. Install driven gear (53).
- b. Install spacer (55), keywasher (56), and locknut (57) on main shaft (33). Ensure recess in spacer faces toward driven gear (53).
- c. Torque locknut (57) with spanner wrench to 20 ft-lbs (27 Nm).
- d. Secure locknut (57) by bending a tab of keywasher (56) into a corresponding groove of the locknut.
5. INSTALL END COVER (59).
 - a. Install new preformed packing (54) in end cover (59).

- b. Using suitable lifting device, install end cover (59) on primary drive housing. Use soft faced hammer to seat cover.
- c. Apply Loctite #242 to hex head bolt threads (61) and (63). Apply RTV to shanks of bolts (63).

NOTE

The two bolts (63) which fit where the brake assembly is to be mounted are longer than the other bolts.

- d. Secure end cover (59) to the primary drive housing with the hex head bolts (61) and (63).
- e. Torque bolts (61) and (63) to 31 ft-lbs (41 Nm).



6. INSTALL OVERRUNNING CLUTCH (64).
 - a. Install bearing spacer (47) on pinion (46).

NOTE

The direction of free rotation of the over-running clutch (64) should be counter-clockwise.

- b. Install overrunning clutch (64) on pinion shaft (46) and secure with key (58).
 - c. Install keywasher (56) and locknut (57). Torque locknut (57) using a spanner wrench to 20 ft-lbs (27 Nm).
 - d. Lock locknut (57) by bending a tab of keywasher (56) into corresponding groove of the locknut (57).
7. ASSEMBLE PLANET CAGE (19).

NOTE

Lubricate the preformed packings, seals and bearings with 90 weight EPGL gear lubricant.

- a. Apply Loctite #271 to oil seal (39) and install in primary drive housing side of drum (32).

NOTE

If the bearings (30) and (36) are being reused, install them on the side from which they were removed.

- b. Press bearings (30) and (36) on both ends of drum (32).
 - c. Press bearing race (29) into planetary side of planet cage housing (23).

- d. Apply Loctite #271 to oil seal (28) and install in drum side of planet cage housing (23).

8. INSTALL DRUM (32) AND PLANET CAGE HOUSING (23).

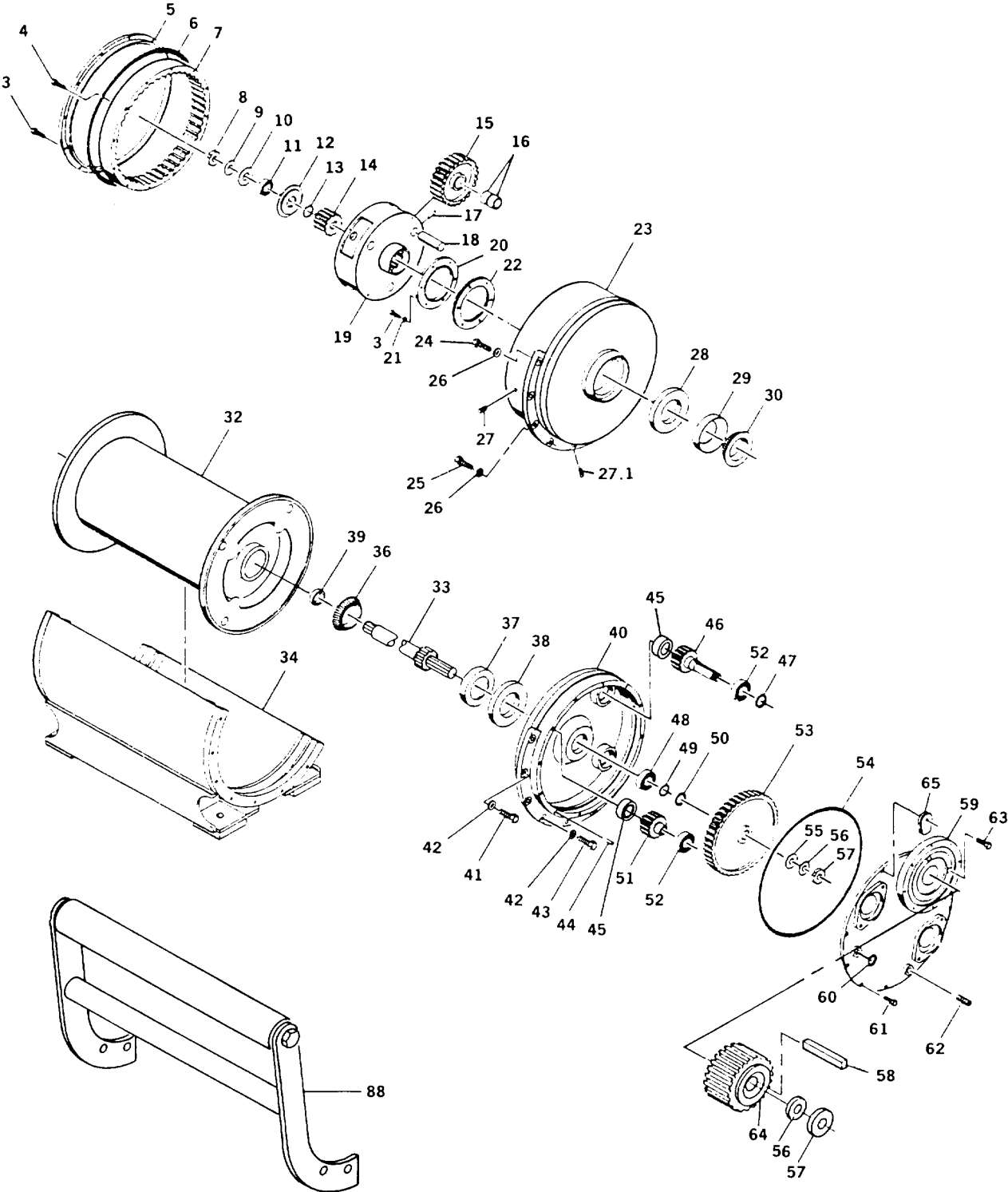
- a. Using suitable lifting device install drum (32) over main shaft (33).
 - b. Apply Loctite #242 to bolt threads (4).
 - c. Install ring gear (7) in planet cage housing (23) using bolts (4).
 - d. Torque bolts (4) to 31 ft-lbs (41 Nm).
 - e. Apply Loctite #242 to hex head bolt threads (25).
 - f. Using suitable lifting device mount planet cage housing (23) on center housing (34) using hex head bolts (25) and washers (26). Torque hex head bolts to 150 ft-lbs (200 Nm).
 - g. Apply Loctite #242 to hex head bolt threads (24) and (41). Install cable reel (88) using hex head bolts (24) and (41) and washers (26) and (42). Torque bolts to 150 ft-lbs (200 Nm).

9. INSTALL BEARING RETAINER (20).

CAUTION

Tighten the bolts (3) only enough to remove the free play from the drum support bearings. Over tightening could result in premature bearing failure.

- a. Mount bearing retainer (20) using only three bolts (3) in a staggered sequence.



- b. Tighten bolt (3) until all free play is removed from drum support bearings.
- c. Use pry bar to check drum (32) for free play.
- d. Using feeler gauge, measure clearance between planet cage housing (23) and bearing retainer (20).
- e. From this reading subtract 0.005 in. (0.127 mm) to find amount of shimming needed to ensure proper preload on drum bearings.
- f. Remove bearing retainer (20).
- g. Install shims (22) with measurement equal to that computed in Step e.
- h. Apply Loctite #242 to the hex head bolt threads (3).
- i. Install bearing retainer (20) using lockwashers (21) and hex head bolts (3). Torque to 31 ft-lbs (41 Nm).
- e. Install retaining nut (9) and torque to 35 ft-lbs (47 Nm).
- f. Install keywasher (10) and locknut (8). Torque locknut (8) to 20 ft-lbs (27 Nm).
- g. Lock locknut (8) by bending tab of keywasher (10) into corresponding groove of locknut.
- h. Install new preformed packing (6) on left end cover (5).
- i. Apply Loctite #242 to the hex head bolt threads (3).
- j. Install left end cover (5) on planet cage housing (23) using hex head bolts (3). Torque hex head bolts (3) to 31 ft-lbs (41 Nm).

10. INSTALL END COVER (5).

- a. Install the planet cage assembly (19).
- b. Install the pinion gear (14).
- c. Install snap ring (13) on main shaft (33).
- d. Install thrust bearing housing (12) and ball thrust bearing (11) so small ID of bearing will face locknut (8).

11. SERVICE FINAL DRIVE.

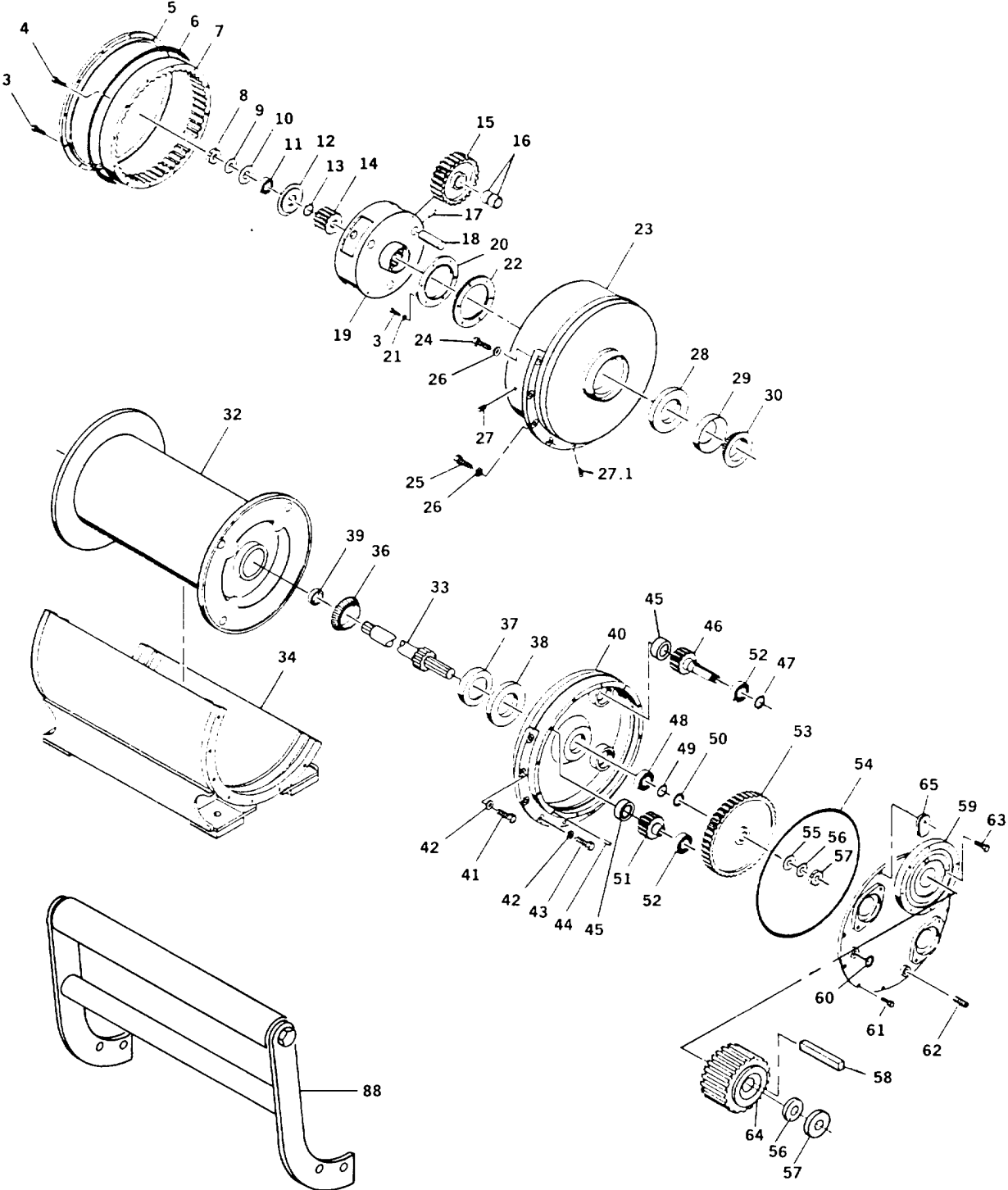
- a. Remove fill/check plug (27) from side of final drive assembly.
- b. Fill with 90 weight EPGL gear lubricant until oil starts to flow out of plug hole.
- c. Install fill/check plug (27).

12. INSTALL HOIST BRAKE ASSEMBLY (REFER TO PAGE 15-64.)

13. INSTALL HOIST MOTORS. (REFER TO PAGE 15-50.)

14. INSTALL HOIST ASSEMBLY. (REFER TO PAGES 15-26 OR 15-34.)

END OF TASK



HOIST MOTOR INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Lockwasher (Item 82, Appendix B) (24 Required)
 Preformed Packing (Item 106, Appendix B) (4 Required)
 Preformed packing (Item 263, Appendix B) (3 Required)
 Preformed packing (Item 264, Appendix B) (4 Required)
 Lockwasher (Item 26, Appendix B)
 Parts kit (Item 77, Appendix B)
 Loctite #242 (Item 6, Appendix B)
 Parts kit (Item 265, Appendix B)

EQUIPMENT CONDITIONS: Pressure relieved from hydraulic system.
 (Refer to TM 5-3810-306-20.)
 Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)

REMOVAL:

1. TAG AND REMOVE HYDRAULIC LINES AND TUBES.

- a. Remove eight cap screws (3) and lockwashers (4) securing clamps on tubes (5) and (6). Remove and discard two preformed packings (7).
- b. Remove line (8) from bottom-right hoist motor (1) to drain tube. Remove and discard preformed packings (9).
- c. Disconnect lines (10), (11) and (12) at hoist brake (2). Remove and discard packings (29).
- d. Remove sixteen capscrews (14) and lockwashers (15) securing clamps on tubes (16) and (17). remove and discard preformed packings (18).
- e. Remove capscrew (19), lockwasher (20), washer (21) and spacer (22) from bracket assembly (23). Remove disconnected lines and tubes as an assembly.

- f. Remove line (24) between hoist motors (1). Remove and discard preformed packings (25).

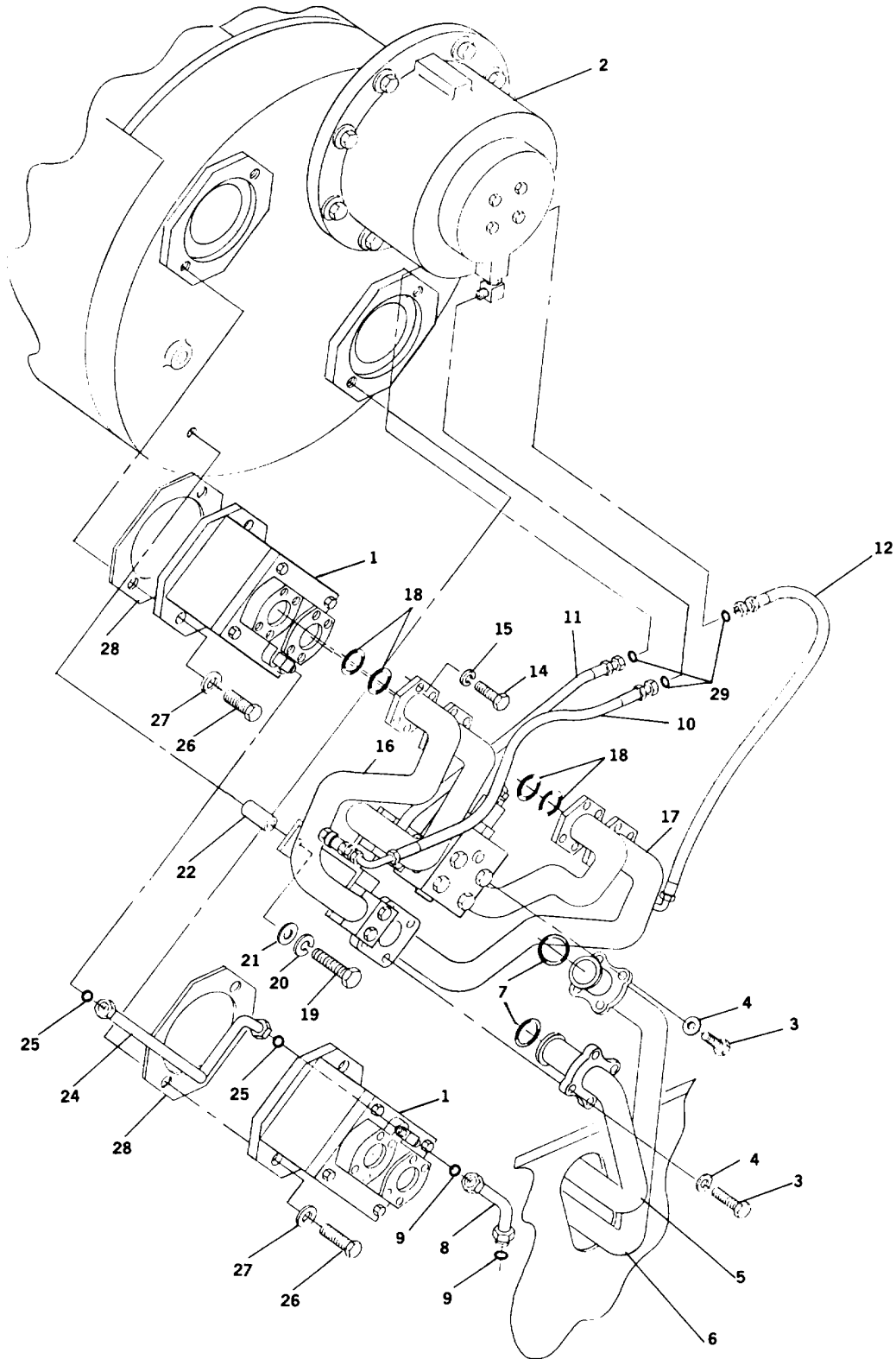
2. REMOVE HOIST MOTORS (1).

- a. Label each hoist motor (1) as to its position (top-bottom, left-right).
- b. Remove capscrews (26) and lockwashers (27) securing hoist motors (1) to hoist.
- c. Remove hoist motors (1). Remove and discard gaskets (28).

INSTALLATION:

1. INSTALL HOIST MOTORS (1).

- a. Install new gaskets (28) on hoist motor mounting flanges.
- b. Install hoist motors (1) on hoist as labeled during removal.



- c. Apply Loctite #242 to bolt threads (26). Secure hoist motors (1) to hoist with bolts (26) and new lockwashers (27). Torque bolts (26) to 150 ft-lbs (200 Nm).

- d. Connect lines (10), (11) and (12) using new packings (29) to hoist brake (2).

- e. Install line (8) and new packings (9) between bottom-right hoist motor (1) and drain tube.

- f. Install new packings (7), new lockwashers (4) and eight capscrews (3) to secure tubes (5) and (6) to tube (16) and hoist motor control valve.

2. INSTALL HYDRAULIC LINES AND TUBES.

- a. Install line (24) and new packings (25) between hoist motors (1).

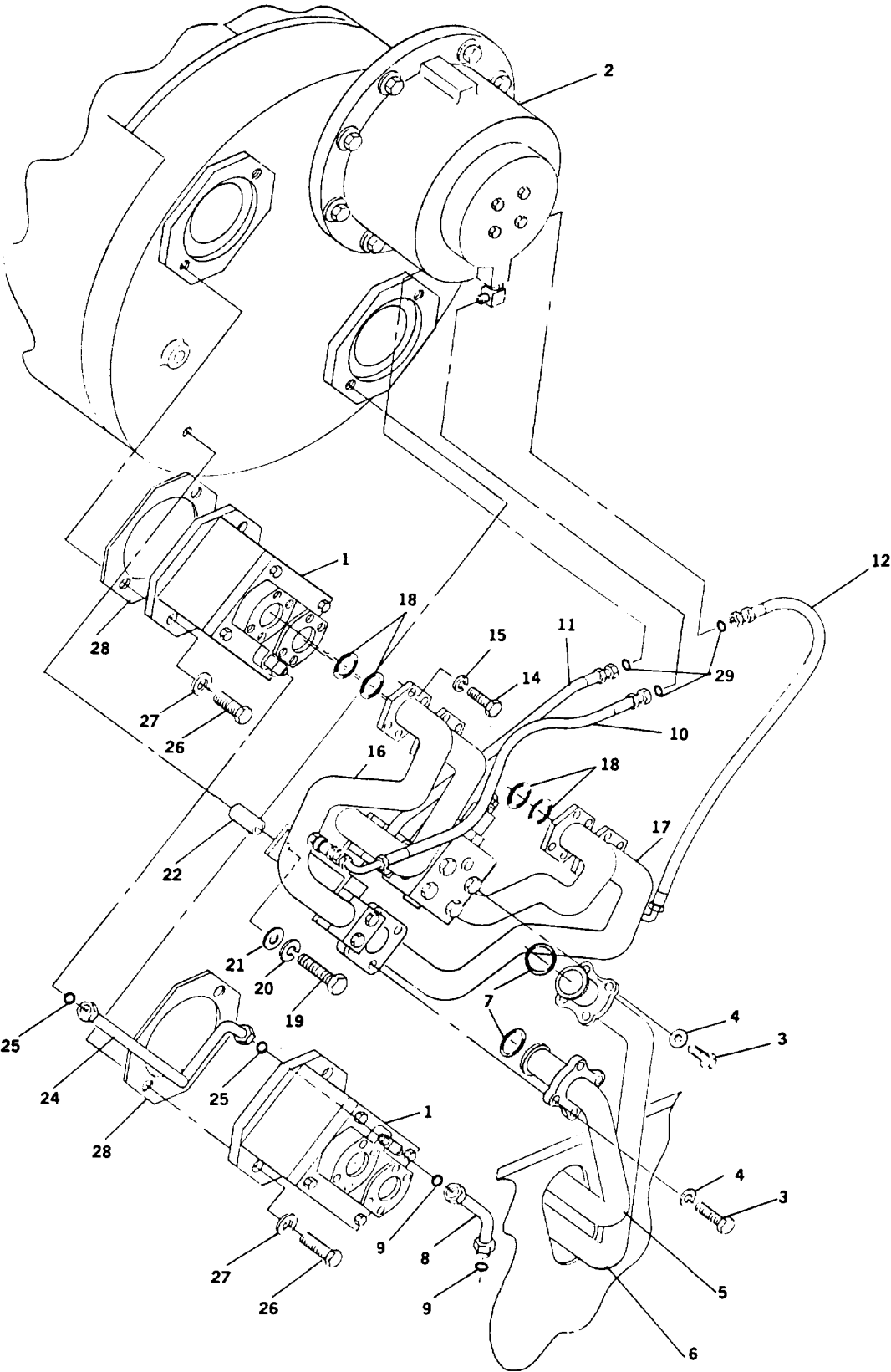
- b. Position lines and tubes assembly and install spacer (22), new lockwasher (20), washer (21) and capscrew (19) through bracket (23).

- c. Install new packings (18), new lockwashers (15), and sixteen capscrews (14) to secure tubes (16) and (17) to hoist motors (1).

3. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

4. OPERATE HOIST AND CHECK FOR PROPER OPERATION AND LEAKS.

END OF TASK



HOIST MOTOR ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Protective cone (Item 2, Appendix C)
 Shaft seal driver (Item 1, Appendix C)

SUPPLIES: Clean rags (Item 2, Appendix B)
 Loctite No. 242 (Item 6, Appendix B)
 Seal kit (Item 7, Appendix B)
 Hydraulic oil (Item 8, Appendix B)
 Grease (Item 9, Appendix B)

EQUIPMENT CONDITIONS: Hoist motor removed. (Refer to page 15-50.)

DISASSEMBLY:

1. PREPARE HOIST MOTOR.
 - a. Match mark end cap (2) and body (21).
 - b. Drain all fluid from the motor and thoroughly clean all exterior surfaces.
 - c. Prepare a clean, lint-free surface on which to lay internal parts of hoist motor.
2. REMOVE END CAP (2).
 - a. Remove screws (1) and end cap (2) from body (21).
 - b. Remove and discard rubber seal ring (3) from end cap (2).
 - c. Check needle bearing (4) in end cap (2). If worn or damaged, replace it.
3. REMOVE CAM RING ASSEMBLY (6).
 - a. Remove dowel pin (5) from cam ring assembly (7).
 - b. Thread two 1/4-20 screws in two tapped holes provided as puller holes in cam ring (7).

NOTE

- If resistance is encountered when lifting the cam ring assembly, lightly tap the outside of body while lifting the assembly. This will help in removing the cam ring, rotor, vanes, and springs as a unit.**
- c. Remove cam ring assembly (6) as unit (7), (8), (9), and (10).

4. DISASSEMBLE CAM RING ASSEMBLY.

WARNING

The vanes are held against the cam ring by tension from the springs in the rotor. If the rotor is pulled from the cam ring with no protection, tension from the springs will throw the vanes out in all directions. The following procedure must be followed when dis-assembling the rotor and vanes from the cam ring.

- a. Place cam ring assembly on a clean, flat surface.
- b. Push rotor and vanes from cam ring far enough to secure a piston ring compressor over vanes (9) and around rotor (8).
- c. After compressor is in place, push rotor and vanes remainder of way out of cam ring.
- d. Release tension on compressor and remove vanes (9) and vane springs (10) from rotor (8).

6. REMOVE SETSCREW (25), VALVE ADAPTER (24), PACKING (13) AND RUBBER SEAL (14).

- a. Remove special setscrew (25) in the side of port plate assembly (12).
- b. Remove valve adapter (24) from the drilled passage.

NOTE

The drilled holes in port plate must be clean and free from burrs.

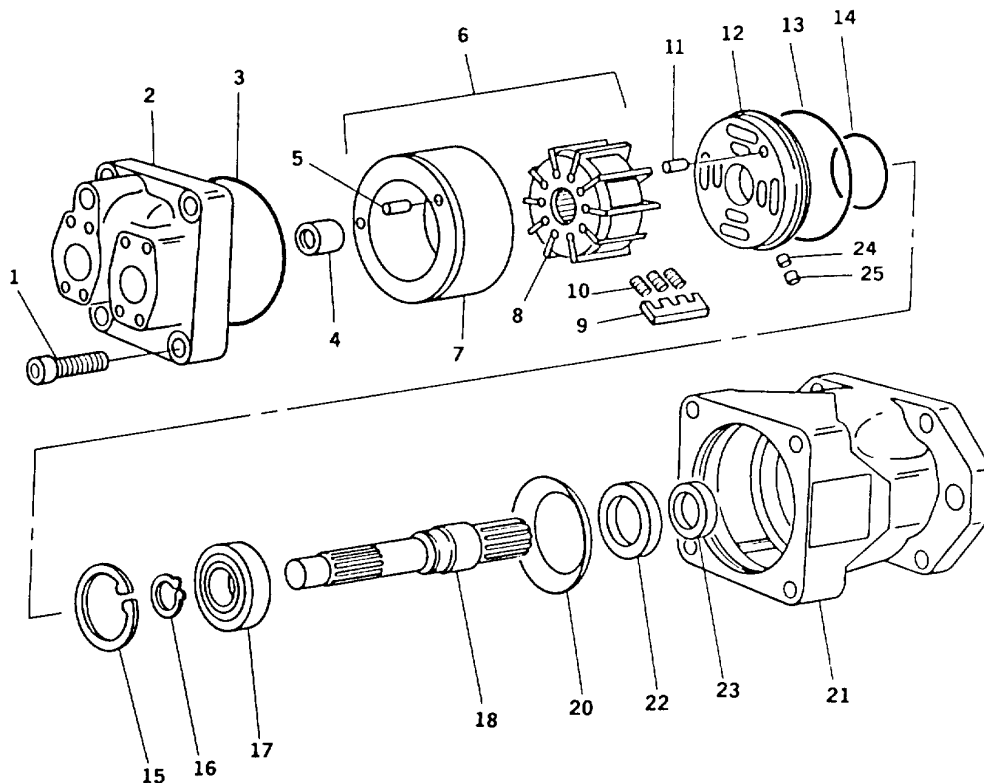
- c. Remove packing (13), rubber seal (14) and Belleville washer (20). Discard packing (13) and seal (14).

5. REMOVE PORT PLATE (12).

- a. Remove dowel pin (11) from port plate assembly (12). Note location of dowel pin (11) in relation to body (21) for reassembly.
- b. Thread two 1/4-20 screws into puller holes in port plate assembly (12) and remove it from body (21).

7. REMOVE SHAFT (18).

- a. Remove snap ring (15) from body (21).



- b. Press on external end of shaft (18) and remove shaft (18) and bearing (17) from body.
- c. Remove external snap-ring (16) and press bearing (17) from shaft (18).
- d. Remove and discard wiper seal (23) and shaft seal (22) from body (21).

CLEANING:

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°C-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

- 1. WASH ALL METAL PARTS IN P-D-680 AND DRY THOROUGHLY.

INSPECTION:

- 1. INSPECT PARTS FOR DAMAGE.

- a. Inspect seals for wear, breaks, cuts, brittleness, scratches and cracks. Discard and replace all defective seals.
- b. Inspect all springs for wear on OD, for cracks or permanent set. Replace all defective springs.
- c. Inspect bearings for wear or flat spots. If bearing are rough or loose they must be replaced.
- d. Inspect cam ring for excessive wear (ripples or washboard marks on contour). Replace a badly worn or defective cam ring.
- e. Inspect rotor for scored, marred, or scratched (faces and vane slots) surfaces. Replace defective rotor.
- f. Inspect vanes for excessive wear marks (burrs, nicks, and scoring). Replace any defective vanes.
- g. Inspect wear surfaces of port plate and end cap for deep scratches. Replace if defective.
- h. Inspect body and end cap for cracks or other casting damage. Replace all damaged castings.
- i. Inspect shaft for excessive wear (internal, spline, bearing surface, and drive end). Replace if defective.

CAUTION

Dirt is a major cause of wear and motor failure. Cover all parts after cleaning to prevent dust and dirt from settling on them. All surfaces should be coated with a film of hydraulic lubricating oil after they have been cleaned.

ASSEMBLY:

NOTE

Tools are required to properly install the shaft oil seal. A driver must be used to install the shaft seal. A protective cone must be used over the shaft end to prevent damage to the shaft seal when installing the shaft.

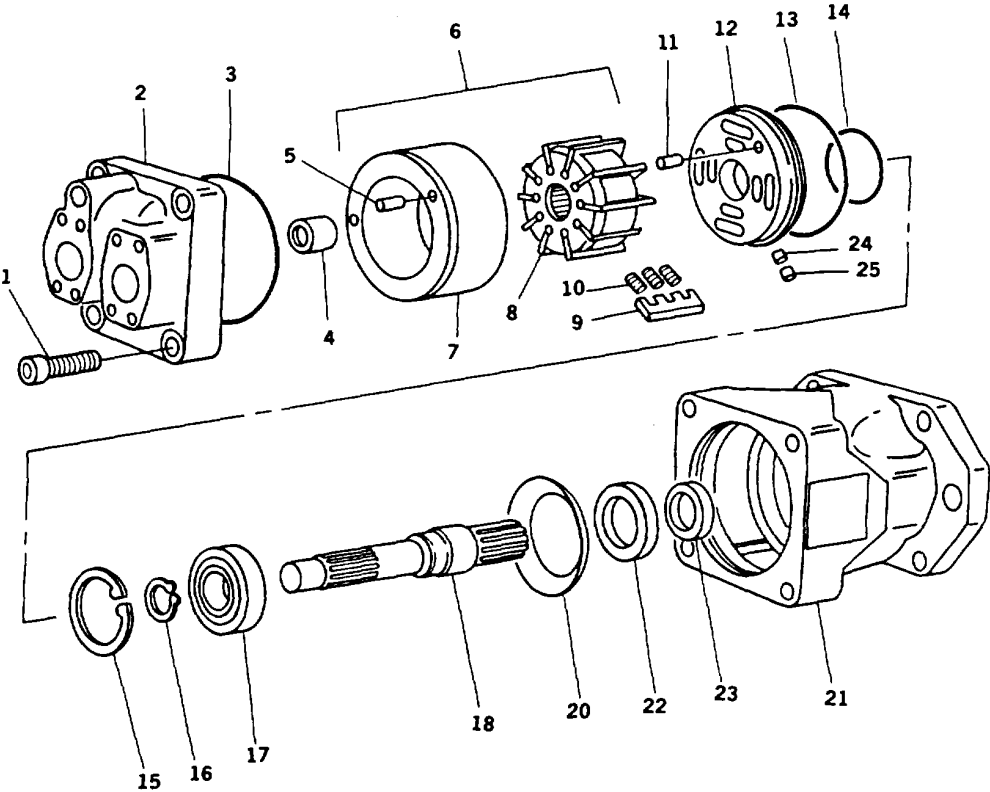
- 1. SOAK SEALS AND BEARINGS IN CLEAN HYDRAULIC OIL.
- 2. INSTALL WIPER SEAL (23).
 - a. Position body (21) on a clean, flat surface with small open end up.
 - b. Press new wiper seal (23) in 2-1/16 inch hole. Wiper seal must be flush with bottom of counterbore.

- 3. INSTALL SHAFT SEAL (22) AND BEARING (17).
 - a. Turn body (21) over with large open end facing up.
 - b. Use shaft seal driver (Item 1, Appendix C) and drive shaft seal (22) into body (21) until it seats in counterbore.

NOTE

Ensure open side of seal is toward inside of the body.

- c. Press bearing (17) on shaft (18) to shoulder and install external snap ring (16).
- d. Ensure ring is seated in snap ring groove.
- 4. INSTALL SHAFT (18).
 - a. Apply lubricating fluid to inside of shaft seal (22) and wiper seal (23).



- b. Install protective cone (Item 2, Appendix C) over shaft (18) extension to protect shaft seal.
 - c. Press shaft and bearing assembly (16), (17), and (18) into body (21).
 - d. Install snap ring (15) in body (21) and against bearing (17) to hold shaft assembly in place.
 - e. Ensure snap ring (15) is fully seated in groove.
5. INSTALL VALVE ADAPTER (24), SETSCREW (25), PACKING (13) AND RUBBER SEAL (14).

NOTE

The setscrew and the port plate including the internal threads must be degreased. Apply a very small amount of Loctite No. 242 to the setscrew (25) only. An excessive amount of Loctite on the screw would force Loctite into the valve adapter bore when the screws are installed. Allow the Loctite to cure for one hour after installing the screw.

- a. Insert valve adapter (24) into bore and install setscrew (25) and tighten.
- b. Tilt port plate sub-assembly back and forth to be certain that spool travels full length of bore.
- c. Lubricate new packing (13) and seal (14) with hydraulic oil and then install on back of port plate.

- d. Place some heavy grease on section seal (14) on back of port plate (12) and on Belleville washer (20).
 - e. Install Belleville washer (20) with the inside diameter on section seal and outside diameter against port plate.
6. INSTALL PORT PLATE (12).
- a. Insert dowel pin (11) in hole in face of port plate assembly.
 - b. Thread two 1/4-20 screws in tapped holes in face of the port plate assembly (12) and position plate (12) in body (21) with dowel pin (11) in approximate position noted in disassembly. DO NOT SEAT.
7. ASSEMBLE CAM RING (6).

CAUTION

Ensure the springs are started in the holes in each rotor slot.

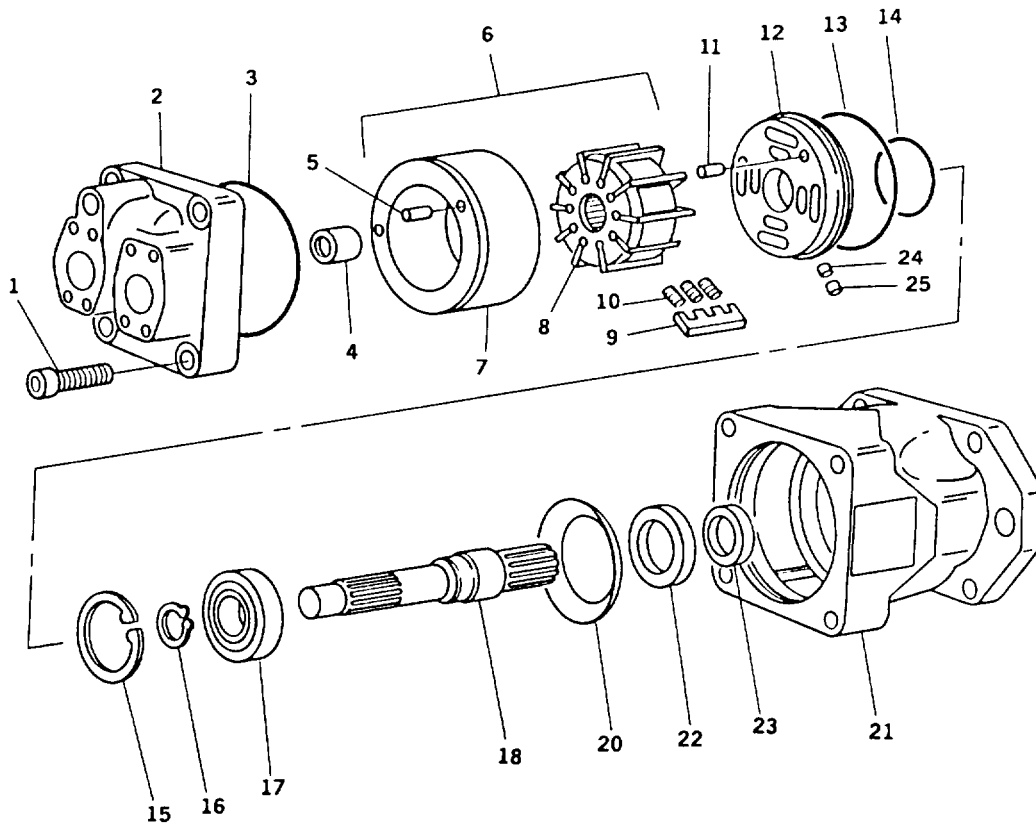
- a. Place cam ring (7), rotor (8), vanes (9), and vane springs (10) on clean flat surface.
- b. Arrange vanes side by side with three spring holes up.
- c. Insert vane springs in vanes.
- d. Install vanes with springs in slots in rotor.

WARNING

Ensure the rotor and vane assembly is inserted far enough in the cam ring to prevent the vanes from flying out of position when the ring compressor is removed.

- e. Place ring compressor around vanes and tighten the compressor gradually until springs and vanes are in position they will occupy while in cam ring.
 - f. Place backup plate, slightly smaller than outside diameter of rotor in ring compressor and push rotor, springs, and vanes into cam ring. The backup plate will prevent vanes from sliding end wise in rotor slots and damaging slots and springs.
8. INSTALL CAM RING (6).
- a. Thread two 1/4-20 screws into cam ring assembly on the same side of the ring that indicates cam size.
 - b. Insert dowel pin (5) in cam ring and position complete assembly in body over other dowel pin (11). DO NOT SEAT.
- c. Lubricate new rubber seal (3) and install it on cap (2).
9. INSTALL END CAP (2).
- a. Press needle bearing (4) into end cap (2) with bearing 0.0625-in. (1.58 mm) below face of cap.
 - b. Position end cap (2) over dowel pin (5). Hold the end cap firmly against cam ring assembly and rotate to line up bolt holes.
 - c. Insert capscrews (1) and tighten evenly to 130 ft-lbs (173 Nm).
10. INSTALL HOIST MOTOR. (REFER TO PAGE 15-50.)

END OF TASK



HOIST MOTOR CONTROL VALVE INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Clean rags (Item 2, Appendix B)
 Lockwashers (Item 13, Appendix B) (8 Required)
 Hydraulic oil (Item 8, Appendix B)
 Packing assortment (Item 14, Appendix B)
 Preformed packing (Item 15, Appendix B)
 Preformed packing (Item 16, Appendix B)
 Preformed packing (Item 17, Appendix B)
 Loctite 545 (Item 18, Appendix B)

EQUIPMENT CONDITIONS: All hydraulic systems shutdown and pressure relieved from lines. (Refer to TM 5-3810-306-20.)
 Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE HOIST MOTOR CONTROL VALVE (4).
 - a. Tag hydraulic lines to control valve (4).
 - b. Remove four capscrews (1), lockwashers (2) and hydraulic line (3) from control valve (4). Remove and discard packing (9).
 - c. Remove hydraulic hose (10), fitting (12) and preformed packings (11) and (13) from control valve. Discard packings (11) and (13).
 - d. Remove four nuts (5), lockwashers (6) and bolts (7) securing valve (4) to hoist piping. Remove valve (4).
 - e. Remove and discard packing (8) from valve (4).

NOTE

The only repair authorized on hoist motor control valve (4) is the replacement of cap packings.

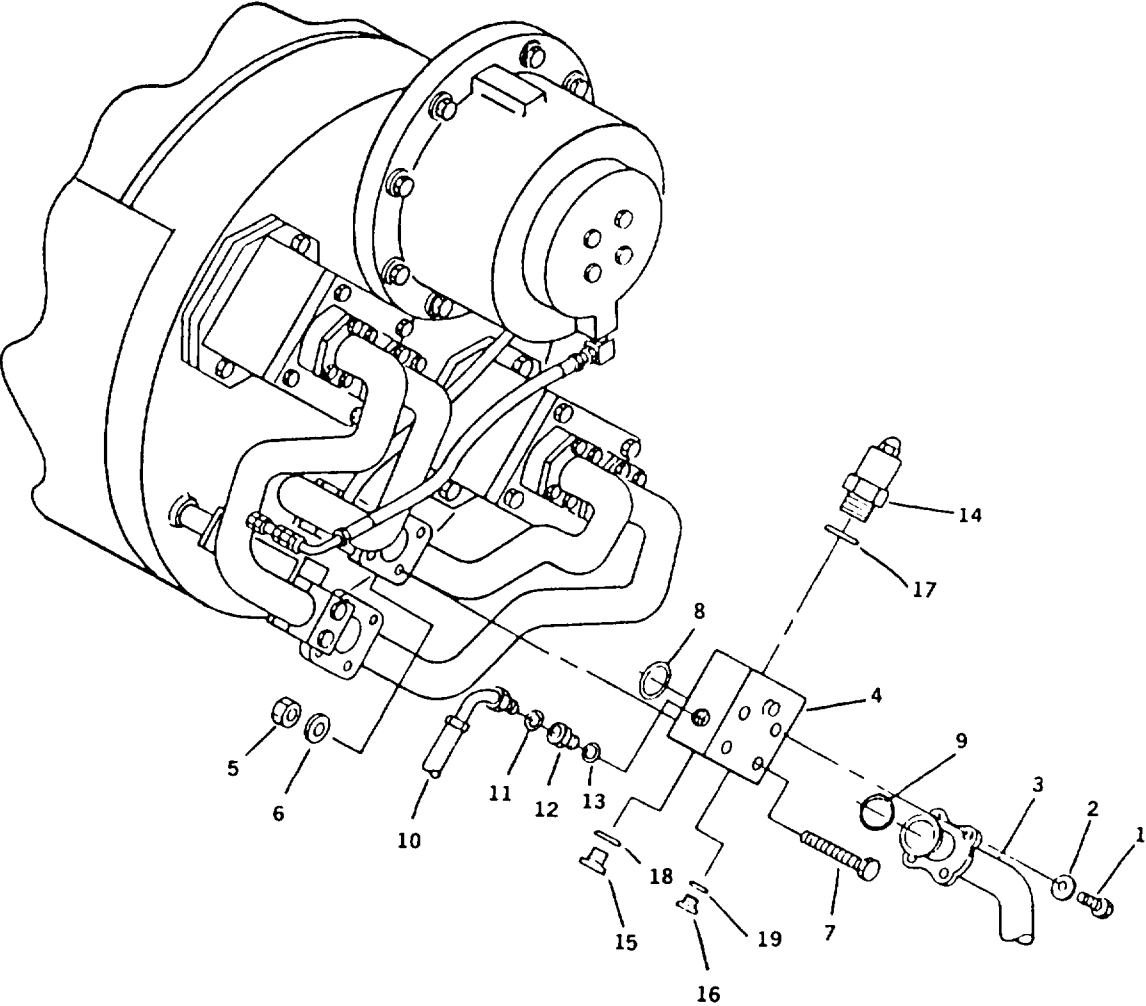
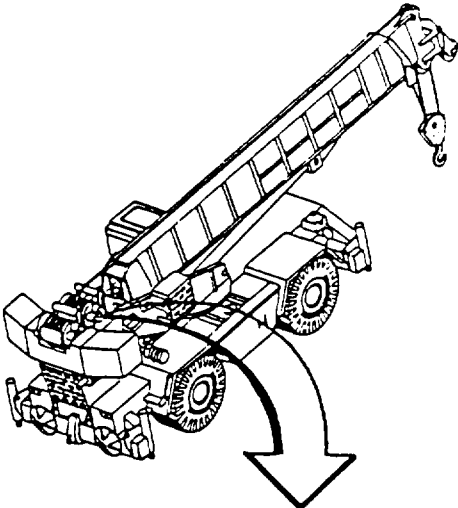
WARNING

Caps (14), (15) and (16) are installed with spring tension. Remove caps carefully to prevent parts from popping out and causing personal injury.

2. REMOVE CAP PACKINGS (17), (18) AND (19).
 - a. Remove caps (14), (15) and (16) from control valve (4).
 - b. Remove and discard packings (17), (18) and (19).

NOTE

If internal parts are removed from valve (4), ensure that positioning is noted and maintained.



INSTALLATION:

NOTE

Prior to installation coat threads of lines and fittings with Loctite 545. Coat seals and packings with clean hydraulic oil.

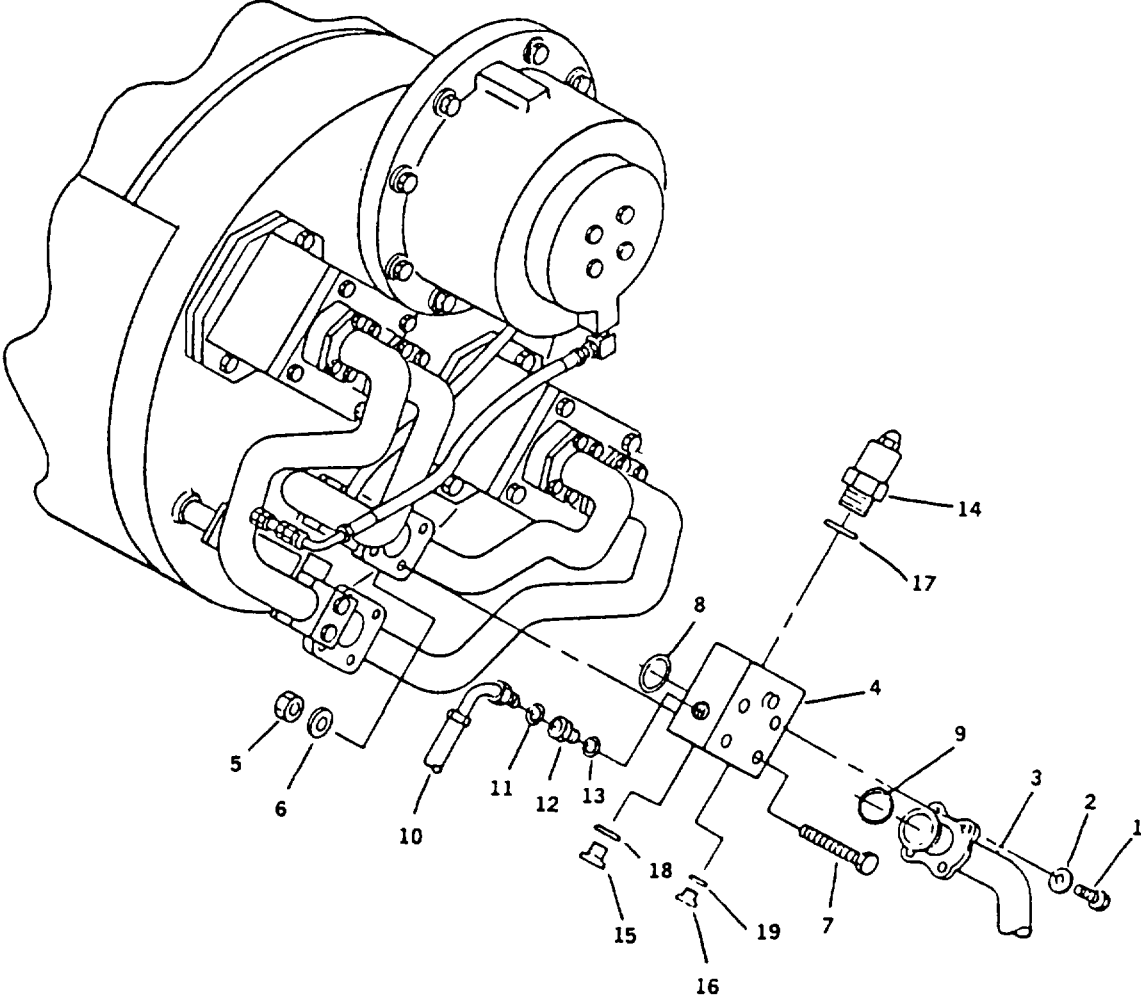
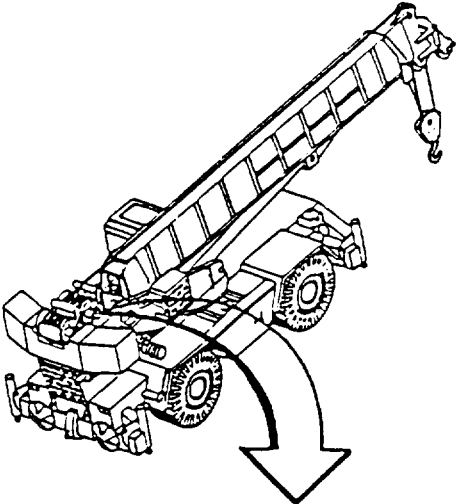
NOTE

If internal parts were removed from valve (4), make sure they are installed in positions marked on removal.

1. INSTALL NEW PACKINGS (17), (18) AND (19), AND CAPS (14), (15) AND (16) IN CONTROL VALVE (4).
2. INSTALL HOIST MOTOR CONTROL VALVE (4).

- a. Install new packing (8) onto valve.
 - b. Install valve (4) onto hoist piping and secure with four bolts (7), lockwashers (6) and nuts (5).
 - c. Install new packing (9), four capscrews (1), and lockwashers (2) to secure hydraulic line (3).
 - d. Install fitting (12), new preformed packings (11) and (13) and hydraulic hose (10) to control valve (4).
3. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
 4. START-UP HYDRAULIC SYSTEM AND CHECK FOR LEAKS.
 5. TEST FOR PROPER OPERATION.

END OF TASK



HOIST BRAKE INSTALLATION AND ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Preformed packing (Item 263, Appendix B) (3 Required)
 Parts kit (Item 77, Appendix B)
 Loctite #242 (Item 6, Appendix B)

EQUIPMENT CONDITIONS: Pressure relieved from hydraulic system.
 (Refer to TM 5-3810-306-20.)
 Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)
 Headache ball or hook block lowered to ground.
 (Refer to TM 5-3810-306-10.)

REMOVAL:

1. REMOVE BRAKE ASSEMBLY (1).
 - a. Disconnect lines (25), (26) and (27) from brake assembly (1). Remove and discard packings (28).
 - b. Remove bolts (2) and washers (3) securing brake assembly (1) to hoist.
 - c. Remove brake assembly (1) from hoist.
 - d. Cover open end of brake assembly (1).

NOTE

If brake discs are to be replaced, perform the following.

2. REMOVE OVERRUNNING CLUTCH (4).
 - a. Knock tab of key washer (5) from its seat on locknut (6).
 - b. Using a spanner wrench, remove locknut (6) and key washer (5).
 - c. Remove overrunning clutch (4) and key (7) from pinion shaft (9).

- d. Remove bearing spacer (8) from pinion shaft (9).

3. REMOVE BRAKE DISCS (10).

- a. Place brake assembly in press.

NOTE

Two large C-clamps can be used to compress the springs for removal of the snap ring.

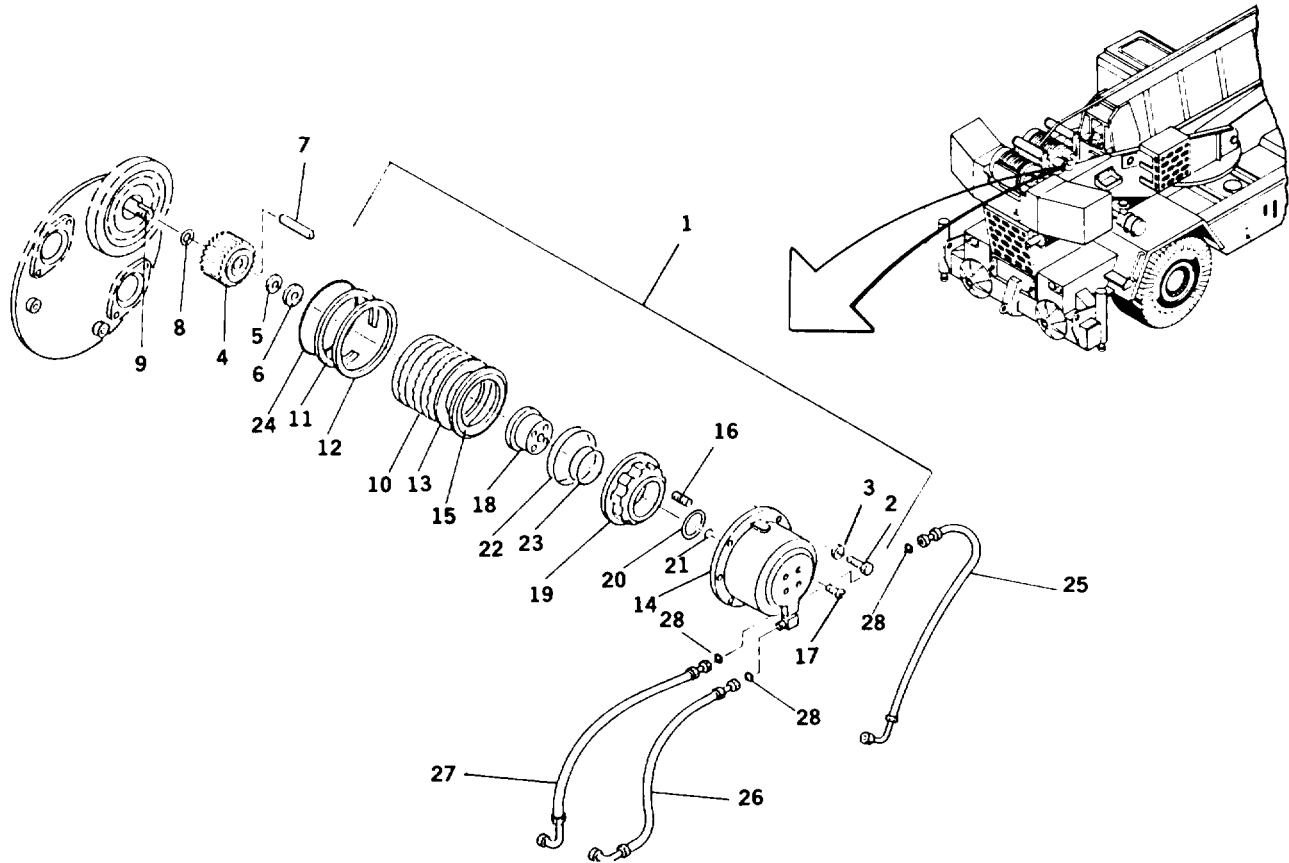
- b. Using a suitable sleeve, compress brake spring and remove snap ring (11).
- c. Remove backing plate (12).
- d. Remove brake discs (10) and stators (13) and set them aside.

NOTE

There are seven brake stators and six brake discs.

4. REMOVE BRAKE HOUSING (14).

- a. Remove pressure plate (15).



- b. Turn brake housing (14) upside down on a wood block about five inches high and with a circumference less than that of the housing.
- c. Lift housing from piston assembly and remove springs (16).
- d. Remove four capscrews (17) to free piston assembly still inside. The block will prevent the piston assembly from falling.
- e. Using soft faced hammer, tap brake piston (18) from brake cylinder (19).
- f. Remove and discard preformed packings (20), (21), (22), and (23) from brake piston (18) and brake cylinder (19).

- g. Remove and discard preformed packing (24) from brake housing (14).

CLEANING:

WARNING

Dry cleaning solvent P-D680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°C-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately

WARNING (Cont'd)

and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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

CAUTION

Do not use gasoline as solvent.

1. CLEAN ALL PARTS THOROUGHLY IN SOLVENT AND DRY WITH COMPRESSED AIR.

INSPECTION:

1. INSPECT ALL PARTS FOR WEAR AND OBVIOUS DAMAGE.
2. MEASURE SPRINGS (16).
 - a. Springs (16) should measure 2.5 in. (63.5 mm) long (free length).
 - b. If any spring measures less than 2.375 in. (60.325 mm) all nine springs should be replaced.

INSTALLATION:

1. INSTALL BRAKE PISTON (18).
 - a. Lubricate preformed packings (20), (21), (22), and (23) and brake piston (18) with clean hydraulic oil.

CAUTION

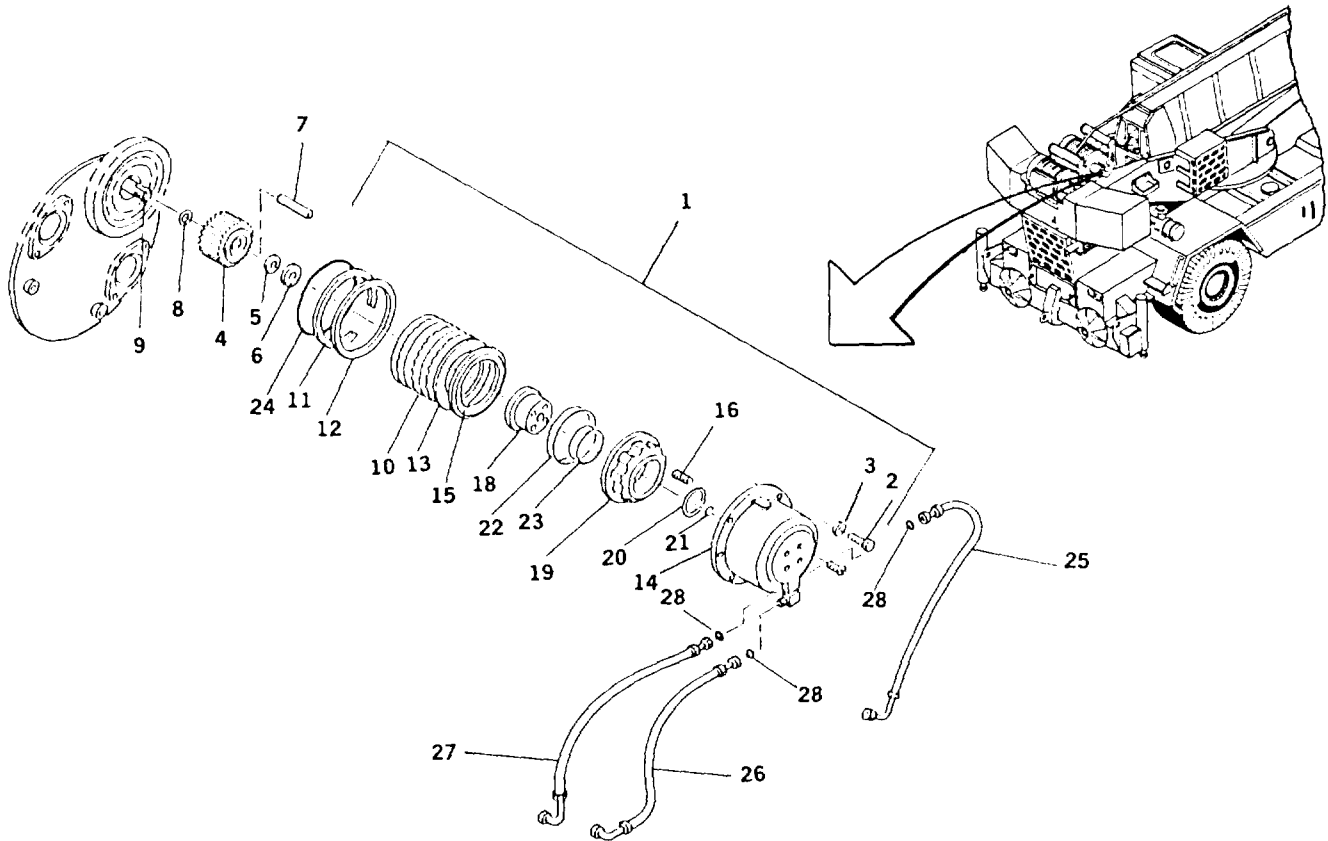
Do not damage the preformed packings.

- b. Install two new preformed packings (22) on side of brake piston (18).
 - c. Install two new preformed packings (23) on brake cylinder (19).
 - d. Lubricate piston and cylinder mating surfaces with light coating of oil.
 - e. Start brake piston (18) into brake cylinder (19). Ensure bolt holes in end of brake piston are aligned so vent hole will face up when installed in brake housing (14) and mounted on hoist.
 - f. Use soft faced hammer to tap brake piston (18) into brake cylinder (19).
 - g. Install new preformed packings (20) and (21) on end of piston (18).
2. SET NINE BRAKE SPRINGS (16) INTO POSITION ON CAST SPROCKET OF BRAKE CYLINDER (19).
 3. INSTALL BRAKE HOUSING (14).
 - a. Set piston/cylinder assembly on wood block about five inches high and with a circumference less than that of brake housing (14).

WARNING

Ensure the brake cylinder is installed so the vent hole will be at the top when installed on the hoist.

- b. Set brake housing (14) over piston cylinder assembly aligning the capscrew holes.



- c. Apply Loctite to threads of capscrews (17).
 - d. Install capscrews (17) and torque to 75 ft-lbs (100 Nm).
4. ASSEMBLE BRAKE DISCS (10).
- a. Set housing face down.
 - b. Place one inch (25.4 mm) block in housing on piston to act as a spacer in aligning brake discs and plates.
 - c. Set overrunning clutch (4) in position in housing.

NOTE

The pressure plate (15) is thicker than the backing plate (12).

- d. Install pressure plate (15).

NOTE

There are seven brake stators (13) and six brake discs (10). Two brake stators (13) are flat and should be installed first and last. The other five brake stators (13) are concaved. Each should be installed with the hump side up.

- e. Install brake stator (13) and brake disc (10) alternating until all stators and discs are installed. The last one should be a brake stator.
- f. Install backing plate (12).

5. ASSEMBLE HOIST BRAKE.
 - a. Place brake housing (14) in press.
 - b. Using sleeve larger than overrunning clutch, push down on backing plate (12) far enough so snap ring (11) can be installed securely.
 - c. Remove brake housing from press.
 - d. Remove overrunning clutch (4).
 - e. Place new preformed packing (24) in groove in housing.

6. INSTALL OVERRUNNING CLUTCH (4).
 - a. Install bearing spacer (8) on pinion shaft (9).

NOTE

The direction of free rotation of the overrunning clutch (4) should be counterclockwise.

- b. Install overrunning clutch (4) on pinion shaft (9) and secure with key (7).
- c. Install keywasher (5) and locknut (6). Torque locknut (6) to 20 ft-lbs (27 Nm).

- d. Lock locknut (6) by bending a tab of keywasher (5) into corresponding groove of the locknut (6).

7. INSTALL BRAKE ASSEMBLY (1).

NOTE

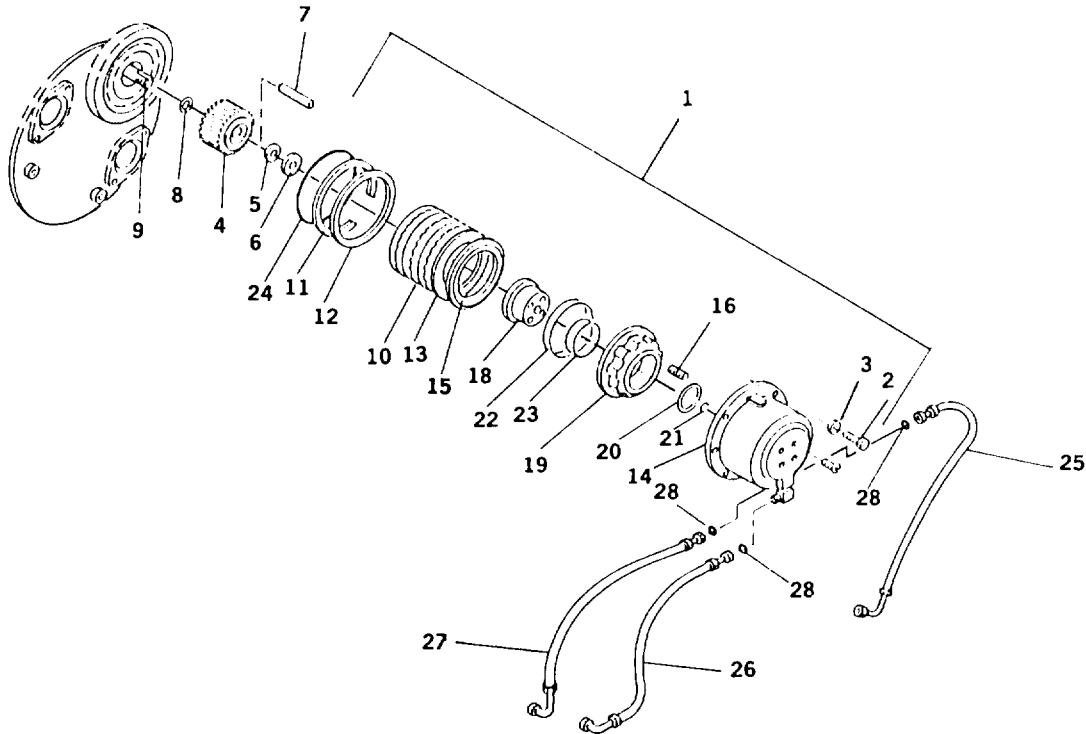
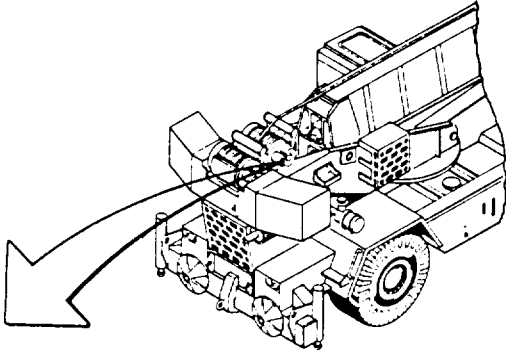
Ensure the plugged hole is at the top when installing the brake assembly (1).

- a. Install brake assembly (1) over overrunning clutch, using a soft faced hammer to tap brake in place.
- b. Apply Loctite to hex head bolt threads (2).
- c. Secure brake assembly with hex head bolts (2) and lockwashers (3). Torque hex head bolts (2) to 31 ft-lbs (41 Nm).
- d. Install new packings (28) and connect lines (25), (26) and (27) to brake assembly (1).

8. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)

9. START CRANE AND CHECK HOIST BRAKE FOR PROPER OPERATION AND LEAKS.

END OF TASK



Section III. TURNTABLE MAINTENANCE

SWIVEL INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1 (4910-00-754-0706)
 Tool Outfit Hyd System; Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784)

SUPPLIES: Preformed packing (Item 106, Appendix B) (4 Required)
 Preformed packing (Item 107, Appendix B) (3 Required)
 Preformed Packing (Item 108, Appendix B) (3 Required)
 Preformed packing (Item 90, Appendix B)
 Preformed packing (Item 117, Appendix B) (3 Required)
 Preformed packing (Item 118, Appendix B) (6 Required)
 Preformed packing (Item 15, Appendix B) (2 Required)
 Hydraulic oil (Item 8, Appendix B)
 Cotter pins (Item 110, Appendix B) (2 Required)
 Loctite 545 (Item 18, Appendix B)
 Oak Posts (Item 39, Appendix B) (2 Required)

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)
 Outriggers fully extended and lowered. (Refer to TM 5-3810-306-10.)
 Boom over front and elevated for access to swivel. (Refer to TM 5-3810-306-10.)
 Air system purged. (Refer to TM 5-3810-306-20.)
 All hydraulic systems shutdown and pressure relieved in lines. (Refer to TM 5-3810-306-20.)

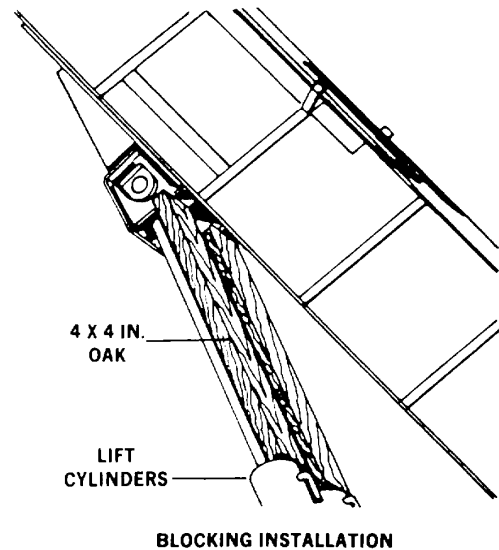
REMOVAL:

1. SUPPORT BOOM.

NOTE

This blocking is to add extra support for the boom. Any seepage or leakage in the holding valve or internally in the cylinder will allow the boom to settle over a period of time.

- a. Measure the distance from the top of the lift cylinders to the base of the boom section where the lift cylinder attaches. Cut a piece of 4 x 4-in. (10.16 x 10.16 cm) oak to fit.

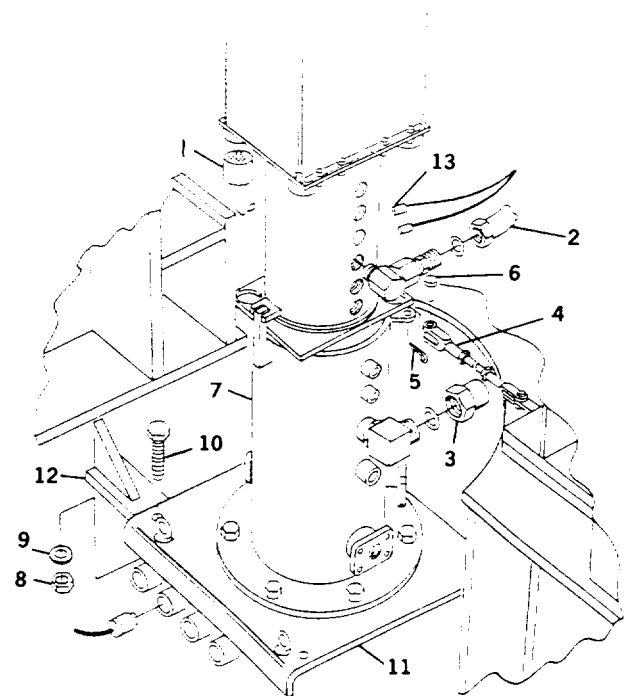
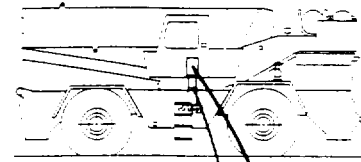


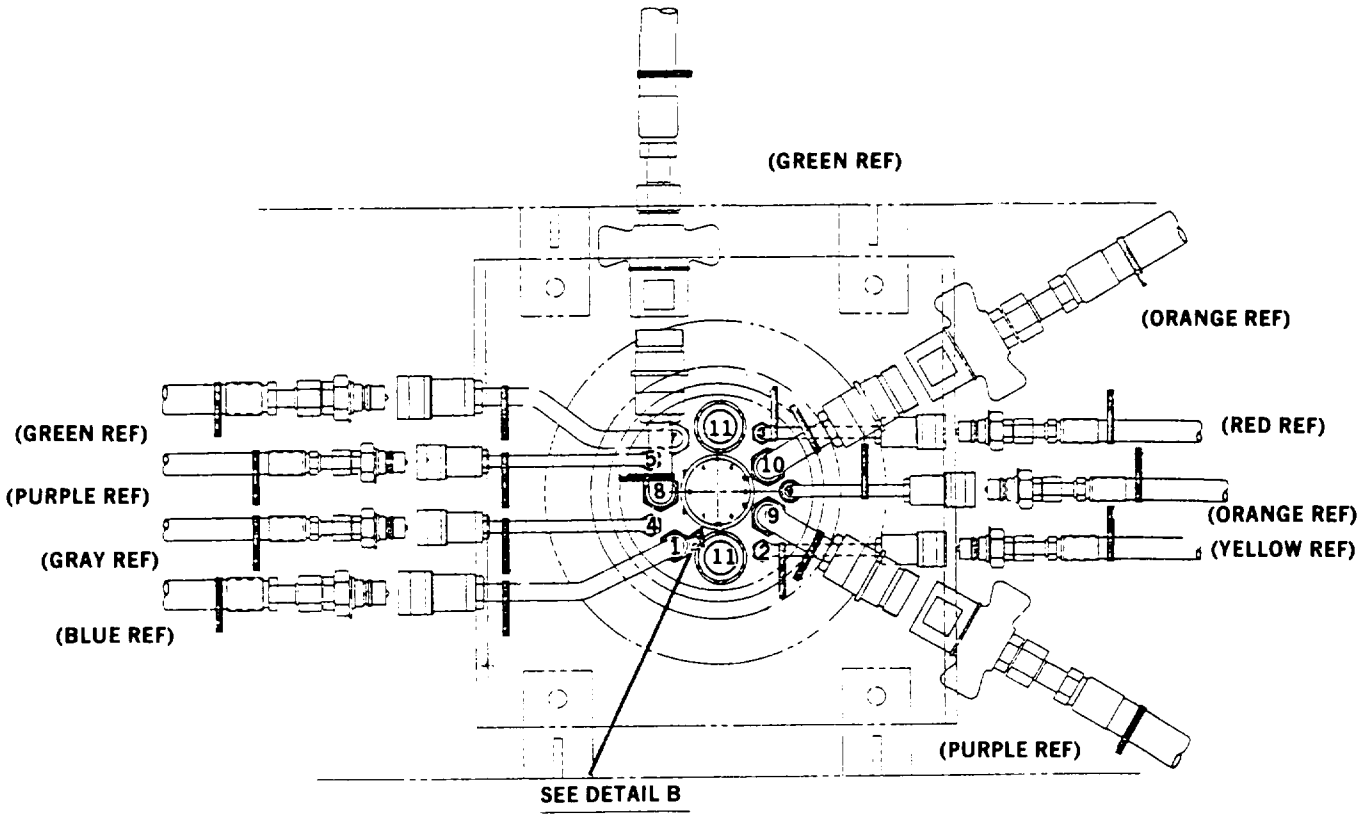
- b. Use the oak blocking to block between the barrel of the lift cylinders and the boom base section.
- 2. TAG AND DISCONNECT TWO WIRES (13) TO AREA DEFINITION SWITCH.
- 3. TAG AND DISCONNECT FOUR ELECTRICAL CONNECTORS (1) TO ELECTRIC SWIVEL.
- 4. TAG AND DISCONNECT HYDRAULIC AND AIR LINES TO SWIVEL BARREL.
 - a. Tag and disconnect twelve lines (2) from air/transmission swivel.
 - b. Tag and disconnect twelve lines (3) from hydraulic swivel.
- 5. DISCONNECT TWO ROD AND LINK ASSEMBLIES (4).
 - a. Remove two cotter pins (5) and hitch clip pins (6) securing rod and link assemblies to swivel. Position rods and links out of way of swivel.
- 6. UNCOUPLE 22 QUICK DISCONNECT COUPLERS AT BOTTOM OF SWIVEL. CAP OPENINGS WITH ATTACHED CAPS.

NOTE

Connections are size matched or color coded to ensure correct replacement.

- 7. TAG AND DISCONNECT THREE ELECTRICAL CONNECTORS TO ELECTRICAL SWIVEL.
- 8. REMOVE SWIVEL (7).
 - a. Remove four nuts (8) washers (9) and capscrews (10) securing swivel mounting channel (11) to mounting brackets (12).



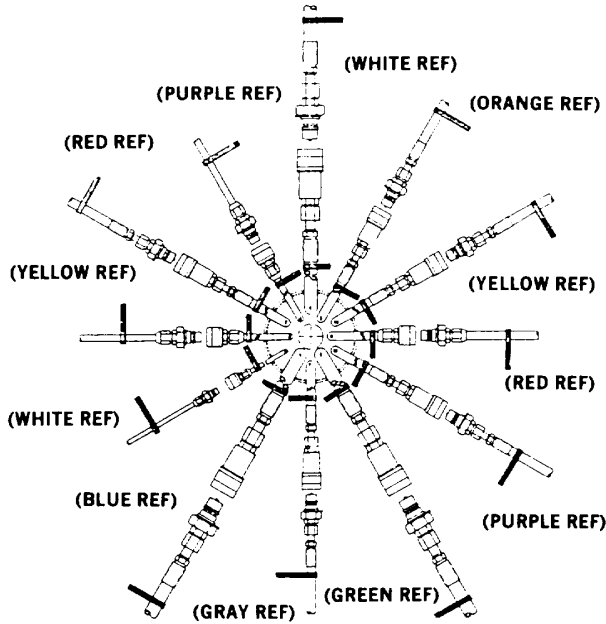


OUTER SPOOL HOSE ARRANGEMENT
VIEW FROM BOTTOM

- b. Attach an appropriate sling to swivel. Using a suitable lifting device attached to sling, raise swivel slightly. Tilt swivel assembly to side while lowering and allow one side of mounting channel to clear under mounting brackets (12). Continue to lower, favoring the one side in order to allow other side of mounting channel to clear brackets (12).

CAUTION

Ensure steel lines are not damaged during swivel removal.



INNER SPOOL HOSE ARRANGEMENT

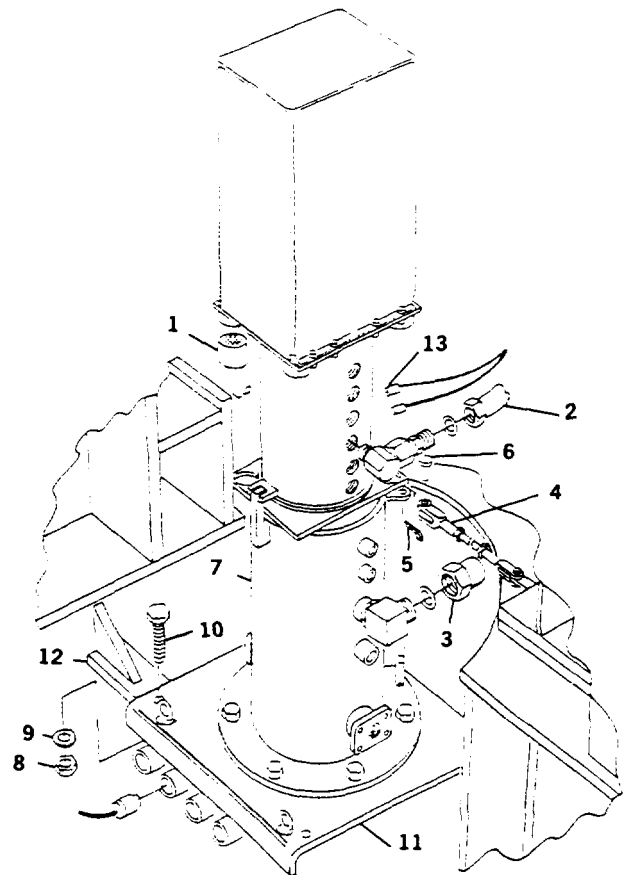
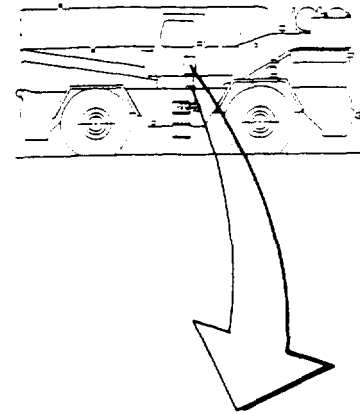
NOTE

For ease in removal, it may be necessary to loosen hydraulic line from swivel to front steer relief valve and position out of way of swivel.

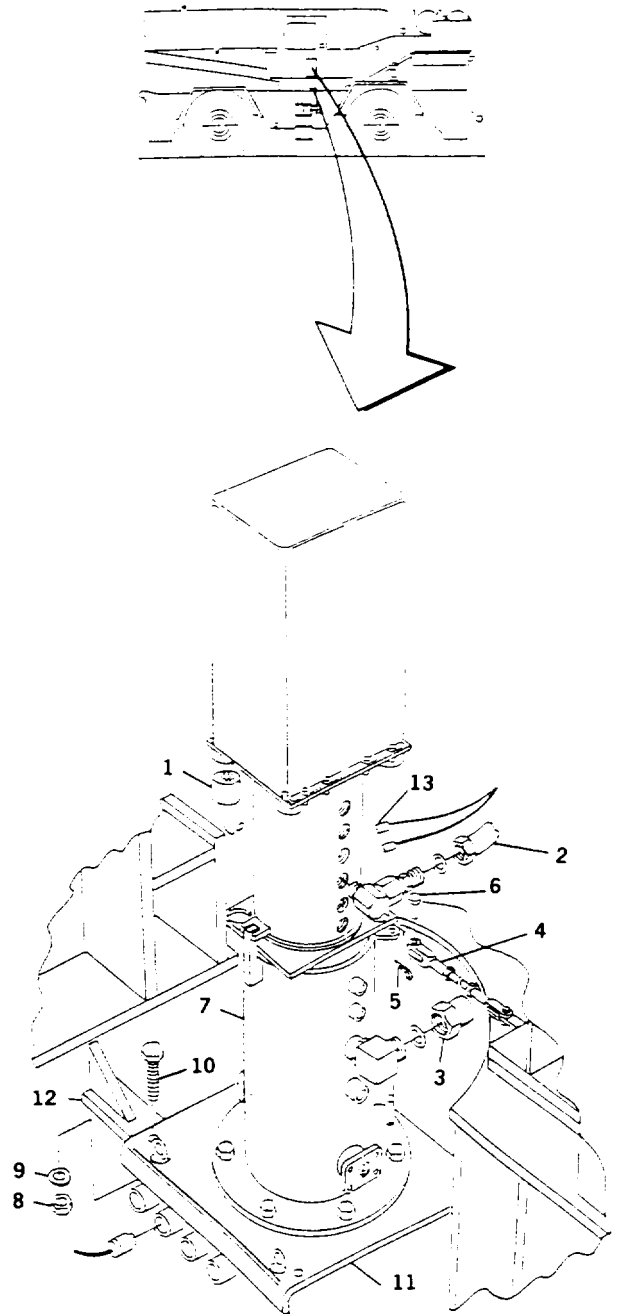
- c. Lower swivel down through hole onto suitable dolly.
- d. Remove lifting device and sling from swivel, roll swivel out from underneath crane.

INSTALLATION:

1. **INSTALL SWIVEL (7).**
 - a. Position swivel (7) on dolly, attach an appropriate sling and roll under crane.
 - b. Lower suitable lifting device through center hole in turntable and attach to sling.
 - c. Slowly raise swivel (7) through hole favoring one side until mounting channel (11) is past mounting brackets (12).
 - d. Continue to raise swivel (7) favoring one side until other side of mounting plate (11) clears mounting brackets (12).
 - e. Lower swivel (7) and mounting channel (11) onto mounting brackets. Align holes and install four cap screws (10), washers (9) and nuts (8). Torque nuts to 250 ft-lbs (333 Nm).
 - f. Remove sling and lifting device.



2. CONNECT HYDRAULIC AND AIR LINES TO SWIVEL (7).
 - a. Join 22 tagged quick disconnect couplers to bottom of swivel. Tighten hose to steer relief valve as necessary.
 - b. Install twelve lines to hydraulic swivel. Use new preformed packings and coat threads with Loctite 545.
 - c. Install twelve lines to air/transmission swivel. Use new preformed packings and coat threads with Loctite 545.
3. CONNECT FOUR TAGGED ELECTRICAL CONNECTORS (1) TO ELECTRICAL SWIVEL.
4. CONNECT THREE TAGGED ELECTRICAL CONNECTORS TO CARRIER HARNESS.
5. CONNECT TWO ROD AND LINK ASSEMBLIES (4).
 - a. Align hole in yoke with hole in ear on swivel barrel. Install hitch clip pins (6) and secure with new cotter pins (5).
6. CONNECT TAGGED WIRES (13) TO AREA DEFINITION SWITCH.
7. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
8. REMOVE BLOCKING FROM LIFT CYLINDER.
9. START CRANE. TEST FOR PROPER OPERATION AND INSPECT FOR LEAKS.



END OF TASK

AIR/TRANSMISSION SWIVEL INSTALLATION

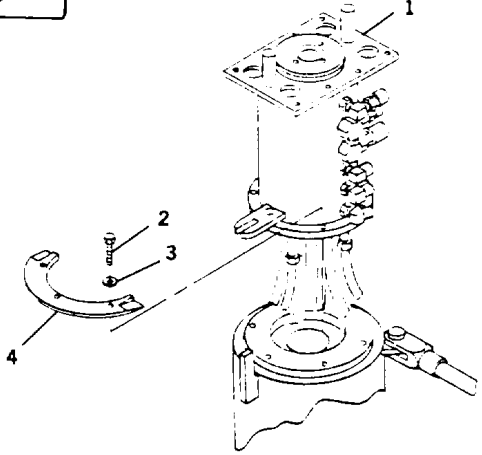
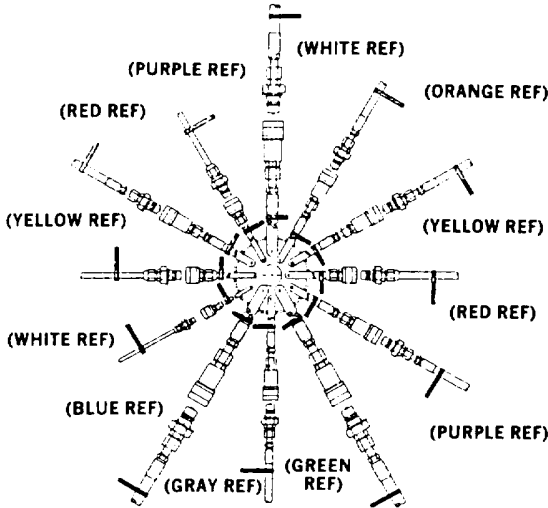
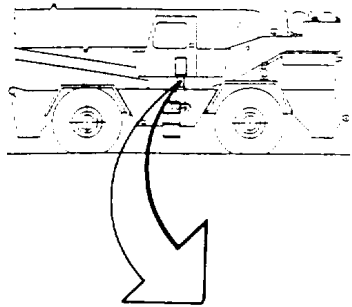
TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Lockwashers (Item 109, Appendix B)
Preformed packing (Item 106, Appendix B) (8 Required)
Preformed packing (Item 114, Appendix B) (4 Required)
Preformed packing (Item 115, Appendix B)
Preformed packing (Item 116, Appendix B) (8 Required)

EQUIPMENT CONDITIONS: Air system is purged. (Refer to TM 5-3810-306-20.)
Hydraulic pressure depleted.
(Refer to TM 5-3810-306-20.)
Negative battery cable disconnected at shunt.
(Refer to TM 5-3810-306-20.)
Electrical swivel ring removed. (Refer to page 15-95.)
Area definition switch removed.
(Refer to TM 5-3810-306-20.)

REMOVAL:

- 1. REMOVE AIR/TRANSMISSION SWIVEL (1).
 - a. Tag and disconnect twelve oil and air lines from swivel barrel. Cap lines and openings.
 - b. Remove six socket head capscrews (2) and lockwashers (3) attaching switch actuating cam (4) and swivel casing to hydraulic swivel.

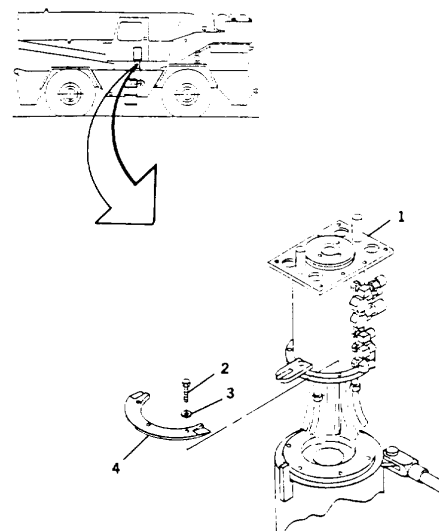


- c. Tag and disconnect lines from quick disconnect couplers below hydraulic swivel.
- d. To allow lines to pass through hydraulic swivel barrel, tag and remove couplers from air and hydraulic lines to air/transmission swivel.

CAUTION

When removing air/transmission swivel, ensure swivel is lifted vertically until all rigid pipe extensions are out of center of hydraulic swivel.

- e. Using an adequate lifting device, remove air/transmission swivel, extension tubes and hoses from hydraulic swivel.
- f. Remove hoses and extension tubes as required.



- c. Place switch actuating cam (4) in place on swivel casing and secure casing to hydraulic swivel using six capscrews (2) and lockwashers (3).
- d. Install tagged couplers onto appropriate hoses. Connect all couplers to tagged lines below hydraulic swivel.
- e. Install twelve air and oil lines to swivel barrel as tagged.

INSTALLATION:

CAUTION

When installing air/transmission swivel, ensure rigid pipe extensions are not bent or crimped.

- 1. INSTALL AIR/TRANSMISSION SWIVEL.
 - a. Position swivel and connect tagged oil and air lines to spool of the swivel.
 - b. Insert swivel, extension tubes and hoses into hydraulic swivel and install slotted arm into keying lug on hydraulic swivel barrel.

- 2. INSTALL AREA DEFINITION SWITCH AND ADJUST. (REFER TO TM 5-3810-30620.)
- 3. INSTALL ELECTRICAL SWIVEL. (REFER TO PAGE 15-95.)
- 4. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
- 5. START UP AIR SYSTEM. RETURN TO NORMAL PRESSURE. (REFER TO TM 53810-306-10.)
- 6. START UP HYDRAULIC SYSTEM. RETURN TO NORMAL PRESSURE. (REFER TO TM 53810-306-10.)
- 7. REMOVE BLOCKING FROM LIFT CYLINDERS.
- 8. TEST FOR PROPER OPERATION AND INSPECT FOR LEAKS.

END OF TASK

AIR/TRANSMISSION SWIVEL ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. (4910-00-754-0706)
 Tool Outfit Hyd System; Test and Repair, 3/4 Ton Trailer Mtd (4940-01-036-5784)

SUPPLIES: Hydraulic Oil (Item 8, Appendix B)
 Parts kit (Item 194, Appendix B)
 Solvent P-D-680 (Item 1, Appendix B)
 Packings as required

EQUIPMENT CONDITIONS: Air/transmission swivel removed. (Refer to page 15-75.)

DISASSEMBLY:

- d. Place spool on a clean work surface in a dust-free area and block spool to prevent movement during disassembly.

NOTE

Any maintenance requiring disassembly of swivel should include replacement of all seals and rings.

CAUTION

When removing seals and rings, avoid scratching the grooved and gland surfaces.

- 1. REMOVE SPOOL (3).
 - a. Tag and disconnect pipe extensions and fittings from bottom of spool.
 - b. Remove clips (1) and screws (2) that retain spool (3).
 - c. Withdraw spool (3) from swivel case (10).

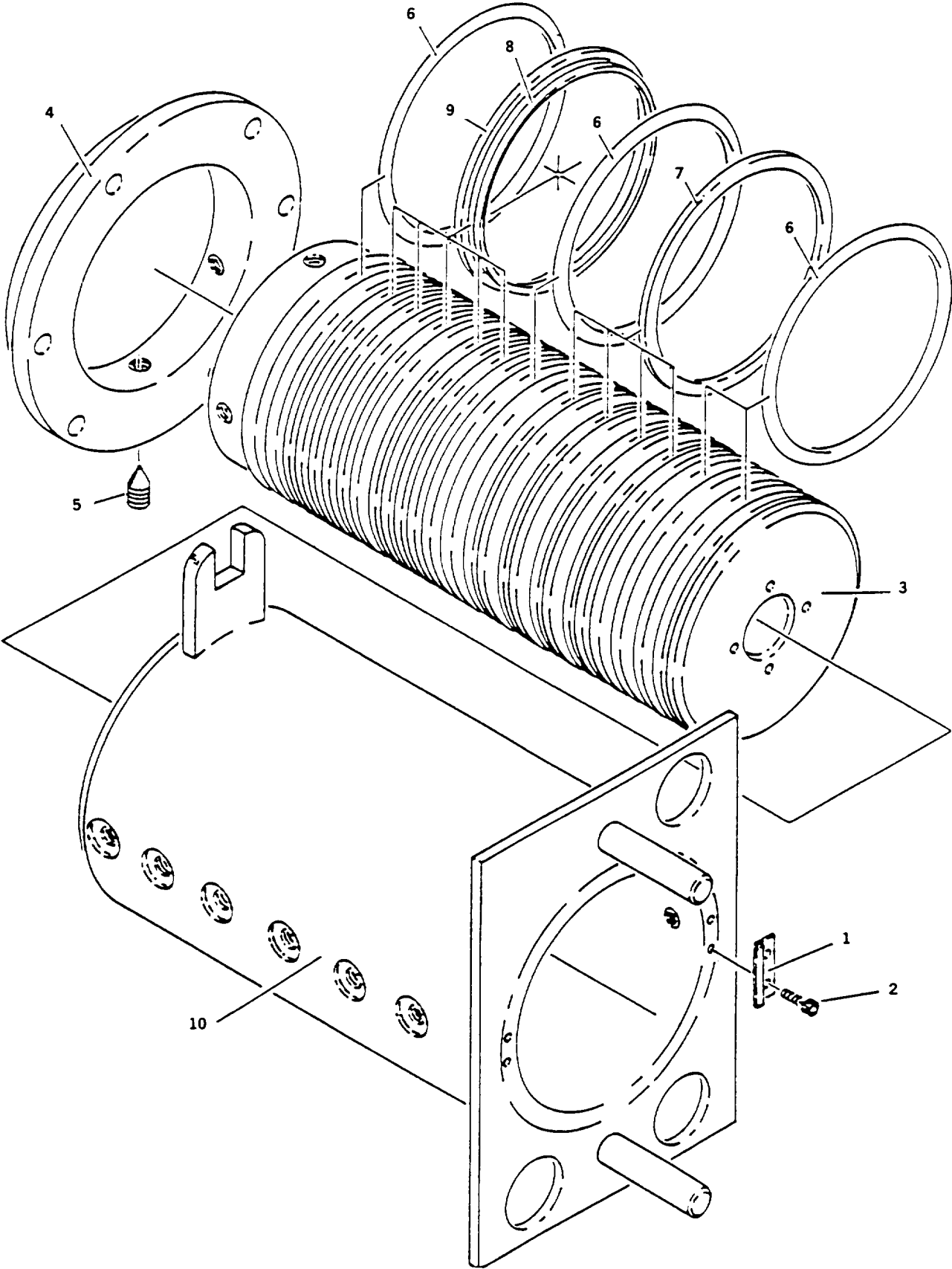
- 2. REMOVE THE SEALS (6), (7) AND (8) AND RINGS (9) FROM SPOOL (3).
 - a. Remove and discard four preformed packings (6), four crown seals (7), five bronze filled seals (8) and quad rings (9).

NOTE

During routine maintenance, it is not necessary to remove mounting plate. Use the mounting plate for blocking. However, if mounting plate is damaged and needs replacement, remove four screws (5) and mounting plate (4).

NOTE

Aligning discarded seals and rings in order of disassembly will assist with installation of new seals and rings.



CLEANING AND INSPECTION:**WARNING**

Dry cleaning solvent P-D680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

1. CLEAN SPOOL (3) AND SWIVEL CASE (10) WITH SOLVENT P-D-680 AND DRY WITH COMPRESSED AIR.
2. CHECK SPOOL (3) AND THE INSIDE OF THE SWIVEL CASE (10) FOR SCRATCHES, GROOVES, SCORING, ETC. IF ANY GROOVES HAVE DEVELOPED WITH A DEPTH EXCEEDING 0.005-IN. (0.1270 MM), UNIT SHOULD BE REPLACED.

3. CHECK PIPE EXTENSIONS FOR ANY CRACKS, BREAKS, OR CRIMPING.

REASSEMBLY:

1. LUBRICATE SPOOL, SEALS, AND RINGS WITH CLEAN HYDRAULIC OIL.

CAUTION

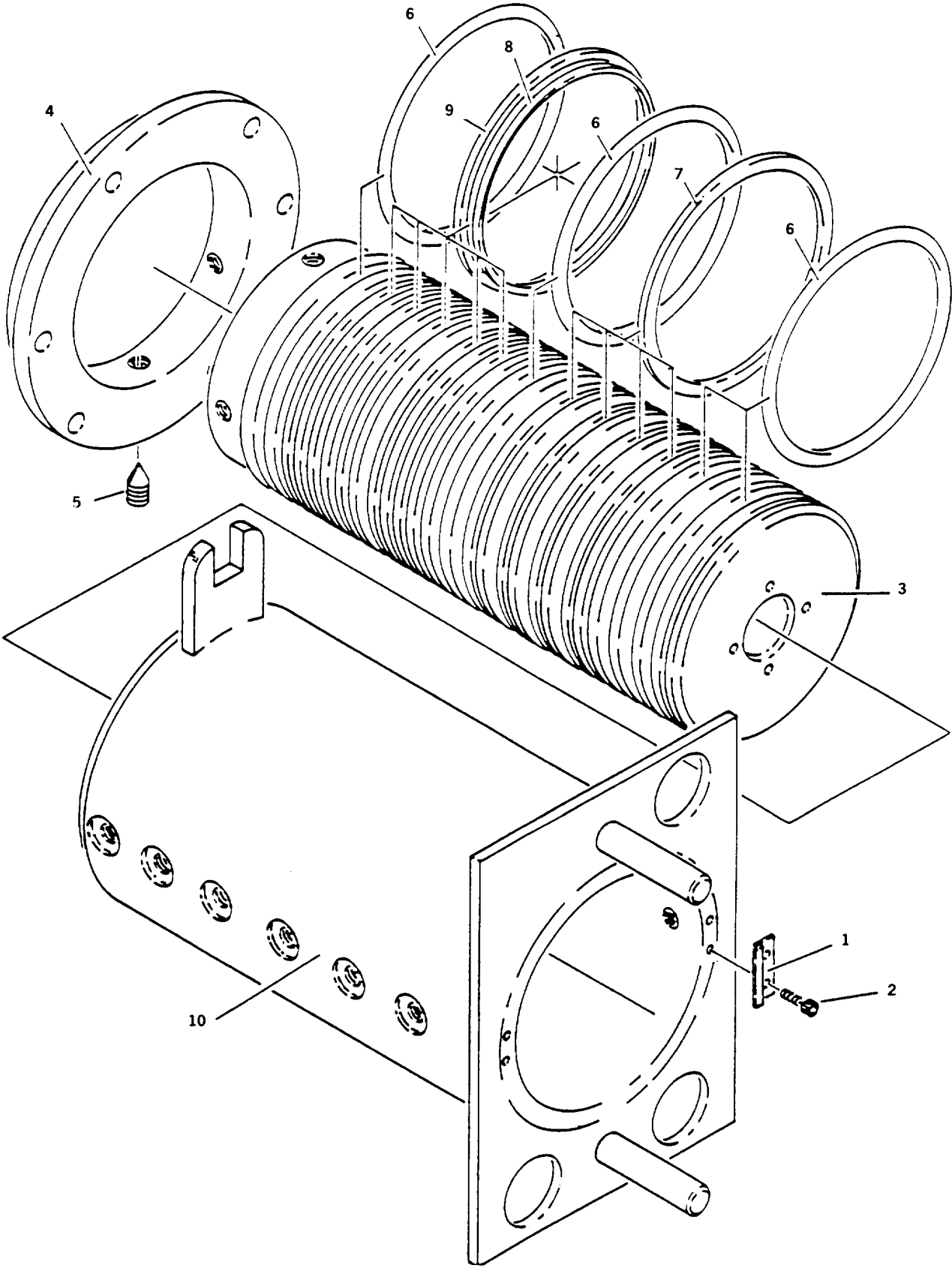
When installing new seals and rings, avoid stretching seals or scratching grooved or gland surfaces.

2. IF REMOVED, INSTALL MOUNTING PLATE (4) AND SECURE WITH SCREWS (5).
3. INSTALL SEALS (6), (7) AND (8) AND RINGS (9) ON SPOOL (3).
 - a. Install four new crown seals (7), four preformed packings (6), five bronze filled seals (8) and quad rings (9).

CAUTION

Proper alignment when inserting spool is required. Do not force spool into swivel case.

4. INSERT SPOOL (3) INTO SWIVEL CASE (10); SECURE WITH CLIPS (1) AND SCREWS (2).
5. INSTALL TAGGED PIPE EXTENSIONS ON SPOOL (3).



PRESSURE TEST:

NOTE

Use only 10W hydraulic oil for testing hydraulic ports. Air pressure should be used to test the air ports.

1. PRESSURE TEST SWIVEL PORTS.

- a. Install a pressure gauge into a port on swivel case.
- b. Install a pressure line in the corresponding port in the swivel spool.

- c. Allow ports, on each side of port to be tested, to vent in order to detect leakage.
- d. Pressurize port to be tested while rotating spool or case 360 degrees.
- e. If leakage is detected disassemble swivel and determine cause.
- f. Pressure check each port individually until all ports have been tested.
- g. Test ports with following pressures:

Port Number	Test Pressure	Function	Port Number	Test Pressure	Function
1	500 psi (3447.5 kPa/ 34.5 bar)	(Oil) Transmission Shift Drain	7	500 psi (3447.5 kPa/ 34.5 bar)	(Oil) Reverse
2	150 psi (1034.3 kPa/ 10.34 bar)	(Air) Throttle	8	500 psi (3447.5 kPa/ 34.5 bar)	(Oil) Forward
3	150 psi (1034.3 kPa/ 10.34 bar)	(Air) Service Brake	9	500 psi (3447.5 kPa/ 34.5 bar)	(Oil) Pressure
4	150 psi (1034.3 kPa/ 10.34 bar)	(Air) Park Brake	10	500 psi (3447.5 kPa/ 34.5 bar)	(Oil) First
5	150 psi (1034.3 kPa/ 10.34 bar)	(Air) Service Supply	11	500 psi (3447.5 kPa/ 34.5 bar)	(Oil) Second
6	150 psi (1034.3 kPa/ 10.34 bar)	(Air) Auxiliary Supply	12	500 psi (3447.5 kPa/ 34.5 bar)	(Oil) Third

END OF TASK

DEMOUNTING AND MOUNTING SUPERSTRUCTURE

TOOLS: General mechanic’s tool kit: automotive (5180-00-177-7033)
Torque wrench tool kit (5180-01-284-8747)
1-7/8 inch socket
Cribbing, planking, block, tiedown chain cables, straps, etc., must be available to stabilize the removed superstructure on its transport vehicle or in its stowed location.
Lifting device (26.5 ton capacity)

SUPPLIES: Bolts, 1-1/4 in. x 7 in. (Item 162, Appendix B) (40 Required)
Nuts (Item 269, Appendix B) (40 required)

EQUIPMENT CONDITIONS: Crane on flat level surface.
Boom over front retracted and horizontal.
(Refer to TM 5-3810-306-10.)
Hook block assembly removed.
(Refer to TM 5-3810-306-20.)
Overhaul ball removed. (Refer to TM 5-3810-306-20.)
All cable rewound onto hoist drums.
(Refer to TM 5-3810-306-20.)
Outriggers retracted and pads stowed.
(Refer to TM 5-3810-306-10.)

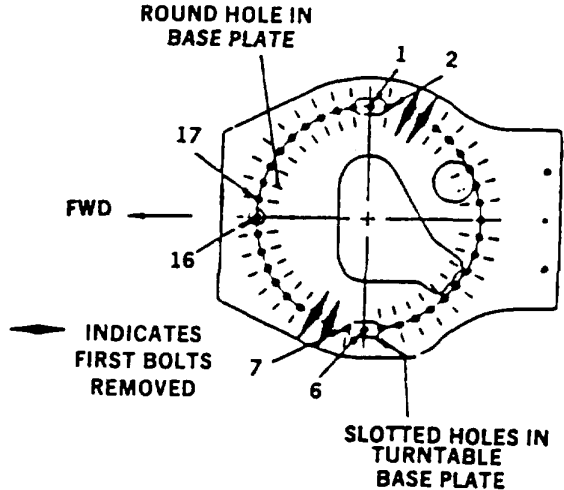
REMOVAL:

- 1. REMOVE TURNTABLE MOUNTING BOLTS 1-40 EXCEPT FOR 1, 2, 6 AND 7.

CAUTION

When swinging boom over rear during bearing bolt removal, the boom must be raised enough to clear the carrier structure and so the operator can see the right side of the turntable.

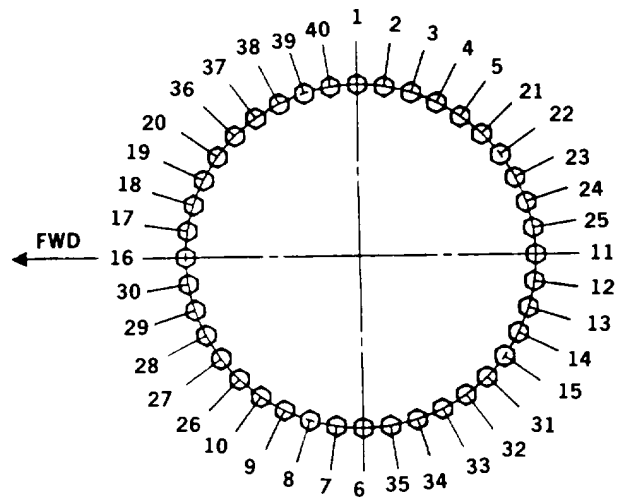
- a. With superstructure rotated 4-1/2 degrees to right, from straight over front, four inner ring bearing bolts 1, 2, 6 and 7 are visible through elongated holes on each side of turntable base plate. Mark these four bolts but do not remove them until all of the following steps are completed.



PLAN VIEW OF TURNTABLE BASE PLATE

PLAN VIEW OF TURNTABLE BASE PLATE

- b. Using crane power, rotate superstructure 18 degrees to right or left of initial position in Step a above, exposing pairs of unmarked bearing bolts in elongated holes on each side of turntable base plate. If the bolts on left side, under cab, can be reached with available tool combination, begin by removing these four (4) bolts (3, 4, 8 and 9 or 34, 35, 39 and 40). Continue rotating the boom in 18-degree increments in same direction and remove all turntable bolts, except 1, 2, 6 and 7 marked previously. If the bolts are tight in holes, after nuts have been removed, tap them out using a hammer.
- c. Alternately, if a multiplier torque wrench combination, air impact or hydraulic wrench is to be used, and lacks vertical space on left side under the cab, all bolts may be removed through the elongated holes on right side of turntable. Remove all bolts, except 1, 2, 6 and 7, in any sequence.
- d. After all bolts except 1, 2, 6 and 7 have been removed, swing boom back to initial 4-1/2 degrees to the right of boom straight over front position. (Bolts 1, 2, 6 and 7 are again exposed through elongated holes in turntable base plate.) If vertical height of tool combination prohibits removal of bolts 6 and 7 from under cab on left side of turntable, break torque of these two bolts when boom is to right of straight over rear position. Leave bolts 6 and 7 snug until final removal in steps below.



2. SUPPORT SUPERSTRUCTURE WITH SUITABLE HOIST.

NOTE

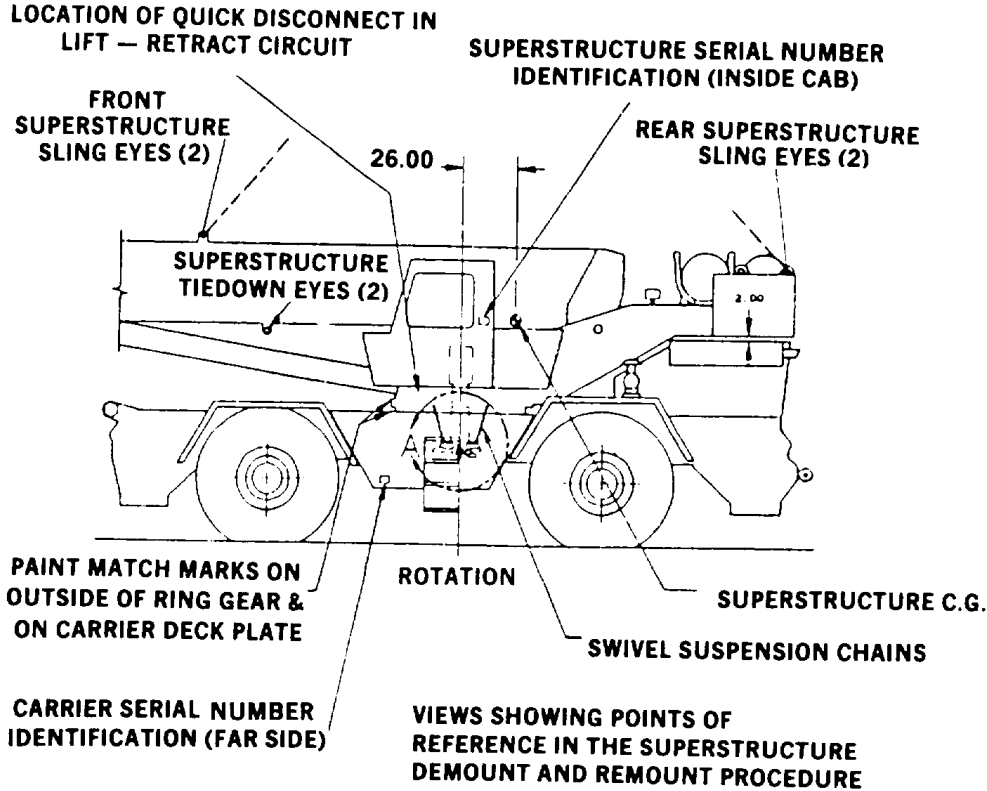
Suitable material handling equipment as noted above must now be employed to demount the superstructure.

- a. Using a four fall sling with single apex positioned above superstructure longitudinal c.g., approximately 28 inches to rear of center of rotation, connect each fall to a superstructure sling eye.

NOTE

For superstructure sling eye locations, refer to Shipping Data Plate or Transportability Data drawing (E6-829-008730).

- b. Hoist up to remove slack from sling falls.
 - c. Remove two bolts 7 and 2.
 - d. Center boom over front, engage swing lock, lower boom to horizontal and turn off engine.
3. DISCONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)



4. DISCONNECT QUICK COUPLER AT BASE END OF LIFT CYLINDER.

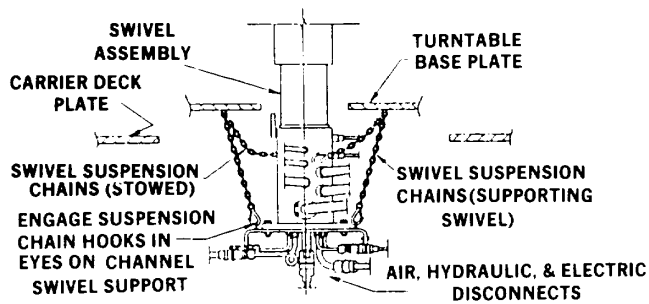
CAUTION

Failure to break this line at disconnect may result in boom raising when superstructure is lifted.

- a. Disconnect quick coupler provided in lift retract circuit located between turntable side plates at base end of lift cylinders. Breaking this line effectively blocks any possible leakage past lift control valve spool which would allow boom to raise during superstructure demount.
- b. Install dust caps to cover quick coupler ends to avoid entrance of dirt.

5. SUPPORT SWIVEL WITH SUSPENSION CHAINS.

- a. From underneath crane, centerline of rotation, find four (4) swivel assembly suspension chains in their stowed positions wrapped around swivel barrel.
- b. Detach chains from their stowed positions. The upper ends of these chains are secured to underside of superstructure turntable base plate.



- c. Engage hooks on lower ends of chains in four eyes provided on corners of carrier swivel support channel.

6. PURGE AIR TANKS, DISCONNECT AIR AND HYDRAULIC QUICK DISCONNECTS.

- a. Purge air reservoirs (Refer to TM 5-3810-306-20.)
- b. Uncouple five air and nineteen hydraulic quick disconnect fittings and three electrical conduit plugs on underside of swivel.
- c. Remove four 3/4 inch bolts, nuts and washers attaching the swivel support channel to supporting lugs. Save bolts, nuts and washers for use in remounting superstructure.
- d. Install dust covers on all quick disconnects.

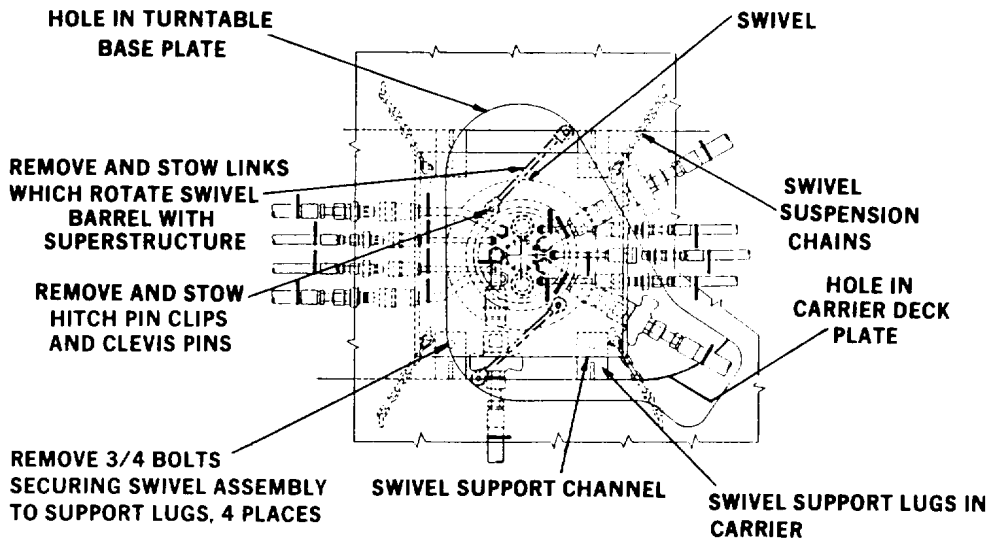
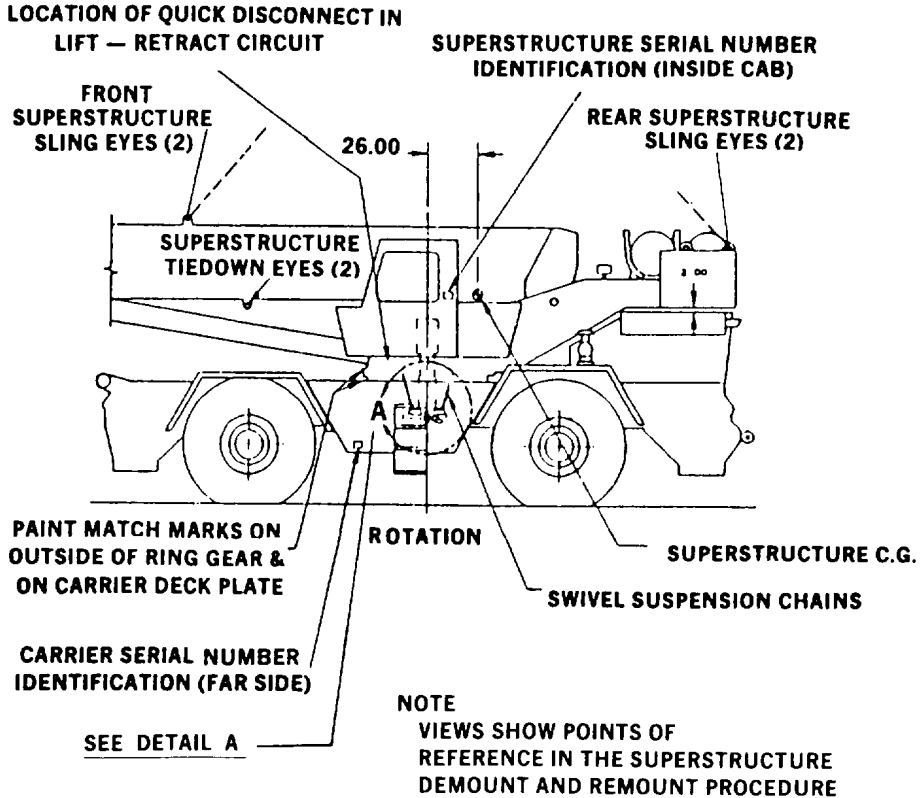
7. REMOVE ROTATION LINKS FROM SWIVEL.

- a. Unpin and remove two rotation links between turntable base plate and swivel barrel.

CAUTION

Code mark these links so that they can be replaced in same location when remounting superstructure. Failure to do so will result in rotary misalignment of swivel assembly. These links rotate swivel barrel with turntable and are not designed to accept the weight of suspended swivel assembly.

- b. Stow links and attaching hardware in tool box for use in remounting the superstructure.



DETAIL A

8. MATCH MARK RING GEAR TO CARRIER BASE PLATE.

- a. Paint indelible match marks on outside of turntable ring gear and carrier base plate. These match marks will aid in remating swivel assembly support channel with support lugs in carrier frame and locating swing lock in relation to boom straight over front position.

9. ELIMINATE SLACK FROM HOIST AND REMOVE BOLTS 1 AND 6.

- a. Verify that slack is removed from sling falls and that apex is over load center-of-gravity (see 2a above).
- b. Remove final two bolts 1 and 6 securing swing bearing and ring gear to carrier deck plate.
- c. Discard all forty of swing bearing tie-down bolts and nuts.

10. REMOVE SUPERSTRUCTURE FROM CRANE.

CAUTION

The crane superstructure, when lowered to a flat supporting surface, must be blocked up approximately 26 inches under turntable bearing ring to protect suspended swivel. The load is unstable when resting on bearing ring without additional supports and tiedowns. See RT875CC transportability data (E6-829-008730) and shipping data plate (E7-376-2128) for locations of tiedowns and supports. For semi-trailer or rail transport of crane superstructure and carrier, see Shipping Data Plate.

- a. Demount superstructure, hoisting carefully to avoid damage to the swivel assembly and surrounding hoses.

NOTE

Protect turntable bearing ring and carrier deck plate machined surfaces against damage and rust while separated.

INSTALLATION:

- 1. INSTALL SUPERSTRUCTURE ONTO CARRIER.

CAUTION

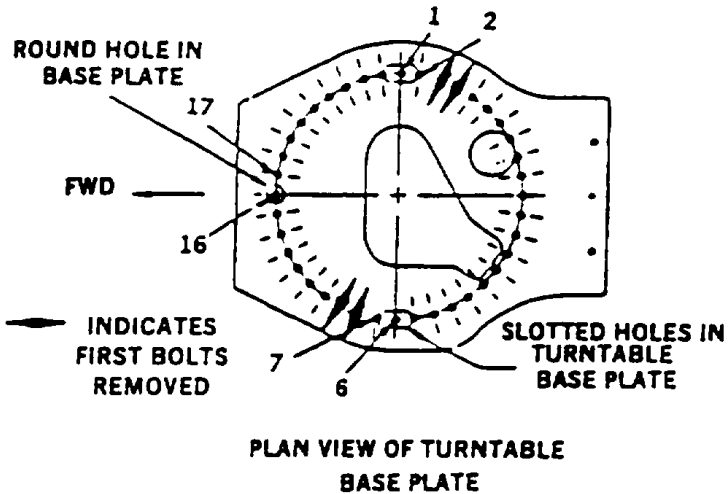
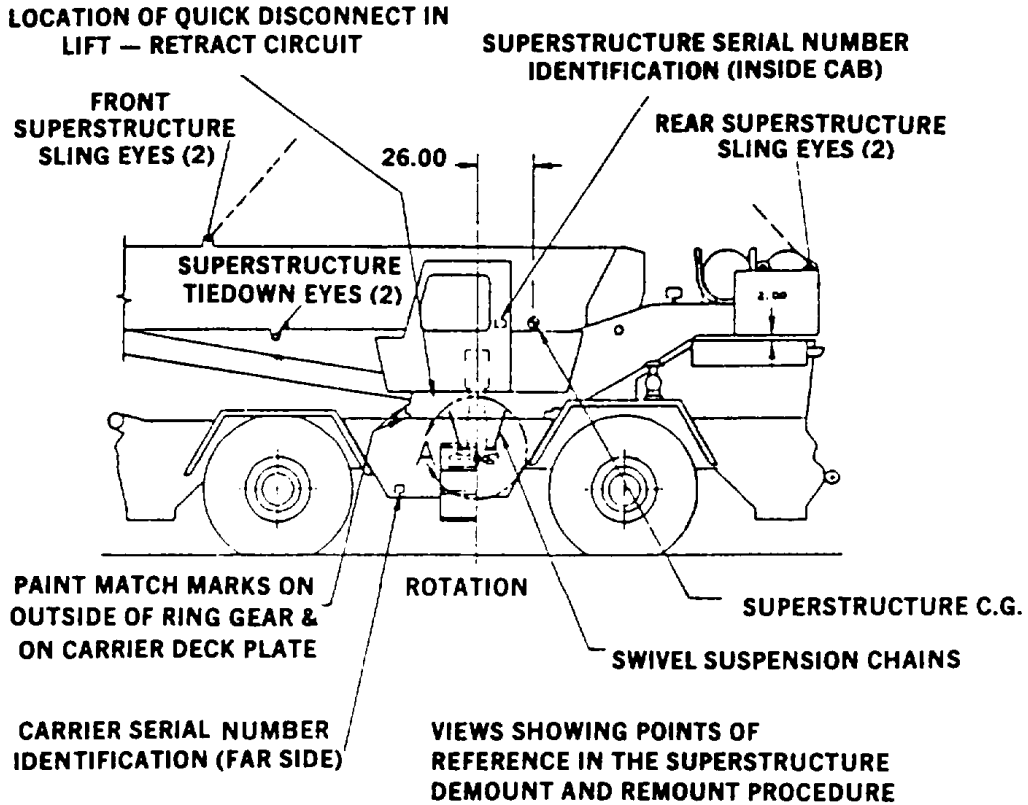
Forty new 1-1/4 in. 7 N.C. x 7 in. long, grade 8, bolts and nuts are required for mounting superstructure. Use the forty bearing bolt washers saved at demount, unless damaged or deformed.

CAUTION

At reassembly of crane superstructure and carrier, do not mix serial numbered components. The crane superstructure should be replaced on carrier from which it was removed.

CAUTION

Pay strict attention to proximity of counterweight to top of engine hood. Only a 2-inch space exists here, after installation, and minor rocking of superstructure during mounting could damage hood.



NOTE

To unload crane carrier and superstructure from transport vehicles, material handling equipment of at least 26.5 ton (24, 041 kg) capacity is required.

- a. Ensure crane carrier is on a flat level surface.
- b. Inspect bearing and carrier deck plate mating surfaces. Mating surfaces should be clean and dry for remounting.
- c. Position material handling boom head with suspended sling over superstructure center of gravity and connect four falls of sling to sling eyes located on the boom base section and counterweight.

NOTE

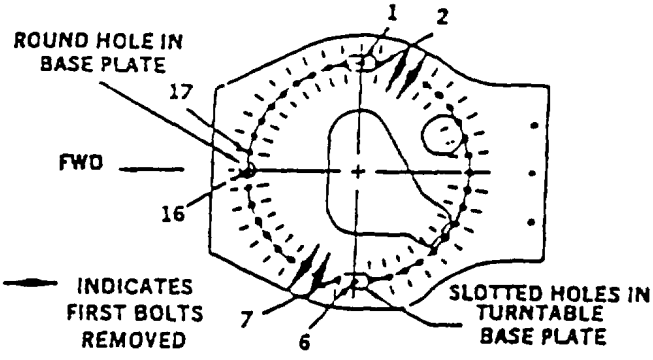
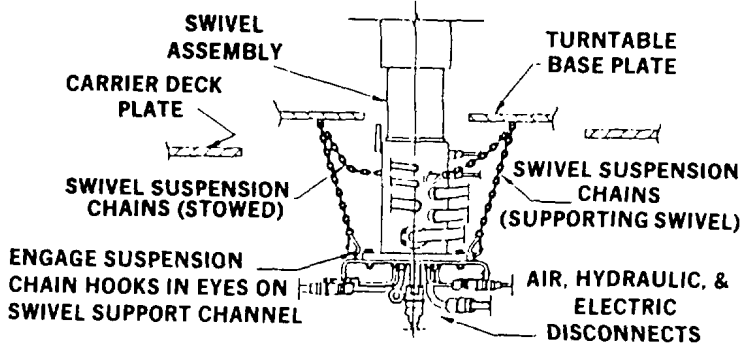
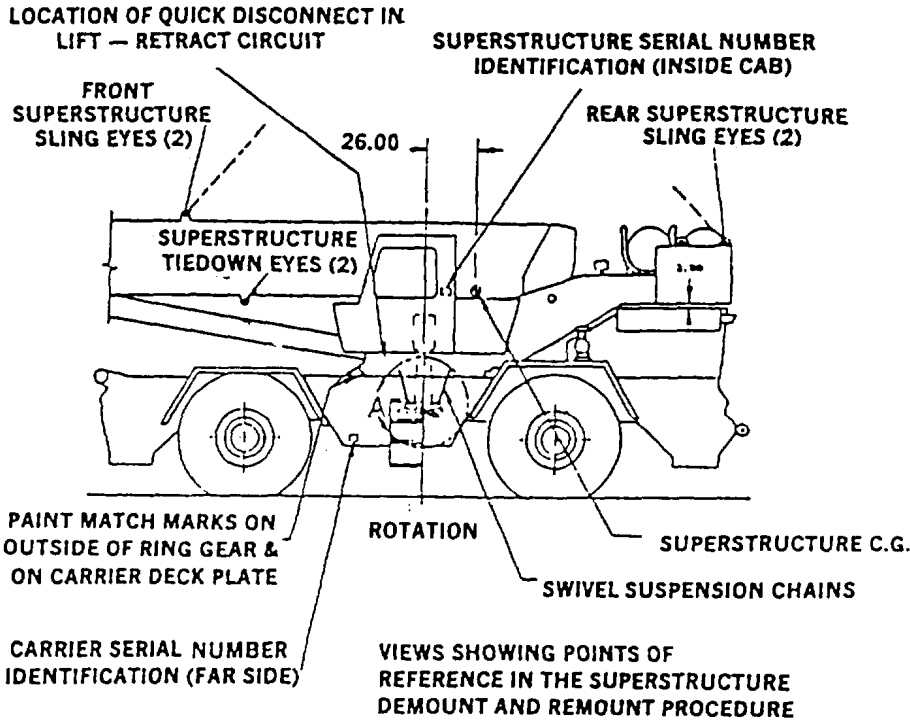
See the Shipping Data Plate (E7-376-002128) and/or the RT875CC Transportability Data (E6-829-008730) for details of superstructure slinging.

- d. Take up slack in sling falls and remove cribbing, planking, supports and superstructure tiedowns. Attach guide ropes at boom nose and/or counterweight (use for rotationally aligning superstructure with carrier during mounting).
- e. Insert three new bearing bolts with washers under heads through exposed holes in turntable bearing ring at 1, 6 and 16. These bolts will serve to align entire superstructure bearing hole pattern with matching holes in carrier deck plate.

CAUTION

Use care to avoid damaging swivel assembly which is suspended from superstructure turntable base plate.

- f. Lift and swing the suspended superstructure over crane carrier. Center boom over front and attempt to align superstructure turntable bearing ring with bearing hole pattern in carrier deck plate.
- g. Station a person on the carrier within view of match marks on front of superstructure bearing ring and carrier deck plate. Also, locate a person under carrier to center swivel assembly support channel onto its supporting lugs in carrier frame, as it is lowered into place.
- h. Lower the superstructure into close contact with the carrier deck plate. The swivel support channel will contact its supporting lugs before turntable bearing contacts carrier deck plate.
- i. Center the channel on the lugs and install four 3/4 inch bolts through the channel and lugs. Install the washers and nuts on the ends of the bolts. Do not tighten.
- j. Unhook swivel assembly suspension chains and secure together around swivel barrel.



PLAN VIEW OF TURNTABLE BASE PLATE

NOTE

The remaining procedure to bring turntable ring gear into final contact with crane carrier deck plate involves small, precise movements of suspended superstructure.

- k. Rotate load using guide line(s) and inch swing, lift and hoist functions of the supporting equipment. The aim is to align match marks on ring gear and carrier deck plate, and finally hole patterns in two units.

NOTE

Accurate final matching of bearing hole patterns is evidenced by three bolts installed in the above dropping through carrier deck plate.

- l. Allow superstructure to settle onto crane carrier, but keep sling falls taut.
 - m. Install washers and nuts on three bolts now in place and tighten snug, but do not torque.
 - n. Tighten bolts securing swivel assembly base channel to supporting lugs in carrier frame. Tighten bolts 1/2 turn past snug-tight.
2. INSTALL ROTATION LINKS TO SWIVEL.
- a. Reinstall drag links according to their coded locations, between turntable base plate and upper end of swivel.

- 3. INSTALL AIR AND HYDRAULIC QUICK COUPLERS.

- a. Reconnect all air and hydraulic quick couplers at base of swivel, being careful to mate aluminum tag coded ends. Uncoded ends and electrical plugs cannot be installed incorrectly and are unmarked.
- b. Recouple the quick disconnect in the lift retract circuit.

- 4. CONNECT NEGATIVE BATTERY AT SHUNT. (REFER TO TM 5-3810-306-20.)

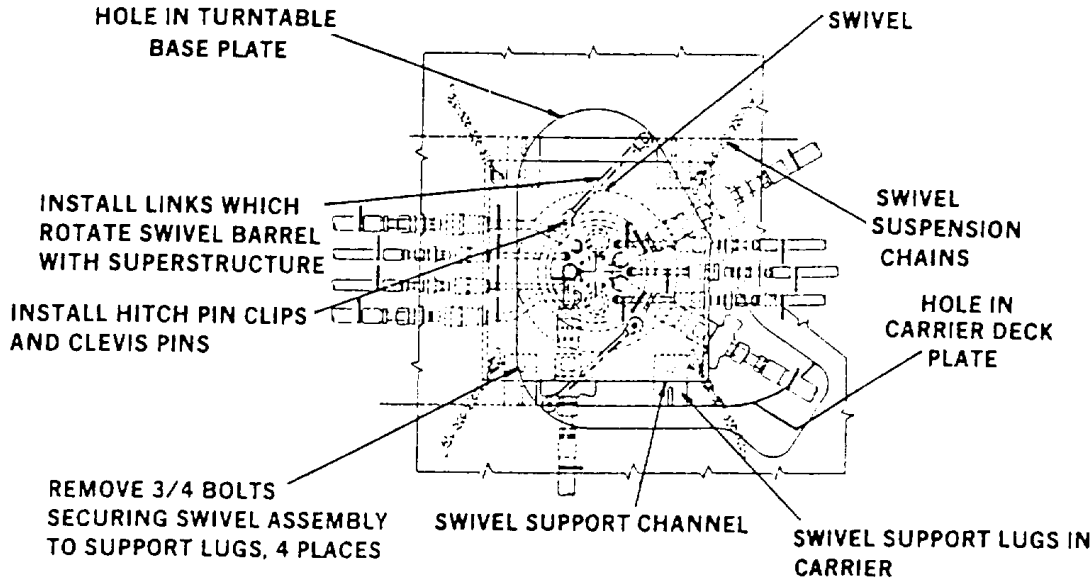
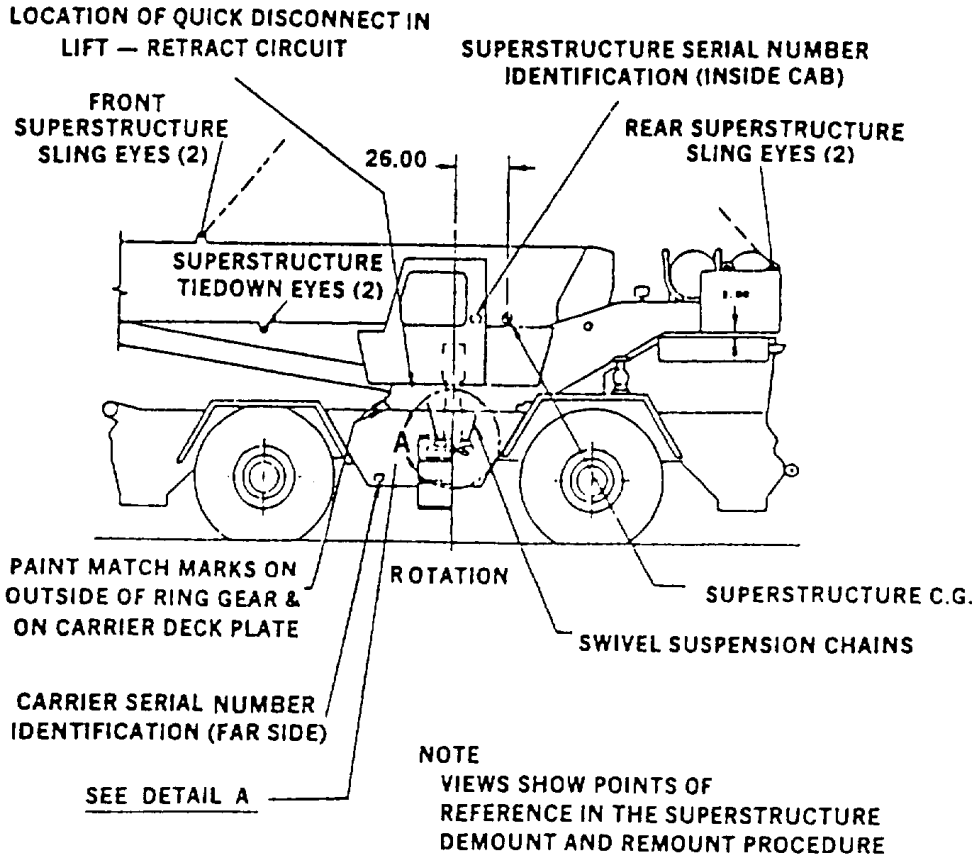
- 5. PERFORM A PREOPERATIONAL CHECK OF CRANE. (REFER TO TM 5-3810-306-10.)

- 6. START ENGINE AND ROTATE BOOM TO INSTALL BOLTS 2, 7 AND 17.

NOTE

Each installed bearing bolt includes washers under head and nut. After initial tightening, torque all bearing bolts using available torque wrench.

- a. Start engine and swing superstructure (with sling falls still attached) 9 degrees to the right. (Refer to TM 5-3810-30610).
- b. Install three more bearing bolts 2, 7 and 17, with washers under heads.



DETAIL A

- c. Install washers and nuts and tighten snug, but do not torque.
 - d. Disconnect the material handling sling falls and remove.
7. INSTALL REMAINING BOLTS, WASHERS, AND NUTS.
- a. Alternately swing left and right and install all remaining bearing bolts, washers, and nuts.
8. TORQUE TURNTABLE BOLTS, EXPLAINED UNDER TURNTABLE BEARING INSTALLATION. (REFER TO PAGE 15144.)
9. REEVE CABLE THROUGH PULLEYS. (REFER TO TM 5-3810-306-20.)
10. INSTALL HOOK BLOCK ASSEMBLY. (REFER TO TM 5-3810-306-20.)
11. INSTALL OVERHAUL BALL. (REFER TO TM 5-3810-306-20.)

END OF TASK

ELECTRICAL SWIVEL RING INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Pin removal tool

SUPPLIES: Lockwashers (Item 38, Appendix B)
4" x 4" Oak lumber (Item 39, Appendix B)
Lockwashers (Item 212, Appendix B)

EQUIPMENT CONDITIONS: Outriggers extended and lowered.
(Refer to TM 5-3810-306-10.)
Boom over front and elevated for access to swivel.
(Refer to TM 5-3810-306-10.)
Air system purged. (Refer to TM 5-3810-306-20.)
Pressure relieved from hydraulic system.
(Refer to TM 5-3810-306-20.)
Negative battery cable disconnected at shunt.
(Refer to TM 5-3810-306-20.)

REMOVAL:

1. SUPPORT BOOM.

- a. Measure the distance from the top of the lift cylinders to the base of the boom section where the lift cylinder attaches. Cut a piece of 4 x 4-in. (10.16 x 10.16 cm) oak to fit.

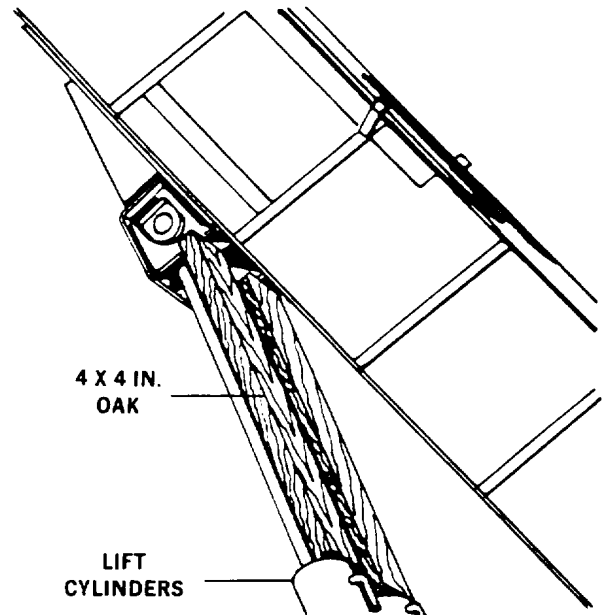
NOTE

This blocking is to add extra support for the boom. Any seepage or leakage in the holding valve or internally in the cylinder will allow the boom to settle over a period of time.

- b. Use the oak blocking to block between the barrel of the lift cylinders and the boom base section.

2. DISCONNECT WIRE HARNESS CONNECTORS.

- a. Locate, tag and disconnect three connectors (14), (15) and (16) that pass through bottom of swivel.



3. REMOVE WIRE HARNESS CONNECTORS.

NOTE

The connectors are too large to pass through center of hydraulic and air/transmission swivels. They must be removed.

NOTE

Do not disconnect the collector ring wires crimped at the top of the swivel assembly.

- a. Cut and tag all wires approximately 6 in. away from connector (14). Collect wires and secure in a bundle. Mark bundle with connector number.
- b. Repeat step a for connectors (15) and (16).

4. REMOVE ELECTRICAL SWIVEL.

- a. Remove eight screws (1), lockwashers (2) and nuts (3) to remove swivel cover (4) and seals (5) and (12).
- b. Tag and disconnect four superstructure harness connectors from bottom of air/transmission swivel mounting plate.
- c. Remove locknuts securing three round superstructure connector receptacles to mounting plate. Note position of each connector.
- d. Remove four screws, lockwashers, washers and nut securing superstructure harness No. 4 connector to mounting plate.

- e. If necessary remove bolts (7) and lockwashers (6) attaching center post (8) to air/transmission swivel spool.
- f. Loosen three setscrews and remove electrical swivel, wiring harness (13), washers (9) and springs (10) from air/transmission swivel.

INSTALLATION:

1. INSTALL WIRING HARNESS.

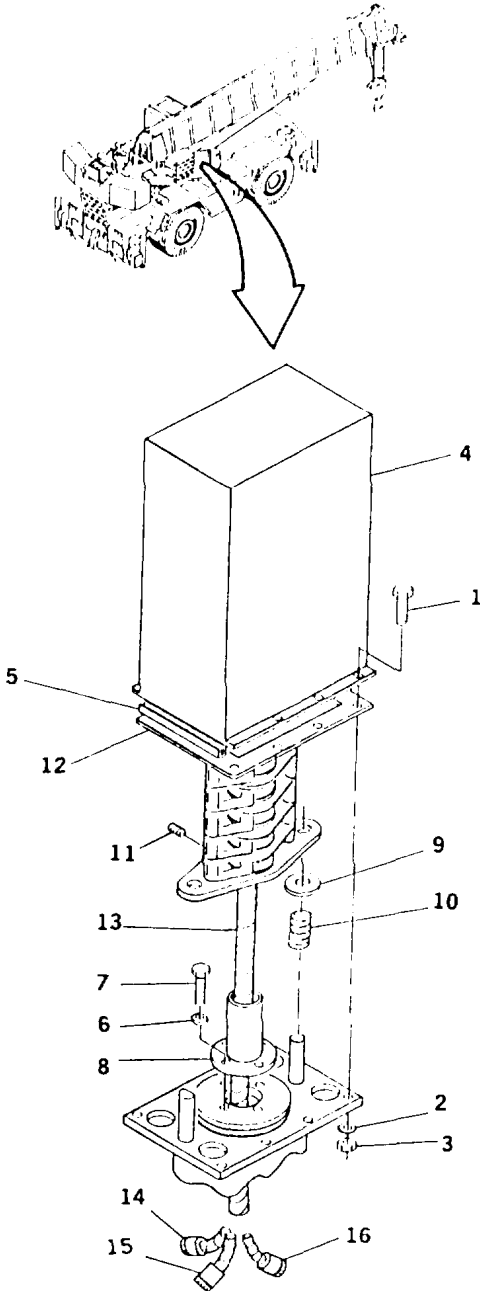
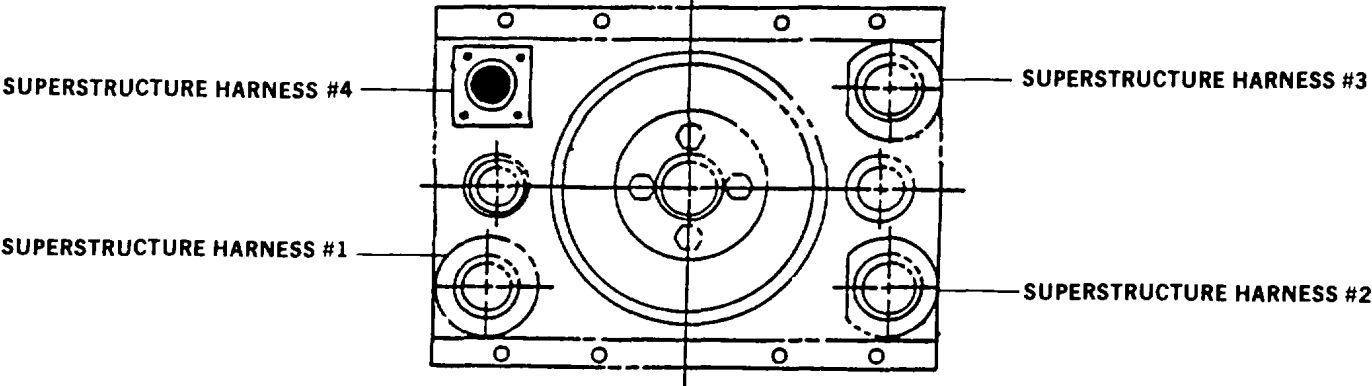
- a. Attach a guide wire to end of wiring harness (13) and pull wiring harness through center of air/transmission and hydraulic swivels.

2. INSTALL ELECTRIC SWIVEL.

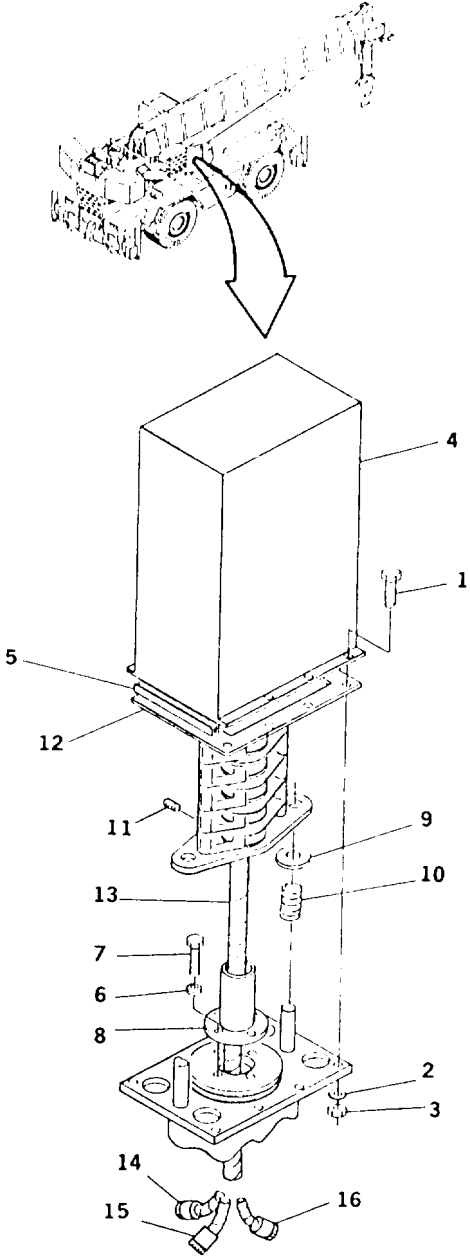
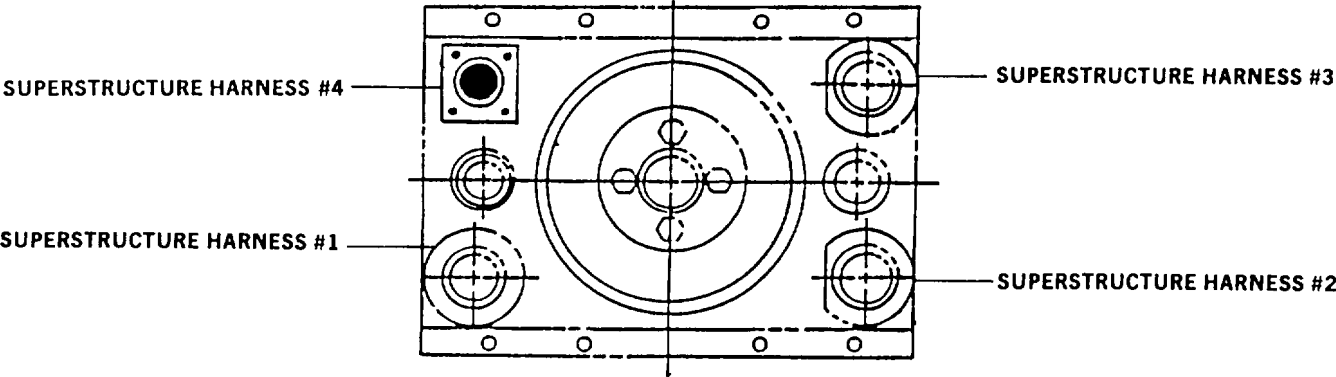
- a. If removed, install bolts (7) and lockwashers (6) securing center post (8) to spool of air/transmission swivel.
- b. Install springs (10) and washers (9) over pins on mounting plate.
- c. Position the swivel mounting bracket over washers (9), springs (10) and pins on mounting plate.
- d. Loosen setscrews (11) securing collector core to center post (8).

NOTE

Prior to tightening setscrews (11) in collector core, rotate swivel ring until area definition switch cam is located in center of detent on ring.



- d. Exert downward pressure on collector core and brush assembly until springs are compressed .5 to .75 in. (1.27 to 1.91 cm). Tighten three setscrews to secure collector core to center post.
 - e. Install three round connector receptacles into mounting plate and secure with locknuts.
 - f. Install superstructure harness No. 4 connector into mounting plate and secure with four screws, washers, lockwashers and nuts.
 - g. Install swivel cover (4), seals (5) and (12), eight screws (1), lockwashers (2) and nuts (3).
 - h. After collector ring harness is routed through hydraulic and air/transmission swivel connect previously tagged wires to connectors (14), (15) and (16).
 - i. Connect carrier and superstructure wiring harnesses as tagged.
3. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
 4. REMOVE BLOCKING FROM LIFT CYLINDERS.
 5. CHECK FOR PROPER OPERATION.
- END OF TASK



ELECTRICAL SWIVEL ASSEMBLY

ELECTRICAL TOOL: General mechanic's tool kit: automotive (5180-00-177-7033) Ohmmeter

SUPPLIES: None.

EQUIPMENT CONDITIONS: Electrical swivel assembly removed. (Refer to page 15-95.)

REMOVAL:

1. PRIOR TO DISASSEMBLY CHECK ELECTRICAL SWIVEL AS FOLLOWS.

NOTE

See electrical swivel slip ring chart (page 15106) to pinpoint problem areas, and aid in disassembly and installation.

- a. Check all brushes (26) and (27) for proper contact with collector ring conductors. Note any brush sets which are oil-soaked or worn to one-half of their original length. These must be replaced.
- b. Check spring tension of each brush. Any that are damaged or weak must be replaced. Spring tension should be sufficient to firmly hold brushes against the collector ring.
- c. Inspect collector ring conductors for arcing, pitting, and corrosion. Under some conditions, ring will have a tendency to collect fine silt and in a salt atmosphere, corrosion will occur. If this happens, rotate collector core several times. This should clean the ring. If it does not, it might be necessary to clean core after disassembly.

- d. Using an ohmmeter check the continuity between each of the collector core rings' surfaces and the electrical leads. If any conductors are defective they must be replaced.

2. TAG AND REMOVE ELECTRICAL HARNESSES (22) AND (24).

- a. Tag and disconnect sleeves (28) and (29) and knife disconnects on the brush and arm assemblies (26) and (27) and remove harness (22).
- b. Tag and disconnect the collector ring wire connectors (15) and (16) located at the top of the swivel and remove harness (24).

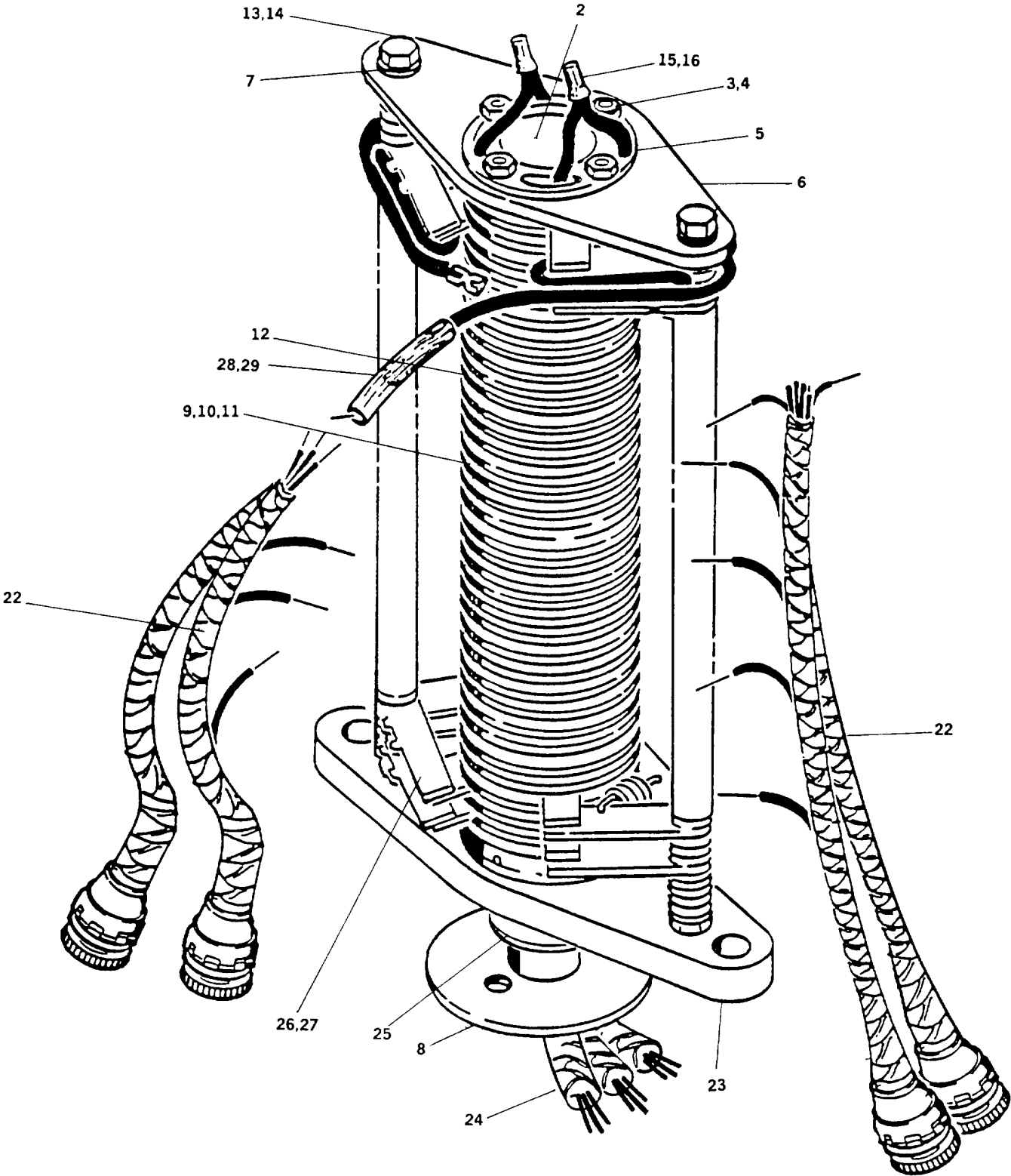
CAUTION

Ensure brush and arm assemblies are properly tagged with the corresponding circuit numbers.

NOTE

When removing brush and arm assemblies, it will help if they are kept in order.

3. REMOVE BRUSH AND ARM ASSEMBLIES (26) AND (27).
 - a. Remove nuts (14) and washers (7) on brush holding studs (13).
 - b. Remove top retainer plate (6).



- c. Remove the brush and arm assemblies (26) and (27).
- 4. LOOSEN SET SCREWS AND REMOVE CAM ROLLER ARM (36) AND SWITCH (31).
- 5. REMOVE COLLECTOR CORE (2).
 - a. Loosen setscrews securing collector core (2) to slip ring center post (8) and remove collector core (2). Retain center post (8) for reinstallation.
 - b. Remove nylon bearing (25) from mounting bracket (23).
- 6. DISASSEMBLE COLLECTOR CORE (2)
 - a. Remove nuts (3) from studs (4) and remove bearing (5).
 - b. Remove spacers (9), collector rings (10) and (11), and insulators (12).
 - c. Remove spacer ring (39).
 - d. Remove cam plate (32) and retaining plate (6).
 - e. If necessary, remove retaining plate (6) from cam plate (32) by loosening clamps (42).
 - f. If necessary, remove studs (4) from holder (40).

use near open flame or excessive heat. the flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

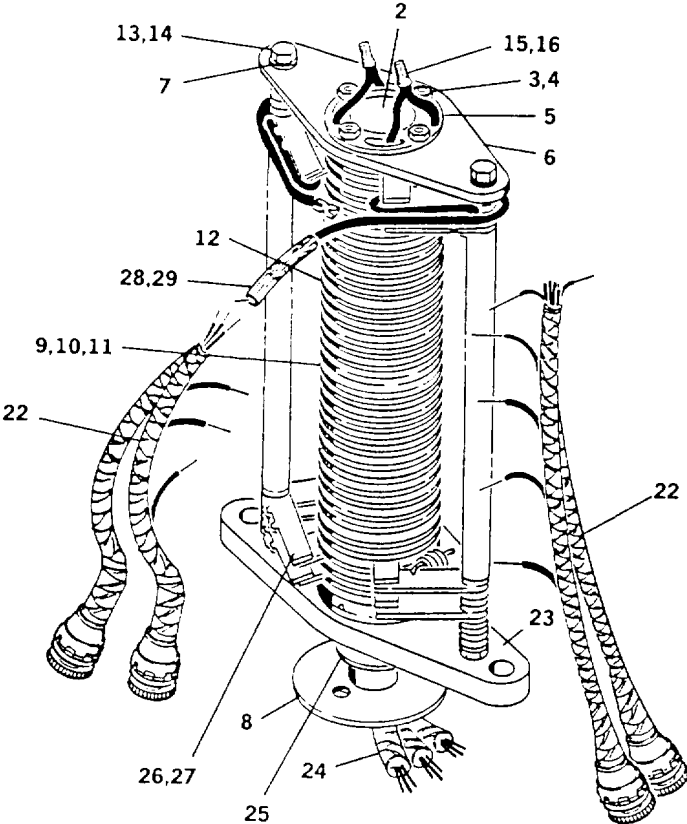
Compressed air used for cleaning purposes will not exceed 30 psi. Use only with effective chip guarding and personal protective equipment (goggles/shield, gloves, etc.).

- 1. IF COLLECTOR RINGS ARE CORRODED, IT MAY BE NECESSARY TO USE P-D-680 TO CLEAN THEM. THEN LIGHTLY SAND BRUSHES WITH DOUBLE-UGHT (2/0) NONABRASIVE MATERIAL. BLOW OUT ANY DUST WITH COMPRESSED AIR.
- 2. ANY BRUSH SETS THAT ARE OIL SOAKED CANNOT BE CLEANED. THEY MUST BE REPLACED.
- 3. IF NYLON BEARING (25) IS WORN, REPLACE IT.
- 4. IF SWITCH CONTACTS, ROLLER (34) OR ROLLER BUSHINGS (35) ARE WORN, REPLACE THEM.

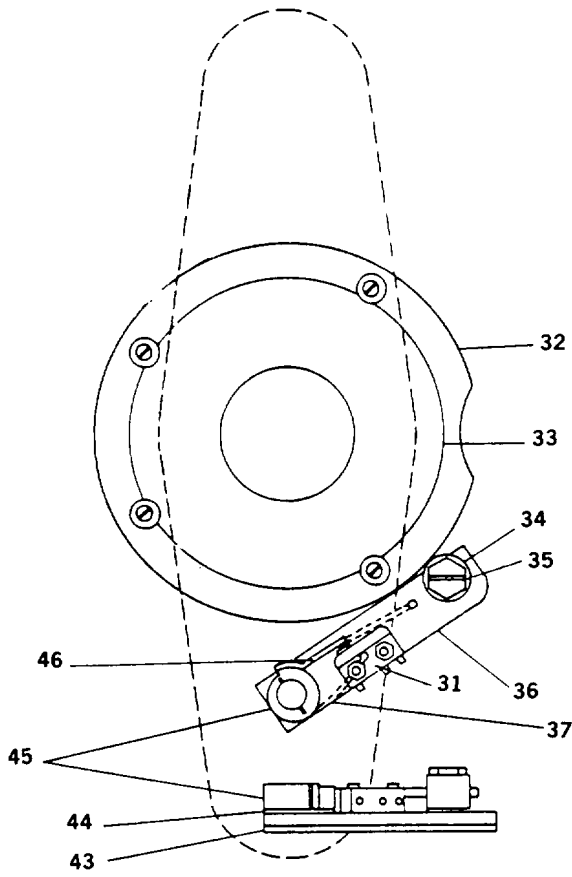
CLEANING AND INSPECTION

WARNING

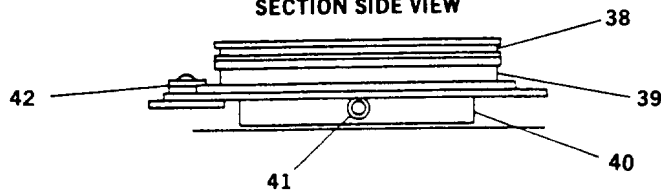
Dry cleaning solvent P-D680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not



SECTION TOP VIEW



SECTION SIDE VIEW



REASSEMBLY

1. ASSEMBLE COLLECTOR CORE (2).
 - a. If removed, install studs (4) in holder (40).
 - b. If removed, install retaining plate (6) on cam plate (32) and tighten clamps (42).
 - c. Install cam plate (32) and retaining plate (6) on collector core (2).
 - d. Install spacer ring (39).
 - e. Install collector rings (10) and (11), insulators (12) and spacers (9).
 - f. Install bearing (5) on studs (4) and secure with nuts (3).
2. INSTALL COLLECTOR CORE (2).
 - a. Install nylon bearing (25) in mounting bracket (23).
 - b. Install collector core (2) in mounting bracket (23) and tighten one setscrew to secure core to center post (8). (This setscrew will be loosened later).

NOTE

When assembling switch (31), ensure switch wiper (46) allows switch to make contact when in detent. Do a continuity check.

3. INSTALL CAM ROLLER ARM (36) AND SWITCH (31).

CAUTION

Ensure brush and arms assemblies are installed in proper order.

CAUTION

Ensure that any brush and arm assemblies that have been replaced are of proper electrical capacity.

NOTE

When installing brush and arm assemblies, do not unhook springs. Use your fingers to spread brush arms while sliding brush and arm assemblies onto holding studs.

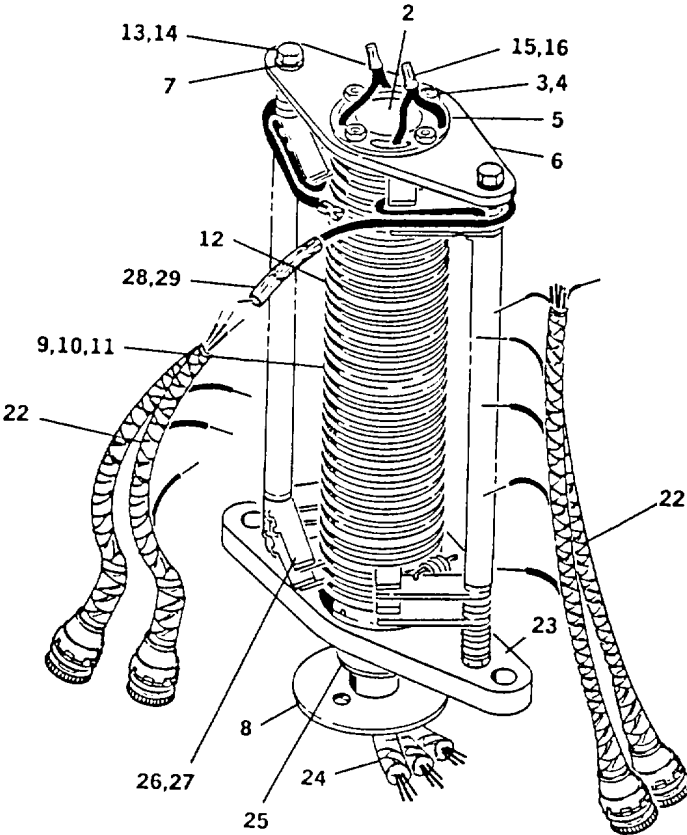
4. INSTALL BRUSH AND ARM ASSEMBLIES (26) AND (27).
5. INSTALL ANY SPACERS THAT WERE TAKEN OFF.
6. INSTALL WASHERS (7) AND NUTS (14) ON STUDS (13).

NOTE

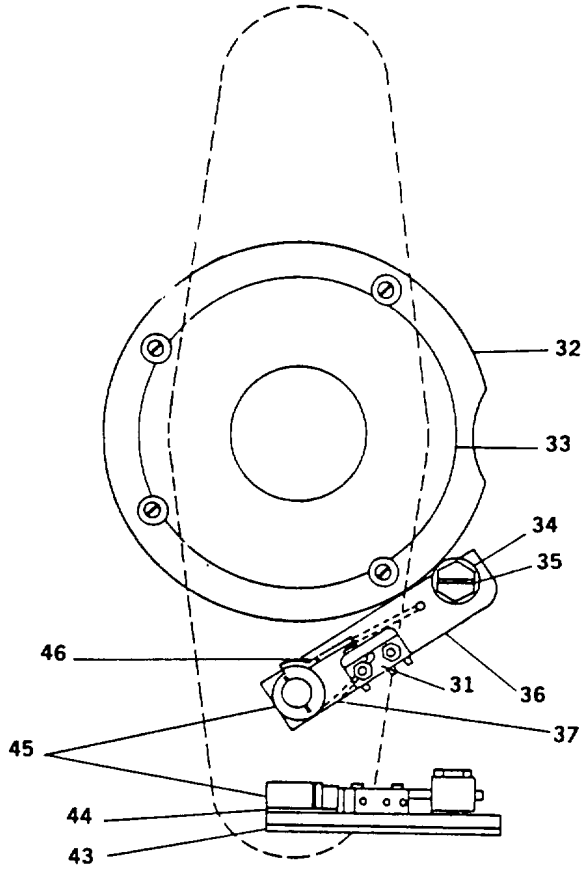
Tighten nuts (14) snugly insuring that brush and arm assemblies move freely.

7. CONNECT KNIFE DISCONNECTS ON BRUSH AND ARMS ASSEMBLIES. SLIDE PLASTIC SLEEVES OVER KNIFE DISCONNECTS.

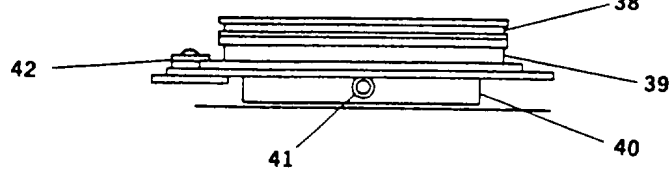
END OF TASK



SECTION TOP VIEW



SECTION SIDE VIEW



Electrical Swivel Slip Rings

Slip Ring	Rated Capacity	Circuit
1	7.5	Right front outrigger
2	7.5	Low oil pressure
3	7.5	Left front outrigger
4	7.5	Rear steer indicator
5	7.5	Right rear outrigger
6	7.5	Trans oil temperature
7	7.5	Left rear outrigger
8	7.5	High water temperature
9	7.5	Outrigger selector extend
10	7.5	Emergency steer indicator
11	7.5	Outrigger selector retract
12	7.5	Trans oil temperature
13	7.5	Right front jack cylinder
14	7.5	Water temperature
15	7.5	Left front jack cylinder
16	7.5	Oil pressure
17	7.5	Right rear jack cylinder
18	7.5	Fuel level
19	7.5	Left rear jack cylinder
20	7.5	Axle lockout
21	7.5	Emergency steer relay
22	7.5	Tachometer
23	7.5	Transmission select
24	7.5	Air dryer, fuel solenoid
25	7.5	Front/rear marker lights
26	7.5	Cold start
27	7.5	Back-up alarm
28	7.5	Starter
29	7.5	Right rear turn signal
30	7.5	Front lights
31	7.5	Left rear turn signal
32	7.5	Rear lights
33	7.5	Back-up alarm switch
34	7.5	Ground
35	7.5	Front marker and rear tail lights
36	7.5	Left front blackout headlight
37	7.5	Front park and rear park lights
38	7.5	Rear stop lights
39	7.5	Left front turn signal
40	7.5	Right front turn signal
41	60	Main power
42	60	Ground

HYDRAULIC SWIVEL ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1 (4910-00-754-0706)
 Tool Outfit Hyd System; Test and Repair, 3/4 Ton Trailer Mtd. (4940-01-036-5784)

SUPPLIES: Hydraulic oil (Item 8, Appendix B)
 Solvent P-D-680 (Item 1, Appendix B)
 Parts kit (Item 197, Appendix B)

EQUIPMENT CONDITIONS: Swivel removed. (Refer to page 15-70.)
 Air/transmission swivel removed. (Refer to page 15-75.)

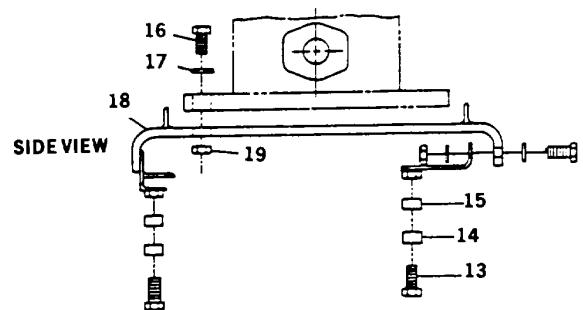
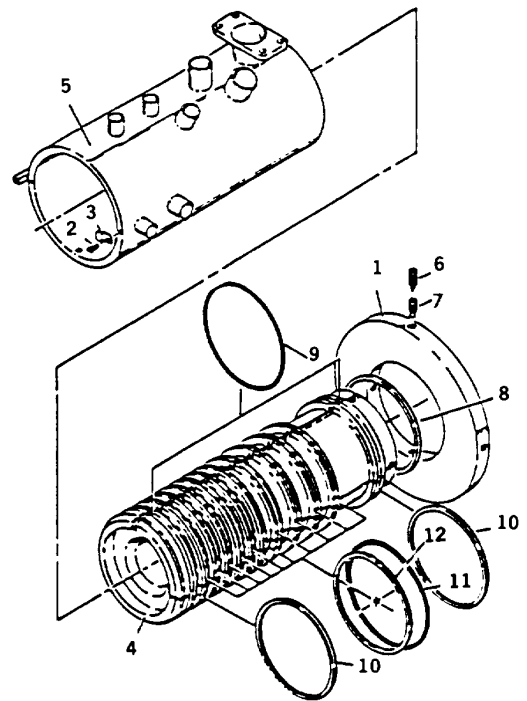
DISASSEMBLY:

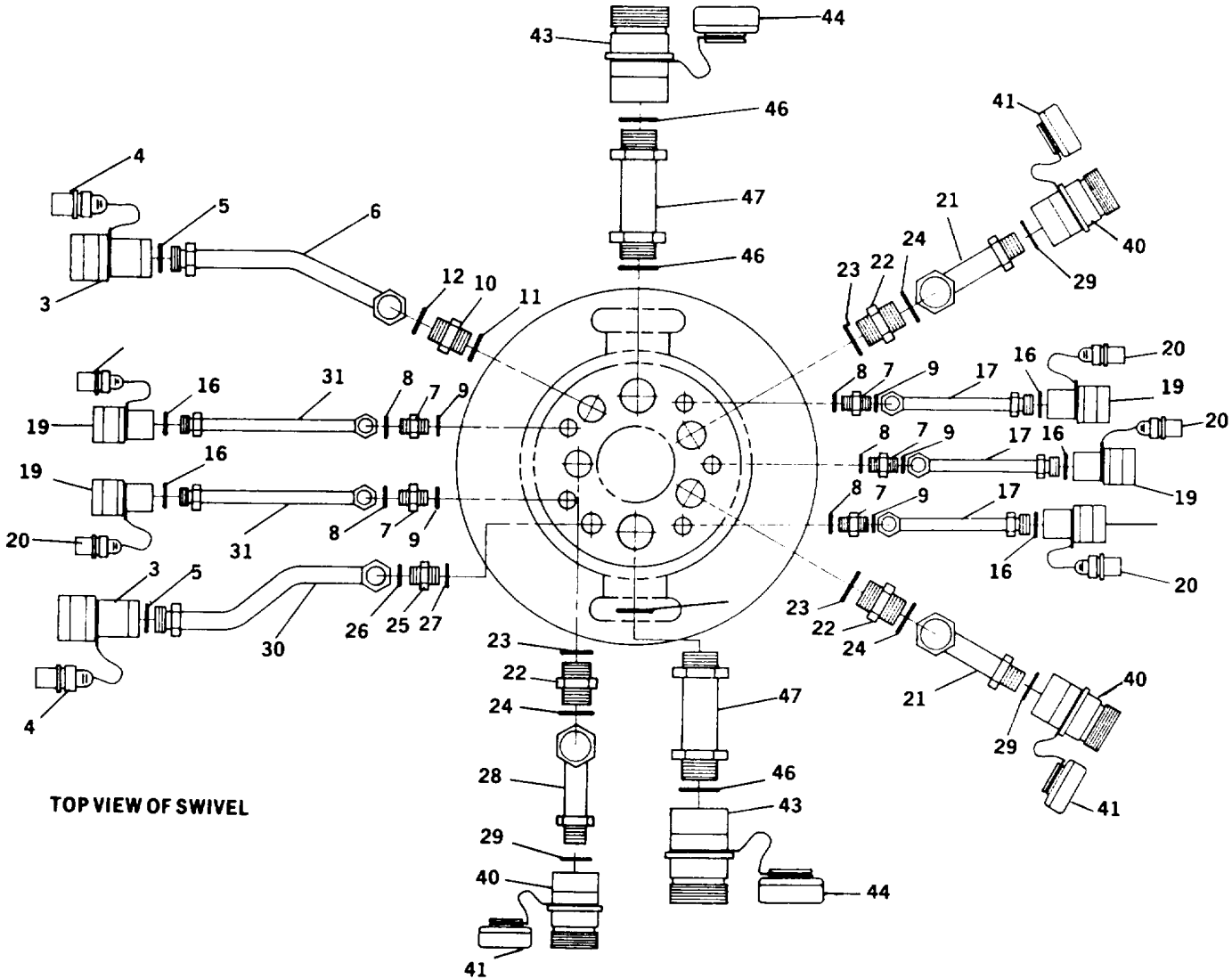
1. REMOVE RIGID PIPING FROM BOTTOM OF SWIVEL.
 - a. Remove capscrews (13), pipe clamps (14) and bolt inserts (15).
 - b. Tag and remove rigid piping from bottom of hydraulic swivel.
2. REMOVE MOUNTING CHANNEL (18) FROM HYDRAULIC SWIVEL.
 - a. Remove six capscrews (16), washers (17) and nuts (19) securing mounting channel (18) to hydraulic swivel mounting plate (1).

NOTE

Any maintenance requiring disassembly of hydraulic swivel should include replacement of all seals and rings.

3. REMOVE SPOOL (4).
 - a. Remove capscrews (2) and retaining clips (3) that secure spool (4) in the swivel case (5).





NOTE

FIND NUMBERS NOT REFERENCED IN TEXT. ILLUSTRATION FOR CLARIFICATION OF RIGID PIPING INSTALLATION (SEE TM5-3810-306-24P).

- b. Withdraw spool (4) from swivel case (5).

CLEANING AND INSPECTION:

NOTE

During routine maintenance it is not necessary to remove mounting plate (1). Use the mounting plate for blocking. If mounting plate is damaged, remove four screws (6) and four setscrews (7) to replace mounting plate and thrust washer (8).

- c. Place spool (4) on a clean work surface in a dust-free area and block spool to prevent movement during disassembly.

CAUTION

When removing seals and rings, avoid scratching grooved and gland surfaces.

4. REMOVE AND DISCARD TWO PREFORMED PACKINGS (9), TWO SPLIT RING BEARINGS (10), TEN QUAD RINGS (11) AND BRONZE FILLED SEALS (12).

NOTE

Aligning the discarded seals and rings in the order of disassembly will assist with installation of new seals and rings.

WARNING

Dry cleaning solvent P-D680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately. 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.).

1. CLEAN ALL PARTS WITH SOLVENT P-D-680.
2. CHECK SPOOL AND INSIDE OF SWIVEL CASE FOR SCRATCHES, GROOVES, SCORING, ETC. IF ANY GROOVES HAVE DEVELOPED WITH A DEPTH EXCEEDING 0.005 IN. (0.1270 MM), THE UNIT SHOULD BE REPLACED.
3. INSPECT RIGID TUBING FOR DAMAGE.

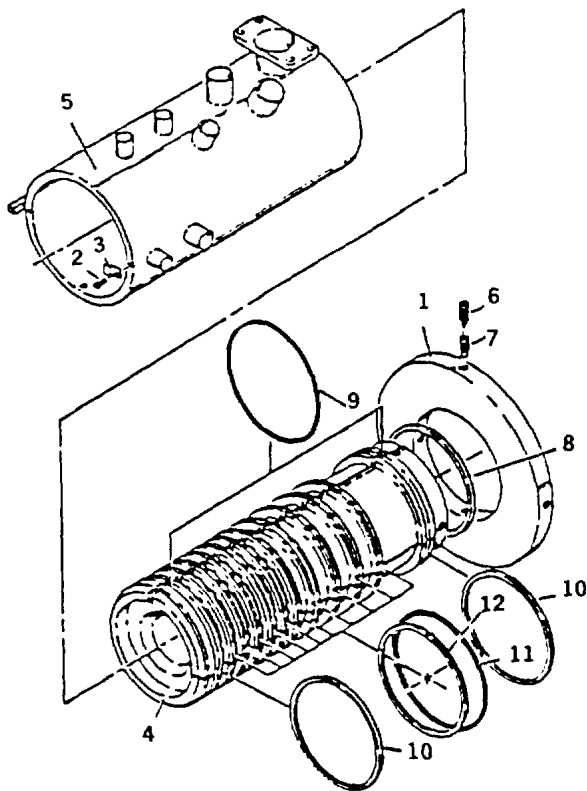
REASSEMBLY:

1. LUBRICATE SPOOL, SEALS, AND RINGS WITH CLEAN HYDRAULIC OIL.
2. IF REMOVED, INSTALL THRUST WASHER (8) AND MOUNTING PLATE (1). SECURE WITH SETSCREWS (7) AND SCREWS (6).

CAUTION

When installing new seals and rings, avoid stretching seals or scratching grooved or gland surfaces.

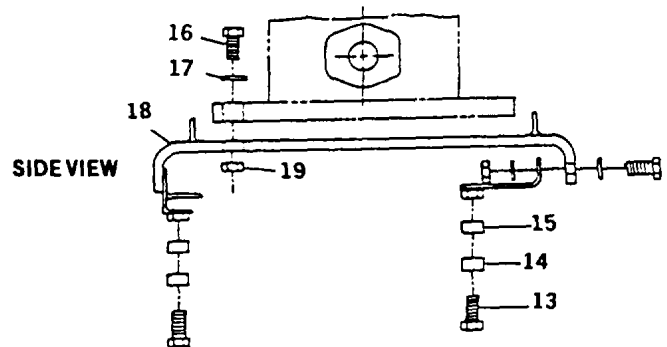
3. INSTALL RINGS AND SEALS.
 - a. Install two new preformed packings (9), two split ring bearings (10), ten quad rings (11) and bronze filled seals (12).



CAUTION

Proper alignment when inserting spool is required. Do not force spool into swivel case.

4. INSERT SPOOL (4) INTO BARREL (5). SECURE SPOOL TO SWIVEL CASE WITH CAPSCREWS (2) AND RETAINING CLIPS (3).
5. INSTALL MOUNTING CHANNEL (18).
 - a. Secure mounting channel (18) to hydraulic swivel mounting plate (1). Secure with six capscrews (16), washers (17) and nuts(19)



6. INSTALL RIGID PIPING AND CLAMPS (14).
- a. Connect tagged piping to bottom of hydraulic swivel.
 - b. Secure piping with pipe clamps (14), bolt inserts (15) and capscrews (13).

Port Number	Test Pressure	Function
1	500 psi (3, 447.5 kPa/ 34.5 bar)	Drain Line
2	2500 psi (17, 237.5 kPa/ 172.5 bar)	Rear Steer
3	2500 psi (17, 237.5 kPa/ 172.5 bar)	Rear Steer
4	2500 psi (17, 237.5 kPa/ 172.5 bar)	Front Steer
5	2500 psi (17, 237.5 kPa/ 172.5 bar)	Front Steer
6	2500 psi (17, 237.5 kPa/ 172.5 bar)	Front Steer Supply
7	1500 psi (10, 342.5 kPa/ 103.4 bar)	Swing
8	2500 psi (17, 237.5 kPa/ 172.5 bar)	Lift, Rear Steer Tele
9	2700 psi (18, 616.5 kPa/ 186.2 bar)	Main Hoist and Aux. Hoist Boost
10	2700 psi (18, 616.5 kPa/ 186.2 bar)	Main Hoist Boost, Aux. Hoist and Lift Boost
11	500 psi (3, 447.5 kPa/ 34.5 bar)	Dual Return

PRESSURE TEST:

NOTE

Use only 10W hydraulic oil during pressure testing.

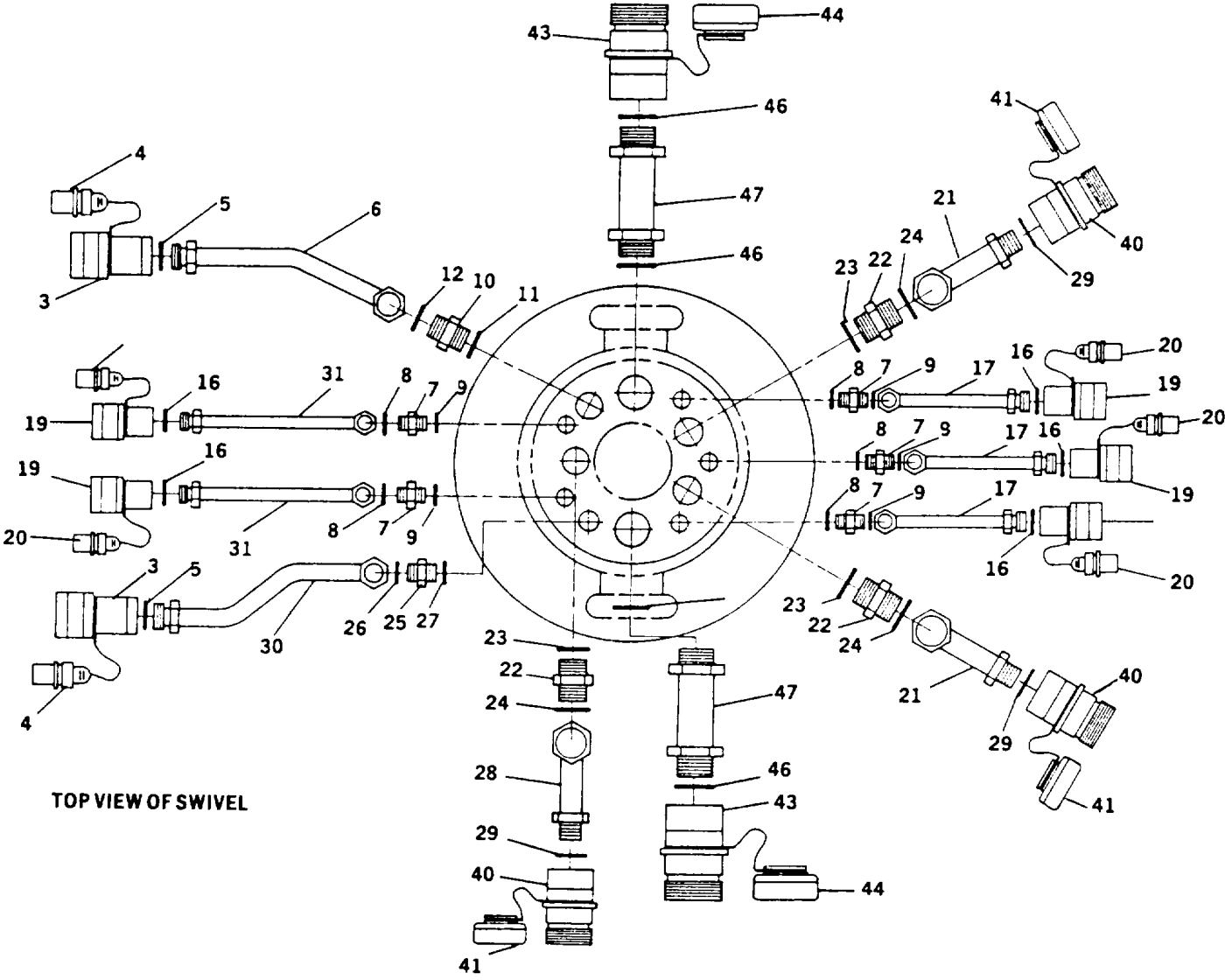
1. PRESSURE TEST SWIVEL PORTS.

NOTE

Each port on spool (4) and barrel (5) is stamped with port number.

- a. Install a pressure gauge into a port on swivel case.
- b. Install a pressure line in corresponding port in swivel spool.
- c. Allow ports on each side of the port to be tested to vent in order to detect leakage.
- d. Pressurize port to be tested while rotating either spool or case 360 degrees.
- e. If leakage is detected disassembly swivel and determine cause.
- f. Pressure check each port individually until all parts have been tested.
- g. Test ports with following pressures:

END OF TASK



NOTE

FIND NUMBERS NOT REFERENCED IN TEXT. ILLUSTRATION FOR CLARIFICATION OF RIGID PIPING INSTALLATION (SEE TM 5-3810-306-24P).

SWING GEARBOX INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Lifting device (500 lb. Capacity)

SUPPLIES: None

EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
(Refer to TM 5-3810-306-20.)
Swing lock is engaged. (Refer to TM 5-3810-306-10.)
Boom fully raised and blocked. (Refer to page 15-95.)
Hydraulic system pressure relieved.
(Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE TWO HYDRAULIC HOSES TO HYDRAULIC MANIFOLD (5) WHICH BLOCK THE REMOVAL OF SWING GEARBOX.
2. REMOVE HYDRAULIC LINE (6) FROM TOP OF OIL COOLER AND PULL HOSE THROUGH HOLE IN SUPERSTRUCTURE OUT OF WAY OF GEARBOX.
3. REMOVE SWING GEARBOX ASSEMBLY.
 - a. Disconnect and cap hydraulic lines from swing motor and swing brake.
 - b. Remove lockwire (1), bolts (2), and washers (3) securing swing gearbox to mounting plate. Attach a suitable sling to lifting eyes on cover.
 - c. Attach an adequate lifting device to sling; remove swing gearbox.

INSTALLATION:

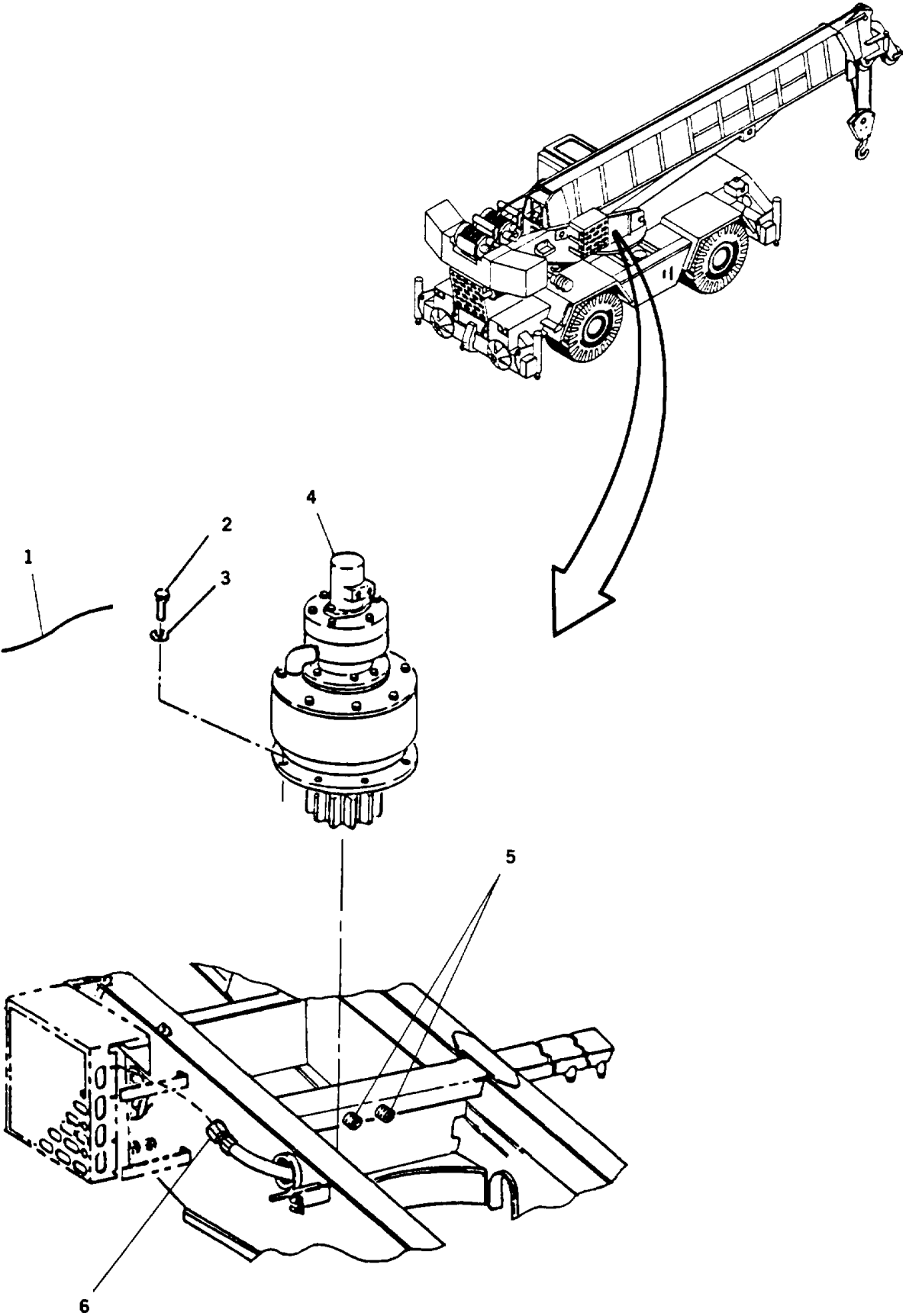
1. INSTALL SWING GEARBOX ASSEMBLY.
 - a. Attach a suitable sling to lifting eyes on swing box cover.
 - b. Using an adequate lifting device, lift and position swing box in place on mounting plate.

NOTE

If a new gearbox is being installed, the key stock welded to deck may not align with grooves in gearbox housing, therefore, some filing may be required.

- c. Install bolts (2) and washers (3). Torque to 250 ft-lbs (333 Nm). Install the lockwire (1) through bolts in direction that resists loosening.
- d. Connect the hydraulic lines to the gearbox, motor, and brake as applicable.
2. POSITION HYDRAULIC LINE (6) THROUGH HOLE IN SUPERSTRUCTURE AND CONNECT TO OIL COOLER.
3. INSTALL TWO HYDRAULIC LINES TO HYDRAULIC MANIFOLD (5).
4. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
5. START CRANE AND CHECK FOR LEAKS AND PROPER OPERATION.

END OF TASK



SWING GEARBOX ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Lockwashers (Item 13, Appendix B) (11 Required)
 Loctite 242 (Item 6, Appendix B)
 Solvent P-D-680 (Item 1, Appendix B)
 Silicone sealant (Item 27, Appendix B)
 Grease (Item 9, Appendix B)

EQUIPMENT CONDITIONS: Swing gearbox assembly removed. (Refer to page 15-114.)
 Swing motor removed. (Refer to TM 5-3810-306-20.)
 Swing brake removed. (Refer to page 15-124.)

DISASSEMBLY:

1. IF NOT ALREADY REMOVED, REMOVE LOCKWIRE, BOLTS (52) AND END CAP (51) FROM BOTTOM OF PINION (50). REMOVE PINION (50) AND SPACER (49) FROM BOTTOM OF PLANET CAGE AND SHAFT (30).

NOTE

For ease of alignment during assembly, scribe or pencil mark a line through housing cover (21) and base (40).

2. REMOVE VENT AND DRAIN PLUGS (20) AND (42). PLACE THE SWING GEARBOX ON ITS SIDE AND DRAIN IT.
3. REMOVE COVER (21).
 - a. Remove hex head bolts (22) and (17), washers (18) and lifting lugs (19) from gear housing cover (21). Remove the cover (21).
4. REMOVE PLANET CAGE AND SHAFT (30) AND BEARINGS (24), (29) AND (37).

NOTE

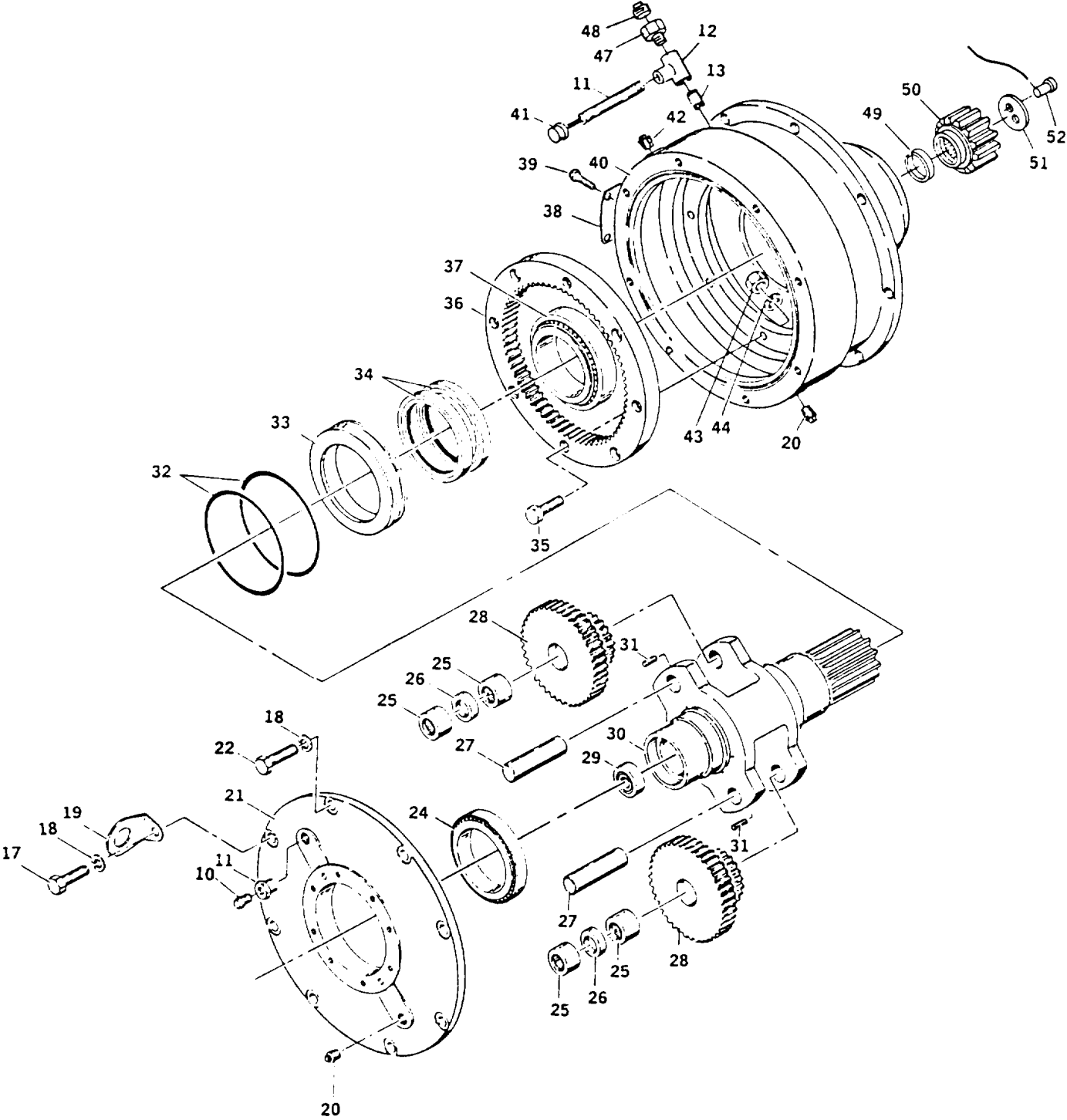
Ensure planet gears (28) are aligned with cutouts in gear housing (40).

- a. Using a suitable driver, remove planet cage and shaft (30) from gear housing (40).
- b. Use a bearing puller to remove planet cage and shaft bearing (24).
- c. Using puller, remove bearing (29) from planet cage and shaft (30).

NOTE

Bearing (37) and seal retainer (33) may remain in housing (40) instead of coming out with planet shaft (30).

- d. Pull lower bearing (37) from planet shaft assembly.
- e. Remove seal retainer (33) from planet shaft. Remove packings (32) from seal retainer. Using a press or driver, remove two seals (34) from seal retainer (33).
5. REMOVE PLANET GEARS (28), BEARINGS (25) AND SPACERS (26) FROM PLANET CAGE (30).



- a. The length of roll pins (31) is slightly less than diameter of planet shafts (27). Use a punch to carefully drive roll pins (31) into planet shafts (27) until planet shafts can be removed. Ensure pins do not engage lip of shafts on inside.
- b. Tap planet shafts (27) from planet gears (28) and planet cage assembly (30). Remove planet gears (28).

NOTE

After planet gear shafts have been removed, roll pins can be tapped out and re-used if they are serviceable.

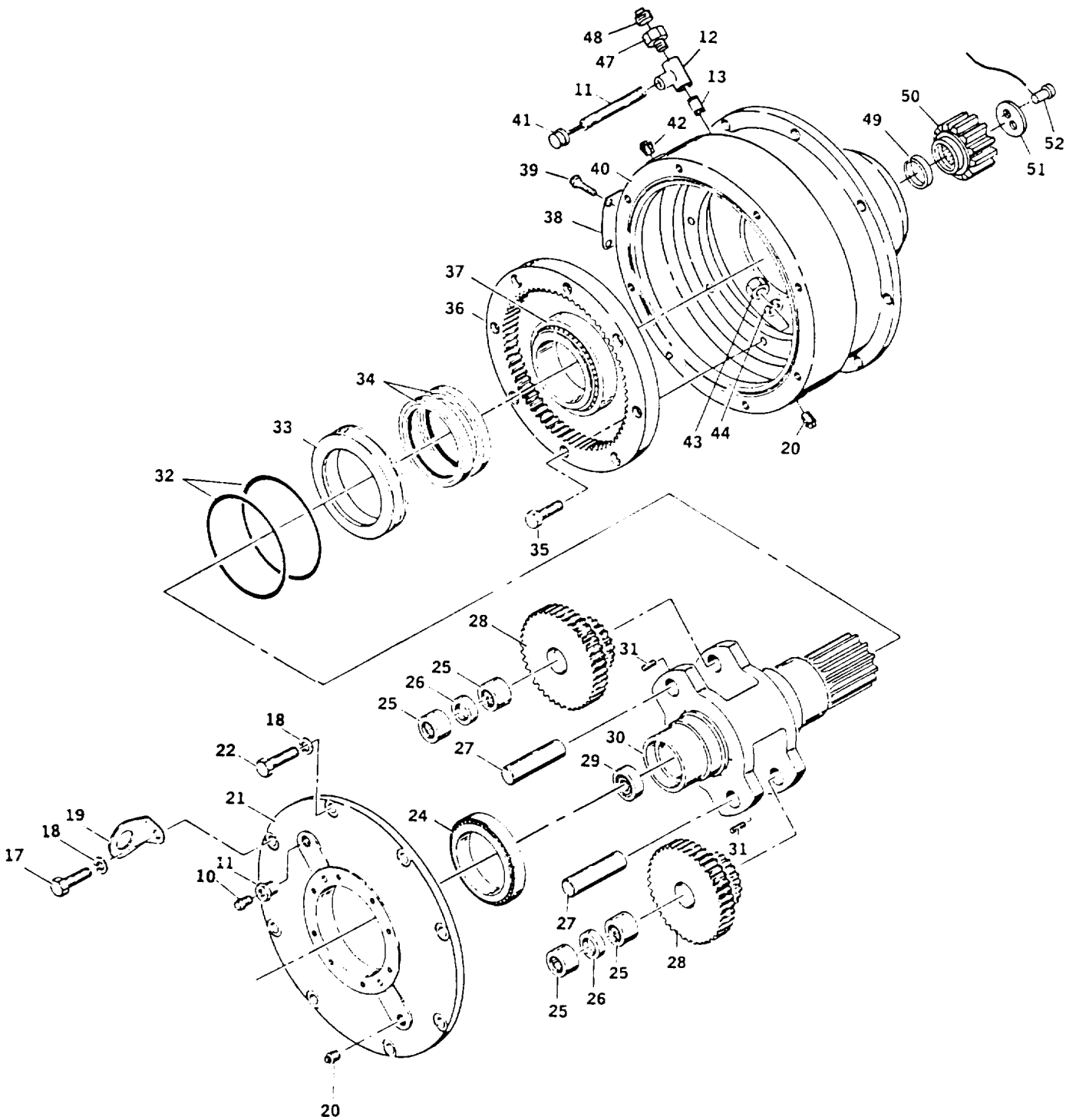
- c. Using a press or driver, remove both bearings (25) and spacer (26) from each planet gear.
- d. If the internal gear (36) needs to be serviced, remove capscrews (35), lockwashers (44) and locknuts (43); otherwise just ensure they are properly torqued to 75 ft-lbs (100 Nm).
- e. If the bearing (37) and seal retainer (33) remained in housing (40), use a puller or driver and remove from housing (40).
- f. Turn housing (40) and, using a brass rod and mallet, remove lower shaft bearing outer race.

CLEANING AND INSPECTION:

WARNING

Dry cleaning solvent P-D680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately. 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.).

1. CLEAN ALL PARTS IN SOLVENT P-D-680.
2. INSPECT GEAR TEETH FOR CRACKS AND DAMAGE.
3. INSPECT BEARINGS AND RACES FOR SCORING AND WEAR.
4. INSPECT PLANET SHAFTS FOR WEAR.



REASSEMBLY:**NOTE**

Prior to assembly, clean all components with a non-residue type solvent.

1. IF REMOVED, INSTALL INTERNAL GEAR (36) USING CAPSCREWS (35), LOCKWASHERS (44), AND LOCKNUTS (43). TORQUE TO 75 FT-LBS (100 NM).
2. PRESS OUTER BEARING RACE IN GEAR HOUSING (40).
3. INSTALL BEARING (37) AND SEAL RETAINER (33).
 - a. Lubricate bearing (37) with MILG-10924 and place it in bearing race.

NOTE

Install seals (34) in retainer (33) with lip of seals facing up.

- b. Use a seal driver to install seals (34) in seal retainer (33). Lubricate packings (32) with clean hydraulic oil; then place them on outside of seal retainer (33).

NOTE

Place seal retainer (33) in housing (40) with lip of seals (34) down.

- c. Lubricate seal retainer (33) with MIL-G-10924 and place it in housing (40). Use a driver to seat it in position.
4. INSTALL BEARINGS (29) AND (24).
 - a. Press support pinion and shaft bearing (29) in planet cage and shaft (30).

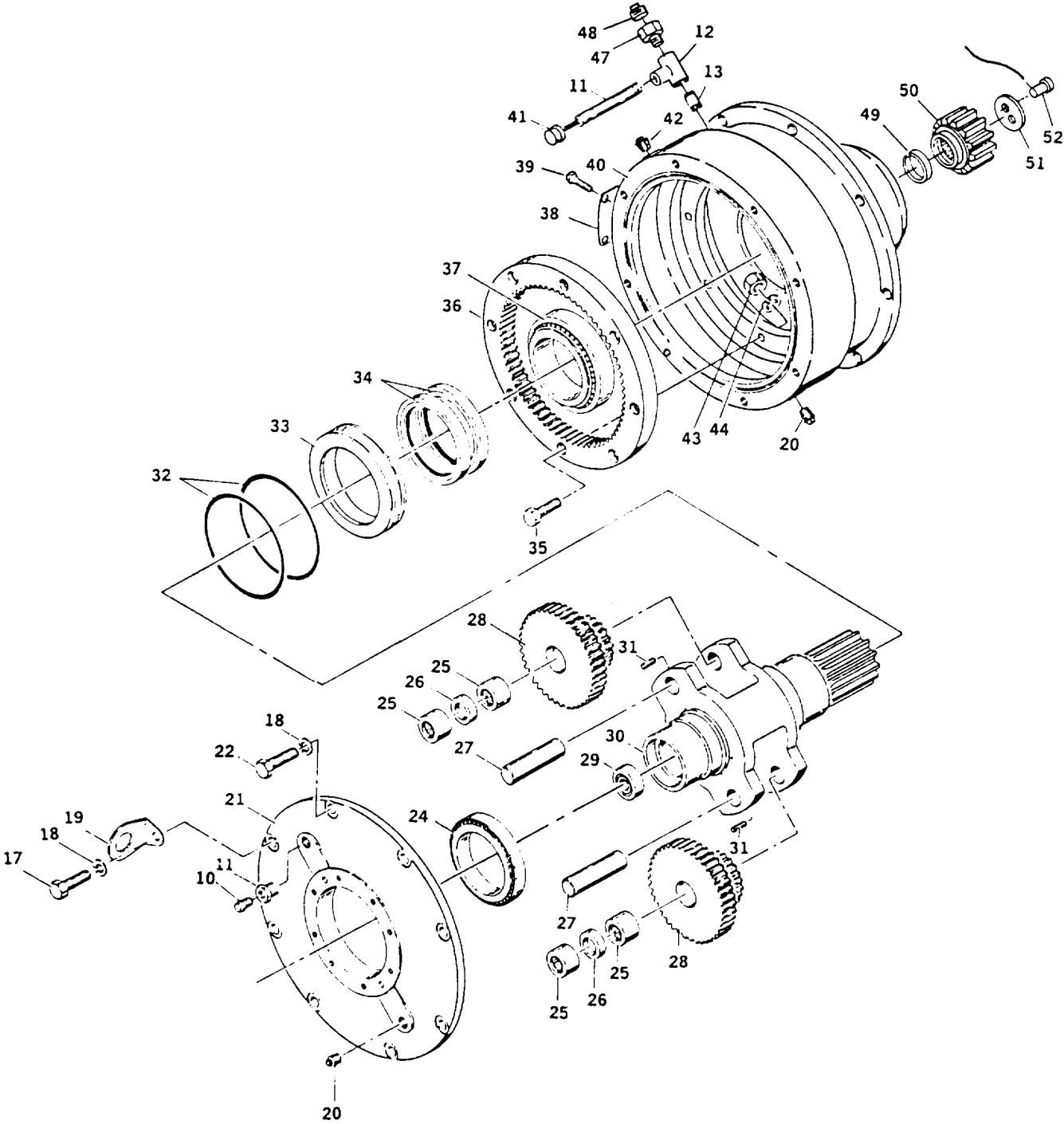
- b. Pack bearing (24) with grease and press on planet cage and shaft (30).

5. INSTALL PLANET GEARS (28).

- a. Use a press to install planet shaft bearings (25), bearing spacers (26), and the other planet shaft bearings (25) in planet gears (28).
- b. Each planet gear has a timing mark (punch hole). Locate timing mark and scribe or mark a line on other side of gear that will be visible when looking down through planet cage and shaft.
- c. Align bores of planet gears (28) with those of planet cage and shaft (30). Carefully tap planet shafts (27) in bores, also aligning bores for roll pins (31).
- d. Tap in roll pins (31) until they are almost flush with planet cage and shaft (30).
- e. Using a drift punch, drive roll pins (31) into planet cage and shaft (30).
- f. Turn the planet gears (28) until the timing marks are directly across from each other.

NOTE

Maintain timing marks aligned while installing planet cage and shaft assembly. This will allow planet gears (28) to mate with internal gear (36).



6. INSTALL PLANET CAGE AND SHAFT (30).
 - a. Lubricate planet cage and shaft assembly (30) and install into gear housing. A slight force may be needed to push shaft through seal retainer (33) and bearing (37). It may be necessary to slightly move planet gear (28) to align with internal gear (36).

7. INSTALL COVER (21).

NOTE

Apply Loctite # 242 to bolts (17) and (22) during assembly.

NOTE

Do not tighten any of cover bolts until all bolts are installed.

- a. Install cover (21). Install lifting lugs (19), washers (18) and hex head bolts (17) in cover opposite each other (the bolts are longer than other cover bolts). Install remaining hex head bolts (22) and washers (18). Torque to 68 ft-lbs (90 Nm).

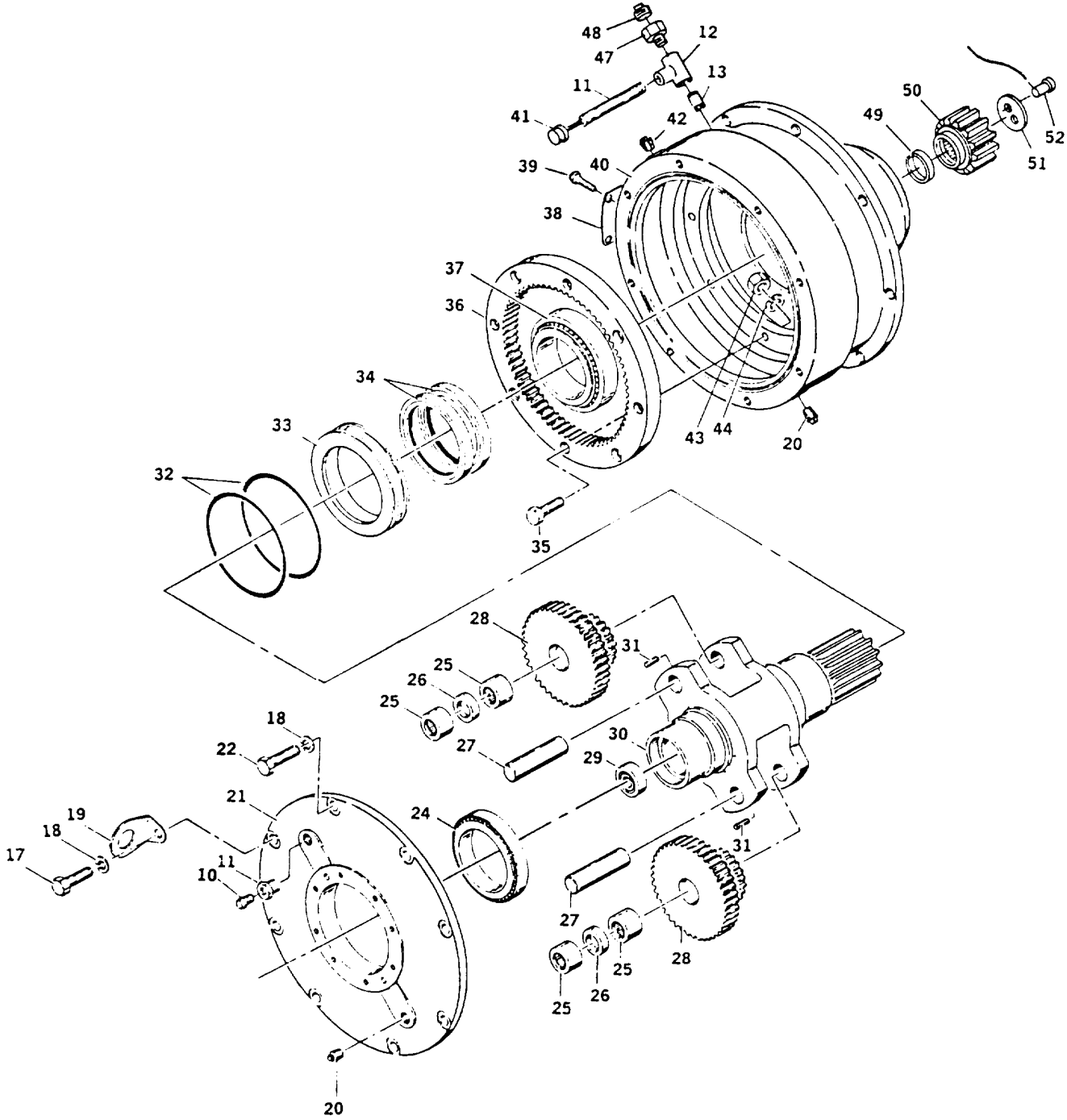
8. INSTALL VENT AND PLUG IN TOP COVER.
9. INSTALL FILL AND DRAIN PIPE.
10. INSTALL PLUGS IN REMAINING HOLES IN HOUSING.

NOTE

Steps 11 and 12 are only necessary if the swing brake and motor are to be installed prior to installation.

11. INSTALL SWING BRAKE. (REFER TO PAGE 15-124.)
12. INSTALL SWING MOTOR. (REFER TO TM 5-3810-306-20.)
13. INSTALL SPACER (49), PINION GEAR (50), CAP (51) AND BOLTS (52). TORQUE BOLTS (52) TO 75 IN-LBS (8 NM).
14. FILL GEARBOX WITH LUBRICANT AND GREASE LOWER BEARING. (REFER TO LO 5-3810-306-12.)
15. INSTALL SWING GEAR BOX. (REFER TO PAGE 15-114.)
16. TEST FOR PROPER OPERATION.

END OF TASK



SWING BRAKE INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: None

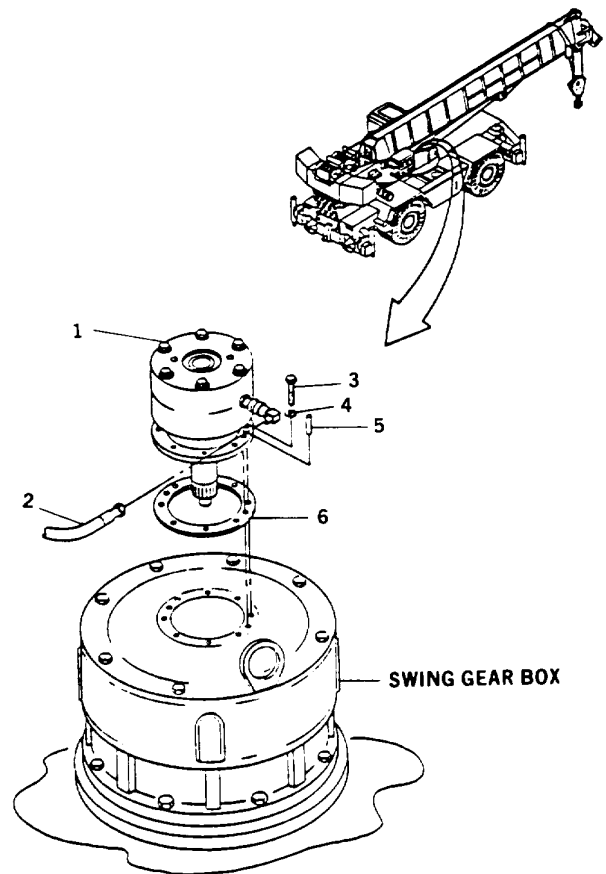
EQUIPMENT CONDITIONS: Negative battery cable disconnected at shunt.
 (Refer to TM 5-3810-306-20.)
 Hydraulic system pressure relieved.
 (Refer to TM 5-3810-306-20.)
 Swing motor removed. (Refer to TM 5-3810-306-20.)

REMOVAL:

1. REMOVE SWING BRAKE ASSEMBLY (1).
 - a. Tag and disconnect line (2) from swing brake (1).
 - b. Remove bolts (3), washers (4) and carefully lift swing brake (1) from swing gear box.
 - c. Remove laminated shim (6) and dowel pins (5) from swing gearbox.

INSTALLATION:

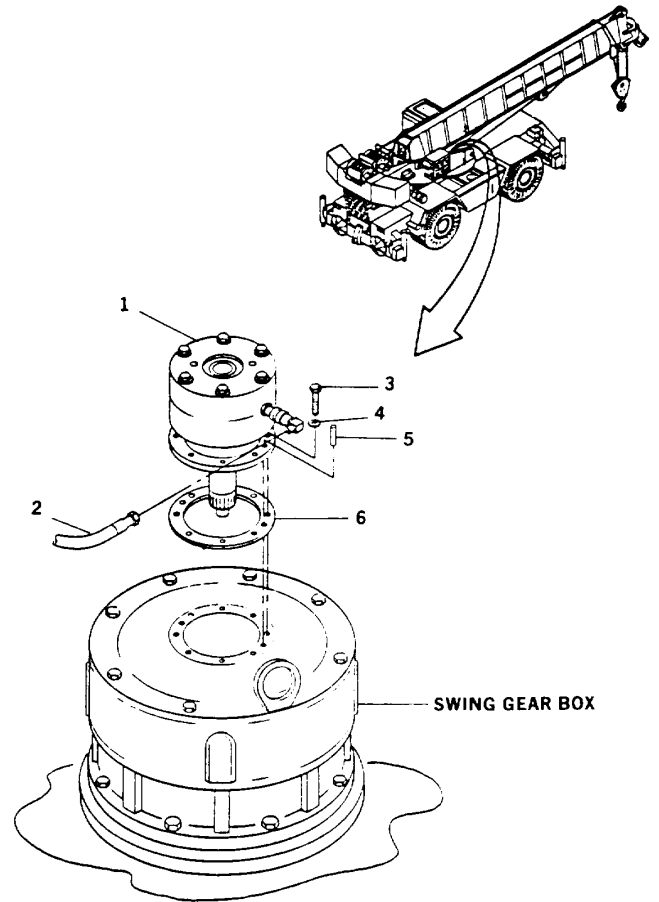
1. INSTALL SWING BRAKE ASSEMBLY (1).
 - a. Position brake assembly (1) on swing gearbox but do not install laminated shim (6).
 - b. Install bolts (3) and washers (4). Torque bolts (3) to 80 in lbs (9 Nm) alternating side to side while working in a circle. Release brake and rotate pinion end of main shaft at least two complete revolutions after torquing.



NOTE

Each lamination of shim (6) is 0.003 in. (0.076 mm) thick. Therefore, thickness of shim installed will be the required thickness +0.000/-0.002 in. (+0.000/-0.051 mm).

- c. Measure gap between brake assembly (1) and swing gearbox at two places, 180° apart, with a feeler gauge. Add two measurements together and divide by 2 to obtain an average gap. subtract 0.020 in. (0.508 mm) from average gap to determine required thickness of shim (6). If average gap is 0.022 in. (0.559 mm) or less, no shim is required.
 - d. Remove brake assembly (1) and install correct shim (6) thickness.
 - e. Place dowel pins (5) in position in swing gearbox.
 - f. Install brake assembly (1) using hex head bolts (3) and washers (4).
 - g. Torque bolts (3) to 200 in-lbs (22 Nm) in the same manner as in Step b. Repeat torquing until all bolts are at 200 in-lbs (22 Nm).
2. INSTALL SWING MOTOR. (REFER TO TM 5-3810-306-20.)
 3. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)
 4. START CRANE AND CHECK FOR LEAK AND PROPER OPERATION.



END OF TASK

SWING BRAKE ASSEMBLY

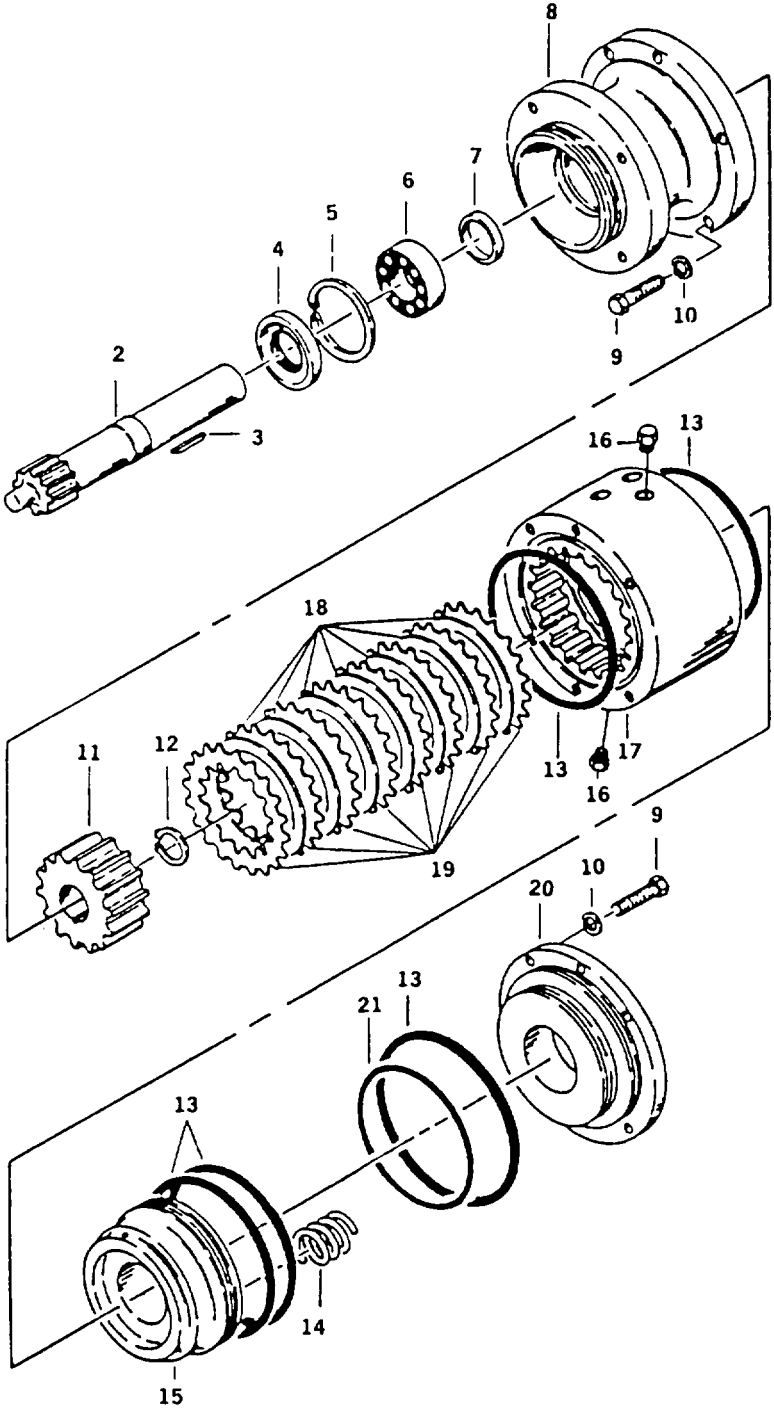
TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Shop Equipment Auto-Maintenance and Repair, FM Basic (4910-00-754-0705)
 Shop Equipment Auto-Maintenance and Repair, FM Suppl No. 1
 (4910-00-754-0706)
 Tool Outfit Hyd System, Test and Repair, 3/4 Ton Trailer Mtd
 (4940-01-036-5784)

SUPPLIES: Parts kit, seal repl. (Item 55, Appendix B)
 Loctite 271 (Item 23, Appendix B)
 Hydraulic oil (Item 8, Appendix B)
 Loctite 242 (Item 6, Appendix B)

EQUIPMENT CONDITIONS: Swing brake assembly removed. (Refer to page 15-124.)

DISASSEMBLY:

1. DRAIN OIL FROM SWING BRAKE ASSEMBLY.
 - a. Remove plug from elbow in check/fill port and drain oil from brake assembly.
 - b. Remove all components from ports on swing brake and retain for reassembly.
2. REMOVE COVER (20) AND PREFORMED PACKINGS (13) AND (21).
 - a. Remove bolts (9) and washers (10) securing cover (20) to brake housing. Remove bolts together, in stages, so as to provide a uniform release of spring pressure.
 - b. Remove cover (20) from the brake housing (17).
 - c. Remove and discard preformed packings (13) and (21) from cover (20).
3. REMOVE PISTON (15) AND PREFORMED PACKING (13).
 - a. Remove six springs (14) from brake piston (15) and remove piston from brake housing (17).
 - b. Remove and discard preformed packings (13) from piston (15).
 - c. Remove and discard preformed packing (13) from inside of brake housing (17).
4. REMOVE MOUNTING FLANGE (8).
 - a. Remove bolts (9) and washers (10) securing mount flange (8) to brake housing (17). Remove mounting flange (8).
 - b. Remove and discard preformed packing (13) from brake housing (17).
5. REMOVE BRAKE DISCS (18) AND STATORS (19).
6. REMOVE SHAFT (2), SEAL (4) AND BEARING (6).
 - a. Remove retaining ring (12) key (3), spacer (7) and gear (11) from shaft (2).
 - b. Remove shaft (2).
 - c. Remove shaft seal (4) from mounting flange (8).
 - d. Remove retainer ring (5) and bearing (6) from mounting flange (8).



CLEANING AND INSPECTION:**WARNING**

Dry cleaning solvent P-D680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and do not breathe vapors. Do not use near open flame or excessive Heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

1. CLEAN ALL PARTS WITH SOLVENT P-D-680 AND BLOW DRY WITH COMPRESSED AIR.
2. INSPECT ALL PARTS FOR CRACKS AND EXCESS WEAR, REPLACE AS NECESSARY.

REASSEMBLY:

1. INSTALL BEARING (6), SHAFT (2) AND GEAR (11).
 - a. Position bearing (6) in mounting flange (8) and secure with retaining ring (5).

- b. Apply Loctite 271 to shaft seal (4) and install in mounting flange (8).
- c. Install shaft (2).
- d. Install spacer (7), key (3) and gear (11) onto shaft (2). Secure with retaining ring (12).

2. INSTALL MOUNTING FLANGE (8).

- a. Install a new preformed packing (13) lubricated with clean hydraulic oil, into brake housing (17).

NOTE

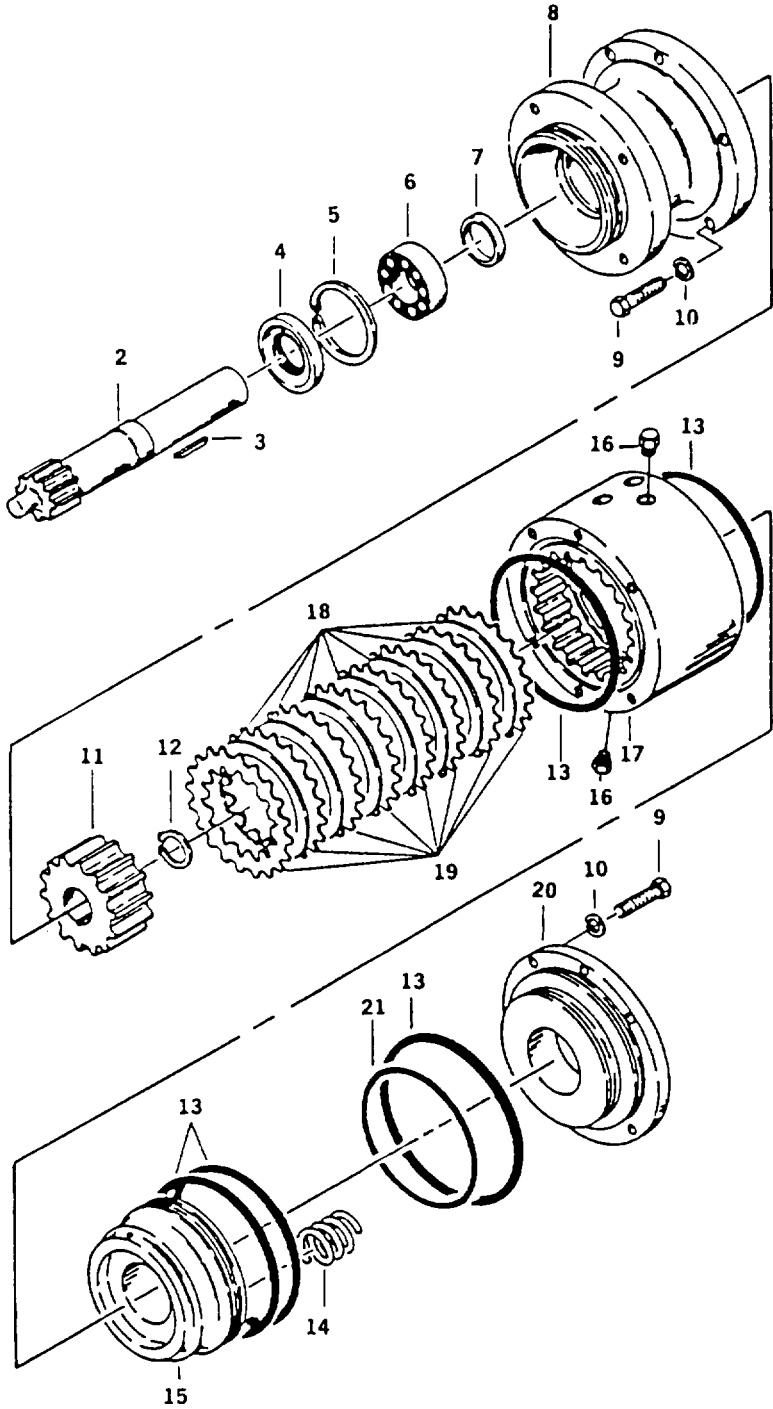
Apply Loctite 242 to all bolts.

- b. Install mounting flange (8) onto brake housing (17) with bolts (9) and washers (10). Torque bolts (9) to 31 ft-lbs (41 Nm).

NOTE

Ensure proper order is maintained (stator with external teeth, then brake disc (18) with internal teeth, etc.).

3. INSTALL THE BRAKE DISCS (18) AND STATORS (19) OVER GEAR.
4. INSTALL PISTON (15) AND PREFORMED PACKING (13).
 - a. Install a new preformed packing (13) lubricated with clean hydraulic oil, into packing groove on inside of brake housing (17).
 - b. Install new preformed packings (13) lubricated with clean hydraulic oil, onto brake piston (15).



- c. Install brake piston (15) into brake housing (17) with spring bores facing out.

5. INSTALL SPRINGS (14).

NOTE

The original length of compression spring (14) is 1.5 in. (3.8 cm). If one or two springs are shorter than others replace only worn springs.

- a. Install six compression springs (14) into holes provided in piston (15).

6. INSTALL COVER (20) AND PREFORMED PACKINGS (13) AND (21).

- a. Install new preformed packings (13) and (21) lubricated with clean hydraulic oil, into packing grooves provided on cover (20).

NOTE

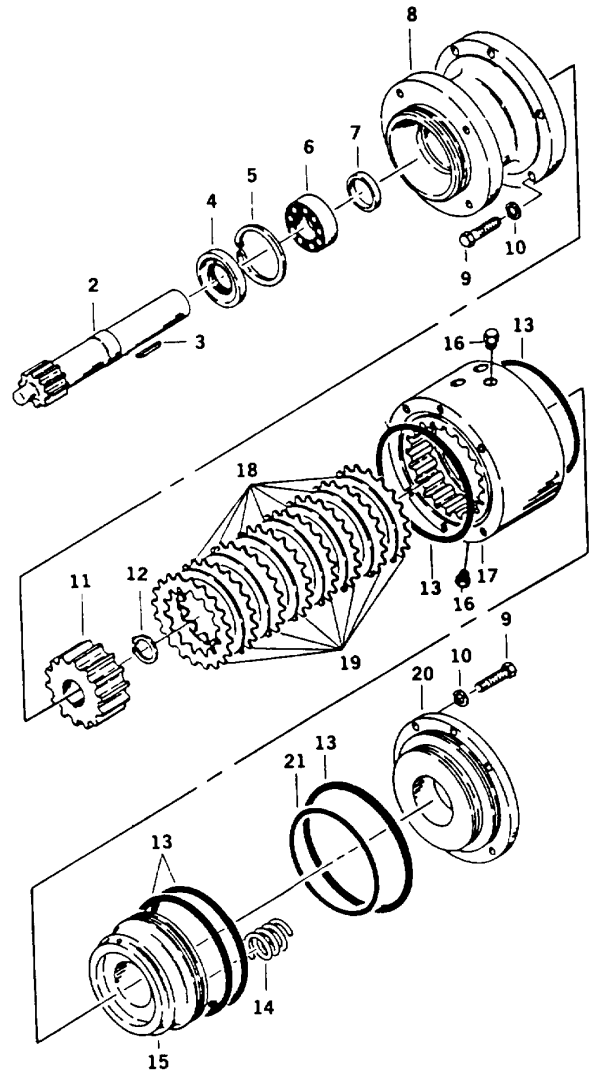
Install the bolts in the holes opposite the ones for mounting the motor.

- b. Install cover (20) onto brake housing (17) with bolts (9) and washers (10). Torque bolts (9) to 31 ft-lbs (41 Nm).

7. INSTALL STREET ELBOW IN BOTTOM PART OF HOUSING (17).

8. FILL DISC/STATOR AREA WITH CLEAN HYDRAULIC OIL. CAPACITY OF BRAKE IS APPROXIMATELY 0.50 PINTS (0.24 L). INSTALL FILL PORT PLUG.

9. INSTALL PLUG IN STREET ELBOW.



- 10. INSTALL BREATHER IN HOLE ON COVER (20).

- 11. INSTALL BLEEDER FITTINGS IN HOUSING.

- 12. INSTALL SWING BRAKE ASSEMBLY. (REFER TO PAGE 15-124.)

END OF TASK

POSITIVE SWING LOCK ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)

SUPPLIES: Clean rags (Item 2, Appendix B)
 Cotter pin (Item 230, Appendix B)
 Lockwashers (Item 234, Appendix B)

EQUIPMENT CONDITIONS: Positive swing lock is not engaged. (Refer to TM 5-3810-306-10.)
 Negative battery cable disconnected at shunt. (Refer to TM 5-3810-306-20.)
 Boom raised enough to allow access to swing lock. (Refer to TM 5-3810-306-10.)
 Swivel removed. (Refer to page 15-70.)

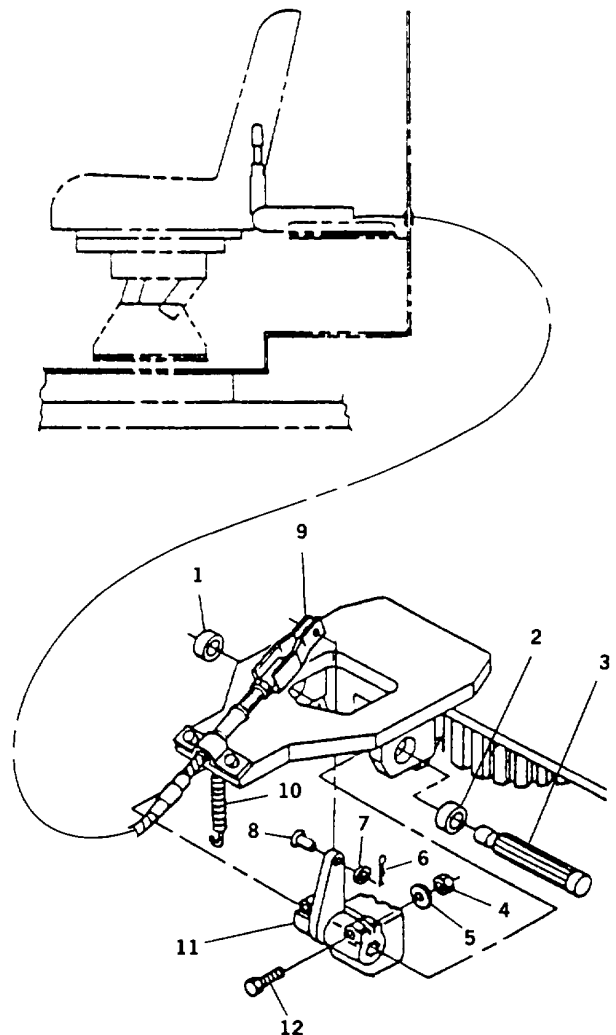
REMOVAL:

1. REMOVE POSITIVE SWING LOCK.
 - a. Remove spring (10) from mounting bracket and swing lock block (11).
 - b. Remove cotter pin (6), washer (7), and clevis pin (8) to free control cable clevis (9) from swing lock block (11). Discard cotter pin (6).
 - c. Remove two capscrews (12), lockwashers (5) and nuts (4) to loosen turntable lock shaft (3).

NOTE

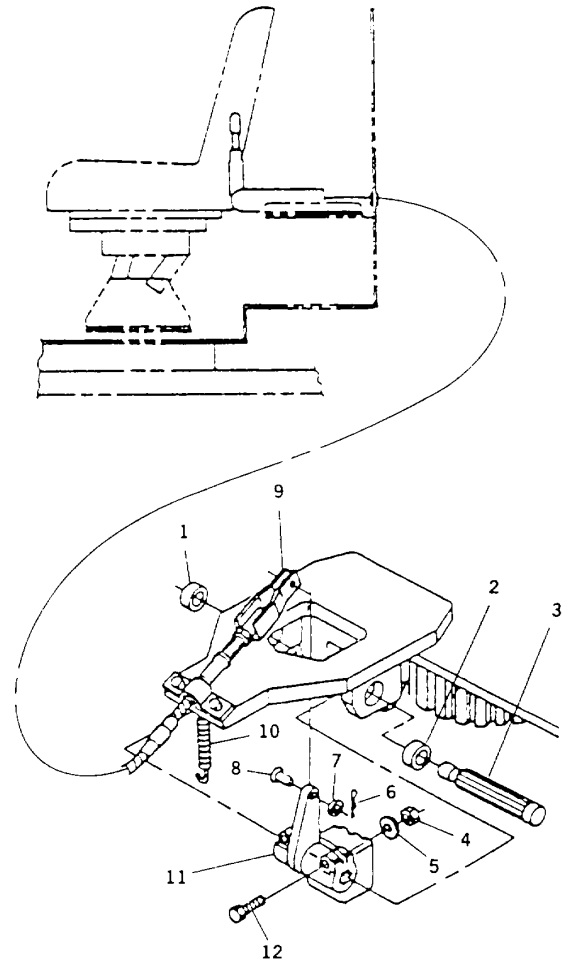
It may be necessary to cut out chain hook on bottom of turntable if shaft does not clear it upon removal.

- d. Support swing lock block (11) and drive out turntable lock shaft (3) (small diameter end) from mounting bracket.
- e. Remove two bearings (1) and (2) from mounting bracket.



INSTALLATION:

1. LUBRICATE BEARING. (REFER TO LO 5-3810-306-12.)
2. INSTALL POSITIVE SWING LOCK.
 - a. Install bearings (1) and (2) in mounting bracket.
 - b. Align swing lock block (11) with mounting bracket holes and insert turntable lock shaft (3). Install two capscrews (12), lockwashers (5) and nuts (4) to secure turntable lock shaft (3).
 - c. Secure control cable clevis (9) to swing lock block (11) with clevis pin (8), washer (7) and new cotter pin (6).
 - d. Install spring (10) on swing lock block (11) and mounting bracket.
3. CHECK POSITIVE SWING LOCK OPERATION. (REFER TO TM 5-3810-306-10.)
4. INSTALL SWIVEL. (REFER TO PAGE 15-70.)
5. CONNECT NEGATIVE BATTERY CABLE AT SHUNT. (REFER TO TM 5-3810-306-20.)



END OF TASK

SWING MOTOR ASSEMBLY

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
Propane torch

SUPPLIES: Petroleum jelly (Item 158, Appendix B)
Gasket and seal set (Item 271, Appendix B)
Loctite #601 (Item 12, Appendix B)
Loctite Primer NF (Item 272, Appendix B)
Hydraulic oil (Item 8, Appendix B)

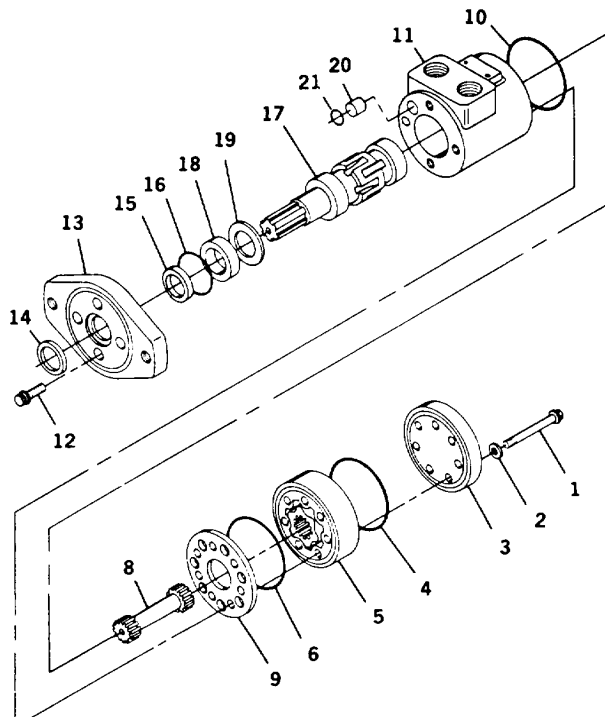
EQUIPMENT CONDITIONS: Swing motor assembly removed. (Refer to TM 5-3810-306-20.)

DISASSEMBLY:

NOTE

It is recommended that the motor be kept in a vise during disassembly.

1. REMOVE END CAP (3) AND SEAL (4).
 - a. Place motor in a vise and clamp across the edge of flange with output shaft down. When clamping use a protective device on vise, such as special soft jaws or pieces of hard rubber or board.
 - b. Remove capscrews (1) and sealwashers (2).
 - c. Remove end cap (3).
 - d. Remove seal (4) from end cap (3).
2. REMOVE GEROTOR (5) AND SEAL (6).
3. REMOVE THE SPLINED DRIVE (8).
4. REMOVE THE WEAR PLATE (9).
5. REMOVE THE SEAL (10) FROM HOUSING (11).
6. REMOVE OUTPUT SHAFT (17) FROM HOUSING.

- 
7. REMOVE BEARING RACE (18) AND NEEDLE THRUST BEARING (19) FROM SHAFT.
 8. REMOVE MOUNTING FLANGE (13) AND SEALS.
 - a. Reposition motor in vise, clamping across ports, not on housing. Excessive clamping pressure on housing causes distortion. Position output shaft upward.

- b. Remove four capscrews (12) from mounting flange (13). These motors are assembled using Loctite on screws (12) to hold them in place. Screws (12) will require approximately 300 to 400 in-lbs (33-44 Nm) of torque to break loose and approximately 100 in-lbs (11 Nm) of torque to remove after they are broken loose. Do not use an impact wrench on screws held with Loctite, this may result in rounded heads or broken sockets. If it requires more than 400 in lbs (44 Nm) to remove capscrews (12) proceed to step c otherwise proceed to step d.

CAUTION

Be careful not to overheat and damage the motor.

- c. Use a small flame propane torch to heat a small area of housing (11) where the screw (12) enters. Apply torque to capscrew (12) with a socket wrench gradually as heat is applied for 8 to 10 seconds. As soon as screw breaks loose, remove heat from housing, and continue turning screw until it is completely removed.
- d. Remove motor from vise and place it on a clean flat surface. Carefully remove flange (13) from the housing (11).

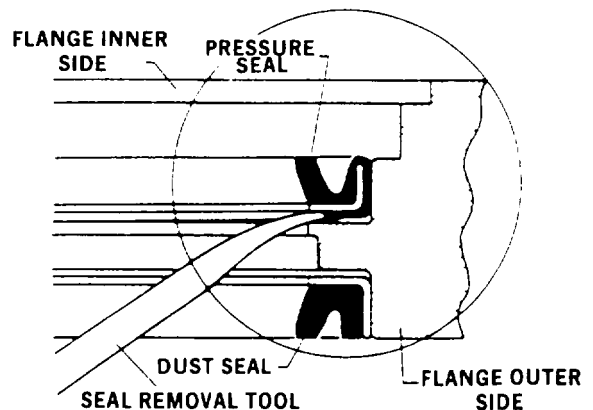
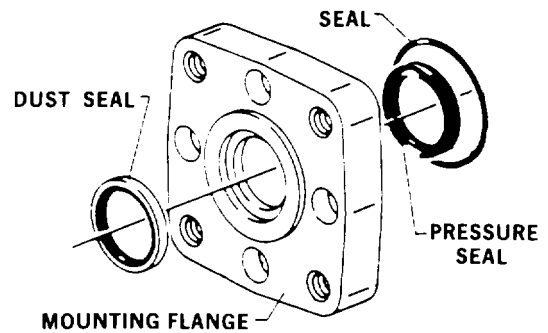
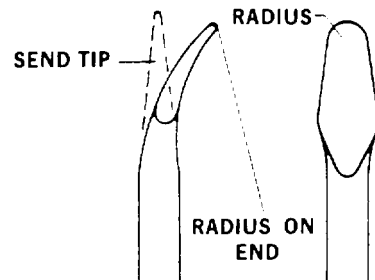
CAUTION

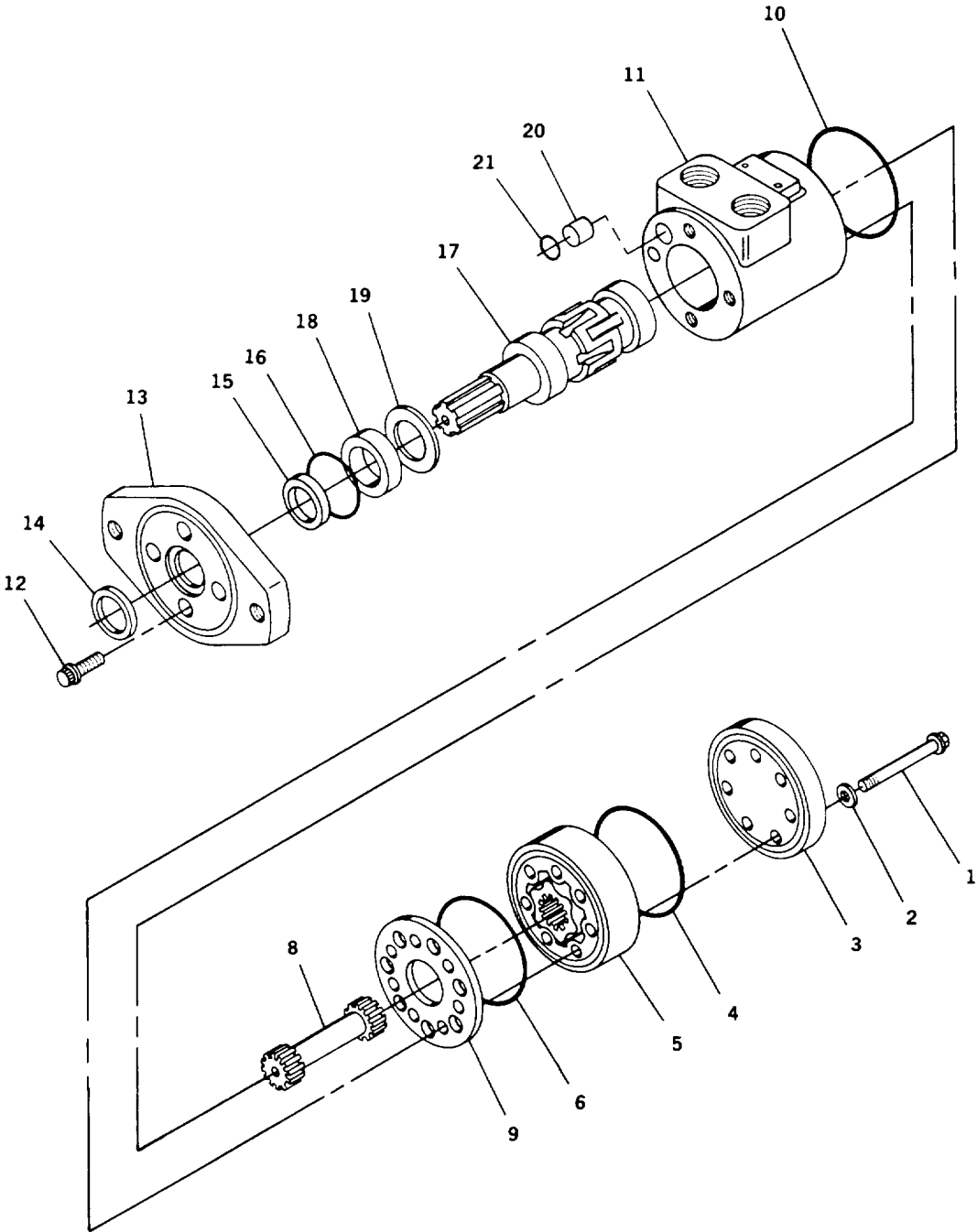
Use care not to scratch seal cavity O.D. This could cause leakage.

NOTE

The dust seal (14), pressure seal (15) and seal (16) will come off with flange (11).

- e. Use a seal remover tool, like the one shown to remove dust seal (14) and pressure seal (15). Work from outer side to remove each seal. Work nose of tool between pressure seal (15) and the flange (13). Pry seal partway. Remove tool and repeat at a point 180 degrees away. Push seal (15) completely out of cavity.





9. REMOVE PLUG (20) AND SEAL (21) IF REQUIRED.

- a. A metal plug (20) and seal (21) is used to plug a machining hole in housing (11). It is not necessary to remove plug and replace seal unless leakage is occurring around plug. To remove plug, insert a 3/16 inch Allen wrench through port opening and push it out.

CLEANING:

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F-138°F (38°-59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

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.).

1. CLEAN ALL METAL PARTS IN CLEAN SOLVENT. BLOW DRY WITH AIR.

- a. Do not wipe parts with a cloth or paper towel because lint or other matter can get into hydraulic system and cause damage.
- b. Wash housing (11) with nonpetroleum base solvent to remove oil, grease, and debris. Petroleum base solvents may leave residue detrimental to successful use of Loctite. Pay particular attention to four tapped holes on flange end.

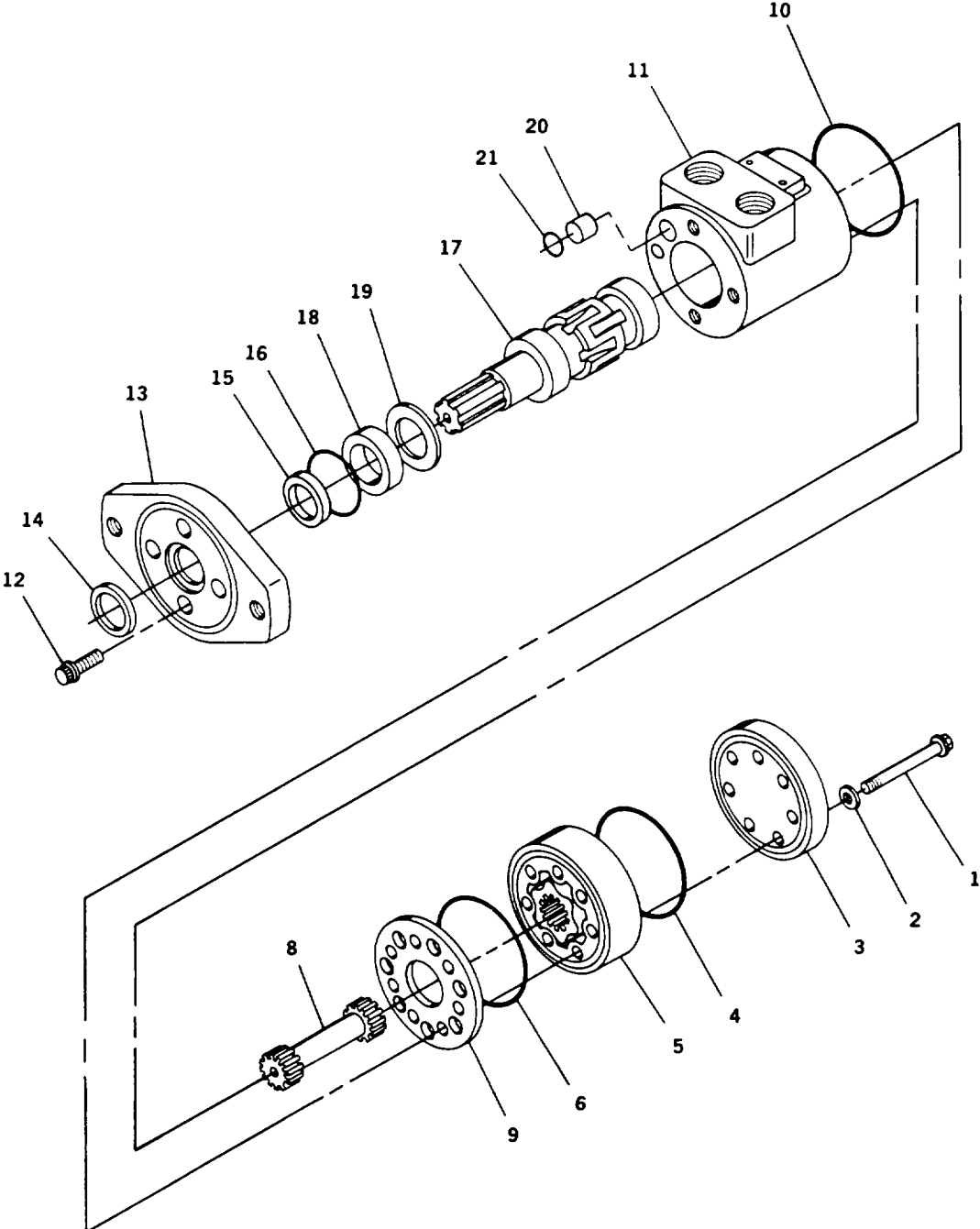
NOTE

Fully cured Loctite resists most solvents, oils, gasoline, kerosene, and is not affected by cleaning operations. It is not necessary to remove cured Loctite that is securely bonded in tapped holes; however, any loose particles of cured Loctite should be removed.

- c. Wire brush screw threads to remove any cured Loctite and other debris. Discard any screws that have damaged thread or a corroded, damaged, or rounded head.
- d. Wash screws with non-petroleum base solvent. Blow dry with compressed air.

INSPECTION:

- 1. INSPECT MOTOR COMPONENTS.



- a. Check all mating surfaces, and replace any parts having scratches or burrs that could cause leakage or damage.
- b. Check around chamfered area of shaft for burrs, nicks, or sharp edges that can damage seals when assembling flange. Nicks or burrs may be removed with a hard, smooth stone (such as an Arkansas stone). Do not try to file or grind this part.

REASSEMBLY:

NOTE

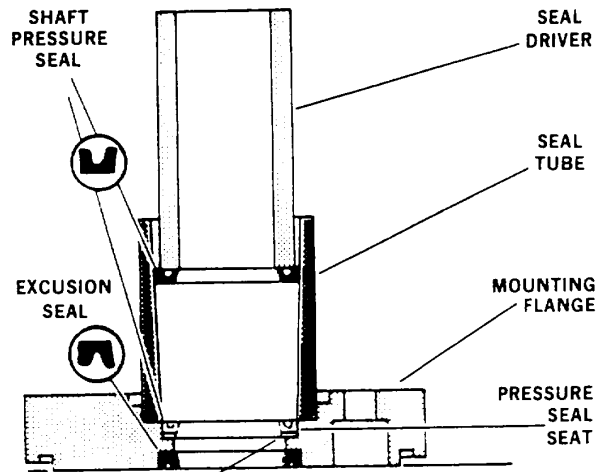
Use all new seals when assembling motor. Lubricate the seals with petroleum jelly before assembly. Do not stretch seals before installing.

1. INSTALL PLUG (20) AND SEAL (21), IF REMOVED.
 - a. If plug (20) and seal (21) were removed, lubricate seal and install it on plug. Push plug into housing so plug and housing are flush. Be careful not to damage seal (21).

NOTE

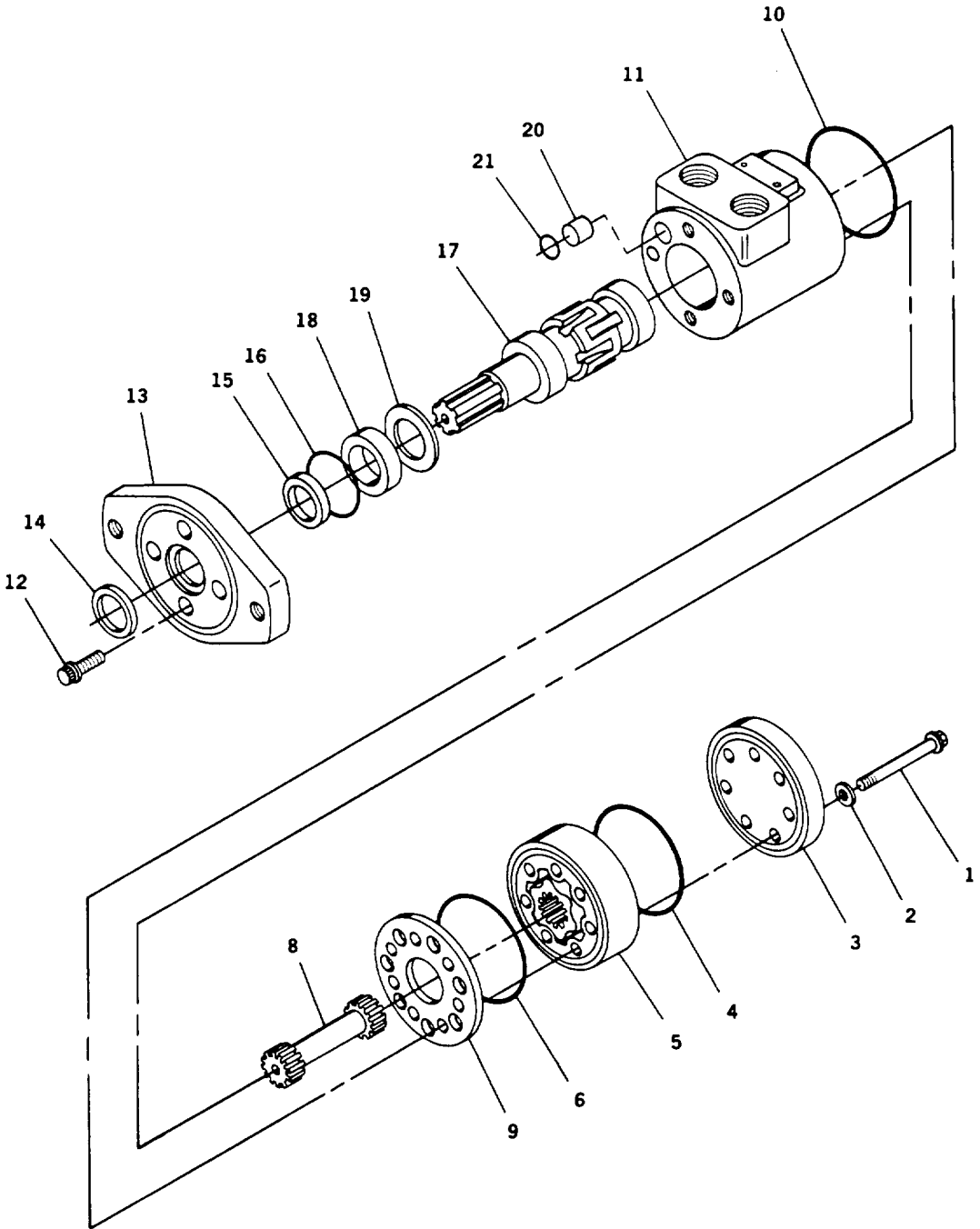
Do not allow oil to get into tapped holes.

2. INSTALL OUTPUT SHAFT (17), NEEDLE THRUST BEARING (19) AND BEARING RACE (18).
 - a. Lubricate output shaft (17) with hydraulic oil. Install shaft in housing (11).
 - b. Install needle thrust bearing (19) then bearing race (18) on shaft (17). Pull shaft partially out of housing, then push all three parts in housing



together. Bearing race must rotate freely when in piston.

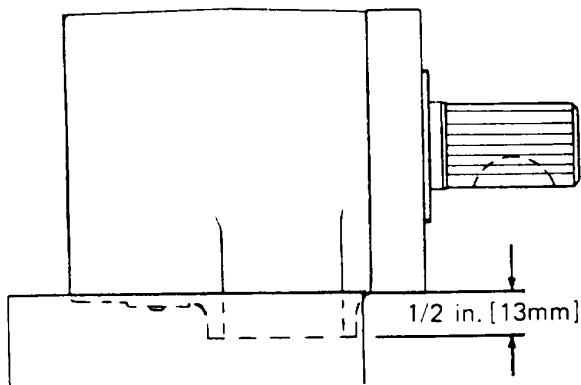
3. INSTALL MOUNTING FLANGE (13) AND SEALS.
 - a. Install dust seal (14) in the flange (13) as shown. Press seal into place carefully, using a tool which will provide proper guiding and positioning to eliminate damage to rubber portion of distortion metal container.
 - b. Lubricate I.D. of seal tube and O.D. of shaft pressure seal (15) with light film of clean petroleum jelly. Align small I.D. end of seal tube with seal seat in mounting flange. Install pressure seal (15) in tube with lip of seal face up as shown. Insert seal driver in tube and firmly push seal seat with a rotating action.



CAUTION

After installing seal in flange, examine seal condition. If damaged or improperly installed, you must replace it before continuing with reassembly.

- c. Install 1.9375 in. (4.92 cm) diameter seal (16) in flange (13).
- d. Apply Loctite to bolts (12).
- e. Before installing flange (13) with seal assembly over shaft, place protective sleeve or bullet over shaft. Then lubricate space between dust seal (14) and pressure seal (15) as well as lips of both seals.
- f. Install flange (13). Rotate flange slowly while pushing down over shaft. Be careful not to invert or damage seals.
- g. After removing bullet, clamp motor in vice as shown. Ensure shaft cannot fall out. Install capscrews (12) and torque immediately 250 in-lbs (28 Nm).



4. INSTALL SPLINED DRIVE (8) AND WEAR PLATE (9).

- a. Clamp housing in a vise, gerotor end up. Refer to step 1a of disassembly for correct clamping procedure.

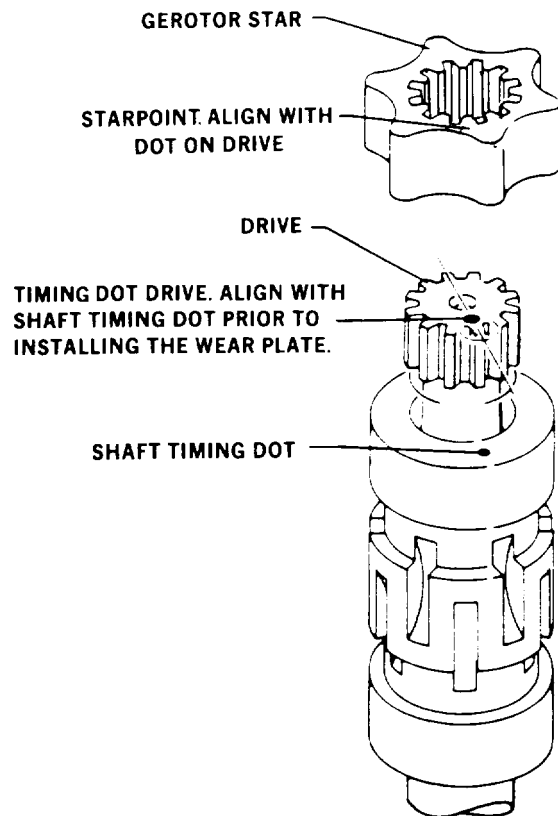
CAUTION

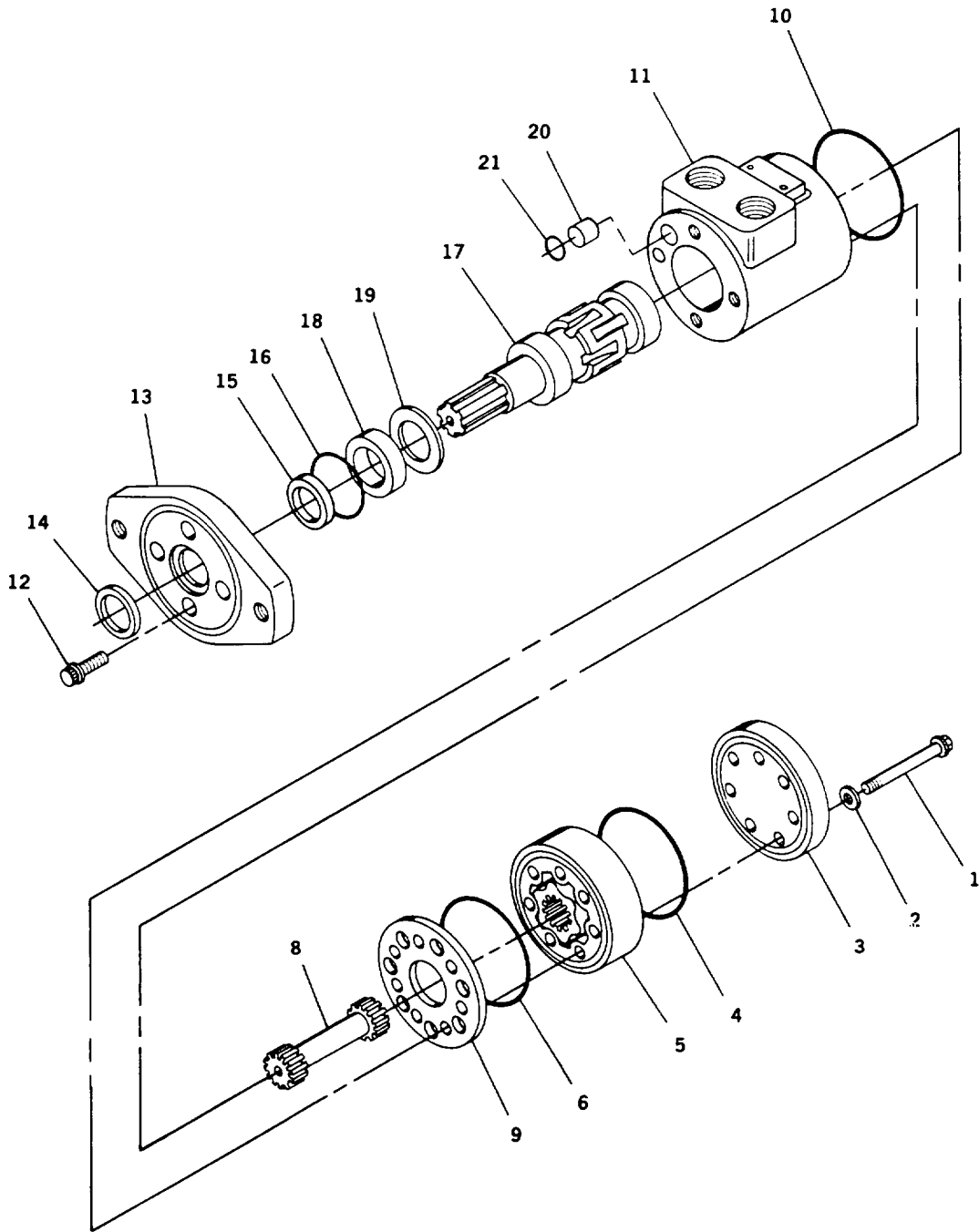
Do not stretch seals before installing them in groove.

NOTE

To aid in installation of seals, apply a light coating of clean petroleum to seal before installing.

- b. Pour approximately 35 cc of hydraulic oil in output shaft cavity.
- c. Install 2.875 in. (7.3 cm) diameter seal (10) in housing seal groove and install wear plate (9) on housing (11).
- d. Install splined drive (8). Use felt tip marker to mark one drive tooth. Align this tooth with the timing mark on shaft. Refer to Motor Timing figure below.

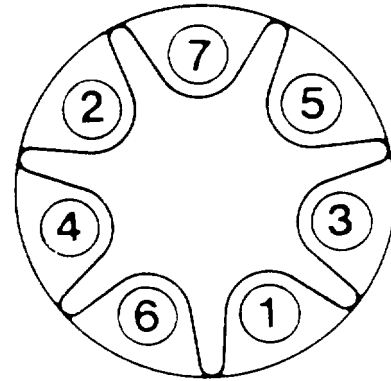
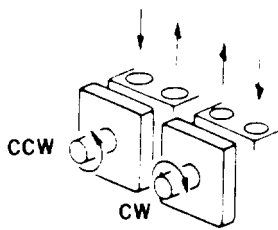




5. INSTALL GEROTOR (5).

- a. Install 2.875 in. (7.3 cm) diameter seal (6) in gerotor seal groove.
- b. Carefully place gerotor (5) on wear plate (9), seal side toward the wear plate. Install the gerotor with any tooth aligned with timing mark on drive.
- c. Turn gerotor (5) to line up holes for capscrews, be careful not to disengage star from drive.
- d. With orientation shown in Motor Timing figure, output shaft (17) will rotate as shown with the ports pressurized as shown.

- b. Install capscrews (1) and sealwashers (2) in end cap. Pretighten all screws to 40 in-lbs (4 Nm). Check to ensure seals are seated properly in grooves. Tighten capscrews to final torque of 275 to 300 in-lbs (30-33 Nm) following the sequence shown.

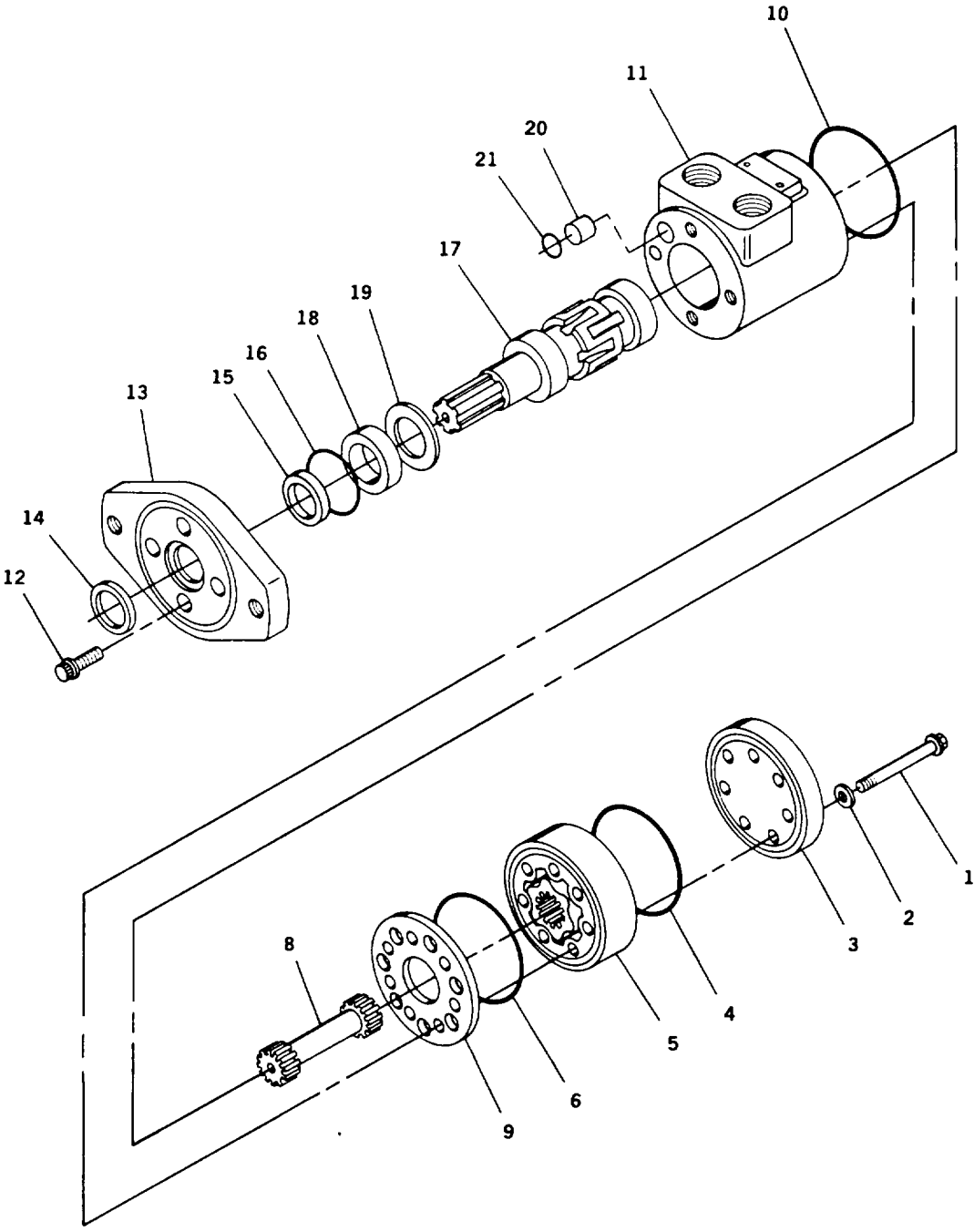


7. INSTALL SWING MOTOR. (REFER TO TM 5-3810-306-20.)

6. INSTALL END CAP (3).

- a. Install 2.875 in. (7.3 cm) diameter seal (4) in end cap (3), then carefully place end cap on gerotor.

END OF TASK



TURNTABLE BEARING INSTALLATION

TOOLS: General mechanic's tool kit: automotive (5180-00-177-7033)
 Torque wrench tool kit (5180-01-284-8747)
 Lifting device (2000 lbs. capacity)

SUPPLIES: Bolt (Item 270, Appendix B) (24 Required)

EQUIPMENT CONDITIONS: Superstructure removed. (Refer to page 15-83.)

REMOVAL:

NOTE

The superstructure must be supported, suspended with sling, or blocked, to allow swing bearing removal.

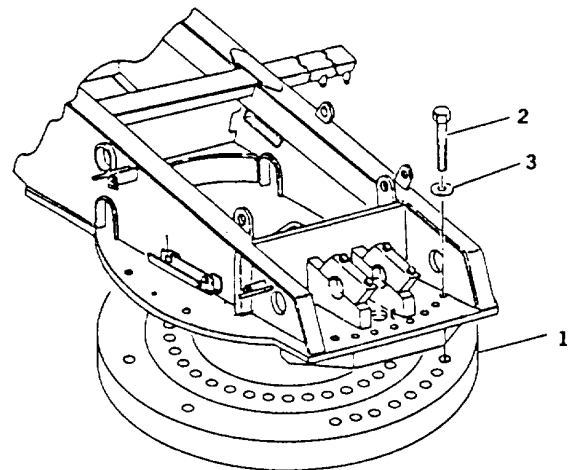
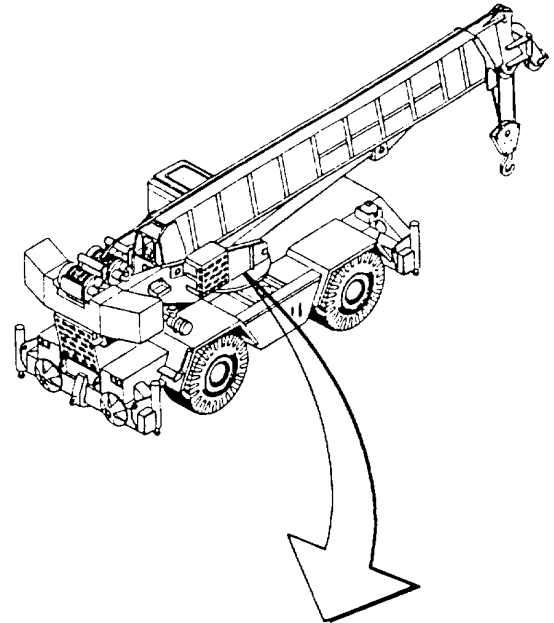
NOTE

Bearing weight is 1300 lbs. and its outer diameter is 66-1/4 inch. Means must be provided to handle detached component.

1. REMOVE BEARING (1).
 - a. Disengage swing lock.
 - b. Remove twenty-four bolts (2), washers (3) and bearing (1) from superstructure.

INSTALLATION:

1. INSTALL BEARING (1).
 - a. Support superstructure, using slings or blocking so that underside of the turntable is exposed for installation of the bearing (1).
 - b. Clean bearing mount surface.



- c. Locate maximum eccentricity point on bearing and lift and install bearing with this point in mesh with drive pinion.
 - d. Install twenty-four new grade 8 bolts (2) and washers (3). Remove washers, if undamaged or deformed, may be reused.
2. TORQUE BOLTS (2) ON SWING BEARING OUTER RACE.
- a. General.

WARNING

Failure to maintain proper torque of the turntable bearing attaching bolts will result in damage to the crane and possible injury to personnel. Maintaining proper torque values for bolts is extremely important for structural strength, performance, and reliability of crane. Variations in torque can cause distortion, binding, or complete separation of the superstructure from the carrier.

CAUTION

Repeated retorquing may cause bolts to stretch. If bolts keep working loose, they must be replaced with new bolts and nuts of the proper grade and size.

WARNING

It is mandatory that bearing attaching bolts be inspected for lack of torque and retorqued, as required, after the first 300 hours of crane operation. The bolts may loosen in service due to vibration, shock-loads, and temperature changes. Therefore, periodic inspection should be

accomplished every 500 hours thereafter, ensuring the bolts are properly torqued.

NOTE

Any bearing bolt found to be loose or that has been removed from the bearing for any reason shall be replaced with a new bolt, nut and hardened washers. The new bolt, nut and washer assembly must be properly torqued before putting the unit back into service. A bearing bolt that continually maintains its proper torque never has to be replaced. With this in mind, it should not be necessary to replace all swing bearing bolts after every 500 hours of operation, but rather, only those that are found to be loose.

WARNING

KNOW YOUR TORQUE WRENCH! Flexible beam type wrenches, even though they might have a pre-set feature must be pulled at right angles and force must be applied at center of handle. Force value readings must be made while tool is in motion. Rigid handle type, with torque limiting devices that can be pre-set to required values, eliminate dial readings and provide more reliable, less variable readings.

NOTE

If multipliers and/or special tools are used to reach hard to get at areas, ensure torque readings are accurate.

NOTE

Torque wrenches are precision instruments and must be handled with care. To ensure accuracy, calibrations must be made on a schedule basis. Whenever there is a possibility that a torque wrench may have been either overstressed or damaged, it should immediately be removed from service until recalibrated. When using a torque wrench, any erratic or jerking motion can result in the application of excessive or improper torque.

NOTE

ALWAYS use a slow, even movement and **STOP** when the predetermined value has been reached. If it is reported by the crane operator or suspected that the crane has been overloaded beyond the capacities specified above the bold line on the cranes' capacity chart, then all turntable bolts must be inspected for looseness and retorqued to specifications. Turntable bolts should be torqued following preliminary and final tightening sequences in tightening figures in this Section. When using step wrenches, calculated wrench settings are valid only when following conditions are met.

- (1) Torque wrenches must be those specified and forces must be applied at the handle grip. The use of handle extensions will change applied torque to bolt.
- (2) All handles must be parallel to the step wrench during final tightening. Multiplier reaction bars may be misaligned no more than 30 degrees without causing serious error in torque.
- (3) Multiplier reaction bar handles must be propped or supported within outer 1/4 of handle length, or serious under or over tightening will occur.

The inner race of bearing is secured to carrier frame by forty 1.25-in. x 7 in. grade 8 bolts and nuts. The outer race of bearing is secured to superstructure by twenty-four 1.25-in. x 4 in. grade 8 bolts.

b. Torque Values.

Preliminary torque on bolts is 1571 ft-lbs (2090 Nm). With two multipliers, set torque wrench for 128 ft-lbs (170 Nm). With six-in. step wrench, set torque wrench for 94 ft-lbs (125 Nm). With eighteen-in. step wrench, set torque wrench 62 ft-lbs (82 Nm).

c. Tools Required.

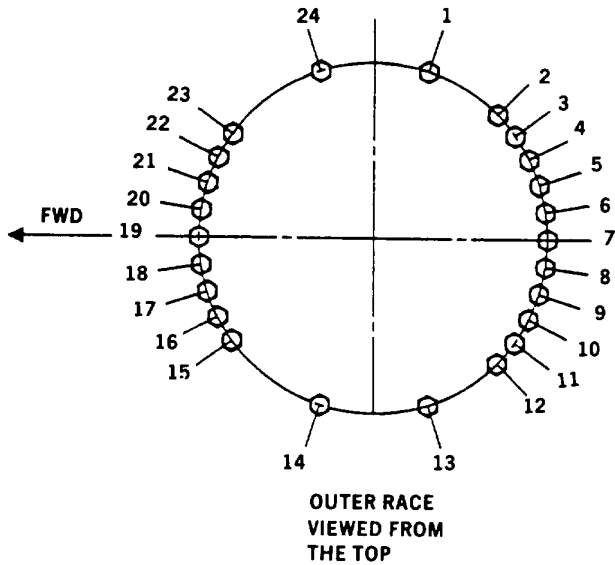
Tools required are listed at the beginning of this procedure.

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d. Outer Race Torquing.

- (1) Fully extend and set outriggers. Fully elevate the boom.

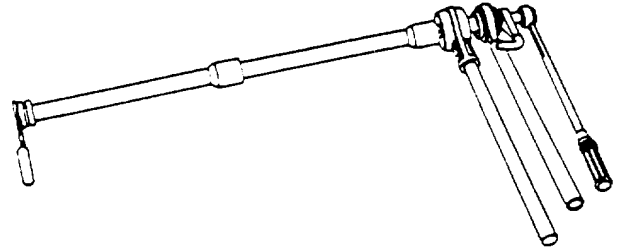


- (2) Torque the bolts using the tools listed in following steps. Apply a preliminary torque of 1571 ft-lbs (2090 Nm) to bolts 1, 14, 7, 19, 2, 15, 12, and 23 in that order. Return to bolt 1 and torque all the bolts sequentially in a clockwise direction to a final torque of 1964 ft-lbs (2090 Nm).

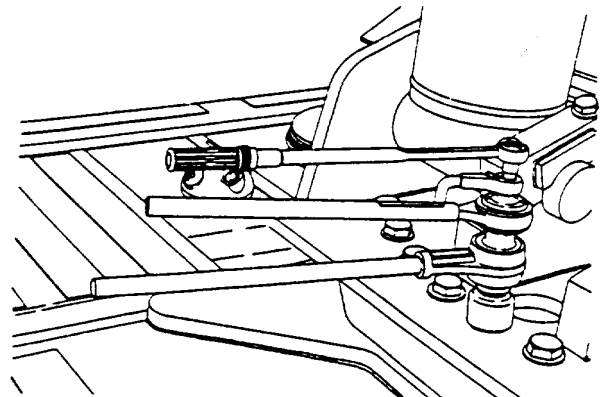
NOTE

The swing gearbox must be removed to gain access to bolts 2, 3, 4, and 5. Refer to **SWING GEARBOX** for information concerning its removal and installation.

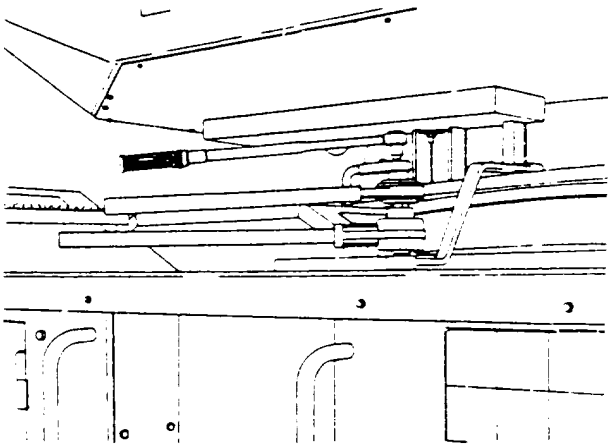
- (3) Use torque wrench, two multipliers, backlash adapter, two extensions, and 6-in. step wrench to torque bolts 7, 12, 11, 10, 9, 8, 6, 5, 4, 3, and 2.



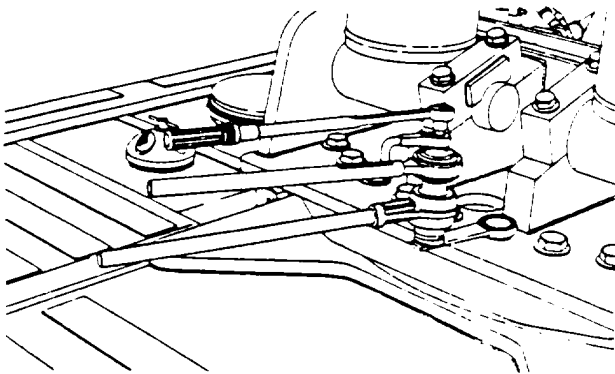
- (4) Use torque wrench, two multipliers, backlash adapter, and socket to torque bolts 19, 24, 1, 20, 21, 18, and 17.



- (5) Use torque wrench, two multipliers, backlash adapter, the 18-in. step wrench to torque bolts 13 and 14.



- (6) Use torque wrench, two multipliers, backlash adapter and 6-in. step wrench to torque bolts 23, 22, 15, and 16.

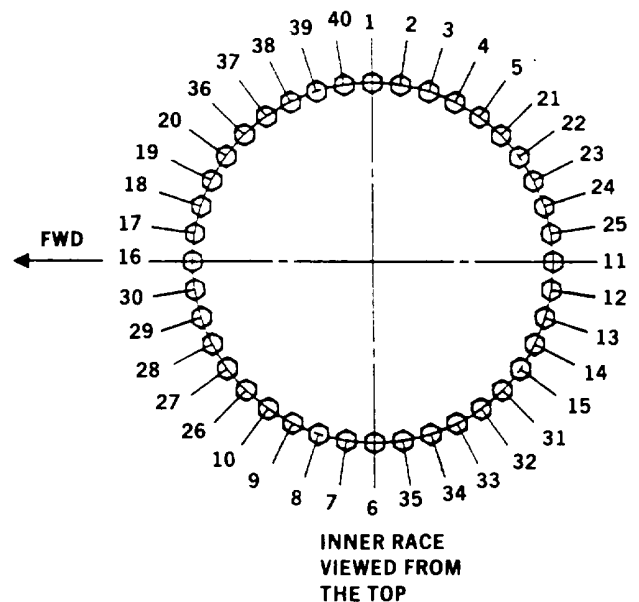


- c. Use a standard 1-7/8 in. open end wrench to hold nut end of bolt from under carrier.
- d. Use torque wrench, two multipliers, backlash adapter and 6-in. step wrench to torque inner race bolts.
- e. Apply a preliminary torque of 1571 ft-lbs (2090 Nm) to bolts 1, 21, 11, 31, 6, 26, 16, and 36 in that order.
- f. Return to bolt 1 and torque all bolts sequentially in a clockwise direction to a final torque of 1964 ft-lbs (2090 Nm).

5. REEVE CABLE THROUGH PULLEYS. (REFER TO TM 5-3810-306-20.)
6. INSTALL HOOK BLOCK ASSEMBLY. (REFER TO TM 5-3810-306-20.)
7. INSTALL OVERHAUL BALL. (REFER TO TM 5-3810-306-20.)
8. PERFORM A PREOPERATIONAL CHECK OF CRANE.

END OF TASK

3. INSTALL SUPERSTRUCTURE. (REFER TO PAGE 15-83.)
4. TORQUE FORTY BOLTS ON SWING BEARING INNER RACE.
 - a. Fully extend and set outriggers. Elevate boom enough to clear hood.
 - b. Rotate the superstructure so access hole is over bolt number 1.



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 direct and general support maintenance of the RT875CC Rough Terrain Container Crane.

A-2. DEPARTMENT OF THE ARMY PAMPHLETS.

Consolidated Index of Army Publications and Blank Forms..... DA Pam 25-30

Using Unit Supply System (Manual Procedures) DA Pam 710-2-1

The Army Maintenance Management System (TAMMS)..... DA Pam 738-750

A-3. FORMS.

Recommended Changes to Publications and Blank Forms..... DA Form 2028

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 DD Form 314

Product Quality Deficiency Report (NSN 7540-00-105-0078) SF 369

A-4. FIELD MANUALS.

NEC Contamination Avoidance FM 3-3

NEC Protection..... FM 3-4

NEC Decontamination FM 3-5

Camouflage FM 5-20

Operation and Maintenance of Ordnance Materiel in Cold Weather
(0 Deg to Minus 65 Deg F) FM 9-207

First Aid for Soldiers FM 21-11

Manual for the Wheeled Vehicle Driver..... FM 21-305

Basic Cold Weather Manual..... FM 31-70

Northern Operations FM 31-71

Army Motor Transport Units and Operations..... FM 55-30

Desert Operations FM 90-3

Mountain Operations (How to Fight)..... FM 90-6

A-5. TECHNICAL BULLETINS.

Tactical Wheeled Vehicles: Repair of FramesTB 9-2300-247-30

Equipment Improvement Report and Maintenance
Digest (US Army Tank-Automotive Command)
Tank-Automotive Equipment..... TB 43-0001-39 series

Color, Marking, and Camouflage Painting of
Military Vehicles, Construction Equipment, and
Materials Handling Equipment TB 43-0209

Maintenance in the Desert..... TB 43-0239

Description, Use, Bonding Techniques, and Properties
of Adhesives..... TB ORD 1032

A-6. TECHNICAL MANUALS.

Inspection, Care, and Maintenance of Antifriction Bearings..... TM 9-214

Operator's Manual for Welding Theory and Application..... TM 9-237

Deepwater Fording of Ordnance Materiel TM 9-238

Materials Used for Cleaning, Preserving, Abrading, and
Cementing Ordnance Materiel and Related Materiel,
Including Chemicals TM 9-247

Organization, Direct Support, and General Support
Care, Maintenance, and Repair of Pneumatic Tires and
Inner Tubes TM 9-2610-200-24

Painting Instructions for Field Use..... TM 43-0139

Procedures for Destruction of Tank-Automotive Equipment
to Prevent Enemy Use..... TM 750-244-6

Operator's Manual for Container Crane, 40 Ton, Rough Terrain,
Model RT875CC, NSN 3810-01-205-2716 TM 5-3810-306-10

Organizational Maintenance Manual for Container Crane,
40 Ton, Rough Terrain, Model RT875CC,
NSN 3810-01-205-2716 TM 5-3810-306-20

Repair Parts and Special Tools List for Container Crane,
40 Ton, Rough Terrain, Model RT875CC,
NSN 3810-01-205-2716TM 5-3810-306-24P

Lubrication Order for Container Crane, 40 Ton,
Rough Terrain, Model RT8755CC, NSN 3810-01-205-2716.....LO 5-3810-306-12

A-7. SPECIFICATIONS AND STANDARDS.

Dry Cleaning Solvent..... Fed Spec F-D-680

Methyl Ethyl Ketone, Technical TT-M-261

Inspection, Liquid Penetrant MethodsMIL-I-6866

Inspection Process, Magnetic Particles.....MIL-I-6868

Human Engineering Design Criteria for Military Systems,
Equipment and Facilities MIL-STD-1472

A-8. OTHER PUBLICATIONS.

Army Medical Department Expendable/Durable ItemsCTA 8-100

Expendable/Durable Items (Except Medical,
Class V, Repair Parts, and Heraldic Items).....CTA 5-970

A-3/A-4 Blank

APPENDIX B**EXPENDABLE/DURABLE SUPPLIES AND MATERIALS LIST****Section I. INTRODUCTION****SCOPE**

Appendix C lists expendable supplies and materials you will need to operate and maintain the RT875CC Rough Terrain Container Crane. This listing is for informational purposes only and is not authority to requisition the listed items. These items are authorized to you by CTH 50-970, Expendable/Durable Items (Except Medical, Class V, Repair Parts, and Heraldic Items), or CTH 8100, Army Medical Department Expendable/Durable Items.

EXPLANATION OF COLUMNS

Items Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Use cleaning compound, item 5, App. B").

Level. This column identifies the lowest level of maintenance that requires the listed item. The symbol designation for the various maintenance categories are as follows:

- C - Operator or Crew
- O - Organizational Maintenance
- F - Direct Support Maintenance
- H - General Support Maintenance
- D - Depot Maintenance

National Stock Number. This is the National stock number assigned to the item; use it to request or requisition the item.

Description. Indicates the federal item name and, if required, a description to identify the item. The last line for each item indicates the Federal Supply Code for Manufacturer (FSCM) in parentheses followed by the part number.

Unit of Measure (U/M). 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.

APPENDIX B

EXPENDABLE MATERIAL LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
1			Solvent, Dry cleaning P-D-680, Type II	
2		9Q7920002929204	Clean rags	pkg
3	H	5330012721282	Seal, nonmetallic	ea
4			Lubriplate 105	
5	H	2815012719792	Ring set, piston ea	
6			Loctite No. 242	
7	F	4320012751629	Parts kit, seal repl.	ea
8		9G9150001116254	Hydraulic oil, MIL-H-46170	pt
9			Grease, MIL-G-81322	
10	F	5315008460126	Pin, cotter ea	
11			Motor oil	
12			Loctite # 601	
13	O	5310005845272	Washer, lock	ea
14	F	5330012776290	Packing assortment	ea
15	O	5330004341494	Packing, preformed	ea
16	F	5330011764809	Packing, preformed	ea
17	F	5330008052966	Packing, preformed	ea
18			Loctite # 545	
19	O	5330011955268	Seal, banjo connect	ea
20	O	5310012708417	Washer, saddle	ea
21	F	3040012819708	Parts kit, linear AC	ea
22	F	5330011577543	Packing	ea
23			Loctite # 271	
24			Never-Seez	
25	F	5310002090965	Washer, lock	ea
26	F	5310006379541	Washer, lock	ea
27			Sealant, silicone	
28	F	5330012810912	Gasket	ea
29	O	5310012090508	Washer, flat sealing	ea
30	O	5310011880997	Washer, flat sealing	ea
31			Permatex No. 2	
32			Copper coat	
33	O	5330012894417	Seal, plain	ea
34	F	5310006379541	Washer, lock	ea
35	F	5315008395822	Pin, cotter	ea
36	F	4820011734642	Kit, check valve part	ea
37		9G9150001900907	Grease, MIL-G-10924	qt
38	F	5310005825965	Washer, lock	ea
39			Oak post, 4" x 4"	ea
40	F	5330012845735	Retainer, packing	ea
41	F	5330004933881	Packing, preformed	ea
42	F	5330001499150	Packing, preformed	ea
43	F	5330001499150	Packing, preformed	ea
44	F	5330001499152	Packing, preformed	ea

APPENDIX B

EXPENDABLE MATERIAL LIST (CONT'D)

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
45	F	5330001191921	Packing, preformed	ea
46	F	5330001191931	Packing, preformed	ea
47	F	5330011045122	Packing assortment	ea
48	F	5330012066813	Seal, quad	ea
49	F	5330012896168	Ring, back-up	ea
50	F	5330011020453	Packing, assortment	ea
51	F	5330012882160	Parts kit, seal repl	ea
52	F	5330012869208	Packing assortment	ea
53	F	5330012869852	Parts kit, seal repl	ea
54	F	2590012689893	Parts kit, cylinder	ea
55	F	2530012726694	Parts kit, seal repl	ea
56	O	5315012807030	Pin, cotter	ea
57	F	4320012690409	Parts kit, seal repl	ea
58	F	2590012688448	Parts kit, linear AC	ea
59	F	5330010185360	Seal, plain encased	ea
60	F	5330005506748	Packing, preformed	ea
61	F	5310010713401	Washer, flat	ea
62	F	5330010180780	Gasket	ea
63	F	2590012821741	Parts kit, linear AC	ea
64	F	5315000137308	Pin, cotter	ea
65			Loctite primer grade T	
66	O	5340002352785	Clip, retaining	ea
67	O	5330011158226	Packing, preformed	ea
68	O	5330011988439	Packing, preformed	ea
69	F	4320012689877	Ring, wearing	ea
70			Adhesive, weather-strip	
71	F	5315000590205	Pin, cotter	ea
72	F	5330012122222	Gasket	ea
73	F	5330012107357	Gasket	ea
74	F	5330012806773	Seal, plain encased	ea
75			Form-a-gasket # 3 (aviation)	
76	O	5330000137784	Packing, preformed	ea
77	F	4320012688450	Parts kit, seal repl	ea
78	F	3110005555207	Bearing	ea
79	F	3110005543081	Bearing	ea
80	F	3110005543318	Bearing	ea
81	F	5310010145136	Washer, key	ea
82	F	5310002090965	Washer, lock	ea
83	F	5310008206653	Washer, lock	ea
84	F	5310001515483	Washer, key	ea
85	F	5310010145136	Washer, key	ea
86			Oil, gear 90 wt	
87	F	4320012815930	Kit, parts, rotary pump	ea
88	F	5330012346369	Seal, plain	ea
89	O	5330010925503	Packing, preformed	ea

APPENDIX B

EXPENDABLE MATERIAL LIST (CONT'D)

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
90	O	5330002287196	Packing, preformed	ea
91		9Q7920000449281	Cloth, lint free "miracle wipe"	box
92	F	5330010122722	Packing, preformed	ea
93	F	5330006336827	Packing, preformed	ea
94			Oil, SAE 10, MIL-L-2104	
95			Emery cloth	
96	F	5330004392539	Packing, preformed	ea
97	F	291001120853	Parts kit, seal repl	ea
98	F	5330011810630	Gasket	ea
99	F		Gasket	ea
100			Loctite #2114	
101		533001157543	Packing	ea
102			Lubriplate 105	
103			Rubber bands	ea
104			Rods, wooden dowel 1/2 in. x 18 in.	ea
105	F	5315008395822	Pin, cotter	ea
106	F	5330012698580	Packing, preformed	ea
107	F	5330012696152	Packing, preformed	ea
108	F	5330012819013	Packing, preformed	ea
109	F	5310000045033	Washer, lock	ea
110	O	5315011847607	Pin, cotter	ea
111	F	5330012819013	Gasket	ea
112	O	5330011901905	Gasket	ea
113	F	3901805	Gasket	ea
114	O	5330011742917	Packing, preformed	ea
115	F	5330011744595	Packing, preformed	ea
116	F	5330011988439	Packing, preformed	ea
117	F	5330011680885	Packing, preformed	ea
118	F	5330012442273	Packing, preformed	ea
119	H	5340004356124	Ring, retaining	ea
120	H	5330011157910	Packing, preformed	ea
121	H	5310004079566	Washer, lock	ea
122	H	5365001446445	Ring, retaining	ea
123	H	5330007746894	Packing, preformed	ea
124	H	5330005596182	Packing, preformed	ea
125	H	5330001198079	Gasket	ea
126	H	5330002502156	Gasket	ea
127	H	5365008388715	Ring, retaining	ea
128	H	2520009963736	Ring, locating	ea
129	H	5365010185447	Ring, retaining	ea
130	H	5330010262916	Gasket	ea
131	H	5310001670680	Washer, lock	ea
132	H	3110010097012	Ring, bearing, inner	ea
133	H	5330005806588	Packing, preformed	ea
134	H	5330002500222	Packing, preformed	ea

APPENDIX B

EXPENDABLE MATERIAL LIST (CONT'D)

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
135	H	5330010135820	Packing, preformed	ea
136	H	5365012715247	Ring, retaining	ea
137	H	5330005366835	Packing, preformed	ea
138	H	5310010374069	Nut	ea
139	H	5310008098541	Washer, flat	ea
140	H	5310010180686	Nut, self-locking	ea
141	H	5310010713400	Washer, flat	ea
142	H	5330002917339	Packing, preformed	ea
143	H	2520001425392	Ring, piston	ea
144	H	5365010185253	Ring, special	ea
145	H	5365010176324	Ring, retaining	ea
146	H	5365002496555	Ring, retaining	ea
147	H	2520001425391	Ring, piston	ea
148	H	5330010185222	Packing, preformed	ea
149	H	5365012713334	Ring, retaining	ea
150	H	5365011052983	Ring, retaining	ea
151	H	5365010185223	Ring, retaining	ea
152	H	5365010185449	Ring, retaining	
153	H	5365010185220	Ring, special	
154	H	5365010185448	Ring, retaining	
155	H	5330010180074	Gasket	
156	H	5365010607228	Ring, retaining	
157	H	5365010562109	Ring, retaining	
158			Jelly, petroleum	
159			Screw, machine, 1/8-24 x 1-1/2 in.	
160		5365010853125	Ring, retaining	ea
161	H	5330010709321	Packing assortment	ea
162			Bolt, 1-1/4 in. x 7 inch	ea
163	O	5330010933503	Packing, preformed	ea
164			Loctite #277	
165	F	5330012721140	Gasket	ea
166	H	5330011014773	Packing, preformed	ea
167	H	2520004204420	Seat, safety valve	ea
168	H	5330011812430	Packing, preformed	ea
169	H	5330004044481	Gasket	ea
170	H	5330010693126	Gasket	ea
171	H	5310001800277	Washer, lock	ea
172	H	5330012803625	Packing, preformed	ea
173	H	5365012805593	Ring, retaining	ea
174	H	5340004342005	Ring, retaining	ea
175	H	5340004398143	Ring, retaining	ea
176	H	5365002471032	Ring, retaining	ea
177	H	5330011812434	Packing, preformed	ea
178	H	5330012803624	Packing, preformed	ea
179	H	5340004398139	Ring, retaining	ea

APPENDIX B

EXPENDABLE MATERIAL LIST (CONT'D)

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
180	H	5310007918733	Washer, lock	ea
181	H	5365008212502	Ring, retaining	ea
182	H	5330007275154	Packing, preformed	ea
183	H	5330012803621	Seal, plain encased	ea
184	H	5330012805579	Packing, preformed	ea
185	H	5365011971631	Ring, retaining	ea
186	H	5365008039971	Ring, retaining	ea
187	H	5365012809483	Ring, retaining	ea
188	H	5330001451509	Packing, preformed	ea
189	H	5365002524746	Ring, retaining	ea
190	F	5330012721122	Packing, preformed	ea
191	F	5330012721121	Packing, preformed	ea
192	O	5310012805611	Washer, flat	ea
193			E, clip	ea
194	F	4820012883938	Kit, parts	ea
195	F		Oil, gear, MIL-L-2105, MPL-85W140	
196	F	5330012813406	Packing, preformed	ea
197	F	4820012893618	Kit, parts	ea
198	F	5330012694323	Packing, preformed	ea
199	F	176027	Gasket	ea
200	F	3048341	Gasket, fuel pump	ea
201	F	119859	Ring, retaining	ea
202	F	180810	Ring, oil	ea
203	F	650330	Ring, piston	ea
204	F	187350	Ring, piston	ea
205	F	154018	Gasket	ea
206	F	3043995	Packing, preformed	ea
207	F	127936	Packing, preformed	ea
208	F	128086	Packing, preformed	ea
209	F	128085	Packing, preformed	ea
210	F	S-605	Lockwasher	ea
211	F	154916	Gasket	ea
212	F	5310005432410	Washer, lock	ea
213	F	5330011918047	Gasket	ea
214	F	5330012708144	Gasket	ea
215			Rockwell adhesive	
216			Gear marking compound	
217	F	5365007157391	Ring, retaining	ea
218	F	5330012694327	Gasket	ea
219	F	5315008806027	Pin, cotter	ea
220	F	5330012714311	Gasket	ea
221	F	5330012719375	Packing, preformed	ea
222	F	5330011922037	Seal	ea
223	F	5330012550176	Gasket	ea
224	F	3913994	Packing, preformed	ea

APPENDIX B

EXPENDABLE MATERIAL LIST (CONT'D)

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
225	F	5330012721141	Gasket	ea
226	F	5330012721143	Gasket	ea
227	F	5330012714310	Gasket	ea
228	F		Pad, cleaning, non-metallic	ea
229	F	2910012719826	Sleeve, fuel injector	ea
230	F	5315008395820	Pin, cotter	ea
231	F	5305012805591	Screw, self-locking	ea
232	F	5315000050442	Cotter pin	ea
233	F	5310002090786	Washer, lock	ea
234	F	5310004079566	Washer, lock	ea
235	F	5330012846648	Packing, preformed	ea
236	F	5330012846657	Gasket	ea
237	F	5330012846656	Gasket	ea
238	F	5330012846649	Packing, preformed	ea
239	F	5330012846650	Packing, preformed	ea
240	F	5330012846658	Gasket	ea
241	F	2540012841677	Matting	AR
242	F	5330012846652	Packing, preformed	ea
243	F	5330012846659	Gasket	ea
244	F	5310006276128	Washer, lock	ea
245	F	5330010573127	Packing	ea
246	F	5330012852593	Packing	ea
247	F	5330004816504	Packing	ea
248	F	5330004384106	Packing	ea
249	F	5330009140795	Packing	ea
250	F	5330012852595	Packing	ea
251	F	5330012852594	Packing	ea
252	F	5330012836673	Packing	ea
253	F	5330012849353	Packing	ea
254	F	5330012849354	Packing	ea
255	F	5330012836674	Packing	ea
256	F	5330011045122	Parts kit	ea
257	F	5330012869853	Parts kit	ea
258	F	4320012721907	Parts kit	ea
259	F	2590012689989	Wear pad	ea
260	F	2590012690422	Wear pad	ea
261	F	2590012689988	Wear pad	ea
262	F	2530012689883	Wear pad	ea
263	F	5330012144857	Packing, preformed	ea
264	F	5330005992766	Packing, preformed	ea
265	F	5330012776290	Kit, parts	ea
266	F	2590012817914	Kit, parts	ea
267	F	5330011251856	Seal	ea
268	F	5330009794342	Seal Assembly	ea
269	F	5310012729047	Nut	ea

APPENDIX B

EXPENDABLE MATERIAL LIST (CONT'D)

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
270 271 272 273 274	F F F F F	5305011651283 5330010397437 5310011912514 5310000453296	Bolt Gasket and seal kit Loctite primer NF Washer, lock Washer, lock	ea ea ea ea ea

APPENDIX C

ILLUSTRATED LIST OF MANUFACTURED ITEMS.

C-1. SCOPE

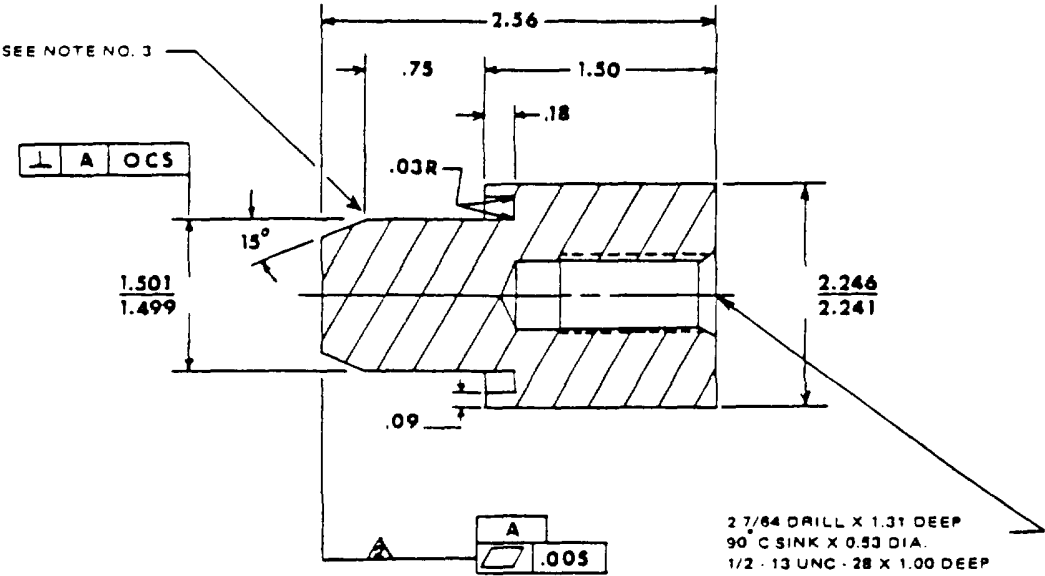
This appendix includes complete instructions for making items authorized to be manufactured or fabricated at organizational maintenance.

C-1/C-2 Blank

APPENDIX C (CONT'D)

ILLUSTRATED LIST OF MANUFACTURED ITEMS.

ITEM 1

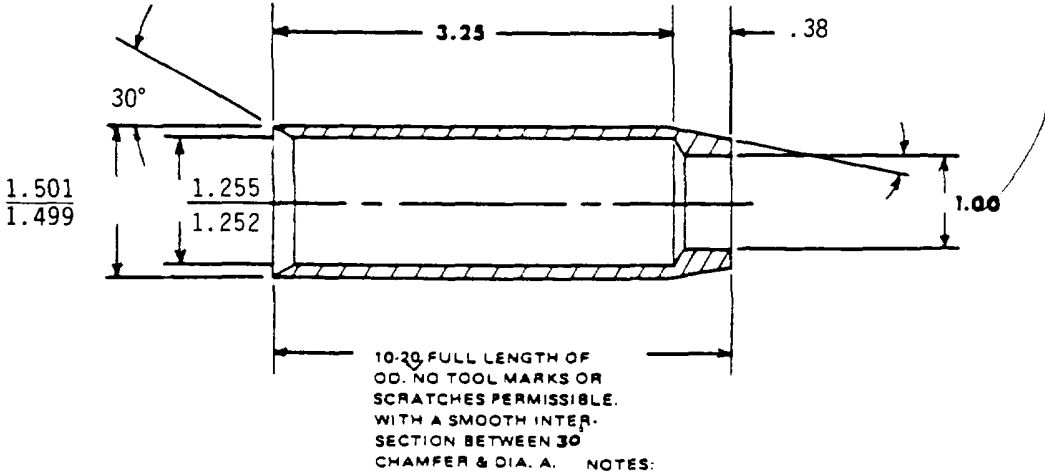


NOTES:

1. Remove all burrs and break sharp edges 0.010/0.005R.
2. Length Δ to be heat treated to RC 50-55.
3. Length Δ to have 10-20 full length, with a smooth intersection between chamfer and DIA. A.
4. Grease OD of length Δ before installing shaft seal onto tool to prevent damage to the seal.
5. Material 4140 or equivalent.

SEAL DRIVER

ITEM 2



NOTES:

1. Remove all burrs and break sharp edges 0.010/0.005R
2. Teflon preferred. alternate 4140 treated after machining to RC 50-55
3. Install protective cone over shaft extension and grease OD to prevent damage to shaft seal.

PROTECTIVE CONE

APPENDIX C (CONT'D)

ILLUSTRATED LIST OF MANUFACTURED ITEMS.

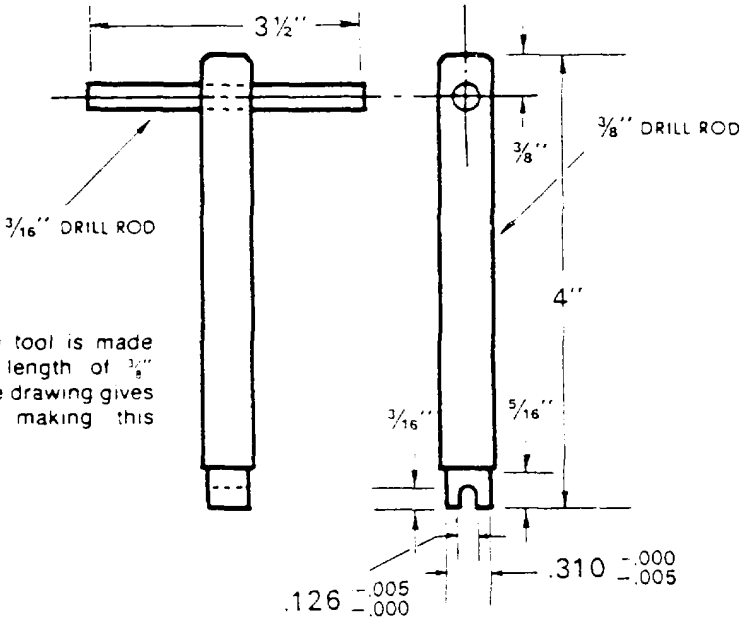
ITEM 3

Seal removal tool can be easily made from an old screwdriver. Heat the tip and bend as shown. Grind off the tip to fit the notch behind the shaft seal.



SEAL REMOVAL TOOL

ITEM 4



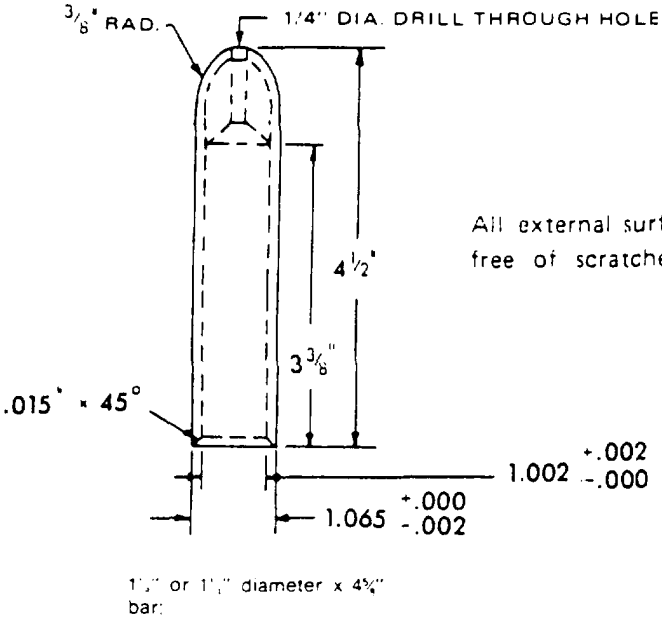
Check valve tool is made from a 4" length of 3/8" drill rod. The drawing gives details for making this handy tool.

CHECK VALVE TOOL

APPENDIX C (CONT'D)

ILLUSTRATED LIST OF MANUFACTURED ITEMS.

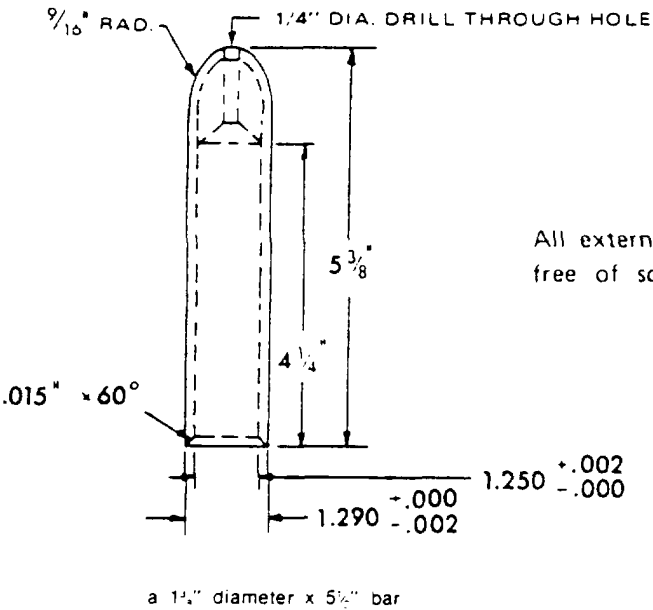
ITEM 5



All external surfaces must be free of scratches and burrs.

SLEEVE

ITEM 6

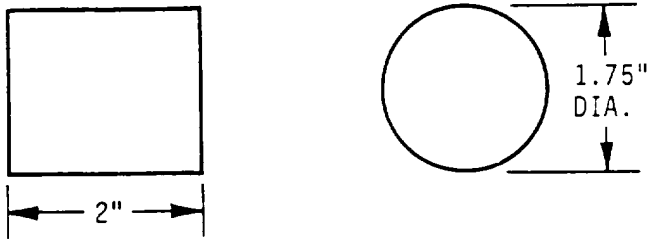
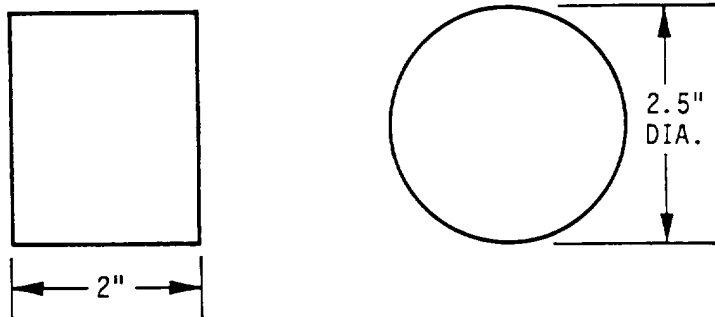
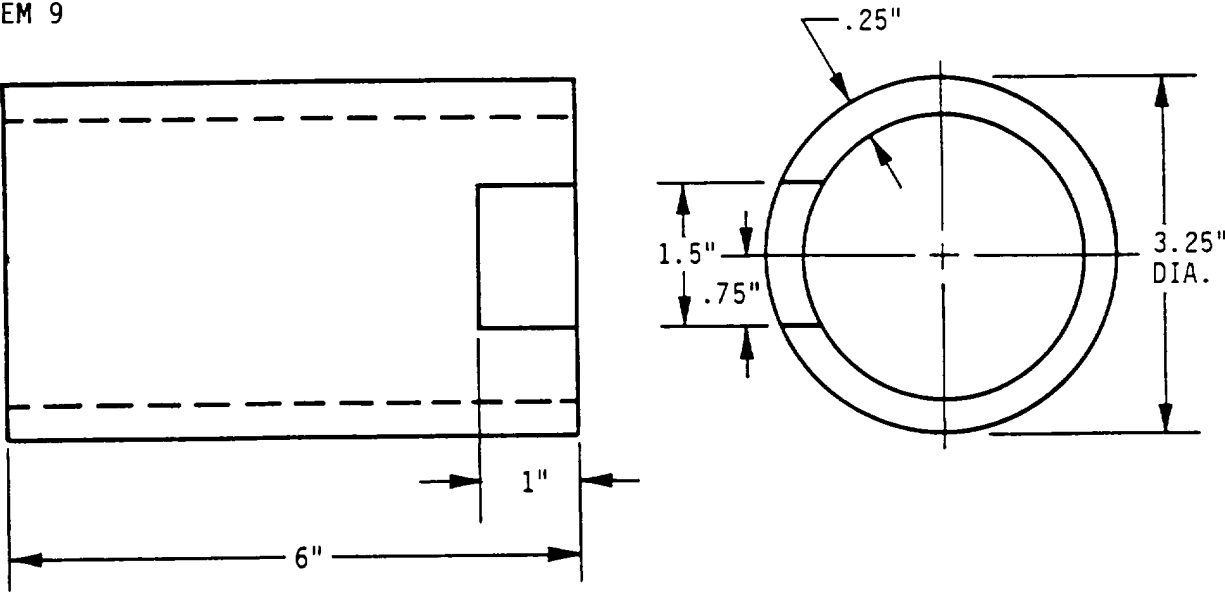


All external surfaces must be free of scratches and burrs.

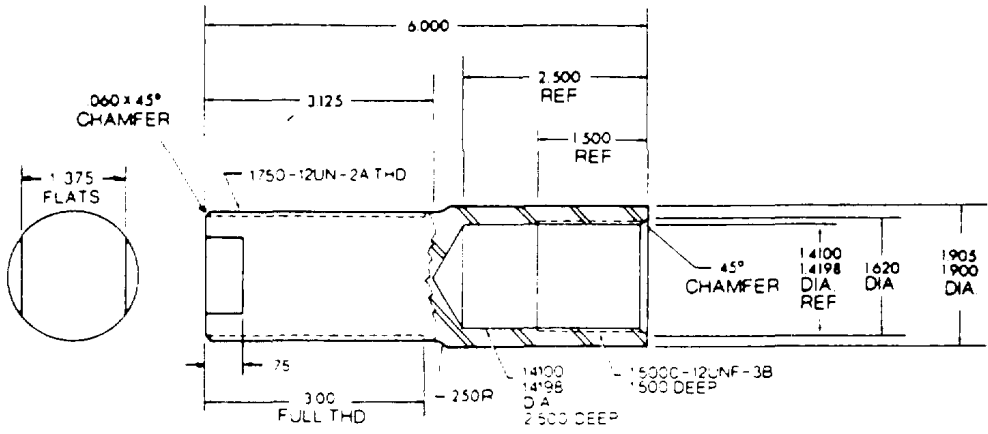
SLEEVE

APPENDIX C (CONT'D)

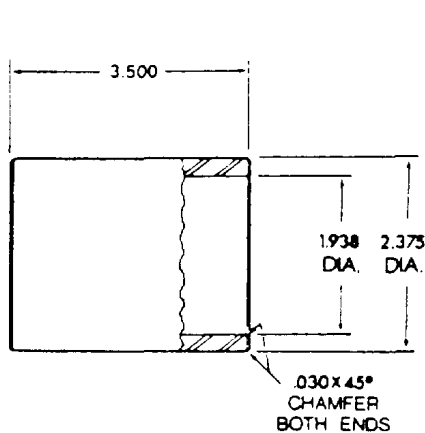
ILLUSTRATED LIST OF MANUFACTURED ITEMS.

<p>ITEM 7</p>	 <p>LIP SEAL INSTALLER</p>
<p>ITEM 8</p>	 <p>LIP SEAL INSTALLER</p>
<p>ITEM 9</p>	 <p>CLUTCH SPRING TOOL</p>

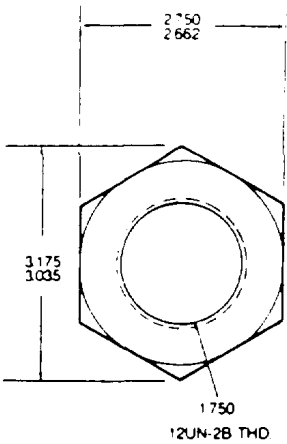
ITEM 10



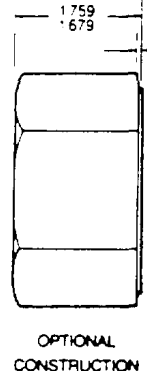
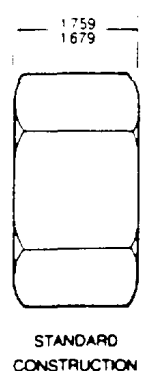
SHAFT



COLLAR

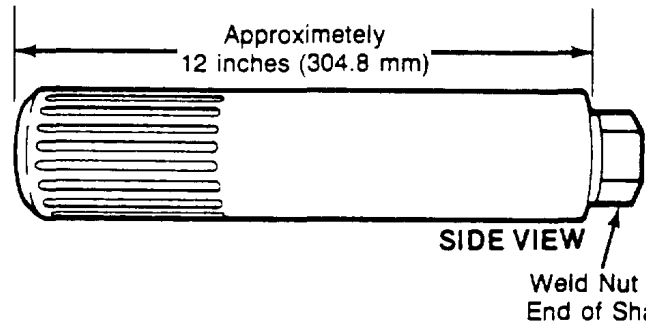


NUT



YOKE THREE-PIECE INSTALLATION TOOL

ITEM 11



Tool can be made from an axle shaft that matches the spline size of the differential side gear.

CHECKING TOOL

APPENDIX C (CONT'D)

ILLUSTRATED LIST OF MANUFACTURED ITEMS.

ITEM 12

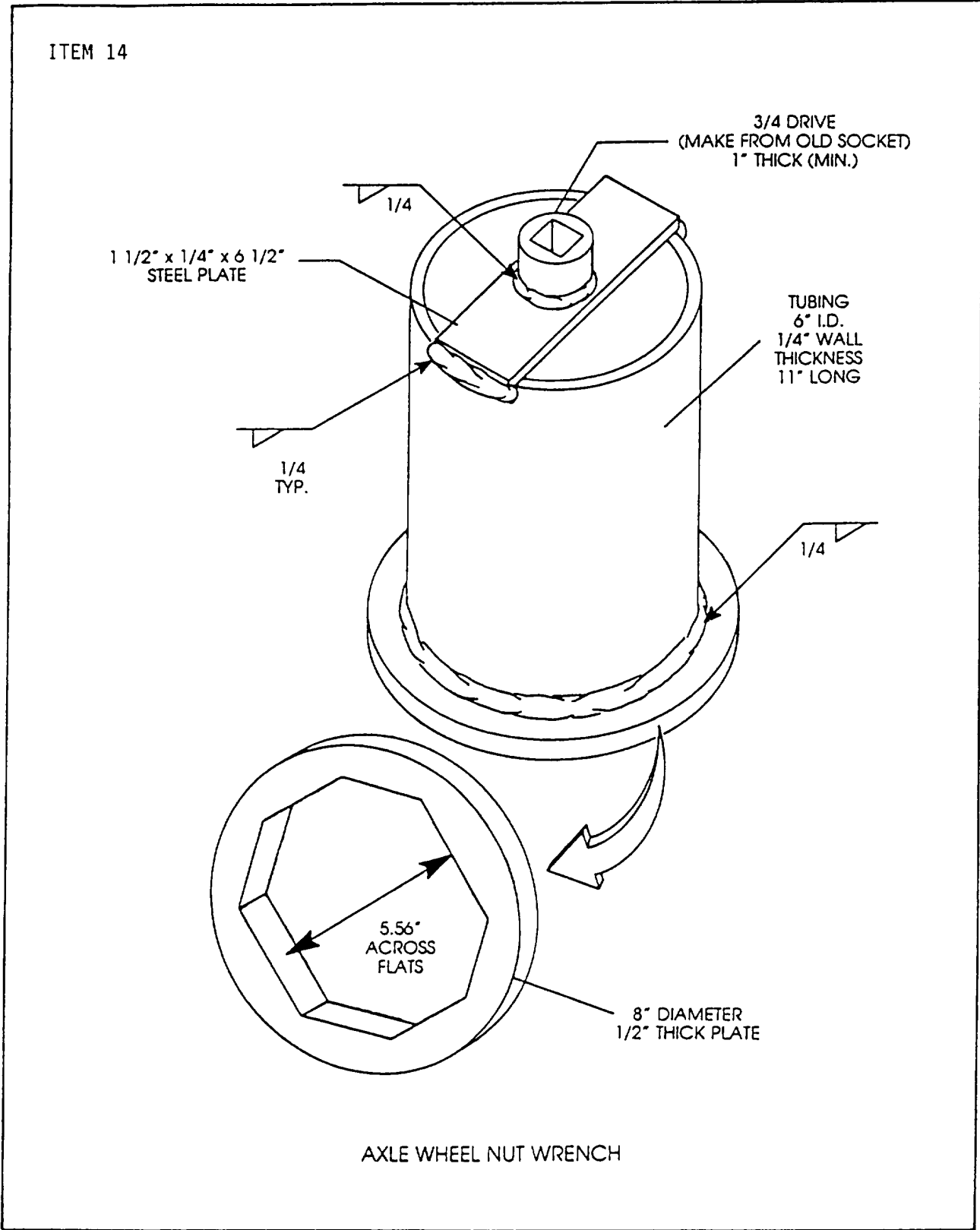
EXHAUST VALVE GUIDE INSTALLATION SPACER

ITEM 13

INTAKE VALVE GUIDE INSTALLATION SPACER

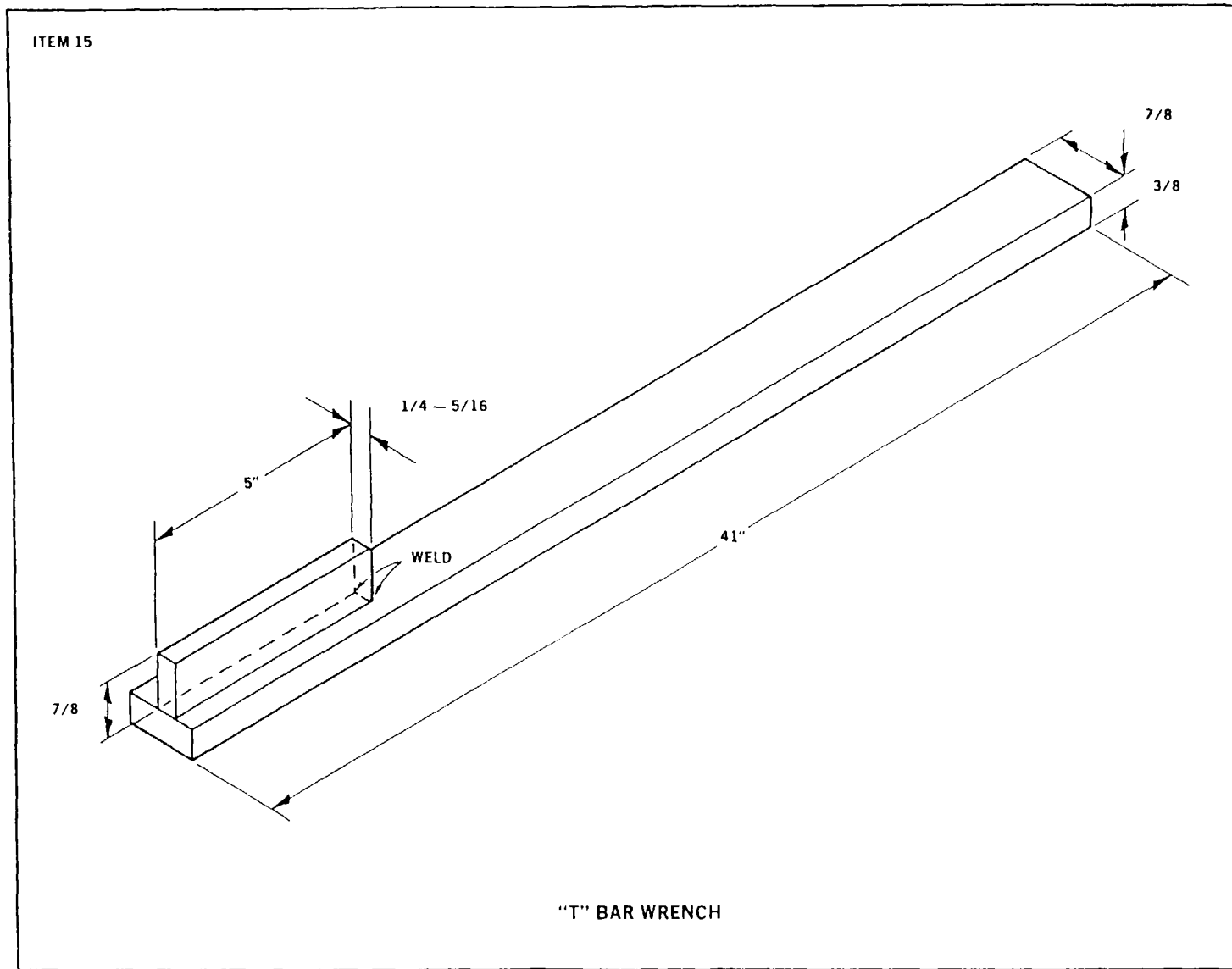
APPENDIX C (CONT'D)

ILLUSTRATED LIST OF MANUFACTURED ITEMS.



APPENDIX C (CONT'D)

ILLUSTRATED LIST OF MANUFACTURED ITEMS.



APPENDIX D

TORQUE LIMITS

INTRODUCTION

Use of proper torque values is extremely important. Improper torquing can seriously affect performance and reliability.

Identification of fastener grade is always necessary. When marked as a high strength bolt (grade 3, 5, etc.), the mechanic must be aware that he is working with a highly stressed component and the fastener should be torqued accordingly.

NOTE

Some special applications require variation from standard torque values. Reference should always be made to component overhaul procedures for recommendations.

Special attention should be given to the existence of lubricant, plating, or other factors that might require variation from standard torque values.

When maximum recommended torque values have been exceeded, the fastener should be replaced.

When referring to the applicable torque charts, use values as close as possible to the torque values shown to allow for wrench calibration tolerance. An erratic or jerking motion of the wrench can easily result in excessive torque. ALWAYS use a slow wrench movement and STOP when the predetermined value has been reached.

Torque wrenches are precision instruments and are to be handled with care to ensure calibrated accuracy. Calibration checks should be made on a scheduled basis. Whenever the wrench might be either overstressed or damaged, it should immediately be removed from service until recalibrated.

KNOW YOUR TORQUE WRENCH! Flexible beam type wrenches, even though they might have a preset feature, must be pulled at right angles and the force must be applied at the exact center of the handle. Force value readings must be made while the tool is in motion.

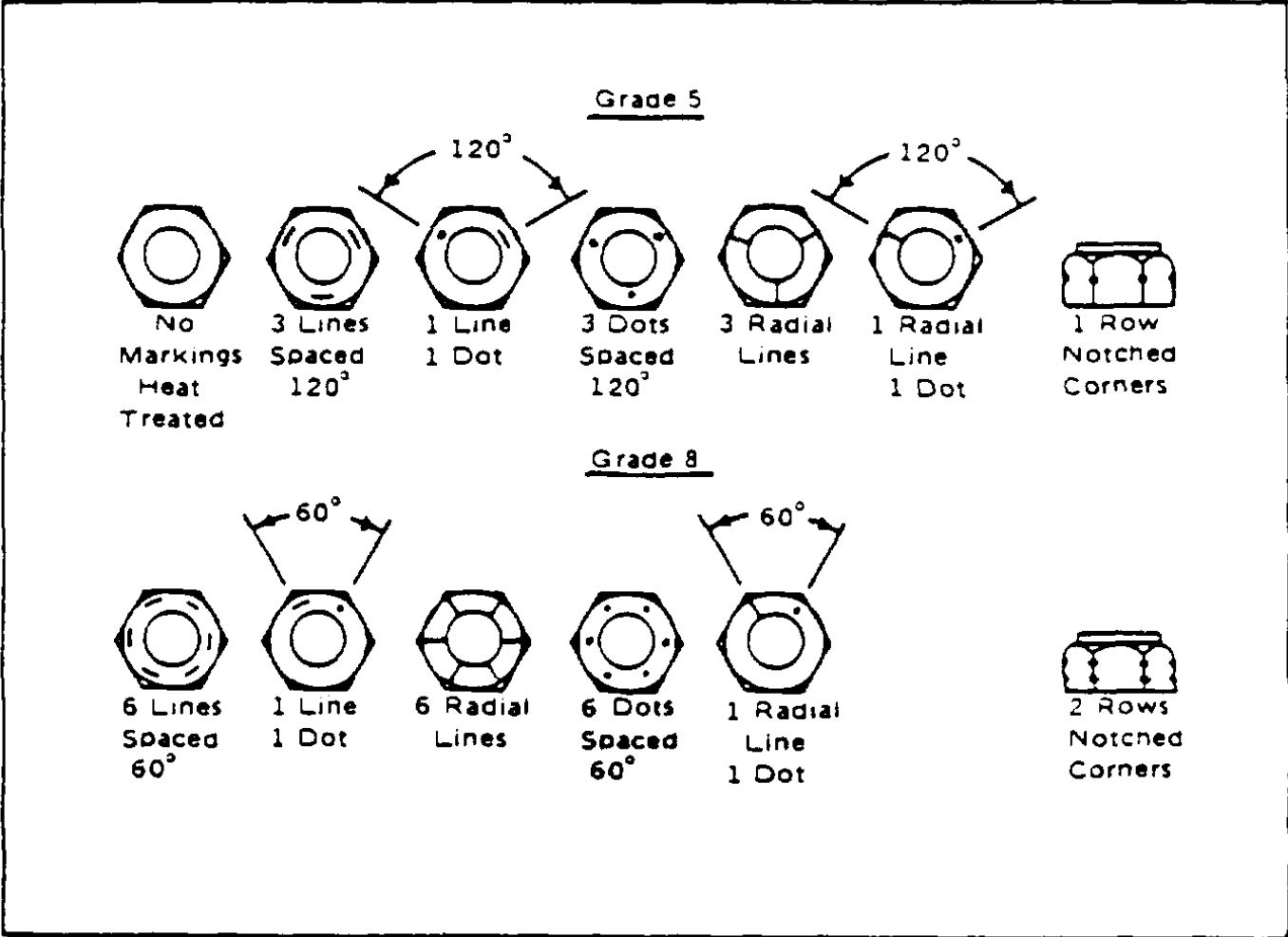
Rigid handle type torque wrenches are available with torque limiting devices that can be preset to required values and which eliminate dial readings.

NOTES













To convert pounds-foot of torque to kilograms meter (kgm), multiply the pounds-foot quantity by 0.138255.

To convert pounds-inch of torque to kilograms centimeter (kgcm), multiply the pounds-inch quantity by 1.152.













When multipliers and/or special tools are used to reach hard to get at spots, ensure torque readings are precisely calculated.






Nut Identification

FINE OR COURSE THREAD FASTENER	GRADE DESIGNATION	TENSILE STRENGTH MINIMUM	MATERIAL	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/4	1 3/8	1 1/2
				TORQUE POUNDS/FOOT										
 CAPSCREW	S.A.E. 2 A.S.T.M. A 307 STEEL	64,000 P.S.I.	Low Carbon Steel	19	30	45	66	93	150	202	300	659		1057
 CAPSCREW	S.A.E. 3 STEEL	100,000 P.S.I.	Medium Carbon Steel	30	47	69	103	145	234	372	551	1211		1943
 CAPSCREW	A.S.T.M. A-449 S.A.E. 5 STEEL	105,000 P.S.I.	Medium Carbon Steel or Low Alloy Heat Treated	31	50	75	110	150	250	378	583	1097		1748
 CAPSCREW	A.S.T.M. 3548B STEEL													
 CAPSCREW	A.S.T.M. A-325													
 CAPSCREW	A.S.T.M. A-354-BC STEEL	125,000 P.S.I.	Low Alloy or Med. Carb. Quenched Tempered	34	54	81	119	167	269	427	644	1392		2234
 CAPSCREW	S.A.E. 6 STEEL	133,000 P.S.I.	Med. Carbon Steel Quenched Tempered	43	69	106	150	209	350	550	825	1815		2913
 CAPSCREW	S.A.E. 7 STEEL		Med. Carbon Alloy, Quenched Tempered Roll Threaded											
 CAPSCREW	S.A.E. 8 STEEL	150,000 P.S.I.	Med. Carbon Alloy Quenched Tempered	46	75	115	165	225	370	591	893	1964	2633	3150
 SOCKET CAPSCREW	SOCKET HEAD CAPSCREW ALSO N.A.S. AIRCRAFT STD.	160,000 P.S.I.	High Carbon Alloy Quenched Tempered	50	81	121	176	240	395	629	964	2120		3402
 CAPSCREW	N.A.S. 144 AIRCRAFT STD. MS20000 MIL. STD.													
 CAPSCREW	N.A.S. 624 NATIONAL AIRCRAFT STANDARD STEEL	180,000 P.S.I.	High Carbon Alloy Quenched Tempered	56	91	136	198	270	444	708	1085	2385		3827

Torque values as shown are for nut-bolt combinations that have not been plated and have not had special lubrications applied to them and/or for those using flat or split ring types of washers. (Discount the residual lubricant present that was applied at the time of manufacture.)

FINE OR COURSE THREAD FASTENER	GRADE DESIGNATION	TENSILE STRENGTH MINIMUM	MATERIAL	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/4	1 3/8	1 1/2
				TORQUE POUNDS/FOOT										
 CAPSCREW	S.A.E. 2 A.S.T.M. A-307 STEEL	64,000 P.S.I.	Low Carbon Steel	17	27	40	59	84	135	182	270	593		951
 CAPSCREW	S.A.E. 3 STEEL	100,000 P.S.I.	Medium Carbon Steel	27	42	62	93	131	211	335	496	1090		1748
 CAPSCREW	A.S.T.M. A-449 S.A.E. 5 STEEL	105,000 P.S.I.	Medium Carbon Steel or Low Alloy Heat Treated	28	45	68	99	135	225	340	524	987		1573
 CAPSCREW	A.S.T.M. 3548B STEEL													
 CAPSCREW	A.S.T.M.A. A-325													
 CAPSCREW	A.S.T.M. A-354-BC STEEL	125,000 P.S.I.	Low Alloy or Med. Carb. Quenched Tempered	31	49	73	107	150	242	384	580	1253		2010
 CAPSCREW	S.A.E. 6 STEEL	133,000 P.S.I.	Med. Carbon Steel Quenched Tempered	39	62	95	135	188	315	495	743	1634		2620
 CAPSCREW	S.A.E. 7 STEEL		Med. Carbon Alloy, Quenched Tempered Roll Threaded											
 CAPSCREW	S.A.E. 8 STEEL	150,000 P.S.I.	Med. Carbon Alloy Quenched Tempered	41	68	104	149	203	333	532	804	1768	2367	2835
 SOCKET CAPSCREW	SOCKET HEAD CAPSCREW ALSO N.A.S. AIRCRAFT STD.	160,000 P.S.I.	High Carbon Alloy Quenched Tempered	45	73	109	158	216	356	566	868	1908		3062
 CAPSCREW	N.A.S. 144 AIRCRAFT STD. MS20000 MIL. STD.													
 CAPSCREW	N.A.S. 624 NATIONAL AIRCRAFT STANDARD STEEL	180,000 P.S.I.	High Carbon Alloy Quenched Tempered	50	82	122	178	243	400	637	977	2147		3444

Torque values as shown are for nut-bolt combinations that have been plated or have had lubrication applied.

FINE OR COURSE THREAD FASTENER	GRADE DESIGNATION	M4	M5	M6	M7	M8	M10	M12	M14	M16	M18	M20	M22	M24	M27	M30
		TORQUE POUNDS/FOOT														
	8.8	2	4	7	11	18	32	58	94	144	190	260	368	470	707	967
	10.9	2.9	6	10	16	25	47	83	133	196	269	366	520	664	996	1357
	12.9	3.6	7	11	20	29	58	100	159	235	323	440	628	794	1205	1630

Torque values as shown are for nut-bolt combinations that have not been plated and have not had special lubrications applied to them and/or for those using flat or split ring types of washers. (discount the residual lubricant present that was applied at the time of manufacture.)

Metric Torque Values

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By Order of the Secretary of the Army:

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THE METRIC SYSTEM AND EQUIVALENTS

WEIGHT 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

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

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
 1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

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

CUBIC MEASURE

1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches
 1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

TEMPERATURE

$5/9(^{\circ}\text{F} - 32) = ^{\circ}\text{C}$
 212° Fahrenheit is equivalent to 100° Celsius
 90° Fahrenheit is equivalent to 32.2° Celsius
 32° Fahrenheit is equivalent to 0° Celsius
 $9/5^{\circ}\text{C} + 32 = ^{\circ}\text{F}$

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
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
its	Liters	0.473
arts	Liters	0.946
allons	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

TO CHANGE	TO	MULTIPLY BY
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
ers	Gallons	0.264
ms	Ounces	0.035
ograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pounds-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
ometers per Liter	Miles per Gallon	2.354
ometers per Hour	Miles per Hour	0.621



